BBCM

BBC&M ENGINEERING, INC.

6190 Enterprise Court, Dublin, Ohio 43016-7297
Phone (614) 793-2226 Fax (614) 793-2410

June 27, 2003
011-07000-110

Ms. Monique Evans, Administrator
ODOT, Office of Research and Development
1980 West Broad Street, 2nd Floor
Columbus, Ohio 43223

Re: Site Investigation Report
Mine Research Project GUE-70-14.10
Guernsey County, Ohio

Ms. Evans:

BBC&M Engineering, Inc. is herewith submitting the Phase II Site Investigation Report for the GUE 70 - 14.10 Mine Research Project. This report was prepared as a cooperative effort between BBC&M Engineering Inc. and our Geophysical Sub-consultants coordinated by Dr. Jeff Daniels of SoftEarth Associates Inc. Collection and interpretation of portions of the geophysical data were completed by Dr. Richard Nolen-Hoeksema of the University of Michigan, Eric Guy of Ohio State University, Dr. Richard Woods of the University of Michigan, Dr. Donald Steeples of the University of Kansas, and Dr. Dennis Hiltunen of Pennsylvania State University. If you have any questions regarding the work completed, please do not hesitate to contact our office.

Respectfully submitted,
BBC&M ENGINEERING, INC.

Christopher K. Hall
Senior Geologist, BBC&M

Jeffery J. Daniels, Ph.D.
The Ohio State University
SoftEarth

Timothy A. Van Echo, P.E.
Executive Vice President, BBC&M

CKH/ckh

submitted:
- 60 copies of Report (2 Binders per Copy)
- 120 copies Executive Summary
- 1 copy Unbound Reproducible Report
- 20 sets of Report Tabs
- 2 copies compact disc with Report Text and Appendices in PDF format
- 2 copies compact disc with Report Text in WordPerfect format
- 2 copies compact disc with data for Site Model (ArcScene)

1. Report No.
FHWA/OH-2003/007

2. Government Accession No.

3. Recipient's Catalog No.

4. Title and subtitle.

Site Investigation Report
Mine Research Project GUE 70 - 14.10
Guernsey County, Ohio

5. Report Date
June 2003

6. Performing Organization Code

8. Performing Organization Report No.

7. Author(s)
Mr. Timothy A. Van Echo, P.E.
Mr. Christopher K. Hall
Dr. Jeffery J. Daniels, PhD

10. Work Unit No. (TRAIS)

9. Performing Organization Name and Address

BBC&M Engineering, Inc.
6190 Enterprise Court
Dublin, Oh 43016-7297

11. Contract or Grant No.
State Job No. 45041(0)

13. Type of Report and Period Covered
Final Report

12. Sponsoring Agency Name and Address
Ohio Department of Transportation
1980 W Broad Street
Columbus, OH 43223

14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract
Geophysical investigative techniques can be a valuable supplement to standard subsurface investigations for the evaluation of abandoned underground coal mine workings and their potential impacts at the ground surface. The GUE 70 - 14.10 Mine Research Project is the investigation of a 2,100-foot long section of Interstate Route 70 in Guernsey County, Ohio. Portions of the highway were damaged as a result of mine subsidence. The damaged areas and other mined areas beneath the highway were remediated in 1995 by placement of grout in the abandoned mine workings beneath the roadway. The intent of the research was to evaluate the effectiveness of investigative techniques at identifying subsurface conditions impacted by past mining activities. The work included the evaluation of geophysical, geotechnical, and hydrogeologic investigative methods in a highway setting typical of the eastern Ohio coal mine region. The geophysical methods evaluated included: surface ground penetrating radar (GPR); side looking GPR; cross-hole GPR; surface seismic methods; cross-hole seismic methods; resistivity, and geophysical borehole logging.

17. Key Words
Interstate Route 70, Geophysical, Geotechnical, Hydrogeologic, Coal Mines, Abandoned Mine Working, Grout, Ground Penetrating Radar, Seismic Methods, Geophysical Borehole Logging, Cross-Hole.

18. Distribution Statement
No Restrictions. This document is available to the public through the National Technical Information Service, Springfield, Virginia 22161

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified		

Disclaimer Statement

The contents of this report reflect the views of the authors who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Ohio Department of Transportation or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

TABLE OF CONTENTS - BINDER 1

SECTION 4 - GEOLOGIC SETTING

SECTION 5 - RESEARCH METHODS

SECTION 9 - APPENDICES

9.1 - MAPS AND CROSS SECTIONS

9.2 - DATA SUMMARIES

9.3 - CALCULATIONS

9.4 - GEOPHYSICAL DATA

9.5 - CONSTRUCTION GROUT DATA

9.6 - PROCEDURES DETAILS

SECTION 10 - SUPPORTING DOCUMENTATION - BINDER 2

10.1 - BORING LOGS

10.2 - HYDROGEOLOGIC DATA

10.3 - GEOTECHNICAL DATA (Soils Laboratory Testing)

SECTION 1 - EXECUTIVE SUMMARY

1.1 PROJECT PURPOSE

The GUE-70-14.10 Mine Research Project is the investigation of a 2,100-foot-long section of Interstate 70 in Guernsey County, Ohio. Portions of the Project Area pavement were damaged as a result of mine subsidence. The damaged areas and other mined areas were remediated in 1995 by placement of grout in the abandoned mine workings beneath the roadway. Concerns are present regarding the post remediation condition of the soils and bedrock beneath the project.

The objectives of the investigation were two fold:

1) detect the presence and ongoing formation of voids or anomalies beneath the pavement using various geophysical, geotechnical, and groundwater investigative methods; and,
2) field test and evaluate investigative methods to determine their suitability for use on other similar projects.

The project work was completed in two phases. Phase I evaluated the effectiveness of various investigative methods on a 200-foot-long segment of the eastbound lanes. A report detailing the findings of the test method evaluation (Phase I) was submitted on January 12, 2001. Phase II of the project applied the most effective methods (as determined by Phase I of the work) to the evaluation of the entire Project Area. This report contains the findings of both the methods evaluation (project research) and evaluates the site specific conditions.

1.2 SITE CONDITIONS

1.2.1 Conclusions

On the whole it is believed that the grouting program completed at the site was successful at stabilizing the mine subsidence that was ongoing during the formation of the original subsidence features and at minimizing the potential for future subsidence within the area where grout was placed. Some un-grouted voids remain within the grouted portion of the Project Area. These logged voids may actually be zones of weak material and were generally less than 12-inches thick. The voids were detected by the loss in water pressure and down pressure during drilling operations, and by missing bedrock core. It is noted that with the methods used to drill the borings, it is difficult to distinguish open voids from voids which are filled with weak "piped" materials and/or mine gob which may have been washed away during drilling. The presence of voids (or possible voids) creates a potential that subsidence could still occur within the area where grout was placed. It is believed, however, that the potential risk of surface deformation as a result of either subsidence into or the loss of material into the remaining voids is relatively low.

It is also believed, however, that the lateral limits of grout placement (distance left and right of the right-of-way centerline) was inadequate, and that a mine collapse immediately adjacent to the grouted zone could cause subsidence features which could impact the roadway. This conclusion is based on the depth to the mine workings, estimated width of the grout curtain, and typical angle of draw values for the types of soils and bedrock at the site.

The grout placed in the mine workings appears to be competent and stable. Grout dissolution is believed to be occurring, however, the rate of dissolution is very slow. The useful life of the grout curtain is believed to be hundreds of years.

Voids were not detected immediately beneath the pavement at any locations. The drilling operations completed during the site remediation are believed to have adversely impacted the near surface soils. The near surface soils, while marginal, appear to be suitable to support the roadway in their present

Some of the conclusions listed above are based on the current site conditions, specifically, the abandoned mine working being in a fully inundated state. If the mine beneath the site were to be dewatered the effects could potentially be adverse to the roadway.

1.2.2 Recommendations

At this time further investigation and remediation at the site is not recommended. It is however, recommended that the Ohio Department of Transportation District 5 maintain a post-remediation Construction Monitoring Program for the Project Area. The program should be based on Section 5 of the "ODOT Manual for Abandoned Mine Inventory and Risk Assessment", May, 1998, specifically, Figure 5.1. If the inspections indicate the formation of potential subsidence features, additional investigation should be completed and additional remediation may be required.

If the District's Construction Monitoring Program indicates a potential mining related subsidence, additional investigation and possibly site remediation may be warranted. Based on the current data, it is believed that the most likely required remedial work would be to extend the width of the grout curtain. If this is required, drilling and grouting two additional lines of boreholes located off both the eastbound and westbound shoulders (total of four lines of borings) may be needed.

1.3 PROJECT RESEARCH

Geophysical methods were tested extensively in Phase I of the research project; the most promising methods were then used to investigate the entire Project Area. The results are summarized in Section 5, graphic data are presented in Section 9.4, and discussions of procedures are included in Section 9.6 of this report. The following methods were tested as part of the work:

- surface seismic reflection;
- cross-hole seismic measurements;
- surface ground penetrating radar (GPR);
- cross-hole radar (GPR);
- side-looking underground radar (SLUR);
- resistivity;
- borehole geophysical well log measurements; and,
- spectral analysis of seismic surface waves (SASW).

It was concluded and reported during the Phase I of the investigation that:

- surface GPR should be used to try to detect any features that might be located directly beneath the roadbed;
- seismic reflection e used to detect fracturing in the bedrock above the mine; and,
- cross-hole measurements be used to provide detailed analysis.

This combination of methods proved to be an effective means for evaluating variations in the stratigraphy from the near-surface to the top of the coal.

The methods used for Phase II of the investigation were generally successful at detecting site conditions which may indicate mine collapse and migration of voids. On this basis, it is believed that geophysical investigations are useful for characterizing sites which are underlain by abandoned mine or other cavities which could collapse and cause subsidence features at the surface.

The sequence of applying the geophysics to site investigations is important and the following recommendations are made with regards to the order and timing of subsidence investigations:

1) Mine maps, existing borings and well logs, geologic and water resource maps, existing mine permits and maps, and any other pertinent available information should be reviewed during the earliest stages of an investigation.
2) A detailed site reconnaissance should be performed by personnel with experience in evaluating and remediating mine subsidence.
3) 3D surface GPR measurements should be conducted on the pavements and shoulders to detect voids or slumping that might be present in the immediate vicinity of the surface. GPR can be used to identify suspect areas that have little or no apparent disturbance at the surface. The absence of a GPR anomaly does not insure that a problem is not present, but GPR is the only geophysical tool that can give a rapid appraisal of the conditions directly under the roadbed.
4) A drilling program should be planned and implemented which investigates any anomalies detected by the GPR and includes the general characterization of the site. The drilling should include standard penetration testing, the collection of undisturbed samples, and obtaining bedrock samples via coring methods. Estimates of the vertical drops of the drilling tools should be recorded to estimate the extent of voids. It is noted that voids can occur within the soil, overburden bedrock, or at the mined zone.
5) For cases where mine dewatering is believed to have been a contributing factor to the subsidence, a hydrogeologic investigation should be performed. The investigation should include the installation of groundwater monitoring wells or piezometers, in-situ and/or laboratory permeability testing, and estimates of lateral and vertical groundwater movement. The lowering of the groundwater level in abandoned mines can significantly increase the effective loading on the mine roof, and result in subsidence. At a minimum, at least three monitoring wells should be installed in each significant water-bearing formation encountered, including the abandoned mine.

6) Resistivity may be useful in the early stages of an investigation to help define the boundaries of the larger slump regions and regions of fracturing in the near surface. Interpretation of data is an iterative process between the drilling program and the geophysical data. The drilling data will improve the interpretation of the geophysical data, and the improved interpretation should be applied to re-direct the drilling to a conclusive result. All geophysical methods are interpretive, and the interpretation improves as more subsurface information becomes available.

7) Where there is a high probability of the presence of collapse features at the soil - bedrock interface, a seismic reflection survey using shear waves is recommended. Furthermore, this study demonstrated that the best component combination is a crossline - crossline (SH-SH) configuration, where the source and detector orientation is orthogonal to the line direction.

8) Confirmatory drilling and sampling of the soil and bedrock should be conducted in the anomalous areas and near haulage-ways. Conventional borehole geophysical log measurements should be made in each borehole. These measurements serve as a continuous record of the lithology, can be used to verify the presence of voids, and can be correlated to determine the continuity of near-horizontal geologic features.

9) Seismic cross-hole and tomography measurements proved to be difficult to implement above the water table. However, this investigation showed the usefulness of cross-hole GPR measurements. These measurements proved to be a high-resolution compliment to surface seismic and surface GPR measurements. Cross-hole GPR was a successful tool to determine the vertical location and extent of fractured zones that may be present between boreholes.

SECTION 2 - INTRODUCTION AND BACKGROUND

2.1 PROJECT SETTING AND HISTORY

The Interstate Route 70 (IR-70) Site is located near Guernsey County mile marker 14.10 which is in Center Township approximately 5.5 miles east of Cambridge, Ohio as shown on Page 1 of Section 9.1. IR-70 is one of three major east to west corridors through the State of Ohio, the other two are IR-76 and IR-80. The average daily traffic on IR-70 at the project location is in excess of 25,000 vehicles per day. Center Township is in a rural sparsely populated portion of Ohio; the average household density near the Project Area is less than 20 households per square mile. In the vicinity of the project, IR-70 is relatively level, trends northeast to southwest, and is within the confines of a narrow valley. The topography beyond the right-of-way is moderately to steeply rolling and is predominantly wooded.

The limits of the project include the area within the right-of-way from highway Station 467+00 to 488+00. Highway stationing is a distance measure in feet which increases from west to east and from south to north. Station 467+00 is 46,700 feet east of the point of origin. Locations within the right-of-way are referenced to station and offset, where the offset is the distance (in feet) left or right of the right-of-way centerline when facing "up-station" (east or north). At the Project Area, the south half of the right-of-way (eastbound lanes) is "right" and the north half of the right-of-way (westbound lanes) is "left".

Abandoned underground mine workings are mapped in the Project Area between Stations 469+00 and 487+00. A sinkhole suddenly developed in the eastbound travel lanes near Station 483+45 during March of 1995 as a result of roof collapse above the abandoned underground mine workings. The sinkhole was approximately 13 feet long, 9 feet wide, and 10 feet deep. Other surface deformation features were present at the site prior to the March 1995 subsidence event. The other sinkholes and roadway depressions were being monitored and several investigations had been completed at the site for the preparation of construction plans for a grouting program to remediate the mine workings. Between March and July of 1995 the abandoned workings beneath the highway were remediated by placing nearly 19,000 cubic yards of grout into the mine workings through nearly 1,500 vertical boreholes. The cost of the remedial work was approximately $3.6 million. During the construction period the interstate had to be closed in both directions, and traffic was diverted onto U.S. Route 40 between Old Washington and Cambridge.

2.2 DATA REVIEW AND MODELING

Various documents were obtained and reviewed for the project. These documents included well logs, boring logs, maps, previous investigation reports, grout takes, grout and flyash compositions, geologic data, and groundwater data. The information was obtained from the Central Office of ODOT, the District 5 Office of ODOT, the Ohio Department of Natural Resources, the Ohio Environmental Protection Agency, American Electric Power, and other sources. Some of the data are presented in their entirety, some data have been summarized or incorporated into drawings or tables, and other data were reviewed but are not presented in this report.

Portions of the site-specific information and background data were converted to electronic data files. These files generally included four fields (X, Y, Z, and attribute) for information such as grout takes, Standard Penetration Test (SPT) results, stratigraphic changes, etc. This information was inserted into an Arc View Geographic Information System (GIS) three-dimensional spatial model. The model is a visual representation of some of the characteristics present at the site. The model was used to aid in the understanding of the site conditions and to direct the focus for further investigations. It was also useful for the identification of conflicting data and potential problem areas.

It was for the purpose of modeling and generation of other digital files that the highway offsets were modified. Point coordinates in the study area were modified from station and offset locations to northings and eastings. The coordinates are a direct conversion from station and offset. The eastings are the project stations, and the axis separating positive and negative northings lies on the centerline of the right of way. The offsets to the left (north) are positive and the offsets to the right (south) are negative. Many of the tables and charts attached to this report reference positive and negative offsets rather than left and right offsets.

2.3 UNDERGROUND MINING

The Number 7 Upper Freeport Coal is the uppermost member of the Allegheny Group of the Pennsylvanian Rock System. The No. 7 Coal was extensively underground mined in Guernsey County in the late 1800's and early 1900's. The mine complex over which IR-70 is constructed consists of two known interconnected mines extending over an area of approximately 2,575 acres (4.0 square miles). The King Mine (GY-58) is located south of the project and was closed in 1927. The Murray Hill No. 2 Mine (GY-29) is located southeast, beneath, and northwest of the project, and was closed in 1935. The approximate extent of these mines are depicted on the Mine/Geology Maps included on Pages 2 and 3 in Section 9.1. For the purpose of simplification throughout this report, mine workings north and northwest of the Project Area are generally referred to as the Murray Hill Mine and mine workings south and southeast of the Project Area are referred to as the King Mine. All known openings into the mines were either slopes or shafts and the coal was extracted from room and pillar workings. No known former openings are mapped within the highway right-of-way at the project site. The mapped location of the nearest known former opening is an air/pumping shaft located beyond the northwest side of the right-of-way immediately west of the Project Area. The fill in this shaft also subsided at the same time the subsidence features on the project developed. The locations of known mapped openings are also shown on the Mine/Geology Maps.

The interconnected mine complex consists of approximately 2.7 square miles of workings northwest of the interstate and 1.3 square miles of workings south and southeast of the interstate. The complex is roughly hourglass shaped with the interstate crossing at the neck of the hourglass. A second narrowing of the workings is present beneath the adjacent valley northwest of the project. Both of these narrowings occur beneath stream channels where the bedrock overburden is relatively thin compared to other regions of the mines. The narrowing may be due to the presence of sand channels within the coal deposit (as noted on the mine map at several locations), unstable roof material (as is also noted on the mine map near the project area), or due to problems with water in-flows from the streams as the result of the thin bedrock overburden combined with a surface water bodies and granular soils. The workings in these areas are generally disorganized compared to the workings in other areas of the mines. It appears as if the main goal of mining operations under the Project Area was to provide access to other regions of the mine.

A small underground coal mine (the Lucas Mine, GY-111) is located approximately 1,500 feet north of the Project Area. The workings of this mine are above the workings for the Murray Hill Mine. The Lucas Mine reportedly had drift (horizontal) openings and was closed in 1932. The working for the Lucas Mine are believed to be at an elevation approximately 120 to 140 feet above the elevation of the ground surface at the Project Area. The coal extracted from the mine is unknown, however, because the mine is located in an upland area (approximately 160 to 200 feet above the workings of the Murray Hill Mine), it is believed that a minor coal seam of the Conemaugh Group was extracted.

2.4 SURFACE MINING

Extensive surface mining of the No. 7 Coal is not present in the vicinity of the project. Relatively narrow crop-line surface mines are present along the western edge of the Murray Hill Mine. The surface-mined area is in a valley and the mines are located on the southeast side of Endley Road. Surface mining also occurred in the valley located between Endley Road and the Project Area (the same valley where the Murray Hill Mine workings narrow). Additionally, an abandoned pit mine is located southeast of and near the right-of-way for IR-70 approximately 4,000 feet southwest of the Project Area. The approximate locations and extent of surface mining are shown on Pages 2 and 3 of Section 9.1 of this report.

The No. 7 Coal is believed to have been extracted from all of the surface mines and, based on the locations of the surface mines and the mapped limits of the underground mines, the surface mines likely connect to the workings of the abandoned underground mines. All of the surface mines (with the exception of the pit mine southwest of the Project Area) are adjacent to the Murray Hill Mine northwest of the Project Area. The pit mine southwest of the Project Area is adjacent to the King Mine workings.

With two exceptions, all of the surface mines have been reclaimed (filled, graded for positive drainage, and re-vegetated). The pit southwest of the project is un-reclaimed and is currently inundated. Until shortly before the roadway subsidence, the mine was in operation and was actively being dewatered. A second unreclaimed pit mine is located 1.7 miles west-northwest of the Project Area on the east side of Endley Road south of the intersection of Endley Road and US Route 40. The mine is currently a pond/wetland and the overflow discharges into the stream which flows along the western side of the Murray Hill Workings.

2.5 ROADWAY SUBSIDENCE

The 1995 subsidence feature in the roadway developed rapidly to a depth near 10 feet. Rapid occurrence of a subsidence feature (not associated with a shaft) is generally the result of block failure of the soil and bedrock overburden. The height of the coal in the vicinity of the subsidence feature is approximately 5 to 6 feet and it can be expected that the height of the mine workings were also approximately 5 to 6 feet. For a block failure to cause a 10-foot depression at the ground surface workings would have needed to be approximately 10 to 15 feet high. This is possible if during the operation of the mine, roof collapse was on-going and each time the roof failed the miners removed the fallen debris. This practice could have caused localized areas of the mine to be substantially thicker than the mined seam, particularly in the haulage-ways. Since none of the 171 exploratory borings drilled at this site revealed the presence of coal or mine workings in excess of 7 feet in height, it is not believed that block failure caused the surface deformation at the at the site.

Because the surface feature was deeper than the workings height, it is believed the subsidence feature was the result of loss of material from beneath the pavement into the workings due to "soil piping". "Soil piping" refers to the process by which groundwater flow causes the movement of soil particles in the subsurface. It is believed that roof collapse had been occurring over time causing the mine void to migrate upward. When the void reached the soil bedrock contact, soil began to "pipe" downward through the fractured bedrock into the workings. Saturated soils and a driving head would have been necessary to cause the soil movement. The loss of material is believed to have caused the depressions in the highway. Where the loss of material was significant, there was a sudden shear failure of the overlying cohesive soils and fills, which resulted in the sinkholes.

2.6 MINE REMEDIATION

The remediation of the mine workings at the site consisted of the drilling of 1,471 borings and the injection of 18,844 cubic yards of grout. That equates to an average of 12.8 cubic yards of grout per borings. The borings were generally drilled on 12 foot centers. The lateral extent of the borings was from 72 feet left to 72 feet right of the centerline, which included the median, and spanned from beyond the western to beyond the eastern mapped limits of the mine. The outside edges of the pavement are 53 feet right and left of the centerline and the outside edges of the paved shoulders are 64 feet right and left. Three general types of grout were placed:

- Barrier Grout — 5,034, cubic yards in 98 borings (51.4 c.y. per boring);
- Production Grout — 12,045 cubic yards in 948 borings (12.7 c.y. per boring); and,
- 80/20 Grout — 1,765 cubic yards in 425 borings (4.2 c.y. per boring).

The following Mix Proportions were used for the grout:

	Cement	Flyash	Sand and Gravel	Slump
Barrier	10%	65%	25%	4" to 6"
Production	10%	65%	25% (sand only)	6" to 9"
80/20	cement and flyash only, variable percentages, maximum flyash 80%			

Barrier grout was installed first and was placed on the outside lines of boring (72 feet right and 72 feet left). The intent was to use a low-flowability grout to isolate the grout placement area minimizing the spread of the production and 80/20 grout beyond the project limits. Details regarding the locations of the injection borings, type of grout placed at each location, and quantity of grout take at each location are included in Section 9.5 of this report.

The borings were drilled using air-rotary methods. After advancing the borings to the bedrock surface, temporary casing was installed and the boring advanced to the mine workings level. A grout pump truck was then used to place grout into the workings using tremie methods and gravity placement.

During the drilling operations, grout, water, and soil commonly were ejected from adjacent boreholes which had not yet been grouted. Additionally, small subsidence features located away from any boreholes occurred while the work was being completed. These occurrences raised concern that the drilling and/or grout placement methods may have compromised the strength and integrity of both the soils and grout.

Due to concerns related to the mined zone consisting largely of caved and broken material, the project remediation also consisted of the construction of two structural concrete slabs beneath the pavement (land bridges). Both of these are present beneath the westbound lanes: one is 700 feet long extending from Station 473+95 to Station 480+95; and, the other is 110 feet long extending from Station 468+25 to Station 469+35. The locations of the land bridges are depicted on the Boring Location Maps included in Section 9.1 of this report.

The fly ash used in the grout was provided by the American Electric Power (AEP) Conesville Plant. No records have been located regarding to the chemical composition of either the fly ash or grout specifically placed during the grouting of the Project Area mine workings. AEP, however, completed fly ash/grout chemical and strength testing as part of a mine grouting program which was being completed in Coshocton County at the same time the Project Area grouting program was being completed. The results of the AEP testing and other data related to the grouting at the site are contained in Section 9.5 of this report.

Two samples of grout collected during the current investigation were submitted for geochemical analysis by means of x-ray diffraction. One of the samples appears to be barrier grout (contains sand and gravel aggregate) which was collected from Boring P-221A. The other sample appears to be production grout (contains sand but does not contain gravel aggregate) which was collected from Boring P-228A. The analysis was completed in order to attempt to identify the percentages of minerals which comprise the grout. The composition of both types of grout are very similar with the exception that the percent of calcium is higher in the barrier grout (20.7 percent in the barrier grout and 14.0 percent in the production grout) and the percent iron is lower in the barrier grout (17.3 percent in the barrier grout and 20.8 percent in the production grout). It is noted that these were discrete samples and the geochemical analysis of these samples may not be representative of the overall composition of the grout placed at the site.

SECTION 3 - RESEARCH APPROACH

The research aspects of the project, were completed in three phases:

- Phase I Test Area Investigation;
- Phase II Site Investigation; and,
- Phase III Technology Transfer.

3.1 METHODS EVALUATION IN LIMITED TEST AREA - PHASE I

The intent of the Phase I investigation was to identify investigative methods for implementation in Phase II. This was accomplished by field testing and evaluating, on a small scale, various field and analytical methods. The research work focused primarily on the evaluation of geophysical investigative techniques. However, the methods evaluation also included the review of various geotechnical and hydrogeologic investigative methods, such as methods for the determination of the coefficient of permeability and groundwater flow. Additionally, more standard geotechnical methods such as field and laboratory methods for determining material compositions and strengths were also evaluated.

The test area consisted of the eastbound lanes between Stations 483+00 and 485+00. The decision process for evaluating the methods for incorporation into Phase II of the work included the following steps:

1) Did the method yield credible data that could be relied upon for evaluation <u>regardless</u> of its applicability to potential pavement failure? If the method did not, the method was not recommended for use during the full site investigation; if the method did, then further evaluation of the method was completed (step 2);
2) Did the method generally yield data which were useful or applicable for the evaluation of subsurface conditions and/or potential pavement failure? If the method did not, the method was not recommended for further site specific use on this project.

The following general geophysical methods were tested during Phase I of the study:

- surface ground penetrating radar (GPR);
- surface seismic methods;
- cross-hole GPR;
- cross-hole seismic methods; and,
- geophysical borehole logging.

During the evaluation of the above listed methods, not only were the general methods evaluated but also specific variations of the methods and variations of techniques of each method were evaluated. Some of these method variations include:

- ground penetrating radar;
- side looking underground radar (SLUR);
- spectral analysis of surface waves (SASW);
- surface seismic reflection;
- resistivity (work completed by others)
- cross-hole ground penetrating radar;
- cross-hole seismic shear wave velocity logging (CSL); and,
- cross-hole seismic tomography (CST).

Descriptions of the various methods including the intent and an evaluation of the effectiveness of the methods and techniques used at the site are included in Section 5 of this report. In general, only the variations of the methods and techniques evaluated which were believed to be useful for the collection of data at the site specific conditions of the Project Area were applied to the full site investigation (Phase II). Exclusion from use in Phase II does not mean that the unused methods are not viable investigative techniques, but only that at the Project Area, the data obtained were either better obtained using other methods or the specific conditions at the Project Area prevented the optimum collection of data.

Brief descriptions of geophysical investigative techniques which were evaluated in Phase I of the project but were not used during Phase II of the project are as follows:

Side Looking GPR (SLUR)

The SLUR method utilizes conventional GPR equipment run in trenches cut into the ground. The "look-angle" provided by the trenches allows the energy of the antennas to be directed at an angle beneath the roadway. SLUR measurements are the only way to obtain a directed remote view underneath the highway from surface measurements. However, experiments conducted in the test area indicate that high resolution reflection shear wave surveys may be an alternate method for investigating underneath the highway from the surface. For this project, SLUR was considered for the potential as a supplemental technique to vertical and slant-hole drilling, and the other surface and borehole techniques. The principle of the method have been described previously (Daniels, 1998). The field operating mode consisted of using a bulldozer to cut a trench with one side at an angle of 40 to 45 degrees from the horizontal. Measurements were made along the trench with the GPR system by towing the antennas along the trench with an ATV that also contained the computer and electronics for the GPR system. The SLUR testing was successful in the identification of anomalous areas, however, the proximity of the trenches to the roadway caused concern for public safety.

Spectral Analysis of Surface Waves (SASW)

Spectral analysis of surface waves (SASW) is a technique that measures the dispersion (frequency dependent velocity) of seismic surface waves. SASW techniques have been developed over the past thirty years to investigate the near-surface velocity of seismic waves. It can be shown that these velocities are related to the mechanical properties of the near surface. Objects in the near surface that cause an increase in the porosity of materials (e.g., voids and slumps) also cause a decrease in the velocities interpreted from SASW measurements.

3.2 APPLICATION OF SUCCESSFUL METHODS - PHASE II

Investigative methods which were determined to be potentially viable were applied to the entire Project Area which extends for approximately 2,100 feet from Station 467+00 to Station 488+00. The overall goal of the research was to perform an evaluation of a variety of techniques for their suitability for predicting potential mine slumps and/or other subsurface weakening processes. The goals of the research were:

- to aid in the determination as to whether or not further remediation or investigation is necessary at the site; and,
- to evaluate state-of-the-art geophysical methods for determining the presence of mine-caused voids and predicting the potentially detrimental effects of ongoing soil and water movement within and around mines at the Project Area.

The individual methods that were used for the full site investigation of the site are described briefly on the following few pages of this report. How the methods were used and tested as well as the findings of each method are described in more detail in Section 5 of this report. Details regarding procedures, data acquisition, and data processing are generally included in Section 9.6 and graphic geophysical data output and interpretations of geophysical data are included in Section 9.4.

3.2.1 Surface Ground Penetrating Radar (GPR)

Surface GPR is a technique that utilizes the fact that high frequency electromagnetic waves propagate in the subsurface at a velocity that is directly related to the electrical permittivity (also called dielectric constant) of the material. If the wave encounters a change in permittivity as it propagates into the subsurface, then some of the energy is refracted into the lower medium, while the remainder of the energy is reflected back to the surface. The energy that is reflected (or diffracted in the case of sharp boundaries, or edges) returns to the surface where its arrival time and energy distribution is mapped. These measurements of the energy that is reflected back to the surface become "records", or maps of the distribution of boundaries between materials of different velocities in the subsurface. Since the velocities are related to the electric permittivity, and the permittivity is related to the density, then

GPR records can be interpreted as two dimensional cross sections of the density distribution in the subsurface.

3.2.2 Surface Seismic Reflection

Surface seismic reflection is a proven technology to provide a reliable cross section of the subsurface along a line of measurements on the surface. The seismic reflection method and the associated data processing techniques are used routinely in the petroleum industry to explore geologic features for the potential of locating oil and gas deposits. Recently the petroleum industry has been investigating the use of shear waves, rather than compressional waves, for subsurface imaging. The tests at the Project Area included the use of both compressional and shear waves. Shear waves have the advantage of having a different direction of motion than the traffic on the highway. Since seismic traffic noise was anticipated as being a problem in this study, the use of shear waves was considered essential in these tests. Shear waves have the added advantage of being much slower (usually around 1/3 slower) than compressional waves. This is important for near-surface studies where the distances from the surface to the targets of interest in the subsurface is very short. The primary purpose of the seismic studies was to provide a rapid non-invasive means of mapping objects in the subsurface.

3.2.3 Cross-hole Ground Penetrating Radar

Cross-hole GPR is a technique that is still in its development stages. The theory is sound, since it is identical to the propagation theory that has been developed to describe surface GPR measurements, which is a proven imaging technique that has been tested for over 40 years. However, there are only 3 manufacturers of borehole GPR systems, and the effects of cable interference and electronic noise have not been thoroughly studied. In theory, cross-hole GPR should be able to provide an excellent high-resolution, two-dimensional image of changes in the velocity of propagation of a high-frequency electromagnetic wave between two boreholes. The velocity of propagation is directly related to the relative electrical permittivity, which in-turn is related to the density of material. Therefore, cross-hole GPR should be a reliable indicator of voids, slumps, and other low-density features related to mine collapse.

3.2.4 <u>Cross-hole Seismic Methods</u>

<u>Cross-hole Seismic Velocity</u> Cross-hole seismic velocity measures the velocity of propagation of a compressional wave between two boreholes. By making measurements at different levels in the wells, a vertical profile of the velocity variations between the two wells can be established. The seismic velocity can then be related to the porosity of the material.

<u>Seismic Tomography</u> Seismic tomography is a technique that is still in its development stages. The theory is sound, since it is identical to propagation theory that has been developed to describe surface seismic measurements, which is a proven imaging technique that has been tested for over 60 years in the petroleum industry and for shallow engineering investigations. Seismic tomography is an inverse imaging technique that has the goal of providing a two dimensional image of changes in the velocity of propagation of a seismic wave between two boreholes. T hese studies differ from conventional seismic tomography that is used in the petroleum industry in two important ways:

1) shear waves and compressional waves are propagated and measured; and,
2) the measurements are conducted in the near surface, where the propagation is affected by the near proximity to the surface and the complexities associated with variations in the water saturation and lithology.

Propagation and measurement of shear waves and compressional waves provides the potential of measuring the full propagation tensor matrix (three orthogonal transmission directions, and three orthogonal measurement directions), which increases the likelihood of obtaining an improved image of the velocity distribution between the drill holes. Seismic tomography should be a reliable indicator of voids, slumps, and other low density features related to mine collapse.

3.2.5 <u>Down-hole Geophysical Borehole Logging</u>

Geophysical boring logs provide a detailed analysis of the physical properties within the immediate vicinity of the borehole wall for each drill hole. They provide a continuous record of the physical properties and indicate the details of the physical property changes much better than traditional methods of sampling or describing the drill cuttings over the interval of the drill hole. The geophysical boring logs included a natural gamma ray and a conductivity (inverse resistivity) logging. There are more sophisticated geophysical well logging methods (e.g., gamma-gamma density, neutron-thermal-neutron porosity, sonic velocity, acoustic televiewer, etc.), which are available but were not tested as part of this study.

3.2.6 Resistivity

Two types of surface resistivity surveys were completed at the IR-70 Study Area by others under a separate contract. The data and findings of the resistivity surveys were reviewed as part of the research completed for this project.

Resistivity equipment can be very simple, consisting of a measurable source of electric current that is injected between two electrodes, and a voltage measuring device between two potential electrodes. The current generating source consists of a transformer/converter that sends a slowly-varying square wave to the current electrodes. The amplitude of the current that is injected into the ground is determined by the separation of the current electrodes and the conductivity of the ground near the surface. The separation of the electrodes, in a general sense, determines the depth of investigation. In practice, the electric current can range from a few milli-Amperes (mA) for shallow engineering investigations, to several Amperes for deep investigations.

Current flowing between two current electrodes spreads out radially into the material. Any change in the resistivity of the host material causes the current flow to change direction and intensity when it reaches the surface. The intrinsic resistivity of the resistive body is greater than the resistivity of the surrounding material. Conversely, the resistivity measured in the presence of a conductive body is less than the surrounding material. The resistive body at the IR-70 Site was the fracture zones, the voids above the mine, and the mine void. Two resistivity systems were tested at the IR-70 Study Area. Both methods are briefly described in the following paragraphs.

One of the systems tested was the Ohm-Mapper, manufactured by Geometrics Corporation, which is a capacitively-coupled system that does not require pounding individual stakes into the ground. Data from the Ohm-Mapper system is recorded on digital media, and the data are then inverted using a two-dimensional modeling program. The modeling program basically outputs a cross section of the subsurface that indicates the zones of high and low resistivity. The anomalously high resistivity regions can potentially be correlated with possible regions of voids or collapse.

The other system tested at the IR-70 Site was the Sting resistivity system. This system is similar to conventional resistivity systems, with the important difference being that multiple electrodes (current and potential) can be deployed simultaneously. This greatly increases the efficiency of the field operation over conventional four electrode systems.

3.3 TRANSFER OF TECHNOLOGY - PHASE III

The ultimate goal of the research completed at the Project Area was to provide a useful evaluation of various investigative techniques for potential use at other highways located over abandoned underground mines both within and outside of the state of Ohio. This transfer of knowledge and technology is presented in a separate document entitled "Guidelines for Geophysical Investigations of Mines Under Highways", which was prepared and submitted to the Ohio Department of Transportation in May of 2003. The Project Area offered a unique opportunity for verifying the efficiency of both the remediation (grouting) program and investigative methods for potential use on other projects.

SECTION 4 - SITE CHARACTERISTICS

4.1 REGIONAL GEOLOGY

4.1.1 Geomorphology

The project lies approximately 5.5 miles east of the City of Cambridge, Ohio within the northeast to southwest trending Mud Run Valley in Center Township of Guernsey County. USGS mapping for the area is on the USGS Old Washington 7.5 minute quadrangle map. The area is within the Allegheny Plateau Physiographic Region of Ohio which is part of the Appalachian Plateau Physiographic Province. The region is un-glaciated and the topography can generally be described as moderately to steeply rolling. Vertical relief from the valley bottoms to the hilltops is generally less than 250 feet with hillside slopes commonly near 25 percent.

The project lies entirely within the confines of Mud Run Valley which is within the Muskingum River Watershed. The floor of the valley, in the immediate vicinity of the site, is relatively level and is approximately 800 feet wide. Mud run is historically a meandering stream, however, during the construction of Interstate 70, Mud Run was channelized and relocated to the southeast side of Interstate 70 along the Project Area.

Mud Run, at the site location, drains approximately 1,820 acres (2.8 square miles). The headwaters of Mud Run are located approximately 2 miles north-northeast of the Project Area and the flow is generally to the southwest. Mud Run discharges into Leatherwood Creek approximately 2 miles southwest of the Project Area. Leatherwood Creek flows northwest and discharges into Wills Creek at Cambridge. Wills Creek generally flows northward then westward and discharges into the Muskingum River near Dresden. The Muskingum River generally flows south by southeast and discharges into the southwest flowing Ohio River at Marietta. The convoluted drainage pattern of the Muskingum River Watershed is the result of the influences of Pleistocene Glaciation in the western portions of Ohio.

4.1.2 <u>Stratigraphy</u>

The soils present in the valley bottoms near the Project Area, including the Mud Run Valley, are a result of the influences that Pleistocene Glaciation had on the drainage patterns of Ohio. According to The Ohio Geological Survey of Ohio, Bulletin 44, "Water in Ohio", Stout, Ver Steet, and Lamb (1943), prior to glaciation, the streams within the valleys near the Project Area discharged into what is referred to as the Cambridge River which generally followed the course of present day Wills Creek. The ancestral Cambridge River, however, extended westward and discharged into the ancestral Groveport River near Newark which discharged into the ancestral Teays River near London, in western-central Ohio.

During the period between Kansan and Illinoian glaciation, the creeks within the valleys near the Project Area discharged into the ancestral Plainfield Creek which followed the course of present day Wills Creek. Plainfield Creek discharged into the southwest flowing ancestral Newark River near present day West Lafayette. Illinoian glaciation blocked the Newark River east of Newark forming a glacial lake which inundated the valleys in the vicinity of the Project Area. The inundation caused lacustrine materials to be deposited within the valleys. During the period between Illinoian and Wisconsin glaciation, streams in the valleys near the Project Area discharged into ancestral Kimbolton Creek which also followed the course of present day Wills Creek to near West Lafayette. Kimbolton Creek discharged into the eastward then northward flowing ancestral Massillon River. Wisconsin glaciation blocked the drainage of Massillon River near Bolivar. The valleys in the vicinity of the project were again inundated by a glacial lake. The inundation facilitated additional lacustrine deposition.

As a result of multiple flooding and draining of the valleys near the Project Area, the following soils (described from the ground surface downward) can be expected within the valleys near the project:

1) recent deposits of alluvial, colluvial, and fluvial materials;
2) Wisconsin lacustrine clays;
3) post Illinoian/pre-Wisconsin deposits of alluvial, colluvial, and fluvial materials;
4) Illinoian lacustrine clays;
5) pre-glacial deposits of alluvial, colluvial, and fluvial materials; and,
6) bedrock.

Erosional processes were also likely to have been on-going concurrently with depositional processes prior to glaciation, during both the inter-glacial periods, and during the current post glacial period.

In the upland areas northwest and southeast of the project, the unconsolidated materials overlying bedrock generally consist of thin cohesive residual soils. The source material for the soils is the underlying bedrock members of the Conemaugh Group which are of Pennsylvanian Age. The bedrock is primarily shales, sandstones, and claystones; with thin layers of limestone and coal. Generally speaking, there are no regionally extensive mineable coal seams within the Conemaugh Group, however, thin discontinuous seams of coal are mined in some areas, such as from the Lucas Mine located approximately 1,500 feet north of the Project Area.

The uppermost bedrock in the valleys near the Project Area consist of the lower members of the Conemaugh Group, Glenshaw Formation which are generally shales and sandstones. In the valley bottoms, these members are generally thin (less than 20 feet thick) and overly the Allegheny Group. The mapped location of the contact line between the Conemaugh and Allegheny Groups is shown on the Mining/Geology Maps included in Section 9.1 of this report. The contact generally is not exposed at the ground surface, but rather, occurs a the soil bedrock contact in valley bottoms west of the Project Area (subsurface outcrop).

The Allegheny Group has a typical thickness of approximately 200 feet and overlies the Pottsville Group. The uppermost member of the Allegheny Group is the Upper Freeport which contains the

No. 7 Coal mined from beneath the project area. The bedrock members beneath the Upper Freeport are generally comprised of shales, sandstone, and coal deposits. Coals in addition to the No. 7 within the Allegheny include the Nos. 6, 5, 4A, and 4 Coals all of which are regionally extensive and mined in various regions of Ohio; there are also thinner coal deposits which are in some cases locally mined. The No 6 Coal (Middle Kittanning) is the first regionally extensive coal beneath the No. 7 Coal and is typically present about 90 feet beneath the No 7 Coal.

The Upper Freeport Member of the Allegheny Group is comprised of the No. 7 Coal overlying a very-soft shale deposit (underclay) overlying a limestone deposit. The coal, in the vicinity of the Project Area, is persistent, generally in excess of 5 feet thick, and extensively mined. The underclay is generally 5 to 10 feet thick and the limestone (where present) is generally less than 2 feet thick.

4.1.3 Structural Features

The Ohio Department of Natural Resources (ODNR), Division of Geologic Survey has prepared *Preliminary Structural Contour Maps of the Top of the Allegheny and Pottsville Groups Undivided* on a 7.5 minute quadrangle maps at 20 foot contour intervals. Because the Upper Freeport (No. 7 Coal) is the uppermost member of the Allegheny Group which overlies the Pottsville Group, these maps are essentially a structural contour map of the top of the No. 7 Coal which was mined from beneath the Project Area. The structural contours have been presented on the Mining/Geology Maps included in Section 9.1 of this report.

The structural mapping indicates that in the immediate vicinity of the project (within about a mile) the coal dips to the south-southeast at about 30 to 35 feet per mile. The strike of the bedrock members is to the northeast nearly parallel to the roadway in the immediate vicinity of the project. There are no mapped faults in the vicinity of the Project Area. Within about 5 miles of the project, the following are evident in the structural mapping:

- the axis of a slight synclinal feature is located about 1.25 miles southwest of the Project Area. The syncline plunges to the southeast at about 40 feet per mile and the side slopes plunge toward the axis at about 50 feet per mile;
- southeast and east of the project the dip is to the southeast and is slightly steeper (about 50 feet per mile); and,
- north and northwest of the project the dip is to the east-southeast at a similar slope as the Project Area.

4.1.4 Hydrogeology

4.1.4.1 Regional Aquifers

Groundwater Resource Mapping has been prepared for Guernsey County by the Ohio Department of Natural Resources, Division of Water. The mapping indicates that there are no developed unconsolidated aquifers in the vicinity of the project. A somewhat discontinuous unconsolidated aquifer is mapped as being present within the Leatherwood Creek Valley located approximately 2 miles southwest of the Project Area. Yields from the Leatherwood Aquifer are mapped as being less than 3 gallons per minute. Similar small discontinuous unconsolidated aquifers are likely present in the other small valleys throughout the region where granular soils are present and the deposits are thick enough for well development.

The primary mapped aquifer near the Project Area (and throughout most of the county) is shale and sandstone bedrock. Typical well depths are about 120 feet and yields are generally less than 3 gallons per minute. The ODNR mapping makes does not differentiate between wells completed in the Conemaugh Group (upland areas) and wells completed in the Allegheny Group (bottom lands) as stratigraphic conditions and water yields are similar in both. A review of logs from household water wells in the area generally supports the data shown on the ODNR mapping.

In addition to the shale and sandstone aquifers, groundwater is also present in the coal deposits. Although the coal seams are generally thin, fractures may yield higher flows. Flows can be expected to be extremely high into wells which penetrate mined coal seams, although the general quality can be expected to be degraded. The mined areas beneath, northwest, and south of the Project Area represent such an aquifer. Coal is described on a number of household water wells logs in the area, however, none of the wells appear to derive water primarily from the coal zones. Regardless of the lack of development, the coal zone should be considered the uppermost aquifer in the immediate vicinity of the project because of the size of the mining complex, presence of water in the workings, and the relatively shallow depth to the No. 7 Coal. Abandoned mine mapping indicates that the mine passageways which lie beneath the valley are connected with a mine complex which encompasses approximately 2.7 square miles up-dip (northwest) of the roadway to an additional 1.3 square miles of workings down-dip (south) of the roadway.

4.1.4.2 Public and Private Water Wells

Records for household water supply wells are maintained by the ODNR Division of Groundwater. Fifty-six wells are known to be present in the vicinity of the Project Area (within about 2 miles of the site). It is likely that additional wells which have not been located by ODNR personnel are present in the area. The logs of unlocated wells were reviewed and the locations were identified for a portion of these wells. Data contained on the located logs (both ODNR and BBC&M located) are summarized in Section 9.2 of this report and a map depicting the locations of the household wells is included in Section 9.1 of this report.

There are no records of any public water supply well in the vicinity of the Project Area and none of the household water wells in the vicinity of the Project Area are completed in granular stratigraphy. The majority of water supply wells (39 of 56) derive groundwater from shale and sandstone bedrock of the Conemaugh Group above the elevation of the No. 7 Coal. Five wells are believed to derive water from the Allegheny Group below the No. 7 Coal. Of the five Allegheny Group wells, four are believed to have penetrated the No. 7 Coal, however, the well casings were extended to an elevation below the level of the coal, presumably to prohibit poorer quality water from entering the well. Twelve wells are believed to derive water partially from the No. 7 Upper Freeport Coal (well is uncased from an elevation above the anticipated elevation of the coal and the bottom of the well is below the anticipated elevation of the coal). Only one of the coal zone wells is within the mapped extent of the mine complex. This well (HW101) was terminated at a depth of 38 feet where the top of the coal was encountered. The static water levels recorded on the logs of the household wells which penetrated coal zone are inconsistent therefore and a reliable groundwater flow map could not be prepared from the data.

4.1.4.3 Recharge and Discharge Areas

Primary recharge to the coal zone aquifer is believed to be the result of infiltration of precipitation. Additional recharge to the aquifer may include discharge from the coal from un-mined areas, and from point and line surface sources (surface water bodies). There are no major surface water bodies above the coal zone in the vicinity of the site (Salt Fork Lake is below the coal zone and Seneccaville Lake is located 6 miles southeast of the site well beyond the extent of the interconnected mines near the project). Several small farm ponds are present above mapped workings and several streams (including Mud Run) cross above the mine workings which may recharge the workings.

According to the Hydrologic Atlas for Ohio, 1991, the area of Ohio where the site is located receives approximately 40 inches of annual rainfall. Of the 40 inches, approximately 15 inches flows overland to streams and the remaining 25 inches either evaporates or infiltrates. Estimates of aquifer recharge rates in the area are listed as from 2.1 to 4.2 inches per year in "Preliminary Estimate of Ground-Water Recharge Rates, Related Streamflow and Water Quality in Ohio" (Pettyjohn, 1979). The regression tree model shown in "Use of Streamflow Records and Basin Characteristics to Estimate Ground-Water Recharge Rates in Ohio" (Dumouchelle, 2002) indicates groundwater recharge near the Project Area be approximately 10.2 inches per year. U.S. Bureau of Mine estimates of recharge rates to underground mines vary 0.2 to as high as 14.7 inches per year. Using a range of 2.1 to 10.2 inches of recharge annually, the total recharge to the 4 square mile area above the mine complexes would range from 400,000 to 1.5 million gallons per day. The infiltration water would percolate into the ground and recharge the aquifers and saturated zones. Some of the water seeps out of the hillsides or provides recharge other aquifers and streams. An unknown percentage of the water would recharge the No. 7 coal/mine zone. Assuming a 50 percent extraction rate and an average mine height of 6 feet, the volume of water which would be in the 4-square mile mine complex would be approximately 2.5 billion gallons.

For most aquifers in Ohio, recharge typically is the greatest during the late Winter and early Spring, and groundwater levels are typically the highest during late Spring. Recharge is typically the lowest during the Autumn, and groundwater levels are typically the lowest during late Autumn and early Winter.

Discharge from the coal zone aquifer can be expected at the following areas:

- vertical downward leakage to other aquifers;
- lateral seepage into unmined coal adjacent to the workings;
- lateral discharge along the subsurface crop line (coal is uppermost bedrock beneath soil); and,
- upward and lateral discharge from mine openings or other openings into the workings.

None of the valleys in the immediate vicinity of the site appear to cut to a low enough elevation into the bedrock to permit discharge to the ground surface from coal zone aquifer. However, geologic mapping indicates the contact between the Conemaugh and Allegheny Groups (coal zone) occurs in the subsurface (at the soil-bedrock contact) in the Mud Run Valley approximately 4,000 feet southwest of the Project Area. This area is lateral to the Project Area (relative to the dip of the coal). The coal also "outcrops" to the soil along the valley walls of Leatherwood Creek which is lateral to slightly up-dip of the Project Area. Additionally, the coal zone "outcrops" to the soil in the valley in which Endley Road is located which is also up-dip from the Project Area. The soil "outcrop" line is shown on the Mine/Geology Maps included in Section 9.1 of this report.

The soil "outcrops" can be expected to hydraulically connect the coal zone and granular deposits in the soils filling the valleys. These connection could permit recharge to or discharge from the coal zone depending upon the hydraulic head in the zones at the locations of the connections. Based on geologic mapping, there are not believed to be any surface or soil "outcrops" of the coal zone down-dip (south, southeast, or east) of the Project Area. A geologic cross section drawn roughly parallel to the dip of the coal is presented on Page 4 of Section 9.1.

The floor of the mine workings cover an areas of approximately 4.0 square miles (approximately 2,560 acres). Assuming a coal height of 6 feet, the exposed coal at the lateral limits of the mine workings has a surface area of approximately 600,000 square feet (14 "acres"). Typical values for the coefficient of horizontal permeability of the in-place coal at the lateral limits of the mine workings can be expected to be near 10^{-4} to 10^{-5} cm/sec and the coefficient of vertical permeability of the underclay, shales, and sandstones beneath the workings can be expected to be near 10^{-6} to 10^{-7} cm/sec. Because there is roughly 2 orders of magnitude difference in both the permeability and contact areas with the floor of the mine and coal at the lateral limits of mining, it would be expected that the quantity water discharging from the mine workings as downward leakage into the underlying bedrock units would be similar to the lateral discharge into unmined coal. However, because the coefficient of permeability of some of the lateral materials (mine spoils and fractured coal near the soil "outcrop") can be expected to be higher than would normally be expected for in-place coal, it is believed that the quantity of water discharging laterally from the mine workings is greater than the quantity of water discharging vertically.

Based on the lack of actual outcrop or soil "outcrop" points down-dip of the project, it is believed that a significant amount of groundwater discharges laterally from the coal zone aquifer up-dip of the Project Area along the subsurface outcrops where the outcrops are in close proximity to the mine workings. Further concentrated discharge from the coal zone could occur at points where the coal has been day-lighted by mining activities. Such points include openings, air and elevator shafts, and surface mines. The ground surface elevations at the openings and shafts are generally well above the water level of the coal and thus these are not believed to represent significant discharge points. However, surface mines, even when backfilled, could represent concentrated discharge points because of the potential for water in the mine to seep into the relatively-high permeability mine spoils.

The pond filling the un-reclaimed pit mine located along Endley Road 1.7 miles west-northwest of the Project Area is believed to be an example of such a concentrated discharge point. The pit mine is believed to be connected (or nearly connected) with the Murray Hill Mine. The pond (pit mine) receives surface runoff from approximately 2.5 acres. Based on flow measurements in the receiving stream, the expected surface water discharge rates in the basin are near 700 gallons per day (gpd) per acre drained. Discharge from the pond would therefore be expected to be near 1,750 gpd (2.5 acres x 700 gpd/ac). Discharge from the pond was measured to be about 55,000 gpd. It is believed that the large discrepancy between the expected and measured discharge is because most of the discharge from the pit mine is water discharging from the mine workings rather than surface water runoff. On the same day the above described flows were measured, discharge from the other un-reclaimed pit mine located 4,000 feet southwest of the Project Area was examined; no discharge was observed. It is believed this pit is a currently acting as a recharge point for the King Mine workings.

4.1.4.4 Regional Groundwater Flow

Regional flow within a bedrock aquifer can be expected to generally follow the dip of the local bedrock. For the coal zone aquifer in the in the vicinity of the project this would be to the southeast. Local variations in regional groundwater flow patterns can be expected near recharge and discharge points. Flow would be expected to be away from recharge points and toward discharge points. Additional localized variations can be expected where the aquifer thins (or thickens), narrows (or widens) and where changes in coefficient of permeability occur. Significant variations in the coefficient of permeability are present within the coal zone aquifer due to the varying conditions of the mine complex (in-place coal, open workings, roof collapse areas, stowed mine gob, etc.). It is possible that the local variation in flow patterns, whether they be from recharge/discharge or conditions in the workings, may supercede the flow patterns expected based on the bedrock structure.

It is believed that horizontal groundwater flow within the mine workings near the Project Area is controlled primarily by discharge points rather than then structural geology. It is estimated that between 400,000 to 1.5 million gallons per day of precipitation infiltration enters the mine workings daily. The primary discharge areas for water in the mine workings is believed to be lateral discharge at the limits of mining and downward leakage into the bedrock beneath the mine. It is believed that more water recharges the workings than can be discharged naturally into either of these two area. The excess water is believed to discharge laterally toward relatively small highly-permeable zones (concentrated discharge towards the area of least resistance). Because these types of areas can be expected to be most common near the soil "outcrop" line and surface mine workings west and northwest (up-dip) of the Project Area, it is believed that flow within the mine complex is generally to the west or northwest.

Laminar groundwater flow can be expected within the in-place coal. Groundwater flow in the abandoned mine works or other areas which have interconnected voids can be expected to generally flow in a manner similar to flow in karst bedrock regions. Flow in these areas may exceed velocities normally associated with laminar flow through a porous medium.

4.2 SITE GEOLOGY

4.2.1 Geomorphology

The Project Area extends the width of the right-of-way (300 feet) for a length of 2,100 feet from Station 467+00 to Station 488+00 and is within the confines of Mud Run Valley. The width of the valley floor varies from approximately 500 to 1000 feet and is relatively level in cross section. Typical ground surface elevations (beyond the roadway fill) range from 815 to 825 feet msl. The valley floor slopes from northwest to southeast at approximately 30 feet per mile.

Mud Run is historically a meandering stream which crossed beneath the location of the right-of-way prior to the construction of IR-70. The approximate location of Mud Run in 1935 is shown on the Potentiometric Maps for the Miscellaneous Sands included in Section 9.1 of this report. During the construction of IR-70, Mud Run was channelized and relocated to the southeast side of the right-of-way. The relocated channel for Mud Run is lies approximately 175 feet southeast of the right-of-way fence and is relatively straight.

Three tributaries drain into the valley within the limits of the Project Area. Two of these are located on the southeast side of the valley and are located near Station 480+00 and 486+00, discharge from these tributaries enters Mud Run. The third tributary enters from the northwest and is located near Station 482+00. Two farm ponds are located in the tributary immediately beyond the limits of the right-of-way. Discharge from the ponds and tributary enters the westbound outside shoulder ditch.

The roadbed for IR-70 is constructed on fill material which raises the highway approximately 5 to 10 feet above the valley floor. The eastbound and westbound lanes are constructed at mirror elevations. The roadway elevation at the east end of the Project Area is near 830 feet msl and the elevation at the west end of the Project Area is near 822 feet msl. The northeast corner of the Project Area (westbound lanes from Station 485+00 eastward) is located in a slight cut area as the right-of-way hugs the northwest valley wall.

Roadway ditches are present beyond the outside of both the eastbound and westbound paved shoulders. The median is raised and ditches are present between both the eastbound and westbound inside paved shoulder and the raised median. All of the ditches drain from east to west, and flow within the ditches is generally poor with standing water common after periods of rainfall. A portion of the ditch flow is carried from the two median ditches to the eastbound shoulder ditch via box culverts located near Stations 476+00 and 484+00.

The locations of the cross-sectional features of the roadway are described in the following table:

Feature	Eastbound	Westbound
Right-of-way Fence	150' Right (-)	150' Left (+)
Outside Shoulder Ditch	110' Right (-)	110' Left (+)
Outside Edge of Paved Shoulder	64.5' Right (-)	64.5' Left (+)
Outside Edge of Pavement	53' Right (-)	53' Left (+)
Inside Edge of Pavement	29' Right (-)	29' Left (+)
Inside Edge of Paved Shoulder	26' Right (-)	26' Left (+)
Median Ditch	15' Right (-)	15' Left (+)
Centerline Right-of-way	0' Right	0' Left

4.2.2 Structural Geology

Significant structural geologic features were not encountered within the Project Area which consists of approximately 14.5 acres. Regional structural mapping indicates that the top of the No. 7 Coal is near Elevation 760 feet msl and dips generally to the south-southeast. This is consistent with the conditions encountered in the Project Area. A structural contour map of the base of the Upper Freeport Coal has been prepared and is presented in Section 9.1 of this report. The map was prepared on the base of the coal rather than the top of the coal because the floor of the mine/base of coal is a consistently identifiable contact, whereas the roof of the mine is often difficult to identify due to collapse and grouting. The bedrock is nearly-horizontally bedded and slight rolls on the coal are evident. The lowest occurrence of the mine floor is near Elevation 752 feet msl at the south right-of-way fence near Station 476+00. High points in the mine floor occur near Elevation 758 feet msl at the west end of the project westbound lanes and near 760 feet msl at the east end of the project eastbound lanes. A dip to the southeast within the Project Area is weakly indicated in the structural contours of the base of the No. 7 Coal.

4.2.3 Stratigraphy/Geotechnical Properties

The general stratigraphy of the Project Area is depicted on the Stratigraphic Profiles and Cross Sections included in Section 9.1 of this report. Full descriptions of the stratigraphy encountered at each boring location are included on the logs of the explorations included in Section 10.1 of the Supplemental Volume of this report. Tables summarizing the depth of stratigraphic changes are included in Section 9.2 of this report.

The borings drilled at the site encountered generally 35 to 45 feet of soil overlying bedrock. For reference in this report, the stratigraphy, listed in descending stratigraphic order, has been grouped into the following categories:

- Roadway Fill;
- Miscellaneous Sands;
- Upper Silty Clay;
- Upper Sand;
- Lower Silty Clay;
- Lower Sand;
- Uppermost Bedrock; and,
- Coal Zone.

The results of geotechnical field tests (standard penetration tests and hand penetrometer values) are shown on the logs of each boring included in Section 10.2 (Supplemental Volume) and are summarized in Section 9.2 of this report. Composite gradation curves for the material types are included in Section 9.2 of this report and the individual curves for each sample tested as well as the results of other laboratory testing are included in Section 10.3 of this report. Calculations of "piping" potential, ratio of buoyant pressure to soil pressure, and coefficient of permeability are presented in Section 9.3 of this report.

Roadway Fill: The roadway fill was placed during the construction of the interstate. The material is generally comprised of stiff to hard silty clay (ASTM CL, HRB A-6 to A-7) and appears to have been placed in a controlled compacted manner. The material typically has a low-granular content (generally less than 20%). The fill is typically 6 feet thick, but in some isolated locations is as thick as 13.5 feet thick. Testing of the material found the fill to have the following characteristics:

	Minimum	Maximum	Average
Standard Penetration Test (blows per foot)	4	58	14
Hand Penetrometer Values (tsf)	0.8	4.5+	3.0
Moisture Content (%)	12	24	18
Liquid Limit (% moisture)	33	45	39
Plastic Limit (% moisture)	18	23	21
Plasticity Index	12	24	19

Surface ground penetrating radar surveys indicate that the fill is anomalous (different from surrounding conditions or materials) in the following general areas:

Eastbound Lanes	Westbound Lanes
469+00 to 470+00	471+00 to 473+00
473+00 to 481+00	479+00 to 481+00
482+40	483+00 to 485+00
483+30 to 483+80	
485+30	
486+20	

The larger areas listed above generally indicate that there are groups or many small anomalous areas within the larger described area. Anomalies may indicate disturbance of the materials, which at this site could be due to slumping or movement of the materials due to collapse of the bedrock.

Miscellaneous Sands: Miscellaneous sand refers to granular materials which occur as generally near-surface isolated pockets which are limited in lateral extent. The deposits are believed to be of the Holocene Epoch (recent post glacial), and the sands are believed to be the result of Mud Run meandering across the valley floor eroding and depositing materials over the past 14,000 years. In most cases, the sands were encountered in single borings and the lateral extent of such deposits are believed to be extremely small (a few feet to tens of feet). The deposits are slightly more extensive in two areas (encountered in multiple borings). The estimated lateral extent of these two deposits are shown on the Potentiometric Maps of Miscellaneous Sands included in Section 9.1 of this report. Only one of these two more extensive deposits is believed to be present beneath the roadway. A lense approximately 50 to 100 feet wide crosses the westbound lanes near Station 476+50 and the eastbound lanes near Station 473+25.

The miscellaneous sand deposits (where present) are typically 7 feet thick with the upper surface generally present at a depth of less than 10 feet. Standard Penetration Tests results (N values) in the deposit ranged from 7 to 17 blows per foot, but the material generally was medium-dense (average N value near 12). The material is typically comprised of 45% sand, 35% gravel, and 20% fines (material passing the No. 200 sieve). The ASTM classification is typically SM or SC and the HRB classification is generally A-2 or A-3. When groundwater levels are high, the deposits are fully saturated and would be considered confined water bearing units; when groundwater levels are low, the deposits become unconfined. Based on field test results, the coefficient of horizontal permeability of the various deposits ranges from 1.2×10^{-4} cm/sec to 5.7×10^{-3} cm/sec.

The ratio between the buoyant pressure and the overlying soil confining pressure was determined at the contact between upper sand and overlying and cohesive soils. This pressure ratio is an indication as to the potential for movement of the soils as a result of uplift pressures. If the pressure ratio meets or exceeds a value of 1, "quick" conditions can result, which facilitate the mixing and migration of materials. The analysis results are believed to be useful for the determination of potential soil migration and formation of soil voids. During the method evaluation phase of the investigation the average ratio for the miscellaneous sand was found to be 0.15, and none of the calculated ratios were near critical levels (near or in excess of 1).

Upper Silty Clay: The upper silty clay is believed to have been deposited during Wisconsin Pleistocene glaciation. During that period, it is believed that Mud Run Valley was inundated by a glacial lake on the bottom of which silts and clays were deposited. The deposit is continuous beneath the Project Area. The deposit is typically 15 feet thick but, in some areas, is as thin as 5 feet and as thick as 25 feet.

The material generally consists of silty clay but also contains pockets of clayey silt (ASTM CL to ML, HRB A-4 to A-7). The consistency of the material varies both laterally and vertically from very soft to very stiff. The stratum generally becomes weaker with depth and is typically stiff. The stratum has a low granular content (generally less than 15%) and contains thin lenses of silt and fine sand. Based on consolidation testing, the coefficient of vertical permeability of this material is believed to be near 5.4×10^{-8} cm/sec. Based upon extensive laboratory tests on Ohio silty clays, coefficients of vertical permeability typically range from 10^{-7} to 10^{-8} cm/sec. Testing of the material found the upper silty clay to have the following characteristics:

	Minimum	Maximum	Average
Standard Penetration Test (blows per foot)	1	34	9
Hand Penetrometer Values (tsf)	0.1	4.5	1.7
Moisture Content (%)	18	32	23
Liquid Limit (% moisture)	25	56	34
Plastic Limit (% moisture)	17	23	20
Plasticity Index	5	35	15

Consolidation testing was completed on the two samples of the upper silty clay. The results are summarized as follows:

	GC-218	GC-215	Averages
Calculated Max Past Pressure	5,600 psf	3,200 psf	4,400 psf
Existing Overburden Pressure	990 psf	1,870 psf	1,430 psf
Over-Consolidation Ratio (OCR)	5.66	1.71	3.68
Cc (within overburden load range)	0.04	0.10	0.07

These results indicate that the upper silty clay has been over-consolidated. There are several potential causes of the over-consolidation of the stratum, the two most likely at the Project Area are:

1) the deposit was originally thicker and the upper portion has been eroded; and/or,
2) the pore water pressure varied prior to material being deposited above the strata which caused dessication due to surface drying.

Triaxial strength testing of the stratum resulted in a total strength parameters of friction angle of 37 degrees and a cohesion value of 0. The testing also resulted in an effective strength parameters of a friction angle of 31 degrees and a cohesion value of 0. The results indicate that the upper silty clay has a higher shear strength and lower compressibility than the lower silty clay. These results are consistent with the conclusion that the upper silty clay is over-consolidated.

The upper silty clay is the stratum supporting the roadway fill. The stratum was found to have a "low strength" in the following general areas:

Eastbound Lanes	**Westbound Lanes**
469+50	470+50
471+50	474+50
478+00	484+00
483+50	
485+50	

For the purposes of this report "low strength" is defined as having a Standard Penetration Test result (N value) of less than 5 blows per foot <u>or</u> a hand penetrometer value (which is an estimate of the unconfined compressive strength) of less than one ton per square foot.

Upper Sand: The upper sand is believed to be an inter-glacial (between Illinoian and Wisconsin Pleistocene glaciation) fluvial deposit. The sands are believed to be the result of an inter-glacial stream meandering across the valley floor. The deposit is not consistently present within the Project Area and generally occurs east of Station 480+00 and west of Station 476+00. These two deposits are most likely hydraulically connected south of the Project Area. The approximate lateral extent is shown graphically on the Potentiometric Maps for the Upper Sand included in Section 9.1 of this report.

Where present, the deposit is, on average, 6 feet thick with the upper surface being present near a depth of 20 feet. Standard Penetration Tests results (N values) in the deposit ranged from 1 to 35 blows per foot, but the material generally was medium-dense (average N value near 13). The deposit typically was comprised of 35% sand, 30 % gravel, and 35 % fines. The ASTM classification is typically SM and the HRB classification is generally A-2 to A-3. The material is fully saturated and would be considered a confined water bearing unit. Based on field test results, the coefficient of horizontal permeability of this deposit is believed to be near 10^{-2} cm/sec.

The ratio between the buoyant pressure and the overlying soil confining pressure was determined at the contact between the upper sand and overlying cohesive soils. During the method evaluation phase of the investigation, the average ratio for the upper sand was found to be 0.27. N one of the calculated ratios were found to be near critical (near or in excess of 1).

An evaluation of the potential movement ("piping") of cohesive material into the upper sand stratum was completed using filtering capabilities of the materials and horizontal flow velocities. The filtering capabilities were determined by calculating the appropriate filter criteria ratios from gradation curves of the soils. Based on filter criterion, there is a potential for movement of cohesive material into the upper sand zone. However, because of the current horizontal velocities (less than 1 foot/day), it is believed that substantial soil movement is not likely occurring. If the flow velocities were to substantially increase (measurable in ft/min), "piping" of the soils could occur.

Lower Silty Clay: The lower silty clay is believed to have been deposited during Illinoian Pleistocene glaciation. During that period it is believed that Mud Run Valley was inundated by a glacial lake on the bottom of which silts and clays were deposited. The deposit is continuous beneath the Project Area and has a typical thickness of 15 feet.

The material is generally comprised of soft to stiff silty clay (ASTM CL, HRB A-6 to A-7). The stratum has a very-low granular content (generally less than 5%) and, at some locations, contains thin seams of silt and fine sand. Based on consolidation testing, the coefficient of vertical permeability of this material is believed to be near 10^{-8} cm/sec. Based on extensive laboratory testing of Ohio silty clays, the coefficient of vertical permeability typically ranges from 10^{-7} to 10^{-8} cm/sec. Testing of the material found the upper silty clay to have the following characteristics:

	Minimum	Maximum	Average
Standard Penetration Test (blow per foot)	1	87	15
Hand Penetrometer Values (tsf)	0.2	4.5+	1.3
Moisture Content (%)	19	31	27
Liquid Limit (% moisture)	27	44	34
Plastic Limit (% moisture)	18	23	21
Plasticity Index	8	22	14

Consolidation testing was completed on two samples of the lower silty clay. The results are summarized in the following table:

	GC-207	GC-207	Averages
Calculated Max. Past Pressure	3,600 psf	4,600 psf	4,100 psf
Existing Overburden Pressure	3,740 psf	3,740 psf	3,740 psf
Over-Consolidation Ratio (OCR)	0.96	1.23	1.09
Cc (within overburden load range)	0.135	0.09	0.112

These results indicate that the lower silty clay is normally consolidated. Triaxial strength testing of samples of the stratum resulted in a total strength parameters of friction angle of 21 degrees and a cohesion value of 0. The testing also resulted in an effective strength parameters of a friction angle of 29 degrees and a cohesion value of 0.

Lower Sand: The lower sand is believed to be a pre-glacial fluvial deposit. The deposit occurs just above the bedrock surface, is generally linear, and is present beneath most of the project. The approximate lateral extent of the deposit is shown on the Potentiometric Maps for the Lower Sand included in Section 9.1 of this report. The deposit is typically 7 feet thick with the upper surface present near a depth of 35 feet. Standard Penetration Tests results (N values) in the deposit ranged from 1 to 88 blows per foot, but the material generally was dense (average N value near 47). The gradation of the material is less consistent than the upper sand, and the material varies from a sand to a gravel; the material, however, typically is comprised of 40% sand, 40% gravel, and 20% fines. The ASTM classification is typically SM to GM and the HRB classification is generally A-1 to A-2. Pockets of cohesive material are present within the deposit, most commonly just above the bedrock surface. The deposit is fully saturated and would be considered to be confined. Based on field test results, the coefficient of horizontal permeability of the material is believed to be near10^{-2} cm/sec.

The ratio between the buoyant pressure and the overlying soil confining pressure was determined at the contact between the lower sand and the overlying cohesive soils. During the method evaluation phase of the investigation, the average ratio was found to be 0.28. None of the calculated ratios were near critical (near or in excess of 1).

An evaluation of "piping" of cohesive material into the lower sand strata was completed using filtering capabilities of the materials and the flow velocities. The filtering capabilities were determined by calculating the appropriate filter criteria ratios from gradation curves of the soils. Based on filter criterion, there is a potential for movement of cohesive material into the lower sand zone. However, because of the current horizontal velocities (less than 1 foot/day), it is believed that substantial soil movement is not likely occurring. If the flow velocities were to substantially increase (measurable in ft/min), "piping" of the soils could occur.

Uppermost Bedrock: The uppermost bedrock beneath the Project Area is comprised of shales and generally fine-grained sandstones of the Glenshaw Formation of the Pennsylvanian Age Conemaugh Group. A topographic map of the bedrock surface has been prepared and is presented in Section 9.1 of this report. The bedrock surface is essentially an extension of the valley walls present northwest and southeast of the Project Area. The bedrock surface generally slopes from north to south toward the travel lanes and beneath the travel lanes the surface slopes from northeast to southwest. The high point of the bedrock surface (beneath the travel lanes) is beneath the westbound lanes at the east end of the Project Area; in this area, the bedrock surface is near Elevation 800 feet msl which is approximately 30 feet beneath the travel lanes. The low point of the bedrock surface (beneath the travel lanes) is beneath the westbound lanes at the west end of the Project Area; in this area, the bedrock surface is near Elevation 770 feet msl which is approximately 52 feet below the travel lanes. The base of the Glenshaw Formation is the top of the No. 7 Coal, which in the vicinity of the Project Area is near Elevation 761 feet msl.

Depressions in the bedrock surface are evident in several areas of the Project. These depressions are believed to be the result of collapse of the underlying mine workings and the migration of voids upward as the roof material fell to the floor of the mine. A generally low area is present beneath the eastbound lanes between Stations 482+00 and 485+00. Within this area, severe depressions (5 to 10 feet lower than the surrounding bedrock surface) are present near Station 483+25 and 483+75. These depressions were expected because this is the area of the original roadway sinkhole. Another general depression in the bedrock surface is present beneath both the eastbound and westbound lanes near Station 474+25. This depression was again expected because this is the area of a main haulage way and a land bridge was constructed in the westbound lanes because significant caved and broken conditions were detected during the grouting of the mine workings. The bedrock surface in the area south of the eastbound lanes is slightly lower than adjacent areas within the following Station ranges:

- 469+00 to 470+00;
- 472+50 to 478+00; and,
- 478+75 to 480+00.

The surface seismic reflection investigation detected 82 fractures in the bedrock overburden with vertical displacement. The displacement most likely indicated collapse of the underground mine workings in the vicinity of the fractures. The general locations of the fractures/collapse areas are as follows:

Eastbound Lanes	Westbound Lanes
468+50 to 469+70	468+20 to 469+50
470+40 to 471+40	
472+30 to 472+50	
473+10 to 473+30	
473+90 to 474+10	
474+60 to 475+30	474+60 to 475+90
	476+20 to 477+20
477+00 to 478+10	477+50 to 478+10
	478+50 to 478+90
479+90 (single fracture)	479+60 (single fracture)
	480+40 to 481+20
482+10 to 482+40	482+00 to 482+60
483+30 to 484+00	483+10 to 484+00
485+40 to 486+40	484+90 to 485+20

The bedrock is generally comprised of medium-hard shale which, at some locations, is silty or sandy. Facies changes occur within the shale; in some areas, the bedrock consists of fine-grained sandstone to siltstone and in a few locations fine to coarse-grained sandstones are present. Bedrock core recovery of the Glenshaw Formation ranged from 12% to 100% and the average was 83%. The

Rock Quality Designation (RQD) ranged from 0% to 100% with the average near 47%. These RQD values are somewhat lower than generally would be expected for the this formation. The low RQD is most likely the result secondary fracturing caused by collapse of the mine roof.

Unconfined compressive strength testing were completed on a sample of the shale, the results found the Maximum Stress to be 7,835 psi at a Strain of 2.0% at failure. It is noted that in order to complete the unconfined compressive strength testing, competent samples needed to be selected for testing; on this basis the overall strength of the bedrock can be expected to be significantly lower than the laboratory testing indicates.

Coefficient of permeability testing of the Glenshaw formation was not completed. The bedrock is not expected to be isotropic and the coefficient of permeability of concern (relative to "piping" of soils through the bedrock to the mine workings) is the coefficient of vertical permeability. Field measurement of permeability determine either the coefficient of horizontal permeability or a composite vertical/horizontal permeability. Laboratory testing could have measured the coefficient of vertical permeability, however, the testing must be completed on a relatively competent sample which would not have been representative of the actual site conditions (secondary fracturing with grout filling). It can be expected that the coefficient of vertical permeability prior to secondary fracturing would have been near 10^{-6} to 10^{-7} cm/sec. Secondary fracturing would have caused the coefficient of vertical permeability to be extremely variable and significantly higher, possibly as high as 10^{-3} cm/sec in localized areas. Grouting of the mine workings and overlying bedrock would have decreased the coefficient of permeability. It is estimated that the post grouting coefficient of vertical permeability of the Glenshaw Formation is near 10^{-6} cm/sec.

Coal/Grout Zone: The No. 7 Coal is the uppermost member of the Pennsylvanian Age Allegheny Group. The coal was extracted from underground mines from beneath the site. Within the Project Area (right-of-way fence to right-of-way fence), mapped mine workings are present beneath approximately 8.6 acres (59% of the Project Area). Grout was placed in the mine workings and overlying bedrock materials for nearly the entire project length from 72 feet left to 72 feet right of the centerline of the right-of-way. Within the are where grout was placed, mapped mines are present beneath 3.9 acres.

The coal zone thickness varies from 4 to 7 feet (average thickness of 5.8 feet) and is generally present between Elevations 761 and 755 msl. The coal is underlain by very-soft shales (claystone or underclay). Bedrock core recovery of the coal/grout zone ranged from 28% to 100% and the average was 83%. The RQD ranged from 0% to 100% with the average near 44%. Unconfined compressive strength testing were completed on select samples of grout, the results are summarized as follows:

Production Grout	GC-306	B-407G	Average
Maximum Stress	4,651 psi	5,124 psi	4,888 psi
Strain @ Failure	1.1%	1.3%	1.2 %
Barrier Grout	B-413H	B-407G	Average
Maximum Stress	3,587 psi	3,644 psi	3,615 psi
Strain @ Failure	1.4%	1.6%	1.5 %

Field testing indicates the following average coefficients of horizontal permeability within the coal zone:

grouted portion of the project	8.9×10^{-3} cm/sec;
ungrouted portion of the project	4.2×10^{-1} cm/sec; and,
in-place coal	4.3×10^{-4} cm/sec.

Logged voids, which could actually be zones of weak materials, were found within the grout placement area at a few locations within both the coal zone and within the overlying bedrock. At most locations, the mine voids were completely grouted. The logged voids or weak zones were generally small (typically one to two feet thick). The maximum void thickness encountered was 3.7 feet which was at the location of Boring B-111 (Station 483+40, 48 feet right). The void encountered at Boring B-111 was actually two voids, a 1.5 foot thick void present near the bedrock surface and a 2.2 foot void present at the mined interval. Full-height voids (in excess of 5 feet) were not encountered in any of the post-grout borings drilled within the zone where grout was placed. Full-height voids were encountered within the zone of grout placement zone in borings drilled prior to grout placement and in borings drilled beyond the limits of grout placement (both before and after grout placement). Post grout voids within the area of grout placement were encountered in the following general areas of the site:

Eastbound Lanes	**Westbound Lanes**
469+75	478+75
475+50	484+00
483+00 to 484+00	
484+50	

The ratio between the buoyant pressure and the overlying material confining pressure was determined at the contact between top of the coal zone and overlying bedrock. During the method evaluation phase of the investigation, the average ratio was found to be 0.38. None of the calculated ratios were near critical (near or in excess of 1).

4.2.4 Hydrogeology

Generally speaking there are three water bearing units at the site:

1) Upper Sands;
2) Lower Sands; and,
3) Coal Zone.

The miscellaneous sands represent a fourth zone, however, these sands generally occur in small isolated pockets which are not generally believed to by hydraulically connected. The miscellaneous sands are not believed to represent a significant zone of groundwater movement near the travel lanes.

Static water levels measured in the monitoring wells installed in each zone are presented in tabular and graphic form in Section 9.2 of this report. The calculations of flows discussed in the following sections are included in Section 9.3 of this report.

4.2.4.1 Horizontal Groundwater Flow

Upper Sand: The upper sand is present in two deposits which may be hydraulically connected south of the project area. The areas are described as the east area and the west area. The east area is generally present east of Station 479+00 and the west area is generally present west of Station 476+00. Components of flow were estimated using a coefficient of permeability of 5.7×10^{-3} cm/sec and Darcy equations.

A groundwater drainage divide is present in the eastern deposit. The highest groundwater levels in the eastern deposit typically were present beneath the median. Horizontal flow north of the median in the east area is typically to the northwest at a gradient of approximately 51 feet per mile at an estimated velocity of 0.26 feet per day. Horizontal flow south of the median in the eastern area is typically to the southeast at a gradient of 33 feet per mile at an estimated velocity of 0.17 feet per day. The divide may be present as a result of recharge from the median ditches. Horizontal flow in the west area is typically to the northwest at a gradient of 36 feet per mile at an estimated velocity of 0.19 feet per day.

The upper surface of the upper sand is generally present near Elevation 804.5 feet msl. Water in the zone is confined with the average water level (using all measurements from all wells installed in the zone) being at 814.2 feet msl. The variation in static levels measured in each well ranged from 1.8 feet in Well P-222C to 4.8 feet in Well P-228C. The average variation was 3.0 feet.

Lower Sand: The lower sand is believed to be a channel deposit present on or near the bedrock surface. The deposit is linear and is roughly parallel to the roadway. Components of flow were estimated using a coefficient of permeability of 10^{-2} cm/sec and Darcy equations. Horizontal groundwater flow within the deposit is variable. Toward the east end of the Project Area, flow is typically to the west-northwest at a gradient of 29 feet per mile at an estimated velocity of 0.17 feet per day. Toward the western end of the Project Area, flow is typically to the north-northwest at a gradient of 43 feet per mile at an estimated velocity of 0.26 feet per day.

The upper surface of the lower sand is generally present near Elevation 790.9 feet msl. Water in the zone is confined with the average water level being at 808.9 feet msl. The variation in static levels measured in each well ranged from 1.0 foot in Well P-228B to 2.3 feet in Well P-307B. The average variation was 1.9 feet.

Coal Zone: Horizontal flow within the coal zone (mine working) is obstructed by the grout placed in the workings to stabilize the Project Area. The grouted workings have a lower coefficient of permeability than the ungrouted workings and therefore flow is generally perpendicular to the narrowest dimension of grout placement (horizontal flow is directly across the right-of-way). Horizontal flow across the grout curtain is typically to the northwest at a gradient of 50 to 55 feet per mile at an approximate velocity of 0.23 feet per day. The average daily discharge of groundwater flowing through the grouted portion of the mine workings within the Project Area is near 13,900 gallons per day.

The mine working up-gradient of the site extend over an area of approximately 1.3 square miles. Assuming a recharge rate between 2.1 and 10.2 inches per year, recharge up-gradient of the site is between 130,000 and 630,000 gallons per day. Horizontal flow through the mined interval at the project area, therefore, represents between 2% and 11% of the recharge to the mine complex up-gradient of the project area.

The upper surface of the No.7 Coal is generally present near Elevation 761.1 feet msl. Water in the zone is confined with the average water level being 808.3 feet msl. Up-gradient (southeast) of the grout curtain the average static level was 809.0 feet msl and the variation in measured static levels was from 1.3 feet in Well PW-001 to 2.0 feet in Well P-304A. Within the grout curtain the average static level was 808.4 feet msl and the variation in measured static levels was from 1.6 feet in Well P-221A to 2.5 feet in Well P-307A. Down-gradient (northwest) of the grout curtain the average static level was 807.6 feet msl and the variation in measured static levels was from1.9 feet in Well P-301A to 2.4 feet in Well P-225A. The typical water level drop across the grout curtain is 1.4 feet.

The horizontal gradients of water within the mine workings beyond the grout curtain (both northwest and southeast) are extremely flat. A limited number of wells were installed in both of these areas at spacings of a few hundred feet. The difference in the static levels in these wells was generally one to three hundredths of a foot. The static levels measured at the site are believed to be accurate to within plus or minus 2 hundredths of a foot (+/- 0.01 feet for surveying and +/- 0.01 for water level measurements). Because the difference in the static levels is nearly the same as the potential error in the static levels, it is believed that determinations of gradients are unreliable because errors could easily be as much as 50 to 100 percent. This magnitude of potential error would be carried over into the calculation of velocity, travel time, flow rate, and loadings. The data are, however, adequate to determine that the horizontal gradients beyond the limits of the grout curtain are generally less than one foot per mile. The presumption is that the quantities and directions of flow are similar to those within the grouted portions of the Project Area (at least in the immediate vicinity of the project).

Horizontal groundwater flow through the grout curtain is up-dip, which was not the anticipated direction of flow. As discussed in the regional geology section of this report, it is believed that the up-dip flow is the result of the locations of lateral discharge points (see Page 4 of Section 9.1). The subsurface coal outcrop and surface mines intercepting the workings of the western portion of the Murray Hill Mine (up-dip) are believed to be the most permeable lateral discharge points. Water recharging the King Mine workings (down-dip) from precipitation infiltration, leakage from overlying aquifers, and infiltration of surface water (i.e. the mine pit southwest of the project and leakage from Mud Run) are believed to flow generally northward through the King Mine workings. The horizontal component of groundwater flow enters the Murray Hill mine workings primarily through the "pinchpoint" of the working beneath the Project Area. Flow is then believed to be generally westward through the Murray Hill Mine workings toward the discharge points on the western and northwestern sides of the Murray Hill Mine. It is noted that a substantial portion of the water within the mine workings is believed to discharge vertically as leakage into the underlying bedrock stratigraphy.

The pit mine located southwest of the Project Area was actively being dewatered until late 1994. It is believed that dewatering of the mine lowered the pool level of both the King Mine and Murray Hill mine workings. The dewatering caused the groundwater flow in the mine under the Project Area to flow toward the southeast (toward the dewatering point). This lowered pool level is believed to have caused the water flow into and out of the mine to be out of balance (recharge not equal to discharge). After the secession of dewatering, water levels in the workings would have begun recovering but would not have reached equilibrium until recharge to the workings equaled discharge from the workings. During the recovery period it is expected that the flow direction would have been controlled by the bedrock structure (flow in the down-dip direction).

Historic measurements of groundwater levels in the coal zone indicate that, between June of 1995 (earliest measurements available) and March of 1998, groundwater flow in the coal zone in the vicinity of the Project Area was to southeast across the grout curtain (down-dip). Based on the data available, a reversal in flow appears to have occurred between March and June of 1998. All data collected after March of 1998 (1st measurement being in June of 1998) indicate a direction of flow (within the Project Area) to the northwest. It is believed that in the Spring of 1998 the coal zone aquifer had fully recovered from the effects of dewatering and had reached equilibrium with the quantity of water recharging the workings equal to the quantity of water discharging from the workings.

4.2.4.2 Vertical Flow

Estimates of vertical groundwater flow between the various water bearing units within the project were determined based on static levels at cluster well, characteristics of the separating materials, and areas were the water bearing units overlap. Generally speaking flow is downward from the stratigraphically higher zones to the stratigraphically lower zones.

Upper Sand to Lower Sand: The total area where the upper sand is present above the lower sand covers approximately 2.9 acres which is divided into 3 segments. Beneath the travel lanes, these areas are located east of Station 480+50, between Stations 474+25 and 475+75, and west of Station 471+00. Using Darcy's equations, recorded groundwater levels, and laboratory measurements of coefficients of permeability, it is estimated that approximately 20 gallons per day of groundwater leaks downward from the upper sand to the lower sand within the Project Area. This water moves under a typical gradient of 0.73 feet per foot at a velocity of 0.008 feet per year.

The vertical gradient between the upper sand and lower sand is relatively high which indicates a potential for "piping". However, because of the low coefficient of permeability of the soil between the sand zones, the velocity of flow is low, and therefore, the potential for active transport of material is also low.

Lower Sand to Coal Zone: The total area of the lower sand within the project limits is approximately 5.0 acres. Using Darcy's equations and recorded groundwater levels and laboratory measurements of coefficients of permeability, it is estimated that approximately 500 gallons per day of groundwater leaks downward from the lower sand to the coal. This water moves under a typical gradient of 0.14 feet per foot at a velocity of 0.12 feet per year and requires over 100 years to move from the lower sand to the coal zone. It is noted that slight upward flow (static level in the coal zone higher than in the lower sand) was observed at the location of cluster Wells P-222 on 5 of the 7 static water level measurement dates from which the above data are based. The static level in the coal zone was 0.02 to 0.27 feet higher on these dates. One of the seven measurements at the location of cluster

Wells P-228 also indicated upward flow. All of the remaining measurements (15 of 21) indicated downward vertical flow with the static level in the lower sand being 0.05 to 0.68 feet higher than the static level in the coal zone.

The gradients and directions of flow are believed to be reliable at all cluster well locations. However, the velocity, quantity, and travel time between the lower sand and the coal zone are not believed to be reliable. The cause of uncertainty is the coefficient of vertical permeability of the fractured grouted bedrock. As indicated by the very low gradients, the static levels of the lower sand and the coal zone are very similar. Typical head differences between the zones are one to two tenths of a foot. The similar static levels tends to indicate a hydraulic connection between the two zones, which is most likely the result of mine-collapse-induced fracturing of the shales and siltstones separating the two zones. It is believed that grouting of the mine voids and overlying bedrock strata significantly reduced the hydraulic connection but did not eliminate the connection. Because of the separation distance between the zones (generally 20 to 25 feet) and the lack of a driving head, substantial mixing of the waters is unlikely. It is also probable that a hydraulic connection between the zones is also present at the coal zone subsurface outcrop located approximately 4,000 feet southwest of the Project Area beneath the sediments filling the Mud Run Valley.

4.2.4.3 Groundwater Quality

Typical groundwater quality concentrations (averages from all sampling events for all wells completed in each zone) are listed on the following page.

	Upper Sand	Lower Sand	Coal Zone Up-Gradient	Coal Zone Down-Gradient
pH (S.U.)	6.06	7.13	6.65	6.90
Conductivity (umhos/cm)	745	735	602	837
TDS (mg/l)	617	632	389	552
Calcium (mg/l)	78	81	39	47
Sulfates (mg/l)	72	61	41	105
Iron (mg/l)	73	27	1.4	0.9
Hardness (mg/l)	310	283	186	152
Alkalinity (mg/l)	856	237	268	369

Spatial variability (particularly in the coal zone) of the water quality is evident. This is to be expected as a result of the variety of chemical compositions of the materials in which the groundwater comes in contact with as it flow through the grout curtain (coal, shale, clay, cement, flyash, and possibly others). With the exception of iron, however, the variability is not large enough to cause the data itself to be unuseable (data were normally distributed). It is noted that the data set is extremely limited and valid statistical comparisons cannot readily be made.

Based on the groundwater quality data collected in the Project Area, it is believed the chemical composition of the two sand zones are generally similar. However, because of the different static water elevations, it is believed that the zones are not hydraulically connected. The quality similarity is most likely the result of the water recharging the zones coming in contact with similar materials.

Most of the parameters have similar concentrations in the coal zone and the sand zones. However, calcium, iron, and hardness are sufficiently different to conclude that significant mixing of the water is not occurring. It does appear that the water quality of the coal zone is impacted as water moves through the grout curtain from up-gradient to down-gradient. Further discussion of these impacts are included in Section 6 of this report.

For all constituents in all zones, the constituent concentrations were unexceptional. While the water in the coal zone, both up-gradient and down-gradient of the grout curtain, would generally be considered "poor", the aquifer could be developed for household use. The water is not typical of acid mine drainage which is generally characterized by a low pH and high acidity. It is believed that the water does not exhibit these characteristics because of the anaerobic conditions of the inundated workings. If the mine were to become dewatered exposing the minerals in the coal zone to air, the acidity of the water would be expected to increase, the pH would be expected to decrease, and the quality of the water would be expected to be significantly reduced.

SECTION 5 - RESEARCH METHODS

5.1 GEOPHYSICAL METHODS

The individual methods that were tested in Phase I and used in Phase II at the Project Area are described in the following paragraphs of this report. Details regarding procedures, data acquisition, and data processing are included in Section 9.6 and graphic data output and interpretations of data are included in Section 9.4 of this report.

5.1.1 Surface Ground Penetrating Radar

Surface Ground Penetrating Radar (GPR) measurements were made along the roadbed, and along the edge of the road over an 1800 foot distance that covered the mined area (from Station 469+00 to 487+00). Thirty five lines were run along each side of the road (eastbound and westbound). The GPR lines were run with a line spacing of one foot, providing a three dimensional pseudo-image of the near surface.

GPR data were measured in the field along 3 sets of lines that were 600 foot long, and these grids were further subdivided into a total of eighteen sub-grids, including the following:

Grid www (westbound, western grid, western sub-grid) from Stations 469+00 to 471+00
Grid wwm (westbound, western grid, middle sub-grid) from Stations 471+00 to 473+00
Grid wwe (westbound, western grid, eastern sub-grid) from Stations 473+00 to 475+00
Grid wmw (westbound, middle grid, western sub-grid) from Stations 475+00 to 477+00
Grid wmm (westbound, middle grid, middle sub-grid) from Stations 477+00 to 479+00
Grid wme (westbound, middle grid, eastern sub-grid) from Stations 479+00 to 481+00
Grid wew (westbound, eastern grid, western sub-grid) from Stations 481+00 to 483+00
Grid wem (westbound, eastern grid, middle sub-grid) from Stations 483+00 to 485+00
Grid wee (eastbound, eastern grid, eastern sub-grid) from Stations 485+00 to 487+00
Grid eww (eastbound, western grid, western sub-grid) from Stations 469+00 to 471+00
Grid ewm (eastbound, western grid, middle sub-grid) from Stations 471+00 to 473+00

Grid ewe (eastbound, western grid, eastern sub-grid) from Stations 473+00 to 475+00

Grid emw (eastbound, middle grid, western sub-grid) from Stations 475+00 to 477+00

Grid emm (eastbound, middle grid, middle sub-grid) from Stations 477+00 to 479+00

Grid eme (eastbound, middle grid, eastern sub-grid) from Stations 479+00 to 481+00

Grid eew (eastbound, eastern grid, western sub-grid) from Stations 481+00 to 483+00

Grid eem (eastbound, eastern grid, middle sub-grid) from Stations 483+00 to 485+00

Grid eee (eastbound, eastern grid, eastern sub-grid) from Stations 485+00 to 487+00

Data that are presented in this report were measured using a Sensors and Software Noggin 250 Mhz bistatic antenna GPR system. Data were recorded as 311 samples per trace over a time interval of 124 Ns. Traces were recorded at even increments of approximately 0.2 feet. These data were originally plotted and analyzed along profiles, or lines. The lines were then processed using a program called gphyz (jeff@geology.ohio-state.edu), which was written under a contract to the US EPA. The profile data were then processed as three dimensional blocks of data. The interpretation and subsequent discussion of the data are an analysis of these 3D blocks. The sequence of the blocks for the eastbound and the westbound lanes are shown on Pages 1 and 2 of Section 9.4. Data were analyzed down to a two-way time of 124 Ns, which is an estimated depth of between 10 to 20 feet. However, due to the high attenuation of the near surface soils, the maximum two-way arrival time of valid data was deemed to be 40 Ns, and the time range of optimum images was between 8 and 31 Ns. The diagrams in on Pages 1 and 2 of Section 9.4 an overview of the blocks, but they do not provide enough detail for a thorough interpretation. Some of the more obvious anomalies are indicated on the blocks. These anomalies are discussed in the captions for the direction of the blocks, which are presented on Pages 2 to 21 of Section 9.4. Locations and Interpretations of the surface GPR anomalies are summarized in the following Table:

Anomaly	Station	GPR Block	Description and Interpretation
B	471 to 473	westbound wwm	Layered, may be shallow slump feature, located primarily beneath travel lane. A large mine complex is located to the east (starting at 474), large grout takes in the area.
F & F'	479 to 481	Westbound wme	F is located beneath median and F' is located beneath travel lane. F appears to be a slump, but may be related to a trench or drain. F' appears to be related to a change in roadbed construction materials.
H & H'	483 to 485	Westbound wem	Present beneath both lanes. H is a surface expression of a deep feature with offset (fracturing). H' is a shallow feature near the middle of the lanes.
J	469 to 470	Eastbound eww	Clear Broad Slump. Most likely already remediated. Clearest feature of project.
L	473 to 475	Eastbound ewe	Region of disturbance, appears to have some offset with slumping, but no indication of voids very near the surface. Previous slumping reported from 473+90 to 474+75, so area most likely already remediated. Haulage-way present 474+50 to 475+25
M, M', & M''	475 to 477	Eastbound emw	Overall changes in the overburden profiles along south side of travel lane. Anomalies show slumping and offset.
N	477 to 479	Eastbound emm	Shows shear, slumping, and offset with some depth. Extends from median to north side of travel lane
O	479 to 481	Eastbound eme	Construction and/or overburden changes along east side of the block. Near surface slump feature.
P	482+40	Eastbound eew	Extensive slump feature on the travel lane shoulder. Some offset in the overburden. No indication of near surface voids.
Q	483+30 to 483+80	Eastbound eem	Remediated area. Area is complex at depth beneath the travel lane shoulder. May be related to drilling.
R & R'	486+20 (R) and 485+30 (R')	Eastbound eee	Near surface, of limited lateral extent, and have depth and offset. Present from north side of travel lane to travel land shoulder. Doubtful if any voids associated.

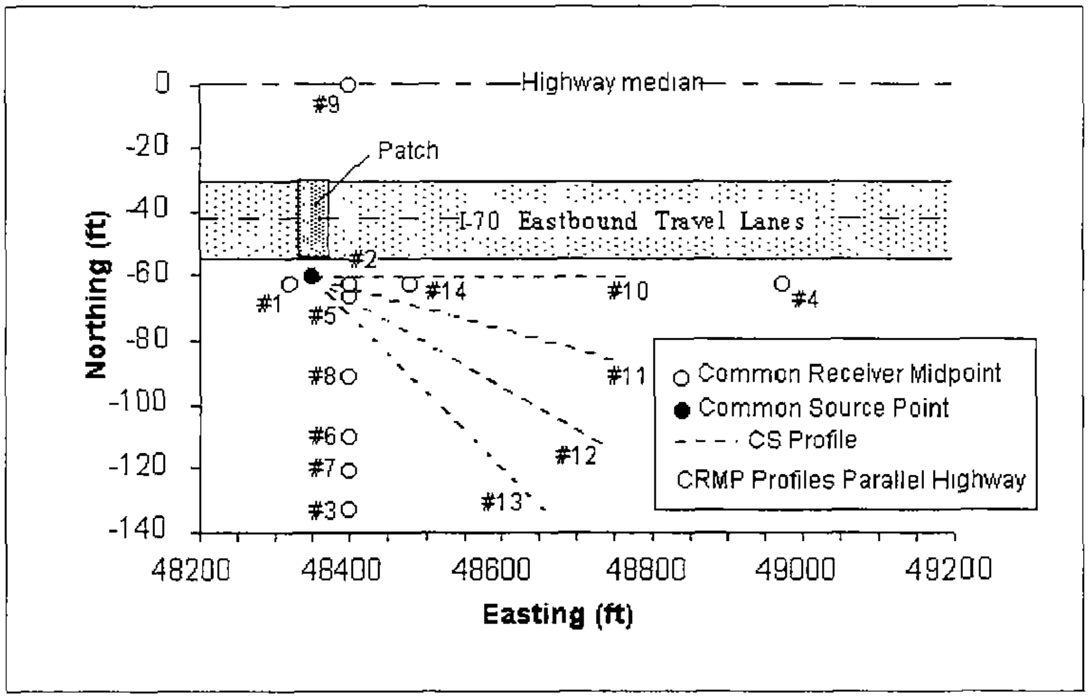
5.1.2 Surface Seismic Investigations

5.1.2.1 Spectral Analysis of Surface Waves (SASW)

Spectral analysis of surface waves (SASW) is a method to estimate the shear wave velocity as a function of depth using analysis of the Rayleigh wave dispersion curve (Stokoe et al., 1994). Principal advantages of SASW are that there is no need for boreholes and the field method is relatively quick and simple to perform. By testing at a number of frequencies (wavelengths), a velocity-depth profile can be obtained.

A Rayleigh wave is a type of seismic surface wave that propagates near the free surface. Particle motion is elliptical in the vertical plane that contains the propagation direction; there is no motion transverse to the propagation direction. Near the free surface the elliptical motion is retrograde, that is, the motion is opposite the propagation direction at the top of the elliptical motion. At a depth of roughly 0.2 wavelength, the horizontal component of the elliptical motion reverses sign and below that depth the elliptical motion becomes prograde. The amplitude of a Rayleigh wave decreases with depth exponentially. The elastic properties to a depth of about one wavelength control the Rayleigh wave velocity. The Rayleigh-wave velocity is roughly 87.4% to 95.5% of the shear-wave velocity, depending on the Poisson's ratio of the material (see Section 3.3 in Richart, Hall, and Woods, 1970, "Vibrations of Soils and Foundations" Prentice-Hall, pp. 80–92).

In a uniform, homogeneous, elastic half-space, Rayleigh waves are not dispersive, that is, their velocity does not change with frequency (wavelength). All Raleigh-wave frequencies (wavelengths) sample the same material properties. In a horizontally layered medium, this is no longer true and Rayleigh waves become dispersive. High frequency (short wavelength) waves sample shallow-layer properties and low frequency (long wavelength) waves sample deep-layer properties. Rayleigh waves have been used to find voids near the earth's surface (Al-Shayea et al., 1994; Luke et al., 1997; Avar and Luke, 1999). Phase distortions of Rayleigh waves have been noted in unpublished data obtained above a mine cavity in the Tri-State lead-zinc district near Joplin, Missouri. Rayleigh waves can also be inverted to develop a vertical low-resolution, background subsurface velocity profile (Stokoe et al, 1994). Such models add long-wavelength spatial constraints not available from higher resolution seismic reflection and refraction analyses. At the Project Area fourteen SASW test sets were conducted near the eastbound lanes of the 200-foot test section (Station 483+00 to Station 485+00). A sharp increase in the phase velocity trend occurs around 10 Hz which corresponds to Rayleigh waves beginning to sample the bedrock beneath the overburden. Inversion of the dispersion curves to obtain a velocity-depth profile indicates that bedrock occurs beginning about 30 to 35 feet deep.



Plan view of SASW tests. CRMP= common receiver midpoint. CS= common source. All CRMP profiles were parallel to the highway.

It was not possible to generate Rayleigh waves with low enough frequencies to sample the depth range of the coal mine, which would require using a source capable of generating surface-wave signals in the 2-4 Hz range. Vibroseis equipment, such as that used in the oil industry, is capable of achieving these low frequencies.

Al-Shayea and co-workers (1994) used a common-source (CS) fan to locate objects in the subsurface. At the Project Area, differences were observed across the fan, particularly in the shallow subsurface. However, the simplest interpretation is that observed differences result from road construction, where 0 degrees is along the shoulder and parallel to the roadway and 45 degrees points off and away from the road. So, in the near surface there is a change in phase velocity as the work rotates progressively away from modified earth resulting from roadway construction. This common-source-fan method might be successful at locating disturbed zones under the highway, but it will require closure of lanes to highway traffic. The coincidence of the SASW dispersion curves (Section 9.4, pp 106 to 108) emphasize that there is little difference in the soil profile along each profile of the common-source (CS) fan, i.e., Tests 10 to 13. The high-frequency differences most likely reflect differences in the preparation of the highway shoulder.

Another method for possibly locating disturbed zones is to reverse the SASW profile and to compare the unwrapped-phase curves of the forward and reverse profiles (Luke et al., 1997; Avar and Luke, 1999). In the Fourier (FFT) domain, a signal (a time function) is converted to a frequency function. The frequency function is a complex function, which can be separated into two parts, the amplitude spectrum and the phase spectrum. The wrapped phase spectrum can have discontinuities every 360 degrees (2 pi radians) of phase. Unwrapping refers to converting this discontinuous wrapped curve into a continuous curve. Wrapping is done for convenience in plotting, but this method was not utilized at the Project Area. The shear-wave was determined as a function of depth using analyses similar to those outlined in Stokoe et al. (1994). A comparison of velocities made with SASW measurements and cross-hole measurements are shown on Page 109 of Section 9.4

Summary comments on the SASW test

- High quality SASW test records were obtained despite the high levels of vibration noise created by heavy truck traffic.
- The vibration shaker sources were adequate to sample the overburden soil and give a strong indication of the depth to the underlying bedrock layer. A stronger source (e.g., full vibroseis) would be required to delineate the rock properties (e.g., shear wave velocity), including any low-velocity zones.

- The dispersion data for the 14 test sets depict similar subsurface characteristics: a thick layer of overburden soil overlying high-velocity rock-like material.
- The data are very consistent among the locations along the edge of the shoulder (1, 2, 4, and 10-14). The overburden soil is approximately 30 feet thick, with a shear wave velocity profile that is curvilinear in shape: 700 fps near the surface, 550 fps at about 15 feet, and increasing to 900 fps near the rock interface.
- The data for the test locations on the median and right-of-way slope (3, 5-9) are more variable than along the shoulder, and the soil near the ground surface is of lower velocity (350-500 fps). The data indicate a depth to bedrock that is also more variable as a result of the tests having been conducted at locations of varying surface elevation.

5.1.2.2 Surface Seismic Reflection

Summary of Findings

YY component data from seismic lines acquired along the westbound passing and travel lanes (referred to as lines WBPass and WBTravel respectively), are shown on pages 24 through 39 of Section 9.4. Disrupted areas and offsets (normal faults) along the bedrock horizon that are indicated on the depth sections, are interpreted to have resulted from mine-related subsidence activity. The locations and apparent dip directions of the bedrock horizon faults, are summarized in the following Table:

Bedrock Fractures with Displacement (Normal Faults) and apparent Dip Directions

Eastbound Travel Lane	Eastbound Passing Lane	Westbound Passing Lane	Westbound Travel lane
468+54, east	469+51, east	468+74, east	468+18, east
468+64, east	469+70, west	469+47, west	468+30, east
469+06, west	470+55, east	474+78, east	468+96, west
469+14, west	470+71, west	475+08, east	474+61, east
469+36, east	471+17, west	475+27, west	475+54, west
469+53, west	472+35, west	475+50, east	475+68, west
470+43, east	472+52, west	475+73, west	475+88, west
471+33, east	473+16, east	476+24, east	476+65, east
473+18, west	473+41, west	476+90, west	476+90, west
474+68, east	473+99, east	477+54, east	477+03, east
474+81, west	474+11, west	477+59, east	477+19, west
475+01, east	474+67, east	478+04, west	477+56, east
475+27, west	477+90, east	479+65, west	478+48, west
477+07, east	478+06, west	480+45, east	478+83, east
477+50, west	482+16, east	480+73, east	481+19, west
477+77, east	482+36, west	482+06, west	482+64, west
477+81, east	483+29, east	483+12, east	483+96, east
479+89, west	483+54, west	483+32, west	485+19, east
483+91, east	485+42, east	483+49, west	
485+96, east	485+56, west	484+98, west	
486+15, west	486+02, east	485+04, west	
	486+43, west		

Maps depicting the locations of the fractures relative to eastbound and westbound lanes are presented on Pages 22 and 23 of Section 9.4 The locations of bedrock horizon disruptions interpreted from the processed seismic depth sections correlate well with the locations of mine workings, observed roadway depressions and subsidence features, and westbound lane land bridges.

Results and Interpretations

Stacked sections constructed using YY component (sometimes called crossline-crossline, or SH-SH) reflection data acquired along the eastbound and westbound lanes of the Project Area are presented in this section. Discussion regarding the acquisition and pre-processing of the data is presented in Section 9.6 of this report. The analysis flow applied to the data presented in this section followed the processing, imaging, and interpretation strategies previously discussed in Section 9.6 of this report for common-mode component reflection information. It was determined that subsurface areas where subsidence processes have been active could be most accurately delineated through the processing and interpretation of YY component data.

<u>Eastbound Lanes: Previous Roadway Collapse Region</u>

The strong reflection event correlating to the overburden and bedrock boundary in shot and common depth point (CDP) gathers is interpretable across stacked sections for each of the three lines. Lower amplitude and less continuous reflectors above the bedrock horizon are evident on stacked sections also, and correlate to sandy units mapped within the overburden. The average dominant frequency of the bedrock horizon on processed sections is 80 Hz for lines Test-1 and GUE-I70-1 (the dominant frequency increases slightly to 90 Hz on the east end of the line Test-1 section), and 100 Hz for line EBPassYY.

Line Test-1 The processed and stacked line Test-1 data are shown on Pages 62 and 63 of Section 9.4. The reflection event imaged at 110 to 120 ms correlates to boring log data, and is the top of bedrock. The horizon is continuous across the line, with slight apparent dip of the bedrock surface evident between Stations 483+45 and 483+80. The slight apparent dip in the horizon is also evident after time-to-depth conversion (Section 9.4, p 63). No significant vertical displacements or lack of continuity can be detected along the bedrock horizon in line Test-1 sections, and therefore no areas of severe disruption related to mine-related subsidence activity (which would indicate a potential risk for surface collapse) are interpreted across this line.

Inferences regarding the possible effects of the mine on the bedrock horizon topography and stacking velocities are difficult using line Test-1 data, because no data regarding the location of room and pillars relevant to the location of line Test-1 were available. However, the coal pillar mapped to the north of the eastern half of line Test-1 can be projected to intersect line Test-1 at Station 483+45. To the immediate east of this station is where the apparent dip in the horizon is evident from stacked data, and where a transition (decrease) in horizon stacking velocity occurs (Section 9.4, p 62). These observations suggest that the absence of a coal pillar may have influenced the bedrock topography along this line, and may have also resulted in a decrease of the overburden material stiffness.

Line GUE-I70-1 The processed and stacked line GUE-I70-1 data are shown on Pages 64 and 65 of Section 9.4. This line was acquired to the immediate south of the previous roadway collapse feature along the southern berm of the roadway. The reflection event imaged at 110 to 120 ms correlates to shot gather events and boring log data, and is the top of bedrock. A number of additional weak reflectors between 50 and 100 ms are also evident within the bedrock overburden. Due to the frequent presence of discontinuous overburden units (as indicated by boring log data), it is difficult to infer whether apparent discontinuity or truncation of these events at certain locations is depositional / lithological in nature, or due to possible subsidence process-related fracturing or faulting within the overburden materials.

Dip and undulations of the bedrock horizon are apparent across time sections, and are evident in depth sections (Section 9.4, p 65). A bedrock high at CDP Location Station 484+60 agrees with the location of a bedrock high interpreted from boring log data acquired at approximately the same time as these seismic data. A coal pillar is present beneath bedrock at this location, and the bedrock stacking velocities are relatively high at this location. These observations suggest that the coal pillar (by supporting overlying materials) may have allowed the original bedrock topography and overburden material stiffness to be maintained at this location subsequent to mining activity. Moving to the west of this location (where the mine map indicates a room beneath line GUE-I70-1), an apparent dip in the bedrock horizon is evident from stacked sections, and stacking velocities begin to decrease. It is possible that this apparent dip in the bedrock surface is related to coal absence, however, it is also possible that the horizon exhibited apparent dip (in this area) prior to mining (data regarding bedrock elevation prior to mining were not available).

The geologic conditions were interpreted based predominately upon the borings with bedrock core recovery. Between CDP Locations 483+30 and 483+60 a relative bedrock low was interpreted from boring log data, and bedrock is also seen to be relatively low in this region on the seismic sections (from CDP Locations 483+30 to 483+70). The mine map indicates the presence of a mine room in this region, and the previous localized collapse occurred at Station 483+45 (about 15 feet north of line GUE-I70-1), however stacking velocities are somewhat higher in this area relative to laterally adjacent areas, and offset or significant disruption of the bedrock horizon is not evident in seismic sections. These observations indicate that either the subsidence processes (at depth) that were responsible for the previous roadway collapse were predominately active to the north of Line GUE-I70-1, or that remediation efforts of the previous collapse area have prevented the continuation of subsidence activity at this location. It is also possible that evidence for bedrock disruption resulting from ongoing subsidence processes since remediation was not seismically detectable at this location using these data.

There is no evidence on the seismic sections that indicates that the voids encountered beneath the bedrock surface during drilling to the west of the previous collapse have continued to propagate upwards through the bedrock surface. This interpretation is supported by cross-hole radar data analyses and boring log data acquired (subsequent to this seismic data interpretation) during 2002.

A discontinuity in the bedrock that resulted in vertical horizon offset is interpreted on the seismic sections (Section 9.4, pp 64 and 65) at CDP Location 483+91. Based on the apparent differences in travel time (and depth on the depth sections) across the discontinuity, the vertical offset is estimated from the seismic section to be between 3 and 4 feet (which is greater than a quarter of the dominant seismic wavelength in the overburden). The applied stacking velocity did not change abruptly in the vicinity of this discontinuity (the stacking velocities were relatively low across this region, possibly due to a fractured and relatively-weak overburden), and the horizon appears to be fairly continuous on either side of the discontinuity. A boring drilled during 2002 at Station 483+95 based on this interpretation, confirmed that bedrock had in fact been down-dropped along a normal fault (mine collapse fracture) between Stations 483+80 and 483+95, and indicated heavy fracturing of the bedrock with no coal encountered in the borehole. Despite the stacked sections indicating a fairly continuous horizon in the immediate vicinity of the mapped discontinuity, indications of severe disruption in the bedrock surface across this area exist in the seismic data.

The diagram on Page 66 of Section 9.4 shows un-interpreted and interpreted shot gathers acquired at the source locations indicated by flags on the x-axis of on the Stakes Section shown on Pages 64 and 65 of Section 9.4. For the 483+65.5 source location gather, the bedrock event is represented by a fairly-well behaved hyperbola. The apex of this event is shifted to the right of the source in the 483+75.5 gather, indicating an apparent dip of the bedrock surface (up-dip direction to the east) at this location (which agrees with the dip apparent at this location on the seismic sections). Dip-move-out (DMO) corrections were not applied to the data to compensate for occasionally apparent dips, and as a result less confidence in a calculated depth of the bedrock horizon estimated using the stacking velocity would result at such locations. The bedrock horizon event is severely distorted in the 483+89.5 source location gather at near offsets, and this supports the interpretation of the discontinuity at CDP Location 483+91 on the stacked sections.

Based on disruptions in the character of the bedrock horizon in the shot gathers shown on Page 66 of Section 9.4, an area of bedrock disturbance resulting from mine-related subsidence processes is evident between CDP Locations 483+80 and 484+08. If the abandoned mine workings were inadequately grouted in this area, it is apparent that a relatively high potential risk for future surface collapse exists along this section of the roadway. Cross-hole radar data analyses conducted subsequent to this interpretation indicated that disruption of the bedrock horizon in this region has occurred between the boreholes and directly beneath the seismic line. The interpreted extent of the range of subsurface disruption is also supported by the character of near-surface reflectors (within the overburden) in this area, which exhibit apparent dip and offset across this CDP range on the seismic sections (Section 9.4, pp 64 and 65). The lateral extent of the interpreted area of disturbance is indicated by the x-axis arrows, and is also indicated by dashed vertical lines across the bedrock horizon. Applying NMO corrections using velocities that best flattened the bedrock event to these shot gathers resulted in a certain amount of smoothing of such sub-spread length features on the stacked sections. However, by paying attention to event character in shot gathers during stacked data interpretation, such features were not overlooked.

A void was encountered beneath the bedrock surface at CDP Location 483+80 during 1999 drilling that was conducted at approximately the same time as the seismic survey. The geologic interpretation of the 1999 boring logs indicates a coherent and continuous bedrock surface to the east of this location (across the disrupted area interpreted from the seismic data), because a boring logged at CDP Location 484+20 indicated an intact bedrock surface. The mine map indicates that the southwest end of a coal pillar (with a northeast strike) is present beneath line GUE-I70-1 between Stations 483+75 and 484+00. Based on the location of the interpreted area of disruption (between Stations 483+80 and 484+08), two different mechanisms (pit or sag subsidence) were considered as the responsible mechanism for the observed bedrock horizon disruption. A complete crushing of the pillar between Stations 483+75 and 484+00 would have likely resulted in a broad region of bedrock subsidence, but the seismic data indicate that bedrock is intact and at a relatively high elevation at Station 483+80. It therefore appears that the observed bedrock disruption resulted from a collapse of the bedrock horizon into the mine room located to the immediate southeast of the coal pillar .Cross-hole radar data analyses and 2002 boring log data indicate that the mine map has placed the eastern edge of this coal pillar too far to the east.

Line EB PASS YY The processed and stacked line EB PASS YY data are shown in on Pages 67 and 68 of Section 9.4. This line was acquired to the north of the previous roadway collapse feature. The reflection event imaged at 105 to 120 ms correlates to shot gather events and boring log data, and is the top of bedrock. Bedrock is seen to be continuous across the length of line EB PASS YY from the time sections and the un-interpreted and interpreted depth sections, except for between CDP Locations 483+29 and 483+54. In this range (indicated in Section 9.4, Pages 67 and 68 by arrows on the x-axis and normal faults on seismic data), the bedrock horizon is interpreted to have been down-dropped, and experienced significant disruption resulting from mine-related subsidence processes. Cross-hole radar data analyses indicate that disruption of the bedrock horizon in this region has occurred between the boreholes and directly beneath the seismic line. The mine map indicates that a mine room is present beneath line EB PASS YY to the immediate east of Station 483+30. Cross-hole radar data analyses and boring log data suggest that the mine map has placed the eastern edge of the coal pillar at 483+30 too far to the east.

The stacking velocities slowly increase towards the west across the disrupted bedrock region, and the horizon would not stack coherently across this region at any of a wide range of applied stacking velocities. Based on the apparent differences in depth on the seismic sections, the downward displacement of the horizon is estimated from the seismic data to be between 3 and 4 feet in the CDP Location Ranges of 483+29 and 483+39, and 483+48 and 483+54. Between CDP Locations 483+39 and 483+48, it appears that a greater amount of downward displacement has occurred. Disruption responsible for a seismic anomaly does not necessarily need to be centered directly beneath the seismic line, due to the Fresnel zone concept (the diameter of the Fresnel zone at the time of the bedrock horizon for these data is about 23 feet). Low amplitude scattering was recorded above the down-dropped bedrock across the disrupted region, and is possibly the result of an impedance contrast that formed from overburden material subsidence into the collapse feature. Alternatively, this low amplitude energy could have resulted from out of plane scattering related to previous remediation efforts conducted to the south of this line (i.e. backfilling of the previous roadway collapse feature). The fact that the previous collapse feature was located approximately 20 feet to the south of this line however (centered at Station 483+45 in the eastbound travel lane) suggests that the latter is less likely.

Geologic conditions interpreted from boring logs acquired during 1999 along the north shoulder of the eastbound passing lane indicate that bedrock is continuous across the length of the seismic line, except for in the vicinity of the disrupted zone interpreted from the seismic data. Boring log data indicate that a bedrock low exists in the approximate Station range of 483+14 to 483+40. Voids were also encountered during drilling below the bedrock surface in this region. The western edge of the disturbed area in seismic data is about 10 feet to the east of the bedrock low interpreted from the boring log data, indicating that interpretation based on boring log data placed the western edge too far to the west, or that the seismic data were not able to exactly delineate the western edge of disturbance. It is not possible from these data alone, to say whether these features (both with lateral extents of about 25 to 26 feet) are the same, as the boring log data and seismic data were not co-registered to the same survey. Based on the modeled results (see above), the apparent width of a subsidence feature interpreted from seismic data would be expected to be somewhat less than the actual width of the feature, which may also explain this interpretation difference. A boring log at Station 483+40 indicated that bedrock had not subsided at this location, however, the seismic data (Section 9.4, pp 67 and 68) indicate that mine-related subsidence processes have been active to the east of Station 483+40. Analyses of cross-hole radar data conducted during 2002, subsequent to the interpretation of these seismic data, indicate that the area of mine-related bedrock horizon disruption directly beneath line EBPassYY extends from Stations 483+14 to 483+54 (see other appendix). Voids were also encountered beneath the bedrock surface in a boring drilled at Station 483+60. The seismic data show an intact bedrock surface at this location, and indicate that these voids have not yet propagated upwards through the bedrock surface.

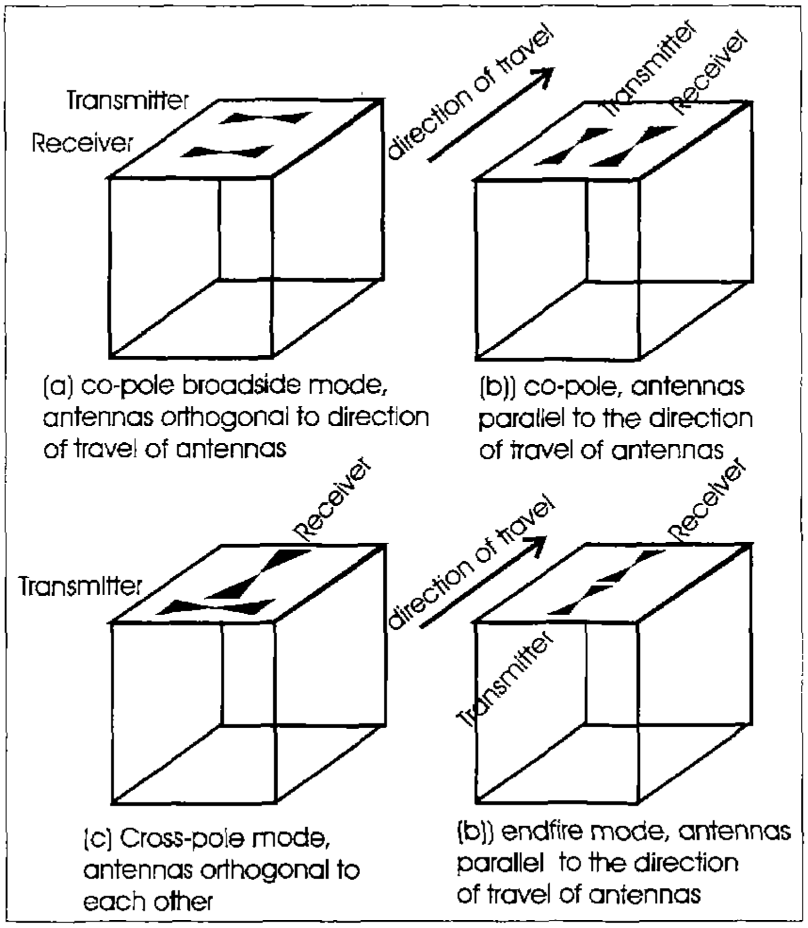
5.1.3 <u>Side Looking Ground Penetrating Radar (SLUR)</u>

The SLUR method utilizes conventional GPR equipment run in trenches cut into the ground. The "look-angle" provided by the trenches allows the energy of the antennas to be directed at an angle underground. SLUR measurements are the only way to obtain a directed remote view underneath the highway from surface measurements. However, experiments conducted in this test area indicate that high resolution reflection shear wave surveys may be an alternate method for investigating underneath the highway from the surface. For this project, SLUR was considered for its potential as a supplemental techniques to vertical and angle drilling, and the other surface and borehole techniques. The principle of the method have been described previously (Daniels, 1998).

A sensors and software PulseEcho-100 GPR system was used for the SLUR measurements. This is a state-of-the-art system that minimizes interference by utilizing fiber-optics data links from the computer/processor to the antennas. Two different frequency antennas were used:

1) 100 Mhz antennas; and,
2) 50 Mhz antennas.

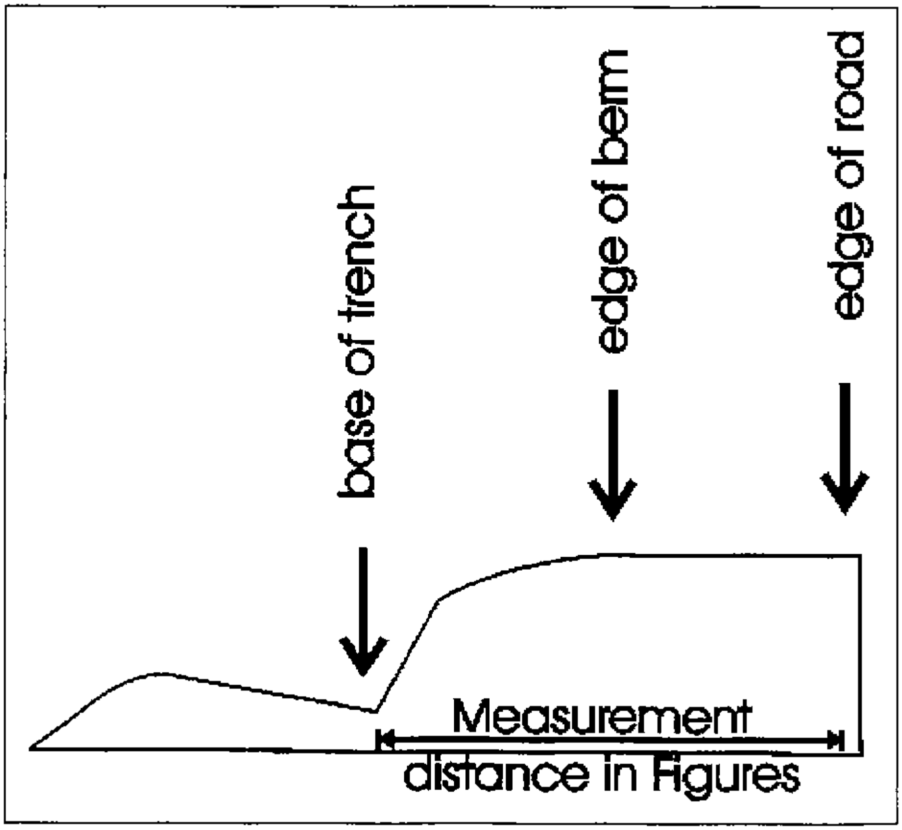
The 100 Mhz antennas were used in co-pole and cross-pole mode. The 50 Mhz antennas were also tested in co-pole mode (antenna's located in adjacent trenches), and so-called end-fire mode (antennas located end-for-end in the same trench). These different configurations are shown schematically below.



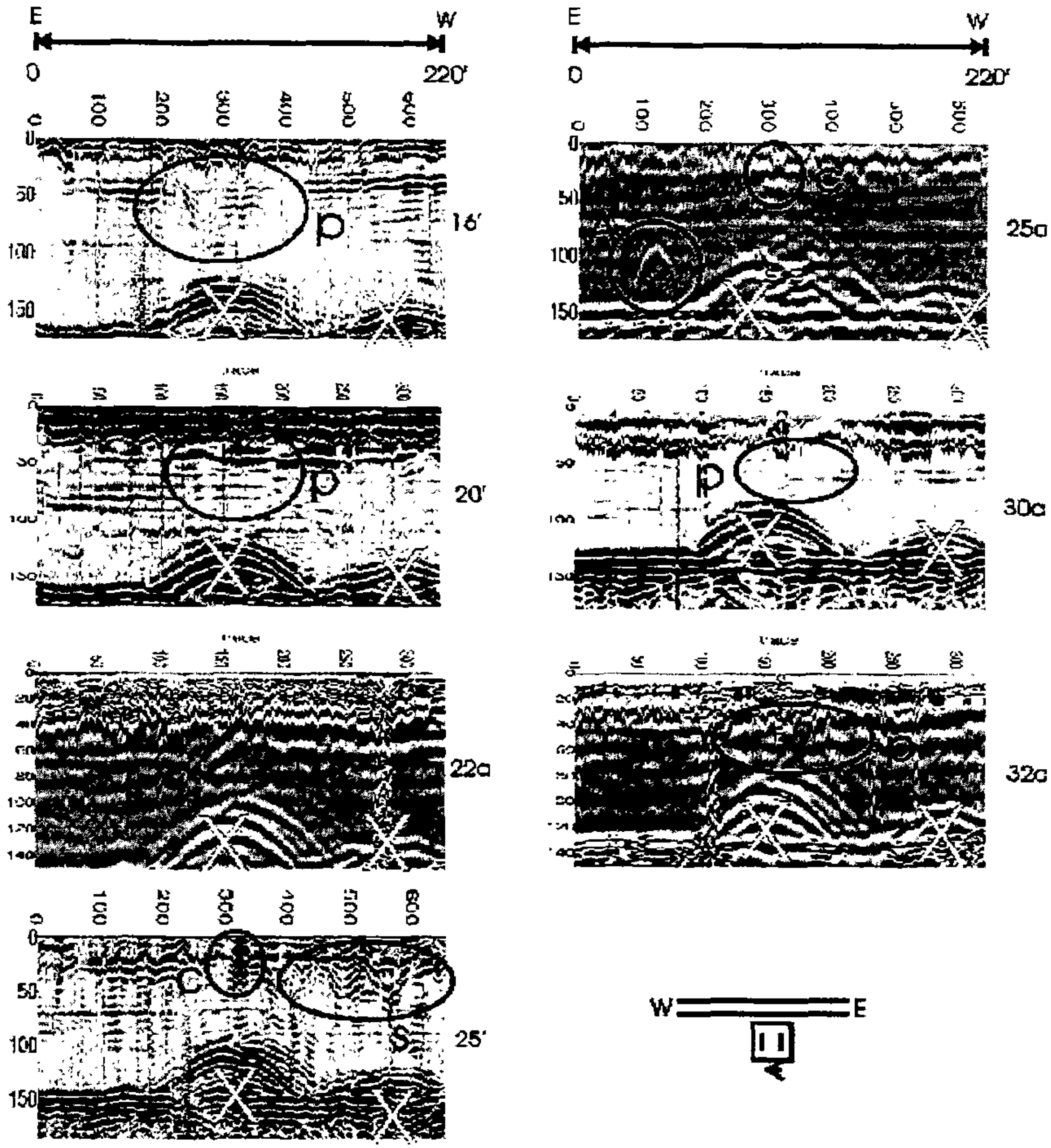
Antenna configurations for SLUR measurements.

The field procedures consisted of using a bulldozer to cut a trench with one side at an angle of 40-45 degrees from horizontal. Measurements were made along the trench with the GPR system by towing the antennas along the trench with an ATV that also contained the computer and electronics for the GPR system. The antennas were towed continuously along the trench, with each measurement line taking less than 5 minutes to run. Three different configurations were used for the 100 Mhz antennas, and one configuration (endfire) was run with the 50 Mhz antennas. In cases where two trenches were available, the 50 Mhz antennas were run in co-pole broadside mode, with the transmit antenna placed in one trench and the receive antenna placed in the other trench.

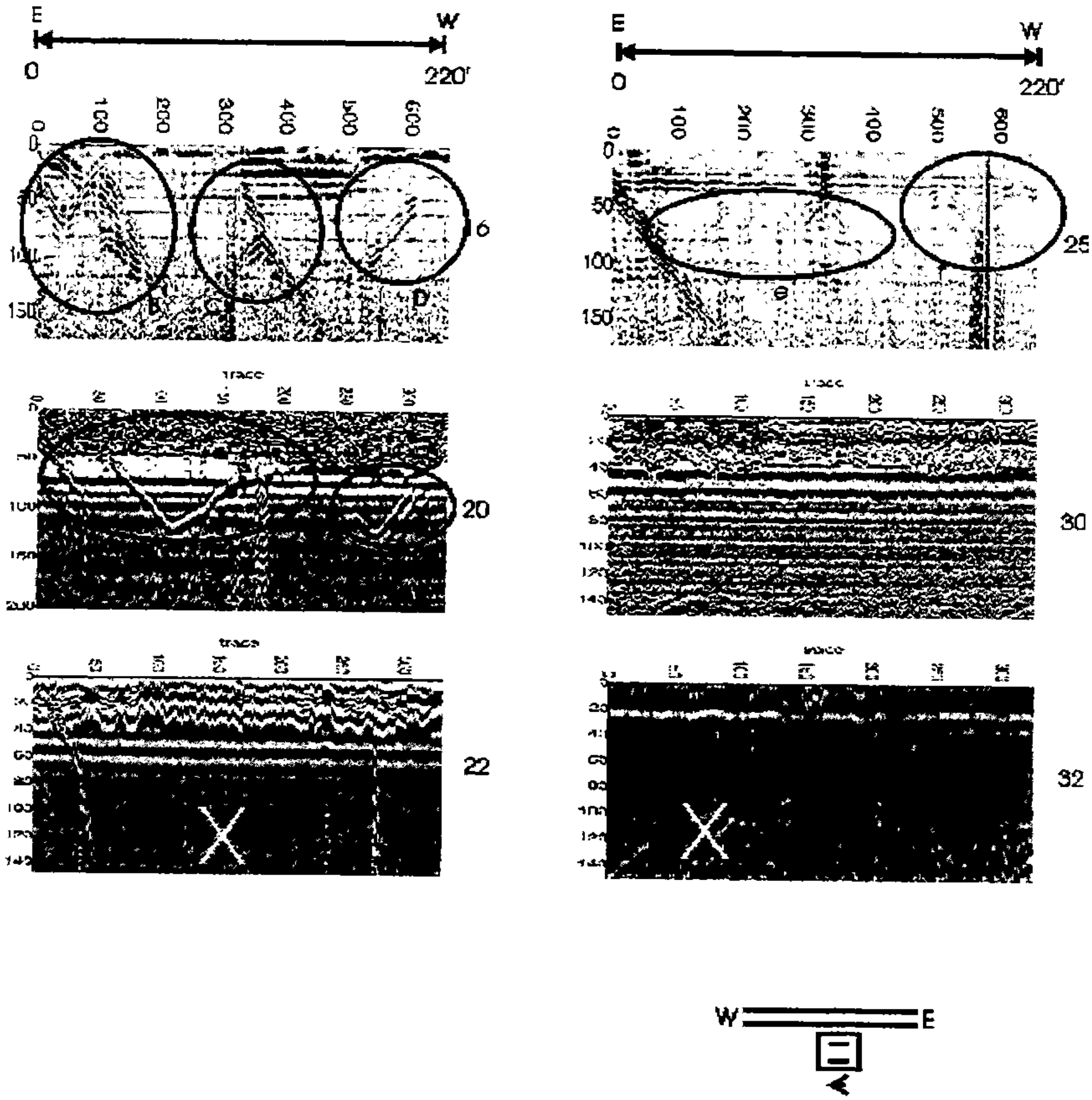
Only two trenches could be cut in one day, and the trenches needed to be backfilled at night. This restricted the overall operation, and made it impossible to test the use of a cryogen in the trenches. The cryogen was proposed as a way to lower the conductivity of the soil in the immediate vicinity of the trenches, thus improving the penetration depth of the radar signals into the ground. This would have required that the trenches be lined and covered with plastic tarps, which would have taken more than a day of preparation for each trench. Hence, plans to freeze the ground with a cryogen were aborted when it was apparent that safety considerations made it impossible to leave the trenches open overnight. The SLUR trench locations with respect to the edge of the road are shown in the Figure below. All trench distance measurements that are stated in this report are the distances between the edge of the road and the base of the trench.



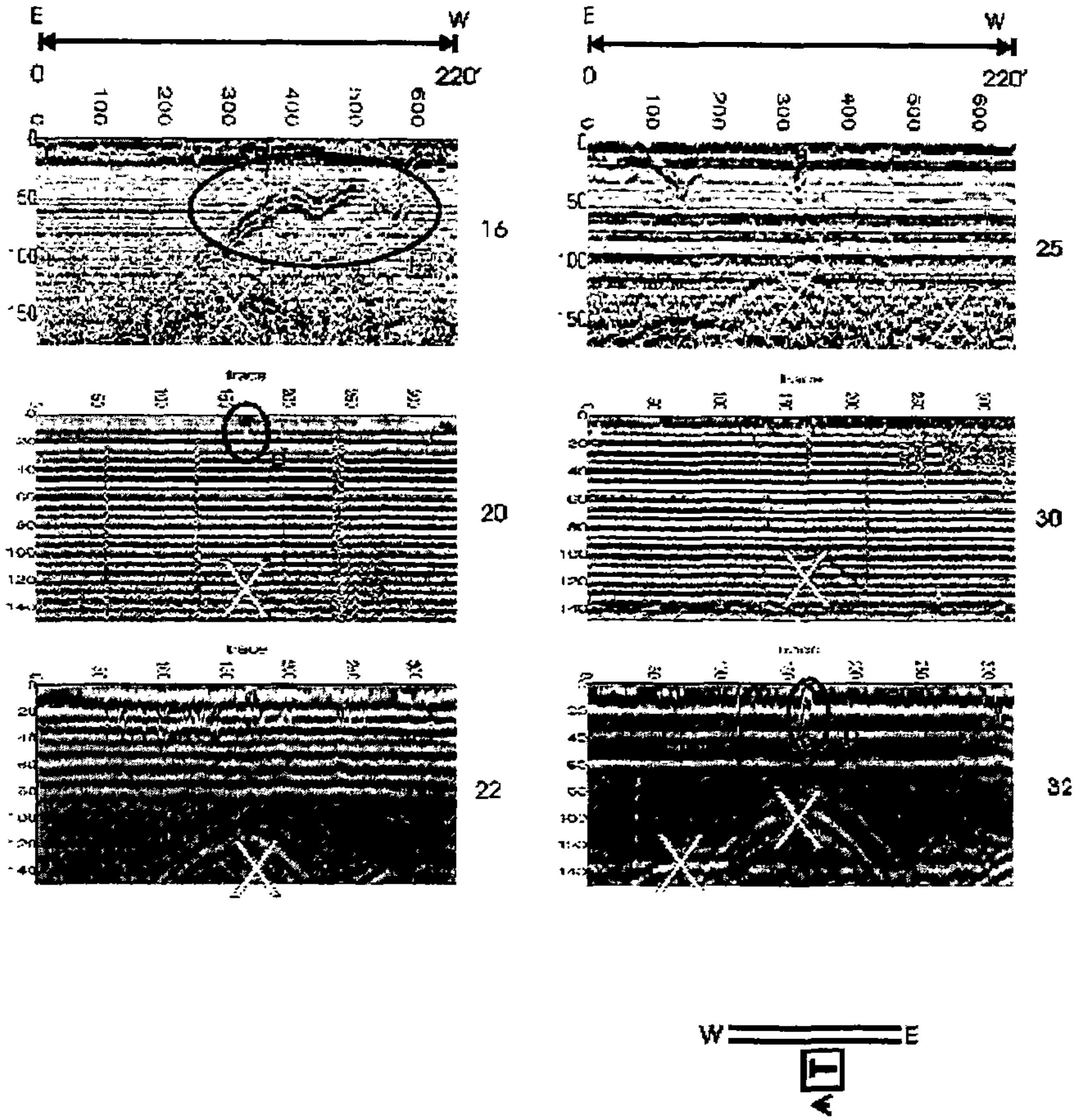
Trench locations with respect to the edge of the road.



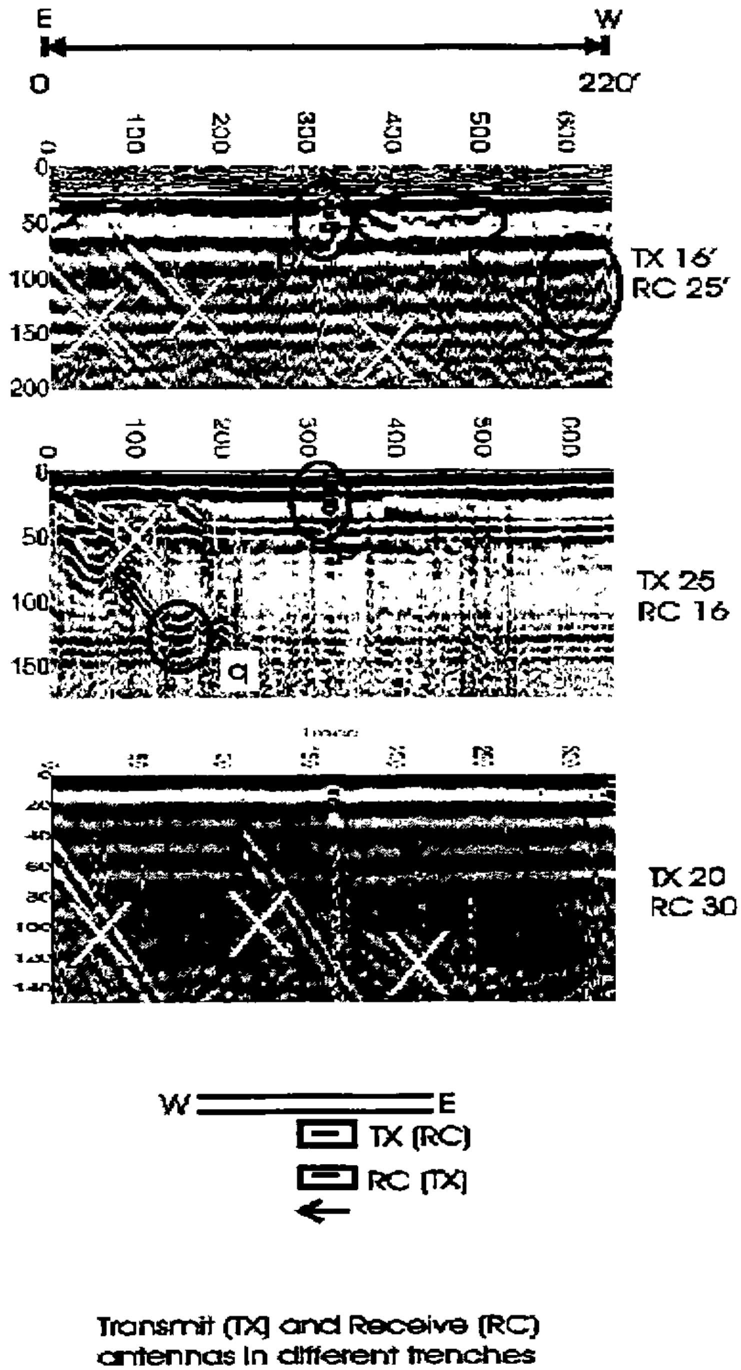
SLUR measurements for increasing distance, 100 MHz antennas, perpendicular mode. Note that gray scale differences are an artifact of the processing, and do not indicate any significant differences in the data. White X's indicate anomalies caused by cultural features above-ground.



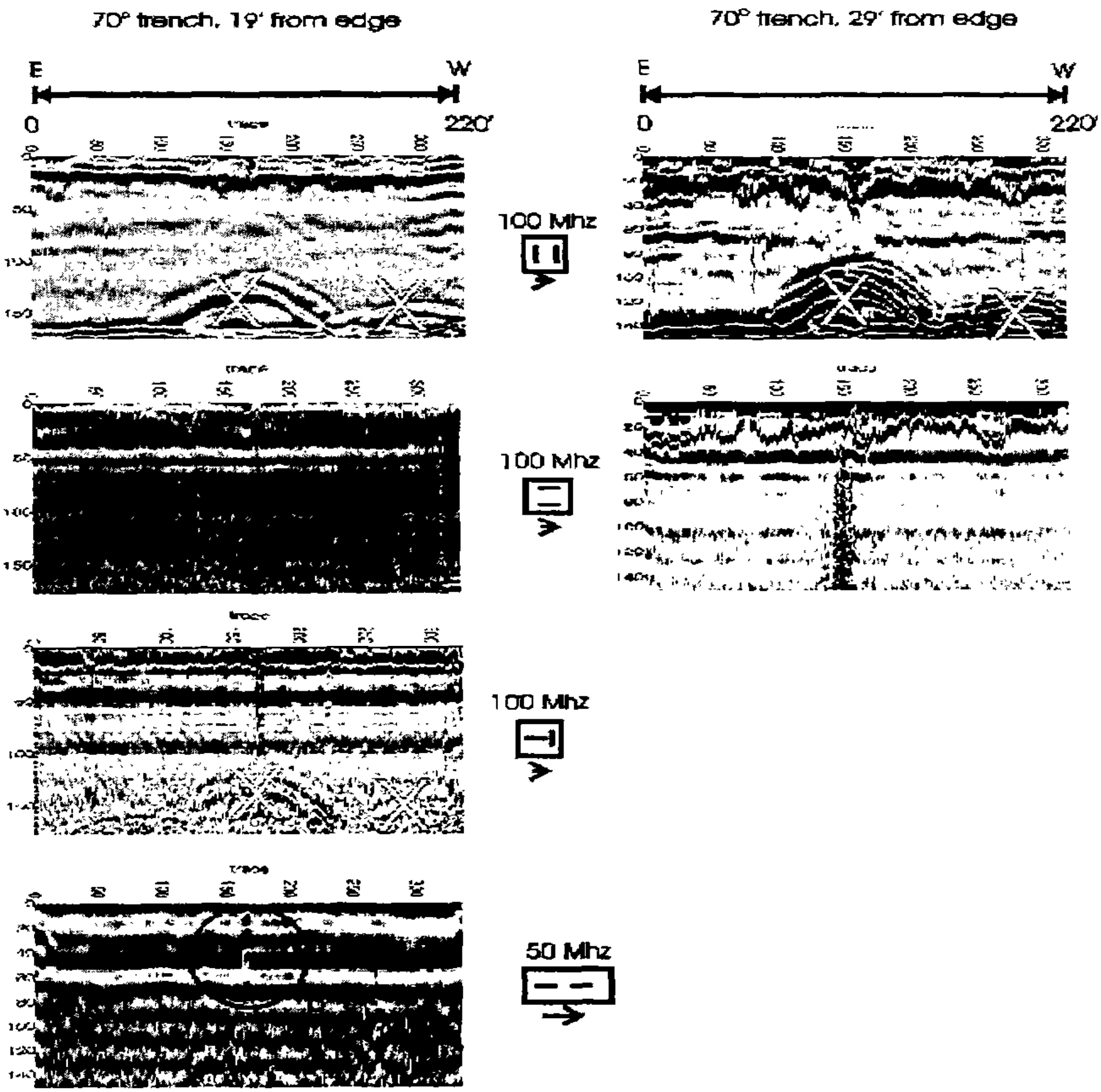
SLUR measurements for increasing distance, 100 MHz antennas, perpendicular mode. Note that gray scale differences are an artifact of the processing, and do not indicate any significant differences in the data. White X's indicate anomalies caused by cultural features above- ground.



SLUR measurements for increasing distance, 100 MHz antennas, cross-pole mode. Note that gray scale differences are an artifact of the processing, and do not indicate any significant differences in the data. White X's indicate anomalies caused by cultural features above- ground.



SLUR measurements for increasing distance, 50 MHz antennas, co-pole parallel mode. The transmitter and receiver are in separate trenches.



STEEP WALLED TRENCHS

Comparison of SLUR findings at same location with varying antenna configurations.

The SLUR tests were successful in evaluating the method for use along I-70. The anomalies (potentially important variations in the data) are encircled, or indicated by letters in the preceding figures. The line locations with respect to the edge of the road and the antenna configurations are indicated by the legends in each figure. The only anomalies that were of interest to this study are the anomalies that are caused by features in the subsurface. These anomalies are encircled in each cross section. Anomalies which may have been caused by features at the surface rather than subsurface have been "X'd" in the cross sections.

The Figure on Page V-21 shows the data for six different trenches offset from the edge of the road by 16 ft., 20 ft., 22 ft., 25 ft., 30 ft., and 32 ft. for a perpendicular co-pole configuration. The large white "x's" indicate anomalies that are caused by objects in the right-of-way that are located above ground. The co-pole configuration also shows a straight anomaly that is associated with the fence that is located on the boundary of the highway right- of-way. These anomalies should not be interpreted as objects below ground. The anomaly that is encircled towards the top of the cross section is caused by sub-surface features. This anomaly is in the vicinity of the roadway subsidence feature which was located on the eastbound lanes near Station 483+45, and is probably caused by the repair boundaries, and objects within the filled sinkhole. The deepest anomaly is at a distance of approximately 15 ft. away from the trench (calculated using a velocity of 0.3 ft/ns, and a two-way travel time of 100 ns). It should be noted that the very-near features (less than 50 ns) were necessarily obscured when the amplitude of the individual traces (scans) was increased to enhance the deeper objects (objects greater than 50 ns in two-way time). This was amplitude "filtering" intentionally done, with the understanding that objects beneath the highway were the primary targets, and objects that are less than 50 ns (7.5 ft) away from the trench have a low priority in this study.

Using the co-pole polarization mode, there are several anomalies on the cross sections which are interesting, but they probably come from objects above the ground. The fact that there is very little consistency from line-to-line for these anomalies adds to the questionable nature of the anomalies. Similar comments apply to the cross-pole configuration in the Figure on Page V-23.

The SLUR results for the 50 Mhz (time domain, center band) antennas is shown in Figures on Pages V-24 and V-25. The antennas were too long to operate in the same trenches in a manner similar to the 100 Mhz antennas. The Figure on page V-24 shows the co-pole polarization results for antennas towed parallel to the direction of the trenches, with the transmitter and receiver antennas in separate trenches. This results in strong anomalies reflected from the edge of the patch area, as shown by the squares in the Figure (a). Two endfire 50 Mhz cross sections are shown in the Figure on Page V-25. Anomalies are seen in this figure near the surface, in the vicinity of the patch, otherwise there are very few anomalies on the cross sections.

Summary of SLUR Measurements

The primary conclusions from the SLUR results are as follows:

1) SLUR does indicate some anomalies in the subsurface, but the anomalies are not consistent from trench-to- trench;
2) SLUR is very difficult to implement along the roadside; and,
3) Conditions at the Project Area are not amenable to proper implementation and analysis of SLUR data for locating voids and associated conditions underneath the highway.

5.1.4 Cross-hole Ground Penetrating Radar

Overview

Constant offset profile and multiple offset gather borehole radar surveys were conducted at the Project Area during July and August of 2002. These surveys were conducted using boreholes that were located in the vicinity of several mine-related subsidence features (bedrock and overburden discontinuities) that were previously imaged using seismic reflection measurements. Cross-hole radar measurements were effective for providing insight into the nature and extent of fracturing and void space within near-surface media, and for reducing uncertainty regarding the locations and extent of mine rooms, coal pillars, and seismically imaged subsidence features.

Processed EM-wave velocity tomograms and amplitude information (derived from the acquired cross-hole radar data) allowed subsurface media distribution to be mapped between the surveyed boreholes. In two cases, radar results indicate that seismically imaged discontinuities are located between boreholes and directly beneath the seismic line. Zones of relatively-low velocity within fully-saturated media were found to correlate with decreased amplitudes, indicating increases in secondary porosity caused by subsidence processes. These EM-wave velocity and amplitude trends correlated with the discontinuities that were seismically-imaged between the boreholes, and with fracture zones and voids that were encountered during drilling. Such correlations rule out the possibility that the observed radar data anomalies resulted solely from location differences in mineralogy, primary porosity, and/or groundwater specific conductance. In two other cases, radar data suggest that seismically imaged discontinuities are located within close proximity to, but not between boreholes or directly beneath the seismic line.

Constant Offset Profile (COP) Measurements

Borehole radar COP surveys were conducted at the Project Area during July of 2002. COP surveys from which data are presented are described in Table included on Page 70 of Section 9.4, and the locations of the boreholes that were used are shown relative to the roadway eastbound lanes and mapped mine workings in on Page 69 of Section 9.4 Due to the small scale of the mine workings map, room and pillar locations relative to the roadway and borehole locations are regarded as approximate. Separations between boreholes were measured at the time of data acquisition (measured separations assume no deviation of the borings from vertical with depth; borehole deviation surveys were not conducted). The maximum measurement depth for each record was dependent upon the depths of the surveyed boreholes, and on the maximum depth that could be surveyed by both antennas (this was limited by a combination of the length of the radar system cables and the allowable position of the surface-located electronics relative to the boreholes).

For each COP record, both antennas were started at the maximum possible depth, and were then both stepped upwards at the same increment (5 inches), with the final measurement made with both antenna midpoints positioned at 3.3 feet (1.0 meter) below the ground surface. In order to accurately position time zero and allow for the correction of any possible system-related drift that may have occurred during measurements, both the first and last 3 to 4 traces of each record were acquired in air with a known (3.3 feet) separation between the antennas.

Multiple Offset Gather (MOG) Measurements

Borehole radar MOG surveys were conducted in the Project Area during August of 2002. MOG surveys from which data are presented are described on Page 70 of Section 9.4, and the locations of the boreholes used are shown on Page 69 of Section 9.4 Survey design for MOG data acquisition was based on prior COP data analyses, through which practical effective penetration distances for the Project Area subsurface media were determined. As expected, useful source to receiver offsets (i.e. antenna separations yielding traces with direct arrival signal distinguishable above the background noise level) that could be recorded in the subsurface varied depending upon lithology. With the employed radar system and antennas, the maximum effective source to receiver offset in consolidated materials (e.g. coal, sandstone, shale) was about 26 feet, the maximum effective offset in unconsolidated fine to coarse sands was about 23 feet, and the maximum effective offset in unconsolidated clay-rich units was about 16 feet. The maximum borehole separation deemed to be suitable for tomographic imaging, considering study area lithologies was about 16 feet. The maximum vertical source and receiver offset was therefore limited to 13 feet during MOG surveying, and measurements were not made between boreholes with a separation significantly greater than 16 feet.

Multiple data files were acquired between each set of boreholes surveyed during MOG data acquisition. For each MOG data file, the transmitter antenna was located and kept stationary at a given position in one boring, while the receiver antenna position was stepped downwards at an increment of 7.75 inches (0.25 meters). The initial location of the transmitter and receiver antennas for each set of borings that were surveyed was 3.3 feet below the ground surface, and the final location of both antennas corresponded to the maximum possible measurement depth for the set of boreholes (see the previous section concerning COP data acquisition). Measurements with the antennas separated by 3.3 feet in air, were frequently and consistently made during MOG data acquisition, in order to allow for time zero and possible system-related drift correction. Detailed information regarding the borehole radar MOG data recording parameters is presented in the following table.

Description	**Parameters**
Center frequency of antennas	100 MHz (in air)
Antenna step increment	5 inches (2.4 traces per foot)*, 10 inches (2.5 traces per yard)**
Time window	600 ns*, 350 ns**
Sample points	750*, 437**
Stacks	32
Transmitter (Tx) and receiver (Rx) spatial relationship	Tx was always located in the eastern-most borehole
Maximum vertical offset between (Tx) and (Rx)	0 feet*, 13.1 feet**
Pulsar voltage	1000 V

Acquisition and recording parameters for cross-hole constant offset profile (COP)* and multiple offset gather (MOG)** radar measurements.

Cross-hole Radar Results and Interpretations

This section presents processed COP data and MOG data-derived EM-wave velocity tomogram results, along with interpretations in terms of subsurface subsidence activity and future roadway collapse risk, for locations of the Project Area that were investigated using cross-hole radar methods. Data results and interpretations are presented in one of the four following sub-sections, depending upon the location of the boreholes used to acquire radar data:

1) eastbound travel lane Stations 469+40 to 469+68;
2) eastbound passing lane Stations 483+04 to 483÷79;
3) eastbound travel lane Stations 483+04 to 483+95; and,
4) eastbound travel lane Stations 485+30 to 486+40.

Processed S-wave seismic reflection sections showing subsidence features (bedrock and overburden discontinuities) that were imaged near the locations of boreholes used to acquire radar data, and information obtained during drilling of the boreholes used for radar measurements are also presented.

Eastbound Travel Lane Stations 469+40 to 469+68

Shown on Page 72 of Section 9.4 are average EM-wave amplitude and velocity plots, processed radar COP data, boring logs, and MOG-data derived EM-wave velocity tomograms for three sets of borings in eastbound travel lane Station range 469+40 to 469+68. A mosaic of the velocity tomograms is presented on Page 85 of Section 9.4, along with a geologic cross section constructed from 2002 boring logs, an interpreted S-wave seismic reflection depth section, and a map showing the approximate locations of mine workings relative to the locations of the data.

From the radar data shown on Pages 72 and 73 of Section 9.4, it is seen that in general there is very-good correlation between calculated average amplitude and velocity value variations versus depth, and lithologic changes that are indicated by boring logs. For example, mineral content and porosity differences (i.e. associated differences in electrical properties) of mapped unconsolidated sand and shale units result in expected EM-wave amplitude and velocity variations with depth. From 44 to 59 feet, shale (having no heavy fracturing detected during drilling) is seen to correlate with relatively high COP-derived values of average amplitude (~3800 μV) and velocity (~0.20 to 0.22 ft/ns). There is a large decrease in both amplitude (to ~500 μV) and velocity (to <0.16 ft/ns) over the depth range of 65 to 71 feet, which correlates with heavily-fractured shale mapped during drilling. Although mineralogic or primary porosity differences between the shale, or groundwater specific conductance differences at different depths may have contributed to the observed differences in measured EM-wave amplitudes and velocities, data suggest that an increase in fracture density (i.e. secondary porosity) of the shale located at greater depth has had an effect on media electrical properties that was detectable using radar. In this situation, it is apparent that EM-wave velocity has decreased and radar signal attenuation has increased due to the fracturing (relative dielectric permittivity and conductivity have increased due to water content increase; radar scattering losses from electrical property discontinuities have also likely increased).

From the radar data shown on Page 73 of Section 9.4, it is seen that there is good lateral and vertical correlation of the EM-wave velocity distribution in the tomogram with boring log information, and that vertical variations in average EM-wave velocity in the tomogram agree with those in the COP data-derived average velocity versus depth plot. From 59 to 65 feet, the boring logs indicate that coal is present at the eastern edge of the tomogram, and that grout is present at the western edge. Relatively high EM-wave velocities are observed near the eastern edge of the tomogram in this depth range, while relatively low EM-wave velocities are observed at the western edge of the tomogram in this depth range. The boring logs indicate that a continuous bituminous coal seam exists between the boreholes from 59 to 65 feet depth. The velocity tomogram indicates that the EM-wave velocity of the continuous coal (~0.30 to 0.32 ft/ns) is higher than that of the overlying shale unit (~0.26 ft/ns). Average amplitude values are also seen to be relatively high at the depth of the continuous coal.

Radar data presented in this section were acquired using boreholes that were located to the immediate north of a seismic reflection line that was positioned just south the eastbound travel lane. The seismic section in the vicinity of the EM-wave velocity tomogram mosaic (Section 9.4, p 85) indicates that the bedrock horizon has subsided into the mine workings along normal faults, within close proximity to the line between Stations 469+38 and 469+57. It is also apparent that a section of bedrock has subsided to a certain degree, into a mine room to the immediate east of these faults. Interpolated boring log information to the north of the seismic line indicate that the local top-of-bedrock is about

44 feet (between the boreholes) from Stations 469+40 to 469+68, while the seismic data indicate that bedrock is around 49 feet deep across this range to the immediate south. Both boring logs and EM-wave velocity distribution in the tomogram indicate that a continuous coal seam was encountered beneath bedrock during drilling to the north of the seismic line, between Stations 469+47 and 469+62. There is a discrepancy between the boring logs and the mapped locations of the mine room and pillar workings, as the mine map indicates that the boreholes should have encountered a mine room and not a coal pillar. It appears that the southeastern edge of the coal pillar (seen beneath the eastbound lane near Borings GC-307 and GC-305) actually extends slightly farther to the southeast than the mine map indicates, and terminates just south of the eastbound travel lane.

Radar COP data and velocity tomograms (Section 9.4, pp 72 and 85) indicate a termination of the coal pillar west edge at approximately Station 469+47, and a decrease in EM-wave velocities (relative to velocities to the immediate east) at the bedrock level between Stations 469+40 and 469+47. A heavily-fractured shale unit that was mapped west of Station 469+47 (see above) suggests that mine-related subsidence processes have been active at the mine level in this area. It is possible that the observed decrease in bedrock EM-wave velocity (above the mine level) to the west of Station 469+47 has resulted from a certain degree of subsidence-related fracturing (which was not indicated by boring logs). Such fracturing may be related to the formation of the bedrock subsidence feature that was seismically imaged to the south of the boreholes. Possible overburden disruption in the station range surveyed by borehole radar is not apparent over the depth range of COP data and EM-wave velocity tomograms.

Considering boring log and EM-wave velocity information, it is apparent that the subsidence feature imaged using seismic reflection, resulted from a collapse of the bedrock horizon into the mine room located immediately south of the coal pillar edge encountered by the boreholes. As was discussed previously, an area of disruption responsible for a 2D seismic section anomaly does not necessarily need to be located directly beneath the seismic line due to the Fresnel zone concept. Based on the close proximity of the seismically imaged bedrock subsidence-related disruption to the southern edge of the eastbound travel lane, the eastbound travel lane Station range of 469+38 to 469+57 would be an area that would warrant additional investigation at a site which had not been previously grouted.

Eastbound Passing Lane Stations 483+04 to 483+79

Shown on Pages 74 to 77 of Section 9.4 are average EM-wave amplitude and velocity plots, processed radar COP data, boring logs, and MOG-data derived EM-wave velocity tomograms for six sets of boreholes in the eastbound passing lane Station Range 483+04 to 483+79. A mosaic of the velocity tomograms is presented on Page 86 of Section 9.4, along with a geologic cross section constructed from 1999 boring logs, an interpreted S-wave seismic reflection depth section, and a map showing the approximate locations of mine workings relative to the locations of the data.

Radar data presented in this section were acquired using boreholes located to the immediate south of a seismic reflection line that was positioned to the north of the eastbound passing lane. The bedrock horizon was interpreted from seismic reflection data to have been down-dropped along normal faults, and to have experienced significant disruption from mine-related subsidence, near the seismic line between Stations 483+29 and 483+54. A geologic cross section interpreted from 1999 boring log data indicated that a bedrock low exists in the approximate Station range of 483+14 to 483+40, and that voids below the bedrock surface also exist in this region. Although the lateral extent (25-26 ft) of both interpreted features was similar, the western edge of disrupted bedrock interpreted from seismic data was located to the east of that interpreted from boring logs.

Consideration of the EM-wave velocity tomogram mosaic across this region (Section 9.4, p 86) suggests that seismic data were unable to exactly delineate the western edge of bedrock horizon disturbance between the boreholes. Between Borings GC-202 and GC-203, a region of low EM-wave velocity (relative to laterally adjacent velocities) exists at depths of 46 to 52.5 feet at the local surveyed bedrock level. The low-velocity zone between these borings exists between Stations 483+14 and 483+19. This bedrock low velocity area is interpreted to be the result of increased water content (the high relative dielectric permittivity of water reduces EM-wave velocity) due to subsidence related fracturing and voids (a void was encountered during 1999 drilling at a depth of 51 feet at Station 483+14). Borings in this region were not drilled to the depths necessary to confirm coal presence or absence. However, data observations suggest that the mine map (which indicates coal beneath Borings GC-202 and GC-203) has placed the eastern edge of the coal pillar in this region too far to the east.

The EM-wave velocity tomogram mosaic (Section 9.4, p 86) indicates a disrupted and down-dropped bedrock horizon between Borings GC-203 and GC-205 (Stations 483+23 to 483+40). Relatively-low EM-wave velocities at the surrounding bedrock level in this region suggest an increased secondary porosity (increased water content) due to fracturing and bedrock subsidence. The inter-layering of grout and shale beneath the bedrock surface (as mapped by Boring GC-205) has contributed to relatively low-velocities within the region at the bedrock and mine levels, and along with fracturing has resulted in COP data wavelet cycle distortion (due to direct arrival and diffraction interference) in the depth range of 52 to 59 feet (Section 9.4, p 76).

Between Borings GC-205 and GC-206 (Stations 483+40 to 483+57) EM-wave velocities at the bedrock level are somewhat higher than those to the immediate west. Although substantial mineralogic or primary porosity differences are possible, this observation suggests a relative decrease in bedrock subsidence-related fracture density, which is consistent with the seismic data that indicate an intact (but down-dropped) section of bedrock between Stations 483+48 and 483+54. The location of borings prevented the eastern edge of bedrock horizon disruption (as indicated by seismic data) from being accurately interpreted from boring log information alone. Boring B-004 is located at Station 483+63, at this location a void 5.5 feet high was present between 53 and 58.5 feet prior to grout placement. Relatively-high average EM-wave velocities at the bedrock level between Stations 483+57 to 483+79 (Section 9.4, p 77), suggest however that the surface of bedrock between these borings is intact and has not been disrupted from subsidence. This observation agrees with seismic data, which show an intact bedrock surface between these stations.

Although it is difficult to infer possible subsidence-related disruption of near-surface overburden materials from the processed radar and seismic data in the eastbound passing lane Station range of 483+14 to 483+54, these data clearly indicate bedrock horizon disruption (between the borings and beneath the seismic line) in this region. This is the area of the 1995 subsidence feature and disrupted conditions were expected; had these conditions been encountered at a previously ungrouted site, the area that would warrant additional investigation.

Eastbound Travel Lane Stations 483+04 to 483+95

Shown on Pages 78 to 81 of Section 9.4 are average EM-wave amplitude and velocity plots, processed radar COP data, boring logs, and MOG-data derived EM-wave velocity tomograms for seven sets of boreholes in the eastbound travel lane Station range 483+04 to 483+95. A mosaic of the velocity tomograms shown on Page 87 of Section 9.4, along with a geologic cross section constructed from 1999 and 2002 boring logs, an interpreted S-wave seismic reflection depth section, and a map showing the approximate locations of mine workings relative to the locations of the data.

Radar data presented in this section were acquired using boreholes located to the immediate north of a seismic reflection line that was positioned to the south of the eastbound travel lane. The bedrock horizon surface was interpreted from seismic reflection data to be intact between Stations 483+04 and 483+40, and this agrees with a geologic cross section constructed from boring log data. An EM-wave velocity tomogram mosaic across this station range also suggests that the bedrock surface is intact in this region, with relatively high EM-wave velocities observed for most of the bedrock depth range. Voids encountered beneath the bedrock surface (56 to 62 feet depth) during the drilling of Borings GC-212, GC-213, and GC-214 are apparent from the velocity tomograms, and are observed as velocity lows (attributed to increased water content). Average amplitude lows (suggesting increased attenuation and scattering loss) are also seen in the void locations from the COP-derived plots (Section 9.4, pp 78 through 80). As was concluded from the seismic data interpretation, it does not appear from the radar COP-data and EM-wave velocity tomograms that these voids have yet propagated up through the bedrock horizon.

A bedrock discontinuity that resulted in vertical horizon offset was interpreted from seismic data at Station 483+91. Analysis of seismic CDP gathers indicated that the mine-related bedrock surface disruption exists near the seismic line from the Station range of 483+80 to 484+08. Near-surface events in seismic data also exhibit apparent dip and offset across this station range, suggesting that overburden materials in this area have also been disturbed by mine-related subsidence activity. Boring B-412E, drilled during 2002 (subsequent to seismic data interpretation) at Station 483+95 confirmed that bedrock had in fact subsided to the east of Station 483+80, along a normal fault located between Stations 483+80 and 483+95. A heavily-fractured shale and siltstone unit was also encountered beneath the bedrock surface during the 2002 drilling of Boring B-412E, and this unit extended to mine level depths with no coal encountered. This suggests that where the mine map indicates a coal pillar beneath Boring B-412E, there should actually be a mine room indicated (i.e. the mine map has placed the eastern edge of the coal pillar too far to the east). Voids were previously encountered (from 43 to 48 feet deep) during the 1999 drilling of Boring GC-217 (located at Station 483+80).

The EM-wave velocity tomogram (Section 9.4, p 87) between Borings GC-217 and B-412E (Stations 483+80 to 483+95) supports the seismic and boring log data interpretations of a disturbed bedrock horizon. Bedrock EM-wave velocities are seen to be low relative to those measured in the eastbound travel lane Station range of 483+04 to 483+40. Overburden velocities are also seen to be low in this region relative to those of unconsolidated units located to the west, suggesting an increase in fracture density (and water content). A comparison of average absolute amplitude plots (Section 9.4, pp 80 and 81) supports this EM-wave velocity-based interpretation. Higher values of average radar signal amplitude would be expected for measurements made between Borings GC-217 and B-412E, which were 13.1 feet apart, than for measurements made between Borings GC-215 and GC-216, which were 19.6 feet apart. The observation that average amplitude values are similar at the depths of overburden for both sets of measurements, suggests that an increase in radar signal attenuation due to an increase in overburden fracture density (and water content) between Borings GC-217 and B412E has occurred.

Due to borehole separation distance, MOG surveying (and thus tomographic imaging) was not conducted between Borings GC-215 and GC-216, or between Borings GC-216 and GC-217 (Stations 483+40 to 483+80). Acquired radar COP data and calculated average velocity and amplitude values between these boreholes are shown on Pages 80 and 81 of Section 9.4. High radar signal attenuation within unconsolidated materials prevents an interpretation concerning overburden integrity based upon these data from being made. Decreasing average velocity and amplitude values at the depth of the void mapped by borehole GC-217 suggests that the void beneath the bedrock surface may extend to the west of this borehole. Average velocities at the bedrock level do not suggest however, that the region of bedrock surface disruption between Stations 483+80 and 484+08 (see above) extends west of Station 483+80, and this interpretation is consistent with a previous interpretation based only on seismic and boring log data.

Mine-related subsidence disruption of the bedrock horizon and near-surface overburden materials is interpreted in the eastbound travel lane Station range of 483+80 to 484+08 (between the boreholes and beneath the seismic line), based upon processed radar and seismic data. This is the area of the 1995 subsidence feature and disrupted conditions were expected; had these conditions been encountered at a previously ungrouted site, the area that would warrant additional investigation.

Eastbound Travel Lane Stations 485+30 to 486+40

Shown on Pages 82 through 84 of Section 9.4 are average EM-wave amplitude and velocity plots, processed radar COP data, boring logs, and EM-wave velocity tomograms for five sets of boreholes in the eastbound travel lane Station Range 485+30 to 486+40. A mosaic of the velocity tomograms is presented on Page 88 of Section 9.4, along with geologic cross sections constructed from 2002 boring logs, an interpreted S-wave seismic reflection depth section, and a map showing the approximate locations of mine workings relative to the locations of the data..

Radar data presented in this section were acquired using boreholes that were located to the immediate north of a seismic reflection line that was positioned just south of the eastbound travel lane. The seismic section in the vicinity of the EM-wave velocity tomogram mosaic (Section 9.4, p 88) indicates that the bedrock horizon surface is intact between Stations 485+30 and 485+50. Both the EM-wave velocity tomograms and boring logs to the north of the seismic line support the seismic data interpretation, indicating relatively high EM-wave velocities for most of the bedrock volume in this area. Grout and void space in the depth range of 62 to 72 feet correlate with relative lows in both average EM-wave velocity and amplitude (Section 9.4, pp 82 and 83). These trends are due to a combination of grout presence and an increase in water content due to fracturing and void space. The distribution of velocity lows associated with the grout and increased secondary porosity is mapped well between the borings by the velocity tomograms. A zone of low velocity is apparent from a tomogram within the bedrock volume over the depth range of 59 to 66 feet, between Stations 485+34 and 485+37. This suggests that a zone of fracturing associated with subsidence activity has propagated up into the bedrock, although it does not appear that the integrity of the entire horizon has been affected yet.

The seismic data indicate that the bedrock horizon has subsided into a mine room along normal faults between Stations 485+96 and 486+15 near the seismic line (Section 9.4, p 88). Borings B-413F and GC-302 and EM-wave velocity distribution in the tomogram indicate that a continuous coal seam was encountered beneath bedrock during drilling to the north of the seismic line, between Stations 486+05 and 486+15. There is a discrepancy between the boring logs and the mapped locations of the mine room and pillar workings, as the mine map indicates that these boreholes should have encountered a mine room and not a coal pillar. It appears that the southwestern edge of the coal pillar (seen beneath the eastbound lane near these borings) actually extends slightly farther to the south than the mine map indicates, and terminates just south of the eastbound travel lane. Radar COP data (Section 9.4, pp 83 and 84) indicate relatively high-values of average EM-wave velocity and amplitude over the bedrock depth range between Stations 485+83 and 486+05, and between Stations 486+15 and 486+40. These observations suggest that the bedrock horizon is intact between the boreholes within these regions.

Due to borehole separations, MOG surveying (and thus tomographic imaging) was not conducted between Borings GC-304 and B413F, or between Borings GC-302 and B-413E.

Considering boring log and EM-wave velocity information, it is possible that the subsidence feature imaged using seismic reflection, resulted from a collapse of the bedrock horizon into the mine room located immediately south of the coal pillar edge (see above) encountered by Borings B-413F and GC-302. As was previously discussed, an area of disruption responsible for a 2D seismic section anomaly does not necessarily need to be located directly beneath the seismic line due to the Fresnel zone concept. Possible disruption of overburden materials in the station range surveyed by boreholes is not apparent from the radar COP data and EM-wave velocity tomograms.

This is the area of the 1995 subsidence feature and disrupted conditions were expected; had these conditions been encountered at a previously ungrouted site, the area that would warrant additional investigation.

5.1.5 Cross-hole Seismic Methods

Cross-hole seismic methods consist of making measurements between two holes with the source and detectors at the same level in the source (transmit) and receiver holes (see Section 9.6.9.1). The idea is to measure the travel-time for an elastic wave of mechanical energy to travel horizontally between two holes. Then, knowing the distance between the two holes, one calculates the horizontal elastic-wave velocity of the medium between the boreholes. A cross-plot of velocity versus depth provides a log of the changes in material between the boreholes. Voids will affect these measurements in at least two ways:

1) they will cause the velocity of the medium to be lower than the material that hosts the voids; and,
2) they will cause the amplitude of the received signals to be lower, making it more difficult to pick first arrivals in a high signal-to-noise area.

The velocity that is calculated from the travel time is plotted as a function of depth, and interpreted in terms of changes in materials between the boreholes.

The cross-hole seismic technique consists of initiating a source of mechanical energy in one boring and recording the transmitted energy with a series of piezoelectric, or electro mechanical detectors in another boring. The principle of field operation and underlying principle of detecting changes in the distribution of physical properties between (and around) the borings is analogous to the principles of cross-hole GPR that were discussed earlier. However, the affecting physical properties contrasts in the case of seismic methods are density and velocity, while the physical properties that affect the propagation of an electromagnetic wave are permittivity and electrical conductivity. Contrasts in the type of material (sand, clay, coal, etc.), the density of the material, and anomalous geotechnical features (e.g., voids) cause a change in the physical properties which are exhibited in the cross-hole seismic data as anomalous velocities, and diffractions, reflections, and diffractions in a manner similar to the cross-hole GPR. The spacing and distances for the cross-hole seismic tomography are summarized below for various surveys at the Project Area.

Survey No.	Source Boring	Receiver Boring	Source & Receiver Spacing	Nominal Inter-Boring Distance (ft)
2a	GC-211	GC-201	3.28 feet (1 meter)	46.3
3a	GC-211	GC- 206	3.28 feet	69.9
4a	GC-216	GC-206	3.28 feet	45.3
5a	GC-216	GC-201	3.28 feet	72.3
2	GC-211	GC-201	(1.09 feet (1/3 meter)	46.3

Eight three-component geophones were used as receivers. These were separated by 6.56 feet (2 meters) of wireline. Signals detected by the geophones were transmitted up 7-conductor wireline to the surface for digitizing. At the surface, the data were recorded at a sample interval of 0.5 milliseconds using an OYO DAS-1 seismograph. The typical shooting pattern fixed the eight geophones and scanned the source from bottom-to-top of the borehole. Receiver points uniformly covered the depths at 3.3 feet (1 meter) or 1.09 feet (1/3-meter) intervals for the low-resolution and high-resolution surveys, respectively.

The source point intervals were the same. Four sweeps, two clockwise and two counterclockwise, were typically recorded at each source point. Each sweep was ten seconds long and consisted of two continuous frequency sweeps; there was an up-sweep for about 5 seconds as the DHOV accelerated (spun up) to its maximum angular acceleration, followed immediately by a 5-second down-sweep as the DHOV decelerated (spun down) to a dead stop. These orbital source motions can be decomposed into pure horizontal radial and transverse directions (Hardage, 1992; Cole, 1997). A typical low-resolution survey yielded about 9,600 data traces, while a high-resolution yielded about 79,000 data traces. Typical source-receiver geometry is shown in Section 9.6.9.1

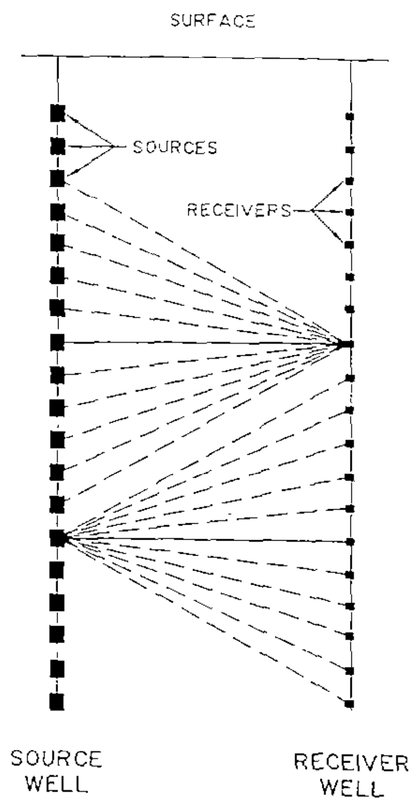
The solution of the nonlinear inversion problem of travel-time tomography involves three distinct steps:

1) observed travel-times must be selected;

2) travel-times for an assumed velocity model are calculated; and,

3) a matrix equation is inverted where the data is given by the travel-time residuals (calculated travel-time minus observed travel-time) to obtain corrections to the assumed velocity model.

Steps two and three are performed iteratively The iterations are generally stopped when an acceptable match between calculated and observed travel-times Algorithms for inverting or reconstructing velocity tomograms from travel-time data are well documented in the literature (e.g., La Porte et al., 1973; Dines and Lytle, 1979; Cotin, et al 1986; Hatton et al., 1986; Ivansson. 1985, 1986. Nolet, 1987; Chapman and Pratt, 1992; Pratt and Chapman. 1992; Rector, 1995).



Typical cross-boring seismic survey geometry. Sources are in one boring, receivers in the other. The solid and dashed lines show idealized direct ray-paths for common source and common receiver gathers.

The tomographic tests carried consisted of borrowing a special system developed by the OYO Corporation. The system consisted of an "elliptically" polarized shear wave source, and shear wave detectors. The polarized shear wave source has the advantages stated for the polarized GPR source. A sh ear w ave s ource adds directional information, since it propagates in a specific orientation. Polarization is a little more complicated in the case of seismic tomography than in the case of electromagnetic wave, since seismic waves can "change modes" of propagation (i.e., a shear wave can convert to a compressional wave at boundaries between different media). In spite of the complications, and the advanced-research nature of the methodology, it was thought that this is a technique that has great potential as a true imaging method in the subsurface.

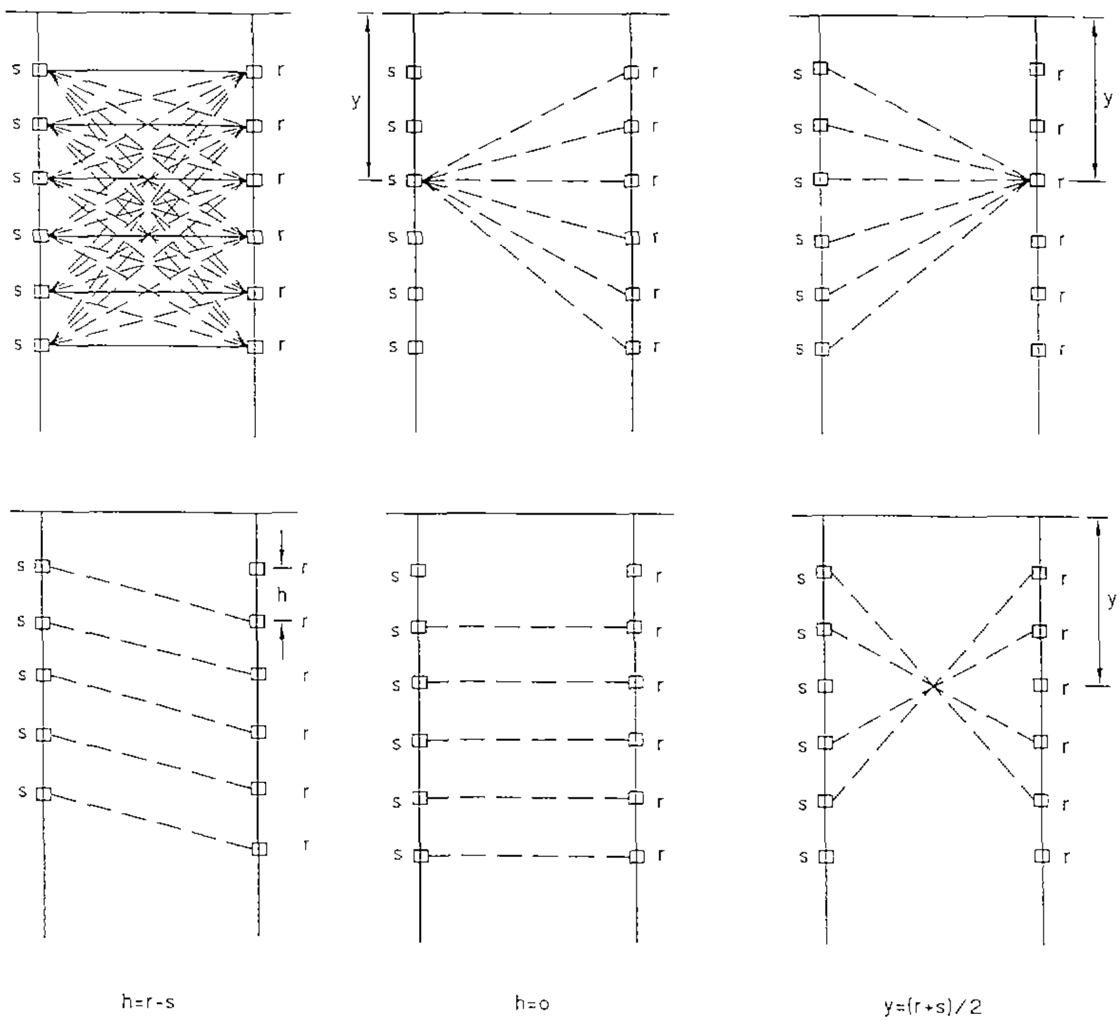
The objective of the cross-hole tomography was to transmit and receive sufficient seismic energy underneath the eastbound lane and to produce tomographic images of the subsurface conditions. A seismic source generates signals along the length of one borehole, while receivers in another borehole record the signals that have traveled through the rock volume that separates the two boreholes. A down-hole orbital vibrator was used for generating the seismic energy (Cole, 1989, 1997; Dong, 1994) and a string of 3-component geophones to record the signals in three perpendicular directions, horizontal directions one and two (H1 and H2) and vertical (V). The down-hole orbital so urce produces simultaneously three types of elastic waves (Dong, 1994): compressional (P or *quasi*-P) waves, horizontally polarized shear (SH) waves, and vertically polarized shear (SV or *quasi*-SV) waves. Using 3-component receivers will permit the decomposition of the received signals into these three wave types, which will be dominant on the horizontal radial (Hr), horizontal transverse (Ht or Hθ), and vertical (V) components, respectively. Four low-resolution (source and receiver spacing = 3.28 feet) cross-road surveys and one high-resolution (source and receiver spacing of 1.09 meter) cross-road survey were made.

The receiver string consists of eight 3-component geophones, each geophone being separated by 6.6 feet (2 meters). The following table shows the correspondence between channel number, geophone, and component orientation. At any receiver level, the shallowest geophone is #1 and the deepest geophone is #8.

Geophone Number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Vertical component (V)	**1**	**4**	**7**	**10**	**13**	**16**	**19**	**22**
Horizontal component 1 (H1)	**2**	**5**	**8**	**11**	**14**	**17**	**20**	**23**
Horizontal component 2 (H2)	**3**	**6**	**9**	**12**	**15**	**18**	**21**	**24**

Geophone numbering system for the three components.

The reformatting and adding geometry to the data steps involve converting the data from the SEG-2 format of the data acquisition system to the SEG-Y format, merging separate data files into a larger survey files, and installing coordinate data to the trace headers. During this process the data are sorted into common receiver gathers (CRGs), which are displays of traces from different source locations into a single receiver. These displays give assurances that data with good signal-to-noise ratio were obtained, where the signal- to-noise ratio is defined as desirable signal divided by the remaining (noise) signal. "Good" is qualitative and usually means that the data can be used to make reliable, reproducible interpretations. Feature on these displays indicate interpretable phenomenon have been recorded.

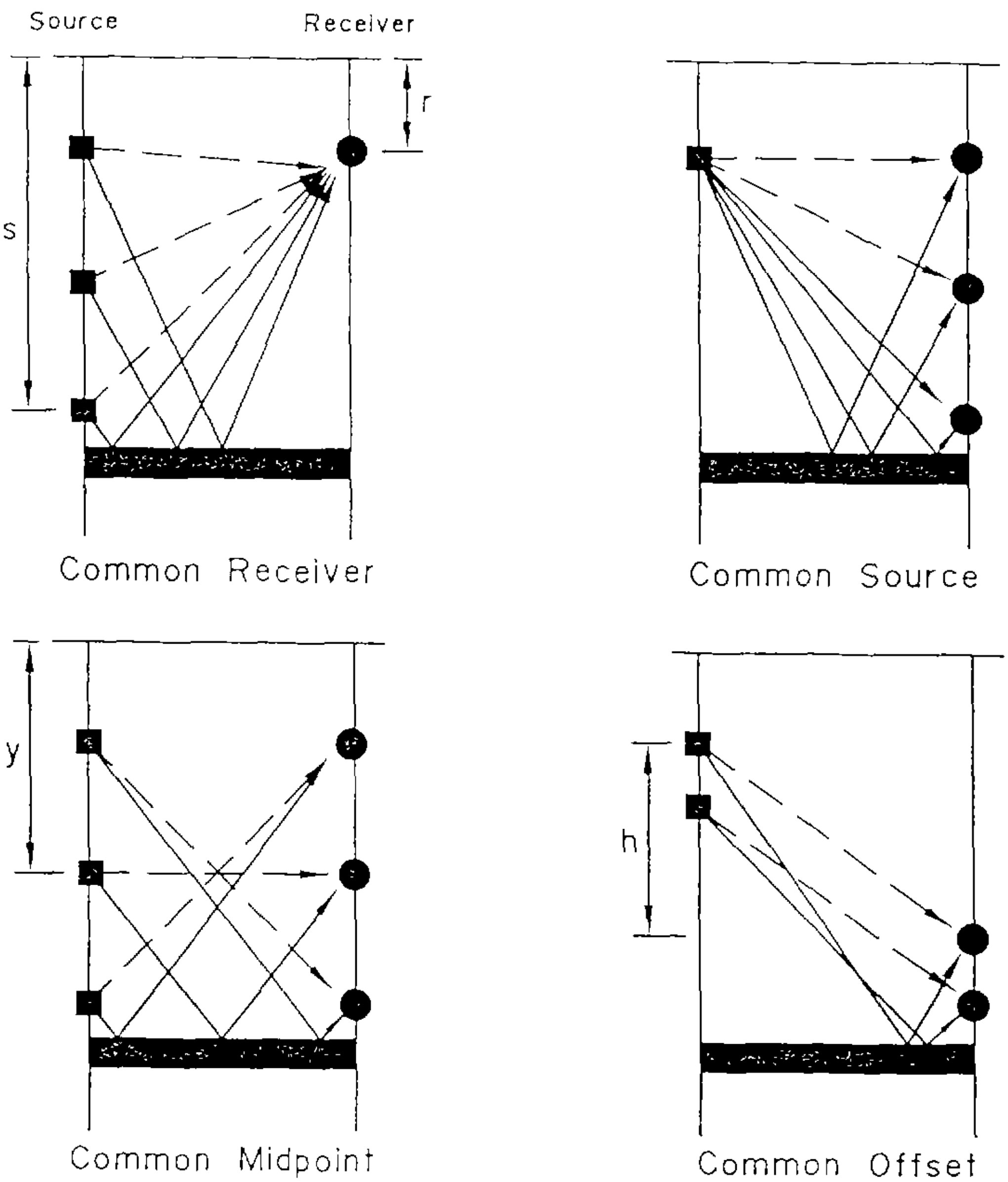


Cross-boring seismic data sorts, where s is the source depth, r is the receiver depth, h is the vertical offset and defined as h= r-s, and y is the vertical midpoint and defined as y = (r+s)/2.

The possible paths of a seismic data arrivals are illustrated above. This figure illustrates the complexity of the interpretation problem, but it also shows the necessity for making measurements in many different locations for both the source and the receivers. Examples of data from specific source-receiver locations are shown on Pages 96 and 97 of Section 9.4. The results shown on Page 96 are a common-receiver gather (CRG) from Survey 2, where the source boring was GC-211, the receiver boring was GC-201, and the nominal hole-to-hole distance was 43.6 feet. The CRG comes from Channel 23 at Receiver Level 2. Channel 23 was the horizontal-one (H1) component from Geophone 8 and, here, was at a depth of 74.8 feet. These data have undergone "Vibroseis correlation", meaning they have been correlated against a pilot trace, in this case a horizontal motion detector on the orbital source. Generally, a pilot trace is a reference trace used to make adjustments to other traces in a record or file. In the cross-hole seismic work, the pilot trace originated from a horizontal motion detector mounted inside the orbital source. A pilot trace (from Channel 25 or 26) was used from each record or file to adjust the geophone traces (Channels 1 – 24) in each file or record. Every time the source vibrates, there is a file or record of 26 traces from 24 data channels and 2 auxiliary channels which come from 2 orthogonal horizontal-motion detects mounted inside the orbital vibrator.

Trace 1 is for the source at depth of 68.9 feet and Trace 62 is for the source at depth 2.2 feet; the source spacing is 1.1 feet (1/3 m). For this CRG the source is moving from the bottom of the boring (GC-211) towards the top. The source is getting farther away from the receiver and the first-arrival time, which is marked by the black curve, increases as the source-receiver distance increases.

The results on Page 97 of Section 9.4 are another CRG from Survey 2. It is a CRG from Channel 9 at Receiver Level 1. Channel 9 was the horizontal-two (H2) component from Geophone 3 and, here, was 43.1 feet deep. As in the results shown on Page 96 of Section 9.4, Trace 1 is for the source at depth of 68.9 feet and Trace 62 is for the source at depth 2.2 feet; the source spacing is 1.1 feet. Here, Geophone 3 is close to the same depth as Source Points 23 (43.7 ft) and 24 (42.7 ft). Notice, the low-velocity zone (LVZ) between Traces 20 and 30 (source depths of 37.2 to 48.1 feet). This LVZ corresponds in depth to the fine-to-coarse sand layer. Also notice the *down-going* P-P reflection emitted from near Trace 62 (depth of 2 2 feet), it is known that this arrival is a P-P reflection because it has the same distance-travel-time move-out as the direct-P arrival. The transmission paths of *down-going* reflections for different source-receiver locations are shown in below.



Ray-path diagrams of direct and up-going reflections in different gather spaces, where s is the source depth, r is the receiver depth, h is the vertical offset and defined as h=r-s, and y is the vertical midpoint and defined as y= (r+s)/2. The solid and dashed lines are reflection and direct ray-paths, respectively

The acquisition of cross-hole seismic data occurs by placing seismic sources and receivers in boreholes close to the target of interest. Many types of seismic information can be extracted from a cross-hole seismic data set (Rector, 1995). First, the direct arrivals between source and receivers can be picked and then inverted to produce a velocity tomogram, a two-dimensional image of the velocity structure between the boreholes. Second, the reflected arrivals from horizons above and below the source and receiver positions can be picked and then inverted to reflection images of the geology between the boreholes. Other types of information, such as guided waves and converted waves, can be processed as well.

In the discussion to this point, the focus has been on cross-hole velocity tomography. This requires the identification of the direct arrival, which results from seismic energy traveling directly from the source to the receiver. To process the field data, the following must be performed:

- the geometry defined for the source and receiver locations;
- the geometry assigned to the traces; each seismic trace has a unique source and receiver combination;
- the source signature de-convolved from the trace;
- the clockwise and counterclockwise circular rotations decomposed of the source into their radial (in-line) and transverse (crossline) linear components (Hardage, 1992; Cole, 1997);
- the signals detected by the receivers rotated into their radial (in-line) and transverse (crossline) components (not implemented yet); and,
- filters applied to retain the dominant frequency information.

A problem unique to the Project Area data set is that there was electrical cross-feed into all the data channels when the source was turned on and off. These spikes (pulses) are difficult to deal with during processing. Normally, in data sets where the boreholes are farther apart, these spikes are not bothersome because during correlation or de-signature they will collapse to a large arrival at zero time on all channels and can be muted out. However, because of the short distance between the boreholes at the Project Area, the expected arrivals in the deeper (bedrock) units are expected to arrive at around

10 milliseconds. The zero-time pulse, which contains a lot of ringing, masks the first arrivals making them difficult to pick.

P-wave velocity tomograms from Survey 2 between Borings GC-211 (source) and GC-201 (receivers) are shown on Pages 98 to 100 of Section 9.4. All tomograms resulted from the same first-arrival travel-time picks and from curved-ray tomographic inversion using GeoTomCG, a three- dimension tomography software package (Tweeton, 1999). The source depths in Boring GC-211 cover 2.2 to 68.9 feet at 1.1-foot intervals; the receiver positions in Boring GC-201 cover 3.8 to 75.9 feet at 1.1-foot intervals. For the tomograms shown on Pages 98 and 99 of Section 9.4, the starting model was 37 feet of overburden over bedrock; the overburden velocity was 2,000 ft/s and 600 ft/s, respectively, while the bedrock velocity was 6000 ft/s and 2000 ft/s, respectively. The starting model for tomogram on Page 100 of Section 9.4 is a homogeneous medium with a uniform velocity of 5,000 ft/s.

When comparing the tomograms, there is some influence of the starting model. However, all tomograms are similar and importantly lead to a common interpretation. In all tomograms, the overburden-to-bedrock interface is clear at a depth of roughly 37 feet, with slow material (dark blue) over fast material (light blue to green). Currently, we believe the very-fast color (red) is an artifact of picking incorrect early arrivals that result from the cross-feed pulses that mask the true early arrivals.

Conclusions on Cross-hole Seismic Velocity and Tomographic Analysis

The cross-hole seismic velocity measurements are simple are valuable in aiding in the interpretation of surface seismic measurements and borehole tomographic measurements. The seismic tomographic measurements at the test site demonstrated that these measurements could be made in very-shallow conditions. It is believed that this test was the first time that shear wave cross-hole tomographic measurements were made for a highway engineering application. The orbital vibrator is a good source, but it will need to be improved before it can be used for routine operations. Overall, these tests proved the feasibility of cross-hole seismic tomographic tests. Since it is a technique that can "see" beneath the highway without drilling into the road surface, development of this technique should be continued.

5.1.6 Down-hole Geophysical Borehole Logging

Borehole geophysical measurements may be made in a single borehole (geophysical boring logging), with the source in the borehole and the receiver, or detector, on the surface (hole-to-surface), with the source on the surface and the receiver in the borehole (surface- to-hole), or with the source and receiver in different boreholes (hole-to-hole). The hole- to-hole, hole-to-surface, and surface-to-hole measurements imply an active source, while the single borehole measurements can be active, or passive. Geophysical boring logging is the most common type of borehole geophysics, and it is intended primarily to measure a specific physical property in a boring.

The basic borehole geophysical field measurement system consists of a down-hole probe, a cable raised by a winch system, a surface module and a recording system. The recording system may consist of an analog strip-chart or a digital magnetic tape recorder. Depth is recorded simultaneously with the geophysical information via an encoder on the wheel which the down-hole cable passes over. Up-hole modules consist of electronic components that transmit and receive the desired information from the probe. A logging cable generally consists of four, or seven, insulated electrical wires that are surrounded by a braided, steel armored, jacket for strength. The probe may either be passive, with all electronics contained up-hole, or active, with some (or all) of the electronics in the down-hole probe. Some of the more recently developed active probes digitize the data before transmitting it to the surface electronics.

Borehole geophysical logs were run in Borings GC-201 through GC-218, and two other borings that were outside of the test area of immediate interest. The purpose of these geophysical logs was to provide a continuous record of physical properties in the borings, and to provide a basis for establishing the lateral continuity of the geologic units. The two geophysical logs that were run included the conductivity and the natural gamma-ray logs.

Natural Gamma Ray Geophysical Log

The gamma-ray log simply measures the natural background gamma radiation in a boring. It is a passive detector that is similar in principle to a Geiger counter. In shallow sediments, the gamma ray probe primarily responds to variations in Potassium-40, and is commonly used in the petroleum industry to differentiate between sands (low gamma-ray count rate) and shales (high gamma-ray count rate). High gamma ray count rate is an indication of increasing shale. Intermediate count rates usually occur in sand, while count rates of nearly zero are indicative of limestone, concrete, or voids in this environment.

The total-count gamma ray log is one of the most useful measurements for defining lithologic and other geologic features. The log measures the total gamma radiation of the rocks and cannot discriminate between different radio-elements. Most of the radio-elements in the earth's crust are K40, or the uranium, or the thorium decay series. Potassium is one of the most abundant elements. Analysis of rocks to determine the K^{40}/K^{39} ratio has shown that the stable non-radioactive form of potassium (K^{39}) is always found in constant proportion with the radioisotope K^{40}. The abundance of potassium in most rock types makes it desirable to use a gamma ray logging device in nearly all types of geologic environments to define lithologies.

Gamma ray logs are often used as a sand-shale indicator, but sand/shale ratios cannot be computed quantitatively from gamma ray logs with any degree of certainty. In spite of these uncertainties, the gamma ray log is one of the best correlation tools available in sedimentary environments. Coal beds often yield a very-low gamma ray response. This same geochemical environment is also conducive to the accumulation of gamma-emitting uranium, and the gamma ray log may not always be a good indicator of coal layers. Uranium in a coal depositional environment is often concentrated in a thin layer of very-low grade coal, or black shale, located at the base of a coal seam.

The following table summarizes the relative gamma ray responses for the lithologies encountered in the borings in this project area.

Relative natural gamma ray log response for a shallow sedimentary environment.

Lithology and/or physical condition	Relative natural gamma ray response
Coal	Low, except when uranium present
sandstone (or sand)	very low
limestone	very low
shale (or clay)	intermediate - high, depends on potassium content of clay
black shale	very high
void	very low
shaley sand	intermediate
sandy shale	intermediate

Resistivity (Conductivity) Geophysical Boring Log

The resistivity log measures the electrical resistivity (by electromagnetic induction) of the material near the borehole (within approximately a 2-foot diameter around the boring). The resistivity is primarily determined by fluid in the hole, with the borehole fluid (water) increasing the conductivity. Since clay and shale have a high porosity, the conductivity is also higher in clay/shale than it is in sand/sandstone. Intermediate conductivity values usually occur in sand, while count rates of nearly zero are indicative of voids in this environment. Fly ash, or concrete fill are expected to have conductivity values above values that will be obtained in sand, and approximately the same as values in shale. Note that conductivity values are reversed with increasing conductivity to the left.

Generalized relative resistivity response for lithologies and other features in the borings surveyed in this study.

Lithology and/or physical condition	Relative resistivity values for the lithology
Coal	High
sandstone (or sand)	intermediate
limestone	intermediate-to-high
shale (or clay)	very low -to- low
black shale	very low
void	very high (theoretically infinite)
shaley sand	intermediate
sandy shale	intermediate

<u>Interpretation of Gamma Ray and Resistivity Logs in the Geophysical Borings</u>

The geophysical boring logs measured in this study are shown in on Pages 111 and 116 of Section 9.4. Individual features corresponding to the summary given in the table above, are between the geophysical and lithologic boring logs shown. However, there are discrepancies, which might be due to the frequency of the sampling used for conventional geotechnical borings. In other words, the gamma ray log is much more sensitive to sand/shale boundaries, and other lithologic features than the 5-foot sample interval that is obtained in conventional geotechnical borings. Additional information is also obtained from borings where the bedrock is not cored. Specifically, the following features can be clearly seen on the geophysical boring logs:

1) The shale (bedrock) boundary is clearly seen on nearly all of the boring logs where it was encountered. The shale has a higher gamma ray log response.
2) Subtle variations in the sands can be seen on the resistivity logs. For example, the increase in resistivity from approximately 25 to 45 feet in Boring B-206 is interpreted as being caused by a change in the cementation in the borings, or it might simply be caused by a change in the

borehole rugosity. A caliper log would help to resolve this difference. However, the point is that the resistivity log shows a difference that cannot be seen on the lithologic log.

3) Very-high resistivities can be seen adjacent to voids. This is to be expected in a dry hole. However, it is important to note that a wet hole would give the opposite response. The measured resistivity of a fluid filled void would be approximately equal to the resistivity of water (usually in the range of 10-100 ohm-m). Voids are indicated by the symbol "v" on the resistivity logs.

4) The coals encountered in Borings B-208, B-216, and B-218 have a very-low gamma ray response, and the boundaries are clearly marked by the gamma ray log. The resistivity logs do not appear to have an anomalous response in the coals. This is probably an indication that the coals are fairly-low grade and are quite porous. It is not uncommon for mid-western low-grade coals (sub-bituminous to bituminous) to have moderately-high resistivity values. It should be noted that high-grade coals usually have an anomalously-high resistivity response (thousands of ohm-m).

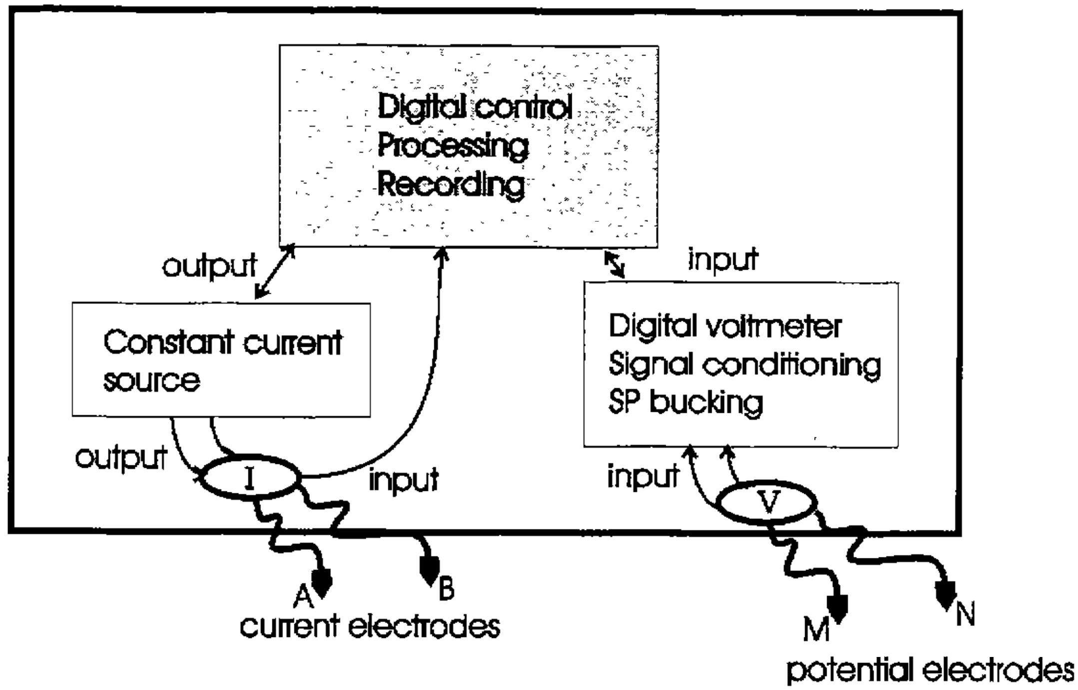
5) The natural water table seems to generally have a resistivity response, with the higher resistivity values being located in the unsaturated region, which is not surprising. In fact, the water table boundary (indicted by "rwt" on the resistivity logs) shows a characteristic signature on all of the logs, which can be described by a gradual increase in the resistivity. The gradation is probably caused by the capillary fringe (partial saturation) above the water table. The water table indicated by the geophysical logs should be a reliable indicator of the boundary between the saturated and unsaturated zones.

The conductivity and gamma ray logs provide a cost-effective means of providing a continuous record of the physical properties in borings. There is a good correspondence between the known tool-drops and the geophysical boring logs. However, the correspondence is not always clear-cut, since the geophysical boring logs respond to variations in the lithology and other physical features on a much more detailed level than the gross lithology logs obtained from interval samples and observation of drill cuttings and drilling behavior.

Other logs (including gamma-gamma density, caliper, acoustic velocity, video, neutron- thermal-neutron, etc.) would help to provide a more complete picture of the subsurface physical properties than the two simple geophysical boring logs tested for this study.

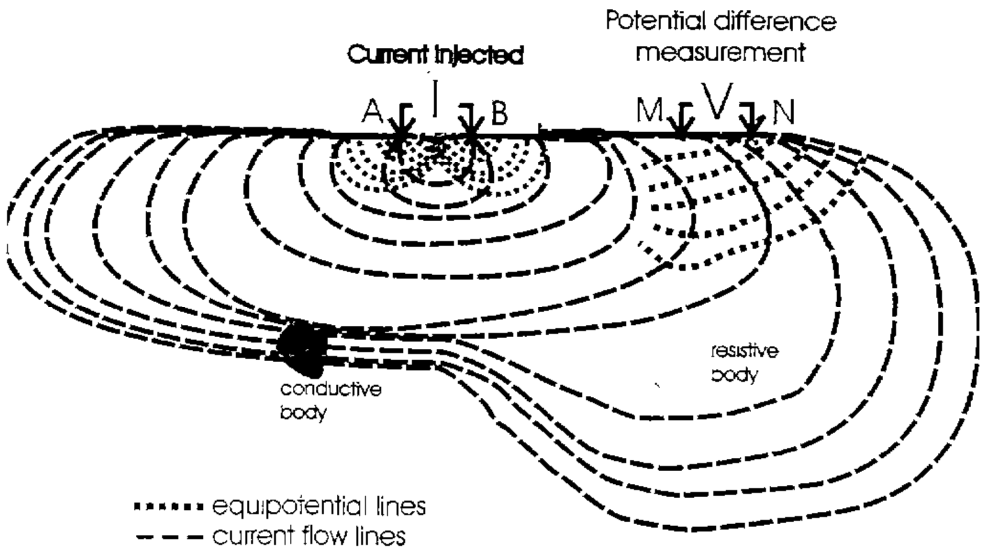
5.1.7 Resistivity Tests

Resistivity equipment can be very simple, consisting of a measurable source of electric current (I) that is injected between two electrodes (electrodes A and B, as shown in the Figure on the following page), and a voltage measuring device between two potential electrodes (electrode M and N, as shown in the Figure on the following page). Traditionally, the current electrodes are usually metal stakes that are pounded into the ground with a hammer. If the ground is very dry, then water is sometimes poured onto the stakes in order to improve the electrical contact with the ground. The current generating source consists of a of transformer/converter that sends a slowly-varying square wave to the current electrodes. Typically, the square wave has a 1-to-5 second period but an alternating current as high as 100 Hz may be a good approximation of direct current in most situations, and several commercially available resistivity systems make use of low frequency alternating current sources. The amplitude of the current that is injected into the ground is determined by the separation of the current electrodes and the conductivity of the ground near the surface. The separation of the electrodes, in a general sense, determines the depth of investigation. In practice, the electric current can range from a few mA for shallow engineering investigations, to several Amperes for deep investigations



The basic elements of a simple resistivity system.

The principle of resistivity is illustrated in the Figure on the following page. Current flowing between two current electrodes (A and B, source and sink, respectively) spreads out radially into the material. Any change in the resistivity of the host material (resistive body, or conductive body) causes the current flow to change direction and intensity when it reaches the surface. The intrinsic resistivity of the resistive body is greater than the resistivity of the surrounding material. Conversely, the resistivity measured in the presence of a conductive body is less than the surrounding material. The resistive body at the IR-70 Site was the fracture zones, the voids above the mine, and the mine void.



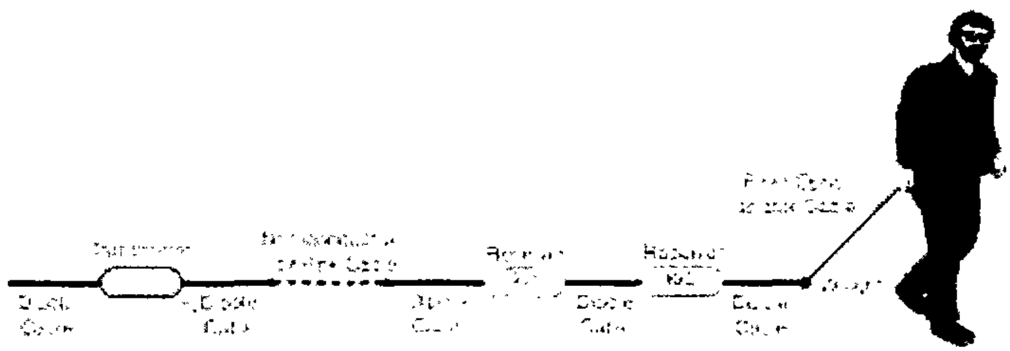
Current flow concentrations, illustrating the effect of a conductive and a resistivity zone causing a change in the concentration of electric current.

There are numerous modifications of the basic four electrode system illustrated in the Figure on the previous page, including multiple electrode systems that automatically switch between current source and potential receiver electrodes, yielding a complete set of resistivity sounding and profiling measurements. Two of these systems were tested at the IR-70 Study Area.

The first of these systems was the Ohm-Mapper, manufactured by Geometrics Corporation, which is a capacitively-coupled system that does not require pounding individual stakes into the ground. According to the description by TerraPlus:

The Ohm-Mapper TR1 is a capacitively-coupled resistivity system designed to measure subsurface resistivity in areas where exploration using a traditional galvanically coupled (DC) resistivity system is impractical, slow, and expensive. The Ohm-Mapper consists of an ungrounded dipole transmitter, receiver, and a data logger. An AC current is coupled into the earth by the transmitter and measured at the receiver. This measured voltage is proportional to the resistivity of the earth between the dipoles. Apparent resistivity is calculated using the appropriate geometric factor for the capacitively-coupled antenna array.

The Ohm-Mapper is designed to be pulled along the ground as a streamer, providing a nearly continuous apparent resistivity profile. The design increases the resolving power and productivity of the system relative to traditional direct current resistivity systems. Data is logged using the Data-Mapper Console. The Ohm-Mapper receiver is connected to one of the serial ports on the console for data acquisition via a fiber-optic interface. Data are graphically displayed in real time on the console screen. The Ohm-Mapper TR1 has a total storage capacity of approximately 24 hours of data acquisition at a sampling rate of two times per second.



Data from the Ohm-Mapper system is recorded on digital media, and the data are then inverted using a two-dimensional modeling program. The modeling program basically outputs a cross section of the subsurface that indicates the zones of high and low resistivity. The anomalously high resistivity regions can potentially be correlated with possible regions of voids or collapse.

The other system tested at the IR-70 Site was the Sting resistivity system. This system is similar to conventional resistivity systems, with the important difference being that multiple electrodes (current and potential) can be deployed simultaneously. This greatly increases the efficiency of the field operation over conventional four electrode systems.

The resistivity surveys are shown on Pages 128 and 129 of Section 9.4. The high resistivity zones on the Sting survey and survey inversion roughly correspond to the inversion results provided by the Ohm-Mapper data. In general, the Ohm-Mapper resulted in a somewhat shallower depth of penetration than the Sting system. The two systems are, however, complimentary with the Ohm-Mapper providing detailed shallow data and the Sting providing a greater depth of penetration.

A comparison was made of the results of the Sting resistivity system, the shear wave reflection data, and the GPR data where measurements were made along the same segment of the project. The Sting data indicated two shallow anomalies along the shoulder of the eastbound lanes near Stations 470+40 and 482+00.

Based on the comparison of the resistivity data and the seismic data, two conclusions can be drawn:

1) the anomalies in the resistivity cross sections do not directly correspond to anomalies on the seismic data; and,
2) the bedrock reflector in the seismic data does not correlate to the depth of the change in resistivity data. Apparently the resistivity is imaging primarily the soils, while the seismic data are showing the bedrock surface.

Although the correspondence is not one-to-one, there is a strong correspondence between the resistivity anomalies and GPR anomalies J and Q. The two techniques (resistivity and GPR) respond to different electrical properties, and a perfect correspondence between the data sets would, therefore, not be expected.

5.2 HYDROGEOLOGIC METHODS

The hydrogeologic conditions at the site were challenging in that standard characteristics (permeabilities and flows) needed to be determined for a nonstandard aquifer (mined and partially grouted coal zone). During the methods evaluation phase of the project (Phase I) a variety of both standard and nonstandard hydrogeologic investigative techniques were attempted. Based on the findings, reliability of the data, and preferences by ODOT, generally only one of the methods evaluated during Phase I of the Project were employed during the site investigation phase of the Project (Phase II). As a result, the research aspects of the hydrogeologic investigation were essentially completed during Phase I of the Project. Because of the limited size of the area evaluated during Phase I (200 feet of the overall 2,100-foot long Project) the findings of the methods evaluations submitted in detail in the Phase I Test Area Investigation Report (1/12/01) in some cases do not match the findings for the overall site investigation which were based on more data collected over a larger area.

5.2.1 <u>Permeability Determination</u>

Permeability determination is required for calculation of groundwater flow. Three field methods of determining permeability of water bearing zones were attempted during Phase I of the Project:

- slug tests;
- pump tests; and,
- specific capacity tests.

The specific capacity and slug tests generally yielded similar results which are believed to be in an expected range for the types of deposits present at the site. Because estimating permeability from specific capacity is nonstandard and because the slug testing was in most cases successful, during Phase II of the investigation, permeabilities were estimated from slug testing. At a few borings, the slug tests completed for Phase I were unsuccessful and additional testing was not completed during Phase II; at these locations the permeability used for the site investigation were the estimated values from specific capacity testing completed during Phase I.

Well PW-1 is a 6-inch diameter well which was installed as a water supply well during the construction grouting. Because of the larger diameter (all other wells have 2-inch-diameter casings), it was possible to attempt pump tests in this well. The well, however, is believed to be completed into an extensive open mine void. Inadequate drawdown could be induced by pumping approximately 10 gallons per minute to permit the calculation of permeability using standard methods (Theis, Cooper-Jacobs, Chow, or distance drawdown). Permeability could, however, be estimated based on specific capacity. Higher pumping rates were not desirable because of the potential impacts of removing a large quantity of water from the mine.

The permeability of the water-bearing units was estimated from the specific capacity by using the general relationship between specific capacity and transmissivity and the relationship between transmissivity and permeability. Specific capacity can generally be described as the rate of discharge from a water well per unit of drawdown; transmissivity is the rate at which water is transmitted through a unit width of an aquifer under a unit gradient. These values are similar when the efficiency of the wells is taken into account.

The permeabilities determined in wells where both specific capacity and slug testing were completed were fairly consistent (generally within an order of magnitude), and neither method consistently yielded a higher (or lower) permeability values. On this basis, it appears that estimates of permeability from specific capacity can be relied on to within about an order of magnitude, which is generally the same reliability given to permeabilities derived from slug testing. Because specific capacity can be determined quickly and cost effectively, it appears to be a viable method of estimating permeability under limited conditions. However, because the value of permeability from specific capacity is an estimate, the values were only used when more traditional methods failed to obtain results.

Most of the difficulties in completing the slug tests during the methods evaluation phase of the Project were because drawdown was induced using hand-bailing methods and water levels were measured using electronic-water measuring devices. While these methods were adequate where permeabilities were low (generally less than 10^{-3} cm/sec), rapid recovery in more permeable materials precluded adequate measurement of recovery over time to calculate permeability. Hand bailing and measurements with electronic water level devices were adequate (even in the more permeable conditions) to permit the determination of total drawdown and a withdraw rate, thus the specific capacity could be computed. During the site conditions investigation (Phase II), the slug tests were completed using a pressure transducer to measure the water-level recoveries and water was displaced using a solid steel rod. The better methods employed for the site investigation permitted completion of slug testing in conditions where the methods used during Phase I of the investigation could not (highly-permeable conditions).

5.2.2 Horizontal Groundwater Flow

Horizontal groundwater flow (direction, gradient, velocity, and flow rate) were determined using two methods during Phase I of the project:

- Darcy Methods; and,
- Flow Net Methods.

Both methods are essentially the same with the exception that the direction of flow for the flow net method is presumed rather than determined by triangulation as is done for Darcy methods. Flow nets are commonly used to calculate seepage through earthen dams where flow can be expected to be perpendicular to the structure. The only zone of flow at the site where flow nets are believed to appropriate is horizontal flow through the grout curtain in the coal zone. In all other zones (coal zone outside the grout curtain and in the granular strata) the direction of flow should not be presumed and therefore flow net methods are not believed to be appropriate.

The grouted portion of the coal zone acts a groundwater control structure and obstructs flow within the coal zone aquifer much as a dam restricts flow in a stream. This is evidenced by the substantial drop in water levels across the grout curtain compared to the water levels on either side of the grout curtain. Triangulation of static water levels on multiple dates in Phase I of the Project confirmed flow generally perpendicular to the grout curtain. Both methods were used during Phase I to calculate flow through the grout curtain. The average daily flow through the 200 foot long test area during Phase I of the investigation was calculated to be 1,900 gallons per day using flow net methods and 2,000 gallons per day using Darcy methods. Because of the similar findings and consistent direction of flow perpendicular to the grout curtain, it was believed that either method was valid for calculating horizontal flow through the grout curtain during Phase II. Flow nets were used for calculation of flow through the grout curtain and Darcy methods were used for all other areas of flow.

Flow net methods permits the calculation of flow using pairs of wells rather than groups of three wells. This was desirable for at the Project Area for following two reasons:

1) comparison of groundwater quality data; and,
2) the calculation of the total quantity of flow through the grout curtain (which was performed by flow through segments, which were then totaled).

It was desired to compare groundwater quality data from the coal zone directly from up-gradient to down-gradient across the grout curtain (paired wells). This required installing wells in linear patterns rather than triangular patterns which would have been optimal for preparation of the potentiometric maps required for the calculation of flow using Darcy methods. Use of flow net to calculate quantities of flow permitted wells to be installed in this pattern.

Additionally, the total flow rate moving through the grout curtain was estimated by breaking the grout curtain into segments, computing the flow through each segment, and then adding the flow rates for each segment. Use of pairs of wells rather than groups of three wells for the determination of groundwater flow was more conducive for dividing the Project into segments for the completion of the analysis. Essentially more zones could be defined using the same number of wells than could have been defined with groups of 3 wells in each segment.

It is noted that potentiometric maps were prepared for the investigation using the linear patterns of wells at the site. These maps were used as a visual representation of the potentiometric surface of water in the coal zone rather than for the calculation of groundwater flow. The maps are believed to be generally reliable, but not as reliable as they would have been if a triangular patterns been used for the selection of well locations.

Use of flow nets to determine groundwater flow is not generally recommended unless the direction of groundwater flow is known and is consistent such as is the case for flow in the coal zone through the grout curtain at the Project Area. Darcy methods were used to calculate flow in the granular zones at the site.

As discussed in Section 4.2.4.1 of this report, the gradient and direction of flow in the coal zone beyond the grout curtain (up-gradient and down-gradient) could not be reliably determined because of the extremely flat gradient in these areas. In addition to difficulties determining gradients, the permeabilities measured beyond the limits of the grout curtain varied in excess of 4 orders of magnitude (variation within the grout curtain was approximately 2 orders of magnitude). The larger variation outside the grout curtain is believed to be the result of the substantially different conditions of the coal zone where it is ungrouted, i.e., in-place coal, open passageways, rooms and collapsed roof material. The grouting program appears to have reduced the variability of the permeability inside the grout curtain by somewhat homogenizing the material by filling the passageways and voids within the collapsed and fractured material. Some portion of the flow is likely through ungrouted void spaces, but based on the measured water levels during well development, sampling, and slug testing (ability to induce drawdown), it is believed that flow through these relatively small void spaces is laminar and use of Darcy equations or flow net equations for calculation of flow is appropriate.

Because the gradient could not be reliably determined and due to the large variability of the permeability of the coal zone beyond the grout curtain, flow rates and velocities in these areas could also not be determined. In Phase I of the Project, Darcy methods were used to estimate flow in the coal zone beyond the grout curtain. The results were inconsistent with flow through the grout curtain which is believed to be significantly better defined. Groundwater flow calculations indicate that within the Project Area approximately 14,000 gallons per day flow horizontally through the grout curtain and approximately 500 gallon per day is recharged to the coal zone from the overlying sands. Because of the substantially different flow rates, it was presumed that the water budget should be nearly in balance for horizontal flow in the immediate vicinity of the grout curtain. The flow rate of groundwater moving horizontally into the grout should be nearly equal to the quantity of water flowing through the grout which should be nearly equal to the quantity of water flowing out of the grout (at least in the immediate vicinity of the grout curtain). Because the horizontal flow is believed to be well defined within the grout curtain, it is believed that applying that quantity of flow to the areas beyond the grout curtain (both immediately up-gradient and down-gradient) is appropriate for estimating the quantity of flow in these areas.

While not completed as part of this project, it may have been possible to overcome the difficulties in accurately determining the gradient (and therefore, direction, velocity, and flow rates) for groundwater movement in the coal zone beyond the limits of the grout curtain by installing wells in a triangular pattern with spacings in excess of 1000 feet (triangulated wells outside the grout curtain had spacings near 200 feet as part of this Project). Additionally, other less traditional methods for determining of flow rates (such as heat pulse flow meters and aqua vision) may have been successful at determining flow rates and directions beyond the grout curtain.

During Phase I of the investigation, flow was also estimated assuming flow through a single open passageway with dimensions of 15 feet by 6 feet. The estimates found that given the gradients evident outside the grout curtain (approximately 1 foot per mile) the quantities were 4 orders of magnitude higher and the velocities were 5 orders of magnitude higher for flow through a single open passageway than flow through the full test area width using Darcy's equations. Because these values do not correspond with the findings from inside the grout curtain where the flows are well defined, it is believed that open passageway calculations (pipe flow) are not valid for this site and flow in this manner is not believed to be occurring.

5.2.3 Grout Durability

One of the goals of the hydrogeologic portion of the investigation was to estimate durability of the grout curtain. Two methods were used in this attempt:

1) estimate grout dissolution based on constituent loadings changes; and,
2) estimate the solubility of the grout based on laboratory testing.

The laboratory solubility testing was completed by collecting a bulk sample (10 gallons) of water from the coal zone up-gradient of the site. The sample was then characterized for alkalinity, calcium, conductivity, iron, hardness, pH, total dissolved solids (TDS), and sulfates. The sample was then divided into 3 containers: a core sample of barrier grout placed in one of the containers; a core sample of production grout was placed in the second containers; and, the third container was used as a control (nothing was added). The containers were covered to minimize reaction with air and periodically (four times over a period of 408 days) samples were collected from each container and analyzed. The hypothesis was that any change in the water chemistry in excess (or less than) the change in the control sample was the result of the dissolution of the grout.

The testing was inconclusive; consistent predictable upward or downward trends were not evident in the data collected (see Pages 30 through 40 of Section 9.5). Typically, distinct changes were observed in the early analysis but over time little distinction was evident between the grout samples and the control sample. The testing may have been more successful if the grout samples had been powdered, less exposure to air been permitted, or if the ratio of grout to water been higher. The changes observed in the chemistry cannot be reliably attributed to the dissolution of the grout samples.

The other method used to estimate the dissolution of the grout curtain was to determine the change in groundwater constituent loads as water moved through the grout curtain. The loadings were determined by multiplying the concentration of a groundwater quality parameter by the flow rate. The result is the pounds per day of a constituent which is being carried within the groundwater. The primary purpose of determining loading was to attempt to determine if the dissolution of the grout curtain is taking place, and if so, at what rate. This was determined by comparing the loadings in the coal zone immediately up-gradient of the grout curtain to the loadings in the coal zone immediately down-gradient of the grout curtain.

Loadings were calculated during Phase I of the project using two methods: "zone flow" and "balanced flow". The constituent concentration for both methods was determined by samples collected from wells installed beyond the limits of grout placement both up-gradient and down-gradient. For the zone flow analysis, the flow rate was determined separately up-gradient and down-gradient beyond the limits of grout placement using Darcy methods. For balanced flow, the flow rate applied to the constituent concentrations both up-gradient and down-gradient was the flow rate within the grout curtain (flow into, through, and out of the grout curtain laterally presumed to be equal).

There was higher variability for the direction of change (positive vs. negative), for percent increase, and for pounds of increase for the zone flow calculation compared to the balanced flow calculation. It is believed that the variability was the result of inaccurate and inconsistent flows caused by non-precise gradient measurement outside the grout curtain (see discussions of coal zone groundwater flow beyond limits of grout curtain in Section 4.2.4.1). The balanced-flow calculation was much more consistent in terms of direction of change, percent change, and pounds of change; and, it was believed that the balanced-flow method yielded a better estimation of actual loading changes and it was this methods that was employed during the investigation of the entire site. On this basis, balanced flow was selected for use on the full site investigation (Phase II). The findings of the analysis are discussed in the "Effectiveness of Grouting" section of this report (Section 6.33).

In addition to variations in the method used to calculate loadings, there are several methods which could have been used to compare the calculated loadings from up-gradient to down-gradient. These include:

1) pooled loads up-gradient compared to pooled loads down-gradient;
2) pooled loads up-gradient compared to loads at individual well locations down-gradient; and,
3) loads at individual well locations up-gradient compared to loads at individual well locations down-gradient.

Because there was no practical means by which to verify which of these methods yielded results most true to what was actually occurring at the site, professional judgement was exercised in selecting a method for comparison. Because of the relatively-small size of the test area (200 linear feet) and the relatively-close spacings of the wells within that area it was decided that for Phase I, a comparison of pooled loads up-gradient to pooled loads down-gradient was the most appropriate comparison to be make. During the full-site investigation (Phase II), because the spacing between the wells was greater, it was believed that a comparison between individual well locations up-gradient to individual well locations down-gradient was the most appropriate comparison. The calculations of load changes for the full Project Area were made by dividing the grouted portion of the Project Area into segments, determining the loading changes for each segment, and summing the segment load changes.

It is believed that the majority of the loadings changes in the coal zone at the site are the result of water coming in contact with the grout, and in particular, the cement portion of the grout. TDS is believed to best represent the net dissolution rate at the site.

SECTION 6 - MINING AND GROUTING

6.1 MINE COLLAPSE

The subsidence at the ground surface occurred as a result of the collapse of the abandoned mine working beneath the site. The surface deformation was exacerbated by dewatering of the mine workings. The site conditions which facilitated the surface subsidence includes: poor mine roof material; thin bedrock overburden; and, overlying saturated soils. The generally disorganized nature of the mine workings beneath the Project Area (compared to both other mines and workings in the Murray Hill and King Mines beyond the Project Area) coupled with notations of "bad roof" on the workings map indicates that roof collapse was an ongoing problem in this section of the mine when the mine was active.

Dewatering of the abandoned working is believed to have accelerated the working collapse and facilitated surface subsidence in two ways:

1) buoyant support of the mine roof was lost or reduced; and,
2) the diving head from the sand zones to the coal zone was increased.

The average moist unit weight of the soil and bedrock overburden above the mine workings can be expected to be near 125 pounds per cubic foot. The saturated unit weight of the material can be expected to be near 145 pounds per cubic foot which, when in a buoyant state, yields a net unit weight near 83 pounds per cubic foot. The overburden thickness is typically near 64 feet and the static level of the water in the mine workings is approximately 47 feet above the top of the coal zone. When the mine is fully inundated the load on the roof of the mine is near 3.0 tons per square foot. Rapid lowering of the water level in the workings would have caused the soil and bedrock below the static level to lose buoyant support; in this saturated state the load on the roof of the mine would have increased to near 4.5 tons per square foot (assuming the water level was lowered to beneath the level of the roof of the mine). The rapid increase in the load from near 3.0 to 4.5 tons per square foot (50 percent increase) would be considered significant.

It is hypothesized that as the roof material collapsed to the floor of the mine, the workings (void) migrated upward to the soil bedrock contact. The lowest soil unit at the site is a generally a saturated granular deposit, the lower sand. While the head difference between the lower sand zone and coal zone prior to collapse and grouting is not known, it would have certainly had a downward gradient when the workings were dewatered. Theoretical calculations of vertical gradient and velocity (assuming current static levels for the sand zones and a "dewatered" mine) indicate a 200-fold increase in vertical velocities (compared to current velocities) when the mine is dewatered and ungrouted secondary fracturing is present. The draining of the lower sand into the mine workings would have caused material to flow ("pipe") from the lower sand into the mine workings. Horizontal flow through the workings could have removed the piped materials to other sections of the mine especially under the flow conditions which would have been present during active dewatering.

As material from the lower sand was lost into the workings, support for the lower silty clay was lost. Fracturing and slumping of the cohesive material could have then occurred. The fractures in the soil would have permitted secondary vertical "piping" of materials from both the upper sand and lower silty clay into the lower sand which was subsequently lost to the mine workings. The secondary "piping" was most likely induced by the head difference between the upper sand and the lower sand which also would have likely been partially dewatered due to drainage into the mine workings. Loss of material from the upper sand could have caused fracturing (shear failure) and slumping of the upper silty clay and roadway fill directly beneath the pavement. The shear failure resulted in a sinkhole and the slumping resulted in depression in the highway.

The process described above could have occurred without dewatering of the mine. However, the induced head difference between the coal zone and lower sand zone and loss of buoyant support from the flooded workings most surely accelerated the process.

6.2 IMPACTS OF DRILLING AND GROUTING

6.2.1 Bedrock Zone

The most detrimental affect of drilling and grouting on the bedrock stratigraphy at the site is believed to be the vertical holes through the bedrock overburden stratigraphy. The grouting program consisted of the drilling of 1,471 borings to the coal/mine zone. Investigative borings drilled prior to this research project included the drilling of 51 borings which penetrated into the bedrock. This research project included the drilling an additional of 53 borings which penetrated bedrock. Each of these borings represent a potential pathway through which water and soil could move from the soil zone to lower elevations.

All of the borings drilled for this research project were either grouted or instrumentation was installed and grouted into the borings. It is not known how the investigative borings drilled for prior investigations were backfilled. During the grouting program, all of the borings were presumably grouted.

Un-grouted boreholes were not detected during this investigation, which indicates that either no un-grouted boreholes exist, or that the investigative methods used were unsuccessful in identifying them If ungrouted boreholes are present under the roadway, the potential vertical flow from the saturated granular soils into the bedrock stratigraphy still exists. The vertical velocities at the location of ungrouted boreholes could be high enough to cause "piping" and the transport of soil material. It is noted, however, that the grouting of the mine beneath the site has reduced the capacity of the mine to accept large quantities of "piped" material.

The drilling and grouting program is believed to have improved the overall integrity of the bedrock overburden material by the injection of grout into fractures and other small void spaces which would have been present as a result of the collapse of roof material. Grouted fractures were encountered in a number of the borings drilled for this investigation. It is believed that the fractures were the pathways through which soils were piped into the mine workings, and that the grout sealed many of these pathways. Grouting of the fractures is believed to have essentially lowered the coefficient of vertical permeability of the bedrock stratigraphy. This reduced permeability serves to reduce the rate at which water can move from the soils to the mined interval. These reductions minimize the potential for "piping" of materials which is believed to have caused the original subsidence features at the site.

6.2.2 Soil Zone

The drilling and grouting program at the site was completed using air-rotary drilling methods through the soil zone. The actual air-pressures used during drilling are unknown, however, it was reported that on a number of occasions while the borings were penetrating both the soil stratigraphy and the mines, air-communication between borings was evident (water and other materials ejected from adjacent boreholes into the air). Because the communication occurred through the soil zone, it can be expected that a reduction in density occurred as a result of loss of material. The competency of the soils was also most likely reduced simply as a result of the disturbance of the stratigraphy as the air-was injected laterally. The soils most likely to be affected are the granular materials which can more easily transmit the air laterally due to the higher permeabilities (compared to the cohesive strata).

The original subsidence feature occurred in the eastbound lanes near Station 483+50. Because of this, a large number of exploratory borings were drilled in this area both before and after grouting. Because of the density of exploratory borings, it is possible to compare soil consistencies at similar locations (within less than 10 feet) from borings drilled prior to grouting to borings drilled after grouting. Such comparisons were possible at six locations and graphs of Standard Penetration Test results (N values) vs elevation from pre- to post-grouting are presented on Pages 47 to 52 of Section 9.2 of this report.

The general shape of the curves from pre- to post-grouting match fairly well at each location. The highest N values are found in the fill material and in the lower sands above the bedrock surface. The lowest N values occur in the upper silty clay and upper sand. At three of the six locations there is no consistent difference between the pre- and post-grout conditions. At the other three locations (483+60, 25' right; 484+00, 60' right; and 485+25, 65' right), the post grout N values are consistently lower. The N value reduction at these locations is typically about 5 blows per foot and, at 483+60 25' right and 484+00, 60' right, the reduction caused the near-surface soils to be considered "very-loose or very-soft to soft" (N value less than 5 blows per foot) in this area.

6.2.3 Groundwater Flow

Coal Zone Horizontal flow in the mine workings has been affected by the placement of grout into the workings beneath the roadway. Because of the lower coefficient of permeability of the grout curtain (compared to mine workings), a head difference has developed between the workings southeast of and the workings northwest of the grout curtain. Because the grout curtain obstructs the groundwater flow, it is believed that the induced head difference represents a rise in the water level southeast of the Project Area as water backs-up attempting to flow through the grout curtain. The head difference and elevated water levels southeast of the Project Area are not believed to be detrimental to the effectiveness of the grouting program. In fact, the elevated water levels southeast of the Project Area can be expected to provide additional buoyant support and reduce vertical flow of groundwater (and potential "piping") from the lower sand to the coal zone than would occur were the grout not in-place. The head difference also indicates that the grout curtain is effective at restricting flow beneath the site implying that the grouting program was effective at filling the workings.

The horizontal coefficient of permeability of the grout curtain is approximately 1.5 orders of magnitude lower than the coal/mine workings which is consistent with the different gradients observed near the Project Area (near 50 feet per mile across the grout curtain and less than 1 foot per mile beyond of the grout curtain). With the lower coefficient of permeability of the grout, it is expected that groundwater flow would be through the shortest dimension of the grout curtain (perpendicular to the roadway) which is consistent with the observations at the site. Significant flow parallel to the curtain and around the curtain are not indicated by the water levels in the wells at the site. A slight low area was consistently present in the potentiometric surface on the up-gradient side of the grout curtain between Stations 478+00 and 480+00. The head drop across the grout curtain in this area was averaged 1.1 feet compared to 1.5 feet for the rest of the Project Area. This may be the result of the grout being more permeable in this area, or the workings are less effectively filled in this zone.

Sand Zones The grouting program is not believed to have significantly affected the groundwater flow patterns in the granular deposits at the site. Lateral spread of grout into the sand zone is expected to have been minimal, and no indications of grout were found in the samples collected from the sand zones. The grouted boreholes are believed to have left essentially vertical columns of grout through the granular deposits which would not be expected to significantly affect groundwater flow.

6.3 EFFECTIVENESS OF GROUTING

6.3.1 Filling of Voids

Evaluation of the effectiveness of grouting is important because the long term stability of the roadway is dependant upon not only the current subgrade conditions but also the potential that future subsidence events could affect the subgrade. If grouting was effective at filling the void spaces then it can be expected that current subgrade conditions will remain in the future. It is believed that the best way to assess the effectiveness of grouting would be to compare the quantity of grout placed to the volume of void space caused by mining. At the GUE 70 Site, however, this comparison cannot be accurately made for the following reasons:

- in the immediate vicinity of the project area, the legibility of the mine map is poor which makes accurate determination of lateral extent of workings and extraction rates difficult;
- it is not known if the available mine map is the "final" mine map;
- the quantity and location of material which may have been stowed in the workings is unknown; and,
- the volume of soil which was "piped" into the workings is unknown.

The factors listed above all affect the estimation of the volume of the void space prior to grouting.

As an alternative to comparing the quantity of grout placed to the volume of void, an estimation of the effectiveness of grouting can be made by assessing the conditions present at the mined interval in the borings drilled after the completion of grouting. This is done by dividing the total thickness of grout by the thickness of the grout plus the existing voids (mine height) encountered in the borings drilled after grouting. Using the data from borings where grout was encountered in the coal/mine zone, it is calculated that approximately 87% of the mine voids at the mined interval were filled with grout (see calculation on Page 40 of Appendix 9.3). It is noted that the actual percentage of mine voids that were grouted in the Project Area cannot be accurately calculated due to the compounding of inaccuracies in the various forms of information needed for such a determination.

In addition to filling the void spaces in the mined zone and overlying fractured bedrock, grout placed at the site would have tended to isolate the remaining unfilled voids. It is believed that the majority of unfilled voids remaining at the site occur as disconnected pockets rather than largely interconnected passageways and fractures. By isolating the voids, the potential for movement and loss of material both vertically and laterally is reduced.

6.3.2 Stabilization of Roadway

Based on the effectiveness of grouting as discussed in Section 6.3.1, it is believed that the grouting program was generally effective at stabilizing the roadway from subsidence in the areas where grout was placed. The stability of the roadway could also be affected by mine subsidence beyond the limits of grout placement. Impacts to the roadway from collapses in ungrouted areas can be caused by the spread of fracturing along the angle of draw laterally as well as vertically. Angle of draw is a function of the phi angle of the soil and bedrock material, and could conceivably vary from about 23 to 45 degrees (Whittaker, 1989). Based on Whittaker's descriptions of site conditions and corresponding expected angles of draw, an angle of draw near 30 degrees (measured from the vertical) can be expected at the Project Area.

Grout was placed from 72 feet left to 72 feet right of the centerline within the Project Area. Grout is believed to have spread laterally beyond these limits. Considering the quantity of grout placed in the barrier lines where the take was in excess of 1 cubic yard, the average take in each barrier boring was 43 cubic yards. Assuming a mine height of 5.8 feet and a 50% extraction ratio, the grout would have spread on average about 11 feet laterally from the injection borings (assuming spread as a cylinder). Because the grout would have spread as a cone rather than a cylinder, and because the grout needs to be in contact with the mine roof to prevent collapse, the area of roof support beyond the boreholes is likely less than 11 feet, perhaps about 6 to 8 feet. On this basis, the area of mine roof supported can be expected to extend from about 79 feet left to about 79 feet right of the centerline.

The average roadway surface elevation in the Project Area is near 826 feet msl and the roof of the mine is on average near 761 feet msl (typical depth of 65 feet). The edges of the travel lanes (pavement) are at 53 feet right and left; and the edges of the paved shoulders are at 64.5 feet right and left. Grout which supports the mine roof at 79 feet left and right would provide support to the pavement if the net angle of draw is near 22 degrees. For the paved shoulder to be supported, the net angle of draw would need to be near 13 degrees.

6.3.3 Long Term Effectiveness

Grout was cored at multiple locations across the site and was found to be in competent condition (fully set, strength and visual condition similar to concrete). Because of the competent condition of the grout and low velocities of flow (0.23 ft/dy) in the coal zone, it is believed that physical erosion (washing away) of the grout is not occurring. It is however, believed that dissolution of the grout occurs as water flows horizontally through the grout curtain. The dissolution of the grout was estimated by calculating the constituent load in the groundwater moving through the coal zone both up-gradient and down-gradient of the grout curtain. The load was determined by multiplying the measured constituent concentration on either side of the grout curtain by the calculated quantity of groundwater flowing through the grout curtain. The following average load increases were determined for the Project Area:

- Total Dissolved Solids — 32.5 pounds per day
- Calcium — -3.2 pounds per day (decrease)
- Sulfate — 11.9 pounds per day
- Iron — 0.008 pounds per day
- Hardness — -6.2 pounds per day (decrease)
- Alkalinity — 16.7 pounds per day

It is believed that the TDS load increase best represents the net dissolution of the grout curtain. Assuming a unit weight for the grout of 140 pounds per cubic foot, approximately 35,800 tons of grout were placed at the site. Assuming the grout curtain would be ineffective if 25 % of the material were lost to dissolution, the grout curtain has a useful life of approximately 1,500 years.

SECTION 7 - COMPARATIVE ANALYSIS

7.1 METHODS COMPARISON

Several general types of potential problem areas at the site were indicated by various investigative methods used and data reviewed for the completion of this investigation. For some of the potential problem types, multiple methods were capable of identifying the potential problem areas. Such potential problems and the methods used to identify them are summarized as follows:

Investigative Method	**Potential Problem Identified**
standard penetration testing (n)	low N values (weak shallow soils), potential slump or disturbed areas
hand-penetrometer measurements (h)	low unconfined compressive strengths (weak shallow soils), potential slump or disturbed areas
surface GPR (r)	anomalous shallow soils, potential slump or disturbed areas
auger drilling (d)	low areas in the bedrock surface, potential mine collapse areas
surface seismic (s)	fractured and displaced bedrock, potential mine collapse areas and piping pathways
bedrock coring (c)	un-grouted voids, potential subsidence areas

When evaluating the potential problem areas, consideration must also be given to mitigation efforts which, at this site, not only includes the placement of grout, but also the construction of land bridges under portions of the westbound lanes.

A table summarizing locations of potential problems and the method used to identify them is included on the following page. The advantage of such a table is that it easily permits a comparison of investigative methods and the types of potential problems they identify. The table also helps to isolate areas of the site which might warrant a closer examination of the available data, which was completed and is presented in Section 7.2. This table can also be misleading and should be used with care. Such a broad presentation implies large areas of potential problems, when in fact, most of the potential problem areas occur as relatively small isolated pockets. For example, in the eastbound lanes between station 477+00 and 479+00, four soil borings were drilled and 15 soil samples were obtained from depths less than 10 feet; only two of those samples would be considered "poor", but the table tends to imply that all of the shallow soils in that area are poor, which is not the case. The table can also be misleading in that conditions which seems to be confirmed by multiple methods may in fact not be confirmed. Specifically, weak/disturbed shallow soils as determined from ground penetrating radar and from field tests ("N" and "H" values). The primary goal of the radar work was to identify cavities directly beneath the pavement by non-intrusive inspection of the base and subgrade materials. The radar was successful at this in that good data resolution was obtained to a depths of approximately 4 feet. Weak/disturbed shallow soils as identified by the field tests were in all cases, except one, present at depths in excess of 5 feet (typically 7 to 10 feet). The one exception was an N value of 4 blows per foot at a depth of 2 feet at Station 483+41, 27 feet right of the centerline.

Comparison of Potential Problem Types, Methods for Identification, and Locations									
Station		Eastbound Lanes			Westbound Lanes				
from	to	weak/ distb soils	mine collapse	post-grout voids	weak/ distb soils	mine collapse	post-grout voids	Land Bridge
467+00	468+00							
468+00	469+00		s			s		yes
469+00	470+00	r,n,h	s,d	c		s		yes
470+00	471+00		s		h			
471+00	472+00	h	s		r			
472+00	473+00		s,d		r			
473+00	474+00	r	s,d					
474+00	475+00	r	s,d		h	s,d		yes
475+00	476+00	r	s,d	c		s		yes
476+00	477+00	r	d			s		yes
477+00	478+00	r,h	s,d			s		yes
478+00	479+00	r,h				s	c	yes
479+00	480+00	r	d		r			yes
480+00	481+00	r			r	s		yes
481+00	482+00					s		
482+00	483+00	r	s,d			s		
483+00	484+00	r,h,n	s,d	c	r,n,h	s	c	
484+00	485+00		d	c	r			
485+00	486+00	r,h	s			s		
486+00	487+00	r						
487+00	488+00							

Key: n - Standard Penetration Test
h - Hand Penetrometer Measurement
r - Surface GPR
d - Auger Drilling
s - Surface Seismic Methods
c - Bedrock Coring

Between the time the mine was abandoned and the site was remediated, the site was highly disturbed by the collapse of the abandoned mine workings. The collapse caused fracturing and slumping of the bedrock overburden, loss of material due to piping, and slumping and shearing failure of the cohesive soils. The grouting program was an attempt to stabilize the fractured materials and prevent future movement. In the efforts to stabilize the site further disturbance was caused by the drilling over 1,600 grout injection and exploratory borings. Disturbed soils and fractured bedrock were expected and were confirmed by the seismic work, by drilling and sampling, and by radar investigations. Post-grout conditions that would cause the most concern regarding potential future surface subsidence in pavement areas would be the combination of fractured bedrock (potential "piping" pathways) and ungrouted voids in areas where land bridges were not constructed. Such overlapping conditions were encountered at the following locations by the field investigative work completed for this investigation:

Eastbound		**Westbound**	
Bedrock Fractures	Ungrouted Voids	Bedrock Fractures	Ungrouted Voids
468+50 to 469+70	469+74, 0.9 feet	483+10 to 484+00	483+97, 0.3 feet
483+30 to 484+00	483+24, 1.6 feet 483+26, 2.5 feet 483+29, 0.8 feet 483+31, 2.0 feet 483+40, 3.7 feet 483+50, 0.6 feet 483+80, 2.8 feet		

These areas represent portions of the project with a higher potential for future surface deformation related to loss of material due to "piping" or roof collapse compared to other areas of the project.

7.2 CONDITIONS COMPARISON

Detailed evaluation and analysis of site conditions is possible where site condition information has been collected by several investigative methods. The discussions below are examples of how such data can be integrated and interpreted to yield a good understanding of the site conditions. The paragraphs below generally address areas where the following data were available:

- Cross-Hole Ground Penetrating Radar;
- Surface Seismic Reflection;
- Surface Ground Penetrating Radar;
- Boring Logs; and,
- Mine Maps.

<u>Eastbound Travel Lane Station 468+75 to 470+00</u>

There are strong indications of a near-surface slump feature on the berm of the eastbound lanes. This is a clear and broad feature. It appears to have been filled in, having the appearance of layering. It is the clearest GPR anomaly in the Project Area. Considering boring log and EM-wave velocity information, it is apparent that the subsidence feature imaged using seismic reflection (Section 9.4, p 85), resulted from a collapse of the bedrock horizon into the mine room located immediately south of the coal pillar encountered by the boreholes. As was discussed previously, an area of disruption responsible for a 2D seismic section anomaly does not necessarily need to be located directly beneath the seismic line due to the Fresnel zone concept. Radar COP data and velocity tomograms (Section 9.4, p 72) indicate a termination of the coal pillar west edge at approximately Station 469+47, and a decrease in EM-wave velocities (relative to velocities to the immediate east) at the bedrock level between Stations 469+40 and 469+47. A heavily-fractured shale unit that was mapped west of Station 469+47 suggests that mine-related subsidence processes have been active at the mine level in this area. The seismic section in the vicinity of the EM-wave velocity tomogram mosaic (Section 9.4, p 85) indicates that the bedrock horizon has subsided into the mine workings along fractures with movement similar to normal faults, within close proximity to the line between Stations 469+38 and 469+57. It is also apparent that a section of bedrock has subsided to a certain degree, into a mine room to the immediately east of these fractures. The configuration of the mine workings in this area includes room and pillar workings from Station 468+70 to 469+25, a haulage-way from Station 469+25 to 469+75, and unmined coal east of Station 469+75. Most of the disturbed areas identified by the geophysical work were in or near the haulage-way, however, bedrock disruptions were also evident in the bedrock above the room and pillar workings. If the area had not been previously grouted, it might warrant additional investigation.

Eastbound Lanes Station 473+00 to 475+25

The surface GPR data indicate a region of disturbance in the eastbound lanes in the vicinity of Stations 473+00 to 475+00. Seismic lines indicate fractures with displacement between: Stations 473+20 and 473+40; Stations 473+80 and 474+10; and, Stations 475+60 and 475+40. Mines are mapped throughout this area with a haulage-way present between Stations 474+70 and 475+25. Surface deformation reportedly occurred in this general area.

Eastbound Lanes, Station 475+00 to 477+00

Overall changes in the overburden profiles from the GPR along the south side of the eastbound traveling lane show slumping and offset in this area. Most of the area is mapped as room and pillar workings, however a haulage-way is mapped from Station 474+80 to 475+30, and unmined coal is mapped between Station 475+30 and 475+60. The seismic lines did not show fractures with displacement.

Eastbound Lanes, Station 480+50 to 482+50

There are slight indications of near-surface slump features on the berm of the travel lane as indicated on the GPR. Seismic surveys did not detect fractures with displacement in this area. Room and pillar workings are mapped between Station 480+50 and 481+50 and a haulage-way is mapped between Stations 481+50 and 482+25.

Eastbound Lanes Station 483+00 to 483+75

The bedrock horizon surface was interpreted from seismic reflection data to be intact between Stations 483+04 and 483+40 (Section 9.4, p 87), and this information agrees with a geologic cross section constructed from boring log data. An EM-wave velocity tomogram mosaic along this roadway segment also suggests that the bedrock surface is intact in this region, with relatively high EM-wave velocities observed for most of the bedrock depth range. Voids encountered beneath the bedrock surface (56 to 62 feet) during the drilling of Wells GC-212, GC-213, and GC-214 are apparent from the velocity tomograms, and are observed as velocity lows (attributed to increased water content). Average amplitude lows (suggesting increased attenuation and scattering loss) are also seen in the void locations from the COP-derived plots (Section 9.4, pp 78 to 80). As was concluded from the seismic data interpretation, it does not appear from the radar COP-data and EM-wave velocity tomograms that these voids have yet propagated up through the bedrock horizon. As discussed earlier in this report, the voids could actually be filled with weak "piped" material and/or mine gob.

The EM-wave velocity tomogram mosaic (Section 9.4, p 86) indicates a disrupted and down-dropped bedrock horizon between Wells GC-203 and GC-205 (Stations 483+23 to 483+40). Relatively-low EM-wave velocities at the surrounding bedrock level in this region suggest an increased secondary porosity (increased water content) due to fracturing and bedrock subsidence. The inter-layering of grout and shale beneath the bedrock surface (as indicated in Boring GC-205) has contributed to relatively-low velocities within the region at the bedrock and mine levels, and along with fracturing has resulted in COP data wavelet cycle distortion (due to direct arrival and diffraction interference) in the depth range of 52.5 to 59 feet (Section 9.4, p 76).

This area includes the original subsidence feature and disrupted conditions were expected.

Eastbound Travel Lane Stations 483+75 to 484+25

Mine-related subsidence disruption of the bedrock horizon and near-surface overburden materials is interpreted (between the boreholes and beneath the seismic line), based upon processed radar and seismic data. A bedrock discontinuity that resulted in vertical horizon offset was interpreted from seismic data at Station 483+91 (Section 9.4, p 87). Analysis of seismic Common Depth Point (CDP) gathers indicated that the mine-related bedrock surface disruption exists. The EM-wave velocity tomogram between Borings GC-217 and B-412E (Stations 483+80 to 483+95) supports the seismic and drill log data interpretations of a disturbed bedrock horizon. Bedrock EM-wave velocities are seen to be low relative to those measured in the eastbound travel lane from Station 483+04 to 483+40. This is an area of mapped room and pillar workings.

Eastbound Travel Lane Station 485+25 to 485+75

The seismic section in the vicinity of the EM-wave velocity tomogram mosaic (Section 9.4, p 88) indicates that the bedrock horizon surface is intact in this area. Both the EM-wave velocity tomograms and boring logs to the north of the seismic line support the seismic data interpretation, indicating relatively high EM-wave velocities for most of the bedrock volume in this area. However, grout and void space in the depth range of 62 to 72 feet correlate with relative lows in both average EM-wave velocity and amplitude (Section 9.4, pp 82 and 83). These trends are caused by an increase in water content due to fracturing and void space. The distribution of velocity lows associated with the grout and increased secondary porosity is mapped well between the borings by the velocity tomograms. A zone of low velocity is apparent from a tomogram within the bedrock volume over the depth range of 59 to 66 feet, between Stations 485+34 and 485+37 (Section 9.4, p 82). This suggests that a zone of fracturing associated with subsidence activity has propagated up into the bedrock, although it does not appear that the integrity of the entire horizon has been affected yet. Cross-hole GPR was completed in this area in Borings GC-301, B-423H, and GC-303. If the area had not been previously grouted, it might warrant additional investigation.

Eastbound Travel Lane Station 485+75 to 486+25

There are indications of GPR anomalies in the vicinity of Stations 485+ 30 to 486+20 on the eastbound lanes. There is some limited lateral extent from the north side of the travel lane to the middle of the berm. The seismic line completed along the southern edge of the eastbound travel lane indicate that the bedrock horizon has subsided into a mine room along normal faults between Stations 485+96 and 486+15. Boring information and EM-wave velocity distribution in the tomogram indicate that a continuous coal seam was encountered beneath bedrock during drilling to the north of the seismic line, between Stations 486+05 and 486+15. The area is mapped as room and pillar workings. If this area had not been previously grouted it might warrant additional investigation.

SECTION 8 - CONCLUSIONS AND RECOMMENDATIONS

8.1 SITE CONDITIONS

8.1.1 Conclusions

The opinion as to whether or not the roadway is in a stable condition includes the evaluation of two general issues:

1) Did remediation adequately reduce the risk of surface deformation as the result of past mine activities?
2) Is the post-grout condition of the near surface soils adequate to support the roadway?

Surface Deformation

The potential of future surface deformation at this site must include consideration of four potential sources of impacts to the roadway:

- loss of material due to "piping";
- collapse of voids remaining within the grouted area;
- impact to the roadway due to mine collapse beyond the grouted area; and,
- stability of the grout.

The loss of material due to "piping", which is believed to have been in large part responsible for the original subsidence features at the site, is believed to have been facilitated by fractured bedrock overburden and dewatering of the mine workings. These conditions coupled with void spaces into which piped material could have moved permitted a loss of material from beneath the cohesive soils and fills supporting the pavement. Because mine dewatering is no longer occurring, there is a very-low driving head between the saturated soils and the mine workings. Additionally, the fractured bedrock overburden has been grouted. The void spaces in the bedrock and coal zone stratigraphy are believed to have been significantly reduced. Because of these factors, it is believed that the potential for loss of material due to "piping" at this site is low.

The potential presence of ungrouted boreholes at the site does increase the potential of loss of material due to "piping". However, because of the lack of a driving head and large void spaces into which the materials can move, it is believed that even the potential for loss of material through ungrouted boreholes is low. It is important to note that this conclusion is based on the current groundwater conditions at the site; if significant changes in groundwater levels were to occur (rise in levels in the granular strata or drop in levels in the coal/mine zone), the potential for "piping" would increase somewhat.

It was calculated that 87 percent of the void spaces present at the mined interval were filled during the grouting program. While it is possible that relatively small sections of ungrouted workings remain, it is believed that large areas of ungrouted voids are not present beneath the roadway. The potential for mine subsidence within the grouted area has been significantly reduced by the placement of nearly 19,000 cubic yards of grout in the mine voids at the site.

The void spaces remaining are believed to generally be present as thin discontinuous pockets. Given the original configuration of the mine, reduced nature of the void space, and depth to the workings, it is unlikely that block failure (rapid translation of a void from the workings depth to the ground surface) will occur. Additionally, because of the grouting program and soil thickness, it is unlikely that large sag areas will develop due to gradual migration of voids from the workings level to the ground surface. It is possible that relatively small isolated pockets of surface deformation could occur as a result of roof collapse in mine rooms or passageways which were not adequately filled during grouting.

The net angle of draw of the soil and bedrock stratigraphy at the site can be expected to be near 30 degrees. If this angle is correct, the grouted area was not wide enough to prevent roof collapse adjacent to the grout curtain from impacting the roadway. For the pavement to be supported, grout would need to be present to about 91 feet left and right of the centerline. For the paved shoulder to be supported, grout would need to be present to about 102 feet left and right of the centerline. Grout is believed to be present on average to about 79 feet left and right of the centerline. On this basis the right (travel) lane in both directions could be affected if subsidence were to occur immediately adjacent to the grout curtain. If subsidence adjacent to the grout curtain were to occur, is it believed that the surface manifestation of such an occurrence would first appear directly above the subsidence and then spread outward along the angle of draw. At the site, this would mean that a feature would be expected to appear in or near the shoulder ditch lines prior to impacting the pavements.

Based on the strength and consistency of the grout samples obtained and based on the velocity of groundwater flow in the coal zone, it is not believed that significant physical erosion (washing-away) of the grout is occurring. Loading changes across the grout curtain indicate that dissolution of the grout is occurring, however, the rate of dissolution is believed to be extremely low (approximately 32.5 pounds per day). It is believed that the grout is stable.

Near Surface Soils

The near-surface soils at the site consist predominantly of cohesive fill material that typically ranges in thickness between 5 to 10 feet. The fill was placed during the construction of the highway nearly 40 years ago, and based on field and laboratory tests, appears to have been placed in a controlled, compacted manner. The naturally deposited soil underlying the fill contained areas that are soft, saturated, and weak and would be considered "poor" for providing roadway subgrade support. Based on the variation of fill thickness, it appears that some over-excavation of these natural soils may have occurred during the highway construction. The drilling methods used during the grouting program are believed to have further weakened the already-marginal naturally-deposited soils.

Voids between the pavement and subgrade were not present at any of the boring locations and the geophysical investigations did not identify any such voids in undrilled areas (where the investigations were completed). The consistency of fill is believed to be adequate to support the pavement highway live-loads. Based on the thickness of the fill, the load of the highway and traffic should not extend through the fill to the underlying weak naturally deposited soils. Due to the age and thickness of the fill materials, additional settlement of the fill and consolidation of the underlying natural soils can be expected to be negligible.

Note that in areas where the fills were disturbed by mine subsidence or mine remediation, additional surface settlement could occur. Additional areas which are susceptible are where the fills are thin which is most common on the western half of the project.

Summary

In summary, it is believed that the potential of surface subsidence at the Project Area as a result of past mining activities is relatively low, with the exception that the roadway could be impacted by mine collapse immediately adjacent to the grout curtain. The potential of surface deformation as a result of this type of subsidence is believed to be moderate without mine dewatering. If mine dewatering were to occur, the potential for surface deformation as a result of subsidence adjacent to the grout curtain would increase significantly. The existing condition of the near surface soils are believed to be generally adequate to support the roadway.

The conclusions are based on the current site conditions. Significant changes from the current conditions, such as mine dewatering, could affect those conditions. Dewatering of the mine workings would increase the potential for subsidence to impact the roadway.

8.1.2 Recommendations

At this time further investigation and remediation at the site is not recommended. It is however, recommended that the Ohio Department of Transportation District 5 maintain a post-remediation Construction Monitoring Program for the Project Area. The program should be based on Section 5 of the "ODOT Manual for Abandoned Mine Inventory and Risk Assessment", May, 1998, specifically, Figure 5.1. If the inspections indicate the formation of potential subsidence features, additional investigation should be completed and additional remediation may be required.

If the District's Construction Monitoring Program indicates a potential mining related subsidence, additional investigation and possibly site remediation may be warranted. Based on the current data, it is believed that the most likely required remedial work would be to extend the width of the grout curtain. If this is required, drilling and grouting two additional lines of boreholes located off both the eastbound and westbound shoulders (total of four lines of borings) may be needed.

8.2 METHODS RESEARCH

8.2.1 Conclusions

The geophysical methods tested at the Project Area were generally successful at detecting site conditions which may indicate mine collapse and migration of voids. On this basis it is believed that geophysical investigations are useful for characterization of sites which are underlain by abandoned mine or other cavities which could collapse and impact surface features.

Geophysical methods were tested extensively in Phase I over the Test Area, with the most promising methods used over the entire Project Area. The following methods were tested in Phase I of the investigation:

- surface seismic reflection;
- spectral analysis of seismic surface waves (SASW);
- surface ground penetrating radar (GPR);
- side-looking underground radar (SLUR);
- cross-hole GPR;
- cross-hole seismic methods; and,
- borehole geophysical logging.

Based on the quality of data collected and site conditions under which data would need to be collected for the full site investigation, it was concluded that for Phase II of the investigation surface GPR should be used to try to detect any features that might be located directly beneath the roadbed, seismic reflection to detect fracturing in the bedrock above the mine, and cross-hole measurements to provide detailed analysis. This combination of methods proved to be an effective means for evaluating variations from the near-surface down to the top of the coal.

Evaluations of the effectiveness of each geophysical method tested at the Project Area are summarized in the following paragraphs.

Surface Seismic Reflection

Surface seismic reflection geophysical methods were effective at the identification of fractures with vertical movement in the bedrock overlying the mine workings. Movement along these fractures indicates that collapse of the workings has occurred in these areas. General consideration for the completion of surface seismic reflection are described below.

<u>S-Wave Target Resolution Potential</u>

1) The coal seam in the Project Area subsurface cannot be imaged using acquired SH-wave reflection data due to: a high reflection coefficient at the overburden and bedrock interface; inadequate signal-to-noise ratio of field data; source-related noise; wavelet ringiness; interference; and, poor resolution.
2) Lateral changes in material properties beneath the overburden and bedrock interface cannot be inferred using field data interference observations and / or amplitude-based criteria. Interference effects from deeper reflections have no evident effect on the top-of-bedrock reflection event at the dominant frequency of acquired field data.
3) Vertical offset of the bedrock interface (along mine subsidence-related normal faults) must be at least a quarter of the dominant wavelength to be easily inferred using field data.
4) Reflections will appear to be continuous across a graben feature resulting from bedrock subsidence into a mine room when the feature's spatial extent is much smaller than the size of the Fresnel zone diameter.

P-Wave Target Resolution Potential

1) P-wave energy reflected from the top-of-saturated-overburden dominates ZZ component synthetic data at all source to receiver offsets.
2) A high reflection coefficient at the top-of-saturated-overburden, lower reflection coefficients at deeper interfaces, noise, interference, and poor resolution prevent the interpretation of reflection events from below the top-of-saturated overburden in ZZ component field records.

Data Processing

1) *f-k* filtering applied to the ZZ component and the YY component data is effective for suppressing coherent noise and enhancing reflection signal.
2) Improvement in stacked signal quality of the ZZ and the YY component data can be obtained by *f-k* filtering with minimal artifact generation.

P- and S-Wave Stacked Section Imaging

A comparison of sections from both (ZZ and YY) components indicates that there are specific advantages and disadvantages associated with P- and S-wave reflection data acquired in the study area, as follows:

1) The top-of-saturated-overburden served as a detectable impedance contrast for P-waves but not for S-waves.
2) P-wave data cannot be used to image impedance contrasts located below the saturated overburden, while images of the top-of-bedrock can be constructed using S-wave reflections.
3) S-wave data offer the potential for allowing possible areas of the subsurface where subsidence processes have been active, to be identified based on observations of disruptions in the bedrock horizon, whereas P-wave data do not provide this potential.

Spectral Analysis of Seismic Surface Waves (SASW)

The methods for collection of data at the site were successful. It is believed that SASW geophysical methods can be used for the collection of subsurface data in a highway setting. Based on the work completed at the site, the following two general conclusions are drawn related to the use of SASW near highways:

1) High-quality SASW test records were obtained despite the high levels of vibration noise created by heavy truck traffic.

2) The vibration shaker sources were adequate to sample the overburden soil and give a strong indication of the depth to the underlying bedrock layer. A stronger source (e.g., full vibroseis) would be required to delineate the rock properties (e.g., shear wave velocity), including any low-velocity zones such as mine workings.

Surface Ground Penetrating Radar (GPR)

Surface GPR methods were successful in the acquisition of data through the highway pavements. Data were analyzed down to a two-way time of 124 Ns, which is an estimated depth of between 10 to 20 feet. However, due to the high attenuation of the near surface soils, the maximum two-way arrival time of valid data was deemed to be 40 Ns, and the time range of optimum images was between 8 and 31 Ns (about 1 to 5 feet).

Side Looking Underground Radar (SLUR)

The primary conclusions from the SLUR results are as follows:

1) SLUR can be used to identify anomalies in the subsurface, however, the anomalies are not consistent from trench-to-trench; and,
2) SLUR is very difficult to implement along the roadside;
3) Conditions in the Project Area are not amenable to proper implementation and analysis of SLUR data for locating voids and associated conditions underneath the highway.

Cross-hole GPR

Cross-hole radar measurements were effective for providing insight into the nature and extent of fracturing and void space within near-surface media, and for reducing uncertainty regarding the locations and extent of mine rooms, coal pillars, and seismically imaged subsidence features with depth. Processed EM-wave velocity tomograms and amplitude information allowed subsurface media distribution to be mapped between the surveyed boreholes. Zones of relatively low-velocity within fully-saturated media were found to correlate with decreased amplitudes, indicating increases in secondary porosity caused by subsidence processes. These EM-wave velocity and amplitude trends correlated with the discontinuities that were seismically imaged between the boreholes, and with fracture zones and voids that were encountered during drilling. Such correlations rule out the possibility that the observed radar data anomalies resulted solely from location differences in mineralogy, primary porosity, and/or groundwater specific conductance.

Cross-hole Seismic Methods

The cross-hole seismic velocity measurements are valuable in aiding in the interpretation of surface seismic measurements and borehole tomographic measurements. The seismic tomographic measurements completed at the site demonstrated that these measurements could be made in very-shallow conditions. It is believed that the Project Study was the first time that shear wave cross-hole tomographic measurements were made for a highway engineering application. The orbital vibrator is a good source, but it will need to be improved before it can be used for routine operations. Overall, these tests proved the feasibility of cross-hole seismic tomographic tests. Since it is one of the few techniques that can "see" beneath the highway without drilling into the road surface, development of this technique should be continued.

Borehole Geophysical Logging

The conductivity and gamma ray logs provide a means of providing a continuous record of the physical properties in un-cored borings. There is a good correlation between the known tool-drops and the geophysical boring logs. However, the correlation is not always clear-cut. The geophysical boring logs respond to variations in the lithology and other physical features on a much more detailed level than the lithology logs obtained by discrete sampling or identification of drill cutting. The following features were clearly seen on the geophysical boring logs:

1) The shale (bedrock) boundary is clearly seen on nearly all of the boring logs where it was encountered. The shale had a higher gamma ray log response.
2) Subtle variations in the sands were seen on the resistivity logs.

3) Very-high resistivities were seen adjacent to voids. This was to be expected in a dry hole, however, it is important to note that a wet hole would give the opposite response. The measured resistivity of a fluid filled void would be approximately equal to the resistivity of water (usually in the range of 10-100 ohm-m).

4) The coals encountered had a very-low gamma ray response, and the boundaries were clearly marked by the gamma ray log. The resistivity logs did not appear to have an anomalous response in the coals. This was probably an indication that the coals are fairly-low grade and are quite porous. It is not uncommon for mid-western low-grade coals (sub-bituminous to bituminous) to have moderately-high resistivity values. It should be noted that high-grade coals usually have an anomalously high resistivity response (thousands of ohm-m).

5) The natural water table seemed to generally have a resistivity response, with the higher resistivity values being located in the unsaturated region. This is not surprising. In fact, the water table boundary showed a characteristic signature on all of the logs, which can be described by a gradual increase in the resistivity. The gradation is probably caused by the capillary fringe (partial saturation) above the water table.

Resistivity

Resistivity data are interpreted using a mathematical inversion procedure, and the results of a resistivity survey are inherently non-unique, but in some cases resistivity can provide a rapid non-intrusive means to detect large voids and fracture zones in the subsurface.

The high resistivity zones on the Sting survey and survey inversion roughly correspond to the inversion results provided by the Ohm-Mapper data. In general, the Ohm-Mapper resulted in a somewhat shallower depth of penetration than the Sting system. The two systems are complimentary with the Ohm-Mapper providing detailed shallow data and the Sting providing a greater depth of penetration.

Based on the comparison of the resistivity data and the seismic data, two conclusions can be drawn:

1) the anomalies in the resistivity cross sections do not directly correlate to anomalies on the seismic data; and,
2) the bedrock reflector in the seismic data does not correlate to the depth of the change in resistivity data. Apparently the resistivity is imaging primarily the soils, while the seismic data are showing the bedrock surface.

Although the correlation is not one-to-one, there is a strong correlation between the resistivity anomalies and GPR anomalies J and Q. The two techniques (resistivity and GPR) respond to different electrical properties, and a perfect correlation between the data sets would, therefore, not be expected.

8.2.2 Recommendations

It is recommended that geophysical investigations be incorporated into the investigation and characterization of abandoned underground mine workings. The sequence of applying the geophysics to site investigations is important, and the following recommendations are made concerning the order and timing of subsidence investigations:

1) Mine maps, existing borings and well logs, geologic and water resource maps, existing mine permits and maps, and any other pertinent available information should be reviewed during the earliest stages of an investigation.
2) A detailed site reconnaissance should be performed by personnel with experience in evaluating and remediating mine subsidence.
3) 3D surface GPR measurements should be conducted on the pavements and shoulders to detect voids or slumping that might be present in the immediate vicinity of the surface. GPR can be used to identify suspect areas that have little or no apparent disturbance at the surface. The absence of a GPR anomaly does not insure that a problem is not present, but GPR is the only geophysical tool that can give a rapid appraisal of the conditions directly under the roadbed.

4) A drilling program should be planned and implemented which investigates any anomalies detected by the GPR and includes the general characterization of the site. The drilling should include standard penetration testing, the collection of undisturbed samples, and obtaining bedrock samples via coring methods. Estimates of the vertical drops of the drilling tools should be recorded to estimate the extent of voids. It is noted that voids can occur within the soil, overburden bedrock, or at the mined zone.

5) For cases where mine dewatering is believed to have been a contributing factor to the subsidence, a hydrogeologic investigation should be performed. The investigation should include the installation of groundwater monitoring wells or piezometers, in-situ and/or laboratory permeability testing, and estimates of lateral and vertical groundwater movement. The lowering of the groundwater level in abandoned mines can significantly increase the effective loading on the mine roof, and result in subsidence. At a minimum, at least three monitoring wells should be installed in each significant water-bearing formation encountered, including the abandoned mine.

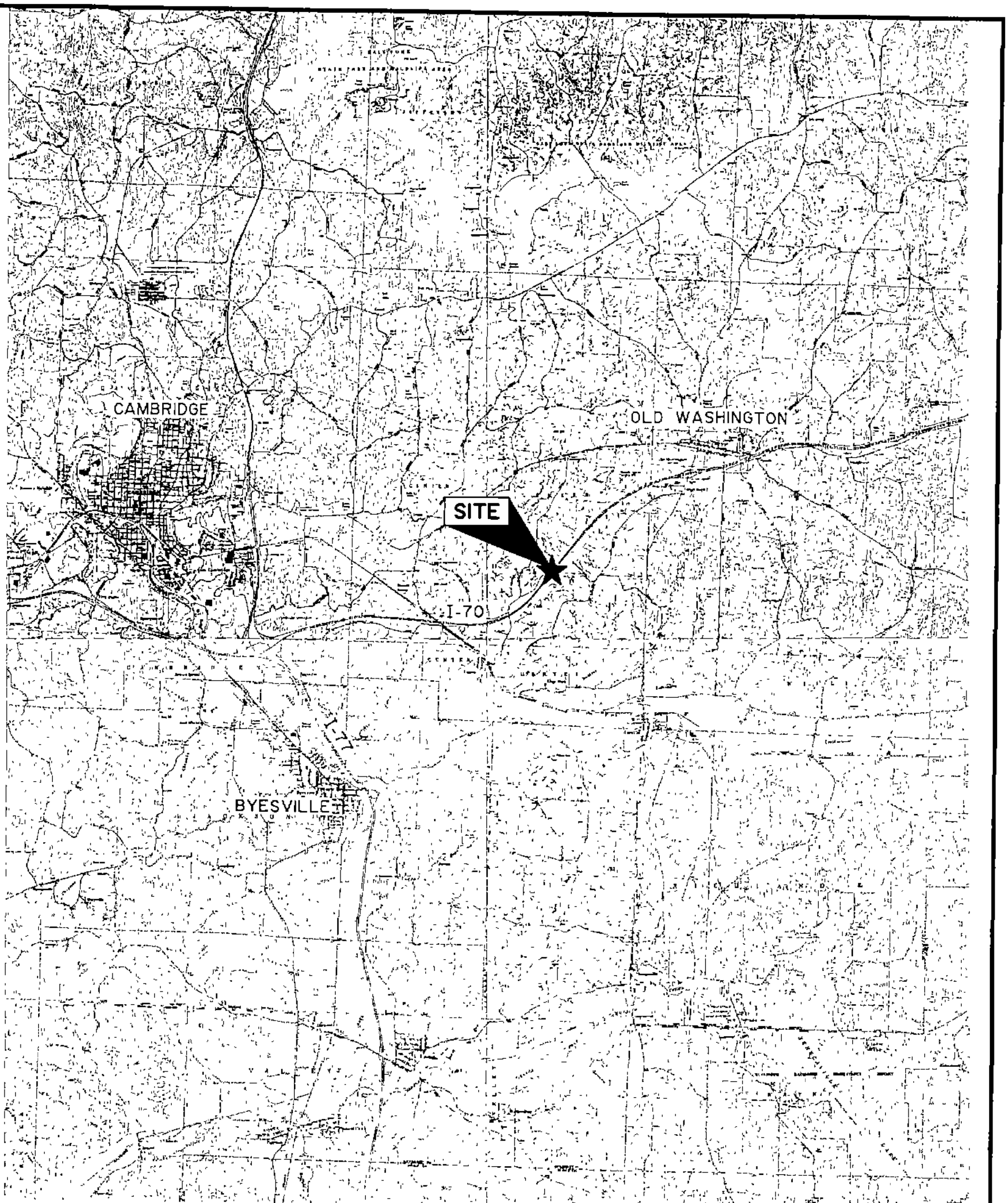
6) Resistivity may be useful in the early stages of an investigation to help define the boundaries of the larger slump regions and regions of fracturing in the near surface. Interpretation of data is an iterative process between the drilling program and the geophysical data. The drilling data will improve the interpretation of the geophysical data, and the improved interpretation should be applied to re-direct the drilling to a conclusive result. All geophysical methods are interpretive, and the interpretation improves as more subsurface information becomes available.

7) Where there is a high probability of the presence of collapse features at the soil - bedrock interface, a seismic reflection survey using shear waves is recommended. Furthermore, this study demonstrated that the best component combination is a crossline - crossline (SH-SH) configuration, where the source and detector orientation is orthogonal to the line direction.

8) Confirmatory drilling and sampling of the soil and bedrock should be conducted in the anomalous areas and near haulage-ways. Conventional borehole geophysical log measurements should be made in each borehole. These measurements serve as a continuous record of the lithology, can be used to verify the presence of voids, and can be correlated to determine the continuity of near-horizontal geologic features.

9) Seismic cross-hole and tomography measurements proved to be difficult to implement above the water table. However, this investigation showed the usefulness of cross-hole GPR measurements. These measurements proved to be a high-resolution compliment to surface seismic and surface GPR measurements. Cross-hole GPR was a successful tool to determine the vertical location and extent of fractured zones that may be present between boreholes.

SECTION 9.1 - MAPS AND CROSS SECTIONS

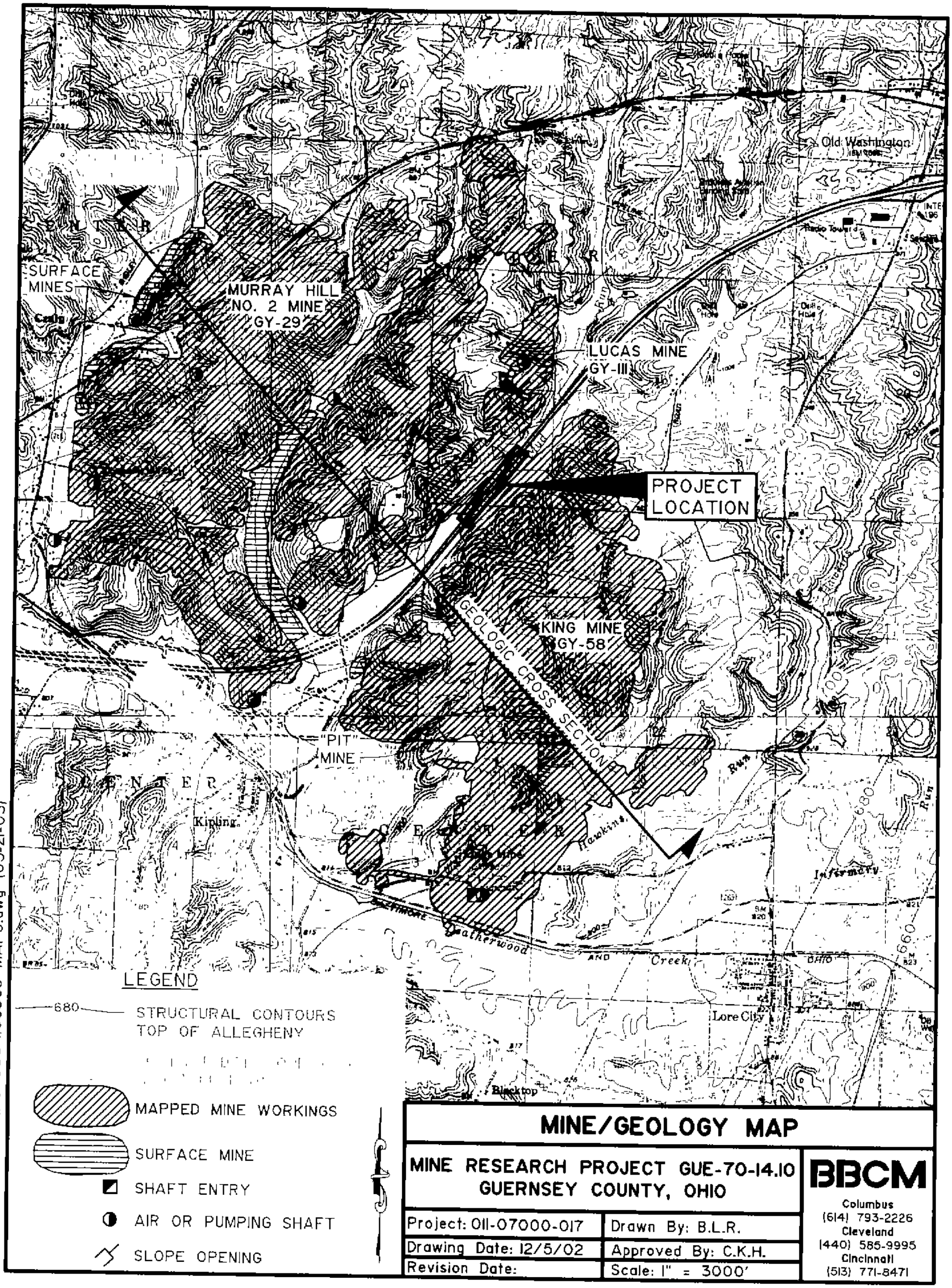


VICINITY MAP

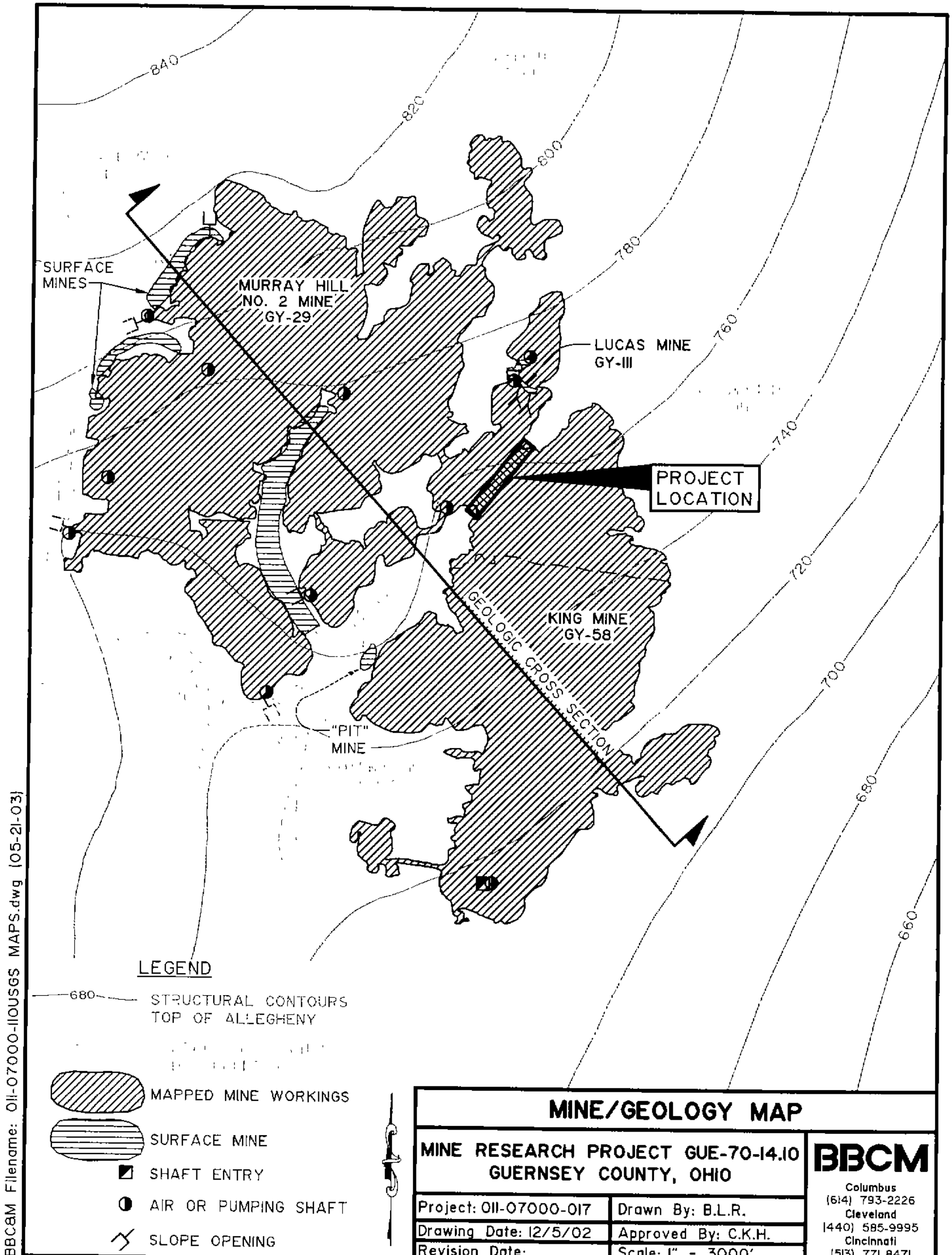
MINE RESEARCH PROJECT GUE-70-14.10
GUERNSEY COUNTY, OHIO

Project: 011-07000-017	Drawn By: B.L.R.	**BBCM** Columbus (614) 793-2226 Cleveland (440) 585-9995 Cincinnati (513) 771-8471
Drawing Date: 12/5/02	Approved By: C.K.H.	
Revision Date:	Scale: 1" = 2 MILES	

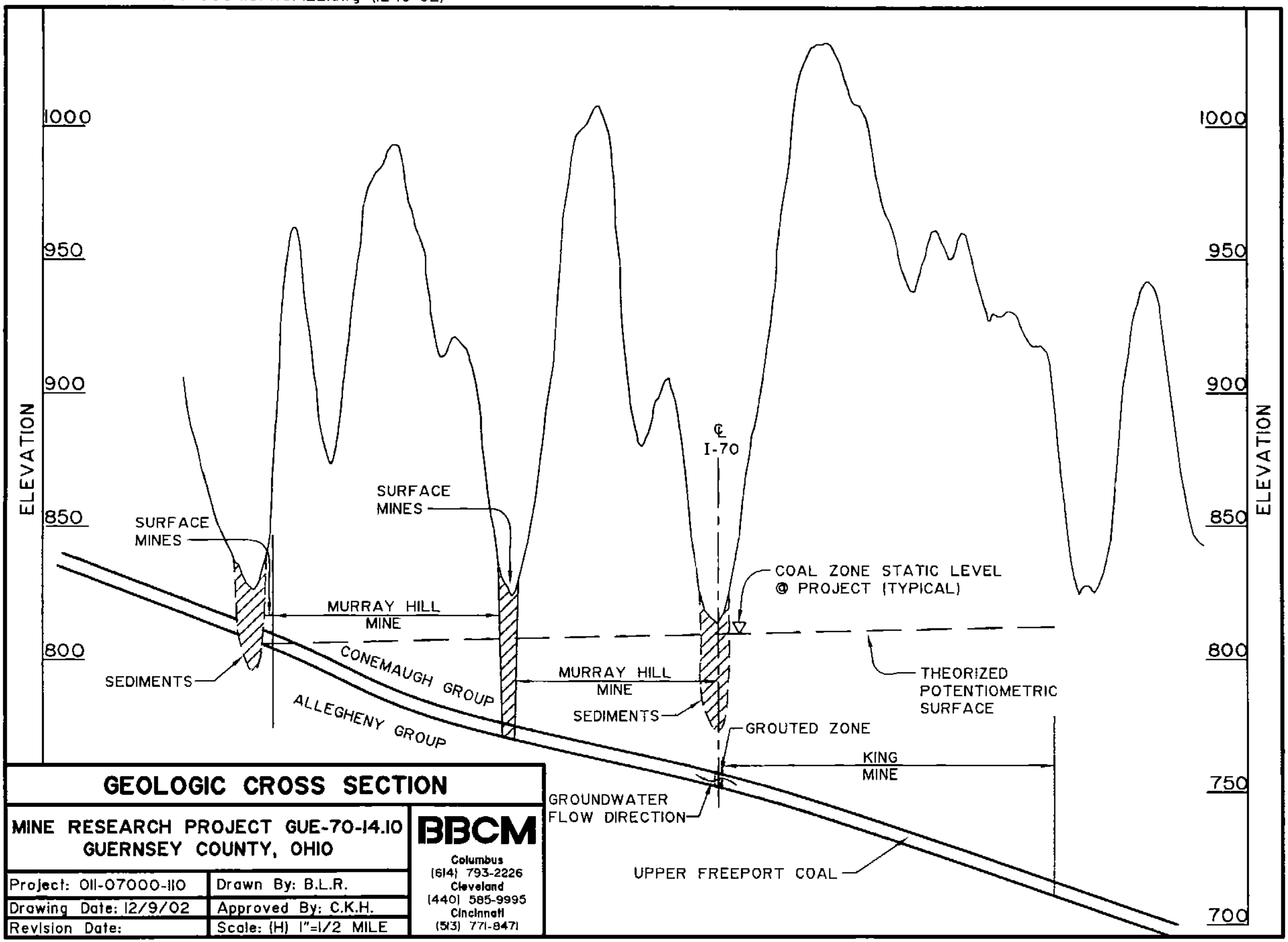
BBC&M Filename: 011-07000-110USGS MAPS.dwg (12-06-02)



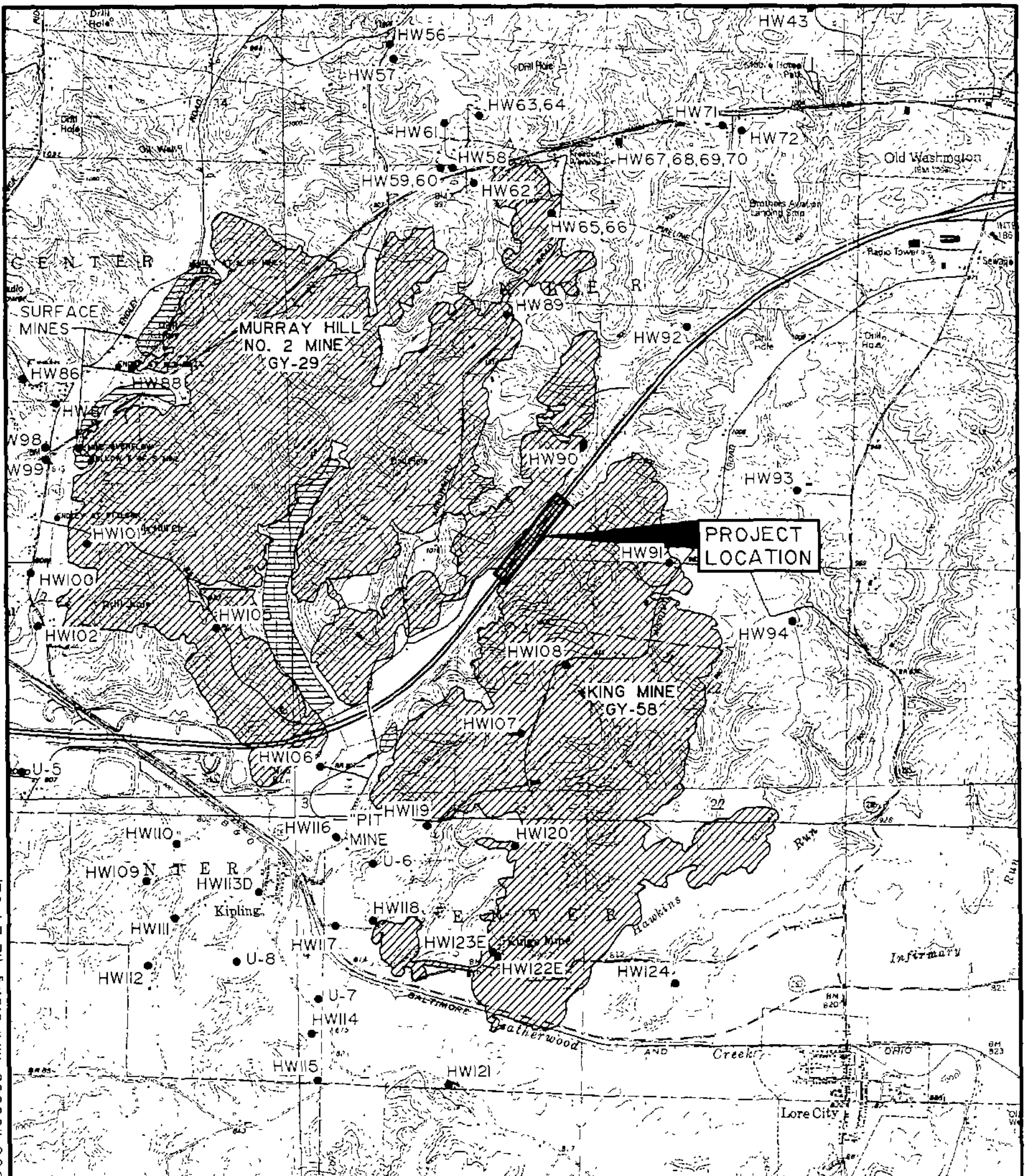
BBC&M Filename: 011-07000-11OUSGS MAPS.dwg (05-21-03)


840
820
800
780
760
740
720
700
680
660
SURFACE MINES
MURRAY HILL NO. 2 MINE GY-29
LUCAS MINE GY-111
PROJECT LOCATION
KING MINE GY-58
GEOLOGIC CROSS SECTION
"PIT" MINE
LEGEND
680 STRUCTURAL CONTOURS TOP OF ALLEGHENY
MAPPED MINE WORKINGS
SURFACE MINE
SHAFT ENTRY
AIR OR PUMPING SHAFT
SLOPE OPENING
MINE/GEOLOGY MAP
MINE RESEARCH PROJECT GUE-70-14.10
GUERNSEY COUNTY, OHIO
BBCM
Columbus (614) 793-2226
Cleveland (440) 585-9995
Cincinnati (513) 771-8471
Project: 011-07000-017
Drawn By: B.L.R.
Drawing Date: 12/5/02
Approved By: C.K.H.
Revision Date:
Scale: 1" = 3000'
BBC&M Filename: 011-07000-110USGS MAPS.dwg (05-21-03)

BBC&M Filename: 011-07000-110PROFILE.dwg (12-16-02)



PLATE



LEGEND

HW 101 • HOUSEHOLD WELL NUMBER AND LOCATION

HOUSEHOLD WELL LOCATIONS

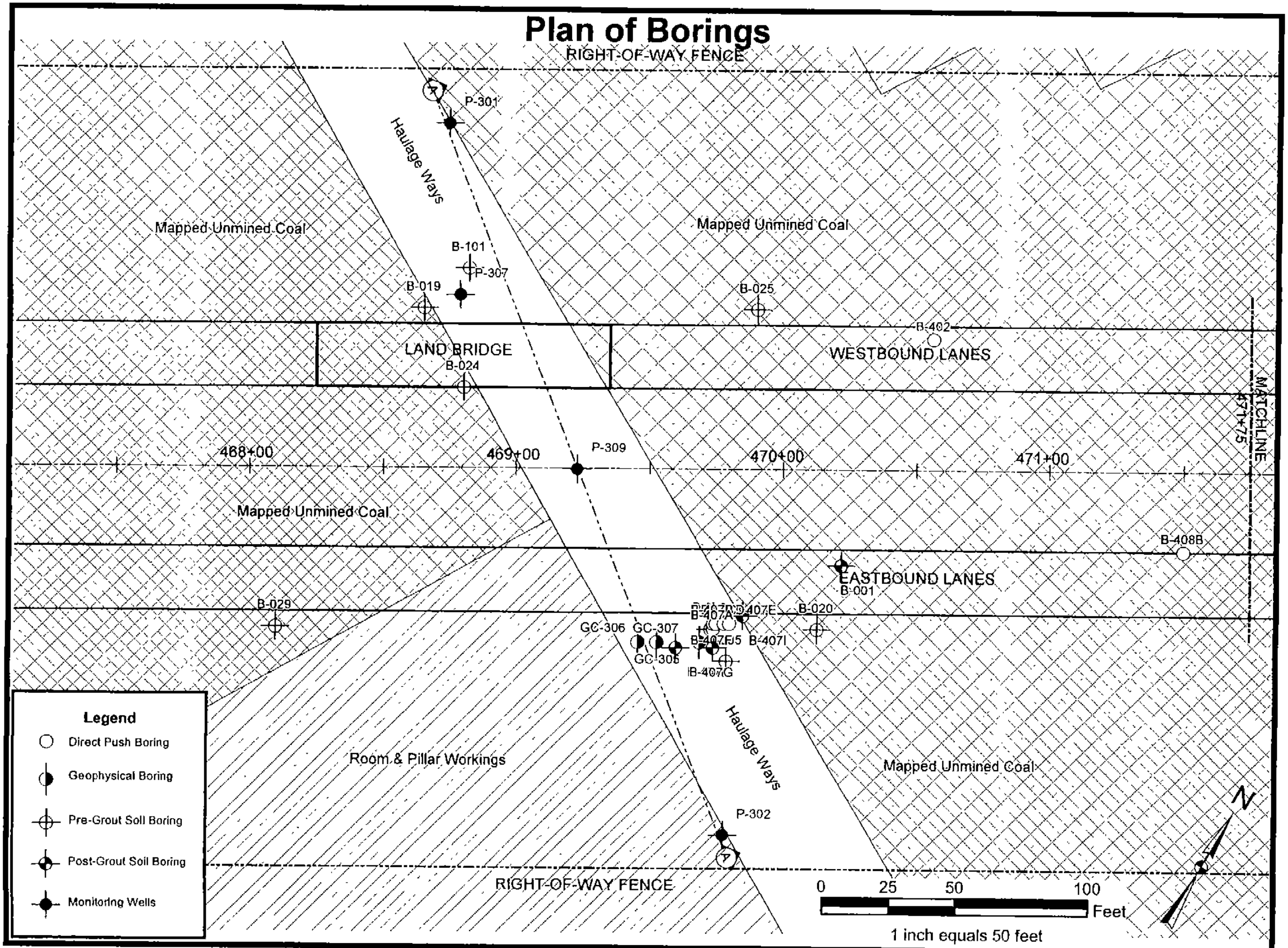
MINE RESEARCH PROJECT GUE-70-14.10
GUERNSEY COUNTY, OHIO

Project: 011-07000-017	Drawn By: B.L.R.
Drawing Date: 12/5/02	Approved By. C.K.H.
Revision Date: 12/24/02	Scale: 1" = 3000'

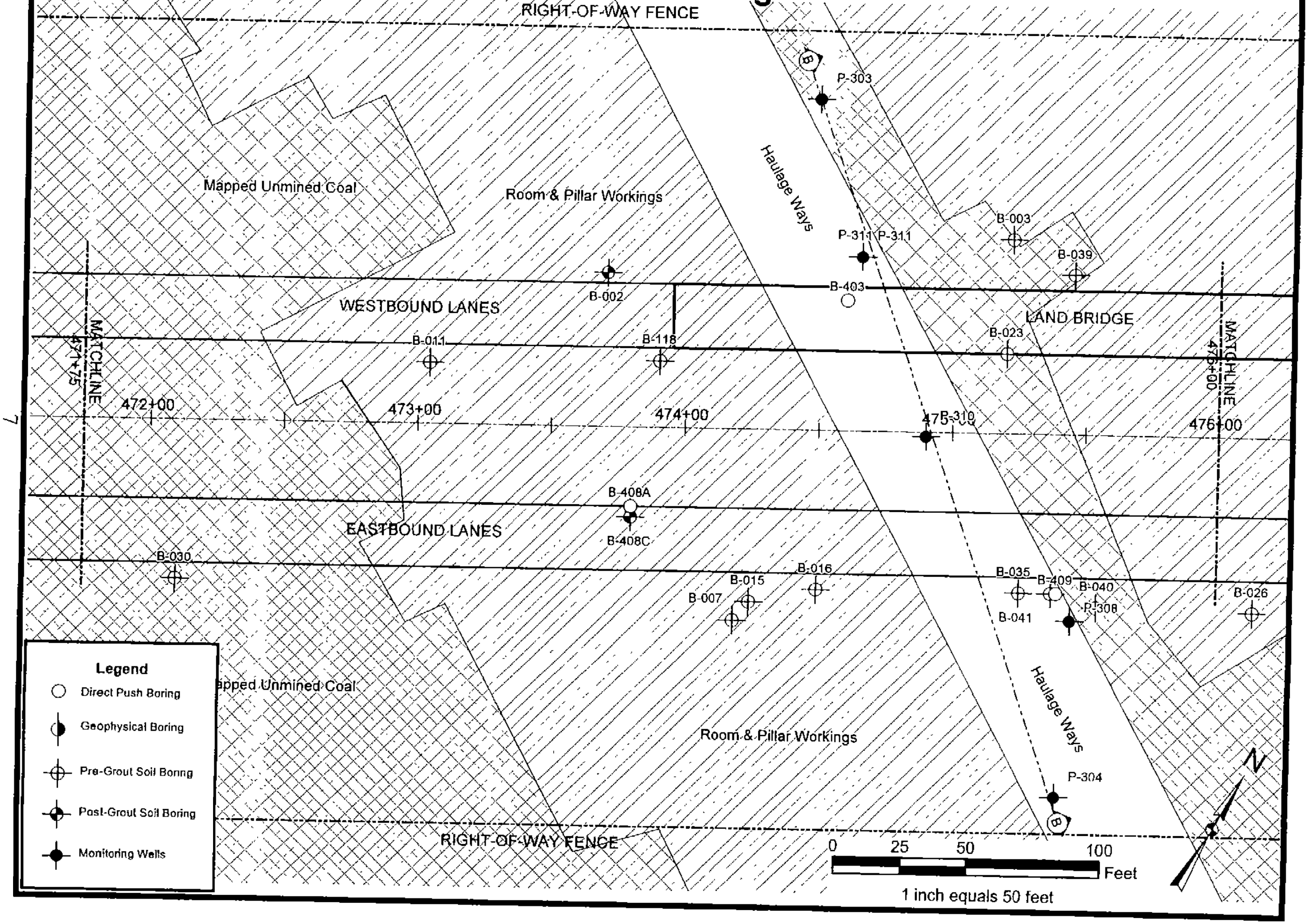
BBCM
Columbus
(614) 793-2226
Cleveland
(440) 585-9995
Cincinnati
(513) 771-8471

BBC&M Filename. 011-07000-110USGS MAPS.dwg (12-24-02)

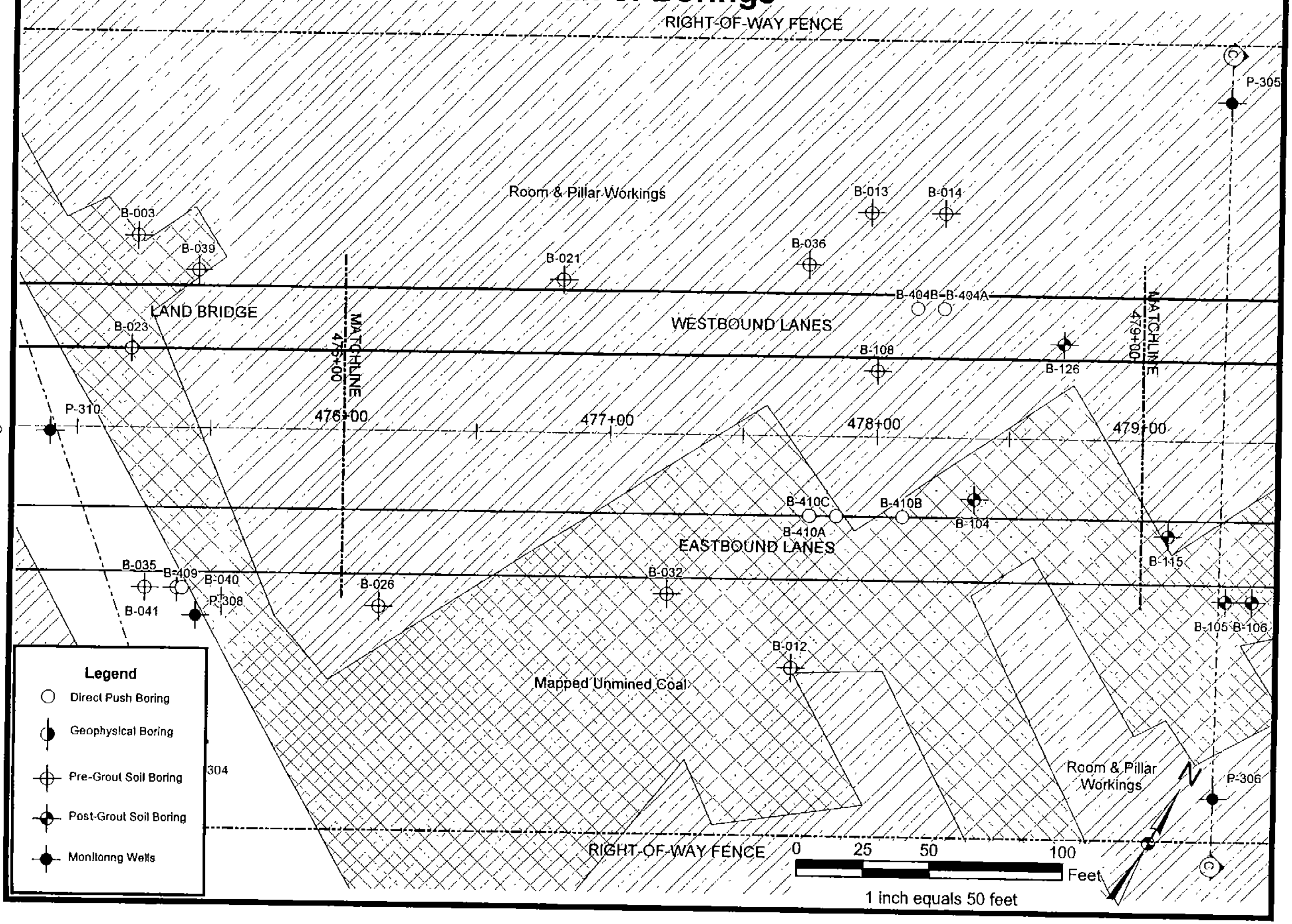
Plan of Borings



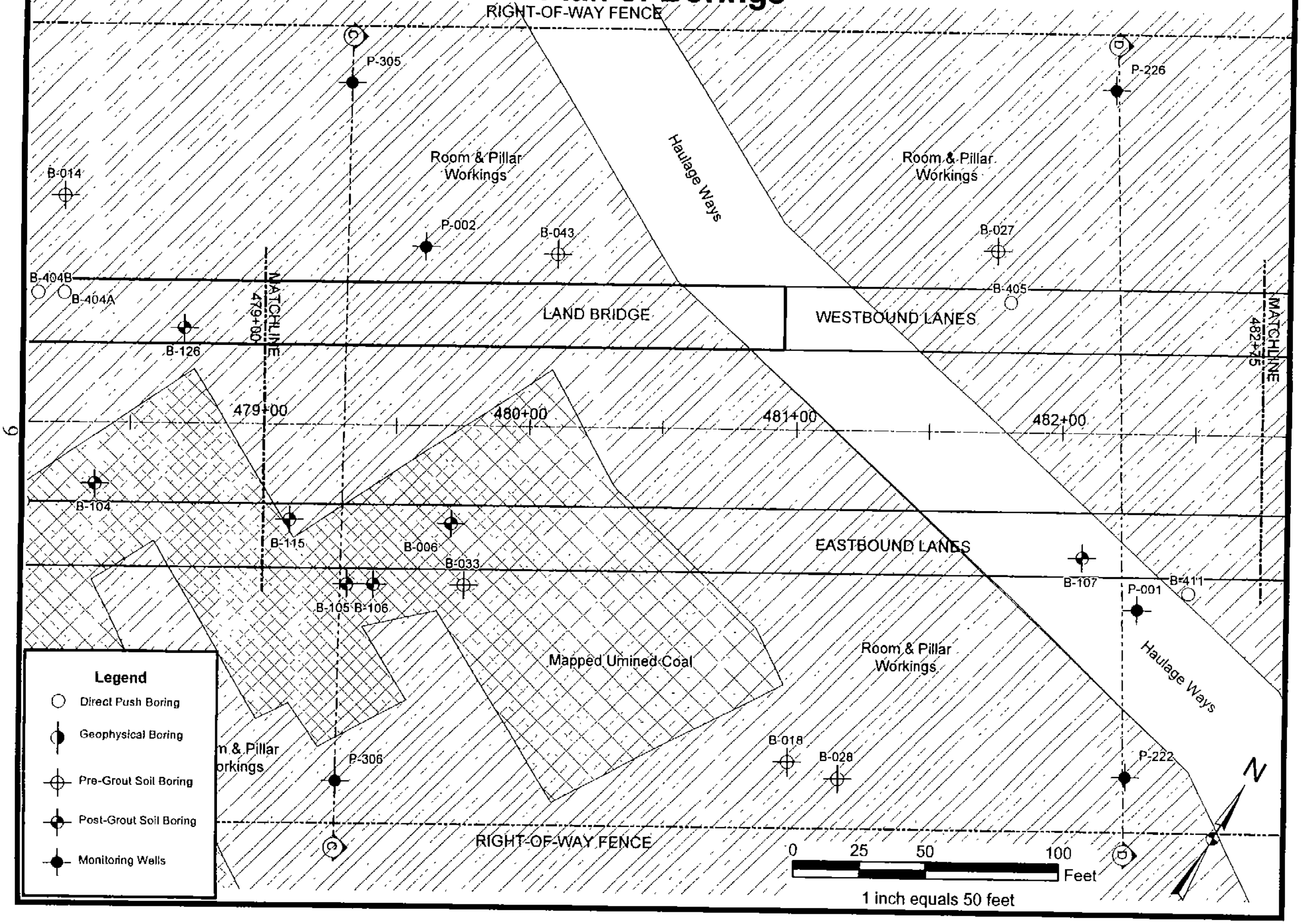
Plan of Borings

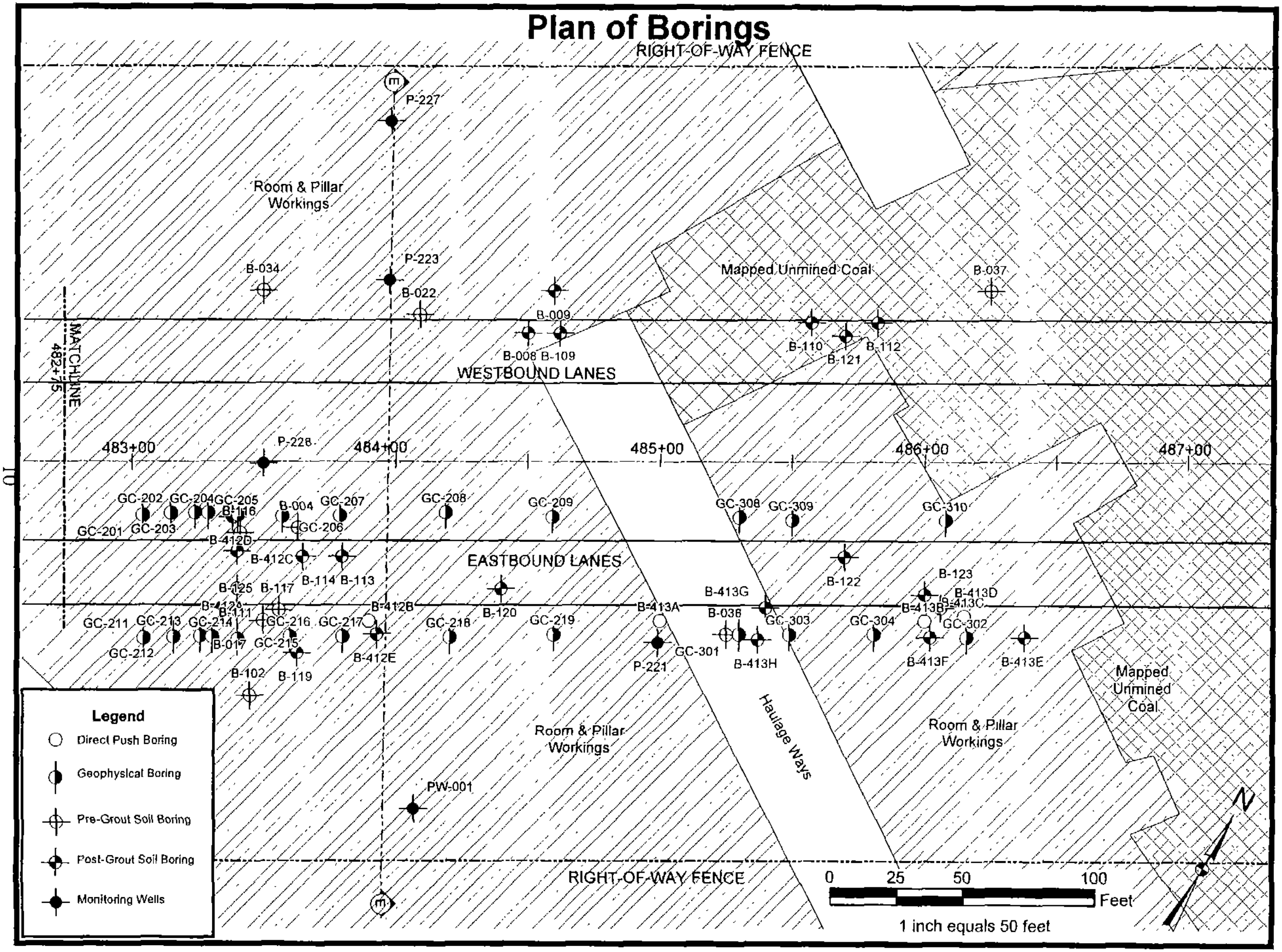


Plan of Borings

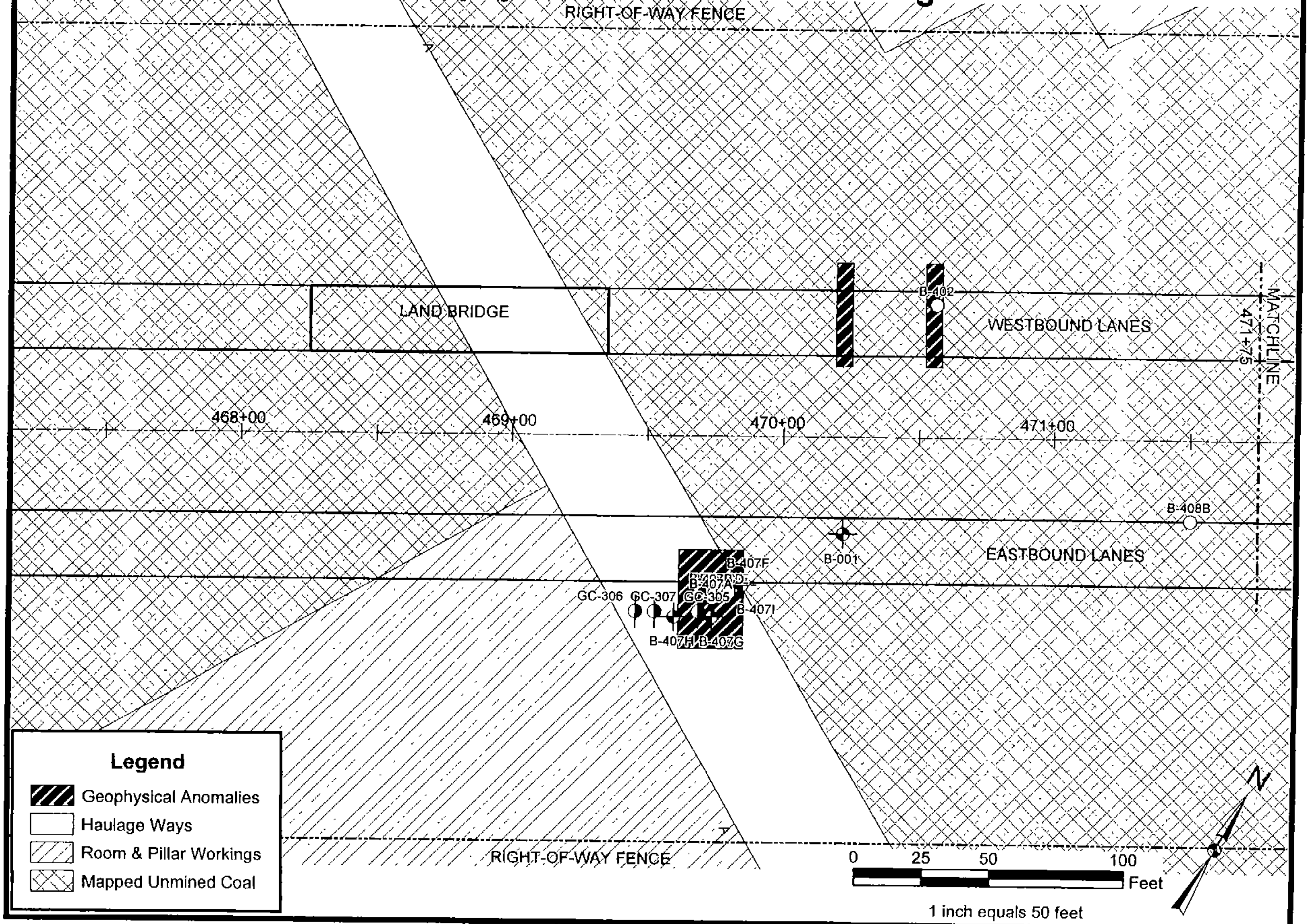


Plan of Borings

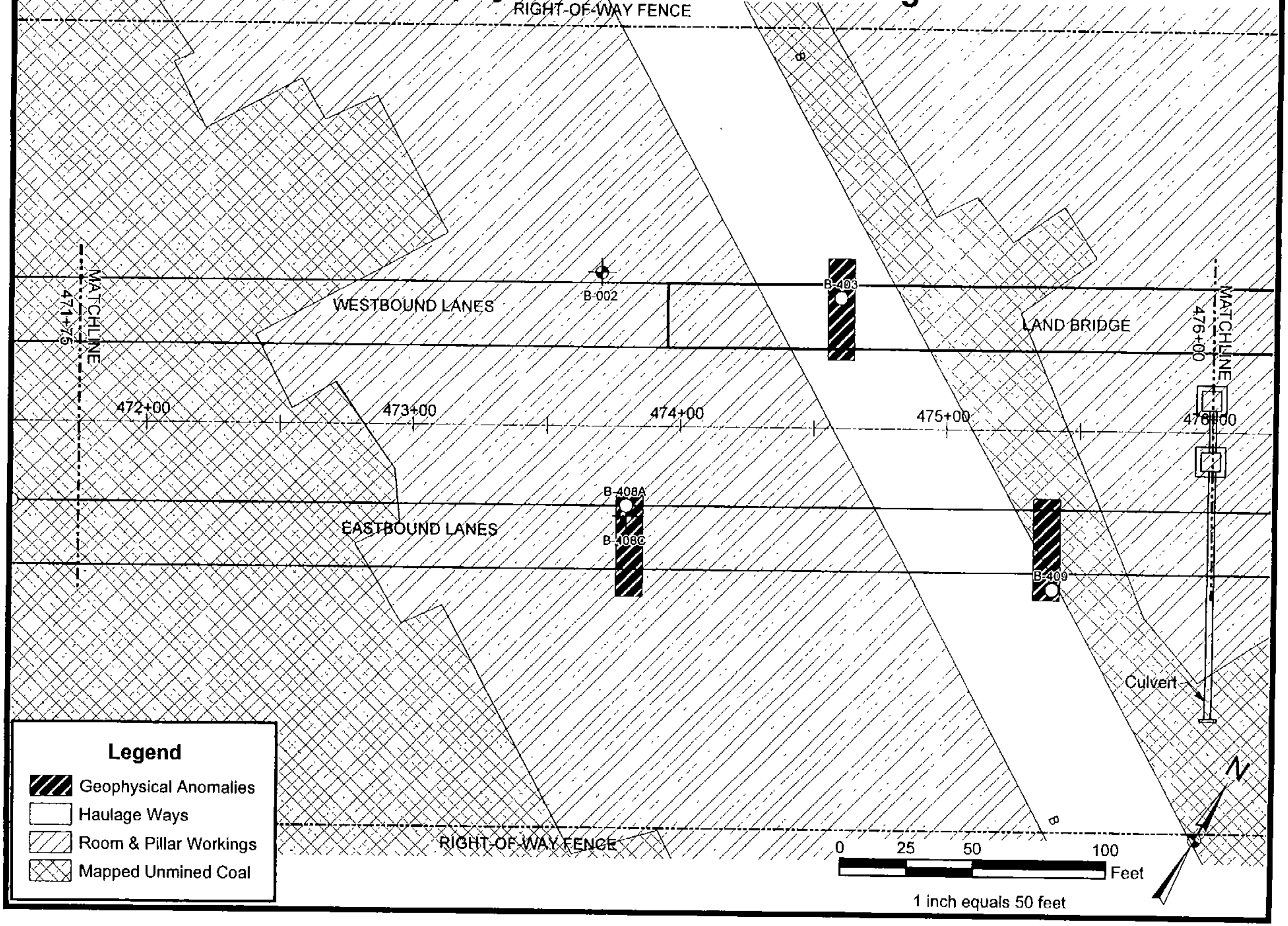


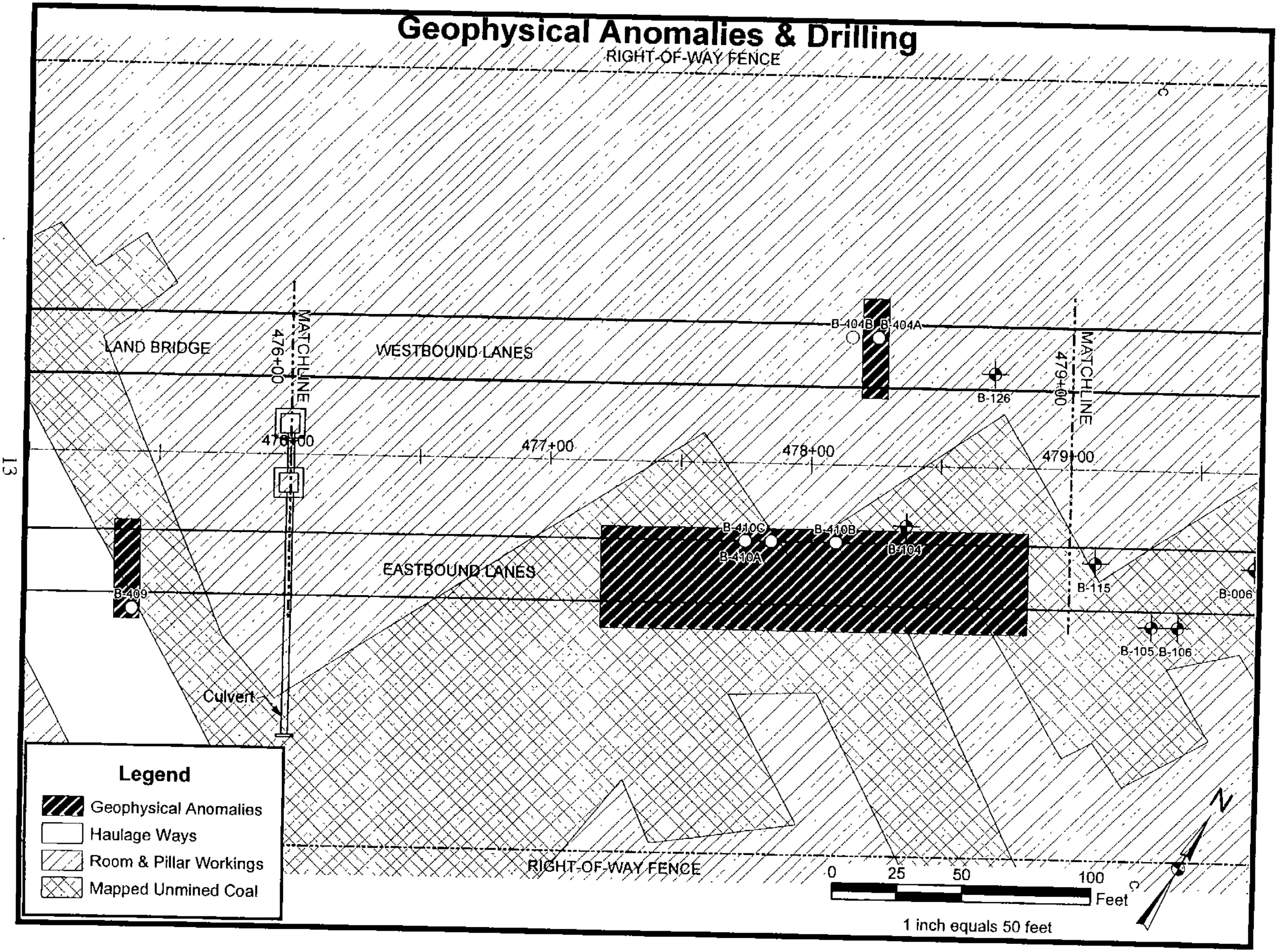

Plan of Borings
RIGHT-OF-WAY FENCE
Room & Pillar Workings
Mapped Unmined Coal
WESTBOUND LANES
EASTBOUND LANES
Haulage Ways
Mapped Unmined Coal
Room & Pillar Workings
Room & Pillar Workings
RIGHT-OF-WAY FENCE
MATCHLINE 482+75
483+00
484+00
485+00
486+00
487+00
P-227
P-223
P-228
PW-001
P-221
B-034
B-022
B-009
B-008 B-109
B-110
B-121
B-112
B-037
B-122
B-123
B-413D
B-413B
B-413C
B-413E
B-413F
B-413G
B-413H
B-413A
B-038
B-412B
B-412C
B-412D
B-412E
B-412A
B-113
B-114
B-116
B-117
B-119
B-120
B-125
B-111
B-102
B-017
B-004
GC-201 GC-202 GC-203 GC-204 GC-205 GC-206 GC-207 GC-208 GC-209
GC-211 GC-212 GC-213 GC-214 GC-215 GC-216 GC-217 GC-218 GC-219
GC-301 GC-302 GC-303 GC-304 GC-308 GC-309 GC-310
Legend
Direct Push Boring
Geophysical Boring
Pre-Grout Soil Boring
Post-Grout Soil Boring
Monitoring Wells
0 25 50 100
Feet
1 inch equals 50 feet
N

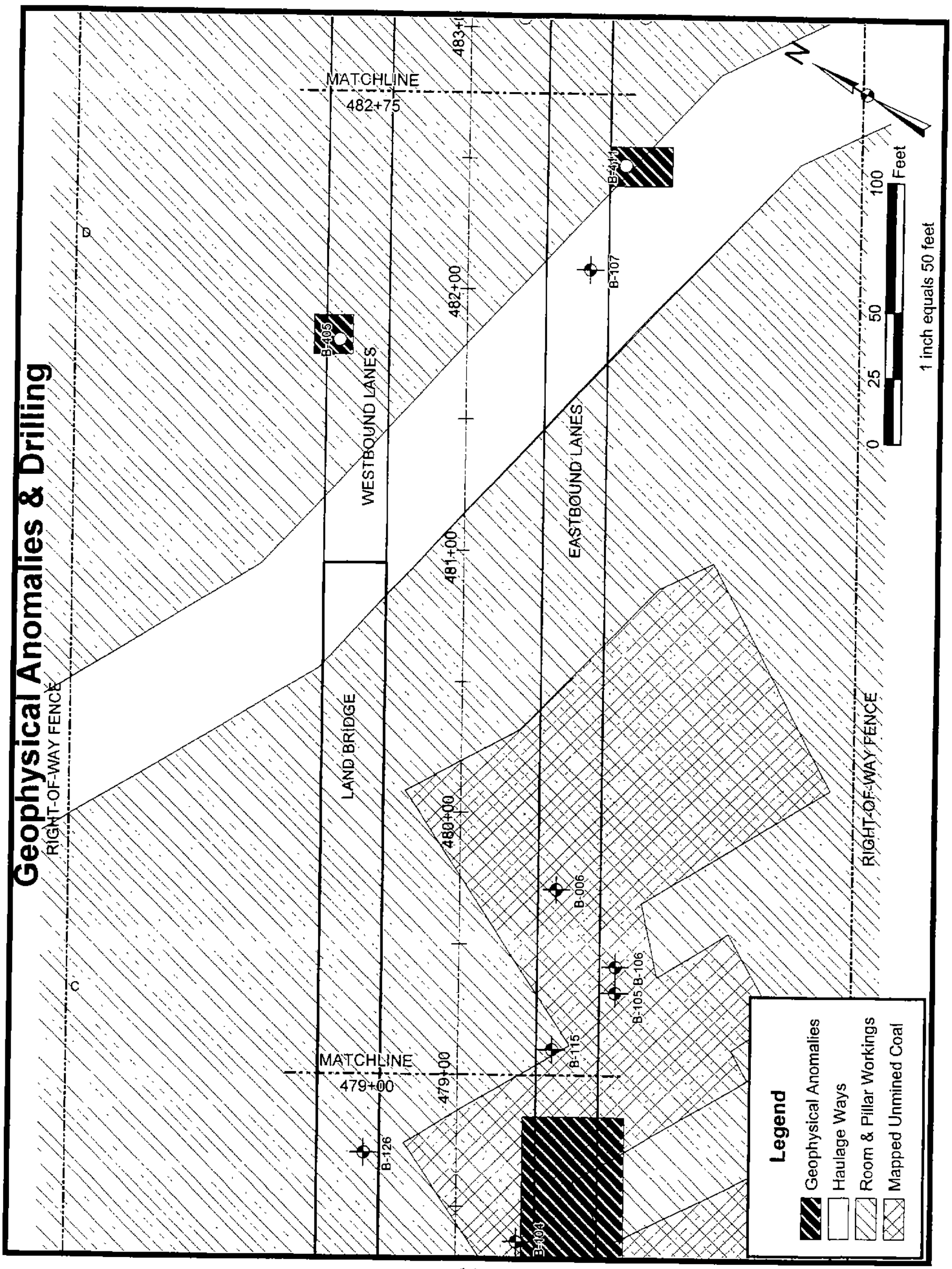
Geophysical Anomalies & Drilling



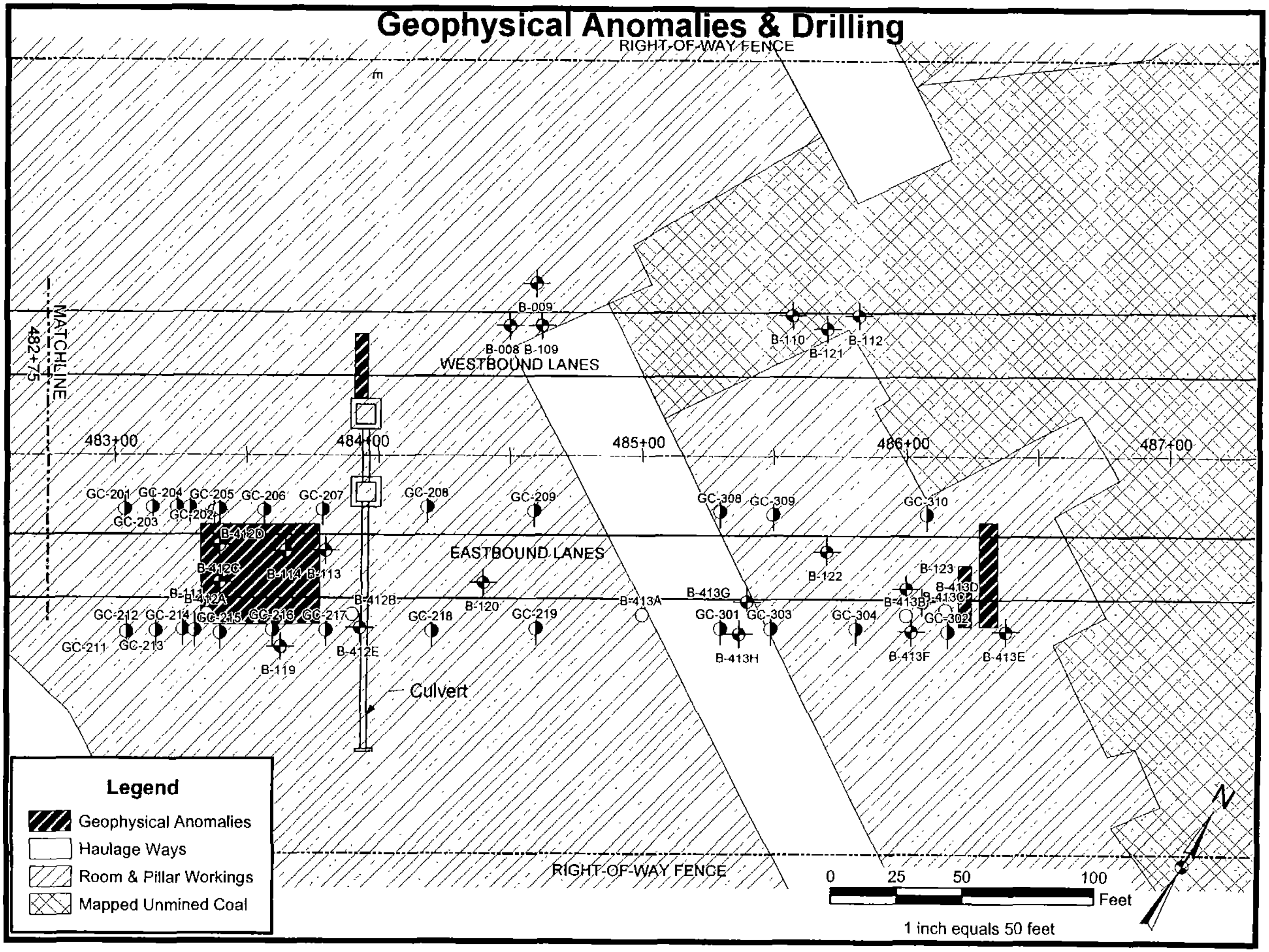
Geophysical Anomalies & Drilling

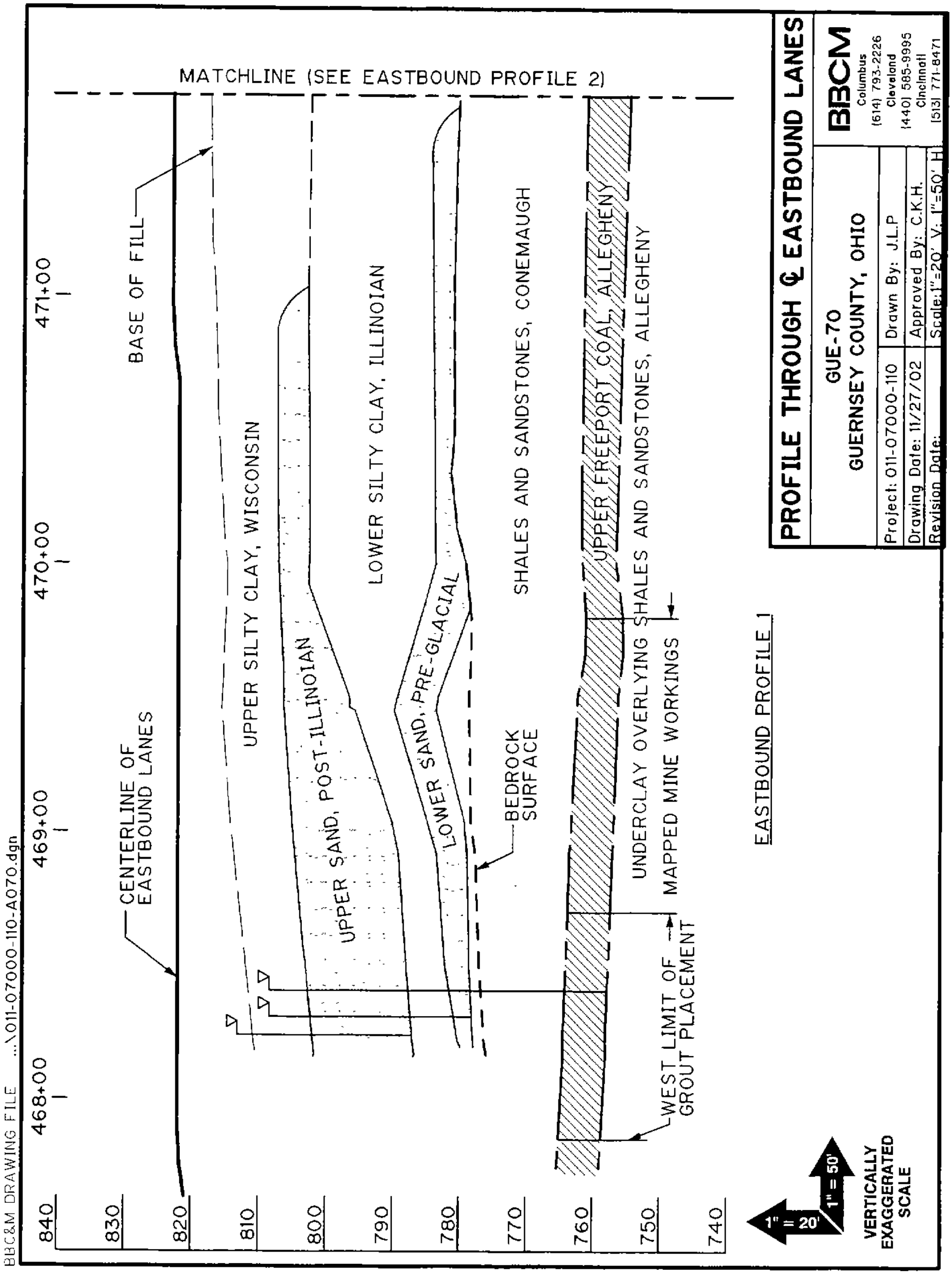


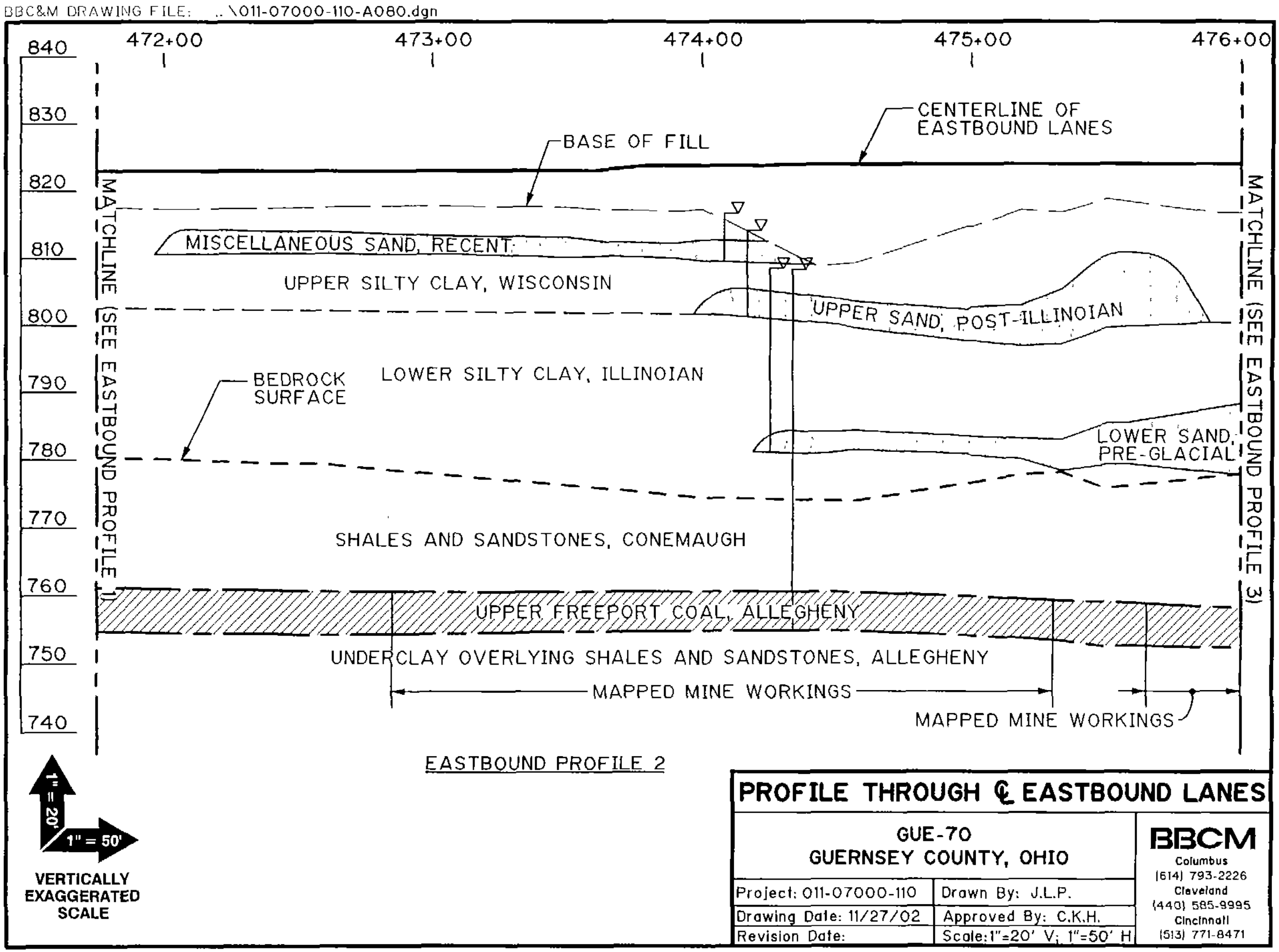

Geophysical Anomalies & Drilling
RIGHT-OF-WAY FENCE
LAND BRIDGE
MATCHLINE
476+00
WESTBOUND LANES
B-404B
B-404A
B-126
MATCHLINE
479+00
476+00
477+00
478+00
479+00
B-410C
B-410A
B-410B
B-104
B-409
EASTBOUND LANES
B-115
B-006
B-105
B-106
Culvert
Legend
Geophysical Anomalies
Haulage Ways
Room & Pillar Workings
Mapped Unmined Coal
RIGHT-OF-WAY FENCE
0
25
50
100
Feet
1 inch equals 50 feet
N

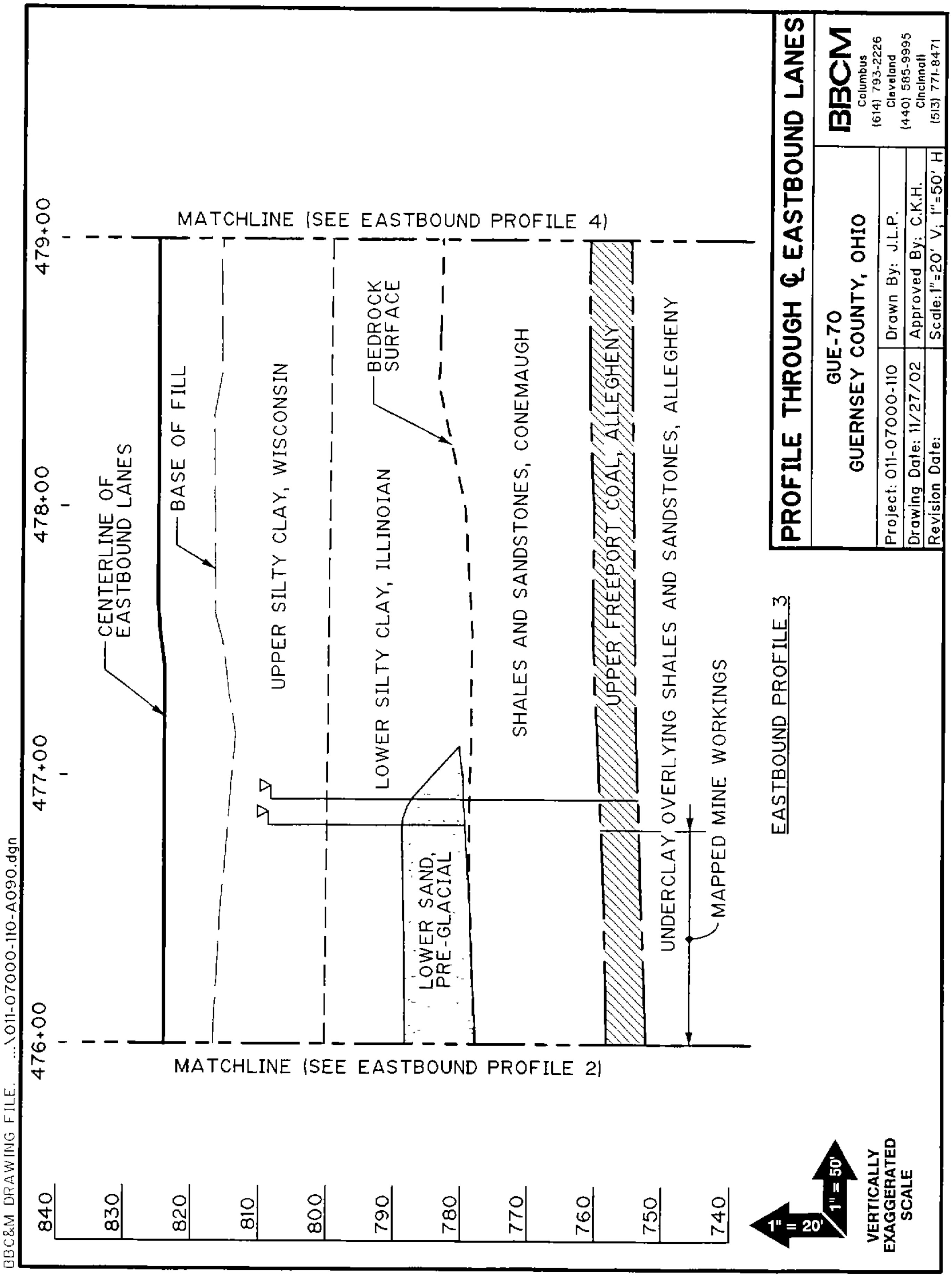


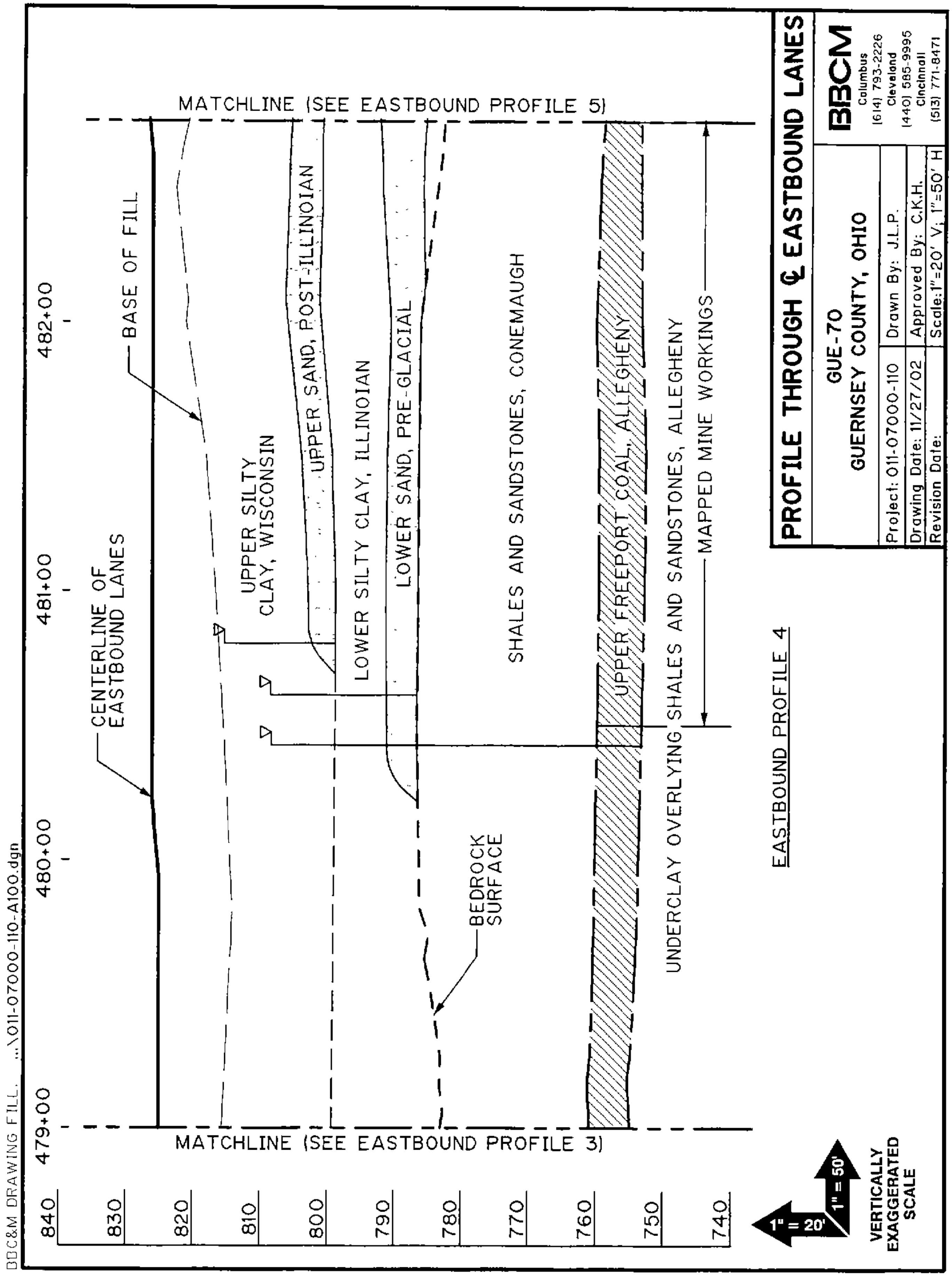
Geophysical Anomalies & Drilling
RIGHT-OF-WAY FENCE
LAND BRIDGE
WESTBOUND LANES
EASTBOUND LANES
RIGHT-OF-WAY FENCE
MATCHLINE
479+00
MATCHLINE
482+75
479+00
480+00
481+00
482+00
483+
B-126
B-101
B-115
B-105
B-106
B-006
B-405
B-107
B-411
C
D
0
25
50
100
Feet
1 inch equals 50 feet
N
Legend
Geophysical Anomalies
Haulage Ways
Room & Pillar Workings
Mapped Unmined Coal

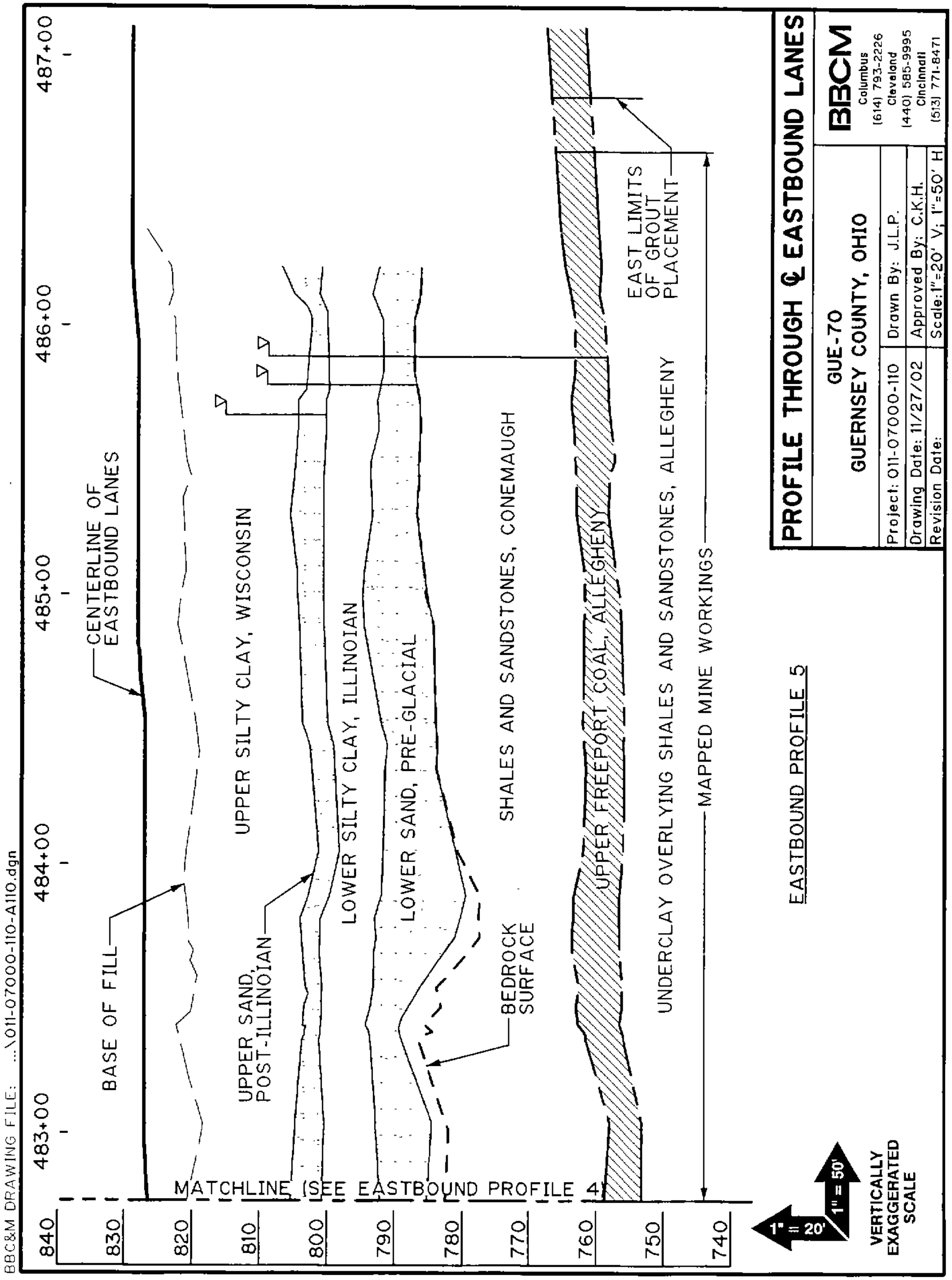

Geophysical Anomalies & Drilling
RIGHT-OF-WAY FENCE
MATCHLINE
482+75
483+00
484+00
485+00
486+00
487+00
WESTBOUND LANES
EASTBOUND LANES
B-009
B-008 B-109
B-110
B-121
B-112
GC-201 GC-204 GC-205 GC-206 GC-207 GC-208 GC-209
GC-203 GC-202
B-412D
B-412C
B-114 B-113
B-111
B-412A
B-412B
GC-212 GC-214 GC-215 GC-216 GC-217
GC-211 GC-213
B-119
B-412E
GC-218
B-120
GC-219
Culvert
B-413A
GC-308 GC-309 GC-310
B-122
B-413G
GC-301 GC-303
B-413H
GC-304
B-123
B-413D
B-413B
B-413C
GC-302
B-413F
B-413E
RIGHT-OF-WAY FENCE
Legend
Geophysical Anomalies
Haulage Ways
Room & Pillar Workings
Mapped Unmined Coal
0 25 50 100
Feet
1 inch equals 50 feet
N

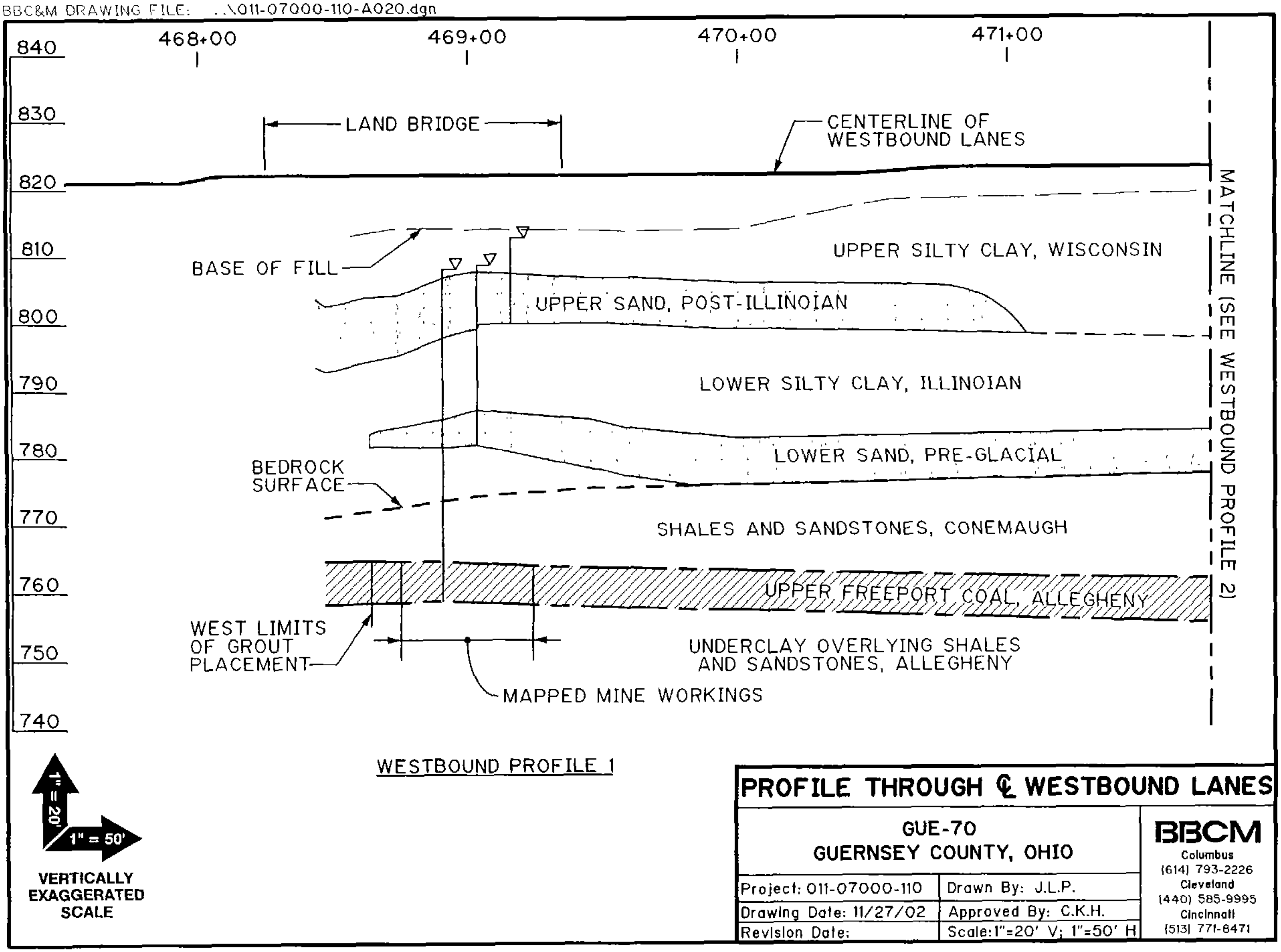

BBC&M DRAWING FILE ...\O11-07000-110-A070.dgn
MATCHLINE (SEE EASTBOUND PROFILE 2)
468+00
469+00
470+00
471+00
840
830
820
810
800
790
780
770
760
750
740
CENTERLINE OF EASTBOUND LANES
BASE OF FILL
UPPER SILTY CLAY, WISCONSIN
UPPER SAND, POST-ILLINOIAN
LOWER SILTY CLAY, ILLINOIAN
LOWER SAND, PRE-GLACIAL
BEDROCK SURFACE
SHALES AND SANDSTONES, CONEMAUGH
UPPER FREEPORT COAL, ALLEGHENY
SHALES AND SANDSTONES, ALLEGHENY
UNDERCLAY OVERLYING MAPPED MINE WORKINGS
WEST LIMIT OF GROUT PLACEMENT
EASTBOUND PROFILE 1
1" = 20'
1" = 50'
VERTICALLY EXAGGERATED SCALE
PROFILE THROUGH ℄ EASTBOUND LANES
GUE-70
GUERNSEY COUNTY, OHIO
BBCM
Columbus (614) 793-2226
Cleveland (440) 585-9995
Cincinnati (513) 771-8471
Project: 011-07000-110
Drawn By: J.L.P
Drawing Date: 11/27/02
Approved By: C.K.H.
Revision Date:
Scale: 1"=20' V; 1"=50' H

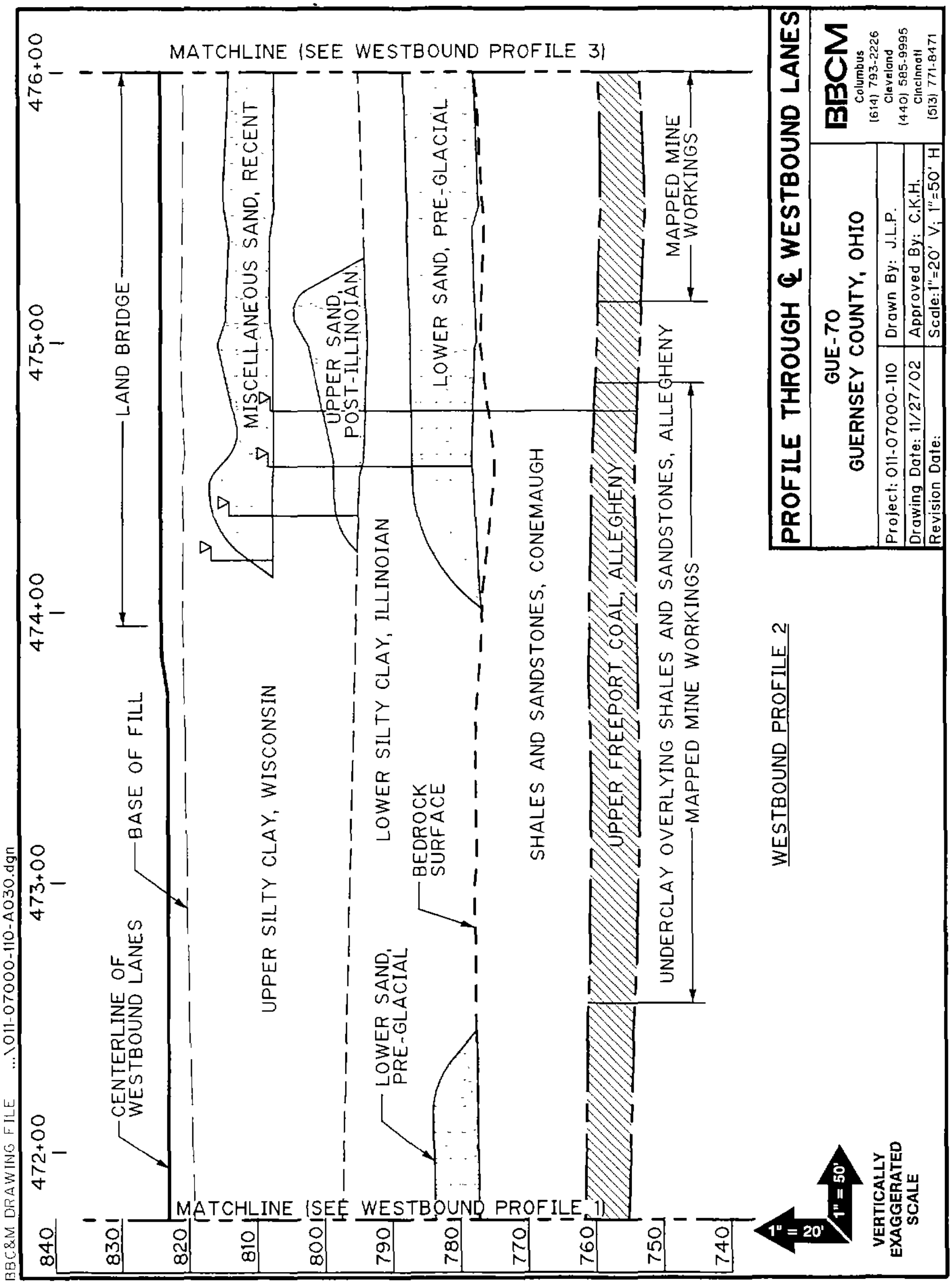

BBC&M DRAWING FILE: ..\011-07000-110-A080.dgn
840
830
820
810
800
790
780
770
760
750
740
472+00
473+00
474+00
475+00
476+00
MATCHLINE (SEE EASTBOUND PROFILE 1)
MATCHLINE (SEE EASTBOUND PROFILE 3)
BASE OF FILL
CENTERLINE OF EASTBOUND LANES
MISCELLANEOUS SAND, RECENT
UPPER SILTY CLAY, WISCONSIN
UPPER SAND, POST-ILLINOIAN
BEDROCK SURFACE
LOWER SILTY CLAY, ILLINOIAN
LOWER SAND, PRE-GLACIAL
SHALES AND SANDSTONES, CONEMAUGH
UPPER FREEPORT COAL, ALLEGHENY
UNDERCLAY OVERLYING SHALES AND SANDSTONES, ALLEGHENY
MAPPED MINE WORKINGS
MAPPED MINE WORKINGS
EASTBOUND PROFILE 2
1" = 20'
1" = 50'
VERTICALLY EXAGGERATED SCALE
PROFILE THROUGH ℄ EASTBOUND LANES
GUE-70
GUERNSEY COUNTY, OHIO
Project: 011-07000-110
Drawn By: J.L.P.
Drawing Date: 11/27/02
Approved By: C.K.H.
Revision Date:
Scale: 1"=20' V; 1"=50' H
BBCM
Columbus
(614) 793-2226
Cleveland
(440) 585-9995
Cincinnati
(513) 771-8471

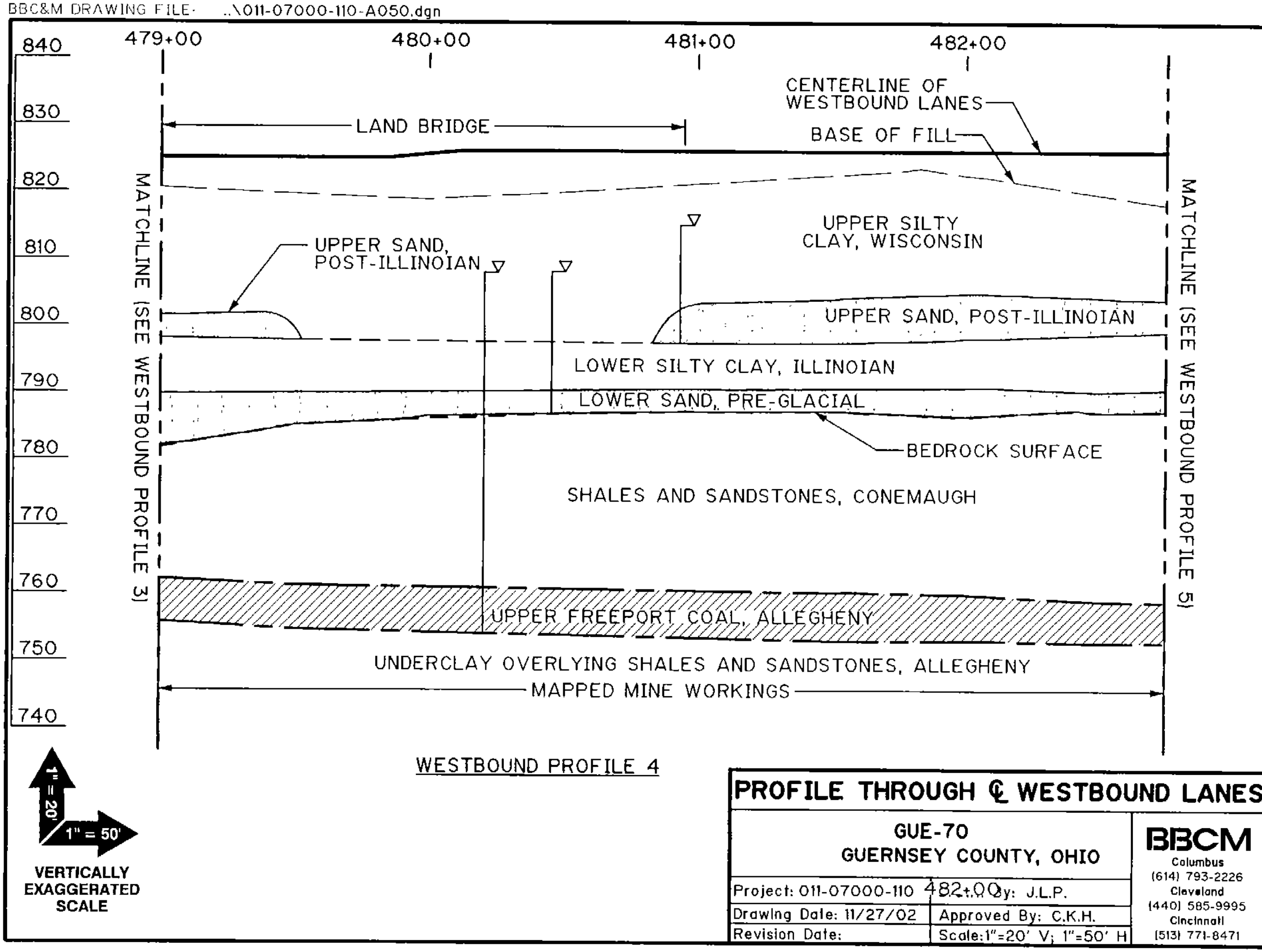

BBC&M DRAWING FILE: ...\011-07000-110-A090.dgn
MATCHLINE (SEE EASTBOUND PROFILE 4)
MATCHLINE (SEE EASTBOUND PROFILE 2)
476+00
477+00
478+00
479+00
840
830
820
810
800
790
780
770
760
750
740
CENTERLINE OF EASTBOUND LANES
BASE OF FILL
UPPER SILTY CLAY, WISCONSIN
LOWER SILTY CLAY, ILLINOIAN
BEDROCK SURFACE
LOWER SAND, PRE-GLACIAL
SHALES AND SANDSTONES, CONEMAUGH
UPPER FREEPORT COAL, ALLEGHENY
UNDERCLAY OVERLYING SHALES AND SANDSTONES, ALLEGHENY
MAPPED MINE WORKINGS
EASTBOUND PROFILE 3
1" = 20'
1" = 50'
VERTICALLY EXAGGERATED SCALE
PROFILE THROUGH ℄ EASTBOUND LANES
GUE-70
GUERNSEY COUNTY, OHIO
Project: 011-07000-110
Drawn By: J.L.P.
Drawing Date: 11/27/02
Approved By: C.K.H.
Revision Date:
Scale: 1"=20' V; 1"=50' H
BBCM
Columbus
(614) 793-2226
Cleveland
(440) 585-9995
Cincinnati
(513) 771-8471

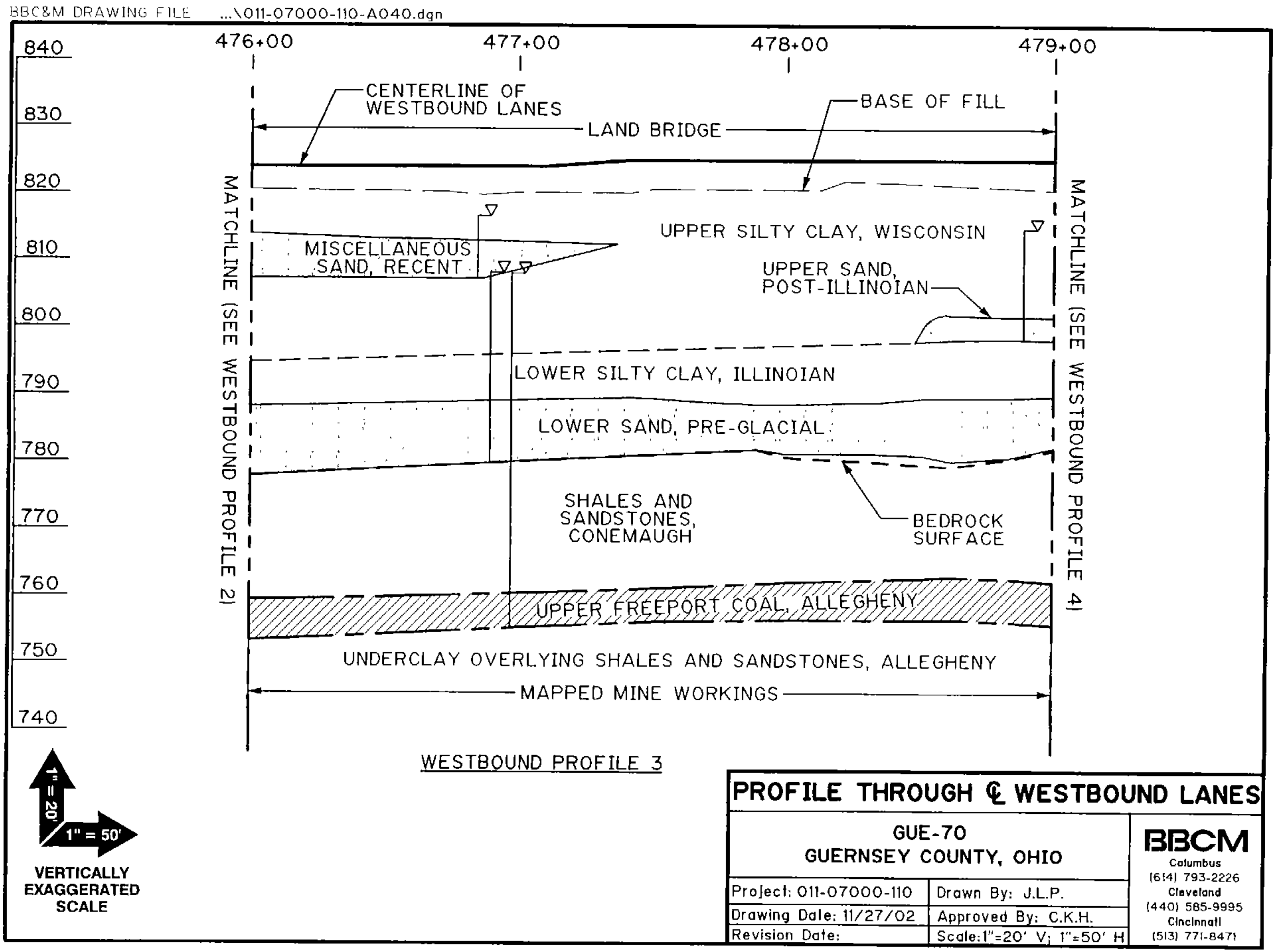

BBC&M DRAWING FILL: ...\011-07000-110-A100.dgn
MATCHLINE (SEE EASTBOUND PROFILE 5)
MATCHLINE (SEE EASTBOUND PROFILE 3)
479+00
480+00
481+00
482+00
840
830
820
810
800
790
780
770
760
750
740
CENTERLINE OF EASTBOUND LANES
BASE OF FILL
UPPER SILTY CLAY, WISCONSIN
UPPER SAND, POST-ILLINOIAN
LOWER SILTY CLAY, ILLINOIAN
LOWER SAND, PRE-GLACIAL
SHALES AND SANDSTONES, CONEMAUGH
BEDROCK SURFACE
UPPER FREEPORT COAL, ALLEGHENY
UNDERCLAY OVERLYING SHALES AND SANDSTONES, ALLEGHENY
MAPPED MINE WORKINGS
EASTBOUND PROFILE 4
1" = 20'
1" = 50'
VERTICALLY EXAGGERATED SCALE
PROFILE THROUGH ℄ EASTBOUND LANES
GUE-70
GUERNSEY COUNTY, OHIO
Project: 011-07000-110
Drawn By: J.L.P.
Drawing Date: 11/27/02
Approved By: C.K.H.
Revision Date:
Scale: 1"=20' V; 1"=50' H
BBCM
Columbus (614) 793-2226
Cleveland (440) 585-9995
Cincinnati (513) 771-8471


BBC&M DRAWING FILE: ...\011-07000-110-A110.dgn
483+00
484+00
485+00
486+00
487+00
840
830
820
810
800
790
780
770
760
750
740
MATCHLINE (SEE EASTBOUND PROFILE 4)
BASE OF FILL
CENTERLINE OF EASTBOUND LANES
UPPER SAND, POST-ILLINOIAN
UPPER SILTY CLAY, WISCONSIN
LOWER SILTY CLAY, ILLINOIAN
LOWER SAND, PRE-GLACIAL
BEDROCK SURFACE
SHALES AND SANDSTONES, CONEMAUGH
UPPER FREEPORT COAL, ALLEGHENY
UNDERCLAY OVERLYING SHALES AND SANDSTONES, ALLEGHENY
MAPPED MINE WORKINGS
EAST LIMITS OF GROUT PLACEMENT
EASTBOUND PROFILE 5
1" = 20'
1" = 50'
VERTICALLY EXAGGERATED SCALE
PROFILE THROUGH ℄ EASTBOUND LANES
GUE-70
GUERNSEY COUNTY, OHIO
BBCM
Columbus (614) 793-2226
Cleveland (440) 585-9995
Cincinnati (513) 771-8471
Project: 011-07000-110
Drawn By: J.L.P.
Drawing Date: 11/27/02
Approved By: C.K.H.
Revision Date:
Scale: 1"=20' V; 1"=50' H

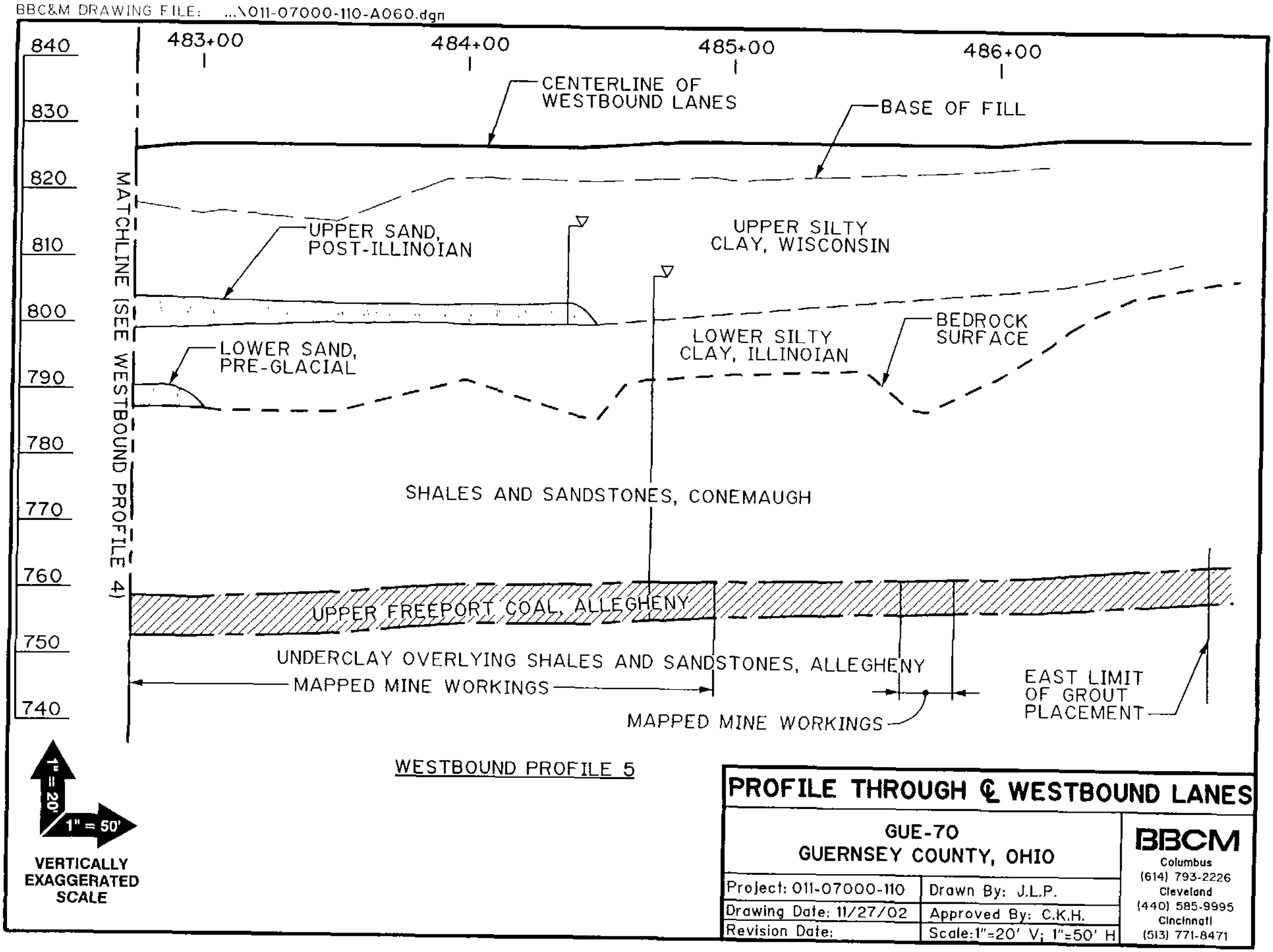

BBC&M DRAWING FILE: ..\011-07000-110-A020.dgn
840
830
820
810
800
790
780
770
760
750
740
468+00
469+00
470+00
471+00
LAND BRIDGE
CENTERLINE OF WESTBOUND LANES
MATCHLINE (SEE WESTBOUND PROFILE 2)
BASE OF FILL
UPPER SILTY CLAY, WISCONSIN
UPPER SAND, POST-ILLINOIAN
LOWER SILTY CLAY, ILLINOIAN
LOWER SAND, PRE-GLACIAL
BEDROCK SURFACE
SHALES AND SANDSTONES, CONEMAUGH
UPPER FREEPORT COAL, ALLEGHENY
WEST LIMITS OF GROUT PLACEMENT
UNDERCLAY OVERLYING SHALES AND SANDSTONES, ALLEGHENY
MAPPED MINE WORKINGS
1" = 20'
1" = 50'
VERTICALLY EXAGGERATED SCALE
WESTBOUND PROFILE 1
PROFILE THROUGH ℄ WESTBOUND LANES
GUE-70
GUERNSEY COUNTY, OHIO
Project: 011-07000-110
Drawn By: J.L.P.
Drawing Date: 11/27/02
Approved By: C.K.H.
Revision Date:
Scale: 1"=20' V; 1"=50' H
BBCM
Columbus
(614) 793-2226
Cleveland
(440) 585-9995
Cincinnati
(513) 771-8471

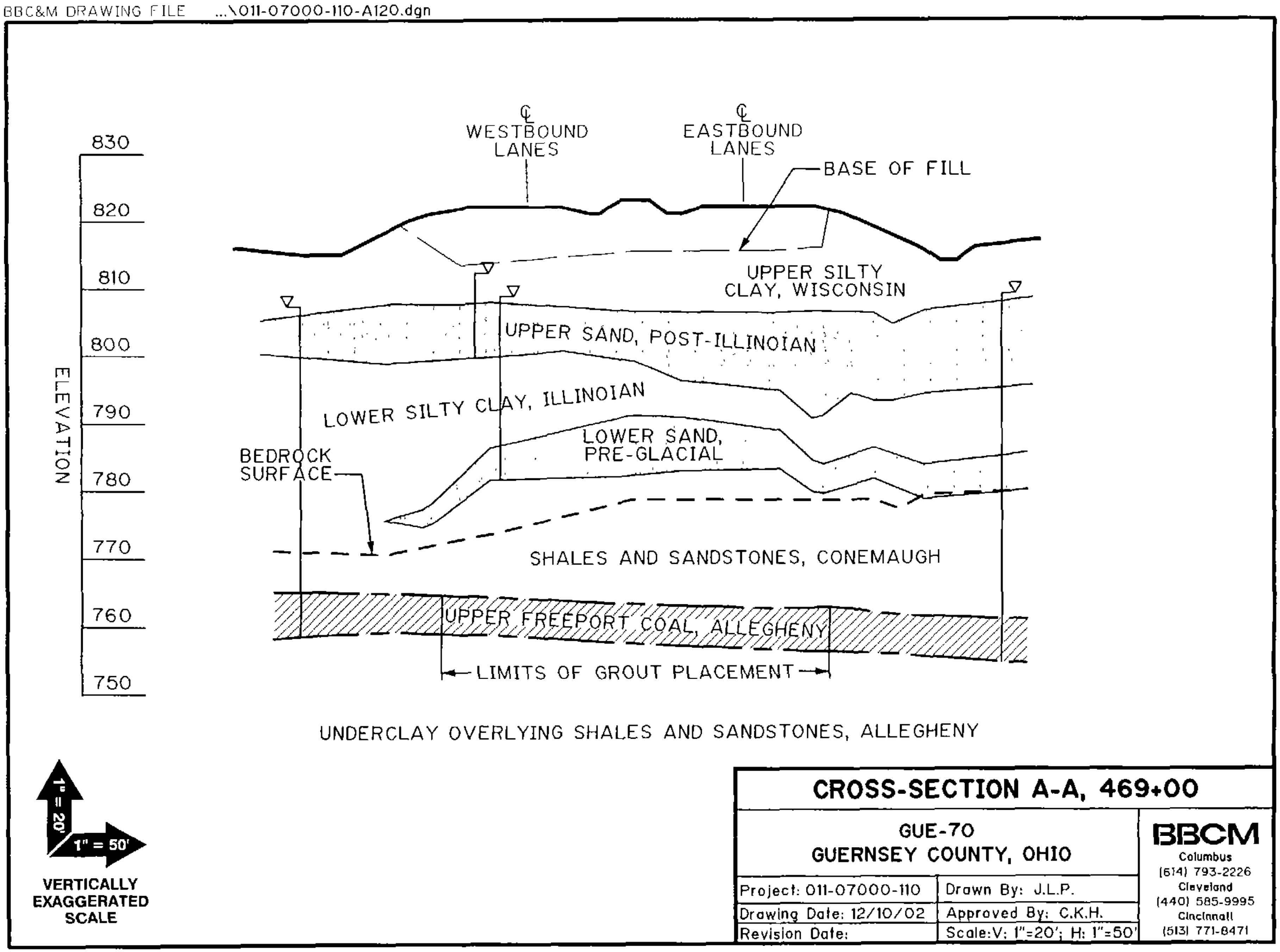

BBC&M DRAWING FILE ...\011-07000-110-A030.dgn
MATCHLINE (SEE WESTBOUND PROFILE 3)
MATCHLINE (SEE WESTBOUND PROFILE 1)
472+00
473+00
474+00
475+00
476+00
840
830
820
810
800
790
780
770
760
750
740
CENTERLINE OF WESTBOUND LANES
BASE OF FILL
LAND BRIDGE
UPPER SILTY CLAY, WISCONSIN
MISCELLANEOUS SAND, RECENT
UPPER SAND, POST-ILLINOIAN
LOWER SAND, PRE-GLACIAL
LOWER SILTY CLAY, ILLINOIAN
BEDROCK SURFACE
SHALES AND SANDSTONES, CONEMAUGH
UPPER FREEPORT COAL, ALLEGHENY
UNDERCLAY OVERLYING SHALES AND SANDSTONES, ALLEGHENY
MAPPED MINE WORKINGS
WESTBOUND PROFILE 2
1" = 20'
1" = 50'
VERTICALLY EXAGGERATED SCALE
PROFILE THROUGH ℄ WESTBOUND LANES
GUE-70
GUERNSEY COUNTY, OHIO
BBCM
Columbus (614) 793-2226
Cleveland (440) 585-9995
Cincinnati (513) 771-8471
Project: 011-07000-110
Drawn By: J.L.P.
Drawing Date: 11/27/02
Approved By: C.K.H.
Revision Date:
Scale: 1"=20' V; 1"=50' H


BBC&M DRAWING FILE- ..\011-07000-110-A050.dgn
840
830
820
810
800
790
780
770
760
750
740
479+00
480+00
481+00
482+00
MATCHLINE (SEE WESTBOUND PROFILE 3)
MATCHLINE (SEE WESTBOUND PROFILE 5)
LAND BRIDGE
CENTERLINE OF WESTBOUND LANES
BASE OF FILL
UPPER SILTY CLAY, WISCONSIN
UPPER SAND, POST-ILLINOIAN
UPPER SAND, POST-ILLINOIAN
LOWER SILTY CLAY, ILLINOIAN
LOWER SAND, PRE-GLACIAL
BEDROCK SURFACE
SHALES AND SANDSTONES, CONEMAUGH
UPPER FREEPORT COAL, ALLEGHENY
UNDERCLAY OVERLYING SHALES AND SANDSTONES, ALLEGHENY
MAPPED MINE WORKINGS
WESTBOUND PROFILE 4
1" = 20'
1" = 50'
VERTICALLY EXAGGERATED SCALE
PROFILE THROUGH ℄ WESTBOUND LANES
GUE-70
GUERNSEY COUNTY, OHIO
Project: 011-07000-110
482+00
By: J.L.P.
Drawing Date: 11/27/02
Approved By: C.K.H.
Revision Date:
Scale: 1"=20' V; 1"=50' H
BBCM
Columbus
(614) 793-2226
Cleveland
(440) 585-9995
Cincinnati
(513) 771-8471

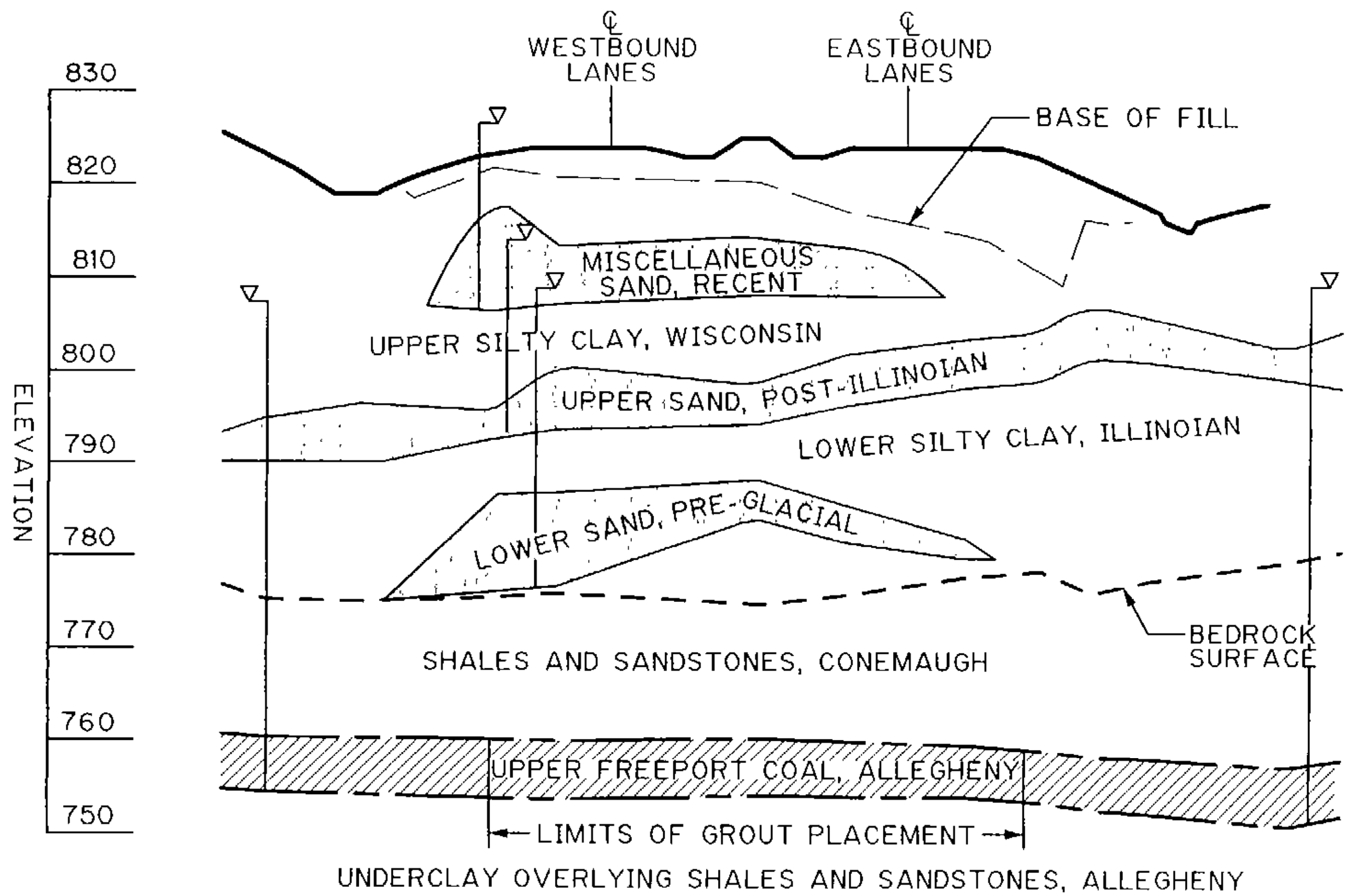


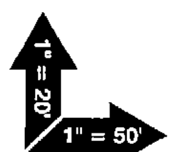
BBC&M DRAWING FILE ...\011-07000-110-A040.dgn
840
830
820
810
800
790
780
770
760
750
740
476+00
477+00
478+00
479+00
CENTERLINE OF WESTBOUND LANES
BASE OF FILL
LAND BRIDGE
MATCHLINE (SEE WESTBOUND PROFILE 2)
MATCHLINE (SEE WESTBOUND PROFILE 4)
UPPER SILTY CLAY, WISCONSIN
MISCELLANEOUS SAND, RECENT
UPPER SAND, POST-ILLINOIAN
LOWER SILTY CLAY, ILLINOIAN
LOWER SAND, PRE-GLACIAL
SHALES AND SANDSTONES, CONEMAUGH
BEDROCK SURFACE
UPPER FREEPORT COAL, ALLEGHENY
UNDERCLAY OVERLYING SHALES AND SANDSTONES, ALLEGHENY
MAPPED MINE WORKINGS
WESTBOUND PROFILE 3
1" = 20'
1" = 50'
VERTICALLY EXAGGERATED SCALE
PROFILE THROUGH ℄ WESTBOUND LANES
GUE-70
GUERNSEY COUNTY, OHIO
Project: 011-07000-110
Drawn By: J.L.P.
Drawing Date: 11/27/02
Approved By: C.K.H.
Revision Date:
Scale: 1"=20' V; 1"=50' H
BBCM
Columbus (614) 793-2226
Cleveland (440) 585-9995
Cincinnati (513) 771-8471


BBC&M DRAWING FILE: ...\011-07000-110-A060.dgn
840
830
820
810
800
790
780
770
760
750
740
483+00
484+00
485+00
486+00
CENTERLINE OF WESTBOUND LANES
BASE OF FILL
UPPER SAND, POST-ILLINOIAN
UPPER SILTY CLAY, WISCONSIN
LOWER SAND, PRE-GLACIAL
LOWER SILTY CLAY, ILLINOIAN
BEDROCK SURFACE
MATCHLINE (SEE WESTBOUND PROFILE 4)
SHALES AND SANDSTONES, CONEMAUGH
UPPER FREEPORT COAL, ALLEGHENY
UNDERCLAY OVERLYING SHALES AND SANDSTONES, ALLEGHENY
MAPPED MINE WORKINGS
MAPPED MINE WORKINGS
EAST LIMIT OF GROUT PLACEMENT
WESTBOUND PROFILE 5
1" = 20'
1" = 50'
VERTICALLY EXAGGERATED SCALE
PROFILE THROUGH ℄ WESTBOUND LANES
GUE-70
GUERNSEY COUNTY, OHIO
Project: 011-07000-110
Drawn By: J.L.P.
Drawing Date: 11/27/02
Approved By: C.K.H.
Revision Date:
Scale: 1"=20' V; 1"=50' H
BBCM
Columbus (614) 793-2226
Cleveland (440) 585-9995
Cincinnati (513) 771-8471


BBC&M DRAWING FILE ...\011-07000-110-A120.dgn
℄ WESTBOUND LANES
℄ EASTBOUND LANES
BASE OF FILL
UPPER SILTY CLAY, WISCONSIN
UPPER SAND, POST-ILLINOIAN
LOWER SILTY CLAY, ILLINOIAN
LOWER SAND, PRE-GLACIAL
BEDROCK SURFACE
SHALES AND SANDSTONES, CONEMAUGH
UPPER FREEPORT COAL, ALLEGHENY
LIMITS OF GROUT PLACEMENT
UNDERCLAY OVERLYING SHALES AND SANDSTONES, ALLEGHENY
ELEVATION
830
820
810
800
790
780
770
760
750
1" = 20'
1" = 50'
VERTICALLY EXAGGERATED SCALE
CROSS-SECTION A-A, 469+00
GUE-70
GUERNSEY COUNTY, OHIO
Project: 011-07000-110
Drawn By: J.L.P.
Drawing Date: 12/10/02
Approved By: C.K.H.
Revision Date:
Scale: V: 1"=20'; H: 1"=50'
BBCM
Columbus
(614) 793-2226
Cleveland
(440) 585-9995
Cincinnati
(513) 771-8471

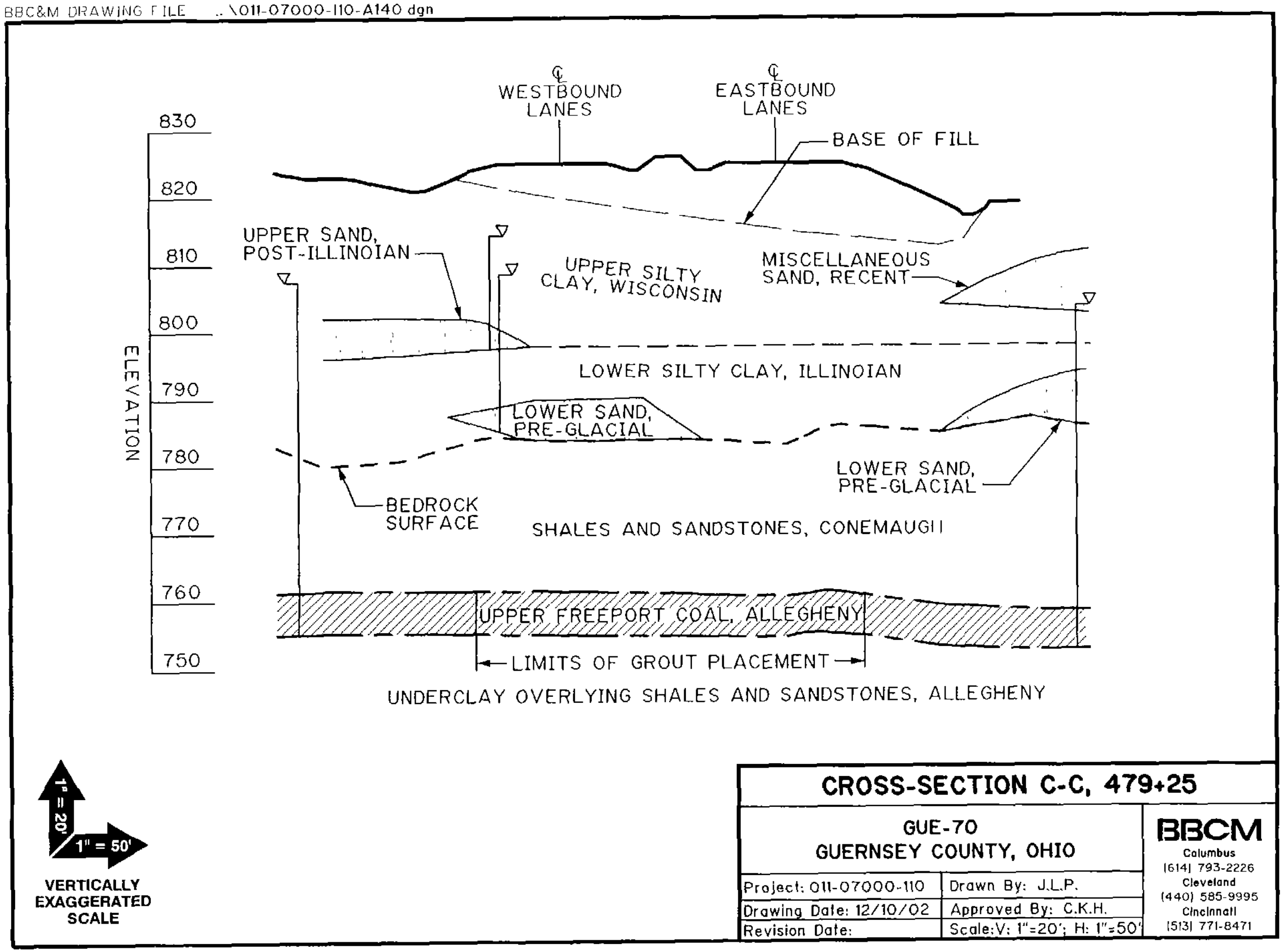
BBC&M DRAWING FILE ..\011-07000-110-A130.dgn

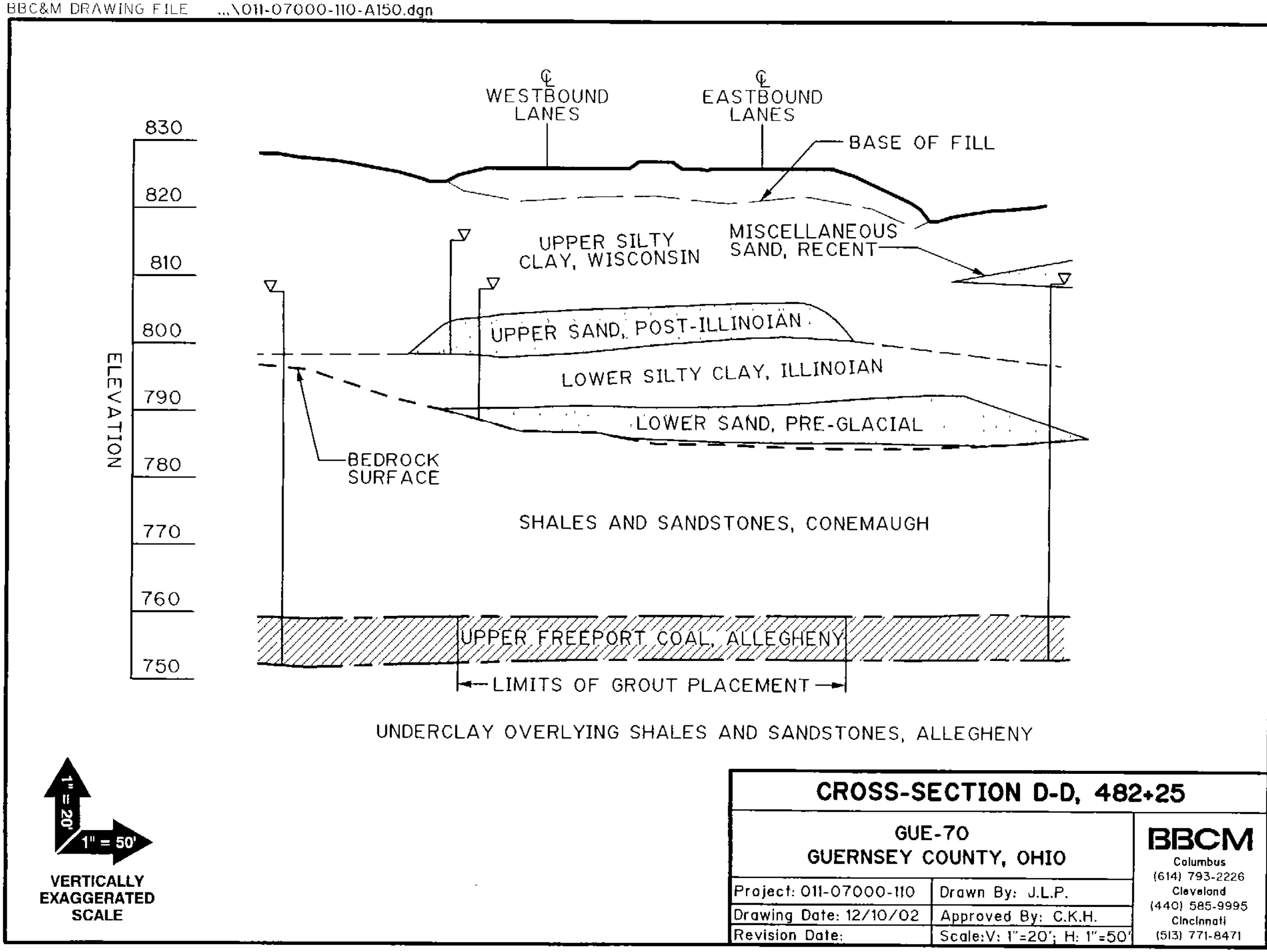


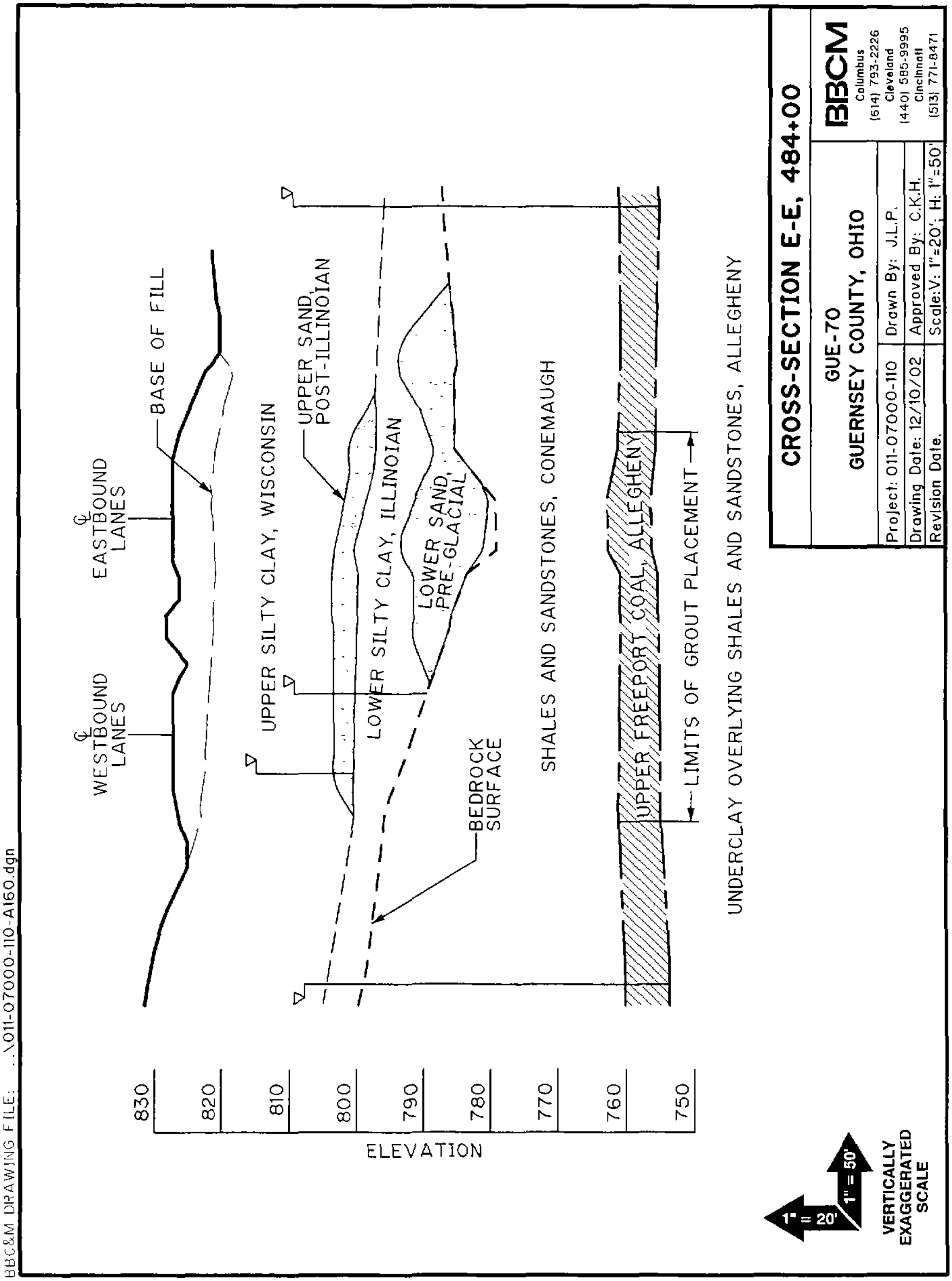


VERTICALLY EXAGGERATED SCALE

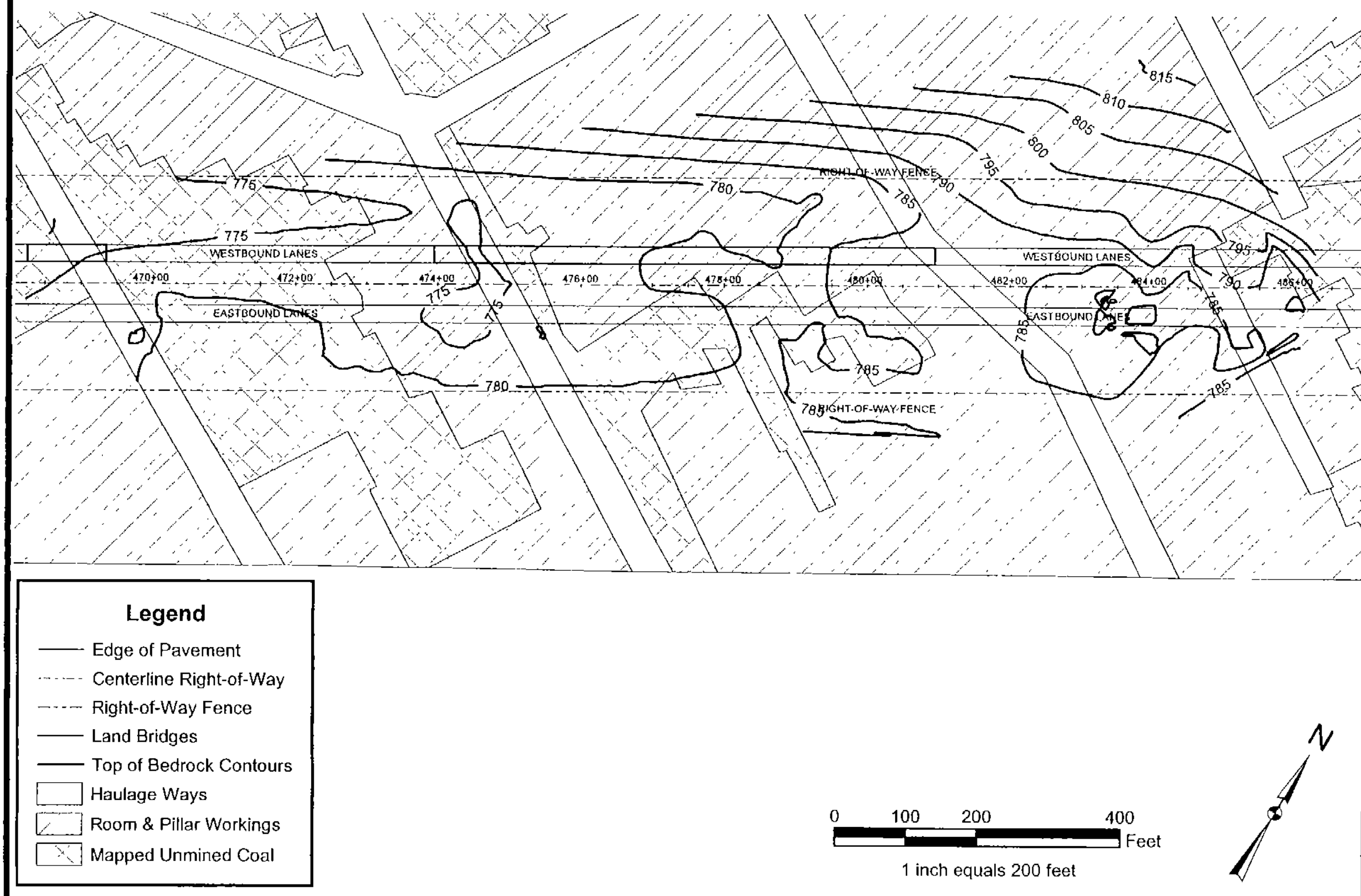
CROSS-SECTION B-B, 475+00		
GUE-70 GUERNSEY COUNTY, OHIO		BBCM Columbus (614) 793-2226 Cleveland (440) 585-9995 Cincinnati (513) 771-8471
Project: 011-07000-110	Drawn By: J.L.P.	
Drawing Date: 12/10/02	Approved By: C.K.H.	
Revision Date:	Scale: V: 1"=20'; H: 1"=50'	

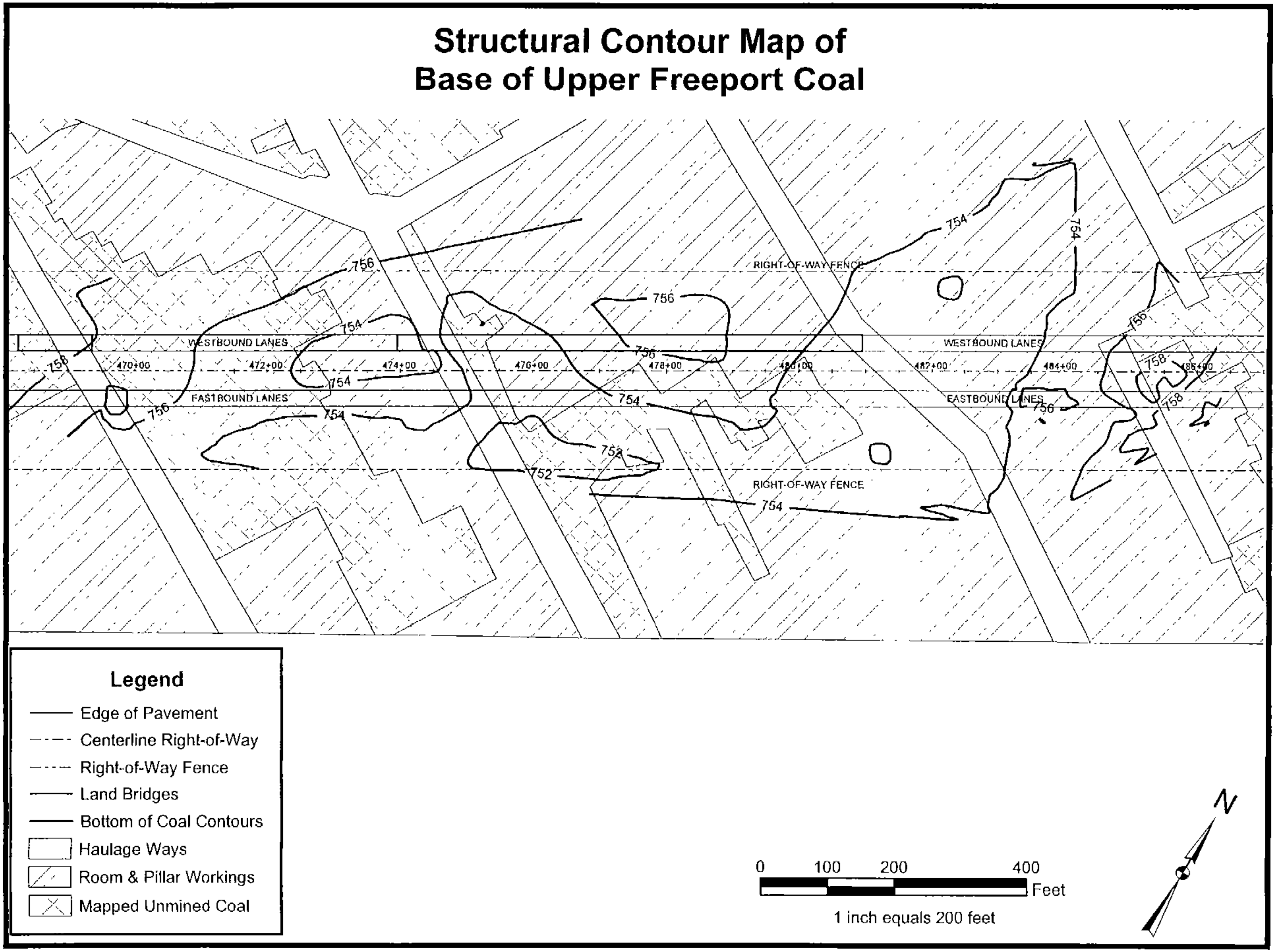

BBC&M DRAWING FILE ..\011-07000-110-A140 dgn
℄ WESTBOUND LANES
℄ EASTBOUND LANES
BASE OF FILL
UPPER SAND, POST-ILLINOIAN
UPPER SILTY CLAY, WISCONSIN
MISCELLANEOUS SAND, RECENT
LOWER SILTY CLAY, ILLINOIAN
LOWER SAND, PRE-GLACIAL
LOWER SAND, PRE-GLACIAL
BEDROCK SURFACE
SHALES AND SANDSTONES, CONEMAUGH
UPPER FREEPORT COAL, ALLEGHENY
LIMITS OF GROUT PLACEMENT
UNDERCLAY OVERLYING SHALES AND SANDSTONES, ALLEGHENY
ELEVATION
830
820
810
800
790
780
770
760
750
1" = 20'
1" = 50'
VERTICALLY EXAGGERATED SCALE
CROSS-SECTION C-C, 479+25
GUE-70
GUERNSEY COUNTY, OHIO
Project: 011-07000-110
Drawn By: J.L.P.
Drawing Date: 12/10/02
Approved By: C.K.H.
Revision Date:
Scale: V: 1"=20'; H: 1"=50'
BBCM
Columbus (614) 793-2226
Cleveland (440) 585-9995
Cincinnati (513) 771-8471


BBC&M DRAWING FILE ...\011-07000-110-A150.dgn
WESTBOUND LANES
EASTBOUND LANES
BASE OF FILL
ELEVATION
830
820
810
800
790
780
770
760
750
UPPER SILTY CLAY, WISCONSIN
MISCELLANEOUS SAND, RECENT
UPPER SAND, POST-ILLINOIAN
LOWER SILTY CLAY, ILLINOIAN
LOWER SAND, PRE-GLACIAL
BEDROCK SURFACE
SHALES AND SANDSTONES, CONEMAUGH
UPPER FREEPORT COAL, ALLEGHENY
LIMITS OF GROUT PLACEMENT
UNDERCLAY OVERLYING SHALES AND SANDSTONES, ALLEGHENY
1" = 20'
1" = 50'
VERTICALLY EXAGGERATED SCALE
CROSS-SECTION D-D, 482+25
GUE-70
GUERNSEY COUNTY, OHIO
Project: 011-07000-110
Drawn By: J.L.P.
Drawing Date: 12/10/02
Approved By: C.K.H.
Revision Date:
Scale:V: 1"=20'; H: 1"=50'
BBCM
Columbus
(614) 793-2226
Cleveland
(440) 585-9995
Cincinnati
(513) 771-8471


BBC&M DRAWING FILE: ...\011-07000-110-A160.dgn
CROSS-SECTION E-E, 484+00
GUE-70
GUERNSEY COUNTY, OHIO
Project: 011-07000-110
Drawn By: J.L.P.
Drawing Date: 12/10/02
Approved By: C.K.H.
Revision Date.
Scale:V: 1"=20', H: 1"=50'
BBCM
Columbus
(614) 793-2226
Cleveland
(440) 585-9995
Cincinnati
(513) 771-8471
WESTBOUND LANES
EASTBOUND LANES
BASE OF FILL
UPPER SILTY CLAY, WISCONSIN
UPPER SAND, POST-ILLINOIAN
LOWER SILTY CLAY, ILLINOIAN
LOWER SAND, PRE-GLACIAL
BEDROCK SURFACE
SHALES AND SANDSTONES, CONEMAUGH
UPPER FREEPORT COAL, ALLEGHENY
LIMITS OF GROUT PLACEMENT
UNDERCLAY OVERLYING SHALES AND SANDSTONES, ALLEGHENY
830
820
810
800
790
780
770
760
750
ELEVATION
1" = 20'
1" = 50'
VERTICALLY EXAGGERATED SCALE

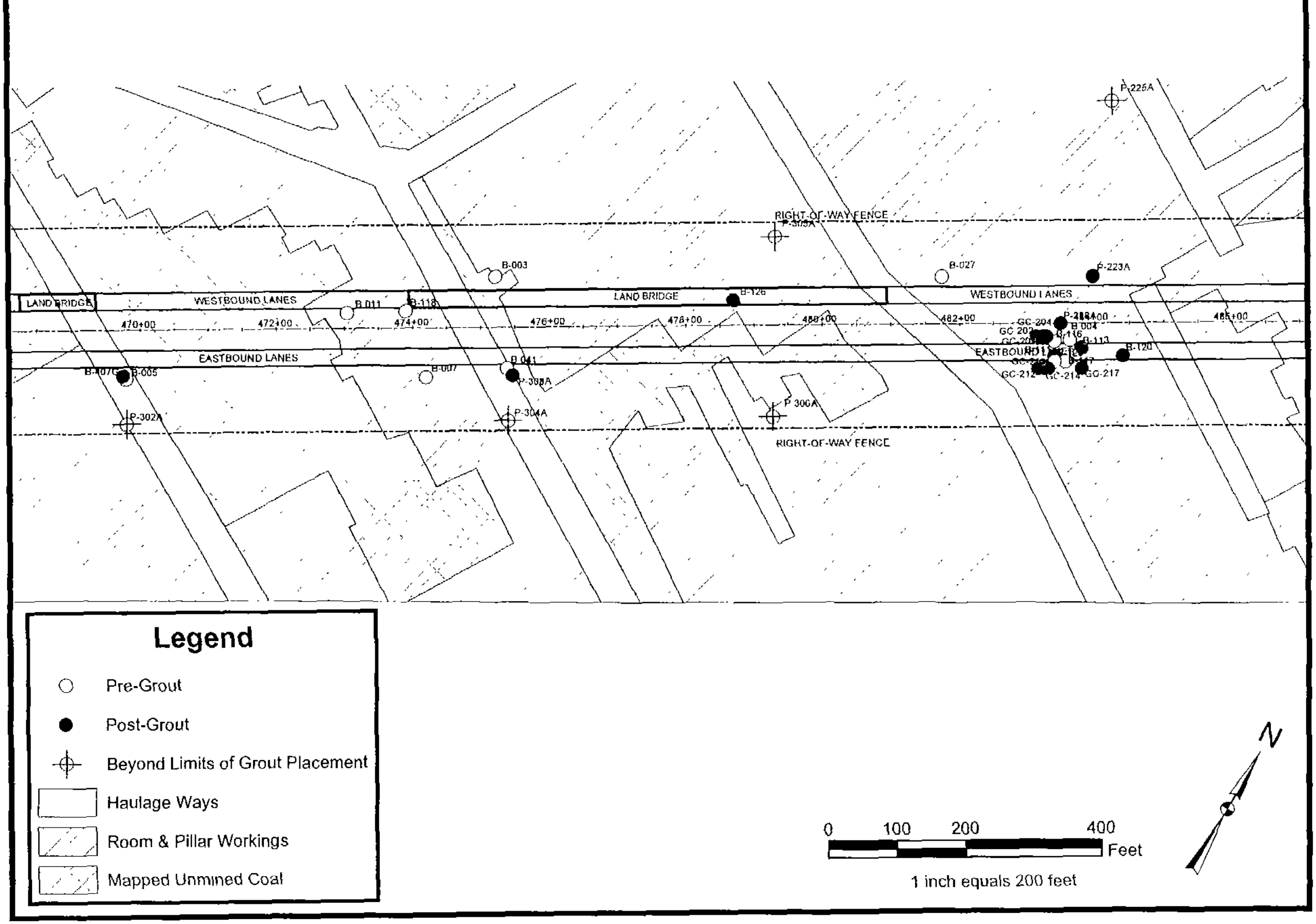
Contour Map of Bedrock Surface



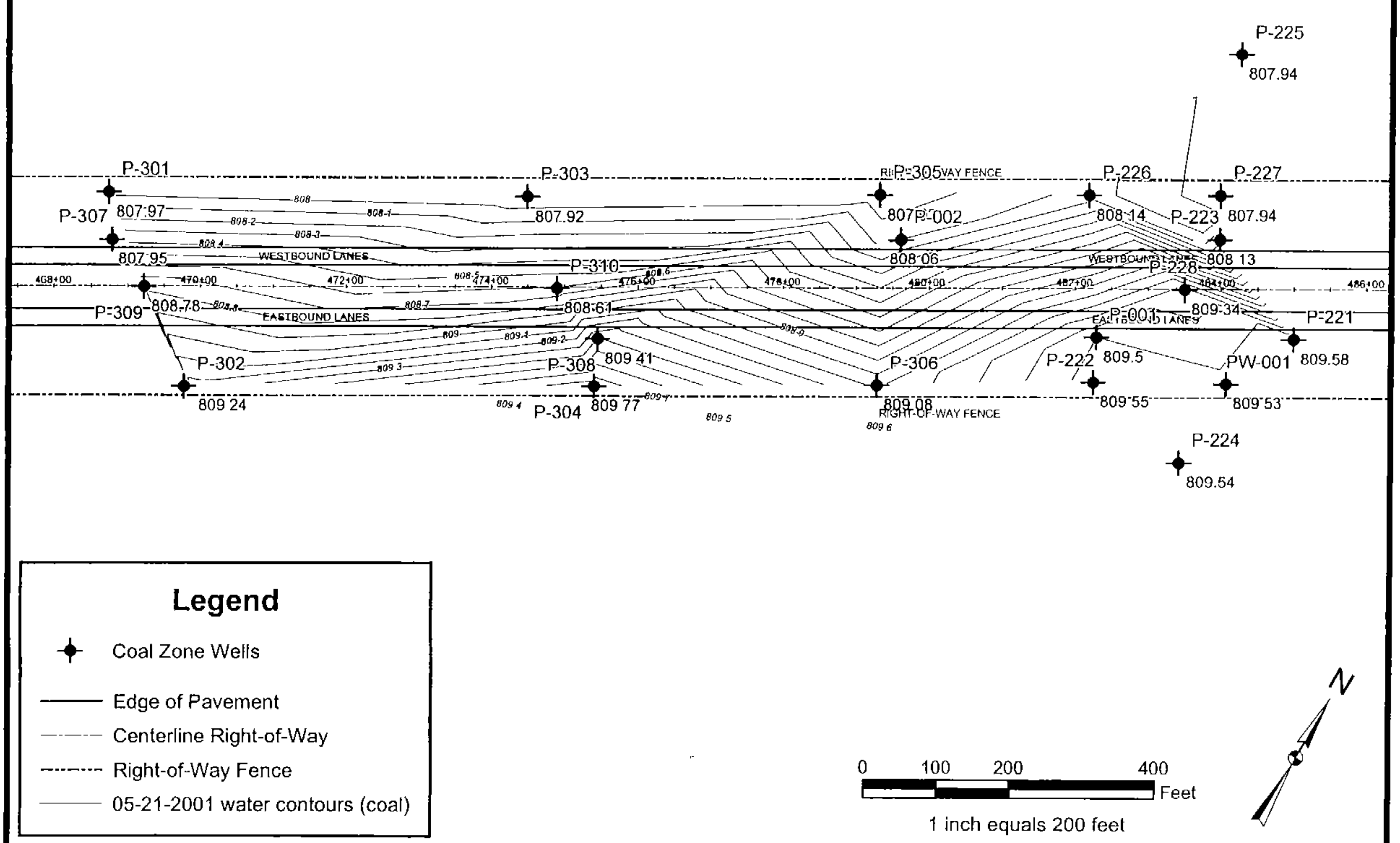


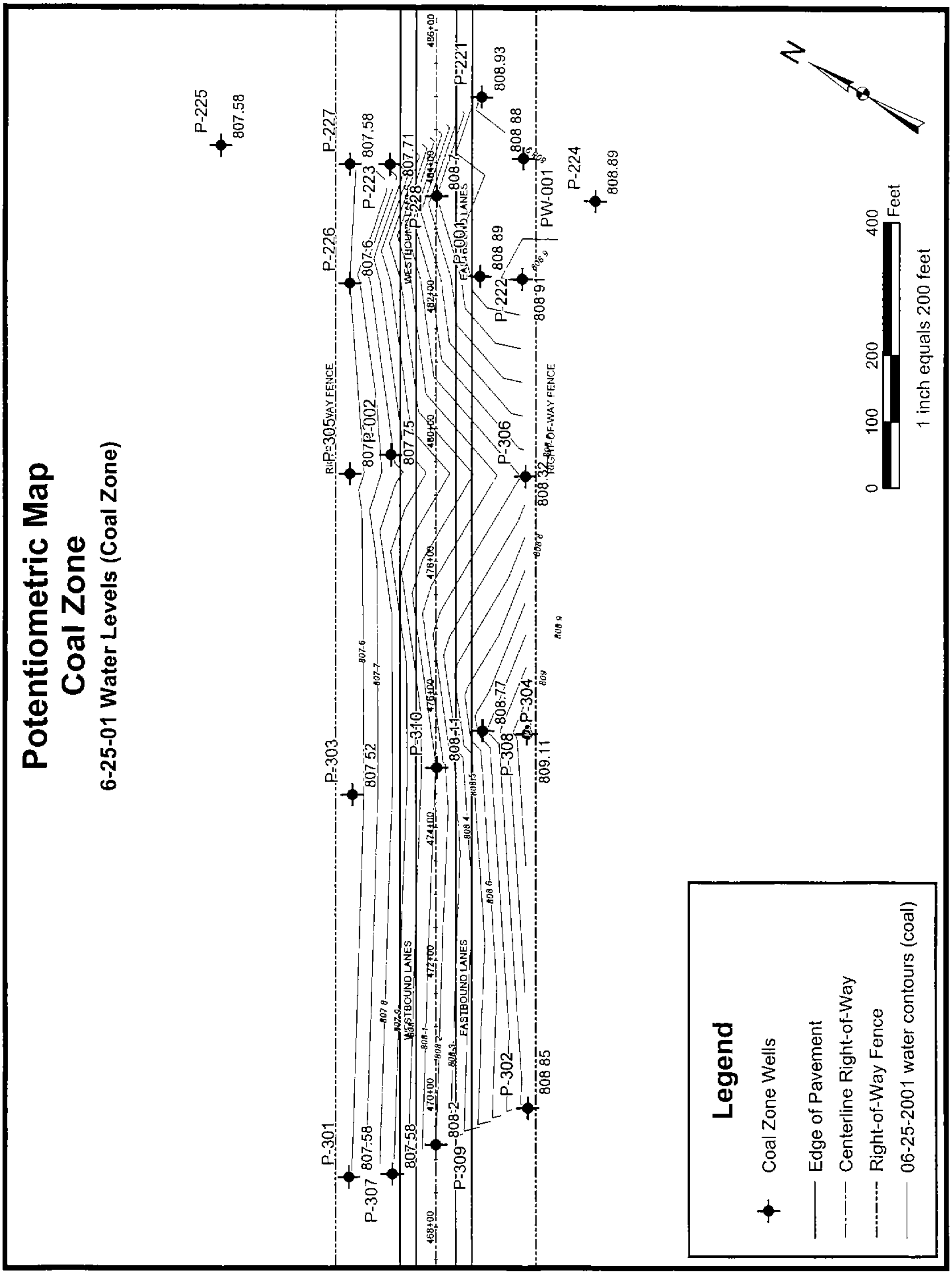
Structural Contour Map of
Base of Upper Freeport Coal
WESTBOUND LANES
EASTBOUND LANES
RIGHT-OF-WAY FENCE
470+00
472+00
474+00
476+00
478+00
482+00
484+00
756
754
752
758
Legend
Edge of Pavement
Centerline Right-of-Way
Right-of-Way Fence
Land Bridges
Bottom of Coal Contours
Haulage Ways
Room & Pillar Workings
Mapped Unmined Coal
0 100 200 400 Feet
1 inch equals 200 feet
N

Voids Encountered by Borings

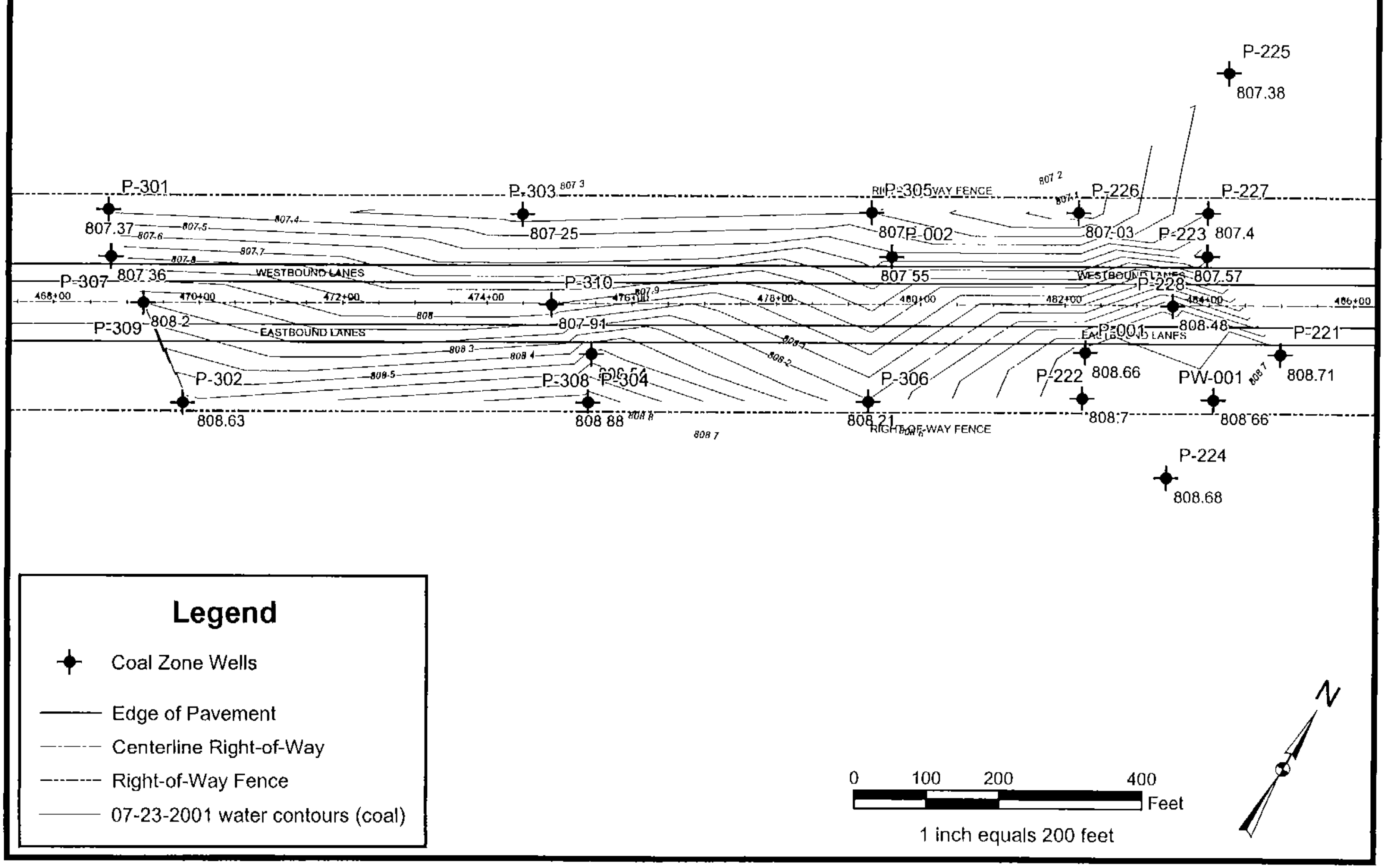


Potentiometric Map
Coal Zone
5-21-01 Water Levels (Coal Zone)

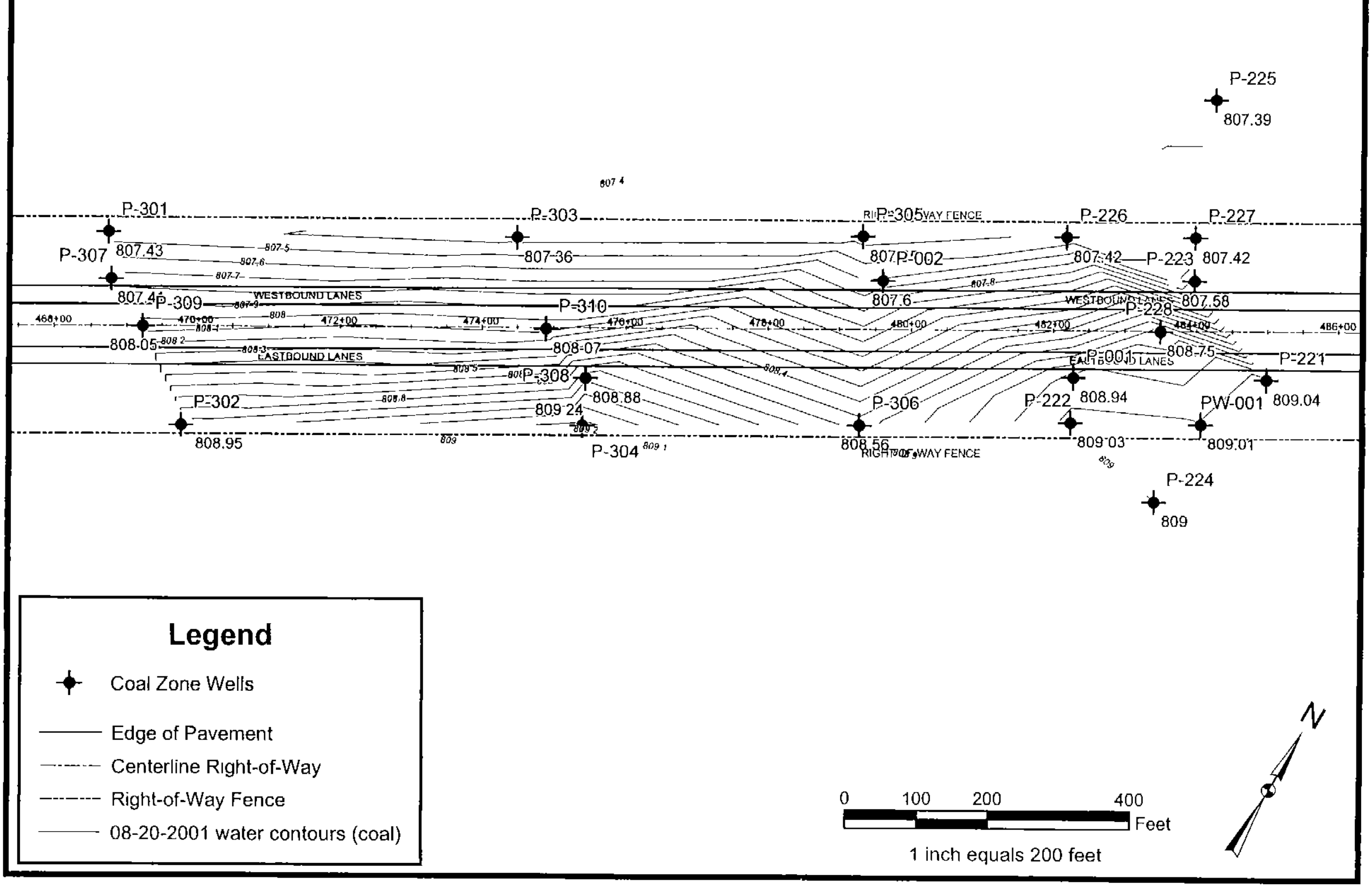


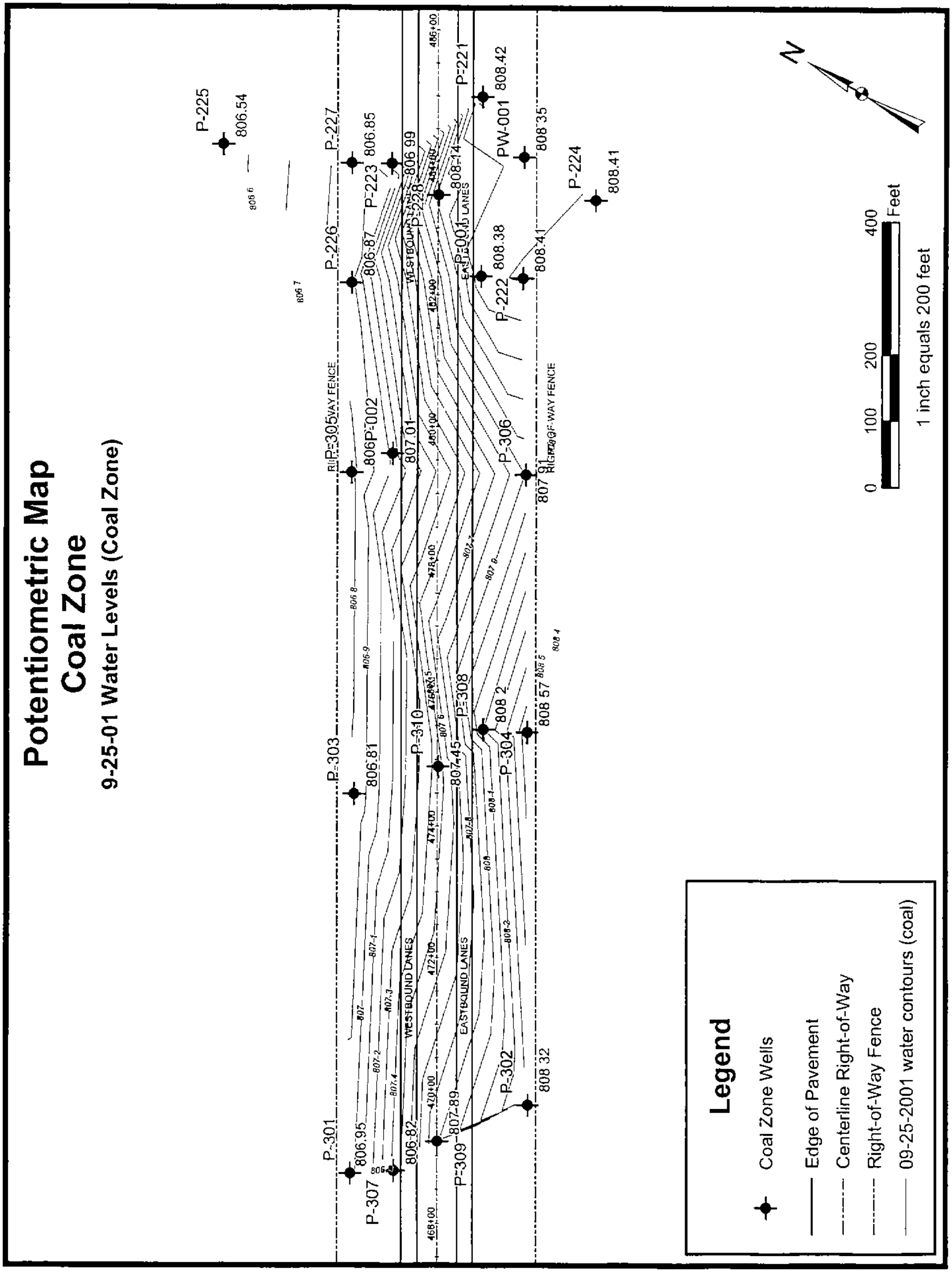

Potentiometric Map
Coal Zone
6-25-01 Water Levels (Coal Zone)
Legend
Coal Zone Wells
Edge of Pavement
Centerline Right-of-Way
Right-of-Way Fence
06-25-2001 water contours (coal)
0
100
200
400
Feet
1 inch equals 200 feet
N
P-225
807.58
P-227
807.58
P-223
807.71
P-228
808.7
P-221
808.93
808.88
P-224
808.89
P-226
807.6
PW-001
P-001
808.89
P-222
808.91
P-305
807
P-002
807.75
P-306
808.32
P-303
807.52
P-310
808.11
808.77
P-304
P-308
809.11
P-301
807.58
P-307
807.58
P-309
808.2
P-302
808.85
WESTBOUND LANES
EASTBOUND LANES
RIGHT-OF-WAY FENCE
468+00
470+00
472+00
474+00
476+00
478+00
480+00
482+00
484+00
486+00

Potentiometric Map
Coal Zone
7-23-01 Water Levels (Coal Zone)

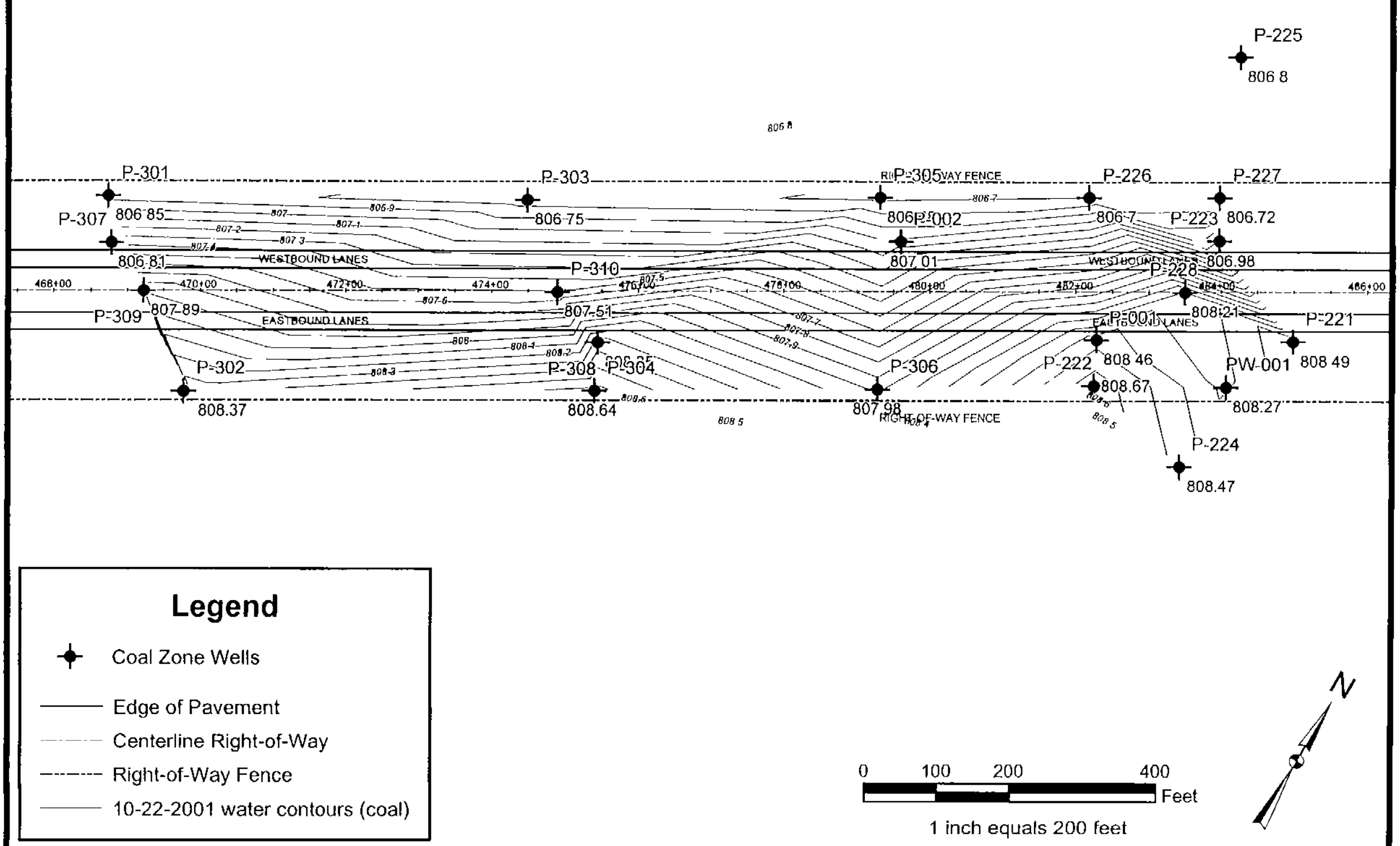


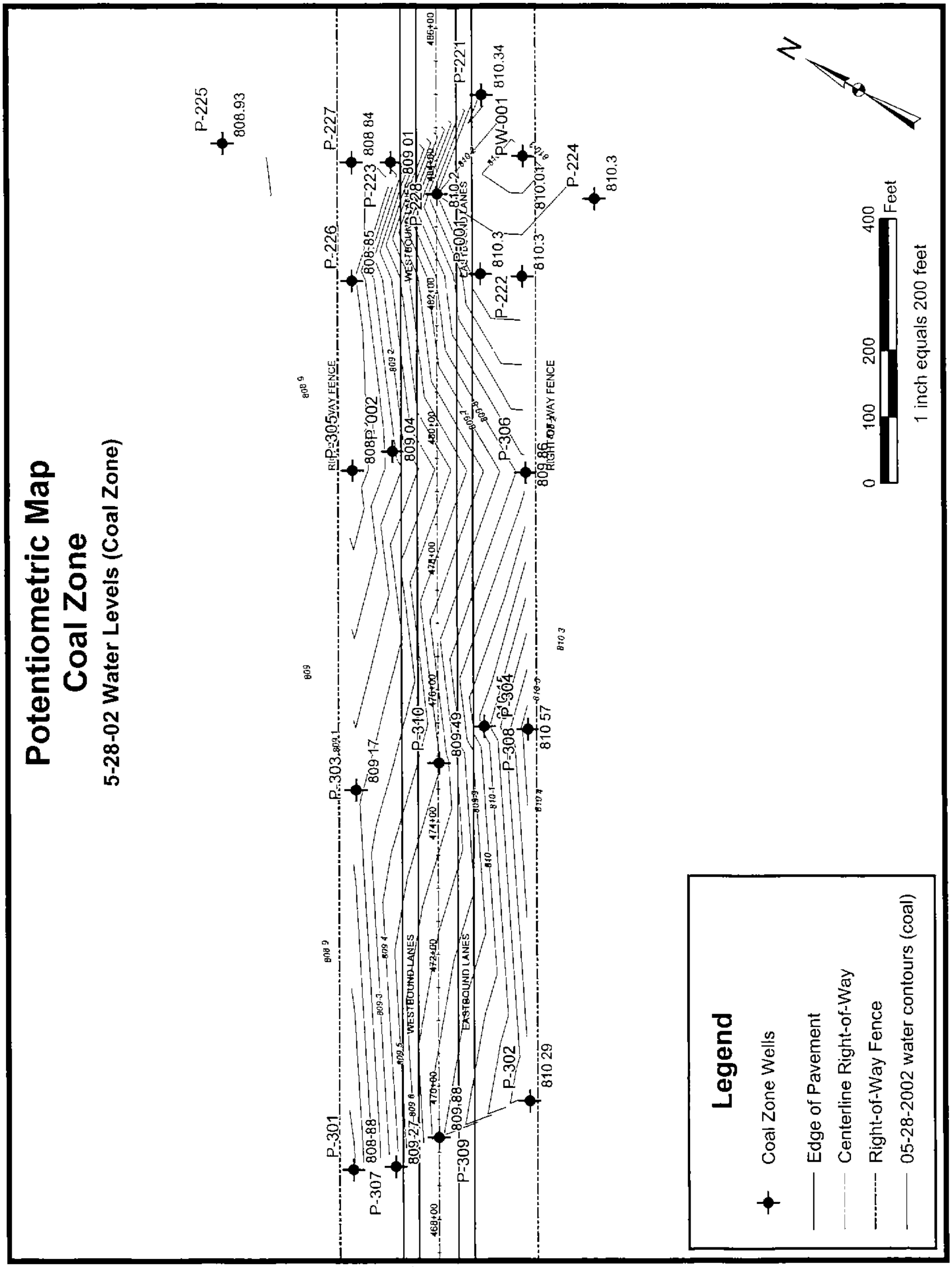
Potentiometric Map
Coal Zone
8-20-01 Water Levels (Coal Zone)




Potentiometric Map
Coal Zone
9-25-01 Water Levels (Coal Zone)
Legend
Coal Zone Wells
Edge of Pavement
Centerline Right-of-Way
Right-of-Way Fence
09-25-2001 water contours (coal)
0 100 200 400 Feet
1 inch equals 200 feet
N
P-225 806.54
P-227 806.85
P-223 806.99
P-226 806.87
P-228 808.14
P-001 808.38
P-221 808.42
PW-001 808.35
P-224 808.41
P-222 808.41
P-305 806
P-002 807.01
P-306 807.91
P-303 806.81
P-310 807.45
P-308 808.2
P-304 808.57
P-301 806.95
P-307
P-309 806.82 807.89
P-302 808.32
WESTBOUND LANES
EASTBOUND LANES
RIGHT-OF-WAY FENCE
468+00
470+00
472+00
474+00
476+00
478+00
480+00
482+00
484+00
486+00

Potentiometric Map
Coal Zone
10-22-01 Water Levels (Coal Zone)

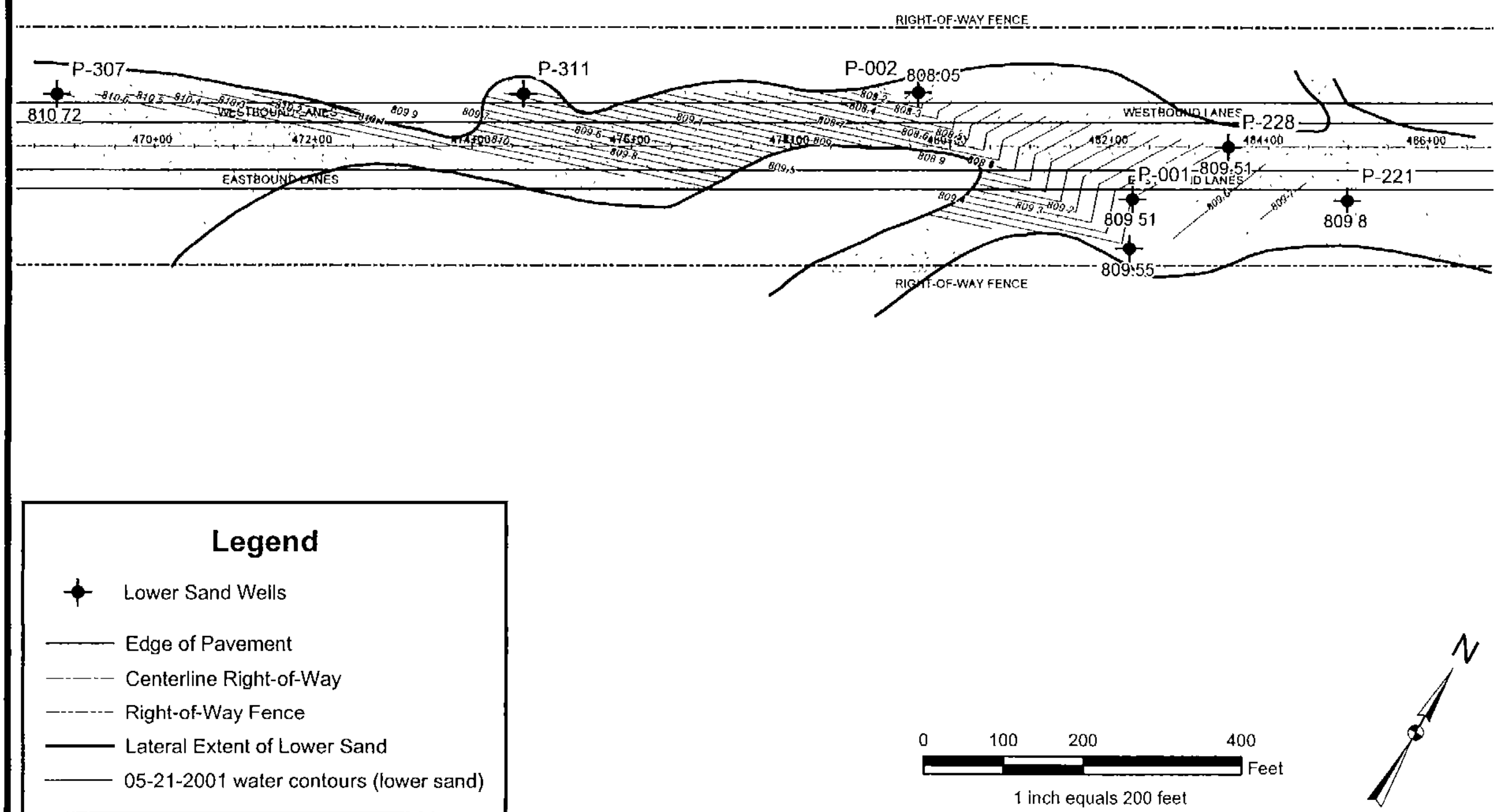




Potentiometric Map
Coal Zone
5-28-02 Water Levels (Coal Zone)
Legend
Coal Zone Wells
Edge of Pavement
Centerline Right-of-Way
Right-of-Way Fence
05-28-2002 water contours (coal)
0
100
200
400
Feet
1 inch equals 200 feet
N
P-225
808.93
P-227
808 84
P-223
809 01
P-226
808.85
P-228
P-221
810.34
PW-001
810.01
P-224
810.3
P-001
810.3
P-222
810.3
P-305
808
P-002
809.04
P-306
809.86
P-303
809.17
P-310
809.49
P-304
P-308
810 57
P-301
808.88
P-307
809.27
P-309
809.88
P-302
810 29
WESTBOUND LANES
EASTBOUND LANES
RIGHT-OF-WAY FENCE

Potentiometric Map
Lower Sand

5-21-01 Water Levels (Lower Sand)

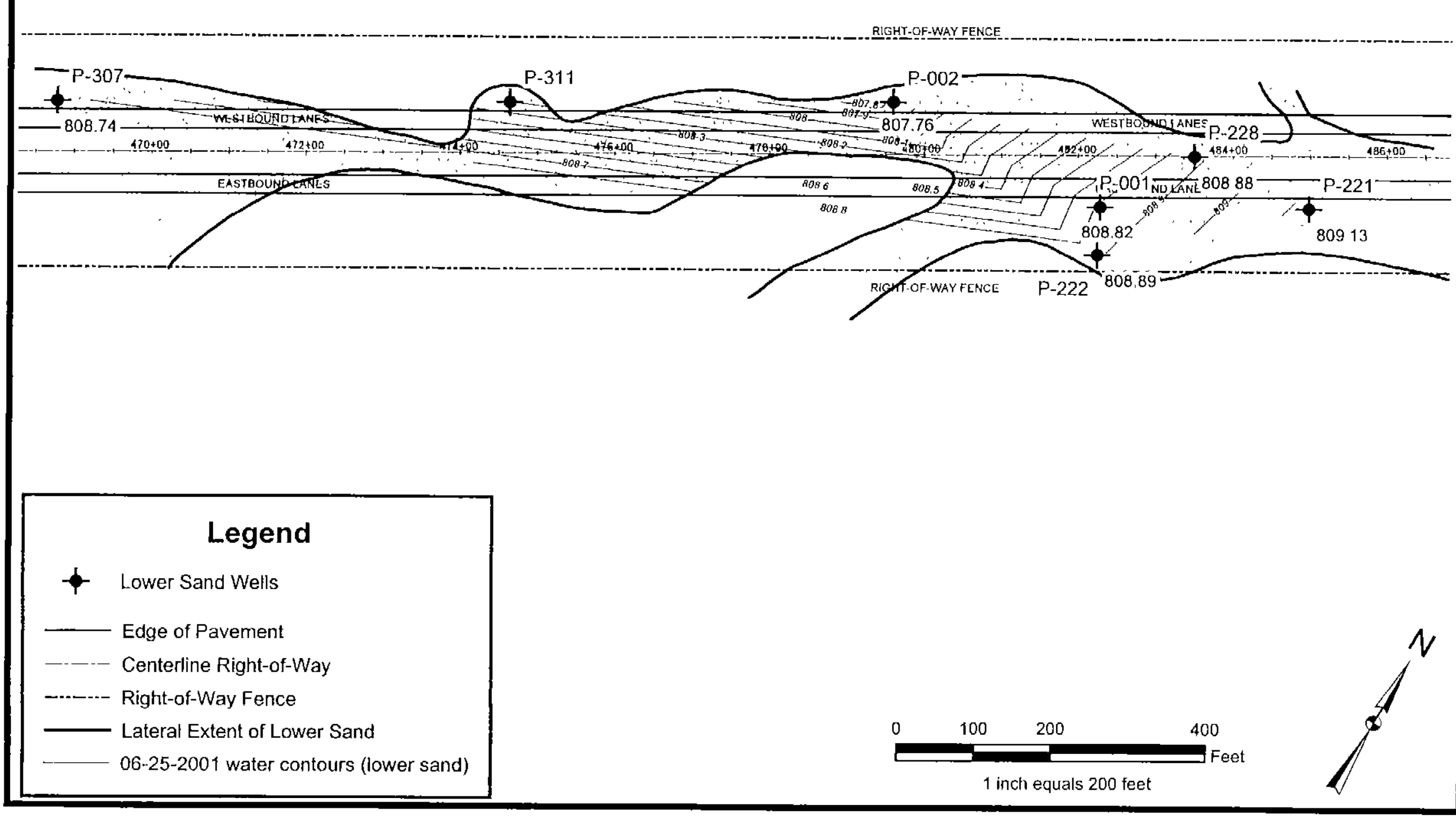


Legend

- Lower Sand Wells
- Edge of Pavement
- Centerline Right-of-Way
- Right-of-Way Fence
- Lateral Extent of Lower Sand
- 05-21-2001 water contours (lower sand)

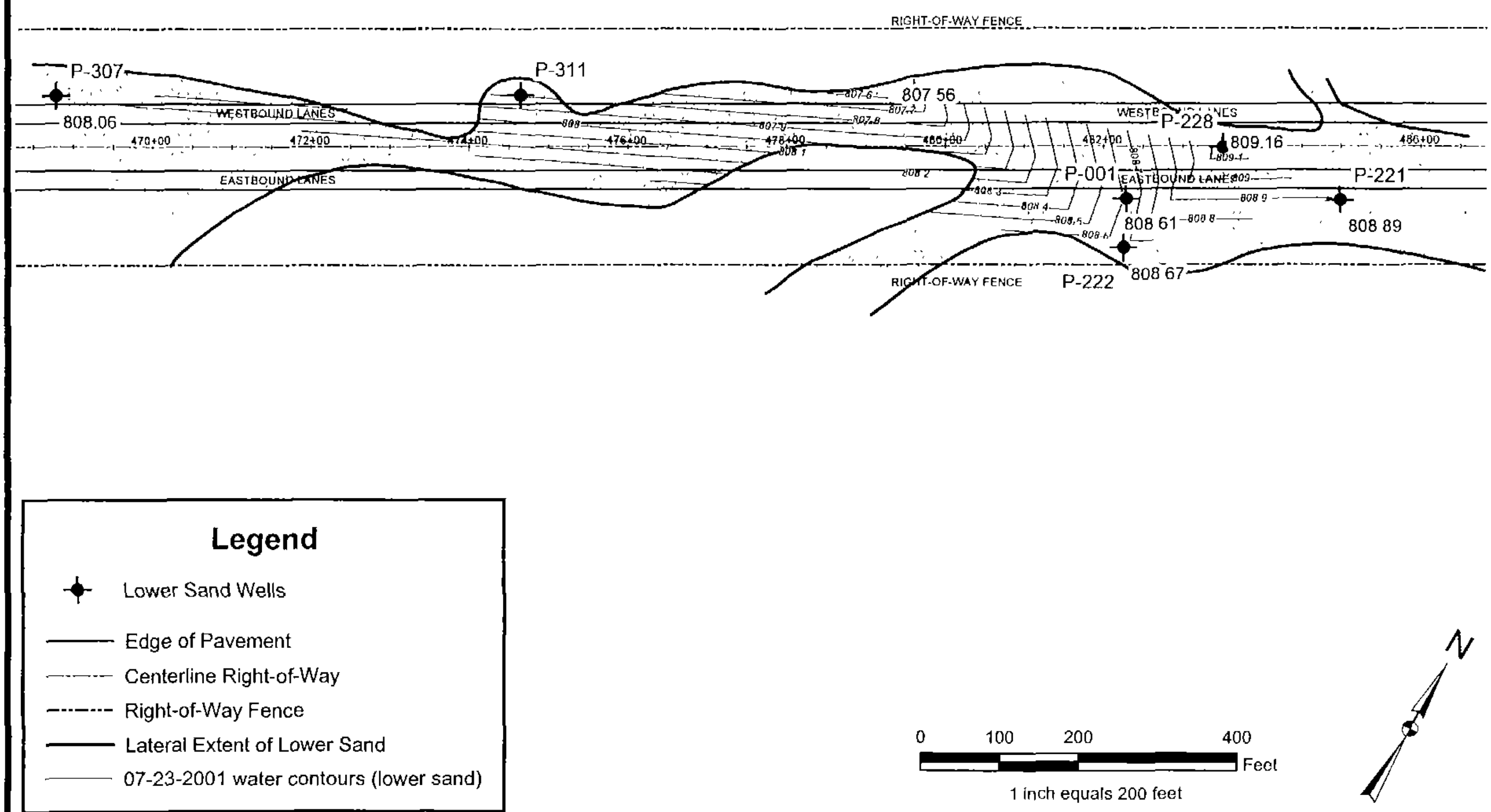
Potentiometric Map
Lower Sand

6-25-01 Water Levels (Lower Sand)



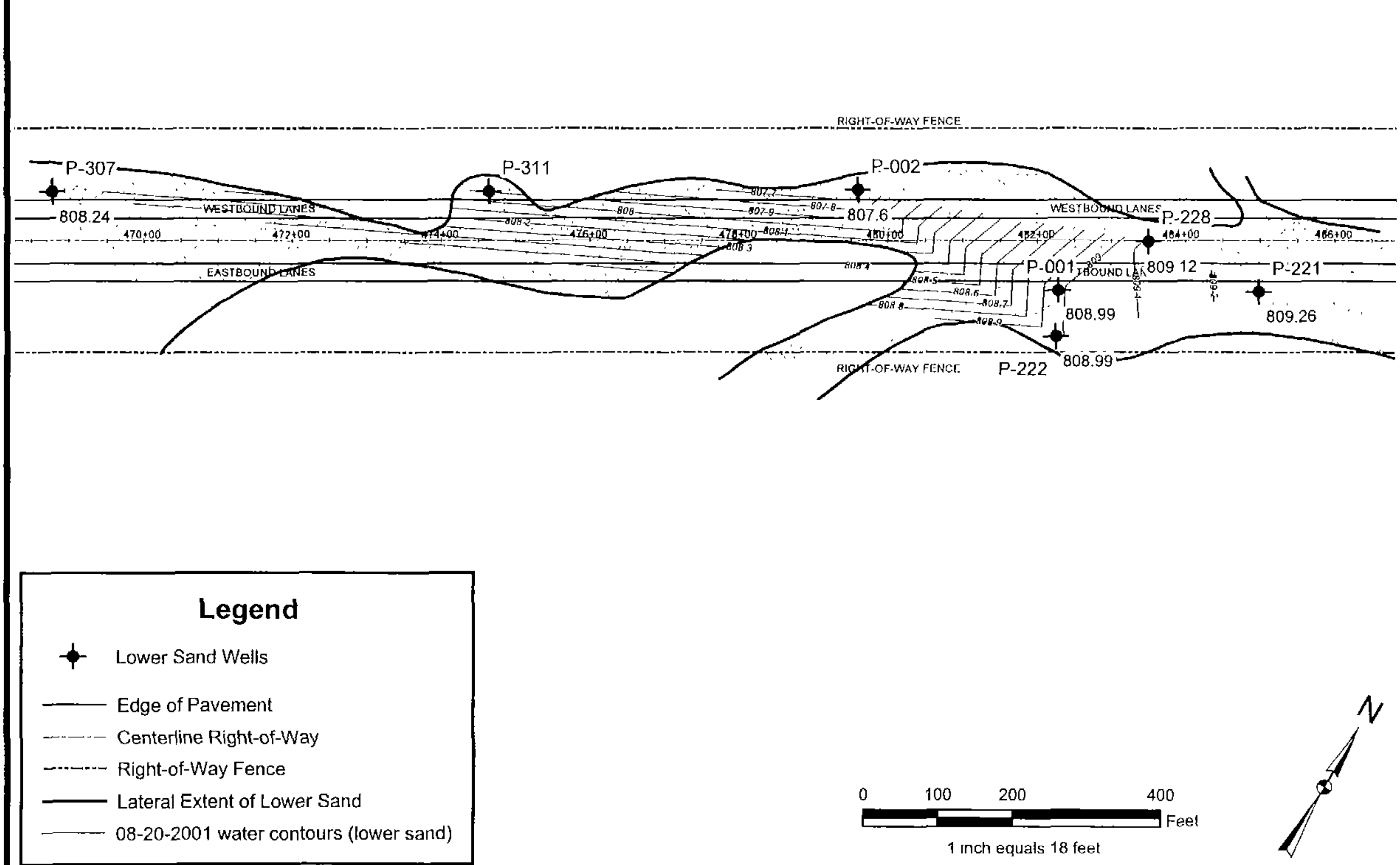
Potentiometric Map
Lower Sand

7-23-01 Water Levels (Lower Sand)



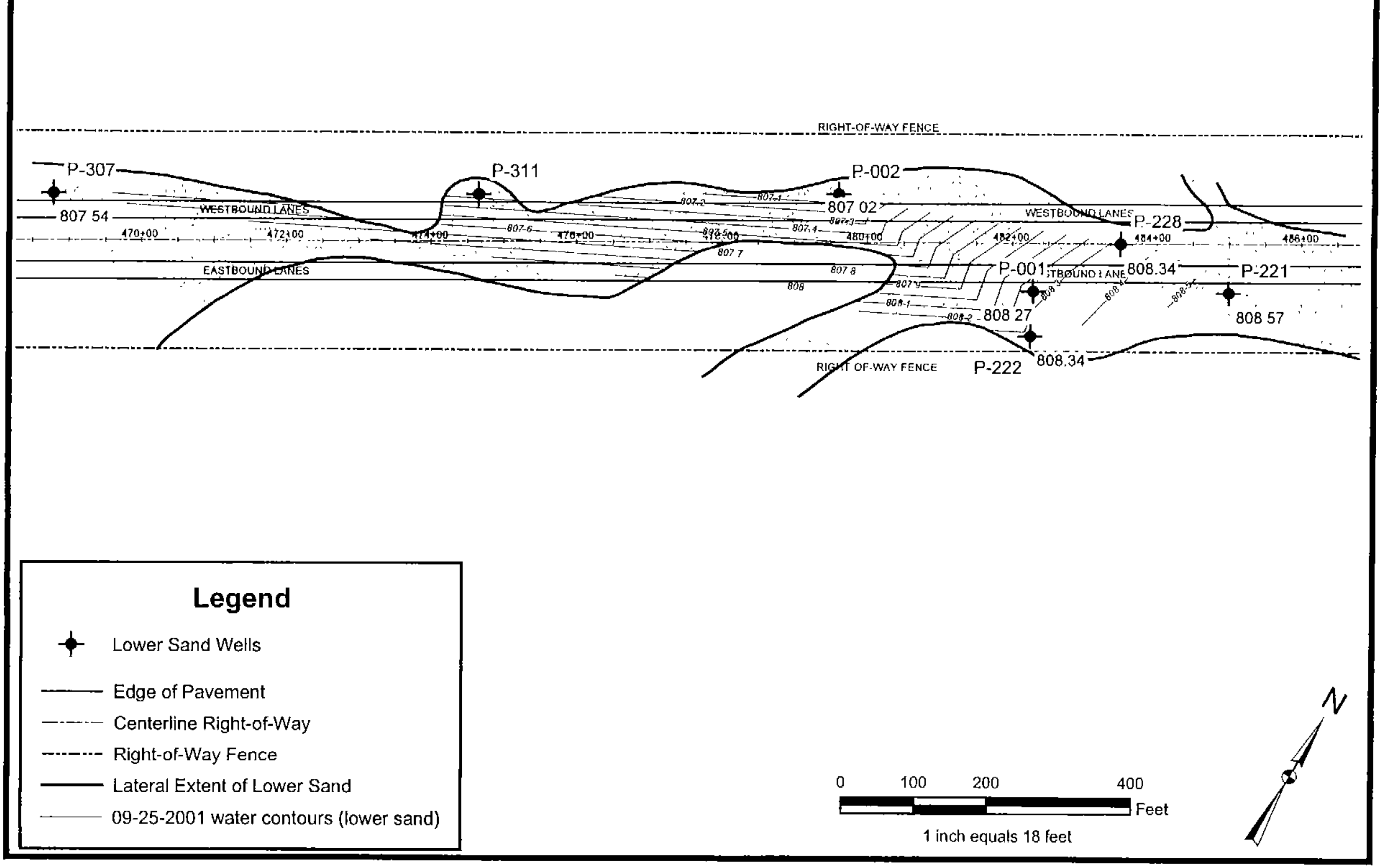
Potentiometric Map
Lower Sand

8-20-01 Water Levels (Lower Sand)



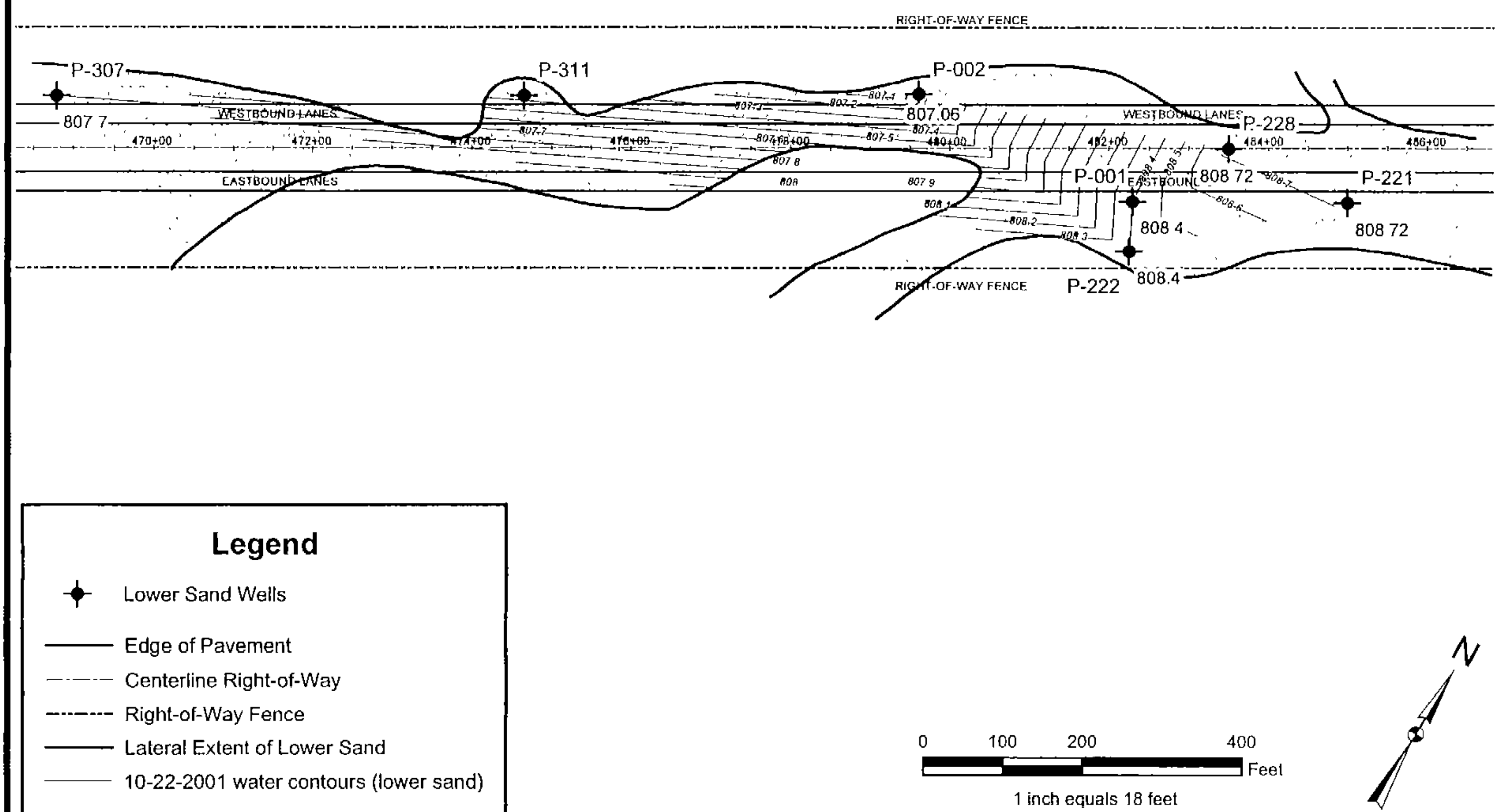
Potentiometric Map
Lower Sand

9-25-01 Water Levels (Lower Sand)



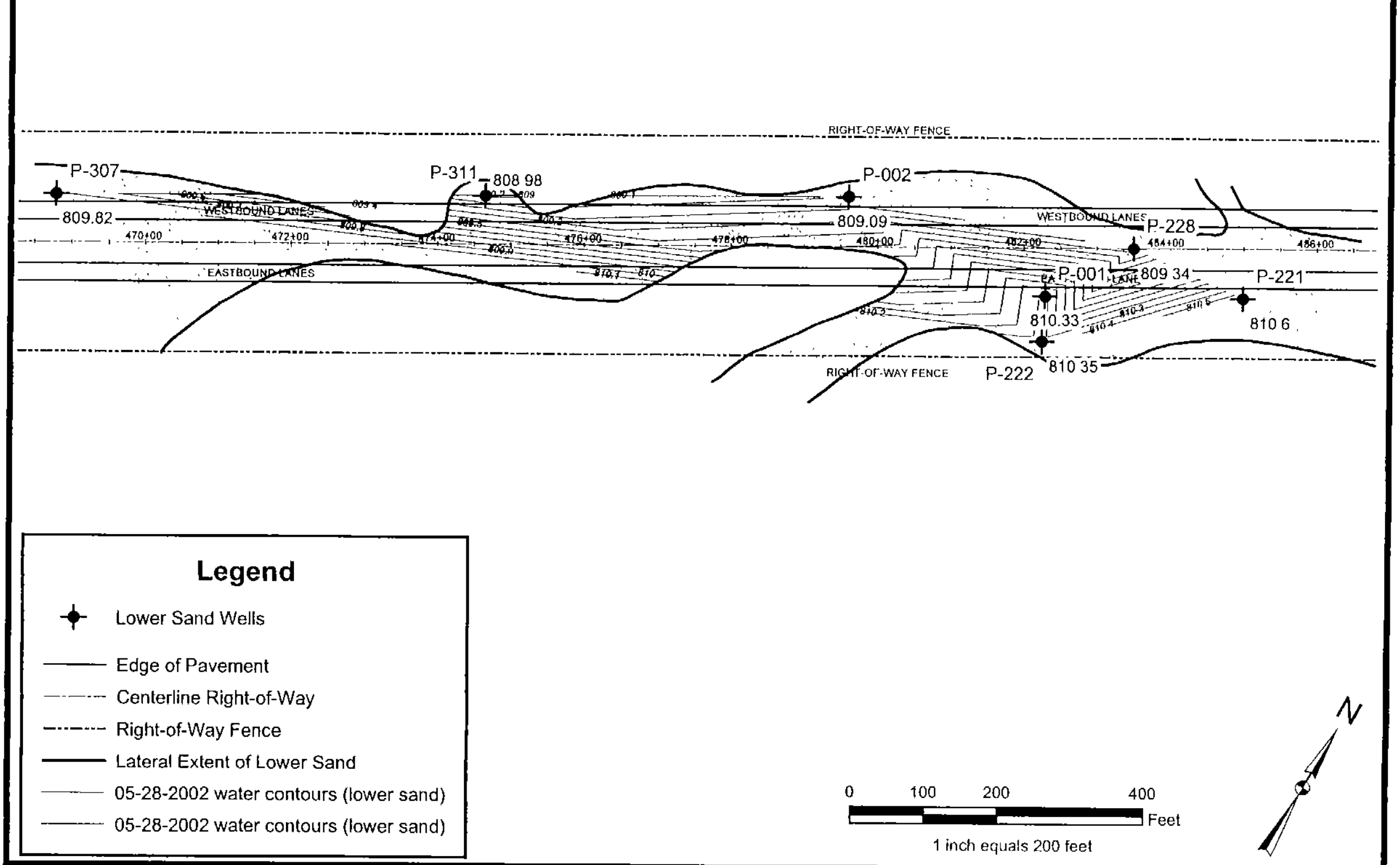
Potentiometric Map
Lower Sand

10-22-01 Water Levels (Lower Sand)



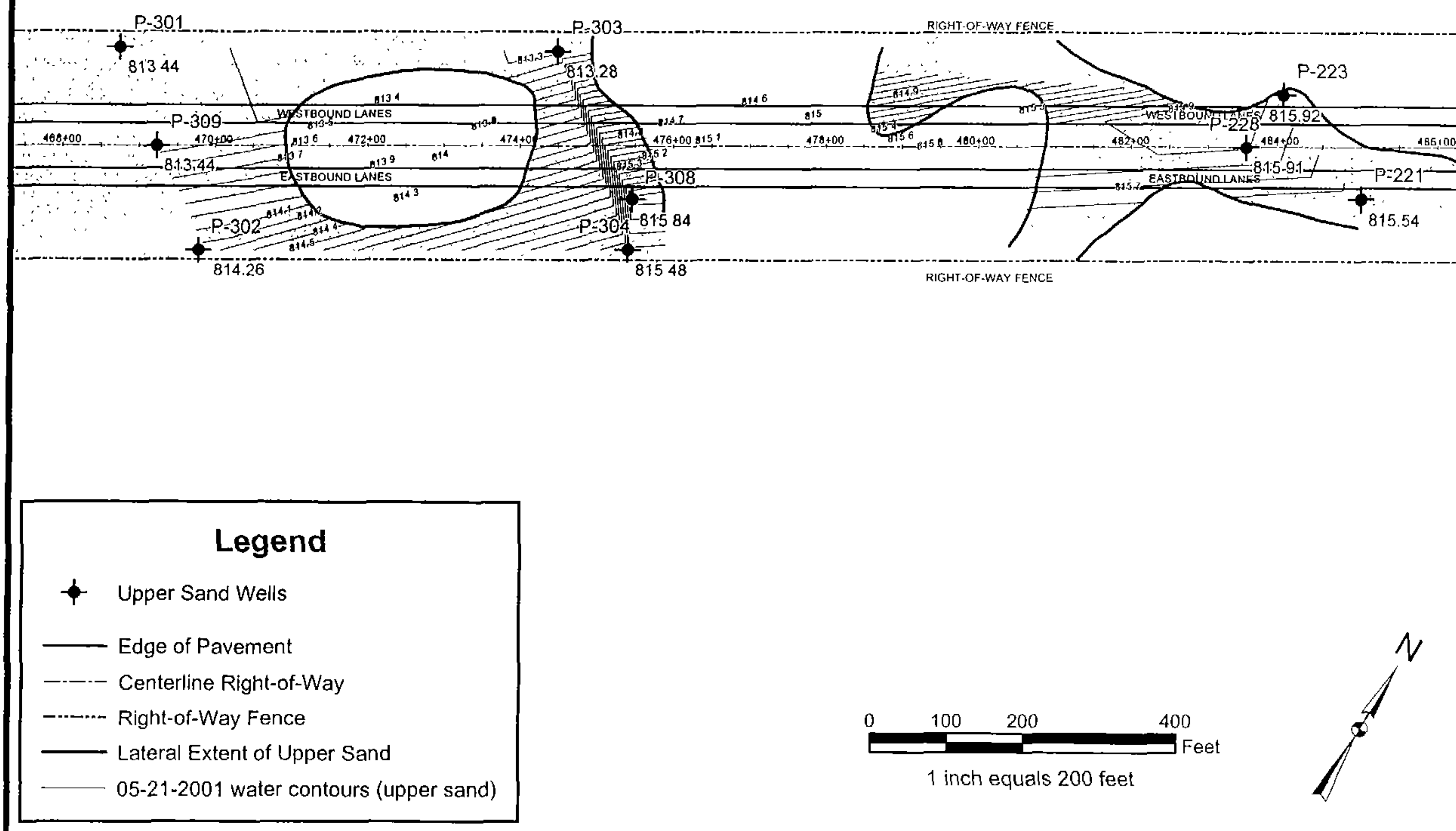
Potentiometric Map
Lower Sand

5-28-02 Water Levels (Lower Sand)



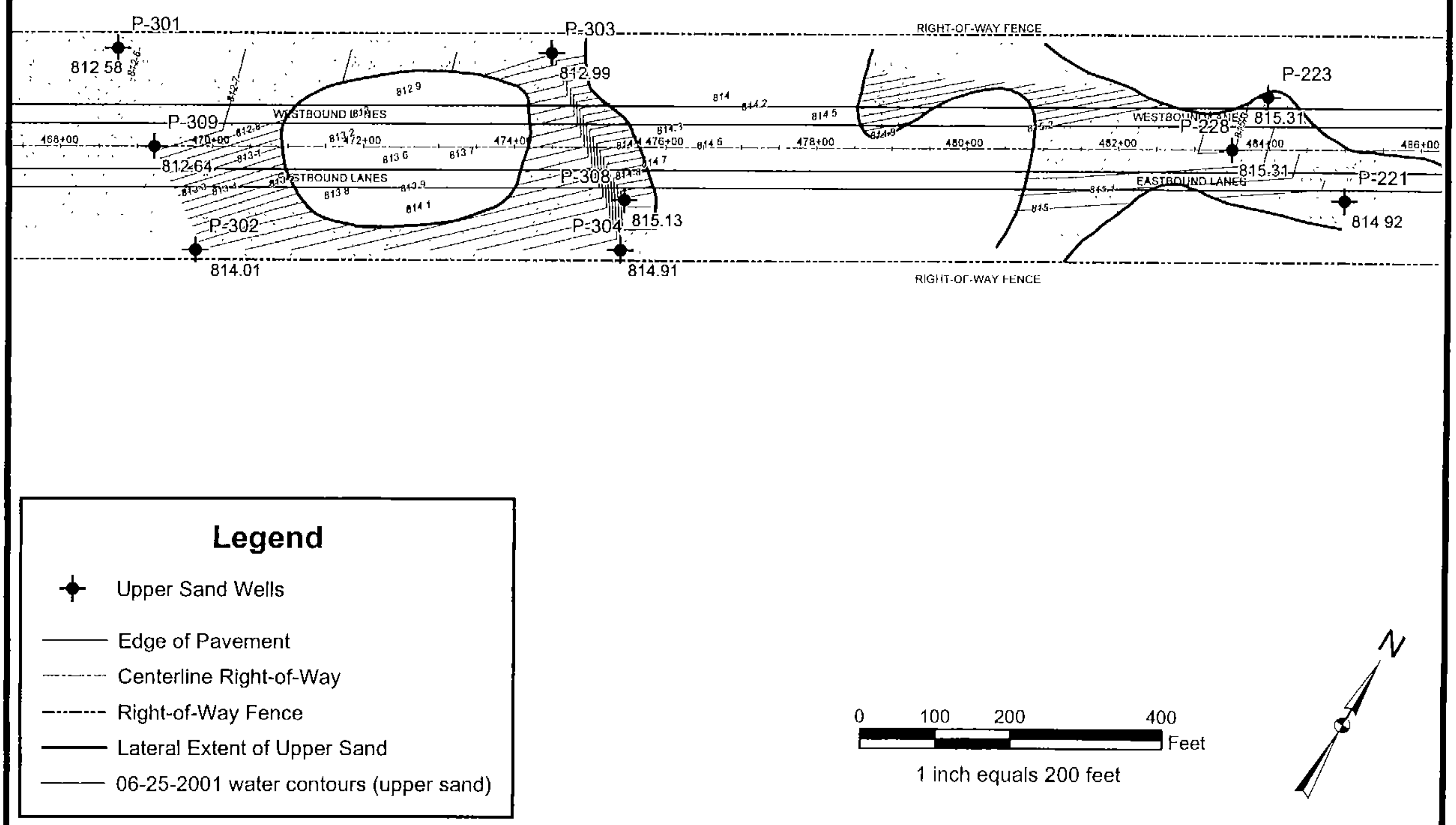
Potentiometric Map
Upper Sand

5-21-01 Water Levels (Upper Sand)



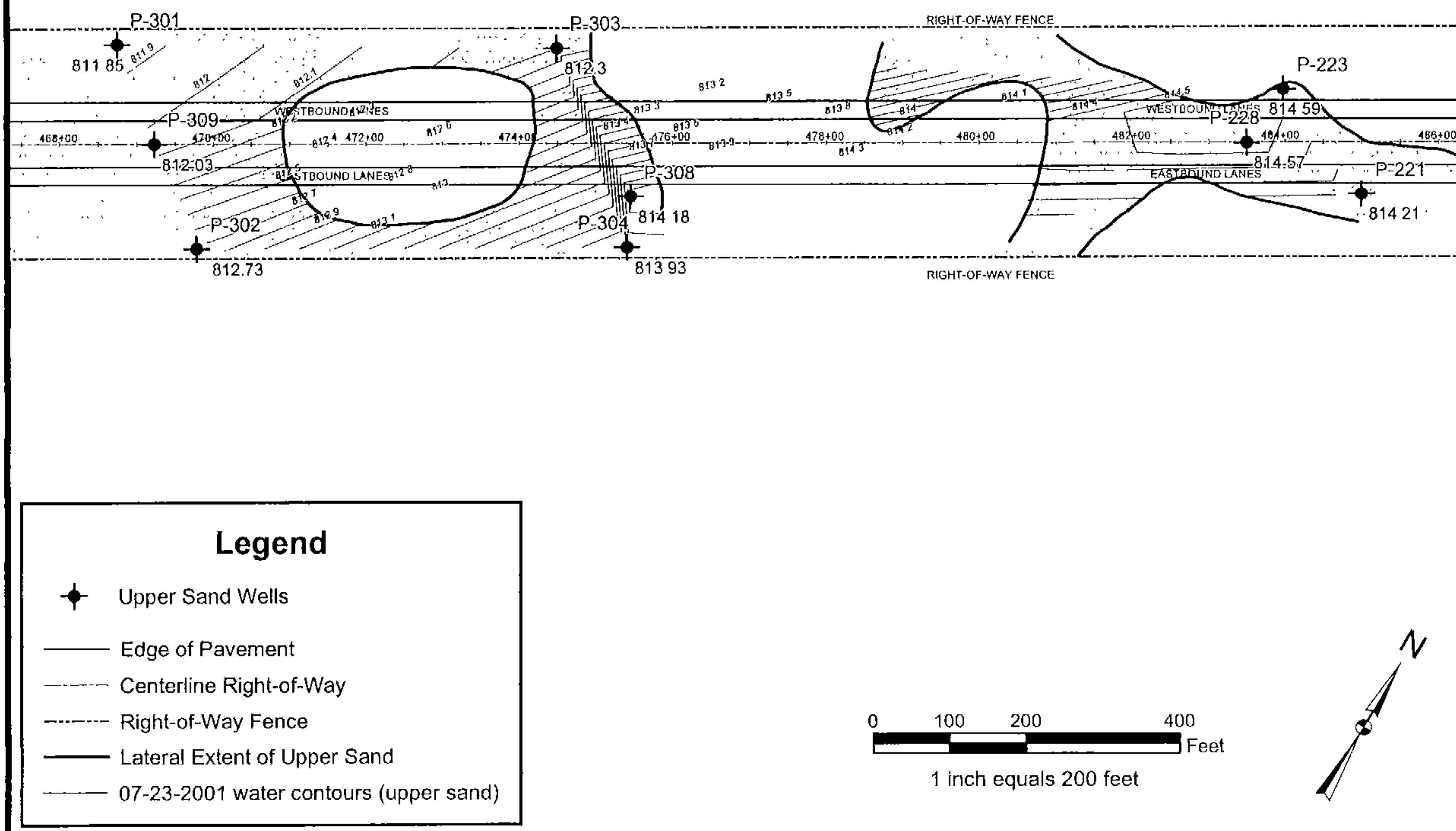
Potentiometric Map
Upper Sand

6-25-01 Water Levels (Upper Sand)



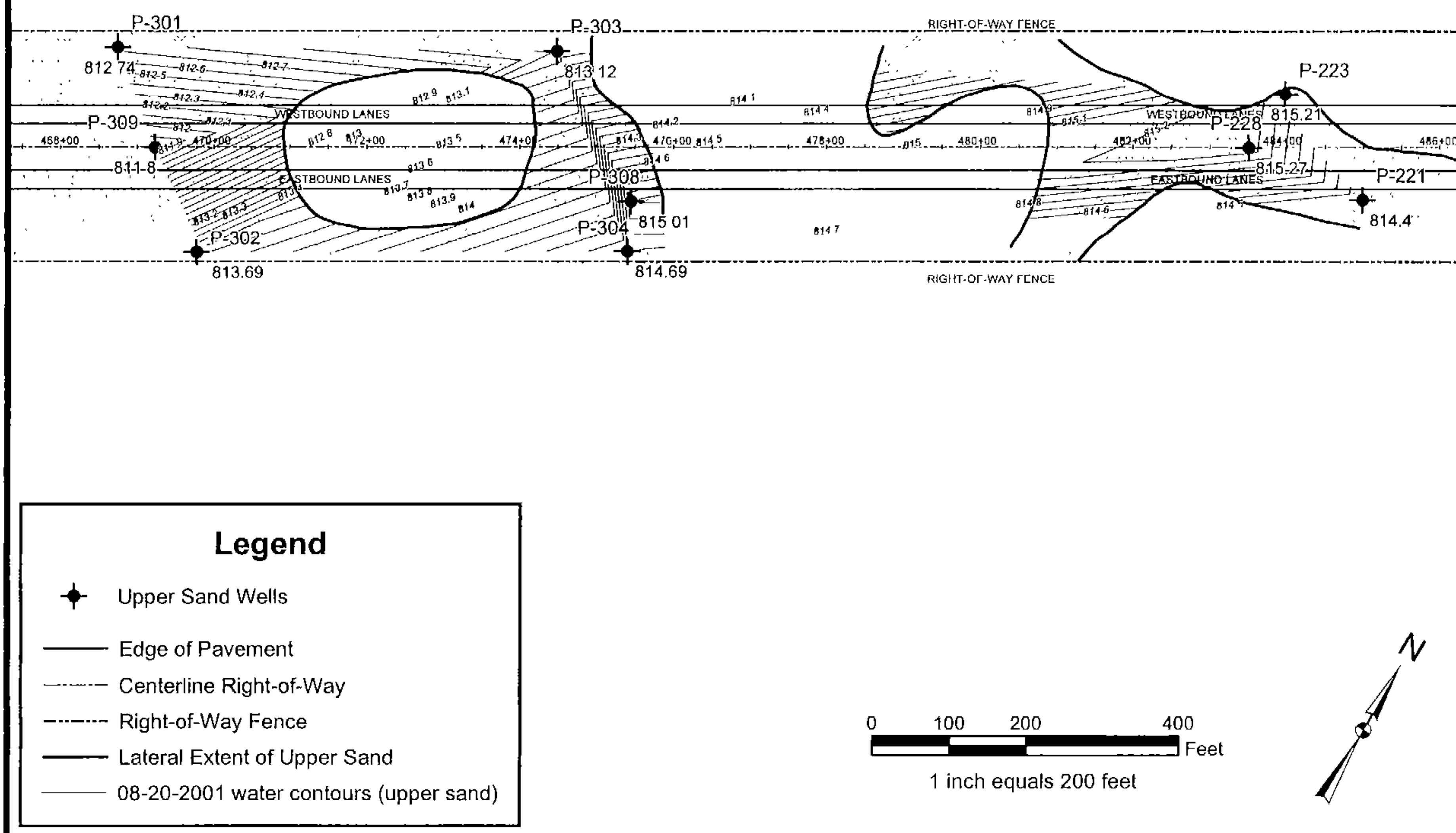
Potentiometric Map
Upper Sand

7-23-01 Water Levels (Upper Sand)



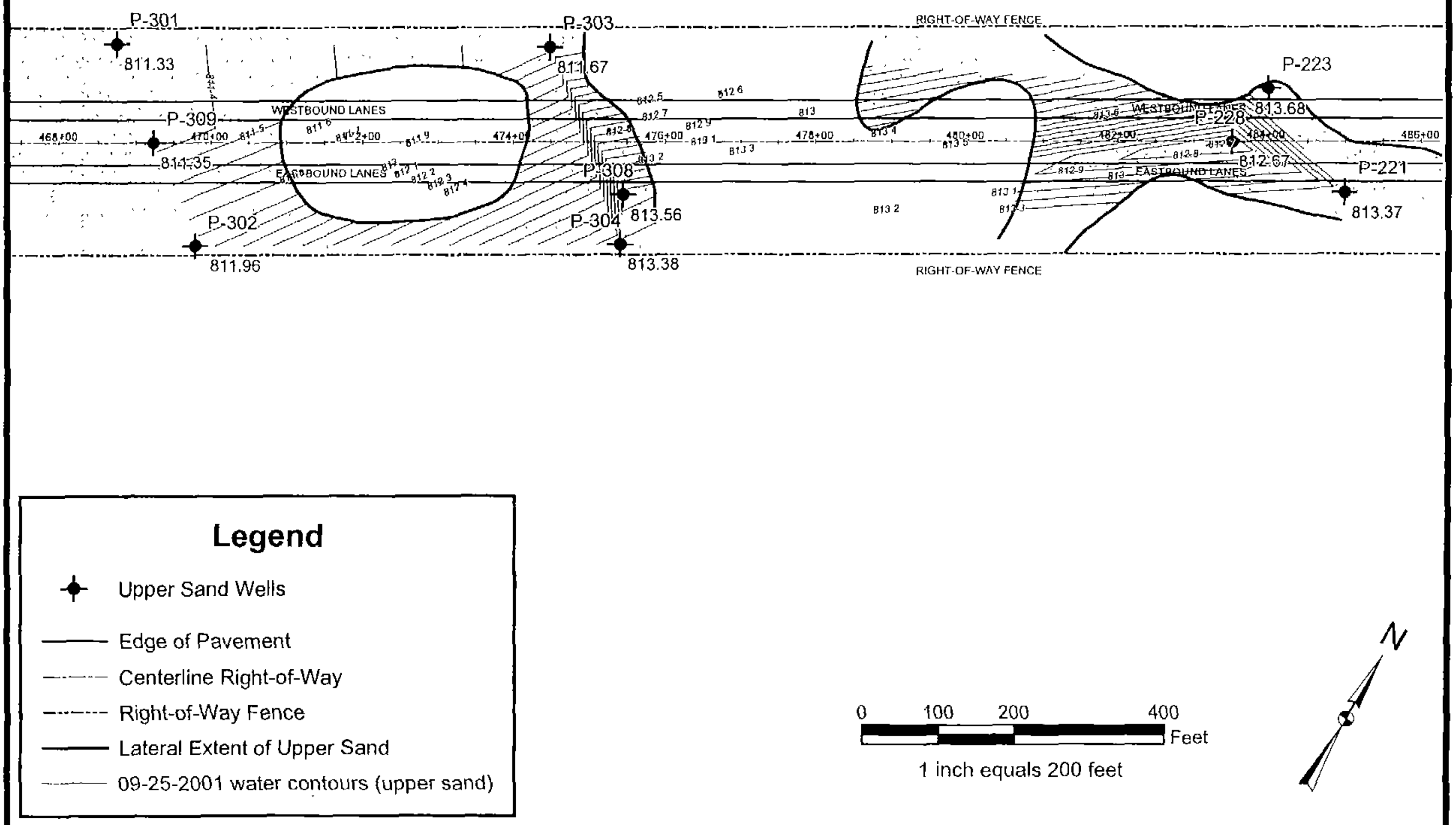
Potentiometric Map
Upper Sand

08-20-01 Water Levels (Upper Sand)



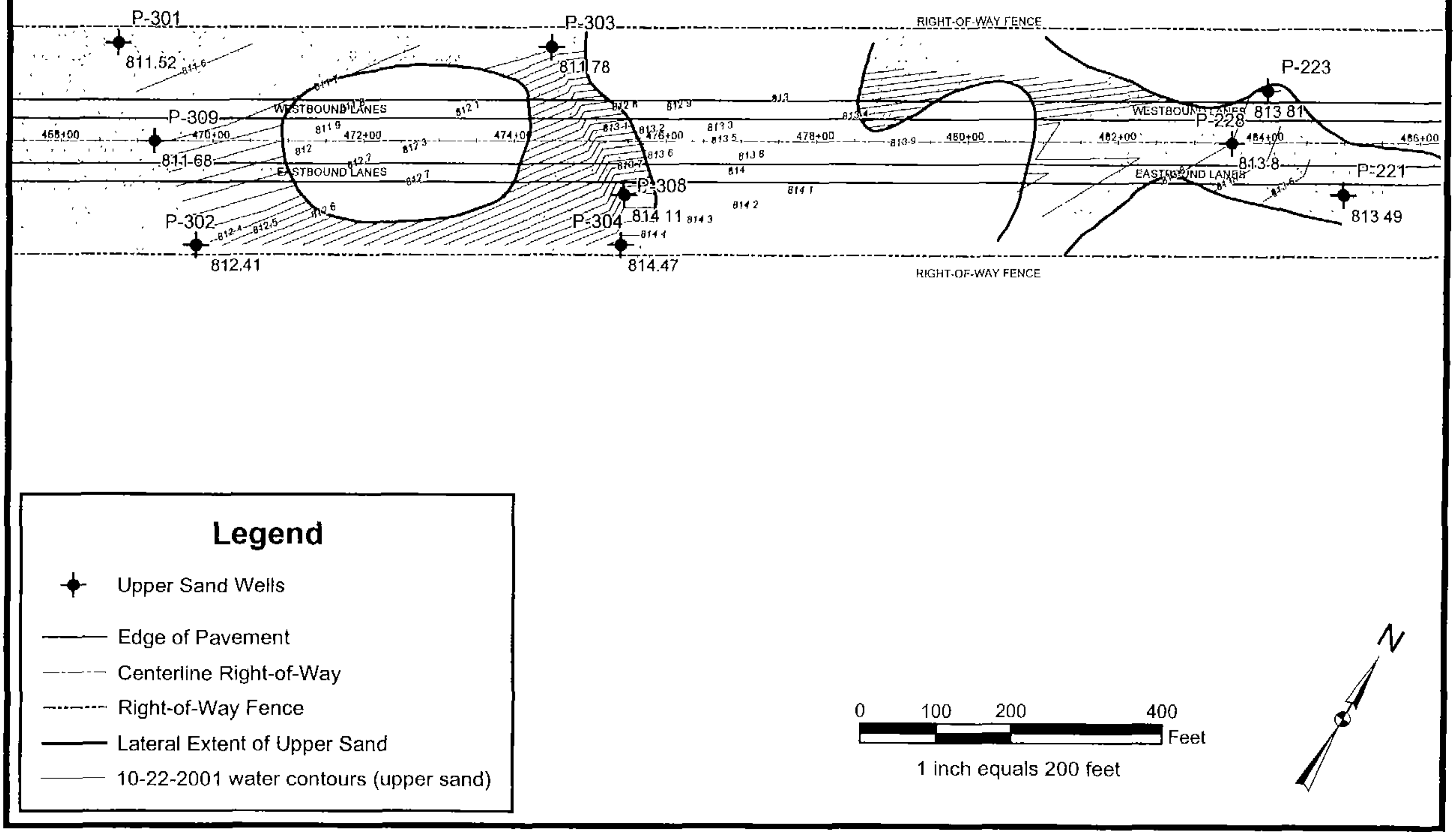
Potentiometric Map
Upper Sand

9-25-01 Water Levels (Upper Sand)



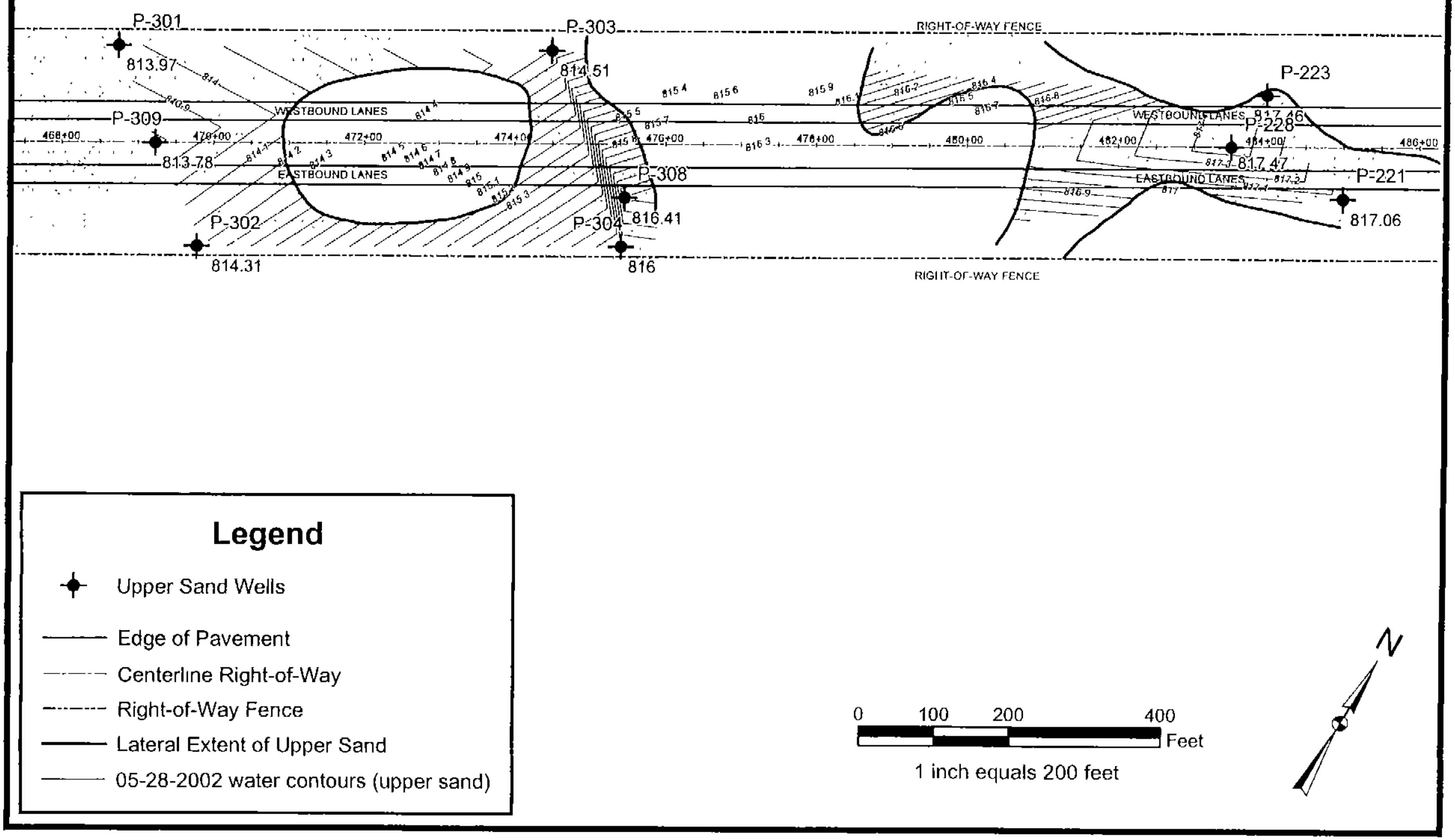
Potentiometric Map
Upper Sand

10-22-01 Water Levels (Upper Sand)



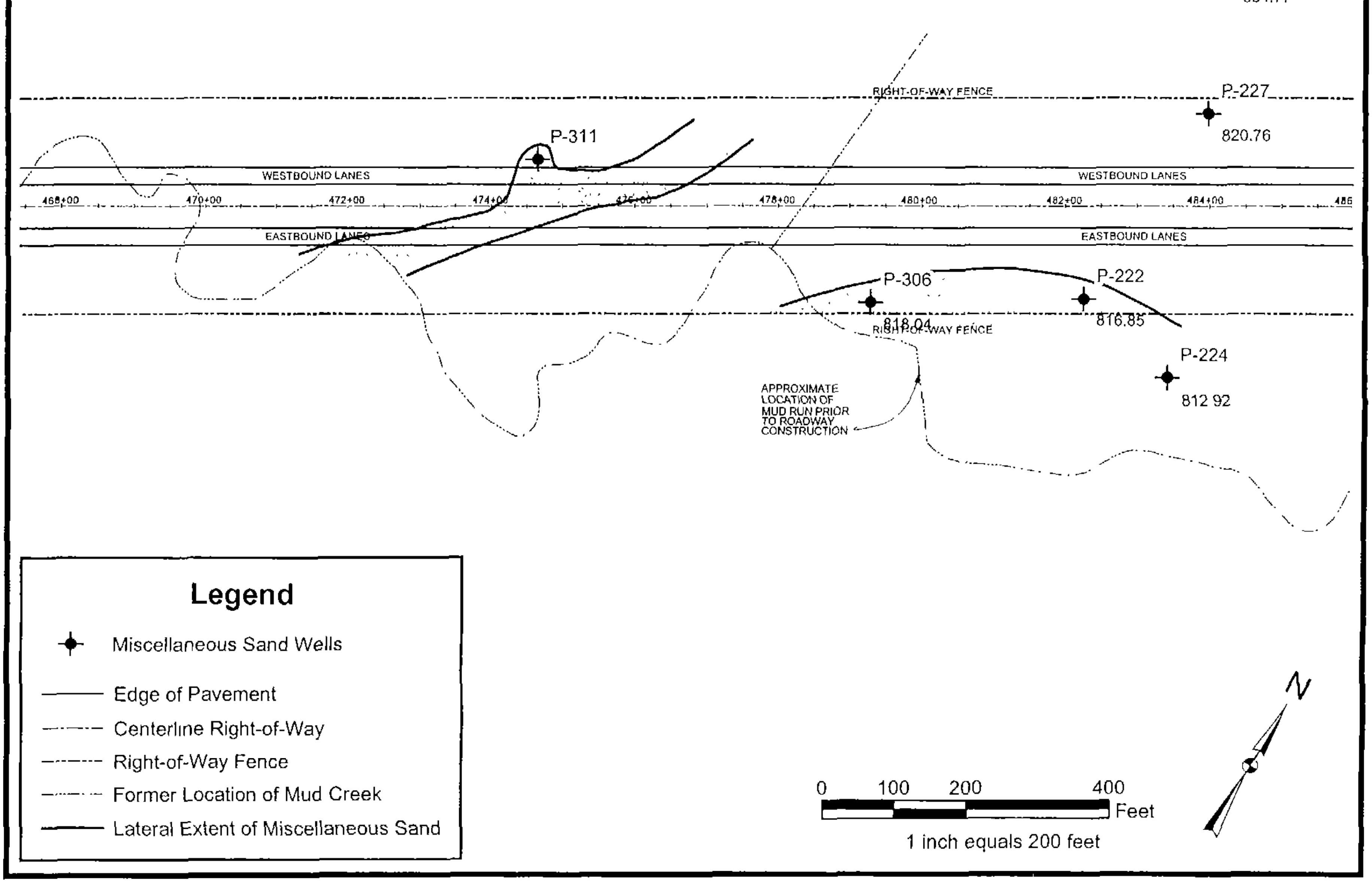
Potentiometric Map
Upper Sand

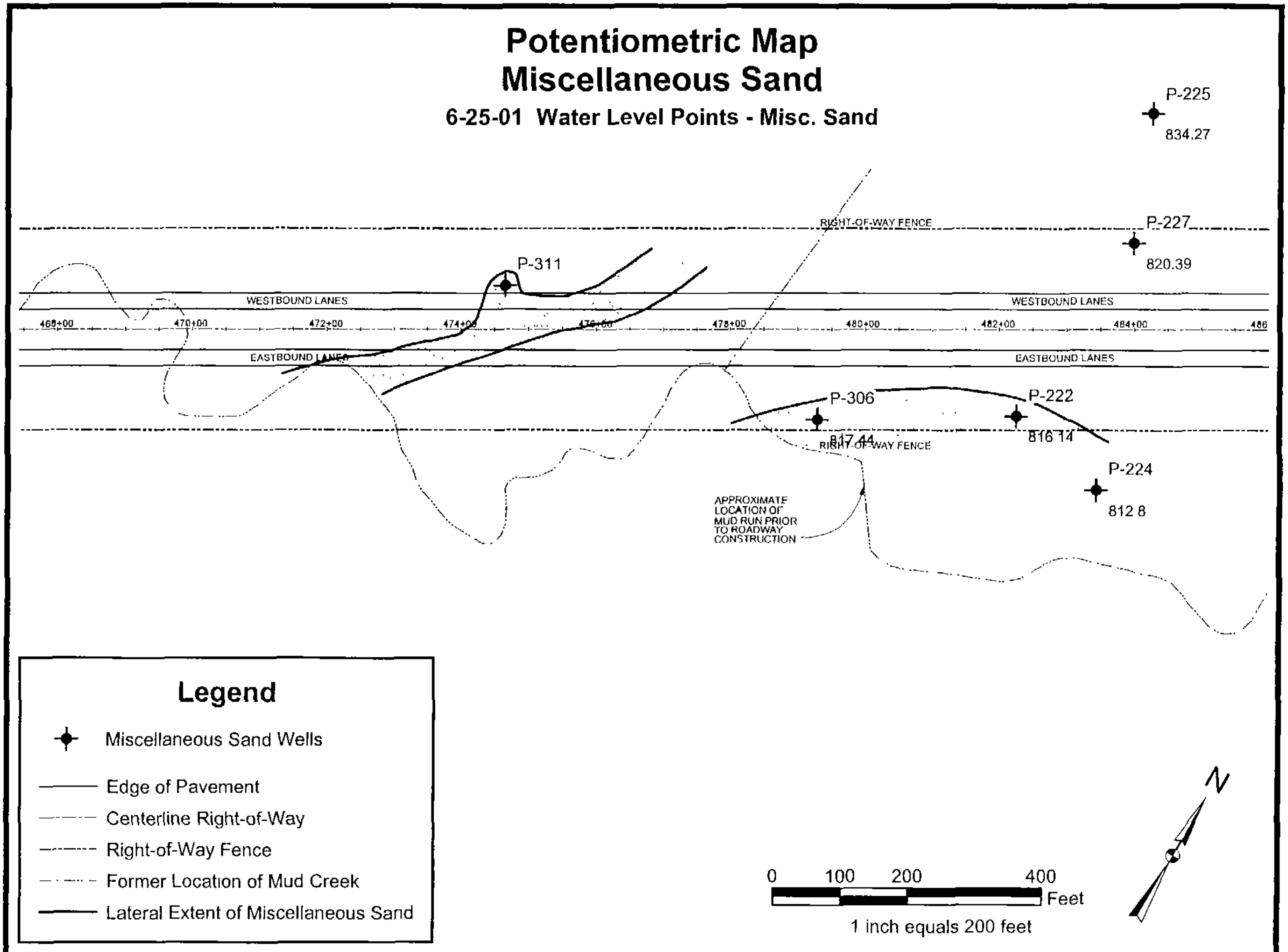
5-28-02 Water Levels (Upper Sand)



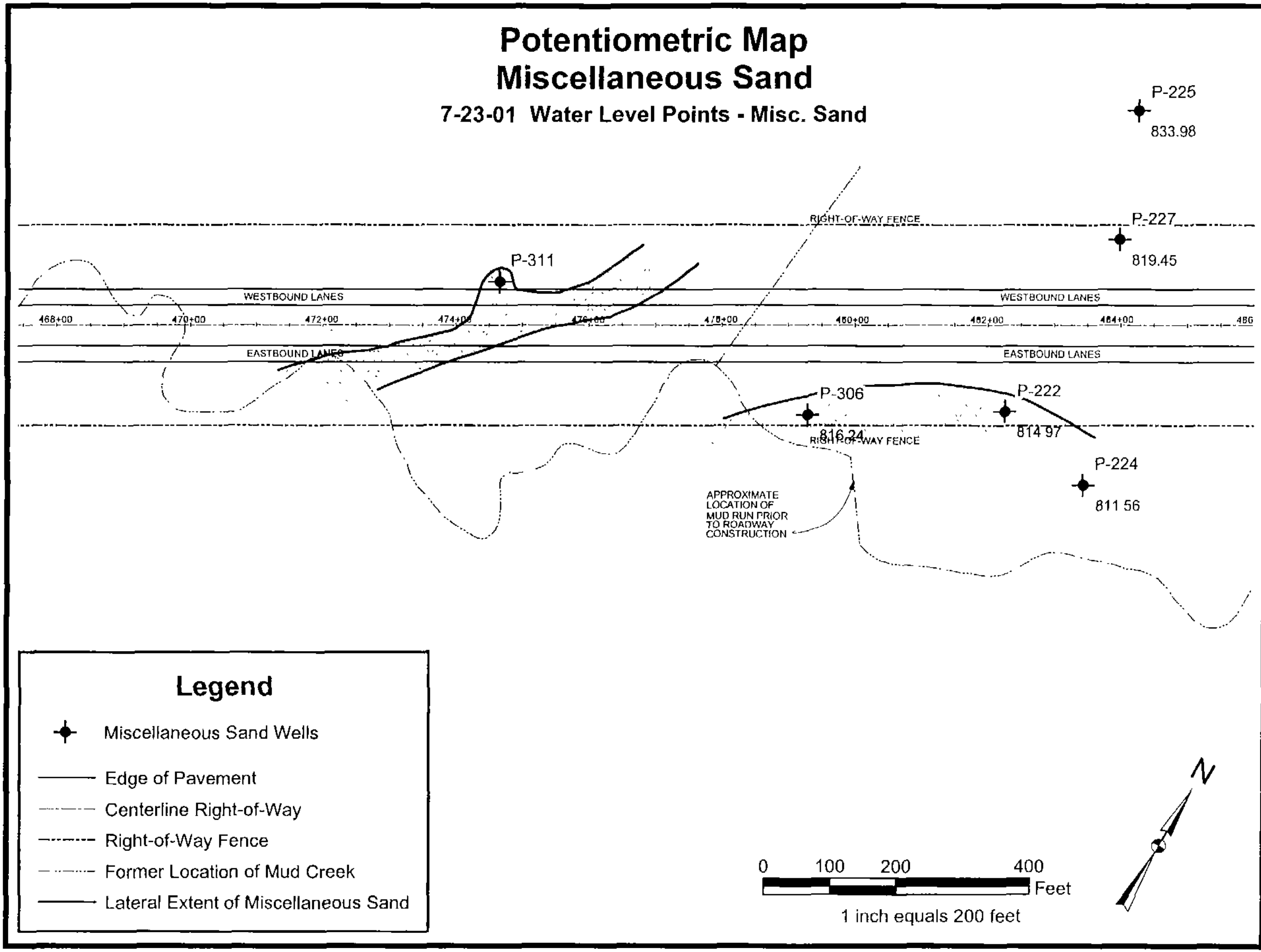
Potentiometric Map
Miscellaneous Sand

5-21-01 Water Level Points - Misc. Sand

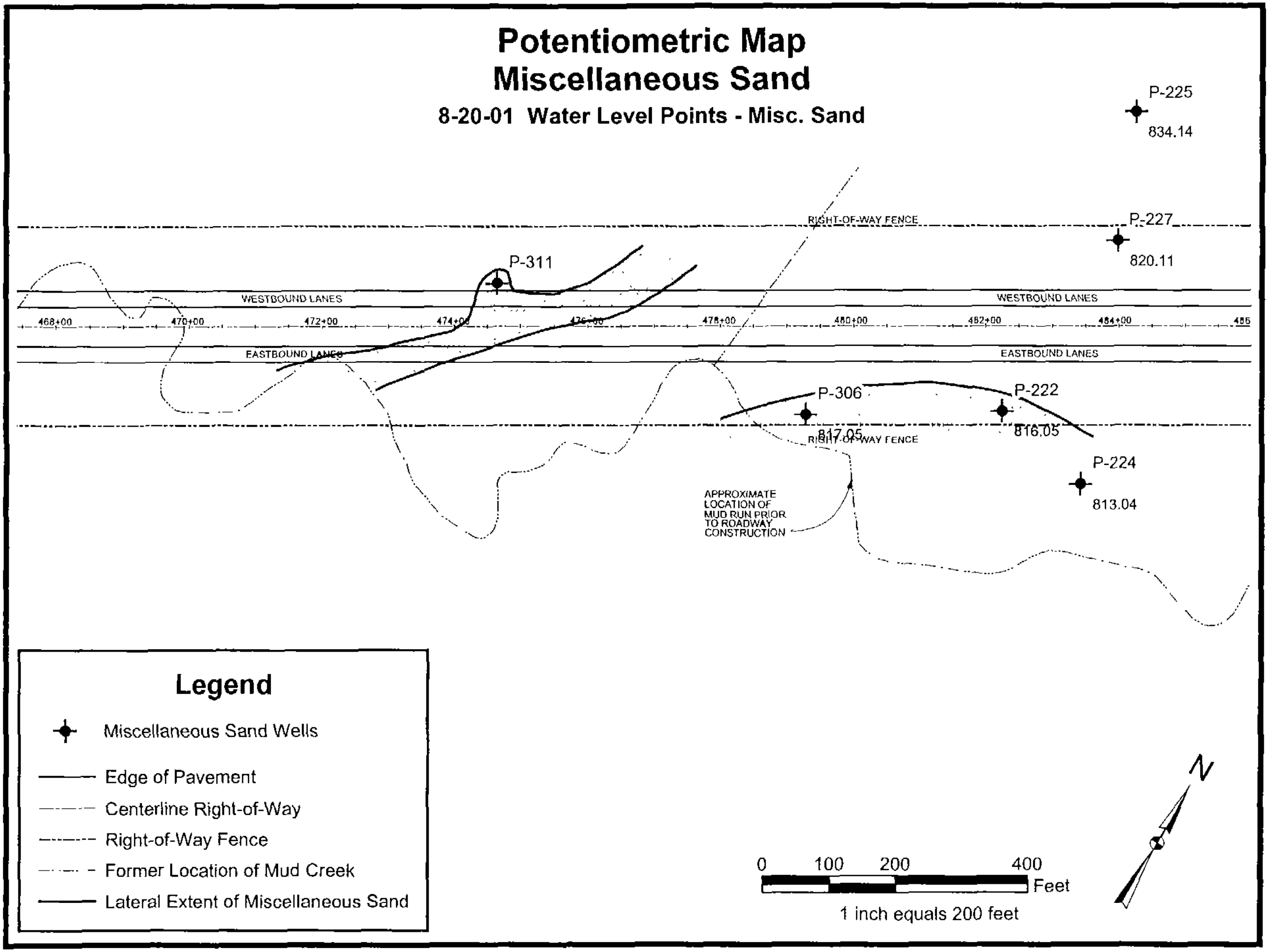


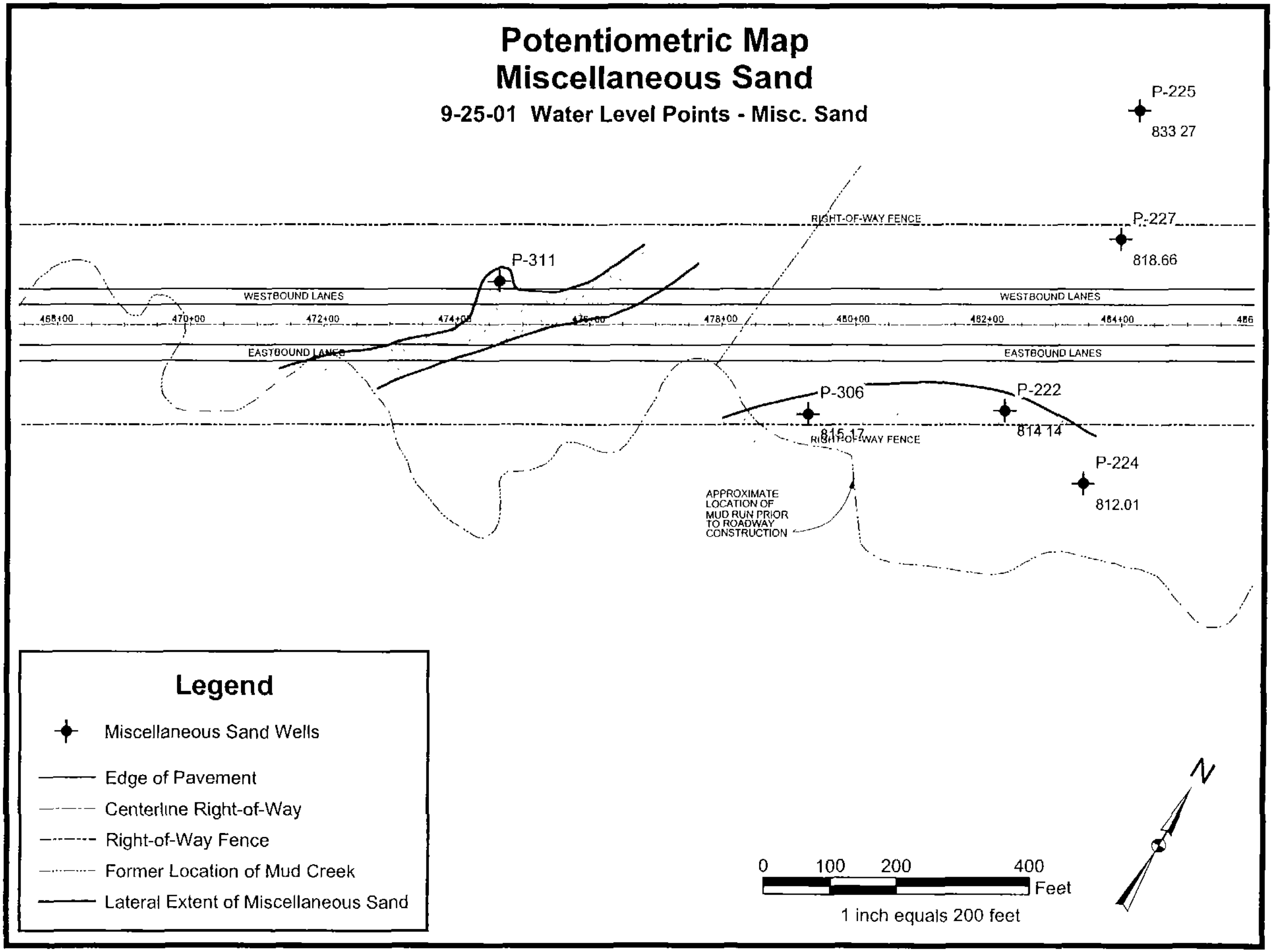


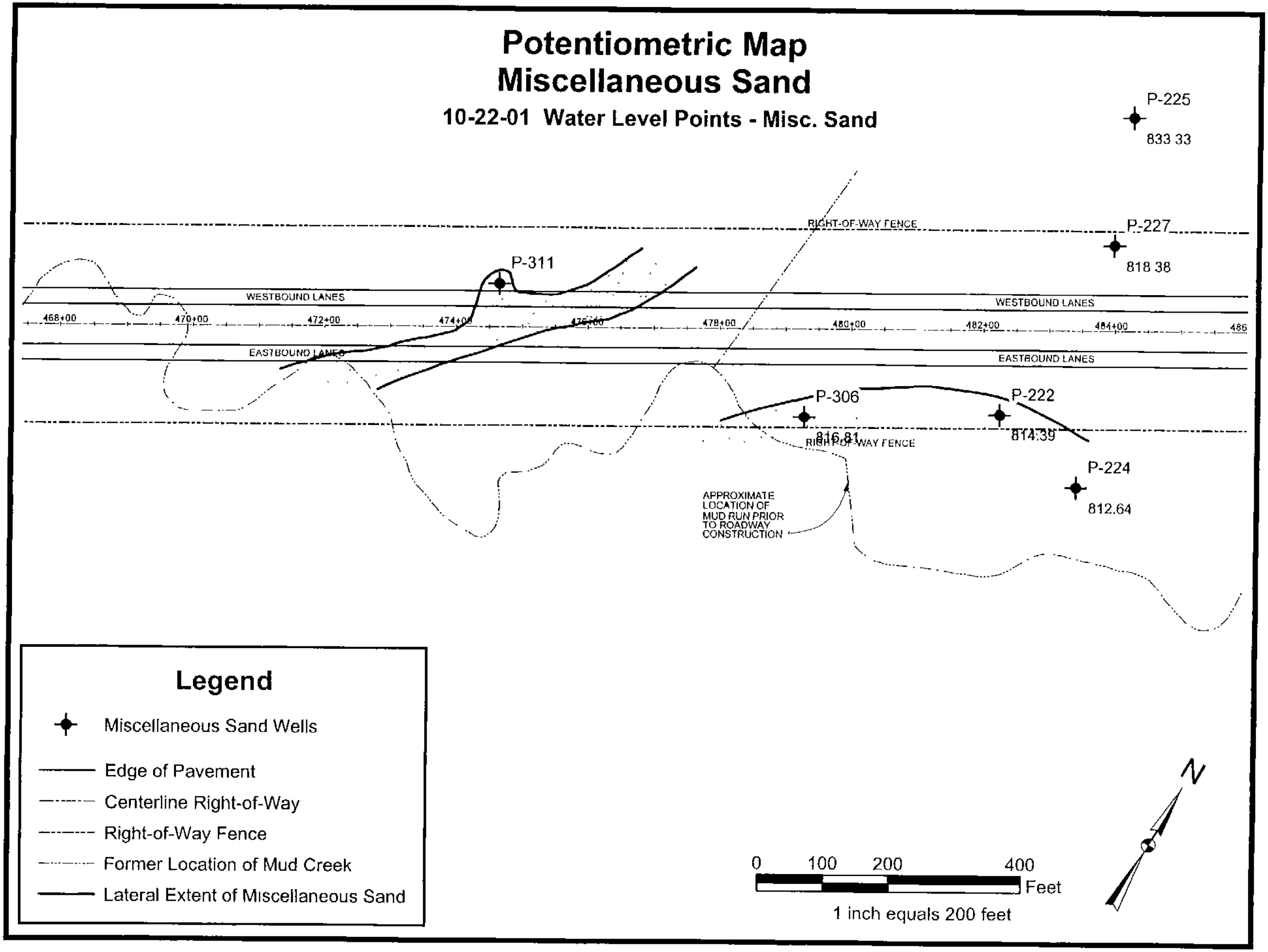
Potentiometric Map
Miscellaneous Sand
6-25-01 Water Level Points - Misc. Sand
P-225
834.27
P-227
820.39
P-311
P-306
817.44
P-222
816 14
P-224
812 8
RIGHT-OF-WAY FENCE
WESTBOUND LANES
EASTBOUND LANES
468+00
470+00
472+00
474+00
476+00
478+00
480+00
482+00
484+00
486
APPROXIMATE LOCATION OF MUD RUN PRIOR TO ROADWAY CONSTRUCTION
Legend
Miscellaneous Sand Wells
Edge of Pavement
Centerline Right-of-Way
Right-of-Way Fence
Former Location of Mud Creek
Lateral Extent of Miscellaneous Sand
0
100
200
400
Feet
1 inch equals 200 feet
N

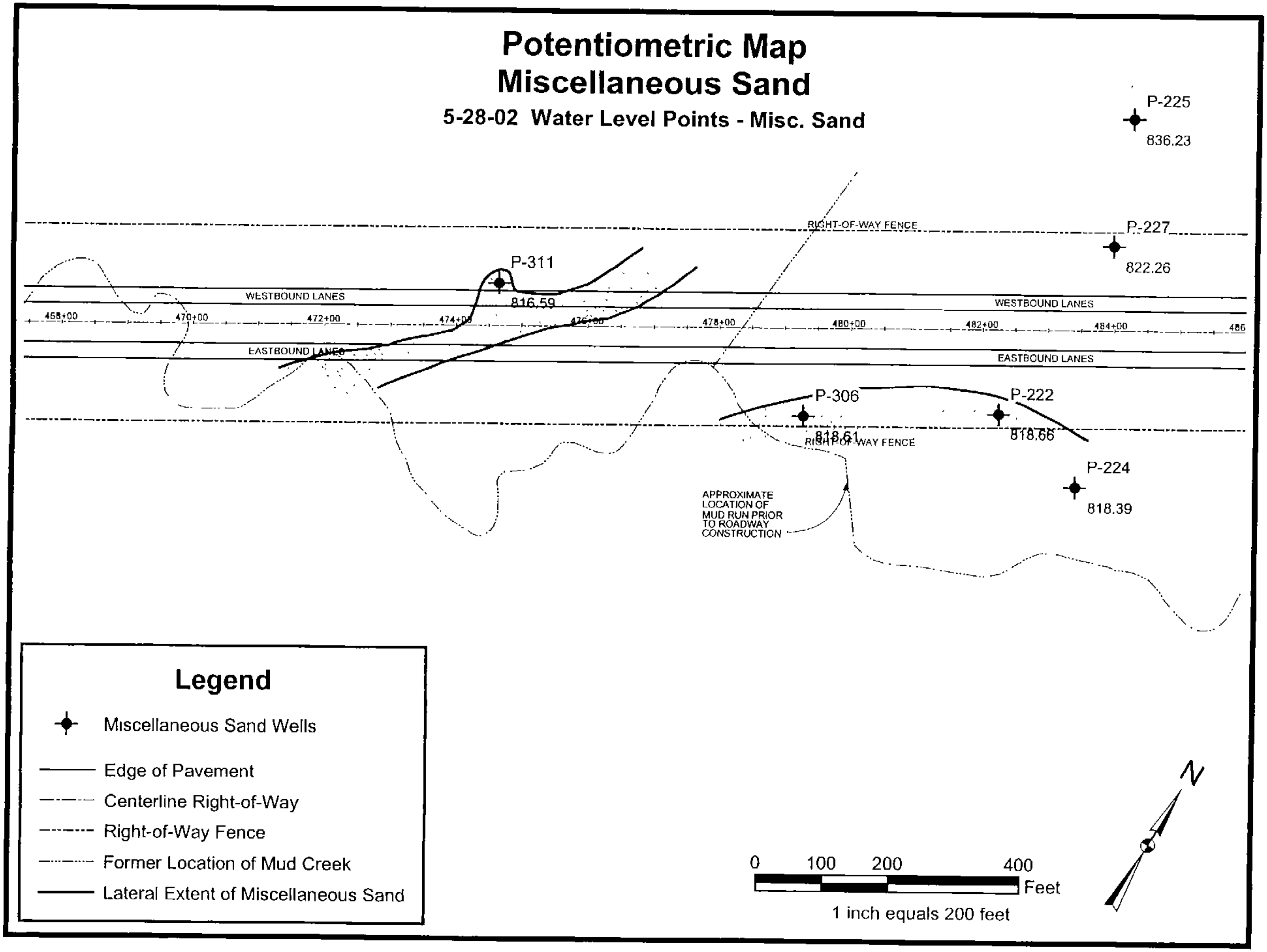


Potentiometric Map
Miscellaneous Sand
7-23-01 Water Level Points - Misc. Sand
P-225
833.98
P-227
819.45
P-311
P-306
816.24
P-222
814 97
P-224
811 56
RIGHT-OF-WAY FENCE
WESTBOUND LANES
EASTBOUND LANES
468+00
470+00
472+00
474+00
476+00
478+00
480+00
482+00
484+00
APPROXIMATE LOCATION OF MUD RUN PRIOR TO ROADWAY CONSTRUCTION
Legend
Miscellaneous Sand Wells
Edge of Pavement
Centerline Right-of-Way
Right-of-Way Fence
Former Location of Mud Creek
Lateral Extent of Miscellaneous Sand
0
100
200
400
Feet
1 inch equals 200 feet
N


Potentiometric Map
Miscellaneous Sand
8-20-01 Water Level Points - Misc. Sand
P-225
834.14
P-227
820.11
RIGHT-OF-WAY FENCE
P-311
WESTBOUND LANES
EASTBOUND LANES
468+00
470+00
472+00
474+00
476+00
478+00
480+00
482+00
484+00
486
P-306
817.05
P-222
816.05
P-224
813.04
APPROXIMATE LOCATION OF MUD RUN PRIOR TO ROADWAY CONSTRUCTION
Legend
Miscellaneous Sand Wells
Edge of Pavement
Centerline Right-of-Way
Right-of-Way Fence
Former Location of Mud Creek
Lateral Extent of Miscellaneous Sand
0
100
200
400
Feet
1 inch equals 200 feet
N


Potentiometric Map
Miscellaneous Sand
9-25-01 Water Level Points - Misc. Sand
P-225
833 27
P-227
818.66
P-311
RIGHT-OF-WAY FENCE
WESTBOUND LANES
EASTBOUND LANES
468+00
470+00
472+00
474+00
478+00
480+00
482+00
484+00
486
P-306
815.17
P-222
814 14
P-224
812.01
APPROXIMATE LOCATION OF MUD RUN PRIOR TO ROADWAY CONSTRUCTION
Legend
Miscellaneous Sand Wells
Edge of Pavement
Centerline Right-of-Way
Right-of-Way Fence
Former Location of Mud Creek
Lateral Extent of Miscellaneous Sand
0
100
200
400
Feet
1 inch equals 200 feet
N


Potentiometric Map
Miscellaneous Sand
10-22-01 Water Level Points - Misc. Sand
P-225
833 33
P-227
818 38
RIGHT-OF-WAY FENCE
P-311
WESTBOUND LANES
EASTBOUND LANES
468+00
470+00
472+00
474+00
476+00
478+00
480+00
482+00
484+00
486
P-306
816.81
P-222
814.39
RIGHT-OF-WAY FENCE
P-224
812.64
APPROXIMATE LOCATION OF MUD RUN PRIOR TO ROADWAY CONSTRUCTION
Legend
Miscellaneous Sand Wells
Edge of Pavement
Centerline Right-of-Way
Right-of-Way Fence
Former Location of Mud Creek
Lateral Extent of Miscellaneous Sand
0
100
200
400
Feet
1 inch equals 200 feet
N



Potentiometric Map
Miscellaneous Sand
5-28-02 Water Level Points - Misc. Sand
P-225
836.23
P-227
822.26
RIGHT-OF-WAY FENCE
P-311
816.59
WESTBOUND LANES
EASTBOUND LANES
458+00
470+00
472+00
474+00
476+00
478+00
480+00
482+00
484+00
486
P-306
818.61
P-222
818.66
P-224
818.39
APPROXIMATE LOCATION OF MUD RUN PRIOR TO ROADWAY CONSTRUCTION
Legend
Miscellaneous Sand Wells
Edge of Pavement
Centerline Right-of-Way
Right-of-Way Fence
Former Location of Mud Creek
Lateral Extent of Miscellaneous Sand
0
100
200
400
Feet
1 inch equals 200 feet
N

SECTION 9.2 - DATA SUMMARIES

Summary of Stratigraphic Data (feet)
GUE 70 - 14.10

Final Log No.	Old Log No	Drill Date	Location Station Easting	Location Offset rt=(-) Northing	Grd Elev	Boring Depth	Boring Type	Water Level	Base of Fill	Misc Sa from	Misc Sa to	Upper Sa from	Upper Sa to	Lower Sa from	Lower Sa to	Bedrx Surface	Voids from	Voids to	Voids from	Voids to	Voids from	Voids to	Coal Zone from	Coal Zone to	Material at Coal Zone Void	Material at Coal Zone Grout	Material at Coal Zone Coal
B-001	B-1	May-96	47,022.0	-36.0	822.5	65.0	Grout Cnfrmtn									41.0							60.5				X
B-002	B-2	Jul-96	47,370.0	58.0	823.8	65.0	Grout Cnfrmtn									46.0							62.8				X
B-003	TB-5	Sep-94	47,522.0	73.0	823.0	64.0	Pre-Grout									43.0	58.0	64.0					64.0	71.0	X		
B-004	B-4	Mar-95	48,363.0	-25.0	826.0	70.0	Pre-Grout	29.0				22.5	26.5	32.5	43.0	43.0	53.0	58.5	67.0	68.0	69.0	70.0	64.0	70.0	X		
B-005	TB-6	Sep-94	46,979.0	-72.0	821.2	64.5	Pre-Grout									48.0	55.0	59.5					59.5	64.5	X		
B-006	B-6	May-96	47,971.0	-37.0	826.1	45.5	Grout Cnfrmtn			No Soil Sampling Completed						40.0											
B-007	TB-7	Sep-94	47,419.0	-72.0	823.0	67.5	Pre-Grout	53.0								50.0	62.5	67.5					62.5	67.5	X		
B-008	B-8	Jul-96	48,450.0	49.0	827.7	70.0	Grout Cnfrmtn									41.0							66.5				X
B-009	B-9	Jun-96	48,460.0	65.0	827.7	72.5	Grout Cnfrmtn							32.0	36.0	36.0							66.3	72.5		X	
B-011	B-11	Sep-94	47,304.0	23.0	823.1	70.0	Pre-Grout										63.0	70.0					63.0	70.0	X		
B-012	TB-8	Sep-94	47,769.0	-87.0	820.6	63.0	Pre-Grout									45.0							63.0				X
B-013	TB-3	Sep-94	47,797.0	85.0	822.0	65.0	Pre-Grout	10.0								45.0							60.3	65.0			X
B-014	TB-4	Sep-94	47,825.0	85.0	822.0	65.0	Pre-Grout	10.0								45.0							60.3	65.0			X
B-015	B 15	Oct-94	47,425.0	-65.0	823.5	21.0	Pre-Grout	14.5	6.5			16.2	20.5														
B-016	B-16	Oct-94	47,450.0	-60.0	823.5	19.5	Pre-Grout	Dry	19.5																		
B-017	B-17	Oct-94	48,350.0	-60.0	825.8	19.5	Pre-Grout	13.6	12.5																		
B-018	B-18	Oct-94	48,098.0	-125.0	818.8	19.5	Pre-Grout	Caved		5.0	14.0	16.4	19.5														
B-019	B-19	Oct-94	46,865.0	60.0	821.5	28.5	Pre-Grout	Dry	8.0			19.5	26.8														
B-020	B-20	Oct-94	47,013.0	-60.0	822.5	19.5	Pre-Grout	Dry	7.5			15.0	19.5														
B-021	B-21	Oct-94	47,682.0	58.0	824.4	19.5	Pre-Grout	Dry	3.5	11.5	17.0																
B-022	B-22	Oct-94	48,409.0	56.0	827.3	21.0	Pre-Grout	Dry		4.0	6.0																
B-023	B-23	Oct-94	47,520.0	30.0	824.0	19.5	Pre-Grout	Dry	3.5	11.5	15.0	17.5															
B-024	B-24	Oct-94	46,880.0	30.0	822.0	27.0	Pre-Grout	Dry	7.5			16.5	26.5														
B-025	B-25	Dec-94	46,990.0	60.0	822.0	65.0	Pre-Grout	42.2	9.0			16.5	24.0	39.5	47.5	47.5							58.7	64.6			X
B-026	B-26	Nov-94	47,614.0	-66.0	823.6	75.0	Pre-Grout	22.9	8.0					35.0	45.5	45.5							65.8	71.5			X
B-027	B-27	Dec-94	48,175.0	68.0	825.6	75.0	Pre-Grout	50.0	9.5			21.0	28.5	34.5	38.0	38.0	65.4	70.5					65.4	72.7	X		
B-028	B-28	Oct-94	48,117.0	-131.0	819.3	70.0	Pre-Grout	23.2	7.0							33.2							60.8	67.5			X
B-029	B-29	Nov-94	46,810.0	-60.0	821.5	65.0	Pre-Grout	25.5	11.5			20.0	36.0	42.5	44.5	44.5							57.1	63.5			X
B-030	B-30	Nov-94	47,210.0	-60.0	823.0	70.0	Pre-Grout	53.7		9.0	11.5					42.3							62.2	68.7			X
B-032	B-32	Nov-94	47,722.0	-60.0	824.2	75.0	Pre-Grout	28.4	12.0							46.4							64.5	70.7			X
B-033	B-33	Nov-94	47,976.0	-60.0	825.0	75.0	Pre-Grout	15.7	12.0							45.0							65.0	71.4			X
B-034	B-34	Dec-94	48,350.0	65.0	826.5	75.0	Pre-Grout	10.0	13.5							36.3							67.3	73.5			X
B-035	B-35	Dec-94	47,526.0	-60.0	824.0	70.0	Pre-Grout	9.7	8.0			20.0	26.0	43.0	45.0	45.0							64.8	70.4			X
B-036	B-36	Dec-94	47,774.0	65.0	824.5	70.0	Pre-Grout	55.0						34.5	43.0	43.0							62.8	67.5			X
B-037	B-37	Dec-94	48,625.0	65.0	828.5	72.0	Pre-Grout	23.0	2.0							25.5							65.8	71.1			X
B-038	B 38	Dec-94	48,525.0	-65.0	827.5	82.0	Pre-Grout	28.8	2.0			24.0	27.5	34.5	53.2	53.2							74.5	80.2			X
B-039	B-39	Dec-94	47,545.0	60.0	824.0	73.5	Pre-Grout	57.4								47.5							64.8	71.5			X
B-040	B-40	Dec-94	47,555.0	-65.0	824.0	73.0	Pre-Grout	15.6								48.0							65.0	71.7			X
B-041	B-41	Dec-94	47,538.0	-60.0	824.0	71.0	Pre-Grout	55.5								49.0	65.0	71.0					65.0	71.0	X		
B-042	B-42	Dec-94	46,973.0	-60.0	822.0	68.0	Pre-Grout	11.2								44.0							61.5	67.0			X
B-043	B-43	Dec-94	48,010.0	65.0	825.0	40.5	Pre-Grout	12.2	5.0					35.0	38.0												
B-101	B-1	Sep-94	46,882.0	75.0	820.5	70.0	Pre-Grout	22.5				12.0	22.0	44.0	46.0	50.0							55.5	61.0			X
B-102	B-2	Sep-94	48,345.0	-88.0	822.4	59.5	Pre-Grout	50.0						30.0	34.0	39.9											
B-104	B-3	May-96	47,837.0	-23.0	825.6	65.0	Grout Cnfrmtn			No Soil Sampling Completed						42.0							63.8				X
B-105	B-4	Jun-96	47,932.0	-60.0	826.0	70.0	Grout Cnfrmtn									40.0							64.5				X
B-106	B-5	Jun-96	47,942.0	-60.0	826.0	72.0	Grout Cnfrmtn									42.5							64.5	70.5		X	
B-107	B-7	Jun-96	48,208.0	-47.0	826.4	40.0	Grout Cnfrmtn					20.0	25.0													X	
B-108	TB-1	Apr-94	47,800.0	25.0	825.0	47.0	Pre-Grout			0.0	4.0			37.5	43.0	43.0											
B-109	B-10	Jun-96	48,462.0	49.0	827.7	70.0	Grout Cnfrmtn									35.0							66.2				X
B-110	B-11	Jun-96	48,557.0	53.0	828.1	33.0	Grout Cnfrmtn									32.9										X	

Summary of Stratigraphic Data (feet)
GUE 70 - 14.10

Final Log No	Old Log No	Drill Date	Location Station Easting	Location Offset rt=(-) Northing	Grd Elev	Boring Depth	Boring Type	Water Level	Base of Fill	Misc Sa from	Misc Sa to	Upper Sa from	Upper Sa to	Lower Sa from	Lower Sa to	Bedrx Surface	Voids from	Voids to	Voids from	Voids to	Voids from	Voids to	Coal Zone from	Coal Zone to	Material at Coal Zone Void	Material at Coal Zone Grout	Material at Coal Zone Coal
B-111	CC-41	Jun-95	48,340 0	-48 0	827 3	75 0	Grout Cnfrmtn		5 0			24 0	26.0	33.2	37 3	40 0	48 5	50 0	68 5	70.7			64 8	70 7	X		
B-112	B-13	Jun-96	48,582 0	53 0	828 2	10 0	Grout Cnfrmtn																			X	
B-113	D-38A	Jun-95	48,380 0	-36 0	827 0	75 0	Grout Cnfrmtn					23 0	26 0	33 9	48 0	51 5	70 2	73 0					63 0	70 2	X		
B-114	D-39A	Jun-95	48,365 0	-36 0	827 0	7 0	Grout Cnfrmtn		7 0																		
B-115	D-77A	Jun-95	47,910 0	-36.0	825 6	75.0	Grout Cnfrmtn	27 0								43 5							64 6	70 5		X	X
B-116	TB-2	Mar-95	48,341 0	-27.0	826 2	75.0	Pre-Grout							31 5	38 0	45 0	63 0	70 0					63 0	70.0	X		
B-117	TB-3	Mar-95	48,356 0	-56 0	826 8	72 0	Pre-Grout							35 0	40 6	45.0	64 0	71 0					64 0	71 0	X		
B-118	TB-3	Apr-94	47,390.0	25.0	823 0	70 0	Pre-Grout			0.0	6 0					46 0	63 0	70 0					63 0	70 0	X		
B-119	B-41A	Jun-95	48,363 0	-72 0	826.0	75 3	Grout Cnfrmtn		2.0			25.0	26 0	34.0	42.2	43 0							65 9	70 0		X	
B-120	CC-33A	Jun-95	48,440 0	-48 0	827 0	75 5	Grout Cnfrmtn					24.7	28 3	36.6	43 0	43 0	65 2	65 5					65 2	71 1			X
B-121	B-12	Jul-96	48,570 0	48 0	828 1	70 0	Grout Cnfrmtn									40.0											
B-122	D-22A	Jun-95	48,570 0	-36 0	828 0	80 1	Grout Cnfrmtn	26.5				24 1	28 0	36 5	41 5	41 5							64 6	70 1		X	
B-123	B-14	Jun-96	48,600 0	-50.0	828 2	66.8	Grout Cnfrmtn							36 0	40 5	40 0							65 0			X	
B-125	TB-1	Mar-95	48,340 0	-56 0	827 1	75 0	Pre-Grout	50 0						35 0	39 0	48 0	40 0	46 0					66 0	71 5	Caved and Broken		
B-126	J-80A	Jun-95	47,870 0	36 0	825 5	75 0	Grout Cnfrmtn					24 0	27 0	36.0	46.0	46 0	58 0	59 5	62 5	62.9	64 0	64 3	62 5	69.0	X	X	
B-402		Apr-02	47,056 0	49 0	822 8	13 0	Direct Push	Dry	4 5																		
B-403		Apr-02	47,460 0	49 0	824 1	14.0	Direct Push	Dry	3 5	12 0																	
B-404A		Apr-02	47,825 0	49 0	825 2	12 0	Direct Push	10 0	3.0																		
B-404B		Apr-02	47,815 0	49 0	825 2	12.0	Direct Push	Dry	4.5																		
B-405		Apr-02	48,180 0	49 0	826 3	12 0	Direct Push	Dry	2 7																		
B-407A		Apr-02	46,974 0	-60 0	822 4	8.0	Direct Push	Dry	6 0																		
B-407B		Apr-02	46,974 0	-58 0	822 4	8 0	Direct Push	Dry	6 5																		
B-407C		Apr-02	46,975 0	-58 0	822 4	8 0	Direct Push	Dry	6 2																		
B-407D		Apr-02	46,978 0	-58 0	822.4	8.0	Direct Push	Dry	6 2	6 2	8 1																
B-407E		Apr-02	46,980.0	-58 0	822 4	8.0	Direct Push	Dry	6 0																		
B-407F		Apr-02	46,974 0	-55 0	822 4	17 1	Geotech	11 2	7 0																		
B-407G		Apr-02	46,974 0	-67 0	821 6	76 7	Geotech		2 0	2 0	7.0	20 0	27 0			42 5	59.6	60.3	65.2	65 4			59.6	65 5	X	X	
B-407H		Apr-02	46,960 0	-67 0	821 7	76.8	Geotech		0.0	0.0	8 0	15 5	28 0	33 0	37 5	43 5							59.6	65.6			X
B-407I		Apr-02	46,985 0	-55 0	822 5	19 5	Geotech	9 4	7 4	0 0	13 0																
B-408A		Apr-02	47,380.0	-30 0	823.5	10 0	Direct Push	Dry	6 4																		
B-408B		Apr-02	47,150 0	-30 0	823 5	10 0	Direct Push	Dry	5 0																		
B-408C		Apr-02	47,380 0	-34 0	823 6	20 0	Geotech	17 2	6 5	11 5	13 2																
B-409		Apr-02	47,540 0	-60.0	824 1	12 0	Direct Push	Dry	4 8																		
B-410A		Apr-02	47,785 0	-30 0	824 7	10.0	Direct Push	Dry	5 3																		
B-410B		Apr-02	47,810 0	-30 0	825 0	10 0	Direct Push	Dry	5 3																		
B-410C		Apr-02	47,775 0	-30 0	824 6	10 0	Direct Push	Dry	5 0																		
B-411		Apr-02	48,248.0	-60 0	828.2	10.0	Direct Push	Dry	4.9																		
B-412A		Apr-02	48,335.0	-60 0	826.9	10 0	Direct Push	Dry	6 0																		
B-412B		Apr-02	48,390 0	-60 0	827.2	10.0	Direct Push	Dry	5.3																		
B-412C		Apr-02	48,340 0	-34 0	827.1	20.0	Geotech	Dry	4 9																		
B-412D		Apr-02	48,338 0	-21.0	826 6	82.8	Geotech		5.0	9.0	13.0	24 0	27.0	36 0	40 7	44.3							67.5	72.5			X
B-412E		Apr-02	48,393 0	-65 0	826 6	86.2	Geotech	16.9	5.9	13 0	15.0	26 0	30.0	38 8	47 0										Caved and Broken		
B-413A		Apr-02	48,500 0	-60 0	827.7	12.0	Direct Push	Dry	4 3																		
B-413B		Apr-02	48,600 0	-60 0	828 5	12 0	Direct Push	Dry	3 5																		
B-413C		Apr-02	48,615 0	-58 0	828.6	12 0	Direct Push	Dry	3 4																		
B-413D		Apr-02	48,606 0	-55 0	828 7	15 5	Geotech	Dry	2.8																		
B-413E		Apr-02	48,638.0	-66.0	828.5	81 0	Geotech		1 6			18 2	28.0	34 5	40 5	40.5							62 4	68 1		X	
B-413F		Apr-02	48,602 0	-66.0	828 2	81 7	Geotech	29.7	4 0			28 0	29 5	34 5	43 5	43.5							62.7	68 8		X	X
B-413G		Apr-02	48,540.0	-55 0	828 3	15.5	Geotech	Dry	4 5																		
B-413H		Apr-02	48,537 0	-67.0	827.5	81 6	Geotech		5 0			21 5	27 0	34 2	43.5	43 5							63 5	68.4		X	

Summary of Stratigraphic Data (feet)
GUE 70 - 14.10

Final Log No.	Old Log No	Drill Date	Location Station Easting	Location Offset rt=(-) Northing	Grd Elev	Boring Depth	Boring Type	Water Level	Base of Fill	Misc Sa from	Misc Sa to	Upper Sa from	Upper Sa to	Lower Sa from	Lower Sa to	Bedrx Surface	Voids from	Voids to	Voids from	Voids to	Voids from	Voids to	Coal Zone from	Coal Zone to	Material at Coal Zone Void	Material at Coal Zone Grout	Material at Coal Zone Coal
GC-201		Oct-99	48,304.0	-20.3	826.2	90.7	Geophysical	34.5	8.0			21.0	25.5	34.5	41.0	45.0							68.0	73.0			
GC-202		Oct-99	48,314.6	-19.5	826.1	58.0	Geophysical		8.0			21.0	25.5	34.5	41.0	43.0	51.0	53.0					68.0	73.0	X		
GC-203		Oct-99	48,323.8	-19.3	826.3	56.0	Geophysical	25.8	8.0			23.0	26.5	34.0	47.5	47.5	52.7	54.3					68.0	73.0	X		
GC-204		Oct-99	48,328.8	-19.5	826.3	75.4	Geophysical		8.0			23.0	26.5	34.0	47.5	53.0	60.2	61.0					67.0	72.0	X		
GC-205		Nov-99	48,340.2	-20.2	826.5	81.5	Geophysical	22.0	8.0			22.0	27.0	34.5	41.0	41.0							67.0	72.0		X	
GC-206		Nov-99	48,357.1	-20.6	826.5	83.0	Geophysical	27.0	8.0			24.4	27.0	34.1	39.2	43.0							66.0	71.5			X
GC-207		Nov-99	48,379.0	-20.5	826.7	82.5	Geophysical	27.0	5.5			22.0	27.0	39.0	43.5	43.5							66.0	71.5			X
GC-208		Nov-99	48,418.8	-19.3	826.4	81.0	Geophysical	24.5	6.6			24.5	27.0	31.0	43.0	43.0							65.7	71.0			X
GC-209		Nov-99	48,459.3	-20.8	827.1	81.0	Geophysical		5.5			23.8	27.0	33.5	44.4	44.4							65.0	71.0		Caved and Broken	
GC-211		Oct-99	48,304.5	-66.6	826.1	78.7	Geophysical	33.0	8.0					32.0	42.5	42.5							68.5	73.0		X	
GC-212		Oct-99	48,315.8	-66.1	826.3	65.1	Geophysical		8.0					32.0	42.5	41.5	61.0	64.2					68.5	73.0	X		
GC-213		Oct-99	48,326.0	-65.7	826.4	73.0	Geophysical	32.4	5.0			23.0	27.0	32.0	39.3	41.5	57.5	60.0					66.0	71.5	X	X	
GC-214		Oct-99	48,330.5	-66.0	826.4	67.5	Geophysical		5.0			23.0	27.0	32.0	39.5	41.5	55.5	57.5					67.0	72.0	X		
GC-215		Nov-99	48,340.3	-67.0	826.4	81.5	Geophysical	27.0	5.5			24.0	26.5	32.0	43.5	43.5							65.0	71.5			X
GC-216		Oct-99	48,360.2	-65.8	826.4	81.0	Geophysical	33.5	5.5					33.5	41.0	41.0							66.0	71.4			X
GC-217		Nov-99	48,380.2	-65.9	826.6	80.0	Geophysical	26.0	8.0			23.0	26.0	34.2	41.0	41.0	44.0	45.0	48.5	49.0			65.5	71.0		X	
GC-218		Nov-99	48,420.5	-66.2	826.6	76.5	Geophysical	24.0	6.4			22.0	28.0	36.0	42.0	42.0							65.5	71.0		X	
GC-219		Nov-99	48,460.0	-65.1	827.2	81.0	Geophysical	26.0	12.0			21.0	26.0	34.2	41.0	41.0							65.0	72.0		X	
GC-301		May-02	48,530.0	-65.0	827.7	89.0	Geophysical	22.0	10.0			21.0	27.0	34.5	42.0	42.0							63.5	70.2		Mine Gob	
GC-302		May-02	48,616.0	-66.0	828.3	89.0	Geophysical	23.0	4.0			22.0	27.0	32.2	40.0	40.0							64.0	67.3			X
GC-303		May-02	48,549.0	-65.0	827.9	89.0	Geophysical	22.0	5.9			22.0	27.0	33.5	43.0	43.0							63.7	69.2			X
GC-304		May-02	48,581.0	-65.0	828.2	89.0	Geophysical	22.0	4.0			22.0	27.0	31.0	42.0	42.0							62.5	68.2		X	
GC-305		May-02	46,969.0	-65.0	821.8	81.0	Geophysical	10.0	2.5			15.5	32.0			43.5							59.8	66.0			X
GC-306		May-02	46,946.0	-65.0	821.9	81.0	Geophysical	15.5	6.0			15.5	33.0	39.3	43.5	43.5							59.3	66.0		X	
GC-307		May-02	46,953.0	-65.0	821.9	83.0	Geophysical	15.5	6.0			15.5	27.0			43.5							59.1	65.7			X
GC-308		May-02	48,530.0	-21.0	827.5	87.0	Geophysical	27.0	10.0			23.0	27.0	34.0	39.7	39.7							65.5	68.5			X
GC-309		May-02	48,550.0	-22.0	827.8	86.0	Geophysical	26.0	8.0					34.5	40.0	40.0							65.2	71.7			X
GC-310		May-02	48,608.0	-22.0	828.2	86.0	Geophysical	24.3	8.0			24.3	27.0	37.0	43.5	43.5							64.5	69.5			X
P-001A	P-1A	Jun-95	48,232.5	-65.6	825.9	72.0	Well, Coal	16.5																			
P-001B	P-1B	Jun-95	48,225.4	-66.3	825.9	37.0	Well, Lwr Sa	16.3																			
P-002A	P-2A	Jun-95	47,932.8	67.4	824.6	71.0	Well, Coal	16.2																			
P-002B	P-2B	Jun-95	47,928.3	67.5	824.3	39.0	Well, Lwr Sa	16.2								40.0											
P-221A		Nov-99	48,499.6	-66.1	826.9	71.9	Well, Coal	42.3	5.0			22.0	26.0	31.0	42.0	42.0							65.2	71.3		X	
P-221B		Nov-99	48,499.2	-68.0	826.9	42.5	Well, Lwr Sa		5.0			22.0	26.0	31.0	42.0	42.0											
P-221C		Nov-99	48,498.9	-70.3	826.8	27.5	Well, Uppr Sa		5.0			22.0	26.0														
P-222A		Nov-99	48,227.7	-128.8	820.6	70.8	Well, Coal	11.0	8.0	8.0	12.0			28.0	35.5	35.5							60.6	67.3			X
P-222B		Nov-99	48,222.6	-129.0	820.7	38.9	Well, Lwr Sa		8.0	8.0	12.0			28.0	35.5	35.5											
P-222C		Nov-99	48,225.9	-129.3	820.7	13.2	Well, Misc Sa		8.0	8.0	12.0																
P-223A		Sep-99	48,397.4	67.7	826.5	74.5	Well, Coal	32.0	3.5			23.0	26.0			31.0	45.0	45.3					65.4	71.5			X
P-223B		Sep-99	48,397.8	70.1	826.3	27.5	Well, Uppr Sa		3.5			23.0	26.0														
P-224A		Dec-99	48,344.7	-238.1	821.7	67.7	Well, Coal	12.0		10.0	28.7					33.7							60.7	67.0			X
P-224B		Dec-99	48,340.7	-239.1	821.8	30.0	Well, Misc Sa			10.0	28.7																
P-225A		Dec-99	48,427.2	322.9	838.9	86.9	Well, Coal	17.5		17.5	18.0					20.5	76.7	81.2					78.7	84.8	X		
P-225B		Dec-99	48,425.7	320.6	828.8	20.0	Well, Misc Sa			17.5	18.0																
P-226A		Dec-99	48,218.9	128.6	827.6	80.0	Well, Coal		0.3							31.5							68.6	75.8			X
P-227A		Oct-99	48,398.2	128.0	830.6	79.9	Well, Coal	28.0	0.5	26.0	31.0					32.0							70.5	77.0			X
P-227B		Sep-99	48,398.0	129.4	830.5	33.0	Well, Misc Sa			26.0	31.0																
P-228A		Dec-99	48,349.7	-0.8	828.6	79.5	Well, Coal	13.0	8.0			26.0	27.0	43.0	48.0	48.0	57.5	57.7	58.6	58.8	60.0	60.2	68.4	74.5	X	X	
P-228B		Dec-99	48,352.7	-0.8	828.3	48.2	Well, Lwr Sa		8.0			26.0	27.0	43.0	48.0												
P-228C		Dec-99	48,346.2	-0.7	828.6	30.0	Well, Uppr Sa		8.0			26.0	27.0														

Summary of Stratigraphic Data (feet)
GUE 70 - 14.10

Final	Old	Drill	Location		Grd	Boring	Boring Type	Water	Base	Misc Sa		Upper Sa		Lower Sa		Bedrx	Voids						Coal Zone		Material at Coal Zone		
Log No	Log No	Date	Station Easting	Offset rt=(-) Northing	Elev	Depth		Level	of Fill	from	to	from	to	from	to	Surface	from	to	from	to	from	to	from	to	Void	Grout	Coal
P-301A		Apr-01	46,875 8	129 4	816 1	63 0	Well, Coal	7 7				11 0	16.0			45 0							51 0	58 0			X
P-301B		Apr-01	46,872 7	129 6	816 2	17 0	Well, Uppr Sa	2 4				11 0	16 0														
P-302A		Apr-01	46,979.6	-137.3	816 5	68 3	Well, Coal	7 3				8 0	21 0	31.0	36 5	36.5	55 7	62 3					55 7	62 3	X		
P-302B		Apr-01	46,976 9	-137 5	816 4	14 2	Well, Uppr Sa	2 0				8 0	21 0														
P-303A		May-01	47,448 6	124 4	823.4	73 0	Well, Coal	14 9				28 5	36 0			48 0							63 0	69 0			X
P-303B		May-01	47,449 5	124 0	823 4	33 5	Well, Uppr Sa	9 9				28 5	36.0														
P-304A		Apr-01	47,539.8	-136 1	818 4	72 6	Well, Coal	8 5				16 0	19 2			39 0	61.3	67 6					61.3	67 6	X		
P-304B		Apr-01	47,541 6	-136 5	818 5	19 4	Well, Uppr Sa	2 5				16 0	19 2														
P-305A		May-01	47,931.9	128 2	823.0	73 0	Well, Coal	14 6				21 0	27 0			43 0	43 5	44.0	55.0	56.0	65 0	67 0	61.4	67.7	X		
P-306A		Apr-01	47,927 3	-133 7	819.2	76 3	Well, Coal	9 6		6 3	17 0			26.0	32 0	32 0	52 0	55.0	58.0	59.0	63 0	64.0	60 6	66 5	X		
P-306B		Apr-01	47,929.9	-134 0	819 9	10 3	Well, Misc Sa	1 0		6 4	17 0																
P-307A		Apr-01	46,875 4	64 8	821 4	73 0	Well, Coal	13.1				5 0	16 0	37 0	38.9	51 0							55 2	62 6		X	
P-307B		Apr-01	46,879.7	65.3	821 3	40 0	Well, Lwr Sa	10 3				5 0	16 0	37 0	38 9												
P-308A		Apr-01	47,546 5	-70.5	823 3	76.7	Well, Coal	13 5				11 0	21.0			48.5	67.0	68 5					65 0	71 0	X	X	
P-308B		Apr-01	47,543 8	-69 9	823 3	20 7	Well, Uppr Sa	7 2				11 0	21.0														
P-309A		May-01	46,919 7	-0 5	823 3	70.6	Well, Coal	14.3	8.0			17 0	27 0	32 0	41 0	44 7							60 1	66.0			X
P-309B		May-01	46,926 1	0 1	823 4	22 0	Well, Uppr Sa	10 0	8 0			17 0	22 0														
P-310A		May-01	47,490 0	-1 7	825 3	77.5	Well, Coal	16 4	5.0	11.0	17 0	27.0	31 0	37 0	41 0	50 5							65 0	71 2			X
P-311B		Apr-02	47,466 8	66 2	823 6	48 7	Well, Lwr Sa	13 3	1 8	5 0	17.0	28.0	31 0	37 0	47.5												
P-311C		Apr-02	47,463.4	65.0	823 6	16 5	Well, Misc Sa	8 9	1 8	5 0	17 0																
PW-001	PW-1	Apr-95	48,407.1	-130 4	821 3	67 5	Well, Coal																				

Summary of Stratigraphic Data (msl)
GUE 70 - 14.10

Final	Station	Offset	Grd	Bot of	Base of	Misc. Sands		Upper Sand		Lower Sand		Bedrock			Voids				Coal Zone	
Log No.	Easting	Northing	Elev	Boring	Fill	from	to	from	to	from	to	Surface	from	to	from	to	from	to	from	to
B-001	47,022.0	-36.0	822.5	757.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	781.5	0.0	0.0	0.0	0.0	0.0	0.0	762.0	0.0
B-002	47,370.0	58.0	823.8	758.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	777.8	0.0	0.0	0.0	0.0	0.0	0.0	761.0	0.0
B-003	47,522.0	73.0	823.0	759.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	780.0	765.0	759.0	0.0	0.0	0.0	0.0	759.0	752.0
B-004	48,363.0	-25.0	826.0	756.0	0.0	0.0	0.0	803.5	799.5	793.5	783.0	783.0	773.0	767.5	759.0	758.0	757.0	756.0	762.0	756.0
B-005	46,979.0	-72.0	821.2	756.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	773.2	766.2	761.7	0.0	0.0	0.0	0.0	761.7	756.7
B-006	47,971.0	-37.0	826.1	780.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	786.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-007	47,419.0	-72.0	823.0	755.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	773.0	760.5	755.5	0.0	0.0	0.0	0.0	760.5	755.5
B-008	48,450.0	49.0	827.7	757.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	786.7	0.0	0.0	0.0	0.0	0.0	0.0	761.2	0.0
B-009	48,460.0	65.0	827.7	755.2	0.0	0.0	0.0	0.0	0.0	795.7	791.7	791.7	0.0	0.0	0.0	0.0	0.0	0.0	761.4	755.2
B-011	47,304.0	23.0	823.1	753.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	760.1	753.1	0.0	0.0	0.0	0.0	760.1	753.1
B-012	47,769.0	-87.0	820.6	757.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	775.6	0.0	0.0	0.0	0.0	0.0	0.0	757.6	0.0
B-013	47,797.0	85.0	822.0	757.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	777.0	0.0	0.0	0.0	0.0	0.0	0.0	761.7	757.0
B-014	47,825.0	85.0	822.0	757.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	777.0	0.0	0.0	0.0	0.0	0.0	0.0	761.7	757.0
B-015	47,425.0	-65.0	823.5	802.5	817.0	0.0	0.0	807.3	803.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-016	47,450.0	-60.0	823.5	804.0	804.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-017	48,350.0	-60.0	825.8	806.3	813.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-018	48,098.0	-125.0	818.8	799.3	0.0	813.8	804.8	802.4	799.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-019	46,865.0	60.0	821.5	793.0	813.5	0.0	0.0	802.0	794.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-020	47,013.0	-60.0	822.5	803.0	815.0	0.0	0.0	807.5	803.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-021	47,682.0	58.0	824.4	804.9	820.9	812.9	807.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-022	48,409.0	56.0	827.3	806.3	0.0	823.3	821.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-023	47,520.0	30.0	824.0	804.5	820.5	812.5	809.0	806.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-024	46,880.0	30.0	822.0	795.0	814.5	0.0	0.0	805.5	795.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-025	46,990.0	60.0	822.0	757.0	813.0	0.0	0.0	805.5	798.0	782.5	774.5	774.5	0.0	0.0	0.0	0.0	0.0	0.0	763.3	757.4
B-026	47,614.0	-66.0	823.6	748.6	815.6	0.0	0.0	0.0	0.0	788.6	778.1	778.1	0.0	0.0	0.0	0.0	0.0	0.0	757.8	752.1
B-027	48,175.0	68.0	825.6	750.6	816.1	0.0	0.0	804.6	797.1	791.1	787.6	787.6	760.2	755.1	0.0	0.0	0.0	0.0	760.2	752.9
B-028	48,117.0	-131.0	819.3	749.3	812.3	0.0	0.0	0.0	0.0	0.0	0.0	786.1	0.0	0.0	0.0	0.0	0.0	0.0	758.5	751.8
B-029	46,810.0	-60.0	821.5	756.5	810.0	0.0	0.0	801.5	785.5	779.0	777.0	777.0	0.0	0.0	0.0	0.0	0.0	0.0	764.4	758.0
B-030	47,210.0	-60.0	823.0	753.0	0.0	814.0	811.5	0.0	0.0	0.0	0.0	780.7	0.0	0.0	0.0	0.0	0.0	0.0	760.8	754.3
B-032	47,722.0	-60.0	824.2	749.2	812.2	0.0	0.0	0.0	0.0	0.0	0.0	777.8	0.0	0.0	0.0	0.0	0.0	0.0	759.7	753.5
B-033	47,976.0	-60.0	825.0	750.0	813.0	0.0	0.0	0.0	0.0	0.0	0.0	780.0	0.0	0.0	0.0	0.0	0.0	0.0	760.0	753.6
B-034	48,350.0	65.0	826.5	751.5	813.0	0.0	0.0	0.0	0.0	0.0	0.0	790.2	0.0	0.0	0.0	0.0	0.0	0.0	759.2	753.0
B-035	47,526.0	-60.0	824.0	754.0	816.0	0.0	0.0	804.0	798.0	781.0	779.0	779.0	0.0	0.0	0.0	0.0	0.0	0.0	759.2	753.6
B-036	47,774.0	65.0	824.5	754.5	0.0	0.0	0.0	0.0	0.0	790.0	781.5	781.5	0.0	0.0	0.0	0.0	0.0	0.0	761.7	757.0
B-037	48,625.0	65.0	828.5	756.5	826.5	0.0	0.0	0.0	0.0	0.0	0.0	803.0	0.0	0.0	0.0	0.0	0.0	0.0	762.7	757.4
B-038	48,525.0	-65.0	827.5	745.5	825.5	0.0	0.0	803.5	800.0	793.0	774.3	774.3	0.0	0.0	0.0	0.0	0.0	0.0	753.0	747.3

Summary of Stratigraphic Data (msl)
GUE 70 - 14.10

Final	Station	Offset	Grd	Bot of	Base of	Misc. Sands		Upper Sand		Lower Sand		Bedrock	Voids						Coal Zone	
Log No	Easting	Northing	Elev	Boring	Fill	from	to	from	to	from	to	Surface	from	to	from	to	from	to	from	to
B-039	47,545.0	60.0	824.0	750.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	776.5	0.0	0.0	0.0	0.0	0.0	0.0	759.2	752.5
B-040	47,555.0	-65.0	824.0	751.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	776.0	0.0	0.0	0.0	0.0	0.0	0.0	759.0	752.3
B-041	47,538.0	-60.0	824.0	753.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	775.0	759.0	753.0	0.0	0.0	0.0	0.0	759.0	753.0
B-042	46,973.0	-60.0	822.0	754.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	778.0	0.0	0.0	0.0	0.0	0.0	0.0	760.5	755.0
B-043	48,010.0	65.0	825.0	784.5	820.0	0.0	0.0	0.0	0.0	790.0	787.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-101	46,882.0	75.0	820.5	750.5	0.0	0.0	0.0	808.5	798.5	776.5	774.5	770.5	0.0	0.0	0.0	0.0	0.0	0.0	765.0	759.5
B-102	48,345.0	-88.0	822.4	762.9	0.0	0.0	0.0	0.0	0.0	792.4	788.4	782.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-104	47,837.0	-23.0	825.6	760.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	783.6	0.0	0.0	0.0	0.0	0.0	0.0	761.8	0.0
B-105	47,932.0	-60.0	826.0	756.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	786.0	0.0	0.0	0.0	0.0	0.0	0.0	761.5	0.0
B-106	47,942.0	-60.0	826.0	754.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	783.5	0.0	0.0	0.0	0.0	0.0	0.0	761.5	755.5
B-107	48,208.0	-47.0	826.4	786.4	0.0	0.0	0.0	806.4	801.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-108	47,800.0	25.0	825.0	778.0	0.0	0.0	821.0	0.0	0.0	787.5	782.0	782.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-109	48,462.0	49.0	827.7	757.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	792.7	0.0	0.0	0.0	0.0	0.0	0.0	761.5	0.0
B-110	48,557.0	53.0	828.1	795.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	795.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-111	48,340.0	-48.0	827.3	752.3	822.3	0.0	0.0	803.3	801.3	794.1	790.0	787.3	778.8	777.3	758.8	756.6	0.0	0.0	762.5	756.6
B-112	48,582.0	53.0	828.2	818.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-113	48,380.0	-36.0	827.0	752.0	0.0	0.0	0.0	804.0	801.0	793.1	779.0	775.5	756.8	754.0	0.0	0.0	0.0	0.0	764.0	756.8
B-114	48,365.0	-36.0	827.0	820.0	820.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-115	47,910.0	-36.0	825.6	750.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	782.1	0.0	0.0	0.0	0.0	0.0	0.0	761.0	755.1
B-116	48,341.0	-27.0	826.2	751.2	0.0	0.0	0.0	0.0	0.0	794.7	788.2	781.2	763.2	756.2	0.0	0.0	0.0	0.0	763.2	756.2
B-117	48,356.0	-56.0	826.8	754.8	0.0	0.0	0.0	0.0	0.0	791.8	786.2	781.8	762.8	755.8	0.0	0.0	0.0	0.0	762.8	755.8
B-118	47,390.0	25.0	823.0	753.0	0.0	0.0	817.0	0.0	0.0	0.0	0.0	777.0	760.0	753.0	0.0	0.0	0.0	0.0	760.0	753.0
B-119	48,363.0	-72.0	826.0	750.7	824.0	0.0	0.0	801.0	800.0	792.0	783.8	783.0	0.0	0.0	0.0	0.0	0.0	0.0	760.1	756.0
B-120	48,440.0	-48.0	827.0	751.5	0.0	0.0	0.0	802.3	798.7	790.4	784.0	784.0	761.8	761.5	0.0	0.0	0.0	0.0	761.8	755.9
B-121	48,570.0	48.0	828.1	758.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	788.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-122	48,570.0	-36.0	828.0	747.9	0.0	0.0	0.0	803.9	800.0	791.5	786.5	786.5	0.0	0.0	0.0	0.0	0.0	0.0	763.4	757.9
B-123	48,600.0	-50.0	828.2	761.4	0.0	0.0	0.0	0.0	0.0	792.2	787.7	788.2	0.0	0.0	0.0	0.0	0.0	0.0	763.2	0.0
B-125	48,340.0	-56.0	827.1	752.1	0.0	0.0	0.0	0.0	0.0	792.1	788.1	779.1	787.1	781.1	0.0	0.0	0.0	0.0	761.1	755.6
B-126	47,870.0	36.0	825.5	750.5	0.0	0.0	0.0	801.5	798.5	789.5	779.5	779.5	767.5	766.0	763.0	762.6	761.5	761.2	763.0	756.5
B-402	47,056.0	49.0	822.8	809.8	818.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-403	47,460.0	49.0	824.1	810.1	820.6	812.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-404A	47,825.0	49.0	825.2	813.2	822.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-404B	47,815.0	49.0	825.2	813.2	820.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-405	48,180.0	49.0	826.3	814.3	823.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-407A	46,974.0	-60.0	822.4	814.4	816.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-407B	46,974.0	-58.0	822.4	814.4	815.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Summary of Stratigraphic Data (msl)
GUE 70 - 14.10

Final	Station	Offset	Grd	Bot of	Base of	Misc. Sands		Upper Sand		Lower Sand		Bedrock	Voids						Coal Zone	
Log No.	Easting	Northing	Elev	Boring	Fill	from	to	from	to	from	to	Surface	from	to	from	to	from	to	from	to
B-407C	46,975.0	-58.0	822.4	814.4	816.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-407D	46,978.0	-58.0	822.4	814.4	816.2	816.2	814.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-407E	46,980.0	-58.0	822.4	814.4	816.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-407F	46,974.0	-55.0	822.4	805.3	815.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-407G	46,974.0	-67.0	821.6	744.9	819.6	819.6	814.6	801.6	794.6	0.0	0.0	779.1	762.0	761.3	756.4	756.2	0.0	0.0	762.0	756.1
B-407H	46,960.0	-67.0	821.7	744.9	0.0	0.0	813.7	806.2	793.7	788.7	784.2	778.2	0.0	0.0	0.0	0.0	0.0	0.0	762.1	756.1
B-407I	46,985.0	-55.0	822.5	803.0	815.1	0.0	809.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-408A	47,380.0	-30.0	823.5	813.5	817.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-408B	47,150.0	-30.0	823.5	813.5	818.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-408C	47,380.0	-34.0	823.6	803.6	817.1	812.1	810.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-409	47,540.0	-60.0	824.1	812.1	819.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-410A	47,785.0	-30.0	824.7	814.7	819.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-410B	47,810.0	-30.0	825.0	815.0	819.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-410C	47,775.0	-30.0	824.6	814.6	819.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-411	48,248.0	-60.0	828.2	818.2	823.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-412A	48,335.0	-60.0	826.9	816.9	820.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-412B	48,390.0	-60.0	827.2	817.2	821.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-412C	48,340.0	-34.0	827.1	807.1	822.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-412D	48,338.0	-21.0	826.6	743.8	821.6	817.6	813.6	802.6	799.6	790.6	785.9	782.3	0.0	0.0	0.0	0.0	0.0	0.0	759.1	754.1
B-412E	48,393.0	-65.0	826.6	740.4	820.7	813.6	811.6	800.6	796.6	787.8	779.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-413A	48,500.0	-60.0	827.7	815.7	823.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-413B	48,600.0	-60.0	828.5	816.5	825.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-413C	48,615.0	-58.0	828.6	816.6	825.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-413D	48,606.0	-55.0	828.7	813.2	825.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-413E	48,638.0	-66.0	828.5	747.5	826.9	0.0	0.0	810.3	800.5	794.0	788.0	788.0	0.0	0.0	0.0	0.0	0.0	0.0	766.1	760.4
B-413F	48,602.0	-66.0	828.2	746.5	824.2	0.0	0.0	800.2	798.7	793.7	784.7	784.7	0.0	0.0	0.0	0.0	0.0	0.0	765.5	759.4
B-413G	48,540.0	-55.0	828.3	812.8	823.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B-413H	48,537.0	-67.0	827.5	745.9	822.5	0.0	0.0	806.0	800.5	793.3	784.0	784.0	0.0	0.0	0.0	0.0	0.0	0.0	764.0	759.1
GC-201	48,304.0	-20.3	826.2	735.5	818.2	0.0	0.0	805.2	800.7	791.7	785.2	781.2	0.0	0.0	0.0	0.0	0.0	0.0	758.2	753.2
GC-202	48,314.6	-19.5	826.1	768.1	818.1	0.0	0.0	805.1	800.6	791.6	785.1	783.1	775.1	773.1	0.0	0.0	0.0	0.0	758.1	753.1
GC-203	48,323.8	-19.3	826.3	770.3	818.3	0.0	0.0	803.3	799.8	792.3	778.8	778.8	773.6	772.0	0.0	0.0	0.0	0.0	758.3	753.3
GC-204	48,328.8	-19.5	826.3	750.9	818.3	0.0	0.0	803.3	799.8	792.3	778.8	773.3	766.1	765.3	0.0	0.0	0.0	0.0	759.3	754.3
GC-205	48,340.2	-20.2	826.5	745.0	818.5	0.0	0.0	804.5	799.5	792.0	785.5	785.5	0.0	0.0	0.0	0.0	0.0	0.0	759.5	754.5
GC-206	48,357.1	-20.6	826.5	743.5	818.5	0.0	0.0	802.1	799.5	792.4	787.3	783.5	0.0	0.0	0.0	0.0	0.0	0.0	760.5	755.0
GC-207	48,379.0	-20.5	826.7	744.2	821.2	0.0	0.0	804.7	799.7	787.7	783.2	783.2	0.0	0.0	0.0	0.0	0.0	0.0	760.7	755.2
GC-208	48,418.8	-19.3	826.4	745.4	819.8	0.0	0.0	801.9	799.4	795.4	783.4	783.4	0.0	0.0	0.0	0.0	0.0	0.0	760.7	755.4

Summary of Stratigraphic Data (msl)
GUE 70 - 14.10

Final Log No.	Station Easting	Offset Northing	Grd Elev	Bot of Boring	Base of Fill	Misc. Sands from	Misc. Sands to	Upper Sand from	Upper Sand to	Lower Sand from	Lower Sand to	Bedrock Surface	Voids from	Voids to	Voids from	Voids to	Voids from	Voids to	Coal Zone from	Coal Zone to
GC-209	48,459.3	-20.8	827.1	746.1	821.6	0.0	0.0	803.3	800.1	793.6	782.7	782.7	0.0	0.0	0.0	0.0	0.0	0.0	762.1	756.1
GC-211	48,304.5	-66.6	826.1	747.4	818.1	0.0	0.0	0.0	0.0	794.1	783.6	783.6	0.0	0.0	0.0	0.0	0.0	0.0	757.6	753.1
GC-212	48,315.8	-66.1	826.3	761.2	818.3	0.0	0.0	0.0	0.0	794.3	783.8	784.8	765.3	762.1	0.0	0.0	0.0	0.0	757.8	753.3
GC-213	48,326.0	-65.7	826.4	753.4	821.4	0.0	0.0	803.4	799.4	794.4	787.1	784.9	768.9	766.4	0.0	0.0	0.0	0.0	760.4	754.9
GC-214	48,330.5	-66.0	826.4	758.9	821.4	0.0	0.0	803.4	799.4	794.4	786.9	784.9	770.9	768.9	0.0	0.0	0.0	0.0	759.4	754.4
GC-215	48,340.3	-67.0	826.4	744.9	820.9	0.0	0.0	802.4	799.9	794.4	782.9	782.9	0.0	0.0	0.0	0.0	0.0	0.0	761.4	754.9
GC-216	48,360.2	-65.8	826.4	745.4	820.9	0.0	0.0	0.0	0.0	792.9	785.4	785.4	0.0	0.0	0.0	0.0	0.0	0.0	760.4	755.0
GC-217	48,380.2	-65.9	826.6	746.6	818.6	0.0	0.0	803.6	800.6	792.4	785.6	785.6	782.6	781.6	778.1	777.6	0.0	0.0	761.1	755.6
GC-218	48,420.5	-66.2	826.6	750.1	820.2	0.0	0.0	804.6	798.6	790.6	784.6	784.6	0.0	0.0	0.0	0.0	0.0	0.0	761.1	755.6
GC-219	48,460.0	-65.1	827.2	746.2	815.2	0.0	0.0	806.2	801.2	793.0	786.2	786.2	0.0	0.0	0.0	0.0	0.0	0.0	762.2	755.2
GC-301	48,530.0	-65.0	827.7	738.7	817.7	0.0	0.0	806.7	800.7	793.2	785.7	785.7	0.0	0.0	0.0	0.0	0.0	0.0	764.2	757.5
GC-302	48,616.0	-66.0	828.3	739.3	824.3	0.0	0.0	806.3	801.3	796.1	788.3	788.3	0.0	0.0	0.0	0.0	0.0	0.0	764.3	761.0
GC-303	48,549.0	-65.0	827.9	738.9	822.0	0.0	0.0	805.9	800.9	794.4	784.9	784.9	0.0	0.0	0.0	0.0	0.0	0.0	764.2	758.7
GC-304	48,581.0	-65.0	828.2	739.2	824.2	0.0	0.0	806.2	801.2	797.2	786.2	786.2	0.0	0.0	0.0	0.0	0.0	0.0	765.7	760.0
GC-305	46,969.0	-65.0	821.8	740.8	819.3	0.0	0.0	806.3	789.8	0.0	0.0	778.3	0.0	0.0	0.0	0.0	0.0	0.0	762.0	755.8
GC-306	46,946.0	-65.0	821.9	740.9	815.9	0.0	0.0	806.4	788.9	782.6	778.4	778.4	0.0	0.0	0.0	0.0	0.0	0.0	762.6	755.9
GC-307	46,953.0	-65.0	821.9	738.9	815.9	0.0	0.0	806.4	794.9	0.0	0.0	778.4	0.0	0.0	0.0	0.0	0.0	0.0	762.8	756.2
GC-308	48,530.0	-21.0	827.5	740.5	817.5	0.0	0.0	804.5	800.5	793.5	787.8	787.8	0.0	0.0	0.0	0.0	0.0	0.0	762.0	759.0
GC-309	48,550.0	-22.0	827.8	741.8	819.8	0.0	0.0	0.0	0.0	793.3	787.8	787.8	0.0	0.0	0.0	0.0	0.0	0.0	762.6	756.1
GC-310	48,608.0	-22.0	828.2	742.2	820.2	0.0	0.0	803.9	801.2	791.2	784.7	784.7	0.0	0.0	0.0	0.0	0.0	0.0	763.7	758.7
P-001A	48,232.5	-65.6	825.9	753.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-001B	48,225.4	-66.3	825.9	788.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-002A	47,932.8	67.4	824.6	753.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-002B	47,928.3	67.5	824.3	785.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	784.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-221A	48,499.6	-66.1	826.9	755.0	821.9	0.0	0.0	804.9	800.9	795.9	784.9	784.9	0.0	0.0	0.0	0.0	0.0	0.0	761.7	755.6
P-221B	48,499.2	-68.0	826.9	784.4	821.9	0.0	0.0	804.9	800.9	795.9	784.9	784.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-221C	48,498.9	-70.3	826.8	799.3	821.8	0.0	0.0	804.8	800.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-222A	48,227.7	-128.8	820.6	749.8	812.6	812.6	808.6	0.0	0.0	792.6	785.1	785.1	0.0	0.0	0.0	0.0	0.0	0.0	760.0	753.3
P-222B	48,222.6	-129.0	820.7	781.8	812.7	812.7	808.7	0.0	0.0	792.7	785.2	785.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-222C	48,225.9	-129.3	820.7	807.5	812.7	812.7	808.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-223A	48,397.4	67.7	826.5	752.0	823.0	0.0	0.0	803.5	800.5	0.0	0.0	795.5	781.5	781.2	0.0	0.0	0.0	0.0	761.1	755.0
P-223B	48,397.8	70.1	826.3	798.8	822.8	0.0	0.0	803.3	800.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-224A	48,344.7	-238.1	821.7	754.0	0.0	811.7	793.0	0.0	0.0	0.0	0.0	788.0	0.0	0.0	0.0	0.0	0.0	0.0	761.0	754.7
P-224B	48,340.7	-239.1	821.8	791.8	0.0	811.8	793.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-225A	48,427.2	322.9	838.9	752.0	0.0	821.4	820.9	0.0	0.0	0.0	0.0	818.4	762.2	757.7	0.0	0.0	0.0	0.0	760.2	754.1
P-225B	48,425.7	320.6	828.8	808.8	0.0	811.3	810.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Summary of Stratigraphic Data (msl)
GUE 70 - 14.10

Final Log No.	Station Easting	Offset Northing	Grd Elev	Bot of Boring	Base of Fill	Misc. Sands from	Misc. Sands to	Upper Sand from	Upper Sand to	Lower Sand from	Lower Sand to	Bedrock Surface	Voids from	Voids to	Voids from	Voids to	Voids from	Voids to	Coal Zone from	Coal Zone to
P-226A	48,218.9	128 6	827.6	747.6	827.3	0.0	0.0	0.0	0.0	0.0	0.0	796.1	0 0	0.0	0.0	0.0	0.0	0 0	759.0	751.8
P-227A	48,398.2	128.0	830.6	750.7	830.1	804.6	799.6	0.0	0.0	0.0	0.0	798.6	0.0	0.0	0.0	0.0	0.0	0.0	760.1	753 6
P-227B	48,398.0	129.4	830.5	797.5	0.0	804 5	799.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0 0
P-228A	48,349.7	-0.8	828.6	749.1	820.6	0.0	0.0	802.6	801.6	785.6	780.6	780.6	771.1	770.9	770.0	769.8	768.6	768.4	760.2	754.1
P-228B	48,352.7	-0.8	828.3	780.1	820.3	0.0	0.0	802.3	801.3	785.3	780.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-228C	48,346.2	-0 7	828.6	798.6	820.6	0.0	0.0	802.6	801.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0 0	0.0	0.0
P-301A	46,875.8	129.4	816.1	753.1	0.0	0 0	0.0	805.1	800.1	0.0	0.0	771.1	0.0	0.0	0.0	0.0	0.0	0.0	765.1	758 1
P-301B	46,872.7	129.6	816.2	799.2	0.0	0.0	0.0	805.2	800.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-302A	46,979.6	-137.3	816.5	748.2	0.0	0.0	0.0	808.5	795.5	785.5	780.0	780.0	760.8	754.2	0.0	0.0	0.0	0.0	760.8	754.2
P-302B	46,976.9	-137.5	816.4	802.2	0.0	0.0	0.0	808.4	795.4	0.0	0.0	0.0	0.0	0.0	0.0	0 0	0 0	0.0	0.0	0.0
P-303A	47,448.6	124.4	823.4	750.4	0.0	0.0	0.0	794.9	787.4	0.0	0.0	775.4	0.0	0.0	0.0	0.0	0.0	0.0	760.4	754.4
P-303B	47,449.5	124.0	823.4	789.9	0.0	0.0	0.0	794.9	787.4	0.0	0.0	0.0	0 0	0.0	0 0	0.0	0.0	0.0	0.0	0.0
P-304A	47,539.8	-136.1	818.4	745.8	0.0	0.0	0.0	802.4	799.2	0 0	0.0	779.4	757.1	750.8	0.0	0.0	0.0	0.0	757.1	750.8
P-304B	47,541.6	-136.5	818.5	799.1	0.0	0.0	0.0	802.5	799.3	0.0	0 0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0 0	0.0
P-305A	47,931.9	128.2	823.0	750.0	0.0	0.0	0.0	802.0	796 0	0.0	0.0	780.0	779.5	779.0	768 0	767.0	758.0	756.0	761.6	755.3
P-306A	47,927.3	-133.7	819.2	742.9	0.0	812.9	802.2	0.0	0.0	793.2	787.2	787.2	767.2	764.2	761.2	760.2	756.2	755.2	758.6	752.7
P-306B	47,929.9	-134.0	819.9	809.6	0.0	813 5	802.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-307A	46,875.4	64 8	821.4	748.4	0.0	0.0	0.0	816.4	805.4	784.4	782.5	770.4	0.0	0.0	0.0	0.0	0 0	0 0	766.2	758.8
P-307B	46,879.7	65 3	821.3	781.3	0.0	0.0	0.0	816.3	805.3	784 3	782.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0 0
P-308A	47,546.5	-70.5	823.3	746.6	0.0	0.0	0.0	812.3	802.3	0.0	0.0	774.8	756 3	754.8	0.0	0.0	0.0	0.0	758.3	752 3
P-308B	47,543.8	-69.9	823.3	802.6	0.0	0.0	0.0	812.3	802.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-309A	46,919.7	-0.5	823.3	752.7	815.3	0.0	0.0	806.3	796 3	791.3	782.3	778.6	0.0	0.0	0.0	0.0	0.0	0.0	763.2	757.3
P-309B	46,926.1	0.1	823.4	801.4	815.4	0.0	0.0	806 4	801.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-310A	47,490.0	-1.7	825.3	747.8	820.3	814.3	808.3	798.3	794.3	788.3	784.3	774.8	0.0	0.0	0.0	0.0	0.0	0.0	760.3	754 1
P-311B	47,466.8	66.2	823.6	774.9	821.8	818.6	806.6	795.6	792.6	786.6	776.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P-311C	47,463 4	65.0	823.6	807.1	821.8	818.6	806.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PW-001	48,407.1	-130.4	821.3	753.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0 0

Geophysical Boring Information
Gue-70-14.10
Guernsey Co., Ohio

Boring Number	Location Easting	Location Northing		Top of Cover	Ground Surface	Top of PVC	Shale Trap	Bot of PVC	Boring Depth	Casing Diam (in)	Type of Grout	8-1/2 Inch from	8-1/2 Inch to	7-7/8 Inch from	7-7/8 Inch to	6-1/2- Inch from	6-1/2- Inch to	5-5/8 Inch from	5-5/8 Inch to	3-1/8 Inch from	3-1/8 Inch to
GC-201	48,304.04	-20.32	Depth	-0.1	0.0	0.6	71.0	79.2	90.7	4	neat cement					0.0	48.6	48.6	90.7		
			MSL	826.3	826.2	825.53	755.2	747.0	735.5							826.2	777.6	777.6	735.5		
GC-202	48,314.63	-19.52	Depth	-0.2	0.0	0.5	50.0	54.7	58.0	4	neat cement					0.0	45.0	45.0	58.0		
			MSL	826.3	826.1	825.67	776.1	771.4	768.1							826.1	781.1	781.1	768.1		
GC-203	48,323.76	-19.29	Depth	-0.0	0.0	0.3	50.4	55.4	56.0	4	neat cement					0.0	48.9	48.9	56.0		
			MSL	826.3	826.3	825.95	775.9	770.9	770.3							826.3	777.4	777.4	770.3		
GC-204	48,328.76	-19.53	Depth	-0.1	0.0	1.1	62.2	72.0	75.4	4	cmnt/bent (50%)					0.0	55.0	55.0	75.4		
			MSL	826.4	826.3	825.13	764.1	754.3	750.9							826.3	771.3	771.3	750.9		
GC-205	48,340.16	-20.15	Depth	-0.2	0.0	0.3	78.1	79.3	81.5	4	cmnt/bent (50%)					0.0	45.0	45.0	81.5		
			MSL	826.7	826.5	826.25	748.4	747.2	745.0							826.5	781.5	781.5	745.0		
GC-206	48,357.08	-20.60	Depth	-0.2	0.0	0.0	79.8	81.2	83.0	4	cmnt/bent (50%)					0.0	44.0	44.0	93.0		
			MSL	826.7	826.5	826.42	746.7	745.3	743.5							826.5	782.5	782.5	733.5		
GC-207	48,378.95	-20.49	Depth	-0.1	0.0	0.4	79.4	80.9	82.5	4	cmnt/bent (50%)					0.0	42.0	42.0	82.5		
			MSL	826.8	826.7	826.26	747.3	745.8	744.2							826.7	784.7	784.7	744.2		
GC-208	48,418.81	-19.26	Depth	-0.1	0.0	0.3	78.3	79.2	81.0	4	cmnt/bent (50%)					0.0	43.0	43.0	81.0		
			MSL	826.5	826.4	826.15	748.1	747.2	745.4							826.4	783.4	783.4	745.4		
GC-209	48,459.30	-20.80	Depth	-0.0	0.0	0.2	78.4	79.7	81.0	4	neat cement					0.0	45.0	45.0	81.0		
			MSL	827.1	827.1	826.86	748.7	747.4	746.1							827.1	782.1	782.1	746.1		
GC-211	48,304.46	-66.59	Depth	-0.2	0.0	0.1	64.8	74.8	78.7	4	neat cement					0.0	43.8	43.8	78.7		
			MSL	826.2	826.1	825.96	761.3	751.3	747.4							826.1	782.3	782.3	747.4		
GC-212	48,315.76	-66.08	Depth	-0.3	0.0	0.1	59.9	63.9	64.3	4	neat cement					0.0	43.5	43.5	64.3		
			MSL	826.6	826.3	826.23	766.4	762.4	762.0							826.3	782.8	782.8	762.0		
GC-213	48,326.03	-65.67	Depth	-0.2	0.0	0.1	56.6	72.8	73.0	4	cmnt/bent (50%)					0.0	43.4	43.4	73.0		
			MSL	826.5	826.4	826.31	769.8	753.6	753.4							826.4	783.0	783.0	753.4		
GC-214	48,330.54	-65.96	Depth	-0.1	0.0	0.3	64.2	64.8	67.5	4	cmnt/bent (50%)					0.0	40.0	40.0	67.5		
			MSL	826.5	826.4	826.19	762.2	761.6	758.9							826.4	786.4	786.4	758.9		
GC-215	48,340.29	-66.99	Depth	-0.2	0.0	0.0	65.7	66.4	81.5	4	cmnt/bent (50%)					0.0	44.2	44.2	81.5		
			MSL	826.6	826.4	826.36	760.7	760.0	744.9							826.4	782.2	782.2	744.9		
GC-216	48,360.19	-65.79	Depth	-0.1	0.0	0.0	70.7	79.7	81.0	4	neat cement					0.0	44.0	44.0	81.0		
			MSL	826.5	826.4	826.40	755.7	746.7	745.4							826.4	782.4	782.4	745.4		
GC-217	48,380.24	-65.88	Depth	-0.1	0.0	0.2	68.4	69.8	80.0	4	cmnt/bent (50%)					0.0	51.2	51.2	80.0		
			MSL	826.7	826.6	826.36	758.2	756.8	746.6							826.6	775.4	775.4	746.6		
GC-218	48,420.48	-66.16	Depth	-0.3	0.0	-0.1	74.5	75.4	76.5	4	cmnt/bent (50%)					0.0	45.5	45.5	76.5		
			MSL	826.9	826.6	826.67	752.1	751.2	750.1							826.6	781.1	781.1	750.1		
GC-219	48,459.98	-65.14	Depth	-0.1	0.0	0.3	78.7	79.8	81.0	4	neat cement					0.0	44.0	44.0	81.0		
			MSL	827.3	827.2	826.91	748.5	747.4	746.2							827.2	783.2	783.2	746.2		
GC-301	48,529.93	-64.78	Depth	-0.0	0.0	0.4	n/a	88.5	89.0	5	cmnt/bent (5%)	0.0	42.0	42.0	89.0						
			MSL	827.7	827.7	827.33		739.2	738.7			827.7	785.7	785.7	738.7						
GC-302	48,615.71	-65.92	Depth	-0.0	0.0	0.2	n/a	88.5	89.0	5	cmnt/bent (5%)	0.0	40.0	40.0	89.0						
			MSL	828.4	828.3	828.11		739.8	739.3			828.3	788.3	788.3	739.3						
GC-303	48,548.99	-64.94	Depth	-0.0	0.0	0.4	n/a	88.5	89.0	5	cmnt/bent (5%)	0.0	40.0	40.0	89.0						
			MSL	827.9	827.9	827.50		739.4	738.9			827.9	787.9	787.9	738.9						
GC-304	48,580.71	-65.02	Depth	-0.0	0.0	0.5	n/a	88.5	89.0	5	cmnt/bent (5%)	0.0	42.0	42.0	89.0						
			MSL	828.2	828.2	827.68		739.7	739.2			828.2	786.2	786.2	739.2						
GC-305	46,968.52	-65.28	Depth	-0.0	0.0	0.2	n/a	80.8	81.0	5	cmnt/bent (5%)	0.0	44.0	44.0	81.0						
			MSL	821.8	821.8	821.57		741.0	740.8			821.8	777.8	777.8	740.8						
GC-306	46,945.86	-65.29	Depth	0.1	0.0	0.4	n/a	80.8	81.0	5	cmnt/bent (5%)	0.0	44.0	44.0	81.0						
			MSL	821.8	821.9	821.49		741.1	740.9			821.9	777.9	777.9	740.9						
GC-307	46,952.70	-65.46	Depth	0.1	0.0	0.5	n/a	81.5	83.0	5	cmnt/bent (5%)	0.0	43.5	43.5	83.0						
			MSL	821.8	821.9	821.41		740.4	738.9			821.9	778.4	778.4	738.9						
GC-308	48,529.47	-21.15	Depth	-0.3	0.0	0.0	n/a	86.0	87.0	5	cmnt/bent (5%)	0.0	40.0	40.0	87.0						
			MSL	827.8	827.5	827.47		741.5	740.5			827.5	787.5	787.5	740.5						
GC-309	48,550.20	-22.24	Depth	-0.3	0.0	0.1	n/a	85.0	86.0	5	cmnt/bent (5%)	0.0	38.5	38.5	86.0						
			MSL	828.1	827.8	827.71		742.8	741.8			827.8	789.3	789.3	741.8						

Geophysical Boring Information
Gue-70-14.10
Guernsey Co., Ohio

Boring Number	Location			Boring and Casing Information								Boring Diameters									
	Easting	Northing		Top of Cover	Ground Surface	Top of PVC	Shale Trap	Bot of PVC	Boring Depth	Casing Diam (in)	Type of Grout	8-1/2 Inch from	8-1/2 Inch to	7-7/8 Inch from	7-7/8 Inch to	6-1/2- Inch from	6-1/2- Inch to	5-5/8 Inch from	5-5/8 Inch to	3-1/8 Inch from	3-1/8 Inch to
GC-310	48,608.18	-21.86	Depth	-0 3	0.0	0.0	n/a	85 5	86.0	5	cmnt/bent (5%)	0.0	45.0	45 0	86.0						
			MSL	828.5	828.2	828.18		742.7	742 2			828.2	783.2	783 2	742.2						
B-407G	46,974.42	-67.48	Depth	-0.1	0.0	0 1	n/a	70 0	76 7	2	cmnt/bent (5%)					0.0	44.2			44.2	76.7
			MSL	821.7	821 6	821.49		751.6	744.9							821.6	777 4			777.4	744.9
B-407H	46,959.43	-66.55	Depth	-0.1	0.0	0.1	n/a	76.3	76.8	2	cmnt/bent (5%)					0.0	45.4			45 4	76 8
			MSL	821.8	821 7	821.53		745.4	744.9							821.7	776.3			776.3	744.9
B-412D	48,337.68	-20.94	Depth	-0.1	0.0	0 1	n/a	82.1	82 8	2	cmnt/bent (5%)					0.0	45.5			45 5	82.8
			MSL	826.7	826.6	826 46		744.5	743 8							826.6	781.1			781 1	743.8
B-412E	48,393.32	-65.37	Depth	-0.0	0.0	0.1	n/a	85.5	86.2	2	cmnt/bent (5%)					0 0	52.9			52.9	86.2
			MSL	826 7	826.6	826 57		741.1	740.4							826.6	773.7			773 7	740.4
B-413E	48,637.86	-66.30	Depth	-0.1	0.0	0.1	n/a	79.8	81.0	2	cmnt/bent (5%)					0.0	40.5			40 5	81.0
			MSL	828.6	828.5	828.47		748 7	747 5							828 5	788 0			788.0	747.5
B-413F	48,602 49	-65.78	Depth	0.0	0.0	0.3	n/a	81.0	81.7	2	cmnt/bent (5%)					0.0	43.2			43.2	81.7
			MSL	828.1	828 2	827 85		747.2	746.5							828.2	785.0			785.0	746.5
B-413H	48,536 66	-66 54	Depth	-0.1	0 0	0 1	n/a	81.6	81.6	2	cmnt/bent (5%)					0.0	45.3			45.3	81.6
			MSL	827.6	827.5	827 42		745.9	745.9							827.5	782.2			782.2	745 9

Note. positive depths are distances below grade and negative depths are distances above grade

Monitoring Well Construction Data
Gue-70-14.10
Guernsey Co., Ohio

Number	Type	Location			Top of Cover	Ground Surface	Top of PVC	Bottom of PVC	Length of PVC	Filter Pack Interval		Screened Interval		Aquifer Interval		Diameter @ Screen
		Easting	Northing							Top	Bottom	Top	Bottom	Top	Bottom	
P-001A	Coal	48,232.5	-65.6	Depth	0.0	0.0	0.2	71.7	71.5	unknown	unknown	unknown	unknown	unknown	unknown	unknown
				MSL	826.0	825.9	825.75	754.2								
P-001B	Lwr Sa	48,225.4	-66.3	Depth	-0.0	0.0	0.2	36.2	36.0	unknown	unknown	unknown	unknown	unknown	unknown	unknown
				MSL	825.9	825.9	825.74	789.7								
P-002A	Coal	47,932.8	67.4	Depth	0.0	0.0	0.2	70.6	70.4	unknown	unknown	unknown	unknown	unknown	unknown	unknown
				MSL	824.7	824.6	824.44	754.0								
P-002B	Lwr Sa	47,928.3	67.5	Depth	0.1	0.0	0.4	38.4	38.0	unknown	unknown	unknown	unknown	unknown	unknown	unknown
				MSL	824.6	824.7	824.29	786.3								
P-221A	Coal	48,499.6	-66.1	Depth	-0.4	0.0	0.0	61.1	61.1	58.0	71.9	55.1	59.1	59.7	71.2	5.625
				MSL	827.3	826.9	826.92	765.8		768.9	755.0	771.8	767.8	767.2	755.7	
P-221B	Lwr Sa	48,499.2	-68.0	Depth	-0.1	0.0	0.1	42.3	42.2	34.8	42.5	37.4	41.4	31.0	42.0	7.500
				MSL	827.0	826.9	826.76	784.6		792.1	784.4	789.5	785.5	795.9	784.9	
P-221C	Uppr Sa	48,498.9	-70.3	Depth	-0.1	0.0	0.4	27.4	27.0	21.2	27.5	22.5	26.5	22.0	26.0	7.500
				MSL	826.9	826.8	826.38	799.4		805.6	799.3	804.3	800.3	804.8	800.8	
P-222A	Coal	48,227.7	-128.8	Depth	-0.2	0.0	0.0	68.2	68.2	58.9	70.8	63.4	67.3	60.6	67.3	5.625
				MSL	820.8	820.6	820.56	752.4		761.7	749.8	757.2	753.3	760.0	753.3	
P-222B	Lwr Sa	48,222.6	-129.0	Depth	-0.2	0.0	0.2	34.6	34.4	29.2	38.9	29.8	33.7	28.0	35.5	7.500
				MSL	820.9	820.7	820.52	786.1		791 5	781.8	790.9	787.0	792.7	785.2	
P-222C	Misc Sa	48,225.9	-129.3	Depth	-0.1	0.0	0 2	13.2	13.0	8.0	13.2	8.5	12.4	11.0	12.0	7.500
				MSL	820.8	820.7	820.53	807.5		812.7	807.5	812.2	808.3	809.7	808.7	
P-223A	Coal	48,397.4	67.7	Depth	-0.3	0.0	0.1	73.7	73.6	66.6	74.5	68.6	73.4	68.0	71.4	3.125
				MSL	826.8	826.5	826.43	752.8		759.9	752.0	757.9	753.1	758.5	755.1	
P-223B	Uppr Sa	48,397.8	70.1	Depth	-0.2	0.0	0.1	27.1	27.0	20.1	27.5	21.8	26.6	23.0	26.0	7.500
				MSL	826.5	826.3	826.19	799.2		806.2	798.8	804.5	799.7	803 3	800.3	
P-224A	Coal	48,344.7	-238.1	Depth	-0.2	0.0	0.1	67.4	67.3	62.8	67.7	62.8	66.7	60.7	67.0	5.625
				MSL	821.8	821.7	821.58	754.3		758.9	754.0	758.9	755.0	761.0	754.7	
P-224B	Misc Sa	48,340.7	-239.1	Depth	-0.2	0.0	0 2	28.7	28.5	23.5	30.0	24.1	28.0	10.0	28.7	7.500
				MSL	822.0	821.8	821.62	793.1		798.3	791.8	797.7	793.8	811.8	793.1	
P-225A	Coal	48,427.2	322.9	Depth	-0.1	0.0	0.2	84.9	84.7	73 0	86.9	75.3	79.3	76.7	84.9	3.125
				MSL	839.0	838.9	838 66	754.0		765.9	752.0	763.6	759.6	762.2	754.0	
P-225B	Misc Sa	48,425.7	320.6	Depth	-0.1	0.0	0.1	20.0	19.9	12.9	20.0	15.6	19.6	17.5	18.0	4.500
				MSL	838.9	838.8	838.46	818.8		825.9	818.8	823.2	819.2	821.3	820.8	
P-226A	Coal	48,218.9	128.6	Depth	-0.1	0.0	0.4	76.0	75.6	69.0	80.0	71.4	75.4	68.5	75.9	5.625
				MSL	827.7	827.6	827.15	751.6		758.6	747.6	756.2	752.2	759.1	751.7	
P-227A	Coal	48,398.2	128.0	Depth	-0.4	0.0	-0.1	76.9	77.0	69.8	79.9	71.8	75.8	70.5	77.0	5.625
				MSL	831.0	830.6	830.66	753.7		760.8	750.7	758.8	754.8	760.1	753.6	
P-227B	Misc Sa	48,398.0	129.4	Depth	-0.2	0.0	0.2	32.0	31.8	24.7	33.0	26.7	31.3	31.5	32.0	6.500
				MSL	830.9	830.7	830.47	798.7		806.0	797.7	804.0	799.4	799.2	798.7	
P-228A	Coal	48,349.7	-0.8	Depth	-0.1	0.0	0.2	76.3	76.1	69.3	79.5	71.6	75 5	68.0	74.5	5.625
				MSL	828.7	828.6	828.37	752.3		759.3	749.1	757.0	753.1	760.6	754.1	
P-228B	Lwr Sa	48,352.7	-0.8	Depth	-0.2	0.0	0.2	48.1	47.9	37.0	48.2	43.3	47.2	38.5	48.2	7.500
				MSL	828.5	828.3	828.15	780.2		791.3	780.1	785.0	781.1	789.8	780.1	

Monitoring Well Construction Data
Gue-70-14.10
Guernsey Co., Ohio

Number	Type	Location Easting	Location Northing		Top of Cover	Ground Surface	Top of PVC	Bottom of PVC	Length of PVC	Filter Pack Interval Top	Filter Pack Interval Bottom	Screened Interval Top	Screened Interval Bottom	Aquifer Interval Top	Aquifer Interval Bottom	Diameter @ Screen
P-228C	Uppr Sa	48,346.2	-0.7	Depth	-0.1	0.0	0.2	30.0	29.8	23.0	30.0	24.9	29.7	26.0	27.0	4.500
				MSL	828.7	828.6	828.41	798.6		805.6	798.6	803.7	798.9	802.6	801.6	
P-301A	Coal	46,875.8	129.4	Depth	0.1	0.0	0.4	57.3	56.9	50.0	63.0	52.0	56.9	51.0	58.0	3.875
				MSL	816.0	816.1	815.70	758.8		766.1	753.1	764.1	759.2	765.1	758.1	
P-301B	Uppr Sa	46,872.7	129.6	Depth	0.1	0.0	0.4	16.4	16.0	9.7	17.0	11.3	16.1	11.0	16.0	7.500
				MSL	816.1	816.2	815.80	799.8		806.5	799.2	804.9	800.1	805.2	800.2	
P-302A	Coal	46,979.6	-137.3	Depth	-0.4	0.0	0.0	64.5	64.5	54.2	68.3	59.3	64.1	55.7	62.3	3.875
				MSL	816.9	816.5	816.49	752.0		762.3	748.2	757.2	752.4	760.8	754.2	
P-302B	Uppr Sa	46,976.9	-137.5	Depth	-0.1	0.0	0.1	14.2	14.1	8.0	15.0	9.0	13.8	8.0	21.0	7 500
				MSL	816.5	816.4	816.29	802.2		808.4	801.4	807.4	802.6	808.4	795.4	
P-303A	Coal	47,448.6	124.4	Depth	0.2	0.0	0.6	69.3	68.7	60.0	73.0	65.2	69.0	63.0	69.0	3.875
				MSL	823.2	823.4	822.79	754.1		763.4	750.4	758.2	754.4	760.4	754.4	
P-303B	Uppr Sa	47,449.5	124.0	Depth	-0.1	0.0	0.2	33.1	32.9	26.5	33.0	28.2	32.4	28.5	36.0	7.500
				MSL	823.5	823.4	823.21	790.3		796.9	790.4	795.2	791.0	794.9	787.4	
P-304A	Coal	47,539.8	-136.1	Depth	-0.1	0.0	0.1	67.6	67.5	58.0	72.6	62.4	67.2	61.3	67.8	3.875
				MSL	818.5	818.4	818.31	750.8		760.4	745.8	756.0	751.2	757.1	750.6	
P-304B	Uppr Sa	47,541.6	-136.5	Depth	-0.0	0.0	0.4	19.4	19.0	13.1	20.2	14.4	19.2	16.0	19.1	7.500
				MSL	818.5	818.5	818.02	799.1		805.4	798.3	804.1	799.3	802.5	799.4	
P-305A	Coal	47,931.9	128.2	Depth	0.1	0.0	0.4	66.5	66.1	44.5	73.0	61.3	66.1	61.8	67.8	3.875
				MSL	822.9	823.0	822.56	756.5		778.5	750.0	761.7	756.9	761.2	755.2	
P-306A	Coal	47,927.3	-133.7	Depth	-0.0	0.0	0.6	65.0	64.4	48.6	76.3	59.8	64.6	48.6	66.0	3.875
				MSL	819.2	819.2	818.64	754.2		770.6	742.9	759.4	754.6	770.6	753.2	
P-306B	Misc Sa	47,929.9	-134.0	Depth	0.7	0.0	0.9	10.3	9.4	4.0	11.0	5.1	9.9	6.4	11.0	7.500
				MSL	819.3	819.9	819.04	809.6		815.9	808.9	814.8	810.0	813.5	808.9	
P-307A	Coal	46,875.4	64.8	Depth	0.1	0.0	0.3	61.3	61.0	52.4	73.0	56.1	60.9	55.0	62.6	3.875
				MSL	821.3	821.4	821.09	760.1		769.0	748.4	765.3	760.5	766.4	758.8	
P-307B	Lwr Sa	46,879.7	65.3	Depth	-0.1	0.0	0.2	39.0	38.8	30.5	40.0	33.8	38.6	37.0	38.9	7.500
				MSL	821.4	821.3	821.06	782.3		790.8	781.3	787.5	782.7	784.3	782.4	
P-308A	Coal	47,546.5	-70.5	Depth	0.0	0.0	0.4	70.5	70.1	64.0	76.7	65.3	70.1	65.4	70.9	3.875
				MSL	823.3	823.3	822.93	752.8		759.3	746.6	758.0	753.2	757.9	752.4	
P-308B	Uppr Sa	47,543.8	-69.9	Depth	0.1	0.0	0.3	20.1	19.8	11.2	20.7	14.7	19.7	11.0	21.0	7.500
				MSL	823.2	823.3	823.02	803.2		812.1	802.6	808.6	803.6	812.3	802.3	
P-309A	Coal	46,919.7	-0.5	Depth	-0.1	0.0	0.2	66.4	66.2	59.7	70.6	61.4	66.0	60.1	66.0	3.875
				MSL	823.4	823.3	823.07	756.9		763.6	752.7	761.9	757.3	763.2	757.3	
P-309B	Uppr Sa	46,926.1	0.1	Depth	-0.3	0.0	0.0	21.7	21.7	15.8	22.0	16.8	21.4	17.4	21.0	3.875
				MSL	823.7	823.4	823.41	801.7		807.6	801.4	806.6	802.0	806.0	802.4	
P-310A	Coal	47,490.0	-1.7	Depth	0.0	0.0	0.3	71.5	71.2	64.0	77.5	66.4	71.2	65.0	71.2	3.875
				MSL	825.3	825.3	824.99	753.8		761.3	747.8	758.9	754.1	760.3	754.1	
P-311B	Lwr Sa	47,466.8	66.2	Depth	-0.0	0.0	0.3	47.9	47.6	40.2	48.7	42.9	47.4	38.9	47.2	7.500
				MSL	823.6	823.6	823.22	775.7		783.4	774.9	780.7	776.2	784.7	776.4	
P-311C	Misc Sa	47,463.4	65.0	Depth	-0.0	0.0	0.2	16.2	16.0	10.0	16.5	11.2	15.7	11.0	17.0	6.500
				MSL	823.6	823.6	823.39	807.4		813.6	807.1	812.4	807.9	812.6	806.6	

Monitoring Well Construction Data
Gue-70-14.10
Guernsey Co., Ohio

Number	Type	Location			Top of Cover	Ground Surface	Top of PVC	Bottom of PVC	Length of PVC	Filter Pack Interval		Screened Interval		Aquifer Interval		Diameter @ Screen
		Easting	Northing							Top	Bottom	Top	Bottom	Top	Bottom	
PW-001	Coal	48,407.1	-130.4	Depth	n/a	0.0	-1.1	67.2	68.3	Well completed with 6-inch diameter casing to bedrock surface and open hole into bedrock						
				MSL		821.3	822.42	754.1								

Note: positive depths are distances below grade and negative depths are distances above grade
All wells (except Well PW-001) are 2" diameter flush-joint PVC

Summary of Household Water Well Data
Gue-70-14.10

Well No	Grd Elev (msl)	Bot of Casing Depth (ft)	Bot of Casing Elev (msl)	Bedrx Surface Depth (ft)	Bedrx Surface Elev (msl)	Bottom of Well Depth (ft)	Bottom of Well Elev (msl)	Coal Zones (ft)	Static Level Depth (ft)	Static Level Elev (msl)	Pumping Test Rate (gpm)	Pumping Test S (ft)	Pumping Test Time (hrs)	Specific Capacity (gpm/ft)	Avail S	Theoretical Max Yield (gpm)
Wells which are uncased through expected elevation of Upper Freeport Coal																
63	1000	15	985	15	985	195	805	135 to 137	160	840	n/a	n/a	n/a	n/a	30	
87	850	20	830	6	844	64	786	none	15	835	5	35	12	0.14	44	6.3
92	850	25	825	3	847	156	694	92 to 93	40	810	0.5	116	2	0.004	111	0.5
99	820	12	808	10	810	80	740	71.5 to 73	58	762	10	n/a	2	n/a	17	
100	810	27	783	20	790	55	755	48 to 51	19	791	12	n/a	2	n/a	31	
101	810	24	786	4	806	38	772	38	15	795	n/a	15	3	n/a	18	
102	820	55	765	10	810	85	735	75 to 78	45	775	3	n/a	n/a	n/a	35	
110	800	18	782	12	788	43	757	42 to 43	10	790	6	n/a	n/a	n/a	28	
124	900	11	889	51	849	200	700	132 to 134	85	815	2.5	n/a	n/a	n/a	110	
U-6	815	28	787	1	814	85	730	60 to 62	40	775	1	40	4	0.03	40	1.0
U-7	805	27	778	0	805	92	713	67 to 68	32	773	10	60	2	0.17	55	9.2
U-8	815	26	789	4	811	120	695	92 to 93	52	763	2	68	2	0.03	63	1.9
															AVERAGE	**3.8**
Wells Deriving Water from Above Coal Zone, Conemaugh Group																
43	1060	42	1018	4	1056	85	975	55 to 56	43	1017	20	0	2.5	n/a	37	
56	980	20	960	4	976	100	880	none	47	933	4	n/a	3	n/a	48	
57	970	21	949	4	966	85	885	55 to 56	43	927	20	n/a	3	n/a	37	
58	1000	18	982	3	997	120	880	none	15	985	5	n/a	n/a	n/a	100	
59	1000	19	981	8	992	102	898	none	43	957	20	0	2.5	n/a	54	
60	1000	19	981	6	994	104	896	none	15	985	10	n/a	n/a	n/a	84	
61	1000	10	990	10	990	100	900	65 to 68	54	946	2	n/a	24	n/a	41	
62	1000	25	975	4	996	90	910	none	25	975	4	n/a	n/a	n/a	60	
64	1000	18	982	15	985	105	895	none	15	985	n/a	n/a	n/a	n/a	85	
65	1000	20	980	8	992	125	875	none	20	980	3	60	16	n/a	100	
66	1030	15	1015	7	1023	138	892	none	n/a	n/a	n/a	n/a	n/a	n/a	133	
67	940	19	921	6	934	130	810	none	60	880	2	n/a	n/a	n/a	65	
68	940	20	920	4	936	100	840	none	20	920	6	n/a	n/a	n/a	75	
69	940	20	920	15	925	94	846	none	n/a	n/a	n/a	n/a	n/a	n/a	89	
70	940	66	874	0	940	65	875	none	30	910	10	n/a	n/a	n/a	30	
71	1000	17	983	8	992	90	910	none	10	990	1	n/a	24	n/a	75	
72	1000	16	984	12	988	98	902	none	18	982	3	n/a	n/a	n/a	75	
86	950	45	905	14	936	95	855	58 to 63.5	42	908	1.5	n/a	1	n/a	48	
89	1005	20	985	4	1001	107	898	none	50	955	1.5	0	48	n/a	52	

Summary of Household Water Well Data
Gue-70-14.10

Well	Grd	Bot of Casing		Bedrx Surface		Bottom of Well		Coal	Static Level		Pumping Test			Specific	Avail	Theoretical
No	Elev (msl)	Depth (ft)	Elev (msl)	Depth (ft)	Elev (msl)	Depth (ft)	Elev (msl)	Zones (ft)	Depth (ft)	Elev (msl)	Rate (gpm)	S (ft)	Time (hrs)	Capacity (gpm/ft)	S	Max Yield (gpm)
90	885	17	868	2	883	55	830	none	28	857	8	6	2	1.33	22	29.3
91	960	20.5	939.5	4	956	140	820	none	64	896	4	0	2	n/a	71	
93	940	10	930	8	932	60	880	none	30	910	2	0	-	n/a	25	
94	950	17.5	932.5	4	946	86	864	none	41	909	8	45	2	0.18	40	7.1
105	980	24	956	3	977	85	895	none	56	924	10	10	3	1.00	24	24.0
107	1015	76	939	3	1012	78	937	none	18	997	5	0	1	n/a	55	
108	960	18	942	5	955	70	890	none	38	922	1	0	3	n/a	27	
109	860	32.5	827.5	29	831	50	810	none	18	842	10	n/a	n/a	n/a	27	
111	870	30	840	25	845	62	808	none	25	845	10	n/a	n/a	n/a	32	
112	940	44	896	32	908	57	883	none	37	903	25	n/a	n/a	n/a	15	
113D	880	66	814	15	865	76	804	none	23	857	10	n/a	2	n/a	48	
114	870	16	854	10	860	60	810	none	36	834	1	n/a	1	n/a	19	
115	890	15	875	4	886	60	830	none	20	870	n/a	n/a	n/a	n/a	35	
117	840	30	810	29	811	80	760	none	15	825	5	n/a	n/a	n/a	60	
118	900	50	850	10	890	80	820	none	50	850	n/a	n/a	n/a	n/a	25	
119	970	18	952	4	966	121	849	none	90	880	n/a	n/a	n/a	n/a	26	
120	970	20	950	4	966	80	890	none	30	940	5	n/a	24	n/a	45	
121	820	16	804	4	816	115	705	none	3	817	2	n/a	3	n/a	107	
122E	900	17	883	3	897	100	800	none	n/a	n/a	n/a	n/a	n/a	n/a	95	
123E	880	26	854	3	877	85	795	none	50	830	30	0	7	n/a	30	
															AVERAGE	**20.1**
Wells Deriving Water from Below Coal Zone, Allegheny Group																
88	820	24	796	2	818	60	760	17 to 18	10	810	2	n/a	1	n/a	45	
98	820	41	779	40	780	51	769	none	30	790	12	n/a	n/a	n/a	16	
106	810	62	748	22	788	85	725	53 to 58	21	789	20	70	1	0.29	59	16.9
116	815	78	737	5	810	115	700	40 to 41	40	775	n/a	n/a	n/a	n/a	70	
U-5	805	44	761	10	795	50	755	34 to 39	30	775	25	0	1	n/a	15	
															AVERAGE	**16.9**

Notes: All Wells derive water from Bedrock

Wells designated as U-X are from unlocated ODNR file, the locations shown on the Plans were determined by personnel of BBC&M

Field Test Results
GUE 70 14.10

Boring Number	Period Drilled	Site Setting	Mapped Mine	Ground Elevation	Location Station	Location Offset	Test Elevation	Test Depth	N Values per foot	H Values (Hand Pen) Low	H Values (Hand Pen) Median	H Values (Hand Pen) High	Bedrock Recovery	Bedrock RQD
B-004	Pre-Grout	Anomaly Q	Yes	826 0	48,363	-25	823.0	3	18					
B-004	Pre-Grout	Anomaly Q	Yes	826 0	48,363	-25	820.0	6	27					
B-004	Pre-Grout	Anomaly Q	Yes	826 0	48,363	-25	818.0	8	13					
B-004	Pre-Grout	Anomaly Q	Yes	826 0	48,363	-25	815.0	11	9					
B-004	Pre-Grout	Anomaly Q	Yes	826 0	48,363	-25	813 0	13	6					
B-004	Pre-Grout	Anomaly Q	Yes	826.0	48,363	-25	810.0	16	8					
B-004	Pre-Grout	Anomaly Q	Yes	826 0	48,363	-25	808.0	18	22					
B-004	Pre-Grout	Anomaly Q	Yes	826.0	48,363	-25	805 0	21	9					
B-004	Pre-Grout	Anomaly Q	Yes	826.0	48,363	-25	803.0	23	22					
B-004	Pre-Grout	Anomaly Q	Yes	826.0	48,363	-25	800.0	26	15					
B-004	Pre-Grout	Anomaly Q	Yes	826.0	48,363	-25	798.0	28	11					
B-004	Pre-Grout	Anomaly Q	Yes	826.0	48,363	-25	795 0	31	10					
B-004	Pre-Grout	Anomaly Q	Yes	826.0	48,363	-25	793 0	33	61					
B-004	Pre-Grout	Anomaly Q	Yes	826.0	48,363	-25	791 0	35	52					
B-004	Pre-Grout	Anomaly Q	Yes	826.0	48,363	-25	788.0	38	45					
B-004	Pre-Grout	Anomaly Q	Yes	826.0	48,363	-25	786 0	40	70					
B-004	Pre-Grout	Anomaly Q	Yes	826.0	48.363	-25	783 0	43	70					
B-004	Pre-Grout	Anomaly Q	Yes	826.0	48,363	-25	781 0	45	60					
B-004	Pre-Grout	Anomaly Q	Yes	826.0	48.363	-25	778.0	48					100	
B-004	Pre-Grout	Anomaly Q	Yes	826.0	48.363	-25	774 0	52					60	
B-004	Pre-Grout	Anomaly Q	Yes	826.0	48.363	-25	769.0	57					26	
B-004	Pre-Grout	Anomaly Q	Yes	826.0	48,363	-25	764 0	62					56	
B-004	Pre-Grout	Anomaly Q	Yes	826.0	48,363	-25	756 0	70					38	
B-008	Post Grout	General	Yes	827.7	48,450	49	765 7	62					100	
B-008	Post Grout	General	Yes	827 7	48.450	49	757 7	70					100	
B-009	Post Grout	General	Yes	827 7	48,460	65	807.7	20	10					
B-009	Post Grout	General	Yes	827 7	48,460	65	802.7	25	22					
B-009	Post Grout	General	Yes	827 7	48,460	65	797.7	30	22					
B-009	Post Grout	General	Yes	827 7	48,460	65	792.7	35	100					
B-009	Post Grout	General	Yes	827 7	48,460	65	790 7	37					100	
B-009	Post Grout	General	Yes	827.7	48,460	65	785.7	42					100	
B-009	Post Grout	General	Yes	827.7	48,460	65	780.7	47					100	
B-009	Post Grout	General	Yes	827.7	48,460	65	775.7	52					100	
B-009	Post Grout	General	Yes	827 7	48,460	65	770 7	57					100	
B-009	Post Grout	General	Yes	827 7	48,460	65	765.7	62					100	
B-009	Post Grout	General	Yes	827.7	48,460	65	760.7	67					90	
B-009	Post Grout	General	Yes	827.7	48,460	65	755 7	72					100	
B-017	Pre-Grout	Anomaly Q	Yes	825 8	48,350	-60	823 8	2	11					
B-017	Pre-Grout	Anomaly Q	Yes	825 8	48,350	-60	821 8	4	13					
B-017	Pre-Grout	Anomaly Q	Yes	825.8	48,350	-60	820 8	5	18					
B-017	Pre-Grout	Anomaly Q	Yes	825.8	48,350	-60	818 8	7	10					
B-017	Pre-Grout	Anomaly Q	Yes	825.8	48,350	-60	817 8	8	10					
B-017	Pre-Grout	Anomaly Q	Yes	825.8	48,350	-60	815 8	10	10					
B-017	Pre-Grout	Anomaly Q	Yes	825.8	48,350	-60	814 8	11	7					
B-017	Pre-Grout	Anomaly Q	Yes	825.8	48,350	-60	812.8	13	7					
B-017	Pre-Grout	Anomaly Q	Yes	825 8	48,350	-60	811.8	14	4					
B-017	Pre-Grout	Anomaly Q	Yes	825 8	48,350	-60	809 8	16	5					
B-017	Pre-Grout	Anomaly Q	Yes	825 8	48,350	-60	808 8	17	4					
B-017	Pre-Grout	Anomaly Q	Yes	825 8	48,350	-60	806.8	19	7					
B-018	Pre-Grout	General	Yes	818 8	48,098	-125	817 8	1	8					
B-018	Pre-Grout	General	Yes	818.8	48,098	-125	816 8	2	6					
B-018	Pre-Grout	General	Yes	818.8	48,098	-125	814.8	4	5					
B-018	Pre-Grout	General	Yes	818.8	48.098	-125	813.8	5	15					
B-018	Pre-Grout	General	Yes	818.8	48,098	-125	811.8	7	11					
B-018	Pre-Grout	General	Yes	818.8	48.098	-125	810.8	8	18					
B-018	Pre-Grout	General	Yes	818.8	48,098	-125	808.8	10	18					
B-018	Pre-Grout	General	Yes	818.8	48,098	-125	807.8	11	32					
B-018	Pre-Grout	General	Yes	818.8	48,098	-125	805.8	13	27					
B-018	Pre-Grout	General	Yes	818 8	48,098	-125	804 8	14	7					
B-018	Pre-Grout	General	Yes	818 8	48,098	-125	802.8	16	12					
B-018	Pre-Grout	General	Yes	818.8	48,098	-125	801.8	17	12					
B-018	Pre-Grout	General	Yes	818 8	48,098	-125	799 8	19	20					
B-022	Pre-Grout	General	Yes	827 3	48 409	56	825 3	2	9					
B-022	Pre-Grout	General	Yes	827.3	48,409	56	823.3	4	15					
B-022	Pre-Grout	General	Yes	827.3	48,409	56	822.3	5	11					
B-022	Pre-Grout	General	Yes	827.3	48,409	56	820.3	7	7					
B-022	Pre-Grout	General	Yes	827 3	48,409	56	819.3	8	10					

Field Test Results
GUE 70 14.10

Boring	Period	Site	Mapped	Ground	Location		Test		N Values	H Values (Hand Pen)			Bedrock	
Number	Drilled	Setting	Mine	Elevation	Station	Offset	Elevation	Depth	per foot	Low	Median	High	Recovery	RQD
B-022	Pre-Grout	General	Yes	827.3	48,409	56	817.3	10	6					
B-022	Pre-Grout	General	Yes	827.3	48,409	56	816.3	11	6					
B-022	Pre-Grout	General	Yes	827.3	48,409	56	814.3	13	7					
B-022	Pre-Grout	General	Yes	827.3	48,409	56	813.3	14	10					
B-022	Pre-Grout	General	Yes	827.3	48,409	56	811.3	16	13					
B-022	Pre-Grout	General	Yes	827.3	48,409	56	810.3	17	9					
B-022	Pre-Grout	General	Yes	827.3	48,409	56	808.3	19	7					
B-022	Pre-Grout	General	Yes	827.3	48,409	56	806.3	21	7					
B-027	Pre-Grout	Anomaly G	Yes	825.6	48,175	68	821.6	4	11					
B-027	Pre-Grout	Anomaly G	Yes	825.6	48,175	68	818.6	7	18					
B-027	Pre-Grout	Anomaly G	Yes	825.6	48,175	68	815.6	10	7	0.8	0.8	0.8		
B-027	Pre-Grout	Anomaly G	Yes	825.6	48,175	68	812.6	13	11	0.6	0.6	0.6		
B-027	Pre-Grout	Anomaly G	Yes	825.6	48,175	68	809.6	16	10	0.7	0.7	0.7		
B-027	Pre-Grout	Anomaly G	Yes	825.6	48,175	68	806.6	19	17	1.8	1.8	1.8		
B-027	Pre-Grout	Anomaly G	Yes	825.6	48,175	68	803.6	22	18					
B-027	Pre-Grout	Anomaly G	Yes	825.6	48,175	68	800.6	25	13					
B-027	Pre-Grout	Anomaly G	Yes	825.6	48,175	68	797.6	28	10					
B-027	Pre-Grout	Anomaly G	Yes	825.6	48,175	68	794.6	31	10					
B-027	Pre-Grout	Anomaly G	Yes	825.6	48,175	68	791.6	34	16					
B-027	Pre-Grout	Anomaly G	Yes	825.6	48,175	68	787.6	38	100					
B-027	Pre-Grout	Anomaly G	Yes	825.6	48,175	68	773.6	52					100	75
B-027	Pre-Grout	Anomaly G	Yes	825.6	48,175	68	768.6	57					100	75
B-027	Pre-Grout	Anomaly G	Yes	825.6	48,175	68	763.6	62					100	75
B-027	Pre-Grout	Anomaly G	Yes	825.6	48,175	68	758.6	67					100	86
B-027	Pre-Grout	Anomaly G	Yes	825.6	48,175	68	750.6	75					27	13
B-028	Pre-Grout	General	Yes	819.3	48,117	-131	815.3	4	18	0.8	0.8	0.8		
B-028	Pre-Grout	General	Yes	819.3	48,117	-131	812.3	7	13	1.0	1.0	1.0		
B-028	Pre-Grout	General	Yes	819.3	48,117	-131	809.3	10	13	0.8	0.8	0.8		
B-028	Pre-Grout	General	Yes	819.3	48,117	-131	806.3	13	18	0.8	0.8	0.8		
B-028	Pre-Grout	General	Yes	819.3	48,117	-131	803.3	16	29	2.0	2.0	2.0		
B-028	Pre-Grout	General	Yes	819.3	48,117	-131	800.3	19	15					
B-028	Pre-Grout	General	Yes	819.3	48,117	-131	797.3	22	17	0.1	0.8	1.4		
B-028	Pre-Grout	General	Yes	819.3	48,117	-131	794.3	25	26					
B-028	Pre-Grout	General	Yes	819.3	48,117	-131	791.3	28	54					
B-028	Pre-Grout	General	Yes	819.3	48,117	-131	788.3	31	91					
B-028	Pre-Grout	General	Yes	819.3	48,117	-131	786.3	33	100					
B-028	Pre-Grout	General	Yes	819.3	48,117	-131	782.3	37					97	39
B-028	Pre-Grout	General	Yes	819.3	48,117	-131	777.3	42					100	87
B-028	Pre-Grout	General	Yes	819.3	48,117	-131	772.3	47					98	82
B-028	Pre-Grout	General	Yes	819.3	48,117	-131	767.3	52					100	55
B-028	Pre-Grout	General	Yes	819.3	48,117	-131	762.3	57					98	43
B-028	Pre-Grout	General	Yes	819.3	48,117	-131	757.3	62					80	1
B-028	Pre-Grout	General	Yes	819.3	48,117	-131	749.3	70					98	1
B-033	Pre-Grout	General	No	825.0	47,976	-60	821.0	4	25					
B-033	Pre-Grout	General	No	825.0	47,976	-60	818.0	7	6	0.7	0.7	0.7		
B-033	Pre-Grout	General	No	825.0	47,976	-60	815.0	10	8	0.5	0.5	0.5		
B-033	Pre-Grout	General	No	825.0	47,976	-60	812.0	13	5	0.1	0.1	0.1		
B-033	Pre-Grout	General	No	825.0	47,976	-60	809.0	16	6	0.1	0.1	0.1		
B-033	Pre-Grout	General	No	825.0	47,976	-60	806.0	19	9	0.1	0.1	0.1		
B-033	Pre-Grout	General	No	825.0	47,976	-60	803.0	22	11					
B-033	Pre-Grout	General	No	825.0	47,976	-60	800.0	25	14					
B-033	Pre-Grout	General	No	825.0	47,976	-60	797.0	28	10					
B-033	Pre-Grout	General	No	825.0	47,976	-60	794.0	31	8	0.1	0.1	0.1		
B-033	Pre-Grout	General	No	825.0	47,976	-60	791.0	34	11	0.5	0.5	0.5		
B-033	Pre-Grout	General	No	825.0	47,976	-60	788.0	37	45					
B-033	Pre-Grout	General	No	825.0	47,976	-60	785.0	40	7	0.5	0.5	0.5		
B-033	Pre-Grout	General	No	825.0	47,976	-60	782.0	43	100					
B-033	Pre-Grout	General	No	825.0	47,976	-60	778.0	47					97	48
B-033	Pre-Grout	General	No	825.0	47,976	-60	773.0	52					96	50
B-033	Pre-Grout	General	No	825.0	47,976	-60	768.0	57					100	95
B-033	Pre-Grout	General	No	825.0	47,976	-60	763.0	62					98	98
B-033	Pre-Grout	General	No	825.0	47,976	-60	758.0	67					100	1
B-033	Pre-Grout	General	No	825.0	47,976	-60	750.0	75					100	66
B-034	Pre-Grout	General	Yes	826.5	48,350	65	822.5	4	12	1.5	1.5	1.5		
B-034	Pre-Grout	General	Yes	826.5	48,350	65	819.5	7	12	1.5	1.5	1.5		
B-034	Pre-Grout	General	Yes	826.5	48,350	65	816.5	10	6	0.5	0.5	0.5		
B-034	Pre-Grout	General	Yes	826.5	48,350	65	813.5	13	7	0.3	0.3	0.3		

Field Test Results
GUE 70 14.10

Boring Number	Period Drilled	Site Setting	Mapped Mine	Ground Elevation	Location Station	Location Offset	Test Elevation	Test Depth	N Values per foot	H Values (Hand Pen) Low	H Values (Hand Pen) Median	H Values (Hand Pen) High	Bedrock Recovery	Bedrock RQD
B-034	Pre-Grout	General	Yes	826.5	48,350	65	810.5	16	9					
B-034	Pre-Grout	General	Yes	826.5	48,350	65	807.5	19	12	0.8	0.8	0.8		
B-034	Pre-Grout	General	Yes	826.5	48,350	65	804.5	22	7	0.5	0.5	0.5		
B-034	Pre-Grout	General	Yes	826.5	48,350	65	801.5	25	15					
B-034	Pre-Grout	General	Yes	826.5	48,350	65	798.5	28	6	0.1	0.1	0.1		
B-034	Pre-Grout	General	Yes	826.5	48,350	65	795.5	31	8	0.1	0.1	0.1		
B-034	Pre-Grout	General	Yes	826.5	48,350	65	792.5	34	20					
B-034	Pre-Grout	General	Yes	826.5	48,350	65	789.5	37	100					
B-034	Pre-Grout	General	Yes	826.5	48,350	65	781.5	45					100	19
B-034	Pre-Grout	General	Yes	826.5	48,350	65	776.5	50					100	31
B-034	Pre-Grout	General	Yes	826.5	48,350	65	771.5	55					80	58
B-034	Pre-Grout	General	Yes	826.5	48,350	65	766.5	60					84	82
B-034	Pre-Grout	General	Yes	826.5	48,350	65	761.5	65					100	65
B-034	Pre-Grout	General	Yes	826.5	48,350	65	756.5	70					100	12
B-034	Pre-Grout	General	Yes	826.5	48,350	65	751.5	75					100	1
B-037	Pre-Grout	General	No	828.5	48,625	65	824.5	4	20					
B-037	Pre-Grout	General	No	828.5	48,625	65	821.5	7	17					
B-037	Pre-Grout	General	No	828.5	48,625	65	818.5	10	15					
B-037	Pre-Grout	General	No	828.5	48,625	65	815.5	13	7					
B-037	Pre-Grout	General	No	828.5	48,625	65	812.5	16	14					
B-037	Pre-Grout	General	No	828.5	48,625	65	809.5	19	22					
B-037	Pre-Grout	General	No	828.5	48,625	65	806.5	22	52					
B-037	Pre-Grout	General	No	828.5	48,625	65	803.5	25	70					
B-037	Pre-Grout	General	No	828.5	48,625	65	801.5	27					100	93
B-037	Pre-Grout	General	No	828.5	48,625	65	796.5	32					100	95
B-037	Pre-Grout	General	No	828.5	48,625	65	791.5	37					100	80
B-037	Pre-Grout	General	No	828.5	48,625	65	786.5	42					98	63
B-037	Pre-Grout	General	No	828.5	48,625	65	781.5	47					100	76
B-037	Pre-Grout	General	No	828.5	48,625	65	776.5	52					100	66
B-037	Pre-Grout	General	No	828.5	48,625	65	771.5	57					96	94
B-037	Pre-Grout	General	No	828.5	48,625	65	766.5	62					98	96
B-037	Pre-Grout	General	No	828.5	48,625	65	761.5	67					100	16
B-037	Pre-Grout	General	No	828.5	48,625	65	756.5	72					100	1
B-038	Pre-Grout	General	Yes	827.5	48,525	-65	823.5	4	20					
B-038	Pre-Grout	General	Yes	827.5	48,525	-65	820.5	7	15					
B-038	Pre-Grout	General	Yes	827.5	48,525	-65	817.5	10	21					
B-038	Pre-Grout	General	Yes	827.5	48,525	-65	814.5	13	14	0.5	0.5	0.5		
B-038	Pre-Grout	General	Yes	827.5	48,525	-65	811.5	16	22					
B-038	Pre-Grout	General	Yes	827.5	48,525	-65	808.5	19	16	0.8	0.8	0.8		
B-038	Pre-Grout	General	Yes	827.5	48,525	-65	805.5	22	18	0.8	0.8	0.8		
B-038	Pre-Grout	General	Yes	827.5	48,525	-65	802.5	25	15					
B-038	Pre-Grout	General	Yes	827.5	48,525	-65	799.5	28	6	0.1	0.1	0.1		
B-038	Pre-Grout	General	Yes	827.5	48,525	-65	796.5	31	11					
B-038	Pre-Grout	General	Yes	827.5	48,525	-65	793.5	34	33					
B-038	Pre-Grout	General	Yes	827.5	48,525	-65	791.5	36	100					
B-038	Pre-Grout	General	Yes	827.5	48,525	-65	775.5	52					80	1
B-038	Pre-Grout	General	Yes	827.5	48,525	-65	770.5	57					100	7
B-038	Pre-Grout	General	Yes	827.5	48,525	-65	765.5	62					100	56
B-038	Pre-Grout	General	Yes	827.5	48,525	-65	760.5	67					100	84
B-038	Pre-Grout	General	Yes	827.5	48,525	-65	755.5	72					100	80
B-038	Pre-Grout	General	Yes	827.5	48,525	-65	750.5	77					100	80
B-038	Pre-Grout	General	Yes	827.5	48,525	-65	745.5	82					80	1
B-043	Pre-Grout	General	Yes	825.0	48,010	65	821.0	4	11					
B-043	Pre-Grout	General	Yes	825.0	48,010	65	818.0	7	13					
B-043	Pre-Grout	General	Yes	825.0	48,010	65	815.0	10	8					
B-043	Pre-Grout	General	Yes	825.0	48,010	65	812.0	13	6					
B-043	Pre-Grout	General	Yes	825.0	48,010	65	809.0	16	9					
B-043	Pre-Grout	General	Yes	825.0	48,010	65	806.0	19	6					
B-043	Pre-Grout	General	Yes	825.0	48,010	65	803.0	22	19					
B-043	Pre-Grout	General	Yes	825.0	48,010	65	800.0	25	13					
B-043	Pre-Grout	General	Yes	825.0	48,010	65	797.0	28	8					
B-043	Pre-Grout	General	Yes	825.0	48,010	65	794.0	31	13					
B-043	Pre-Grout	General	Yes	825.0	48,010	65	791.0	34	9					
B-043	Pre-Grout	General	Yes	825.0	48,010	65	788.0	37	49					
B-043	Pre-Grout	General	Yes	825.0	48,010	65	785.0	40	57					
B-102	Pre-Grout	General	Yes	822.4	48,345	-88	820.4	2	9					
B-102	Pre-Grout	General	Yes	822.4	48,345	-88	817.4	5	14					

Field Test Results
GUE 70 14.10

Boring Number	Period Drilled	Site Setting	Mapped Mine	Ground Elevation	Location Station	Location Offset	Test Elevation	Test Depth	N Values per foot	H Values (Hand Pen) Low	H Values (Hand Pen) Median	H Values (Hand Pen) High	Bedrock Recovery	Bedrock RQD
B-102	Pre-Grout	General	Yes	822.4	48,345	-88	815.4	7	11					
B-102	Pre-Grout	General	Yes	822.4	48,345	-88	812.4	10	10					
B-102	Pre-Grout	General	Yes	822.4	48,345	-88	810.4	12	14					
B-102	Pre-Grout	General	Yes	822.4	48,345	-88	807.4	15	11					
B-102	Pre-Grout	General	Yes	822.4	48,345	-88	805.4	17	18					
B-102	Pre-Grout	General	Yes	822.4	48,345	-88	802.4	20	18					
B-102	Pre-Grout	General	Yes	822.4	48,345	-88	800.4	22	18					
B-102	Pre-Grout	General	Yes	822.4	48,345	-88	797.4	25	15					
B-102	Pre-Grout	General	Yes	822.4	48,345	-88	792.4	30	83					
B-102	Pre-Grout	General	Yes	822.4	48,345	-88	790.4	32	60					
B-102	Pre-Grout	General	Yes	822.4	48,345	-88	787.4	35	76					
B-102	Pre-Grout	General	Yes	822.4	48,345	-88	785.4	37	12					
B-102	Pre-Grout	General	Yes	822.4	48,345	-88	785.4	37	54					
B-102	Pre-Grout	General	Yes	822.4	48,345	-88	782.4	40	60					
B-102	Pre-Grout	General	Yes	822.4	48,345	-88	770.4	52					100	
B-102	Pre-Grout	General	Yes	822.4	48,345	-88	762.4	60					100	
B-105	Post Grout	General	No	826.0	47,932	-60	779.0	47					100	
B-105	Post Grout	General	No	826.0	47,932	-60	774.0	52					100	
B-105	Post Grout	General	No	826.0	47,932	-60	769.0	57					100	
B-105	Post Grout	General	No	826.0	47,932	-60	764.0	62					100	
B-105	Post Grout	General	No	826.0	47,932	-60	756.0	70					100	
B-106	Post Grout	General	No	826.0	47,942	-60	779.0	47					100	
B-106	Post Grout	General	No	826.0	47,942	-60	774.0	52					100	
B-106	Post Grout	General	No	826.0	47,942	-60	769.0	57					100	
B-106	Post Grout	General	No	826.0	47,942	-60	764.0	62					100	
B-106	Post Grout	General	No	826.0	47,942	-60	759.0	67					100	
B-106	Post Grout	General	No	826.0	47,942	-60	754.0	72					100	
B-109	Post Grout	General	Yes	827.7	48,462	49	765.7	62					100	
B-109	Post Grout	General	Yes	827.7	48,462	49	757.7	70					100	
B-111	Post Grout	Anomaly Q	Yes	827.3	48,340	-48	826.3	1	5					
B-111	Post Grout	Anomaly Q	Yes	827.3	48,340	-48	823.3	4	10					
B-111	Post Grout	Anomaly Q	Yes	827.3	48,340	-48	820.3	7	11					
B-111	Post Grout	Anomaly Q	Yes	827.3	48,340	-48	817.3	10	3					
B-111	Post Grout	Anomaly Q	Yes	827.3	48,340	-48	814.3	13	5					
B-111	Post Grout	Anomaly Q	Yes	827.3	48,340	-48	811.3	16	8					
B-111	Post Grout	Anomaly Q	Yes	827.3	48,340	-48	808.3	19	5					
B-111	Post Grout	Anomaly Q	Yes	827.3	48,340	-48	805.3	22	12					
B-111	Post Grout	Anomaly Q	Yes	827.3	48,340	-48	802.3	25	11					
B-111	Post Grout	Anomaly Q	Yes	827.3	48,340	-48	799.3	28	13					
B-111	Post Grout	Anomaly Q	Yes	827.3	48,340	-48	796.3	31	5					
B-111	Post Grout	Anomaly Q	Yes	827.3	48,340	-48	793.3	34	81					
B-111	Post Grout	Anomaly Q	Yes	827.3	48,340	-48	790.3	37	100					
B-111	Post Grout	Anomaly Q	Yes	827.3	48,340	-48	787.3	40					50	1
B-111	Post Grout	Anomaly Q	Yes	827.3	48,340	-48	785.3	42					18	1
B-111	Post Grout	Anomaly Q	Yes	827.3	48,340	-48	780.3	47					24	1
B-111	Post Grout	Anomaly Q	Yes	827.3	48,340	-48	775.3	52					30	1
B-111	Post Grout	Anomaly Q	Yes	827.3	48,340	-48	772.8	55					100	40
B-111	Post Grout	Anomaly Q	Yes	827.3	48,340	-48	770.3	57					88	46
B-111	Post Grout	Anomaly Q	Yes	827.3	48,340	-48	765.3	62					96	48
B-111	Post Grout	Anomaly Q	Yes	827.3	48,340	-48	760.3	67					52	1
B-111	Post Grout	Anomaly Q	Yes	827.3	48,340	-48	752.3	75					94	62
B-112	Post Grout	General	Yes	828.2	48,582	53	824.2	4	33					
B-112	Post Grout	General	Yes	828.2	48,582	53	822.2	6	50					
B-112	Post Grout	General	Yes	828.2	48,582	53	818.2	10					56	
B-113	Post Grout	Anomaly Q	Yes	827.0	48,380	-36	826.0	1	11					
B-113	Post Grout	Anomaly Q	Yes	827.0	48,380	-36	823.0	4	11					
B-113	Post Grout	Anomaly Q	Yes	827.0	48,380	-36	820.0	7	11					
B-113	Post Grout	Anomaly Q	Yes	827.0	48,380	-36	817.0	10	7					
B-113	Post Grout	Anomaly Q	Yes	827.0	48,380	-36	814.0	13	3					
B-113	Post Grout	Anomaly Q	Yes	827.0	48,380	-36	811.0	16	5					
B-113	Post Grout	Anomaly Q	Yes	827.0	48,380	-36	808.0	19	13					
B-113	Post Grout	Anomaly Q	Yes	827.0	48,380	-36	805.0	22	11					
B-113	Post Grout	Anomaly Q	Yes	827.0	48,380	-36	802.0	25	19					
B-113	Post Grout	Anomaly Q	Yes	827.0	48,380	-36	799.0	28	10					
B-113	Post Grout	Anomaly Q	Yes	827.0	48,380	-36	796.0	31	8					
B-113	Post Grout	Anomaly Q	Yes	827.0	48,380	-36	793.0	34	46					
B-113	Post Grout	Anomaly Q	Yes	827.0	48,380	-36	790.0	37	44					

Field Test Results
GUE 70 14.10

Boring Number	Period Drilled	Site Setting	Mapped Mine	Ground Elevation	Location Station	Location Offset	Test Elevation	Test Depth	N Values per foot	H Values (Hand Pen) Low	H Values (Hand Pen) Median	H Values (Hand Pen) High	Bedrock Recovery	Bedrock RQD
B-113	Post Grout	Anomaly Q	Yes	827.0	48,380	-36	787.0	40	35					
B-113	Post Grout	Anomaly Q	Yes	827.0	48,380	-36	784.0	43	19					
B-113	Post Grout	Anomaly Q	Yes	827.0	48,380	-36	781.0	46	12					
B-113	Post Grout	Anomaly Q	Yes	827.0	48,380	-36	778.0	49	57					
B-113	Post Grout	Anomaly Q	Yes	827.0	48,380	-36	775.5	52	81					
B-113	Post Grout	Anomaly Q	Yes	827.0	48,380	-36	760.0	67					86	16
B-113	Post Grout	Anomaly Q	Yes	827.0	48,380	-36	752.0	75					90	38
B-114	Post Grout	Anomaly Q	Yes	827.0	48,365	-36	826.0	1	41					
B-114	Post Grout	Anomaly Q	Yes	827.0	48,365	-36	823.0	4	58					
B-114	Post Grout	Anomaly Q	Yes	827.0	48,365	-36	820.0	7	100					
B-115	Post Grout	General	Yes	825.6	47,910	-36	821.6	4	27					
B-115	Post Grout	General	Yes	825.6	47,910	-36	818.6	7	9					
B-115	Post Grout	General	Yes	825.6	47,910	-36	815.6	10	11					
B-115	Post Grout	General	Yes	825.6	47,910	-36	812.6	13	8					
B-115	Post Grout	General	Yes	825.6	47,910	-36	809.6	16	8					
B-115	Post Grout	General	Yes	825.6	47,910	-36	806.6	19	10					
B-115	Post Grout	General	Yes	825.6	47,910	-36	803.6	22	6					
B-115	Post Grout	General	Yes	825.6	47,910	-36	800.6	25	22					
B-115	Post Grout	General	Yes	825.6	47,910	-36	797.6	28	20					
B-115	Post Grout	General	Yes	825.6	47,910	-36	794.6	31	8					
B-115	Post Grout	General	Yes	825.6	47,910	-36	791.6	34	9					
B-115	Post Grout	General	Yes	825.6	47,910	-36	788.6	37	50					
B-115	Post Grout	General	Yes	825.6	47,910	-36	785.6	40	17					
B-115	Post Grout	General	Yes	825.6	47,910	-36	782.6	43	100					
B-115	Post Grout	General	Yes	825.6	47,910	-36	778.6	47					93	1
B-115	Post Grout	General	Yes	825.6	47,910	-36	776.6	49					100	30
B-115	Post Grout	General	Yes	825.6	47,910	-36	773.6	52					100	28
B-115	Post Grout	General	Yes	825.6	47,910	-36	768.6	57					100	60
B-115	Post Grout	General	Yes	825.6	47,910	-36	763.6	62					100	70
B-115	Post Grout	General	Yes	825.6	47,910	-36	758.6	67					100	80
B-115	Post Grout	General	Yes	825.6	47,910	-36	750.6	75					90	58
B-116	Pre-Grout	Anomaly Q	Yes	826.2	48,341	-27	825.2	1	5					
B-116	Pre-Grout	Anomaly Q	Yes	826.2	48,341	-27	824.2	2	4					
B-116	Pre-Grout	Anomaly Q	Yes	826.2	48,341	-27	822.2	4	13					
B-116	Pre-Grout	Anomaly Q	Yes	826.2	48,341	-27	821.2	5	31					
B-116	Pre-Grout	Anomaly Q	Yes	826.2	48,341	-27	819.2	7	18					
B-116	Pre-Grout	Anomaly Q	Yes	826.2	48,341	-27	818.2	8	14					
B-116	Pre-Grout	Anomaly Q	Yes	826.2	48,341	-27	816.2	10	12					
B-116	Pre-Grout	Anomaly Q	Yes	826.2	48,341	-27	815.2	11	6					
B-116	Pre-Grout	Anomaly Q	Yes	826.2	48,341	-27	813.2	13	6					
B-116	Pre-Grout	Anomaly Q	Yes	826.2	48,341	-27	812.2	14	10					
B-116	Pre-Grout	Anomaly Q	Yes	826.2	48,341	-27	810.2	16	7					
B-116	Pre-Grout	Anomaly Q	Yes	826.2	48,341	-27	809.2	17	7					
B-116	Pre-Grout	Anomaly Q	Yes	826.2	48,341	-27	807.2	19	8					
B-116	Pre-Grout	Anomaly Q	Yes	826.2	48,341	-27	806.2	20	17					
B-116	Pre-Grout	Anomaly Q	Yes	826.2	48,341	-27	804.2	22	14					
B-116	Pre-Grout	Anomaly Q	Yes	826.2	48,341	-27	803.2	23	14					
B-116	Pre-Grout	Anomaly Q	Yes	826.2	48,341	-27	801.2	25	17					
B-116	Pre-Grout	Anomaly Q	Yes	826.2	48,341	-27	800.2	26	9					
B-116	Pre-Grout	Anomaly Q	Yes	826.2	48,341	-27	798.2	28	11					
B-116	Pre-Grout	Anomaly Q	Yes	826.2	48,341	-27	797.2	29	11					
B-116	Pre-Grout	Anomaly Q	Yes	826.2	48,341	-27	795.2	31	8					
B-116	Pre-Grout	Anomaly Q	Yes	826.2	48,341	-27	794.2	32	8					
B-116	Pre-Grout	Anomaly Q	Yes	826.2	48,341	-27	792.2	34	100					
B-116	Pre-Grout	Anomaly Q	Yes	826.2	48,341	-27	791.2	35	100					
B-116	Pre-Grout	Anomaly Q	Yes	826.2	48,341	-27	790.2	36	100					
B-116	Pre-Grout	Anomaly Q	Yes	826.2	48,341	-27	789.2	37	100					
B-116	Pre-Grout	Anomaly Q	Yes	826.2	48,341	-27	786.2	40	100					
B-116	Pre-Grout	Anomaly Q	Yes	826.2	48,341	-27	784.2	42	100					
B-116	Pre-Grout	Anomaly Q	Yes	826.2	48,341	-27	783.2	43	100					
B-116	Pre-Grout	Anomaly Q	Yes	826.2	48,341	-27	778.2	48					100	
B-116	Pre-Grout	Anomaly Q	Yes	826.2	48,341	-27	773.2	53					86	
B-116	Pre-Grout	Anomaly Q	Yes	826.2	48,341	-27	768.2	58					96	
B-116	Pre-Grout	Anomaly Q	Yes	826.2	48,341	-27	754.2	72					82	
B-117	Pre-Grout	Anomaly Q	Yes	826.8	48,356	-56	823.8	3	18					
B-117	Pre-Grout	Anomaly Q	Yes	826.8	48,356	-56	820.8	6	18					
B-117	Pre-Grout	Anomaly Q	Yes	826.8	48,356	-56	818.8	8	11					

Field Test Results
GUE 70 14.10

Boring Number	Period Drilled	Site Setting	Mapped Mine	Ground Elevation	Location Station	Location Offset	Test Elevation	Test Depth	N Values per foot	H Values (Hand Pen) Low	H Values (Hand Pen) Median	H Values (Hand Pen) High	Bedrock Recovery	Bedrock RQD
B-117	Pre-Grout	Anomaly Q	Yes	826.8	48,356	-56	815.8	11	11					
B-117	Pre-Grout	Anomaly Q	Yes	826.8	48,356	-56	813.8	13	6					
B-117	Pre-Grout	Anomaly Q	Yes	826.8	48,356	-56	810.8	16	7					
B-117	Pre-Grout	Anomaly Q	Yes	826.8	48,356	-56	808.8	18	10					
B-117	Pre-Grout	Anomaly Q	Yes	826.8	48,356	-56	805.8	21	15					
B-117	Pre-Grout	Anomaly Q	Yes	826.8	48,356	-56	803.8	23	15					
B-117	Pre-Grout	Anomaly Q	Yes	826.8	48,356	-56	800.8	26	7					
B-117	Pre-Grout	Anomaly Q	Yes	826.8	48,356	-56	798.8	28	8					
B-117	Pre-Grout	Anomaly Q	Yes	826.8	48,356	-56	795.8	31	5					
B-117	Pre-Grout	Anomaly Q	Yes	826.8	48,356	-56	793.8	33	31					
B-117	Pre-Grout	Anomaly Q	Yes	826.8	48,356	-56	790.8	36	84					
B-117	Pre-Grout	Anomaly Q	Yes	826.8	48,356	-56	788.8	38	51					
B-117	Pre-Grout	Anomaly Q	Yes	826.8	48,356	-56	786.5	40	88					
B-117	Pre-Grout	Anomaly Q	Yes	826.8	48,356	-56	783.0	44	80					
B-119	Post Grout	Anomaly Q	Yes	826.0	48,363	-72	825.0	1	6					
B-119	Post Grout	Anomaly Q	Yes	826.0	48,363	-72	822.0	4	10					
B-119	Post Grout	Anomaly Q	Yes	826.0	48,363	-72	819.0	7	6					
B-119	Post Grout	Anomaly Q	Yes	826.0	48,363	-72	816.0	10	5					
B-119	Post Grout	Anomaly Q	Yes	826.0	48,363	-72	813.0	13	5					
B-119	Post Grout	Anomaly Q	Yes	826.0	48,363	-72	810.0	16	9					
B-119	Post Grout	Anomaly Q	Yes	826.0	48,363	-72	807.0	19	5					
B-119	Post Grout	Anomaly Q	Yes	826.0	48,363	-72	804.0	22	17					
B-119	Post Grout	Anomaly Q	Yes	826.0	48,363	-72	801.0	25	11					
B-119	Post Grout	Anomaly Q	Yes	826.0	48,363	-72	798.0	28	5					
B-119	Post Grout	Anomaly Q	Yes	826.0	48,363	-72	795.0	31	8					
B-119	Post Grout	Anomaly Q	Yes	826.0	48,363	-72	792.0	34	52					
B-119	Post Grout	Anomaly Q	Yes	826.0	48,363	-72	789.0	37	82					
B-119	Post Grout	Anomaly Q	Yes	826.0	48,363	-72	786.0	40	54					
B-119	Post Grout	Anomaly Q	Yes	826.0	48,363	-72	782.6	43	100					
B-119	Post Grout	Anomaly Q	Yes	826.0	48,363	-72	782.0	44					33	1
B-119	Post Grout	Anomaly Q	Yes	826.0	48,363	-72	780.0	46					85	1
B-119	Post Grout	Anomaly Q	Yes	826.0	48,363	-72	777.0	49					50	1
B-119	Post Grout	Anomaly Q	Yes	826.0	48,363	-72	774.0	52					12	1
B-119	Post Grout	Anomaly Q	Yes	826.0	48,363	-72	769.0	57					60	1
B-119	Post Grout	Anomaly Q	Yes	826.0	48,363	-72	767.0	59					75	1
B-119	Post Grout	Anomaly Q	Yes	826.0	48,363	-72	764.0	62					84	24
B-119	Post Grout	Anomaly Q	Yes	826.0	48,363	-72	759.0	67					72	20
B-119	Post Grout	Anomaly Q	Yes	826.0	48,363	-72	751.0	75					70	44
B-120	Post Grout	General	Yes	827.0	48,440	-48	823.0	4	16					
B-120	Post Grout	General	Yes	827.0	48,440	-48	820.0	7	13					
B-120	Post Grout	General	Yes	827.0	48,440	-48	817.0	10	7					
B-120	Post Grout	General	Yes	827.0	48,440	-48	814.0	13	7					
B-120	Post Grout	General	Yes	827.0	48,440	-48	811.0	16	5					
B-120	Post Grout	General	Yes	827.0	48,440	-48	808.0	19	8					
B-120	Post Grout	General	Yes	827.0	48,440	-48	805.0	22	13					
B-120	Post Grout	General	Yes	827.0	48,440	-48	802.0	25	5					
B-120	Post Grout	General	Yes	827.0	48,440	-48	799.0	28	9					
B-120	Post Grout	General	Yes	827.0	48,440	-48	796.0	31	10					
B-120	Post Grout	General	Yes	827.0	48,440	-48	793.0	34	6					
B-120	Post Grout	General	Yes	827.0	48,440	-48	790.0	37	71					
B-120	Post Grout	General	Yes	827.0	48,440	-48	787.0	40	40					
B-120	Post Grout	General	Yes	827.0	48,440	-48	784.0	43	100					
B-120	Post Grout	General	Yes	827.0	48,440	-48	775.0	52					94	67
B-120	Post Grout	General	Yes	827.0	48,440	-48	770.0	57					100	91
B-120	Post Grout	General	Yes	827.0	48,440	-48	766.0	61					100	90
B-120	Post Grout	General	Yes	827.0	48,440	-48	760.0	67					52	1
B-120	Post Grout	General	Yes	827.0	48,440	-48	752.0	75					92	21
B-122	Post Grout	General	No	828.0	48,570	-36	824.0	4	15					
B-122	Post Grout	General	No	828.0	48,570	-36	821.0	7	7					
B-122	Post Grout	General	No	828.0	48,570	-36	818.0	10	17					
B-122	Post Grout	General	No	828.0	48,570	-36	815.0	13	14					
B-122	Post Grout	General	No	828.0	48,570	-36	812.0	16	20					
B-122	Post Grout	General	No	828.0	48,570	-36	809.0	19	13					
B-122	Post Grout	General	No	828.0	48,570	-36	806.0	22	6					
B-122	Post Grout	General	No	828.0	48,570	-36	803.0	25	19					
B-122	Post Grout	General	No	828.0	48,570	-36	800.0	28	14					
B-122	Post Grout	General	No	828.0	48,570	-36	797.0	31	7					

Field Test Results
GUE 70 14.10

Boring Number	Period Drilled	Site Setting	Mapped Mine	Ground Elevation	Location Station	Location Offset	Test Elevation	Test Depth	N Values per foot	H Values (Hand Pen) Low	H Values (Hand Pen) Median	H Values (Hand Pen) High	Bedrock Recovery	Bedrock RQD
B-122	Post Grout	General	No	828.0	48,570	-36	794 0	34	8					
B-122	Post Grout	General	No	828 0	48,570	-36	791 0	37	100					
B-122	Post Grout	General	No	828.0	48,570	-36	787 5	41	100					
B-122	Post Grout	General	No	828.0	48,570	-36	786 0	42					45	1
B-122	Post Grout	General	No	828.0	48,570	-36	783.0	45					80	1
B-122	Post Grout	General	No	828.0	48,570	-36	781 0	47					91	26
B-122	Post Grout	General	No	828 0	48,570	-36	776 0	52					100	90
B-122	Post Grout	General	No	828 0	48,570	-36	771.0	57					100	100
B-122	Post Grout	General	No	828.0	48,570	-36	766.0	62					94	84
B-122	Post Grout	General	No	828 0	48,570	-36	761 0	67					70	60
B-122	Post Grout	General	No	828.0	48,570	-36	756.0	72					76	14
B-122	Post Grout	General	No	828 0	48,570	-36	748.0	80					100	80
B-123	Post Grout	General	Yes	828.2	48,600	-50	823.2	5	12					
B-123	Post Grout	General	Yes	828.2	48,600	-50	818.2	10	24					
B-123	Post Grout	General	Yes	828.2	48,600	-50	813.2	15	34					
B-123	Post Grout	General	Yes	828.2	48,600	-50	808.2	20	12					
B-123	Post Grout	General	Yes	828.2	48,600	-50	803.2	25	4					
B-123	Post Grout	General	Yes	828 2	48,600	-50	798.2	30	6					
B-123	Post Grout	General	Yes	828.2	48,600	-50	793.2	35	56					
B-123	Post Grout	General	Yes	828.2	48 600	-50	788 2	40	100					
B-125	Pre-Grout	Anomaly Q	Yes	827.1	48,340	-56	824.1	3	17					
B-125	Pre-Grout	Anomaly Q	Yes	827 1	48,340	-56	821.1	6	14					
B-125	Pre-Grout	Anomaly Q	Yes	827.1	48,340	-56	819.1	8	16					
B-125	Pre-Grout	Anomaly Q	Yes	827.1	48,340	-56	816.1	11	11					
B-125	Pre-Grout	Anomaly Q	Yes	827.1	48,340	-56	814 1	13	10					
B-125	Pre-Grout	Anomaly Q	Yes	827.1	48,340	-56	811.1	16	11					
B-125	Pre-Grout	Anomaly Q	Yes	827.1	48,340	-56	809.1	18	11					
B-125	Pre-Grout	Anomaly Q	Yes	827.1	48,340	-56	806 1	21	19					
B-125	Pre-Grout	Anomaly Q	Yes	827 1	48,340	-56	804.1	23	15					
B-125	Pre-Grout	Anomaly Q	Yes	827.1	48,340	-56	801.1	26	9					
B-125	Pre-Grout	Anomaly Q	Yes	827.1	48,340	-56	799.1	28	7					
B-125	Pre-Grout	Anomaly Q	Yes	827.1	48,340	-56	796.1	31	8					
B-125	Pre-Grout	Anomaly Q	Yes	827.1	48,340	-56	794 1	33	51					
B-125	Pre-Grout	Anomaly Q	Yes	827.1	48,340	-56	791.1	36	100					
B-125	Pre-Grout	Anomaly Q	Yes	827.1	48,340	-56	789 1	38	37					
B-125	Pre-Grout	Anomaly Q	Yes	827.1	48,340	-56	784.1	43	1					
B-125	Pre-Grout	Anomaly Q	Yes	827.1	48,340	-56	781 1	46	100					
B-125	Pre-Grout	Anomaly Q	Yes	827 1	48,340	-56	776 1	51	56					
B-125	Pre-Grout	Anomaly Q	Yes	827.1	48,340	-56	774 1	53					22	
B-125	Pre-Grout	Anomaly Q	Yes	827.1	48,340	-56	769 1	58					28	
B-125	Pre-Grout	Anomaly Q	Yes	827.1	48,340	-56	759.1	68					28	
B-125	Pre-Grout	Anomaly Q	Yes	827.1	48,340	-56	752.1	75					100	
B-402	Post Grout	Anomaly A	No	822.8	47,056	49	819.8	3		4 5	4.5	4.5		
B-402	Post Grout	Anomaly A	No	822.8	47,056	49	817.8	5		3.1	3 2	3 2		
B-402	Post Grout	Anomaly A	No	822.8	47,056	49	815.8	7		3 0	3.1	3.2		
B-402	Post Grout	Anomaly A	No	822.8	47,056	49	813.8	9		1.1	1 2	1.3		
B-402	Post Grout	Anomaly A	No	822.8	47,056	49	812.8	10		0.5	0 8	1 0		
B-402	Post Grout	Anomaly A	No	822 8	47,056	49	810.8	12		2.3	2 4	2 5		
B-403	Post Grout	Anomaly C	Yes	824.1	47,460	49	821.1	3		2 2	2 4	2.6		
B-403	Post Grout	Anomaly C	Yes	824.1	47,460	49	819 1	5		4 5	4.5	4.5		
B-403	Post Grout	Anomaly C	Yes	824.1	47,460	49	817.1	7		4 5	4.5	4.5		
B-403	Post Grout	Anomaly C	Yes	824.1	47,460	49	815.1	9		4 5	4 5	4 5		
B-404A	Post Grout	Anomaly E	Yes	825.2	47,825	49	822 2	3		2 1	2 3	2 5		
B-404A	Post Grout	Anomaly E	Yes	825.2	47,825	49	820 2	5		1 4	1 8	2 1		
B-404A	Post Grout	Anomaly E	Yes	825.2	47,825	49	818 2	7		1 9	2.2	2.5		
B-404A	Post Grout	Anomaly E	Yes	825 2	47,825	49	816.2	9		1.7	2 1	2.4		
B-404A	Post Grout	Anomaly E	Yes	825.2	47,825	49	814.2	11		2.9	3 0	3.1		
B-404B	Post Grout	Anomaly E	Yes	825 2	47,815	49	822.2	3		4 5	4.5	4 5		
B-404B	Post Grout	Anomaly E	Yes	825 2	47,815	49	820.2	5		2.4	2 8	3.1		
B-404B	Post Grout	Anomaly E	Yes	825.2	47,815	49	818.2	7		1 9	2 2	2 4		
B-404B	Post Grout	Anomaly E	Yes	825 2	47,815	49	816.2	9		1.7	1 8	1.9		
B-404B	Post Grout	Anomaly E	Yes	825 2	47,815	49	814.2	11		3 5	4.0	4.5		
B-405	Post Grout	Anomaly G	Yes	826.3	48,180	49	823.3	3		2 0	2 1	2.2		
B-405	Post Grout	Anomaly G	Yes	826 3	48,180	49	821.3	5		2 0	2.2	2.3		
B-405	Post Grout	Anomaly G	Yes	826 3	48,180	49	819.3	7		1 7	2 0	2.2		
B-405	Post Grout	Anomaly G	Yes	826.3	48,180	49	817.3	9		1 7	2 1	2.5		
B-405	Post Grout	Anomaly G	Yes	826.3	48,180	49	815.3	11		1.2	1.6	1.9		

Field Test Results
GUE 70 14.10

Boring Number	Period Drilled	Site Setting	Mapped Mine	Ground Elevation	Location Station	Location Offset	Test Elevation	Test Depth	N Values per foot	H Values (Hand Pen) Low	H Values (Hand Pen) Median	H Values (Hand Pen) High	Bedrock Recovery	Bedrock RQD
B-407A	Post Grout	Anomaly J	Yes	822.4	46,974	-60	821.4	1		4.5	4.5	4.5		
B-407A	Post Grout	Anomaly J	Yes	822.4	46,974	-60	819.4	3		3.5	3.8	4.0		
B-407A	Post Grout	Anomaly J	Yes	822.4	46,974	-60	817.4	5		3.0	3.3	3.5		
B-407A	Post Grout	Anomaly J	Yes	822.4	46,974	-60	815.4	7		1.5	1.8	2.0		
B-407B	Post Grout	Anomaly J	Yes	822.4	46,974	-58	819.4	3		2.6	3.0	3.4		
B-407B	Post Grout	Anomaly J	Yes	822.4	46,974	-58	817.4	5		2.4	2.7	3.0		
B-407B	Post Grout	Anomaly J	Yes	822.4	46,974	-58	815.4	7		2.2	2.4	2.6		
B-407C	Post Grout	Anomaly J	Yes	822.4	46,975	-58	819.4	3		2.0	2.2	2.4		
B-407C	Post Grout	Anomaly J	Yes	822.4	46,975	-58	815.4	7		1.0	1.1	1.1		
B-407D	Post Grout	Anomaly J	Yes	822.4	46,978	-58	821.4	1		3.6	4.1	4.5		
B-407D	Post Grout	Anomaly J	Yes	822.4	46,978	-58	819.4	3		4.5	4.5	4.5		
B-407D	Post Grout	Anomaly J	Yes	822.4	46,978	-58	817.4	5		4.5	4.5	4.5		
B-407E	Post Grout	Anomaly J	Yes	822.4	46,980	-58	821.4	1		4.5	4.5	4.5		
B-407E	Post Grout	Anomaly J	Yes	822.4	46,980	-58	819.4	3		3.2	3.4	3.5		
B-407E	Post Grout	Anomaly J	Yes	822.4	46,980	-58	817.4	5		1.5	1.9	2.2		
B-407E	Post Grout	Anomaly J	Yes	822.4	46,980	-58	815.4	7		1.5	1.7	1.9		
B-407F	Post Grout	Anomaly J	Yes	822.4	46,974	-55	819.4	3	11	1.1	2.3	3.4		
B-407F	Post Grout	Anomaly J	Yes	822.4	46,974	-55	817.4	5	8	1.8	2.6	3.3		
B-407F	Post Grout	Anomaly J	Yes	822.4	46,974	-55	815.4	7	8					
B-407F	Post Grout	Anomaly J	Yes	822.4	46,974	-55	813.4	9	7	0.8	1.3	1.8		
B-407F	Post Grout	Anomaly J	Yes	822.4	46,974	-55	811.4	11	1	0.1	0.2	0.2		
B-407F	Post Grout	Anomaly J	Yes	822.4	46,974	-55	809.4	13	1	0.5	0.9	1.2		
B-407F	Post Grout	Anomaly J	Yes	822.4	46,974	-55	807.4	15	1	2.8	3.3	3.8		
B-407F	Post Grout	Anomaly J	Yes	822.4	46,974	-55	805.4	17	10	0.7	1.2	1.6		
B-407G	Post Grout	Anomaly J	Yes	821.6	46,974	-67	819.6	2	11	1.1	1.6	2.0		
B-407G	Post Grout	Anomaly J	Yes	821.6	46,974	-67	817.6	4	7	1.0	1.7	2.4		
B-407G	Post Grout	Anomaly J	Yes	821.6	46,974	-67	815.6	6	15	1.5	2.0	2.5		
B-407G	Post Grout	Anomaly J	Yes	821.6	46,974	-67	813.6	8	2	0.8	0.8	0.8		
B-407G	Post Grout	Anomaly J	Yes	821.6	46,974	-67	811.6	10	1	0.5	0.6	0.7		
B-407G	Post Grout	Anomaly J	Yes	821.6	46,974	-67	809.6	12	4	0.5	0.9	1.2		
B-407G	Post Grout	Anomaly J	Yes	821.6	46,974	-67	807.6	14	8					
B-407G	Post Grout	Anomaly J	Yes	821.6	46,974	-67	804.6	17	9					
B-407G	Post Grout	Anomaly J	Yes	821.6	46,974	-67	802.6	19	29					
B-407G	Post Grout	Anomaly J	Yes	821.6	46,974	-67	797.6	24	30					
B-407G	Post Grout	Anomaly J	Yes	821.6	46,974	-67	792.6	29	3	1.4	1.7	2.0		
B-407G	Post Grout	Anomaly J	Yes	821.6	46,974	-67	787.6	34	7	0.6	1.0	1.4		
B-407G	Post Grout	Anomaly J	Yes	821.6	46,974	-67	782.6	39	17	1.8	2.4	2.9		
B-407G	Post Grout	Anomaly J	Yes	821.6	46,974	-67	777.6	44	50					
B-407G	Post Grout	Anomaly J	Yes	821.6	46,974	-67	770.6	51					99	83
B-407G	Post Grout	Anomaly J	Yes	821.6	46,974	-67	760.6	61					95	83
B-407G	Post Grout	Anomaly J	Yes	821.6	46,974	-67	750.6	71					76	65
B-407G	Post Grout	Anomaly J	Yes	821.6	46,974	-67	744.6	77					100	100
B-407H	Post Grout	Anomaly J	Yes	821.7	46,960	-67	819.7	2	12	1.8	2.4	3.0		
B-407H	Post Grout	Anomaly J	Yes	821.7	46,960	-67	817.7	4	9	1.6	2.0	2.4		
B-407H	Post Grout	Anomaly J	Yes	821.7	46,960	-67	815.7	6	14	1.3	1.3	1.3		
B-407H	Post Grout	Anomaly J	Yes	821.7	46,960	-67	813.7	8	4	1.8	1.8	1.8		
B-407H	Post Grout	Anomaly J	Yes	821.7	46,960	-67	811.7	10	1	0.1	0.3	0.5		
B-407H	Post Grout	Anomaly J	Yes	821.7	46,960	-67	809.7	12	2	0.7	1.0	1.2		
B-407H	Post Grout	Anomaly J	Yes	821.7	46,960	-67	807.7	14	3	0.5	1.0	1.5		
B-407H	Post Grout	Anomaly J	Yes	821.7	46,960	-67	804.7	17	12					
B-407H	Post Grout	Anomaly J	Yes	821.7	46,960	-67	802.7	19	26					
B-407H	Post Grout	Anomaly J	Yes	821.7	46,960	-67	797.7	24	31					
B-407H	Post Grout	Anomaly J	Yes	821.7	46,960	-67	792.7	29	12	1.8	1.8	1.8		
B-407H	Post Grout	Anomaly J	Yes	821.7	46,960	-67	787.7	34	9					
B-407H	Post Grout	Anomaly J	Yes	821.7	46,960	-67	782.7	39	13	2.2	2.5	2.8		
B-407H	Post Grout	Anomaly J	Yes	821.7	46,960	-67	770.7	51					90	54
B-407H	Post Grout	Anomaly J	Yes	821.7	46,960	-67	760.7	61					100	60
B-407H	Post Grout	Anomaly J	Yes	821.7	46,960	-67	752.7	69					74	1
B-407H	Post Grout	Anomaly J	Yes	821.7	46,960	-67	745.7	76					96	70
B-407I	Post Grout	Anomaly J	Yes	822.5	46,985	-55	820.5	2	8	1.6	1.8	2.0		
B-407I	Post Grout	Anomaly J	Yes	822.5	46,985	-55	817.5	5	13	2.7	3.3	3.9		
B-407I	Post Grout	Anomaly J	Yes	822.5	46,985	-55	815.5	7	13	3.4	3.7	4.0		
B-407I	Post Grout	Anomaly J	Yes	822.5	46,985	-55	813.5	9	4	0.3	1.0	1.7		
B-407I	Post Grout	Anomaly J	Yes	822.5	46,985	-55	811.5	11	1	0.6	0.8	0.9		
B-407I	Post Grout	Anomaly J	Yes	822.5	46,985	-55	809.5	13	4	0.1	0.9	1.7		
B-407I	Post Grout	Anomaly J	Yes	822.5	46,985	-55	807.5	15	14					
B-407I	Post Grout	Anomaly J	Yes	822.5	46,985	-55	803.5	19	11					

Field Test Results
GUE 70 14.10

Boring Number	Period Drilled	Site Setting	Mapped Mine	Ground Elevation	Location Station	Location Offset	Test Elevation	Test Depth	N Values per foot	H Values (Hand Pen) Low	H Values (Hand Pen) Median	H Values (Hand Pen) High	Bedrock Recovery	Bedrock RQD
B-408A	Post Grout	Anomaly L	Yes	823.5	47,380	-30	820 5	3		4.5	4.5	4.5		
B-408A	Post Grout	Anomaly L	Yes	823.5	47,380	-30	818.5	5		3 4	4.0	4.5		
B-408A	Post Grout	Anomaly L	Yes	823.5	47,380	-30	816 5	7		1 4	1.8	2.2		
B-408A	Post Grout	Anomaly L	Yes	823.5	47,380	-30	814 5	9		1 3	1 5	1.7		
B-408B	Post Grout	General	No	823.5	47,150	-30	820 5	3		3.2	3.3	3 4		
B-408B	Post Grout	General	No	823 5	47,150	-30	818 5	5		1 7	2.1	2.4		
B-408B	Post Grout	General	No	823 5	47,150	-30	816.5	7		0 8	1.3	1.8		
B-408B	Post Grout	General	No	823 5	47,150	-30	814 5	9		0 5	0 7	0.8		
B-408C	Post Grout	Anomaly L	Yes	823 6	47,380	-34	820.6	3	9	3 6	4.1	4.5		
B-408C	Post Grout	Anomaly L	Yes	823 6	47,380	-34	818.6	5	19	3 3	3.9	4.5		
B-408C	Post Grout	Anomaly L	Yes	823 6	47,380	-34	816.6	7	16	3 0	3.8	4.5		
B-408C	Post Grout	Anomaly L	Yes	823 6	47,380	-34	814.6	9	6	1.0	1 5	1.9		
B-408C	Post Grout	Anomaly L	Yes	823.6	47,380	-34	812 6	11	8	0.9	1.5	2 1		
B-408C	Post Grout	Anomaly L	Yes	823.6	47,380	-34	810 6	13	5	0.4	0.6	0.8		
B-408C	Post Grout	Anomaly L	Yes	823 6	47,380	-34	808 6	15	5	0 7	1.1	1.5		
B-408C	Post Grout	Anomaly L	Yes	823.6	47,380	-34	804.6	19	7	1.2	1.7	2.2		
B-409	Post Grout	Anomaly M	Yes	824.1	47,540	-60	823.1	1		2.9	3.0	3.0		
B-409	Post Grout	Anomaly M	Yes	824.1	47,540	-60	821.1	3		2.4	2.8	3 2		
B-409	Post Grout	Anomaly M	Yes	824.1	47,540	-60	819.1	5		1.3	1.5	1.7		
B-409	Post Grout	Anomaly M	Yes	824.1	47,540	-60	817.1	7		1.5	1.9	2.2		
B-409	Post Grout	Anomaly M	Yes	824.1	47,540	-60	815 1	9		4.5	4.5	4 5		
B-409	Post Grout	Anomaly M	Yes	824.1	47,540	-60	813.1	11		1.5	1.8	2 0		
B-410A	Post Grout	Anomaly N'	No	824 7	47,785	-30	821 7	3		1.8	2.1	2 3		
B-410A	Post Grout	Anomaly N'	No	824.7	47,785	-30	819 7	5		2.1	2.4	2 6		
B-410A	Post Grout	Anomaly N'	No	824 7	47,785	-30	817 7	7		0 5	0.8	1 1		
B-410A	Post Grout	Anomaly N'	No	824.7	47,785	-30	815.7	9		1.8	2.4	2.9		
B-410B	Post Grout	Anomaly N'	No	825.0	47,810	-30	822.0	3		2.2	2.5	2 7		
B-410B	Post Grout	Anomaly N'	No	825 0	47,810	-30	820.0	5		0.8	1.1	1 3		
B-410B	Post Grout	Anomaly N'	No	825.0	47,810	-30	818.0	7		0.7	1.1	1.5		
B-410B	Post Grout	Anomaly N'	No	825.0	47,810	-30	816.0	9		1.2	1.3	1 4		
B-410C	Post Grout	Anomaly N'	No	824.6	47,775	-30	821.6	3		2.7	3.3	3.8		
B-410C	Post Grout	Anomaly N'	No	824 6	47,775	-30	819 6	5		0.8	1.0	1 1		
B-410C	Post Grout	Anomaly N'	No	824.6	47,775	-30	817.6	7		0.5	0.8	1.1		
B-410C	Post Grout	Anomaly N'	No	824.6	47,775	-30	815.6	9		2.1	2 3	2 4		
B-411	Post Grout	Anomaly P	Yes	828.2	48,248	-60	825.2	3		2 1	2.4	2 6		
B-411	Post Grout	Anomaly P	Yes	828.2	48,248	-60	823.2	5		3.5	3 7	3.9		
B-411	Post Grout	Anomaly P	Yes	828.2	48,248	-60	821.2	7		3.1	3 2	3.3		
B-411	Post Grout	Anomaly P	Yes	828 2	48,248	-60	819 2	9		1.3	1 5	1 6		
B-412A	Post Grout	Anomaly Q	Yes	826.9	48,335	-60	823.9	3		1.9	2.1	2.3		
B-412A	Post Grout	Anomaly Q	Yes	826 9	48,335	-60	821 9	5		1.9	2.2	2 4		
B-412A	Post Grout	Anomaly Q	Yes	826 9	48,335	-60	819.9	7		1.7	1.9	2.1		
B-412A	Post Grout	Anomaly Q	Yes	826.9	48,335	-60	817.9	9		1 5	1 6	1 7		
B-412B	Post Grout	General	Yes	827.2	48,390	-60	826.2	1		4.5	4.5	4.5		
B-412B	Post Grout	General	Yes	827.2	48,390	-60	824.2	3		2.9	3.0	3.1		
B-412B	Post Grout	General	Yes	827.2	48,390	-60	822.2	5		2.3	2.5	2.6		
B-412B	Post Grout	General	Yes	827.2	48,390	-60	820.2	7		1.2	1.8	2.4		
B-412B	Post Grout	General	Yes	827.2	48,390	-60	818.2	9		0.3	0.5	0.8		
B-412C	Post Grout	Anomaly Q	Yes	827 1	48,340	-34	825.1	2	27					
B-412C	Post Grout	Anomaly Q	Yes	827 1	48,340	-34	823.1	4	12	3.4	4.0	4.5		
B-412C	Post Grout	Anomaly Q	Yes	827 1	48,340	-34	821.1	6	7	1.4	1.5	1.6		
B-412C	Post Grout	Anomaly Q	Yes	827.1	48,340	-34	819.1	8	10	1.8	2.4	3.0		
B-412C	Post Grout	Anomaly Q	Yes	827.1	48,340	-34	817 1	10	6	1.7	2.0	2.2		
B-412C	Post Grout	Anomaly Q	Yes	827 1	48,340	-34	816.1	11	6	1.5	1.7	1.9		
B-412C	Post Grout	Anomaly Q	Yes	827 1	48,340	-34	815.1	12	6	1.4	2.1	2.8		
B-412C	Post Grout	Anomaly Q	Yes	827 1	48,340	-34	813.1	14	9	0.6	0.9	1.2		
B-412C	Post Grout	Anomaly Q	Yes	827 1	48,340	-34	808 1	19	5	0.7	1.1	1.5		
B-412D	Post Grout	Anomaly Q	Yes	826.6	48,338	-21	824.6	2	14	3.7	4.0	4.2		
B-412D	Post Grout	Anomaly Q	Yes	826 6	48,338	-21	822.6	4	12	3.9	4.2	4.5		
B-412D	Post Grout	Anomaly Q	Yes	826.6	48,338	-21	820.6	6	17	1.2	1.9	2.5		
B-412D	Post Grout	Anomaly Q	Yes	826 6	48,338	-21	818.6	8	10	1.9	2.6	3.2		
B-412D	Post Grout	Anomaly Q	Yes	826 6	48,338	-21	816.6	10	7	0.8	1.2	1.5		
B-412D	Post Grout	Anomaly Q	Yes	826 6	48,338	-21	814.6	12	13					
B-412D	Post Grout	Anomaly Q	Yes	826 6	48,338	-21	812.6	14	3					
B-412D	Post Grout	Anomaly Q	Yes	826.6	48,338	-21	809.6	17	5					
B-412D	Post Grout	Anomaly Q	Yes	826 6	48,338	-21	807.6	19	8					
B-412D	Post Grout	Anomaly Q	Yes	826.6	48,338	-21	802.6	24	7					
B-412D	Post Grout	Anomaly Q	Yes	826 6	48,338	-21	797 6	29	6					

Field Test Results
GUE 70 14.10

Boring	Period	Site	Mapped	Ground	Location		Test		N Values	H Values (Hand Pen)			Bedrock	
Number	Drilled	Setting	Mine	Elevation	Station	Offset	Elevation	Depth	per foot	Low	Median	High	Recovery	RQD
B-412D	Post Grout	Anomaly Q	Yes	826.6	48,338	-21	792.6	34	7					
B-412D	Post Grout	Anomaly Q	Yes	826 6	48,338	-21	787.6	39	63					
B-412D	Post Grout	Anomaly Q	Yes	826.6	48,338	-21	782.6	44	70	1.0	1.3	1.5		
B-412D	Post Grout	Anomaly Q	Yes	826 6	48,338	-21	777.6	49					78	1
B-412D	Post Grout	Anomaly Q	Yes	826 6	48,338	-21	771.6	55					30	1
B-412D	Post Grout	Anomaly Q	Yes	826 6	48,338	-21	765.6	61					88	33
B-412D	Post Grout	Anomaly Q	Yes	826.6	48,338	-21	756.6	70					64	1
B-412D	Post Grout	Anomaly Q	Yes	826.6	48,338	-21	748 6	78					100	57
B-412E	Post Grout	General	Yes	826.6	48,393	-65	824.6	2	10	2.0	2.8	3.6		
B-412E	Post Grout	General	Yes	826.6	48,393	-65	822.6	4	13	3.0	3.4	3.8		
B-412E	Post Grout	General	Yes	826.6	48,393	-65	821.6	5	6	2.0	2 4	2.8		
B-412E	Post Grout	General	Yes	826.6	48,393	-65	820.6	6	6	0.8	1 4	2.0		
B-412E	Post Grout	General	Yes	826.6	48,393	-65	819 6	7	6	1.0	1.4	1.8		
B-412E	Post Grout	General	Yes	826 6	48,393	-65	818.6	8	6	0.8	1.2	1 5		
B-412E	Post Grout	General	Yes	826.6	48,393	-65	816.6	10	10	1.2	1.7	2.2		
B-412E	Post Grout	General	Yes	826 6	48,393	-65	814.6	12	3	0.2	0.6	1 0		
B-412E	Post Grout	General	Yes	826 6	48,393	-65	812.6	14	3	0 5	0.9	1.2		
B-412E	Post Grout	General	Yes	826.6	48,393	-65	810.6	16	4	0.6	0.8	1.0		
B-412E	Post Grout	General	Yes	826.6	48,393	-65	807.6	19	5	0 6	0.7	0.8		
B-412E	Post Grout	General	Yes	826.6	48,393	-65	802.6	24	8	1.0	1.3	1.5		
B-412E	Post Grout	General	Yes	826.6	48,393	-65	797.6	29	4					
B-412E	Post Grout	General	Yes	826.6	48,393	-65	792.6	34	1					
B-412E	Post Grout	General	Yes	826.6	48,393	-65	787.6	39	10					
B-412E	Post Grout	General	Yes	826.6	48,393	-65	782.6	44	6					
B-412E	Post Grout	General	Yes	826.6	48,393	-65	777 6	49	28	4 5	4.5	4.5		
B-412E	Post Grout	General	Yes	826.6	48,393	-65	770 6	56					39	7
B-412E	Post Grout	General	Yes	826.6	48,393	-65	763 6	63					77	23
B-412E	Post Grout	General	Yes	826.6	48,393	-65	754 6	72					68	31
B-412E	Post Grout	General	Yes	826 6	48,393	-65	745 6	81					98	87
B-413A	Post Grout	General	Yes	827.7	48,500	-60	826.7	1		4.5	4.5	4.5		
B-413A	Post Grout	General	Yes	827.7	48,500	-60	824.7	3		4.5	4.5	4 5		
B-413A	Post Grout	General	Yes	827.7	48,500	-60	822 7	5		2 0	2.8	3.5		
B-413A	Post Grout	General	Yes	827.7	48,500	-60	820.7	7		3.0	3.4	3 8		
B-413A	Post Grout	General	Yes	827.7	48,500	-60	818.7	9		2 9	3.0	3.1		
B-413A	Post Grout	General	Yes	827.7	48,500	-60	816.7	11		2.2	2.4	2.5		
B-413B	Post Grout	General	Yes	828.5	48,600	-60	827.5	1		4.5	4.5	4 5		
B-413B	Post Grout	General	Yes	828.5	48,600	-60	825.5	3		3.5	4.0	4 5		
B-413B	Post Grout	General	Yes	828.5	48,600	-60	823.5	5		2 5	2.8	3 0		
B-413B	Post Grout	General	Yes	828.5	48,600	-60	821.5	7		4.5	4.5	4.5		
B-413B	Post Grout	General	Yes	828.5	48,600	-60	819.5	9		1.0	1.3	1.5		
B-413B	Post Grout	General	Yes	828.5	48,600	-60	817.5	11		1.5	1 8	2 0		
B-413C	Post Grout	Anomaly R	Yes	828.6	48,615	-58	827.6	1		4.5	4.5	4 5		
B-413C	Post Grout	Anomaly R	Yes	828.6	48,615	-58	825 6	3		2 4	3.5	4.5		
B-413C	Post Grout	Anomaly R	Yes	828 6	48,615	-58	823 6	5		1 0	1.6	2.2		
B-413C	Post Grout	Anomaly R	Yes	828 6	48,615	-58	821.6	7		2.9	3.1	3 3		
B-413C	Post Grout	Anomaly R	Yes	828 6	48,615	-58	819.6	9		2.6	3 0	3.4		
B-413C	Post Grout	Anomaly R	Yes	828.6	48,615	-58	817 6	11		3.4	4.0	4.5		
B-413D	Post Grout	General	Yes	828.7	48,606	-55	826 7	2	11	3.0	3.8	4.5		
B-413D	Post Grout	General	Yes	828.7	48,606	-55	824 7	4	16	2.1	3.3	4.5		
B-413D	Post Grout	General	Yes	828.7	48,606	-55	822.7	6	8	1.7	2 0	2.3		
B-413D	Post Grout	General	Yes	828.7	48,606	-55	821.7	7	8	1.9	2.2	2.5		
B-413D	Post Grout	General	Yes	828.7	48,606	-55	820.7	8	10	1.8	2.1	2.4		
B-413D	Post Grout	General	Yes	828.7	48,606	-55	818 7	10	12	1.5	2.2	2.8		
B-413D	Post Grout	General	Yes	828.7	48,606	-55	816 7	12	12	1.8	2.3	2.8		
B-413D	Post Grout	General	Yes	828.7	48,606	-55	814.7	14	17	3.4	4 0	4.5		
B-413D	Post Grout	General	Yes	828.7	48,606	-55	813 7	15	17	1.7	2 2	2.6		
B-413E	Post Grout	Anomaly R'	Yes	828.5	48,638	-66	826 5	2	11	4.0	4 3	4 5		
B-413E	Post Grout	Anomaly R'	Yes	828.5	48,638	-66	825 5	3	12	4.0	4.3	4 5		
B-413E	Post Grout	Anomaly R'	Yes	828 5	48,638	-66	824.5	4	12	1.5	2 3	3.0		
B-413E	Post Grout	Anomaly R'	Yes	828.5	48,638	-66	822 5	6	19	1 2	2.0	2 7		
B-413E	Post Grout	Anomaly R'	Yes	828.5	48.638	-66	820 5	8	12	1.1	1.6	2.1		
B-413E	Post Grout	Anomaly R'	Yes	828.5	48.638	-66	818.5	10	9	1.8	2.4	2.9		
B-413E	Post Grout	Anomaly R'	Yes	828.5	48.638	-66	816 5	12	7	1.0	1.3	1.6		
B-413E	Post Grout	Anomaly R'	Yes	828.5	48,638	-66	814.5	14	7	1.0	1.5	2.0		
B-413E	Post Grout	Anomaly R'	Yes	828.5	48,638	-66	811.5	17	17	2.5	2.9	3.2		
B-413E	Post Grout	Anomaly R'	Yes	828.5	48,638	-66	809.5	19	10	1 6	1.9	2.2		
B-413E	Post Grout	Anomaly R'	Yes	828.5	48,638	-66	804.5	24	8					

Field Test Results
GUE 70 14.10

Boring Number	Period Drilled	Site Setting	Mapped Mine	Ground Elevation	Location Station	Location Offset	Test Elevation	Test Depth	N Values per foot	H Values (Hand Pen) Low	H Values (Hand Pen) Median	H Values (Hand Pen) High	Bedrock Recovery	Bedrock RQD
B-413E	Post Grout	Anomaly R'	Yes	828 5	48,638	-66	799 5	29	3					
B-413E	Post Grout	Anomaly R'	Yes	828.5	48,638	-66	794 5	34	19					
B-413E	Post Grout	Anomaly R'	Yes	828 5	48,638	-66	789.5	39	73					
B-413E	Post Grout	Anomaly R'	Yes	828.5	48,638	-66	785.5	43					30	1
B-413E	Post Grout	Anomaly R'	Yes	828 5	48,638	-66	779.5	49					90	52
B-413E	Post Grout	Anomaly R'	Yes	828 5	48,638	-66	772.5	56					97	81
B-413E	Post Grout	Anomaly R'	Yes	828.5	48,638	-66	762.5	66					70	54
B-413E	Post Grout	Anomaly R'	Yes	828.5	48,638	-66	752 5	76					91	80
B-413F	Post Grout	General	Yes	828.2	48,602	-66	826 2	2	9					
B-413F	Post Grout	General	Yes	828.2	48,602	-66	825 2	3	16	3 8	4.2	4.5		
B-413F	Post Grout	General	Yes	828.2	48,602	-66	824.2	4	16	2 5	2.5	2.5		
B-413F	Post Grout	General	Yes	828.2	48,602	-66	823.2	5	16	1 9	2.5	3.0		
B-413F	Post Grout	General	Yes	828.2	48,602	-66	822.2	6	19	1 0	1 3	1 5		
B-413F	Post Grout	General	Yes	828.2	48,602	-66	821 2	7	19	0.7	1.2	1.7		
B-413F	Post Grout	General	Yes	828.2	48,602	-66	820.2	8	13	2.6	3.2	3.7		
B-413F	Post Grout	General	Yes	828.2	48,602	-66	818 2	10	9	1.3	1.9	2 4		
B-413F	Post Grout	General	Yes	828.2	48,602	-66	816.2	12	10	1.3	2 0	2 7		
B-413F	Post Grout	General	Yes	828 2	48,602	-66	814 2	14	9	1.0	1 5	1.9		
B-413F	Post Grout	General	Yes	828.2	48,602	-66	811.2	17	12	1.5	1 8	2.0		
B-413F	Post Grout	General	Yes	828.2	48,602	-66	809 2	19	8	1.2	1.6	1.9		
B-413F	Post Grout	General	Yes	828 2	48,602	-66	804 2	24	8	1.7	1.9	2.1		
B-413F	Post Grout	General	Yes	828.2	48,602	-66	799 2	29	3					
B-413F	Post Grout	General	Yes	828.2	48,602	-66	794 2	34	20					
B-413F	Post Grout	General	Yes	828.2	48,602	-66	789.2	39	75					
B-413F	Post Grout	General	Yes	828.2	48,602	-66	781.2	47					97	34
B-413F	Post Grout	General	Yes	828 2	48,602	-66	771.2	57					100	97
B-413F	Post Grout	General	Yes	828 2	48,602	-66	761.2	67					96	49
B-413F	Post Grout	General	Yes	828 2	48,602	-66	751 2	77					100	72
B-413G	Post Grout	General	Yes	828.3	48,540	-55	825 3	3	11	4.3	4.4	4.5		
B-413G	Post Grout	General	Yes	828 3	48,540	-55	823 3	5	17	2.4	3.5	4.5		
B-413G	Post Grout	General	Yes	828.3	48,540	-55	821 3	7	10	2.2	2.3	2.4		
B-413G	Post Grout	General	Yes	828 3	48,540	-55	819 3	9	10	1.2	2.2	3.2		
B-413G	Post Grout	General	Yes	828.3	48,540	-55	817 3	11	9	1.3	2.9	4.5		
B-413G	Post Grout	General	Yes	828.3	48,540	-55	815.3	13	8	1.3	1.6	1.9		
B-413G	Post Grout	General	Yes	828.3	48,540	-55	813.3	15	100					
B-413H	Post Grout	General	Yes	827.5	48,537	-67	825.5	2	12	3 5	4 0	4 5		
B-413H	Post Grout	General	Yes	827.5	48,537	-67	823 5	4	13	1.6	2.2	2.8		
B-413H	Post Grout	General	Yes	827.5	48,537	-67	821.5	6	9	1.2	1.7	2.1		
B-413H	Post Grout	General	Yes	827.5	48,537	-67	819.5	8	7	0.6	1.1	1 5		
B-413H	Post Grout	General	Yes	827.5	48,537	-67	817.5	10	9	0.7	1.3	1 9		
B-413H	Post Grout	General	Yes	827.5	48,537	-67	815.5	12	6	0.6	0.9	1 2		
B-413H	Post Grout	General	Yes	827.5	48,537	-67	813.5	14	6	0.5	0.7	0.9		
B-413H	Post Grout	General	Yes	827.5	48,537	-67	810 5	17	12	0.8	1.3	1.8		
B-413H	Post Grout	General	Yes	827.5	48,537	-67	807.5	20	9	1.2	1 6	2.0		
B-413H	Post Grout	General	Yes	827 5	48,537	-67	803 5	24	8					
B-413H	Post Grout	General	Yes	827.5	48,537	-67	797.5	30	4	0.4	0.5	0.6		
B-413H	Post Grout	General	Yes	827 5	48,537	-67	792 5	35	32					
B-413H	Post Grout	General	Yes	827 5	48.537	-67	788 5	39	70					
B-413H	Post Grout	General	Yes	827.5	48,537	-67	783.5	44	72					
B-413H	Post Grout	General	Yes	827.5	48,537	-67	776.5	51					95	44
B-413H	Post Grout	General	Yes	827 5	48,537	-67	766.5	61					100	70
B-413H	Post Grout	General	Yes	827.5	48,537	-67	756.5	71					94	50
B-413H	Post Grout	General	Yes	827.5	48,537	-67	746 5	81					98	
GC-201	Post Grout	General	Yes	826.2	48,304	-20	822.2	4	11	3 2	3.8	4.3		
GC-201	Post Grout	General	Yes	826.2	48,304	-20	820 2	6	8	2 6	3.1	3.6		
GC-201	Post Grout	General	Yes	826.2	48,304	-20	817 2	9	4	0.5	0.9	1.3		
GC-201	Post Grout	General	Yes	826.2	48,304	-20	812.2	14	3	0.3	0.5	0.7		
GC-201	Post Grout	General	Yes	826.2	48,304	-20	807.2	19	6	0 5	1.5	2.4		
GC-201	Post Grout	General	Yes	826.2	48,304	-20	802.2	24	14	1.1	1.7	2.2		
GC-201	Post Grout	General	Yes	826.2	48,304	-20	797.2	29	3	0 4	0 6	0.8		
GC-201	Post Grout	General	Yes	826.2	48,304	-20	792.2	34	16	0 7	1.2	1.7		
GC-201	Post Grout	General	Yes	826.2	48,304	-20	787 2	39	30	3.5	3.7	3 8		
GC-201	Post Grout	General	Yes	826.2	48,304	-20	781 2	45	100	4 2	4.3	4.3		
GC-201	Post Grout	General	Yes	826.2	48,304	-20	778.2	48	100					
GC-203	Post Grout	General	Yes	826.3	48,324	-19	822 3	4	21	4.0	4.3	4.5		
GC-203	Post Grout	General	Yes	826.3	48,324	-19	820.3	6	15	2.0	2.8	3 5		
GC-203	Post Grout	General	Yes	826.3	48,324	-19	817.3	9	9	1.0	2.5	4.0		

Field Test Results
GUE 70 14.10

Boring Number	Period Drilled	Site Setting	Mapped Mine	Ground Elevation	Location Station	Offset	Test Elevation	Depth	N Values per foot	H Values (Hand Pen) Low	Median	High	Bedrock Recovery	RQD
GC-203	Post Grout	General	Yes	826.3	48,324	-19	812.3	14	5	0.5	1.0	1.5		
GC-203	Post Grout	General	Yes	826.3	48,324	-19	807 3	19	11	1.5	1.9	2.2		
GC-203	Post Grout	General	Yes	826.3	48,324	-19	802.3	24	22					
GC-203	Post Grout	General	Yes	826.3	48,324	-19	797 3	29	7	0 5	1.0	1.5		
GC-203	Post Grout	General	Yes	826.3	48,324	-19	792 3	34	34					
GC-203	Post Grout	General	Yes	826 3	48,324	-19	787 3	39	69					
GC-203	Post Grout	General	Yes	826 3	48,324	-19	782.3	44	29					
GC-203	Post Grout	General	Yes	826.3	48,324	-19	777 3	49	100					
GC-204	Post Grout	Anomaly Q	Yes	826.3	48,329	-20	770.3	56					88	1
GC-204	Post Grout	Anomaly Q	Yes	826 3	48,329	-20	766.3	60					56	18
GC-204	Post Grout	Anomaly Q	Yes	826 3	48,329	-20	762.3	64					76	15
GC-205	Post Grout	Anomaly Q	Yes	826 5	48,340	-20	822.5	4	17	2 3	2.5	2.6		
GC-205	Post Grout	Anomaly Q	Yes	826 5	48,340	-20	819.5	7	12	2 1	2.9	3.6		
GC-205	Post Grout	Anomaly Q	Yes	826 5	48,340	-20	817.5	9	10	0 5	1.0	1.5		
GC-205	Post Grout	Anomaly Q	Yes	826 5	48,340	-20	812.5	14	4	0.5	0.8	1 1		
GC-205	Post Grout	Anomaly Q	Yes	826.5	48,340	-20	807 5	19	11	1.5	1.7	1.8		
GC-205	Post Grout	Anomaly Q	Yes	826 5	48,340	-20	802.5	24	17					
GC-205	Post Grout	Anomaly Q	Yes	826.5	48,340	-20	797.5	29	11	0.6	1.1	1.6		
GC-205	Post Grout	Anomaly Q	Yes	826 5	48,340	-20	792.5	34	27	1.1	1.4	1 6		
GC-205	Post Grout	Anomaly Q	Yes	826.5	48,340	-20	787.5	39	51					
GC-205	Post Grout	Anomaly Q	Yes	826 5	48,340	-20	782.5	44	100					
GC-206	Post Grout	Anomaly Q	Yes	826.5	48,357	-21	822.5	4	11	2.3	3.0	3 6		
GC-206	Post Grout	Anomaly Q	Yes	826.5	48,357	-21	819.5	7	10	1.9	2.5	3 0		
GC-206	Post Grout	Anomaly Q	Yes	826 5	48,357	-21	817.5	9	6	0.7	1.2	1 7		
GC-206	Post Grout	Anomaly Q	Yes	826.5	48,357	-21	812.5	14	3	0.5	0.9	1.3		
GC-206	Post Grout	Anomaly Q	Yes	826.5	48.357	-21	807.5	19	11	2.2	2.6	2.9		
GC-206	Post Grout	Anomaly Q	Yes	826.5	48.357	-21	802.5	24	11	1.2	1.5	1.8		
GC-206	Post Grout	Anomaly Q	Yes	826.5	48.357	-21	797.5	29	9	0.7	0.8	0.9		
GC-206	Post Grout	Anomaly Q	Yes	826.5	48.357	-21	792.5	34	47	0.7	1.1	1.4		
GC-206	Post Grout	Anomaly Q	Yes	826.5	48.357	-21	787.5	39	33	2 2	2.3	2.4		
GC-206	Post Grout	Anomaly Q	Yes	826.5	48.357	-21	782.5	44	100					
GC-207	Post Grout	Anomaly Q	Yes	826.7	48,379	-21	822 7	4	14	3.7	3.8	3 9		
GC-207	Post Grout	Anomaly Q	Yes	826.7	48.379	-21	819.7	7	11	2 3	2.9	3.5		
GC-207	Post Grout	Anomaly Q	Yes	826.7	48,379	-21	817.7	9	4	0.4	1.1	1.7		
GC-207	Post Grout	Anomaly Q	Yes	826.7	48,379	-21	812.7	14	6	0 5	0.7	0 8		
GC-207	Post Grout	Anomaly Q	Yes	826.7	48,379	-21	807.7	19	7	1.4	1.8	2.2		
GC-207	Post Grout	Anomaly Q	Yes	826.7	48,379	-21	802.7	24	12					
GC-207	Post Grout	Anomaly Q	Yes	826.7	48,379	-21	797.7	29	6	0.3	0.5	0.7		
GC-207	Post Grout	Anomaly Q	Yes	826.7	48,379	-21	792.7	34		1.1	1.4	1.6		
GC-207	Post Grout	Anomaly Q	Yes	826.7	48.379	-21	787.7	39	34					
GC-208	Post Grout	General	Yes	826.4	48,419	-19	822 4	4	12	1.2	1.9	2.5		
GC-208	Post Grout	General	Yes	826.4	48,419	-19	819 4	7	8	0.4	1.3	2.2		
GC-208	Post Grout	General	Yes	826.4	48,419	-19	817.4	9		1.5	2.0	2.5		
GC-208	Post Grout	General	Yes	826.4	48,419	-19	812.4	14	6	1.1	1.8	2.4		
GC-208	Post Grout	General	Yes	826.4	48,419	-19	807 4	19	9	1.1	1.5	1.9		
GC-208	Post Grout	General	Yes	826.4	48,419	-19	802 4	24	14					
GC-208	Post Grout	General	Yes	826.4	48,419	-19	797 4	29	7	0.3	0.6	0.8		
GC-208	Post Grout	General	Yes	826.4	48,419	-19	792 4	34	100					
GC-208	Post Grout	General	Yes	826.4	48,419	-19	787.4	39	32					
GC-208	Post Grout	General	Yes	826.4	48,419	-19	776 4	50					100	47
GC-208	Post Grout	General	Yes	826.4	48,419	-19	771 4	55					100	75
GC-208	Post Grout	General	Yes	826.4	48,419	-19	766.4	60					93	49
GC-208	Post Grout	General	Yes	826.4	48,419	-19	761.4	65					100	42
GC-208	Post Grout	General	Yes	826.4	48,419	-19	753 4	73					57	38
GC-209	Post Grout	General	Yes	827.1	48,459	-21	823 1	4	85	3.9	4.2	4 5		
GC-209	Post Grout	General	Yes	827.1	48,459	-21	820 1	7	20	1.7	2.1	2 4		
GC-209	Post Grout	General	Yes	827.1	48,459	-21	818.1	9	18	2.9	3.3	3 6		
GC-209	Post Grout	General	Yes	827.1	48,459	-21	813.1	14	17	1.8	2.6	3.4		
GC-209	Post Grout	General	Yes	827.1	48,459	-21	808.1	19	11	1.3	1.6	1.8		
GC-209	Post Grout	General	Yes	827.1	48,459	-21	803 1	24	11	1.0	1.1	1 1		
GC-209	Post Grout	General	Yes	827.1	48,459	-21	798.1	29	5	0.3	0.6	0.8		
GC-209	Post Grout	General	Yes	827.1	48,459	-21	793 1	34	60					
GC-209	Post Grout	General	Yes	827.1	48,459	-21	788.1	39	13					
GC-209	Post Grout	General	Yes	827.1	48,459	-21	783 1	44	100					
GC-211	Post Grout	General	Yes	826 1	48,305	-67	822 1	4	19	3.5	4.0	4 5		
GC-211	Post Grout	General	Yes	826 1	48,305	-67	820 1	6	5	2.0	2.3	2 5		
GC-211	Post Grout	General	Yes	826.1	48,305	-67	817.1	9	8	2.0	2.8	3.5		

Field Test Results
GUE 70 14.10

Boring Number	Period Drilled	Site Setting	Mapped Mine	Ground Elevation	Location Station	Location Offset	Test Elevation	Test Depth	N Values per foot	H Values (Hand Pen) Low	H Values (Hand Pen) Median	H Values (Hand Pen) High	Bedrock Recovery	Bedrock RQD
GC-211	Post Grout	General	Yes	826.1	48,305	-67	812.1	14	7	1.5	1.8	2.0		
GC-211	Post Grout	General	Yes	826.1	48,305	-67	807.1	19	6	1.5	2.0	2 5		
GC-211	Post Grout	General	Yes	826.1	48,305	-67	802.1	24	9	2.5	3.5	4.5		
GC-211	Post Grout	General	Yes	826 1	48,305	-67	797.1	29	7	1.0	1.5	2.0		
GC-211	Post Grout	General	Yes	826 1	48,305	-67	792.1	34	29					
GC-211	Post Grout	General	Yes	826 1	48,305	-67	787.1	39	25					
GC-211	Post Grout	General	Yes	826 1	48,305	-67	782.1	44	100					
GC-213	Post Grout	Anomaly Q	Yes	826 4	48,326	-66	822.4	4	22	4.5	4 5	4.5		
GC-213	Post Grout	Anomaly Q	Yes	826 4	48,326	-66	820.4	6	10	1.5	2 3	3 0		
GC-213	Post Grout	Anomaly Q	Yes	826 4	48,326	-66	817.4	9	13	1.5	2 3	3 0		
GC-213	Post Grout	Anomaly Q	Yes	826 4	48,326	-66	812.4	14	7	1 0	1 3	1 5		
GC-213	Post Grout	Anomaly Q	Yes	826 4	48,326	-66	807.4	19	8	1.0	1 3	1.5		
GC-213	Post Grout	Anomaly Q	Yes	826 4	48,326	-66	802.4	24	12					
GC-213	Post Grout	Anomaly Q	Yes	826 4	48,326	-66	797.4	29	9	1.5	1.5	1.5		
GC-213	Post Grout	Anomaly Q	Yes	826 4	48,326	-66	792.4	34	32					
GC-213	Post Grout	Anomaly Q	Yes	826 4	48,326	-66	787.4	39	17					
GC-215	Post Grout	Anomaly Q	Yes	826 4	48,340	-67	822.4	4	12	3.5	4.0	4 5		
GC-215	Post Grout	Anomaly Q	Yes	826 4	48,340	-67	819.4	7	13	3.0	3.8	4.5		
GC-215	Post Grout	Anomaly Q	Yes	826 4	48,340	-67	817 4	9	10	1.5	2.0	2.5		
GC-215	Post Grout	Anomaly Q	Yes	826 4	48,340	-67	812.4	14	4	0.3	0.6	1.0		
GC-215	Post Grout	Anomaly Q	Yes	826.4	48,340	-67	810 4	16		1.3	1.9	2.5		
GC-215	Post Grout	Anomaly Q	Yes	826.4	48,340	-67	807.4	19	8	1.0	1.8	2.5		
GC-215	Post Grout	Anomaly Q	Yes	826 4	48,340	-67	802.4	24	14	2 5	2 5	2.5		
GC-215	Post Grout	Anomaly Q	Yes	826.4	48,340	-67	797.4	29	5	0 8	0.9	1.0		
GC-215	Post Grout	Anomaly Q	Yes	826.4	48,340	-67	792.4	34	35					
GC-215	Post Grout	Anomaly Q	Yes	826.4	48,340	-67	787.4	39	48					
GC-215	Post Grout	Anomaly Q	Yes	826.4	48,340	-67	782.4	44	100					
GC-216	Post Grout	Anomaly Q	Yes	826.4	48,360	-66	822 4	4	56	4.5	4 5	4.5		
GC-216	Post Grout	Anomaly Q	Yes	826.4	48,360	-66	820 4	6	11	4.5	4.5	4.5		
GC-216	Post Grout	Anomaly Q	Yes	826.4	48,360	-66	817.4	9	13	2.5	3 0	3.5		
GC-216	Post Grout	Anomaly Q	Yes	826.4	48,360	-66	812 4	14	5	1.5	2.8	4.0		
GC-216	Post Grout	Anomaly Q	Yes	826.4	48,360	-66	807.4	19	11	1.2	1 9	2.5		
GC-216	Post Grout	Anomaly Q	Yes	826.4	48,360	-66	802 4	24	14	3.0	3.8	4.5		
GC-216	Post Grout	Anomaly Q	Yes	826.4	48,360	-66	797 4	29	7	0.5	1.0	1.5		
GC-216	Post Grout	Anomaly Q	Yes	826.4	48,360	-66	792 4	34	66					
GC-216	Post Grout	Anomaly Q	Yes	826.4	48.360	-66	787 4	39	68					
GC-216	Post Grout	Anomaly Q	Yes	826 4	48.360	-66	782.4	44	100					
GC-217	Post Grout	Anomaly Q	Yes	826 6	48,380	-66	822 6	4	20	2 6	3.0	3.4		
GC-217	Post Grout	Anomaly Q	Yes	826.6	48,380	-66	819 6	7	15	1.0	1.6	2.2		
GC-217	Post Grout	Anomaly Q	Yes	826.6	48,380	-66	817 6	9	14	1 6	2.3	2.9		
GC-217	Post Grout	Anomaly Q	Yes	826 6	48.380	-66	812 6	14	9	0 7	1.2	1.7		
GC-217	Post Grout	Anomaly Q	Yes	826 6	48,380	-66	807 6	19	9	0 7	0.9	1.1		
GC-217	Post Grout	Anomaly Q	Yes	826 6	48,380	-66	805 6	21		2 2	2.3	2.4		
GC-217	Post Grout	Anomaly Q	Yes	826.6	48,380	-66	802.6	24	19					
GC-217	Post Grout	Anomaly Q	Yes	826.6	48,380	-66	797.6	29	6	0.7	0.8	0 9		
GC-217	Post Grout	Anomaly Q	Yes	826 6	48,380	-66	792.6	34	34					
GC-217	Post Grout	Anomaly Q	Yes	826.6	48,380	-66	787.6	39	52					
GC-217	Post Grout	Anomaly Q	Yes	826 6	48,380	-66	782.6	44	1					
GC-217	Post Grout	Anomaly Q	Yes	826.6	48,380	-66	776.6	50	61					
GC-218	Post Grout	General	Yes	826.6	48,421	-66	822 6	4	25	3.0	3.8	4 5		
GC-218	Post Grout	General	Yes	826.6	48,421	-66	819.6	7	15	1 5	2.0	2.5		
GC-218	Post Grout	General	Yes	826.6	48,421	-66	817.6	9		1.7	2.7	3.7		
GC-218	Post Grout	General	Yes	826.6	48,421	-66	812.6	14	9	1.5	2.5	3.5		
GC-218	Post Grout	General	Yes	826.6	48,421	-66	807.6	19	9	0 7	1.3	1.9		
GC-218	Post Grout	General	Yes	826.6	48,421	-66	805.6	21	5	0.2	0.4	0.6		
GC-218	Post Grout	General	Yes	826.6	48,421	-66	802.6	24	20					
GC-218	Post Grout	General	Yes	826.6	48,421	-66	797.6	29	7	0.2	0.7	1.2		
GC-218	Post Grout	General	Yes	826.6	48,421	-66	792.6	34	11	0.7	1.1	1.4		
GC-218	Post Grout	General	Yes	826.6	48,421	-66	787.6	39	79					
GC-218	Post Grout	General	Yes	826.6	48,421	-66	782.6	44	100					
GC-219	Post Grout	General	Yes	827.2	48,460	-65	823.2	4	24	2.3	3.3	4.2		
GC-219	Post Grout	General	Yes	827.2	48,460	-65	820 2	7	25	2.1	2.8	3 5		
GC-219	Post Grout	General	Yes	827.2	48,460	-65	818.2	9	17	2.1	3.0	3.9		
GC-219	Post Grout	General	Yes	827.2	48,460	-65	813 2	14	7	0.6	1 1	1 5		
GC-219	Post Grout	General	Yes	827.2	48,460	-65	808.2	19	8	0 6	0 9	1.2		
GC-219	Post Grout	General	Yes	827.2	48,460	-65	803 2	24	7					
GC-219	Post Grout	General	Yes	827.2	48,460	-65	798 2	29	4	0.3	0 5	0.6		

Field Test Results
GUE 70 14.10

Boring Number	Period Drilled	Site Setting	Mapped Mine	Ground Elevation	Location Station	Location Offset	Test Elevation	Test Depth	N Values per foot	H Values (Hand Pen) Low	H Values (Hand Pen) Median	H Values (Hand Pen) High	Bedrock Recovery	Bedrock RQD
GC-219	Post Grout	General	Yes	827.2	48,460	-65	793.2	34	34					
GC-219	Post Grout	General	Yes	827.2	48,460	-65	788.2	39	50					
GC-219	Post Grout	General	Yes	827 2	48,460	-65	783.2	44	100					
GC-301	Post Grout	General	Yes	827.7	48,530	-65	826.7	1	14					
GC-301	Post Grout	General	Yes	827.7	48,530	-65	824.7	3	8	3.2	3.9	4.5		
GC-301	Post Grout	General	Yes	827.7	48,530	-65	822 7	5	12	2.4	2.8	3.2		
GC-301	Post Grout	General	Yes	827 7	48,530	-65	820 7	7	9	2.2	3.2	4 2		
GC-301	Post Grout	General	Yes	827 7	48,530	-65	818.7	9	10	1.6	2 2	2 7		
GC-301	Post Grout	General	Yes	827 7	48,530	-65	816 7	11	9	0.9	1 4	1 9		
GC-301	Post Grout	General	Yes	827.7	48,530	-65	814 7	13	12	1.2	1.6	2.0		
GC-301	Post Grout	General	Yes	827.7	48,530	-65	813.7	14	5	0 9	1.1	1.2		
GC-301	Post Grout	General	Yes	827.7	48,530	-65	810 7	17	14	1.7	1.8	1.9		
GC-301	Post Grout	General	Yes	827.7	48,530	-65	808.7	19	14	2.1	2.3	2 4		
GC-301	Post Grout	General	Yes	827.7	48.530	-65	803.7	24	9					
GC-301	Post Grout	General	Yes	827.7	48.530	-65	798 7	29	6					
GC-301	Post Grout	General	Yes	827.7	48.530	-65	793 7	34	8	0.4	0.5	0.6		
GC-301	Post Grout	General	Yes	827.7	48,530	-65	788.7	39	82					
GC-301	Post Grout	General	Yes	827.7	48,530	-65	781.7	46					85	53
GC-301	Post Grout	General	Yes	827.7	48,530	-65	771.7	56					96	98
GC-301	Post Grout	General	Yes	827 7	48,530	-65	761.7	66					100	100
GC-301	Post Grout	General	Yes	827.7	48,530	-65	756.7	71					48	42
GC-301	Post Grout	General	Yes	827.7	48,530	-65	746.7	81					100	100
GC-302	Post Grout	Anomaly R	Yes	828.3	48,616	-66	827.3	1	17					
GC-302	Post Grout	Anomaly R	Yes	828.3	48,616	-66	825.3	3	31	3.4	4.0	4 5		
GC-302	Post Grout	Anomaly R	Yes	828.3	48,616	-66	823.3	5	16	2.2	3.3	4 3		
GC-302	Post Grout	Anomaly R	Yes	828.3	48,616	-66	821.3	7	13	2.4	3.1	3 7		
GC-302	Post Grout	Anomaly R	Yes	828.3	48,616	-66	819.3	9	12	2.2	2 7	3 1		
GC-302	Post Grout	Anomaly R	Yes	828.3	48,616	-66	817.3	11	13	2.1	2.4	2 7		
GC-302	Post Grout	Anomaly R	Yes	828.3	48,616	-66	815 3	13	7	1.4	1.7	1.9		
GC-302	Post Grout	Anomaly R	Yes	828.3	48,616	-66	814 3	14	10	1.9	2.1	2.3		
GC-302	Post Grout	Anomaly R	Yes	828.3	48,616	-66	811 3	17	13	1.9	2.6	3.2		
GC-302	Post Grout	Anomaly R	Yes	828.3	48,616	-66	809.3	19	9	1.4	1.8	2 1		
GC-302	Post Grout	Anomaly R	Yes	828.3	48,616	-66	804 3	24	4					
GC-302	Post Grout	Anomaly R	Yes	828.3	48,616	-66	799.3	29	4					
GC-302	Post Grout	Anomaly R	Yes	828.3	48,616	-66	794 3	34	13	0.6	0.7	0.8		
GC-302	Post Grout	Anomaly R	Yes	828 3	48,616	-66	789.3	39					80	54
GC-302	Post Grout	Anomaly R	Yes	828.3	48,616	-66	789.3	39	81					
GC-302	Post Grout	Anomaly R	Yes	828.3	48,616	-66	782.3	46					13	1
GC-302	Post Grout	Anomaly R	Yes	828.3	48,616	-66	774.3	54					96	88
GC-302	Post Grout	Anomaly R	Yes	828.3	48,616	-66	764.3	64					94	81
GC-302	Post Grout	Anomaly R	Yes	828.3	48,616	-66	757.3	71					100	57
GC-302	Post Grout	Anomaly R	Yes	828.3	48,616	-66	748.3	80					63	60
GC-303	Post Grout	General	Yes	827.9	48,549	-65	826.9	1	11					
GC-303	Post Grout	General	Yes	827 9	48,549	-65	824.9	3	12	3.1	3 4	3.7		
GC-303	Post Grout	General	Yes	827 9	48,549	-65	822.9	5	12	2.0	3.2	4.3		
GC-303	Post Grout	General	Yes	827 9	48,549	-65	820.9	7	7	1.7	2.5	3.2		
GC-303	Post Grout	General	Yes	827.9	48,549	-65	818.9	9	8	1.6	2 0	2.4		
GC-303	Post Grout	General	Yes	827 9	48,549	-65	816 9	11	8	1 2	1.8	2.3		
GC-303	Post Grout	General	Yes	827 9	48,549	-65	814.9	13	10	1 4	2 1	2 7		
GC-303	Post Grout	General	Yes	827.9	48,549	-65	813.9	14	11	1.4	2 0	2.6		
GC-303	Post Grout	General	Yes	827 9	48,549	-65	810.9	17	13	1.9	2.3	2.7		
GC-303	Post Grout	General	Yes	827 9	48,549	-65	808 9	19	16	2.2	2.7	3.2		
GC-303	Post Grout	General	Yes	827 9	48,549	-65	803.9	24	9					
GC-303	Post Grout	General	Yes	827 9	48,549	-65	798.9	29	3	0.4	0.6	0.7		
GC-303	Post Grout	General	Yes	827 9	48,549	-65	793.9	34	73					
GC-303	Post Grout	General	Yes	827 9	48,549	-65	788.9	39	73	2.2	2.3	2.3		
GC-303	Post Grout	General	Yes	827.9	48,549	-65	783.9	44					55	43
GC-303	Post Grout	General	Yes	827 9	48,549	-65	777.9	50					100	89
GC-303	Post Grout	General	Yes	827.9	48,549	-65	767.9	60					100	100
GC-303	Post Grout	General	Yes	827 9	48,549	-65	757.9	70					100	43
GC-303	Post Grout	General	Yes	827 9	48,549	-65	746.9	81					100	94
GC-304	Post Grout	General	Yes	828.2	48,581	-65	827.2	1	12					
GC-304	Post Grout	General	Yes	828.2	48,581	-65	825.2	3	16	3.4	3 8	4.2		
GC-304	Post Grout	General	Yes	828 2	48,581	-65	823.2	5	12	2 4	2.8	3.2		
GC-304	Post Grout	General	Yes	828 2	48,581	-65	821.2	7	8	0.2	2 4	4.5		
GC-304	Post Grout	General	Yes	828 2	48,581	-65	819.2	9	14	3.2	3.5	3.8		
GC-304	Post Grout	General	Yes	828 2	48,581	-65	817.2	11	12	2.2	2.6	3.0		

Field Test Results
GUE 70 14.10

Boring Number	Period Drilled	Site Setting	Mapped Mine	Ground Elevation	Location: Station	Location: Offset	Test: Elevation	Test: Depth	N Values per foot	H Values (Hand Pen): Low	H Values (Hand Pen): Median	H Values (Hand Pen): High	Bedrock: Recovery	Bedrock: RQD
GC-304	Post Grout	General	Yes	828.2	48 581	-65	815.2	13	13	2 4	2.9	3 4		
GC-304	Post Grout	General	Yes	828.2	48.581	-65	814.2	14	16	2.7	3 1	3 4		
GC-304	Post Grout	General	Yes	828 2	48,581	-65	811.2	17	11	1.2	1.8	2 3		
GC-304	Post Grout	General	Yes	828.2	48,581	-65	809.2	19	8	1.2	1 7	2 1		
GC-304	Post Grout	General	Yes	828 2	48,581	-65	804.2	24	10					
GC-304	Post Grout	General	Yes	828.2	48,581	-65	799.2	29	6	0 8	1.2	1 5		
GC-304	Post Grout	General	Yes	828 2	48,581	-65	794.2	34	73					
GC-304	Post Grout	General	Yes	828 2	48.581	-65	789 2	39	87					
GC-304	Post Grout	General	Yes	828 2	48,581	-65	784 2	44					60	50
GC-304	Post Grout	General	Yes	828 2	48,581	-65	778 2	50					100	93
GC-304	Post Grout	General	Yes	828 2	48.581	-65	768.2	60					100	100
GC-304	Post Grout	General	Yes	828 2	48,581	-65	758.2	70					58	50
GC-304	Post Grout	General	Yes	828 2	48.581	-65	748.2	80					100	100
GC-305	Post Grout	Anomaly J	Yes	821 8	46.969	-65	820.8	1	12					
GC-305	Post Grout	Anomaly J	Yes	821 8	46,969	-65	818.8	3	8	2.1	3.3	4.5		
GC-305	Post Grout	Anomaly J	Yes	821.8	46,969	-65	816 8	5	8	1 1	2.3	3.4		
GC-305	Post Grout	Anomaly J	Yes	821 8	46,969	-65	814.8	7	8	1.1	2.3	3 4		
GC-305	Post Grout	Anomaly J	Yes	821.8	46,969	-65	812 8	9	2	0 3	0.4	0.5		
GC-305	Post Grout	Anomaly J	Yes	821 8	46,969	-65	810.8	11	4	0 3	0 4	0.5		
GC-305	Post Grout	Anomaly J	Yes	821.8	46,969	-65	808 8	13	1	0 5	0.7	0 9		
GC-305	Post Grout	Anomaly J	Yes	821 8	46,969	-65	807.8	14	5	1.4	1.8	2.2		
GC-305	Post Grout	Anomaly J	Yes	821.8	46,969	-65	804 8	17	10					
GC-305	Post Grout	Anomaly J	Yes	821.8	46,969	-65	802.8	19	25					
GC-305	Post Grout	Anomaly J	Yes	821.8	46,969	-65	797.8	24	22					
GC-305	Post Grout	Anomaly J	Yes	821.8	46,969	-65	792.8	29	13					
GC-305	Post Grout	Anomaly J	Yes	821.8	46,969	-65	787.8	34	11	0.7	1.1	1 4		
GC-305	Post Grout	Anomaly J	Yes	821.8	46,969	-65	782.8	39	18	2.5	2.8	3 1		
GC-305	Post Grout	Anomaly J	Yes	821.8	46,969	-65	771.8	50					96	86
GC-305	Post Grout	Anomaly J	Yes	821.8	46,969	-65	761.8	60					100	87
GC-305	Post Grout	Anomaly J	Yes	821.8	46,969	-65	756.8	65					100	1
GC-305	Post Grout	Anomaly J	Yes	821.8	46,969	-65	751.8	70					100	86
GC-305	Post Grout	Anomaly J	Yes	821.8	46,969	-65	741 8	80					100	92
GC-306	Post Grout	General	Yes	821.9	46,946	-65	820.9	1	9					
GC-306	Post Grout	General	Yes	821.9	46,946	-65	818 9	3	13	3 4	4.0	4.5		
GC-306	Post Grout	General	Yes	821.9	46,946	-65	816.9	5	15	2.2	2.3	2 4		
GC-306	Post Grout	General	Yes	821.9	46,946	-65	814.9	7	9	0.7	1.0	1.2		
GC-306	Post Grout	General	Yes	821.9	46,946	-65	812.9	9	1	0.3	0.3	0 4		
GC-306	Post Grout	General	Yes	821.9	46,946	-65	810.9	11	1	0.4	0.6	0.7		
GC-306	Post Grout	General	Yes	821.9	46,946	-65	808.9	13	6	0.5	0.8	1.0		
GC-306	Post Grout	General	Yes	821.9	46,946	-65	807.9	14	1	0.4	0.7	1 0		
GC-306	Post Grout	General	Yes	821.9	46,946	-65	804.9	17	17					
GC-306	Post Grout	General	Yes	821.9	46,946	-65	802 9	19	25					
GC-306	Post Grout	General	Yes	821.9	46,946	-65	797.9	24	25					
GC-306	Post Grout	General	Yes	821.9	46,946	-65	792.9	29	12					
GC-306	Post Grout	General	Yes	821.9	46,946	-65	787.9	34	14	1.9	2.2	2 4		
GC-306	Post Grout	General	Yes	821.9	46,946	-65	782.9	39	32	4.1	4 3	4.5		
GC-306	Post Grout	General	Yes	821 9	46,946	-65	771.9	50					97	84
GC-306	Post Grout	General	Yes	821.9	46,946	-65	761 9	60					94	94
GC-306	Post Grout	General	Yes	821.9	46,946	-65	756.9	65					86	86
GC-306	Post Grout	General	Yes	821.9	46,946	-65	751 9	70					100	62
GC-306	Post Grout	General	Yes	821.9	46,946	-65	741 9	80					100	97
GC-307	Post Grout	General	Yes	821.9	46,953	-65	820.9	1	16					
GC-307	Post Grout	General	Yes	821 9	46,953	-65	818.9	3	15	1 9	3.0	4.1		
GC-307	Post Grout	General	Yes	821.9	46,953	-65	816.9	5	10	2 2	3.4	4 5		
GC-307	Post Grout	General	Yes	821 9	46,953	-65	814.9	7	4	0 4	0.7	0.9		
GC-307	Post Grout	General	Yes	821 9	46,953	-65	812 9	9	1	0 4	0.7	0.9		
GC-307	Post Grout	General	Yes	821.9	46,953	-65	810.9	11	1	0.3	0.4	0.5		
GC-307	Post Grout	General	Yes	821.9	46,953	-65	808.9	13	7	0.8	1.0	1 2		
GC-307	Post Grout	General	Yes	821.9	46,953	-65	807 9	14	6	0.2	0.6	0 9		
GC-307	Post Grout	General	Yes	821.9	46,953	-65	804 9	17	10					
GC-307	Post Grout	General	Yes	821 9	46,953	-65	802 9	19	22					
GC-307	Post Grout	General	Yes	821.9	46,953	-65	797 9	24	30					
GC-307	Post Grout	General	Yes	821.9	46,953	-65	792 9	29	10	1.2	1 5	1 7		
GC-307	Post Grout	General	Yes	821.9	46,953	-65	787.9	34	14	1.7	1.8	1.9		
GC-307	Post Grout	General	Yes	821.9	46,953	-65	782 9	39	19	2.6	2.7	2.8		
GC-307	Post Grout	General	Yes	821.9	46,953	-65	771.9	50					100	96
GC-307	Post Grout	General	Yes	821.9	46,953	-65	761.9	60					100	84

Field Test Results
GUE 70 14.10

Boring	Period	Site	Mapped	Ground	Location		Test		N Values	H Values (Hand Pen)			Bedrock	
Number	Drilled	Setting	Mine	Elevation	Station	Offset	Elevation	Depth	per foot	Low	Median	High	Recovery	RQD
GC-307	Post Grout	General	Yes	821 9	46,953	-65	756.9	65					100	1
GC-307	Post Grout	General	Yes	821 9	46,953	-65	751.9	70					100	60
GC-307	Post Grout	General	Yes	821.9	46.953	-65	741 9	80					100	100
GC-308	Post Grout	General	Yes	827 5	48.530	-21	826.5	1	12	4 5	4.5	4.5		
GC-308	Post Grout	General	Yes	827 5	48,530	-21	824.5	3	24	3.7	4 1	4.5		
GC-308	Post Grout	General	Yes	827.5	48,530	-21	822 5	5	11	2 5	2.9	3.3		
GC-308	Post Grout	General	Yes	827 5	48,530	-21	820.5	7	8	1.4	2.4	3.3		
GC-308	Post Grout	General	Yes	827.5	48.530	-21	818 5	9	11	2 4	2.8	3.2		
GC-308	Post Grout	General	Yes	827.5	48.530	-21	816.5	11	10	0 5	1.0	1.5		
GC-308	Post Grout	General	Yes	827.5	48.530	-21	814.5	13	14	2.3	2.8	3.3		
GC-308	Post Grout	General	Yes	827 5	48,530	-21	812.5	15	9	2 4	2.9	3.3		
GC-308	Post Grout	General	Yes	827 5	48.530	-21	810.5	17	10	2.4	2 8	3.1		
GC-308	Post Grout	General	Yes	827 5	48,530	-21	808.5	19	9	1.8	2.0	2.1		
GC-308	Post Grout	General	Yes	827.5	48,530	-21	803.5	24	17					
GC-308	Post Grout	General	Yes	827.5	48.530	-21	797 5	30	5	0 4	0.5	0.6		
GC-308	Post Grout	General	Yes	827 5	48.530	-21	793 5	34	37					
GC-308	Post Grout	General	Yes	827 5	48,530	-21	787.5	40	80					
GC-308	Post Grout	General	Yes	827 5	48,530	-21	784.5	43					40	1
GC-308	Post Grout	General	Yes	827 5	48.530	-21	779 5	48					92	26
GC-308	Post Grout	General	Yes	827 5	48,530	-21	769.5	58					95	53
GC-308	Post Grout	General	Yes	827.5	48,530	-21	759 5	68					93	47
GC-308	Post Grout	General	Yes	827 5	48,530	-21	754 5	73					80	62
GC-308	Post Grout	General	Yes	827 5	48.530	-21	744.5	83					94	86
GC-309	Post Grout	General	Yes	827.8	48,550	-22	826 8	1	15	3 7	4.1	4.5		
GC-309	Post Grout	General	Yes	827.8	48,550	-22	824 8	3	21	4 5	4.5	4.5		
GC-309	Post Grout	General	Yes	827.8	48,550	-22	822 8	5	9	3 0	3.2	3.4		
GC-309	Post Grout	General	Yes	827 8	48.550	-22	820 8	7	10	2 2	3.2	4.2		
GC-309	Post Grout	General	Yes	827 8	48 550	-22	818.8	9	6	1.9	2 3	2.7		
GC-309	Post Grout	General	Yes	827 8	48,550	-22	816.8	11	10	2.2	2.5	2.7		
GC-309	Post Grout	General	Yes	827.8	48.550	-22	814.8	13	12	2.3	2.8	3 3		
GC-309	Post Grout	General	Yes	827.8	48.550	-22	813.8	14	14	2.5	3.0	3 4		
GC-309	Post Grout	General	Yes	827 8	48,550	-22	810.8	17	14	2.5	2.9	3.2		
GC-309	Post Grout	General	Yes	827.8	48,550	-22	808.8	19	14	1.5	1.9	2.3		
GC-309	Post Grout	General	Yes	827.8	48,550	-22	803 8	24	10	1.7	1.9	2 1		
GC-309	Post Grout	General	Yes	827.8	48,550	-22	798.8	29	2	0.2	0.4	0.5		
GC-309	Post Grout	General	Yes	827.8	48,550	-22	793 8	34	20	1.0	1.2	1.4		
GC-309	Post Grout	General	Yes	827.8	48.550	-22	783.8	44					93	23
GC-309	Post Grout	General	Yes	827.8	48,550	-22	773.8	54					41	15
GC-309	Post Grout	General	Yes	827.8	48,550	-22	763.8	64					95	44
GC-309	Post Grout	General	Yes	827.8	48.550	-22	753 8	74					100	16
GC-309	Post Grout	General	Yes	827.8	48.550	-22	743 8	84					98	45
GC-310	Post Grout	General	Yes	828.2	48,608	-22	827.2	1	12	3.7	4.1	4.5		
GC-310	Post Grout	General	Yes	828.2	48,608	-22	825.2	3	12	2.7	3.6	4.5		
GC-310	Post Grout	General	Yes	828.2	48,608	-22	823.2	5	13	1.8	2.6	3.3		
GC-310	Post Grout	General	Yes	828.2	48,608	-22	821.2	7	12	2.3	2.7	3.0		
GC-310	Post Grout	General	Yes	828.2	48,608	-22	819 2	9	13	2.3	2.6	2.9		
GC-310	Post Grout	General	Yes	828.2	48.608	-22	817.2	11	11	2.3	2.7	3.1		
GC-310	Post Grout	General	Yes	828.2	48,608	-22	815.2	13	11	2.0	2.4	2.7		
GC-310	Post Grout	General	Yes	828.2	48,608	-22	814.2	14	15	2.2	2.6	3.0		
GC-310	Post Grout	General	Yes	828.2	48,608	-22	811.2	17	8	1.8	2.1	2 4		
GC-310	Post Grout	General	Yes	828.2	48,608	-22	809.2	19	7	1.6	2.1	2.6		
GC-310	Post Grout	General	Yes	828.2	48,608	-22	804.2	24	8	0.8	1.3	1.7		
GC-310	Post Grout	General	Yes	828.2	48,608	-22	799.2	29	8					
GC-310	Post Grout	General	Yes	828.2	48,608	-22	794.2	34	11	0.8	1.1	1.4		
GC-310	Post Grout	General	Yes	828.2	48,608	-22	789.2	39	72					
GC-310	Post Grout	General	Yes	828.2	48,608	-22	784 2	44	80					
GC-310	Post Grout	General	Yes	828.2	48,608	-22	779.2	49					47	1
GC-310	Post Grout	General	Yes	828.2	48,608	-22	769.2	59					67	1
GC-310	Post Grout	General	Yes	828.2	48,608	-22	759.2	69					96	31
GC-310	Post Grout	General	Yes	828.2	48,608	-22	749.2	79					87	74
GC-310	Post Grout	General	Yes	828.2	48,608	-22	743.2	85					49	38
P-221A	Post Grout	General	Yes	826.9	48,500	-66	822.9	4	19	2.5	3.5	4.5		
P-221A	Post Grout	General	Yes	826.9	48,500	-66	819.9	7	18	2.0	2 3	2.5		
P-221A	Post Grout	General	Yes	826.9	48,500	-66	817.9	9	15	2.5	3 3	4.0		
P-221A	Post Grout	General	Yes	826.9	48,500	-66	812.9	14	6	0.3	0 5	0.8		
P-221A	Post Grout	General	Yes	826.9	48,500	-66	807 9	19	9	1 0	1.3	1.5		
P-221A	Post Grout	General	Yes	826.9	48,500	-66	802 9	24	12					

Field Test Results
GUE 70 14.10

Boring	Period	Site	Mapped	Ground	Location		Test		N Values	H Values (Hand Pen)			Bedrock	
Number	Drilled	Setting	Mine	Elevation	Station	Offset	Elevation	Depth	per foot	Low	Median	High	Recovery	RQD
P-221A	Post Grout	General	Yes	826.9	48,500	-66	797 9	29	4	0.5	0 8	1.0		
P-221A	Post Grout	General	Yes	826.9	48,500	-66	792 9	34	56					
P-221A	Post Grout	General	Yes	826 9	48,500	-66	787.9	39	100					
P-221A	Post Grout	General	Yes	826.9	48,500	-66	782 9	44	100					
P-221A	Post Grout	General	Yes	826.9	48,500	-66	776 9	50					94	20
P-221A	Post Grout	General	Yes	826 9	48,500	-66	771.9	55					99	95
P-221A	Post Grout	General	Yes	826 9	48,500	-66	761 9	65					66	34
P-222A	Post Grout	General	Yes	820.6	48,228	-129	816 6	4	19	3.0	3.8	4.5		
P-222A	Post Grout	General	Yes	820.6	48,228	-129	813 6	7	18	2.5	3.5	4.5		
P-222A	Post Grout	General	Yes	820.6	48,228	-129	811 6	9	16					
P-222A	Post Grout	General	Yes	820 6	48,228	-129	806.6	14	32					
P-222A	Post Grout	General	Yes	820.6	48,228	-129	801.6	19	37	4.5	4.5	4.5		
P-222A	Post Grout	General	Yes	820.6	48,228	-129	796.6	24	8	1.5	1.8	2.0		
P-222A	Post Grout	General	Yes	820.6	48,228	-129	791.6	29	40					
P-222A	Post Grout	General	Yes	820.6	48,228	-129	786 6	34	41					
P-222A	Post Grout	General	Yes	820.6	48,228	-129	782 0	39	100					
P-222A	Post Grout	General	Yes	820.6	48,228	-129	775 6	45					96	67
P-222A	Post Grout	General	Yes	820.6	48,228	-129	765.6	55					100	99
P-222A	Post Grout	General	Yes	820 6	48,228	-129	755.6	65					100	47
P-222A	Post Grout	General	Yes	820 6	48,228	-129	750.6	70					96	76
P-223A	Post Grout	General	Yes	826.5	48,397	68	822.5	4	6	3.2	3.4	3.5		
P-223A	Post Grout	General	Yes	826.5	48,397	68	820.5	6	4	0.5	0.9	1.2		
P-223A	Post Grout	General	Yes	826.5	48,397	68	817.5	9	3	0 3	0.9	1 5		
P-223A	Post Grout	General	Yes	826.5	48,397	68	812.5	14	6	1.3	1.9	2.5		
P-223A	Post Grout	General	Yes	826.5	48,397	68	807.5	19	5	1.5	1.8	2.0		
P-223A	Post Grout	General	Yes	826.5	48.397	68	802.5	24	9					
P-223A	Post Grout	General	Yes	826 5	48,397	68	797.5	29	19	4.5	4.5	4.5		
P-223A	Post Grout	General	Yes	826 5	48,397	68	792.5	34	100					
P-223A	Post Grout	General	Yes	826.5	48,397	68	788.5	38	100					
P-223A	Post Grout	General	Yes	826.5	48,397	68	786.5	40					86	1
P-223A	Post Grout	General	Yes	826.5	48,397	68	774.5	52					55	13
P-223A	Post Grout	General	Yes	826.5	48,397	68	752 5	74					56	1
P-224A	Post Grout	General	Yes	821 7	48,345	-238	817.7	4	12	0 7	2.0	3.2		
P-224A	Post Grout	General	Yes	821.7	48,345	-238	814 7	7	16	1.5	1.9	2.2		
P-224A	Post Grout	General	Yes	821 7	48,345	-238	812 7	9	5	0.2	0.6	0.9		
P-224A	Post Grout	General	Yes	821 7	48,345	-238	807.7	14	29					
P-224A	Post Grout	General	Yes	821 7	48,345	-238	802.7	19	34					
P-224A	Post Grout	General	Yes	821.7	48,345	-238	797 7	24	72					
P-224A	Post Grout	General	Yes	821.7	48,345	-238	792 7	29	13	1.9	2.8	3.6		
P-224A	Post Grout	General	Yes	821 7	48,345	-238	788.7	33	50	4.0	4.3	4.5		
P-224A	Post Grout	General	Yes	821 7	48,345	-238	782.7	39					91	71
P-224A	Post Grout	General	Yes	821.7	48,345	-238	772.7	49					99	87
P-224A	Post Grout	General	Yes	821 7	48,345	-238	762.7	59					83	70
P-225A	Post Grout	General	Yes	838.9	48,427	323	834 9	4	12	2.0	2.8	3.5		
P-225A	Post Grout	General	Yes	838.9	48,427	323	831.9	7	16	2 0	3.3	4.5		
P-225A	Post Grout	General	Yes	838.9	48,427	323	829.9	9	11	3.5	4.0	4.5		
P-225A	Post Grout	General	Yes	838.9	48,427	323	824.9	14	12	4.5	4.5	4 5		
P-225A	Post Grout	General	Yes	838.9	48,427	323	819.9	19	15	4.5	4.5	4.5		
P-225A	Post Grout	General	Yes	838.9	48,427	323	814 9	24	100					
P-225A	Post Grout	General	Yes	838.9	48,427	323	809.9	29	100					
P-225A	Post Grout	General	Yes	838.9	48,427	323	804.9	34	100					
P-225A	Post Grout	General	Yes	838.9	48,427	323	799.9	39	100					
P-225A	Post Grout	General	Yes	838.9	48,427	323	794 9	44	100					
P-225A	Post Grout	General	Yes	838.9	48,427	323	789 9	49					100	68
P-225A	Post Grout	General	Yes	838.9	48,427	323	779.9	59					100	60
P-225A	Post Grout	General	Yes	838.9	48,427	323	769 9	69					100	83
P-225A	Post Grout	General	Yes	838 9	48.427	323	757.9	81					36	12
P-226A	Post Grout	General	Yes	827.6	48,219	129	824.6	3	12	3 0	3 8	4.5		
P-226A	Post Grout	General	Yes	827.6	48,219	129	821.6	6	13	1.5	2 8	4.0		
P-226A	Post Grout	General	Yes	827 6	48,219	129	818.6	9	2	0.1	0.3	0.5		
P-226A	Post Grout	General	Yes	827 6	48,219	129	813.6	14	3	0.5	0 8	1.0		
P-226A	Post Grout	General	Yes	827 6	48,219	129	808.6	19	11	1.5	2 0	2.5		
P-226A	Post Grout	General	Yes	827.6	48,219	129	803 6	24	18	4.5	4 5	4.5		
P-226A	Post Grout	General	Yes	827.6	48,219	129	798 6	29	26	4.5	4 5	4.5		
P-226A	Post Grout	General	Yes	827 6	48,219	129	792 6	35					92	40
P-226A	Post Grout	General	Yes	827.6	48,219	129	782 6	45					100	73
P-226A	Post Grout	General	Yes	827.6	48,219	129	772 6	55					100	95

Field Test Results
GUE 70 14.10

Boring Number	Period Drilled	Site Setting	Mapped Mine	Ground Elevation	Location Station	Location Offset	Test Elevation	Test Depth	N Values per foot	H Values (Hand Pen) Low	H Values (Hand Pen) Median	H Values (Hand Pen) High	Bedrock Recovery	Bedrock RQD
P-226A	Post Grout	General	Yes	827.6	48,219	129	762.6	65					100	100
P-226A	Post Grout	General	Yes	827.6	48,219	129	752.6	75					100	68
P-227A	Post Grout	General	Yes	830.6	48,398	128	826.6	4	9	2 5	3.0	3 5		
P-227A	Post Grout	General	Yes	830 6	48,398	128	823.6	7	3	2 0	2 3	2.5		
P-227A	Post Grout	General	Yes	830 6	48,398	128	821.6	9	5	0 5	1 9	3.2		
P-227A	Post Grout	General	Yes	830 6	48,398	128	816.6	14	8	1.5	2.0	2 4		
P-227A	Post Grout	General	Yes	830.6	48,398	128	811.6	19	5	0.7	1.0	1 3		
P-227A	Post Grout	General	Yes	830 6	48,398	128	806.6	24	7	1.3	1.9	2.5		
P-227A	Post Grout	General	Yes	830.6	48,398	128	801.6	29	43	3.5	4 0	4.5		
P-227A	Post Grout	General	Yes	830 6	48,398	128	796.6	34	100					
P-227A	Post Grout	General	Yes	830.6	48,398	128	791.6	39	100					
P-227A	Post Grout	General	Yes	830.6	48,398	128	788.6	42					90	85
P-227A	Post Grout	General	Yes	830 6	48,398	128	780.6	50					62	27
P-227A	Post Grout	General	Yes	830.6	48,398	128	770.6	60					93	70
P-227A	Post Grout	General	Yes	830.6	48,398	128	765.6	65					100	52
P-227A	Post Grout	General	Yes	830 6	48,398	128	760.6	70					100	25
P-227A	Post Grout	General	Yes	830.6	48,398	128	755.6	75					97	7
P-227A	Post Grout	General	Yes	830.6	48,398	128	750.6	80					67	16
P-228A	Post Grout	General	Yes	828.6	48,350	-1	821.6	7	14	2.0	3 3	4.5		
P-228A	Post Grout	General	Yes	828 6	48,350	-1	819 6	9	13	2.0	2.8	3.5		
P-228A	Post Grout	General	Yes	828.6	48,350	-1	814.6	14	1	0.5	1.0	1.5		
P-228A	Post Grout	General	Yes	828.6	48,350	-1	809.6	19	3	0.5	0 9	1.2		
P-228A	Post Grout	General	Yes	828.6	48,350	-1	804.6	24	1	0.2	0.5	0 7		
P-228A	Post Grout	General	Yes	828 6	48,350	-1	799 6	29	1	0.2	0.4	0 5		
P-228A	Post Grout	General	Yes	828.6	48,350	-1	794 6	34	1	0 1	0.2	0.2		
P-228A	Post Grout	General	Yes	828 6	48,350	-1	789 6	39	1	0 1	0.2	0.2		
P-228A	Post Grout	General	Yes	828.6	48,350	-1	785.6	43	100					
P-228A	Post Grout	General	Yes	828 6	48,350	-1	780.6	48	100					
P-228A	Post Grout	General	Yes	828.6	48,350	-1	773 6	55					100	1
P-228A	Post Grout	General	Yes	828.6	48,350	-1	768.6	60					79	16
P-228A	Post Grout	General	Yes	828.6	48,350	-1	763.6	65					91	13
P-228A	Post Grout	General	Yes	828.6	48,350	-1	753 6	75					86	32
P-301A	Post Grout	General	Yes	816.1	46,876	129	812.1	4	10	1.4	2.0	2.6		
P-301A	Post Grout	General	Yes	816.1	46,876	129	810.1	6	14	0 5	2.0	3.4		
P-301A	Post Grout	General	Yes	816.1	46,876	129	807 1	9	6	0 5	1.0	1.5		
P-301A	Post Grout	General	Yes	816.1	46.876	129	802 1	14	10					
P-301A	Post Grout	General	Yes	816.1	46.876	129	797 1	19	21	2 2	2 7	3.1		
P-301A	Post Grout	General	Yes	816.1	46.876	129	792.1	24	16	1.4	1.9	2.4		
P-301A	Post Grout	General	Yes	816 1	46,876	129	787.1	29	13	1 5	2 1	2.6		
P-301A	Post Grout	General	Yes	816.1	46,876	129	782 1	34	38					
P-301A	Post Grout	General	Yes	816.1	46,876	129	777 1	39	28					
P-301A	Post Grout	General	Yes	816.1	46,876	129	772.1	44	88	4.5	4.5	4.5		
P-301A	Post Grout	General	Yes	816.1	46,876	129	766.1	50					96	14
P-301A	Post Grout	General	Yes	816.1	46,876	129	753 1	63					86	60
P-302A	Post Grout	General	Yes	816.5	46,980	-137	812.5	4	2	0.3	0.3	0.3		
P-302A	Post Grout	General	Yes	816.5	46,980	-137	810.5	6	5	0 3	0.4	0 5		
P-302A	Post Grout	General	Yes	816.5	46,980	-137	807.5	9	5					
P-302A	Post Grout	General	Yes	816.5	46,980	-137	802 5	14	17					
P-302A	Post Grout	General	Yes	816.5	46,980	-137	797.5	19	25					
P-302A	Post Grout	General	Yes	816.5	46,980	-137	792.5	24	26					
P-302A	Post Grout	General	Yes	816.5	46,980	-137	787.5	29	22	2.9	3.4	3 9		
P-302A	Post Grout	General	Yes	816.5	46,980	-137	782.5	34	59					
P-302A	Post Grout	General	Yes	816.5	46,980	-137	777.5	39	100					
P-302A	Post Grout	General	Yes	816 5	46,980	-137	771.5	45					94	88
P-302A	Post Grout	General	Yes	816.5	46,980	-137	766.5	50					100	98
P-302A	Post Grout	General	Yes	816.5	46,980	-137	761.5	55					100	100
P-302A	Post Grout	General	Yes	816.5	46,980	-137	748.5	68					46	26
P-303A	Post Grout	General	No	823 4	47,449	124	819.4	4	17	1.6	2.2	2.7		
P-303A	Post Grout	General	No	823.4	47,449	124	817.4	6	12	1.2	2 0	2.7		
P-303A	Post Grout	General	No	823 4	47,449	124	814.4	9	6	0.4	0.6	0.7		
P-303A	Post Grout	General	No	823 4	47,449	124	809.4	14	9	0.5	1.4	2.2		
P-303A	Post Grout	General	No	823 4	47,449	124	804.4	19	14	1.7	2.1	2.4		
P-303A	Post Grout	General	No	823.4	47,449	124	799.4	24	12	0.9	1.4	1.9		
P-303A	Post Grout	General	No	823 4	47,449	124	794.4	29	5	0.3	0 3	0 3		
P-303A	Post Grout	General	No	823 4	47,449	124	789.4	34	5	0.3	0.3	0.3		
P-303A	Post Grout	General	No	823.4	47,449	124	784 4	39	11					
P-303A	Post Grout	General	No	823.4	47,449	124	779 4	44	64					

Field Test Results
GUE 70 14.10

Boring	Period	Site	Mapped	Ground	Location		Test		N Values	H Values (Hand Pen)			Bedrock	
Number	Drilled	Setting	Mine	Elevation	Station	Offset	Elevation	Depth	per foot	Low	Median	High	Recovery	RQD
P-303A	Post Grout	General	No	823.4	47,449	124	773.4	50					97	97
P-303A	Post Grout	General	No	823.4	47,449	124	763.4	60					100	46
P-303A	Post Grout	General	No	823.4	47 449	124	750 4	73					100	36
P-304A	Post Grout	General	Yes	818.4	47,540	-136	814.4	4	3	0 3	0.3	0.3		
P-304A	Post Grout	General	Yes	818 4	47,540	-136	812.4	6	5	0 3	0.8	1.4		
P-304A	Post Grout	General	Yes	818.4	47,540	-136	809 4	9	4	0.3	0.6	0 9		
P-304A	Post Grout	General	Yes	818 4	47,540	-136	804 4	14	3	0 3	0.6	0 9		
P-304A	Post Grout	General	Yes	818 4	47,540	-136	799 4	19	5	0 4	0.9	1.4		
P-304A	Post Grout	General	Yes	818 4	47,540	-136	794.4	24	5					
P-304A	Post Grout	General	Yes	818.4	47,540	-136	789 4	29	9	0.7	1.1	1.4		
P-304A	Post Grout	General	Yes	818.4	47.540	-136	784 4	34	21	1.6	2.4	3.1		
P-304A	Post Grout	General	Yes	818.4	47,540	-136	779 4	39	100	4.5	4.5	4.5		
P-304A	Post Grout	General	Yes	818.4	47,540	-136	773 4	45					96	73
P-304A	Post Grout	General	Yes	818.4	47,540	-136	763 4	55					99	94
P-304A	Post Grout	General	Yes	818.4	47,540	-136	758.4	60					56	56
P-305A	Post Grout	General	Yes	823.0	47,932	128	819.0	4	1	0.3	0.3	0.3		
P-305A	Post Grout	General	Yes	823.0	47,932	128	817.0	6	4	0.4	0.5	0 6		
P-305A	Post Grout	General	Yes	823.0	47,932	128	814.0	9	5	0.5	0.9	1.2		
P-305A	Post Grout	General	Yes	823.0	47,932	128	809.0	14	7	0.5	0.9	1.3		
P-305A	Post Grout	General	Yes	823.0	47,932	128	804.0	19	6	0.6	0 8	0.9		
P-305A	Post Grout	General	Yes	823.0	47,932	128	799.0	24	7					
P-305A	Post Grout	General	Yes	823 0	47,932	128	794 0	29	4	0.3	0 4	0.6		
P-305A	Post Grout	General	Yes	823 0	47,932	128	789 0	34	9	0.3	0 4	0.6		
P-305A	Post Grout	General	Yes	823.0	47,932	128	784 0	39	5	0.3	0 3	0 4		
P-305A	Post Grout	General	Yes	823.0	47 932	128	779 0	44	100					
P-305A	Post Grout	General	Yes	823.0	47,932	128	773.0	50					73	45
P-305A	Post Grout	General	Yes	823.0	47.932	128	768.0	55					31	6
P-305A	Post Grout	General	Yes	823.0	47,932	128	758.0	65					64	6
P-305A	Post Grout	General	Yes	823.0	47.932	128	750 0	73					100	82
P-306A	Post Grout	General	Yes	819.2	47,927	-134	815.2	4	3	0 3	0.3	0.3		
P-306A	Post Grout	General	Yes	819.2	47,927	-134	813.2	6	7	0 4	0.5	0.5		
P-306A	Post Grout	General	Yes	819.2	47,927	-134	810 2	9	9					
P-306A	Post Grout	General	Yes	819.2	47,927	-134	805.2	14	24					
P-306A	Post Grout	General	Yes	819.2	47,927	-134	800.2	19	12	0.4	1.8	3 2		
P-306A	Post Grout	General	Yes	819 2	47,927	-134	795 2	24	7	1.2	2.1	2.9		
P-306A	Post Grout	General	Yes	819.2	47,927	-134	790.2	29	42	4.5	4.5	4.5		
P-306A	Post Grout	General	Yes	819.2	47,927	-134	785.2	34	100	4.5	4 5	4.5		
P-306A	Post Grout	General	Yes	819.2	47 927	-134	780.2	39	100	4.5	4.5	4.5		
P-306A	Post Grout	General	Yes	819.2	47,927	-134	774 2	45					96	90
P-306A	Post Grout	General	Yes	819.2	47,927	-134	764 2	55					63	25
P-306A	Post Grout	General	Yes	819.2	47,927	-134	754 2	65					37	23
P-306A	Post Grout	General	Yes	819.2	47,927	-134	743.2	76					100	66
P-307A	Post Grout	General	Yes	821 4	46,875	65	817.4	4	14	1.6	1.9	2.2		
P-307A	Post Grout	General	Yes	821 4	46,875	65	815.4	6	10					
P-307A	Post Grout	General	Yes	821.4	46,875	65	812.4	9	7					
P-307A	Post Grout	General	Yes	821.4	46,875	65	807.4	14	10					
P-307A	Post Grout	General	Yes	821.4	46,875	65	802 4	19	4	1.5	1.8	2.1		
P-307A	Post Grout	General	Yes	821.4	46.875	65	797.4	24	1	0.3	0.3	0.4		
P-307A	Post Grout	General	Yes	821.4	46.875	65	792.4	29	3	0.4	0.7	0.9		
P-307A	Post Grout	General	Yes	821.4	46,875	65	787 4	34	8	0.7	0.9	1.1		
P-307A	Post Grout	General	Yes	821.4	46,875	65	782 4	39	31					
P-307A	Post Grout	General	Yes	821.4	46 875	65	777 4	44	12	4.5	4.5	4.5		
P-307A	Post Grout	General	Yes	821.4	46,875	65	772.4	49					75	30
P-307A	Post Grout	General	Yes	821.4	46,875	65	772 4	49	19					
P-307A	Post Grout	General	Yes	821.4	46,875	65	767 4	54	80					
P-307A	Post Grout	General	Yes	821.4	46,875	65	761.4	60					47	10
P-307A	Post Grout	General	Yes	821.4	46,875	65	748 4	73					75	55
P-308A	Post Grout	Anomaly M	Yes	823.3	47,547	-71	819.3	4	16	4.5	4.5	4.5		
P-308A	Post Grout	Anomaly M	Yes	823.3	47,547	-71	817 3	6	10	1.9	2.3	2.6		
P-308A	Post Grout	Anomaly M	Yes	823.3	47,547	-71	814.3	9	10	1 7	2.6	3.5		
P-308A	Post Grout	Anomaly M	Yes	823.3	47,547	-71	809.3	14	6					
P-308A	Post Grout	Anomaly M	Yes	823.3	47,547	-71	804.3	19	11					
P-308A	Post Grout	Anomaly M	Yes	823 3	47,547	-71	799 3	24	4	0.3	0.5	0.7		
P-308A	Post Grout	Anomaly M	Yes	823.3	47,547	-71	794 3	29	10	1.2	1.7	2.2		
P-308A	Post Grout	Anomaly M	Yes	823 3	47,547	-71	789 3	34	6	0.3	0.4	0.6		
P-308A	Post Grout	Anomaly M	Yes	823.3	47,547	-71	784 3	39	6	0.6	1.5	2.3		
P-308A	Post Grout	Anomaly M	Yes	823.3	47,547	-71	779.3	44	68	4 5	4.5	4.5		

Field Test Results
GUE 70 14.10

Boring	Period	Site	Mapped	Ground	Location		Test		N Values	H Values (Hand Pen)			Bedrock	
Number	Drilled	Setting	Mine	Elevation	Station	Offset	Elevation	Depth	per foot	Low	Median	High	Recovery	RQD
P-308A	Post Grout	Anomaly M	Yes	823.3	47,547	-71	774.7	49	100					
P-308A	Post Grout	Anomaly M	Yes	823.3	47,547	-71	768.3	55					88	33
P-308A	Post Grout	Anomaly M	Yes	823 3	47,547	-71	763 3	60					90	58
P-308A	Post Grout	Anomaly M	Yes	823 3	47,547	-71	746 3	77					89	82
P-309A	Post Grout	General	Yes	823.3	46,920	-1	819 3	4	14	4.5	4.5	4.5		
P-309A	Post Grout	General	Yes	823.3	46,920	-1	817.3	6	14	2.7	3 5	4 2		
P-309A	Post Grout	General	Yes	823.3	46,920	-1	814.3	9	7	0.7	1.3	1.9		
P-309A	Post Grout	General	Yes	823.3	46,920	-1	809.3	14	3	0 3	0.5	0.7		
P-309A	Post Grout	General	Yes	823.3	46,920	-1	804.3	19	9					
P-309A	Post Grout	General	Yes	823.3	46,920	-1	799.3	24	35					
P-309A	Post Grout	General	Yes	823.3	46,920	-1	794.3	29	9	1.2	1.3	1 3		
P-309A	Post Grout	General	Yes	823.3	46,920	-1	789.3	34	14					
P-309A	Post Grout	General	Yes	823.3	46 920	-1	784.3	39	17	1.2	1.3	1.3		
P-309A	Post Grout	General	Yes	823.3	46,920	-1	779.3	44	80	4.5	4.5	4.5		
P-309A	Post Grout	General	Yes	823 3	46,920	-1	773.3	50					81	32
P-309A	Post Grout	General	Yes	823 3	46,920	-1	763.3	60					100	38
P-310A	Post Grout	General	Yes	825 3	47,490	-2	821 3	4	6	4 5	4.5	4.5		
P-310A	Post Grout	General	Yes	825.3	47,490	-2	819.3	6	13	2.0	2 4	2.8		
P-310A	Post Grout	General	Yes	825 3	47,490	-2	816 3	9	12	2.0	2.7	3.4		
P-310A	Post Grout	General	Yes	825 3	47,490	-2	811 3	14	4					
P-310A	Post Grout	General	Yes	825.3	47,490	-2	806.3	19	3	0 3	0 5	0.7		
P-310A	Post Grout	General	Yes	825.3	47,490	-2	801.3	24	5	0.7	1 1	1 4		
P-310A	Post Grout	General	Yes	825 3	47,490	-2	796.3	29	11					
P-310A	Post Grout	General	Yes	825.3	47,490	-2	791 3	34	4	0.7	0.9	1.0		
P-310A	Post Grout	General	Yes	825.3	47,490	-2	786 3	39	58					
P-310A	Post Grout	General	Yes	825.3	47,490	-2	781.3	44	11	0.9	1.0	1.1		
P-310A	Post Grout	General	Yes	825 3	47,490	-2	776.3	49	71	4.5	4.5	4.5		
P-310A	Post Grout	General	Yes	825.3	47,490	-2	770.3	55					98	82
P-310A	Post Grout	General	Yes	825.3	47,490	-2	760.3	65					95	57
P-310A	Post Grout	General	Yes	825.3	47,490	-2	748 3	77					75	50
P-311B	Post Grout	Anomaly C	Yes	823.6	47,467	66	820.6	3	7	1.4	1.6	1 8		
P-311B	Post Grout	Anomaly C	Yes	823.6	47,467	66	819.6	4	13	2.2	2 7	3 2		
P-311B	Post Grout	Anomaly C	Yes	823.6	47,467	66	817 6	6	14					
P-311B	Post Grout	Anomaly C	Yes	823 6	47,467	66	815 6	8	6	0 8	1.4	2.0		
P-311B	Post Grout	Anomaly C	Yes	823.6	47,467	66	813.6	10	8	1.3	1 7	2.0		
P-311B	Post Grout	Anomaly C	Yes	823.6	47,467	66	811.6	12	12					
P-311B	Post Grout	Anomaly C	Yes	823 6	47,467	66	809.6	14	7					
P-311B	Post Grout	Anomaly C	Yes	823 6	47,467	66	806 6	17	3	0 1	0 1	0.1		
P-311B	Post Grout	Anomaly C	Yes	823.6	47,467	66	803.6	20	3	0.1	0.1	0.1		
P-311B	Post Grout	Anomaly C	Yes	823.6	47,467	66	798.6	25	4	0.8	0 9	0.9		
P-311B	Post Grout	Anomaly C	Yes	823 6	47,467	66	793.6	30	1					
P-311B	Post Grout	Anomaly C	Yes	823.6	47,467	66	788 6	35	1	0 1	0 2	0.2		
P-311B	Post Grout	Anomaly C	Yes	823.6	47,467	66	783.6	40	4					
P-311B	Post Grout	Anomaly C	Yes	823.6	47,467	66	778.6	45	41					
P-311B	Post Grout	Anomaly C	Yes	823.6	47,467	66	775.6	48	100					

Summary of Near Surface Field Test Results in Pavement Areas
East-Bound Lanes
GUE 70 - 14.10

Boring Number	Station	Offset	Depth	N Value blows/ft	H Value tsf
Station 467+00 to 469+75					
GC-306	46,946	-65	1	9	
GC-306			3	13	4.0
GC-306			5	15	2.3
GC-306			7	9	1.0
GC-306			9	1	0.3
GC-307	46,953	-65	1	16	
GC-307			3	15	3.0
GC-307			5	10	3.4
GC-307			7	4	0.7
GC-307			9	1	0.7
B-407H	46,960	-67	2	12	2.4
B-407H			4	9	2.0
B-407H			6	14	1.3
B-407H			8	4	1.8
B-407H			10	1	0.3
GC-305	46,969	-65	1	12	
GC-305			3	8	3.3
GC-305			5	8	2.3
GC-305			7	8	2.3
GC-305			9	2	0.4
B-407A	46,974	-60	1		4.5
B-407A			3		3.8
B-407A			5		3.3
B-407A			7		1.8
B-407B	46,974	-58	3		3.0
B-407B			5		2.7
B-407B			7		2.4
B-407F	46,974	-55	3	11	2.3
B-407F			5	8	2.6
B-407F			7	8	
B-407F			9	7	1.3
B-407G	46,974	-67	2	11	1.6
B-407G			4	7	1.7
B-407G			6	15	2.0
B-407G			8	2	0.8
B-407G			10	1	0.6

Boring Number	Station	Offset	Depth	N Value blows/ft	H Value tsf
Station 469+75 to 476+50					
B-407C	46,975	-58	3		2.2
B-407C			7		1.1
B-407D	46,978	-58	1		4.1
B-407D			3		4.5
B-407D			5		4.5
B-407E	46,980	-58	1		4.5
B-407E			3		3.4
B-407E			5		1.9
B-407E			7		1.7
B-407I	46,985	-55	2	8	1.8
B-407I			5	13	3.3
B-407I			7	13	3.7
B-407I			9	4	1.0
B-408B	47,150	-30	3		3.3
B-408B			5		2.1
B-408B			7		1.3
B-408B			9		0.7
B-408A	47,380	-30	3		4.5
B-408A			5		4.0
B-408A			7		1.8
B-408A			9		1.5
B-408C	47,380	-34	3	9	4.1
B-408C			5	19	3.9
B-408C			7	16	3.8
B-408C			9	6	1.5
B-409	47,540	-60	1		3.0
B-409			3		2.8
B-409			5		1.5
B-409			7		1.9
B-409			9		4.5
P-308A	47,547	-71	4	16	4.5
P-308A			6	10	2.3
P-308A			9	10	2.6

Summary of Near Surface Field Test Results in Pavement Areas
East-Bound Lanes
GUE 70 - 14.10

Boring Number	Station	Offset	Depth	N Value blows/ft	H Value tsf
Station 476+50 to 483+25					
B-410C	47,775	-30	3		3.3
B-410C			5		1.0
B-410C			7		0.8
B-410C			9		2.3
B-410A	47,785	-30	3		2.1
B-410A			5		2.4
B-410A			7		0.8
B-410A			9		2.4
B-410B	47,810	-30	3		2.5
B-410B			5		1.1
B-410B			7		1.1
B-410B			9		1.3
B-115	47,910	-36	4	27	
B-115			7	9	
B-115			10	11	
B-033	47,976	-60	4	25	
B-033			7	6	0.7
B-033			10	8	0.5
B-411	48,248	-60	3		2.4
B-411			5		3 7
B-411			7		3.2
B-411			9		1.5
GC-201	48,304	-20	4	11	3.8
GC-201			6	8	3.1
GC-201			9	4	0.9
GC-211	48,305	-67	4	19	4.0
GC-211			6	5	2.3
GC-211			9	8	2 8
GC-203	48,324	-19	4	21	4.3
GC-203			6	15	2.8
GC-203			9	9	2.5
GC-213	48,326	-66	4	22	4.5
GC-213			6	10	2.3
GC-213			9	13	2.3

Boring Number	Station	Offset	Depth	N Value blows/ft	H Value tsf
Station 483+25 to 483+45					
B-412A	48,335	-60	3		2.1
B-412A			5		2.2
B-412A			7		1.9
B-412A			9		1.6
B-412D	48,338	-21	2	14	4.0
B-412D			4	12	4.2
B-412D			6	17	1.9
B-412D			8	10	2.6
B-412D			10	7	1.2
B-111	48,340	-48	1	5	
B-111			4	10	
B-111			7	11	
B-111			10	3	
B-125	48,340	-56	3	17	
B-125			6	14	
B-125			8	16	
B-412C	48,340	-34	2	27	
B-412C			4	12	4.0
B-412C			6	7	1.5
B-412C			8	10	2.4
B-412C			10	6	2.0
GC-205	48,340	-20	4	17	2.5
GC-205			7	12	2.9
GC-205			9	10	1.0
GC-215	48,340	-67	4	12	4.0
GC-215			7	13	3.8
GC-215			9	10	2.0
B-116	48,341	-27	1	5	
B-116			2	4	
B-116			4	13	
B-116			5	31	
B-116			7	18	
B-116			8	14	
B-116			10	12	

Summary of Near Surface Field Test Results in Pavement Areas
East-Bound Lanes
GUE 70 - 14.10

Boring Number	Station	Offset	Depth	N Value blows/ft	H Value tsf
Station 483+45 to 483+85					
B-017	48,350	-60	2	11	
B-017			4	13	
B-017			5	18	
B-017			7	10	
B-017			8	10	
B-017			10	10	
B-117	48,356	-56	3	18	
B-117			6	18	
B-117			8	11	
GC-206	48,357	-21	4	11	3.0
GC-206			7	10	2.5
GC-206			9	6	1.2
GC-216	48,360	-66	4	56	4.5
GC-216			6	11	4.5
GC-216			9	13	3.0
B-004	48,363	-25	3	18	
B-004			6	27	
B-004			8	13	
B-119	48,363	-72	1	6	
B-119			4	10	
B-119			7	6	
B-119			10	5	
B-114	48,365	-36	1	41	
B-114			4	58	
B-114			7	100	
GC-207	48,379	-21	4	14	3.8
GC-207			7	11	2.9
GC-207			9	4	1.1
B-113	48,380	-36	1	11	
B-113			4	11	
B-113			7	11	
B-113			10	7	
GC-217	48,380	-66	4	20	3.0
GC-217			7	15	1.6
GC-217			9	14	2.3

Boring Number	Station	Offset	Depth	N Value blows/ft	H Value tsf
Station 483+85 to 485+00					
B-412B	48,390	-60	1		4.5
B-412B			3		3.0
B-412B			5		2.5
B-412B			7		1.8
B-412B			9		0.5
B-412E	48,393	-65	2	10	2.8
B-412E			4	13	3.4
B-412E			5	6	2.4
B-412E			6	6	1.4
B-412E			7	6	1.4
B-412E			8	6	1.2
B-412E			10	10	1.7
GC-208	48,419	-19	4	12	1.9
GC-208			7	8	1.3
GC-208			9		2.0
GC-218	48,421	-66	4	25	3.8
GC-218			7	15	2.0
GC-218			9		2.7
B-120	48,440	-48	4	16	
B-120			7	13	
B-120			10	7	
GC-209	48,459	-21	4	85	4.2
GC-209			7	20	2.1
GC-209			9	18	3.3
GC-219	48,460	-65	4	24	3.3
GC-219			7	25	2.8
GC-219			9	17	3.0
P-221A	48,500	-66	4	19	3.5
P-221A			7	18	2.3
P-221A			9	15	3.3
B-413A	48,500	-60	1		4.5
B-413A			3		4.5
B-413A			5		2.8
B-413A			7		3.4
B-413A			9		3.0

Summary of Near Surface Field Test Results in Pavement Areas
East-Bound Lanes
GUE 70 - 14.10

Boring Number	Station	Offset	Depth	N Value blows/ft	H Value tsf
Station 485+00 to 485+75					
B-038	48,525	-65	4	20	
B-038			7	15	
B-038			10	21	
GC-301	48,530	-65	1	14	
GC-301			3	8	3.9
GC-301			5	12	2.8
GC-301			7	9	3.2
GC-301			9	10	2.2
GC-308	48,530	-21	1	12	4.5
GC-308			3	24	4.1
GC-308			5	11	2.9
GC-308			7	8	2.4
GC-308			9	11	2.8
B-413H	48,537	-67	2	12	4.0
B-413H			4	13	2.2
B-413H			6	9	1.7
B-413H			8	7	1.1
B-413H			10	9	1.3
B-413G	48,540	-55	3	11	4.4
B-413G			5	17	3.5
B-413G			7	10	2.3
B-413G			9	10	2.2
GC-303	48,549	-65	1	11	
GC-303			3	12	3.4
GC-303			5	12	3.2
GC-303			7	7	2.5
GC-303			9	8	2.0
GC-309	48,550	-22	1	15	4.1
GC-309			3	21	4.5
GC-309			5	9	3.2
GC-309			7	10	3.2
GC-309			9	6	2.3
B-122	48,570	-36	4	15	
B-122			7	7	
B-122			10	17	

Boring Number	Station	Offset	Depth	N Value blows/ft	H Value tsf
Station 485+75 to 486+15					
GC-304	48,581	-65	1	12	
GC-304			3	16	3.8
GC-304			5	12	2.8
GC-304			7	8	2.4
GC-304			9	14	3.5
B-123	48,600	-50	5	12	
B-123			10	24	
B-413B	48,600	-60	1		4.5
B-413B			3		4.0
B-413B			5		2.8
B-413B			7		4.5
B-413B			9		1.3
B-413F	48,602	-66	2	9	
B-413F			3	16	4.2
B-413F			4	16	2.5
B-413F			5	16	2.5
B-413F			6	19	1.3
B-413F			7	19	1.2
B-413F			8	13	3.2
B-413F			10	9	1.9
B-413D	48,606	-55	2	11	3.8
B-413D			4	16	3.3
B-413D			6	8	2.0
B-413D			7	8	2.2
B-413D			8	10	2.1
B-413D			10	12	2.2
GC-310	48,608	-22	1	12	4.1
GC-310			3	12	3.6
GC-310			5	13	2.6
GC-310			7	12	2.7
GC-310			9	13	2.6
B-413C	48,615	-58	1		4.5
B-413C			3		3.5
B-413C			5		1.6
B-413C			7		3.1
B-413C			9		3.0

Summary of Near Surface Field Test Results in Pavement Areas
East-Bound Lanes
GUE 70 - 14.10

Boring Number	Station	Offset	Depth	N Value blows/ft	H Value tsf
Station 486+15 to 488+00					
GC-302	48,616	-66	1	17	
GC-302			3	31	4.0
GC-302			5	16	3.3
GC-302			7	13	3.1
GC-302			9	12	2.7
B-413E	48,638	-66	2	11	4.3
B-413E			3	12	4.3
B-413E			4	12	2.3
B-413E			6	19	2.0
B-413E			8	12	1.6
B-413E			10	9	2.4

Summary of Near Surface Field Test Results in Pavement Areas
West-Bound Lanes
GUE 70 - 14.10

Boring Number	Station	Offset	Depth	N Value blows/ft	H Value tsf
Station 467+00 to 481+00					
P-307A	46,875	65	4	14	1.9
P-307A			6	10	
P-307A			9	7	
B-402	47,056	49	3		4.5
B-402			5		3.2
B-402			7		3.1
B-402			9		1.2
B-402			10		0.8
B-403	47,460	49	3		2.4
B-403			5		4.5
B-403			7		4.5
B-403			9		4.5
P-311B	47,467	66	3	7	1.6
P-311B			4	13	2.7
P-311B			6	14	
P-311B			8	6	1.4
P-311B			10	8	1.7
B-404B	47,815	49	3		4.5
B-404B			5		2.8
B-404B			7		2.2
B-404B			9		1.8
B-404A	47,825	49	3		2.3
B-404A			5		1.8
B-404A			7		2.2
B-404A			9		2.1
B-043	48,010	65	4	11	
B-043			7	13	
B-043			10	8	

Boring Number	Station	Offset	Depth	N Value blows/ft	H Value tsf
Station 481+00 to 488+00					
B-027	48,175	68	4	11	
B-027			7	18	
B-027			10	7	0.8
B-405	48,180	49	3		2.1
B-405			5		2.2
B-405			7		2.0
B-405			9		2.1
B-034	48,350	65	4	12	1.5
B-034			7	12	1.5
B-034			10	6	0.5
P-223A	48,397	68	4	6	3.4
P-223A			6	4	0.9
P-223A			9	3	0.9
B-022	48,409	56	2	9	
B-022			4	15	
B-022			5	11	
B-022			7	7	
B-022			8	10	
B-022			10	6	
B-112	48,582	53	4	33	
B-112			6	50	
B-112			10		
B-037	48,625	65	4	20	
B-037			7	17	
B-037			10	15	

SUMMARY of VOIDS
GUE 70 - 14.10

Borings Drilled both after Grout Placement and within the area of Grout Placement

Number of Borings Drilled to Coal Elevation	61
Number Encountering Voids	15
Percent Encountering Voids	25%
Average Void Thickness	1.7

Boring	Station	Offset	Voids Top	Bot	Height (ft)	Ttl for Boring
East-Bound Lanes						
B-407G	46,974	-67	59.6	60.3	0.7	
B-407G	46,974	-67	65.2	65.4	0.2	0.9
P-308A	47,547	-71	67.0	68.5	1.5	1.5
GC-202	48,315	-20	51.0	53.0	2.0	2.0
GC-212	48,316	-66	61.0	64.2	3.2	3.2
GC-203	48,324	-19	52.7	54.3	1.6	1.6
GC-213	48,326	-66	57.5	60.0	2.5	2.5
GC-204	48,329	-20	60.2	61.0	0.8	0.8
GC-214	48,331	-66	55.5	57.5	2.0	2.0
B-111	48,340	-48	48.5	50.0	1.5	
B-111	48,340	-48	68.5	70.7	2.2	3.7
P-228A	48,350	-1	57.5	57.7	0.2	
P-228A	48,350	-1	58.6	58.8	0.2	0.6
P-228A	48,350	-1	60.0	60.2	0.2	
B-113	48,380	-36	70.2	73.0	2.8	2.8
GC-217	48,380	-66	44.0	45.0	1.0	
GC-217	48,380	-66	48.5	49.0	0.5	0.5
B-120	48,440	-48	65.2	65.5	0.3	0.3
West-Bound Lanes						
B-126	47,870	36	58.0	59.5	1.5	
B-126	47,870	36	62.5	62.9	0.4	2.2
B-126	47,870	36	64.0	64.3	0.3	
P-223A	48,397	68	45.0	45.3	0.3	0.3

Borings Drilled either Prior to Grout Placement o Located Outside the Limits of Grout Placement

Number of Borings Drilled to Coal Elevation	41
Number Encountering Voids	16
Percent Encountering Voids	39%
Average Void Thickness	5.9

Boring	Station	Offset	Voids Top	Bot	Height (ft)	Ttl for Boring
East-Bound Lanes						
B-005	46,979	-72	55.0	59.5	4.5	4.5
P-302A	46,980	-137	55.7	62.3	6.6	6.6
B-007	47,419	-72	62.5	67.5	5.0	5.0
B-041	47,538	-60	65.0	71.0	6.0	6.0
P-304A	47,540	-136	61.3	67.6	6.3	6.3
P-306A	47,927	-134	52.0	55.0	3.0	
P-306A	47,927	-134	58.0	59.0	1.0	5.0
P-306A	47,927	-134	63.0	64.0	1.0	
B-125	48,340	-56	40.0	46.0	6.0	6.0
B-116	48,341	-27	63.0	70.0	7.0	7.0
B-117	48,356	-56	64.0	71.0	7.0	7.0
B-004	48,363	-25	53.0	58.5	5.5	
B-004	48,363	-25	67.0	68.0	1.0	7.5
B-004	48,363	-25	69.0	70.0	1.0	
West-Bound Lanes						
B-011	47,304	23	63.0	70.0	7.0	7.0
B-118	47,390	25	63.0	70.0	7.0	7.0
B-003	47,522	73	58.0	64.0	6.0	6.0
P-305A	47,932	128	43.5	44.0	0.5	
P-305A	47,932	128	55.0	56.0	1.0	3.5
P-305A	47,932	128	65.0	67.0	2.0	
B-027	48,175	68	65.4	70.5	5.1	5.1
P-225A	48,427	323	76.7	81.2	4.5	4.5

Summary of Weak Shallow Soil Samples Near Pavement Areas
Based on Field Test Results
GUE 70 - 14.10

East-Bound Lanes

Number	Station	Offset	Depth	N per foot	H (tsf) Low	H (tsf) Median	H (tsf) High
Near Sta 469+50							
B-407F	46,974	-55	9	7	0 8	1.3	1.8
B-407G	46,974	-67	8	2	0.8	0.8	0 8
B-407G	46,974	-67	10	1	0.5	0.6	0 7
B-407H	46,960	-67	8	4	1.8	1.8	1.8
B-407H	46,960	-67	10	1	0.1	0 3	0.5
B-407I	46,985	-55	9	4	0 3	1.0	1.7
GC-305	46,969	-65	9	2	0 3	0 4	0.5
GC-306	46,946	-65	7	9	0.7	1.0	1 2
GC-306	46,946	-65	9	1	0.3	0.3	0 4
GC-307	46,953	-65	7	4	0.4	0.7	0 9
GC-307	46,953	-65	9	1	0.4	0.7	0 9
Near Sta 471+50							
B-408B	47,150	-30	7		0.8	1.3	1.8
B-408B	47,150	-30	9		0.5	0.7	0.8
Near Sta 478+00							
B-410A	47,785	-30	7		0.5	0 8	1.1
B-410B	47,810	-30	5		0.8	1.1	1.3
B-410B	47,810	-30	7		0.7	1.1	1.5
B-410C	47,775	-30	5		0.8	1.0	1.1
B-410C	47,775	-30	7		0.5	0 8	1.1
Near Sta 483+50							
B-111	48,340	-48	10	3			
B-116	48,341	-27	2	4			
B-412B	48,390	-60	9		0.3	0.5	0.8
B-412D	48,338	-21	10	7	0.8	1.2	1.5
B-412E	48,393	-65	6	6	0.8	1.4	2.0
B-412E	48,393	-65	8	6	0.8	1.2	1.5
GC-201	48,304	-20	9	4	0.5	0.9	1.3
GC-205	48,340	-20	9	10	0 5	1.0	1.5
GC-206	48,357	-21	9	6	0.7	1.2	1.7
GC-207	48,379	-21	9	4	0.4	1 1	1.7
GC-208	48,419	-19	7	8	0.4	1 3	2.2
Near Sta 485+50							
B-413B	48,600	-60	9		1.0	1.3	1.5
B-413F	48,602	-66	7	19	0.7	1.2	1 7
B-413H	48,537	-67	8	7	0 6	1.1	1.5
B-413H	48,537	-67	10	9	0.7	1.3	1.9

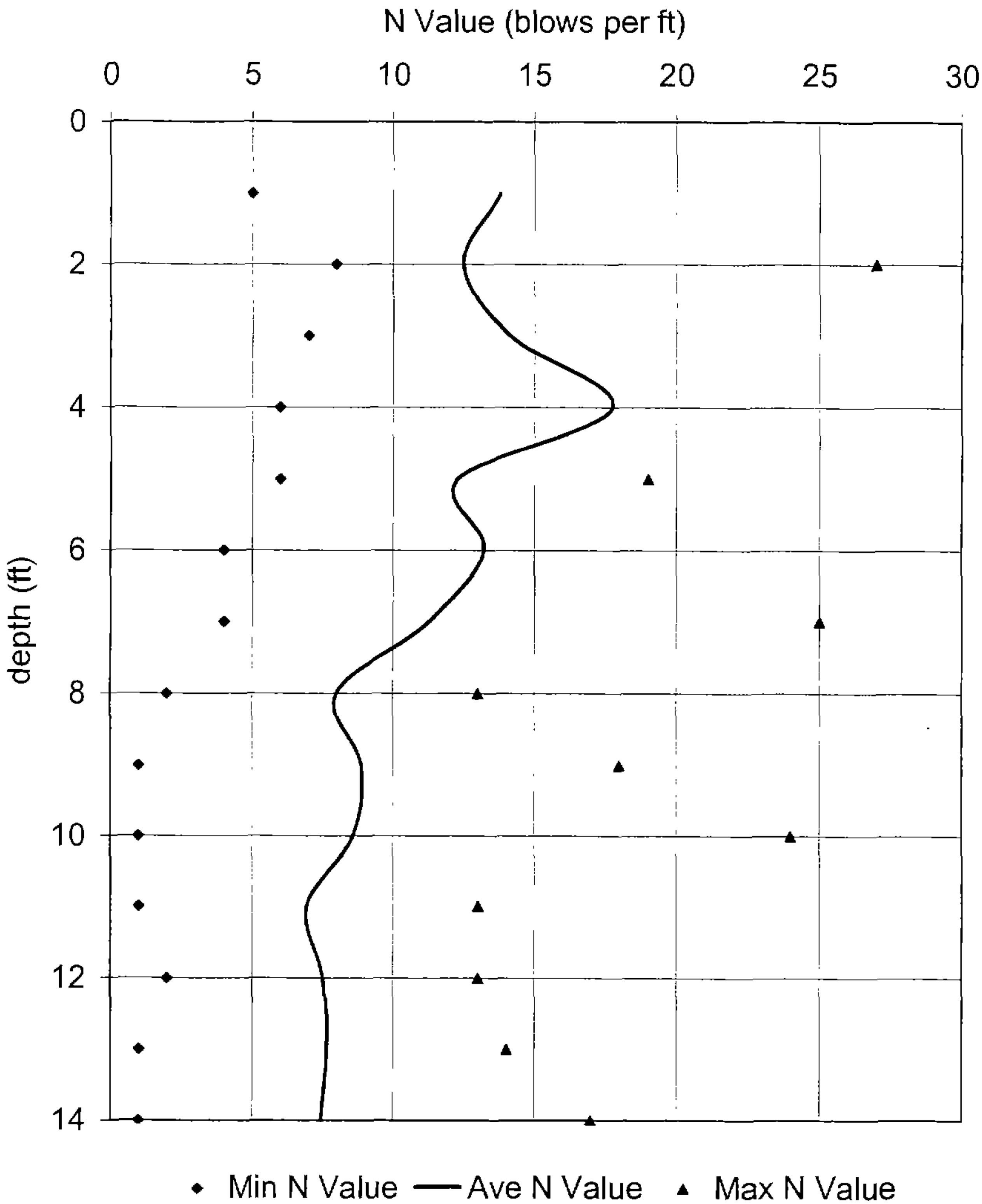
West-Bound Lanes

Number	Station	Offset	Depth	N per foot	H (tsf) Low	H (tsf) Median	H (tsf) High
Near Sta 470+50							
B-402	47,056	49	10		0 5	0.8	1.0
Near Sta 474+50							
P-311B	47,467	66	8	6	0 5	0 9	1 2
					0.3	0.9	1 5
Near Sta 484+00							
P-223A	48,397	68	6	4			
P-223A	48,397	68	9	3	0.8	1 4	2.0

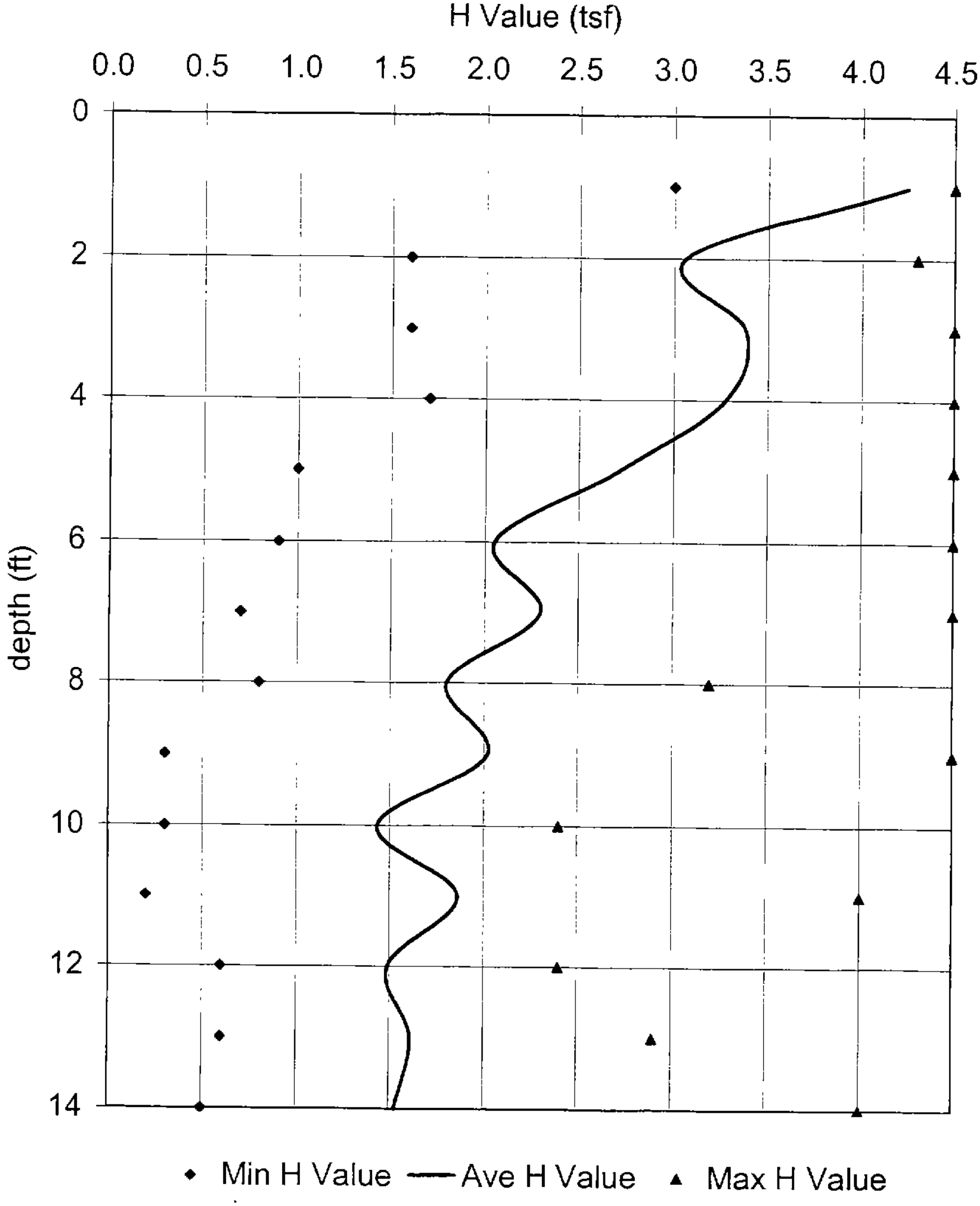
NOTES: Shallow is defined as less than 10' deep

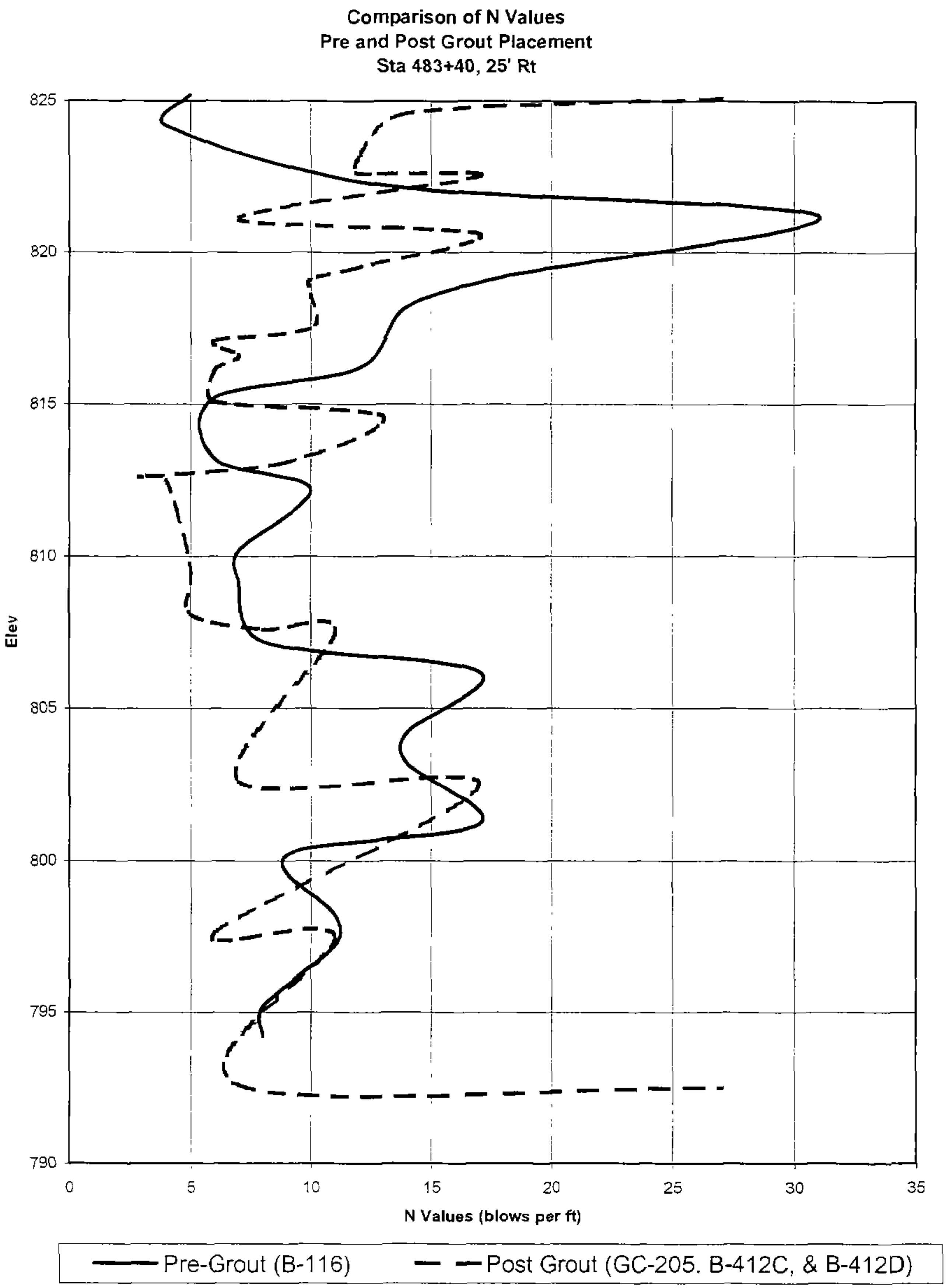
Weak is defined as N Value < 5 or H Value < 1.0

Typical N Values
Pavement Area, Post Grout

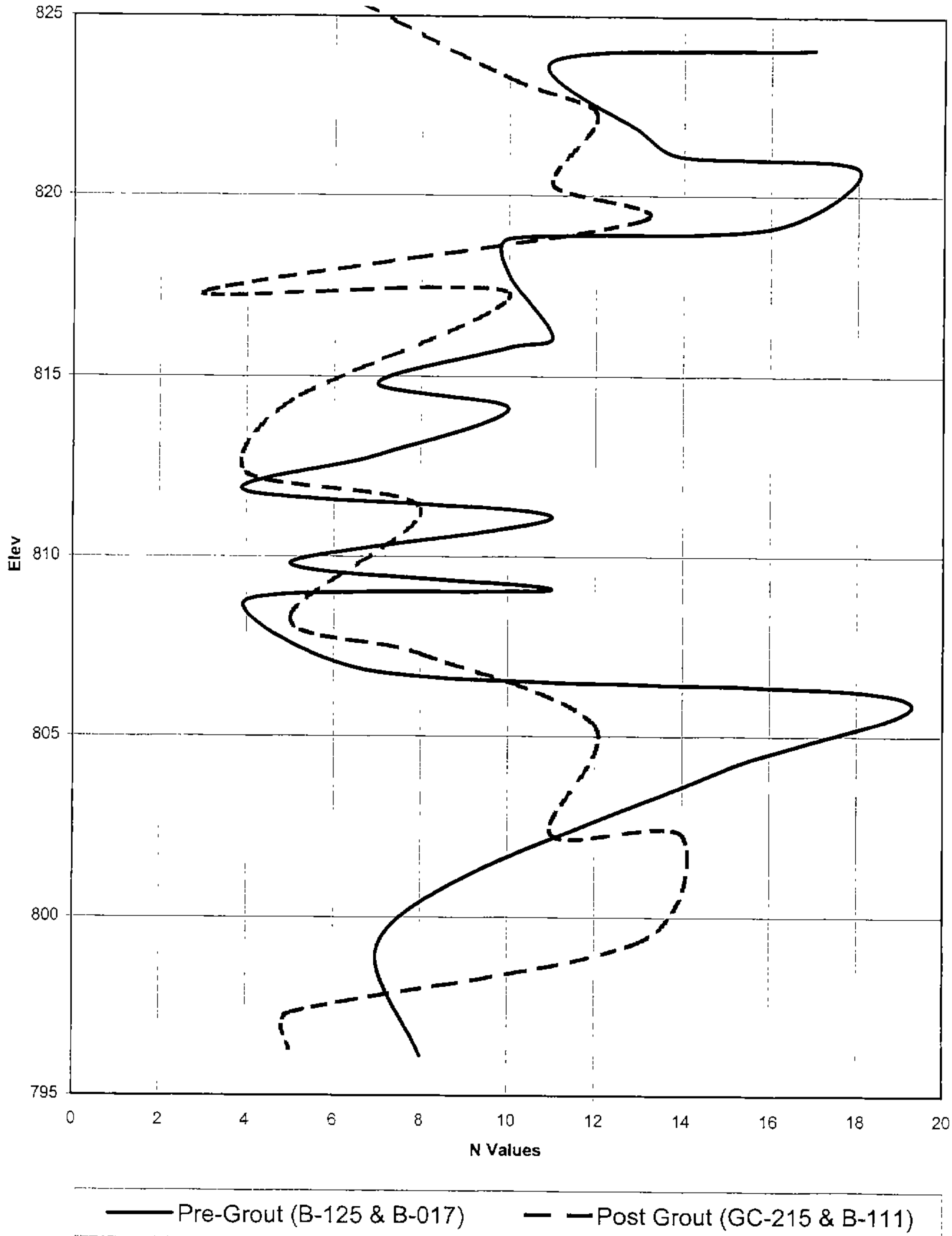


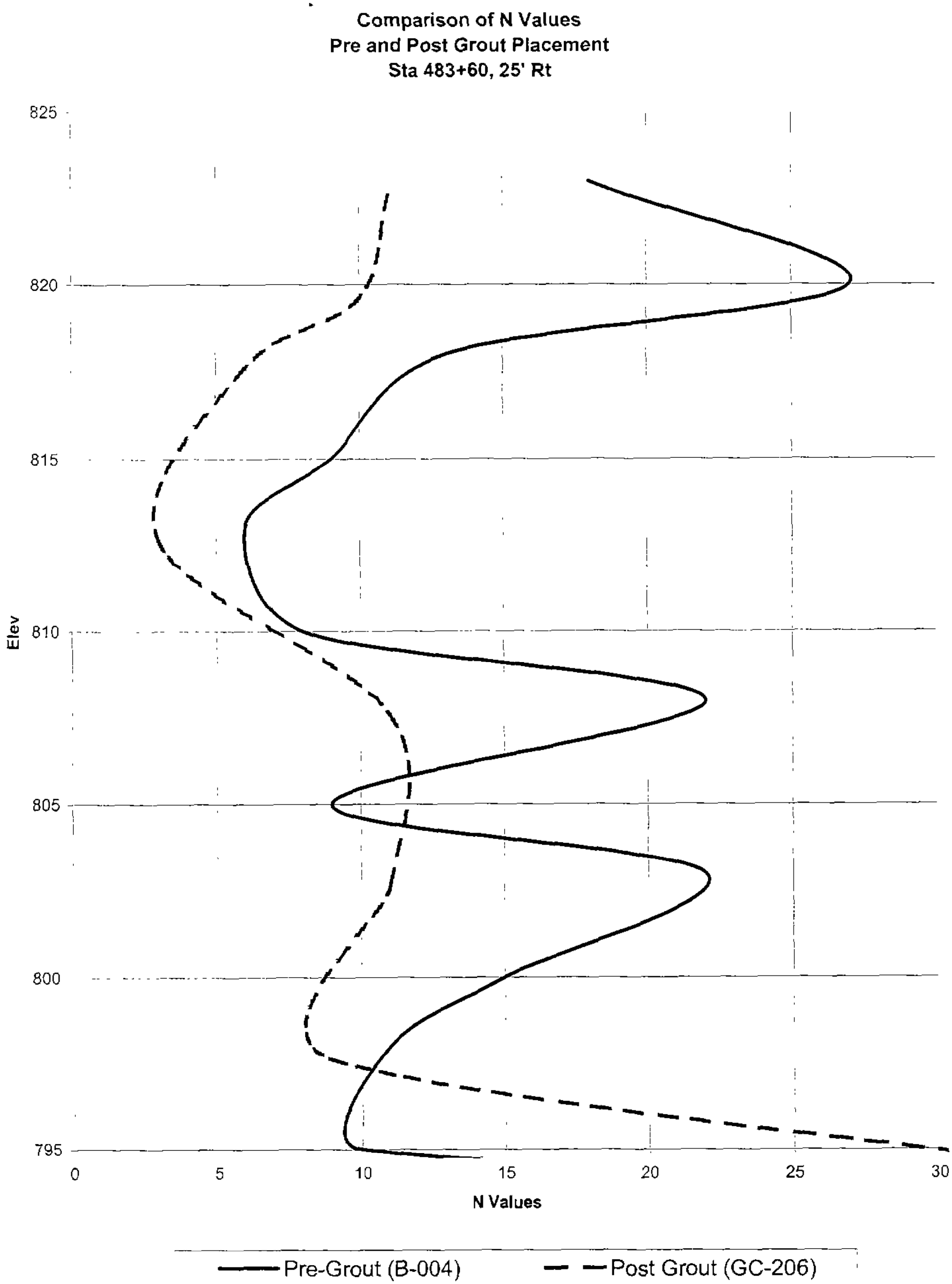
Typical H Values
Pavement Area, Post Grout

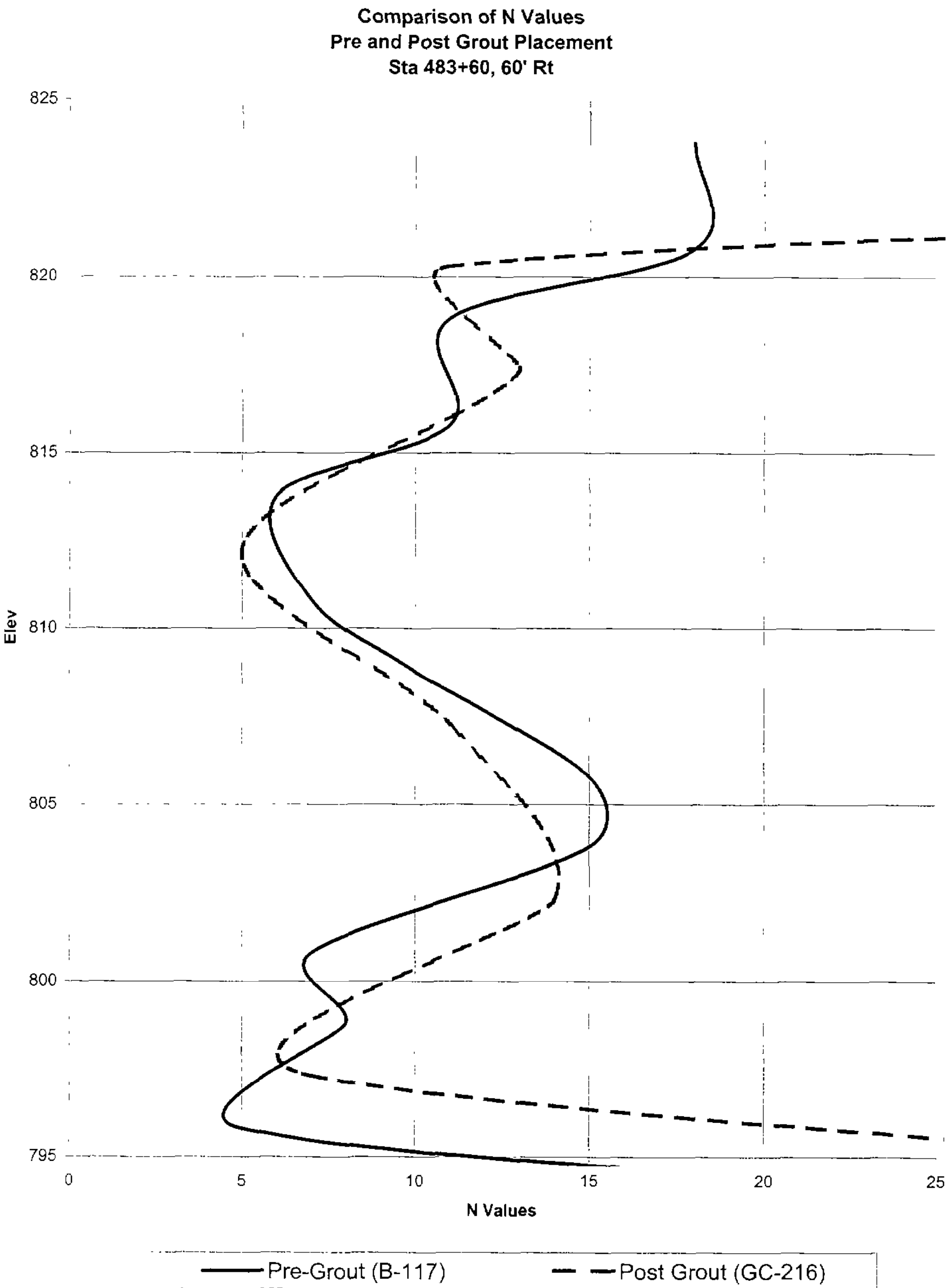



Comparison of N Values
Pre and Post Grout Placement
Sta 483+40, 25' Rt
Elev
825
820
815
810
805
800
795
790
0
5
10
15
20
25
30
35
N Values (blows per ft)
Pre-Grout (B-116)
Post Grout (GC-205. B-412C, & B-412D)

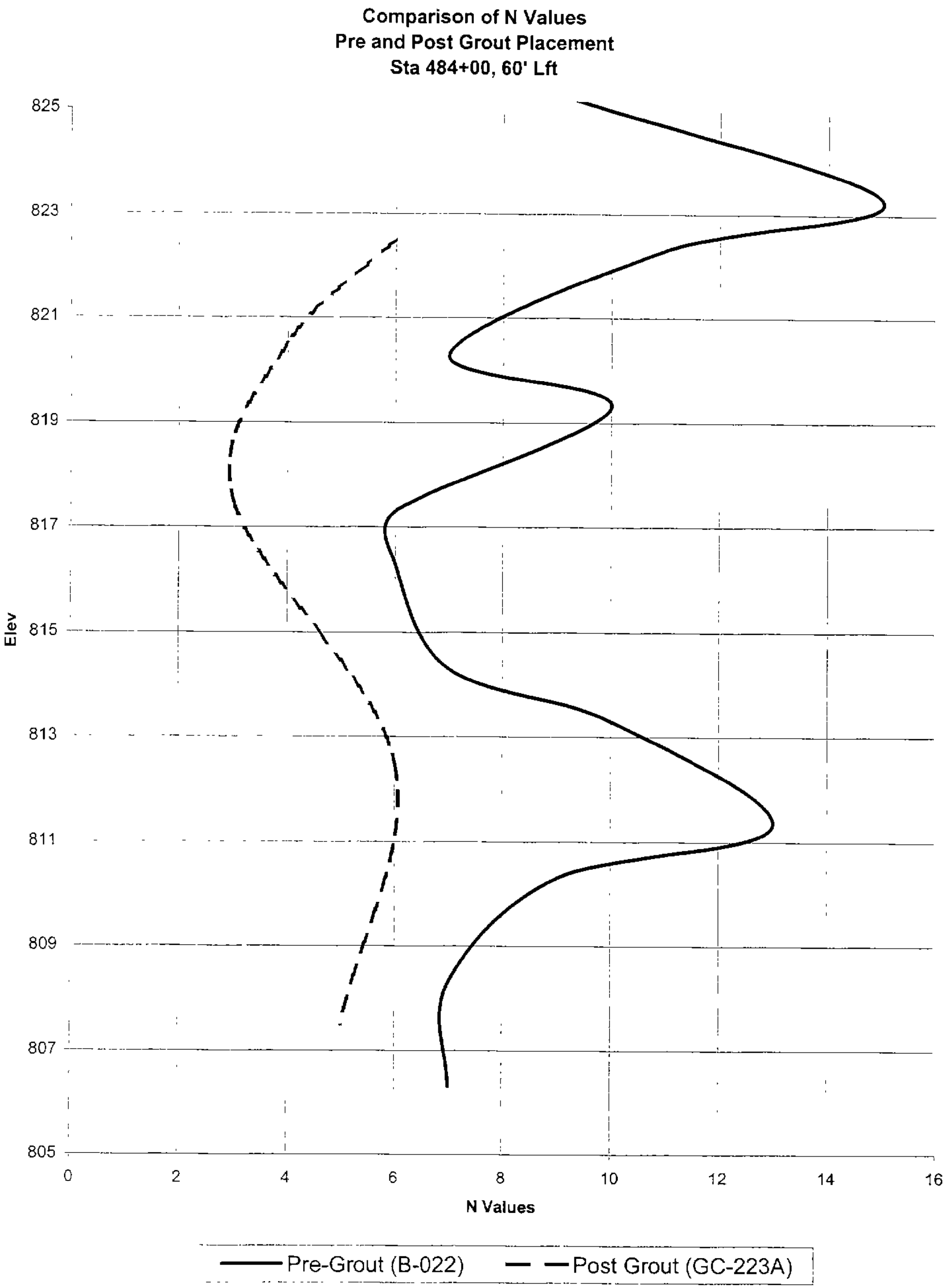
Comparison of N Values
Pre and Post Grout Placement
Sta 483+40, 60' Rt



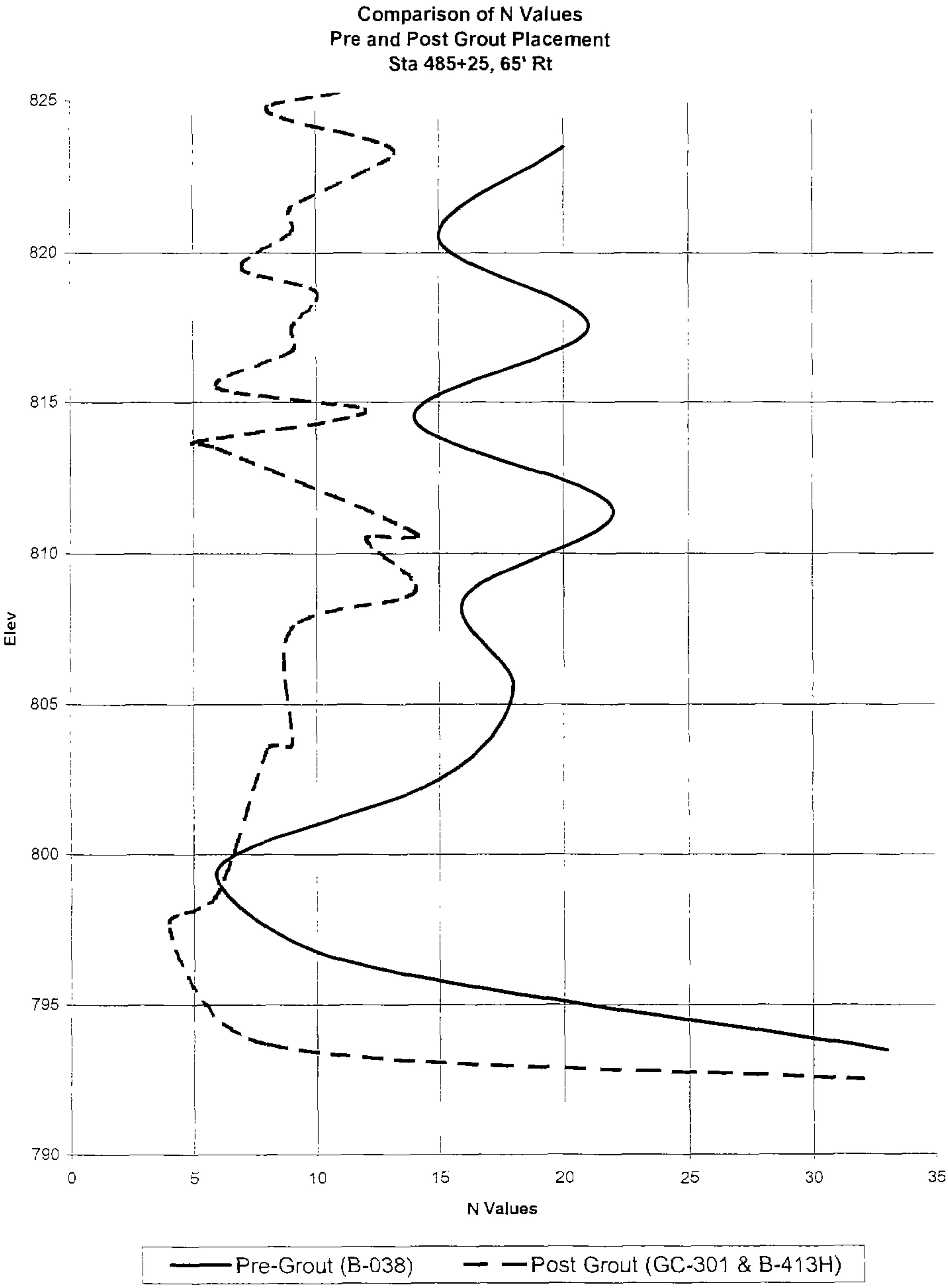

Comparison of N Values
Pre and Post Grout Placement
Sta 483+60, 25' Rt
825
820
815
810
805
800
795
Elev
0
5
10
15
20
25
30
N Values
Pre-Grout (B-004)
Post Grout (GC-206)

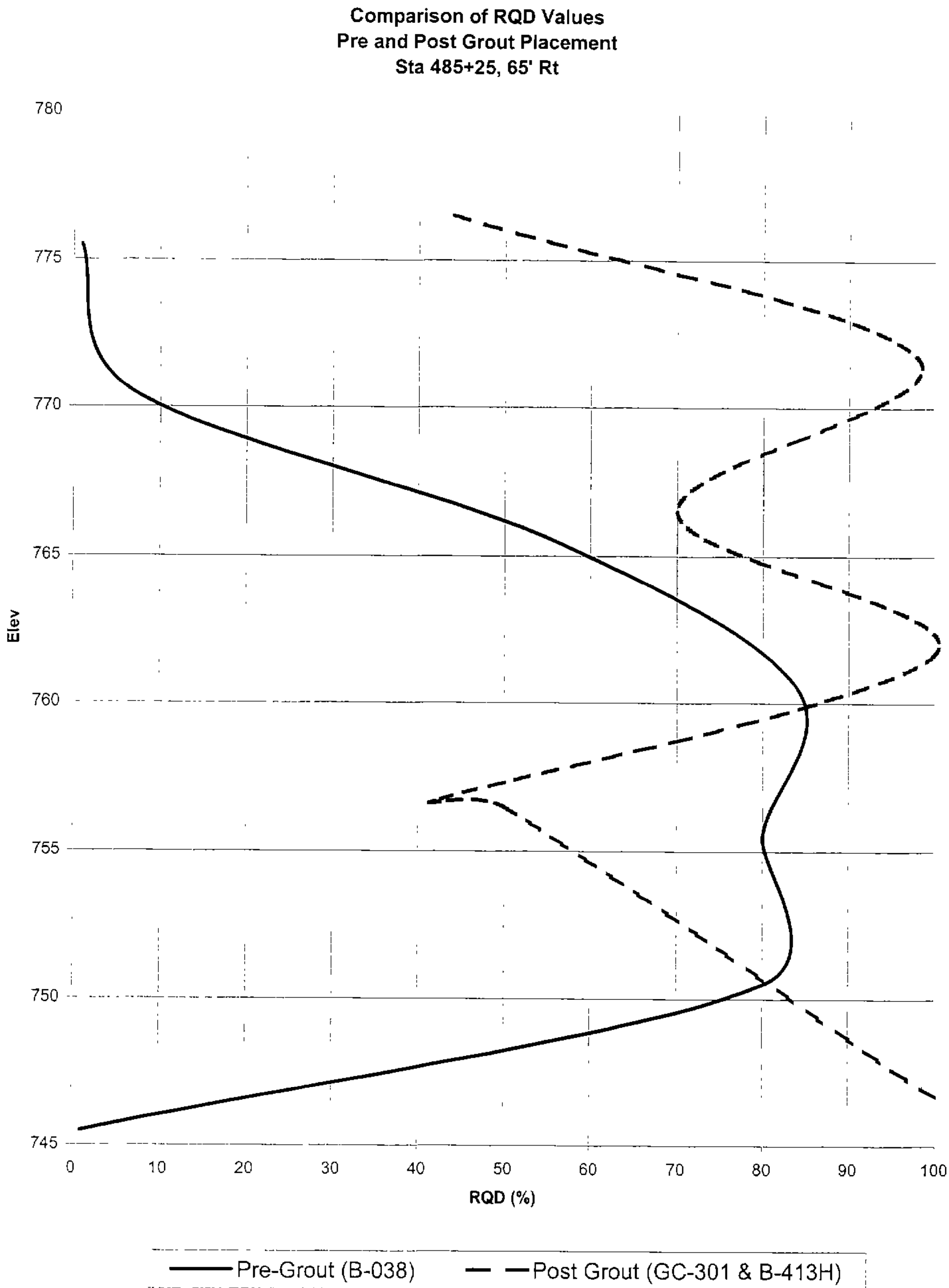


Comparison of N Values
Pre and Post Grout Placement
Sta 483+60, 60' Rt
825
820
815
810
805
800
795
Elev
0
5
10
15
20
25
N Values
Pre-Grout (B-117)
Post Grout (GC-216)



Comparison of N Values
Pre and Post Grout Placement
Sta 484+00, 60' Lft
825
823
821
819
817
815
813
811
809
807
805
Elev
0
2
4
6
8
10
12
14
16
N Values
Pre-Grout (B-022)
Post Grout (GC-223A)


Comparison of N Values
Pre and Post Grout Placement
Sta 485+25, 65' Rt
825
820
815
810
805
800
795
790
Elev
0
5
10
15
20
25
30
35
N Values
Pre-Grout (B-038)
Post Grout (GC-301 & B-413H)


Comparison of RQD Values
Pre and Post Grout Placement
Sta 485+25, 65' Rt
780
775
770
765
760
755
750
745
Elev
0
10
20
30
40
50
60
70
80
90
100
RQD (%)
Pre-Grout (B-038)
Post Grout (GC-301 & B-413H)

SUMMARY OF LABORATORY TEST RESULTS

BORING	G'int Id.	MC	LL	PL	PI	AGGREGATE	COARSE SAND	FINE SAND	SILT	CLAY	SILT/CLAY	D / 50	GRADATION sieve	GRADATION Hydrometer short	GRADATION Hydrometer long	COMPACTION standard	COMPACTION modified	TRIAXIAL uncons.	TRIAXIAL undrain	TRIAXIAL consolid undrain	TRIAXIAL w/ pores	TRIAXIAL drained	DIRECT SHEAR drained	DIRECT SHEAR undrain	DIRECT SHEAR residual	UNCONFIN COMPRESS	CONSOLID.	L. O. I.	SPECIFIC GRAVITY	LOG OF SHELBY TUBE
		%	%	%	%	%	%	%	%	%	%	m m	* SEE INDIVIDUAL TEST CURVES															%		
GC-201	24.1					31	13	17			39	0.2341																		
GC-203	6.3	26	62	21	41	0	1	3	44	52		0.0045	A-7-6(20)																	
GC-203	14.3	24	27	18	9	0	0	13	64	23		0.0178	A-4b(8)																	
GC-203	37.6					35	27	25			13	0.8459																		
GC-205	23.9					27	16	21			36	0.2425																		
GC-206	3.3	21	44	22	22	1	3	10	42	44		0.0080	A-7-6(14)																	
GC-206	14	25	37	18	19	0	0	0	57	43		0.0068	A-6b(12)																	
GC-206	24.7					27	16	22			35	0.2612																		
GC-207	29.3		37	22	15	0	0	0	69	31		0.0113	A-6a(10)																	
GC-207	33.75	31	27	18	9	0	0	0	45	55		0.0037	A-4a(8)																	
GC-207	33.78																													
GC-207	33.81																													
GC-207	33.84																													
GC-207	33.87																													
GC-207	33.9																													
GC-207	33.93																													
GC-207	33.96																													
GC-207	34.25	23	32	19	13	0	0	13	66	21		0.0296	A-6a(9)																	
GC-207	34.28																													
GC-207	34.31																													

BBC&M ENGINEERING, INC.

TESTING SUMMARY - ODOT

PROJECT GUE-70-14.10
LOCATION Guernsey County, Ohio
JOB NO. 7000.040 DATE 2/10/00

SUMMARY OF LABORATORY TEST RESULTS

BORING	G'int Id.	MC	LL	PL	PI	AGGREGATE	COARSE SAND	FINE SAND	SILT	CLAY	SILT/CLAY	D / 50	GRADATION			COMPACTION		TRIAXIAL			DIRECT SHEAR			UNCONFIN COMPRESS	CONSOLID.	L.O.I.	SPECIFIC GRAVITY	LOG OF SHELBY TUBE
													sieve	Hydrometer short	Hydrometer long	standard	modified	uncons undrain	consolid undrain w/pores	drained	drained	undrain	residual					
		%	%	%	%	%	%	%	%	%	%	mm	* SEE INDIVIDUAL TEST CURVES													%		
GC-207	34.34																											
GC-207	34.37																											
GC-207	34.4																											
GC-207	34.43																											
GC-207	34.46																											
GC-207	34.49																											
GC-208	14	27	28	19	9		0	4	73	23		0.0142	A-4b(8)															
GC-209	14	18	39	20	19	3	6	13	35	43		0.0089	A-6b(12)															
GC-209	24.7					30	14	22			34	0.2798																
GC-209	29.2	29	34	22	12		0	0	69	31		0.0104	A-6a(9)															
GC-209	38.7		NP	NP	NP																							
GC-211	34					42	19	21			18	1.0419																
GC-213	29.3	27	33	22	11	0	0	2	69	29		0.0118	A-6a(8)															
GC-215	9.1	22	39	19	20	8	3	7	53	29		0.0157	A-6b(12)															
GC-215	15.75	22	36	18	18	0	0	3	55	42		0.0083	A-6b(11)															
GC-215	15.78																											
GC-215	15.81																											
GC-215	15.84																											
GC-215	15.87																											
GC-215	15.9																											

BBC&M ENGINEERING, INC.

TESTING SUMMARY - ODOT

PROJECT GUE-70-14.10
LOCATION Guernsey County, Ohio
JOB NO. 7000.040 DATE 2/10/00

SUMMARY OF LABORATORY TEST RESULTS

BORING	G'int Id.	MC	LL	PL	PI	AGGREGATE	COARSE SAND	FINE SAND	SILT	CLAY	SILT/CLAY	D / 50	GRADATION sieve	GRADATION Hydrometer short	GRADATION Hydrometer long	COMPACTION standard	COMPACTION modified	TRIAXIAL uncons.	TRIAXIAL undrain	TRIAXIAL consolid undrain	TRIAXIAL w/pores	TRIAXIAL drained	DIRECT SHEAR drained	DIRECT SHEAR undrain	DIRECT SHEAR residual	UNCONFIN COMPRESS	CONSOLID.	L.O.I	SPECIFIC GRAVITY	LOG OF	SHELBY TUBE
		%	%	%	%	%	%	%	%	%	%	mm	* SEE INDIVIDUAL TEST CURVES															%			
GC-215	15.93																														
GC-215	15.96																														
GC-215	15.99																														
GC-215	25					25	18	20			37	0.2474																			
GC-216	10.75	20																													
GC-216	10.8	20																													
GC-216	11.25	20	29	19	10	5	4	11	59	21		0.0242	A-4b(8)																		
GC-216	11.3	20																													
GC-216	11.75	23																													
GC-216	11.8	23																													
GC-216	30.75	26																													
GC-216	30.8	26																													
GC-216	31.25	29	37	23	14	0	0	0	68	32		0.0100	A-6a(10)																		
GC-216	31.3	29																													
GC-216	31.75	29																													
GC-216	31.8	29																													
GC-217	3.5	20	44	20	24	4	4	10	45	37		0.0112	A-7-6(14)																		
GC-217	21																														
GC-218	8.75	23	56	21	35	0	1	1	50	48		0.0060	A-7-6(19)																		
GC-218	8.78																														

BBC&M ENGINEERING, INC.

TESTING SUMMARY - ODOT

PROJECT GUE-70-14.10
LOCATION Guernsey County, Ohio
JOB NO. 7000.040 DATE 2/10/00

SUMMARY OF LABORATORY TEST RESULTS

BORING	G'int Id.	MC	LL	PL	PI	AGGREGATE	COARSE SAND	FINE SAND	SILT	CLAY	SILT/CLAY	D / 50	GRADATION sieve	GRADATION Hydrometer short	GRADATION Hydrometer long	COMPACTION standard	COMPACTION modified	TRIAXIAL uncons undrain	TRIAXIAL consolid undrain w/pores	TRIAXIAL drained	DIRECT SHEAR drained	DIRECT SHEAR undrain	DIRECT SHEAR residual	UNCONFIN COMPRESS	CONSOLID.	L.O.I.	SPECIFIC GRAVITY	LOG OF SHELBY TUBE
		%	%	%	%	%	%	%	%	%	%	m m	* SEE INDIVIDUAL TEST CURVES													%		
GC-218	8.81																											
GC-218	8.84																											
GC-218	8.87																											
GC-218	8.9																											
GC-218	8.93																											
GC-218	8.96																											
GC-218	8.99																											
GC-218	24					41	15	23			21	0.8181																
P-221A	23.8					41	13	24			22	0.6845																
P-221A	29.3	28	34	20	14	0	0	1	69	30		0.0118	A-6a(10)															
P-221A	34					44	19	15			22	1.2692																
P-222A	9.2					34	16	22	18	10		0.4250																
P-228A	9.1	25	54	20	34		0	1	54	45		0.0064	A-7-6(19)															
P-228A	13.5	24																										
P-228A	14.4	25																										
P-228A	18.5	25																										
P-228A	19.6	27																										
P-228A	23.7	21	37	19	18	3	1	11	46	39		0.0089	A-6b(11)															
P-228A	39.3	27	34	19	15	14	8	13	39	26		0.0295	A-6a(8)															

BBC&M ENGINEERING, INC.

TESTING SUMMARY - ODOT

PROJECT GUE-70-14.10
LOCATION Guernsey County, Ohio
JOB NO. 7000.040 DATE 2/10/00

SUMMARY OF LABORATORY TEST RESULTS

BORING	G'int Id.	MC %	LL %	PL %	PI %	AGGREGATE %	COARSE SAND %	FINE SAND %	SILT %	CLAY %	SILT/CLAY %	D / 50 mm	D / 90 mm	HRB ODOT CLASS.	ELEVATION	STATION, LOCATION
P-301A	34.00					39	20	17			24	0.8487	11.9512			As Staked per Plan
P-302A	6.50	18	29	19	10	6	15	37	26	16		0.1154	1.3679	A-4a(1)		As Staked per Plan
P-302A	8.90					40	13	18			29	0.5981	13.2074			As Staked per Plan
P-302A	24.00					39	17	20			24	0.7014	11.4540			As Staked per Plan
P-303A	34.25	31	39	20	19		0	1	56	43		0.0068	0.0483	A-6b(12)		As Staked per Plan
P-303A	44.00					36	21	17			26	0.7111	9.0261			As Staked per Plan
P-304A	3.40	27	35	22	13	0	1	21	53	25		0.0186	0.1573	A-6a(9)		As Staked per Plan
P-304A	9.00	21	25	20	5	0	2	16	63	19		0.0203	0.1432	A-4b(8)		As Staked per Plan
P-304A	23.75					58	11	13			18	3.1654	19.9295			As Staked per Plan
P-305A	8.80	21	35	19	16	3	6	18	37	36		0.0138	0.3816	A-6b(10)		As Staked per Plan
P-305A	23.90					30	16	20			34	0.3241	8.1598			As Staked per Plan
P-305A	34.25	31	44	22	22		0	1	46	53			0.0446	A-7-6(14)		As Staked per Plan
P-306A	8.90					43	17	19			21	1.0755	11.5715			As Staked per Plan
P-306A	13.90					38	16	17			29	0.6407	8.8192			As Staked per Plan
P-306A	18.90	22	31	19	12	1	3	17	58	21		0.0203	0.1847	A-6a(9)		As Staked per Plan
P-307A	38.70					3	10	76			11	0.2403	0.6764			As Staked per Plan
P-308A	23.90	24	32	20	12	0	1	11	85	3		0.0240	0.0913	A-6a(9)		As Staked per Plan
P-309A	9.00	28	44	22	22	1	1	1	53	44		0.0067	0.0524	A-7-6(14)		As Staked per Plan
P-309A	14.00	23	26	19	7	1	1	42	36	20		0.0490	0.3020	A-4a(4)		As Staked per Plan
P-309A	18.90					46	20	12			22	1.4672	10.7814			As Staked per Plan

BBC&M ENGINEERING INC.

TESTING SUMMARY - ODOT

PROJECT GUE-70-14.10
LOCATION GUERNSEY COUNTY, OHIO
JOB NO. 01107000.090 DATE 8/6/01

SUMMARY OF LABORATORY TEST RESULTS

BORING	G'int Id.	MC %	LL %	PL %	PI %	AGGREGATE %	COARSE SAND %	FINE SAND %	SILT %	CLAY %	SILT/CLAY %	D / 50 mm	D / 90 mm	HRB ODOT CLASS.	ELEVATION	STATION, LOCATION
P-309A	39.00					34	15	14			37	0.3804	16.6065			As Staked per Plan

BBC&M ENGINEERING, INC.

TESTING SUMMARY - ODOT

PROJECT GUE-70-14.10
LOCATION GUERNSEY COUNTY, OHIO
JOB NO. 01107000.090 DATE 8/6/01

SUMMARY OF LABORATORY TEST RESULTS

BORING	G'int Id.	MC %	LL %	PL %	PI %	AGGREGATE %	COARSE SAND %	FINE SAND %	SILT %	CLAY %	SILT/CLAY %	D / 50 mm	D / 90 mm	HRB ODOT CLASSIFICATION
B-407H	2.40	16	38	18	20	8	14	11	37	30		0.0209	1.5325	A-6b(10)
B-407H	10.00	27	35	20	15	2	3	19	61	15		0.0249	0.2294	A-6a(10)
B-407H	14.00	23	37	20	17	0	2	13	54	31		0.0133	0.1205	A-6b(11)
B-407H	19.25	12				21	32	20	17	10		0.4914	10.9156	
B-407H	34.25	22				15	22	22	26	15		0.1450	3.7849	
B-407I	2.75	15	35	20	15	5	14	15	36	30		0.0219	1.1503	A-6a(8)
B-407I	12.10	25	28	21	7	0	3	26	51	20		0.0248	0.3280	A-4b(7)
B-407I	13.85	22	32	18	14	0	5	20	49	26		0.0193	0.2148	A-6a(10)
B-407I	18.00	13				15	28	28	19	10		0.2855	6.0697	
B-408C	4.00	17	38	19	19	2	14	11	69	4		0.0316	0.8254	A-6b(11)
B-408C	7.50	27	45	23	22	0	1	5	52	42		0.0074	0.0598	A-7-6(14)
B-408C	15.00	22	28	20	8	0	0	7	70	23		0.0151	0.0683	A-4b(8)
B-412E	2.20	17	34	18	16	2	15	12	41	30		0.0194	0.9088	A-6b(9)
B-412E	8.25	29	70	23	47	0	1	2	39	58			0.0446	A-7-6(20)
B-412E	29.25	19	30	22	8	4	23	25	30	18		0.0871	1.3352	A-4a(3)
B-412E	44.25	16				28	24	21	18	9		0.4854	8.0100	
GC-305	2.65	24	45	23	22	1	2	7	49	41		0.0081	0.0750	A-7-6(14)
GC-305	12.75	21	30	18	12	0	3	29	43	25		0.0252	0.2042	A-6a(7)
GC-306	9.00	26	31	20	11	0	1	15	59	25		0.0167	0.1155	A-6a(8)
GC-306	11.00	27	31	19	12	0	3	41	33	23		0.0487	0.3277	A-6a(5)
P-311B	2.35	21	41	19	22	2	3	4	57	34		0.0114	0.0710	A-7-6(13)
P-311B	4.00	20	34	17	17	0	2	10	59	29		0.0141	0.0975	A-6b(11)
P-311B	17.50	21	31	18	13	1	2	13	55	29		0.0144	0.1335	A-6a(9)
P-311B	23.70													
P-311B	24.10													
P-311B	24.90	19	27	17	10	1	12	56	10	21		0.1263	0.6260	A-2-4(0)

BBC&M ENGINEERING INC

PROJECT GUE-70-14.10
LOCATION GUERNSEY COUNTY, OHIO
JOB NO. 01107000.090 DATE 8/30/02

SUMMARY OHDOT (PORTRAIT)

SUMMARY OF LABORATORY TEST RESULTS

BORING	G'int Id.	MC %	LL %	PL %	PI %	AGGREGATE %	COARSE SAND %	FINE SAND %	SILT %	CLAY %	SILT/CLAY %	D / 50 mm	D / 90 mm	HRB ODOT CLASSIFICATION
B-407H	2.40	16	38	18	20	8	14	11	37	30		0.0209	1.5325	A-6b(10)
B-407H	10.00	27	35	20	15	2	3	19	61	15		0.0249	0.2294	A-6a(10)
B-407H	14.00	23	37	20	17	0	2	13	54	31		0.0133	0.1205	A-6b(11)
B-407H	19.25	12				21	32	20	17	10		0.4914	10.9156	
B-407H	34.25	22				15	22	22	26	15		0.1450	3.7849	
B-407I	2.75	15	35	20	15	5	14	15	36	30		0.0219	1.1503	A-6a(8)
B-407I	9.75	28												
B-407I	10.25	29												
B-407I	10.75	32	36	21	15	0	1	25	48	26		0.0194	0.1803	A-6a(10)
B-407I	12.10	25	28	21	7	0	3	26	51	20		0.0248	0.3280	A-4b(7)
B-407I	13.85	22	32	18	14	0	5	20	49	26		0.0193	0.2148	A-6a(10)
B-407I	18.00	13				15	28	28	19	10		0.2855	6.0697	
B-407I	18.84													
B-408C	4.00	17	38	19	19	2	14	11	69	4		0.0316	0.8254	A-6b(11)
B-408C	7.50	27	45	23	22	0	1	5	52	42		0.0074	0.0598	A-7-6(14)
B-408C	15.00	22	28	20	8	0	0	7	70	23		0.0151	0.0683	A-4b(8)
B-412E	2.20	17	34	18	16	2	15	12	41	30		0.0194	0.9088	A-6b(9)
B-412E	8.25	29	70	23	47	0	1	2	39	58			0.0446	A-7-6(20)
B-412E	29.25	19	30	22	8	4	23	25	30	18		0.0871	1.3352	A-4a(3)
B-412E	44.25	16				28	24	21	18	9		0.4854	8.0100	
GC-301	59.90	0												
GC-301	80.30	0												
GC-305	2.65	24	45	23	22	1	2	7	49	41		0.0081	0.0750	A-7-6(14)
GC-305	12.75	21	30	18	12	0	3	29	43	25		0.0252	0.2042	A-6a(7)
GC-306	9.00	26	31	20	11	0	1	15	59	25		0.0167	0.1155	A-6a(8)
GC-306	11.00	27	31	19	12	0	3	41	33	23		0.0487	0.3277	A-6a(5)
GC-306	62.30	0												
P-301A	34.00					39	20	17			24	0.8487	11.9512	
P-302A	6.50	18	29	19	10	6	15	37	26	16		0.1154	1.3679	A-4a(1)
P-302A	8.90					40	13	18			29	0.5981	13.2074	

BBCM

PROJECT GUE-70-14.10
LOCATION GUERNSEY COUNTY, OHIO
JOB NO. 01107000.090 DATE 9/26/02

SUMMARY OHDOT (PORTRAIT)

SUMMARY OF LABORATORY TEST RESULTS

BORING	G'int Id.	MC %	LL %	PL %	PI %	AGGREGATE %	COARSE SAND %	FINE SAND %	SILT %	CLAY %	SILT/CLAY %	D / 50 mm	D / 90 mm	HRB ODOT CLASSIFICATION
P-302A	24.00					39	17	20			24	0.7014	11.4540	
P-303A	34.25	31	39	20	19		0	1	56	43		0.0068	0.0483	A-6b(12)
P-303A	44.00					36	21	17			26	0.7111	9.0261	
P-304A	3.40	27	35	22	13	0	1	21	53	25		0.0186	0.1573	A-6a(9)
P-304A	9.00	21	25	20	5	0	2	16	63	19		0.0203	0.1432	A-4b(8)
P-304A	23.75					58	11	13			18	3.1654	19.9295	
P-305A	8.80	21	35	19	16	3	6	18	37	36		0.0138	0.3816	A-6b(10)
P-305A	23.90					30	16	20			34	0.3241	8.1598	
P-305A	34.25	31	44	22	22		0	1	46	53			0.0446	A-7-6(14)
P-306A	8.90					43	17	19			21	1.0755	11.5715	
P-306A	13.90					38	16	17			29	0.6407	8.8192	
P-306A	18.90	22	31	19	12	1	3	17	58	21		0.0203	0.1847	A-6a(9)
P-307A	38.70					3	10	76			11	0.2403	0.6764	
P-308A	23.90	24	32	20	12	0	1	11	85	3		0.0240	0.0913	A-6a(9)
P-309A	9.00	28	44	22	22	1	1	1	53	44		0.0067	0.0524	A-7-6(14)
P-309A	14.00	23	26	19	7	1	1	42	36	20		0.0490	0.3020	A-4a(4)
P-309A	18.90					46	20	12			22	1.4672	10.7814	
P-309A	39.00					34	15	14			37	0.3804	16.6065	
P-311B	2.35	21	41	19	22	2	3	4	57	34		0.0114	0.0710	A-7-6(13)
P-311B	4.00	20	34	17	17	0	2	10	59	29		0.0141	0.0975	A-6b(11)
P-311B	17.50	21	31	18	13	1	2	13	55	29		0.0144	0.1335	A-6a(9)
P-311B	23.70													
P-311B	24.10													
P-311B	24.90	19	27	17	10	1	12	56	10	21		0.1263	0.6260	A-2-4(0)

BBCM

PROJECT GUE-70-14.10
LOCATION GUERNSEY COUNTY, OHIO
JOB NO. 01107000.090 DATE 9/26/02

SUMMARY ODOT (PORTRAIT)

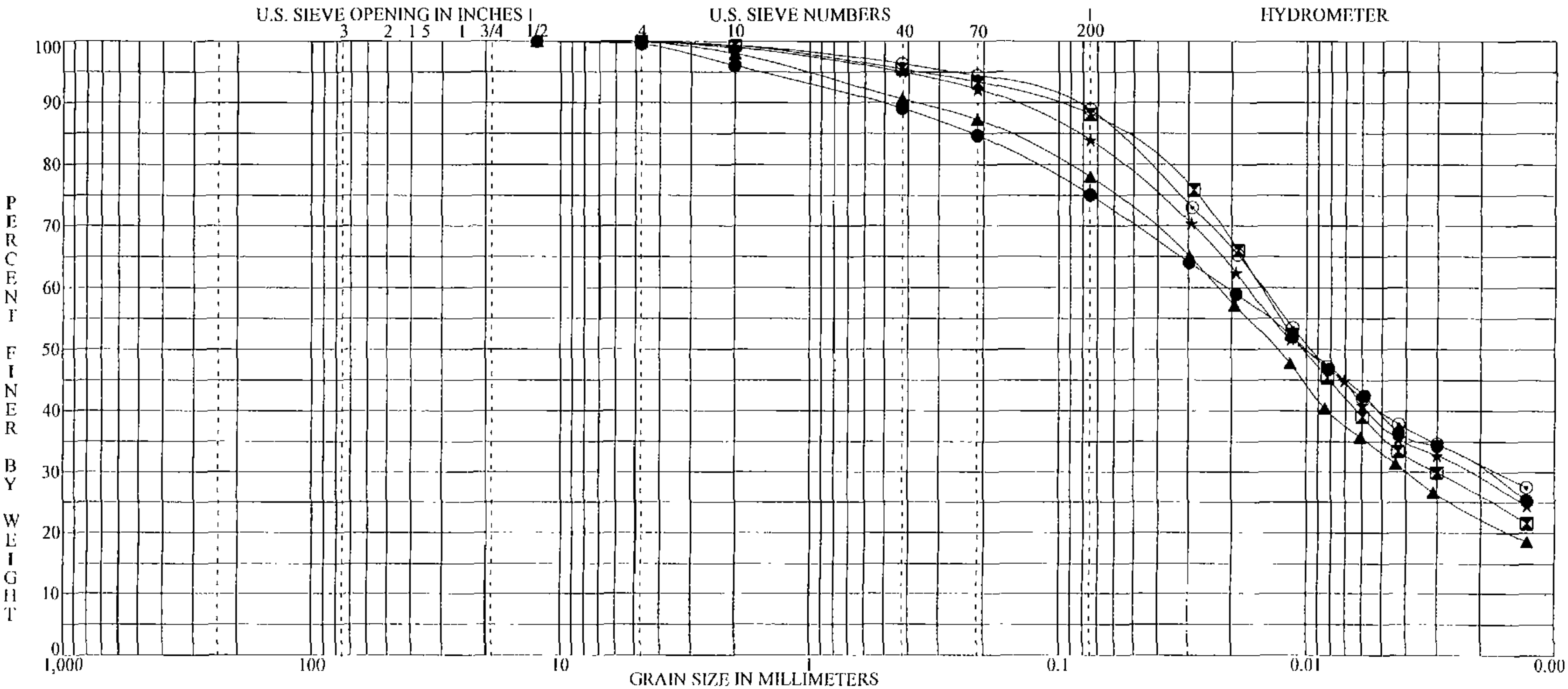
SUMMARY OF LABORATORY TEST RESULTS

BORING	G'int Id.	MC %	LL %	PL %	PI %	AGGREGATE %	COARSE SAND %	FINE SAND %	SILT %	CLAY %	SILT/CLAY %	D / 50 mm	D / 90 mm	HRB ODOT CLASSIFICATION
B-407G	4.50	15	36	23	13	4	20	12	24	40		0.0096	1.2567	A-6a(7)
B-412E	4.00	19	42	21	21	2	3	11			84		0.1800	A-7-6(13)
B-413H	4.00	18	38	20	18	1	3	8	51	37		0.0100	0.1125	A-6b(11)
GC-301	3.00	17	42	22	20	4	7	14	36	39		0.0100	0.5200	A-7-6(12)
GC-302	3.00	16	37	21	16	1	4	10	48	37		0.0108	0.1631	A-6b(10)
GC-304	3.00	18	41	22	19	1	2	15	40	42		0.0087	0.1700	A-7-6(12)
GC-306	3.20	19	33	21	12	1	4	7	52	36		0.0103	0.1075	A-6a(9)
GC-307	5.00	18	40	23	17	2	7	13	45	33		0.0132	0.3748	A-6b(11)
GC-308	3.00	12	38	19	19	1	4	11	46	38		0.0103	0.1605	A-6b(12)
GC-309	3.00	18	41	19	22	1	3	7	49	40		0.0096	0.0924	A-7-6(13)

BBCM

PROJECT GUE-70-14.10
LOCATION GUERNSEY COUNTY, OHIO
JOB NO. 01107000.090 DATE 1/16/03

SUMMARY OHDOT (PORTRAIT)



BOULDERS	COBBLES	AGGREGATE coarse	AGGREGATE fine	SAND coarse	SAND fine	SILT OR CLAY

Specimen Identification - Depth				Classification	MC%	LL	PL	PI	D15	D85
●	GC-301	S-2	2.0' to 3.2'	Composite Gradation Curves, Fill Material	17	42	22	20		0.2218
⊠	GC-306	S-2B	2.4' to 3.0'		19	33	21	12		0.0583
▲	GC-307	S-3	4.0' to 4.9'		18	40	23	17		0.1642
★	GC-308	S-2	2.0' to 3.0'		12	38	19	19		0.0851
⊙	GC-309	S-2	2.0' to 3.0'		18	41	19	22		0.0594

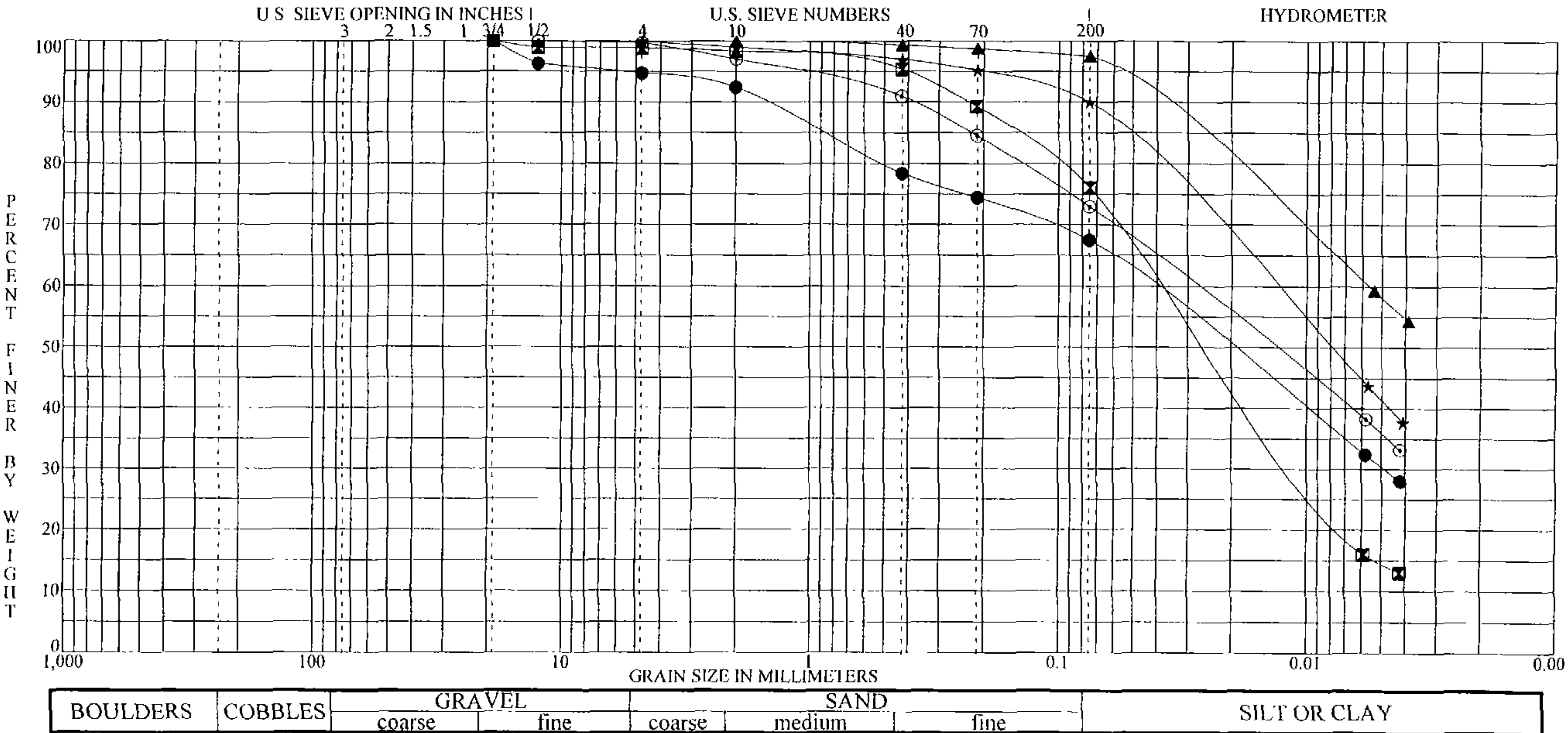
Specimen Identification - Depth				D90	D50	D30	D10	%Aggregate	%Sand	%Silt	%Clay
●	GC-301	S-2	2.0' to 3.2'	0.5200	0.0100	0.0020		4	21	36	39
⊠	GC-306	S-2B	2.4' to 3.0'	0.1075	0.0103	0.0030		1	11	52	36
▲	GC-307	S-3	4.0' to 4.9'	0.3748	0.0132	0.0040		2	20	45	33
★	GC-308	S-2	2.0' to 3.0'	0.1605	0.0103	0.0023		1	15	46	38
⊙	GC-309	S-2	2.0' to 3.0'	0.0924	0.0096	0.0017		1	10	49	40

BBCM

GRADATION CURVE

PROJECT GUE-70-14.10
LOCATION GUERNSEY COUNTY, OHIO
JOB NO. 01107000.090 DATE 1/20/03

GRN-ODOT



Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● B-407H S-1B 1.8' to 2.5'	COMPOSITE OF TYPICAL RESULTS	16	38	18	20		
⊠ B-407H S-5 9.0' to 10.6'		27	35	20	15		
▲ B-412E S-4B 7.5' to 8.3'	UPPER SILTY CLAY	29	70	23	47		
★ GC-305 S-2B 2.4' to 2.9'		24	45	23	22		
⊙ P-305A S-3 8.5' to 9.2'		21	35	19	16		

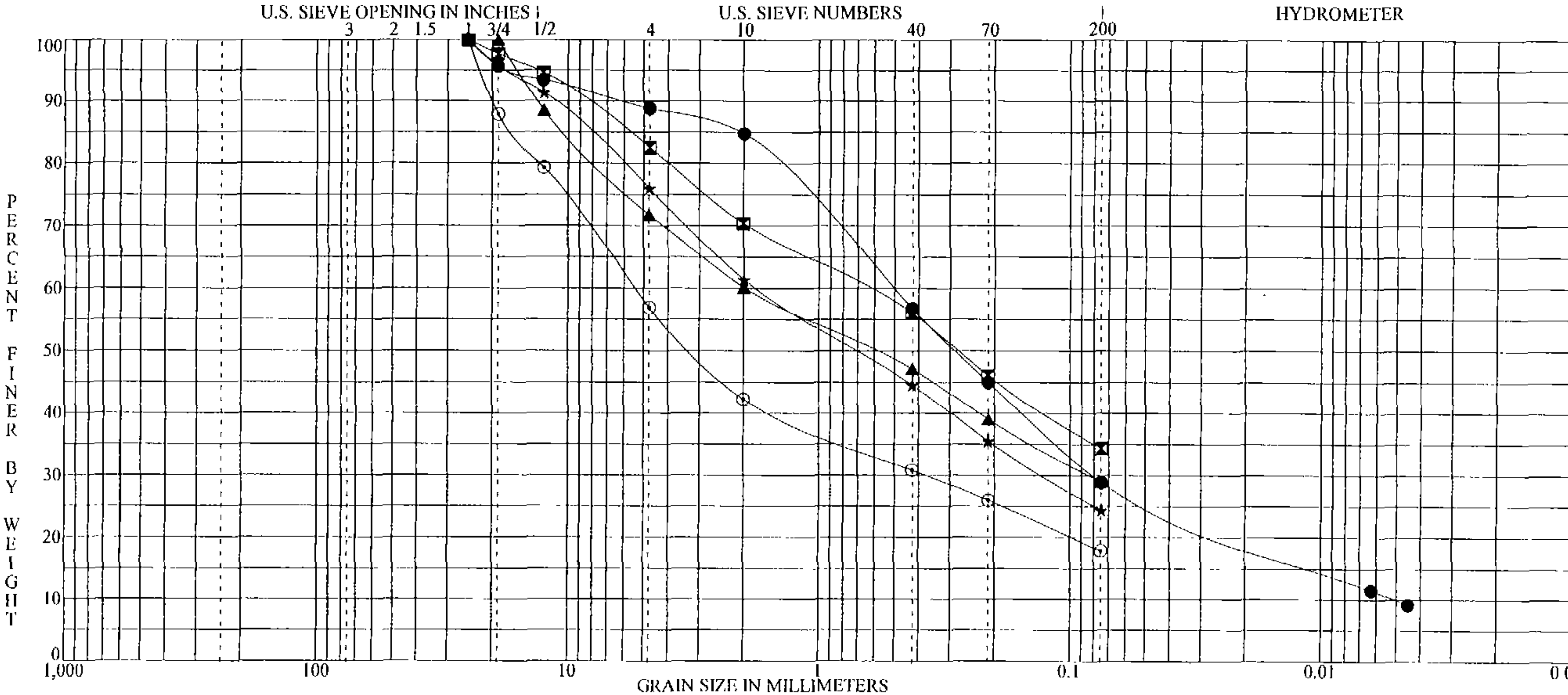
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● B-407H S-1B 1.8' to 2.5'	19.0000	0.0434	0.0049		5.3	27.2	37.1	30.4
⊠ B-407H S-5 9.0' to 10.6'	19.0000	0.0380	0.0107		1.1	22.8	61.5	14.6
▲ B-412E S-4B 7.5' to 8.3'	2.0000	0.0057			0.0	2.4	39.4	58.1
★ GC-305 S-2B 2.4' to 2.9'	4.7500	0.0141			0.0	10.0	48.7	41.3
⊙ P-305A S-3 8.5' to 9.2'	12.5000	0.0288			0.3	26.7	37.1	35.9

BBCM

GRADATION CURVE

PROJECT GUE-70-14.10
LOCATION GUERNSEY COUNTY, OHIO
JOB NO. 01107000.090 DATE 11/18/02

GRN-REG



BOULDERS	COBBLES	GRAVEL coarse	GRAVEL fine	SAND coarse	SAND medium	SAND fine	SILT OR CLAY

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● B-407I S-8 17.5' to 18.2'	COMPOSITE OF TYPICAL RESULTS	13					
⊠ GC-209 S-6B 23.8' to 24.7'							
▲ P-302A S-3 8.5' to 9.3'	UPPER SAND ZONE						
★ P-302A S-6 23.5' to 24.6'							
⊙ P-304A S-6 23.5' to 24.0'							

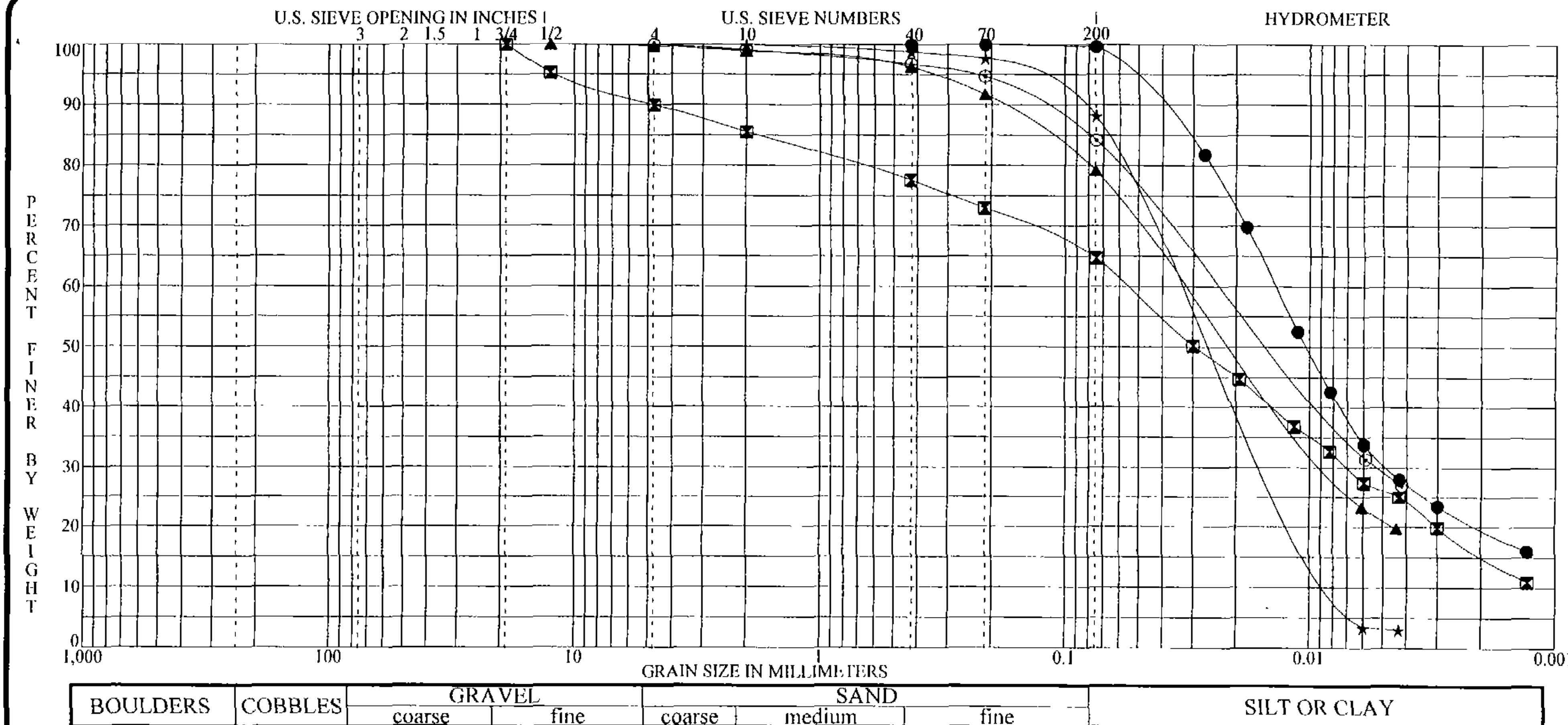
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● B-407I S-8 17.5' to 18.2'	25.0000	0.5084	0.0809	0.0051	11.2	60.0	19.0	9.9
⊠ GC-209 S-6B 23.8' to 24.7'	25.0000	0.6514			17.4	48.3	34.3	
▲ P-302A S-3 8.5' to 9.3'	19.0000	1.9676	0.0836		28.2	42.9	28.9	
★ P-302A S-6 23.5' to 24.6'	25.0000	1.7606	0.1276		24.0	51.7	24.3	
⊙ P-304A S-6 23.5' to 24.0'	25.0000	5.4362	0.3789		43.1	39.0	17.9	

BBCM

GRADATION CURVE

PROJECT GUE-70-14.10
LOCATION GUERNSEY COUNTY, OHIO
JOB NO. 01107000.090 DATE 11/18/02

GRN-REG



Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● GC-209 S-7 28.5' to 29.8'	Composite of Typical Results	29	34	22	12		
⊠ P-228A S-9 38.5' to 40.0'		27	34	19	15		
▲ P-306A S-5 18.5' to 19.3'	Lower Silty Clay	22	31	19	12		
★ P-308A S-6 23.5' to 24.3'		24	32	20	12		
⊙ P-311B S-8B 17.0' to 17.9'		21	31	18	13		

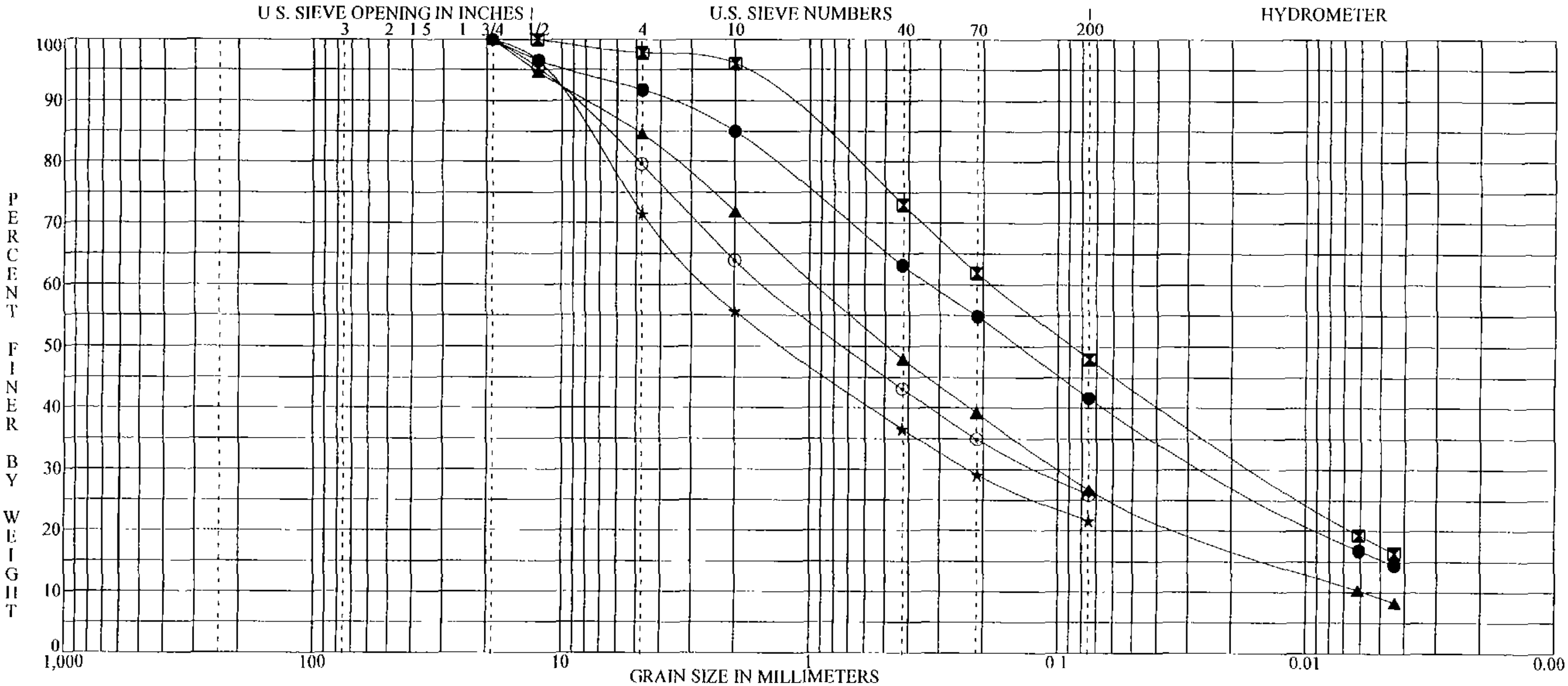
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● GC-209 S-7 28.5' to 29.8'	0.4250	0.0138	0.0048		0.0	0.3	69.0	30.6
⊠ P-228A S-9 38.5' to 40.0'	19.0000	0.0559	0.0070		10.1	25.3	38.5	26.1
▲ P-306A S-5 18.5' to 19.3'	12.5000	0.0318	0.0083		0.3	20.6	58.1	21.1
★ P-308A S-6 23.5' to 24.3'	2.0000	0.0324	0.0132	0.0073	0.0	11.8	85.0	3.2
⊙ P-311B S-8B 17.0' to 17.9'	4.7500	0.0234	0.0053		0.0	15.8	54.9	29.3

BBCM

GRADATION CURVE

PROJECT GUE-70-14.10
LOCATION GUERNSEY COUNTY, OHIO
JOB NO. 01107000.090 DATE 11/18/02

GRN-REG



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	B-407H S-12 33.5' to 34.0'	Composite of Typical Results	22					
⊠	B-412E S-11 28.5' to 29.0'		19	30	22	8		
▲	B-412E S-14 43.5' to 44.2'	Lower Sand Zone	16					
★	P-221A S-8 33.5' to 34.5'							
⊙	P-303A S-10 43.5' to 44.5'							

	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-407H S-12 33.5' to 34.0'	19.0000	0.3273	0.0232		8.2	50.2	26.2	15.4
⊠	B-412E S-11 28.5' to 29.0'	12.5000	0.1839	0.0155		2.2	49.8	30.5	17.5
▲	B-412E S-14 43.5' to 44.2'	19.0000	0.9284	0.0992	0.0059	15.4	57.9	17.6	9.0
★	P-221A S-8 33.5' to 34.5'	19.0000	2.5414	0.2306		28.5	49.9	21.6	
⊙	P-303A S-10 43.5' to 44.5'	19.0000	1.4993	0.1210		20.4	53.8	25.8	

BBCM

GRADATION CURVE

PROJECT GUE-70-14.10
LOCATION GUERNSEY COUNTY, OHIO
JOB NO. 01107000.090 DATE 11/18/02

GRN-REG

Static Water Levels, Coal Zone
Gue-70-14.10

Well	Ref	PVC	06/26/95	07/11/95	07/28/95	08/04/95	08/18/95	08/30/95	10/09/95	11/02/95	11/06/95	12/15/95	01/30/96	03/27/96	05/22/96	06/25/96	12/11/96
Down-gradient Wells																	
P-225A	Depth	0.20															
	msl	838.66															
P-226A	Depth	0.40															
	msl	827.15															
P-227A	Depth	-0.10															
	msl	830.66															
P-301A	Depth	0.40															
	msl	815.70															
P-303A	Depth	0.60															
	msl	822.79															
P-305A	Depth	0.40															
	msl	822.56															
		Averages															
Wells Inside Grout Curtain																	
P-001A	Depth	0.20	20.90	20.30	20.75	20.83	20.33	20.67	20.75	20.33	20.33	19.42	16.83	16.25	16.58	17.67	17.25
	msl	825.75	804.85	805.45	805.00	804.92	805.42	805.08	805.00	805.42	805.42	806.33	808.92	809.50	809.17	808.08	808.50
P-002A	Depth	0.20	16.80	16.68	16.25	17.00	17.17	17.00	16.83	14.67	16.75	14.29	13.25	11.83	11.88	15.08	14.92
	msl	824.44	807.64	807.76	808.19	807.44	807.27	807.44	807.61	809.77	807.69	810.15	811.19	812.61	812.56	809.36	809.52
P-221A	Depth	0.00															
	msl	826.92															
P-223A	Depth	0.10															
	msl	826.43															
P-228A	Depth	0.20															
	msl	828.37															
P-307A	Depth	0.30															
	msl	821.09															
P-308A	Depth	0.40															
	msl	822.93															
P-309A	Depth	0.20															
	msl	823.07															
P-310A	Depth	0.30															
	msl	824.99															
		Averages	**806.2**	**806.6**	**806.6**	**806.2**	**806.3**	**806.3**	**806.3**	**807.6**	**806.6**	**808.2**	**810.1**	**811.1**	**810.9**	**808.7**	**809.0**
Up-Gradient Wells																	
P-222A	Depth	0.00															
	msl	820.56															
P-224A	Depth	0.10															
	msl	821.58															
PW-001	Depth	-1.10															
	msl	822.42															
P-302A	Depth	0.00															
	msl	816.49															
P-304A	Depth	0.10															
	msl	818.31															
P-306A	Depth	0.60															
	msl	818.64															
		Averages															

Static Water Levels, Coal Zone
Gue-70-14.10

Well	Ref	PVC	02/20/97	03/20/97	10/06/97	11/19/97	12/17/97	03/05/98	06/10/98	07/27/99	12/30/99	01/05/2000	01/27/2000 Lowest	02/14/2000 2nd Highest	03/06/2000	03/18/2000
Down-gradient Wells																
P-225A	Depth	0.20										30.60	32.16	30.56	30.62	30.20
	msl	838.66										808.06	806.50	808.10	808.04	808.46
P-226A	Depth	0.40										19.10	20.68	19.07	19.11	18.69
	msl	827.15										808.05	806.47	808.08	808.04	808.46
P-227A	Depth	-0.10										22.62	24.20	22.59	22.63	22.22
	msl	830.66										808.04	806.46	808.07	808.03	808.44
P-301A	Depth	0.40														
	msl	815.70														
P-303A	Depth	0.60														
	msl	822.79														
P-305A	Depth	0.40														
	msl	822.56														
		Averages										**808.1**	**806.5**	**808.1**	**808.0**	**808.5**
Wells Inside Grout Curtain																
P-001A	Depth	0.20	17.25	16.69	18.42	18.00	17.17	16.92	17.96	17.58	16.80	16.49	17.07	15.90	16.34	16.17
	msl	825.75	808.50	809.06	807.33	807.75	808.58	808.83	807.79	808.17	808.95	809.26	808.68	809.85	809.41	809.58
P-002A	Depth	0.20	14.83	13.92	17.08	14.83	13.58	14.00	17.50	17.08	17.30	16.19	17.69	16.16	15.79	15.83
	msl	824.44	809.61	810.52	807.36	809.61	810.86	810.44	806.94	807.36	807.14	808.25	806.75	808.28	808.65	808.61
P-221A	Depth	0.00										17.40	18.14	16.93	17.46	17.30
	msl	826.92										809.52	808.78	809.99	809.46	809.62
P-223A	Depth	0.10										18.21	19.69	18.13	17.89	17.90
	msl	826.43										808.22	806.74	808.30	808.54	808.53
P-228A	Depth	0.20										19.79	20.14	18.91	19.19	19.02
	msl	828.37										808.58	808.23	809.46	809.18	809.35
P-307A	Depth	0.30														
	msl	821.09														
P-308A	Depth	0.40														
	msl	822.93														
P-309A	Depth	0.20														
	msl	823.07														
P-310A	Depth	0.30														
	msl	824.99														
		Averages	**809.1**	**809.8**	**807.3**	**808.7**	**809.7**	**809.6**	**807.4**	**807.8**	**808.0**	**808.8**	**807.8**	**809.2**	**809.0**	**809.1**
Up-Gradient Wells																
P-222A	Depth	0.00										11.05	11.82	10.66	11.13	11.00
	msl	820.56										809.51	808.74	809.90	809.43	809.56
P-224A	Depth	0.10										12.08	12.86	11.68	12.18	12.03
	msl	821.58										809.50	808.72	809.90	809.40	809.55
PW-001	Depth	-1.10										12.87	13.72	12.55	13.02	12.89
	msl	822.42										809.55	808.70	809.87	809.40	809.53
P-302A	Depth	0.00														
	msl	816.49														
P-304A	Depth	0.10														
	msl	818.31														
P-306A	Depth	0.60														
	msl	818.64														
		Averages										**809.5**	**808.7**	**809.9**	**809.4**	**809.5**

Static Water Levels, Coal Zone
Gue-70-14.10

Well	Ref	PVC	08/25/2000	05/21/2001	06/25/2001 typical	07/23/2001	08/20/2001	09/25/2001 Lowest	10/22/2001	05/28/2002 Highest	AVE	Variability
Down-gradient Wells												
P-225A	Depth	0.20	31.47	30.72	31.08	31.28	31.27	32.12	31.86	29.73		
	msl	838.66	807.19	807.94	807.58	807.38	807.39	806.54	806.80	808.93	**807.6**	2.4
P-226A	Depth	0.40	19.94	19.01	19.55	20.12	19.73	20.28	20.45	18.30		
	msl	827.15	807.21	808.14	807.60	807.03	807.42	806.87	806.70	808.85	**807.6**	2.4
P-227A	Depth	-0.10	23.46	22.72	23.08	23.26	23.24	23.81	23.94	21.82		
	msl	830.66	807.20	807.94	807.58	807.40	807.42	806.85	806.72	808.84	**807.6**	2.4
P-301A	Depth	0.40		7.73	8.12	8.33	8.27	8.75	8.85	6.82		
	msl	815.70		807.97	807.58	807.37	807.43	806.95	806.85	808.88	**807.6**	1.9
P-303A	Depth	0.60		14.87	15.27	15.54	15.43	15.98	16.04	13.62		
	msl	822.79		807.92	807.52	807.25	807.36	806.81	806.75	809.17	**807.5**	2.4
P-305A	Depth	0.40		14.63	15.04	15.26	15.21	15.79	15.88	13.75		
	msl	822.56		807.93	807.52	807.30	807.35	806.77	806.68	808.81	**807.5**	2.0
		Averages	**807.2**	**808.0**	**807.6**	**807.3**	**807.4**	**806.8**	**806.8**	**808.9**	**807.6**	**2.3**
Wells Inside Grout Curtain												
P-001A	Depth	0.20	17.29	16.25	16.86	17.09	16.81	17.37	17.29	15.45		
	msl	825.75	808.46	809.50	808.89	808.66	808.94	808.38	808.46	810.30	**807.8**	1.6
P-002A	Depth	0.20	17.04	16.38	16.69	16.89	16.84	17.43	17.43	15.40		
	msl	824.44	807.40	808.06	807.75	807.55	807.60	807.01	807.01	809.04	**808.6**	2.3
P-221A	Depth	0.00	18.42	17.34	17.99	18.21	17.88	18.50	18.43	16.58		
	msl	826.92	808.50	809.58	808.93	808.71	809.04	808.42	808.49	810.34	**809.2**	1.6
P-223A	Depth	0.10	19.11	18.30	18.72	18.86	18.85	19.44	19.45	17.42		
	msl	826.43	807.32	808.13	807.71	807.57	807.58	806.99	806.98	809.01	**807.8**	2.3
P-228A	Depth	0.20	20.11	19.03	19.67	19.89	19.62	20.23	20.16	18.17		
	msl	828.37	808.26	809.34	808.70	808.48	808.75	808.14	808.21	810.20	**808.8**	2.0
P-307A	Depth	0.30		13.14	13.51	13.73	13.68	14.27	14.28	11.82		
	msl	821.09		807.95	807.58	807.36	807.41	806.82	806.81	809.27	**807.6**	2.5
P-308A	Depth	0.40		13.52	14.16	14.39	14.05	14.73	14.58	12.78		
	msl	822.93		809.41	808.77	808.54	808.88	808.20	808.35	810.15	**808.9**	1.9
P-309A	Depth	0.20		14.29	14.87	14.87	15.02	15.18	15.18	13.19		
	msl	823.07		808.78	808.20	808.20	808.05	807.89	807.89	809.88	**808.4**	2.0
P-310A	Depth	0.30		16.38	16.88	17.08	16.92	17.54	17.48	15.50		
	msl	824.99		808.61	808.11	807.91	808.07	807.45	807.51	809.49	**808.2**	2.0
		Averages	**808.0**	**808.8**	**808.3**	**808.1**	**808.3**	**807.7**	**807.7**	**809.7**	**808.4**	**2.0**
Up-Gradient Wells												
P-222A	Depth	0.00	12.06	11.01	11.65	11.86	11.53	12.15	11.89	10.26		
	msl	820.56	808.50	809.55	808.91	808.70	809.03	808.41	808.67	810.30	**809.2**	1.6
P-224A	Depth	0.10	13.10	12.04	12.69	12.90	12.58	13.17	13.11	11.28		
	msl	821.58	808.48	809.54	808.89	808.68	809.00	808.41	808.47	810.30	**809.1**	1.6
PW-001	Depth	-1.10	13.96	12.89	13.54	13.76	13.41	14.07	14.15	12.41		
	msl	822.42	808.46	809.53	808.88	808.66	809.01	808.35	808.27	810.01	**809.1**	1.3
P-302A	Depth	0.00		7.25	7.64	7.86	7.54	8.17	8.12	6.20		
	msl	816.49		809.24	808.85	808.63	808.95	808.32	808.37	810.29	**809.0**	2.0
P-304A	Depth	0.10		8.54	9.20	9.43	9.07	9.74	9.67	7.74		
	msl	818.31		809.77	809.11	808.88	809.24	808.57	808.64	810.57	**809.3**	2.0
P-306A	Depth	0.60		9.56	10.32	10.43	10.08	10.73	10.66	8.78		
	msl	818.64		809.08	808.32	808.21	808.56	807.91	807.98	809.86	**808.6**	1.9
		Averages	**808.5**	**809.5**	**808.8**	**808.6**	**809.0**	**808.3**	**808.4**	**810.2**	**809.0**	**1.7**

Static Water Levels, Granular Zones
Gue-70-14.10

Well	Ref	PVC	06/26/95	07/11/95	07/28/95	08/04/95	08/18/95	08/30/95	10/09/95	11/02/95	11/06/95	12/15/95	01/30/96	03/27/96	05/22/96	06/25/96	12/11/96	02/20/97
Lower Sand																		
P-001B	Depth	0.20	20.10	19.46	20.00	20.00	19.67	19.91	20.17	19.58	19.58	18.75	15.71	15.52	15.54	17.12	16.67	17.50
	msl	825.74	805.64	806.28	805.74	805.74	806.07	805.83	805.57	806.16	806.16	806.99	810.03	810.22	810.20	808.62	809.07	808.24
P-002B	Depth	0.40	15.70	16.04	15.50	15.92	16.50	16.67	16.71	16.58	16.54	15.56	11.83	11.58	8.75	11.17	14.58	14.58
	msl	824.29	808.59	808.25	808.79	808.37	807.79	807.62	807.58	807.71	807.75	808.73	812.46	812.71	815.54	813.12	809.71	809.71
P-221B	Depth	0.10																
	msl	826.76																
P-222B	Depth	0.20																
	msl	820.52																
P-228B	Depth	0.20																
	msl	828.15																
P-307B	Depth	0.20																
	msl	821.06																
P-311B	Depth	0.30																
	msl	823.22																
		Averages	807.1	807.3	807.3	807.1	806.9	806.7	806.6	806.9	807.0	807.9	811.2	811.5	812.9	810.9	809.4	809.0
Upper Sand																		
P-221 C	Depth	0.00																
	msl	826.38																
P-222 C	Depth	0.00																
	msl	820.53																
P-223 B	Depth	0.00																
	msl	826.19																
P-228 C	Depth	0.00																
	msl	828.41																
P-301B	Depth	0.00																
	msl	815.80																
P-302B	Depth	0.00																
	msl	816.29																
P-303B	Depth	0.00																
	msl	823.21																
P-304B	Depth	0.00																
	msl	818.02																
P-306B	Depth	0.00																
	msl	819.04																
P-308B	Depth	0.00																
	msl	823.02																
P-309B	Depth	0.00																
	msl	823.41																
		Averages																
Misc Sands																		
P-311C	Depth	0.00																
	msl	823.41																
P-224B	Depth	0.20																
	msl	821.62																
P-225B	Depth	0.10																
	msl	838.46																
P-227B	Depth	0.20																
	msl	830.47																
P-306B	Depth	0.90																
	msl	819.04																

Static Water Levels, Granular Zones
Gue-70-14.10

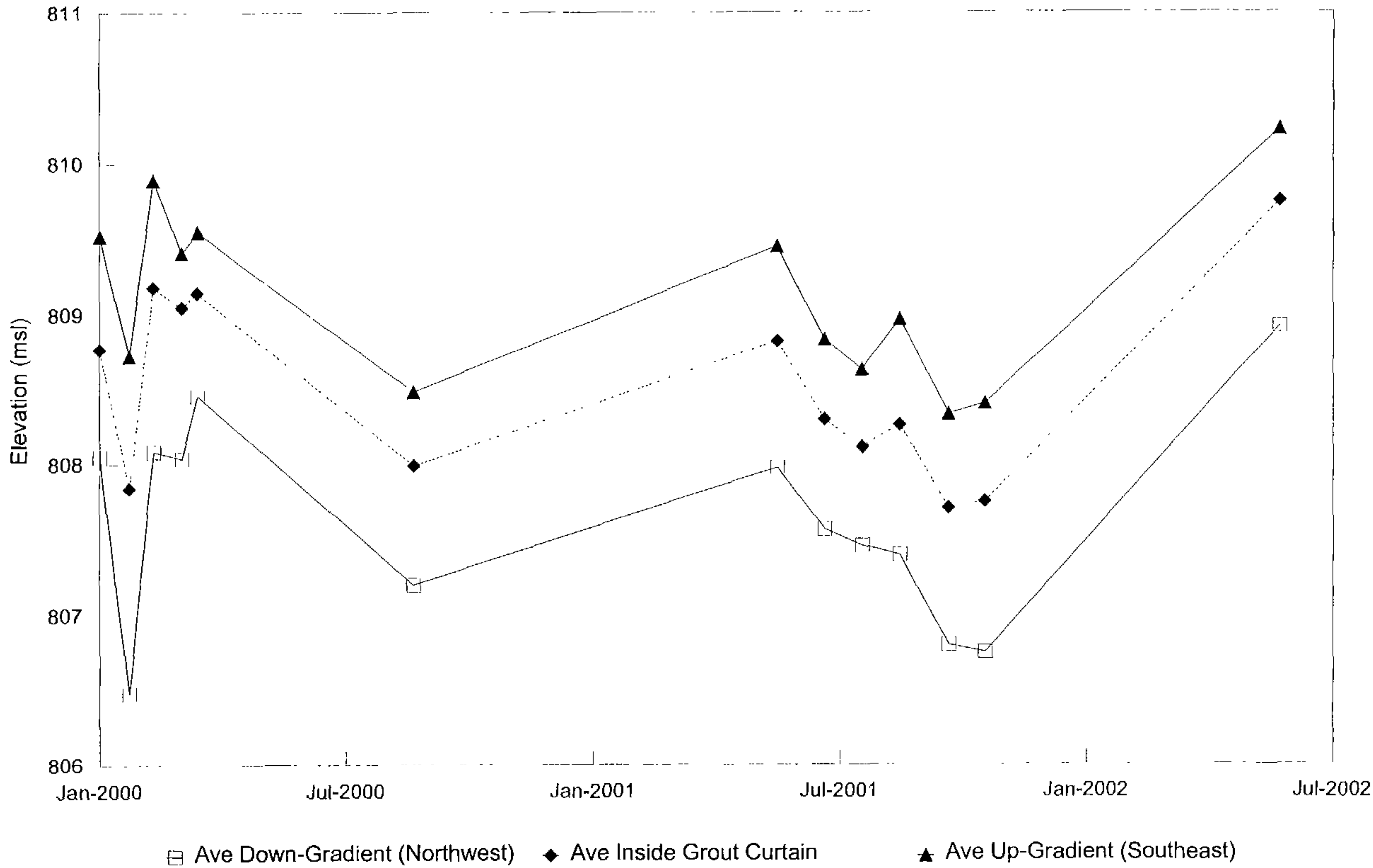
Well	Ref	PVC	03/20/97	10/06/97	11/19/97	12/17/97	03/05/98	06/10/98	07/27/99	12/30/99	01/05/00	01/27/00	02/14/00	3/6/00	3/18/00	8/25/00	05/21/01
Lower Sand																	
P-001B	Depth	0.20	16 00	18.50	18 42	17 50	17 33	18 00	17.58		16 26	17.34	16.23	16.43	16.23	17.40	16 23
	msl	825.74	809.74	807 24	807 32	808.24	808 41	807 74	808 16		809 48	808 40	809.51	809.31	809 51	808 34	809.51
P-002B	Depth	0.40	13.58	16 75	16 50	15 75	14 92	13.25	14 58	17 30	16.16	17 59	16 13	16 06	15 74	16 96	16.24
	msl	824 29	810.71	807 54	807 79	808 54	809 37	811 04	809 71	806.99	808 13	806 70	808.16	808 23	808 55	807 33	808.05
P-221B	Depth	0.10									17 19	17 86	16.85	17.09	16 99	18.07	16.96
	msl	826.76									809.57	808 90	809 91	809 67	809.77	808.69	809 80
P-222B	Depth	0 20									11 16	12 00	10 95	11.07	10.99	12 09	10 97
	msl	820.52									809 36	808 52	809 57	809 45	809 53	808.43	809.55
P-228B	Depth	0 20									19 18	19 64	18.51	18.80	18 65	19 72	18 64
	msl	828 15									808 97	808 51	809.64	809.35	809 50	808 43	809 51
P-307B	Depth	0 20															10.34
	msl	821 06															810 72
P-311B	Depth	0 30															
	msl	823 22															
		Averages	**810.2**	**807.4**	**807.6**	**808.4**	**808.9**	**809.4**	**808.9**	**807.0**	**809.1**	**808.2**	**809.4**	**809.2**	**809.4**	**808.2**	**809.2**
Upper Sand																	
P-221 C	Depth	0 00									12.13	12 36	11.71	11 07	11 32	13 12	10 84
	msl	826 38									814 25	814 02	814.67	815.31	815 06	813 26	815 54
P-222 C	Depth	0 00									2 87	5 50	2 77	4 25	3 23	6 49	3 68
	msl	820.53									817.66	815 03	817 76	816 28	817 30	814 04	816 85
P-223 B	Depth	0 00									11 49	11.80	11 17	10 53	10 79	11 85	10 27
	msl	826 19									814 70	814.39	815.02	815.66	815 40	814.34	815 92
P-228 C	Depth	0 00									13.66	14 08	13 39	12 79	13 04	14 90	12 50
	msl	828 41									814 75	814 33	815 02	815.62	815 37	813 51	815.91
P-301B	Depth	0.00															2 36
	msl	815 80															813 44
P-302B	Depth	0 00															2 03
	msl	816 29															814 26
P-303B	Depth	0 00															9 93
	msl	823 21															813 28
P-304B	Depth	0 00															2 54
	msl	818.02															815 48
P-306B	Depth	0.00															1 00
	msl	819 04															818 04
P-308B	Depth	0.00															7.18
	msl	823.02															815 84
P-309B	Depth	0.00															9 97
	msl	823 41															813.44
		Averages									**815.3**	**814.4**	**815.6**	**815.7**	**815.8**	**813.8**	**815.3**
Misc Sands																	
P-311C	Depth	0 00															
	msl	823 41															
P-224B	Depth	0.20									8 94	10.16	8 11	9.40	8 94	11 24	8 70
	msl	821.62									812.68	811 46	813.51	812 22	812 68	810 38	812 92
P-225B	Depth	0 10									2 10	3 96	2.16	2 94	1 85	4 88	3 69
	msl	838.46									836 36	834 50	836.30	835.52	836 61	833 58	834 77
P-227B	Depth	0 20									11 11	10 89	10 73	9 85	10 09	12 01	9 71
	msl	830 47									819 36	819 58	819.74	820.62	820.38	818 46	820 76
P-306B	Depth	0 90															1 00
	msl	819.04															818.04

Static Water Levels, Granular Zones
Gue-70-14.10

Well	Ref	PVC	06/25/01 typical	07/23/01	08/20/01	09/25/01 lowest	10/22/01	05/28/2002 highest	AVE	Variability
Lower Sand										
P-001B	Depth	0.20	16.92	17.13	16.75	17.47	17.34	15.41		
	msl	825.74	808.82	808.61	808.99	808.27	808.40	810.33	**808.1**	2.1
P-002B	Depth	0.40	16.53	16.73	16.69	17.27	17.23	15.20		
	msl	824.29	807.76	807.56	807.60	807.02	807.06	809.09	**808.8**	2.1
P-221B	Depth	0.10	17.63	17.87	17.50	18.19	18.04	16.16		
	msl	826.76	809.13	808.89	809.26	808.57	808.72	810.60	**809.3**	2.0
P-222B	Depth	0.20	11.63	11.85	11.53	12.18	12.12	10.17		
	msl	820.52	808.89	808.67	808.99	808.34	808.40	810.35	**809.1**	2.0
P-228B	Depth	0.20	19.27	18.99	19.03	19.81	19.43	18.81		
	msl	828.15	808.88	809.16	809.12	808.34	808.72	809.34	**809.0**	1.0
P-307B	Depth	0.20	12.32	13.00	12.82	13.52	13.36	11.24		
	msl	821.06	808.74	808.06	808.24	807.54	807.70	809.82	**808.7**	2.3
P-311B	Depth	0.30						14.24		
	msl	823.22						808.98	**809.0**	n/a
		Averages	**808.6**	**808.5**	**808.6**	**808.0**	**808.5**	**809.8**	**808.9**	**1.9**
Upper Sand										
P-221 C	Depth	0.00	11.46	12.17	11.98	13.01	12.89	9.32		
	msl	826.38	814.92	814.21	814.40	813.37	813.49	817.06	**814.4**	3.7
P-222 C	Depth	0.00	4.39	5.56	4.48	6.39	6.14	1.87		
	msl	820.53	816.14	814.97	816.05	814.14	814.39	818.66	**815.9**	1.8
P-223 B	Depth	0.00	10.88	11.60	10.98	12.51	12.38	8.73		
	msl	826.19	815.31	814.59	815.21	813.68	813.81	817.46	**814.8**	3.7
P-228 C	Depth	0.00	13.10	13.84	13.14	15.74	14.61	10.94		
	msl	828.41	815.31	814.57	815.27	812.67	813.80	817.47	**814.7**	4.8
P-301B	Depth	0.00	3.22	3.95	3.06	4.47	4.28	1.83		
	msl	815.80	812.58	811.85	812.74	811.33	811.52	813.97	**812.2**	2.6
P-302B	Depth	0.00	2.28	3.56	2.60	4.33	3.88	1.98		
	msl	816.29	814.01	812.73	813.69	811.96	812.41	814.31	**813.2**	2.4
P-303B	Depth	0.00	10.22	10.91	10.09	11.54	11.43	8.70		
	msl	823.21	812.99	812.30	813.12	811.67	811.78	814.51	**812.5**	2.8
P-304B	Depth	0.00	3.11	4.09	3.33	4.64	3.55	2.02		
	msl	818.02	814.91	813.93	814.69	813.38	814.47	816.00	**814.5**	2.6
P-306B	Depth	0.00	1.60	2.80	1.99	3.87	2.23	0.04		
	msl	819.04	817.44	816.24	817.05	815.17	816.81	819.00	**816.8**	3.8
P-308B	Depth	0.00	7.89	8.84	8.01	9.46	8.91	6.61		
	msl	823.02	815.13	814.18	815.01	813.56	814.11	816.41	**814.6**	2.3
P-309B	Depth	0.00	10.77	11.38	11.61	12.06	11.73	9.63		
	msl	823.41	812.64	812.03	811.80	811.35	811.68	813.78	**812.2**	2.0
		Averages	**814.7**	**813.8**	**814.5**	**812.9**	**813.5**	**816.2**	**814.2**	**3.0**
Misc Sands										
P-311C	Depth	0.00						6.80		
	msl	823.41						816.61	**816.6**	n/a
P-224B	Depth	0.20	8.82	10.06	8.58	9.61	8.98	3.23		
	msl	821.62	812.80	811.56	813.04	812.01	812.64	818.39	**812.8**	6.8
P-225B	Depth	0.10	4.19	4.48	4.32	5.19	5.13	2.23		
	msl	838.46	834.27	833.98	834.14	833.27	833.33	836.23	**834.8**	3.0
P-227B	Depth	0.20	10.08	11.02	10.36	11.81	12.09	8.21		
	msl	830.47	820.39	819.45	820.11	818.66	818.38	822.26	**819.9**	3.6
P-306B	Depth	0.90	1.60	2.80	1.99	3.87	2.23	0.43		
	msl	819.04	817.44	816.24	817.05	815.17	816.81	818.61	**817.1**	3.4

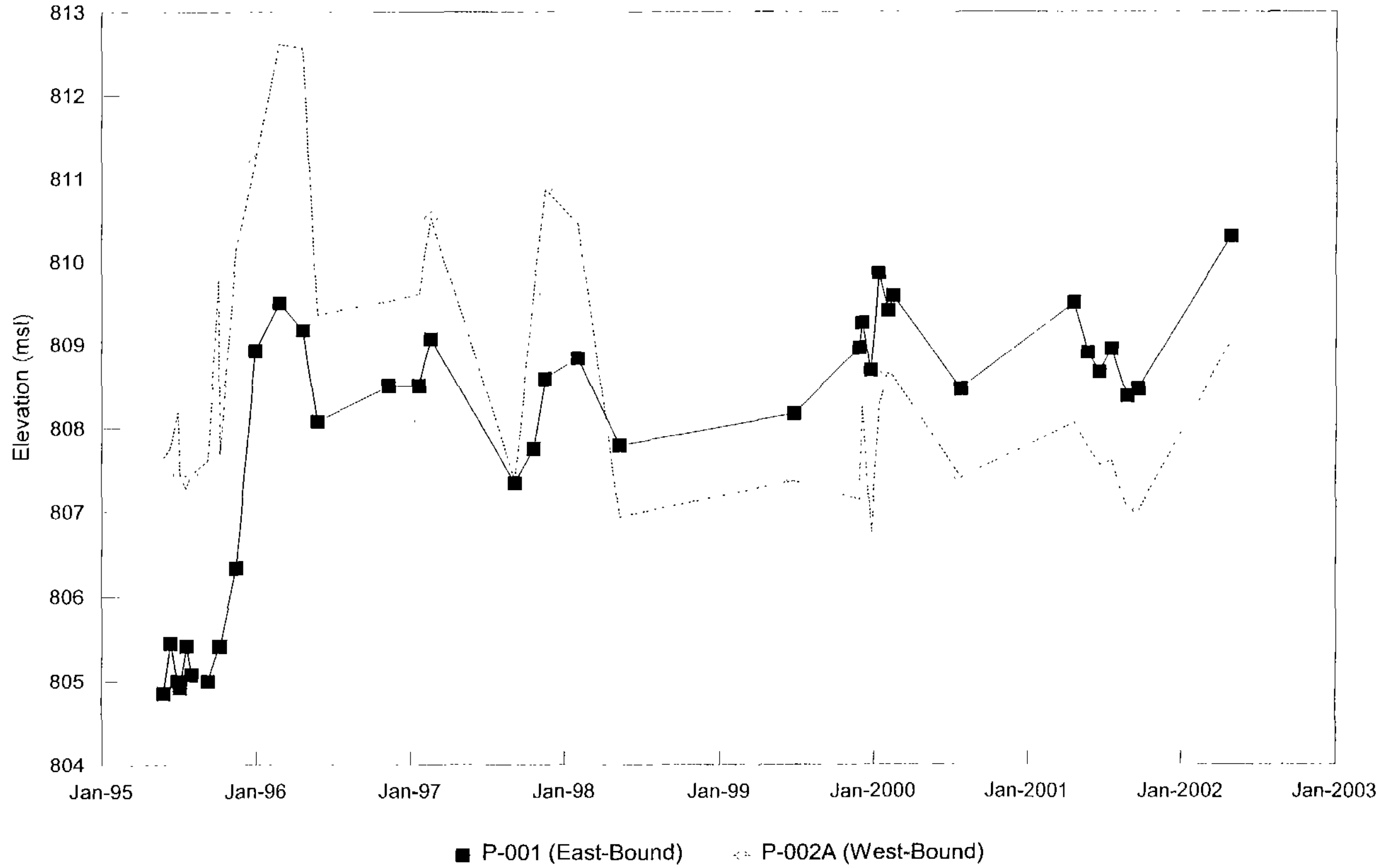
Static Groundwater Levels, Coal Zone

Gue-70-14.10



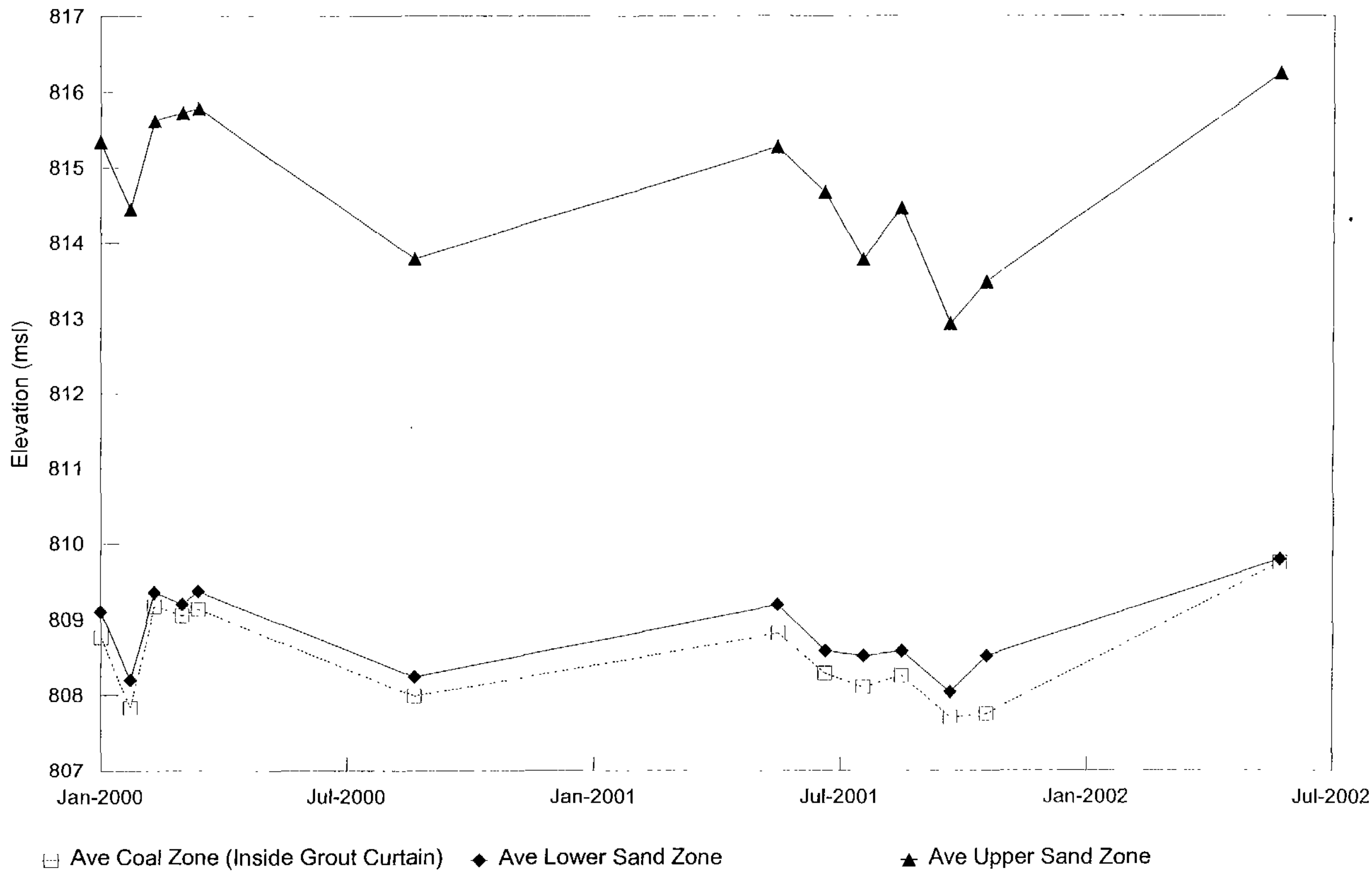
Static Groundwater Levels, "Old" Coal Zone Wells

Gue-70-14.10



Static Groundwater Levels, All Zones

Gue-70-14.10



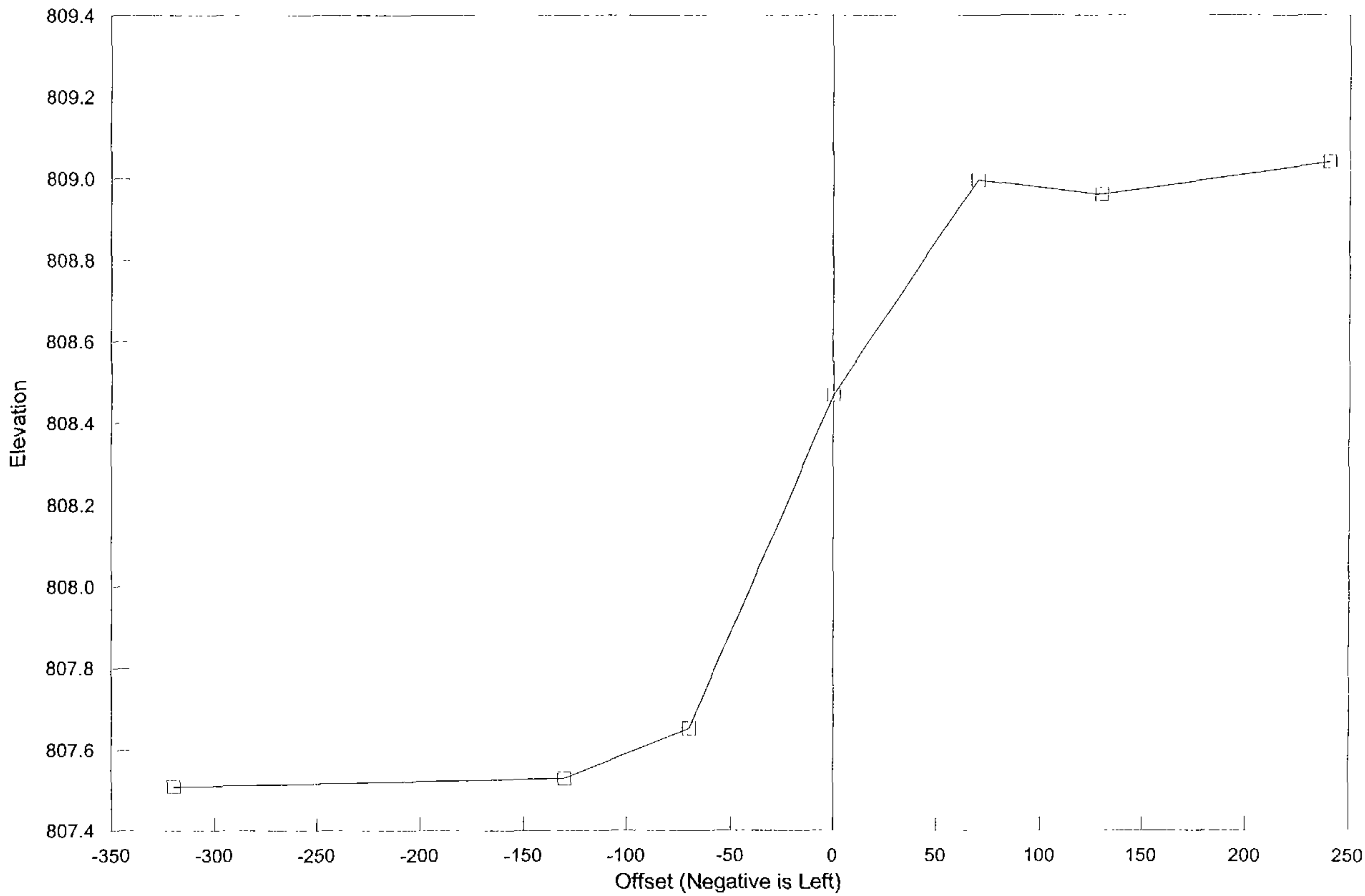
Ground Water Levels in Flow Zones
Coal Zone Aquifer
Gue-70-14.10

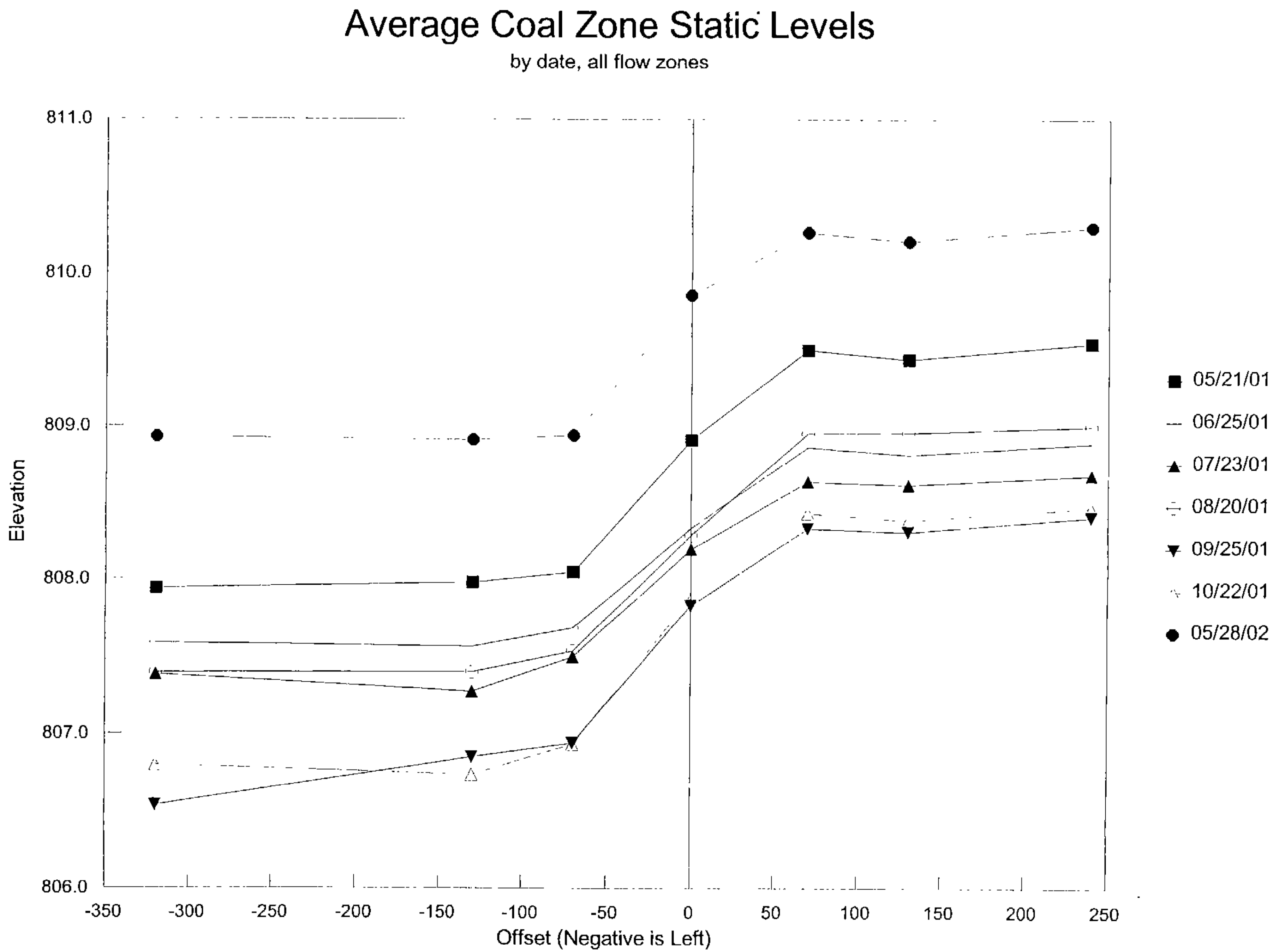
Date	Far NW of Curtain ~320' Lft	NW of Grout Curtain ~130' Lft	In Grout NW Side ~70' Lft	In Grout Middle ~Ctr Line	In Grout SE Side ~70' Rt	SE of Grout Curtain ~130' Rt	Far SE of Curtain ~240' Rt	Water Level Drop from SE to NW (-130 to 130)
Sta 469+00		P-301A	P-307A	P-309A		P-302A		
05/21/01		807.97	807.95	808.78		809.24		1.3
06/25/01		807.58	807.58	808.20		808.85		1.3
07/23/01		807.37	807.36	808.20		808.63		1.3
08/20/01		807.43	807.41	808.05		808.95		1.5
09/25/01		806.95	806.82	807.89		808.32		1.4
10/22/01		806.85	806.81	807.89		808.37		1.5
05/28/02		808.88	808.77	809.88		810.29		1.4
Averages		**807.6**	**807.5**	**808.4**		**809.0**		**1.4**
Sta 475+00		P-303A		P-310A	P-308A	P-304A		
05/21/01		807.92		808.61	809.41	809.77		1.9
06/25/01		807.52		808.11	808.77	809.11		1.6
07/23/01		807.25		807.91	808.54	808.88		1.6
08/20/01		807.36		808.07	808.88	809.24		1.9
09/25/01		806.81		807.45	808.20	808.57		1.8
10/22/01		806.75		807.51	808.35	808.64		1.9
05/28/02		809.17		809.49	810.15	810.57		1.4
Averages		**807.5**		**808.2**	**808.9**	**809.3**		**1.7**
Sta 479+50		P-305A	P-002A			P-306A		
05/21/01		807.93	808 06			809.08		1.2
06/25/01		807.52	807.75			808.32		0.8
07/23/01		807.30	807.55			808.21		0.9
08/20/01		807.35	807.60			808.56		1.2
09/25/01		806.77	807.01			807.91		1.1
10/22/01		806.68	807.01			807.98		1.3
05/28/02		808.81	809.04			809.86		1.0
Averages		**807.48**	**807.72**			**808.56**		**1.1**
Sta 482+25		P-226A			P-001A	P-222A		
05/21/01		808.14			809.50	809.55		1.4
06/25/01		807.60			808.89	808.91		1.3
07/23/01		807.03			808.66	808.70		1.7
08/20/01		807.42			808.94	809.03		1.6
09/25/01		806.87			808.38	808.41		1.5
10/22/01		806.70			808.46	808.67		2.0
05/28/02		808.85			810.30	810.30		1.4
Averages		**807.5**			**809.0**	**809.1**		**1.6**
Sta 484+00	P-225 A	P-227A	P-223A	P228A	P221A	PW-001	P-224A	
05/21/01	807.94	807.94	808.13	809.34	809.58	809.53	809.54	1.6
06/25/01	807.58	807.58	807.71	808.70	808.93	808.88	808.89	1.3
07/23/01	807.38	807.40	807.57	808.48	808.71	808.66	808.68	1.3
08/20/01	807.39	807.42	807.58	808.75	809.04	809.01	809.00	1.6
09/25/01	806.54	806.85	806.99	808.14	808.42	808.35	808.41	1.5
10/22/01	806.80	806.72	806.98	808.21	808.49	808.27	808.47	1.5
05/28/02	808.93	808.84	809.01	810.20	810.34	810.01	810.30	1.2
Averages	**807.5**	**807.5**	**807.7**	**808.8**	**809.1**	**809.0**	**809.0**	**1.4**

Overall Site Average	**1.4**

Average Coal Zone Static Levels

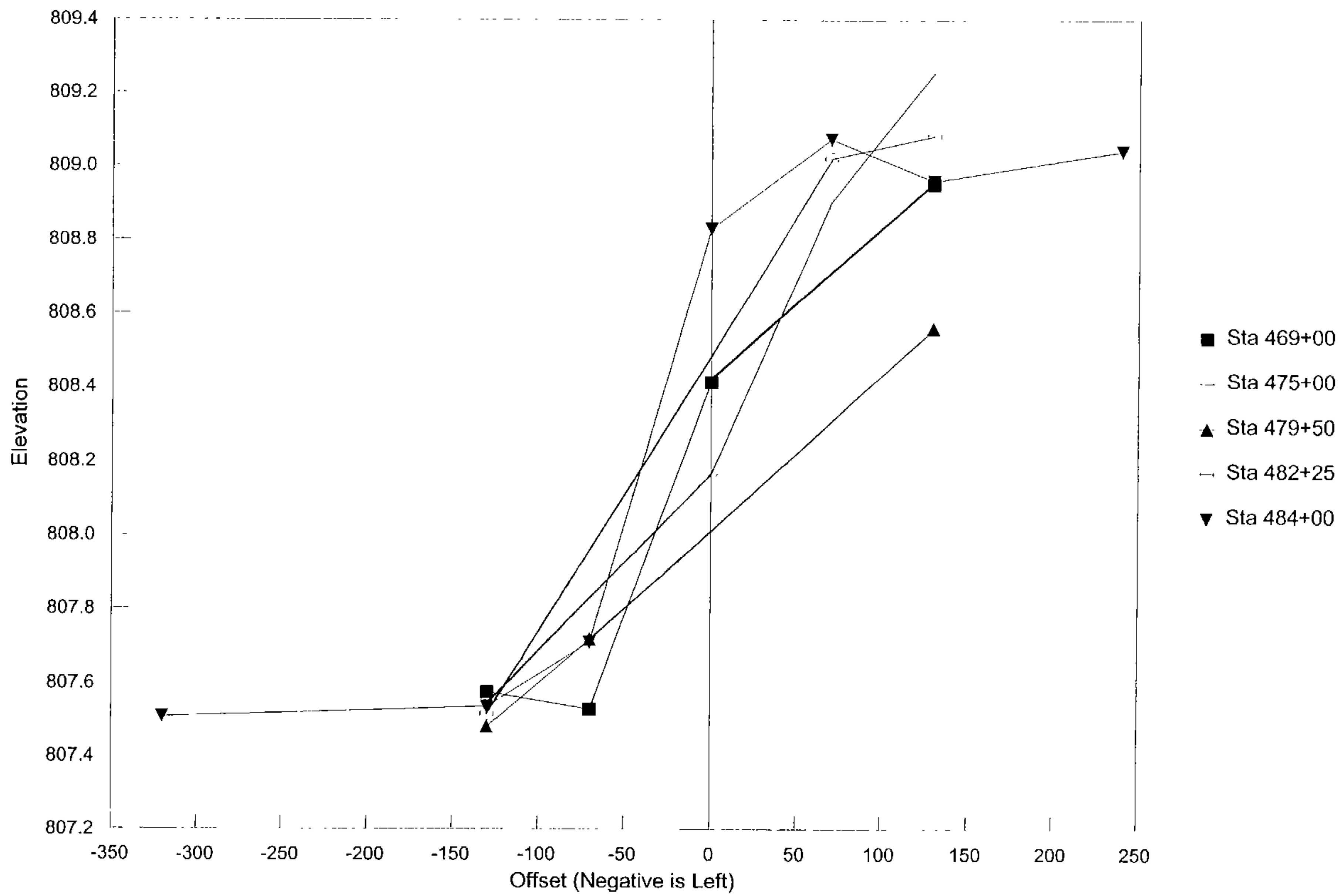
all dates and all flow zones




Average Coal Zone Static Levels
by date, all flow zones
811.0
810.0
809.0
808.0
807.0
806.0
Elevation
-350
-300
-250
-200
-150
-100
-50
0
50
100
150
200
250
Offset (Negative is Left)
05/21/01
06/25/01
07/23/01
08/20/01
09/25/01
10/22/01
05/28/02

Average Coal Zone Static Levels

by flow zone, all dates



Summary of Field Permeabilities
GUE 70 14.10

Coal Zone Wells

Outside of Grout Curtain

P-222A	8.7E-04
* P-224A	1.0E-01
* P-225A	2.5E-02
P-226A	1.8E-04
P-227A	3.0E-04
P-301A	5.0E-04
P-302A	1.2E-02
P-303A	5.0E-03
P-304A	1.5E-02
P-305A	2.0E-02
P-306A	1.2E-02
* PW-001	4.8E+00
Average	**4.2E-01**

Inside Grout Curtain

* P-001A	3.9E-03
* P-002A	4.3E-03
* P-221A	1.6E-02
P-223A	2.0E-04
P-228A	2.9E-03
P-307A	2.5E-02
P-308A	2.7E-02
P-309A	1.3E-04
P-310A	8.4E-04
Average	**8.9E-03**

Granular Strata Wells

Lower Sand

* P-001B	1.7E-02
* P-002B	2.6E-02
P-221B	8.7E-05
* P-222B	2.1E-02
P-228B	4.9E-05
P-307B	4.7E-04
Average	**1.1E-02**

Upper Sand

* P-221C	6.7E-02
P-223B	1.9E-03
P-228C	7.3E-04
P-301B	1.2E-02
P-302B	1.7E-04
P-303B	2.7E-03
P-304B	1.6E-04
P-308B	1.3E-03
P-309B	3.5E-04
Average	**9.6E-03**

Misc Sands

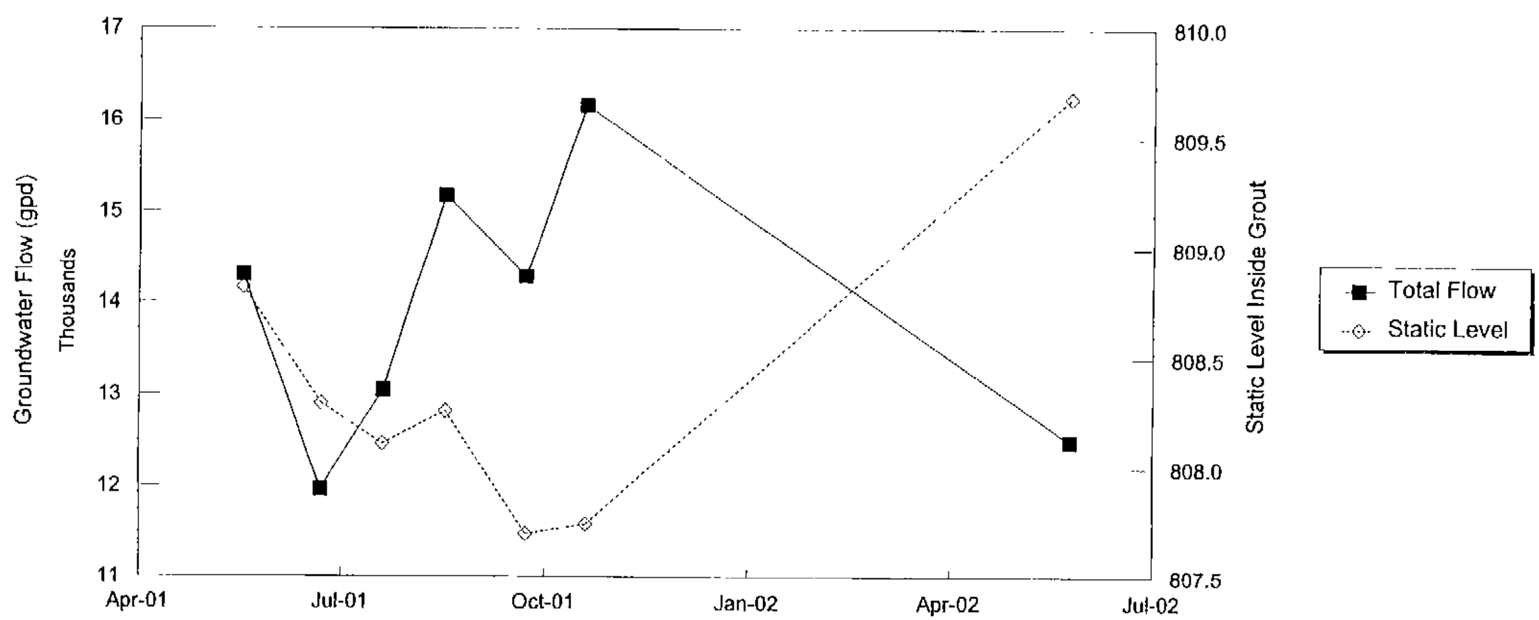
P-222C	2.4E-03
P-224B	5.7E-03
P-225B	6.5E-04
P-227B	1.2E-04
P-306B	1.8E-03

* Permeability estimated from Specific Capacity, all others based on Slug Testing

Summary of Groundwater Flow, Coal Zone
Calculated by Zone
Gue 70 - 14.10

	Ground Water Flow per Zone					Total	Average Static Levels		
Date	469+00	475+00	479+25	482+00	484+50	Flow	Down-gradient	Inside Grout	Up-gradient
05/21/01	1,079	3,315	3,359	3,078	3,470	**14,302**	808.0	808.8	809.5
06/25/01	1,079	2,849	2,337	2,860	2,837	**11,963**	807.6	808.3	808.9
07/23/01	1,071	2,921	2,658	3,646	2,750	**13,046**	807.3	808.1	808.6
08/20/01	1,292	3,369	3,534	3,515	3,470	**15,180**	807.4	808.3	809.0
09/25/01	1,164	3,154	3,330	3,362	3,274	**14,284**	806.7	807.7	808.4
10/22/01	1,292	3,387	3,797	4,301	3,383	**16,160**	806.8	807.7	808.4
05/28/02	1,198	2,509	3,067	3,165	2,554	**12,493**	808.9	809.7	810.3
Averages	**1,168**	**3,072**	**3,155**	**3,418**	**3,105**	13,918	807.5	808.4	809.0

Quantities are in Gallons per Day
Static Levels are in msl



SUMMARY OF CHEMICAL ANALYSIS
GUE -70 -14.10

Averages from all Sampling Events

	FIELD ANALYSIS			LABORATORY ANALYSIS					
	TDS (mg/l)	Conduct umhos/cm	pH (SU)	TDS (mg/l)	Calcium (mg/l)	Sulfates (mg/l)	Iron (mg/l)	Hardness (mg/l)	Alkalinity (mg/l)
COAL ZONE WELLS									
NW of Grout Curtain									
P-225A	247	493	6 40		54.0	44.0	3.00	175	213
P-226A	687	1337	6.81	747	41.8	232.3	0.42	127	453
P-227A	620	1203	6 86	727	55 7	214 2	0 38	148	446
P-301A	354	626	6.90	394	33 7	7 8	0.39	189	364
P-303A	388	724	7.91	525	15 1	34.5	0 10	54	474
P-305A	426	641	6.55	427	80.8	96.6	1.28	217	262
Averages	454	837	6 90	564	46.8	104.9	0.93	152	369
Std Deviation	153	316	0.48	148	20 4	87.9	1.00	52	100
Coeff of Variance	0.3	0.4	0 1	0.3	0.4	0.8	1.1	0 3	0.3
Inside Grout Curtain									
P-221 A	261	530	6 90		76 0	44.0	0.90	220	220
P-223 A	387	875	8.30		29 0	143 0	0.20	99	310
P-228 A	322	642	10.40		19.0	118 0	1 10	32	108
P-307A	368	741	8 02	488	40 2	40.2	0.19	44	330
P-308A	273	545	6.25	417	36.8	36 8	0 87	176	250
P-309A	573	1150	6 11	720	179.0	179.0	0.86	229	405
P-310A	510	1020	6.20	748	132 0	132 0	3 69	142	330
Averages	385	786	7 45	593	73.1	99.0	1.12	135	279
Std Deviation	109	221	1 46	143	56 0	53.6	1 10	74	89
Coeff of Variance	0 3	0.3	0 2	0.2	0.8	0 5	1.0	0.5	0.3
SE of Grout Curtain									
P-222 A	350	699	7.08	401	5.9	5.9	0.38	91	359
P-224A	292	584	6 80		40.0	51.0	4.00	224	223
PW-001	262	560	6 54	312	47 8	47.8	2.83	233	233
P-302A	350	655	6.57	427	47 0	47.0	0.06	115	313
P-304A	274	565	6.38	291	45 4	45.4	0 33	223	243
P-306A	271	551	6.55	317	47.6	47 6	0.66	226	238
Averages	300	602	6 65	350	38 9	40.8	1 38	185	268
Std Deviation	37	55	0.23	54	15.0	15 7	1 49	59	50
Coeff. of Variance	0.1	0.1	0 0	0.2	0 4	0 4	1.1	0.3	0.2
LOWER SAND									
P-221 B	413	827	6 70		112.0	55.0	67.30	393	193
P-222 B	234	486	7.80		64.0	53.0	7.50	266	200
P-228 B	401	799	6 90		95.0	76.0	14.10	349	223
P-307B	363	725	5 77	438	80 8	52 2	18 50	280	340
P-311B				307	35.2	49 2	1 26	100	250
P-001 B	443	881	8.25		94 0	62 0	37 10	269	200
P-002 B	345	690	7.34		87 0	83 0	46 20	322	250
Averages	367	735	7.13	373	81 1	61 5	27 42	283	237
Std Deviation	67	128	0.80	66	23 1	12 1	21 96	86	48
Coeff of Variance	0.2	0.2	0.1	0.2	0.3	0.2	0.8	0 3	0.2
UPPER SAND									
P-221 C	453	905	6 70		84 0	72.0	130.40	355	208
P-223 B	394	771	7 70		87.0	78.0	10 20	392	350
P-228 C	368	732	6.50		147 0	63.0	242.40	515	240
P-301B	203	409	5.37		47.1	51 9	3 85	156	
P-302B	327	651	4 25	500	80 8	48.0	4 95	276	2700
P-303B	343	677	6 02	387	65 3	31 0	1 79	212	600
P-304B	390	783	6.61		41 3	96.4	253.00		1300
P-308B	459	948	5.92	570	81 7	93.4	7.15	352	1140
P-309B	412	829	5.44	500	70 3	115 0	0 43	220	310
Averages	372	745	6.06	489	78.3	72.1	72 69	310	856
Std Deviation	73	150	0.93	66	28 7	25.1	101.34	109	798
Coeff of Variance	0.2	0 2	0 2	0.1	0 4	0 3	1.4	0.4	0.9
MISC. SANDS									
P-222 C	213	422	7.41		70.0	44.0	132 00	206	190
P-224 B	306	619	7 58		83.0	64.0	85.00	276	230
P-225 B	256	511	7.22		85.0	41.0	101 00	286	240
P-227 B	340	664	7 91		111.0	78.0	40.80	308	310
P-306B	273	542	5.94	200	70.1	50 4	0 83	188	210
P-311C				703	64.1	42.6	15.50	496	290

SUMMARY OF CHEMICAL ANALYSIS BY SAMPLING EVENT
GUE -70 -14.10
Guernsey County , Ohio

Sampling date· January 03, 2000

	FIELD ANALYSIS				LABORATORY ANALYSIS				
	TDS (mg/l)	Conduct. umhos/cm	pH (SU)	Temp. (C)	Calcium (mg/l)	Sulfates (mg/l)	Iron (mg/l)	Hardness (mg/l)	Alkalinity (mg/l)
COAL ZONE WELLS									
NW of Grout Curtain									
P-225 A	262	524	7.02	13.6	49.5	52.3	3.5	175	240
P-226 A	684	1376	8.01	8.4	39.4	264.0	28.6	126	430
P-227 A	643	1298	8.08	6.4	50.0	267.0	2.3	142	410
Inside Grout Curtain									
P-1 A	311	623	8.02	11.3	52 0	43.0	0.7	182	220
P-2 A	616	1443	12.34	12.6	38.1	287.0	2.5	88	180
P-221 A	258	548	7.93	9 0	68 3	50.1	1.0	228	200
P-223 A	387	875	8 31	10.9	28.5	143.0	0.2	99	310
P-228 A	326	650	11.94	10.5	10.5	131.0	1.0	26	100
SE of Grout Curtain									
P-222 A	362	721	7.88	11.6	23.4	13.5	0 8	90	350
P-224 A	276	546	7.55	8.6	62.1	54.3	8.1	226	220
PW-1	256	516	7.49	8.7	70.1	42.4	11.6	232	280
LOWER SAND									
P-221 B	427	851	7.73	10 7	113.0	78.6	139.0	352	170
P-222 B	234	486	7.83	8.7	64.1	53.1	7.5	266	200
P-228 B	374	743	7.98	10.2	79.3	83 3	4.7	298	310
P-1B	443	881	8.25	13.7	93.7	62.4	37.1	269	200
P-2B	345	690	7 34	12.3	86.7	83.3	46 2	322	250
UPPER SAND									
P-221 C	480	961	7.52	11.2	81.6	92.0	139.0	308	200
P-223 B	394	771	7.69	10.3	87.0	77.9	10.2	392	350
P-224 B	306	619	7.58	7.3	82.8	64.0	85.4	276	230
P-228 C	394	770	7.21	10.4	117.0	81.9	182.0	338	220
MISC. SANDS									
P-222 C	213	422	7.41	8.8	70.1	43.9	132.0	206	190
P-225 B	256	511	7.22	14 1	84 8	41.2	101.0	286	240
P-227 B	340	664	7.91	7 3	111.0	77.9	40.8	308	310

SUMMARY OF CHEMICAL ANALYSIS BY SAMPLING EVENT
GUE -70 -14.10
Guernsey County , Ohio

Sampling date: January 25, 2000

	FIELD ANALYSIS				LABORATORY ANALYSIS				
	TDS (mg/l)	Conduct. umhos/cm	pH (SU)	Temp. (C)	Calcium (mg/l)	Sulfates (mg/l)	Iron (mg/l)	Hardness (mg/l)	Alkalinity (mg/l)
COAL ZONE WELLS									
NW of Grout Curtain									
P-225 A	248	494	5.75	7.7	52.5	45.6	4.16	172	200
P-226 A	627	1250	6.24	8 1	77 7	249	31	186	430
P-227 A	603	1215	6.95	8.1	84	244	2.14	162	415
Inside Grout Curtain									
P-1 A	280	558	6.52	11.9	83.8	28.7	0.54	196	235
P-221 A	251	508	6.15	9.9	75.7	42.7	1.24	188	240
P-228 A	314	630	9 68	10.7	36.2	118	0.72	34	110
SE of Grout Curtain									
P-222 A	347	697	6 56	9.1	40.7	5.72	0.56	88	365
P-224 A	298	591	6.26	8.6	3.8	59.5	3 7	222	230
PW-1	238	471	6 75	10.9	92.2	25.1	10 6	172	205
LOWER SAND									
P-221 B	405	815	5.81	9.0	100	50.4	14.2	388	200
P-228 B	388	768	6 04	8.0	92	65	10.2	356	180
UPPER SAND									
P-221 C	414	824	6.04	9.6	89	35.3	19.6	344	210
P-228 C	350	702	5.79	8.8	142	49	78.5	340	250

SUMMARY OF CHEMICAL ANALYSIS BY SAMPLING EVENT
GUE -70 -14.10
Guernsey County , Ohio

Sampling date: February 16, 2000

	FIELD ANALYSIS				LABORATORY ANALYSIS				
	TDS (mg/l)	Conduct. umhos/cm	pH (SU)	Temp. (C)	Calcium (mg/l)	Sulfates (mg/l)	Iron (mg/l)	Hardness (mg/l)	Alkalinity (mg/l)
COAL ZONE WELLS									
NW of Grout Curtain									
P-225 A	236	478	6.30	11 1	83.2	40.2	2.1	184	200
P-226 A	653	1317	6 72	15.8	78.0	277	2.4	144	430
P-227 A	598	1195	6 70	15.7	91.3	248	3.4	180	410
Inside Grout Curtain									
P-1 A	328	655	6.72	12.8	78 5	26.8	0.38	200	230
P-221 A	262	519	6 34	11.7	99 4	41 3	0.68	240	210
P-228 A	313	626	9 77	12.8	16.7	111	1.3	44	110
SE of Grout Curtain									
P-222 A	345	692	7.14	10.7	13.2	4.89	0.64	96	300
P-224 A	299	599	6.61	12.0	55.0	65.5	2.2	240	230
PW-1	248	515	6 33	12.5	94.0	39 1	0.63	260	230
LOWER SAND									
P-221 B	405	811	6.51	11 9	164.0	48.3	71.1	440	200
P-228 B	405	816	6.52	12 2	137.0	85.3	7 4	344	210
UPPER SAND									
P-221 C	455	909	6.40	11.4	101.0	105	274	408	210
P-228 C	356	714	6.29	11 3	219.0	79.9	389	520	250

GUE -70 -14.10
Guernsey County , Ohio

Sampling date March 06, 2000

	FIELD ANALYSIS					LABORATORY ANALYSIS			
	TDS (mg/l)	Conduct umhos/cm	pH (SU)	Temp (C)	Calcium (mg/l)	Sulfates (mg/l)	Iron (mg/l)	Hardness (mg/l)	Alkalinity (mg/l)
COAL ZONE WELLS									
NW of Grout Curtain									
P-225 A	243	477	6 58	16.9	31.9	38 8	2 2	168	210
P-226 A	677	1347	6 93	17.2	20 7	227	1.2	132	450
P-227 A	585	1179	7 14	16 1	32 2	209	1.6	160	430
Inside Grout Curtain									
P-1 A	336	672	7 16	15 9	24 2	28 8	0 6	176	240
P-221 A	272	545	7 14	17 6	61 4	43 6	0 9	224	230
P-228 A	333	663	10 22	16 8	11 6	110	1 6	24	110
SE of Grout Curtain									
P-222 A	340	677	7 22	12 9	13 7	3 9	0.6	84	350
P-224 A	294	599	6 76	10 1	38 4	23 3	1.8	208	210
PW-1	268	537	6 78	12.3	55 2	43 2	1.0	236	220
LOWER SAND									
P-221 B	416	832	6 73	17 1	72 1	43 4	45.0	392	200
P-228 B	435	867	7 00	17 1	71.4	72.1	34.0	396	190
UPPER SAND									
P-221 C	463	924	6 72	17 8	64.0	55 1	116 0	360	210
P-228 C	372	743	6 86	17 2	111 0	42.1	320.0	860	240

SUMMARY OF CHEMICAL ANALYSIS BY SAMPLING EVENT
GUE -70 -14.10
Guernsey County , Ohio

Sampling Date May 21, 2001

WELLS	FIELD ANALYSIS			LABORATORY ANALYSIS					
COAL ZONE WELLS	pH	Conduct.	TDS	Diss Solid	Calcium	Sulfates	Iron	Hardness	Alkalinity
NW of Grout Curtain	(SU)	umhos/cm	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
P-226 A	6 27	1315	661	820	49.6	246 0	0.300	108	535
P-227 A	6 29	1190	605	800	66 6	207 0	0 784	146	465
P-301A	6 19	646	329	212	38 9	1 0	0 610	192	350
P-303A	7.22	737	366	507	18 8	33 5	0 060	56	360
P-305A	6.37	752	374	462	73 0	134 0	0.258	178	225
Inside Grout Curtain									
P-309A	6 03	973	486	673	114 0	181 0	0 897	238	430
SE of Grout Curtain									
P-222 A	6.45	716	357	384	31 9	7.3	0 159	80	390
PW-1	5.20	603	302	413	110.0	69 9	0 915	228	225
P-302A	5.71	706	350	453	50.5	52.3	0.058	116	300
P-304A	5 45	552	274	290	102 0	55 9	0 346	222	240
P-306A	5 79	543	271	194	102.0	54 2	0 697	224	220

SUMMARY OF CHEMICAL ANALYSIS BY SAMPLING EVENT
GUE -70 -14.10
Guernsey County , Ohio

Sampling Date June 25, 2001

WELLS	FIELD ANALYSIS			LABORATORY ANALYSIS					
COAL ZONE WELLS	pH	Conduct.	TDS	Diss. Solid	Calcium	Sulfates	Iron	Hardness	Alkalinity
NW of Grout Curtain	(SU)	umhos/cm	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
P-226 A	6 32	1276	636	806	38.1	137 0	1 090	108	210
P-227 A	6.26	1160	580	819	46.9	161.0	1 040	128	470
P-301A	6 44	659	331	490	32 1	1 7	0.718	84	360
P-303A	7.31	749	374	471	16.7	26.1	0.322	60	390
P-305A	5.89	627	315	438	64.7	53.8	1.930	174	250
Inside Grout Curtain									
P-307A	8 00	741	368	488	21 9	40 2	0.19	44	330
P-308A	6 25	545	273	417	60 2	36 8	0 87	176	250
P-309A	6 20	1327	660	767	72 4	177 0	0 826	220	380
P-310A	6 19	1020	510	748	57 4	132.0	3.690	142	330
SE of Grout Curtain									
P-222 A	6 56	677	340	506	29.6	8.0	0 524	72	360
PW-1	5 67	616	306	372	75 3	45 7	1 410	216	230
P-302A	5.72	701	350	426	39 8	33 7	0.098	100	320
P-304A	5.66	551	274	297	70.3	39.8	0.747	220	200
P-306A	6.31	569	285	303	69.2	38.7	0.861	244	230
LOWER SAND									
P-307B	5.77	725	363	438	80.8	52.2	18.50	280	340
UPPER SAND									
P-301B	5 37	409	203		47.1	51.9	3.85	156	
P-302B	4.25	651	327	500	80 8	48 0	4 95	276	2700
P-303B	6.02	677	343	387	65 3	31 0	1 79	212	600
P-304B	6 61	783	390		41.3	96.4	253 00		1300
P-309B	5 44	829	412	500	70.3	115.0	0.43	220	310
MISC. SANDS									
P-306B	5.94	542	273	200	70.1	50.4	0.83	188	210

SUMMARY OF CHEMICAL ANALYSIS BY SAMPLING EVENT
GUE -70 -14.10
Guernsey County , Ohio

Sampling Date July 25, 2001

WELLS	FIELD ANALYSIS			LABORATORY ANALYSIS					
COAL ZONE WELLS	pH	Conduct	TDS	Diss. Solid	Calcium	Sulfates	Iron	Hardness	Alkalinity
NW of Grout Curtain	(SU)	umhos/cm	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
P-226 A	7 09	1456	729	784	38 8	220 70	0 463	68	430
P-227 A	6 85	1266	638	781	58 0	242 00	0.806	1000	405
P-301A	7 11	718	359	238	31 1	1 97	0.218	132	310
P-303A	8 02	723	365	416	10 2	25.09	0.050	40	350
P-305A	6.86	671	537	281	90 3	88 30	0.370	188	210
SE of Grout Curtain									
P-222 A	7 26	766	386	325	27 7	1.80	0 050	104	310
PW-1	6 49	595	300	263	119.2	70 25	0 827	228	195
P-302A	6 79	736	368	313	42 4	50.48	0.098	112	260
P-304A	6 60	606	302	275	102 7	57 10	0 532	216	220
P-306A	6 72	584	290	263	93 0	53 16	0 581	204	200

SUMMARY OF CHEMICAL ANALYSIS BY SAMPLING EVENT
GUE -70 -14.10
Guernsey County , Ohio

Sampling Date August 20, 2001

WELLS	FIELD ANALYSIS			LABORATORY ANALYSIS					
COAL ZONE WELLS	pH	Conduct	TDS	Diss. Solid	Calcium	Sulfates	Iron	Hardness	Alkalinity
NW of Grout Curtain	(SU)	umhos/cm	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
P-226 A	6 46	1330	662	897	50 2	256.0	0 426	124	480
P-227 A	6.30	1191	595	877	71 0	245.0	0 151	136	450
P-301A	6 55	560	278	420	40 1	16 1	0 241	120	350
P-303A	7 89	768	387	610	14 6	41 4	0 050	56	380
P-305A	6.24	672	334	483	105 1	88 8	1.330	244	270
SE of Grout Curtain									
P-222 A	7.01	681	339	533	39.2	4.73	0 226	88	360
PW-1	7.08	699	347	407	120.6	53 1	0 667	260	220
P-302A	6 68	647	324	560	54 1	54 3	0 050	116	300
P-304A	6.45	575	286	407	111 1	36 5	0 356	224	260
P-306A	6.47	524	261	480	124.5	47 0	0 541	220	240

SUMMARY OF CHEMICAL ANALYSIS BY SAMPLING EVENT
GUE -70 -14.10
Guernsey County , Ohio

Sampling Date. September 25, 2001

WELLS	FIELD ANALYSIS			LABORATORY ANALYSIS					
COAL ZONE WELLS	pH	Conduct	TDS	Diss Solid	Calcium	Sulfates	Iron	Hardness	Alkalinity
NW of Grout Curtain	(SU)	umhos/cm	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
P-226 A	7 04	1430	900	837	37 6	227 0	0 214	114	540
P-227 A	7 07	1220	800	927	44 9	205 0	0 058	138	485
P-301A	7.79	460	470	527	29 2	5 6	0 353	520	390
P-303A	8.75	570	440	747	29 2	34 5	0 050	46	910
P-305A	7.19	470	330	497	19 7	104.0	1 481	238	285
SE of Grout Curtain									
P-222 A	7 59	692	440	447	27.3	3.74	0 050	106	380
PW-1	7 10	510	330	380	85.7	54 0	0.532	234	245
P-302A	7 35	460	460	427	37 4	39.2	0 050	128	330
P-304A	7 23	569	370	350	74 4	49 5	0 121	234	250
P-306A	7.19	510	330	373	74 4	46 2	0.674	230	250

SUMMARY OF CHEMICAL ANALYSIS BY SAMPLING EVENT
GUE -70 -14.10
Guernsey County , Ohio

Sampling Date October 21, 2001

WELLS	FIELD ANALYSIS			LABORATORY ANALYSIS					
COAL ZONE WELLS NW of Grout Curtain	pH (SU)	Conduct. umhos/cm	TDS (mg/l)	Diss. Solid (mg/l)	Calcium (mg/l)	Sulfates (mg/l)	Iron (mg/l)	Hardness (mg/l)	Alkalinity (mg/l)
P-226 A	7.02	1276	637	743	36.2	272.0	0.050	104	540
P-227 A	6.91	1115	557	640	47.0	222.0	1.090	152	470
P-301A	7.29	711	355	10	30.5	6.18	0.189	96	385
P-303A	8.26	795	397	10	10.7	30.0	0.050	48	425
P-305A	6.77	654	667	403	72.2	110.0	1.337	224	270
SE of Grout Curtain									
P-222 A	7.14	670	336	423	30.0	2.68	0.050	116	375
PW-1	6.55	542	272	60	78.0	52.0	0.259	232	250
P-302A	6.97	682	377	383	36.6	48.0	0.050	116	325
P-304A	6.87	537	268	127	75.9	54.2	0.050	216	250
P-306A	6.79	574	288	10	72.9	52.6	0.630	220	250

SUMMARY OF CHEMICAL ANALYSIS BY SAMPLING EVENT
GUE -70 -14.10
Guernsey County , Ohio

Sampling Date: May 25, 2002

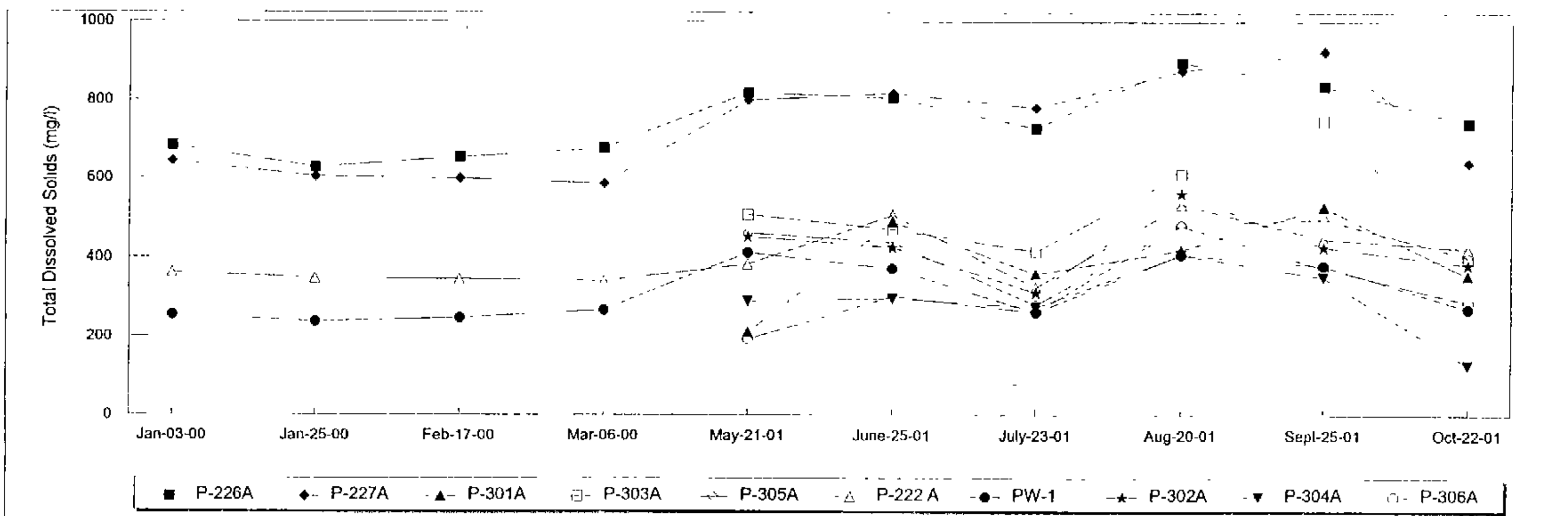
WELLS		FIELD ANALYSIS			LABORATORY ANALYSIS					
		pH (SU)	Conduct. umhos/cm	TDS (mg/l)	Diss Solid (mg/l)	Calcium (mg/l)	Sulfates (mg/l)	Iron (mg/l)	Hardness (mg/l)	Alkalinity (mg/l)
LOWER SAND										
	P-311B				703	64 1	42 6	15.500	496	290
MISC. SAND										
	P-311C				307	35 2	49 2	1 260	100	250

Summary of Chemical Analysis by Parameter
GUE-70 -14.10

Total Dissolved Solids (mg/l)

COAL ZONE WELLS		Jan-03-00	Jan-25-00	Feb-17-00	Mar-06-00	May-21-01	June-25-01	July-23-01	Aug-20-01	Sept-25-01	Oct-22-01	Average
		Sample Date										
Downgradient Wells	P-226A	684	627	653	677	820	806	729	897	837	743	747
	P-227A	643	603	598	585	800	819	781	877	927	640	727
	P-301A					212	490	359	420	527	355	394
	P-303A					507	471	416	610	747	397	525
	P-305A					462	438	281	483	497	403	427
Upgradient Wells	P-222 A	362	347	345	340	384	506	325	533	447	423	401
	PW-1	256	238	248	268	413	372	263	407	380	272	312
	P-302A					453	426	313	560	427	383	427
	P-304A					290	297	275	407	350	127	291
	P-306A					194	303	263	480	373	288	317
Inside Grout Curtain	P-1 A	311	280	328	336							314
	P-2 A	616										616
	P-221 A	258	251	262	272							261
	P-223 A	387										387
	P-228 A	326	314	313	333							322
	P-307A						488					488
	P-308A						417					417
	P-309A					673	767					720
	P-310A						748					748

Note: Results prior to 2001 are field measurements; Results after 2000 are laboratory measurents



Summary of Chemical Analysis by Parameter
GUE-70 -14.10

Total Dissolved Solids (mg/l)

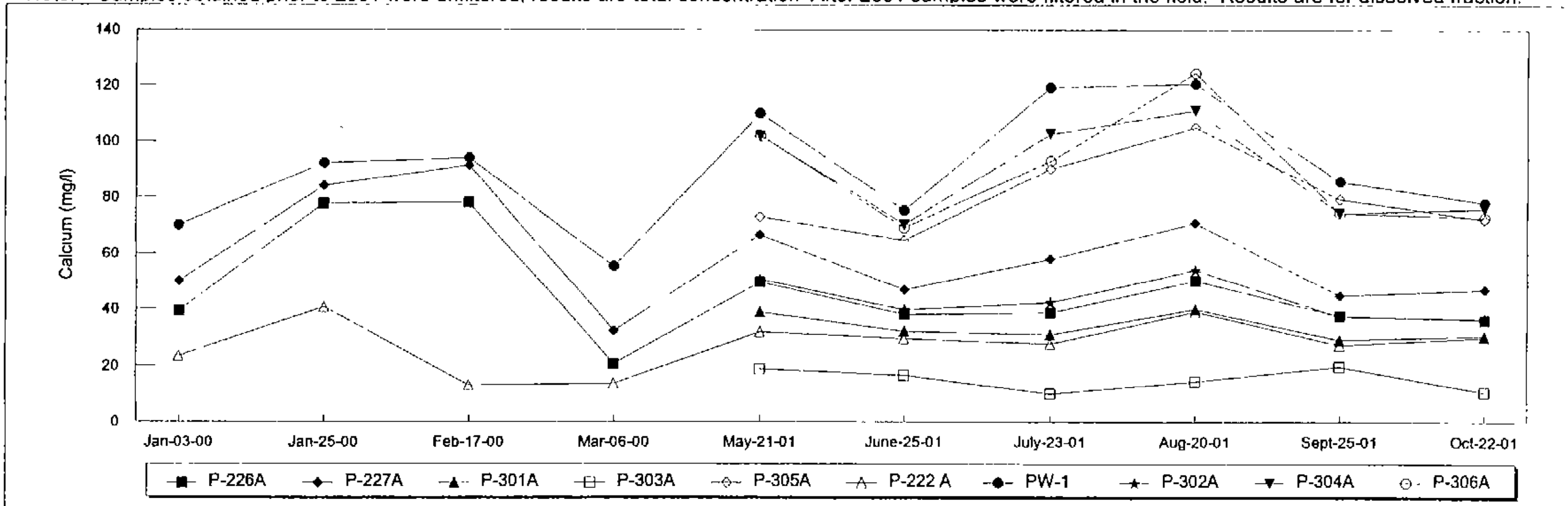
GRANULAR ZONE WELLS		Sample Date: Jan-03-00	Jan-25-00	Feb-17-00	Mar-06-00	May-21-01	June-25-01	July-23-01	Aug-20-01	Sept-25-01	Oct-22-01	Average
Lower Sand	P-221 B	427	405	405	416							413
	P-222 B	234										234
	P-228 B	374	388	405	435							401
	P-307 B						438					438
	P-311 B											
	P-1 B	443										443
	P-2 B	345										345
Upper Sand	P-221 C	480	414	455	463							453
	P-223 B	394										394
	P-228 C	394	350	356	372							368
	P-301 B						203					203
	P-302 B						500					500
	P-303 B						387					387
	P-304 B						390					390
	P-308 B						570					570
	P-309 B						500					500
Misc. Sand	P-222 C	213										213
	P-224 B	306										306
	P-225 B	256										256
	P-227 B	340										340
	P-306 B						200					200
	P-311 C											

Summary of Chemical Analysis by Parameter
GUE-70 -14.10

Calcium (mg/l)

		Sample Date										
COAL ZONE WELLS		Jan-03-00	Jan-25-00	Feb-17-00	Mar-06-00	May-21-01	June-25-01	July-23-01	Aug-20-01	Sept-25-01	Oct-22-01	Average
Downgradient Wells	P-226A	39.4	77.7	78.0	20.7	49.6	38 1	38.8	50 2	37 6	36.2	41.8
	P-227A	50.0	84.0	91.3	32.2	66.6	46.9	58.0	71.0	44.9	47.0	55.7
	P-301A					38.9	32.1	31.1	40 1	29.2	30.5	33.7
	P-303A					18.8	16.7	10.2	14.6	19.7	10.7	15.1
	P-305A					73.0	64.7	90.3	105.1	79.4	72.2	80.8
Upgradient Wells	P-222 A	23.4	40.7	13.2	13.7	31.9	29.6	27.7	39.2	27.3	30.0	27.7
	PW-1	70.1	92.2	94.0	55.2	110.0	75.3	119.2	120.6	85.7	78.0	90.0
	P-302A					50.5	39.8	42.4	54.1	37.4	36.6	43.5
	P-304A					102.0	70.3	102.7	111.1	74.4	75.9	89.4
	P-306A					102 0	69.2	93.0	124.5	74.4	72.9	89.3
Inside Grout Curtain	P-1 A	52	83.8	78.5	24.2							n/a
	P-2 A	38.1										n/a
	P-221 A	68.3	75.7	99.4	61.4							n/a
	P-223 A	28.5										n/a
	P-228 A	10.5	36.2	16.7	11.6							n/a
	P-307A						21 9					21 9
	P-308A						60.2					60 2
	P-309A					114 0	72.4					93.2
	P-310A						57.4					57.4

Note: Samples obtained prior to 2001 were unfiltered; results are total concentration After 2001 samples were filtered in the field. Results are for dissolved fraction.



Summary of Chemical Analysis by Parameter
GUE-70 -14.10

Calcium (mg/l)

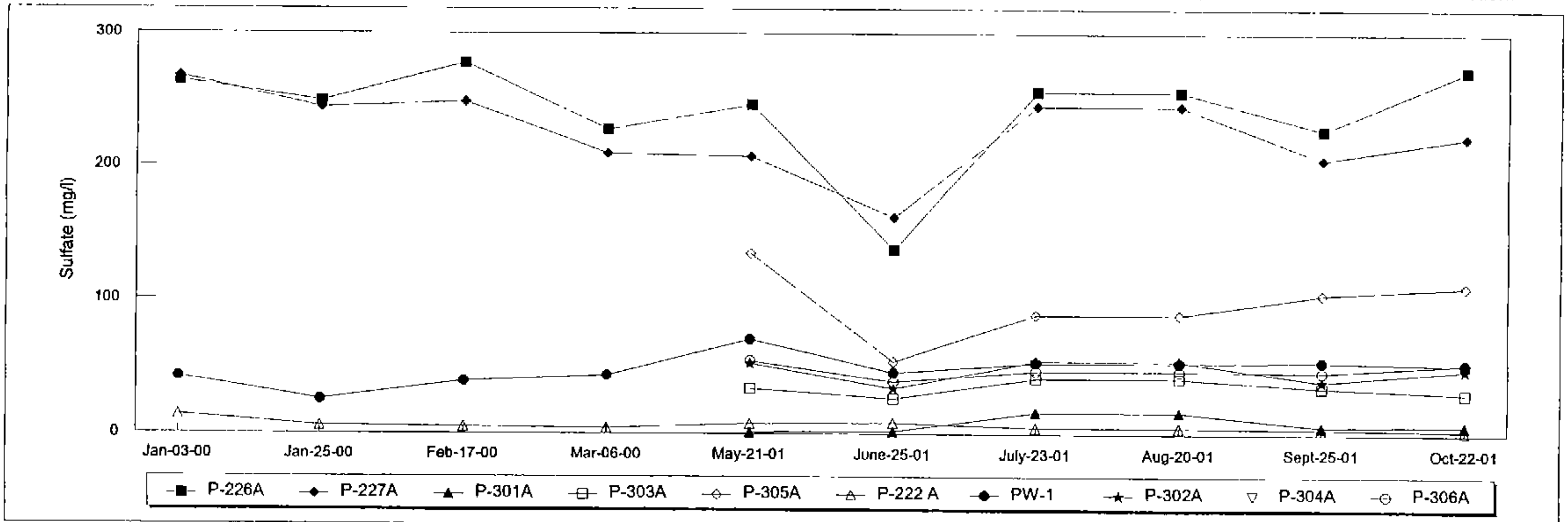
GRANULAR ZONE WELLS		Sample Date: Jan-03-00	Jan-25-00	Feb-17-00	Mar-06-00	May-21-01	June-25-01	July-23-01	Aug-20-01	Sept-25-01	Oct-22-01	Average
Lower Sand	P-221 B	113 0	100.0	164.0	72 1							112.3
	P-222 B	64.1										64.1
	P-228 B	79.3	92.0	137.0	71.4							94.9
	P-307 B						80.8					80.8
	P-311 B											
	P-1 B	93.7										93.7
	P-2 B	86.7										86.7
Upper Sand	P-221 C	81.6	89.0	101.0	64.0							83.9
	P-223 B	87.0										87.0
	P-228 C	117.0	142.0	219.0	111.0							147.3
	P-301 B						47 1					47.1
	P-302 B						80.8					80.8
	P-303 B						65 3					65.3
	P-304 B						41.3					41.3
	P-308 B						81.7					81.7
	P-309 B						70.3					70.3
Misc. Sand	P-222 C	70.1										70.1
	P-224 B	82 8										82.8
	P-225 B	84.8										84.8
	P-227 B	111.0										111.0
	P-306 B						70 1					70.1
	P-311 C											

Summary of Chemical Analysis by Parameter
GUE-70 -14.10

Sulfate(mg/l)

COAL ZONE WELLS		Jan-03-00	Jan-25-00	Feb-17-00	Mar-06-00	May-21-01	June-25-01	July-23-01	Aug-20-01	Sept-25-01	Oct-22-01	Average
		Sample Date										
Downgradient Wells	P-226A	264.0	249.0	277.0	227.0	246.0	137.0	256.0	256.0	227.0	272.0	232 3
	P-227A	267.0	244.0	248.0	209.0	207.0	161.0	245.0	245.0	205.0	222.0	214.2
	P-301A					1.0	1.7	16.1	16.1	5.6	6.2	7.8
	P-303A					33.5	26.1	41.4	41.4	34.5	30.0	34.5
	P-305A					134.0	53.8	88.8	88.8	104.0	110.0	96.6
Upgradient Wells	P-222 A	13 5	5.7	4.9	3.9	7.3	8.0	4.73	4 73	3 74	2 68	5.9
	PW-1	42.4	25.1	39.1	43.2	69.9	45.7	53.1	53.1	54.0	52.0	47.8
	P-302A					52.3	33.7	54.3	54.3	39.2	48.0	47.0
	P-304A					55.9	39.8	36.5	36.5	49.5	54.2	45.4
	P-306A					54.2	38.7	47.0	47.0	46.2	52.6	47.6
Inside Grout Curtain	P-1 A	43 0	28.7	26.8	28.8							n/a
	P-2 A	287.0										n/a
	P-221 A	50.1	42.7	41.3	43.6							n/a
	P-223 A	143.0										n/a
	P-228 A	131.0	118.0	111.0	110.0							n/a
	P-307A						40 2					40.2
	P-308A						36.8					36 8
	P-309A					181.0	177.0					179.0
	P-310A						132.0					132.0

Note: Samples obtained prior to 2001 were unfiltered; results are total concentration. After 2001 samples were filtered in the field; Results are for dissolved fraction.



Summary of Chemical Analysis by Parameter
GUE-70 -14.10

Sulfate(mg/l)

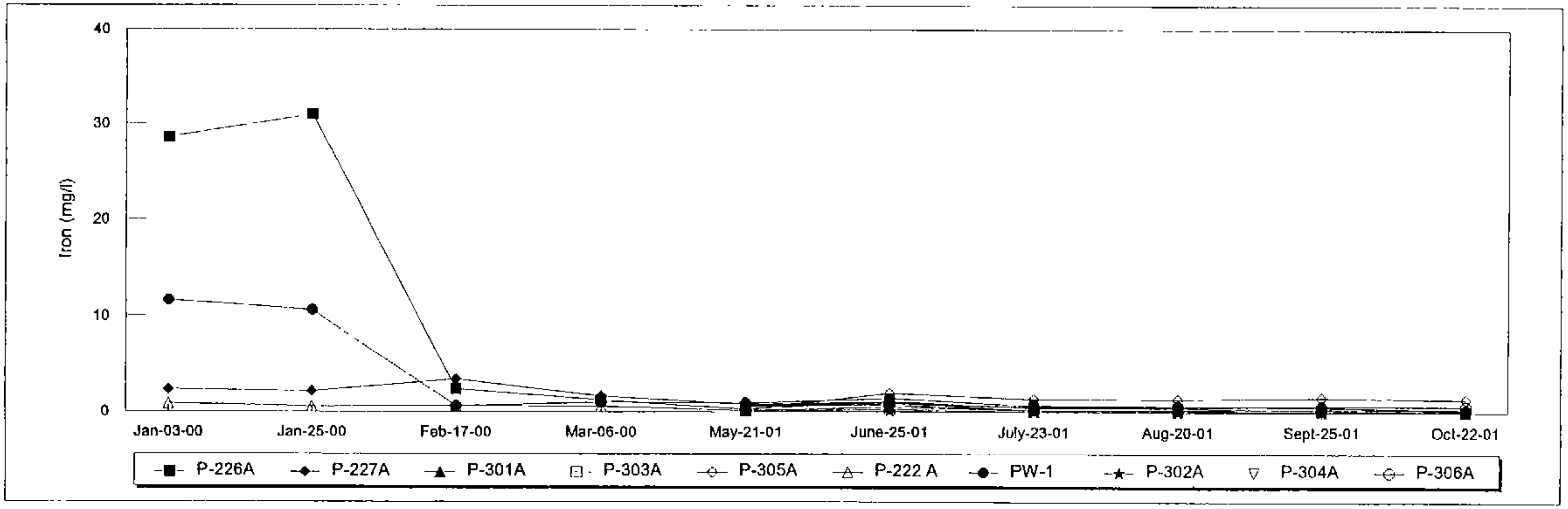
GRANULAR ZONE WELLS		Jan-03-00	Jan-25-00	Feb-17-00	Mar-06-00	May-21-01	June-25-01	July-23-01	Aug-20-01	Sept-25-01	Oct-22-01	Average
Lower Sand	P-221 B	78.6	50.4	48.3	43.4							55.2
	P-222 B	53.1										53.1
	P-228 B	83.3	65.0	85.3	72 1							76.4
	P-307 B						52.2					52 2
	P-311 B											
	P-1 B	62.4										62.4
	P-2 B	83.3										83.3
Upper Sand	P-221 C	92.0	35.3	105.0	55.1							71.9
	P-223 B	77.9										77.9
	P-228 C	81.9	49.0	79.9	42.1							63.2
	P-301 B						51.9					51.9
	P-302 B						48.0					48.0
	P-303 B						31.0					31.0
	P-304 B						96.4					96.4
	P-308 B						93.4					93.4
	P-309 B						115.0					115.0
Misc. Sand	P-222 C	43.9										43.9
	P-224 B	64.0										64.0
	P-225 B	41.2										41.2
	P-227 B	77.9										77.9
	P-306 B						50.4					50.4
	P-311 C											

Summary of Chemical Analysis by Parameter
GUE-70 -14.10

Iron (mg/l)

COAL ZONE WELLS		Jan-03-00	Jan-25-00	Feb-17-00	Mar-06-00	May-21-01	June-25-01	July-23-01	Aug-20-01	Sept-25-01	Oct-22-01	Average
		Sample Date										
Downgradient Wells	P-226A	28.60	31.00	2.40	1.20	0.30	1.09	0.43	0.43	0 21	0 05	0.42
	P-227A	2.31	2.14	3.40	1.60	0.78	1.04	0.15	0.15	0.06	0.11	0.38
	P-301A					0.61	0.72	0.24	0.24	0.35	0.19	0.39
	P-303A					0.06	0.32	0.05	0.05	0.05	0.05	0.10
	P-305A					0.26	1.93	1.33	1.33	1.48	1.34	1.28
Upgradient Wells	P-222 A	0.83	0.56	0.64	0.57	0.16	0.52	0.23	0.23	0.05	0.05	0.38
	PW-1	11.60	10.60	0.63	1.00	0.92	1.41	0 67	0.67	0.53	0.26	2.83
	P-302A					0.06	0.10	0.05	0.05	0.05	0.05	0.06
	P-304A					0.35	0.75	0.36	0.36	0.12	0.05	0.33
	P-306A					0.70	0.86	0.54	0.54	0.67	0.63	0.66
Inside Grout Curtain	P-1 A	0.65	0.54	0.38	0.58							n/a
	P-2 A	2.50										n/a
	P-221 A	0.96	1.24	0.68	0 91							n/a
	P-223 A	0.25										n/a
	P-228 A	0.97	0.72	1.30	1.60							n/a
	P-307A						0.19					0.19
	P-308A						0.87					0 87
	P-309A					0.90	0.83					0.86
	P-310A						3 69					3.69

Note: Samples obtained prior to 2001 were unfiltered, results are total concentration. After 2001 samples were filtered in the field; Results are for dissolved fraction



Summary of Chemical Analysis by Parameter
GUE-70 -14.10

Iron (mg/l)

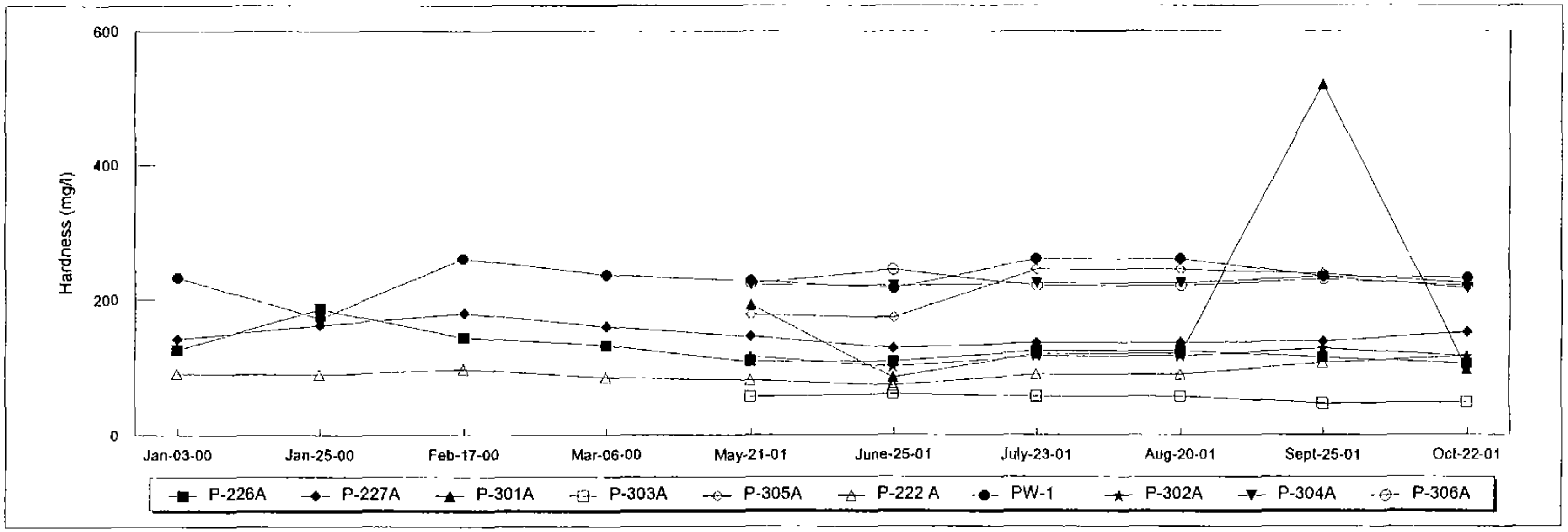
GRANULAR ZONE WELLS		Sample Date										Average
		Jan-03-00	Jan-25-00	Feb-17-00	Mar-06-00	May-21-01	June-25-01	July-23-01	Aug-20-01	Sept-25-01	Oct-22-01	
Lower Sand	P-221 B	139.0	14.2	71.1	45.0							67.3
	P-222 B	7.5										7.5
	P-228 B	4.7	10.2	7.4	34.0							14.1
	P-307 B						18.5					18.5
	P-311 B											
	P-1 B	37.1										37.1
	P-2 B	46.2										46.2
Upper Sand	P-221 C	139.0	19.6	247.0	116.0							130.4
	P-223 B	10.2										10.2
	P-228 C	182.0	78.5	389.0	320.0							242.4
	P-301 B						3.9					3.9
	P-302 B						4.9					4.9
	P-303 B						1.8					1.8
	P-304 B						253.0					
	P-308 B						7.2					7.2
	P-309 B						0.4					0.4
Misc. Sand	P-222 C	132.0										132.0
	P-224 B	85.4										85.4
	P-225 B	101.0										101.0
	P-227 B	40.8										40.8
	P-306 B						0.8					0.8
	P-311 C											

Summary of Chemical Analysis by Parameter
GUE-70 -14.10

Hardness(mg/l)

COAL ZONE WELLS		Jan-03-00	Jan-25-00	Feb-17-00	Mar-06-00	May-21-01	June-25-01	July-23-01	Aug-20-01	Sept-25-01	Oct-22-01	Average
Downgradient Wells	P-226A	126	186	144	132	108	108	124	124	114	104	127
	P-227A	142	162	180	160	146	128	136	136	138	152	148
	P-301A					192	84	120	120	520	96	189
	P-303A					56	60	56	56	46	48	54
	P-305A					178	174	244	244	238	224	217
Upgradient Wells	P-222 A	90	88	96	84	80	72	88	88	106	116	91
	PW-1	232	172	260	236	228	216	260	260	234	232	233
	P-302A					116	100	116	116	128	116	115
	P-304A					222	220	224	224	234	216	223
	P-306A					224	244	220	220	230	220	226
Inside Grout Curtain	P-1 A	182	196	200	176							189
	P-2 A	88										88
	P-221 A	228	188	240	224							220
	P-223 A	99										99
	P-228 A	26	34	44	24							32
	P-307A						44					44
	P-308A						176					176
	P-309A					238	220					229
	P-310A						142					142

(The "Sample Date" header spans the ten date columns.)



Summary of Chemical Analysis by Parameter
GUE-70 -14.10

Hardness(mg/l)

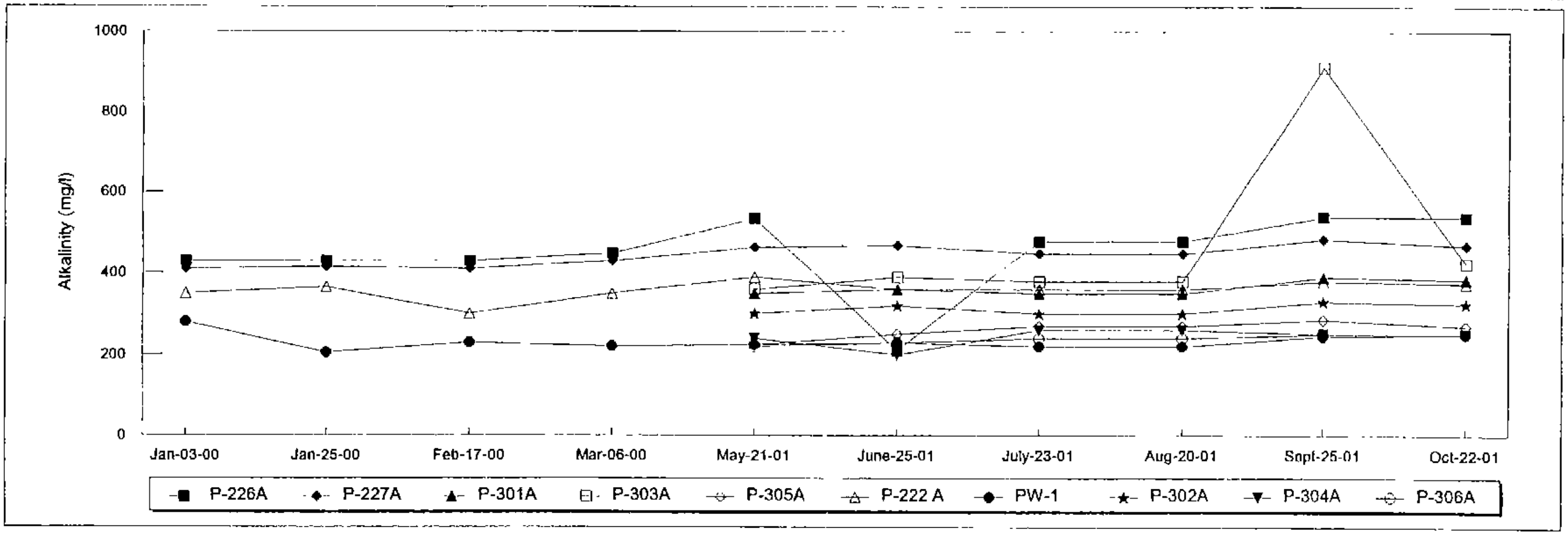
GRANULAR ZONE WELLS		Sample Date Jan-03-00	Jan-25-00	Feb-17-00	Mar-06-00	May-21-01	June-25-01	July-23-01	Aug-20-01	Sept-25-01	Oct-22-01	Average
Lower Sand	P-221 B	352	388	440	392							393
	P-222 B	266										266
	P-228 B	298	356	344	396							349
	P-307 B						280					280
	P-311 B											
	P-1 B	269										269
	P-2 B	322										322
Upper Sand	P-221 C	308	344	408	360							355
	P-223 B	392										392
	P-228 C	338	340	520	860							515
	P-301 B						156					156
	P-302 B						276					276
	P-303 B						212					212
	P-304 B											
	P-308 B						352					352
	P-309 B						220					220
Misc. Sand	P-222 C	206										206
	P-224 B	276										276
	P-225 B	286										286
	P-227 B	308										308
	P-306 B						188					188
	P-311 C											

Summary of Chemical Analysis by Parameter
GUE-70 -14.10

Alkalinity (mg/l)

COAL ZONE WELLS		Jan-03-00	Jan-25-00	Feb-17-00	Mar-06-00	May-21-01	June-25-01	July-23-01	Aug-20-01	Sept-25-01	Oct-22-01	Average
Downgradient Wells	P-226A	430	430	430	450	535	210	480	480	540	540	453
	P-227A	410	415	410	430	465	470	450	450	485	470	446
	P-301A					350	360	350	350	390	385	364
	P-303A					360	390	380	380	910	425	474
	P-305A					225	250	270	270	285	270	262
Upgradient Wells	P-222 A	350	365	300	350	390	360	360	360	380	375	359
	PW-1	280	205	230	220	225	230	220	220	245	250	233
	P-302A					300	320	300	300	330	325	313
	P-304A					240	200	260	260	250	250	243
	P-306A					220	230	240	240	250	250	238
Inside Grout Curtain	P-1 A	220	235	230	240							231
	P-2 A	180										180
	P-221 A	200	240	210	230							220
	P-223 A	310										310
	P-228 A	100	110	110	110							108
	P-307A						330					330
	P-308A						250					250
	P-309A					430	380					405
	P-310A						330					330

(The date columns are headed "Sample Date".)



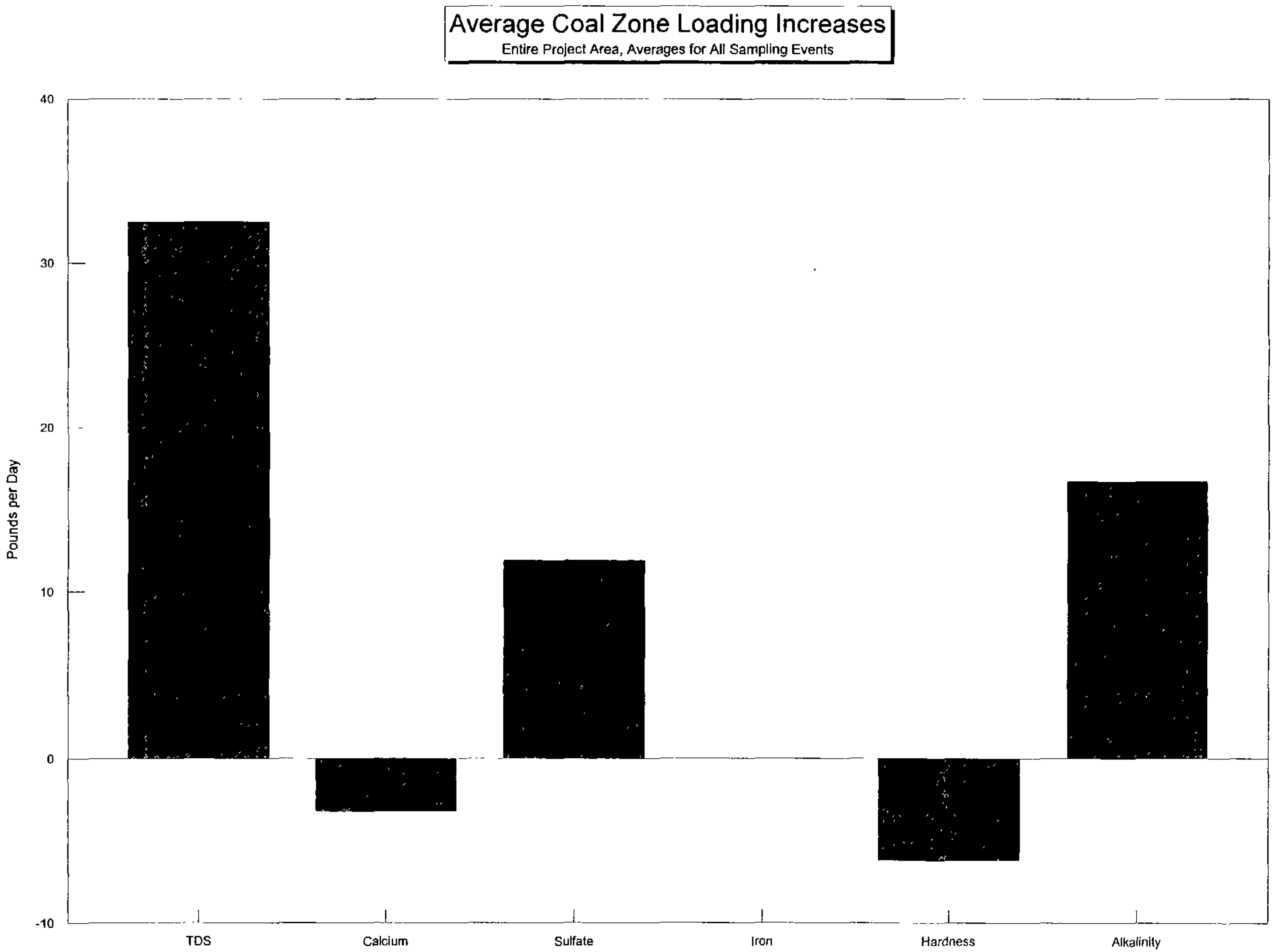
Summary of Chemical Analysis by Parameter
GUE-70 -14.10

Alkalinity (mg/l)

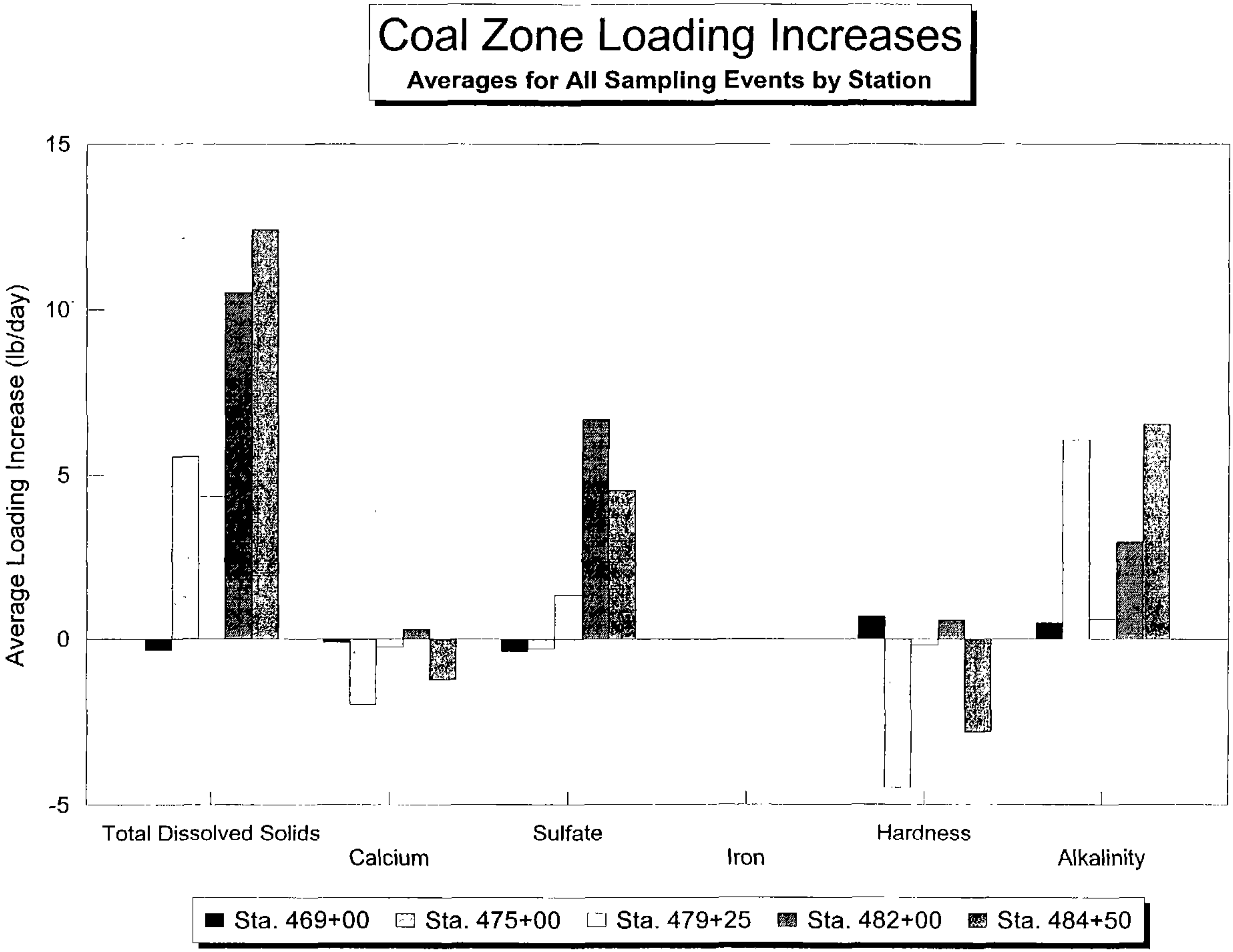
GRANULAR ZONE WELLS		Sample Date: Jan-03-00	Jan-25-00	Feb-17-00	Mar-06-00	May-21-01	June-25-01	July-23-01	Aug-20-01	Sept-25-01	Oct-22-01	Average
Lower Sand	P-221 B	170	200	200	200							193
	P-222 B	200										200
	P-228 B	310	180	210	190							223
	P-307 B						340					340
	P-311 B											
	P-1 B	200										200
	P-2 B	250										250
Upper Sand	P-221 C	200	210	210	210							208
	P-223 B	350										350
	P-228 C	220	250	250	240							240
	P-301 B											
	P-302 B						2700					2700
	P-303 B						600					600
	P-304 B						1300					1300
	P-308 B						1140					1140
	P-309 B						310					310
Misc. Sand	P-222 C	190										190
	P-224 B	230										230
	P-225 B	240										240
	P-227 B	310										310
	P-306 B						210					210
	P-311 C											

Summary of Coal Zone Groundwater Constituent Loading Increases from Up-Gradient to Down-Gradient Gue-70-14.10

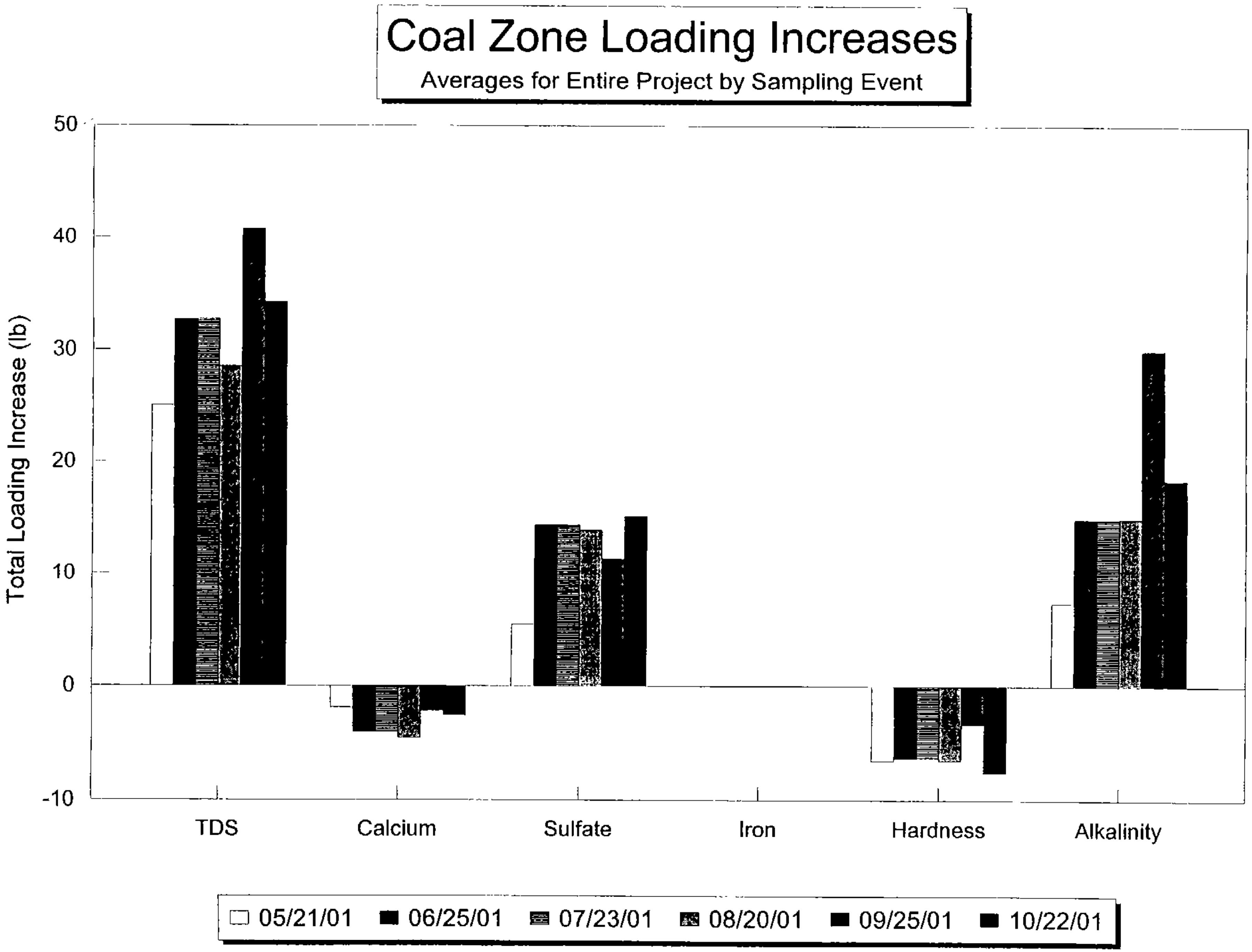
	TDS (lb/day)	Calcium (lb/day)	Sulfate (lb/day)	Iron (lb/day)	Hardness (lb/day)	Alkalinity (lb/day)
Project Section 469+00						
05/21/01	-2.2	-0.1	-0.5	0.005	0.7	0.5
06/25/01	0.6	-0.1	-0.3	0.006	-0.1	0.4
07/23/01	0.4	-0.1	-0.3	0.002	0.0	0.4
08/20/01	-1.5	-0.2	-0.4	0.002	0.0	0.5
09/25/01	1.0	-0.1	-0.3	0.003	3.8	0.6
10/22/01	-0.2	-0.1	-0.5	0.001	-0.2	0.6
Average	-0.3	-0.1	-0.4	0.003	0.7	0.5
Project Section 475+00						
05/21/01	6.0	-2.3	-0.6	-0.008	-4.6	3.3
06/25/01	4.1	-1.3	-0.3	-0.010	-3.8	4.5
07/23/01	3.4	-2.3	0.1	-0.007	-4.1	2.9
08/20/01	5.7	-2.7	0 1	-0.009	-4.7	3.4
09/25/01	10.4	-1.4	-0.4	-0.002	-4.9	17.4
10/22/01	3.6	-1.8	-0.7	0.000	-4.7	4.9
Average	5.6	-2.0	-0.3	-0.006	-4.5	6.1
Project Section 479+25						
05/21/01	7.5	-0.8	2.2	-0.012	-1.3	0.1
06/25/01	2.6	-0.1	0.3	0.021	-1.4	0.4
07/23/01	0.4	-0.1	0.9	0.018	0.5	0.7
08/20/01	0.1	-0.6	1.2	0.023	0.7	0.9
09/25/01	3.4	0.1	1.6	0.022	0.2	1.0
10/22/01	12.0	-0.0	1.8	0.022	0.1	0.6
Average	4.3	-0.2	1.4	0.016	-0.2	0.6
Project Section 482+00						
05/21/01	11.2	0.5	6.1	0.004	0.7	3.7
06/25/01	7.2	0.2	3.1	0.014	0.9	-3.6
07/23/01	12.3	0.3	7.6	0.006	1.1	3.7
08/20/01	10.7	0.3	7.4	0.006	1.1	3.5
09/25/01	10.9	0.3	6.3	0.005	0.2	4.5
10/22/01	10.8	0.2	9.7	0.000	-0.4	5.9
Average	10.5	0.3	6.7	0.006	0.6	3.0
Project Section 484+50						
05/21/01	11.2	-1.3	4.0	-0.004	-2.4	6.9
06/25/01	10.6	-0.7	2.7	-0.009	-2.1	5.7
07/23/01	16.2	-1.9	6.0	-0.016	-3.9	7.2
08/20/01	13.6	-1.4	5.6	-0.015	-3.6	6.7
09/25/01	14.9	-1.1	4.1	-0.013	-2.6	6.6
10/22/01	8.0	-0.9	4.8	-0.004	-2.3	6.2
Average	12.4	-1.2	4.5	-0.010	-2.8	6.5
Total Project Area						
05/21/01	33.8	-4.0	11.3	-0.015	-6.9	14.6
06/25/01	25.1	-1.9	5.5	0.021	-6.5	7.4
07/23/01	32.7	-4.0	14.4	0.002	-6.3	14.9
08/20/01	28.6	-4.5	13.9	0.008	-6.5	15.0
09/25/01	40.8	-2.2	11.3	0.015	-3.3	30.0
10/22/01	34.3	-2.6	15.1	0.020	-7.5	18.4
Average Total per day	32.5	-3.2	11.9	0.008	-6.2	16.7



Average Coal Zone Loading Increases
Entire Project Area, Averages for All Sampling Events
Pounds per Day
40
30
20
10
0
-10
TDS
Calcium
Sulfate
Iron
Hardness
Alkalinity



Coal Zone Loading Increases
Averages for All Sampling Events by Station
15
10
5
0
-5
Average Loading Increase (lb/day)
Total Dissolved Solids
Calcium
Sulfate
Iron
Hardness
Alkalinity
Sta. 469+00
Sta. 475+00
Sta. 479+25
Sta. 482+00
Sta. 484+50


Coal Zone Loading Increases
Averages for Entire Project by Sampling Event
Total Loading Increase (lb)
50
40
30
20
10
0
-10
TDS
Calcium
Sulfate
Iron
Hardness
Alkalinity
05/21/01
06/25/01
07/23/01
08/20/01
09/25/01
10/22/01

SECTION 9.3 - CALCULATIONS

- SPECIFIC CAPACITY CALCULATIONS

SPECIFIC CAPACITY (S.C. IN $\frac{GPM}{FT.}$) = WR/S

WHERE: WR = WITHDRAW RATE IN gpm
(MEASURED DURING WELL DEVELOP)

S = DRAWDOWN IN FT.
(INDUCED DURING DEVELOPMENT)

- UNIT CORRECTION

$GPM/FT = (GPM)\left(\frac{1}{FT}\right)$

NO CORRECTION NEEDED

SPECIFIC CAPACITY CALCULATIONS
GUE-70 -14.10

Well Number	Test Date	Static Level (feet)	Withdraw Rate (gpm)	Drawdown (feet)	Specific Capacity (gpm/ft)	Average Spec C. (gpm/ft)
P-221A	12/28/99	17.30	0.48	0.10	4.80	
P-221A	02/15/00	17.14	0.55	0.26	2.12	2.73
P-221A	03/06/00	17.34	0.58	0.46	1.26	
P-221B	12/28/99	17.40	0.45	0.10	4.50	
P-221B	02/16/00	16.64	0.56	0.16	3.50	4.57
P-221B	03/06/00	16.99	0.57	0.10	5.70	
P-221C	11/30/99	11.70	0.65	1.20	0.54	
P-221C	02/16/00	11.44	0.56	0.10	5.60	2.38
P-221C	03/06/00	11.00	0.69	0.70	0.99	
P-222A	01/04/00	11.00	0.45	13.40	0.03	
P-222A	02/15/00	10.81	0.48	14.49	0.03	0.03
P-222A	03/06/00	11.15	0.48	15.05	0.03	
P-222B	01/25/00	11.40	0.71	0.52	1.37	1.37
P-222C	01/25/00	4.78	0.79	1.30	0.61	0.61
P-223A	12/29/99	19.30	0.38	24.10	0.02	
P-223A	03/06/00	18.36	0.43	22.54	0.02	0.13
P-223B	12/29/99	11.20	0.53	1.50	0.35	
P-223B	03/06/00	10.53	0.63	2.67	0.24	0.24
P-224A	01/05/00	12.00	0.55	0.30	1.83	
P-224A	02/15/00	11.80	0.52	0.10	5.20	3.78
P-224A	03/06/00	12.18	0.43	0.10	4.30	
P-224B	01/05/00	8.90	0.69	3.20	0.22	0.22
P-225A	01/03/00	32.00	0.38	0.40	0.95	
P-225A	02/15/00	29.85	0.53	0.25	2.12	1.36
P-225A	03/06/00	30.62	0.48	0.48	1.00	
P-225B	01/03/00	2.90	0.53	2.70	0.20	0.20
P-226A	12/28/99	20.10	0.38	47.60	0.01	
P-226A	02/14/00	19.07	0.37	33.73	0.01	0.01
P-226A	03/06/00	19.11	0.33	34.39	0.01	
P-227A	12/28/99	23.50	0.35	27.90	0.01	
P-227A	02/14/00	22.59	0.34	41.31	0.01	0.01
P-227A	03/06/00	22.63	0.38	25.47	0.01	
P-227B	12/28/99	11.10	0.44	19.00	0.02	0.02
P-228A	12/29/99	19.90	0.48	2.30	0.21	
P-228A	02/15/00	18.87	0.48	4.23	0.11	0.18
P-228A	03/06/00	19.14	0.53	2.56	0.21	
P-228B	12/29/99	20.60	0.78	27.10	0.03	
P-228B	02/16/00	18.29	0.47	29.45	0.02	0.03
P-228B	03/06/00	18.64	0.54	13.10	0.04	
P-228C	12/29/99	13.50	0.45	0.70	0.64	
P-228C	02/16/00	13.00	0.48	1.40	0.34	0.46
P-228C	03/06/00	12.70	0.63	1.60	0.39	
P-001A	12/30/99	16.80	0.28	1.00	0.28	
P-001A	02/15/00	15.98	0.48	9.32	0.05	0.22
P-001A	03/06/00	16.32	0.56	1.68	0.33	
P-001B	12/29/99	16.90	0.29	0.20	1.45	1.45
P-002A	12/30/99	17.30	0.37	1.50	0.25	0.25
P-002B	12/30/99	17.30	0.44	0.20	2.20	2.20
PW-001	02/16/00	12.90	10.00	0.02	500	458
PW-001	03/06/00	12.97	8.33	0.02	417	

- PERMEABILITY ESTIMATE FROM SPECIFIC CAPACITY

PERMEABILITY $\left(K \text{ IN } \frac{GPD}{FT^2}\right) = T/d$

- WHERE: d = SATURATED THICKNESS OF AQUIFER IN FT. (FROM BORING LOGS)

T = TRANSMISSIVITY IN gPD/FT (FROM S.C. SEE BELOW)

- UNIT CORRECTION

$$GPD/FT^2 = \left(\frac{gPD}{FT}\right)\left(\frac{1}{FT}\right)$$

NO CORRECTION REQUIRED

- T IN $\frac{gPD}{FT} \approx (S.C.)(EFF)$

WHERE: SC = SPECIFIC CAPACITY IN $\frac{gpm}{FT.}$ (SEE SEPARATE CALCULATION)

EFF = WELL EFFICIENCY IN %
FOR ALL 2" WELLS ESTIMATE
EFF @ 60%.

FOR PW-1 ESTIMATE @ 100%.
(UNCASED RX WELL)

- UNIT CORRECTION

$$\frac{gPD}{FT} = \left(\frac{gpm}{FT}\right)(\%)\left(\frac{1440 \text{ MIN}}{DY}\right)$$

- K CONVERSION FROM $\frac{gPD}{FT^2}$ TO $\frac{cm}{SEC}$

$$\frac{cm}{SEC} = \left(\frac{GAL}{DY \cdot FT^2}\right)\left(\frac{FT^3}{7.48 \text{ GAL}}\right)\left(\frac{30.48 \text{ CM}}{FT}\right)\left(\frac{DY}{86400 \text{ SEC}}\right)$$

$$= \frac{gPD}{FT^2} \cdot (0.0000472)$$

Permeability Estimates based on Specific Capacity
GUE-70 -14.10

Well Number	Specific Capacity (gpm/ft)	Estimated Well Efficiency	T (gpd/ft)	Staurated Thickness (feet)	K (gpd/ft^2)	K (cm/sec)
COAL ZONE WELLS						
Inside Grout Curtain						
P-221A	2.73	80%	4,906	14.7	334	1.6E-02
P-223A	0.13	60%	311	3.4	91	4.3E-03
P-228A	0.18	60%	423	6.5	65	3.1E-03
P-001A	0.22	60%	532	6.5	82	3.9E-03
P-002A	0.25	60%	592	6.5	91	4.3E-03
				Average	**95**	**6.3E-03**
Outside Grout Curtain						
P-222A	0.03	60%	79	6.7	12	5.6E-04
P-224A	3.78	60%	9,067	4.1	2,211	1.0E-01
P-225A	1.36	80%	2,442	4.6	531	2.5E-02
P-226A	0.01	60%	23	11.4	2	9.4E-05
P-227A	0.01	60%	29	6.5	4	2.1E-04
PW-001	458	100%	659,880	6.5	101,520	4.8E+00
				Average	**8,753**	**8.2E-01**
LOWER SAND						
P-221B	4.57	60%	3,288	11.0	299	1.4E-02
P-222B	1.37	60%	3,297	7.5	440	2.1E-02
P-228B	0.03	60%	69	9.7	7	3.3E-04
P-001B	1.45	60%	3,480	9.4	370	1.7E-02
P-002B	2.20	60%	5,280	9.4	562	2.6E-02
				Average	**335**	**1.6E-02**
UPPER SAND						
P-221C	2.38	60%	5,702	4.0	1,425	6.7E-02
P-223B	1.37	60%	3,297	3.0	1,099	5.2E-02
P-228C	0.46	60%	1,104	1.0	1,104	5.2E-02
				Average	**1,209**	**5.7E-02**
MISC. SAND						
P-222C	0.61	60%	1,457	1.0	1,457	6.9E-02
P-224B	0.22	60%	518	18.7	28	1.3E-03
P-225B	0.20	60%	471	0.5	942	4.4E-02
P-227B	0.02	60%	56	0.1	556	2.6E-02

AQUIFER CHARACTERISTICS CALCULATIONS

- PERMEABILITY OF SCREENED INTERVAL FROM DEVELOPMENT RECOVERY DATA (MODIFIED SLUG TEST)

REF: BOUWER & RICE SLUG TEST
VOL 27, NO. 3 GROUNDWATER MAY-JUNE '89

$$\text{PERMEABILITY } (K) = \frac{r_c^2 \cdot \ln(R_e/r_w)}{2L_e} \cdot \frac{1}{T} \cdot \ln \frac{Y_o}{Y_T}$$

$$\text{WHERE: } \ln \frac{R_e}{r_w} = \left| \frac{1.1}{\ln(L_w/r_w)} + \frac{A + B \cdot \ln\left[\frac{(H-L_w)}{r_w}\right]}{(L_e/r_w)} \right.$$

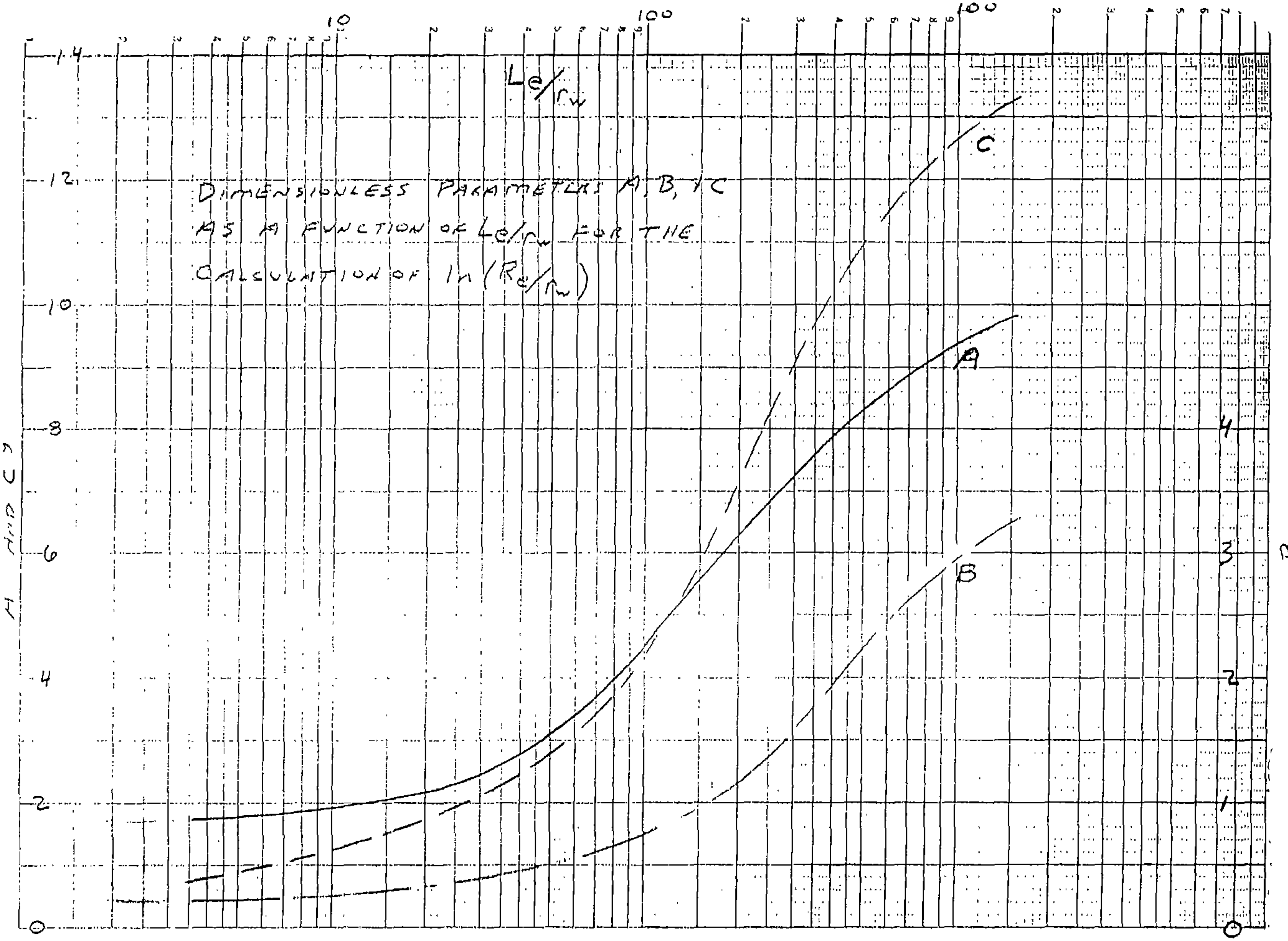
WHERE: A AND B ARE DIMENSIONLESS PARAMETERS DERIVED GRAPHICALLY FROM THE RESULT OF L_e/r_w (SEE ATTACHED GRAPH)

UNIT VERIFICATION $$K\left(\frac{cm}{sec}\right) = \frac{cm^2 \cdot \ln\left(\frac{cm}{cm}\right)}{2(cm)} \cdot \frac{1}{sec} \cdot \ln\left(\frac{cm}{cm}\right)$$

A AND B ARE UNITLESS

DEFINITION OF PARAMETERS

L_e = LENGTH OF SCREEN BELOW STATIC EXPOSED TO AQUIFER
Y_o = DRAWDOWN @ TIME 0, FROM PLOT OF RECOVERY DATA
Y_T = DRAWDOWN @ TIME T, FROM PLOT OF RECOVERY DATA
T = TIME @ WHICH Y_T OCCURS, FROM PLOT OF RECOVERY DATA
R_e = RADIAL DISTANCE OVER WHICH DRAWDOWN IS DISSIPATED
r_w = RADIAL DISTANCE TO UNDISTURBED PORTION OF AQUIFER, RADIUS OF BORING
r_c = RADIUS OF WELL INCLUDING PORIOUS PORTION OF FILTER PACK
$= [(1-n) r_c^2 + n r_w^2]^{1/2}$ WHERE n = POROSITY OF FILTER PACK
r_c = RADIUS OF CASING I.D.
H = VERTICAL DISTANCE FROM STATIC LEVEL TO BOTTOM OF AQUIFER
L_w = VERTICAL DISTANCE FROM STATIC LEVEL TO BOTTOM OF SCREEN, IF BOTTOM OF WELL FULLY PENETRATING ($L_w > H$) USE $L_w = H - 1cm$


SEMI-LOGARITHMIC 358-31
Le/rw
DIMENSIONLESS PARAMETERS A, B, & C
AS A FUNCTION OF Le/rw FOR THE
CALCULATION OF ln (Re/rw)
A
B
C
A AND C
B
10
100
1000
0
2
4
6
8
10
12
1.4
0
1
2
3
4

Modified Slug Test Permeability Calculations
Gue-70-14.10

	Data from Completion Diagrams, Boring Logs, and Static Levels						Data from Graph Plots			Preliminary Calculations			From Plot of L(e)/r(w)		Result
	r (w) (cm)	L (e) (cm)	L (w) (cm)	H (cm)	Casing Radius (cm)	Filter Pack Porosity (n)	Y(o) (cm)	Y(t) (cm)	t (sec)	r(c) (cm)	L(e)/r(w)	ln(R(e)/r(w))	A	B	K (cm/sec)
Coal Zone Wells															
	Outside of Grout Curtain														
P-222A	7.14	119	1692	1693	2.625	40%	570	14	1500	5.0	16.7	3.43	2.1	0.30	8.7E-04
P-226A	7.14	122	1706	1721	2.625	40%	680	285	1400	5.0	17.1	2.95	2.1	0.31	1.8E-04
P-227A	7.14	122	1578	1615	2.625	40%	950	190	1500	5.0	17.1	2.80	2.1	0.31	3.0E-04
P-301A	4.92	146	1487	1520	2.625	40%	9.14	1.16	600	3.7	29.7	3.07	2.45	0.78	5.0E-04
P-302A	4.92	91	1732	1733	2.625	40%	3.05	0.04	120	3.7	18.6	4.38	2.15	0.62	1.2E-02
P-303A	4.92	146	1631	1632	2.625	40%	9.14	0.27	150	3.7	29.7	4.51	2.45	0.78	5.0E-03
P-304A	4.92	146	1785	1786	2.625	40%	1.28	0.02	60	3.7	29.7	4.52	2.45	0.78	1.5E-02
P-305A	4.92	131	1555	1556	2.625	40%	2.74	0.03	54	3.7	26.6	4.53	2.33	0.74	2.0E-02
P-306A	4.92	146	746	747	2.625	40%	1.22	0.02	60	3.7	29.7	3.92	2.45	0.78	1.2E-02
	Inside Grout Curtain														
P-223A	3.97	146	1582	1583	2.625	40%	870	58	2000	3.2	36.8	4.16	2.7	0.44	2.0E-04
P-228A	7.14	88	1658	1659	2.625	40%	23	1.70	400	5.0	12.3	3.15	2.0	0.28	2.9E-03
P-307A	4.92	146	1447	1448	2.625	40%	7.62	0.08	36	3.7	29.7	4.11	2.45	0.78	2.5E-02
P-308A	4.92	146	1713	1714	2.625	40%	1.52	0.02	36	3.7	29.7	4.55	2.45	0.78	2.7E-02
P-309A	4.92	140	1569	1570	2.625	40%	8.84	5.18	900	3.7	28.5	4.36	2.41	0.77	1.3E-04
P-310A	4.92	146	1661	1662	2.625	40%	9.14	0.94	600	3.7	29.7	4.69	2.45	0.78	8.4E-04
Lower Sand															
P-221B	9.52	122	736	754	2.625	40%	705	540	1200	6.4	12.8	2.36	2.0	0.29	8.7E-05
P-228B(1)	9.52	119	813	843	2.625	40%	820	795	1200	6.4	12.5	2.31	2.0	0.28	1.0E-05
P-228B(2)	9.52	119	870	900	2.625	40%	865	723	800	6.4	12.5	2.33	2.0	0.28	8.9E-05
P-307B	9.53	49	854	855	2.625	40%	7.92	6.1	600	6.4	5.1	2.59	1.78	0.46	4.7E-04
Upper Sand															
P-223B	9.52	128	444	445	2.625	40%	58	1.4	800	6.4	13.4	2.58	2.0	0.29	1.9E-03
P-228C(1)	5.72	30	411	412	2.625	40%	12	5.3	1000	4.1	5.2	1.90	1.8	0.22	4.5E-04
P-228C(2)	5.72	30	432	433	2.625	40%	15	5	600	4.1	5.2	1.91	1.8	0.22	1.0E-03
P-301B	9.53	143	407	408	2.625	40%	4.57	0.3	90	6.4	15.0	2.93	2.05	0.59	1.2E-02
P-302B	9.53	146	355	356	2.625	40%	5.49	4.27	600	6.4	15.4	3.02	2.06	0.60	1.7E-04
P-303B	9.53	119	679	680	2.625	40%	9.45	0.85	480	6.4	12.5	3.18	2.00	0.55	2.7E-03
P-304B	9.53	94	493	494	2.625	40%	3.96	3.66	300	6.4	9.9	2.86	1.92	0.50	1.6E-04
P-308B	9.53	146	373	374	2.625	40%	4.57	0.67	600	6.4	15.4	2.91	2.06	0.60	1.3E-03
P-309B	9.53	110	349	350	2.625	40%	7.32	3.96	840	6.4	11.5	2.60	1.96	0.53	3.5E-04
Misc Sands															
P-222C	9.52	107	271	272	2.625	40%	15	1.5	400	6.4	11.2	2.22	2.0	0.26	2.4E-03
P-224B	9.52	119	547	568	2.625	40%	130	2.9	250	6.4	12.5	2.23	2.0	0.28	5.7E-03
P-225B	5.72	12	479	506	2.625	40%	42	14	1000	4.1	2.1	0.82	1.7	0.22	6.5E-04
P-227B	8.26	9	612	633	2.625	40%	528	460	1000	5.6	1.1	0.50	1.7	0.22	1.2E-04
P-306B	9.53	107	245	246	2.625	40%	0.61	0.15	360	6.4	11.2	2.46	1.96	0.52	1.8E-03

BBC&M ENGINEERING, INC.
GEOTECHNICAL ENGINEERING CONSULTANTS

Job No. 7000.050 Div. of Work

SUBJECT GUE-70

Temp. Sheet No.

Calc. by CKH Date 2/18/00

Checked by TVE Date 6/20/03

Sheet No. 1 of 3

PERMEABILITY FROM CONSOLIDATION TESTING

PERMEABILITY $K = \dfrac{C_v \, a_v \, \gamma_w}{1+e}$ WHERE: C_v = COEFFICIENT OF CONSOLIDATION

: a_v = COEFFICIENT OF COMPRESSIBILITY

: γ_w = UNIT WEIGHT OF WATER

: e = VOID RATIO AT OVERBURDEN PRES.

1) DETERMINE OVERBURDEN PRESSURE (OP)

OP = SAMPLE DEPTH * WET UNIT WEIGHT OF SOIL

$= (\text{FT})(\text{M.C.} + 1)(\text{D.D. IN lb/FT}^3)\left(\frac{\text{TON}}{2000 \text{ lb}}\right)$

= TSF

2) SELECT TEST LOAD DATA NEAREST OP.

3) USE TIME CURVE FOR LOAD DATA NEAREST O.P. TO GRAPHICALLY DETERMINE T_{50} IN MINUTES

4) CALCULATE AVERAGE SAMPLE THICKNESS PER DRAINAGE SURFACE FOR LOAD DURING TEST. (H) FOR LOAD DATA NEAREST O.P.

$$H = \frac{\underset{\text{INITIAL HEIGHT}}{H_{INITIAL}} - \left(\dfrac{\underset{\text{CHANGE IN SAMPLE HEIGHT}}{H_{FINAL} - H_{INITIAL}}}{2}\right)}{2} \quad \text{IN INCHES}$$

5) CALCULATE $C_v = \dfrac{0.197 H^2}{T_{50}}$

$= \dfrac{0.197(\text{IN}^2)}{\text{MIN}}$

$= \text{IN}^2/\text{MIN}$

6) DETERMINE COMPRESSION INDEX C_c BY:

a) DRAW BEST STRAIGHT LINE THROUGH HIGH PRESSURE, PRESSURE - VOID RATIO CURVE

b) DETERMINE SLOPE OF LINE BY CHOOSING TWO POINTS WHICH ARE 1 LOG CYCLE APART

c) $C_c = \left| de/dp \right|$ (UNITLESS)

7) CALCULATE $a_v = \dfrac{0.435\, C_c}{P}$ IN $\dfrac{1}{TSF}$ OR $\dfrac{FT^2}{TON}$

WHERE P IS THE AVERAGE OF THE P's USED TO DETERMINE C_c $\left(\dfrac{P_1 + P_2}{2}\right)$

8) DETERMINE @ FOR LOAD TEST DATA NEAREST OP. FROM RESULTS OF CONSOLIDATION – UNIT LESS

9) CALCULATE $K = \dfrac{C_v \cdot a_v \cdot \gamma_w}{1+e}$ IN FT/DY

$$= \frac{\left(\frac{IN^2}{MIN}\right)\left(\frac{FT^2}{TON}\right)\left(\frac{62.4\ lb}{FT^3}\right)}{1 + \text{UNITLESS}} \underbrace{\left(\frac{TONS}{2000\ lb}\right)\left(\frac{FT}{12\ IN}\right)\left(\frac{1440\ MIN}{DAY}\right)}_{\text{UNIT CORRECTION FACTOR } 0.06}$$

Calculaiton of Permeability from Colsolidation Data

Boring No.	Sample No	Depth (ft)	MC	DD (lb/ft^3)	Overburdn Pressure (tsf)	Test Presure (tsf)	Height Initial (in)	Loading Readings zero (in)	Loading Readings final (in)	H (in)	T50 (min)
B-218	S-4(I)	8.5	0.23	103	0.54	0.52	0.743	0.00100	0.00215	0.371	4
B-215	S-5A (II)	15	0.22	105	0.96	1.03	0.744	0.00295	0.01140	0.370	1.3
B-207	S-8 (I)	33.5	0.31	93	2.04	2.07	0.744	0.01465	0.02885	0.368	12
B-207	S-8 (II)	34	0.23	102	2.13	2.07	0.743	0.01110	0.01940	0.369	4

Boring No.	Sample No	Cv (in^2/min)	Compression Index E(1)	Compression Index E(2)	Compression Index P(1)	Compression Index P(2)	Compression Index Cc	Av (ft^2/ton	E	K (ft/dy)	K cm/sec
B-218	S-4(I)	0.0068	0.655	0.476	3.5	35	0.0057	0.00478	0.654	7.35E-05	2.6E-08
B-215	S-5A (II)	0.0207	0.580	0.377	2	20	0 0113	0.00476	0.586	2.33E-04	8.2E-08
B-207	S-8 (I)	0.0022	0.800	0.510	1.5	15	0.0215	0.00451	0.67	2.26E-05	8.0E-09
B-207	S-8 (II)	0.0067	0.660	0.494	1.5	15	0.0123	0.00258	0.614	4.03E-05	1.4E-08

BBC&M ENGINEERING, INC.
GEOTECHNICAL ENGINEERING CONSULTANTS

Job No. 7000.050 Div. of Work

SUBJECT GUE-70

Temp. Sheet No.

Calc. by CKH Date 2/18/00

Checked by TVE Date 6/20/03

- VERTICAL GRADIENT CALCULATIONS

VERTICAL GRADIENT (V.G UNITLESS) = $\frac{\partial h}{\partial l}$

- WHERE ∂h = HEAD DIFFERENCE BETWEEN UPPER ZONE & LOWER ZONE
= STATIC LEVEL UPPER (FT) — STATIC LEVEL LOWER (FT)

∂l = VERTICAL DISTANCE BETWEEN ZONES
= ELEVATION OF BOTTOM OF UPPER ZONE (FT) — ELEVATION OF TOP OF LOWER ZONE (FT)

- UNIT CORRECTION

UNITLESS = FT/FT

NO CORRECTION REQUIRED

Vertical Gradient Calculations
Gue-70-14.10

	Upper Sand to Lower Sand			Upper Sand to Coal				Lower Sand to Coal			
	P-221 C to B	P-228 C to B	Averages	P-223 C to A	P-301 C to A	P-308 C to A	Averages	P-221 B to A	P-222 B to A	P-228 B to A	Averages
Static Water Levels											
Upper Sand											
05/21/2001	815.54	815.91	815.7	815.92	813.44	815.84	815.1				
06/25/2001	814.92	815.31	815.1	815.31	812.58	815.13	814.3				
07/23/2001	814.21	814.57	814.4	814.59	811.85	814.18	813.5				
08/20/2001	814.40	815.27	814.8	815.21	812.74	815.01	814.3				
09/25/2001	813.37	812.67	813.0	813.68	811.33	813.56	812.9				
10/22/2001	813.49	813.80	813.6	813.81	811.52	814.11	813.1				
05/28/2002	817.06	817.47	817.3	817.46	813.97	816.41	815.9				
Lower Sand											
05/21/2001	809.80	809.51	809.7					809.80	809.55	809.51	809.62
06/25/2001	809.13	808.88	809.0					809.13	808.89	808.88	808.97
07/23/2001	808.89	809.16	809.0					808.89	808.67	809.16	808.91
08/20/2001	809.26	809.12	809.2					809.26	808.99	809.12	809.12
09/25/2001	808.57	808.34	808.5					808.57	808.34	808.34	808.42
10/22/2001	808.72	808.72	808.7					808.72	808.40	808.72	808.61
05/28/2002	810.60	809.34	810.0					810.60	810.35	809.34	810.10
Coal Zone											
05/21/2001				808.13	807.97	809.41	808.5	809.58	809.55	809.34	809.49
06/25/2001				807.71	807.58	808.77	808.0	808.93	808.91	808.70	808.85
07/23/2001				807.57	807.37	808.54	807.8	808.71	808.70	808.48	808.63
08/20/2001				807.58	807.43	808.88	808.0	809.04	809.03	808.75	808.94
09/25/2001				806.99	806.95	808.2	807.4	808.42	808.41	808.14	808.32
10/22/2001				806.98	806.85	808.35	807.4	808.49	808.67	808.21	808.46
05/28/2002				809.01	808.88	810.15	809.3	810.34	810.30	810.20	810.28
Head Difference (dh)											
05/21/2001	5.74	6.40	6.1	7.79	5.47	6.43	6.6	0.22	0.00	0.17	0.13
06/25/2001	5.79	6.43	6.1	7.60	5.00	6.36	6.3	0.20	-0.02	0.18	0.12
07/23/2001	5.32	5.41	5.4	7.02	4.48	5.64	5.7	0.18	-0.03	0.68	0.28
08/20/2001	5.14	6.15	5.6	7.63	5.31	6.13	6.4	0.22	-0.04	0.37	0.18
09/25/2001	4.80	4.33	4.6	6.69	4.38	5.36	5.5	0.15	-0.07	0.20	0.09
10/22/2001	4.77	5.08	4.9	6.83	4.67	5.76	5.8	0.23	-0.27	0.51	0.16
05/28/2002	6.46	8.13	7.3	8.45	5.09	6.26	6.6	0.26	0.05	-0.86	-0.18
Seperation Difference (dl)	5.0	16.3	10.7	39.2	35.1	44	39.6	23.2	25.1	20.2	22.8
Vertical Gradient (dh/dl)											
05/21/2001	1.15	0.39	0.77	0.20	0.16	0.15	0.15	0.01	0.00	0.01	0.00
06/25/2001	1.16	0.39	0.78	0.19	0.14	0.14	0.14	0.01	-0.00	0.01	0.00
07/23/2001	1.06	0.33	0.70	0.18	0.13	0.13	0.13	0.01	-0.00	0.03	0.02
08/20/2001	1.03	0.38	0.70	0.19	0.15	0.14	0.15	0.01	-0.00	0.02	0.01
09/25/2001	0.96	0.27	0.61	0.17	0.12	0.12	0.12	0.01	-0.00	0.01	0.00
10/22/2001	0.95	0.31	0.63	0.17	0.13	0.13	0.13	0.01	-0.01	0.03	0.01
05/28/2002	1.29	0.50	0.90	0.22	0.15	0.14	0.14	0.01	0.00	-0.04	-0.02
Averages	1.09	0.37	**0.73**	0.19	0.14	0.14	**0.14**	0.0090	-0.0022	0.0088	**0.0033**

Theoretical Vertical Gradient Calculations
Dewatered Coal Zone
Gue-70-14.10

	per Sand to"Dry" Coal				Lower Sand to "Dry" Coal			
	P-223 C to A	P-301 C to A	P-308 C to A	Averages	P-221 B to A	P-222 B to A	P-228 B to A	Averages
Static Water Levels								
Upper Sand								
05/21/2001	815.92	813.44	815.84	815.1				
06/25/2001	815.31	812 58	815.13	814.3				
07/23/2001	814.59	811.85	814.18	813.5				
08/20/2001	815.21	812.74	815.01	814.3				
09/25/2001	813.68	811.33	813.56	812.9				
10/22/2001	813.81	811.52	814.11	813.1				
05/28/2002	817.46	813.97	816.41	815.9				
Lower Sand								
05/21/2001					809.80	809.55	809.51	809.62
06/25/2001					809.13	808.89	808.88	808.97
07/23/2001					808.89	808.67	809.16	808.91
08/20/2001					809.26	808.99	809.12	809.12
09/25/2001					808.57	808.34	808.34	808.42
10/22/2001					808.72	808.40	808.72	808.61
05/28/2002					810.60	810.35	809.34	810.10
Coal Zone								
05/21/2001	755.00	758.10	752 3	755.1	755.60	753.30	754.10	754.33
06/25/2001	755.00	758.10	752.3	755.1	755.60	753 30	754.10	754.33
07/23/2001	755.00	758.10	752.3	755.1	755 60	753.30	754.10	754.33
08/20/2001	755.00	758.10	752.3	755.1	755.60	753.30	754.10	754.33
09/25/2001	755.00	758.10	752.3	755.1	755.60	753.30	754.10	754.33
10/22/2001	755.00	758.10	752.3	755.1	755.60	753.30	754.10	754.33
05/28/2002	755.00	758.10	752.3	755.1	755.60	753.30	754.10	754.33
Head Difference (dh)								
05/21/2001	60.92	55.34	63.54	59.9	54.20	56.25	55.41	55.29
06/25/2001	60.31	54.48	62.83	59.2	53.53	55.59	54.78	54.63
07/23/2001	59.59	53.75	61.88	58.4	53.29	55.37	55.06	54.57
08/20/2001	60.21	54.64	62.71	59.2	53 66	55.69	55.02	54.79
09/25/2001	58.68	53.23	61.26	57.7	52.97	55.04	54.24	54.08
10/22/2001	58.81	53.42	61.81	58.0	53.12	55.10	54.62	54.28
05/28/2002	62.46	55 87	64.11	60.8	55.00	57.05	55.24	55.76
Seperation Difference (dl)	39.2	35.1	44	39.6	23.2	25.1	20.2	22 8
Vertical Gradient (dh/dl)								
05/21/2001	1 55	1.58	1 44	1.51	2.34	2.24	2.74	2.49
06/25/2001	1.54	1.55	1.43	1.49	2.31	2.21	2.71	2.46
07/23/2001	1.52	1.53	1.41	1.47	2.30	2.21	2.73	2.47
08/20/2001	1.54	1.56	1.43	1.49	2.31	2.22	2.72	2.47
09/25/2001	1.50	1 52	1.39	1.45	2.28	2.19	2.69	2.44
10/22/2001	1.50	1.52	1.40	1.46	2.29	2.20	2.70	2.45
05/28/2002	1.59	1 59	1.46	1.52	2.37	2.27	2.73	2.50
Averages	1.53	1.55	1.42	**1.49**	2.31	2.22	2.72	**2.47**

BBC&M ENGINEERING, INC.
GEOTECHNICAL ENGINEERING CONSULTANTS

Job No. 7000.050 Div. of Work ______

SUBJECT GUE-70

Temp. Sheet No. ______
Calc. by CKH Date 1/18/00
Checked by TVE Date 6/20/03

- VERTICAL FLOW CALCULATIONS

VELOCITY V IN $FT/YR = K \frac{\partial h}{\partial \ell}$

- WHERE: K = VERTICAL PERMEABILITY OF MATERIAL BETWEEN WATER BEARING ZONE $\left(\frac{cm}{sec}\right)$

FOR SOIL SEE SEPARATE CALCULATION

FOR RX USE PUBLISHED ESTIMATE $= 1.0 \, E \, 10^{-7}$ cm/sec

$\partial h / \partial \ell$ = AVERAGE VERTICAL GRADIENT (SEE SEPARATE CALCULATION)

- UNIT CORRECTION

$$\left(\frac{FT}{YR}\right) = \left(\frac{cm}{SEC}\right)\left(\frac{FT}{FT}\right)\left(\frac{FT}{30.48 \text{ cm}}\right)\left(\frac{31{,}536{,}000 \text{ SEC}}{YR}\right)$$

$$= \left(\frac{cm}{SEC}\right)\left(\frac{FT}{FT}\right)\left(1{,}034{,}646\right)$$

QUANTITY Q IN $\frac{GAL}{DY} = V \cdot A$

- WHERE: V = VELOCITY IN FT/YR (SEE ABOVE)
A = AREA IN FT^2
TEST AREA 200 FT LONG
PAVEMENT 38 FT WIDE
$= 200 \text{ FT} \cdot 38 \text{ FT}$
$= 7{,}600 \text{ FT}^2$

- UNIT CORRECTION

$$\frac{GAL}{DY} = \left(\frac{FT}{YR}\right)\left(FT^2\right)\left(\frac{7.48 \text{ GAL}}{FT^3}\right)\left(\frac{YR}{365 \text{ DYS}}\right)$$

$$= \left(\frac{FT}{YR}\right)\left(FT^2\right)\left(0.02049\right)$$

- VERTICAL FLOW CALCS. CON'T

TRAVEL TIME + IN YRS = dl/V

- WHERE : dl = AVERAGE SEPARATION BETWEEN WATER BEARING ZONE (FT)
SEE VERTICAL GRADIENT CALC.

V = VELOCITY IN FT/YR (SEE ABOVE)

- UNIT CORRECTION

$$YRS = (FT) \cdot \left(\frac{YR}{FT}\right)$$

NO CORRECTION RQD.

Vertical Flow Calculations
Gue-70-14.10

	K (cm/sec)	A (ft^2)	dl (ft)	dh/dl	V (ft/yr)	Q (gpd)	t (years)
Upper Sand to Lower Sand							
05/21/2001	1.1E-08	125,300	10.7	0.77	0.009	22.5	1,220
06/25/2001	1.1E-08	125,300	10.7	0.78	0.009	22.7	1,211
07/23/2001	1.1E-08	125,300	10.7	0.70	0.008	20.4	1,347
08/20/2001	1.1E-08	125,300	10.7	0.70	0.008	20.5	1,338
09/25/2001	1.1E-08	125,300	10.7	0.61	0.007	17.9	1,534
10/22/2001	1.1E-08	125,300	10.7	0.63	0.007	18.5	1,486
05/28/2002	1.1E-08	125,300	10.7	0.90	0.010	26.2	1,050
Averages				**0.7**	**0.0**	**21.2**	**1312.4**
Upper Sand to Coal							
05/21/2001	1.0E-07	135,300	39.6	0.15	0.016	43	2,535
06/25/2001	1.0E-07	135,300	39.6	6.32	0.654	1813	61
07/23/2001	1.0E-07	135,300	39.6	5.71	0.591	1639	67
08/20/2001	1.0E-07	135,300	39.6	6.36	0.658	1823	60
09/25/2001	1.0E-07	135,300	39.6	5.48	0.567	1571	70
10/22/2001	1.0E-07	135,300	39.6	5.75	0.595	1650	67
05/28/2002	1.0E-07	135,300	39.6	6.60	0.683	1893	58
Averages				**5.2**	**0.5**	**1490**	**416.7**
Lower Sand to Coal Zone							
05/21/2001	1.0E-06	215,862	22.8	0.13	0.135	595	170
06/25/2001	1.0E-06	215,862	22.8	0.12	0.124	549	184
07/23/2001	1.0E-06	215,862	22.8	0.28	0.286	1266	80
08/20/2001	1.0E-06	215,862	22.8	0.18	0.190	839	120
09/25/2001	1.0E-06	215,862	22.8	0.09	0.097	427	236
10/22/2001	1.0E-06	215,862	22.8	0.16	0.162	717	141
05/28/2002	1.0E-06	215,862	22.8	-0.18	-0.190	-839	(120)
Averages				**0.111**	**0.115**	**508**	**116**

Theoretical Vertical Flow Calculations
Dewatered Coal Zone
Gue-70-14.10

	K (cm/sec)	A (ft^2)	dl (ft)	dh/dl	V (ft/yr)	Q (gpd)	t (years)
Upper Sand to "Dry" Coal Zone							
05/21/2001	1.0E-06	135,300	39.6	1.51	1.56	4,332	25
06/25/2001	1.0E-06	135,300	39.6	1.49	1.54	4,274	26
07/23/2001	1.0E-06	135,300	39.6	1.47	1.52	4,213	26
08/20/2001	1.0E-06	135,300	39.6	1.49	1.54	4,277	26
09/25/2001	1.0E-06	135,300	39.6	1.45	1.50	4,172	26
10/22/2001	1.0E-06	135,300	39.6	1.46	1.51	4,197	26
05/28/2002	1.0E-06	135,300	39.6	1.52	1.58	4,372	25
Averages					**1.54**	**4,263**	**26**
Lower Sand to "Dry" Coal Zone							
05/21/2001	1.0E-05	215,862	22.8	2.49	25.8	114,043	0.88
06/25/2001	1.0E-05	215,862	22.8	2.46	25.5	112,727	0.89
07/23/2001	1.0E-05	215,862	22.8	2.47	25.5	112,844	0.89
08/20/2001	1.0E-05	215,862	22.8	2.47	25.6	113,090	0.89
09/25/2001	1.0E-05	215,862	22.8	2.44	25.2	111,614	0.90
10/22/2001	1.0E-05	215,862	22.8	2.45	25.3	112,099	0.90
05/28/2002	1.0E-05	215,862	22.8	2.50	25.9	114,579	0.88
Averages					**25.5**	**113,000**	**0.89**

HORIZONTAL FLOW CALCS.

FLOW ACROSS GROUT CURTAIN USING FLOW NET METHODS

$$Q = Kh \frac{nf}{nd} \times L$$

WHERE Q = QUANTITY OF FLOW IN gpd

K = PERMEABILITY OF GROUTED COAL ZONE
= 6.6×10^{-3} cm/SEC (SEE PERM. CALCS.)

h = HEAD DIFFERENCE ACROSS GROUT CURTAIN (FT.)
= (STATIC LEVEL P-222A - STATIC LEVEL P-227A)

nf = AVERAGE THICKNESS OF COAL ZONE
= 6.6'

nd = DISTANCE ACROSS GROUT CURTAIN
= 144'

L = LENGTH OF TEST AREA
= 200'

UNIT CORRECTION

$$\frac{GAL}{DY} = \left(\frac{cm}{SEC}\right)(FT)\left(\frac{FT}{FT}\right)(FT) \cdot \left(\frac{FT}{30.48\ cm}\right)\left(\frac{7.48\ GAL}{FT^3}\right)\left(\frac{86400\ SEC}{DY}\right)$$

$$Q = Kh\frac{nf}{nd}L \cdot 21{,}203$$

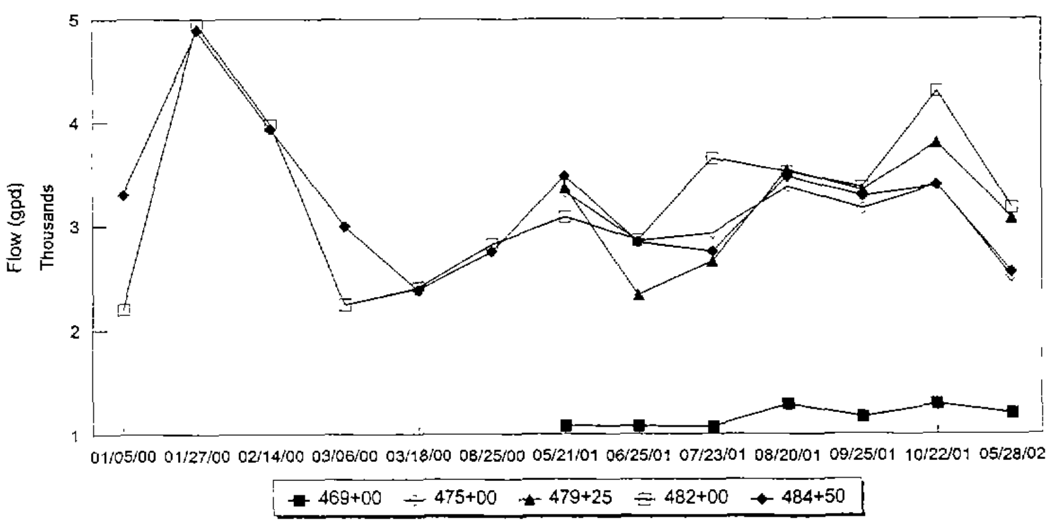
Horizontal Quantities of Groundwater Flow in Coal Zone
Flow Across Grout Curtain (flow net method)
Gue-70-14.10

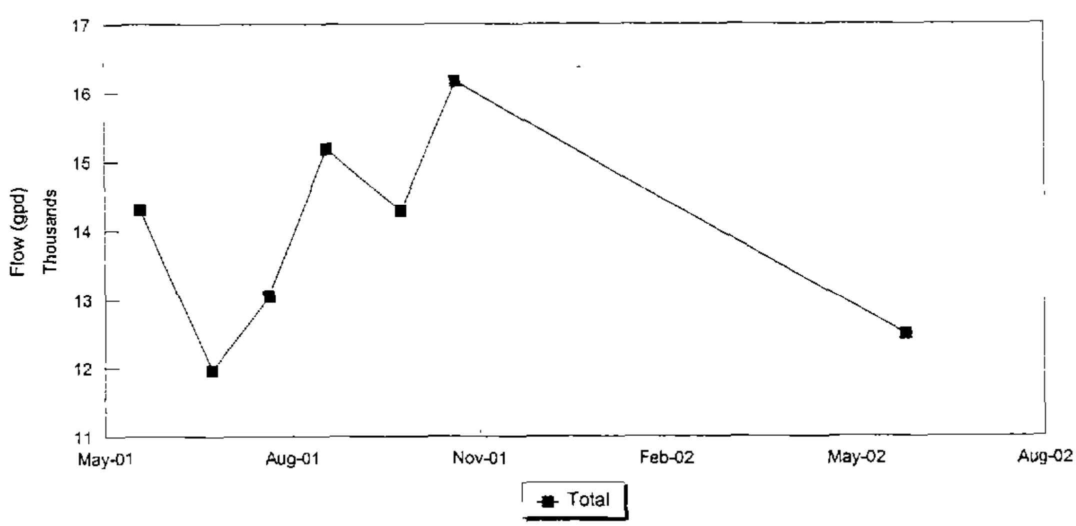
Date	Static Levels (msl)		K (cm/sec)	h (ft)	nf (ft)	L (ft)	nd (ft)	Q (gpd)
	P-302A	P-301A	**Project Section Sta 469+00**					
05/21/01	809.24	807.97	8.2E-03	1.27	6.8	115	160	1,079
06/25/01	808.85	807.58	8.2E-03	1.27	6.8	115	160	1,079
07/23/01	808.63	807.37	8.2E-03	1.26	6.8	115	160	1,071
08/20/01	808.95	807.43	8.2E-03	1.52	6.8	115	160	1,292
09/25/01	808.32	806.95	8.2E-03	1.37	6.8	115	160	1,164
10/22/01	808.37	806.85	8.2E-03	1.52	6.8	115	160	1,292
05/28/02	810.29	808.88	8.2E-03	1.41	6.8	115	160	1,198
	P-304A	P-303A	**Project Section Sta 475+00**					
05/21/01	809.77	807.92	8.2E-03	1.85	6.2	266	160	3,315
06/25/01	809.11	807.52	8.2E-03	1.59	6.2	266	160	2,849
07/23/01	808.88	807.25	8.2E-03	1.63	6.2	266	160	2,921
08/20/01	809.24	807.36	8.2E-03	1.88	6.2	266	160	3,369
09/25/01	808.57	806.81	8.2E-03	1.76	6.2	266	160	3,154
10/22/01	808.64	806.75	8.2E-03	1.89	6.2	266	160	3,387
05/28/02	810.57	809.17	8.2E-03	1.40	6.2	266	160	2,509
	P-306A	P-305A	**Project Section Sta 479+25**					
05/21/01	809.08	807.93	8.2E-03	1.15	6.0	448	160	3,359
06/25/01	808.32	807.52	8.2E-03	0.80	6.0	448	160	2,337
07/23/01	808.21	807.30	8.2E-03	0.91	6.0	448	160	2,658
08/20/01	808.56	807.35	8.2E-03	1.21	6.0	448	160	3,534
09/25/01	807.91	806.77	8.2E-03	1.14	6.0	448	160	3,330
10/22/01	807.98	806.68	8.2E-03	1.30	6.0	448	160	3,797
05/28/02	809.86	808.81	8.2E-03	1.05	6.0	448	160	3,067
	P-222A	P-226A	**Project Section Sta 482+00**					
01/05/00	809.51	808.50	8.2E-03	1.01	7.0	287	160	2,205
01/27/00	808.74	806.47	8.2E-03	2.27	7.0	287	160	4,956
02/14/00	809.90	808.08	8.2E-03	1.82	7.0	287	160	3,973
03/06/00	809.43	808.40	8.2E-03	1.03	7.0	287	160	2,249
03/18/00	809.56	808.46	8.2E-03	1.10	7.0	287	160	2,401
08/25/00	808.50	807.21	8.2E-03	1.29	7.0	287	160	2,816
05/21/01	809.55	808.14	8.2E-03	1.41	7.0	287	160	3,078
06/25/01	808.91	807.60	8.2E-03	1.31	7.0	287	160	2,860
07/23/01	808.70	807.03	8.2E-03	1.67	7.0	287	160	3,646
08/20/01	809.03	807.42	8.2E-03	1.61	7.0	287	160	3,515
09/25/01	808.41	806.87	8.2E-03	1.54	7.0	287	160	3,362
10/22/01	808.67	806.70	8.2E-03	1.97	7.0	287	160	4,301
05/28/02	810.30	808.85	8.2E-03	1.45	7.0	287	160	3,165
	PW-1	P-227A	**Project Section Sta 484+50**					
01/05/00	809.55	808.04	8.2E-03	1.51	6.5	309	160	3,296
01/27/00	808.70	806.46	8.2E-03	2.24	6.5	309	160	4,889
02/14/00	809.87	808.07	8.2E-03	1.80	6.5	309	160	3,929
03/06/00	809.40	808.03	8.2E-03	1.37	6.5	309	160	2,990
03/18/00	809.53	808.44	8.2E-03	1.09	6.5	309	160	2,379
08/25/00	808.46	807.20	8.2E-03	1.26	6.5	309	160	2,750
05/21/01	809.53	807.94	8.2E-03	1.59	6.5	309	160	3,470
06/25/01	808.88	807.58	8.2E-03	1.30	6.5	309	160	2,837
07/23/01	808.66	807.40	8.2E-03	1.26	6.5	309	160	2,750
08/20/01	809.01	807.42	8.2E-03	1.59	6.5	309	160	3,470
09/25/01	808.35	806.85	8.2E-03	1.50	6.5	309	160	3,274
10/22/01	808.27	806.72	8.2E-03	1.55	6.5	309	160	3,383
05/28/02	810.01	808.84	8.2E-03	1.17	6.5	309	160	2,554

Horizontal Quantities of Groundwater Flow in Coal Zone
Flow Across Grout Curtain (flow net method)
Gue-70-14.10

Totals for Project Area

Date	469+00	475+00	479+25	482+00	484+50	Total
01/05/00				2,205	3,296	
01/27/00				4,956	4,889	
02/14/00				3,973	3,929	
03/06/00				2,249	2,990	
03/18/00				2,401	2,379	
08/25/00				2,816	2,750	
05/21/01	1,079	3,315	3,359	3,078	3,470	**14,302**
06/25/01	1,079	2,849	2,337	2,860	2,837	**11,963**
07/23/01	1,071	2,921	2,658	3,646	2,750	**13,046**
08/20/01	1,292	3,369	3,534	3,515	3,470	**15,180**
09/25/01	1,164	3,154	3,330	3,362	3,274	**14,284**
10/22/01	1,292	3,387	3,797	4,301	3,383	**16,160**
05/28/02	1,198	2,509	3,067	3,165	2,554	**12,493**
Averages	**1,168**	**3,072**	**3,155**	**3,418**	**3,105**	**13,918**





HORIZONTAL GROUND FLOW

GRADIENT = dh/dl

WHERE: dh = HEAD DIFFERENCE BETWEEN POTENTIO CONTOURS PARALLEL TO GROUNDWATER FLOW

dl = HORIZONTAL DISTANCE BETWEEN CONTOURS USED TO CALCULATE dh, MEASURED PARALLEL TO GROUNDWATER FLOW

UNIT CORRECTION

$$\frac{dh}{dl} = \frac{ft}{ft} \text{ UNITLESS OR } = \frac{FT}{FT}\left(\frac{5280\ FT}{mi}\right)$$

$$= FT/mi$$

VELOCITY

- VELOCITY (V IN FT/YR) = $K\ dh/dl$

WHERE: K = PERMEABILITY IN cm/SEC FROM FIELD TESTING

dh/dl = GRADIENT, SEE ABOVE

UNIT CORRECTION

$$FT/YR = \left(\frac{cm}{SEC}\right)\left(\frac{FT}{FT}\right)\left(\frac{FT}{30.48\ cm}\right)\left(\frac{31536000\ SEC}{YR}\right)$$

$$= \left(\frac{cm}{SEC}\right)\left(\frac{FT}{FT}\right)(1034645.7)$$

TRAVEL TIME

TIME (t IN YRS) = d/v

WHERE: d = DISTANCE IN FEET ACROSS GROUT CURTAIN MEASURED PARALLEL TO DIRECTION OF FLOW

V = VELOCITY IN FT/YR, SEE ABOVE

- UNIT CORRECTION

- YRS = $(FT)\left(\frac{YR}{FT}\right)$ NONE REQUIRED

QUANTITY

QUANTITY, Q IN gpd = $KA\frac{dh}{dl}$

WHERE: K = PERMEABILITY FROM FIELD TESTING IN cm/sec

A = CROSS-SECTIONAL AREA OF AQUIFER IN FT^2
= WIDTH · HEIGHT
WHERE WIDTH = DISTANCE ACROSS TEST AREA MEASURED PERPENDICULAR TO G.W. FLOW
HEIGHT = AVERAGE THICKNESS OF AQUIFER

dh/dl = GRADIENT, SEE ABOVE

UNIT CORRECTION

$$\frac{GAL}{DAY} = \left(\frac{cm}{SEC}\right)\left(FT^2\right)\left(\frac{FT}{FT}\right)\left(\frac{FT}{30.48\ cm}\right)\left(\frac{7.48\ GAL}{FT^3}\right)\left(\frac{86400\ SEC}{DY}\right)$$

$$= \left(\frac{cm}{SEC}\right)\left(FT^2\right)\left(FT/FT\right)\left(21203.15\right)$$

Horizontal Groundwater Flow Sand Zones
Darcy Methods
Gue-70-14.10

	K cm/sec	dh (ft)	dl (ft)	dh/dl	dh/dl (ft/mi)	V (ft/dy)	Direction (deg)	dh (ft)	dl (ft)	dh/dl	dh/dl (ft/mi)	V (ft/dy)	Direction (deg)	dh (ft)	dl (ft)	dh/dl	dh/dl (ft/mi)	V (ft/dy)	Direction (deg)
Lower Sand		**West Area**						**East Area**											
05/21/01	1.1E-02	1.3	112	0.0116	61	0.36	345	0.6	110	0.0055	29	0.17	290						
06/25/01	1.1E-02	0.8	114	0.0070	37	0.22	340	0.4	107	0.0037	20	0.12	275						
07/23/01	1.1E-02	0.7	110	0.0064	34	0.20	330	0.9	253	0.0036	19	0.11	265						
08/20/01	1.1E-02	0.8	100	0.0080	42	0.25	335	0.6	127	0.0047	25	0.15	280						
09/25/01	1.1E-02	0.8	108	0.0074	39	0.23	335	0.5	110	0.0045	24	0.14	295						
10/22/01	1.1E-02	0.9	118	0.0076	40	0.24	335	1.0	240	0.0042	22	0.13	270						
05/28/02	1.1E-02	1.0	105	0.0095	50	0.30	340	0.9	72	0.0125	66	0.39	335						
	Averages			**0.0082**	**43**	**0.26**	**337 (N-NW)**			**0.0055**	**29**	**0.17**	**287 (W-NW)**						
Upper Sand		**West Area**						**East Area, North Side**						**East Area, South Side**					
05/21/01	9.6E-03	2.0	250	0.0080	42	0.22	315	0.7	75	0.0093	49	0.25	320	0.2	40	0.0050	26	0.14	145
06/25/01	9.6E-03	1.8	255	0.0071	37	0.19	315	0.7	70	0.0100	53	0.27	320	0.2	40	0.0050	26	0.14	145
07/23/01	9.6E-03	1.5	255	0.0059	31	0.16	310	0.6	68	0.0088	47	0.24	320	0.3	60	0.0050	26	0.14	150
08/20/01	9.6E-03	1.4	248	0.0056	30	0.15	310	0.7	68	0.0103	54	0.28	315	0.6	57	0.0105	56	0.29	145
09/25/01	9.6E-03	1.6	258	0.0062	33	0.17	310	0.7	78	0.0090	47	0.24	320	0.4	45	0.0089	47	0.24	145
10/22/01	9.6E-03	2.5	260	0.0096	51	0.26	305	0.8	72	0.0111	59	0.30	325	0.2	88	0.0023	12	0.06	115
05/28/02	9.6E-03	1.2	215	0.0056	29	0.15	295	0.6	68	0.0088	47	0.24	315	0.5	70	0.0071	38	0.19	155
	Averages			**0.0069**	**36**	**0.19**	**309 (NW)**			**0.0096**	**51**	**0.26**	**319 (NW)**			**0.0063**	**33**	**0.17**	**143 (SE)**

GROUNDWATER CONSTITUENT LOADINGS

CONSTITUENT LOADING, (L) IN lb/DY = Q · C

WHERE: Q = FLOW IN GAL/DY — SEE G.W. FLOW CALC.
C = CONCENTRATION IN mg/L

UNIT CORRECTION

$$\text{lb/DY} = \left(\frac{\text{GAL}}{\text{DY}}\right)\left(\frac{\text{mg}}{\text{L}}\right)\left(\frac{3.7852\ \text{L}}{\text{GAL}}\right)\left(\frac{2.2046\ \text{lb}}{1000\ \text{g}}\right)\left(\frac{\text{g}}{1000\ \text{mg}}\right)$$

$$= \left(\frac{\text{GAL}}{\text{DY}}\right)\left(\frac{\text{mg}}{\text{L}}\right)\left(8.345 \times 10^{-6}\right)$$

Coal Zone Groundwater Constituent Loading Calculations
Gue-70-14.10

Total Dissolved Solids Loadings

Location Date	Flow Quantity (gpd)	Groundwater Concentrations Upgradient (mg/l)	Groundwater Concentrations Downgradient (mg/l)	Groundwater Loadings Upgradient (lb/day)	Groundwater Loadings Downgradient (lb/day)	Loading Increase (lb/dy)	Percent Increase (%)
Project Section 469+00		P-302A	P-301A				
05/21/01	1,079	453	212	4.1	1.9	-2.2	-53%
06/25/01	1,079	426	490	3.8	4.4	0.6	15%
07/23/01	1,071	313	359	2.8	3.2	0.4	15%
08/20/01	1,292	560	420	6.0	4.5	-1.5	-25%
09/25/01	1,164	427	527	4.1	5 1	1.0	23%
10/22/01	1,292	**377**	**355**	4.1	3.8	-0.2	-6%
Project Section 475+00		P-304A	P-303A				
05/21/01	3,315	290	507	8.0	14.0	6.0	75%
06/25/01	2,849	297	471	7.1	11.2	4.1	59%
07/23/01	2,921	275	416	6.7	10.1	3.4	51%
08/20/01	3,369	407	610	11.4	17.1	5.7	50%
09/25/01	3,154	350	747	9.2	19.7	10.4	113%
10/22/01	3,387	**268**	**397**	7.6	11.2	3.6	48%
Project Section 479+25		P-306A	P-305A				
05/21/01	3,359	194	462	5 4	13.0	7.5	138%
06/25/01	2,337	303	438	5 9	8.5	2.6	45%
07/23/01	2,658	263	281	5.8	6.2	0 4	7%
08/20/01	3,534	480	483	14.2	14.2	0.1	1%
09/25/01	3,330	373	497	10.4	13.8	3.4	33%
10/22/01	3,797	**288**	**667**	9.1	21.1	12.0	132%
Project Section 482+00		P-222A	P-226A				
05/21/01	3,078	384	820	9.9	21.1	11.2	114%
06/25/01	2,860	506	806	12.1	19.2	7.2	59%
07/23/01	3,646	325	729	9.9	22.2	12.3	124%
08/20/01	3,515	533	897	15.6	26.3	10.7	68%
09/25/01	3,362	447	837	12.5	23.5	10.9	87%
10/22/01	4,301	**336**	**637**	12.1	22.9	10.8	90%
Project Section 484+50		PW-001	P-227A				
05/21/01	3,470	413	800	12.0	23.2	11.2	94%
06/25/01	2,837	372	819	8.8	19.4	10.6	120%
07/23/01	3,750	263	781	8.2	24.4	16.2	197%
08/20/01	3,470	407	877	11.8	25.4	13.6	115%
09/25/01	3,274	380	927	10.4	25.3	14.9	144%
10/22/01	3,383	**272**	**557**	7.7	15 7	8.0	105%

Project Total Load Increases

Lb/Dy	469+00	475+00	479+25	482+00	484+00	**Totals**
05/21/01	-2.2	6 0	7 5	11.2	11.2	**33.8**
06/25/01	0.6	4 1	2 6	7.2	10.6	**25.1**
07/23/01	0 4	3 4	0.4	12.3	16.2	**32.7**
08/20/01	-1 5	5 7	0.1	10.7	13.6	**28.6**
09/25/01	1.0	10.4	3.4	10.9	14.9	**40.8**
10/22/01	-0.2	3.6	12 0	10.8	8.0	**34.3**
Averages	**-0.3**	**5.6**	**4.3**	**10.5**	**12.4**	**32.5**

Percent	469+00	475+00	479+25	482+00	484+00	**Totals**
05/21/01	-53%	75%	138%	114%	94%	**46%**
06/25/01	15%	59%	45%	59%	120%	**40%**
07/23/01	15%	51%	7%	124%	197%	**49%**
08/20/01	-25%	50%	1%	68%	115%	**33%**
09/25/01	23%	113%	33%	87%	144%	**47%**
10/22/01	-6%	48%	132%	90%	105%	**46%**
Averages	**-5%**	**66%**	**59%**	**90%**	**129%**	**43%**

Coal Zone Groundwater Constituent Loading Calculations
Gue-70-14.10

Calcium Loadings
Based on quantity of flow and constituent concentrations for each sampling event

Location Date	Flow Quantity (gpd)	Groundwater Concentrations Upgradient (mg/l)	Downgradient (mg/l)	Groundwater Loadings Upgradient (lb/day)	Downgradient (lb/day)	Loading Increase (lb)	Percent Increase
Project Section 469+00							
05/21/01	984	51	39	0 4	0.3	-0.10	-23%
06/25/01	984	40	32	0 3	0.3	-0.06	-19%
07/23/01	977	42	31	0 3	0.3	-0 09	-27%
08/20/01	1,178	54	40	0.5	0.4	-0.14	-26%
09/25/01	1,062	37	29	0 3	0.3	-0.07	-22%
10/22/01	1,178	37	31	0 4	0.3	-0.06	-17%
Average	1 061	43	34	0.4	0.3	-0.09	-22%
Project Section 475+00							
05/21/01	3,024	102	19	2 6	0.5	-2.10	-82%
06/25/01	2,599	70	17	1.5	0.4	-1.16	-76%
07/23/01	2,665	103	10	2.3	0.2	-2.06	-90%
08/20/01	3,073	111	15	2 8	0.4	-2.47	-87%
09/25/01	2,877	74	20	1.8	0.5	-1.31	-74%
10/22/01	3,090	76	11	2.0	0.3	-1.68	-86%
Average	2,888	89	15	2.2	0 4	-1.80	-82%
Project Section 479+25							
05/21/01	3,064	102	73	2.6	1.9	-0.74	-28%
06/25/01	2,132	69	65	1.2	1.2	-0.08	-7%
07/23/01	2,425	93	90	1.9	1.8	-0.05	-3%
08/20/01	3,224	125	105	3.3	2.8	-0.52	-16%
09/25/01	3,037	74	79	1.9	2.0	0.13	7%
10/22/01	3,464	73	72	2.1	2.1	-0.02	-1%
Average	2,891	89	81	2.2	2.0	-0.22	-8%
Project Section 482+00							
05/21/01	2,868	32	50	0.8	1 2	0.42	55%
06/25/01	2,668	30	38	0.7	0.8	0.19	29%
07/23/01	1,394	28	39	0.3	0.5	0.13	40%
08/20/01	3,266	39	50	1.1	1 4	0.30	28%
09/25/01	3,127	27	38	0.7	1 0	0.27	38%
10/22/01	3,983	30	36	1.0	1 2	0.21	21%
Average	2,884	31	42	0.8	1.0	0.25	35%
Project Section 484+50							
05/21/01	3,245	110	67	3.0	1 8	-1.18	-39%
06/25/01	2,668	75	47	1.7	1.0	-0.63	-38%
07/23/01	2,588	119	58	2 6	1.3	-1.32	-51%
08/20/01	3,245	121	71	3.3	1 9	-1 34	-41%
09/25/01	3,066	86	45	2.2	1 1	-1 04	-48%
10/22/01	3,166	78	47	2 1	1.2	-0.82	-40%
Average	2,996	98	56	2.5	1.4	-1.06	-43%
Project Area							
Average Total per day	12,720	70	227	1.6	1.0	-0.58	-37%

Coal Zone Groundwater Constituent Loading Calculations
Gue-70-14.10

Sulfate Loadings
Based on quantity of flow and constituent concentrations for each sampling event

Location Date	Flow Quantity (gpd)	Groundwater Concentrations Upgradient (mg/l)	Downgradient (mg/l)	Groundwater Loadings Upgradient (lb/day)	Downgradient (lb/day)	Loading Increase (lb)	Percent Increase
Project Section 469+00							
05/21/01	984	52	1	0.4	0.0	-0.42	-98%
06/25/01	984	34	2	0.3	0.0	-0.26	-95%
07/23/01	977	54	16	0.4	0.1	-0.31	-70%
08/20/01	1,178	54	16	0.5	0.2	-0 38	-70%
09/25/01	1,062	39	6	0 3	0 0	-0.30	-86%
10/22/01	1,178	48	6	0.5	0.1	-0.41	-87%
Average	1,061	47	8	0.4	0.1	-0.35	-84%
Project Section 475+00							
05/21/01	3,024	56	34	1.4	0.8	-0.57	-40%
06/25/01	2,599	40	26	0.9	0.6	-0.30	-34%
07/23/01	2,665	37	41	0.8	0.9	0.11	13%
08/20/01	3,073	37	41	0 9	1.1	0.13	13%
09/25/01	2,877	50	35	1 2	0.8	-0.36	-30%
10/22/01	3,090	54	30	1.4	0 8	-0.62	-45%
Average	2,888	45	34	1.1	0.8	-0.27	-20%
Project Section 479+25							
05/21/01	3,064	54	134	1.4	3.4	2.04	147%
06/25/01	2,132	39	54	0 7	1.0	0.27	39%
07/23/01	2,425	47	89	1.0	1.8	0.85	89%
08/20/01	3,224	47	89	1.3	2.4	1.12	89%
09/25/01	3,037	46	104	1.2	2.6	1.47	125%
10/22/01	3,464	53	110	1.5	3.2	1.66	109%
Average	2,891	48	97	1.2	2.4	1 23	100%
Project Section 482+00							
05/21/01	2,868	7	246	0.2	5.9	5.71	3270%
06/25/01	2,668	8	137	0.2	3.1	2.87	1623%
07/23/01	1,394	5	256	0.1	3.0	2.92	5312%
08/20/01	3,266	5	256	0.1	7.0	6.85	5312%
09/25/01	3,127	4	227	0.1	5.9	5.82	5970%
10/22/01	3,983	3	272	0.1	9.0	8.95	10049%
Average	2,884	5	232	0.1	5.6	5.52	5256%
Project Section 484+50							
05/21/01	3,245	70	207	1.9	5.6	3.71	196%
06/25/01	2,668	46	161	1.0	3.6	2.57	252%
07/23/01	2,588	53	245	1.1	5.3	4 14	361%
08/20/01	3,245	53	245	1.4	6.6	5 20	361%
09/25/01	3,066	54	205	1.4	5.2	3 86	280%
10/22/01	3,166	52	222	1.4	5.9	4.49	327%
Average	2,996	55	214	1.4	5 4	4.00	296%
Project Area							
Average Total per day	12,720	40	585	0.8	2.9	2.03	243%

Coal Zone Groundwater Constituent Loading Calculations
Gue-70-14.10

Iron Loadings
Based on quantity of flow and constituent concentrations for each sampling event

Location Date	Flow Quantity (gpd)	Groundwater Concentrations Upgradient (mg/l)	Downgradient (mg/l)	Groundwater Loadings Upgradient (lb/day)	Downgradient (lb/day)	Loading Increase (lb)	Percent Increase
Project Section 469+00							
05/21/01	984	0.058	0.610	0.000	0.005	0.005	952%
06/25/01	984	0.098	0.718	0.001	0.006	0.005	633%
07/23/01	977	0.050	0.241	0.000	0.002	0.002	382%
08/20/01	1,178	0.050	0.241	0.000	0 002	0.002	382%
09/25/01	1,062	0.050	0.353	0.000	0.003	0.003	606%
10/22/01	1,178	0.050	0.189	0.000	0 002	0.001	278%
Average	1,061	0.059	0.392	0.001	0.003	0.003	539%
Project Section 475+00							
05/21/01	3,024	0.346	0.060	0.009	0.002	-0.007	-83%
06/25/01	2,599	0.747	0.322	0.016	0.007	-0.009	-57%
07/23/01	2,665	0.356	0.050	0.008	0 001	-0.007	-86%
08/20/01	3,073	0.356	0.050	0.009	0 001	-0.008	-86%
09/25/01	2,877	0.121	0.050	0.003	0.001	-0.002	-59%
10/22/01	3,090	0 050	0.050	0 001	0.001	0 000	0%
Average	2,888	0.329	0 097	0.008	0.002	-0.005	-62%
Project Section 479+25							
05/21/01	3,064	0 697	0.258	0 018	0.007	-0.011	-63%
06/25/01	2,132	0.861	1.930	0 015	0.034	0.019	124%
07/23/01	2,425	0.541	1.330	0 011	0.027	0.016	146%
08/20/01	3,224	0.541	1.330	0 015	0.036	0.021	146%
09/25/01	3,037	0.674	1.481	0.017	0.038	0.020	120%
10/22/01	3,464	0.630	1.337	0.018	0.039	0.020	112%
Average	2,891	0.657	1 278	0.016	0.030	0.014	97%
Project Section 482+00							
05/21/01	2,868	0 159	0 300	0 004	0.007	0.003	89%
06/25/01	2,668	0 524	1.090	0 012	0.024	0.013	108%
07/23/01	1,394	0.226	0.426	0 003	0.005	0.002	88%
08/20/01	3,266	0.226	0.426	0.006	0.012	0.005	88%
09/25/01	3,127	0.050	0.214	0.001	0.006	0.004	328%
10/22/01	3,983	0.050	0.050	0.002	0.002	0.000	0%
Average	2,884	0.206	0 418	0.005	0.009	0.005	117%
Project Section 484+50							
05/21/01	3,245	0 915	0 784	0.025	0.021	-0.004	-14%
06/25/01	2,668	1.410	1.040	0.031	0.023	-0.008	-26%
07/23/01	2,588	0.667	0.151	0 014	0.003	-0.011	-77%
08/20/01	3,245	0.667	0.151	0.018	0.004	-0.014	-77%
09/25/01	3,066	0.532	0.058	0.014	0.001	-0.012	-89%
10/22/01	3,166	0.259	0 109	0.007	0.003	-0.004	-58%
Average	2,996	0.742	0.382	0 018	0.009	-0 009	-57%
Project Area							
Average Total per day	12,720	0.399	0.513	0 047	0.054	0.008	16%

Coal Zone Groundwater Constituent Loading Calculations
Gue-70-14.10

Hardness Loadings
Based on quantity of flow and constituent concentrations for each sampling event

Location Date	Flow Quantity (gpd)	Groundwater Concentrations Upgradient (mg/l)	Downgradient (mg/l)	Groundwater Loadings Upgradient (lb/day)	Downgradient (lb/day)	Loading Increase (lb)	Percent Increase
Project Section 469+00							
05/21/01	984	116	192	0.95	1.58	0.62	66%
06/25/01	984	100	84	0.82	0.69	-0.13	-16%
07/23/01	977	116	120	0.95	0.98	0.03	3%
08/20/01	1,178	116	120	1.14	1.18	0.04	3%
09/25/01	1,062	128	520	1.13	4.61	3.47	306%
10/22/01	1,178	116	96	1.14	0.94	-0.20	-17%
Average	1,061	115	189	1.02	1.66	0.64	58%
Project Section 475+00							
05/21/01	3,024	222	56	5.60	1.41	-4.19	-75%
06/25/01	2,599	220	60	4 77	1.30	-3 47	-73%
07/23/01	2,665	224	56	4.98	1.25	-3.74	-75%
08/20/01	3,073	224	56	5.74	1 44	-4.31	-75%
09/25/01	2,877	234	46	5.62	1.10	-4.51	-80%
10/22/01	3,090	216	48	5 57	1.24	-4 33	-78%
Average	2,888	223	54	5 38	1.29	-4 09	-76%
Project Section 479+25							
05/21/01	3,064	224	178	5 73	4.55	-1 18	-21%
06/25/01	2,132	244	174	4.34	3.10	-1.25	-29%
07/23/01	2,425	220	244	4.45	4.94	0.49	11%
08/20/01	3,224	220	244	5.92	6.56	0.65	11%
09/25/01	3,037	230	238	5.83	6.03	0.20	3%
10/22/01	3,464	220	224	6 36	6.47	0.12	2%
Average	**2,891**	226	217	5.44	5.28	-0.16	-4%
Project Section 482+00							
05/21/01	2,868	80	108	1.91	2.58	0.67	35%
06/25/01	2,668	72	108	1.60	2.40	0.80	50%
07/23/01	1,394	88	124	1.02	1.44	0.42	41%
08/20/01	3,266	88	124	2.40	3.38	0.98	41%
09/25/01	3,127	106	114	2.77	2.97	0.21	8%
10/22/01	3,983	116	104	3.86	3.46	-0.40	-10%
Average	2,884	92	114	2.26	2.71	0.45	27%
Project Section 484+50							
05/21/01	3,245	228	146	6.17	3.95	-2.22	-36%
06/25/01	2.668	216	128	4.81	2.85	-1.96	-41%
07/23/01	2,588	260	136	5.62	2.94	-2.68	-48%
08/20/01	3,245	260	136	7.04	3.68	-3.36	-48%
09/25/01	3,066	234	138	5.99	3.53	-2.46	-41%
10/22/01	3,166	232	152	6.13	4.02	-2.11	-34%
Average	2,996	238	139	5.96	3.49	-2 46	-41%
Project Area							
Average Total per day	12,720	179	142	20	14	-5.63	-28%

Coal Zone Groundwater Constituent Loading Calculations
Gue-70-14.10

Alkalinity Loadings
Based on quantity of flow and constituent concentrations for each sampling event

Location Date	Flow Quantity (gpd)	Groundwater Concentrations Upgradient (mg/l)	Downgradient (mg/l)	Groundwater Loadings Upgradient (lb/day)	Downgradient (lb/day)	Loading Increase (lb)	Percent Increase
Project Section 469+00							
05/21/01	984	300	350	2 46	2.88	0.41	17%
06/25/01	984	320	360	2.63	2 96	0.33	13%
07/23/01	977	300	350	2.45	2.85	0.41	17%
08/20/01	1,178	300	350	2 95	3 44	0.49	17%
09/25/01	1,062	330	390	2 92	3.46	0.53	18%
10/22/01	1,178	325	385	3.20	3.79	0 59	18%
Average	1,061	313	364	2.77	3.23	0 46	17%
Project Section 475+00							
05/21/01	3,024	240	360	6.06	9.09	3 03	50%
06/25/01	2,599	200	390	4.34	8.46	4.12	95%
07/23/01	2,665	260	380	5 78	8.45	2.67	46%
08/20/01	3,073	260	380	6.67	9.75	3.08	46%
09/25/01	2,877	250	910	6.00	21.85	15 85	264%
10/22/01	3,090	250	425	6.45	10.96	4 51	70%
Average	2,888	243	474	5.88	11.42	5.54	95%
Project Section 479+25							
05/21/01	3,064	220	225	5.63	5.75	0.13	2%
06/25/01	2,132	230	250	4.09	4.45	0.36	9%
07/23/01	2,425	240	270	4.86	5.46	0.61	13%
08/20/01	3,224	240	270	6.46	7.26	0.81	13%
09/25/01	3,037	250	285	6.34	7.22	0.89	14%
10/22/01	3,464	250	270	7 23	7.80	0.58	8%
Average	2,891	238	262	5 77	6.33	0.56	10%
Project Section 482+00							
05/21/01	2,868	390	535	9.33	12 80	3.47	37%
06/25/01	2,668	360	210	8.02	4.68	-3.34	-42%
07/23/01	1,394	360	480	4.19	5.58	1.40	33%
08/20/01	3,266	360	480	9.81	13 08	3.27	33%
09/25/01	3,127	380	540	9.91	14 09	4.17	42%
10/22/01	3,983	375	540	12.46	17 95	5.48	44%
Average	2,884	371	464	8.95	11 36	2.41	25%
Project Section 484+50							
05/21/01	3,245	225	465	6.09	12.59	6.50	107%
06/25/01	2,668	230	470	5 12	10 46	5.34	104%
07/23/01	2,588	220	450	4.75	9.72	4.97	105%
08/20/01	3,245	220	450	5.96	12.19	6.23	105%
09/25/01	3,066	245	485	6.27	12.41	6.14	98%
10/22/01	3,166	250	470	6 60	12 42	5.81	88%
Average	2,996	232	465	5.80	11.63	5.83	101%
Project Area							
Average Total per day	12,720	279	406	29	44	14.80	51%

BBCM Columbus (614) 793-2226 Cleveland (440) 585-9995 Cincinnati (513) 771-8471

Project/Proposal No 7000.110	Calculated By CKH	Date 12/4/02
Project/Proposal Name GUE 70	Checked By TVE	Date 6/20/03
Subject GROUT DISSOLUTION	Sheet 1 of 1	

- ASSUMPTIONS
  1) TDS LOAD INCREASE REPRESENTS NET TOTAL DISSOLUTION
  2) ALL DISSOLUTION IS GROUT (NO COAL OR BEDROCK DISSOLUTION
  3) GROUT INEFFECTIVE WHEN 25% REMOVED VIA DISSOLUTION

- DISSOLUTION TIME (T) = GROUT MASS (M) / DISSOLUTION RATE (R)

M = VOLUME OF GROUT UNIT WEIGHT OF GROUT

$= (18{,}844\ \text{YDS}^3)(120\ \text{lbs/ft}^3)(27\ \text{ft}^3/\text{YDS}^3)\left(\frac{\text{TONS}}{2000\ \text{lbs}}\right)$

$= 30{,}527$ TONS

R = AVE DAILY LOAD INCREASE FOR TDS

$= 32.5$ lbs/DAY

$T = M/R$

$= (30{,}527\ \text{TONS})(1\ \text{DAY}/32.5\ \text{lbs})(2000\ \text{lbs/TON})\left(\frac{\text{YR}}{365\ \text{DAYS}}\right)$

$= 5147$ YEARS

- USEFUL LIFE = 25% OF DISSOLUTION TIME

$= (5147\ \text{YRS})(0.25)$

$\boxed{= 1{,}287\ \text{YRS}}$

RATIO OF BOYANT PRESSURE TO SOIL PRESSURE @ TOP OF WATER ZONES

PRESSURE RATIO UNITLESS $= \frac{B.P}{S.P}$

- WHERE: SP = SOIL PRESSURE IN lb/FT^2 (SEE BELOW)
  BP = BOYANT (PORE) PRESSURE IN lb/FT^2 (SEE BELOW)

- UNIT CORRECTION
  UNITLESS = psf/psf NO CORRECTION RQD.

- SP = TOTAL SOIL PRESSURE
  = UNSATURATED PRESSURE (PSF) + SATURATED PRESSURE (PSF)

  WHERE: UN-SAT P = (GROUND ELEV. - STATIC LEV.) · (UNIT WEIGHT)
  FOR UN SAT SOIL UNIT WEIGHT = 100 lb/FT^3

  SAT P = (STATIC ELEV - TOP AQUIFER ELEV.) · (UNIT WEIGHT)
  FOR SAT SOIL UNIT WEIGHT = 125 lb/FT^3

UNIT CORRECTION

$$lb/FT^2 = (FT - FT)\frac{lb}{FT^3} + (FT - FT)\frac{lb}{FT^3}$$ NONE RQD.

- BP = UPWARD BOYANT FORCE
  = (STATIC ELEV. - TOP AQUIFER ELEV.) UNIT WEIGHT
  FOR WATER USE UNIT WEIGHT OF 62.4 lb/FT^3

UNIT CORRECTION

$$lb/FT^2 = (FT - FT)\ lb/FT^3$$ NONE REQUIRED

Average Pressure Ratios
Gue-70

	Average Ratio by Date				Average
	05-Jan-00	27-Jan-00	02/14/00	03/06/00	
Coal Zone	0.38	0.37	0.38	0.38	0.38
Lower Sand	0.28	0.27	0.29	0.28	0.28
Upper Sand	0.26	0.25	0.27	0.28	0.27
Misc Sands	0.22	0.12	0.24	0.01	0.15

Ratio of Buoyant Pressure to Soil Pressure at Top of Water Bearing Zones
Gue-70-14.10

Static Level Date 05-Jan-00

	Ground Surface (msl)	Top of Aquifer (msl)	Static Level (msl)	Saturated Soil		Unsaturated Soil		Total Soil Pressure (lb/ft^2)	Buoyant Pressure (lb/ft^2)	Pressure Ratio
				Thickness (feet)	Pressure (lb/ft^2)	Thickness (feet)	Pressure (lb/ft^2)			
COAL ZONE										
P-221 A	827.1	782.0	809.52	27.5	3,440	17.6	1,762	5,202	1,717	0.33
P-222 A	820.7	760.0	809.51	49.5	6,189	11.2	1,121	7,310	3,089	0.42
P-223 A	826.6	756.2	808.22	52.0	6,502	18.4	1,840	8,342	3,246	0.39
P-224 A	821.7	758.7	809.50	50.8	6,350	12.2	1,220	7,570	3,170	0.42
P-225 A	839.1	762.4	808.06	45.7	5,707	31.0	3,104	8,811	2,849	0.32
P-226 A	827.7	758.6	808.05	49.5	6,181	19.7	1,965	8,146	3,086	0.38
P-227 A	830.6	760.2	808.04	47.8	5,980	22.6	2,256	8,236	2,985	0.36
P-228 A	828.7	756.8	809.58	52.8	6,598	19.1	1,912	8,510	3,293	0.39
									Average	**0.38**
LOWER SAND										
P-221 B	826.9	795 9	809.57	13.7	1,706	17.3	1,735	3,441	852	0.25
P-222 B	820.8	792.6	809 36	16.8	2,095	11.5	1,148	3,243	1,046	0.32
P-228 B	828.5	789.7	808.97	19.3	2,409	19.5	1,953	4,362	1,202	0.28
									Average	**0.28**
UPPER SAND										
P-221 C	826.8	804.4	814.25	9.8	1,231	12.5	1,251	2,482	615	0.25
P-223 B	826.4	803.2	814.70	11.5	1,438	11.7	1,170	2,608	718	0.28
P-228 C	828.7	802.7	814.75	12.0	1,506	14.0	1,395	2,901	752	0.26
									Average	**0.26**
MISC. SANDS										
P-222 C	820.8	809.6	817.66	8.1	1,007	3.2	315	1,323	503	0 38
P-224 B	821.8	811.8	812.68	0 9	110	9.1	912	1,022	55	0.05
									Average	**0.22**

Ratio of Buoyant Pressure to Soil Pressure at Top of Water Bearing Zones
Gue-70-14.10

Static Level Date 27-Jan-00

	Ground Surface (msl)	Top of Aquifer (msl)	Static Level (msl)	Saturated Soil Thickness (feet)	Saturated Soil Pressure (lb/ft^2)	Unsaturated Soil Thickness (feet)	Unsaturated Soil Pressure (lb/ft^2)	Total Soil Pressure (lb/ft^2)	Buoyant Pressure (lb/ft^2)	Pressure Ratio
COAL ZONE										
P-221 A	827.1	782.0	808.78	26.8	3,348	18.4	1,836	5,184	1,671	0.32
P-222 A	820.7	760.0	808.74	48.7	6,093	12 0	1,198	7,290	3,041	0.42
P-223 A	826.6	756.2	806.74	50.5	6,317	19.9	1,988	8,306	3,154	0.38
P-224 A	821.7	758.7	808.72	50.0	6,252	13.0	1,298	7,551	3,121	0.41
P-225 A	839.1	762.4	806.50	44.1	5,512	32.6	3,260	8,772	2,752	0.31
P-226 A	827.7	758.6	806.47	47.9	5,984	21.2	2,123	8,107	2,987	0.37
P-227 A	830.6	760.2	806.46	46.3	5,783	24.1	2,414	8,196	2,887	0.35
P-228 A	828.7	756.8	808.23	51.4	6,429	20.5	2,047	8,476	3,209	0.38
									Average	**0.37**
LOWER SAND										
P-221 B	826 9	795.9	808.90	13.0	1,623	18.0	1,802	3,425	810	0.24
P-222 B	820.8	792.6	808.52	15.9	1,990	12.3	1,232	3,222	993	0.31
P-228 B	828.5	789.7	808.51	18.8	2,351	20.0	1,999	4,350	1,174	0.27
									Average	**0.27**
UPPER SAND										
P-221 C	826.8	804.4	814.02	9.6	1,202	12.7	1,274	2,476	600	0.24
P-223 B	826.4	803.2	814.39	11.2	1,399	12.0	1,201	2,600	698	0.27
P-228 C	828.7	802.7	814.33	11.6	1,454	14.4	1,437	2,891	726	0.25
									Average	**0.25**
MISC. SANDS										
P-222 C	820.8	809.6	815.03	5.4	679	5.8	578	1,257	339	0.27
P-224 B	821.8	811.8	811.46	-0.3	(42)	10.3	1,034	992	(21)	-0.02
									Average	**0.12**

Ratio of Buoyant Pressure to Soil Pressure at Top of Water Bearing Zones
Gue-70-14.10

Static Level Date 14-Feb-00

	Ground Surface (msl)	Top of Aquifer (msl)	Static Level (msl)	Saturated Soil		Unsaturated Soil		Total Soil Pressure (lb/ft^2)	Buoyant Pressure (lb/ft^2)	Pressure Ratio
				Thickness (feet)	Pressure (lb/ft^2)	Thickness (feet)	Pressure (lb/ft^2)			
COAL ZONE										
P-221 A	827.1	782.0	809.99	28.0	3,499	17.2	1,715	5,214	1,747	0.33
P-222 A	820.7	760.0	809.90	49.9	6,238	10.8	1,082	7,319	3,114	0.43
P-223 A	826.6	756.2	808.30	52.1	6,512	18.3	1,832	8,345	3,251	0.39
P-224 A	821.7	758.7	809.90	51.2	6,400	11.8	1,180	7,580	3,195	0.42
P-225 A	839.1	762.4	808.10	45.7	5,712	31.0	3,100	8,812	2,852	0.32
P-226 A	827.7	758.6	808.08	49.5	6,185	19.6	1,962	8,147	3,088	0.38
P-227 A	830.6	760.2	808.07	47.9	5,984	22.5	2,253	8,237	2,987	0.36
P-228 A	828.7	756.8	809.46	52.7	6,583	19.2	1,924	8,507	3,286	0.39
									Average	**0.38**
LOWER SAND										
P-221 B	826.9	795.9	809.91	14.0	1,749	17.0	1,701	3,450	873	0.25
P-222 B	820.8	792.6	809.57	17.0	2,121	11.3	1,127	3,248	1,059	0.33
P-228 B	828.5	789.7	809.64	19.9	2,493	18.9	1,886	4,379	1,244	0.28
									Average	**0.29**
UPPER SAND										
P-221 C	826.8	804.4	814.67	10.3	1,284	12.1	1,209	2,493	641	0.26
P-223 B	826.4	803.2	815.02	11.8	1,478	11.4	1,138	2,616	738	0.28
P-228 C	828.7	802.7	815.02	12.3	1,540	13.7	1,368	2,908	769	0.26
									Average	**0.27**
MISC. SANDS										
P-222 C	820.8	809.6	817.76	8.2	1,020	3.0	305	1,325	509	0.38
P-224 B	821.8	811.8	813.51	1.7	214	8.3	829	1,043	107	0.10
									Average	**0.24**

Ratio of Buoyant Pressure to Soil Pressure at Top of Water Bearing Zones
Gue-70-14.10

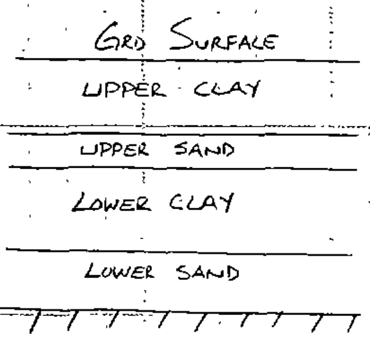
Static Level Date 06-Mar-00

	Ground Surface (msl)	Top of Aquifer (msl)	Static Level (msl)	Saturated Soil Thickness (feet)	Saturated Soil Pressure (lb/ft^2)	Unsaturated Soil Thickness (feet)	Unsaturated Soil Pressure (lb/ft^2)	Total Soil Pressure (lb/ft^2)	Buoyant Pressure (lb/ft^2)	Pressure Ratio
COAL ZONE										
P-221 A	827.1	782.0	809.46	27.5	3,433	17.7	1,768	5,201	1,714	0.33
P-222 A	820.7	760.0	809.43	49.4	6,179	11.3	1,129	7,308	3,084	0.42
P-223 A	826.6	756.2	808.54	52.3	6,542	18.1	1,808	8,350	3,266	0.39
P-224 A	821.7	758.7	809.40	50.7	6,338	12.3	1,230	7,568	3,164	0.42
P-225 A	839.1	762.4	808.04	45.6	5,705	31.1	3,106	8,811	2,848	0.32
P-226 A	827.7	758.6	808.04	49.4	6,180	19.7	1,966	8,146	3,085	0.38
P-227 A	830.6	760.2	808.03	47.8	5,979	22.6	2,257	8,236	2,985	0.36
P-228 A	828.7	756.8	809.18	52.4	6,548	19.5	1,952	8,500	3,269	0.38
									Average	**0.38**
LOWER SAND										
P-221 B	826.9	795.9	809.67	13 8	1,719	17 3	1,725	3,444	858	0.25
P-222 B	820.8	792.6	809.53	16.9	2,116	11.3	1,131	3,247	1,056	0.33
P-228 B	828.5	789.7	809.35	19.6	2,456	19.2	1,915	4,371	1,226	0.28
									Average	**0.28**
UPPER SAND										
P-221 C	826.8	804.4	815.31	10.9	1,364	11.5	1,145	2,509	681	0.27
P-223 B	826.4	803.2	815.66	12.5	1,557	10.7	1,074	2,632	778	0.30
P-228 C	828.7	802.7	815.62	12.9	1,615	13.1	1,308	2,923	806	0.28
									Average	**0.28**
MISC. SANDS										
P-222 C	820.8	809.6	809.39	-0.2	-26	11.4	1,142	1,116	-13	-0.01
P-224 B	821.8	811 8	812.22	0.4	52	9.6	958	1,010	26	0.03
									Average	**0.01**

Piping Potential Calculations

- Filter Evaluation

$$\frac{D_{15}\ \text{Filter}}{D_{85}\ \text{Soil}} < 4 \text{ to } 5 < \frac{D_{15}\ \text{Filter}}{D_{15}\ \text{Soil}} < 40 \quad \text{AND} \quad \frac{D_{50}\ \text{Filter}}{D_{50}\ \text{Soil}} \leq 25$$



Based on Composite of Gradation Curves

	D_{15}		D_{50}		D_{85}	
	MIN	MAX	MIN	MAX	MIN	MAX
UPPER C.	0.001	0.002	0.006	0.02	0.028	0.17
UPPER S.	0.009	0.04	0.24	0.60	N.R.	N.R.
LOWER C.	0.001	0.003	0.01	0.03	0.03	0.07
LOWER S.	0.03	0.1	0.8	1.3	N.R.	N.R.

- Upper Clay & Upper Sand

	MIN		MAX	
$\frac{D_{15}F}{D_{85}S}$	$\frac{0.009}{0.17} = 0.05$	OK	$\frac{0.04}{0.028} = 1.4$	OK
$\frac{D_{15}F}{D_{15}S}$	$\frac{0.009}{0.002} = 4.5$ (MARGINAL)	OK	$\frac{0.04}{0.001} = 40$	OK (MARGINAL)
$\frac{D_{50}F}{D_{50}S}$	$\frac{0.24}{0.02} = 12$	OK	$\frac{0.6}{0.006} = 100$	TOO HIGH

PIPING POTENTIAL CALCS. (CON'T)

- UPPER SAND AND LOWER CLAY

	MIN		MAX	
$\frac{D_{15}F}{D_{85}S}$	$\frac{0.009}{0.07} = 0.13$	OK	$\frac{0.04}{0.003} = 13$	TOO HIGH
$\frac{D_{15}F}{D_{15}S}$	$\frac{0.009}{0.003} = 3$	TOO LOW	$\frac{0.04}{0.001} = 40$	OK (MARGINAL)
$\frac{D_{50}F}{D_{50}S}$	$\frac{0.24}{0.03} = 8$	OK	$\frac{0.60}{0.01} = 60$	TOO HIGH

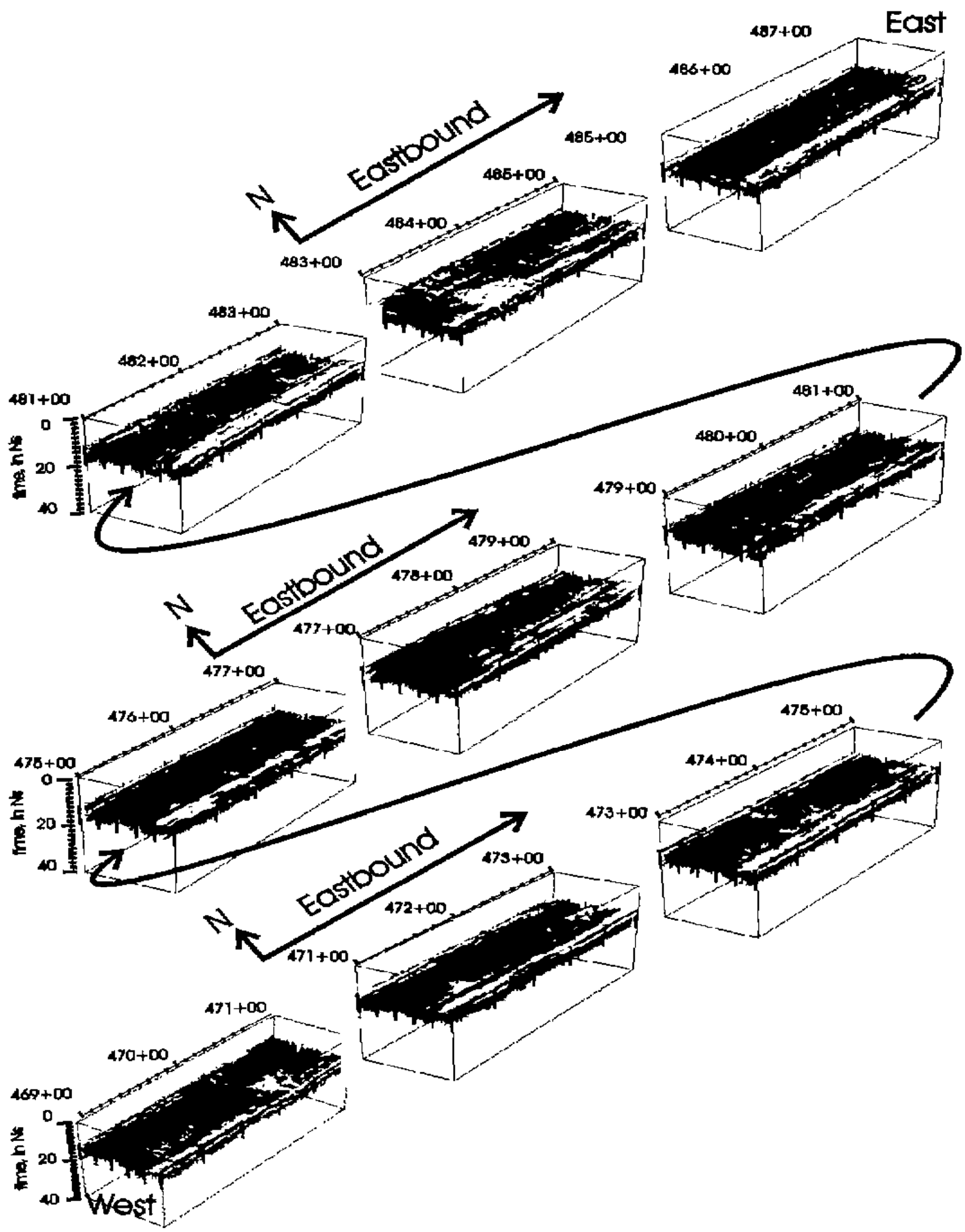
- LOWER CLAY AND LOWER SAND

	MIN		MAX	
$\frac{D_{15}F}{D_{85}S}$	$\frac{0.03}{0.07} = 0.43$	OK	$\frac{0.1}{0.03} = 3.3$	OK
$\frac{D_{15}F}{D_{15}S}$	$\frac{0.03}{0.003} = 10$	OK	$\frac{0.1}{0.001} = 100$	TOO HIGH
$\frac{D_{50}F}{D_{50}S}$	$\frac{0.8}{0.03} = 26$	TOO HIGH (MARGINAL)	$\frac{1.3}{0.01} = 130$	TOO HIGH

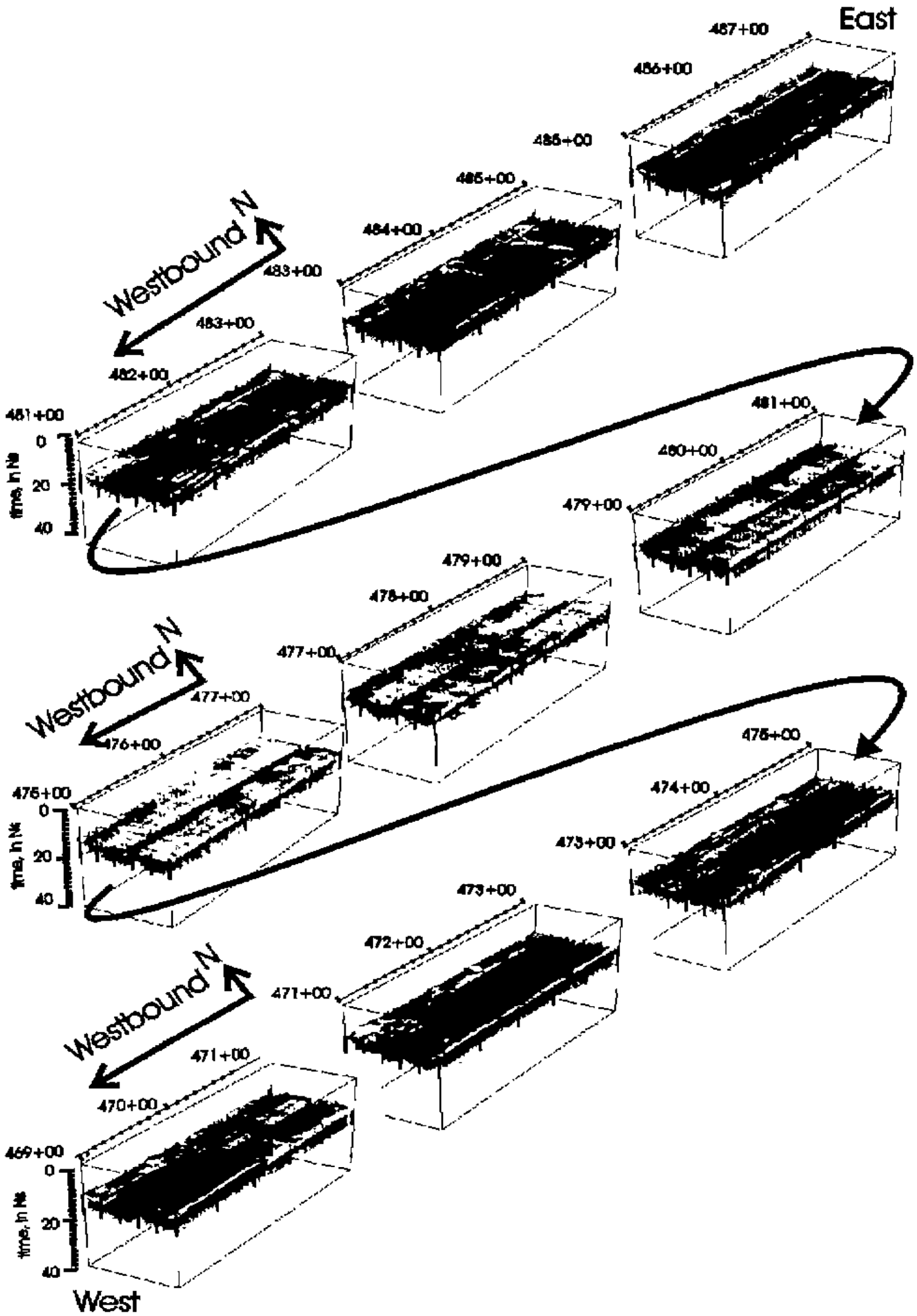
GUE-70-14.10
CALCULATION OF THE EFFECTIVENESS OF GROUTING
011-07000-120
Calc by: TVE
Rev. by: CKH

Borings Encountered Grout at Coal Zone	Grout Thickness (feet)	Void Thickness (feet)	Grout/(Grout + Void) (%)
B-009	5.0	0.0	100.0%
B-106	5.9	0.0	100.0%
B-111	4.1	1.5	73.2%
B-115	5.5	0 0	100.0%
B-122	4.1	1.4	74.5%
B-123	1.8	0.0	100.0%
B-407-G	4.8	0.9	84.2%
B-413-E	4.8	0.0	100.0%
B-413-H	5.0	0.0	100.0%
GC-212	0.8	3.2	20.0%
GC-213	2.2	2.5	46.8%
GC-217	4.5	1.5	75.0%
GC-301	3.6	0.0	100.0%
GC-304	5.6	0.0	100.0%
GC-306	6.8	0.0	100.0%
P-221-A	3.7	0.0	100.0%
P-228-A	4.5	0.6	88.2%
P-307-A	6.3	0.0	100.0%
P-308-A	5.6	1.5	78.9%
Totals	84.6	13.1	86.6%

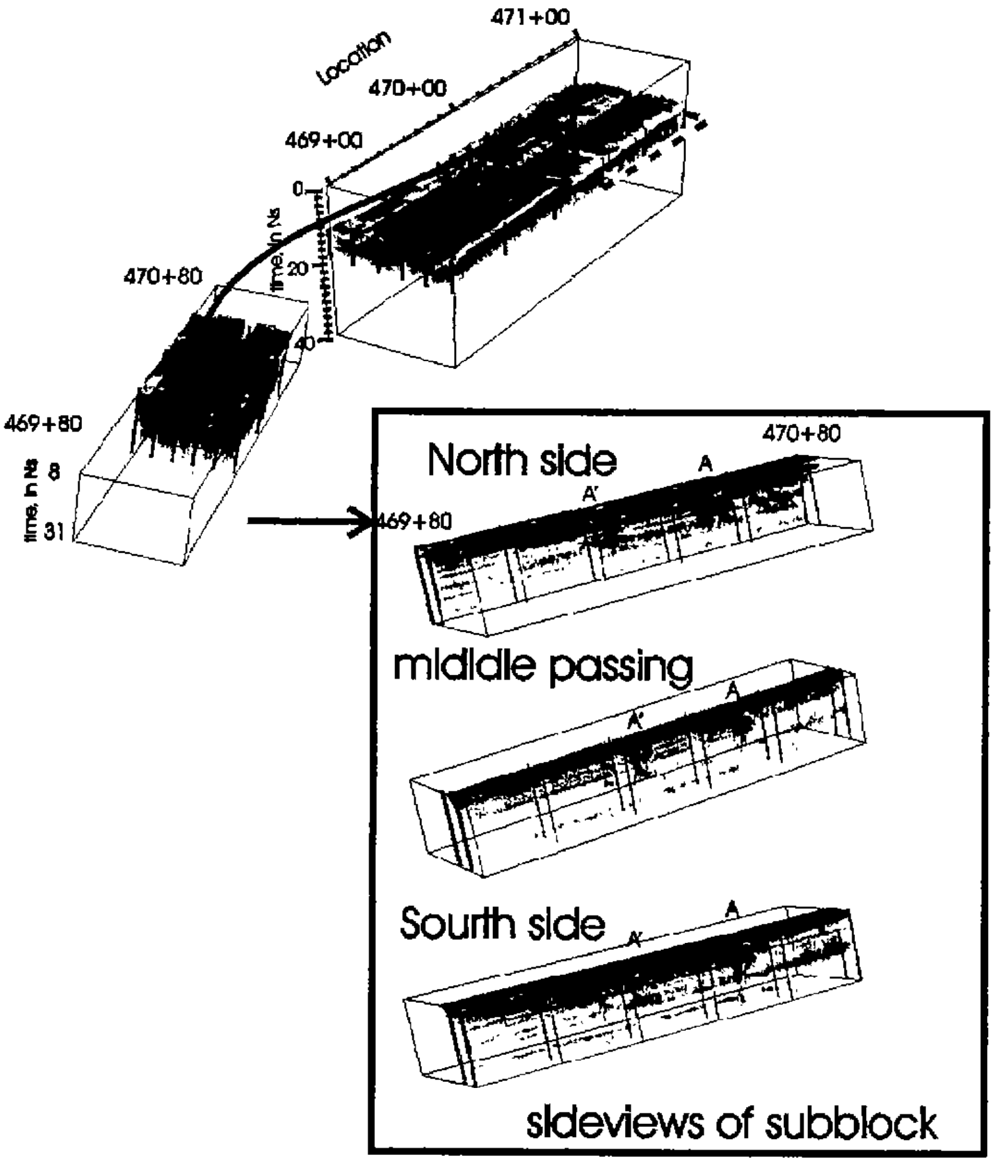
SECTION 9.4 - GEOPHYSICAL DATA



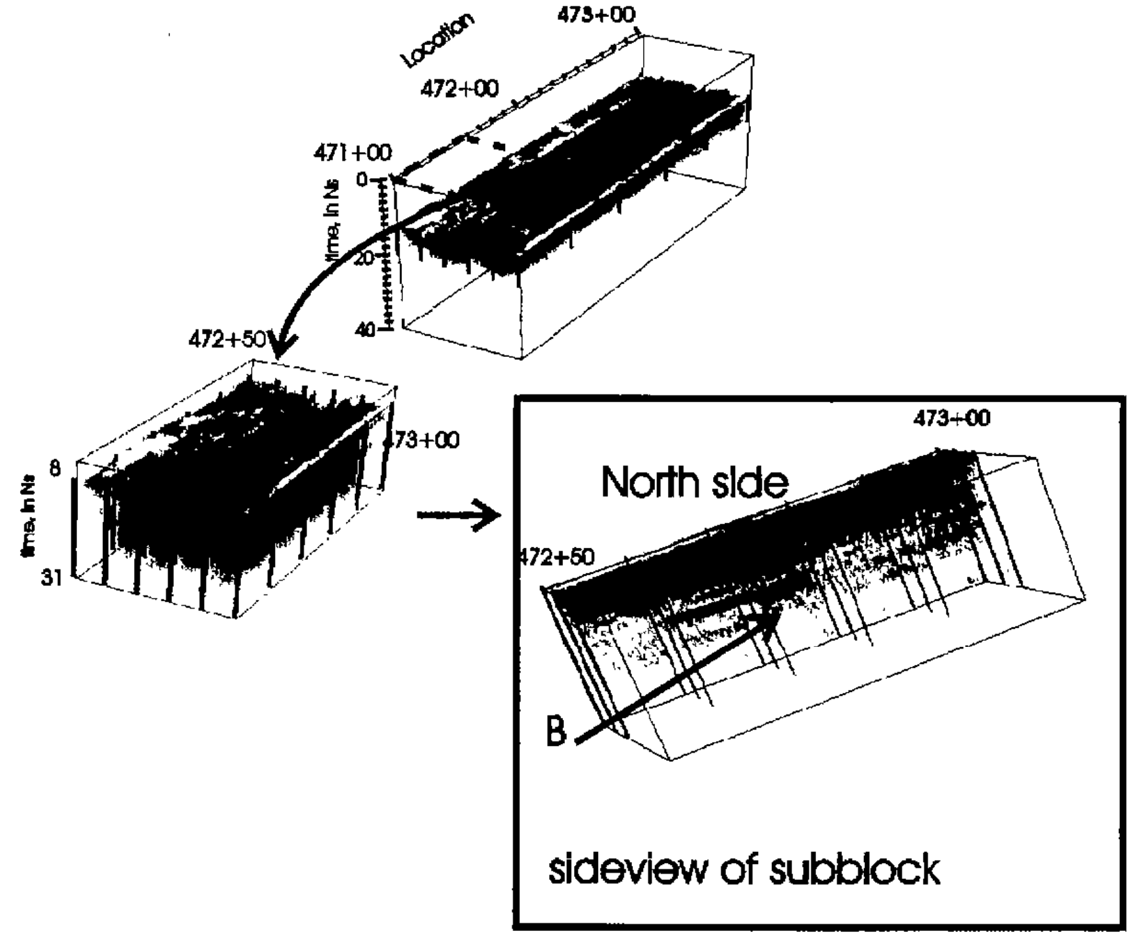
Basic block views of GPR data from eastbound lanes.



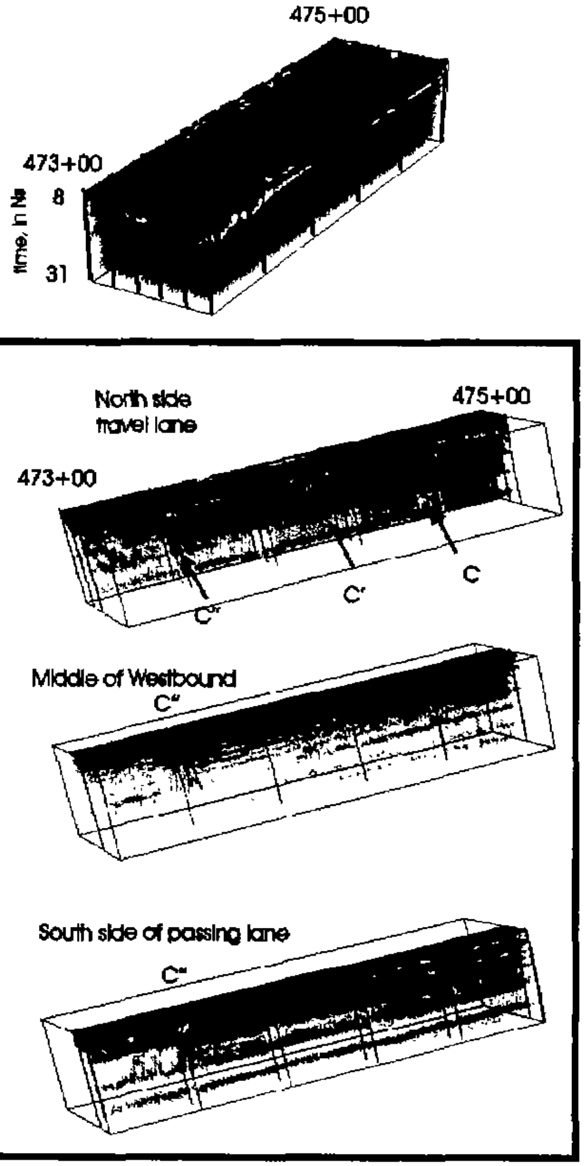
Basic block views of GPR data from the westbound lanes.



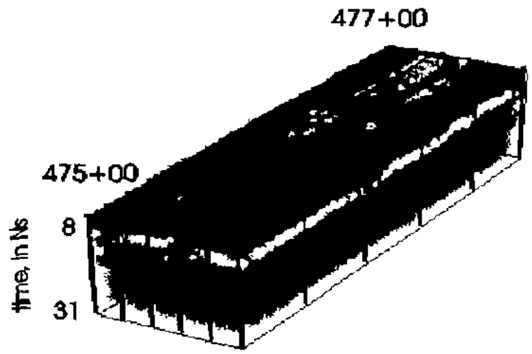
Westbound data www. Anomaly A is shallow and non-layered. Anomaly A' is layered and shallow. Both anomalies extend across the road, but stronger on the traveling lane side. Mine workings are located to the west of the anomalies (469+00 to 469+50). Could be construction features.

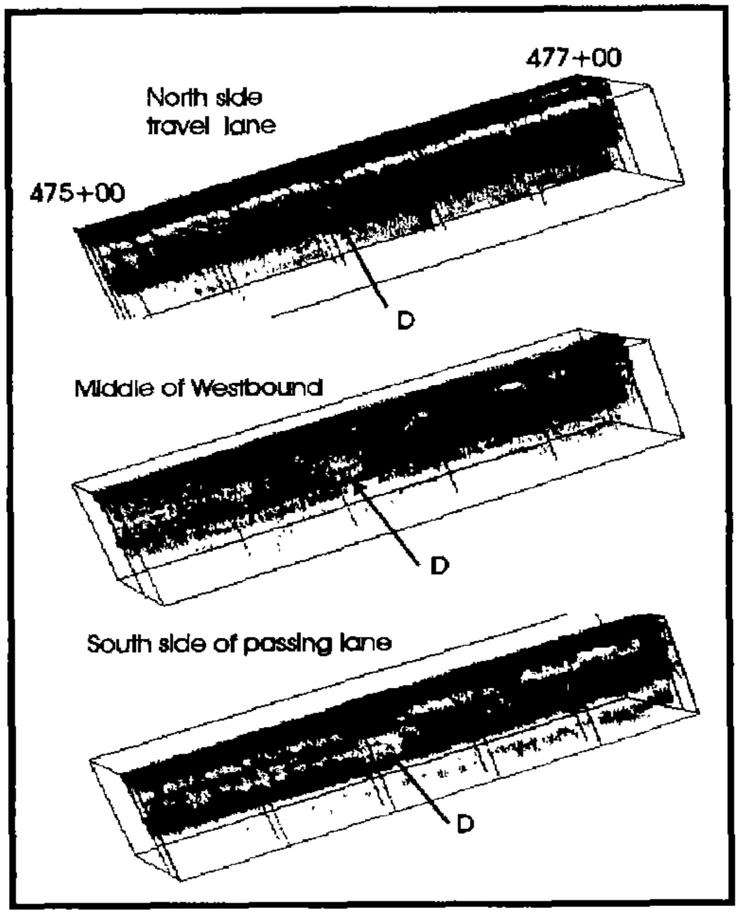


Westbound block wwm. Anomaly B appears to be layerd, may be a shallow slump feature. Large mine complex to the east (starting at 474+00). Anomaly is primarily on the North (traveling lane side).

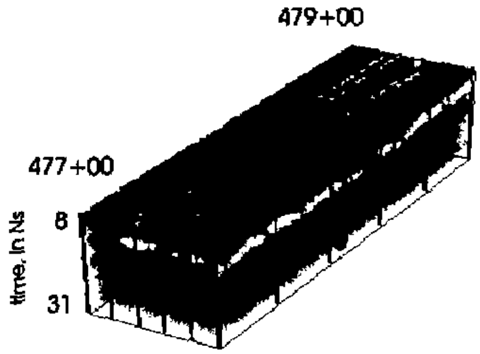


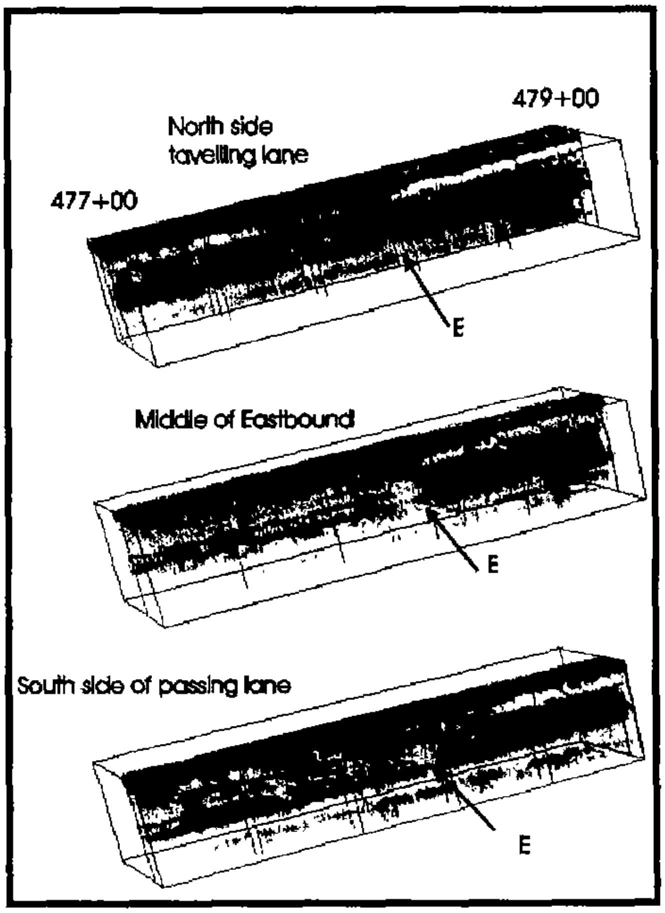
Westbound block wwe. Anomaly expressions are shallow, but anomalies also show an extended anomaly deeper (still shallow). Anomaly C'' may be the edge of the landbridge. Mine workings directly underneath all three anomalies.



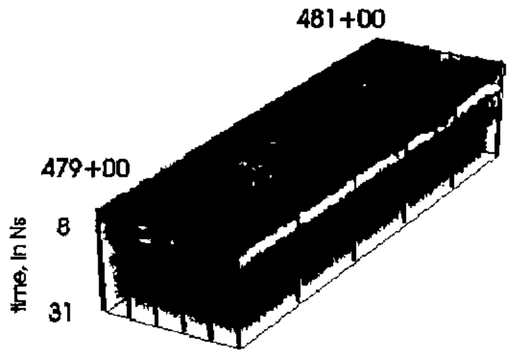


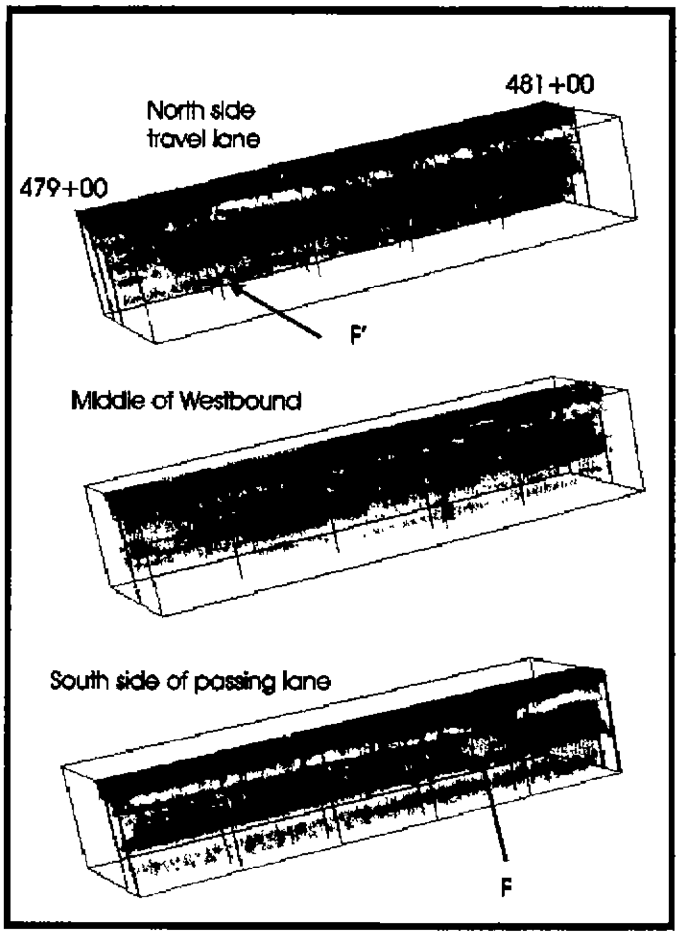
Westbound block wmw. Anomaly D appears to have some depth extend in the middle of the westbound lanes. This anomaly may be construction related (e.g., thicker, or thinner, roadbed). Previous roadway surface depressions and remediated regions were observed from 474+50 to 475+50 and from 476+50 to 478+00. Anomaly D could be a non-remediated area in between the remediated areas.



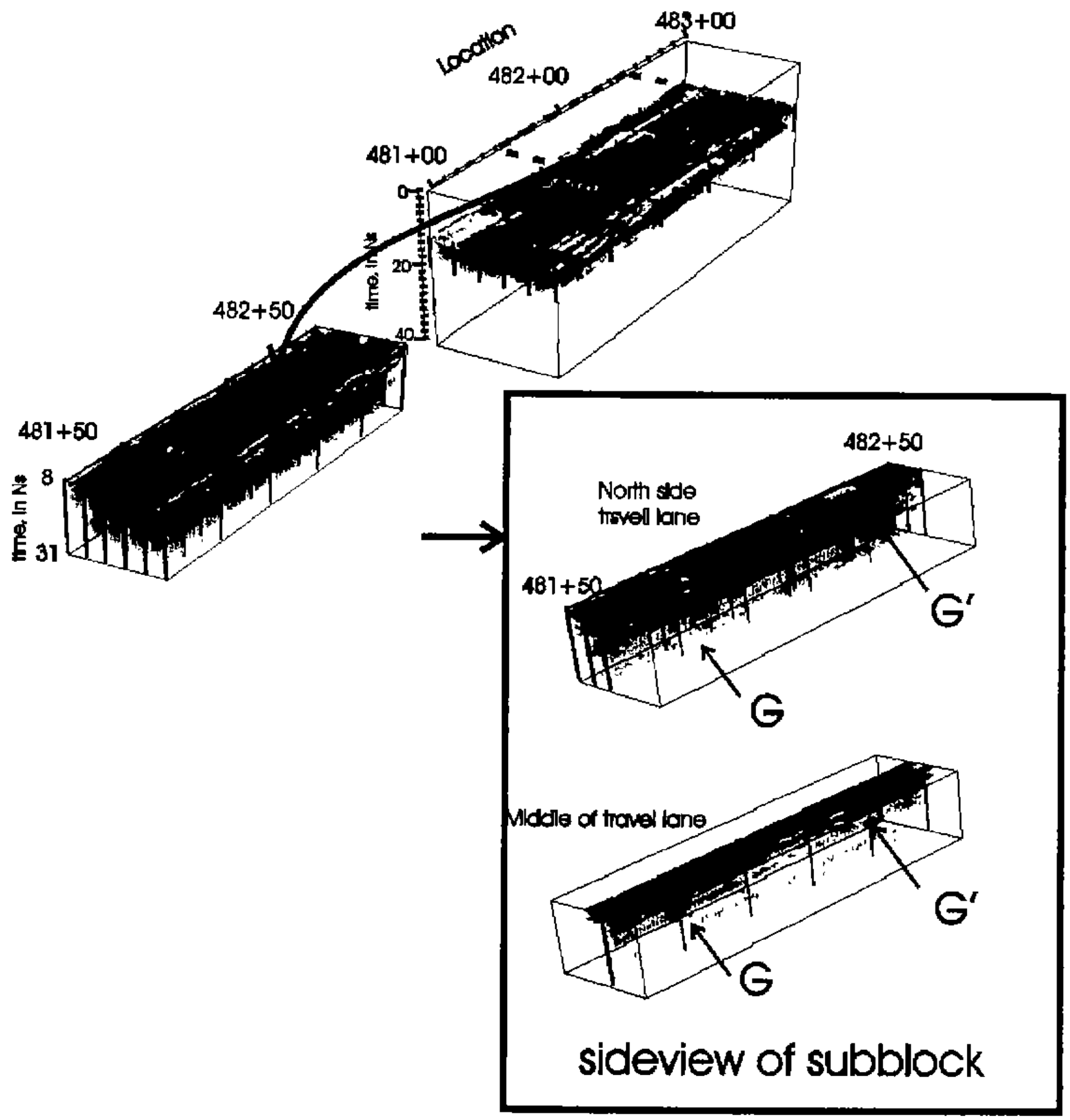


Westbound block wmm. Anomaly E is probably construction related. Arrow shows the edge of a change in the road construction. Anomaly E may be related to a previously depressed and remediated area to the east of 478+00. The arrow marks the edge of this remediated area. There was a sinkhole that previously occurred in the median at 478+25.

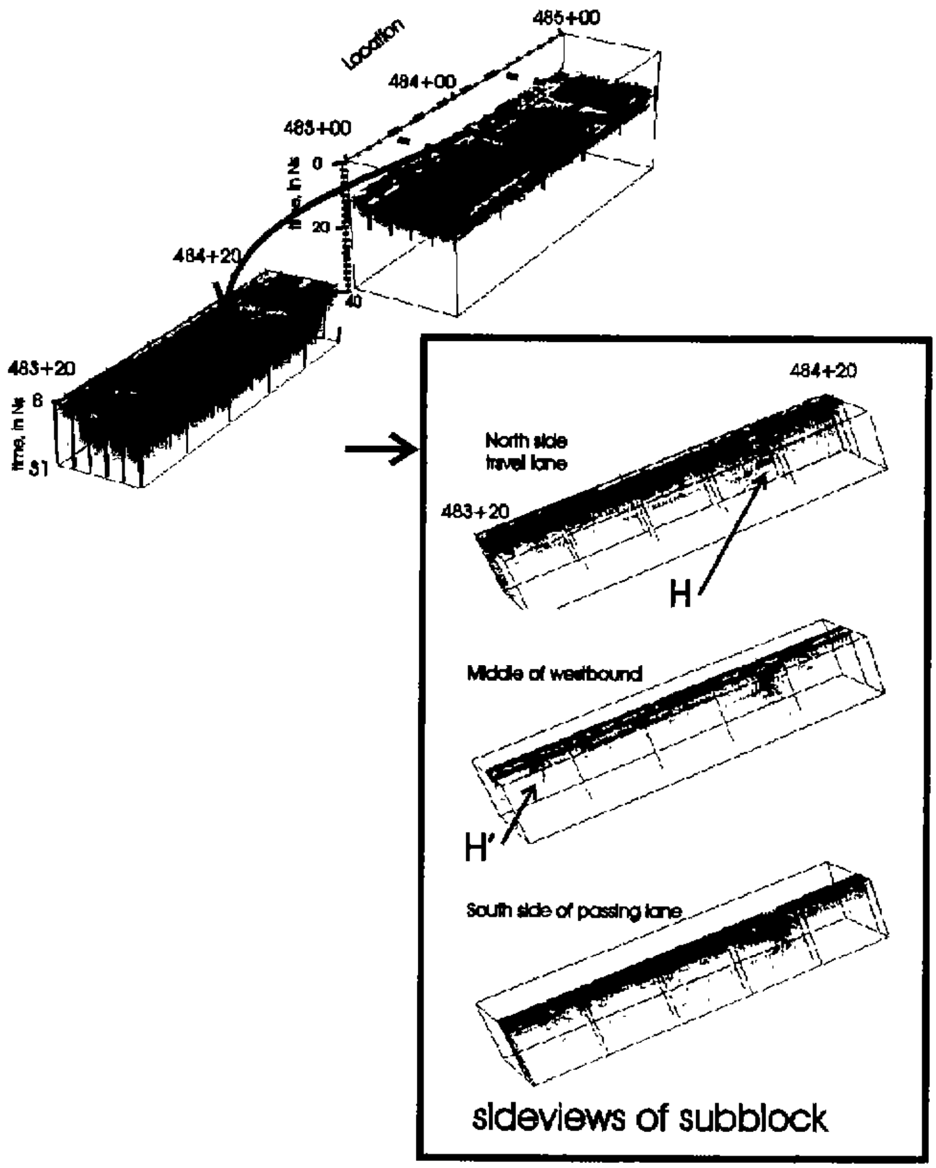




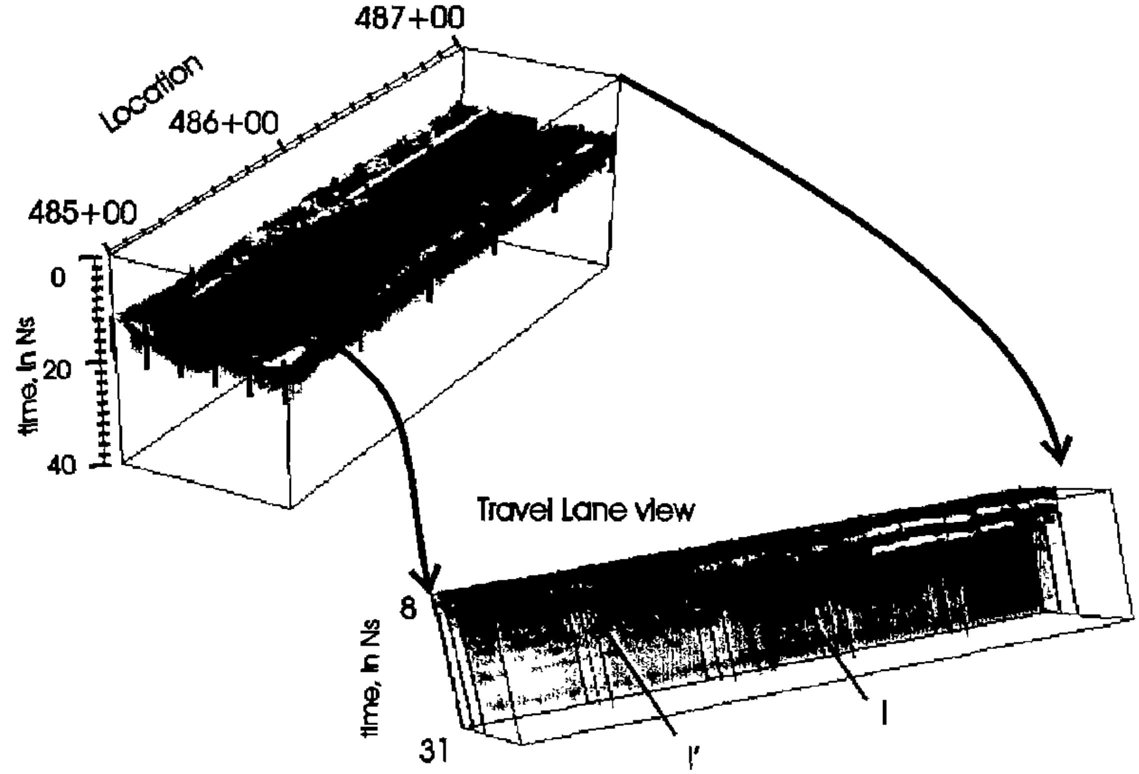
Westbound block wme. Anomaly F is off the roadbed (on the median side of the traveling lane). It appears to be a slump, but may be related to a trench and/or drain. Anomaly F' on the north side (travel lane) appears to be related to a change in construction (fill material, soil profile).



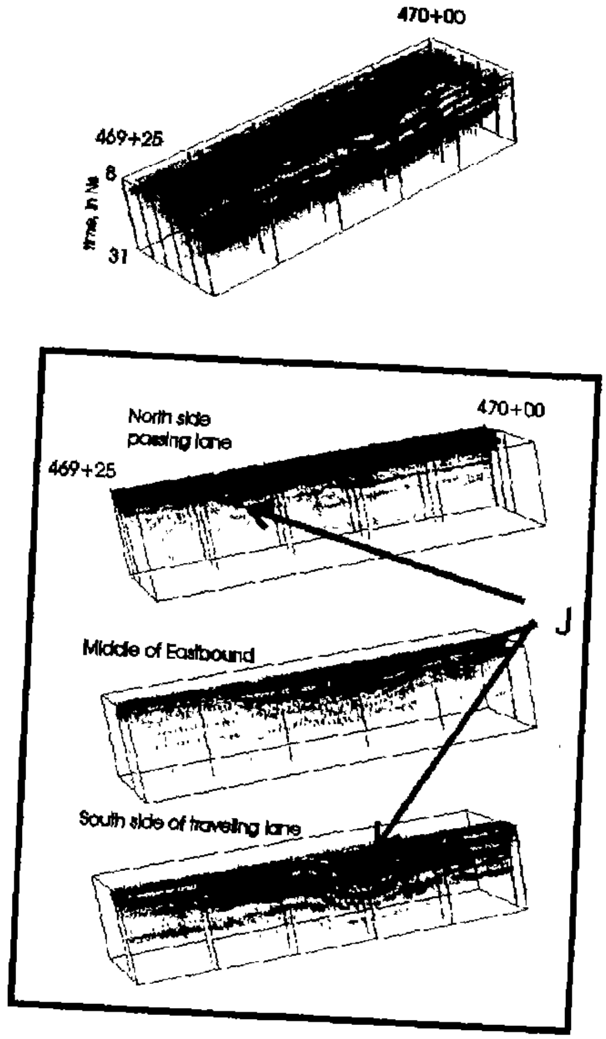
Westbound block wew. Anomaly G is a strong surface expression that appears to extend to depth. This anomaly is present over an extensive mined area. Anomaly extends from the middle of the passing lane to the north side of the road (berm of travel lane).



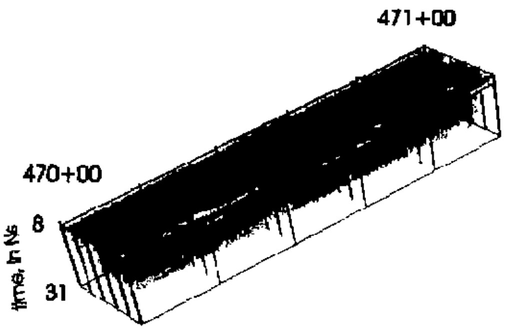
Westbound block wem. Anomaly H is a surface expression that extends across the road (travel-to-passing lane). The anomaly has depth, and appears to have offset (fracturing) on the south side of the passing lane. Anomaly H' is a shallow feature near the middle of the road.

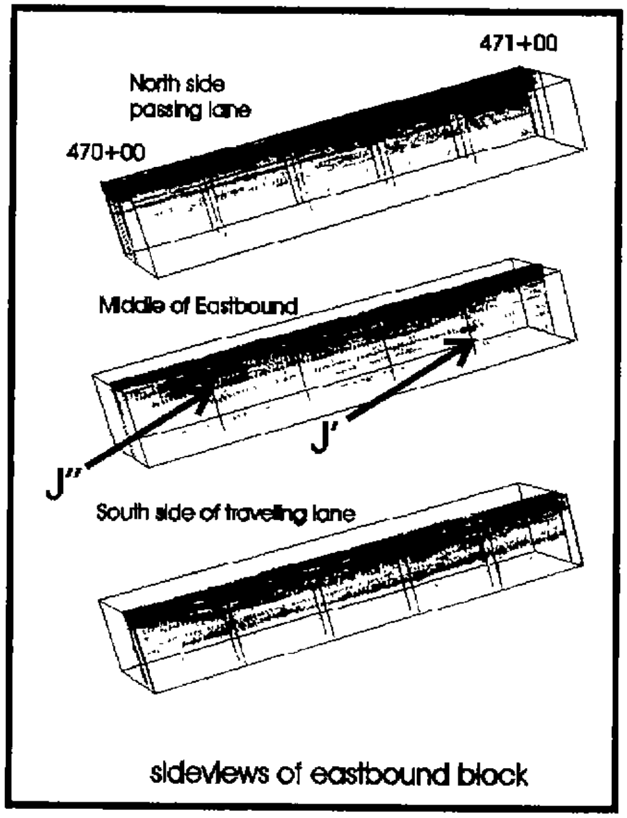


Westbound block wee. Lateral change occurs in the roadbed conditions. Anomalies I and I' are shallow, and probably related to roadbed changes. Anomaly I has an indication of moderate depth extent. Area from 484+00 to 485+50 is currently being monitored for subsidence, which is the point of change in the subsurface. The area west of 485+50 has probably been previously remediated.

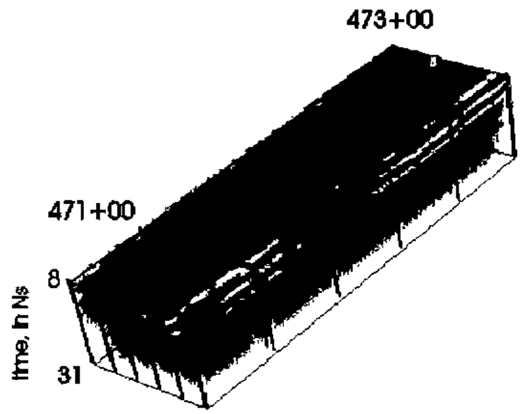


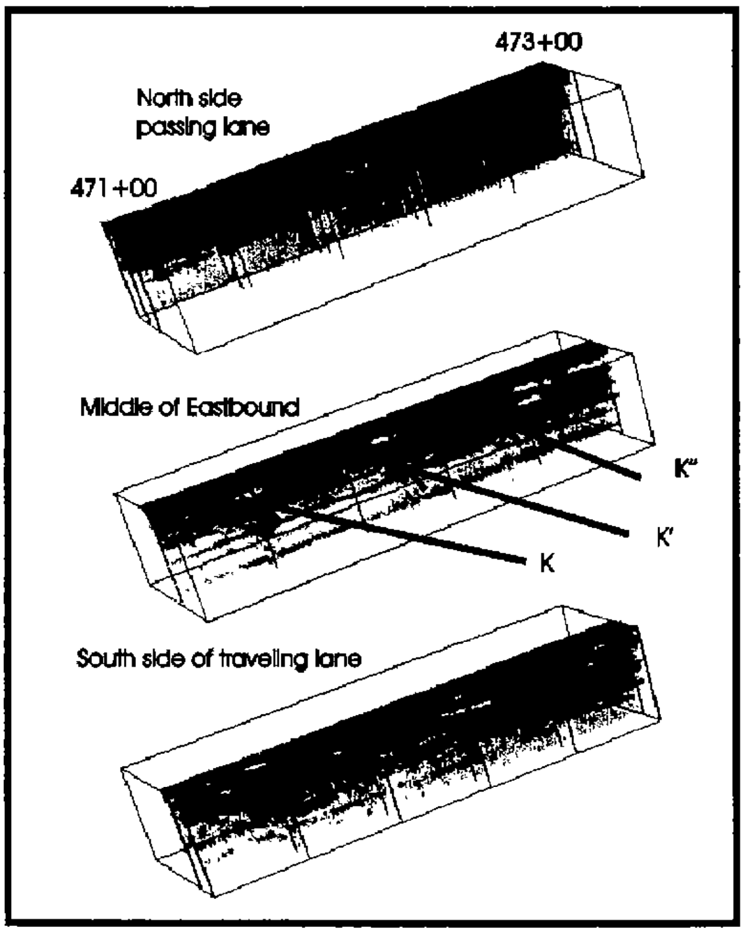
Eastbound block view eww. Anomaly J is a clear, broad slump. Probably already remediated.



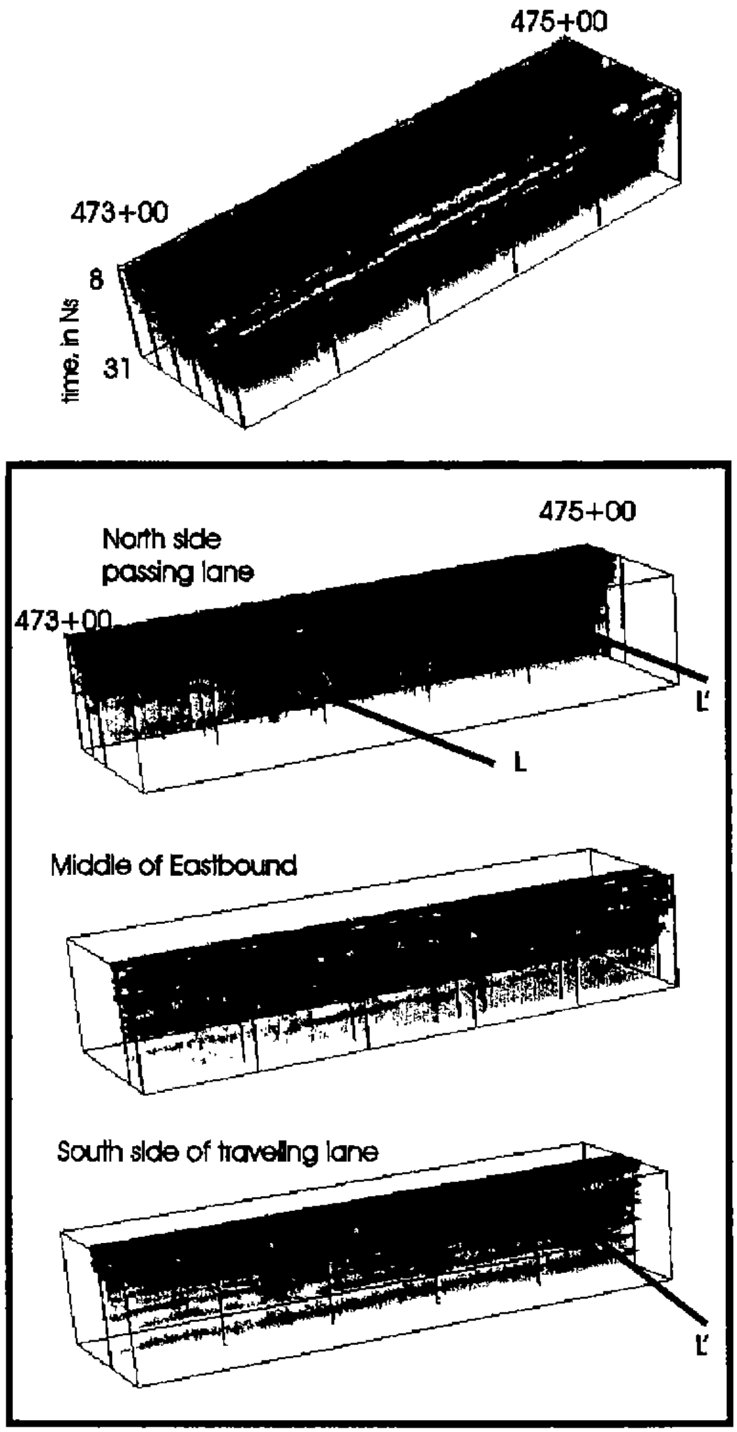


Eastbound block eww. Anomaly J' are shallow anomalies with some offset (fracturing). Neither anomaly appears to be associated with a shallow void.

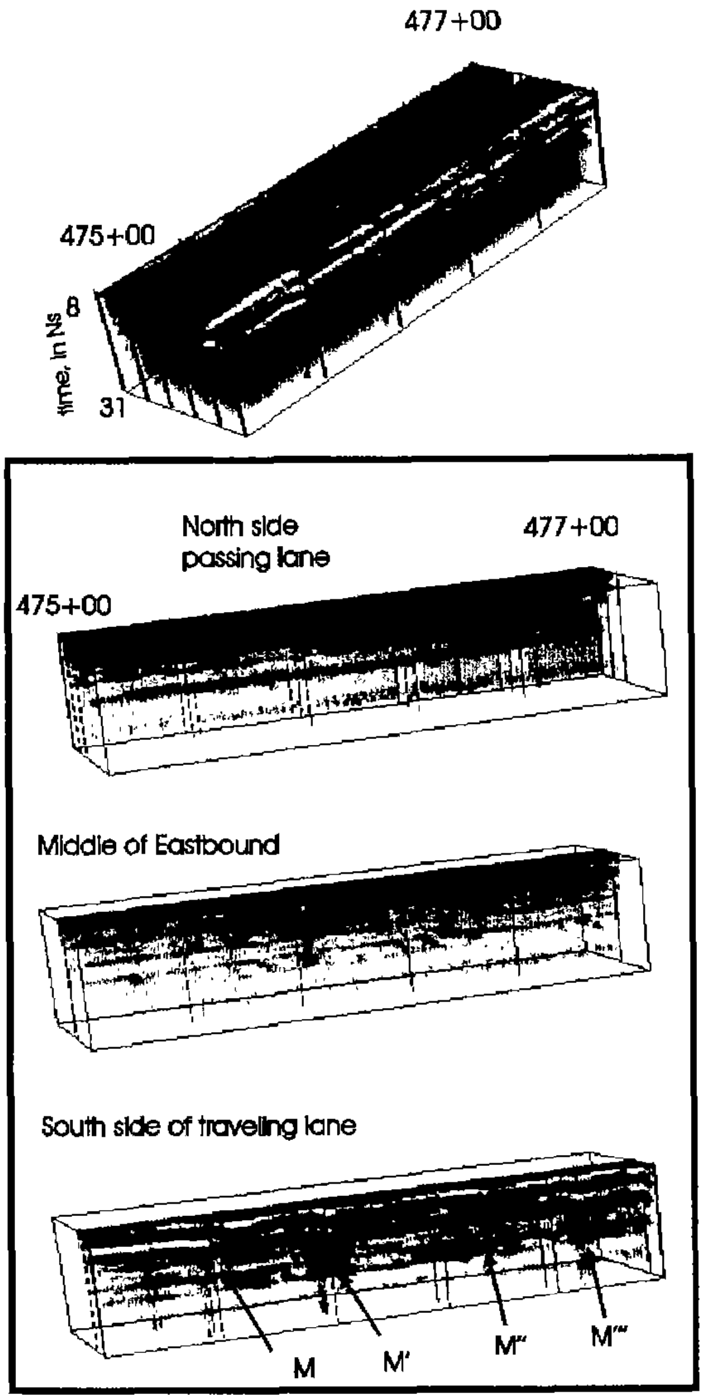




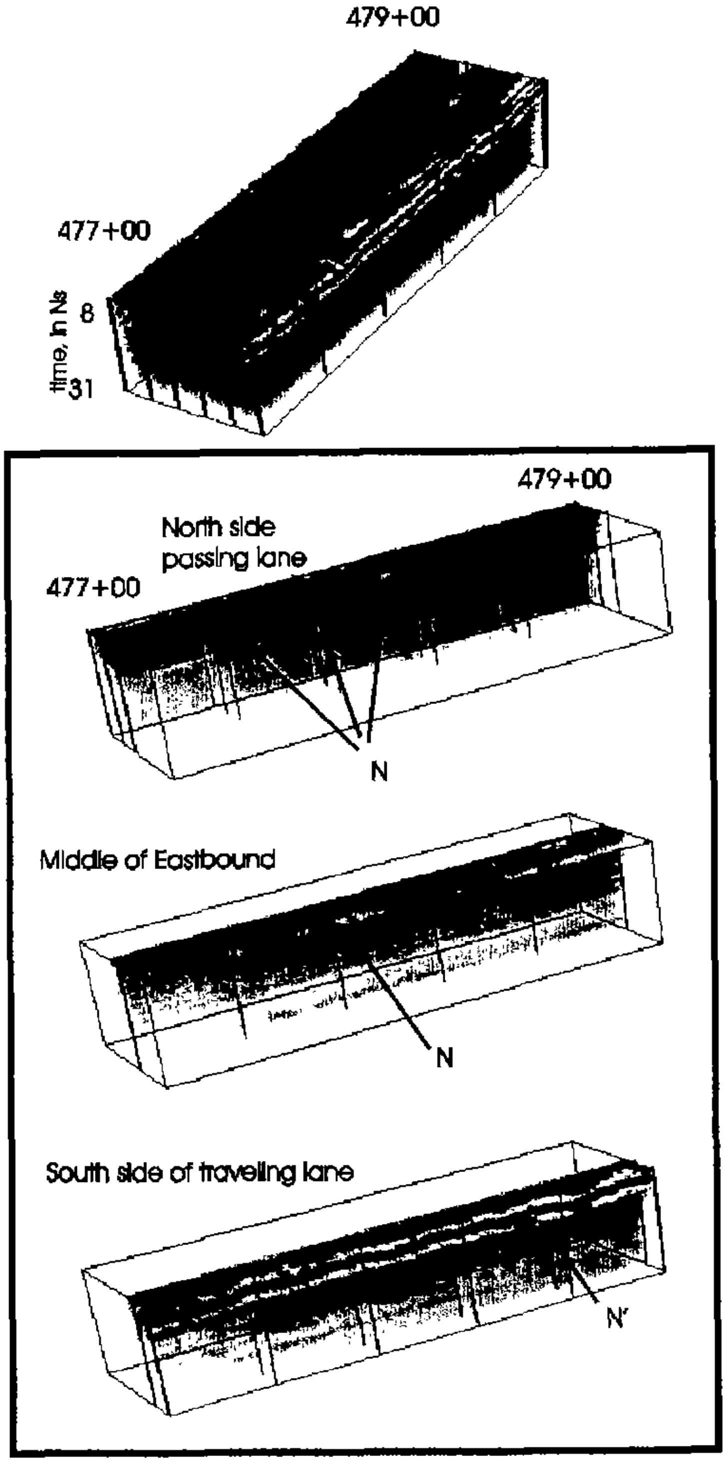
Eastbound block ewm. This is a complex shallow area. Anomalies K, K', and K" do not have clear specific expressions, but represent shallow changes in the overburden profile. There are no mapped mines beneath this block. Area from 471 to 472+50 is an area of previously observed roadway surface depression and likely remediation. Anomaly K" warrants attention.



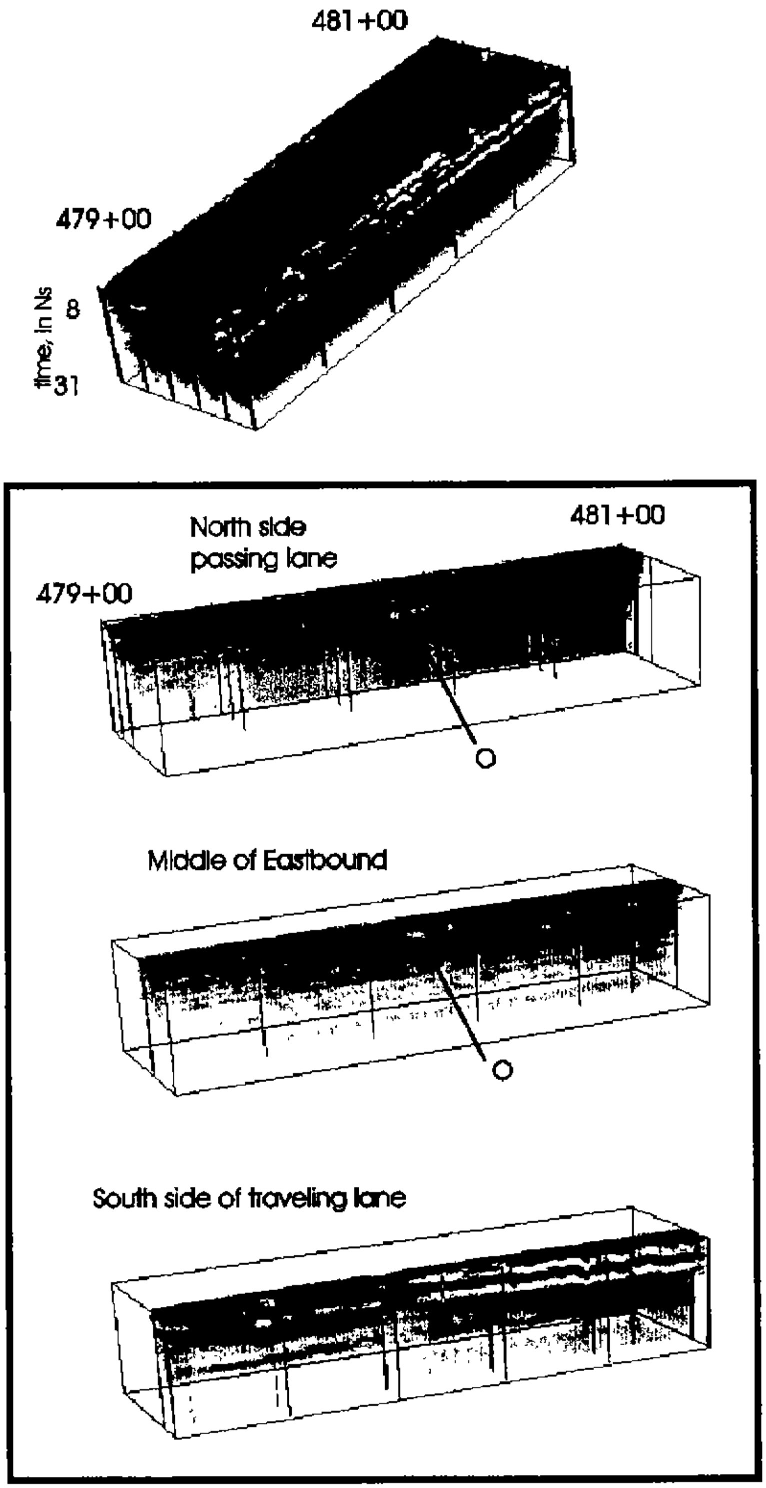
Eastbound block ewe. Region of disturbance. Anomaly L appears to have some offset. Slumping but no indication of voids very near the surface. Previous slumping reported from 473+90 to 474+75, so this area has probably been remediated. The area from 474+00 to 475+00 is currently being monitored. A mine haulage is present beneath 474+50 to 475+25.



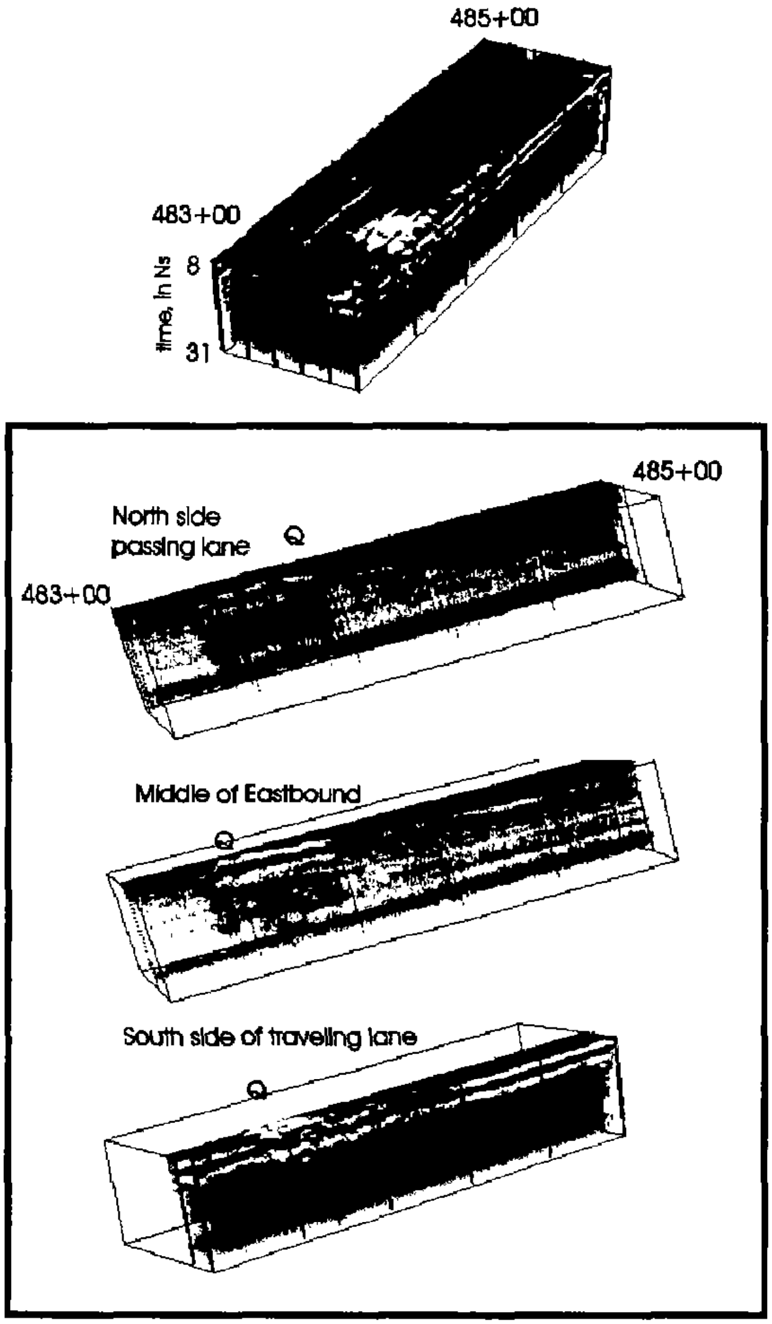
Eastbound block emw. Overall changes in the overburden profiles along the south side of the traveling lane. Anomalies M, M', and M'' show slumping and offset.



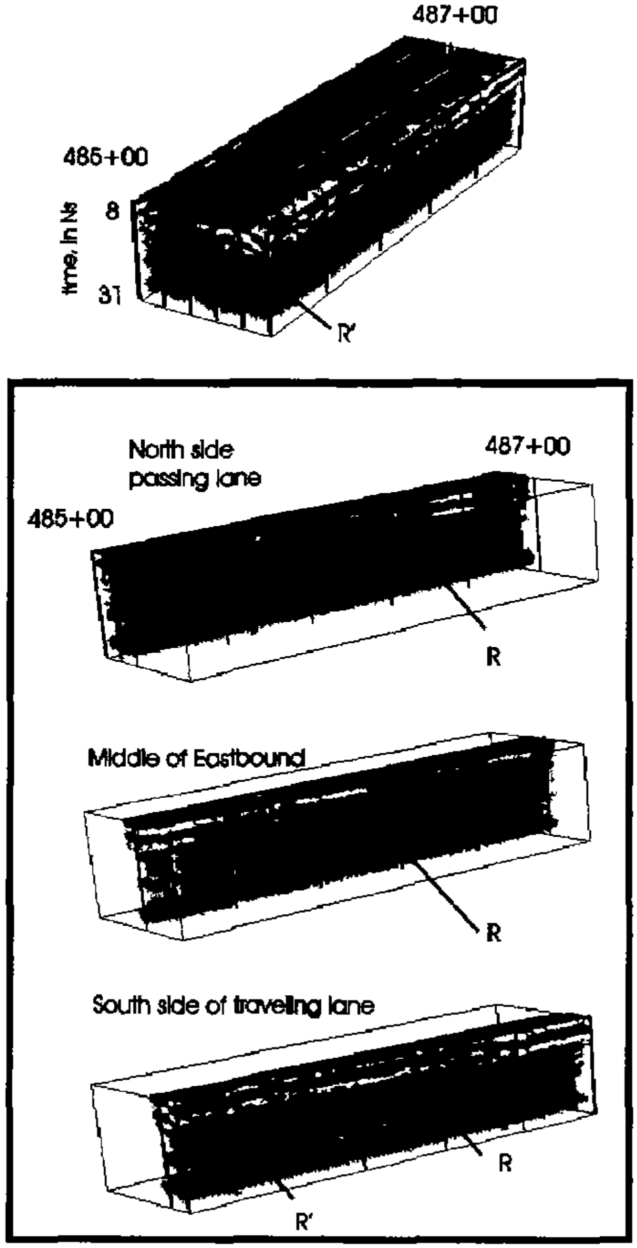
Eastbound block emm. Anomaly N shows shear, slumping and offset. Anomaly extends from the median to the north side of the travel lane. Anomaly shows some depth extent.



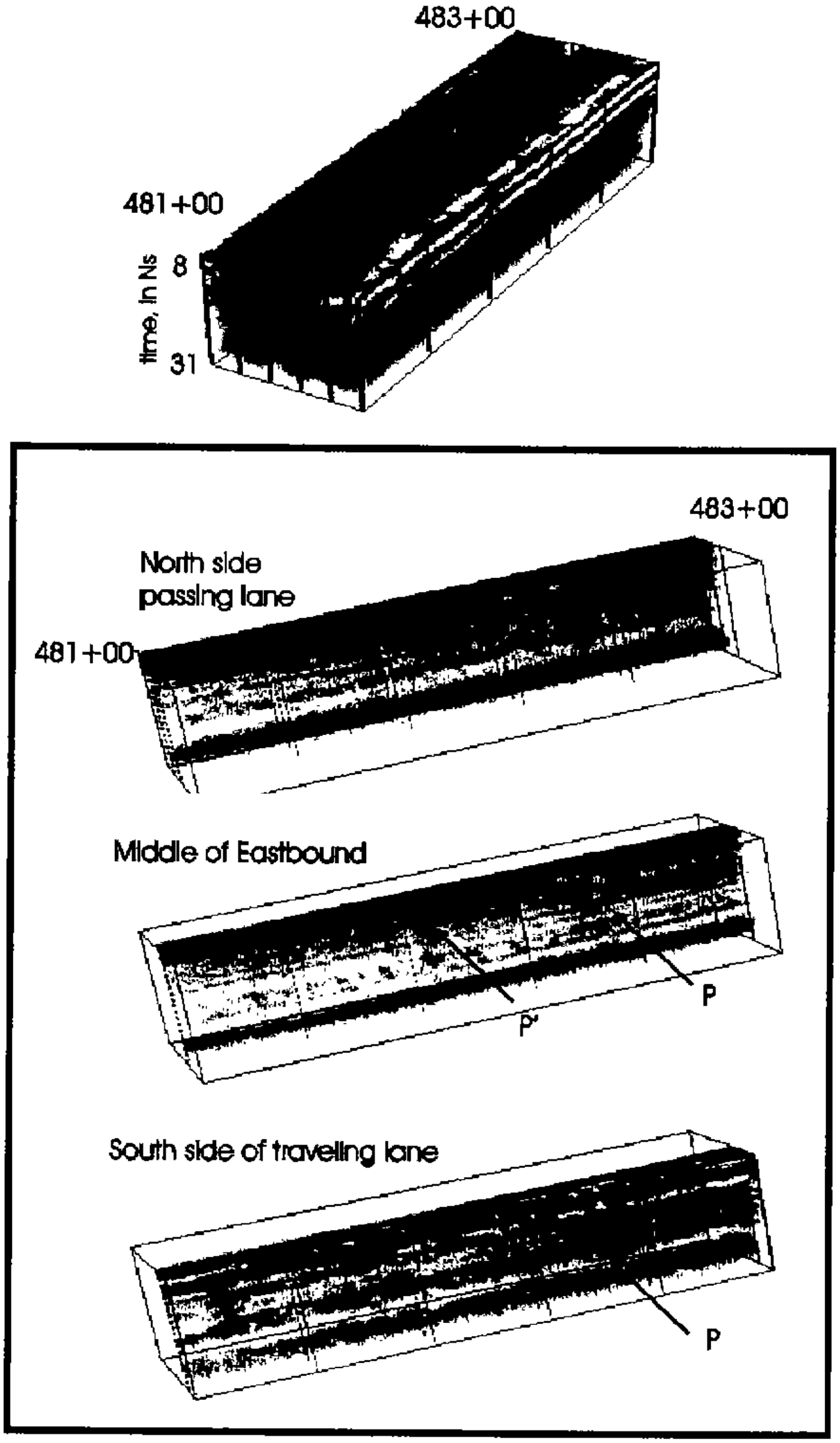
Eastbound block eme. Construction and/or overburden changes along the east side of the block. Anomaly O is a near surface slump feature.



Eastbound block eem. Area Q is the remediated area. Area complex at depth on the travel lane berm. These anomalies may be related to drilling, but there are strong indications of voids (strong hyperbolic anomalies).

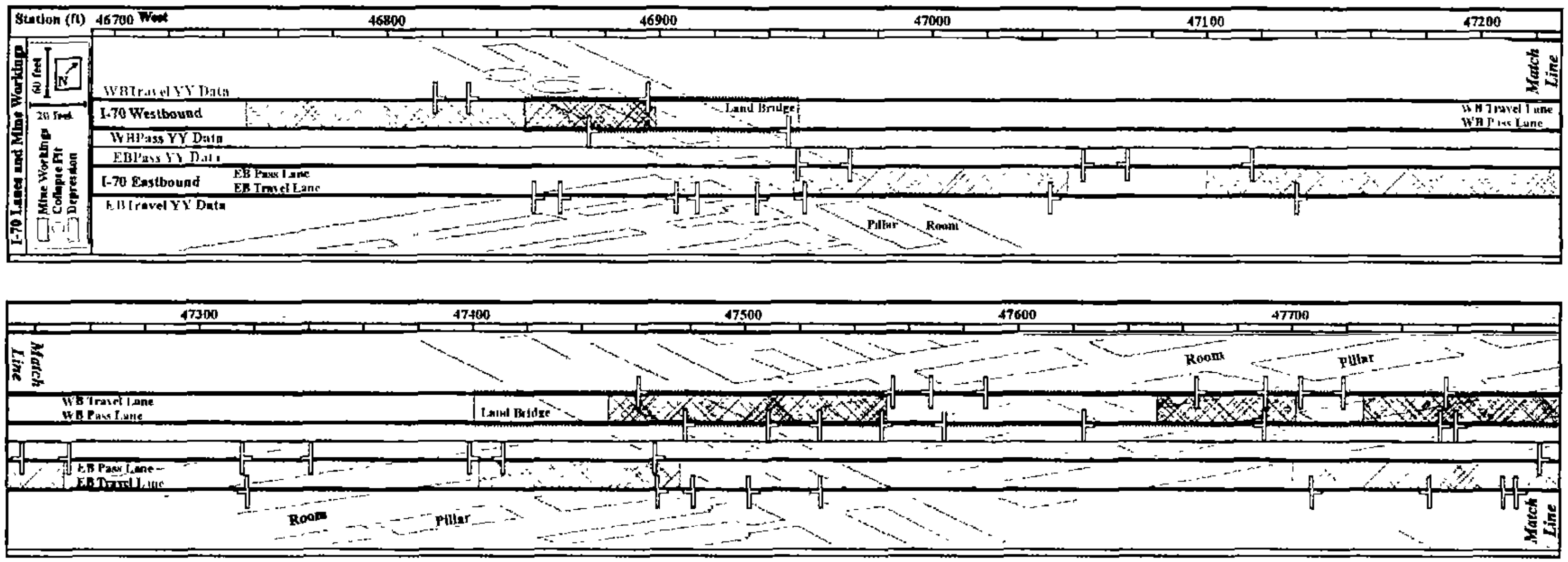


Eastbound block eee. Anomaly R is near surface, limited lateral extent from the north side of the travel lane to the middle of the berm. Some depth extent and offset. Doubtful if there is a void associated with it.

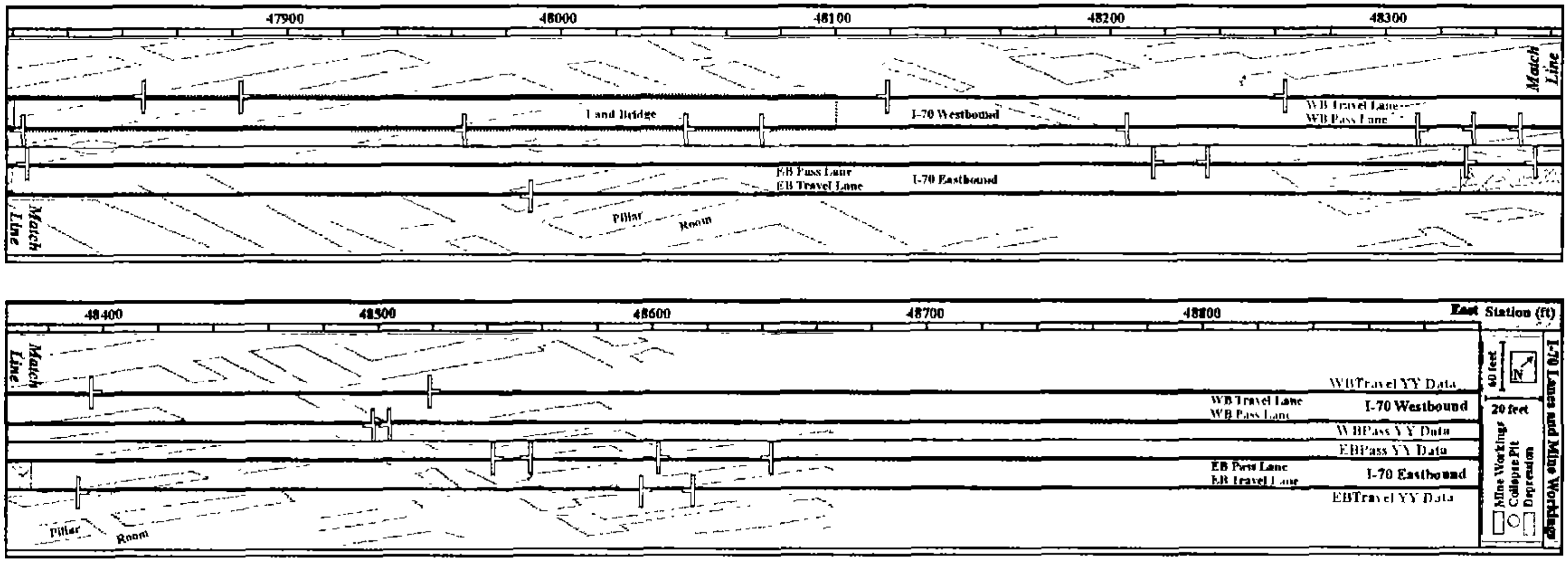


Eastbound block eew. Anomaly P is a slump feature on the berm of the travel lane. There is some offset in the overburden. Anomaly is extensive. No indication of near surface voids.

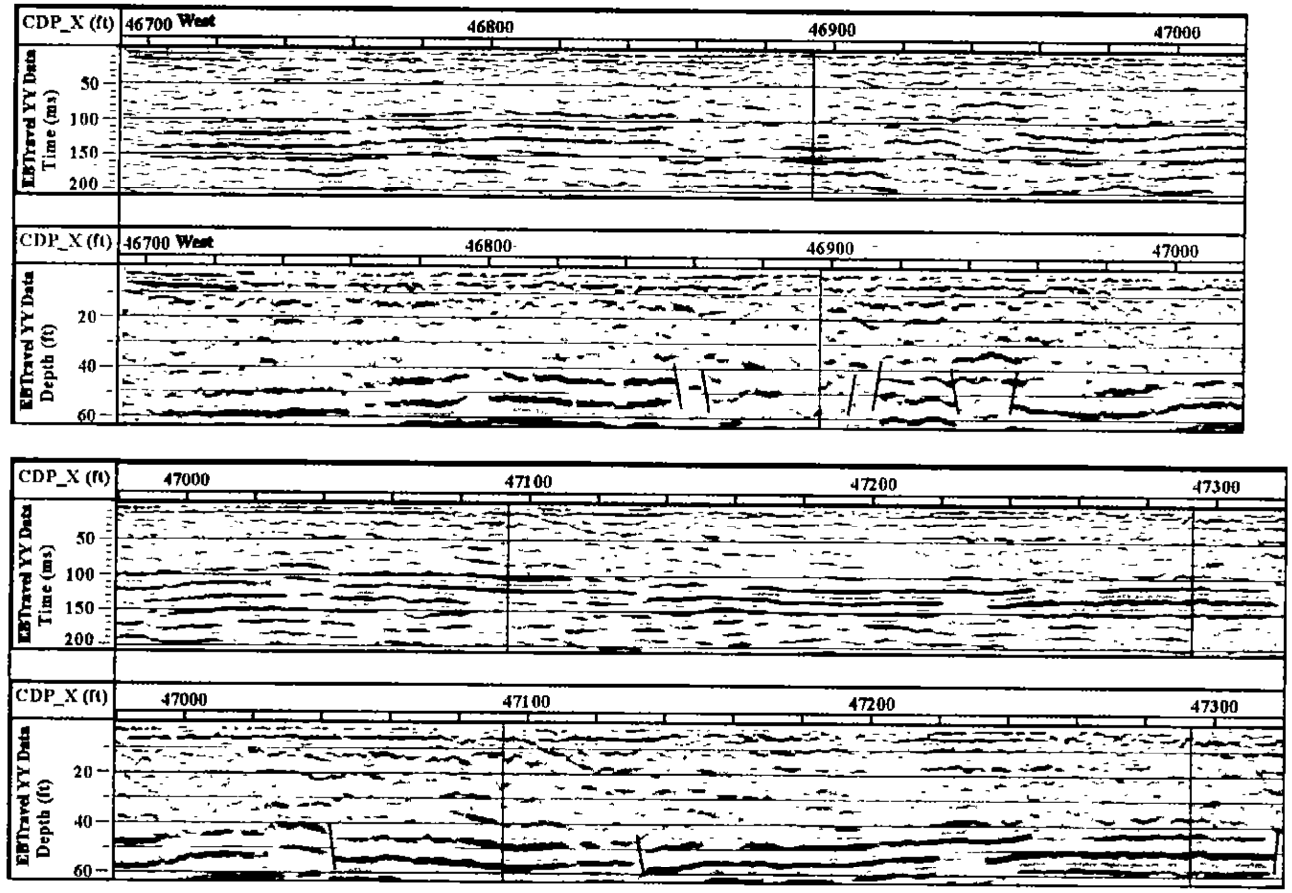
Page 1 of 2



Map view of I-70 eastbound and westbound lanes showing locations and apparent dip directions of YY component-derived mine-related faults relative to mapped mine workings, observed roadway depressions and subsidence features, and westbound lane land bridges.

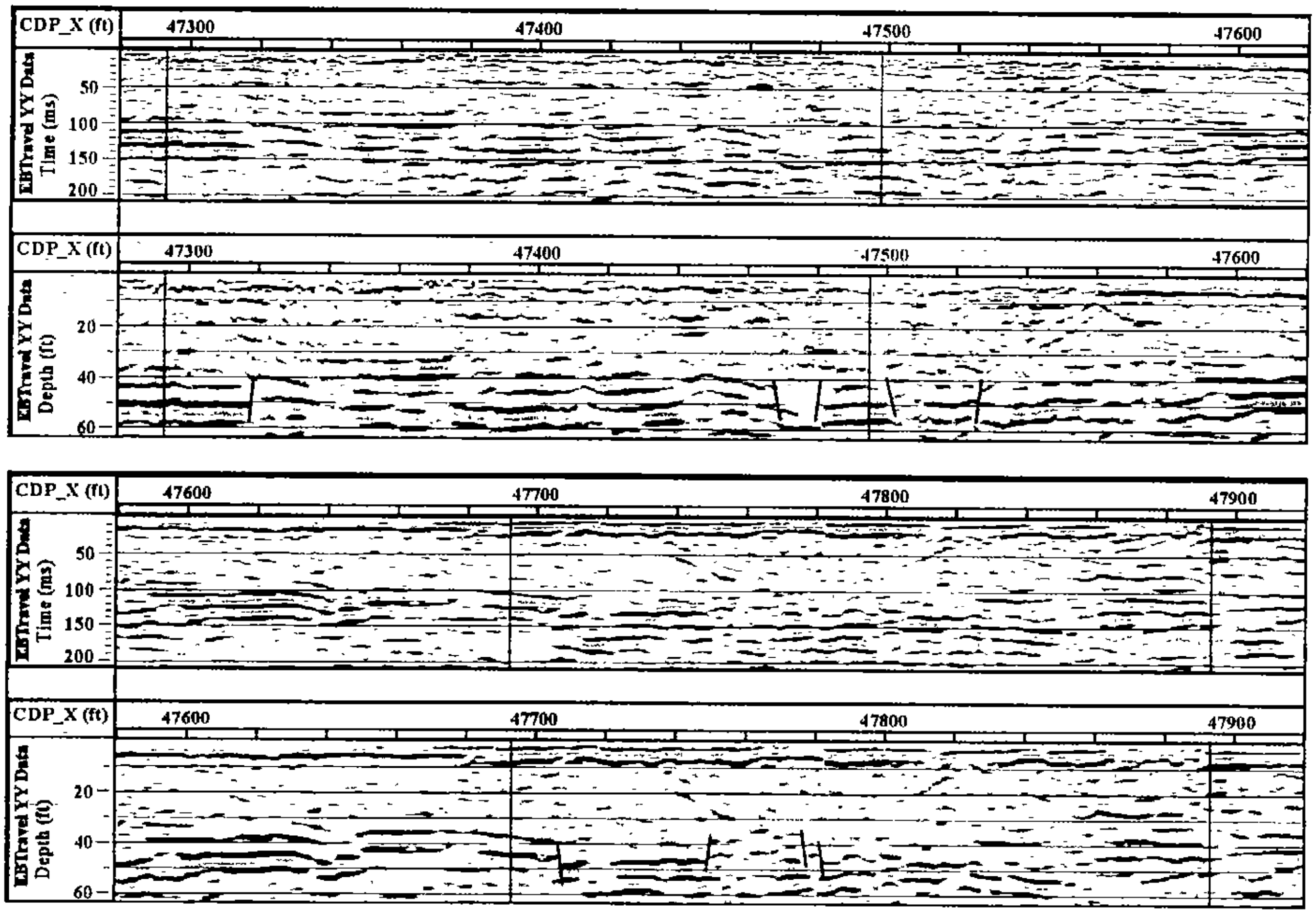


Map of I-70 lanes relative to YY component-derived mine-related faults.



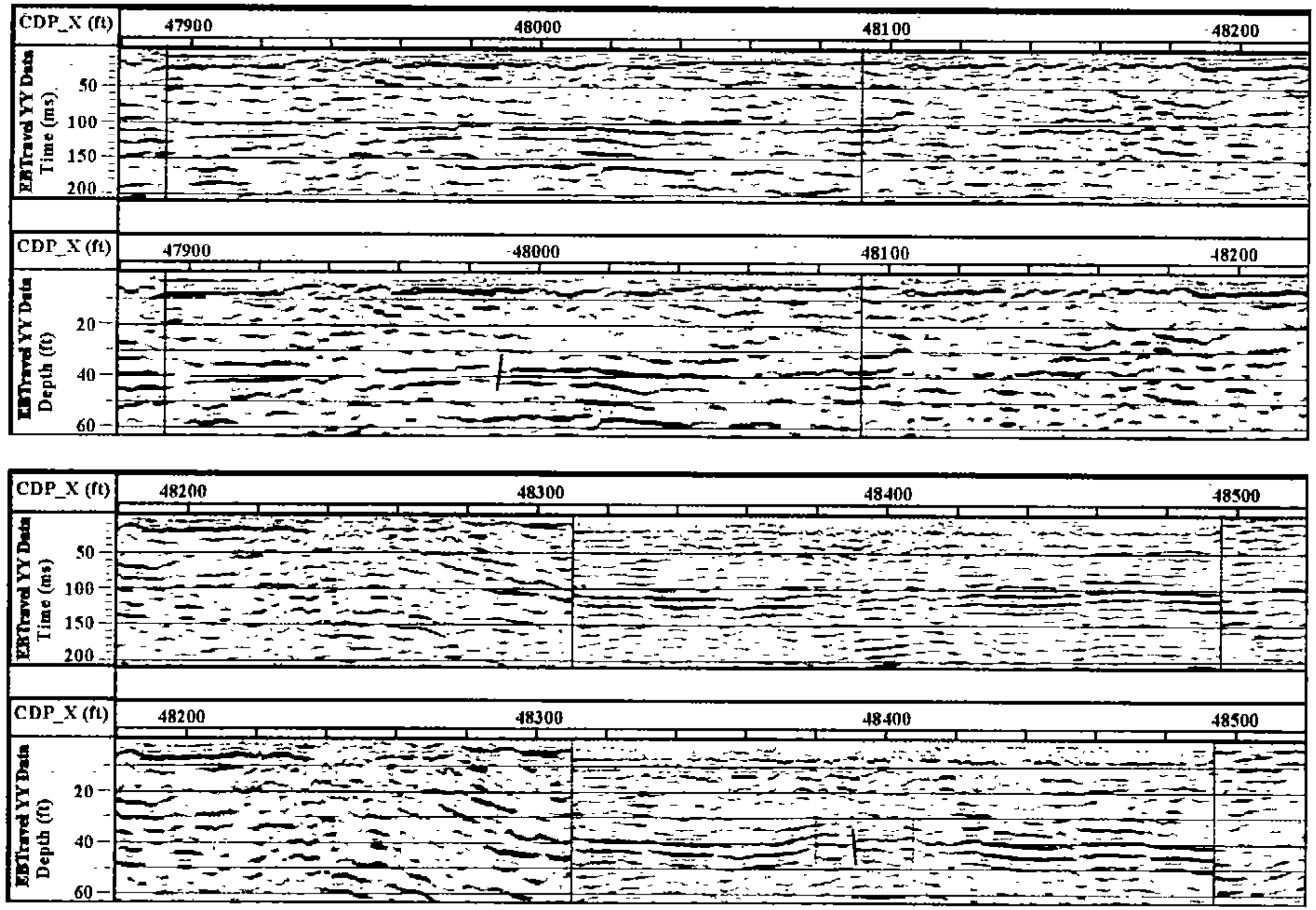
(a) EBTravel YY component (stations 46700-47300).

Eastbound travel lane stacked time (uninterpreted) and depth (with bedrock horizon interpreted) sections (YY component data). Yellow lines indicate bedrock surface. Red lines denote fractures in bedrock stratigraphy.

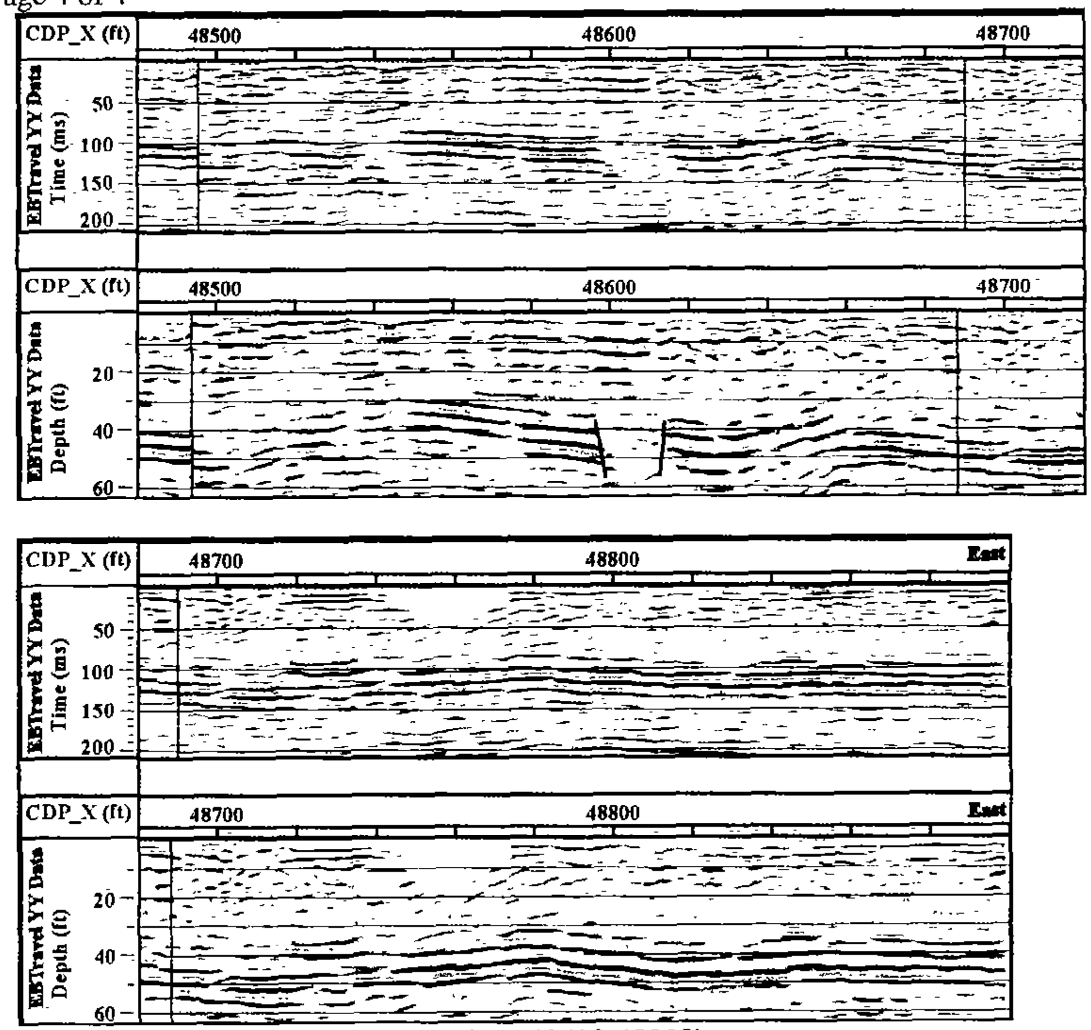


(b) EBTravel YY component (stations 47300-47900).

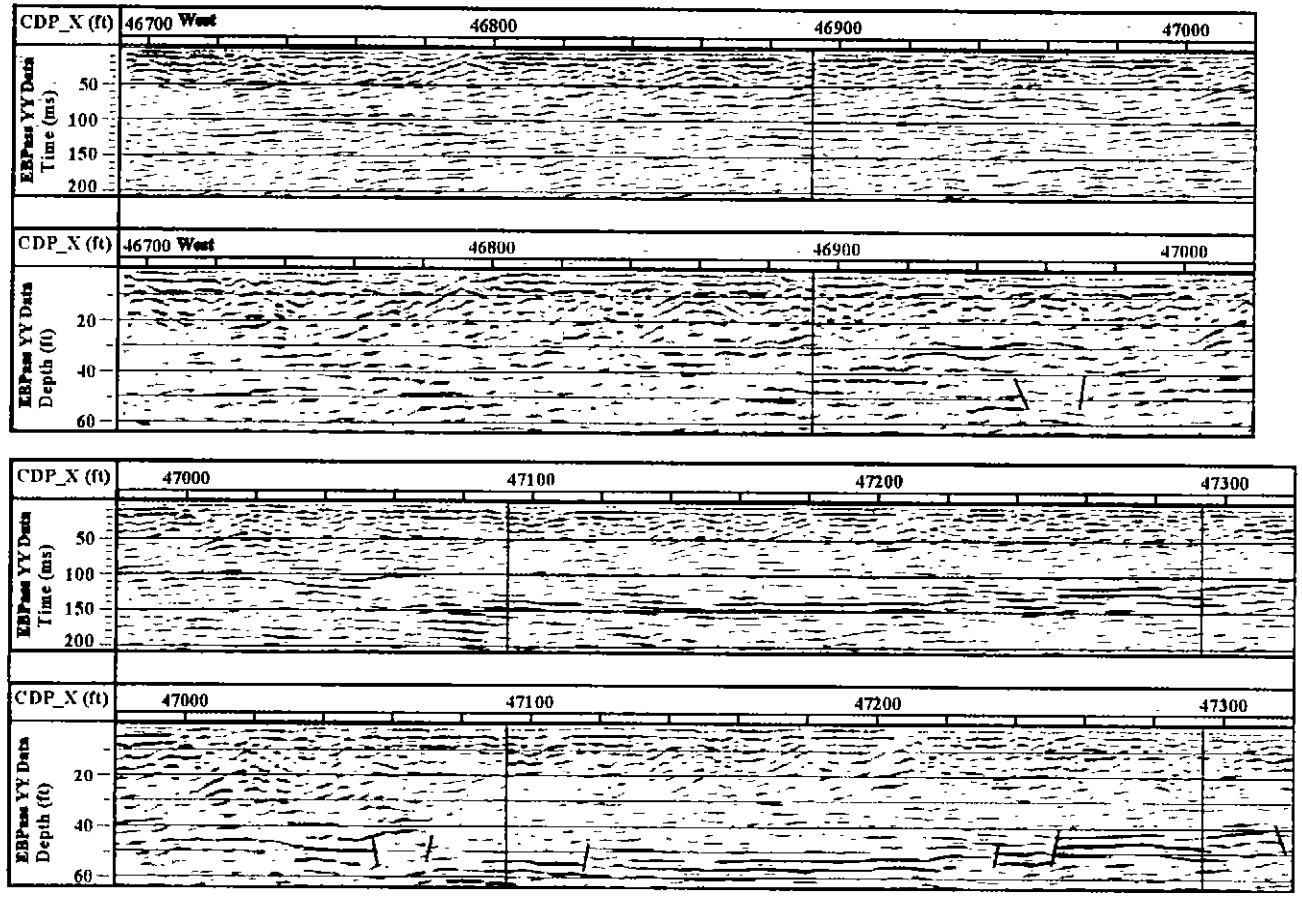
Yellow lines indicate bedrock surface. Red lines denote fractures in bedrock stratigraphy.



(c) EBTravel YY component (stations 47900-48500).
Yellow lines indicate bedrock surface. Red lines denote fractures in bedrock stratigraphy.

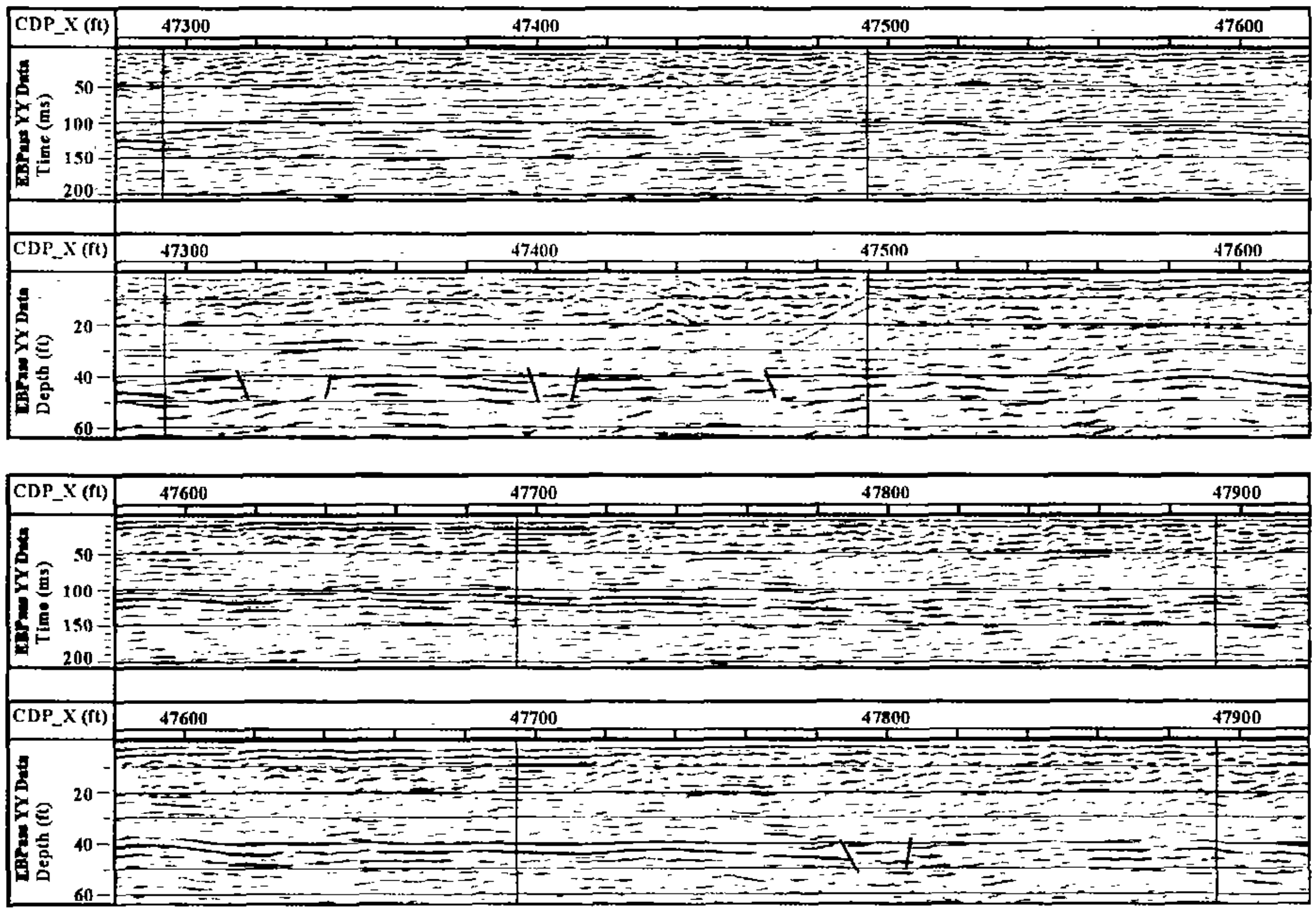


(d) EBTravel YY component (stations 48500-48900).
Yellow lines indicate bedrock surface.
Red lines denote fractures in bedrock stratigraphy.

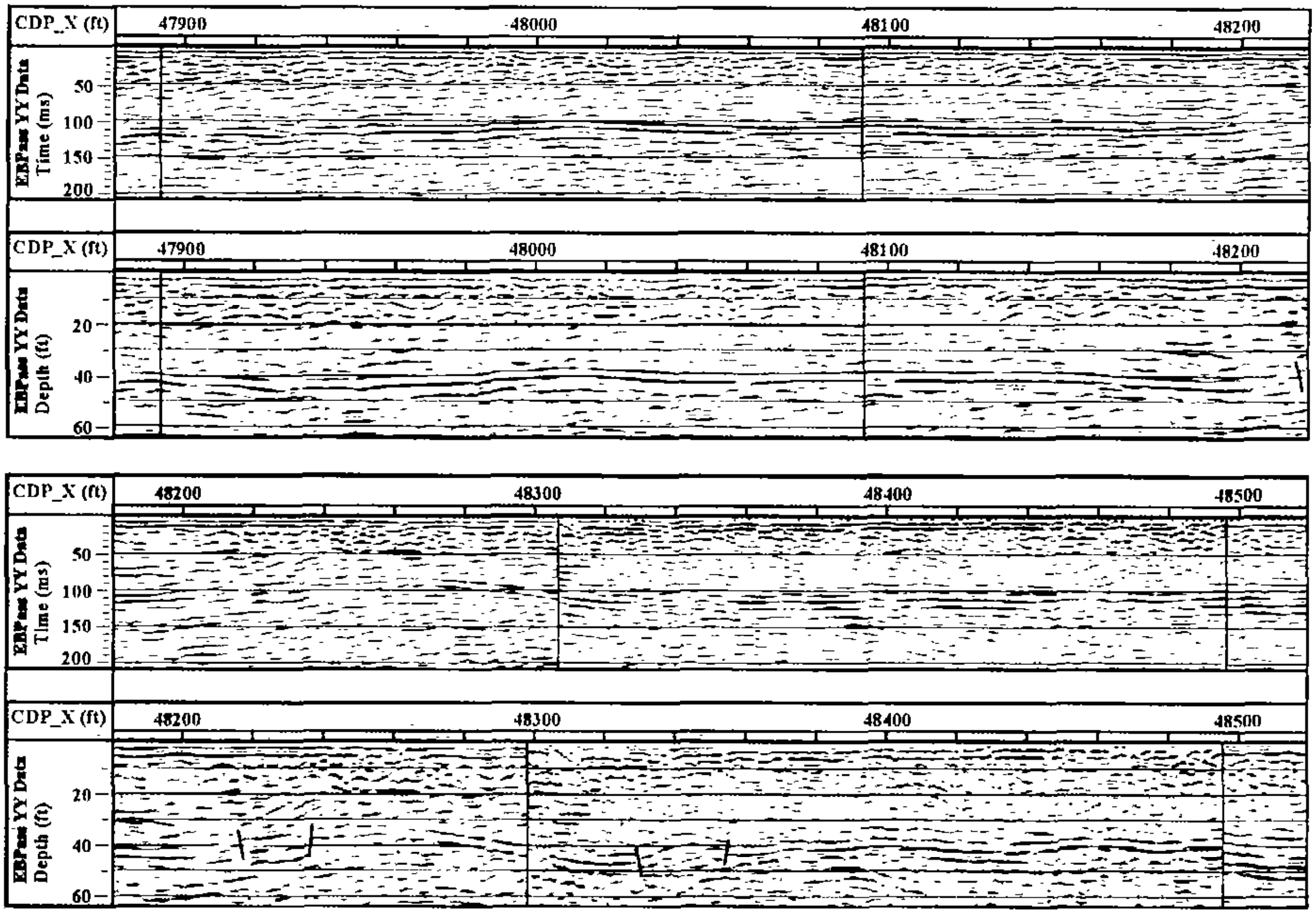


(a) EBPass YY component (stations 46700-47300).

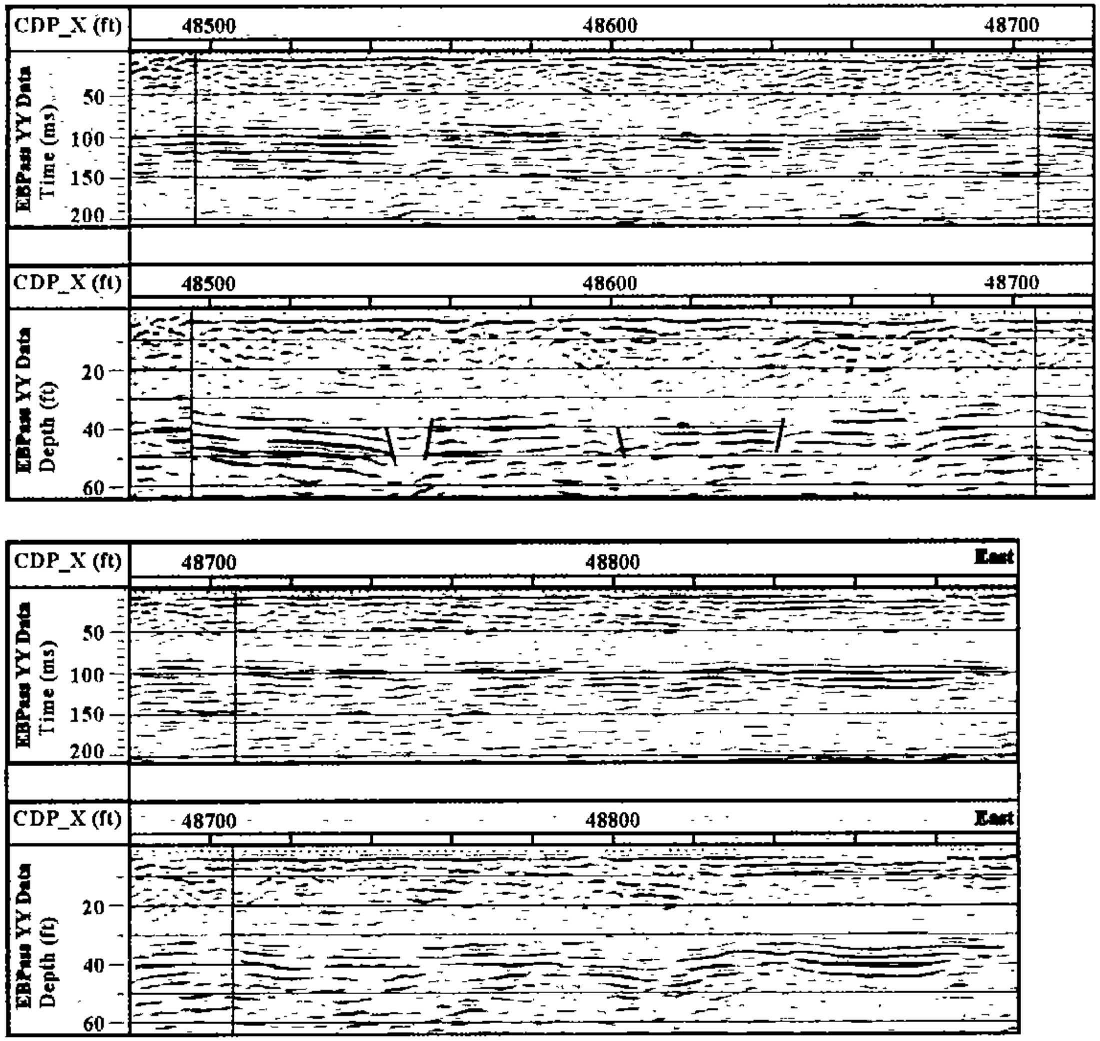
Eastbound passing lane (EBPass) time (uninterpreted) and depth (with bedrock horizon interpreted) sections (YY component data). Yellow lines indicate bedrock surface. Red lines denote fractures in bedrock stratigraphy.



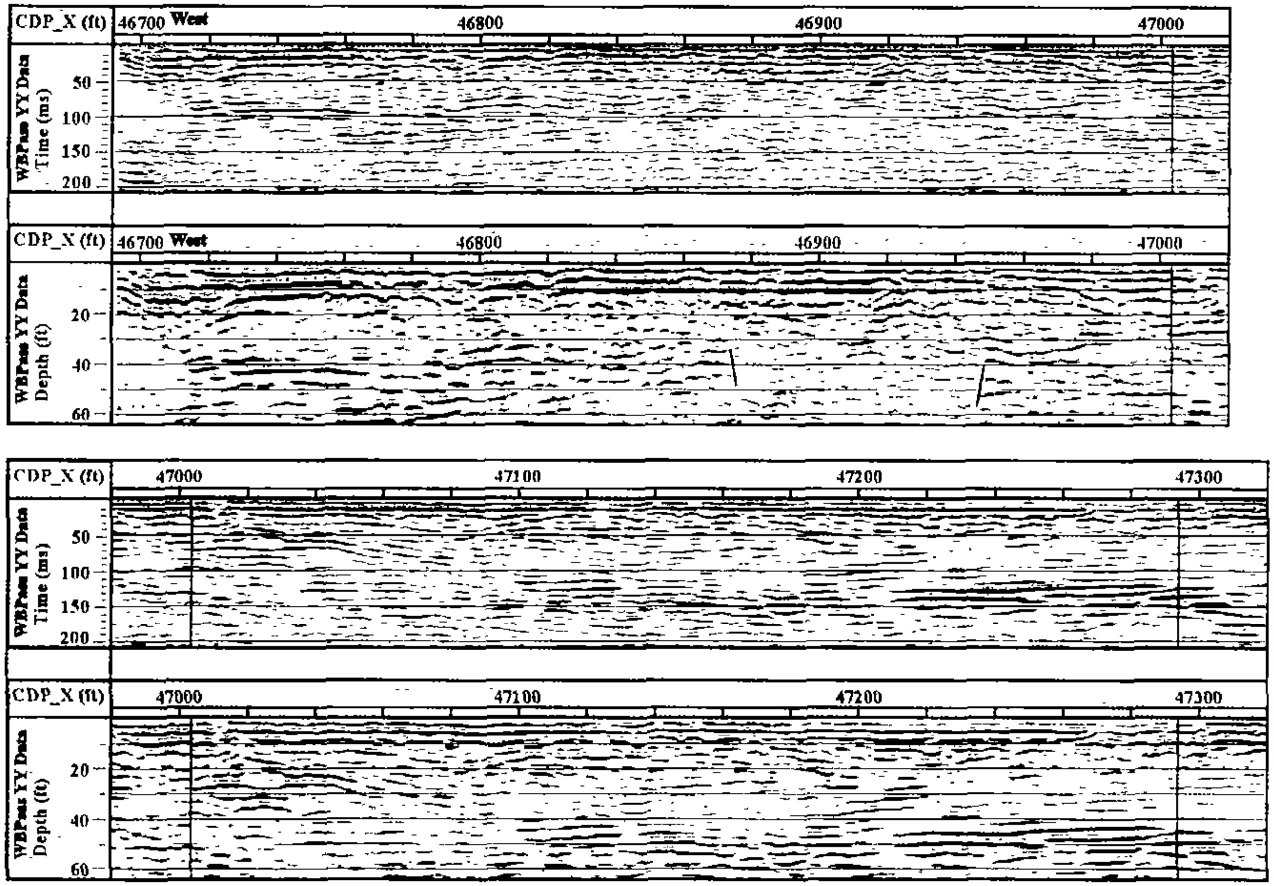
(b) EBPass YY component (stations 47300-47900).
Yellow lines indicate bedrock surface. Red lines denote fractures in bedrock stratigraphy.



(c) EBPass YY component (stations 47900-48500).
Yellow lines indicate bedrock surface. Red lines denote fractures in bedrock stratigraphy.

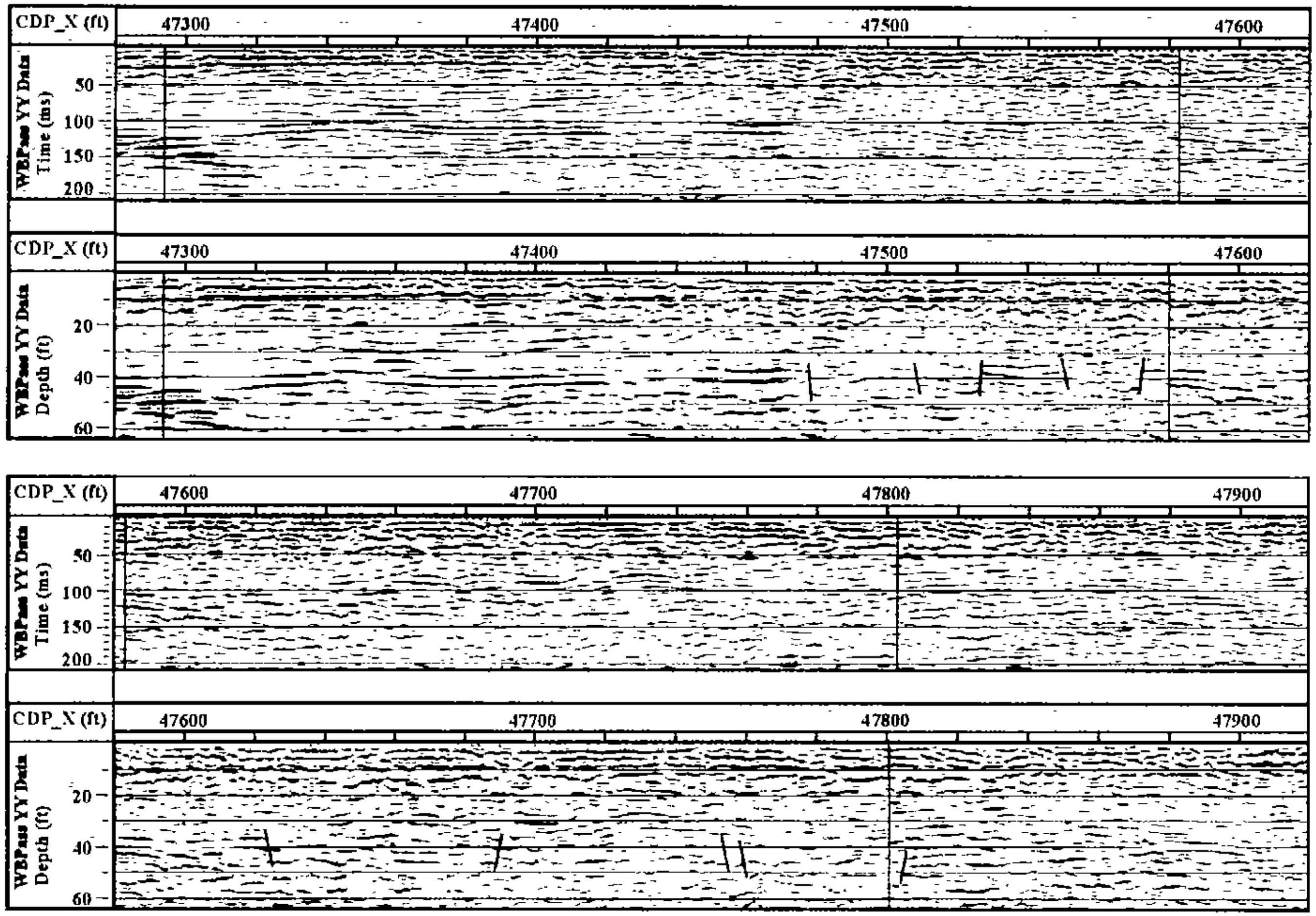


(d) EBPass YY component (stations 48500-48900).
Yellow lines indicate bedrock surface. Red lines denote fractures in bedrock stratigraphy.

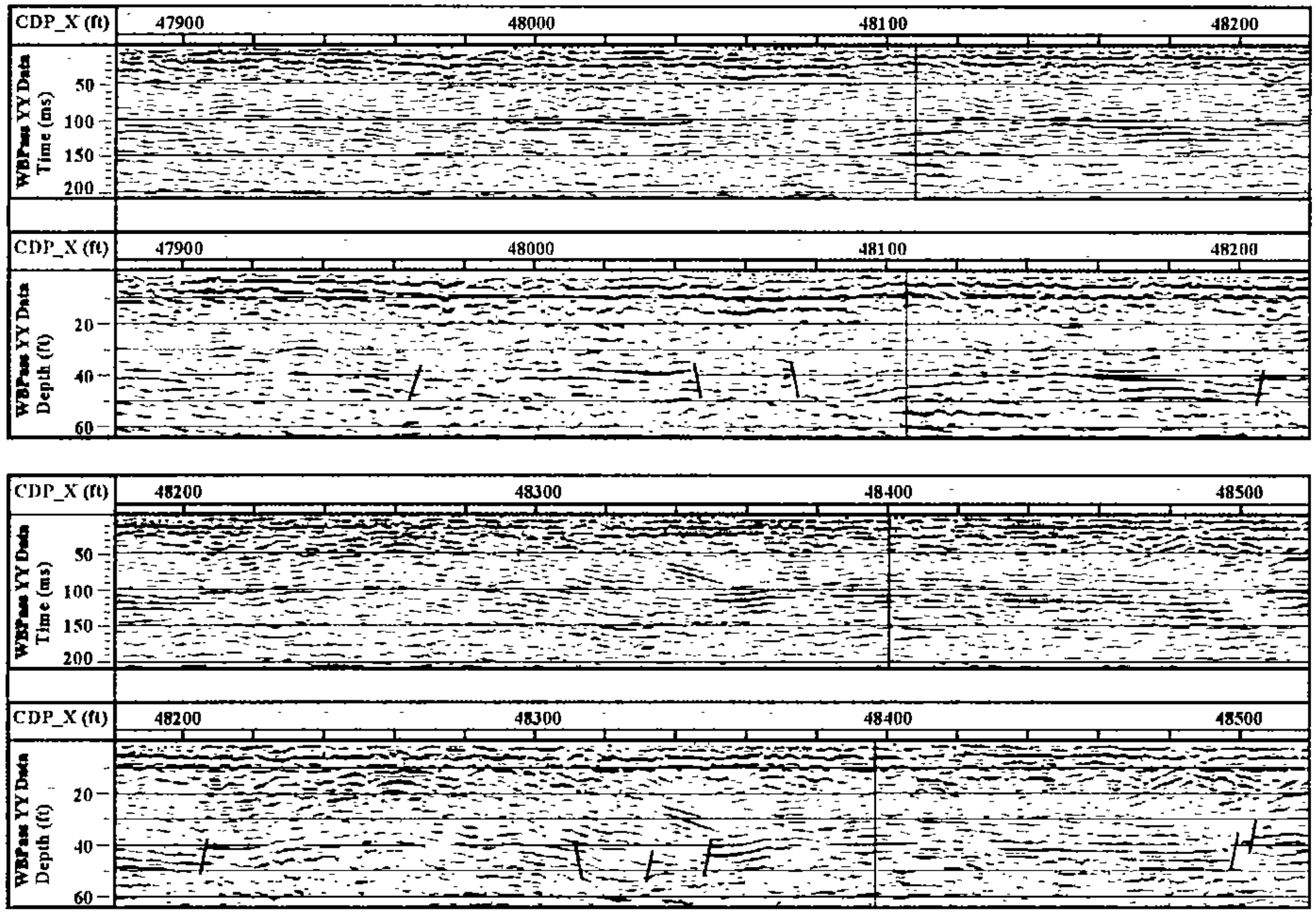


(a) WBPass YY component (stations 46700-47300).

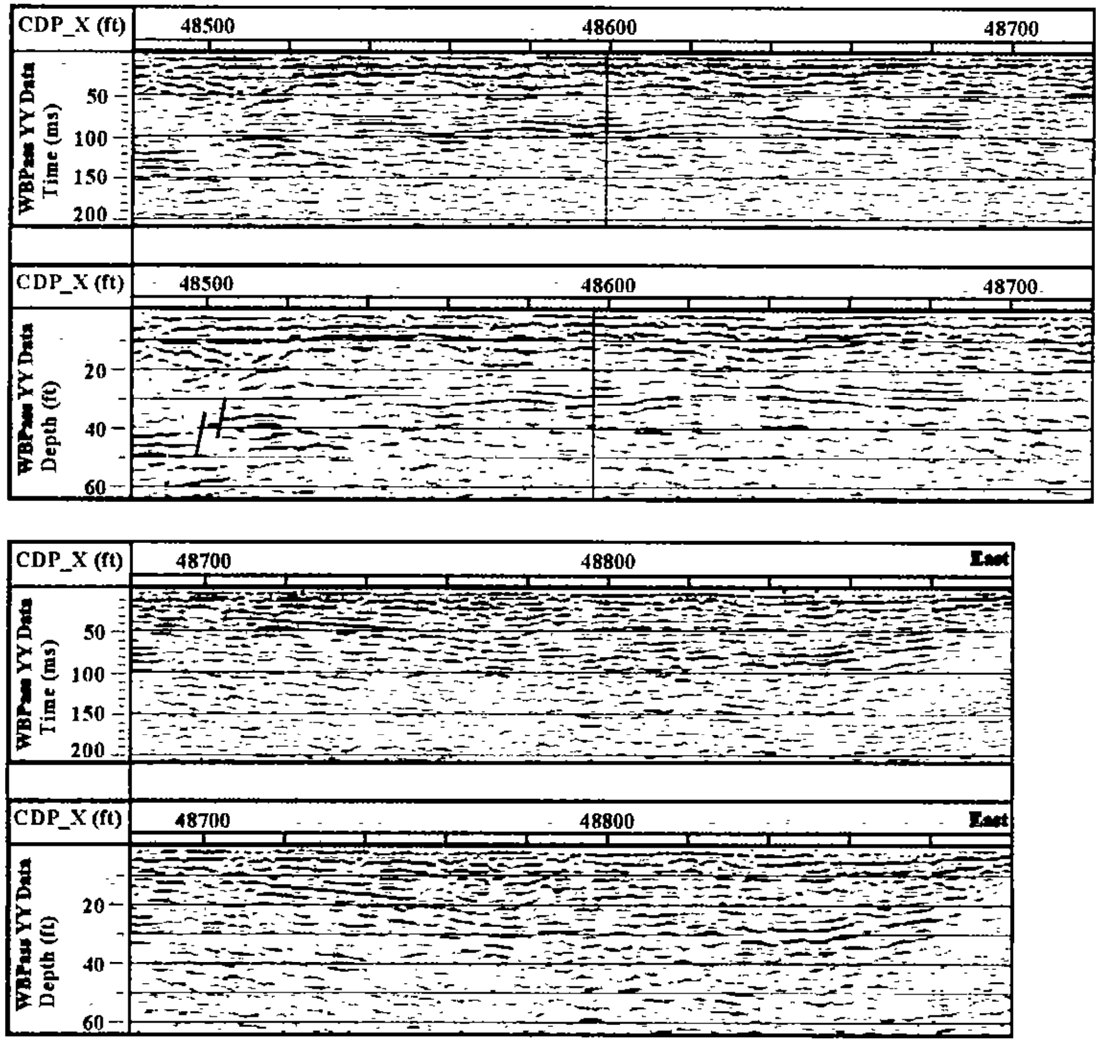
Westbound passing lane (WBPass) stacked time (uninterpreted) and depth (with bedrock horizon interpreted) sections (YY component data). Yellow lines indicate bedrock surface. Red lines denote fractures in bedrock stratigraphy.



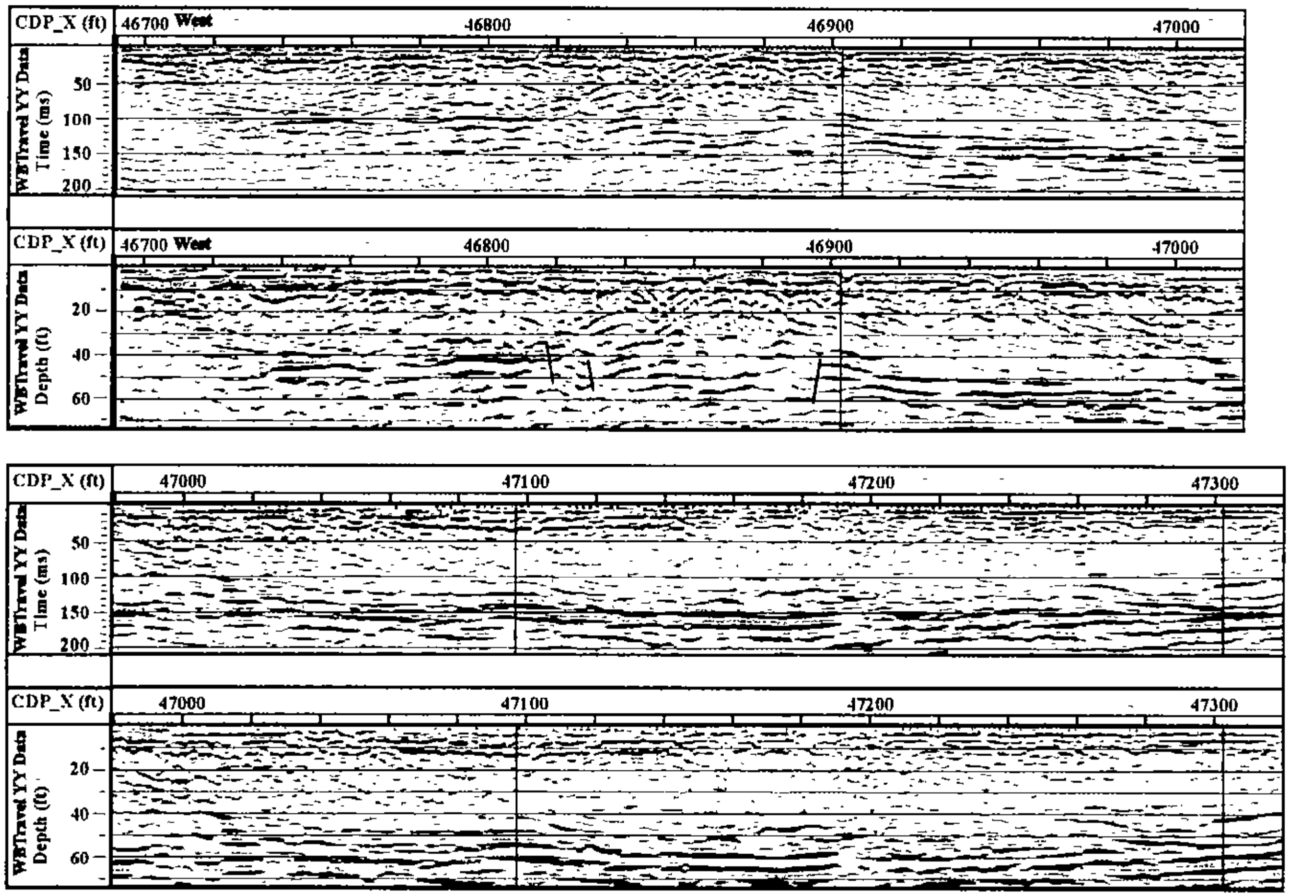
(b) WBPass YY component (stations 47300-47900).
Yellow lines indicate bedrock surface. Red lines denote fractures in bedrock stratigraphy.



(c) WBPass YY component (stations 47900-48500).
Yellow lines indicate bedrock surface. Red lines denote fractures in bedrock stratigraphy.

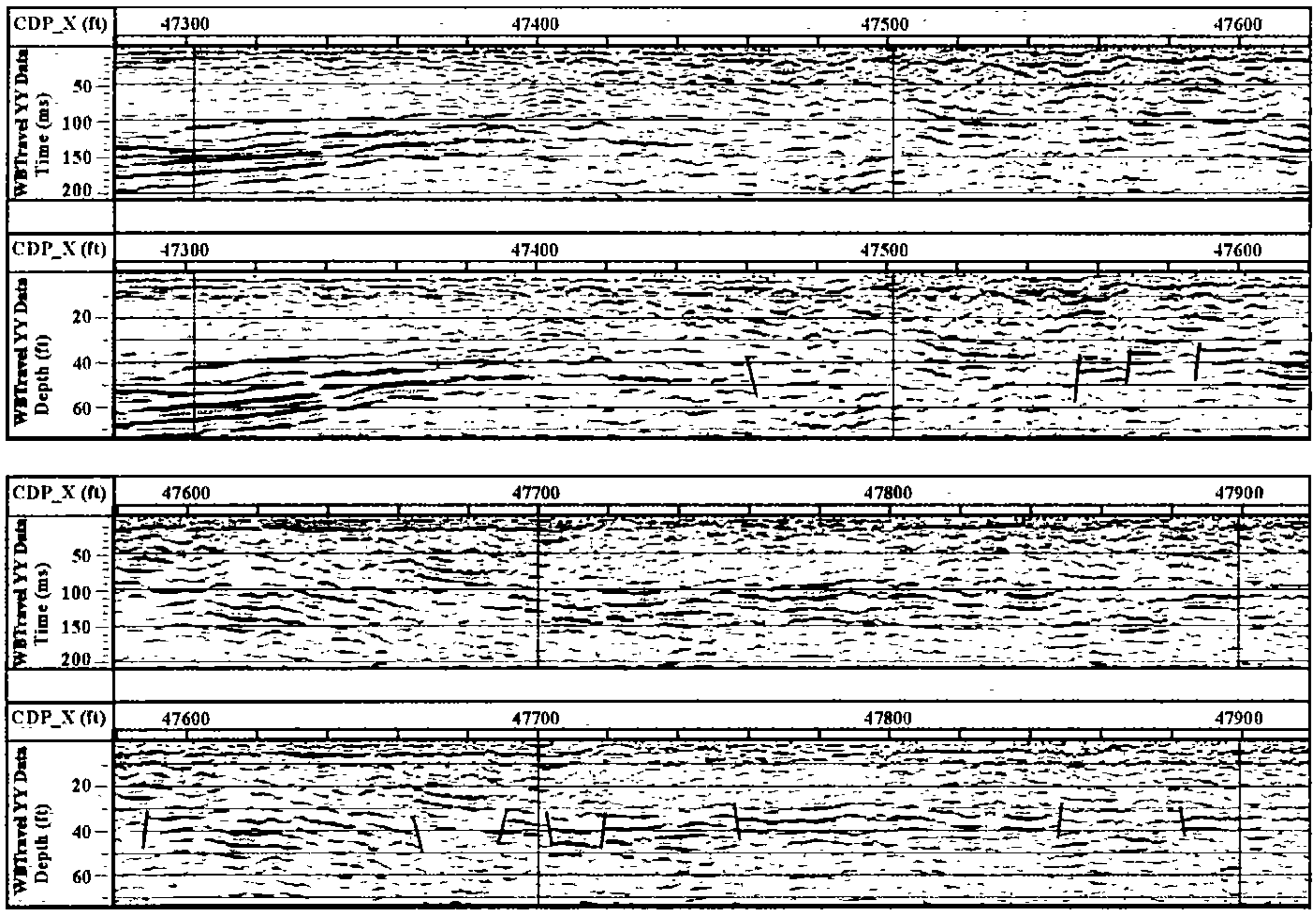


(d) WBPass YY component (stations 48500-48900).
Yellow lines indicate bedrock surface. Red lines denote fractures in bedrock stratigraphy.

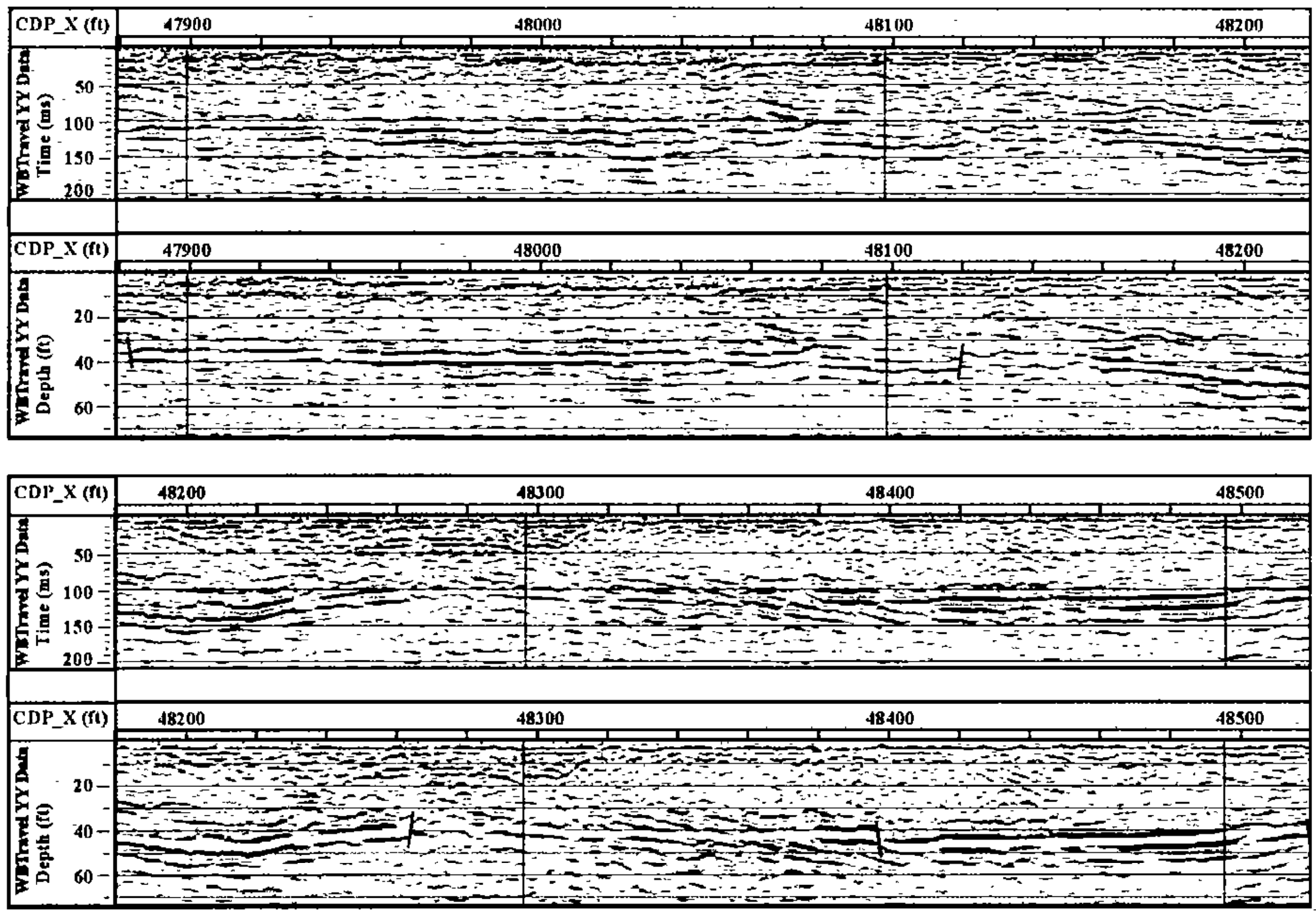


(a) WBTravel YY component (stations 46700-47300).

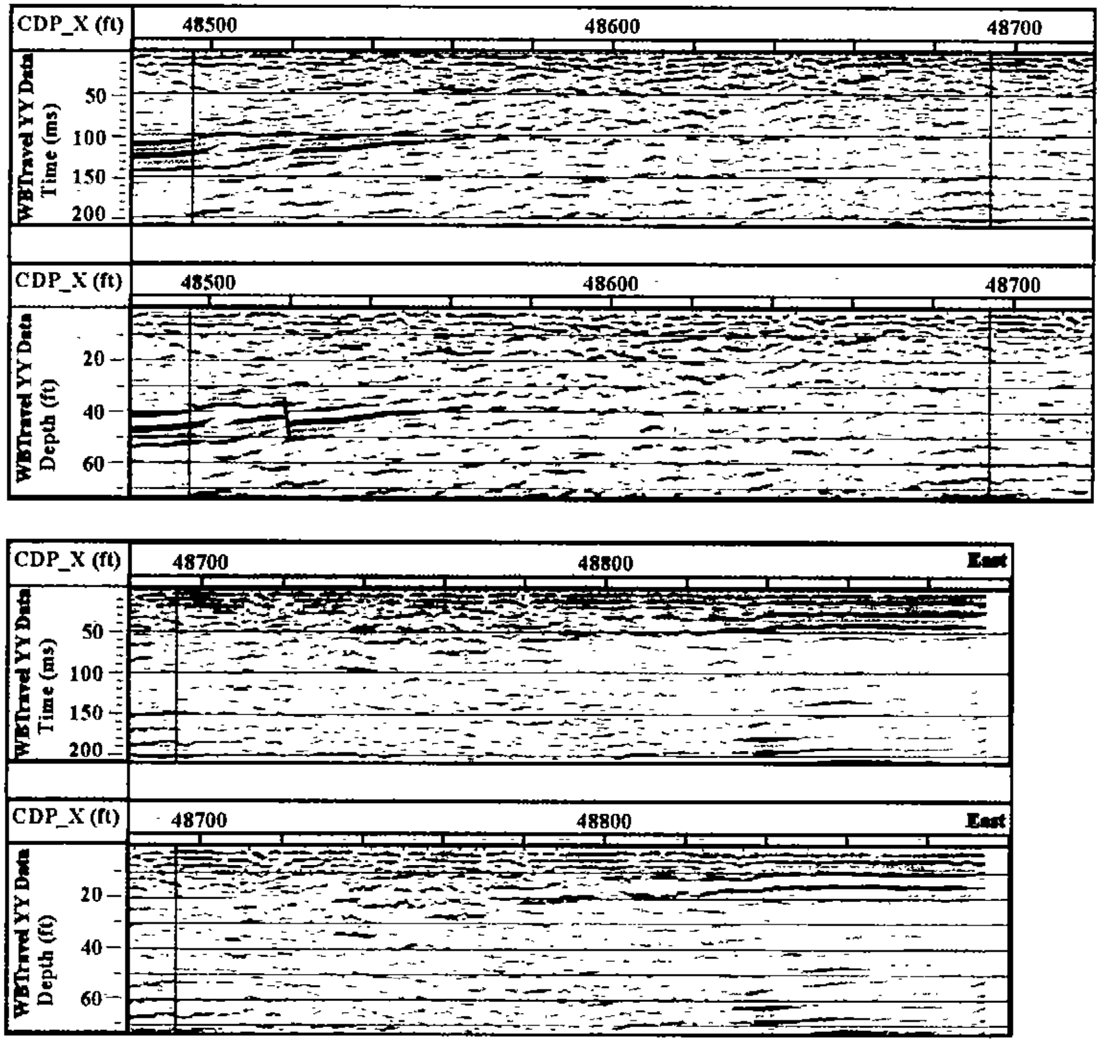
Westbound travel lane (WBTravel) time (uninterpreted) and depth (with bedrock horizon interpreted) sections (YY component data). Yellow lines indicate bedrock surface. Red lines denote fractures in bedrock stratigraphy.



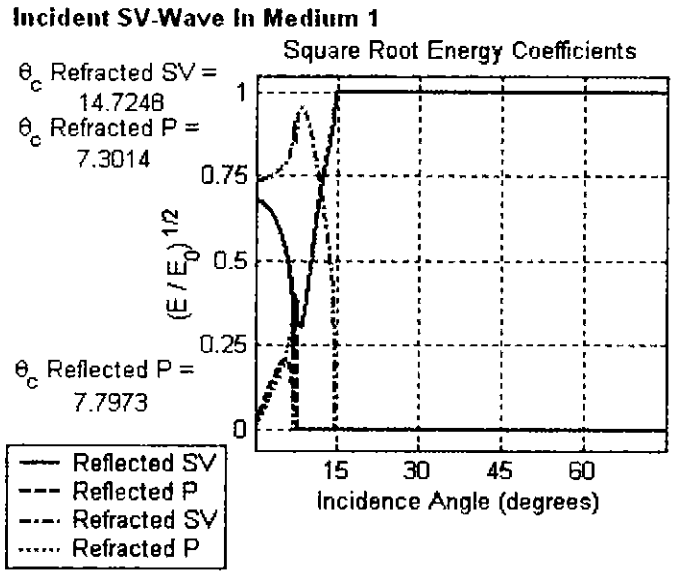
(b) WBTravel YY component (stations 47300-47900). Yellow lines indicate bedrock surface. Red lines denote fractures in bedrock stratigraphy.

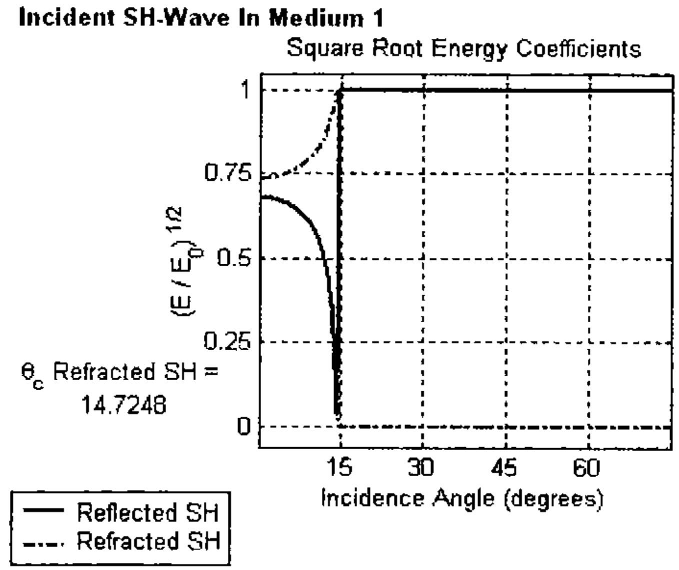


(c) WBTravel YY component (stations 47900-48500). Yellow lines indicate bedrock surface. Red lines denote fractures in bedrock stratigraphy.



(d) WBTravel YY component (stations 48500-48900).
Yellow lines indicate bedrock surface. Red lines denote fractures in bedrock stratigraphy.

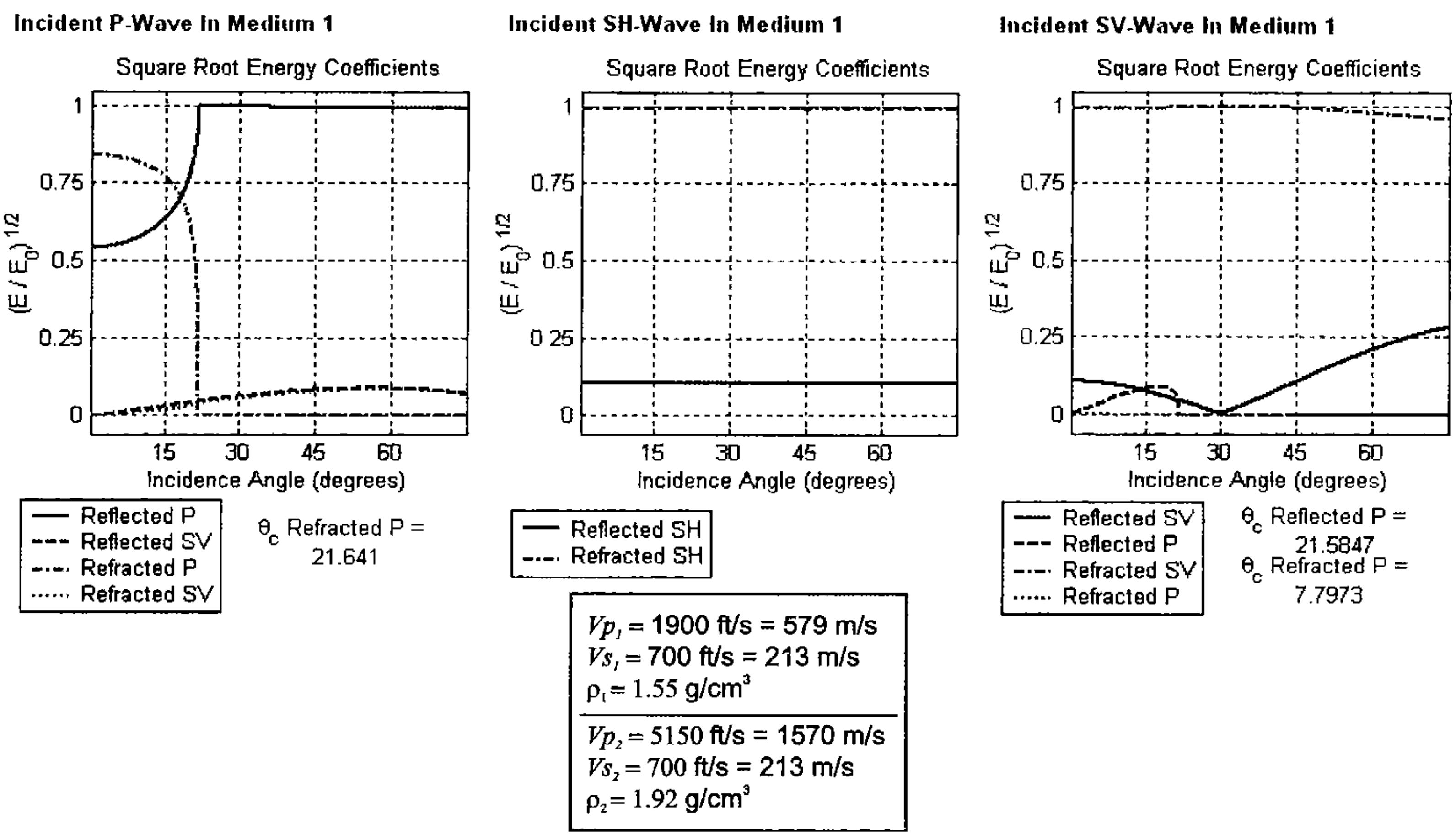




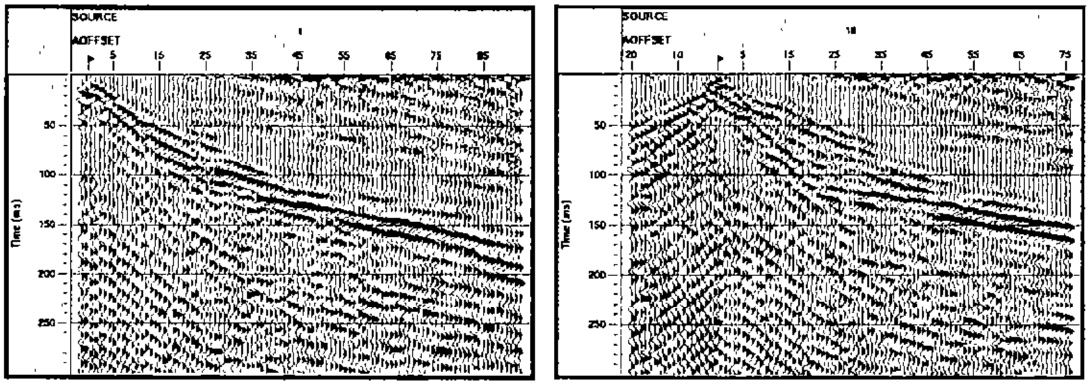
Vp_1 = 5150 ft/s = 1570 m/s
Vs_1 = 700 ft/s = 213 m/s
ρ_1 = 1.92 g/cm^3

Vp_2 = 5500 ft/s = 1676 m/s
Vs_2 = 2750 ft/s = 838 m/s
ρ_2 = 2.55 g/cm^3

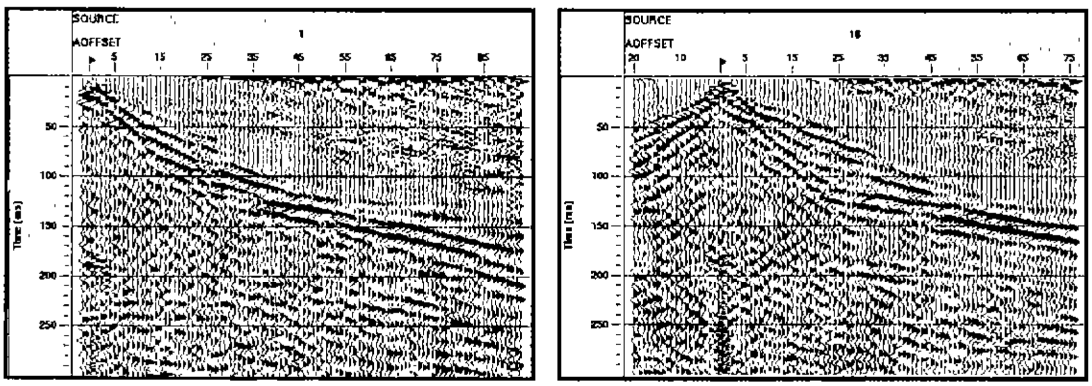
Plots showing normalized square root energy coefficients as a function of incidence angle for a SV-wave (left) and a SH-wave (right) incident on the overburden (medium 1) and bedrock (medium 2) interface.



Plots showing normalized square root energy coefficients as a function of incidence angle for a P-wave (left), a SH-wave (middle), and a SV-wave (right) incident on the interface between unsaturated overburden (medium 1) and saturated overburden (medium 2).

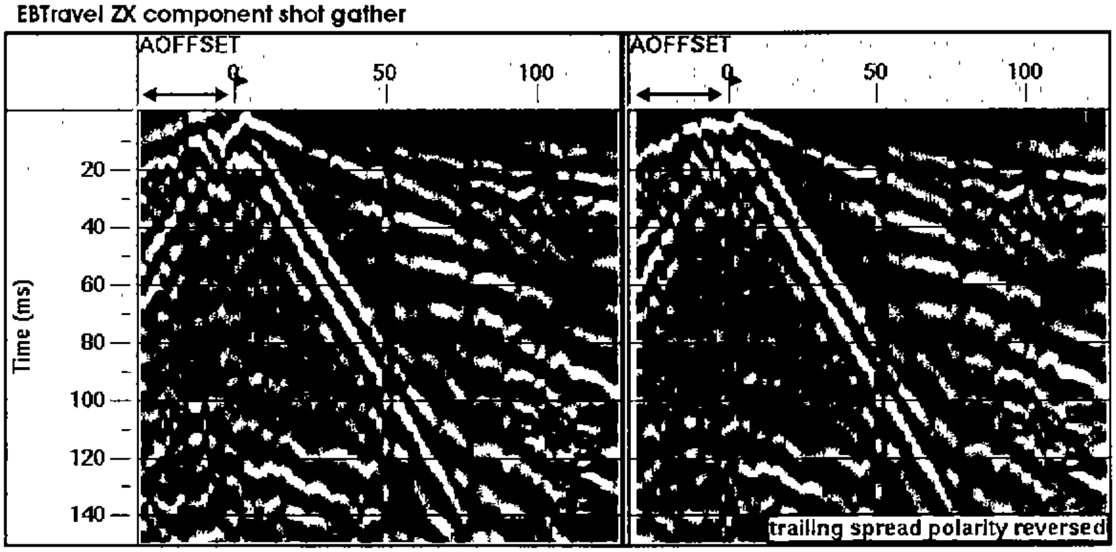


(a) Line Test-1 shot gathers correlated using field channel -2

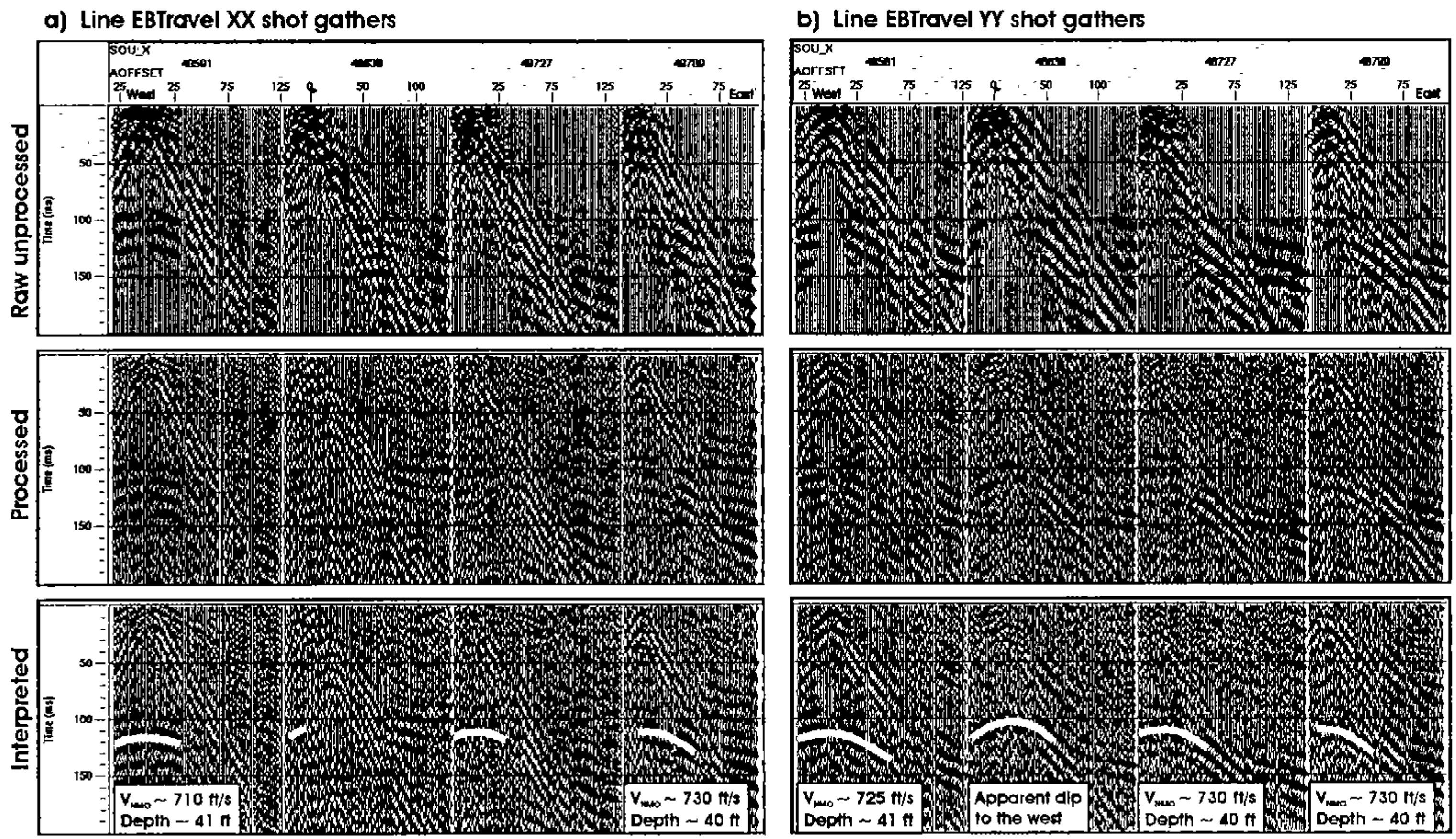


(b) Line Test-1 shot gathers correlated using synthetic sweep

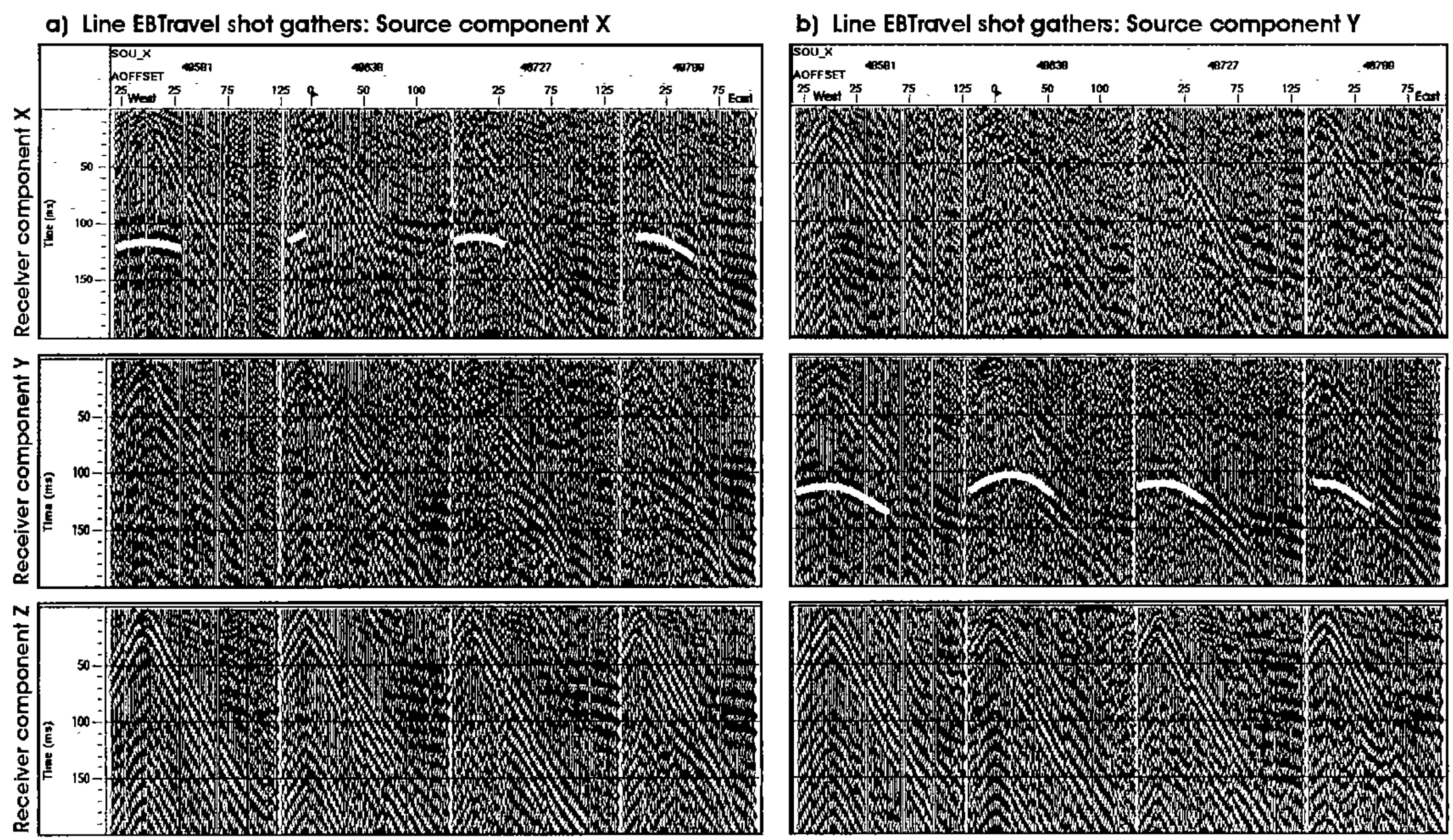
Line Test-1 shot gathers: (a) correlated using AUX channel –2, and (b) correlated using a synthetic sweep. The steeply-dipping periodic noise (with dominant frequency of 65 Hz) evident at near offsets in shot gathers correlated using AUX channel –2 was suppressed when shot gathers were correlated using a synthetic sweep. Shot gathers are unfiltered and have AGC scaling (100 ms window) applied for display purposes. The X-axes scales of absolute offset from the source are in feet.



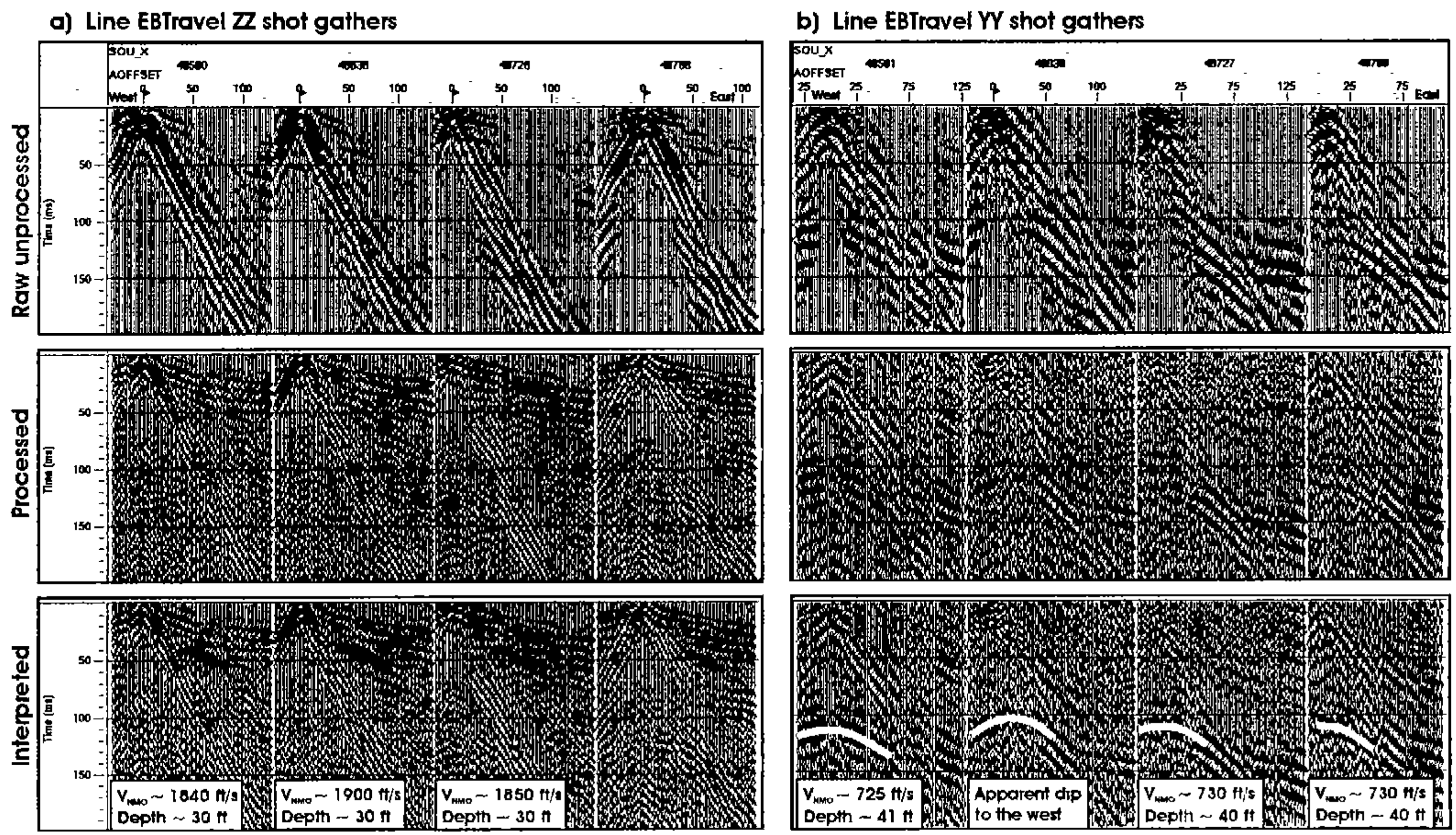
Shot gather (P-wave source, Z component) recorded using horizontal, inline (X component) geophone elements: (left) before, and (right) after polarity reversal of trailing spread. Absolute values of offset from the source on the x-axis are in ft.



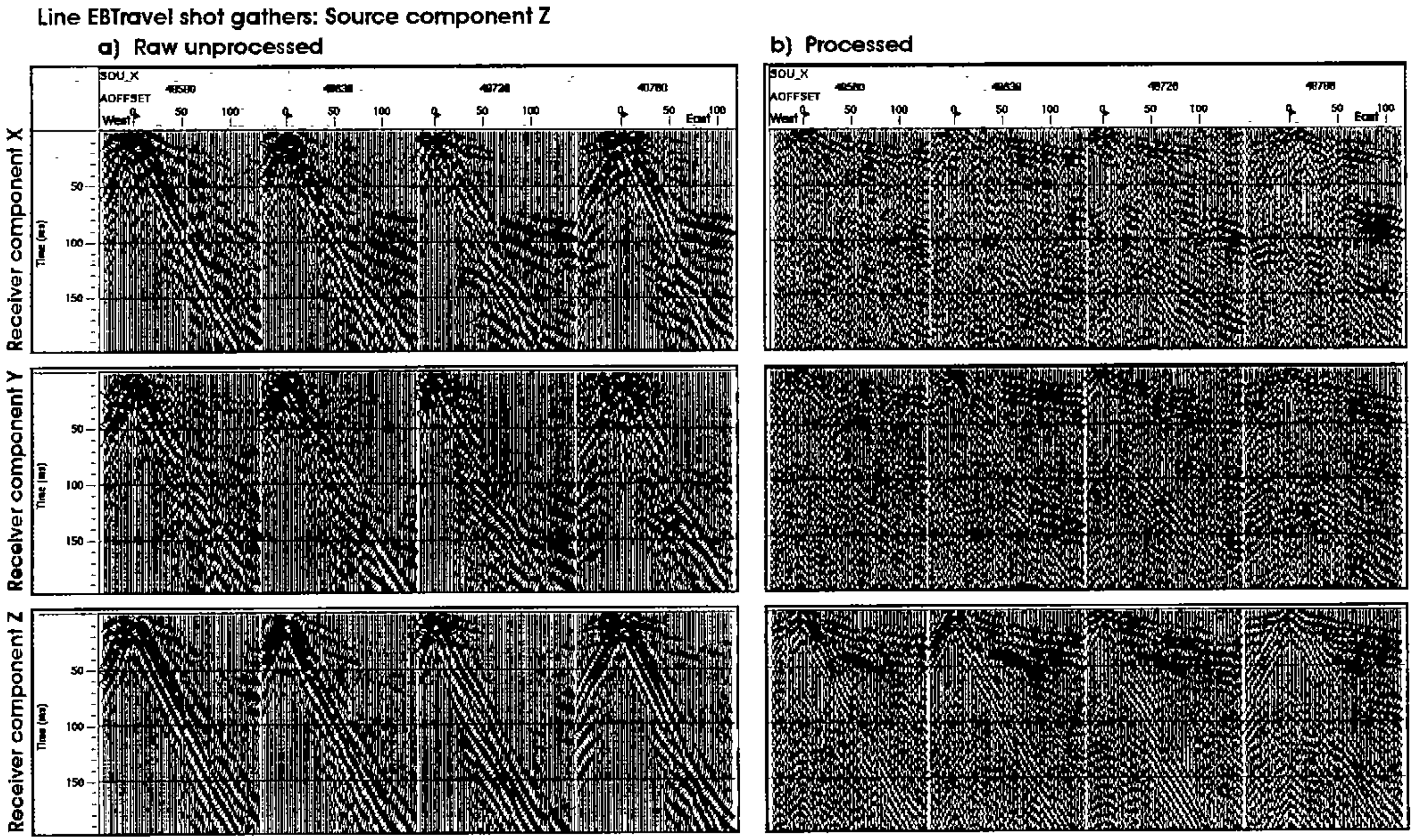
Line EBTravel shot gathers: (a) XX component, and (b) YY component. Gathers are shown: (top) unprocessed, (middle) with a bandpass filter (50-80-160-200 Hz) and AGC (100 ms window) applied, and (bottom) interpreted. S-wave reflections from the top-of-bedrock are indicated, and apparent NMO velocities and approximate depths are given. The x-axis scales of absolute offset (AOFFSET) from the source.



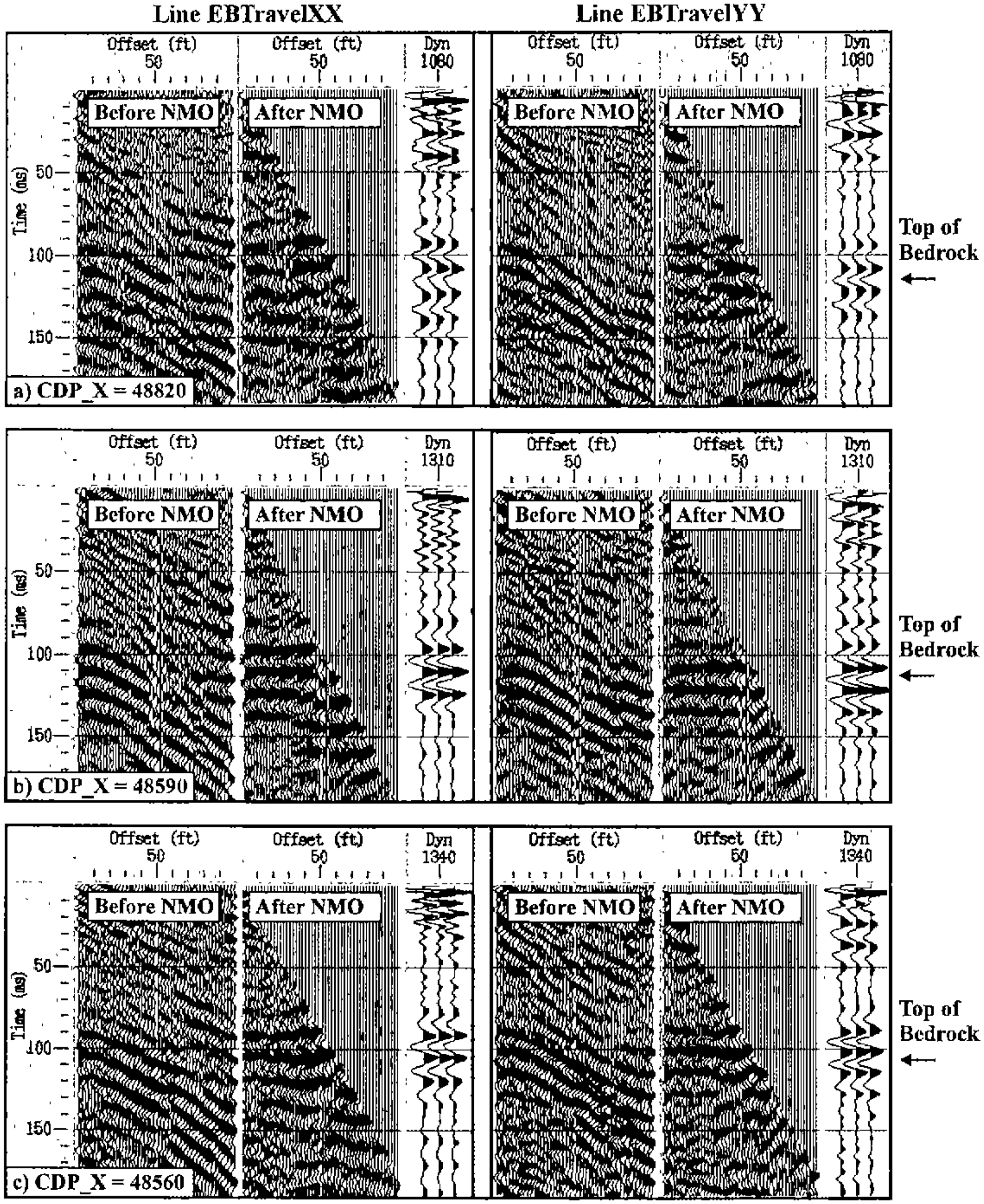
Processed (bandpass filter and AGC gain applied) line EBTravel multicomponent shot gathers: source components X (a), and Y (b). The S-wave reflections interpreted in Figure 5.13.10 are superimposed on the common-mode component (XX and YY) gathers. The x-axis scales of absolute offset (AOFFSET) from the source.



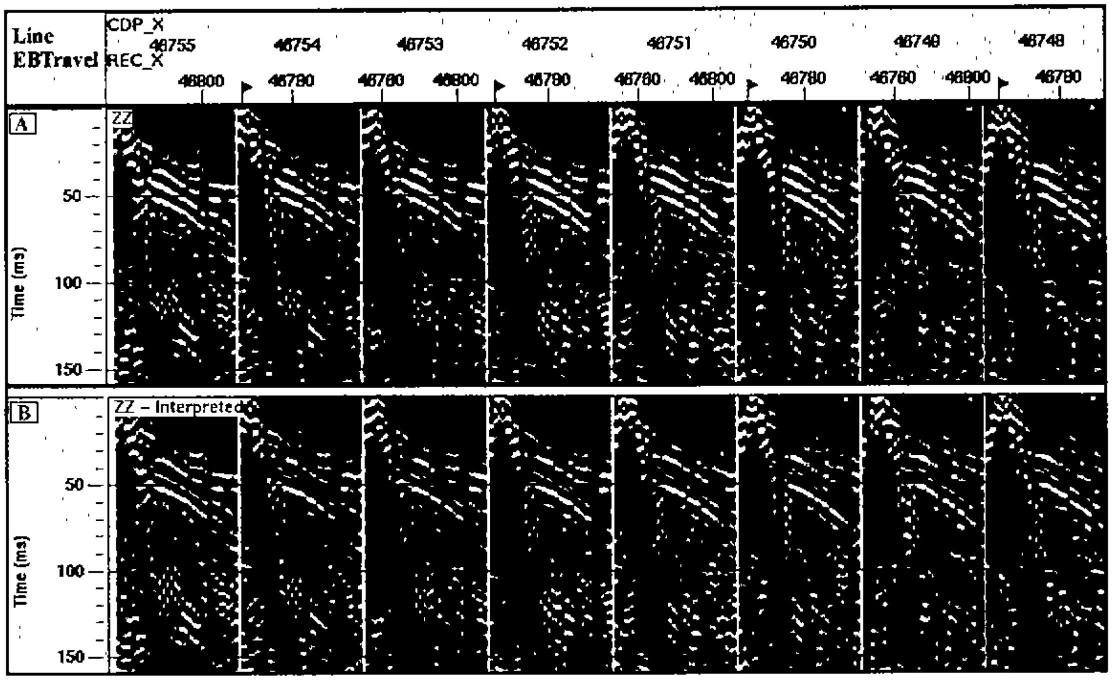
Line EBTravel shot gathers: (a) ZZ component, and (b) YY component. Gathers are shown: (top) unprocessed, (middle) with a bandpass filter (ZZ: 80-120-200-240 Hz, YY: 50-80-160-200 Hz) and AGC (100 ms window) applied, and (bottom) interpreted. P-wave reflections from the top-of-saturated-overburden (a) are indicated in blue, and S-wave reflections from the top-of-bedrock (b) are indicated in yellow, with apparent NMO velocities and approximate depths given. The x-axis scales of absolute offset (AOFFSET) from the source locations are in feet.



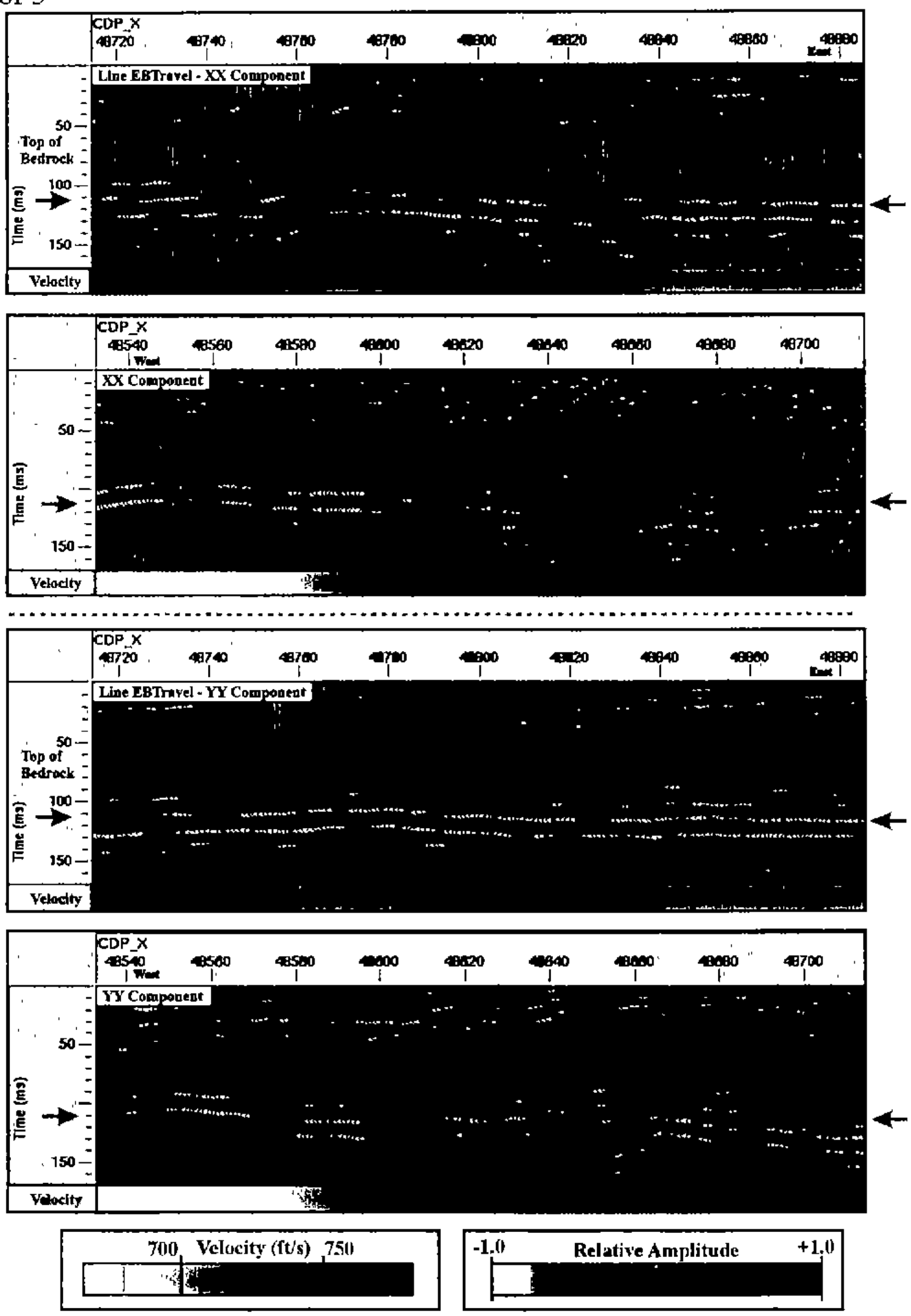
Line EBTravel multicomponent (source component Z, receiver components X, Y, and Z) shot gathers: (a) unprocessed, and (b) processed (bandpass filter: 80-120-200-240 Hz, and AGC gain with 100 ms window applied). P-wave reflections are superimposed on the processed common-mode component (ZZ) gathers. The x-axis scales of absolute offset (AOFFSET) from the source locations are in feet.



Line EBTravel CDP supergathers: XX component (left), and YY component (right). Gathers are shown before and after NMO correction using YY component-derived (Table 5.13.4) S-wave stacking velocities of: (a) 737 ft/s, (b) 705 ft/s, and (c) 675 ft/s. Arrows next to dynamic stack functions indicate the top-of-bedrock reflection event. This reflection is slightly over-corrected on the 48820 (a) XX component gather (although data still stack reasonably well at the applied velocity). For supergathers centered at the other two locations (b and c), this event is corrected similar on both the XX and YY components.

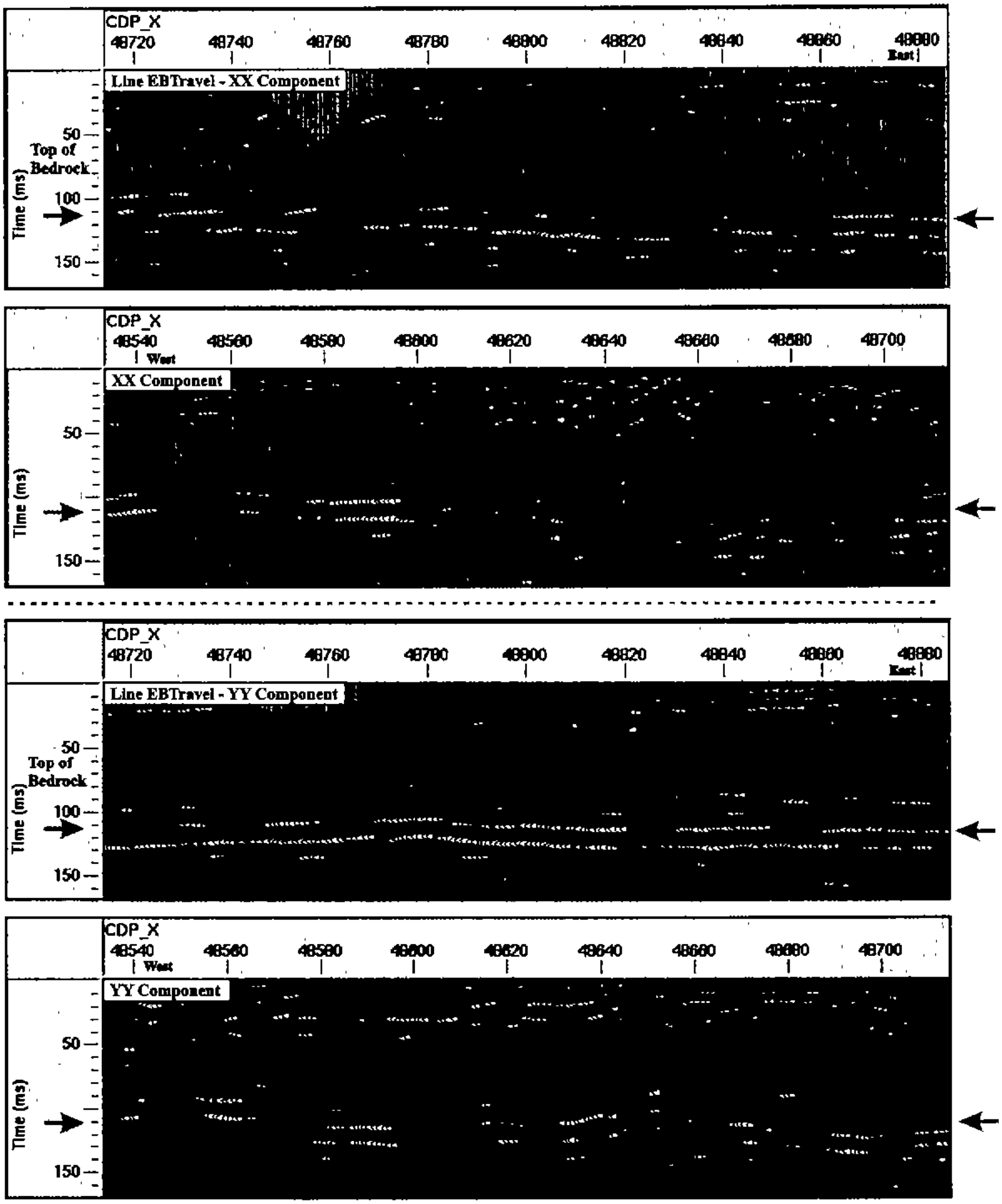


Line EBTravel ZZ component CMP gathers: (a) uninterpreted, and (b) interpreted. Gathers are shown with a bandpass filter (80-120-200-240 Hz) and AGC (100 ms window) applied. P-wave reflections from the top-of-saturated-overburden are indicated in (b), with apparent NMO velocities around 1900 ft/sec, and reflector depths of about 32 feet. X-axis scales of CMP location (CDP_X) and receiver location (REC_X) are in feet, and correspond to road stations.



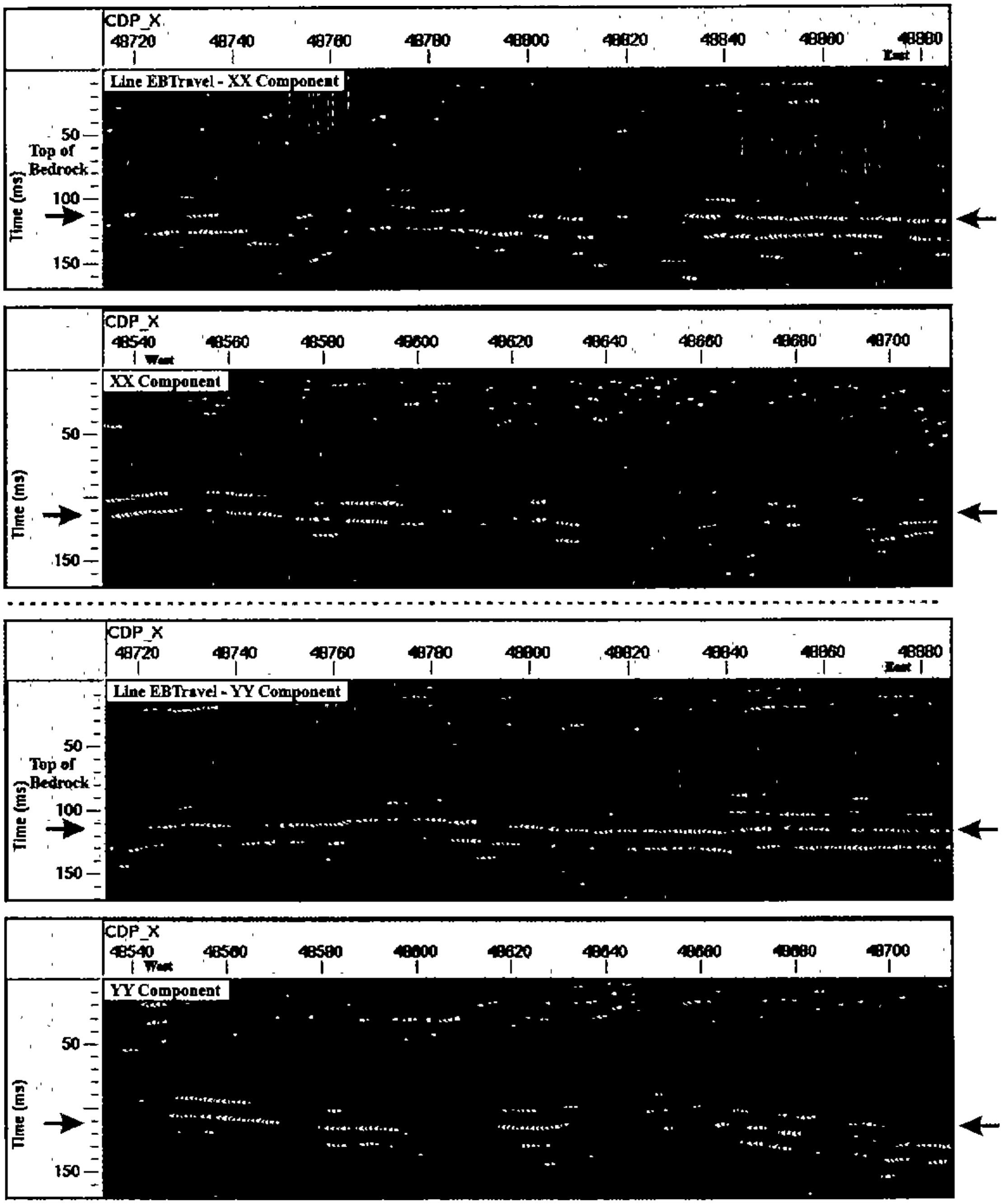
a) 100 Percent of Stacking Velocities

Line EBTravel XX and YY component time sections after similar processing, and NMO corrections made using the same velocity model: (a) 100 percent of stacking velocities, (b) 95 percent, and (c) 105 percent. Y-axis arrows indicate the top of the bedrock horizon. The YY component sections have a higher signal-to-noise ratio, and provide a better stack of the bedrock horizon. No previous mining occurred below line EBTravel between CDP locations 48880 and 48660. Near surface feature on EBTravel at 48760 is interpreted as a velocity anomaly due to difficulties with contact at the near surface rather than a real feature in the ground.



b) 95 Percent of Stacking Velocities

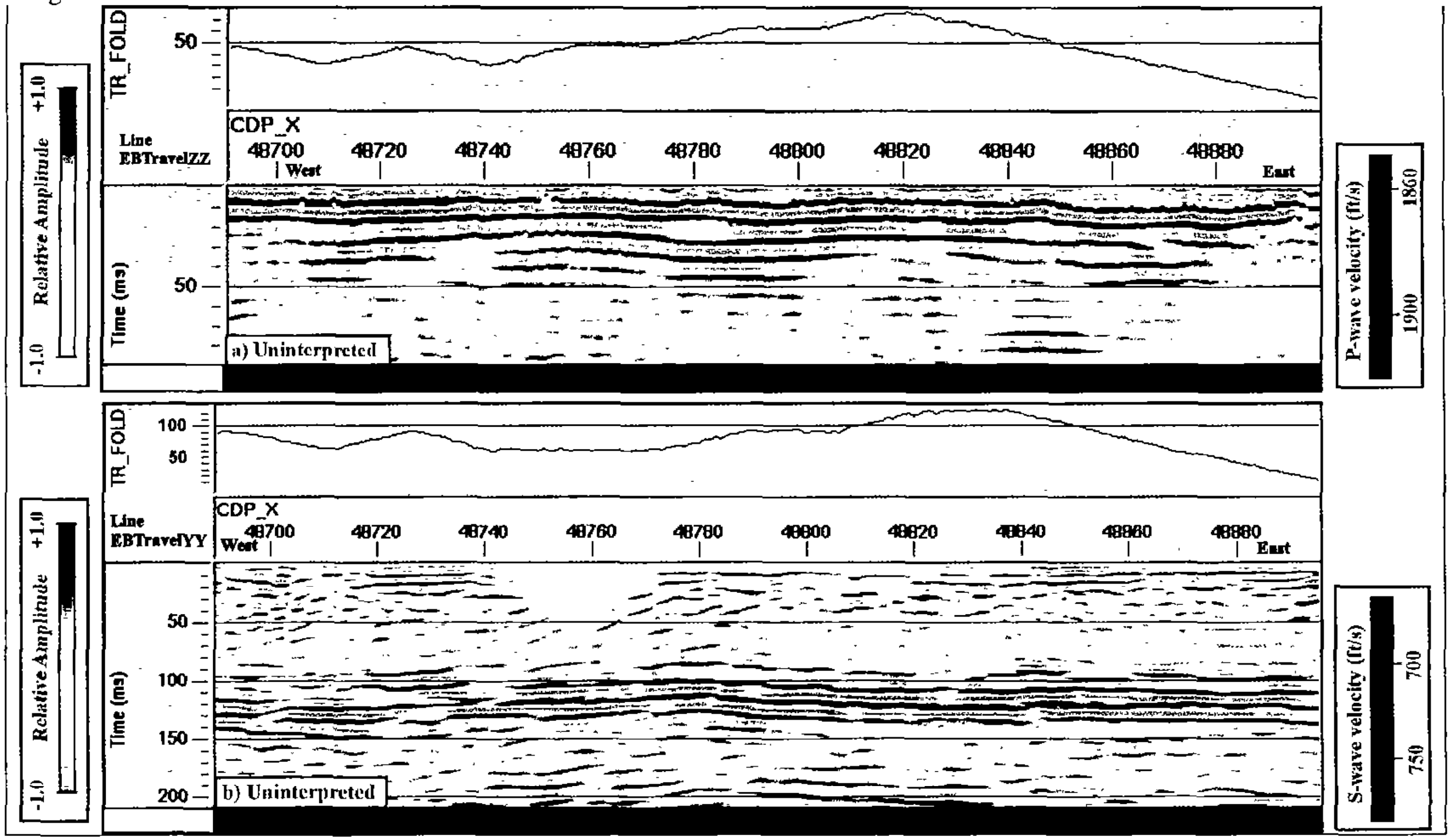
(b) Line EBTravel XX and YY component sections after similar processing. Near surface feature on EBTravel at 48760 is interpreted as a velocity anomaly due to difficulties with contact at the near surface rather than a real feature in the ground.



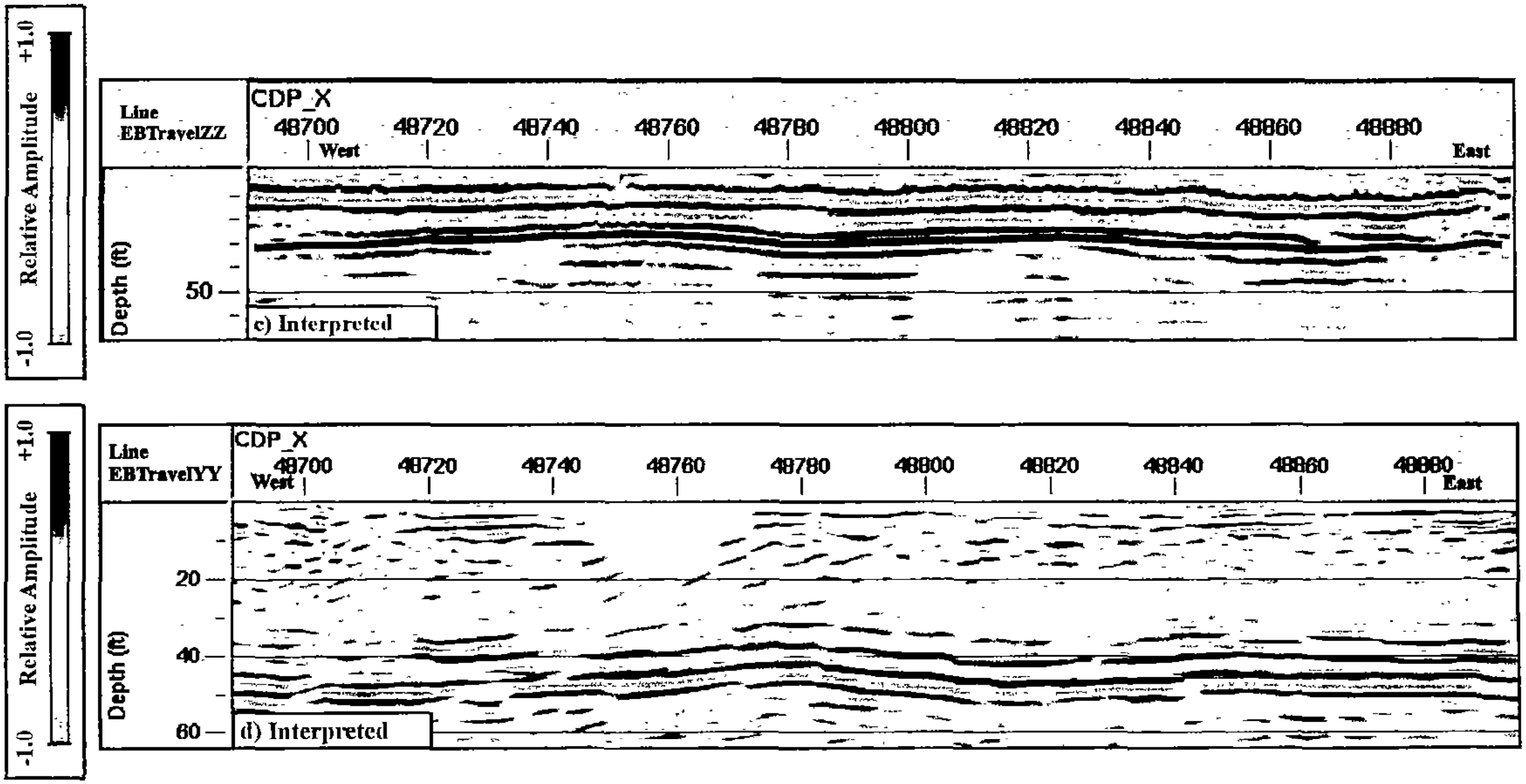
c) 105 Percent of Stacking Velocities

(c) Line EBTravel XX and YY component sections after similar processing. Near surface feature on EBTravel at 48760 is interpreted as a velocity anomaly due to difficulties with contact at the near surface rather than a real feature in the ground.

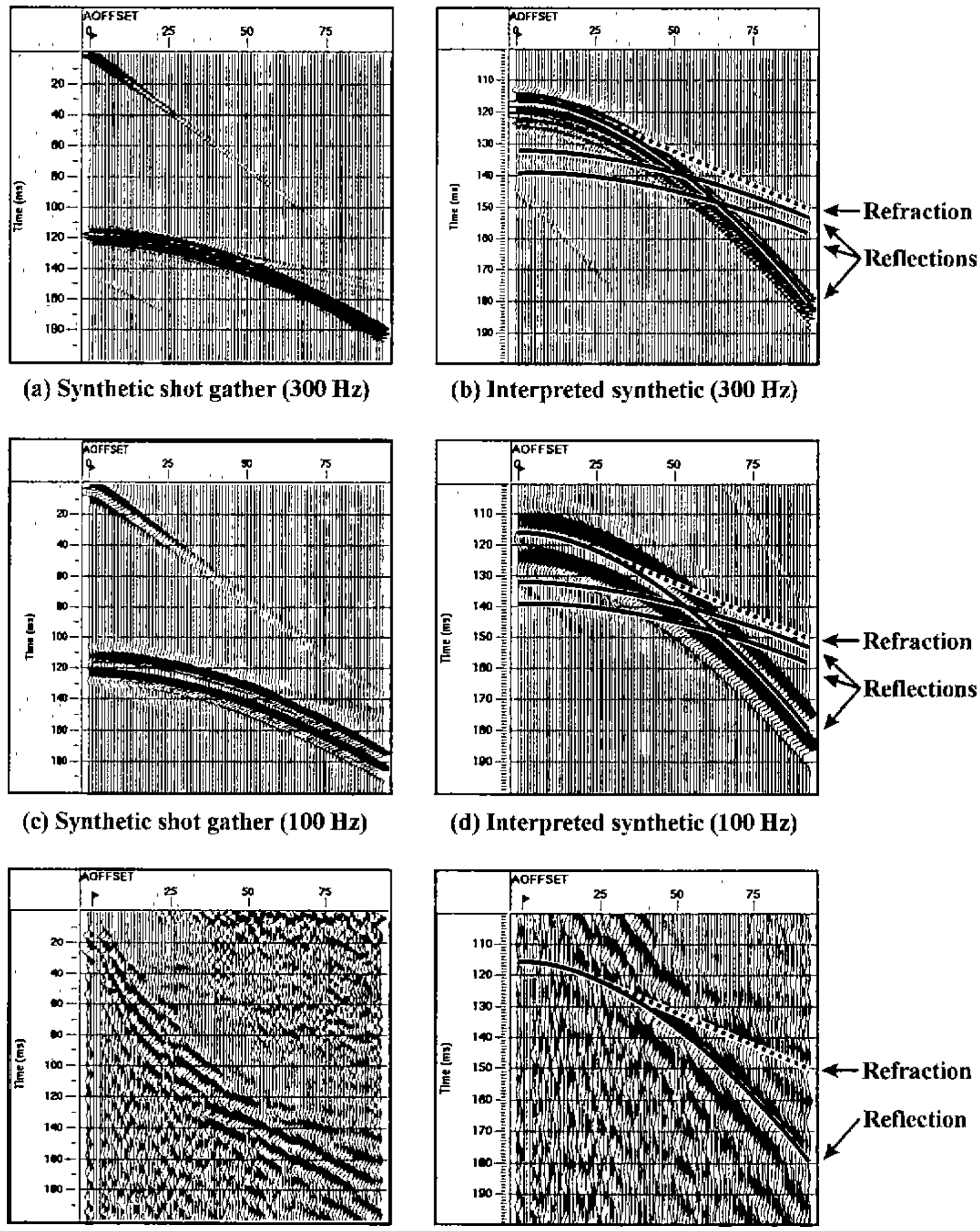
Page 1 of 2



Line EBTravel ZZ component (a) and YY component (b) time sections. The P-wave event at 28 to 33 ms (a) is the top-of-saturated-overburden (blue) on the depth section (c). The S-wave event at 105 to 115 ms (b) is the top-of-bedrock (yellow) on the depth section (d). The scales on the bottom x-axes of (a) and (b) show P-wave and S-wave stacking velocities respectively (velocity scales are to the right of the sections). Near surface feature on EBTravel at 48760 is interpreted as a velocity anomaly due to difficulties with velocity control at the near surface rather than a real feature in the ground.



(c) and (d) Line EBTravel ZZ component and YY component depth sections. CDP location numbers (CDP_X) correspond to road stations (given in feet from the western county line). See previous page for complete caption. Near surface feature on EBTravel at 48760 is interpreted as a velocity anomaly due to difficulties with velocity control at the near surface rather than a real feature in the ground.



(a) Synthetic shot gather (300 Hz)

(b) Interpreted synthetic (300 Hz)

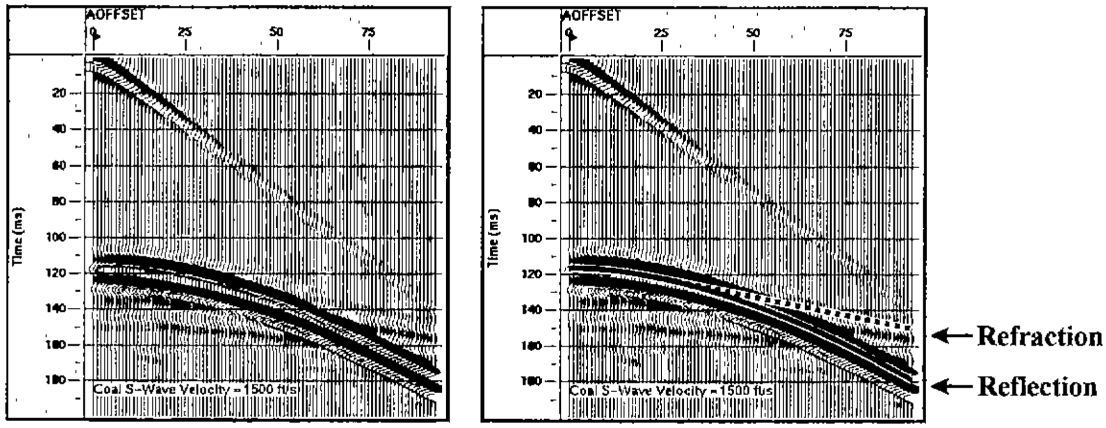
(c) Synthetic shot gather (100 Hz)

(d) Interpreted synthetic (100 Hz)

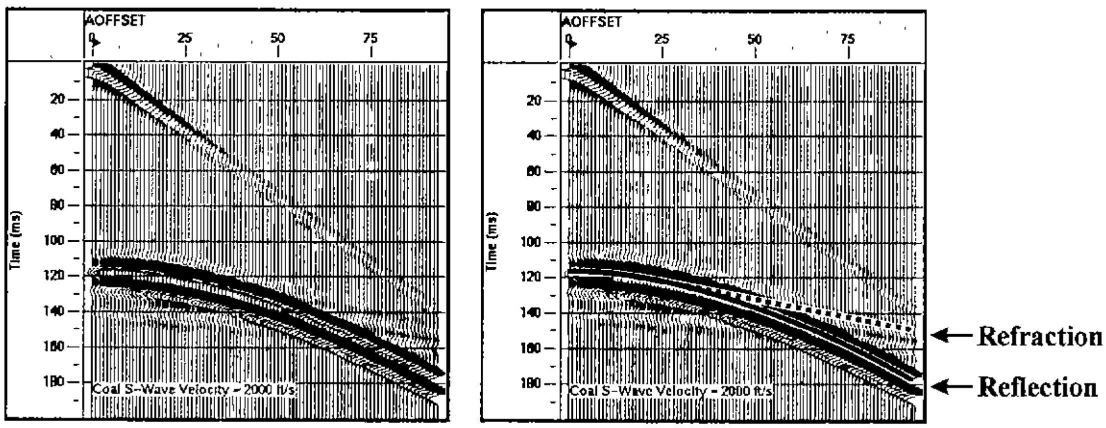
(e) Processed shot gather

(f) Interpreted shot gather

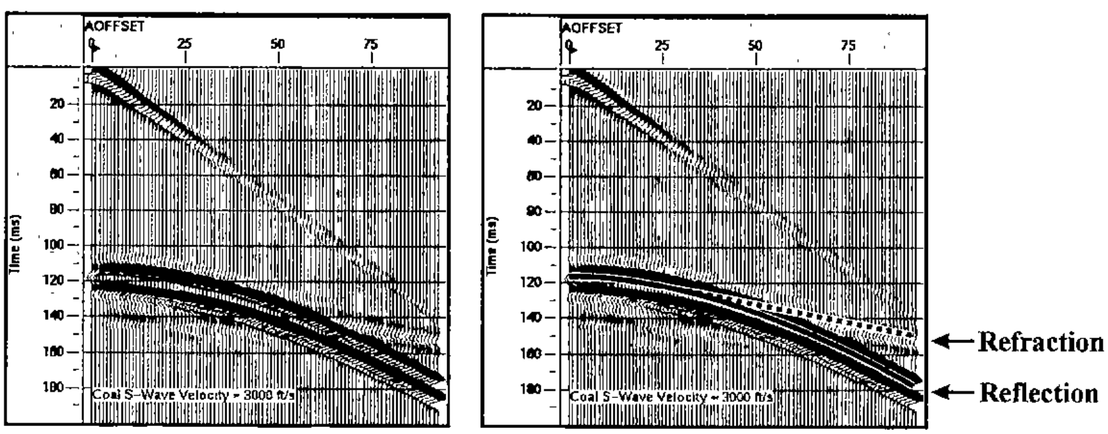
Uninterpreted synthetic seismograms generated with a center source frequency of 300 Hz (a), and 100 Hz (c). The three model interfaces are resolved at near and far offsets with a source frequency of 300 Hz (b), while only the primary event is easily interpreted with a source frequency of 100 Hz (d). Also shown is the uninterpreted (e) and interpreted (f) shot gather used as a basis for forward modeling. A high reflection coefficient at the overburden-bedrock interface, near offset noise, a lower signal to noise ratio, interference, and wavelet ringiness result in only the overburden and bedrock reflection being interpretable from the field data. The x-axis scale of absolute offset from the source is in feet.



(a) Coal S-wave velocity = 1500 ft/s

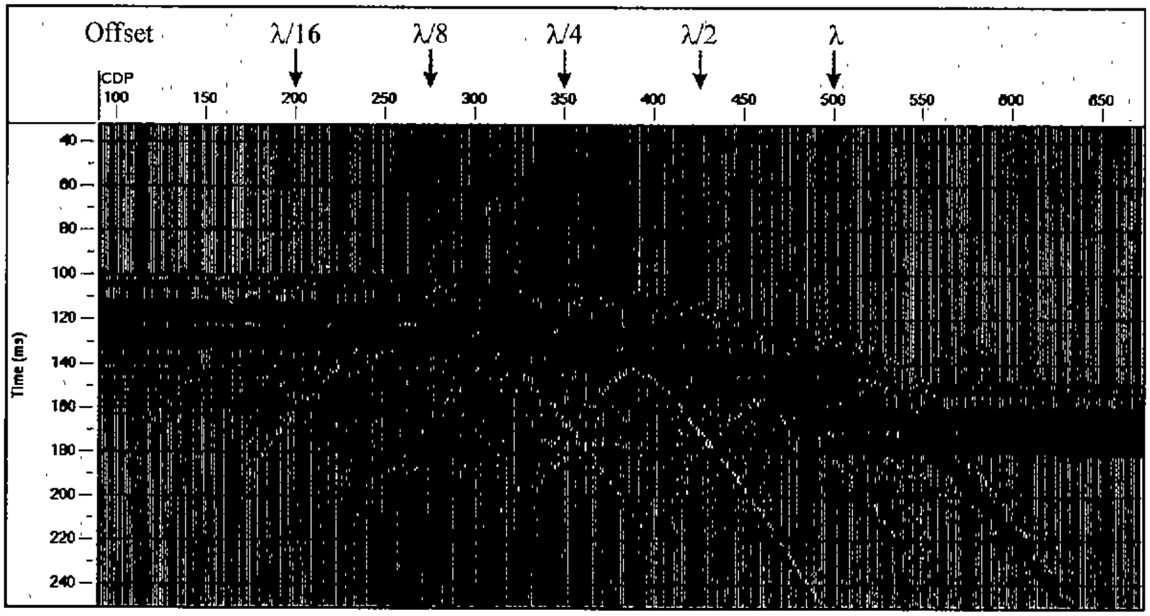


(b) Coal S-wave velocity = 2000 ft/s

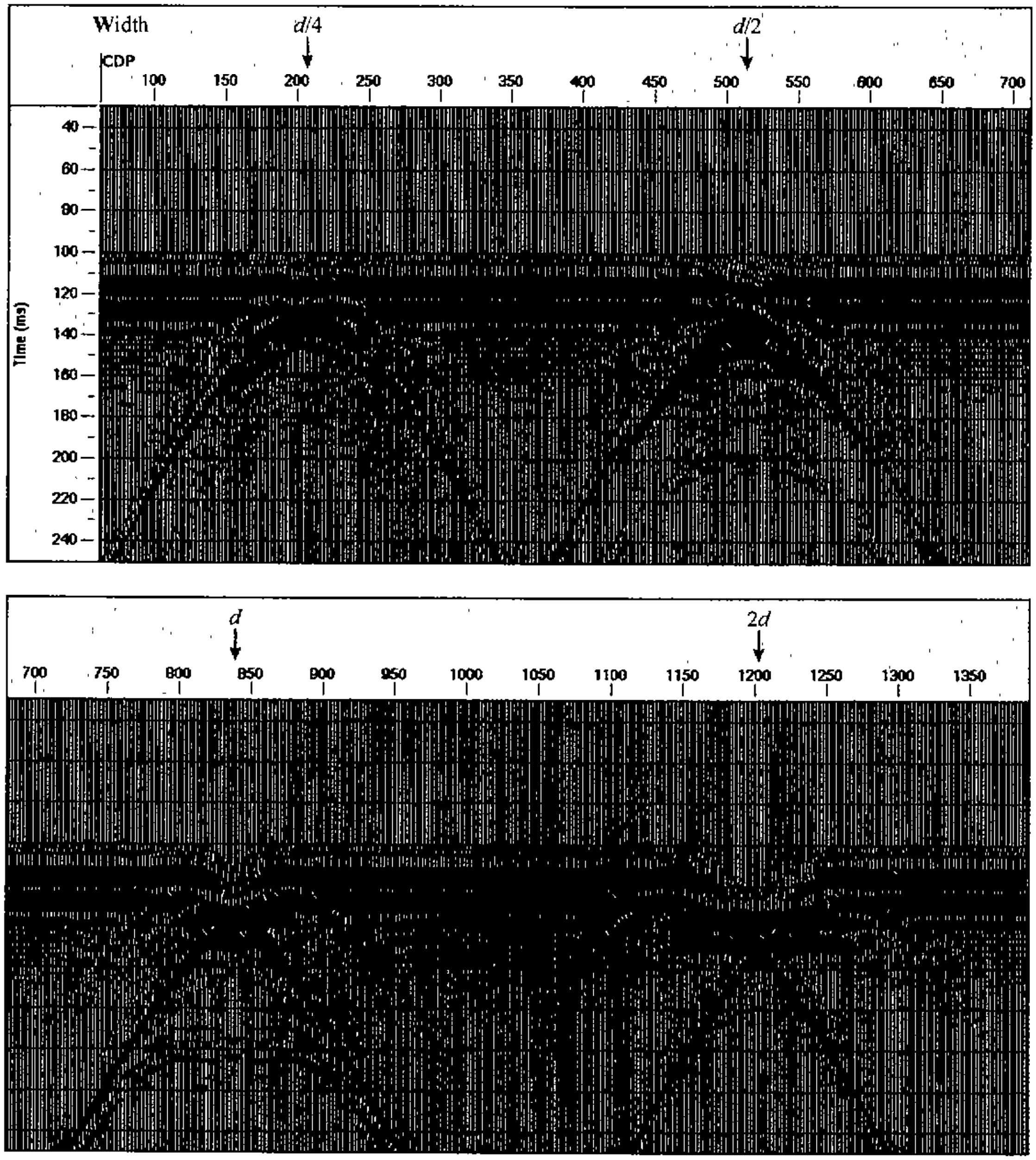


(c) Coal S-wave velocity = 3000 ft/s

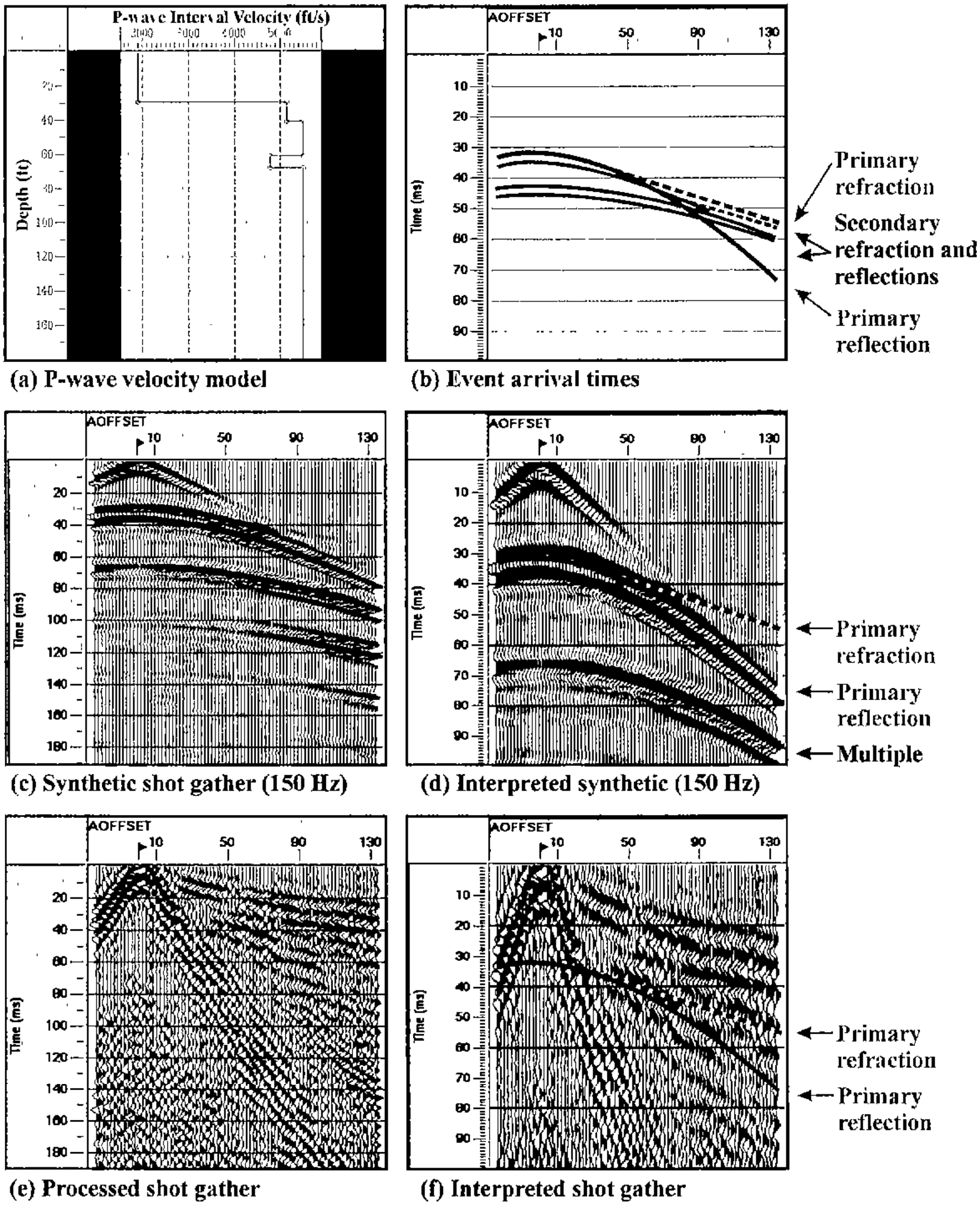
Uninterpreted (left), and with the top of bedrock reflection and refraction interpreted (right) synthetic seismograms (center source frequency = 100 Hz) generated using different S-wave velocities for the coal seam than those discussed in text. Interference of reflection energy does not allow lower amplitude events from the coal top or bottom to be easily interpreted at any of these modeled coal S-wave velocities.



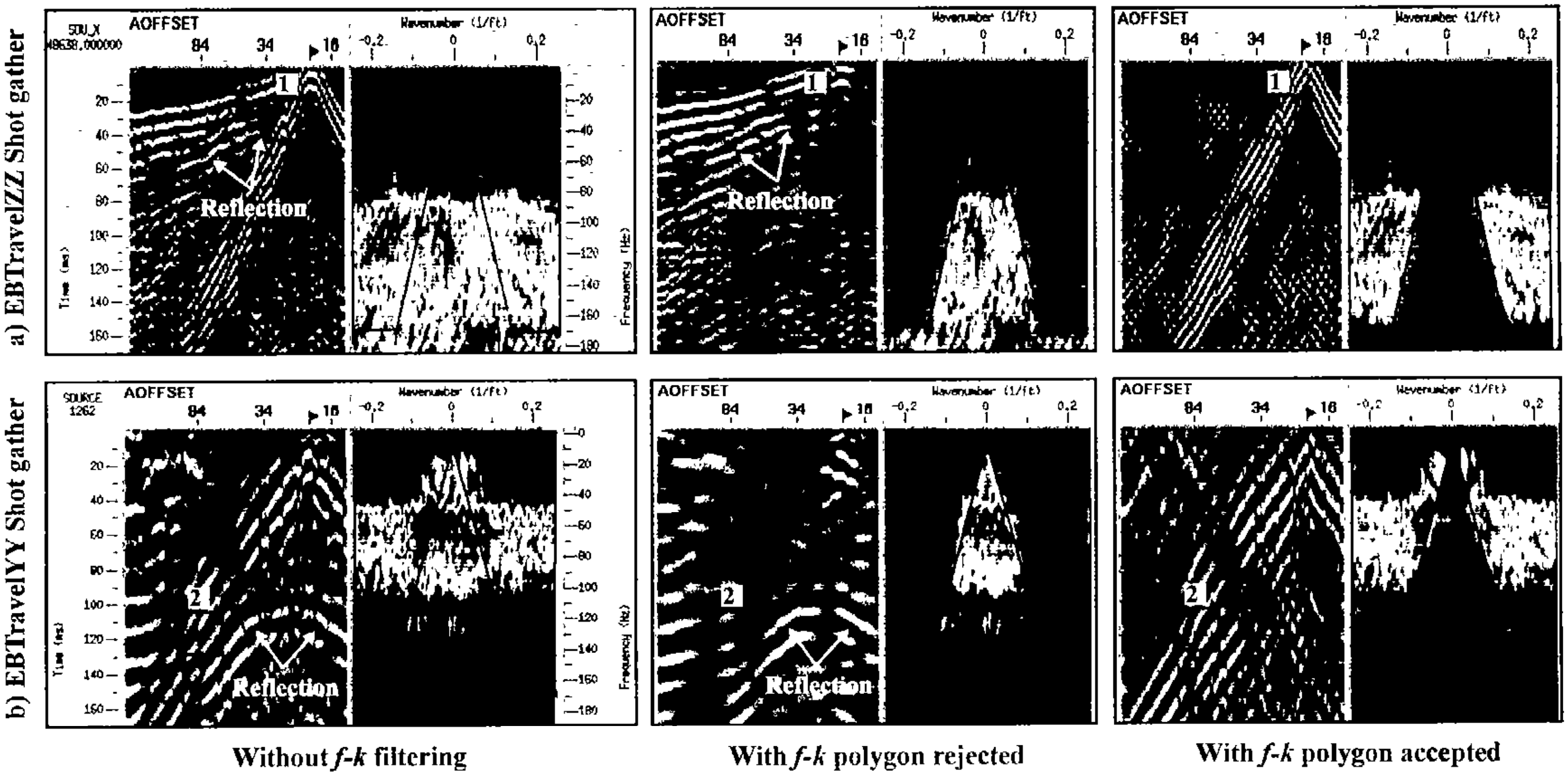
A synthetic section generated using the overburden and bedrock velocity and depth parameters determined from the field data as a basis. Five faults (fault locations are indicated by arrows on the x-axis) were modeled, with the amount of vertical offset for each fault specified as a fraction of the dominant wavelength (λ). As seen by the modeled results, vertical offset of the bedrock interface must be at least a quarter of the dominant wavelength to be easily inferred without relying on diffraction events (which may not be observed in field data with a lower signal to noise ratio). The overburden and bedrock boundary is 39 feet deep at CDP 100, and due to continued downward offset this interface is at a depth of 55.3 ft at CDP 600 (CDP spacing is 0.5 ft).



A synthetic stacked section generated using the overburden and bedrock velocity and depth parameters determined from the field data in Figure 5.13.19f as a basis. Four bedrock graben structures resulting from mine-related subsidence activity (graben locations are indicated by arrows on the x-axis) were modeled, with the width of each structure specified as a fraction of the Fresnel zone diameter (*d*). As seen by the modeled results, reflections appear to be continuous across a bedrock subsidence feature when the spatial extent of the feature is much smaller than the size of the Fresnel zone. The top of bedrock exists at a depth of 39 feet at all CDP locations, except where this boundary has subsided to a depth of 46 ft in the grabens (CDP spacing is 0.5 ft).

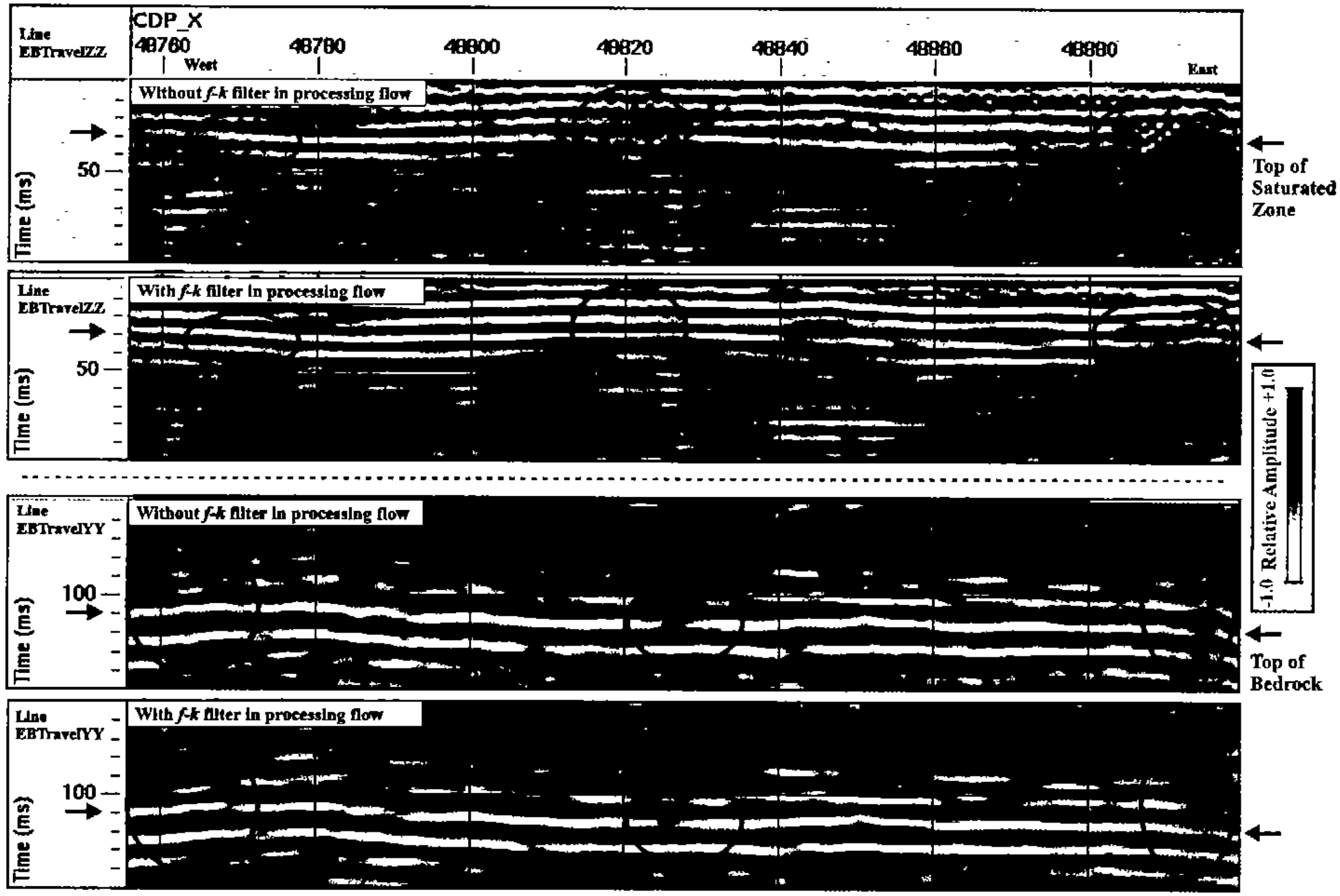


Comparison of synthetic data with line EBTravel field data (ZZ component). Plots of the velocity model and calculated event arrival times are shown in (a) and (b) respectively. A synthetic seismogram generated using the model in (a) with a 150 Hz source is shown uninterpreted in (c), and interpreted in (d). A shot gather used as a basis for modeling is shown uninterpreted in (e), and interpreted in (f). A high reflection coefficient at the unsaturated-saturated overburden (primary) interface, noise, and interference prevent interpretation of secondary events in field data (f).

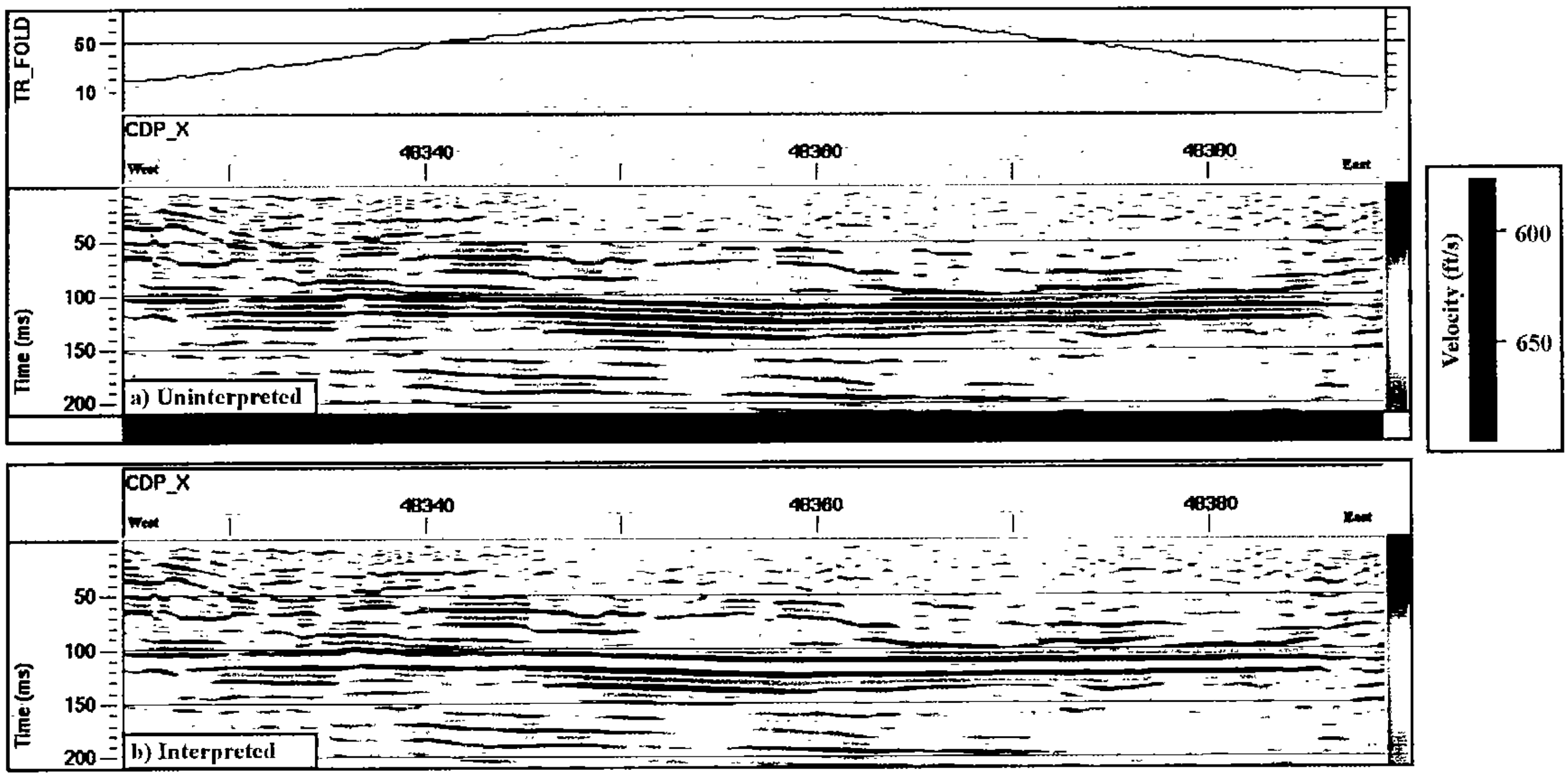


Without *f-k* filtering — With *f-k* polygon rejected — With *f-k* polygon accepted

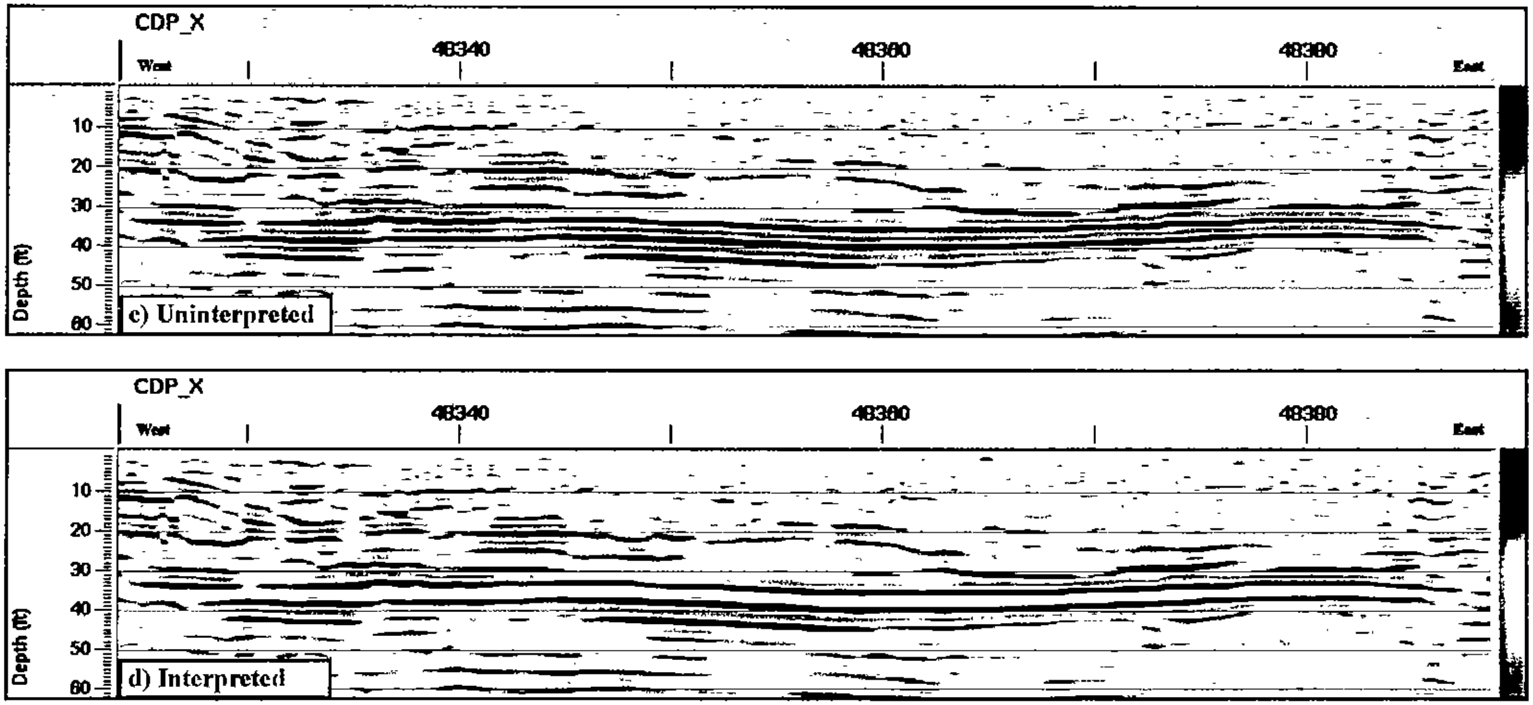
Line EBTravel ZZ component (a) and YY component (b) shot gathers (source located at road station 48638, east direction to left) and *f-k* spectra: (left) gathers without *f-k* filter applied showing reflections with zero-offset times of 32 ms (a) and 110 ms (b), and *f-k* amplitude spectra showing defined mute polygons, (middle) with polygons rejected to suppress noise (indicated in boxes 1 and 2), and (right) with polygons accepted (showing noise rejected through filter application). Bandpass filters and AGC gain were applied to the gathers before generating these plots in order to demonstrate *f-k* filter non-reflection energy suppression across reflection signal bandwidths. The x-axis scales of absolute offset from the sources are in feet. This figure is an example of methods of filtering "noise" from true reflections, the feature shown is typical of the data.



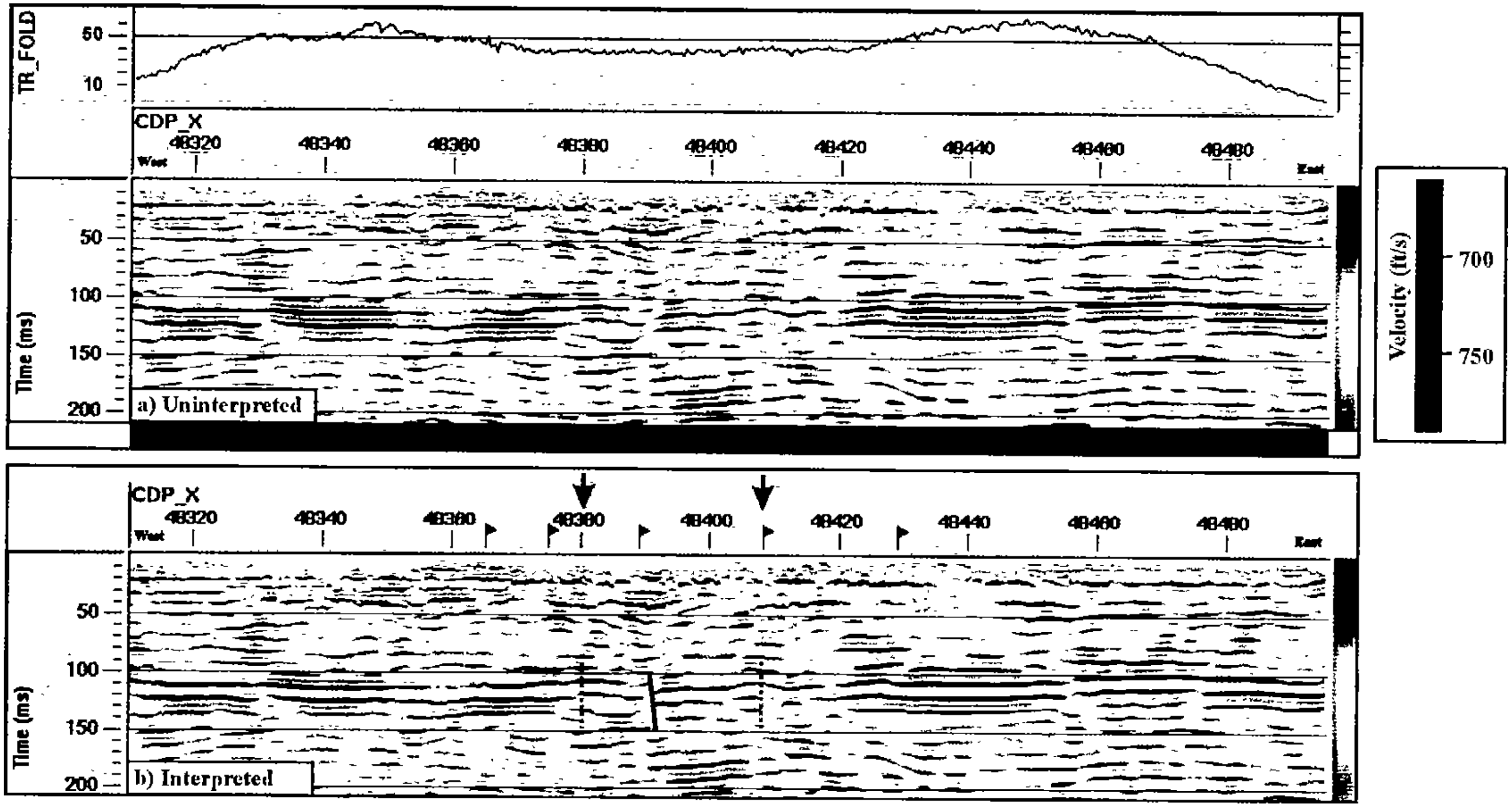
Line EBTravel ZZ component (top) and YY component (bottom) time sections without and with *f-k* filtering in processing flows Notice the suppression of noise and enhancement of reflection signal (within the circled regions) achieved through application of *f-k* filters.



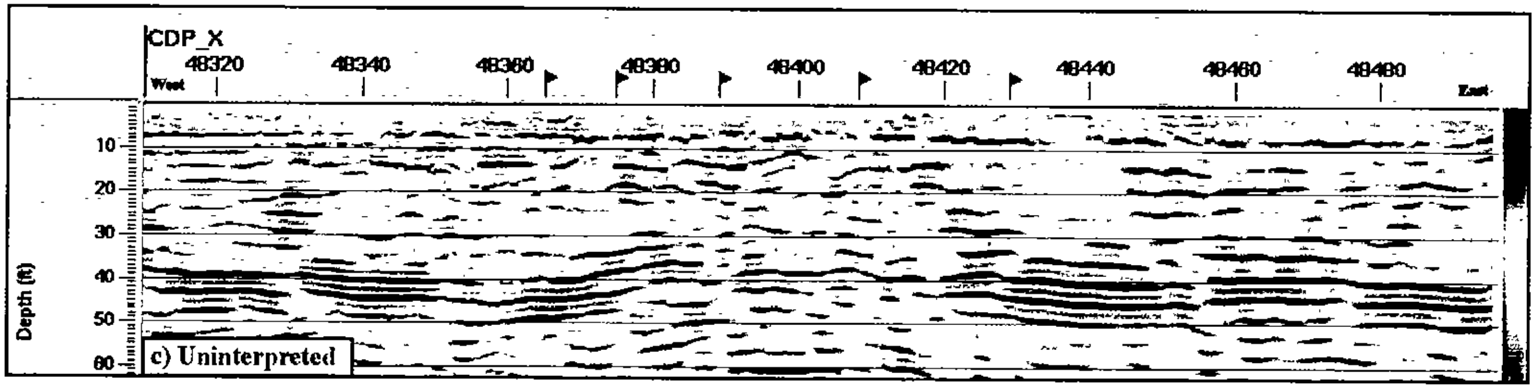
Line Test-1 stacked section with fold (TR_FOLD) plot. The continuous reflection event at 110 to 120 ms (a), is the top of bedrock (b). The color bar on the bottom x-axis of (a) shows bedrock horizon stacking velocities. Uninterpreted (c) and interpreted (d) depth sections are also shown. To the east of CDP 48345 the overburden-bedrock horizon dips down to the east and stacking velocities decrease, suggesting that the removal of coal in this region may have influenced the bedrock topography and resulted in a decreased overburden stiffness.

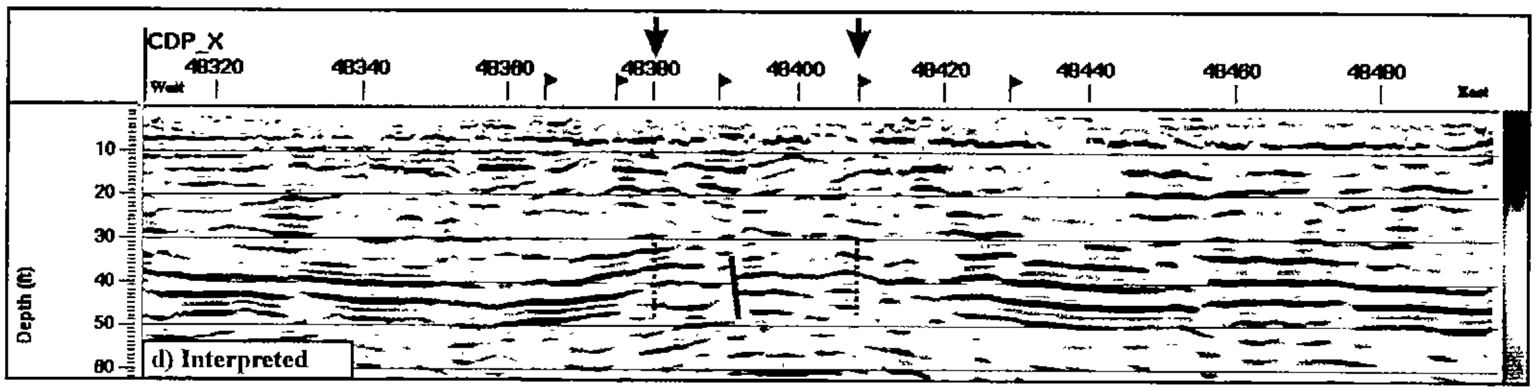


(c) and (d) Line Test-1 stacked depth section.

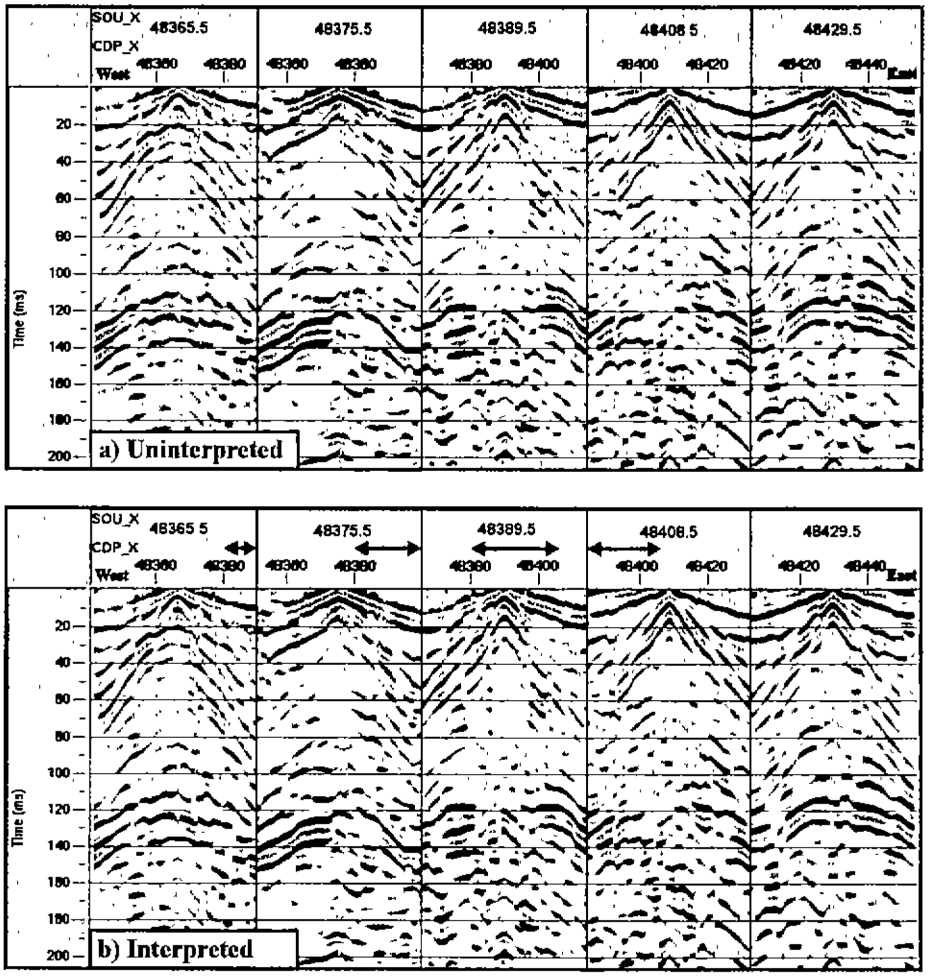


Line GUE-I70-1 stacked section with fold (TR_FOLD) plot (a). The reflection at 110 to 120ms (a), is the top of bedrock (b). The color bar on the bottom x-axis of (a) shows bedrock stacking velocities. Uninterpreted (c) and interpreted (d) depth sections are also shown. A bedrock discontinuity is interpreted at CDP_X 48391, and an area of disrupted bedrock is interpreted between CDP_X 48380 and 48408. The interpreted disruption is based upon on wavelet character and analysis of the shot gathers.

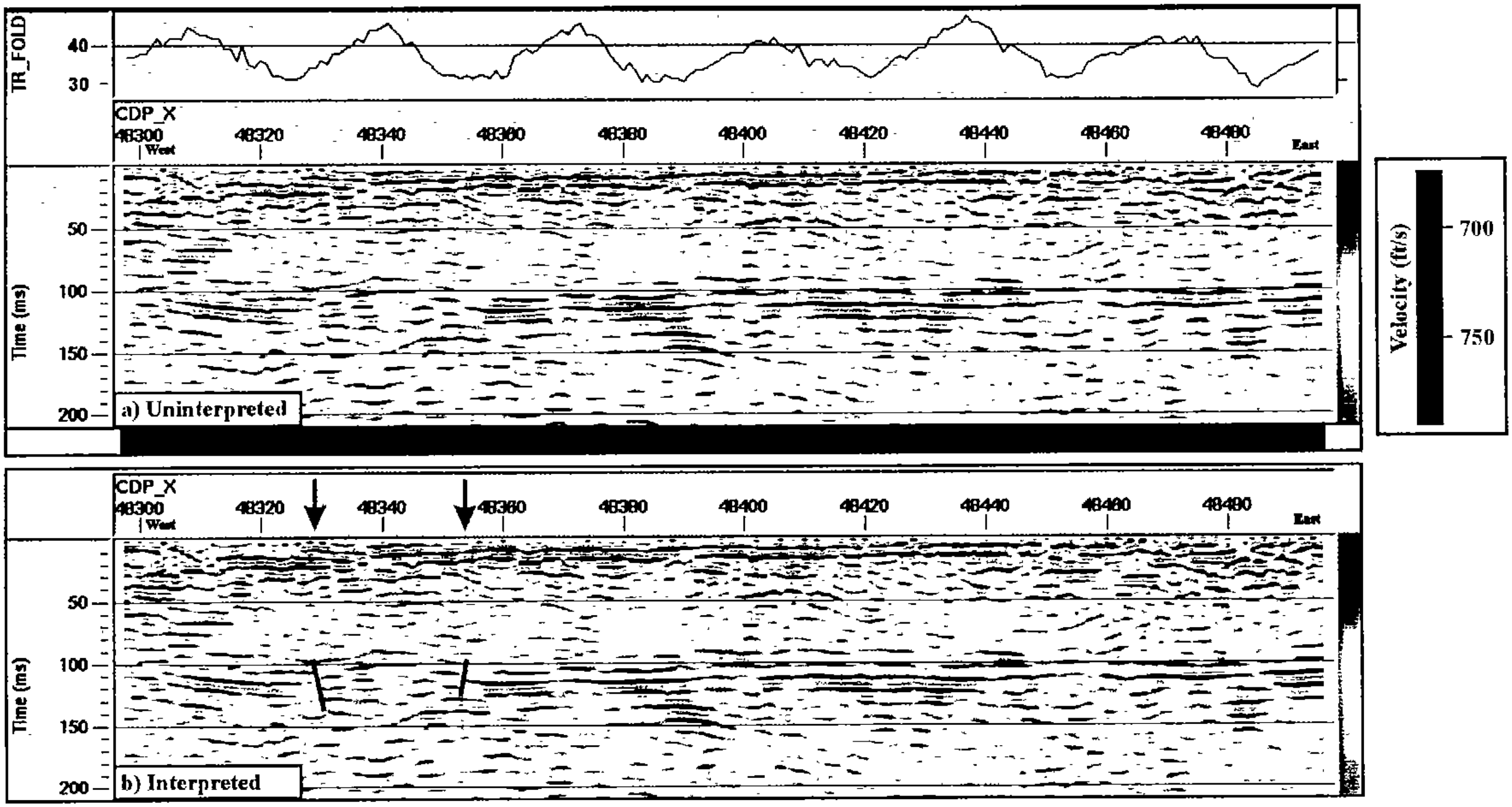




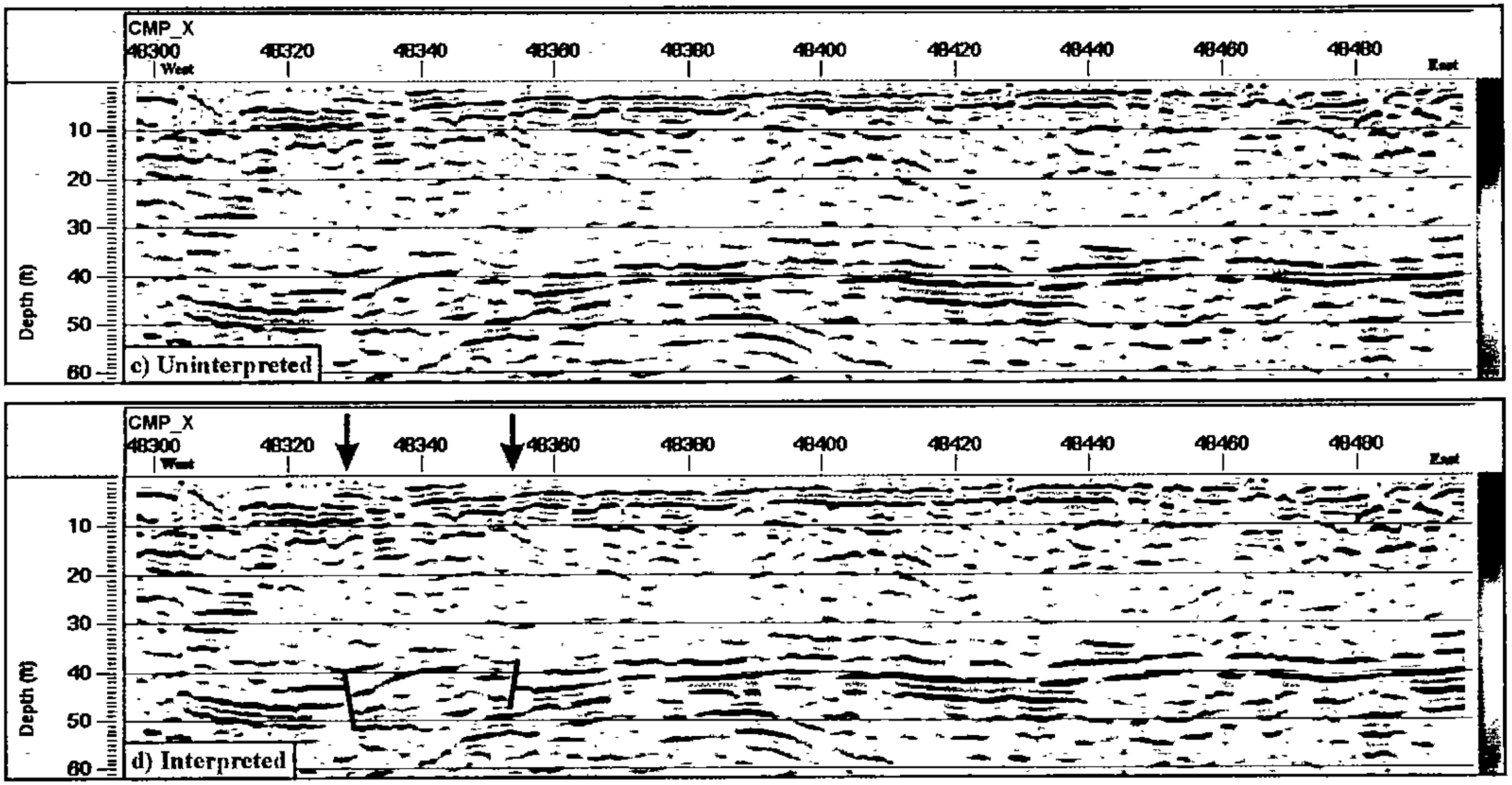
(c) and (d) Line GUE-I70-1 stacked depth section.



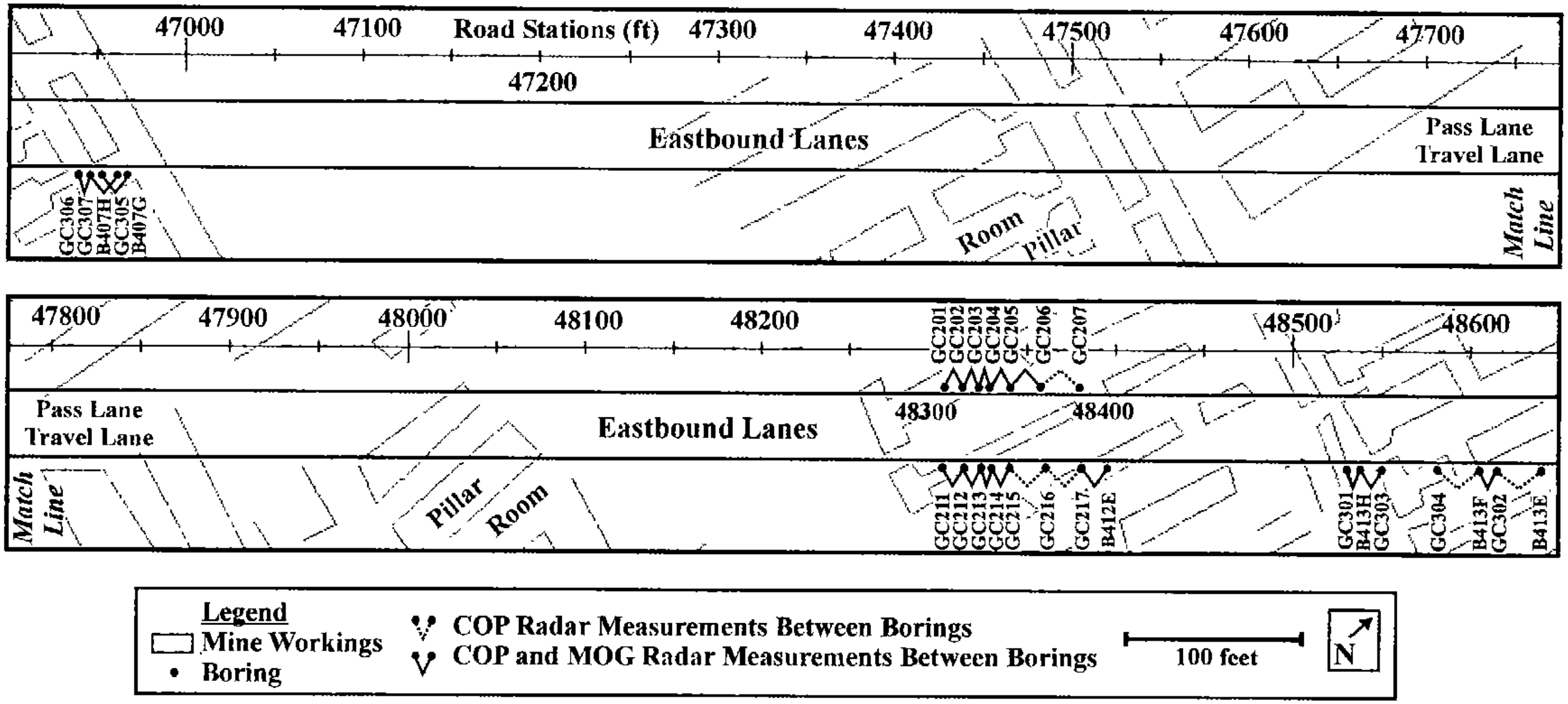
Line GUE-I70-1 uninterpreted (a) and interpreted (b) shot gathers. The reflection at 110 to 120 ms (b) is the top of bedrock. The 48375.5 shot gather indicates an apparent updip direction to the east at this location. Based on shot gather reflection character, an area of disrupted bedrock is interpreted between CDP's 48380 and 48408.



Line EBPassYY stacked section with fold (TR_FOLD) plot (a). The reflection at 105 to 115 ms (a), is the top of bedrock (b). The color bar on the bottom x-axis of the uninterpreted section (a) shows bedrock horizon stacking velocities. Uninterpreted (c) and interpreted (d) depth sections are also shown. The bedrock horizon is continuous across the section, except between CDP_X 48329 and 48354, where discontinuity is interpreted.



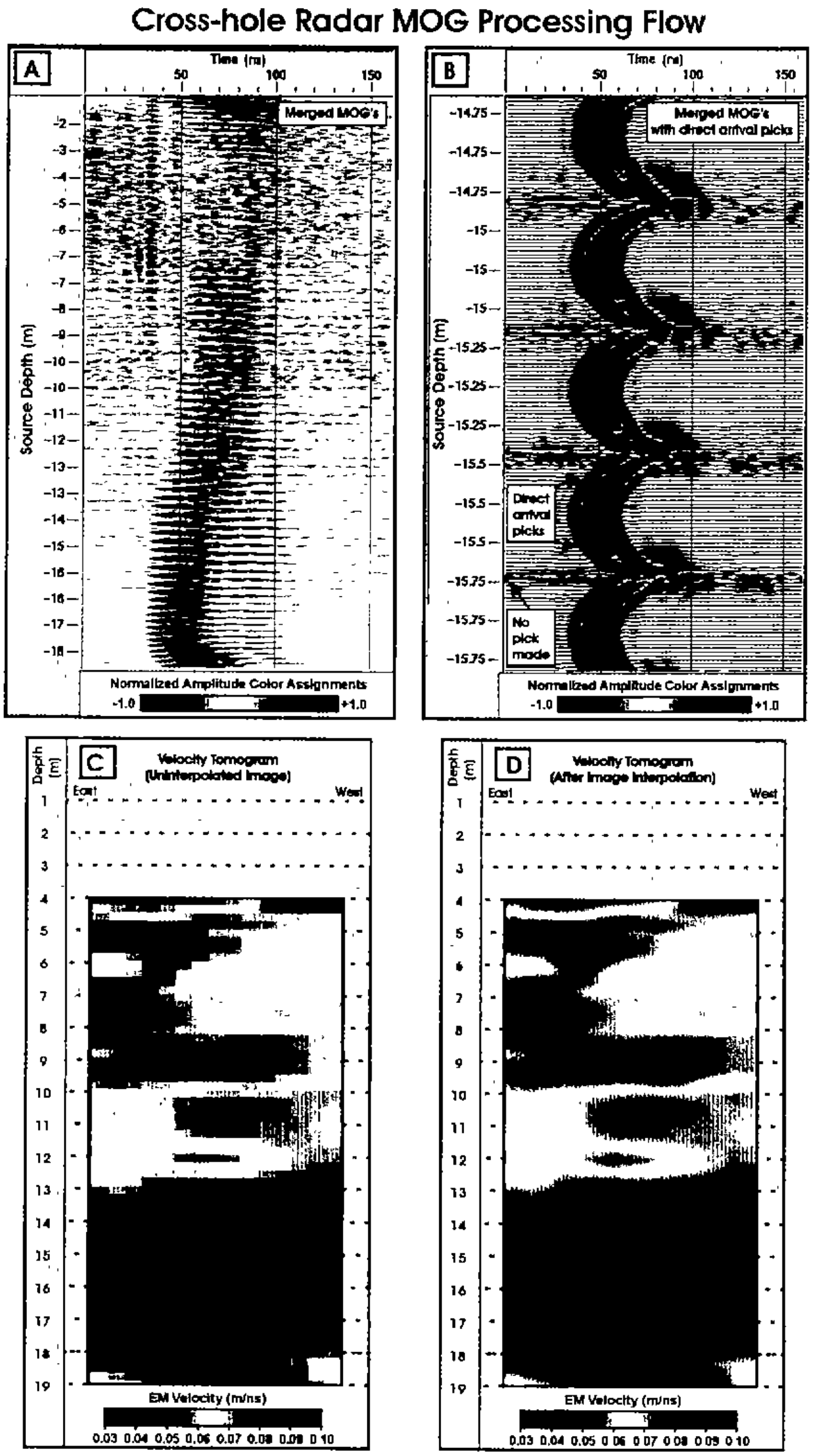
(c) and (d) Line EBPassYY stacked depth section.



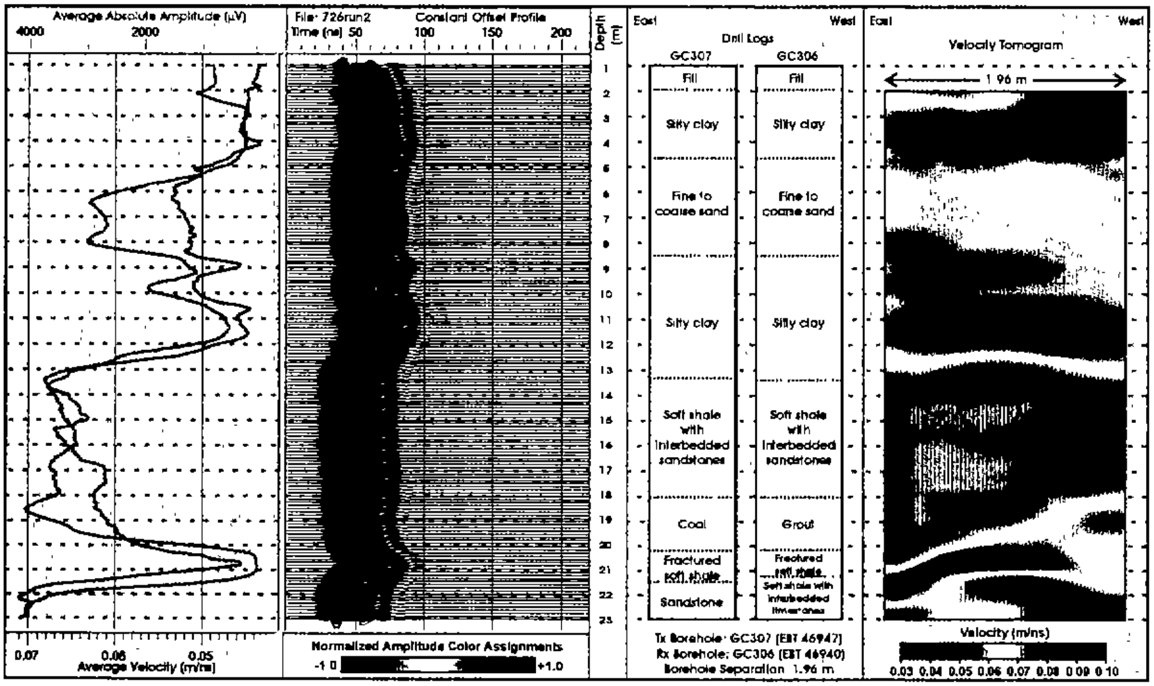
Map of the eastbound lanes of I-70 showing the locations of cross-hole constant offset profile (COP) and multiple offset gather (MOG) radar measurements between borings, relative to the mapped locations of underground mine workings.

COP data filename	MOG measurements made?	Transmit (Tx) borehole	Tx borehole location (easting, ft), drill date	Receive (Rx) borehole	Rx borehole location (easting, ft), drill date	Borehole separation (m)	Maximum antennas depth (m)
726run1	Yes	GC305	EBT 46962, 5/9/02	GC307	EBT 46947, 5/13/02	4.88	22
726run2	Yes	GC307	EBT 46947, 5/13/02	GC306	EBT 46940, 5/10/02	1.96	23
726run3	Yes	B407G	EBT 46968, 4/18/02	B407H	EBT 46954, 4/23/02	4.57	19
726run4	Yes	GC212	EBT 48315, 10/19/99	GC211	EBT 48304, 10/14/99	3.5	19
726run5	Yes	GC213	EBT 48326, 10/22/99	GC212	EBT 48315, 10/19/99	3.12	19
726run6	Yes	GC214	EBT 48330, 10/27/99	CG213	EBT 48326, 10/22/99	1.4	19
726run7	Yes	GC215	EBT 48340, 11/4/99	GC214	EBT 48330, 10/27/99	3.05	19
726run8	No	GC216	EBT 48360, 10/18/99	GC215	EBT 48340, 11/4/99	5.97	20
726run9	No	GC217	EBT 48380, 11/12/99	GC216	EBT 48360, 10/18/99	6.15	20
726run10	Yes	B412E	EBT 48395, 4/19/02	GC217	EBT 48380, 11/12/99	3.99	21
726run13	Yes	B413H	EBT 48537, 4/22/02	GC301	EBT 48530, 5/6/02	2.16	24
726run14	Yes	GC303	EBT 48550, 5/7/02	B413H	EBT 48537, 4/22/02	3.81	23
727run1	No	B413F	EBT 48605, 4/23/02	GC304	EBT 48583, 5/8/02	6.71	20
727run2	Yes	GC302	EBT 48615, 5/7/02	B413F	EBT 48605, 4/23/02	3.99	23
727run3	No	B413E	EBT 48640, 4/22/02	GC302	EBT 48615, 5/7/02	6.71	20
727run6	Yes	GC202	EBP 48314, 10/19/99	GC201	EBP 48304, 10/8/99	3.25	16
727run7	Yes	GC203	EBP 48323, 10/21/99	GC202	EBP 48314, 10/19/99	2.79	16
727run8	Yes	GC204	EBP 48328, 10/26/99	GC203	EBP 48323, 10/21/99	1.6	16
727run9	Yes	GC205	EBP 48340, 11/19/99	GC204	EBP 48328, 10/26/99	3.5	19
727run10	Yes	GC206	EBP 48357, 11/10/99	GC205	EBP 48340, 11/19/99	5.13	22
727run11	No	GC207	EBP 48379, 11/16/99	GC206	EBP 48357, 11/10/99	6.65	20

Cross-hole constant offset profile (COP) and multiple offset gather (MOG) radar measurements in the I-70 study area (Figure 5.14.1). Borehole locations correspond to road stations; EBT = eastbound travel lane, EBP = eastbound passing lane.

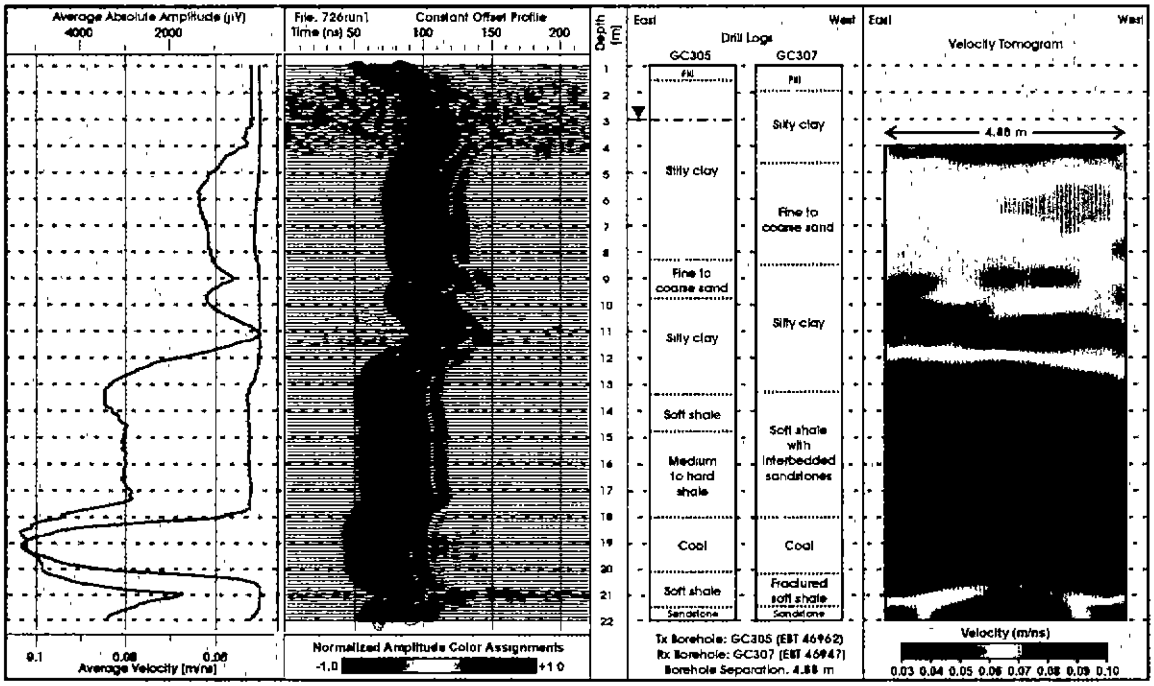


Demonstration of multiple offset gather data processing and imaging flow: (a) field data after dewow correction, merging, time-zero correction, trace editing, truncation, bandpass filtering, and trace normalization, (b) zoomed in look at MOG's after direct arrival picks, (c) plot of calculated velocity distribution between boreholes obtained through inversion, and (d) velocity distribution plot after image interpolation.

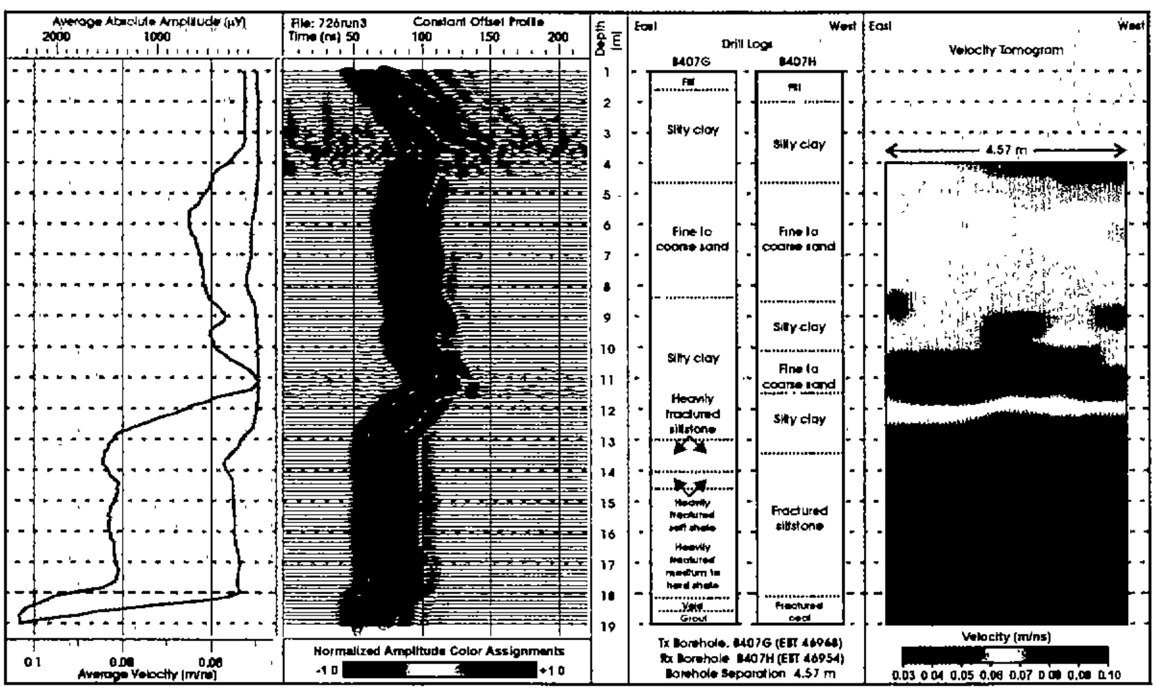


(a) Borehole radar data and drill-log plots for wells GC307 and GC306.

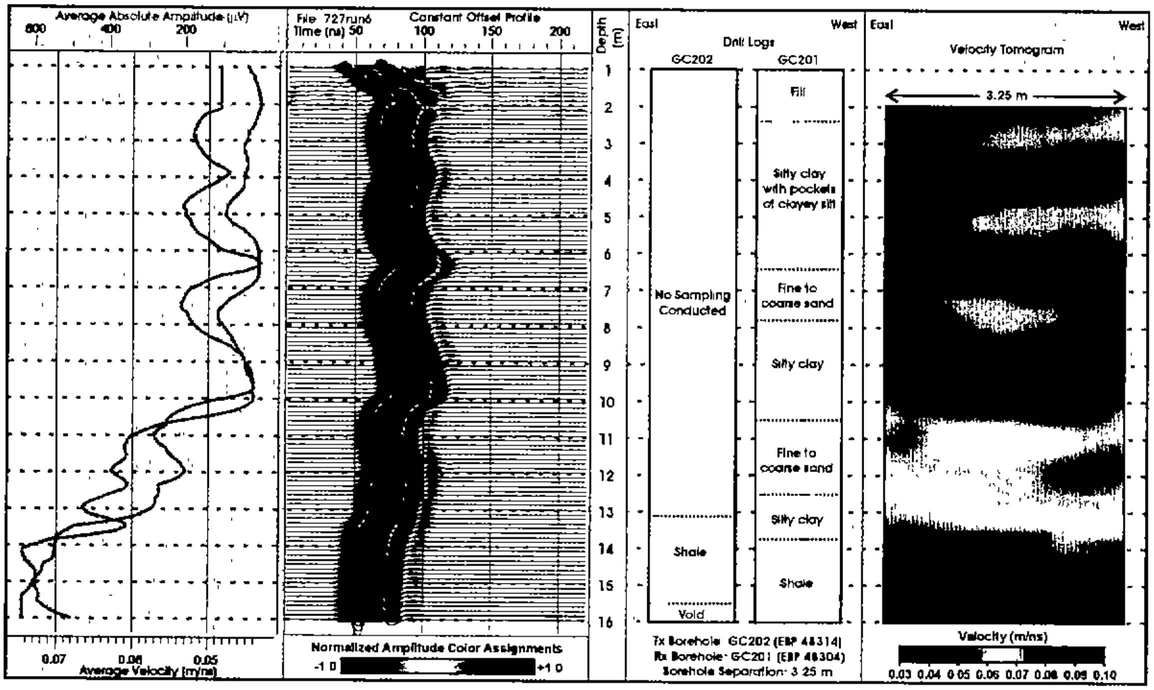
Average EM-wave velocity and average absolute amplitude plots, radar COP data, drill logs, and EM-wave velocity tomograms.



(b) Borehole radar data and drill-log plots for wells GC305 and GC307.

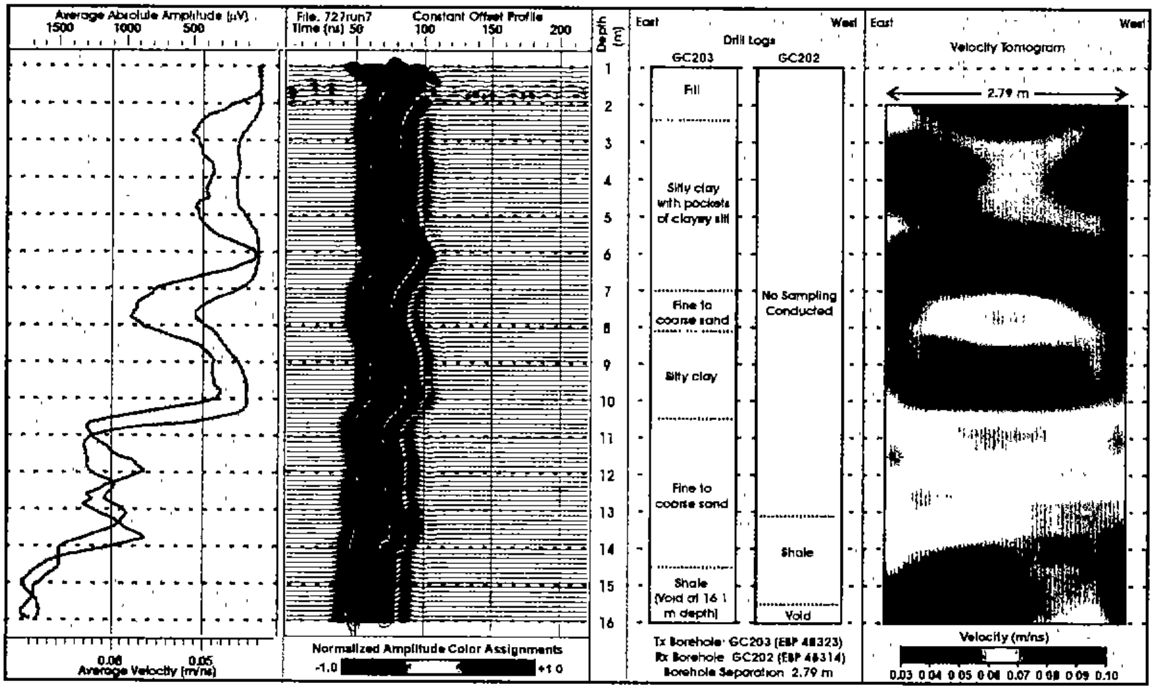


(c) Borehole radar data and drill-log plots for wells B407G and B407H.

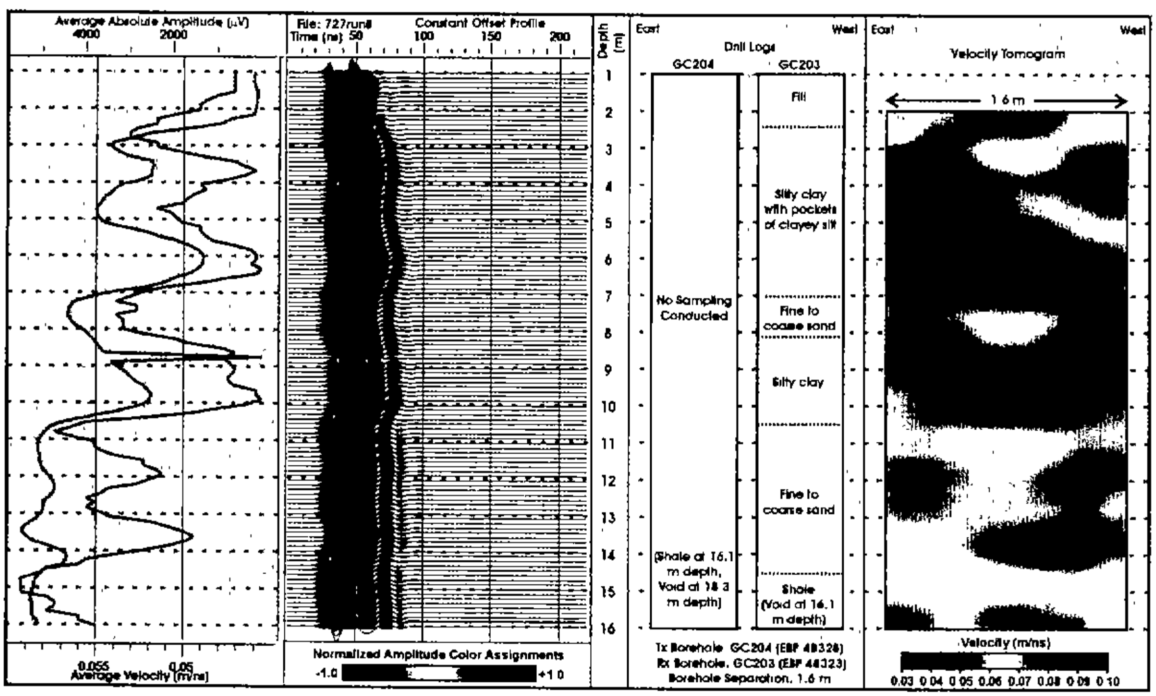


(a) Borehole radar data and drill-log plots for wells GC202 and GC201.

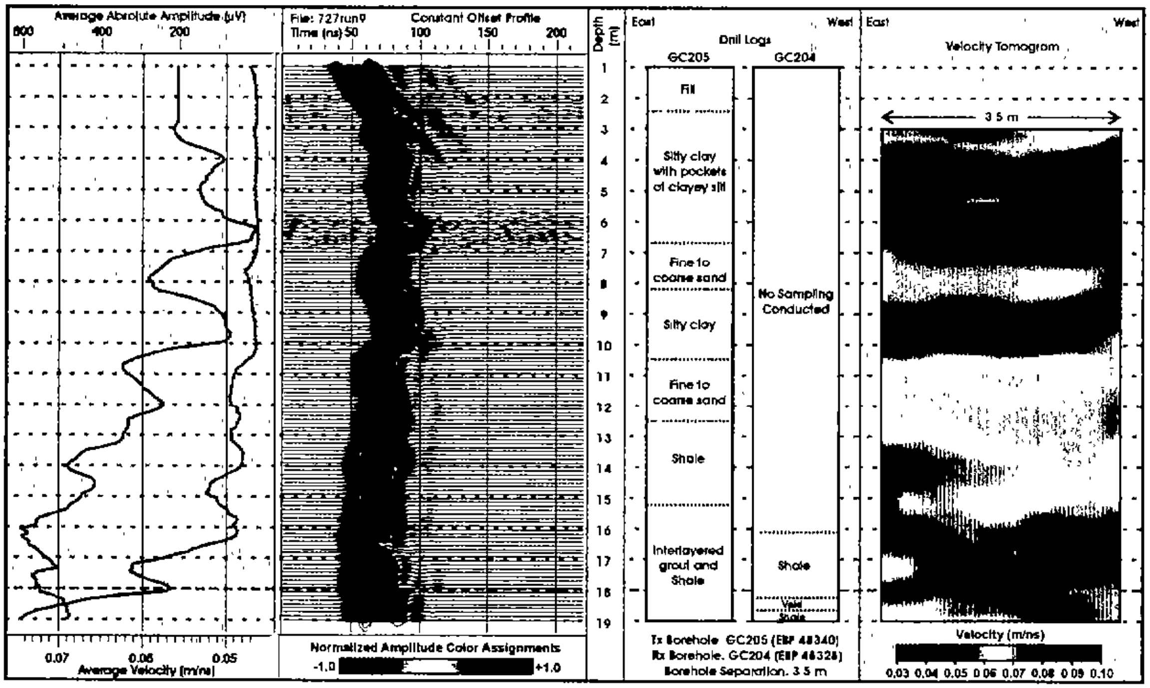
Average EM-wave velocity and average absolute amplitude plots, radar COP data, drill logs, and EM-wave velocity tomograms.



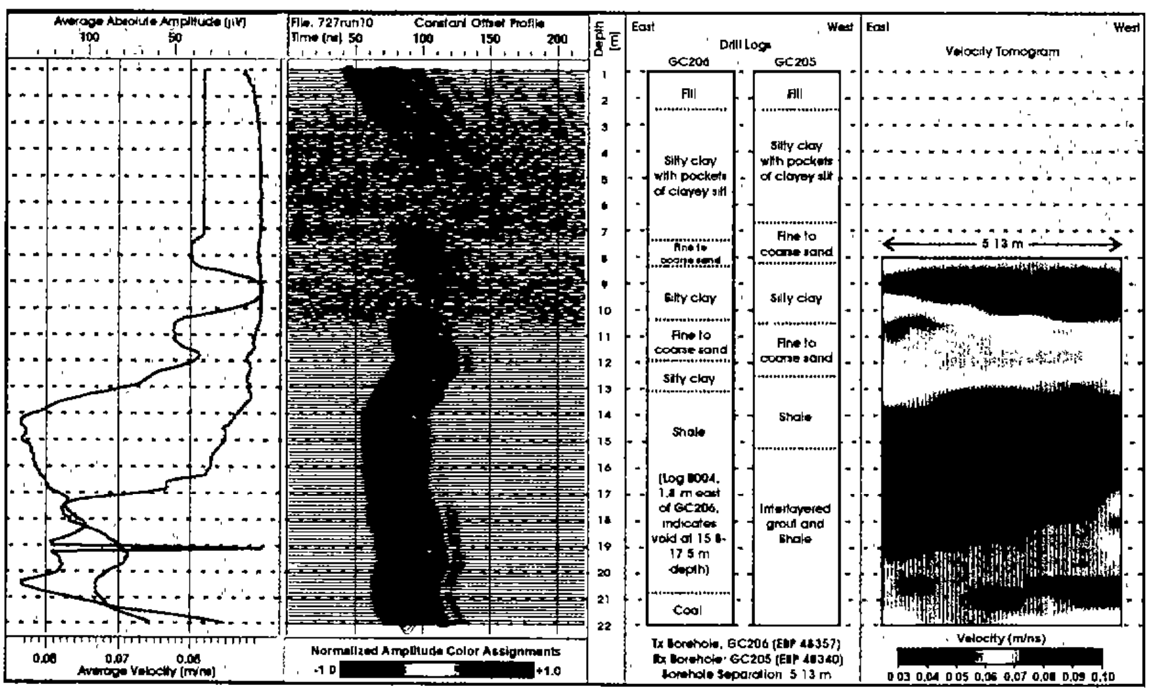
(b) Borehole radar data and drill-log plots for wells GC203 and GC202.



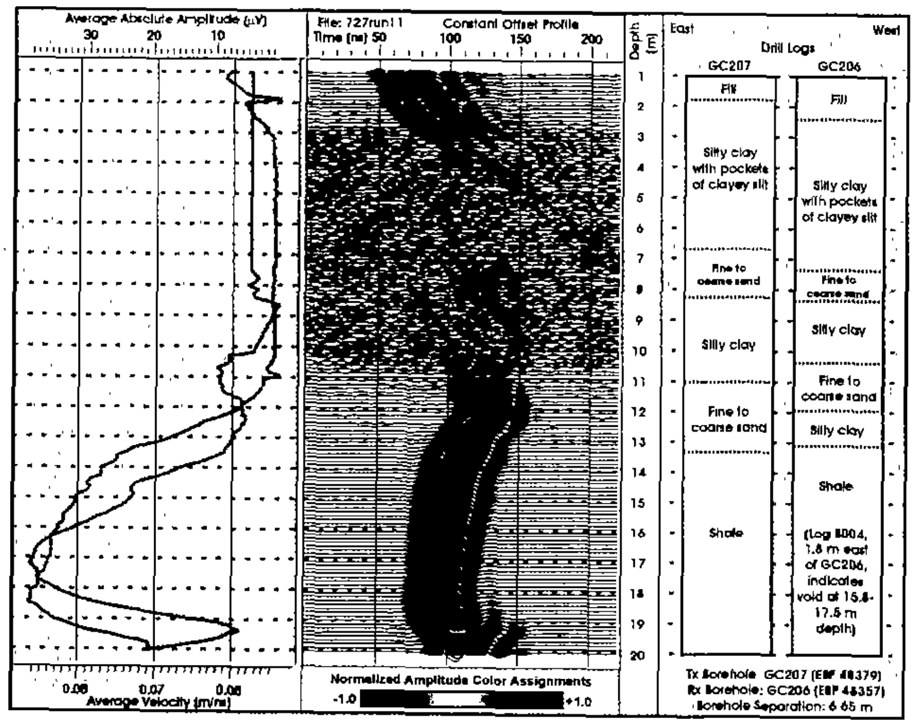
(c) Borehole radar data and drill-log plots for wells GC204 and GC203.



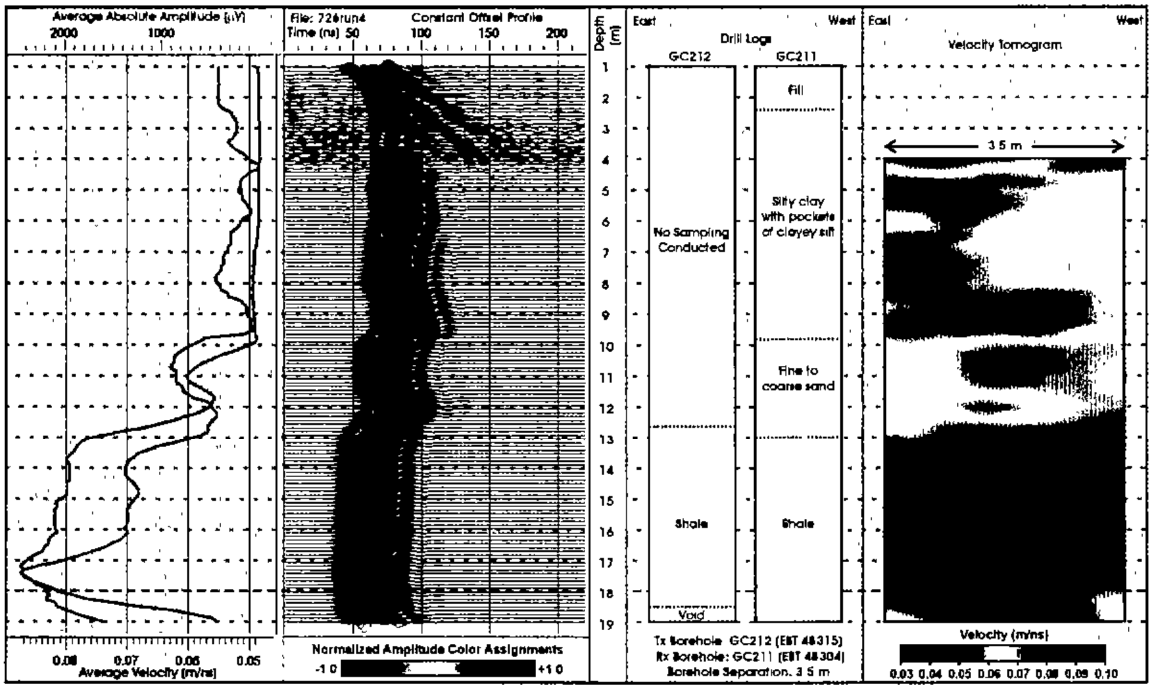
(d) Borehole radar data and drill-log plots for wells GC205 and GC204.



(e) Borehole radar data and drill-log plots for wells GC206 and GC205.

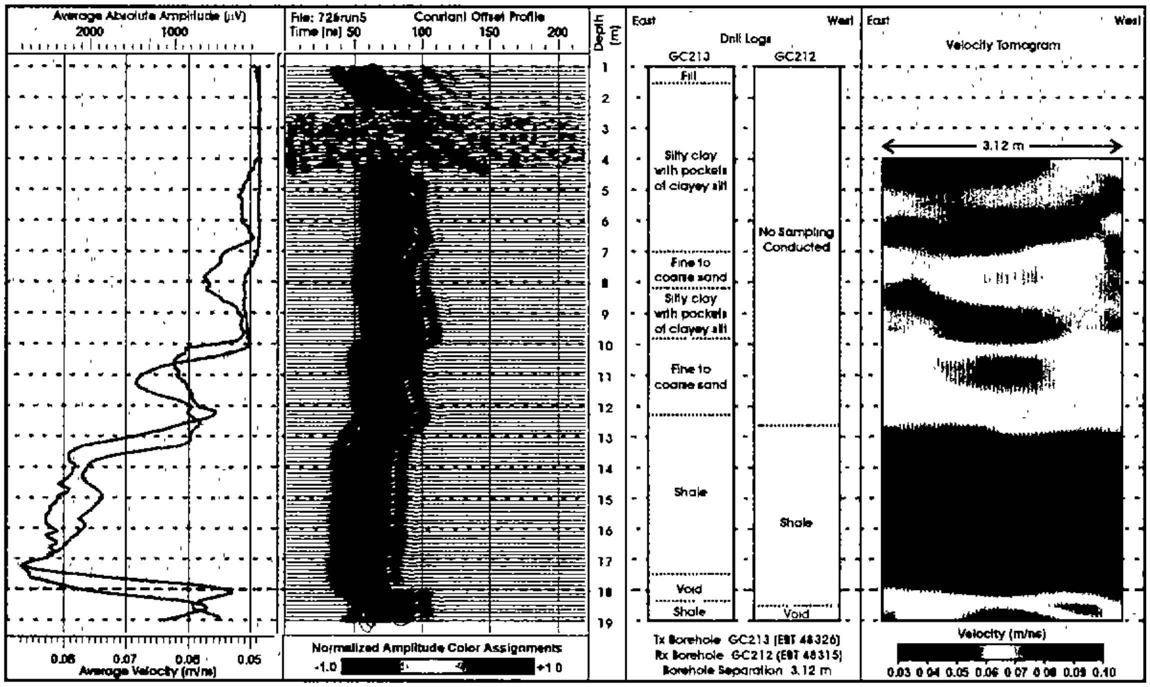


(f) Borehole radar data and drill-log plots for wells GC207 and GC206.

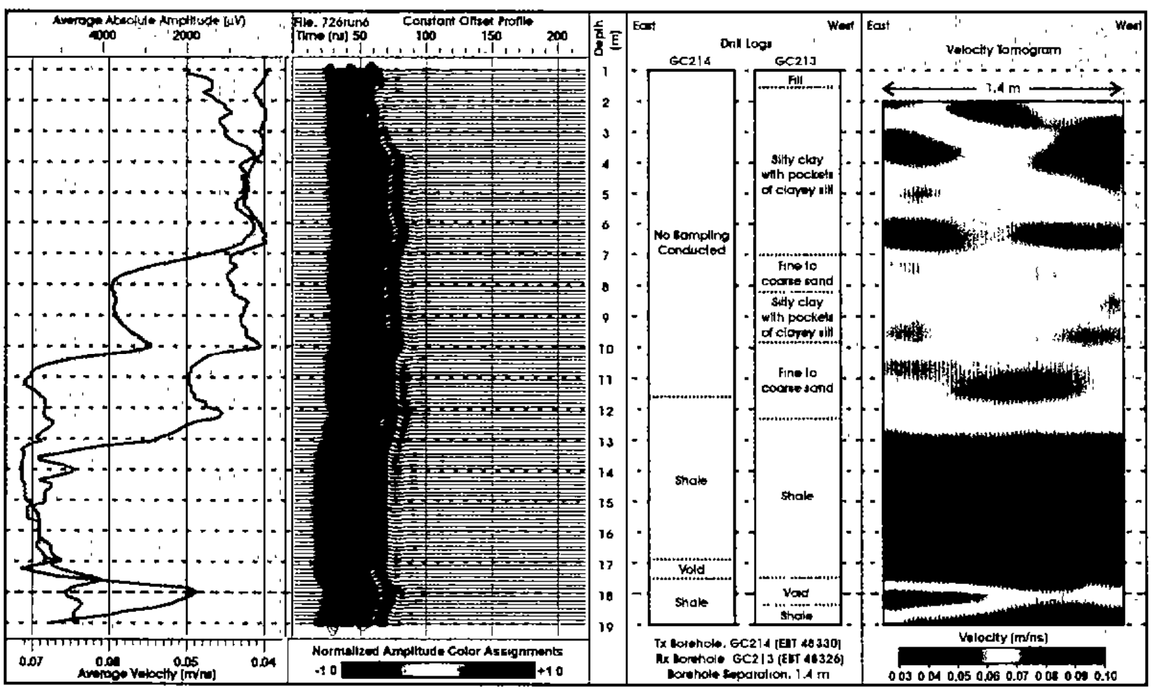


(a) Borehole radar data and drill-log plots for wells GC212 and GC211.

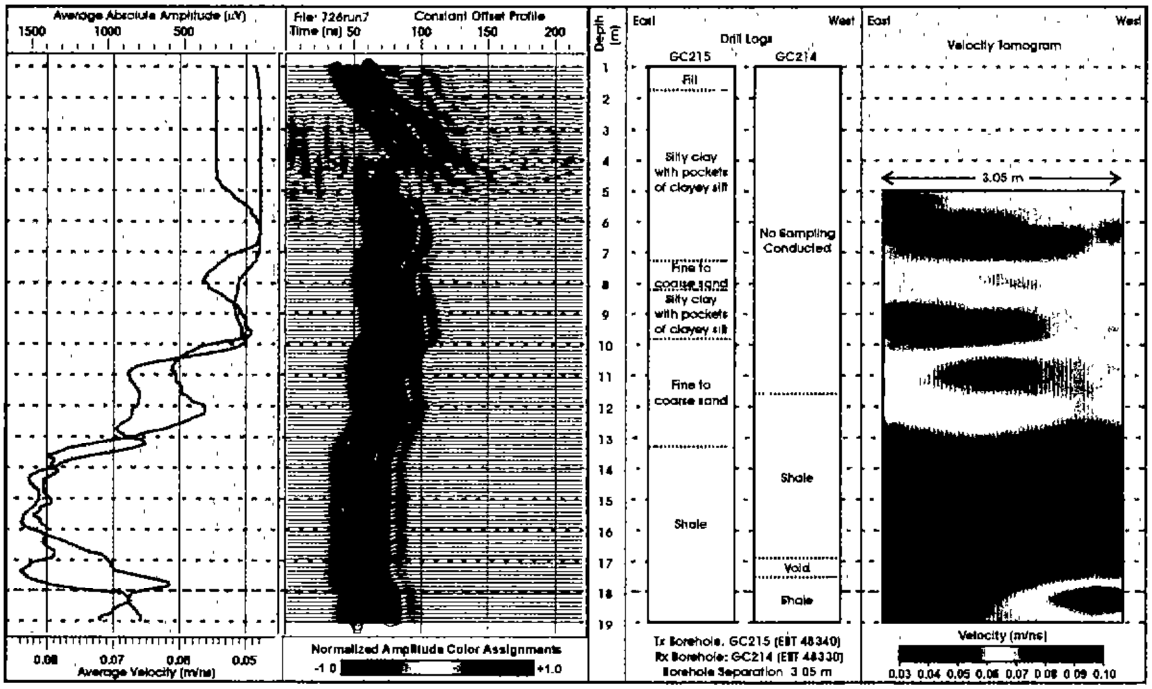
Average EM-wave velocity and average absolute amplitude plots, radar COP data, drill logs, and EM-wave velocity tomograms.



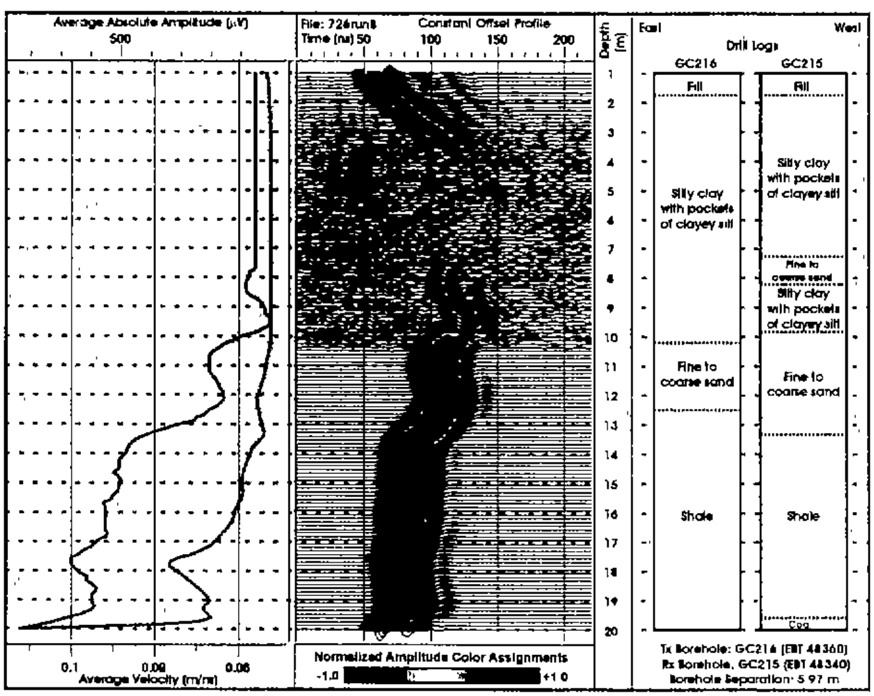
(b) Borehole radar data and drill-log plots for wells GC213 and GC212.



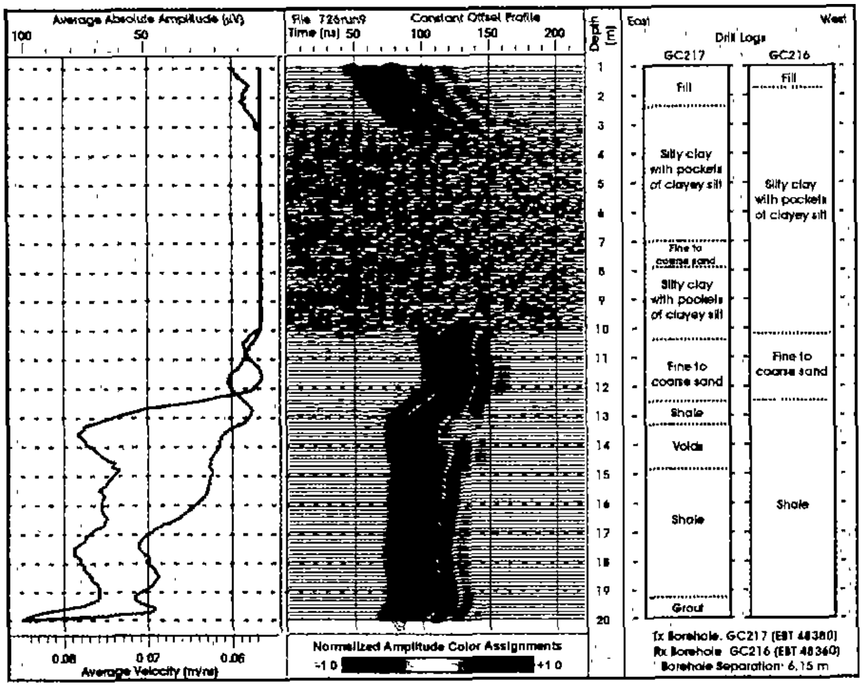
(c) Borehole radar data and drill-log plots for wells GC214 and GC213.



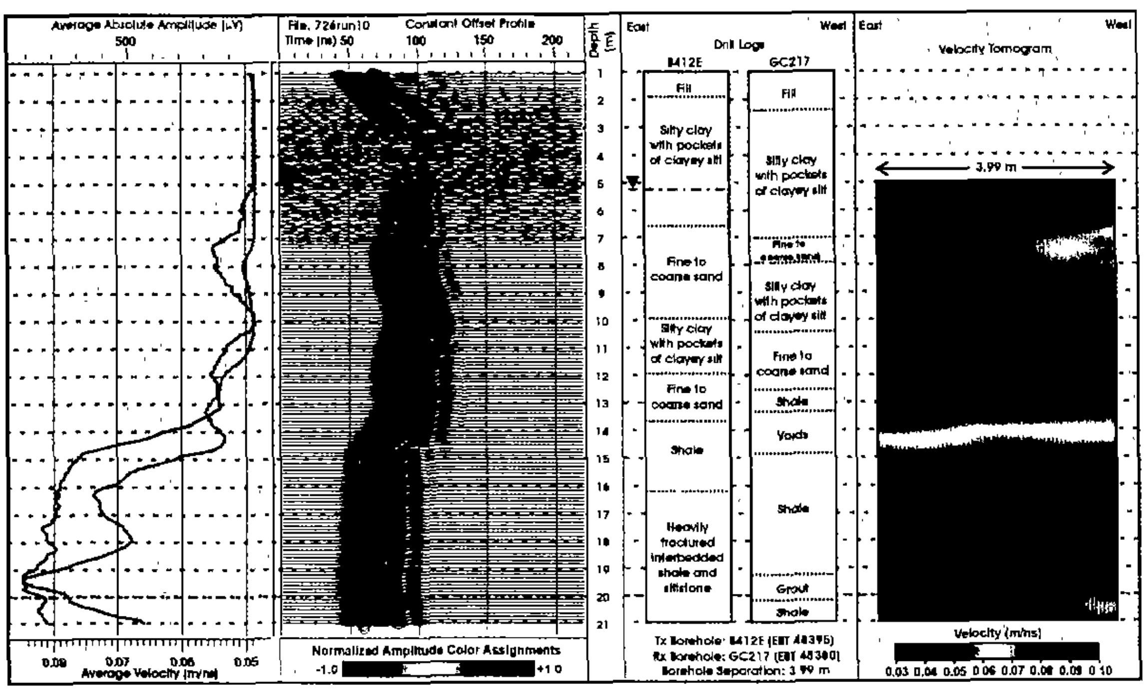
(d) Borehole radar data and drill-log plots for wells GC215 and GC214.



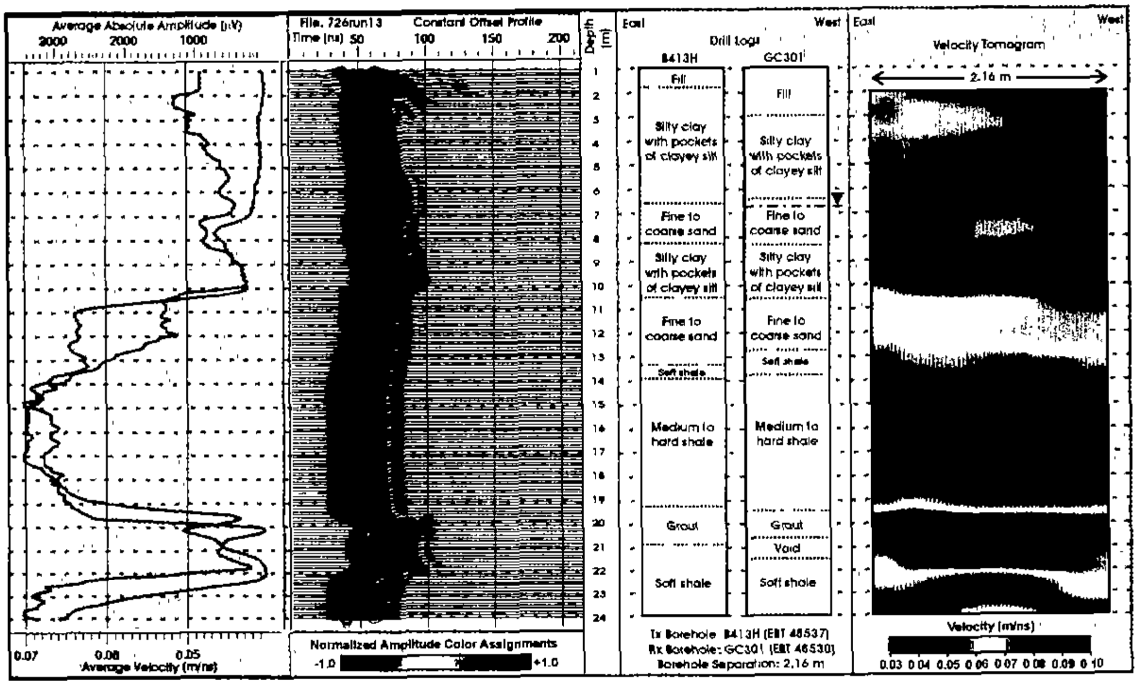
(e) Borehole radar data and drill-log plots for wells GC216 and GC215.



(f) Borehole radar data and drill-log plots for wells GC217 and GC216.

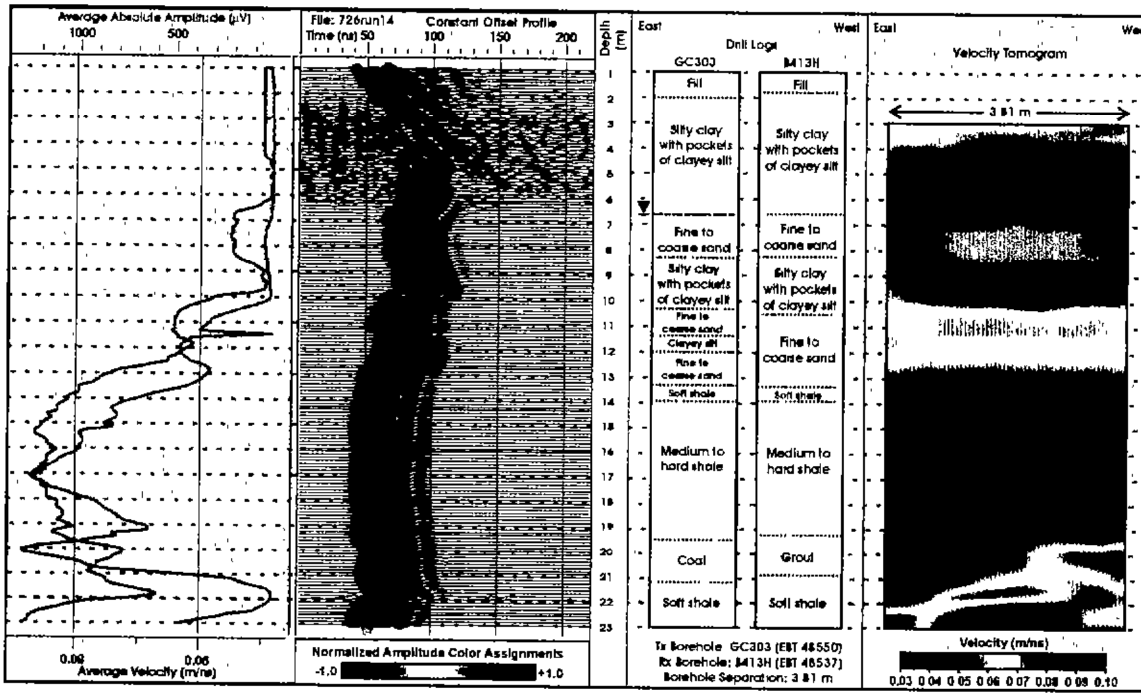


(g) Borehole radar data and drill-log plots for wells B412E and GC217.

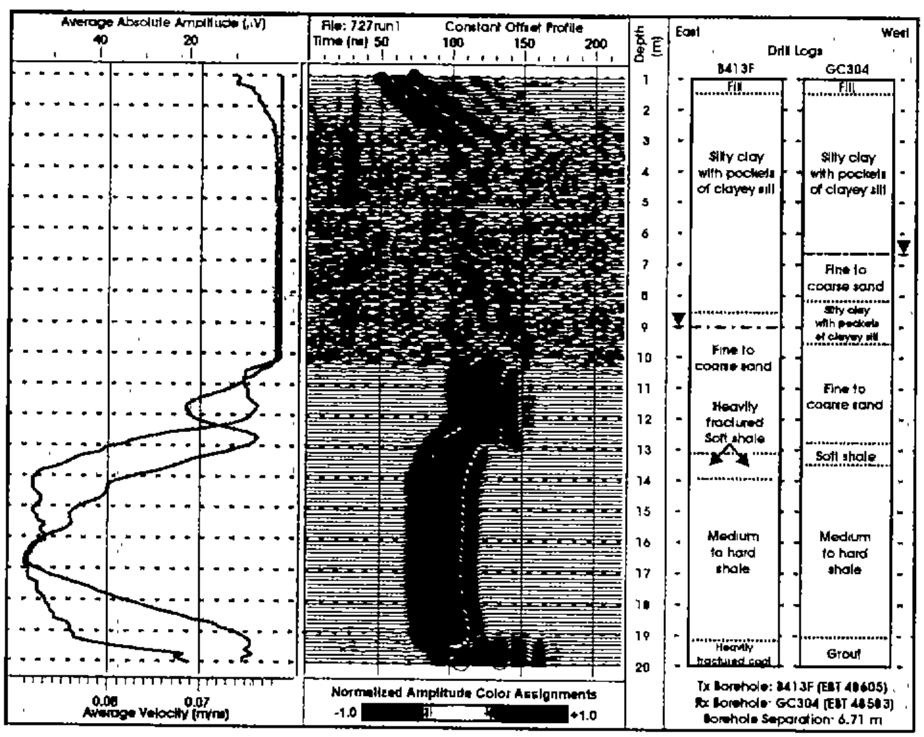


(a) Borehole radar data and drill-log plots for wells B413H and GC301.

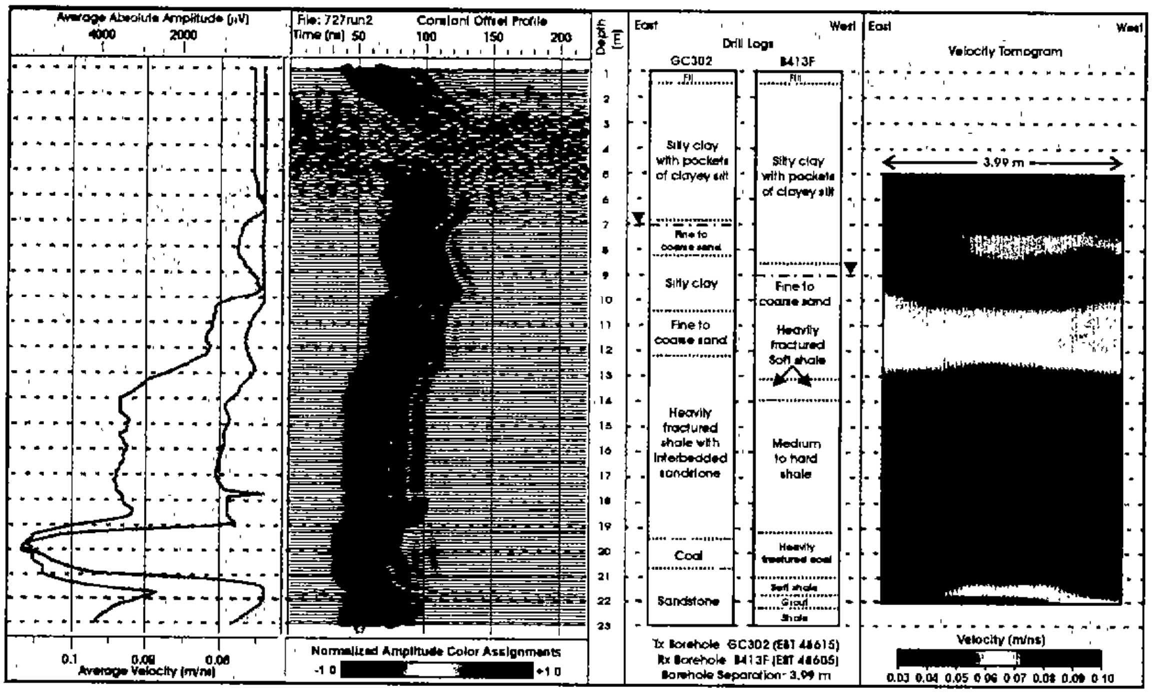
Figure 5.14.11. Average EM-wave velocity and average absolute amplitude plots, radar COP data, drill logs, and EM-wave velocity tomograms for I-70 eastbound travel lane road station range 48530 to 48640 (Table 5.14.1, Figure 5.14.1): (a) wells B413H and GC301, (b) wells GC303 and B413H, (c) wells B413F and GC304 (no MOG data acquired), (d) wells GC302 and B413F, and (e) wells B413E and GC302 (no MOG data acquired). A mosaic of the velocity tomograms and well log information are shown along with interpreted seismic reflection data and a mine map in Figure 5.14.12. See text for a discussion of plots.



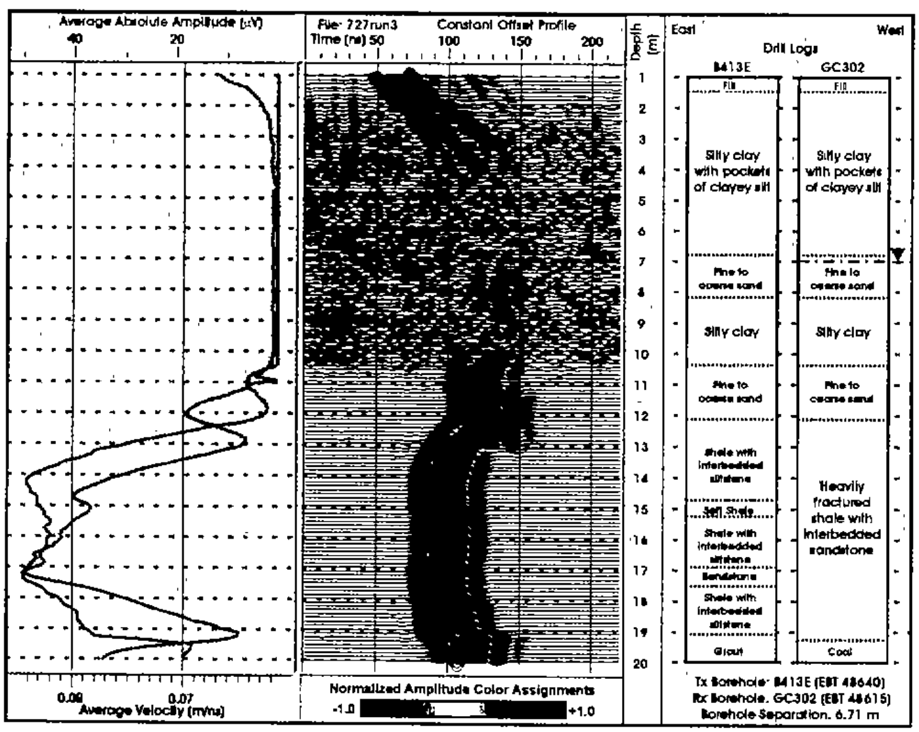
(b) Borehole radar data and drill-log plots for wells GC303 and B413H.



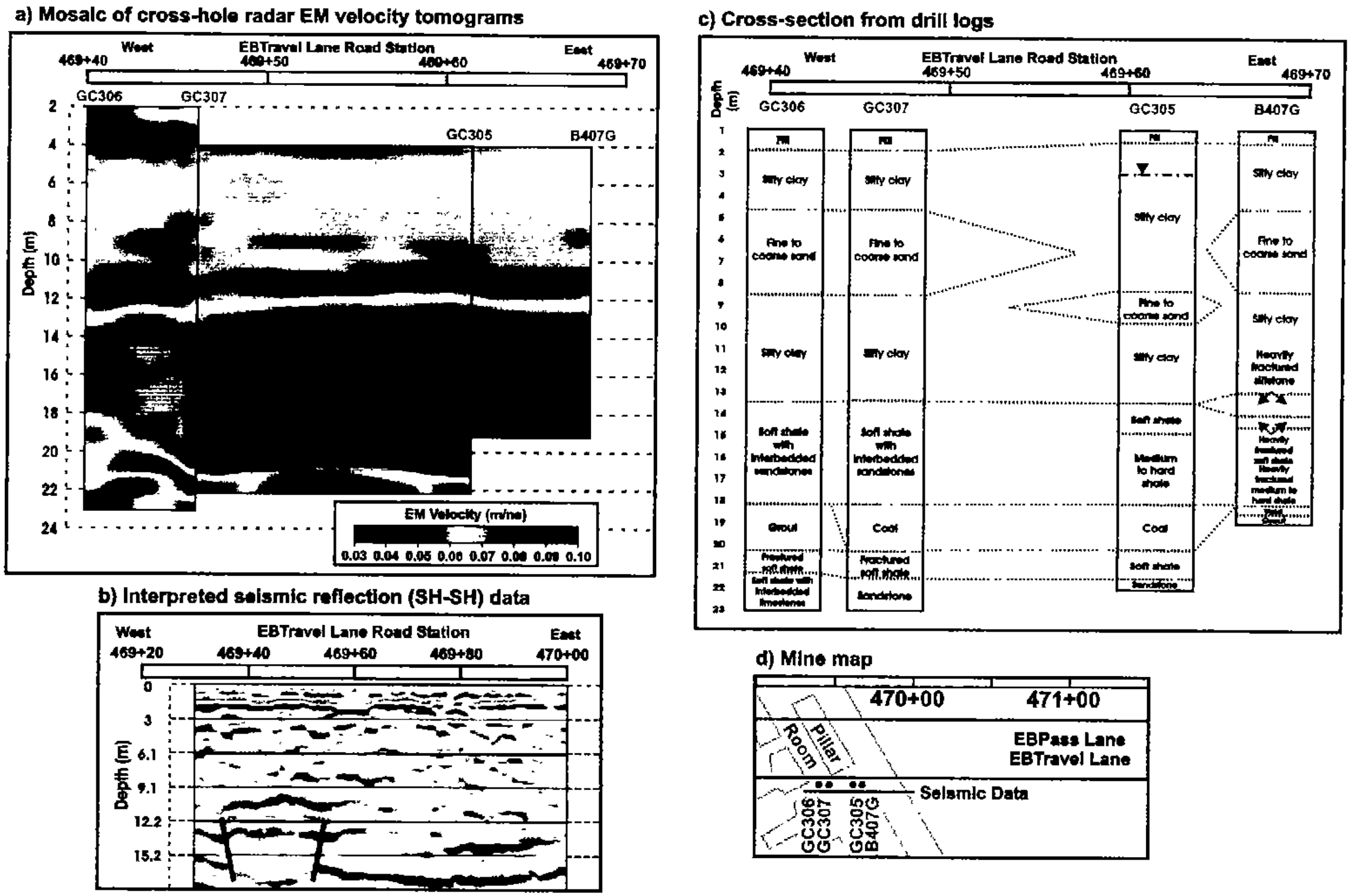
(c) Borehole radar data and drill-log plots for wells B413F and GC304.



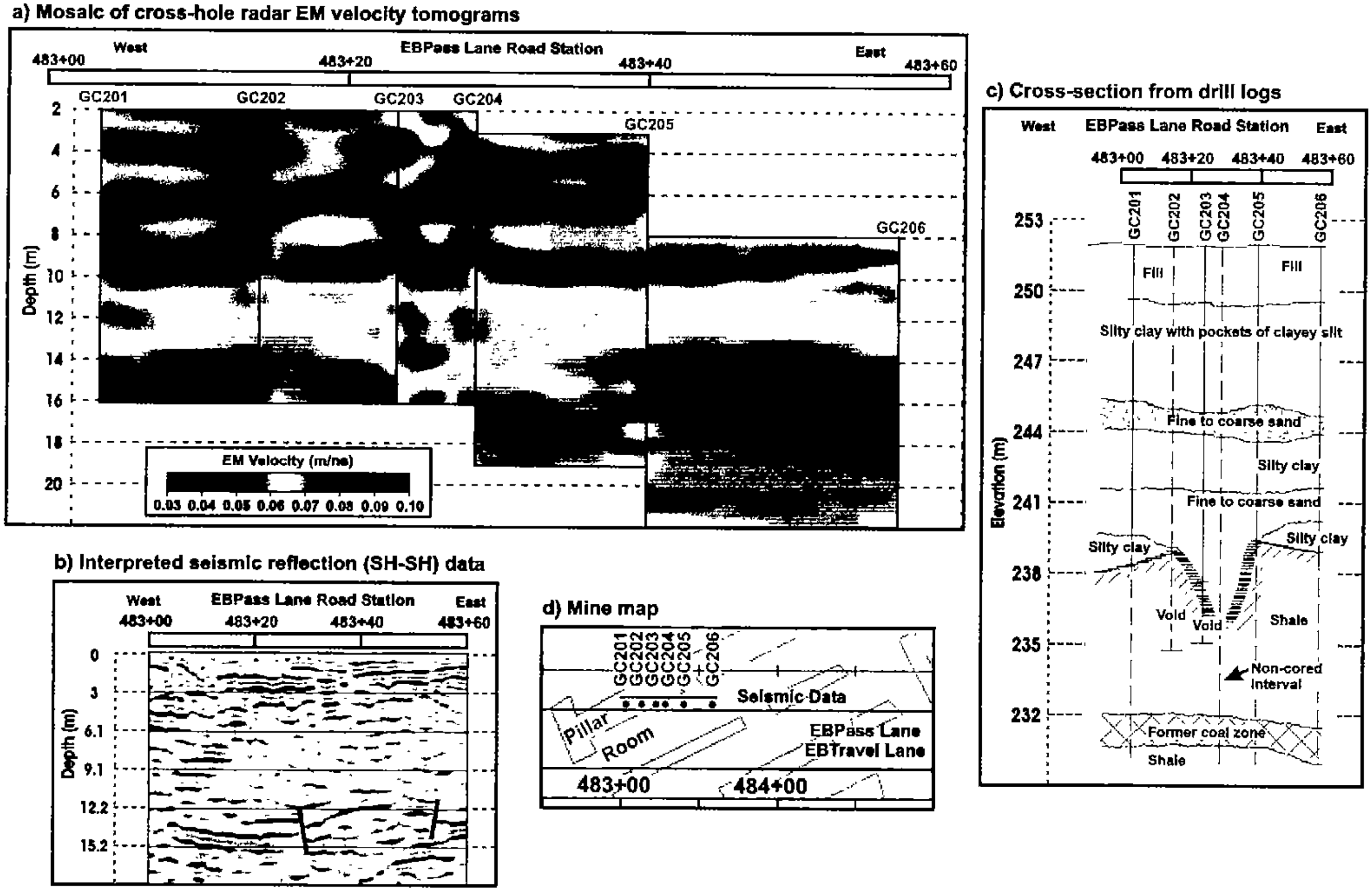
(d) Borehole radar data and drill-log plots for wells GC302 and B413F.



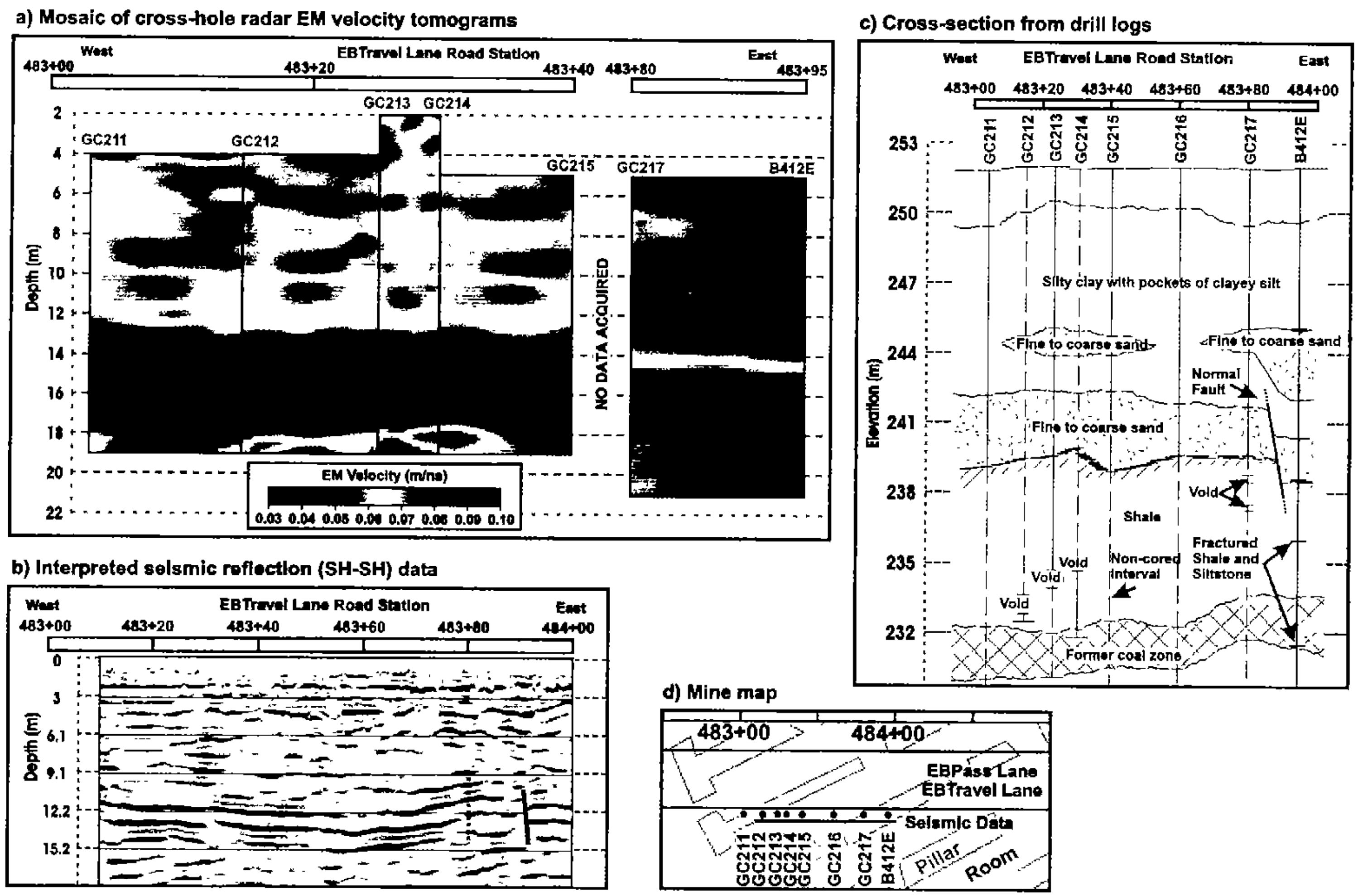
(e) Borehole radar data and drill-log plots for wells B413E and GC302.



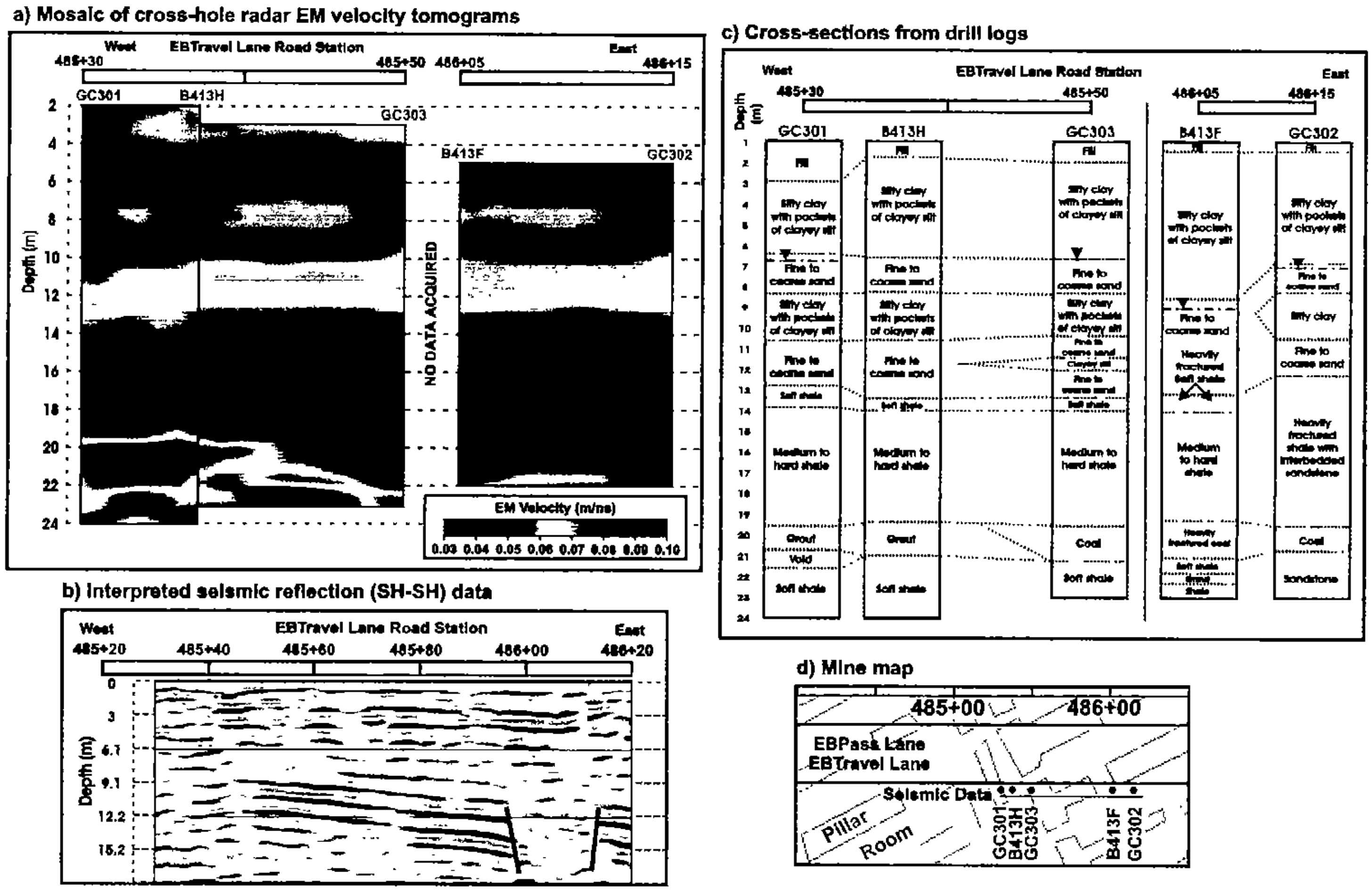
I-70 eastbound travel lane road station range 46940 to 46968: (a) EM-wave velocity mosaic, (b) S-wave reflection data, (c) geologic cross-section from logs, and (d) approximate locations of mine workings. Velocities (a) and drill logs (c) indicate that the SE edge of the coal pillar beneath the road actually extends farther SE than mapped in (d), and that the seismically imaged subsidence feature (b) resulted from bedrock collapse into the mine room located immediately south of this pillar.



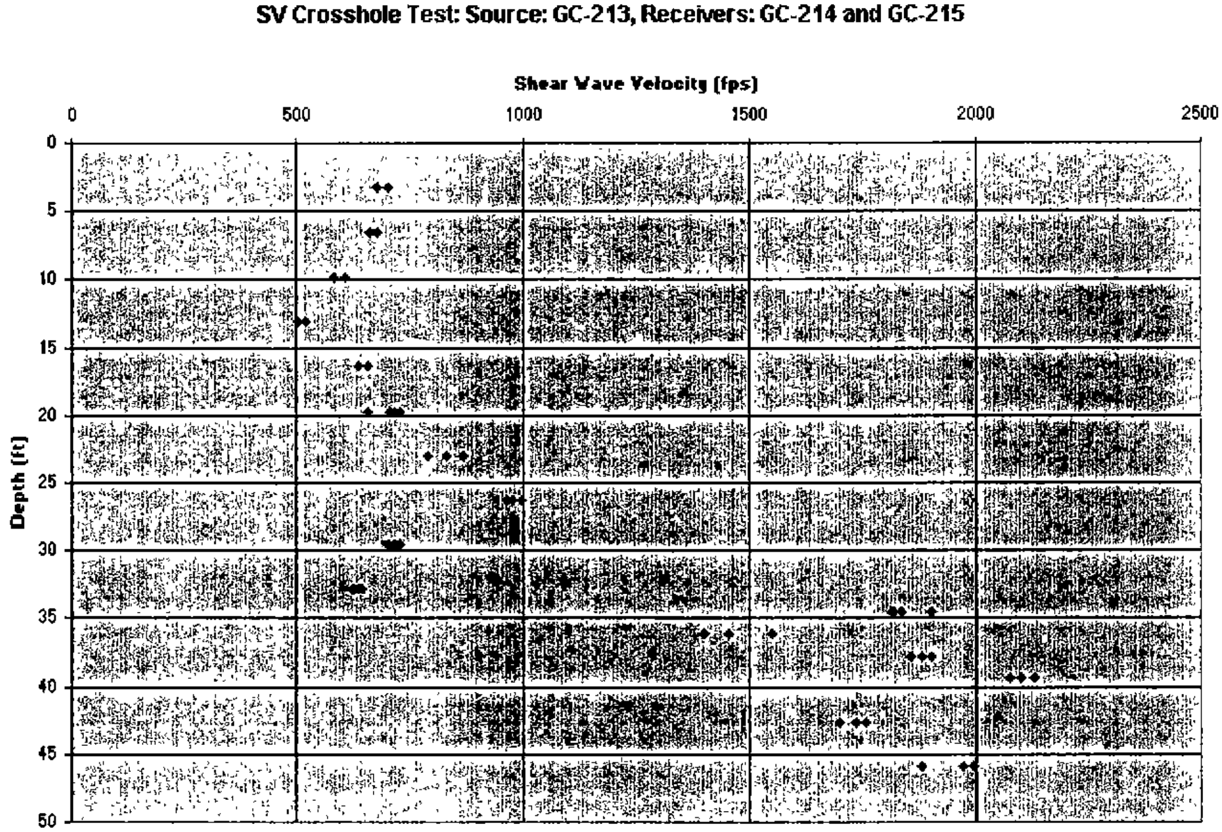
I-70 eastbound passing lane road station range 48300 to 48360: (a) EM-wave velocity mosaic, (b) S-wave reflection data, (c) geologic cross-section, and (d) approximate locations of mine workings. Velocities (a) indicate the mine-related bedrock subsidence interpreted from seismic data (b) has occurred between the boreholes and directly beneath the seismic line. Velocities (a) also extend the west edge of disruption interpreted from seismic data an additional several meters west.



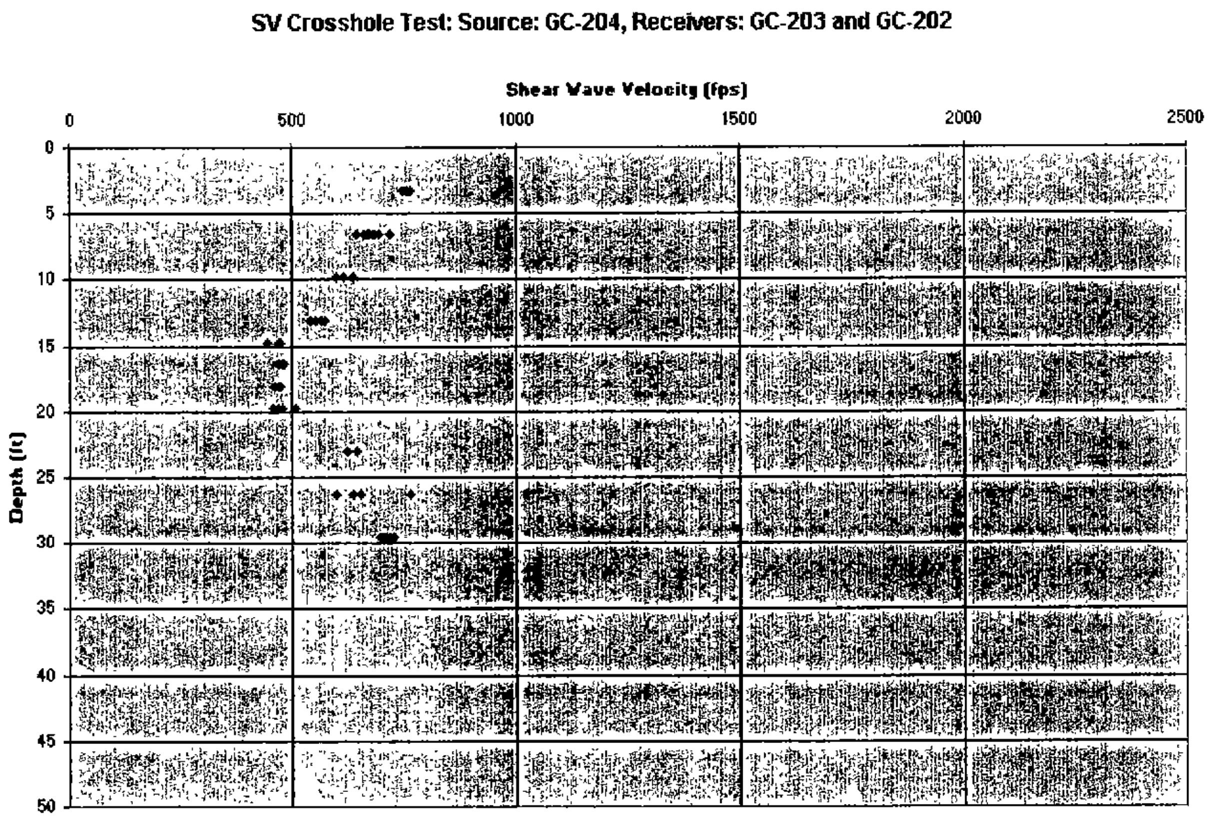
I-70 eastbound travel lane road stations 48304 to 48400: (a) EM-wave velocity mosaic, (b) S-wave reflection data, (c) geologic cross-section from logs, and (d) approximate locations of mine workings. Velocities (a) support seismic data interpretation (b) of an intact bedrock surface (stations 48304 to 48340), and bedrock and overburden subsidence-related disruption (stations 48380 to 48408), indicating this disruption occurred between the boreholes and directly beneath the seismic line.



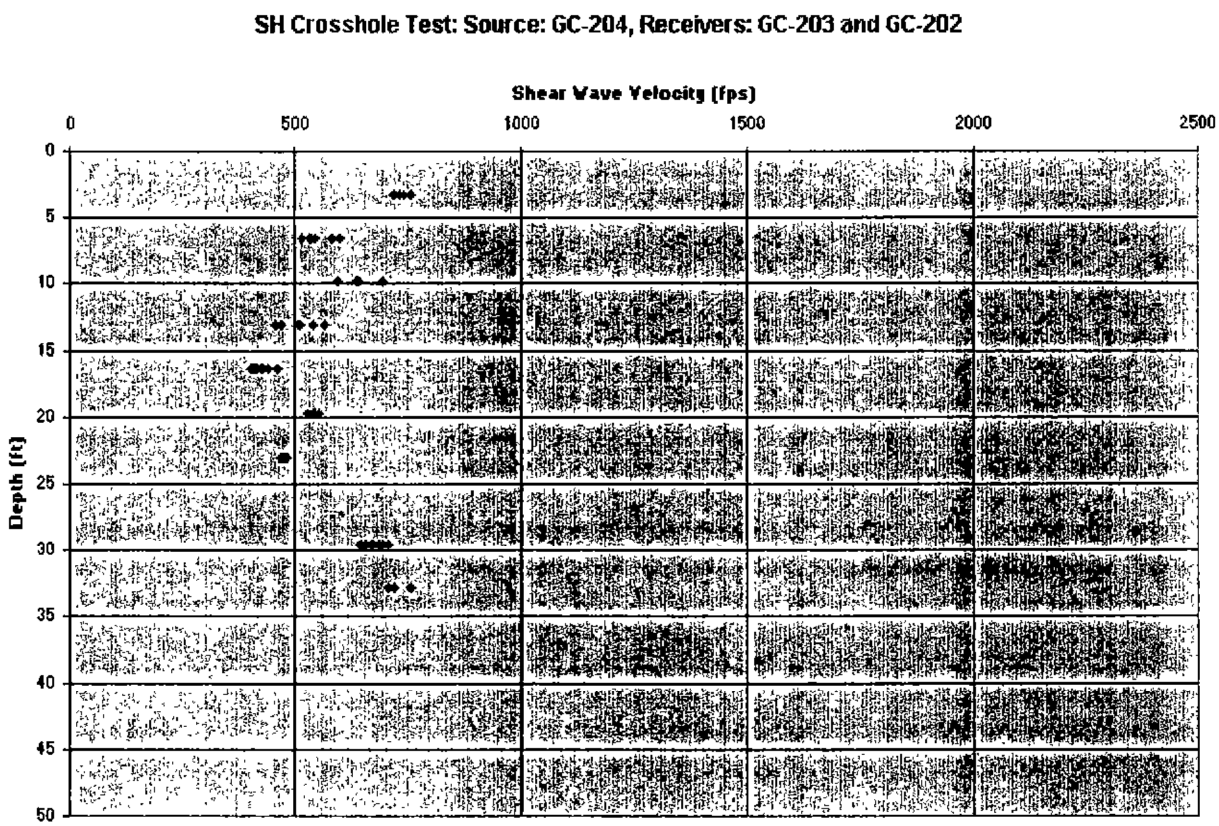
I-70 eastbound travel lane road station range 48530 to 48620: (a) EM-wave velocity mosaic, (b) S-wave reflection data, (c) geologic cross-sections from logs, and (d) approximate locations of mine workings. Velocities (a) suggest that the coal pillar beneath the road (stations 48605 to 48615) actually extends farther south than mapped in (d), and that the seismically imaged subsidence feature (b) resulted from bedrock collapse into the mine room located just south of this pillar.



Shear velocity cross-hole test with the source in hole GC-213 and receivers in holes GC-211 and GC-215.

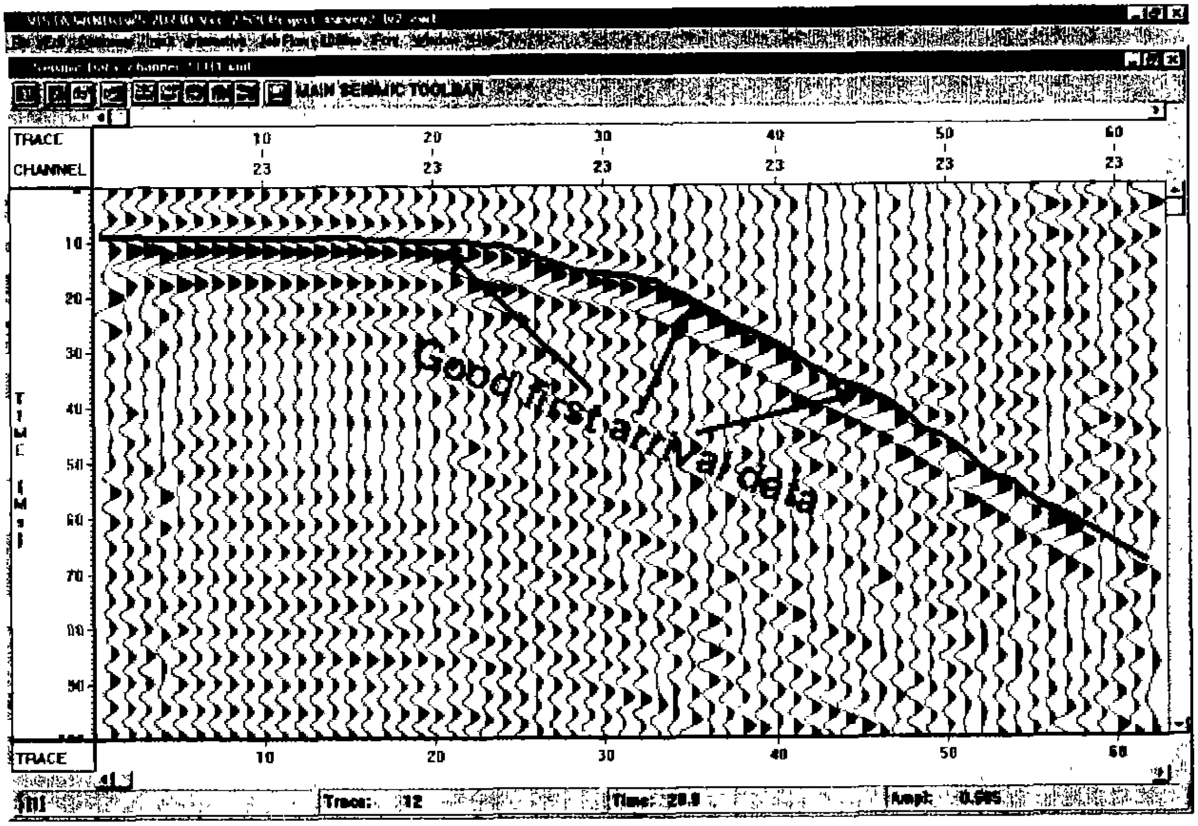


Shear wave cross-hole test with the source in hole GC-204 and receivers in holes GC-203 and GC-202.



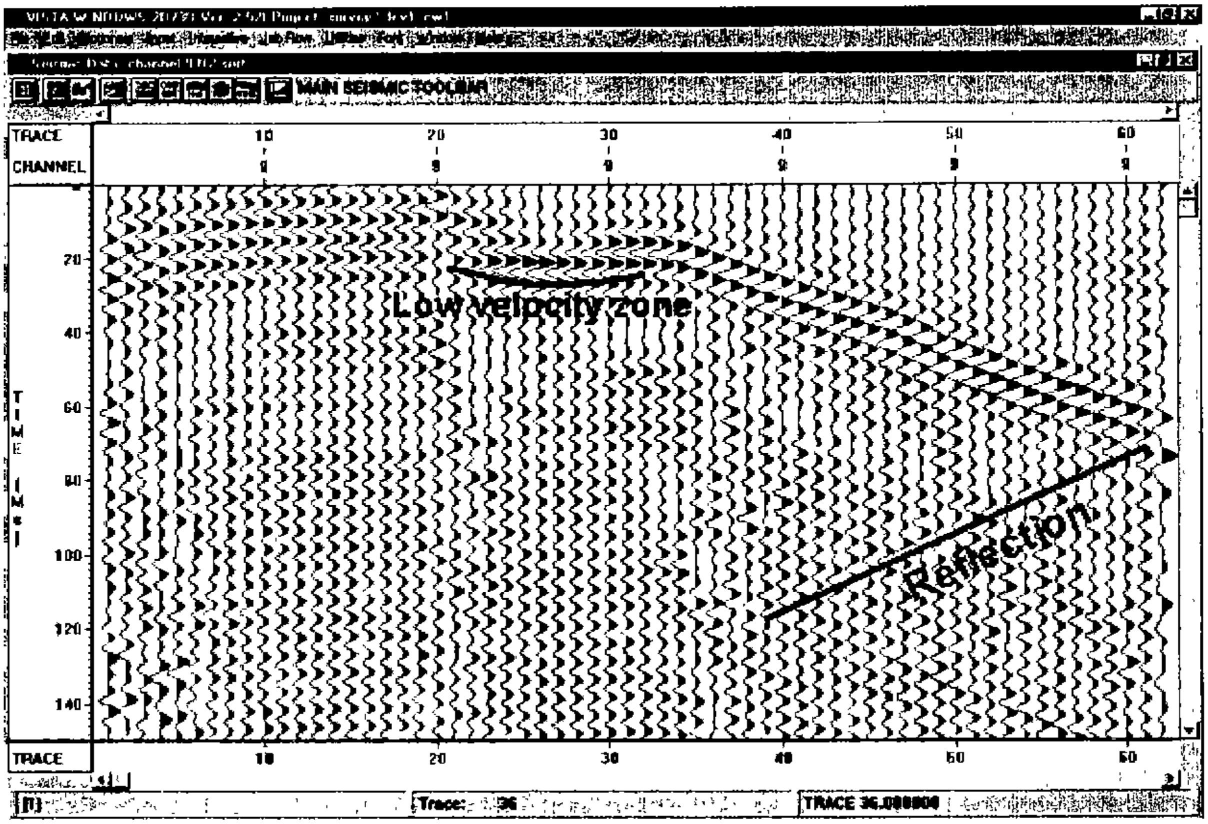
Shear wave cross-hole tests with the source in Hole GC-204, receivers in holes GC-203 and GC-202

Survey #2, RcvrLev2, CW1, Channel 23, H1 Component, Vibroseis correlation



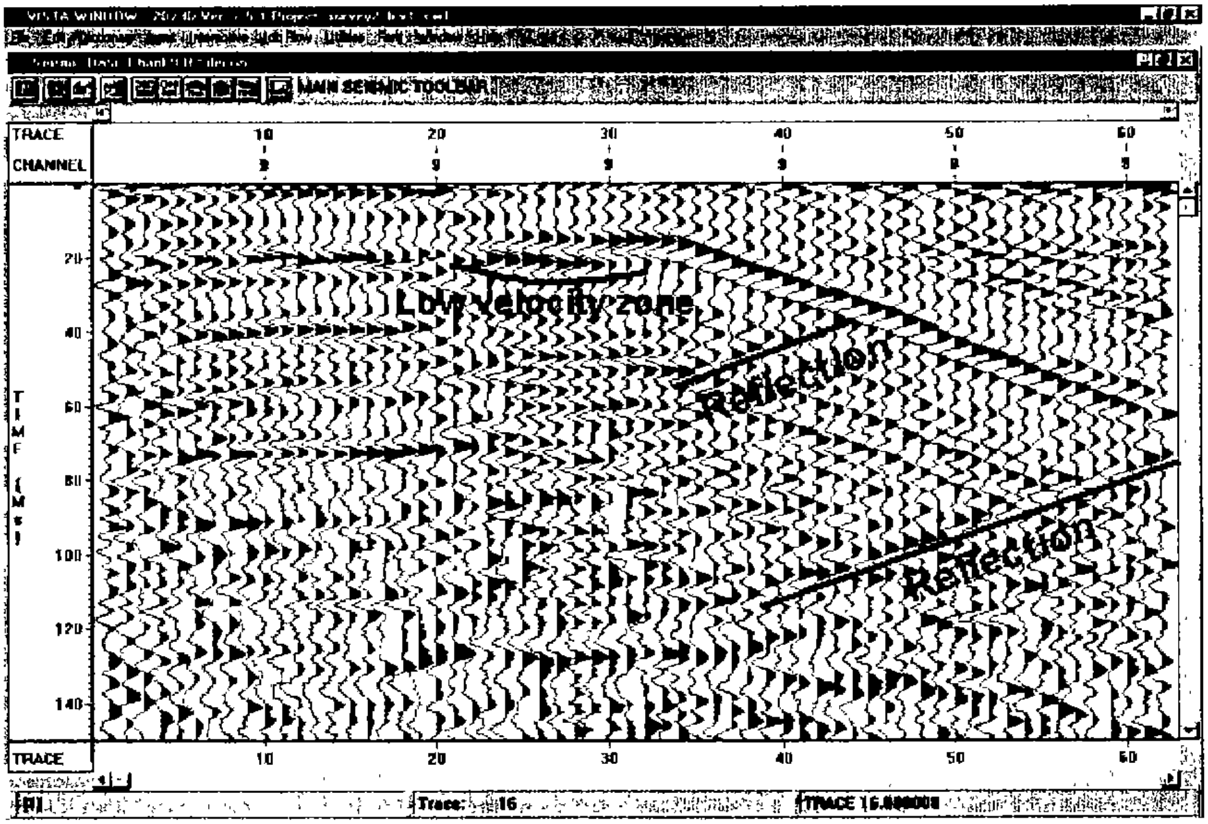
Interpretation of one cross-hole record for a clockwise rotation of the shear wave source.

Survey #2, RcvrLev1, CW1, H2 Component, Vibroseis correlation

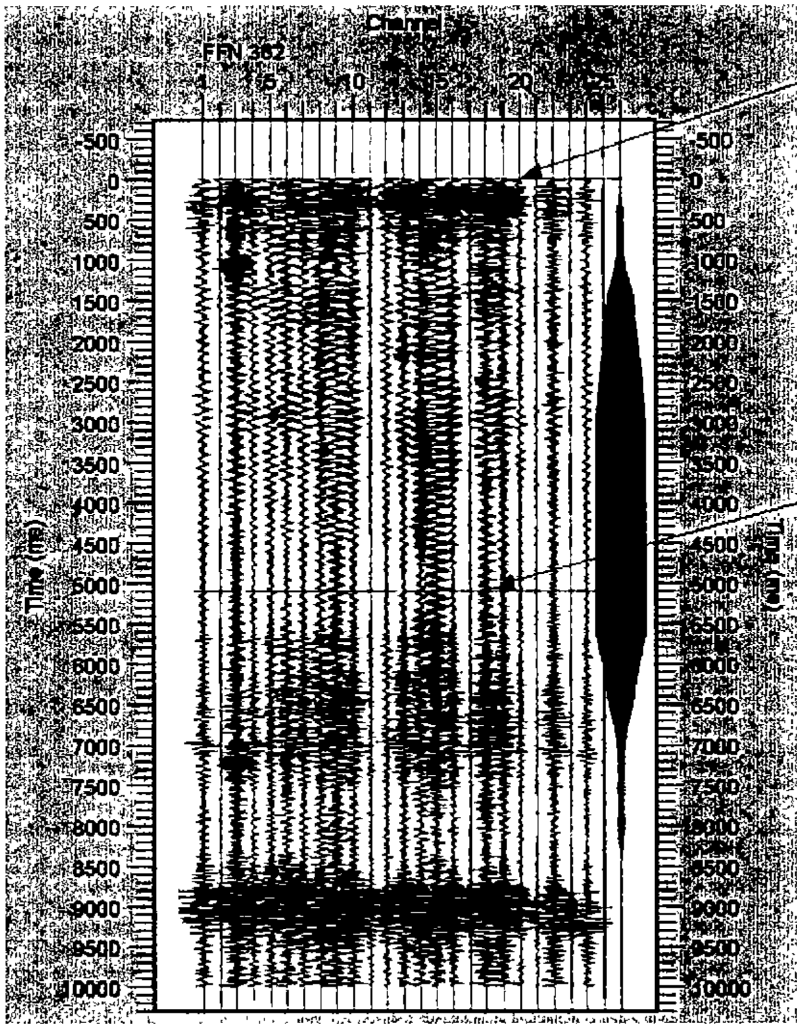


Interpretation of a cross-hole record, showing a "soft" low velocity zone and a refraction.

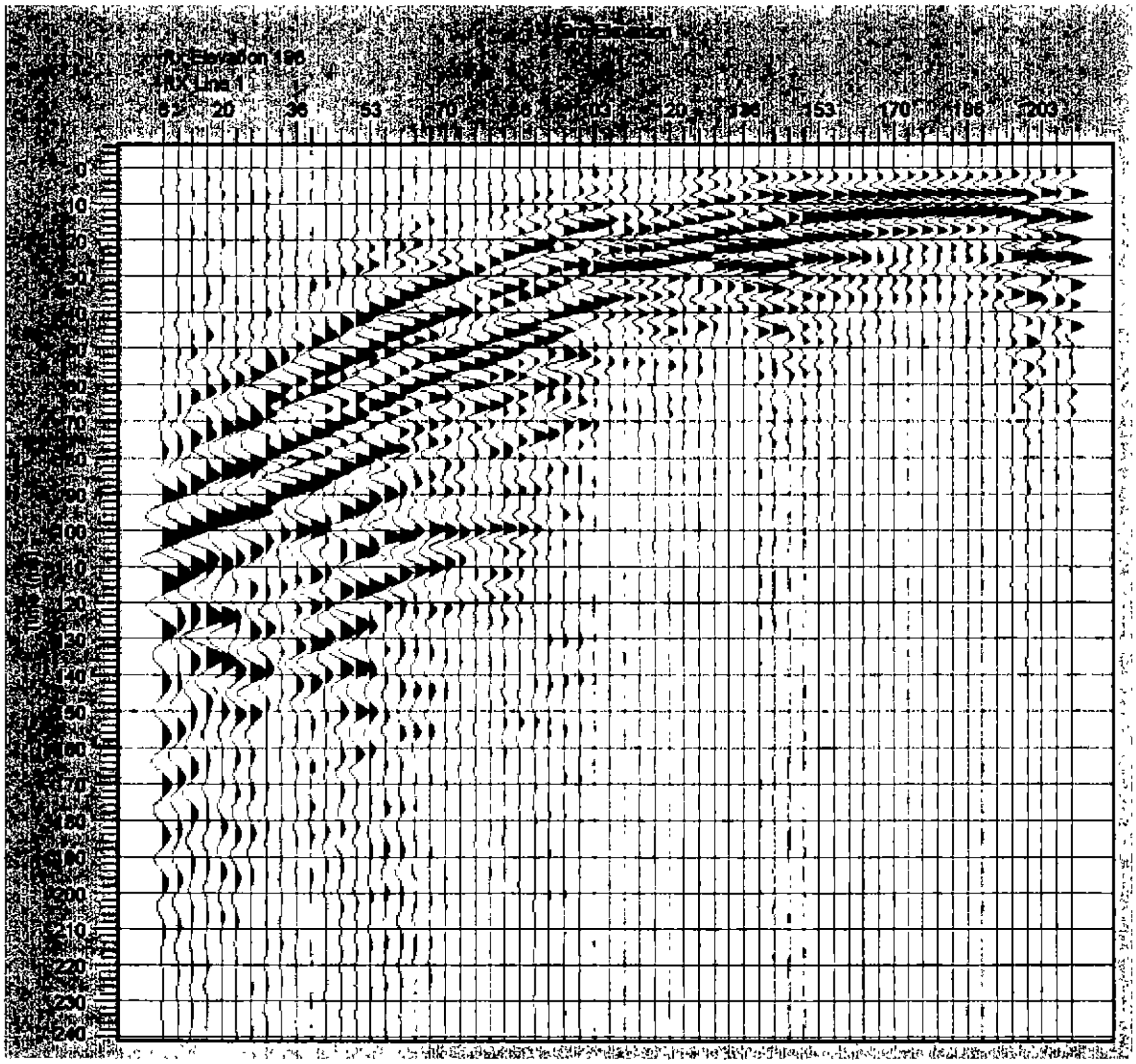
Survey #2, RcvrLev1, CW1, H2 Component, Vibroseis correlation, Spiking decon



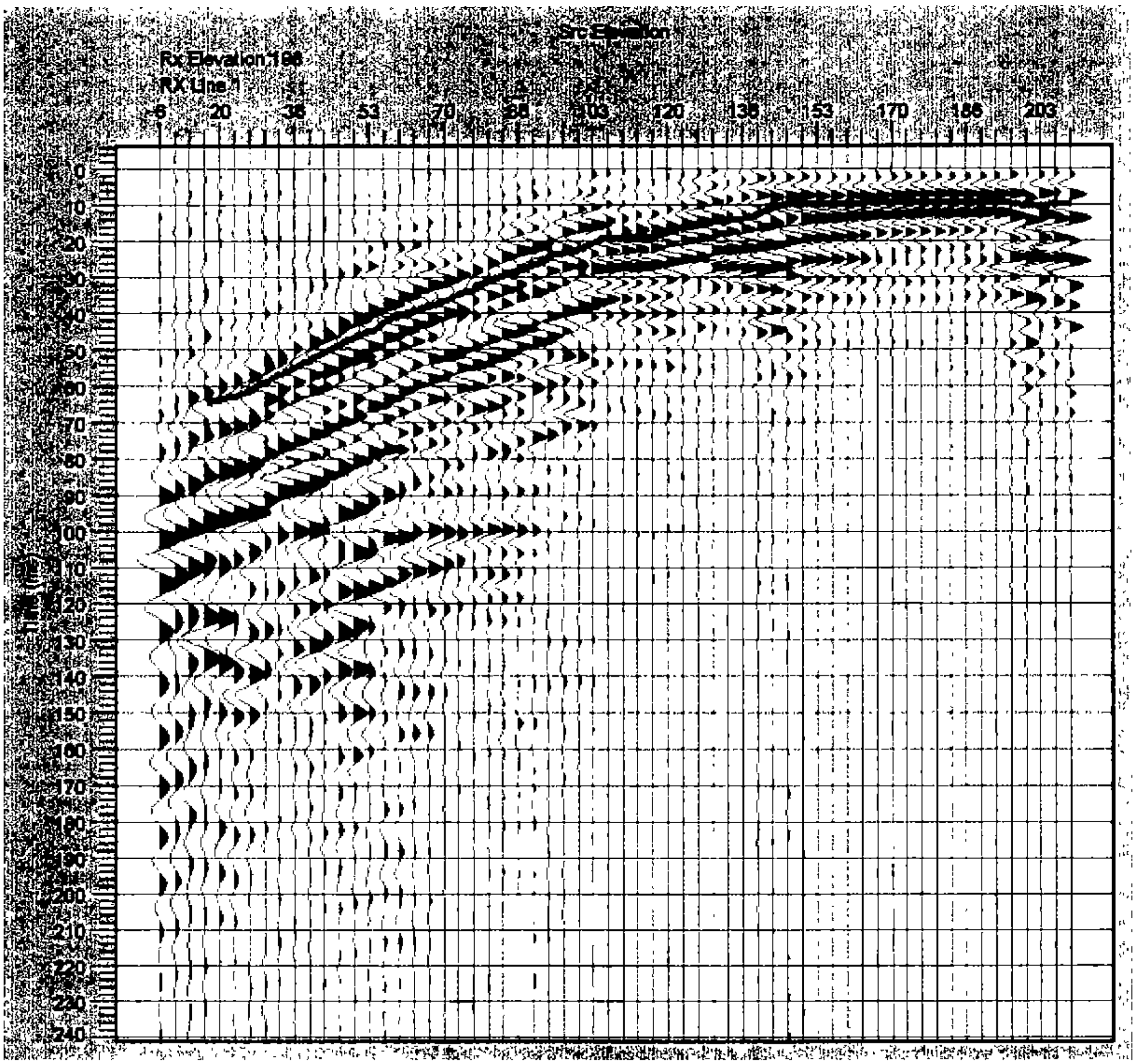
Interpretation of a cross-hole elliptically polarized record showing a "soft" low velocity zone, and reflections.



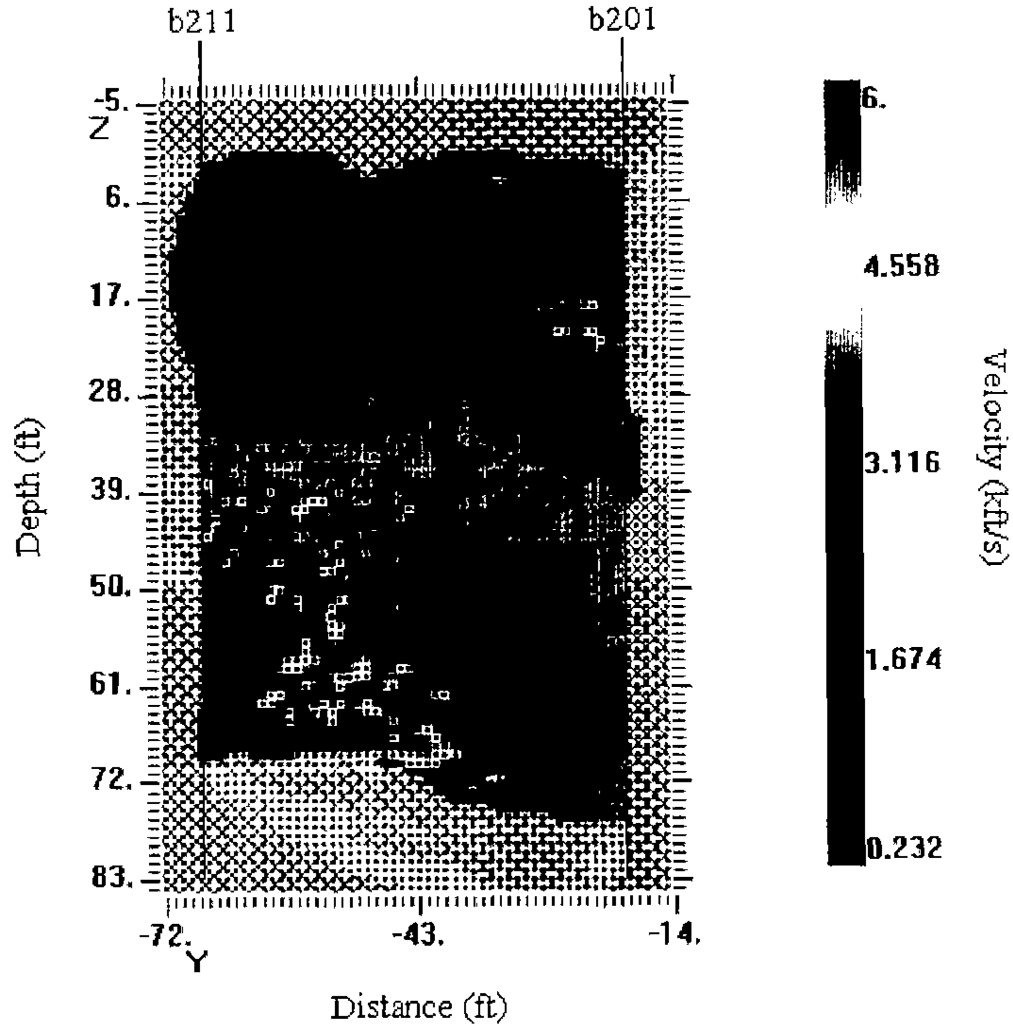
Raw field file (FFN) 362 from Survey 5a (b216-b201). Traces 25-26 monitor the source. Trace 25 is dead. Consequently, we use Trace 26 as the pilot trace for correlation or designature of the data traces (1-24). Notice the begin-of-sweep and end-of-sweep crossfeed pulse on all traces.



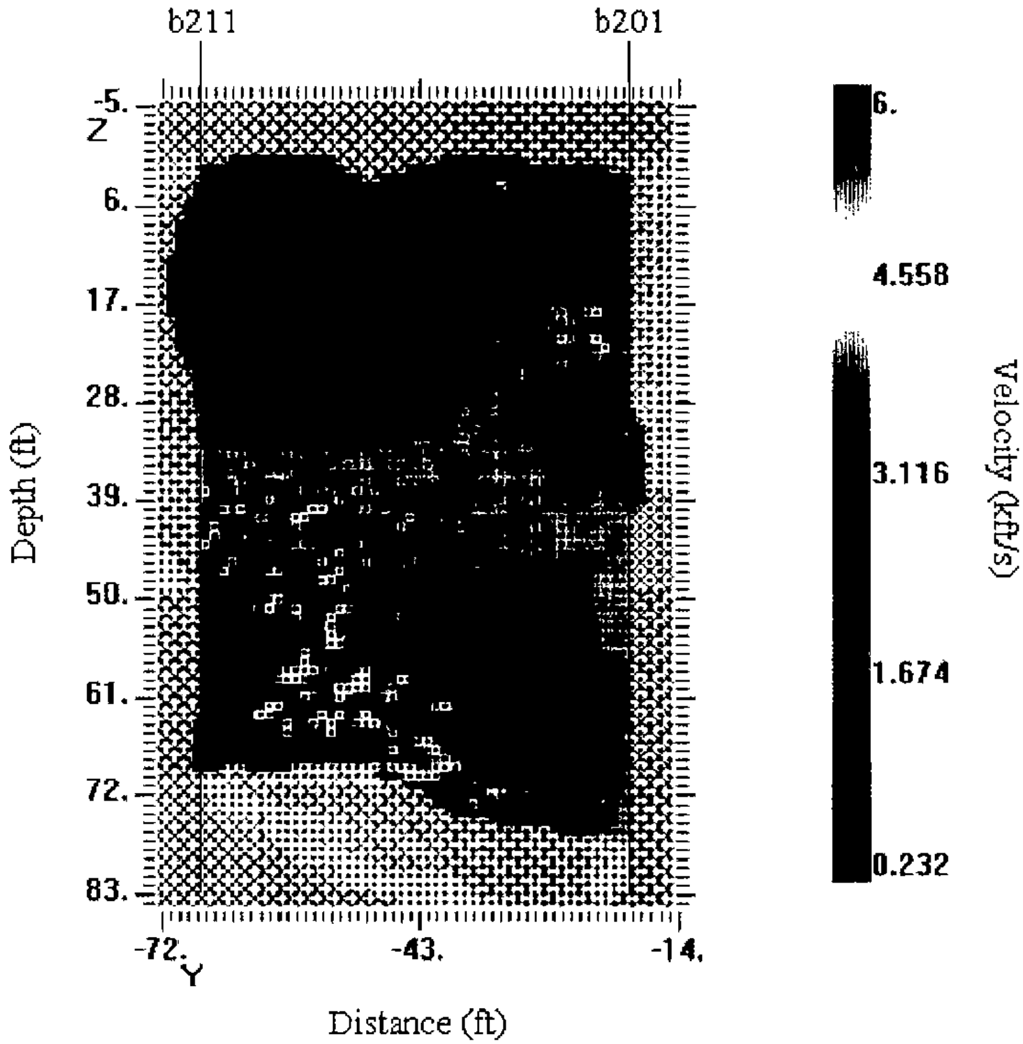
Common receiver gather (CRG) from Survey 2 (211-b201). The receiver is at a depth of 19.8m (65 ft.). (Notice that all depths have been multiplied by 10, and all depths are in meters.) The source depths are 0.33, 0.67, 1.00, 1.33,..., 19.67, 20.00, 20.33, 20.67, 21.00 m (1-69 ft.). Notice the arrivals from source depths 13.6 - 21.0 m (45-69 ft.). The receiver is a vertical component geophone. The circular clockwise and counterclockwise source components have been decomposed into their linear radial and transverse components. These sources are radial, or inline, sources.



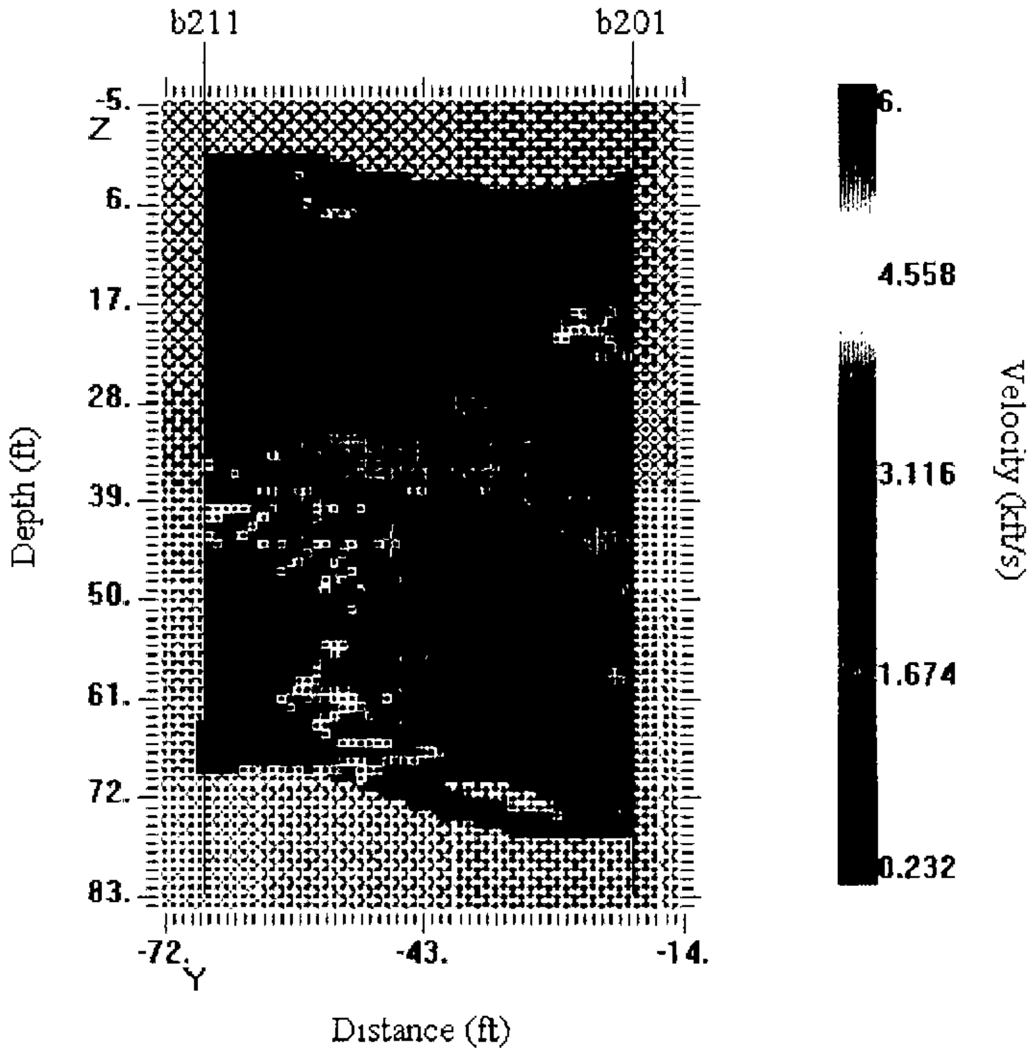
The same CRG from Survey 2 as on Page 96. The green dots (redline) show our first-arrival picks.



A P-wave velocity tomogram from Survey 2 between boreholes 211 (source) and 201 (receivers). Here, the starting model was 37 feet of overburden (200 ft/s = 610 m/s) over bedrock (600 ft/s = 1830 m/s).



A P-wave velocity tomogram from Survey 2 between boreholes 211 (source) and 201 (receivers). Here, the starting model was 37 ft. of overburden (600 ft/s) over bedrock (2000 ft/s).



A P-wave velocity tomogram from Survey 2 between boreholes 211 (source) and 201 (receivers). Here, the starting model was a homogenous half-space (medium) with a uniform velocity of 5000 ft/s (1524 m/s).

Cross hole seismic data tests

Project: **I-70/Cambridge ODOT Research Site** | Grumman Exploration, Inc.
Location: Cambridge, Ohio | Nominal Test Hole Separation:
Client/Owner: Softearth Associates, Inc. | ~10 ft

Test Depth	Notes	Est'd Velocity (fps) V_P	V_S	Esimated Wave Arrival Time (msec) P_{211}	P_{211}	S_{212}	S_{211}	receiver separation (ft)[1]
2.5			441	n/a	n/a	11.50	37.0	11.250
5.0			595	n/a	n/a	16.80	35.70	11.250
7.5			551	n/a	n/a	16.30	36.70	11.250
10.0			598	n/a	n/a	16.60	35.40	11.250
12.5			625	n/a	n/a	18.00	36 00	11.250
15.0			584	n/a	n/a	18.50	37.75	11.250
17.5			600	n/a	n/a	20.25	39 00	11.250
20.0			771	n/a	n/a	19.30	33 90	11.250
22.5			726	n/a	n/a	19.00	34.50	11.250
25.0			938	n/a	n/a	13.80	25.80	11.250
27.5			650	n/a	n/a	16.70	34.00	11.250
30.0			682	n/a	n/a	19.60	36.10	11.250
32.5			1844	n/a	n/a	8.40	14.50	11.250
35.0			1243	n/a	n/a	8.75	17.80	11.250
37.5			1585	n/a	n/a	8.60	15.70	11.250
40.0			1563	n/a	n/a	8.90	16.10	11.250
42.5			1758	n/a	n/a	8 20	14.60	11 250
45.0			2679	n/a	n/a	6.40	10.60	11 250
47.5			2557	n/a	n/a	8 10	12.50	11 250
50.0			2344	n/a	n/a	7 10	11.90	11 250
52.5			2885	n/a	n/a	7.00	10.90	11 250
55.0			2961	n/a	n/a	6 70	10.50	11 250
57.5				n/a	n/a	7.30	n/a	11.250
60.0			3041	n/a	n/a	10.30	14.00	11.250
62.5			5114	n/a	n/a	9.30	11.50	11.250

Field Equipment: EG&G SmartSeis S-12, 12-channel, signal enhancement siesmograph
Two Triaxial Geophones, 10-ft nominal surface separation distance centered at depth indicated
Downhole, reversible polarity hammer source
[1] Ground surface separation, no deviation survey performed
n/a uninterpretable/poor quality waveform

Cross hole seismic data for hole pair GC 211-GC 212.

Crosshole Seismic Testing Field Data Spreadsheet

Test/Well IDs: B-214 & B-215 Shot Hole: B-213

Project: **I-70/Cambridge ODOT Research Site**

Location: Cambridge, Ohio

Client/Owner: Softearth Associates, Inc.

Grumman Exploration, Inc.

Nominal Test Hole Separation: ~10 ft

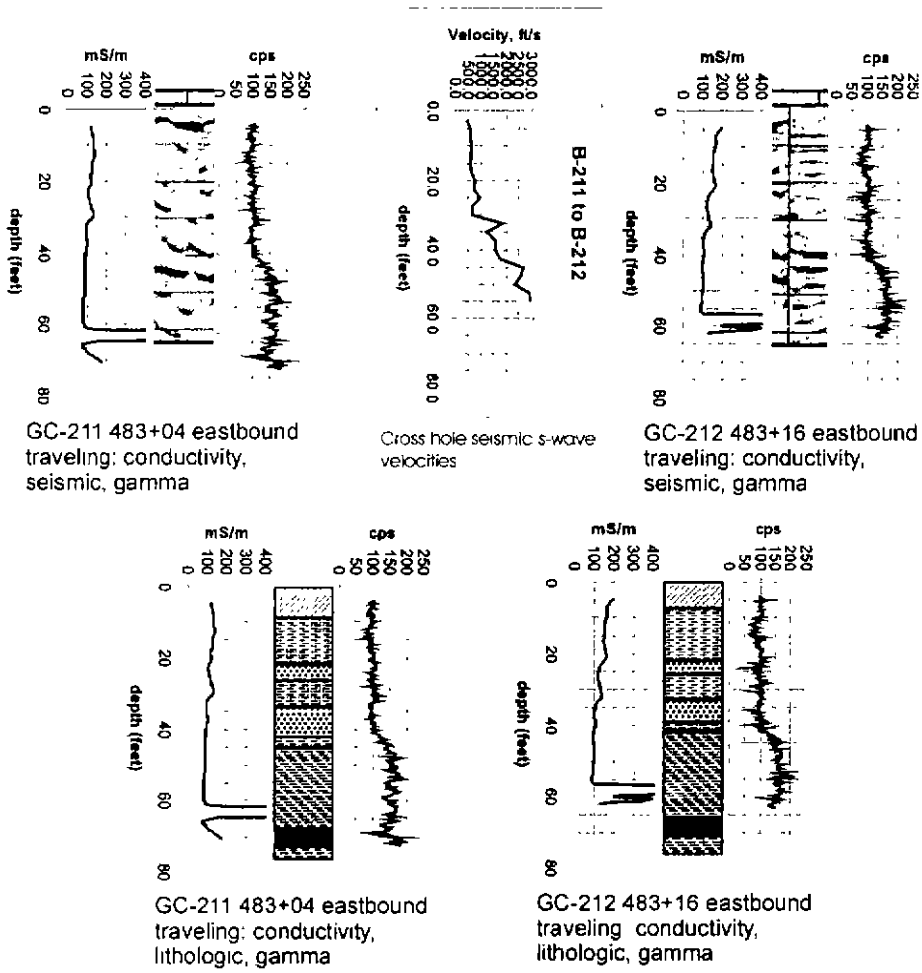
Test Depth	Notes	Est'd Velocity (fps) V_P	V_S	Estimated Wave Arrival Time (msec) P_{211}	P_{211}	S_{212}	S_{211}	receiver separation (ft)[1]
2 5			560	n/a	n/a	9.50	29.6	11.250
5 0			577	n/a	n/a	9.50	29.00	11.250
7.5			628	n/a	n/a	10.90	28.80	11.250
10.0			686	n/a	n/a	8 50	24.90	11.250
12.5			636	n/a	n/a	12 30	30 00	11.250
15.0			652	n/a	n/a	13.25	30.50	11 250
17.5			538	n/a	n/a	11.10	32.00	11 250
20.0			583	n/a	n/a	10.70	30.00	11.250
22.5			554	n/a	n/a	9.60	29.90	11.250
25.0			776	n/a	n/a	9.50	24.00	11.250
27.5			650	n/a	n/a	12.20	29.50	11.250
30 0			750	n/a	n/a	14.00	29.00	11.250
32.5			1679	n/a	n/a	7.00	13.70	11.250
35.0			1389	n/a	n/a	5.80	13.90	11.250
37.5			2184	n/a	n/a	5.60	10.75	11.250
40.0			1957	n/a	n/a	5.50	11.25	11.250
42.5			2123	n/a	n/a	5.60	10.90	11.250
45.0			2163	n/a	n/a	4.90	10.10	11.250
47.5			2296	n/a	n/a	4.70	9.60	11.250
50.0			2368	n/a	n/a	4.50	9.25	11 250
52.5			3309	n/a	n/a	4.40	7.80	11.250
55.0			3041	n/a	n/a	4.20	7.90	11.250
57.5			2616	n/a	n/a	4.10	8.40	11.250
60.0			2296	n/a	n/a	4.30	9.20	11.250
62.5			3000	n/a	n/a	5.00	8 75	11.250

Field Equipment: EG&G SmartSeis S-12, 12-channel, signal enhancement siesmograph
Two Triaxial Geophones, 10-ft nominal surface separation distance centered at depth indicated
Downhole, reversible polarity hammer source

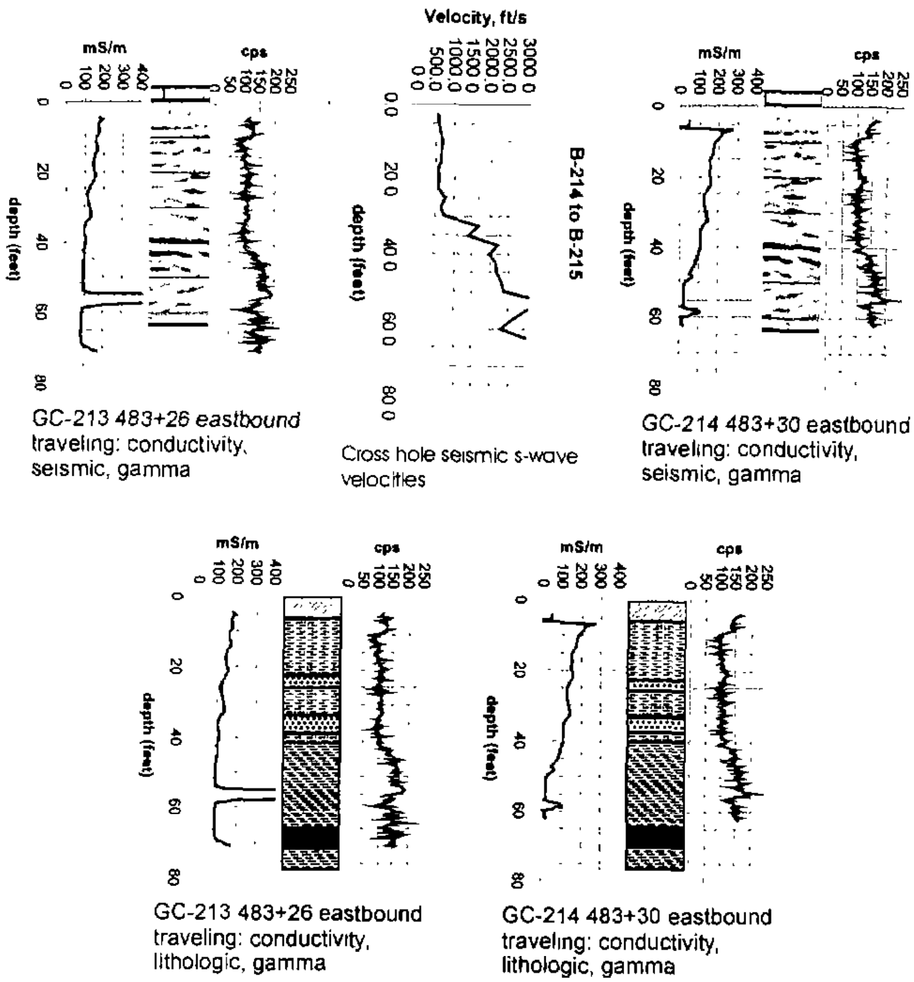
[1] Ground surface separation, no deviation survey performed

n/a uninterpretable/poor quality waveform

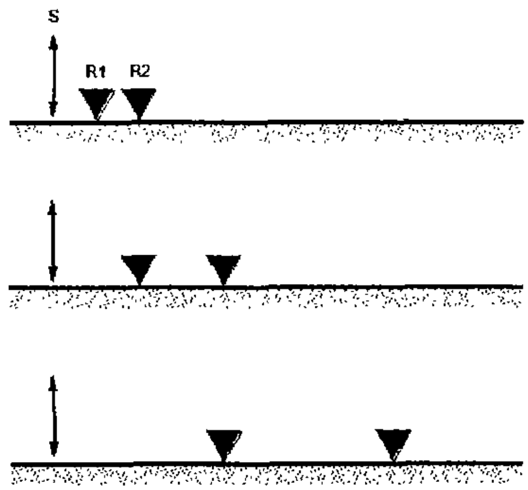
Cross-hole seismic data for hole pari GC-213 and GC-214.



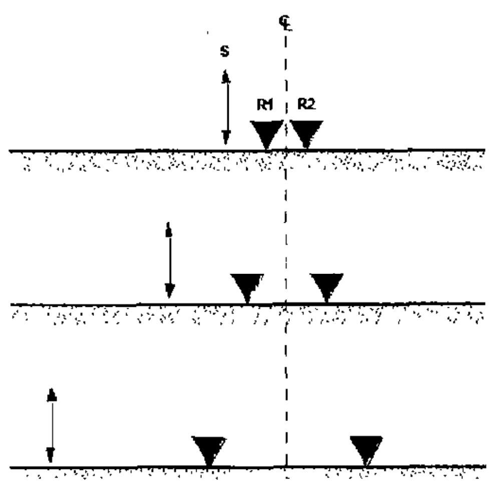
Cross-well seismic shear wave velocity well log and other well logs in holes GC-211 and GC-212.



Cross-well seismic shear wave velocity well log and other well logs in holes GC-213 and 214.

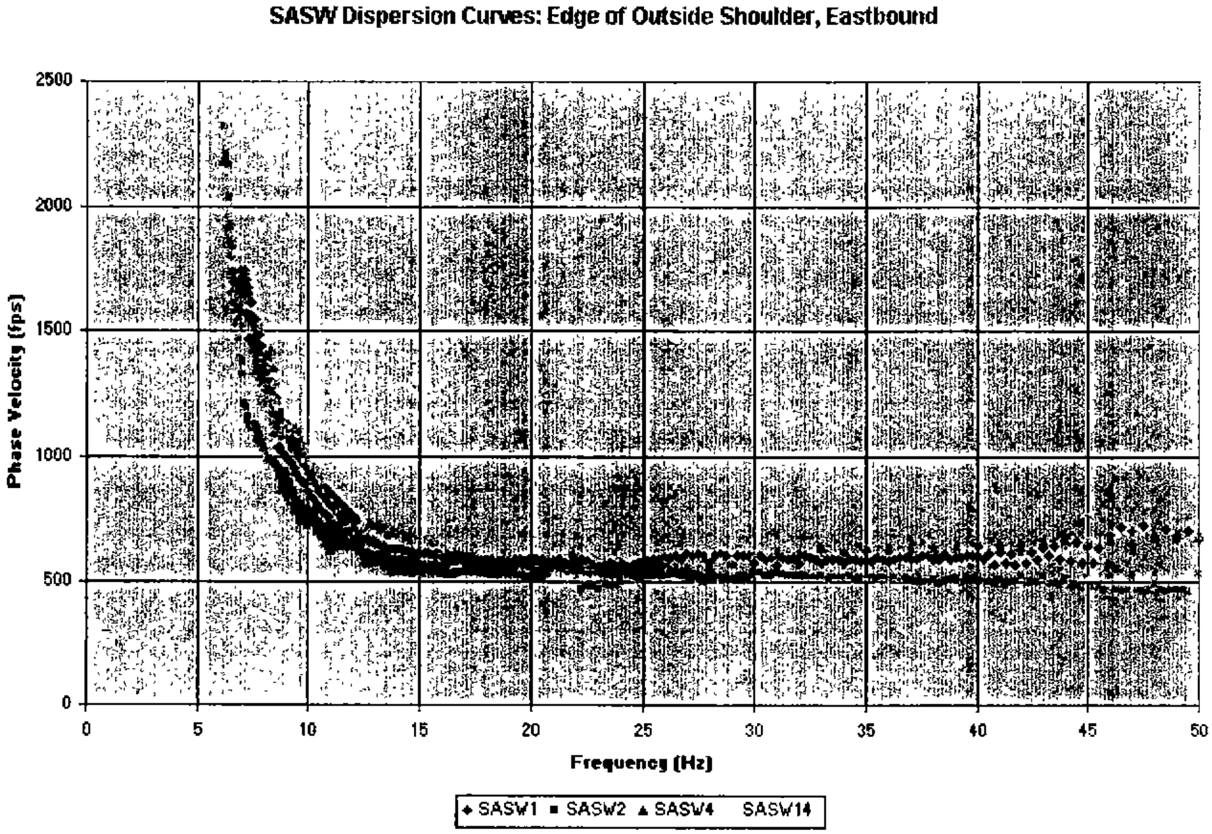


(a) SASW common source (CS) geometry

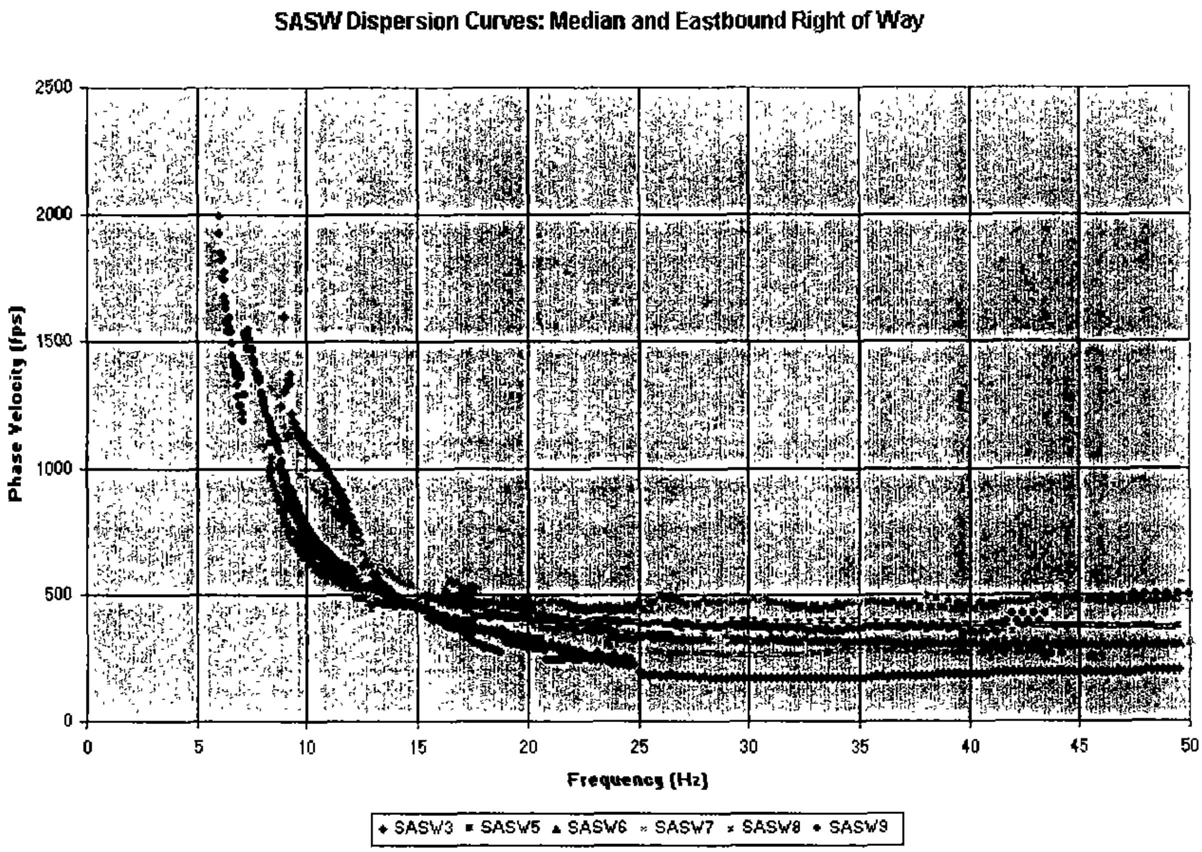


(b) SASW common receiver midpoint (CRMP) geometry

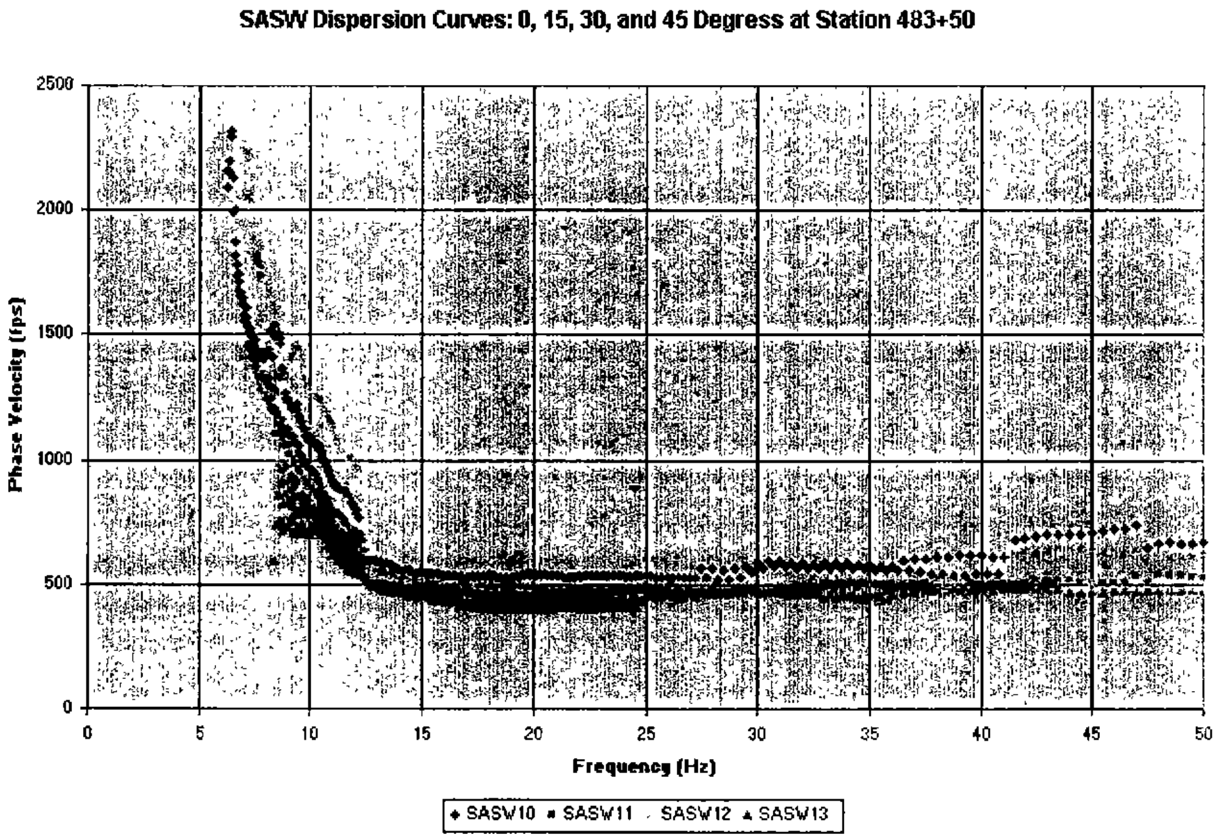
Geometry used for spectral analysis of surface waves (SASW) testing.



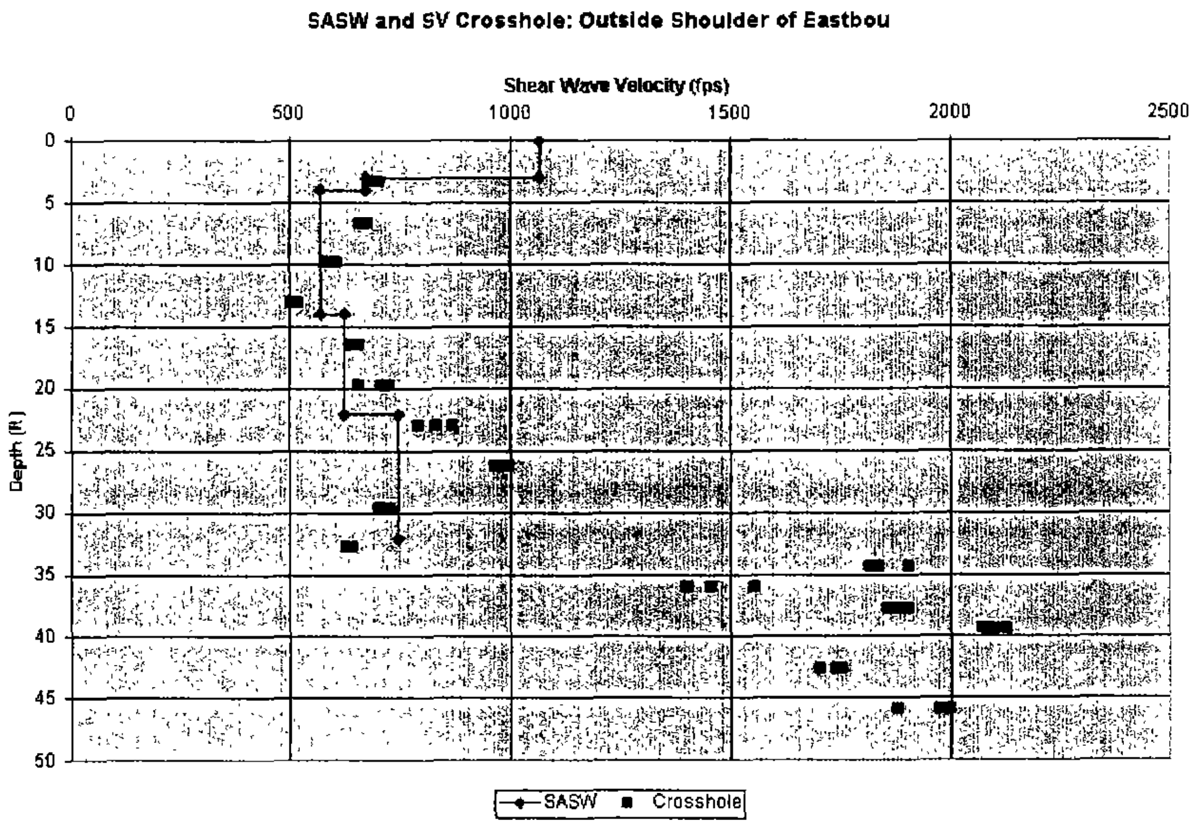
SASW dispersion curves for the edge of outside shoulder on the eastbound lanes.



SASW dispersion curves for the median right-of-way, on the eastbound side.



SASW dispersion curves: 0, 15, 30, and 45 degrees at station 453.50.



Comparison of SASW and Cross-hole velocity measurements.

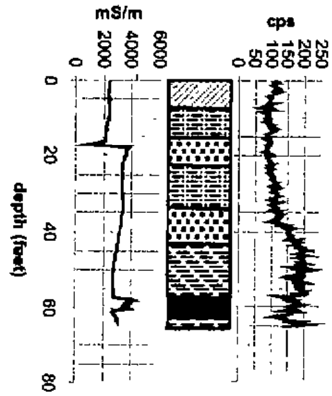
Geophysical well logs

Locations

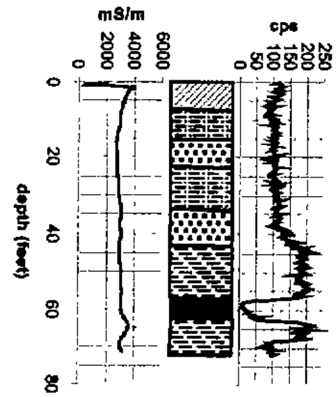
conductivity	gamma	location	depth	possible field names where holes not marked
B-229	B-229			
B-407G	B-407G	469+74 east travel		
B-407H	B-407H	469+59 east travel		
B-413E	B-413E	486+38 east travel		
B-413F	B-413F	486+02 east travel		
B-413H	B-413H	485+37 east travel		
BM-01	BM-01			
MN		469+54	72.01	GC 307
	BP-01			
BP-02				
	DE-02			
DI-01		469+80 east travel	65.7->65.7	B-005
DJ-01	DJ-01	483+95 east	24.66	B-412B, B-412E
DP-01		475+55 other side ditch	62.35	B-040
DX-01	DX-01	483+40 east travel	72.2	B-125, B-111
GC-201	GC-201	483+04 east pass		
GC-202	GC-202	483+14 6 east pass		
GC-203	GC-203	483+23.8 east pass		
GC-204	GC-204	483+28.8 east pass		
GC-205	GC-205	483+40.2 east pass		
GC-206	GC-206	483+57.1 east pass		
GC-207	GC-207	483+78.9 east pass		
GC-208	GC-208	484+18.8 east pass		
GC-211	GC-211	483+04.5 east travel		
GC-212	GC-212	483+15.8 east travel		
GC-213	GC-213	483+26 east travel		
GC-214	GC-214	483+30.5 east travel		
GC-215	GC-215	483+40.3 east travel		
GC-216	GC-216	483+60.2 east travel		
GC-217	GC-217	483+80.2 east travel		
GC-218	GC-218	484+20.5 east travel		
GC-219	GC-219	484+60 east travel		
GC-308	GC-308	485+29 east pass		
LB-01	LB-01			
MP	MP	469+54 east travel	71.59->50.49	GC 307
MW	MW	469+74 east travel	64.3	B-042
P-001A	P-001A	482+29 east travel		
P-221A (ZP)	P-221A	485+00 east travel	55.84	
P-223A	P-223A	483+97.4 west travel		
P-228A	P-228A	483+49.7 center med		
P-301B	P-301B	468+74 west travel med		
P-302A	P-302A	469+80 east travel med		
P-308B	P-308B	475+49 east travel		
P-310A	P-310A	474+90 center med		
P-311C (MV)	P-311C	474+63 west travel		
RR	RR-01			
RT	RT-01			
	RV-01			
SE (VX)		468+70	55.71	P-301
TR				
ZB	ZB-01	486+40	75.62	B-413E
ZG	ZG-01	484+60	64.8	GC-209, GC-210, B-009, B-109
ZK	ZK-01	484+20 east	69.32	
ZQ	ZQ			
ZT	ZT			
ZY	ZY	485+40		B-413G, B-413G

Locations of the boring logs in this study.

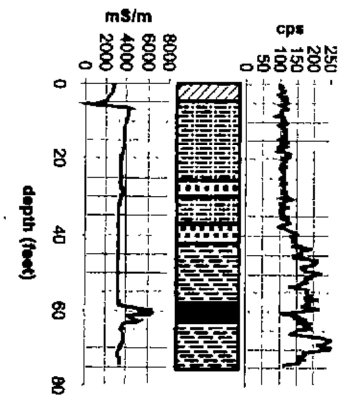
Gamma, conductivity and lithologic logs



B-407G 469+74 eastbound traveling: conductivity, lithologic, gamma

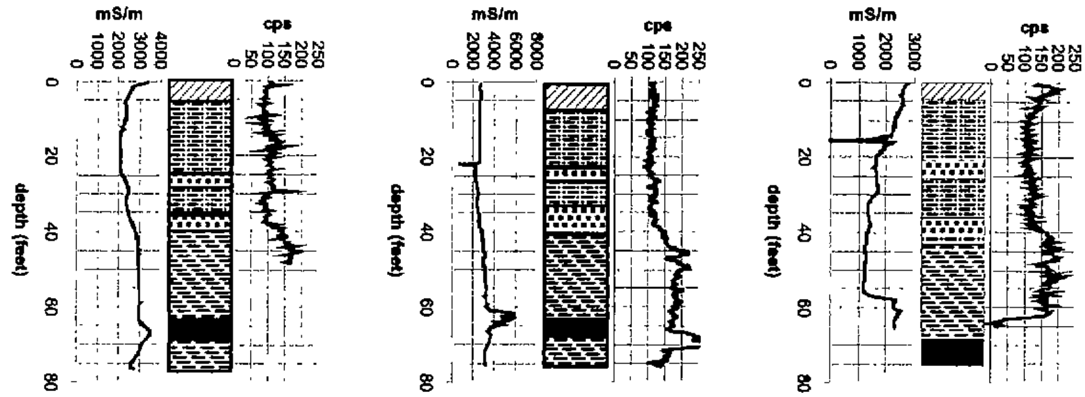


B-407H 469+59 eastbound traveling: conductivity, lithologic, gamma



B-413E 486+38 eastbound traveling: conductivity, lithologic, gamma

Gamm ray, conductivity, and lithologic logs B-407G, B-407H, and B-413E.

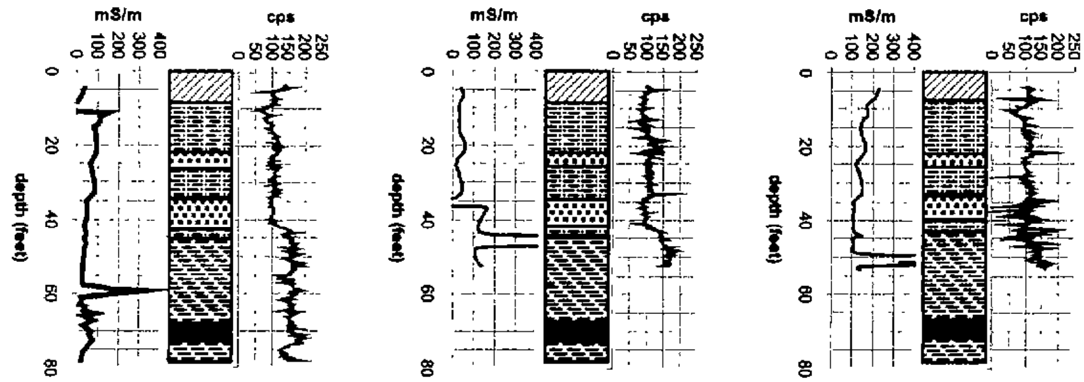


B-413F 486+02 eastbound traveling: conductivity, lithologic, gamma

B-413H 485+37 eastbound traveling: conductivity, lithologic, gamma

P-001A 482+29 eastbound traveling: conductivity, lithologic, gamma

Gamm ray, conductivity, and lithologic logs B-413F, B-413H, and P-001A.

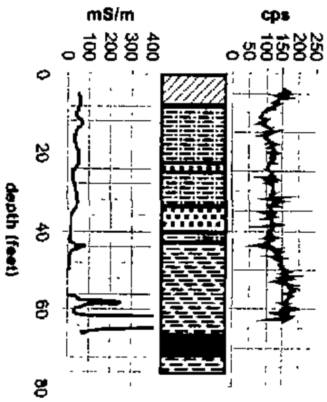


GC-201 483+04 eastbound passing: conductivity, lithologic, gamma

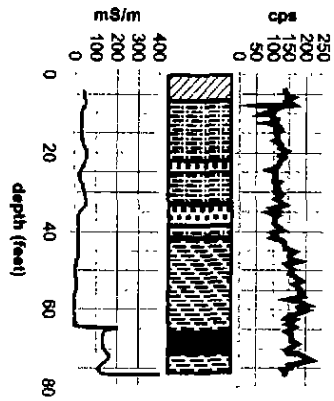
GC-202 483+15 eastbound passing: conductivity, lithologic, gamma

GC-203 483+24 eastbound passing: conductivity, lithologic, gamma

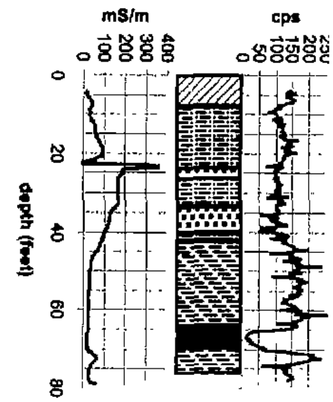
Gamm ray, conductivity, and lithologic logs GC-201, GC-202, and GC-203.



GC-204 483+29 eastbound passing: conductivity, lithologic, gamma

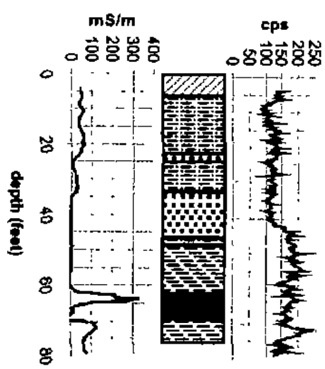


GC-205 483+40 eastbound passing: conductivity, lithologic, gamma

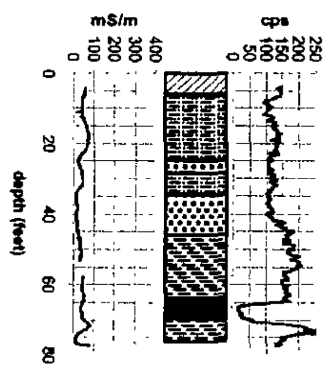


GC-206 483+57 eastbound passing: conductivity, lithologic, gamma

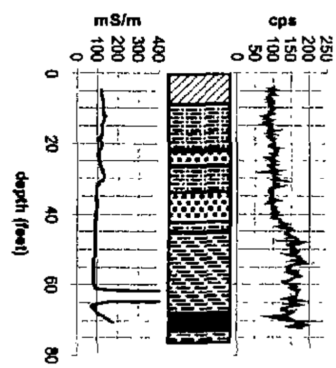
Gamm ray, conductivity, and lithologic logs GC-204, GC-205, and GC-208.



GC-207 483+79 eastbound passing: conductivity, lithologic, gamma

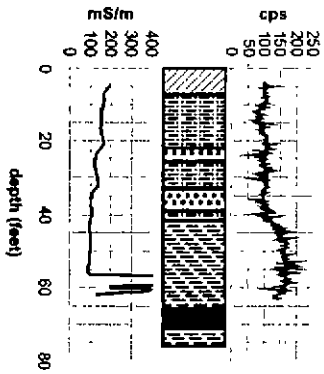


GC-208 484+19 eastbound passing: conductivity, lithologic, gamma

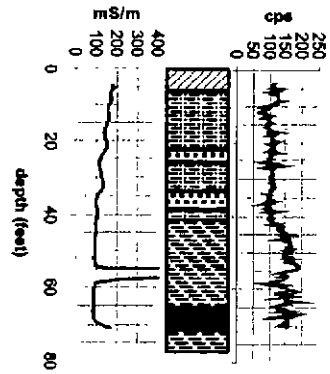


GC-211 483+04 eastbound traveling: conductivity, lithologic, gamma

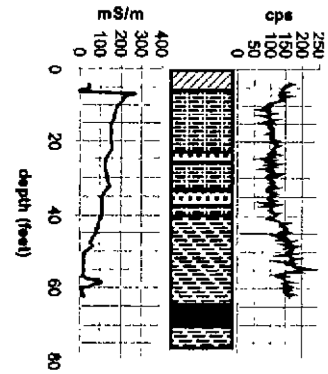
Gamm ray, conductivity, and lithologic logs GC-207, GC-208, and GC-211.



GC-212 483+16 eastbound traveling: conductivity, lithologic, gamma

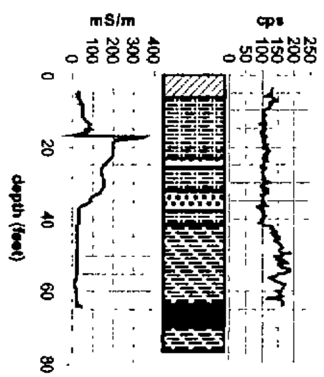


GC-213 483+26 eastbound traveling. conductivity, lithologic, gamma

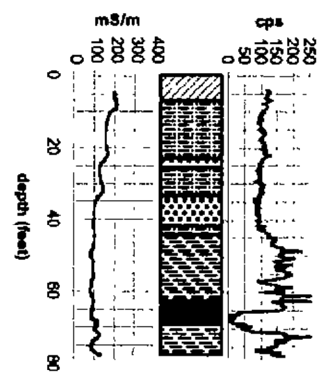


GC-214 483+30 eastbound traveling: conductivity, lithologic, gamma

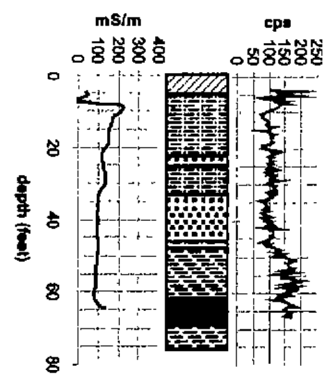
. Gamm ray, conductivity, and lithologic logs GC-212, GC-213, and GC-214.



GC-215 483+40 eastbound traveling: conductivity, lithologic, gamma

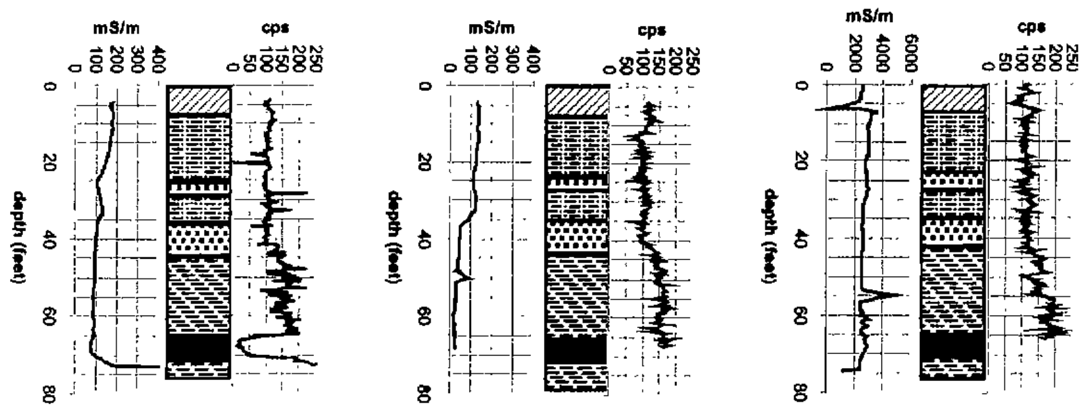


GC-216 483+60 eastbound traveling: conductivity, lithologic, gamma



GC-217 483+80 eastbound traveling: conductivity, lithologic, gamma

Gamm ray, conductivity, and lithologic logs GC-215, GC-216, and GC-217.

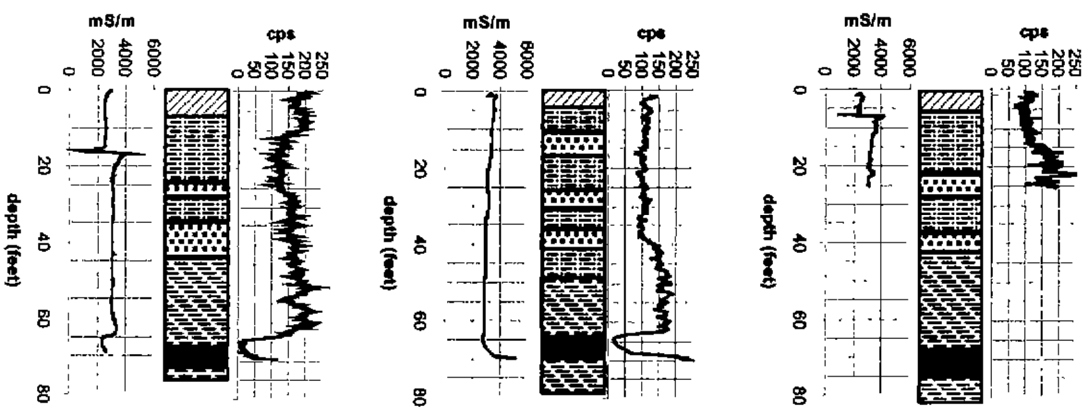


GC-218 484+20 eastbound traveling: conductivity, lithologic, gamma

GC-219 484+60 eastbound traveling: conductivity, lithologic, gamma

GC-308 485+29 eastbound passing: conductivity, lithologic, gamma

Gamm ray, conductivity, and lithologic logs GC-218, GC-219, and GC-308.

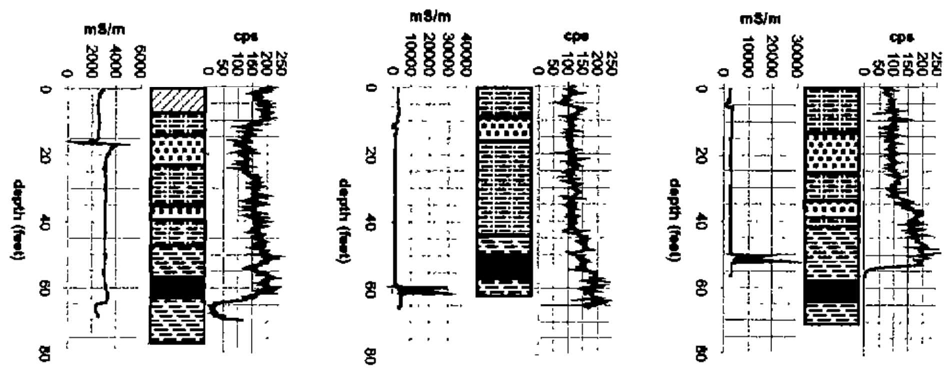


P-221A 485+00 eastbound traveling: conductivity, lithologic, gamma

P-311C 474+90 center median: conductivity, lithologic, gamma

P-228A 483+50 center median: conductivity, lithologic, gamma

Gamm ray, conductivity, and lithologic logs P-221A, P-311C, and P-228A.

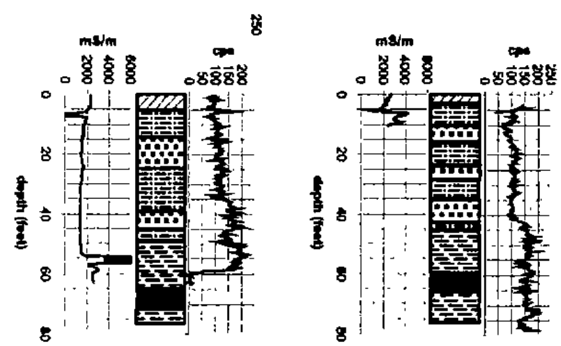


P-223A 483+97 westbound traveling: conductivity, lithologic, gamma

P-301B 468+79 west median: conductivity, lithologic, gamma

P-302A 469+80 east median: conductivity, lithologic, gamma

Gamm ray, conductivity, and lithologic logs P223A, P-301B, and P-302A.

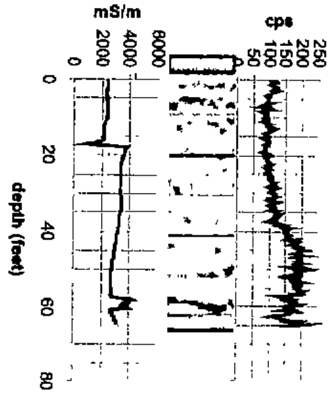


P-308B 475+49 eastbound traveling: conductivity, lithologic, gamma

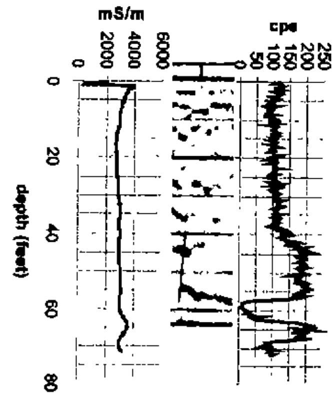
P-311C 474+63 west traveling: conductivity, lithologic, gamma

Gamm ray, conductivity, and lithologic logs P-308B, and P-311C.

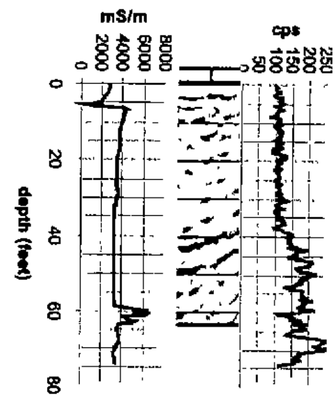
Gamma, conductivity, and seismic data portions



B-407G 469+74 eastbound traveling: conductivity, seismic, gamma

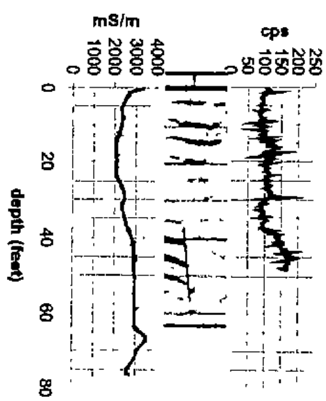


B-407H 469+59 eastbound traveling: conductivity, seismic, gamma

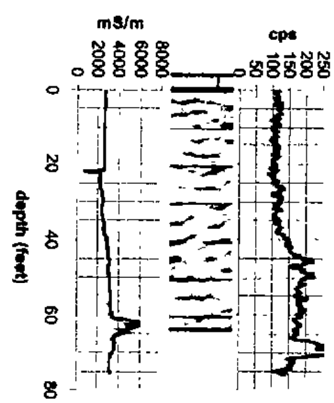


B-413E 486+38 eastbound traveling: conductivity, seismic, gamma

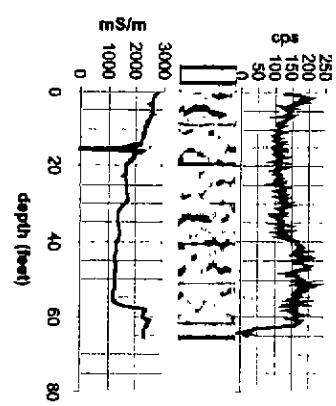
Gamm ray, and conductivity logs compared to the portion of the seismic section that crosses closest to the boreholes for hoels B-407G, B-407H, and B-413E.



B-413F 486+02 eastbound traveling: conductivity, seismic, gamma

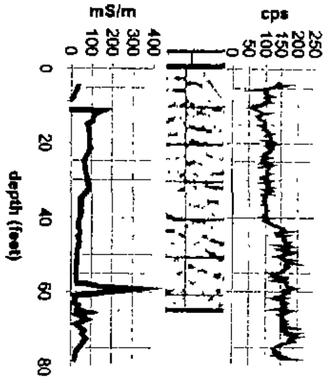


B-413H 485+37 eastbound traveling: conductivity, seismic, gamma

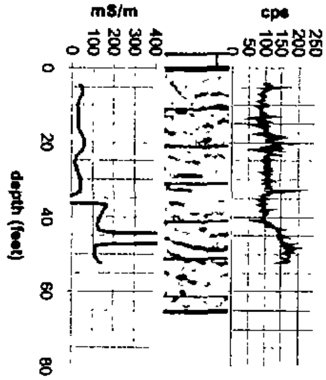


P-001A 482+29 eastbound traveling: conductivity, seismic, gamma

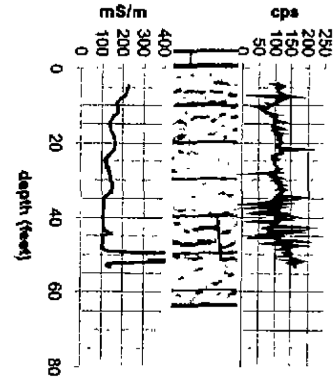
Gamm ray, and conductivity logs compared to the portion of the seismic section that crosses closest to the boreholes for hoels B-413F, B-413H, and P-001A.



GC-201 483+04 eastbound passing: conductivity, seismic, gamma

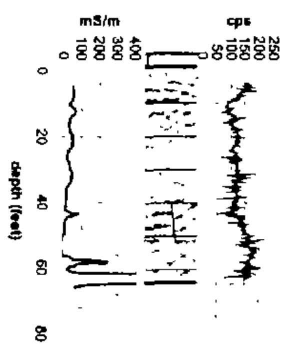


GC-202 483+15 eastbound passing: conductivity, seismic, gamma

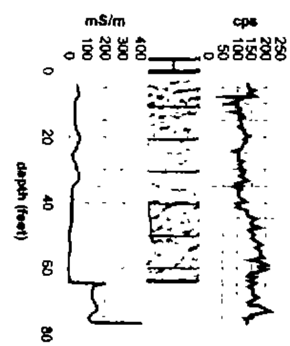


GC-203 483+24 eastbound passing: conductivity, seismic, gamma

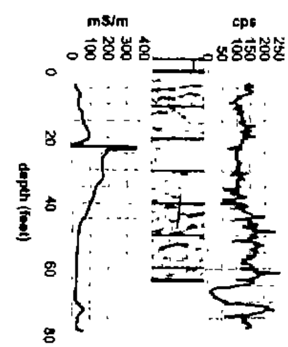
Gamm ray, and conductivity logs compared to the portion of the seismic section that crosses closest to the boreholes for hoels GC-201, GC-202, and GC-208.



GC-204 483+29 eastbound passing: conductivity, seismic, gamma

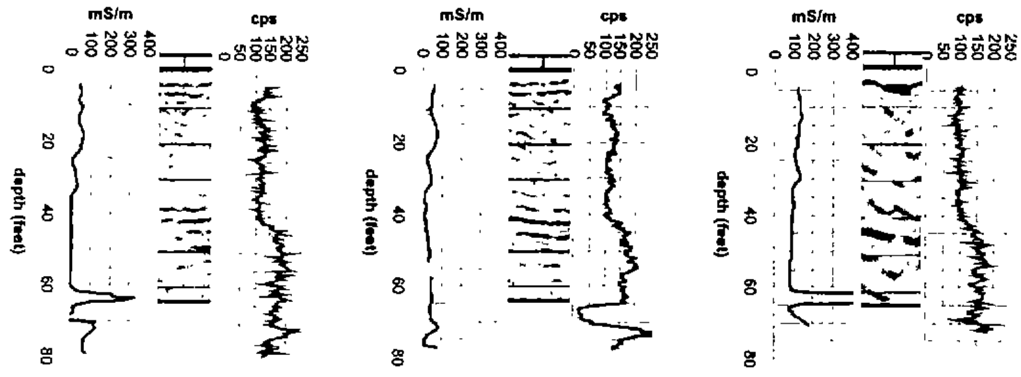


GC-205 483+40 eastbound passing: conductivity, seismic, gamma



GC-206 483+57 eastbound passing: conductivity, seismic, gamma

Gamm ray, and conductivity logs compared to the portion of the seismic section that crosses closest to the boreholes for hoels GC-204, GC-205, and GC-206.

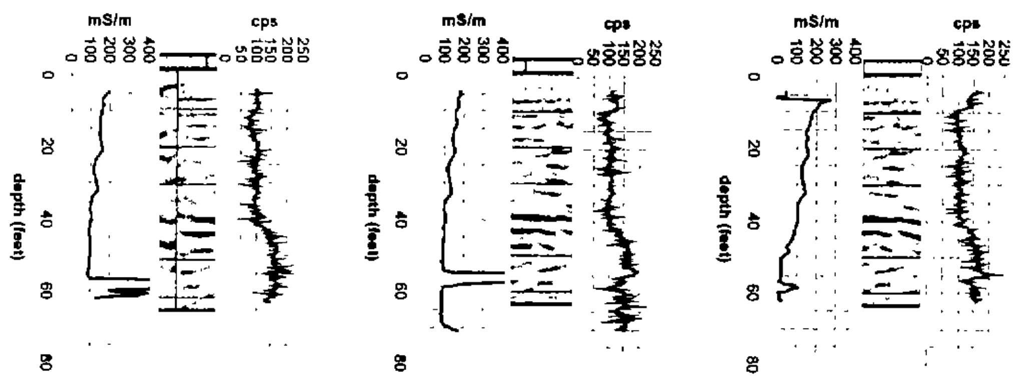


GC-207 483+79 eastbound passing: conductivity, seismic, gamma

GC-208 484+19 eastbound passing: conductivity, seismic, gamma

GC-211 483+04 eastbound traveling. conductivity, seismic, gamma

Gamm ray, and conductivity logs compared to the portion of the seismic section that crosses closest to the boreholes for hoels GC-207, GC-208, and GC-211.

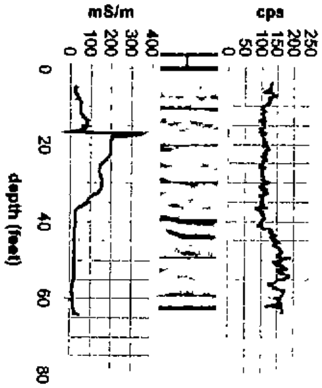


GC-212 483+16 eastbound traveling: conductivity, seismic, gamma

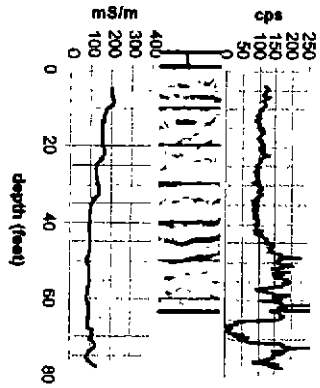
GC-213 483+26 eastbound traveling· conductivity, seismic, gamma

GC-214 483+30 eastbound traveling: conductivity, seismic, gamma

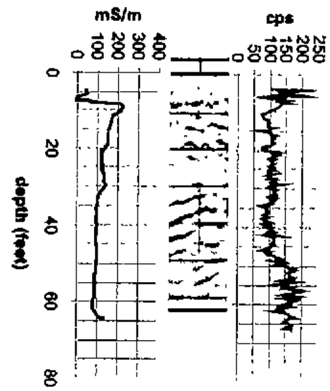
Gamm ray, and conductivity logs compared to the portion of the seismic section that crosses closest to the boreholes for hoels GC-212, GC-213, and GC-214.



GC-215 483+40 eastbound traveling: conductivity, seismic, gamma

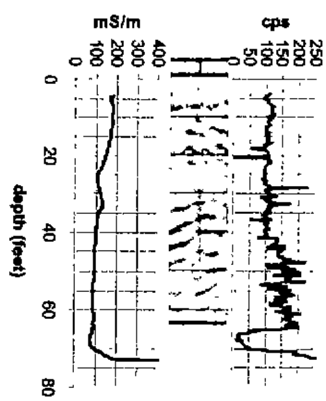


GC-216 483+60 eastbound traveling: conductivity, seismic, gamma

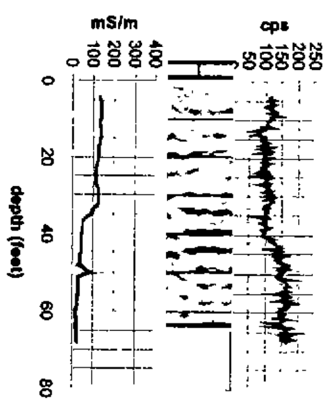


GC-217 483+80 eastbound traveling: conductivity, seismic, gamma

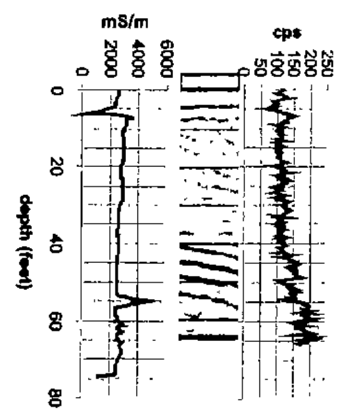
Gamm ray, and conductivity logs compared to the portion of the seismic section that crosses closest to the boreholes for hoels GC-215, GC-216, and GC-217.



GC-218 484+20 eastbound traveling: conductivity, seismic, gamma

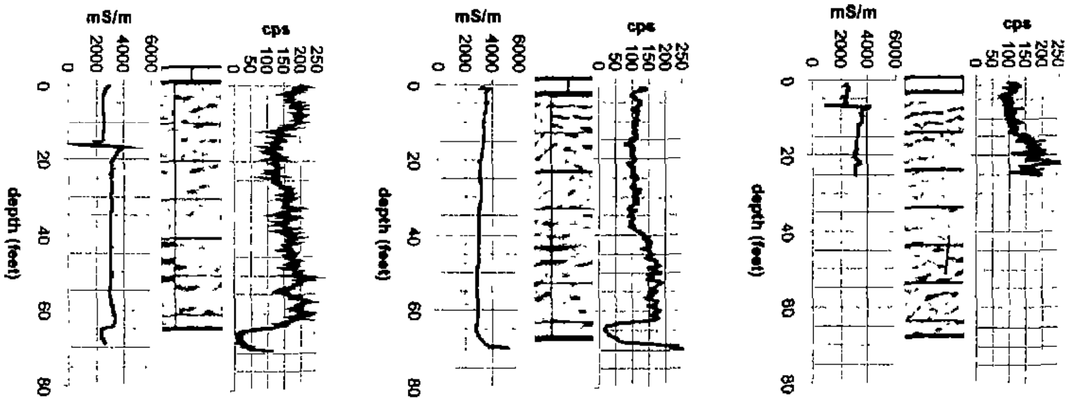


GC-219 484+60 eastbound traveling: conductivity, seismic, gamma



GC-308 485+29 eastbound passing: conductivity, seismic, gamma

Gamm ray, and conductivity logs compared to the portion of the seismic section that crosses closest to the boreholes for hoels GC-218, GC-219, and GC-308.

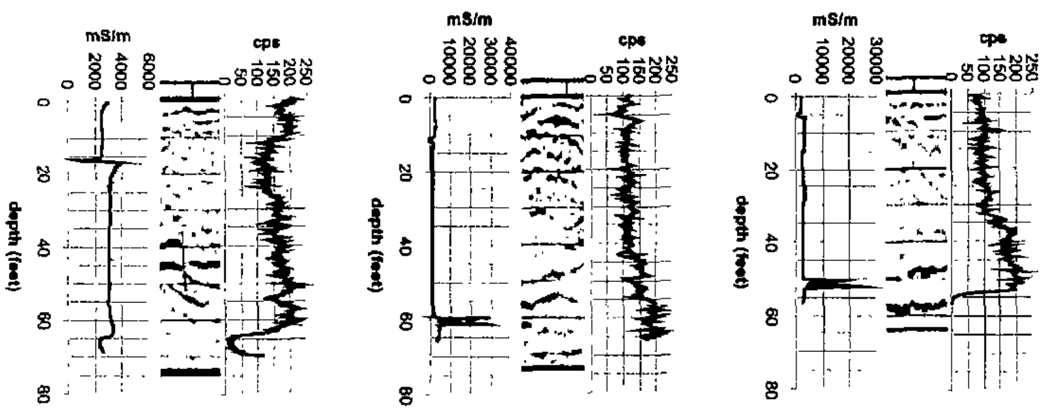


P-221A 485+00 eastbound traveling: conductivity, seismic, gamma

P-311C 474+90 center median: conductivity, seismic, gamma

P-228A 483+50 center median: conductivity, seismic, gamma

Gamm ray, and conductivity logs compared to the portion of the seismic section that crosses closest to the boreholes for hoels P-221A, P-311C, and P-228A.

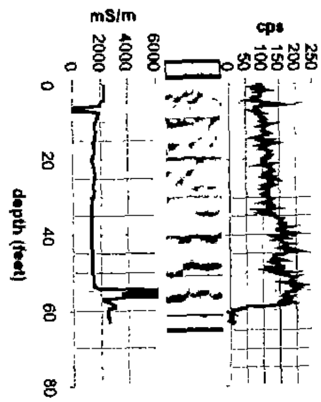


P-223A 483+97 westbound traveling: conductivity, seismic, gamma

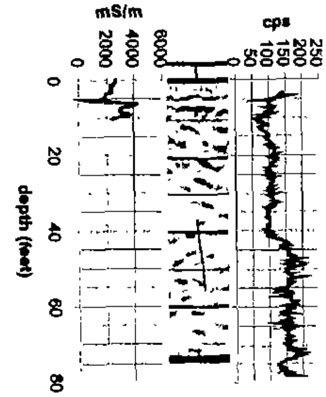
P-301B 468+79 west median: conductivity, seismic, gamma

P-302A 469+80 east median: conductivity, seismic, gamma

Gamm ray, and conductivity logs compared to the portion of the seismic section that crosses closest to the boreholes for hoels P-223A, P-301B, and P-302A.



P-308B 475+49 eastbound traveling: conductivity, seismic, gamma



P-311C 474+63 west traveling: conductivity, seismic, gamma

Gamm ray, and conductivity logs compared to the portion of the seismic section that crosses closest to the boreholes for hoels P-500B and P-311C.

Gamma, conductivity, and cross hole GPR

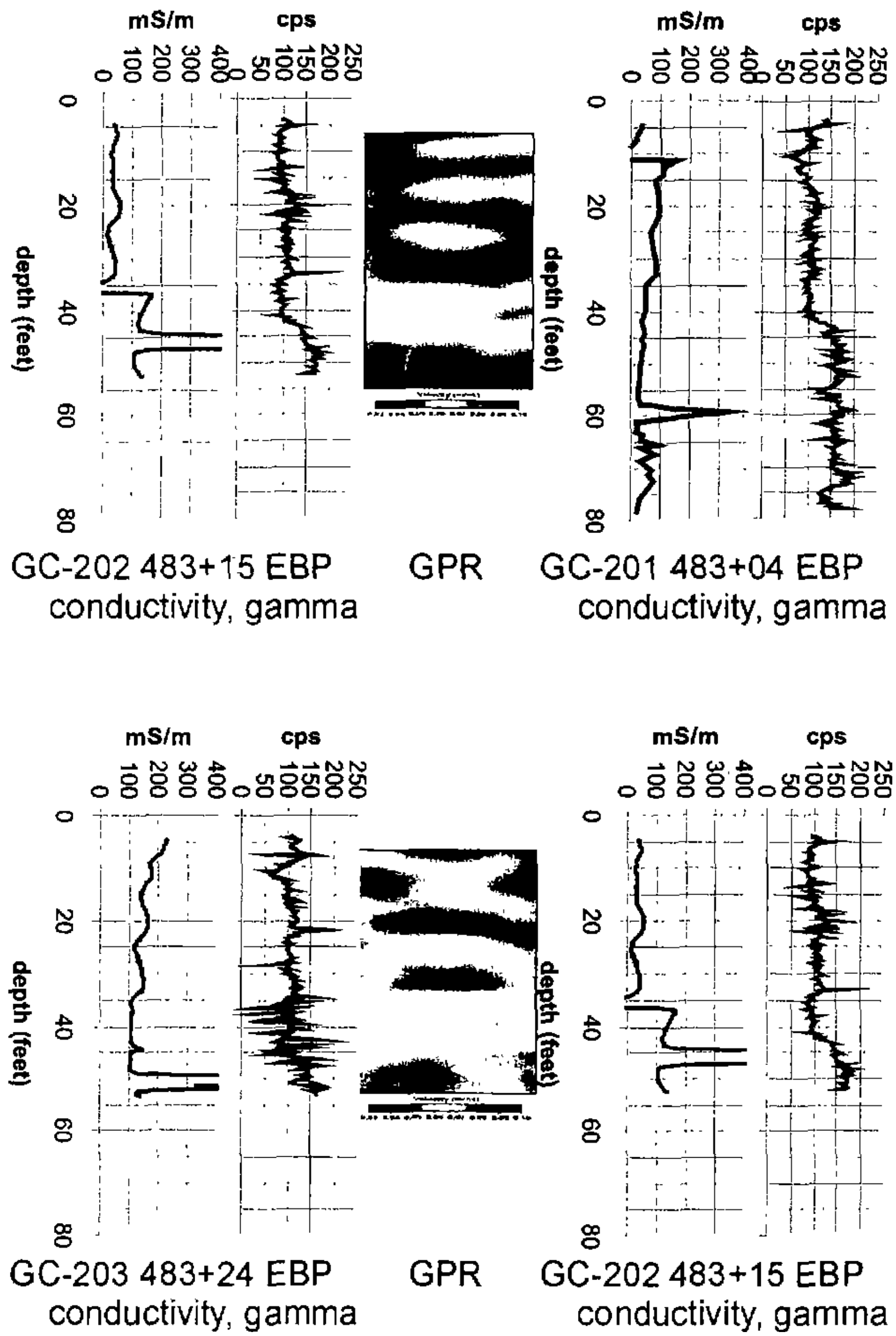


FIGURE 35. Gamma ray, conductivity, and GPR tomogram for cross-hole pairs GC-201 and 202, and GC-203 and 202.

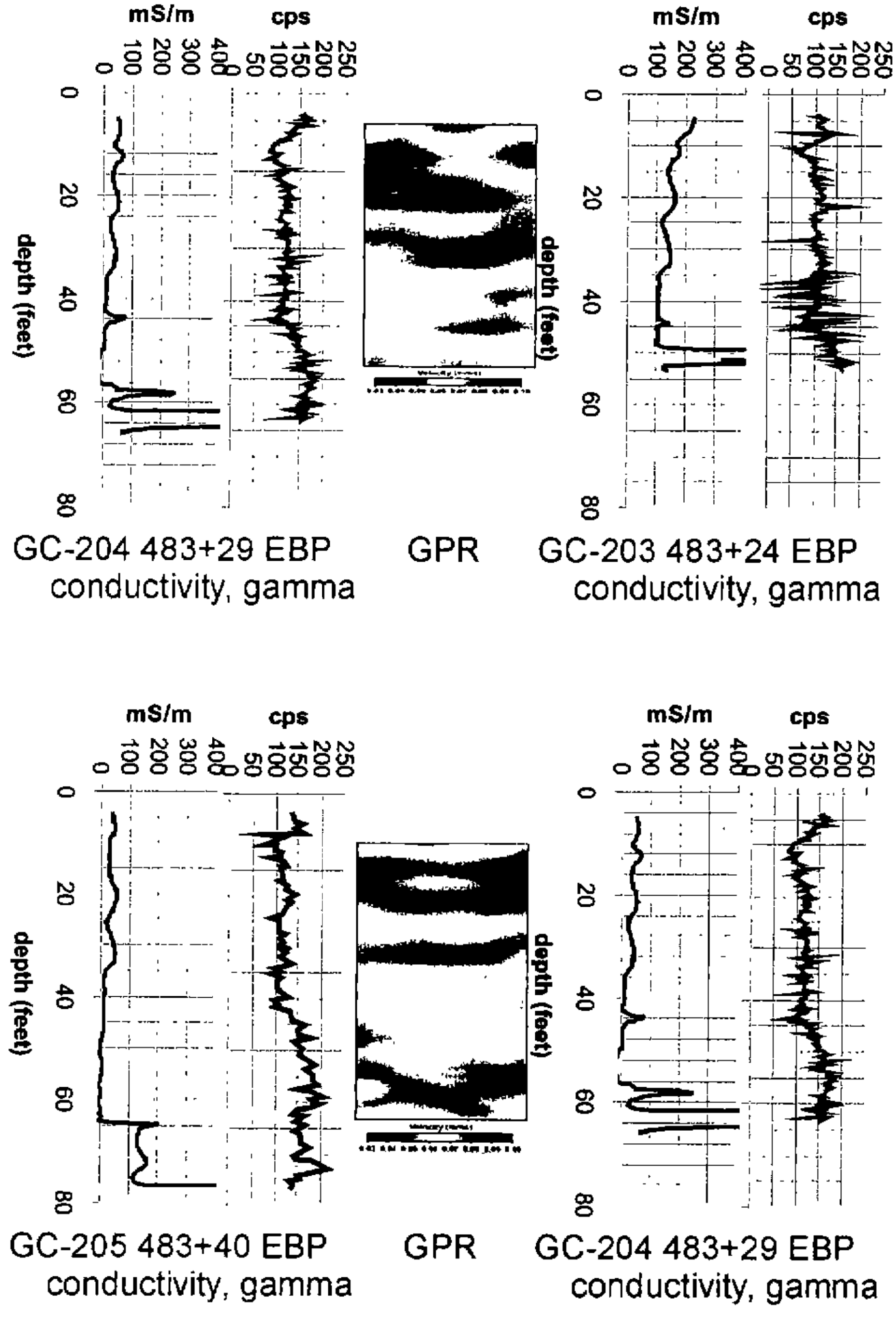
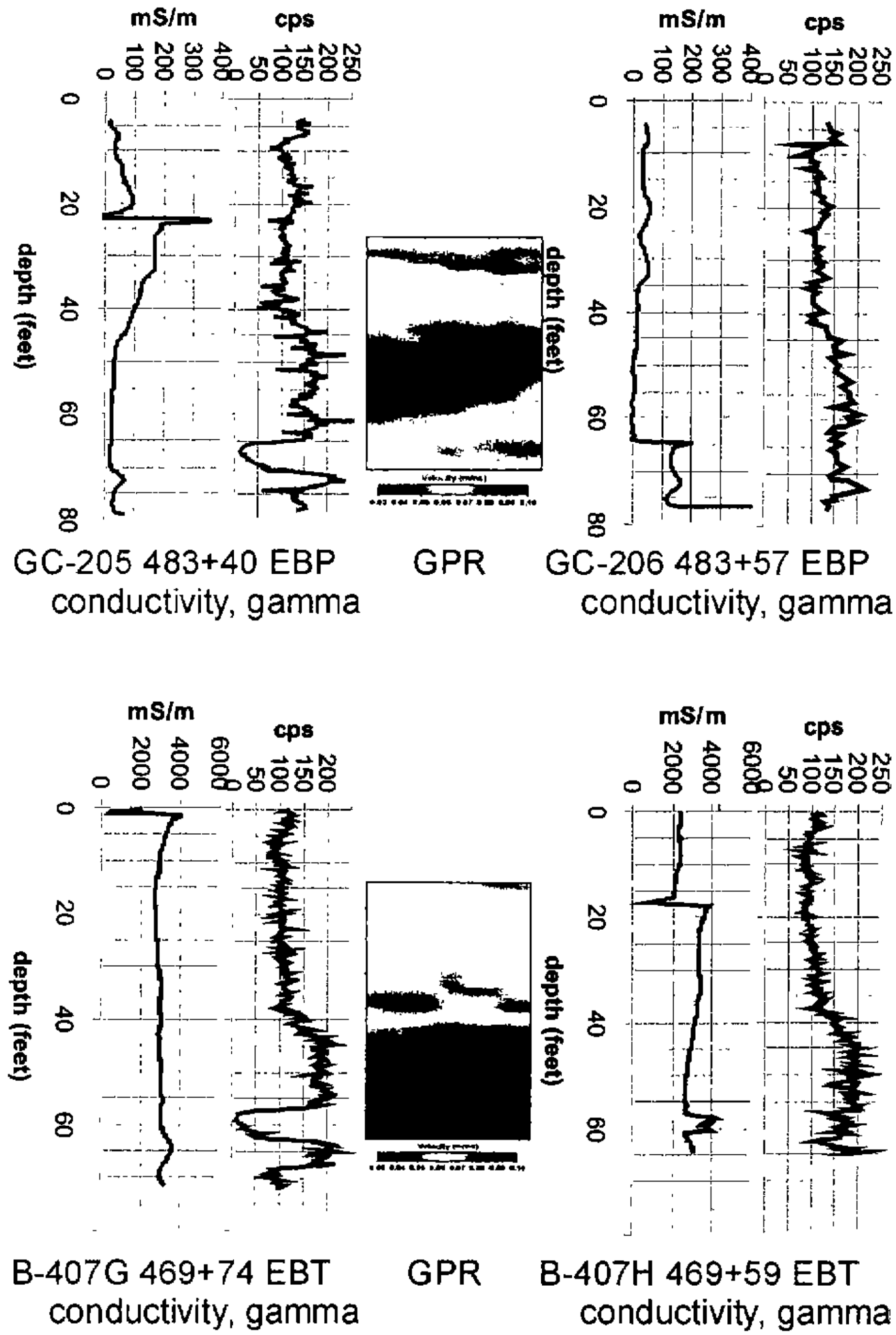
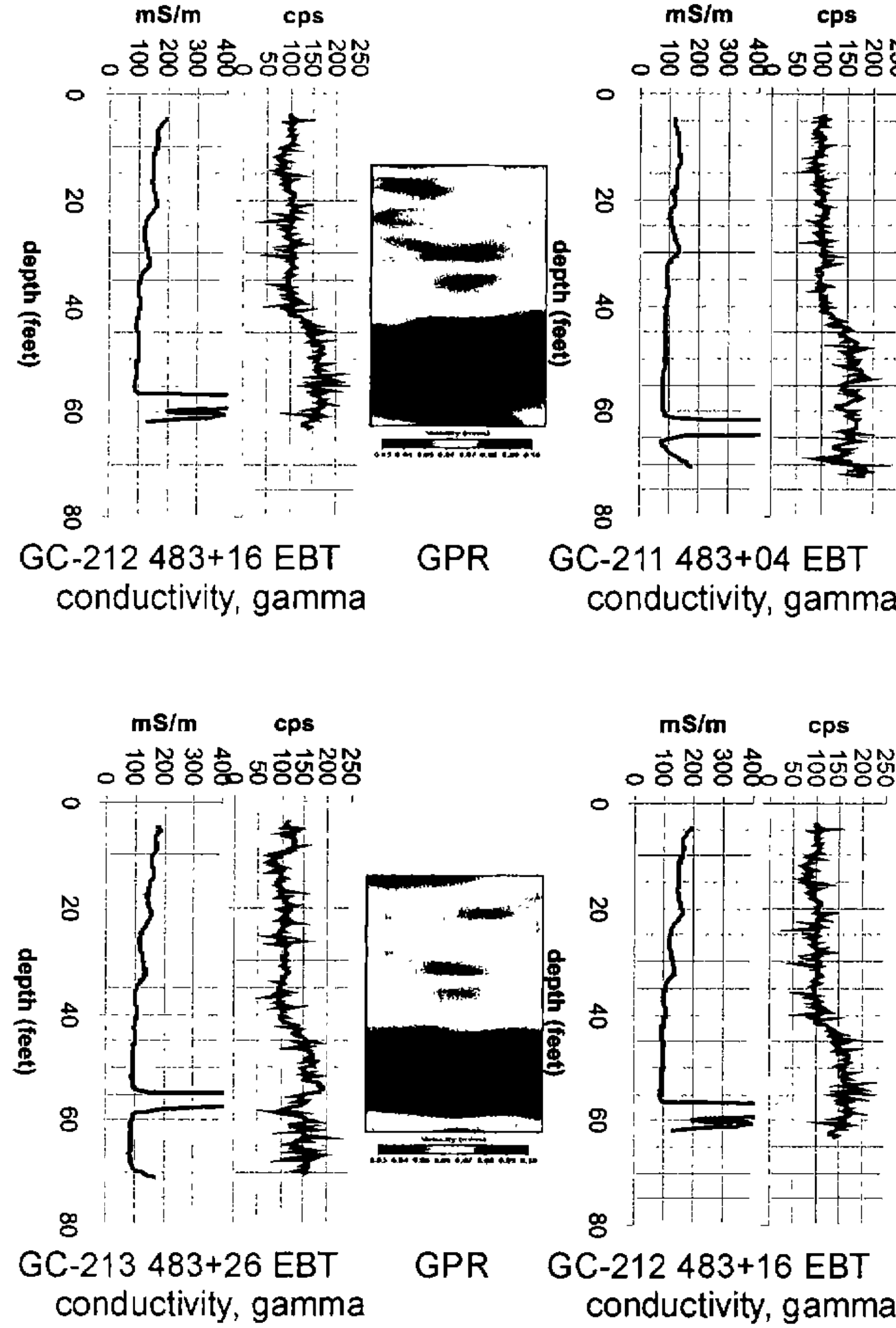


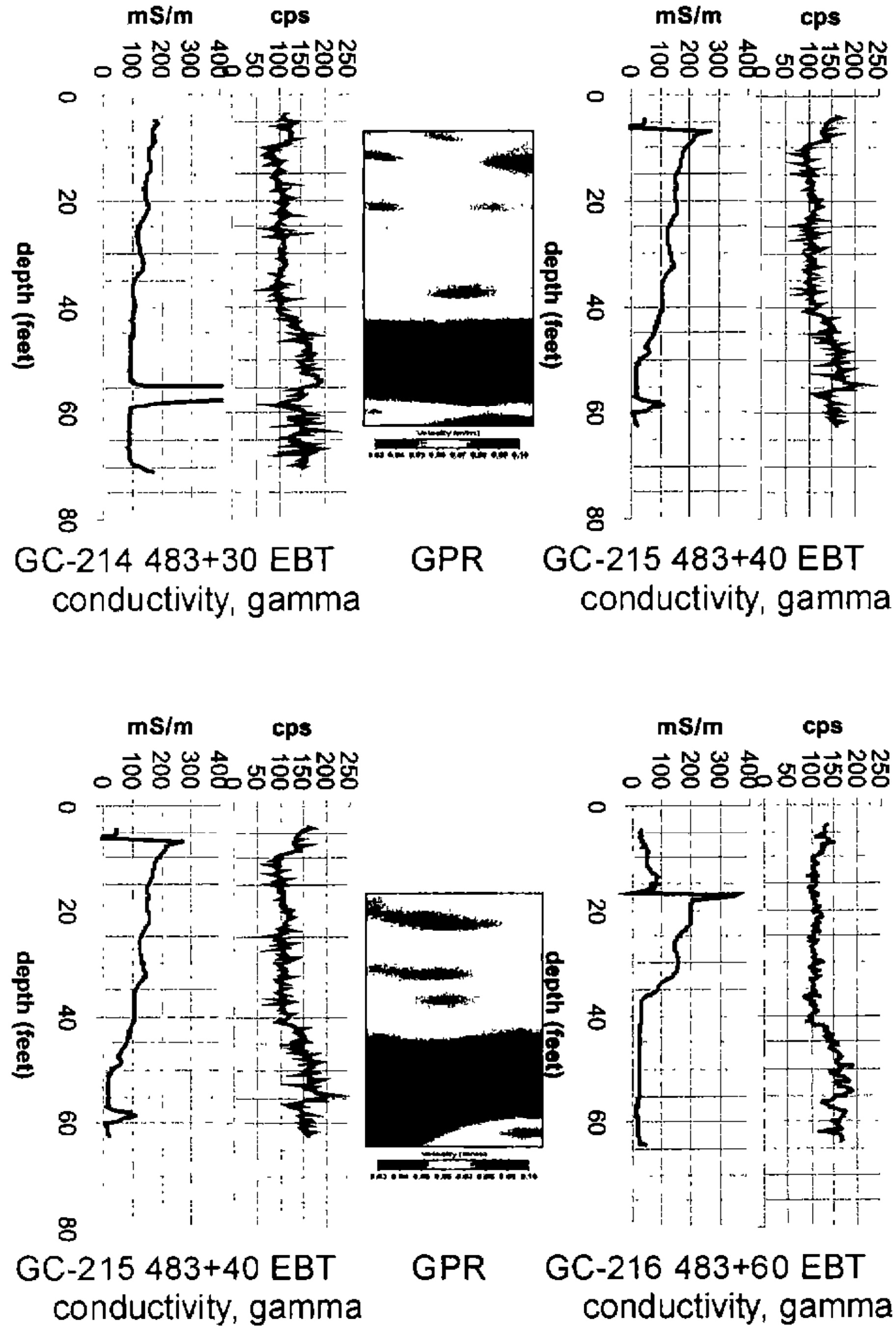
FIGURE 36. Gamma ray, conductivity, and GPR tomogram for cross-hole pairs GC-204 and 203, and GC-205 and 204.



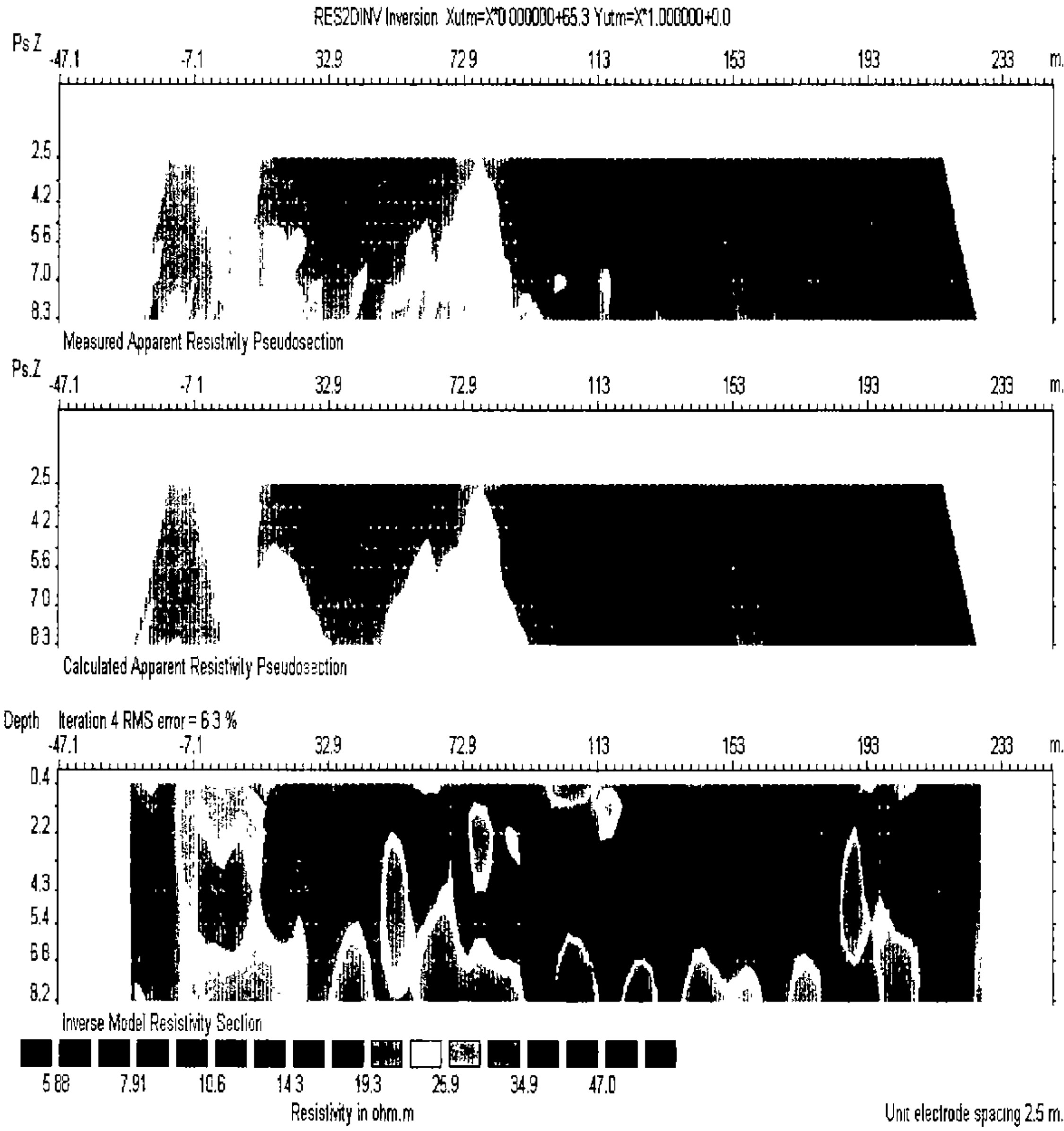
. **Gamma ray, conductivity, and GPR tomogram for cross-hole pairs GC-205 and 206, and B-407G and 407H.**



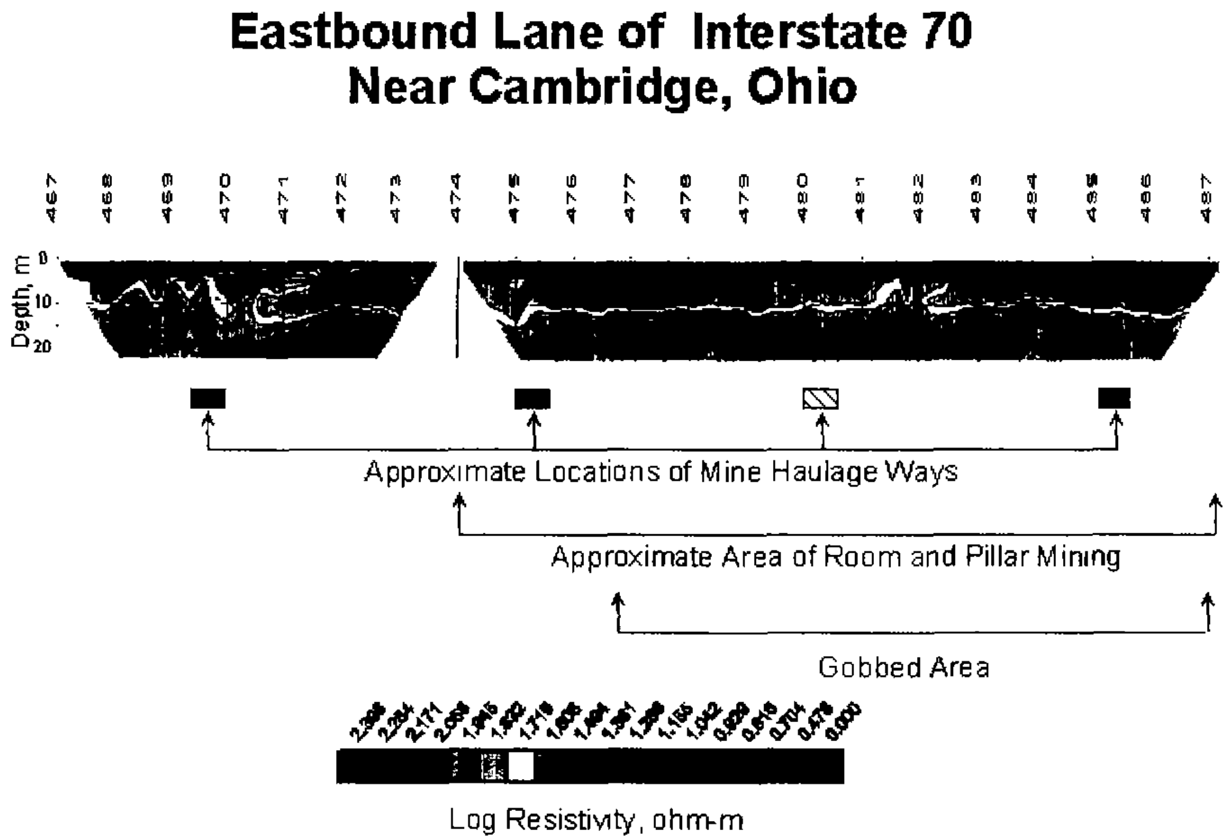
Gamma ray, conductivity, and GPR tomogram for cross-hole pairs GC-212 and 211, and GC-213 and 212.



Gamma ray, conductivity, and GPR tomogram for cross-hole pairs GC-214 and 215, and GC-215 and 216.



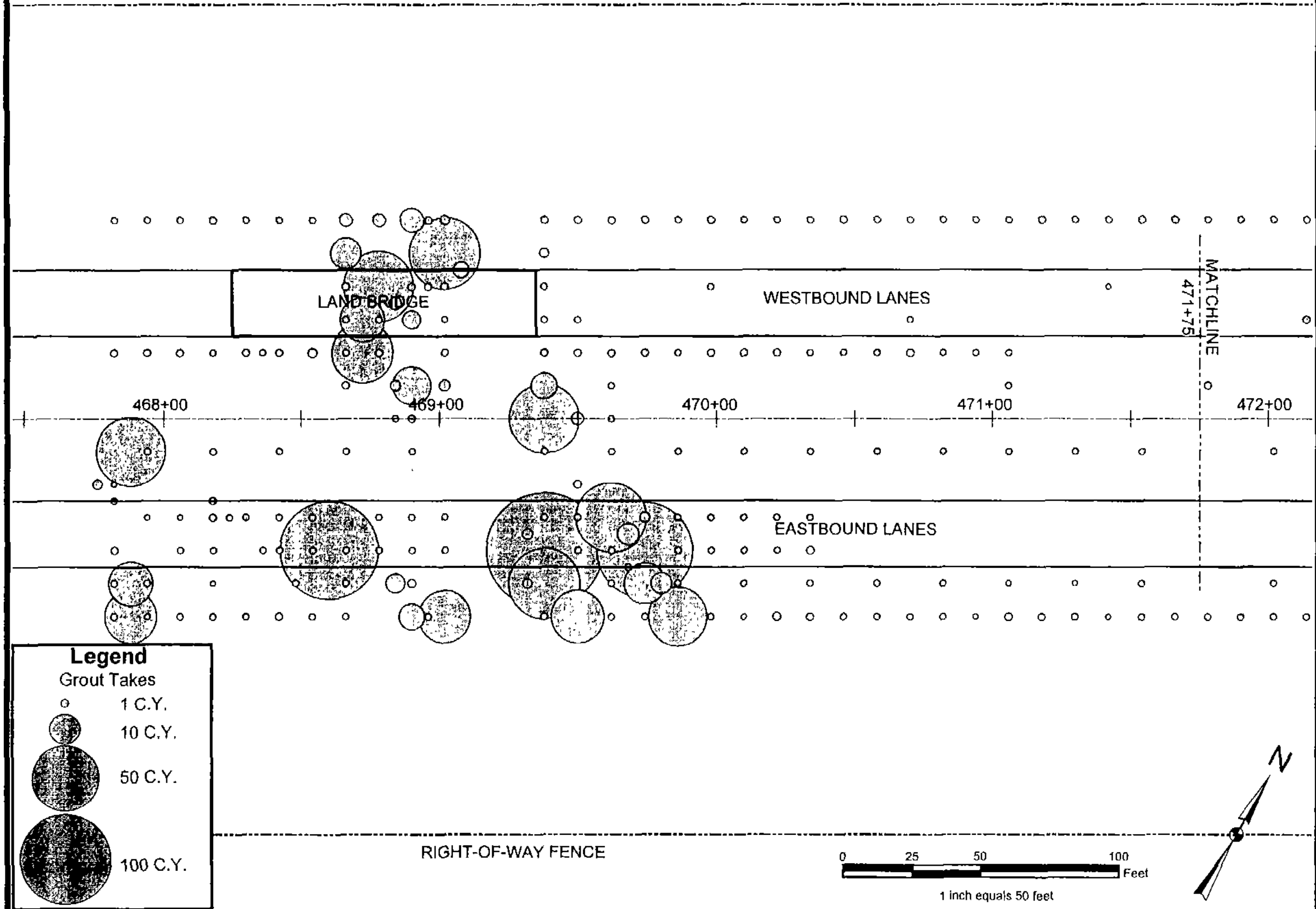
Results of Ohm-mapper survey across the remediated section along the eastbound travel lane of I-70.



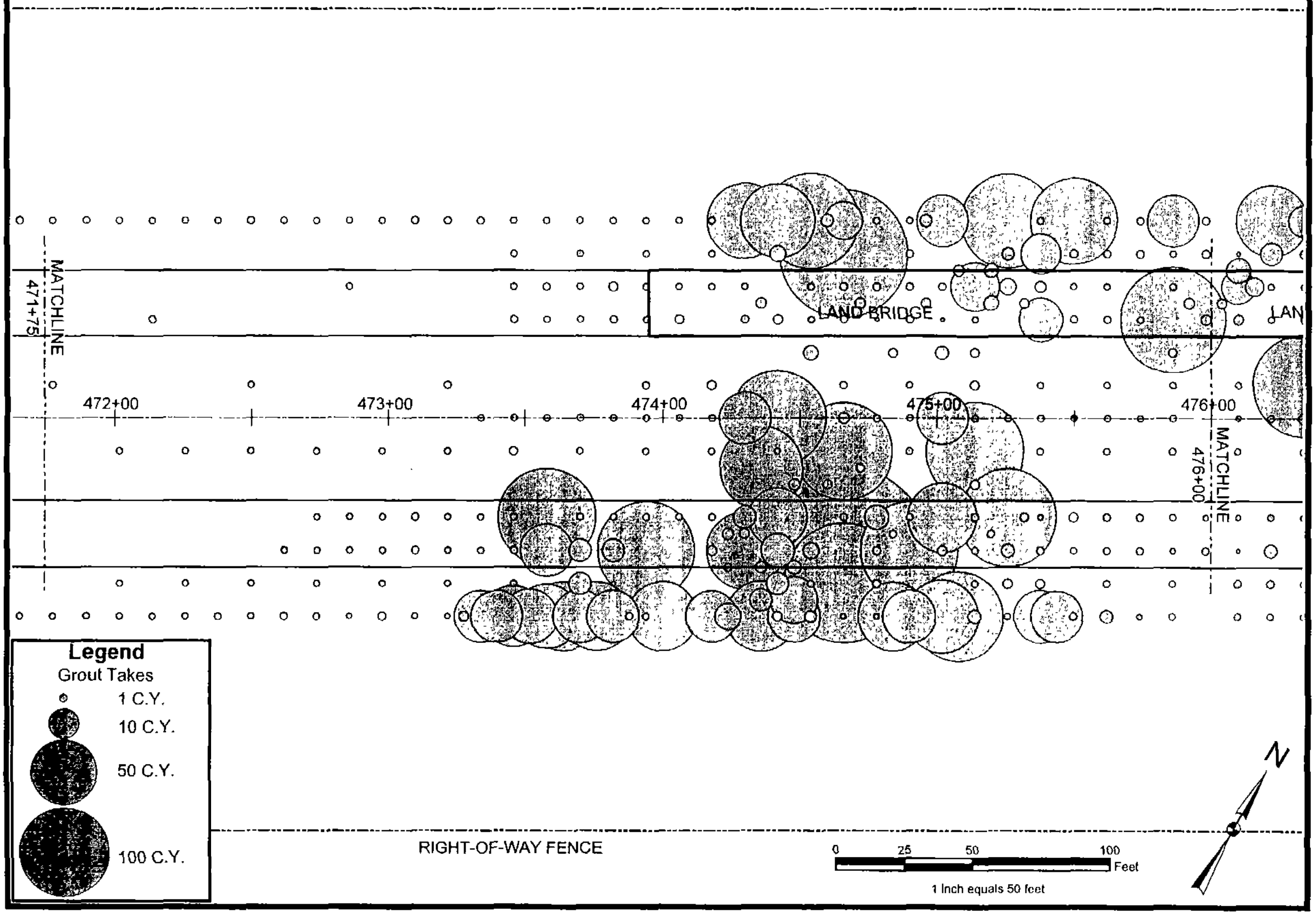
Results of Sting resistivity survey along the travel lane of I-70. Data and inversion courtesy of Richard W. Hammack, National Energy Technology Laboratory, U.S. Dept. of Energy, Pittsburgh, PA

SECTION 9.5 - CONSTRUCTION GROUT DATA

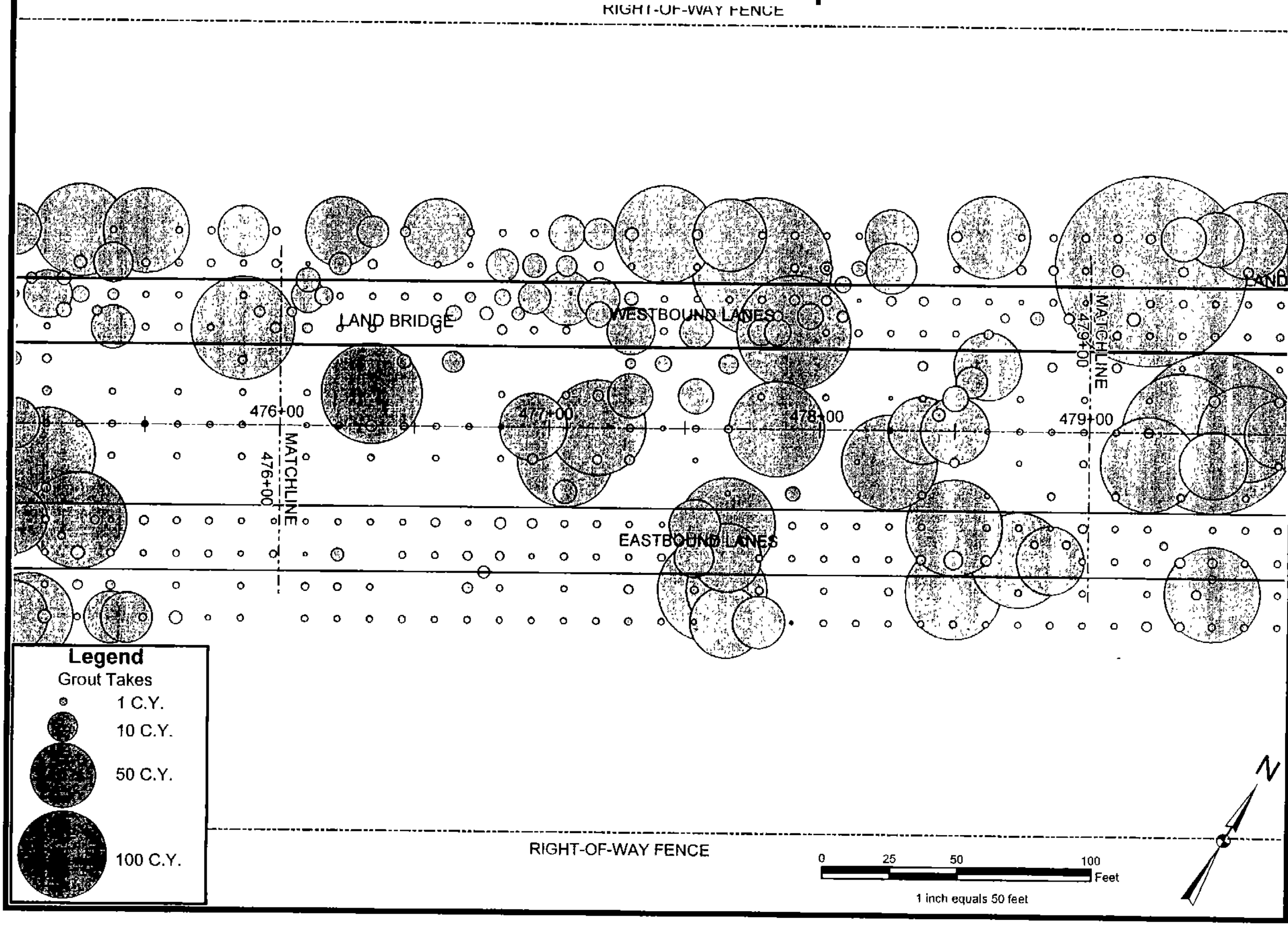
Grout Placement Map



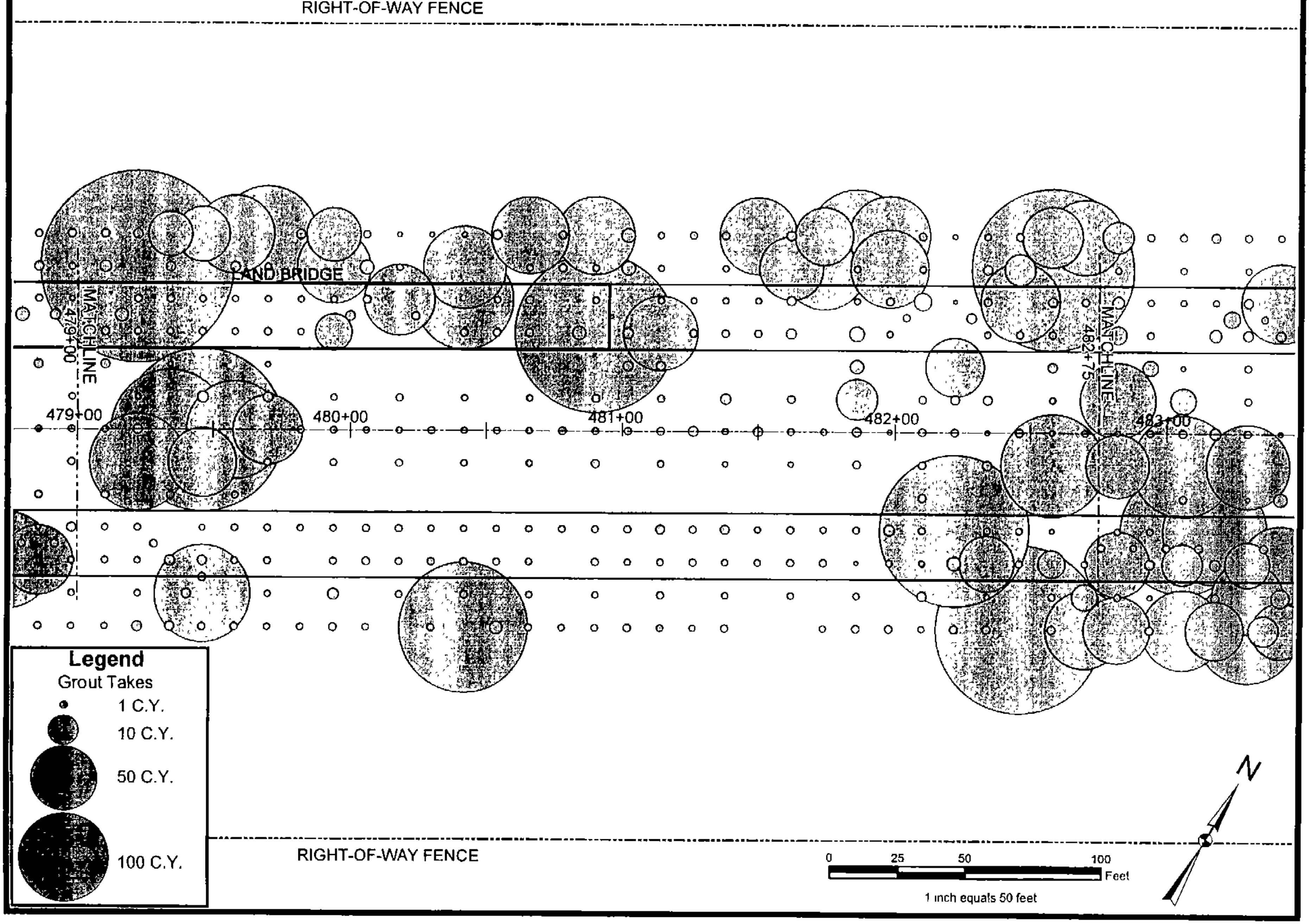
Grout Placement Map

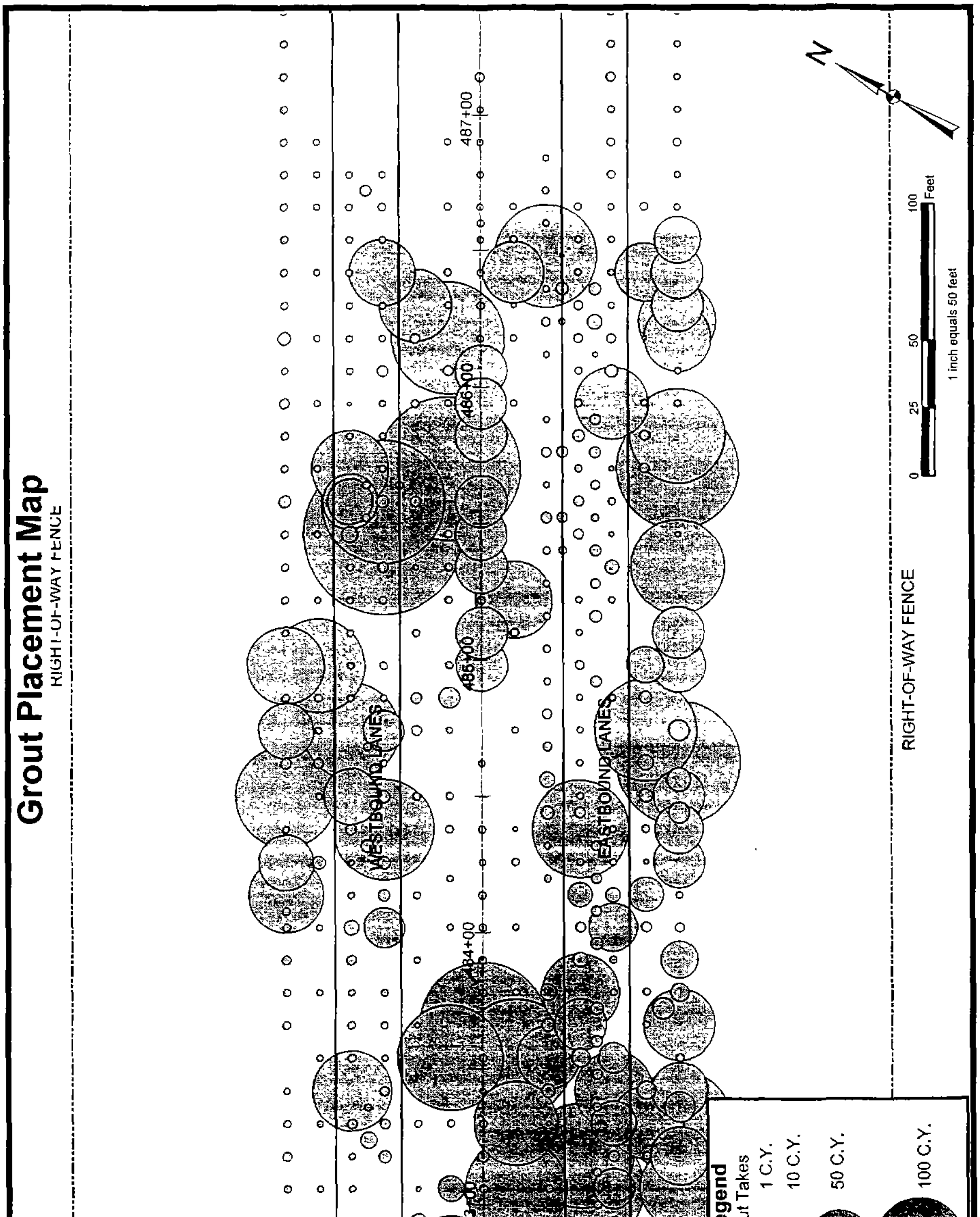


Grout Placement Map

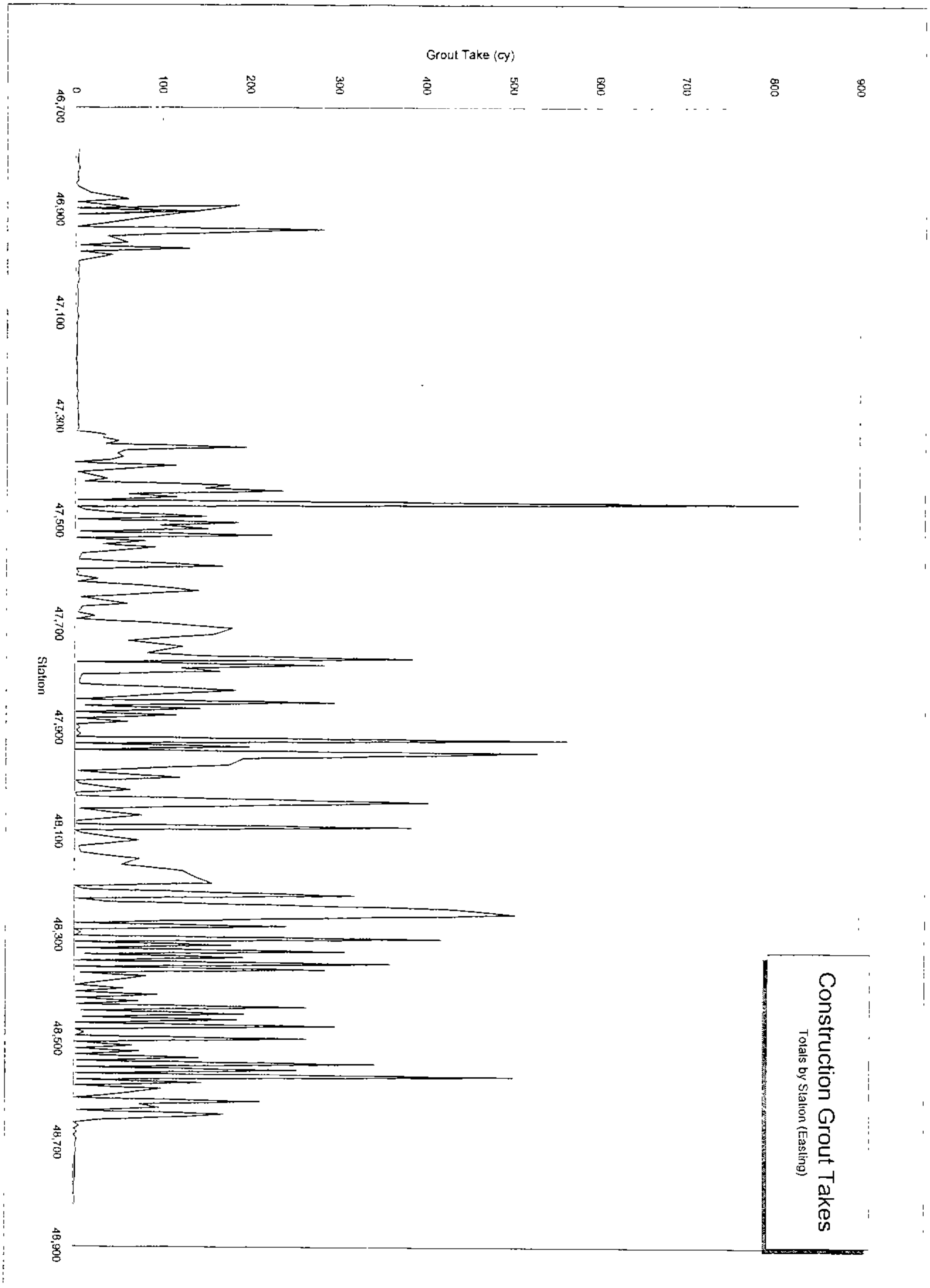


Grout Placement Map





Grout Placement Map
RIGHT-OF-WAY FENCE
WESTBOUND LANES
EASTBOUND LANES
RIGHT-OF-WAY FENCE
MATCHLINE
482+75
483+00
484+00
485+00
486+00
487+00
Legend
Grout Takes
1 C.Y.
10 C.Y.
50 C.Y.
100 C.Y.
N
0
25
50
100
Feet
1 inch equals 50 feet


Construction Grout Takes
Totals by Station (Easting)
Grout Take (cy)
0
100
200
300
400
500
600
700
800
900
Station
46,700
46,900
47,100
47,300
47,500
47,700
47,900
48,100
48,300
48,500
48,700
48,900

Construction Grout Takes
Gue-70-14.10

Grout Takes are shown as Cubic Yards

Northing / Easting	-72	-66	-60	-54	-48	-42	-36	-30	-24	-18	-12	-6	0	6	12	18	24	30	36	42	48	54	60	66	72	Totals
46,782	0.5		0.5		0.7			0.5	0.5								0.7								0.5	4
46,794	0.5		0.5				0.5				0.5						0.7								0.5	3
46,806	0.5				0.5		0.5										0.7								0.5	3
46,818	0.5		0.5		0.5		0.7	0.7			0.6						0.5								0.7	5
46,830	0.5						0.5										0.7								0.5	2
46,842	0.7				0.5		0.5				0.5						0.7								0.5	3
46,848			0.5																							1
46,854	0.5				0.5		0.5										1.0								0.5	3
46,866	0.5		0.5		0.5						0.5				0.7		0.5		0.5		0.7		11.0		2.0	18
46,878					0.5		0.5										0.7		0.5		57.1				2.0	61
46,884																				1.9						2
46,890	8.0		0.9		0.5		0.5				0.5		0.7		18.0		0.0		4.2		0.7				7.0	41
46,902	32.0				0.5		0.5								1.5		0.7		0.5		0.7		60.0		1.0	97
46,908																						2.9				3
46,902	32.0		23.0		0.5		0.5		1.2		56.6		0.7		0.5		0.5		1.7		24.6		0.3			142
46,896																				1.6						2
46,890	0.5		4.7		112.0								0.5		1.3		44.0		23.5		0.7				0.7	188
46,932			1.0			1.3																				2
46,938	0.6		58.0		156.0		0.5				0.5		56.0		8.0		0.7		0.5		0.5		1.0		0.7	283
46,950	32.0				0.5		0.5		0.8				1.7				0.7		0.5						0.7	37
46,962	0.5		0.5		0.5		56.0				0.5		0.5		0.5		0.7								0.7	61
46,968				0.5		5.3																				6
46,974	0.5		20.0		108.0		1.1										0.7								0.7	131
46,980			5.3																							5
46,986	39.5		0.5		0.5		0.5				0.5						0.5								0.5	43
46,998	0.5				0.5		0.5										0.7				0.5				0.7	3
47,010	0.5		0.5		0.5		0.5				0.5						0.7								0.5	4
47,022	0.9				0.5		0.5										0.7								0.5	3
47,034	0.7		0.5		0.8		0.5				0.5						0.5								0.5	4
47,046	0.5																0.5								0.7	2
47,058	0.5		0.5								0.5						0.5								0.5	3
47,070	0.5																0.8		0.5						0.5	2
47,082	0.5		0.5								0.5						0.5								0.5	3
47,094	0.5																0.5								0.5	1
47,106	0.8		0.5								0.5				0.5		0.5								0.5	3
47,118	0.6																								0.7	1
47,130	0.6		0.5								0.5														0.5	2
47,142	0.4																				0.3				0.5	1
47,154	0.5		0.5								0.5														0.7	2
47,166	0.5																								0.7	1
47,178	0.5														0.7										0.5	2
47,190	0.5																								0.5	1
47,202	0.5		0.5								0.5														0.5	2
47,214	0.5																		0.7						0.5	2
47,226	0.5		0.5								0.5														0.5	2
47,238	0.6																								0.5	1
47,250	0.5		0.5								0.5				0.5										0.7	3

Construction Grout Takes
Gue-70-14.10

Grout Takes are shown as Cubic Yards

Northing / Easting	-72	-66	-60	-54	-48	-42	-36	-30	-24	-18	-12	-6	0	6	12	18	24	30	36	42	48	54	60	66	72	Totals
47,262	0 7				0.5																				0.5	2
47,274	0 6		0 5		0.5		0 5				0.5														0.5	3
47,286	0 5				0 5		0.5														0.5				0.5	3
47,298	0.9		0 5		0 5		0 5				0.5														0.5	4
47,310	0.5				0.8		0.8																		0.8	3
47,322	0 5		0.5		0.5		0.5				0 5				0 7										0.7	4
47,328	1.2																									1
47,334	32.7				0.5		0.5						0.5												0.7	35
47,340	32.0																									32
47,346	45 3		0.5		0.6		0.5				0.9		0 5						0.7		0.5		0.5		0 5	51
47,352	35.3																									35
47,358	49.3				32.0		112.0						0.5						0 5		0.7				0.5	196
47,364	57.3																									57
47,370	33.3		6.0		6.0		0.5				0.5		0.6						0.5		0.5		0.5		0.5	49
47,376	56.5																									57
47,382	32.7		0.2		6.0		0.5						0.5						0.7		1.0				0.5	42
47,388	0.6																									1
47,394	0.5				111 0		0 5				0 5		0.5		0 7				0.5		0.5		0.5		0.5	116
47,400	57.0																									57
47,406							0.5						0.5						1.0		0.5				0.5	3
47,418	32.0				1.0		0.6				0.5		0.6		1.0						0 5		0.5		0.5	37
47,424	8.3			0.8		1.5																				11
47,430					70.0	1.0	6 0						32 0						0.8		0.5				67 0	177
47,436	59 0	6 0		1 5						81 0										1.4						149
47,442	1.0		6.0		13.0		40.0				0 4		108.0						1 2				3 0		65.0	238
47,448	32.0	26.0		2.3					1.5																	62
47,454	1.5		0.5		3.0												2.5		0.5		0.5				108.0	117
47,460									1.0																1.8	3
47,466	0 3		168 0		336 0		0 6				112.7		1 4		0.7				0.7		0 7		192.0		17.0	830
47,472										0 8										1 3						2
47,478	0.3		0.8		0 9		7 0						0 6						0.3		0 7				0.5	11
47,484	56.0					0.7											1 0									58
47,490	33.5				112.0		0.5				0.6		0.5		0.5				0.7		0 7		0 7		0.5	150
47,496																				1.3					1.7	3
47,502	63.5				1 0		56.0						32.0				2.2		0.3		0.7				32.0	188
47,508	97.0																					1.5				99
47,514	2.0		0.5		0.5		0.7		1.0		115 5		0.5		1 0		1.0		0.5		28.5					152
47,520						0.7														2.5		2 4				6
47,526	0 5		1 2		2 0		112.0						0.5								3.3		1 7		104 0	225
47,532							0.9													1.2						2
47,538	33 5		1 0		0 7		0 3				0.6		0.6		0.5				23.5		1.5		18.8		0.5	81
47,544	32.0																									32
47,550	0.7				0.5		1.0						0 5						0.7		0.5		0.8		88.0	93
47,562	2.1		0.6		0.6		0.7				0 5		0 5		0.5				0 7		0.5		0.7		0.5	8
47,574	0.5				0.7		0 7						0.5						0.5				0.8		0 7	4
47,586	0.5		0.5		0 5		0 5				0.6		0.6		0.5		0.9		132.0		0.5		0.5		32.0	170
47,592																				1.4						1

Construction Grout Takes
Gue-70-14.10

Grout Takes are shown as Cubic Yards

Northing / Easting	-72	-66	-60	-54	-48	-42	-36	-30	-24	-18	-12	-6	0	6	12	18	24	30	36	42	48	54	60	66	72	Totals
47,598					0.7		0.5												1.3				0.9		0.8	4
47,604																				1.1						1
47,610	0.6		0.8		0.2		0.5				0.5		0.5		0.5				1.3		14.0	7.5	0.3			27
47,616																					4.0					4
47,622	0.5		0.8		2.1		0.5						0.5						0.5		0.5		5.9		60.0	71
47,634	0.5		0.5				0.5				0.6		1.5		123.7				0.7		0.5		1.0		12.0	142
47,646	0.7				0.7		0.5						0.6				2.3				0.7				1.3	7
47,658	0.5				0.6		1.0				0.5		0.5						0.7		0.7		0.5		56.0	61
47,664																	5.7			3.0						9
47,670	0.6		1.4		1.0		0.5						0.5								1.3		0.3		0.7	6
47,676				1.8																2.3						4
47,682	0.5		0.6		1.0		1.8				0.5		0.3		0.5				1.3		3.3		13.0		0.7	24
47,688																				2.1						2
47,694	0.5				0.5		1.3				1.2		56.5						0.7		13.3		7.0		0.7	82
47,706	0.5		0.5		0.7		0.7		6.7		112.7				0.7				0.7		37.0		5.0		16.0	181
47,718	0.6				0.5		0.7				1.0		112.5		1.4					7.8	21.5		1.0		11.8	159
47,730	0.7		1.0		0.5		0.5				1.2		0.7		24.0		1.3		27.5		2.3		0.5		2.0	62
47,742	0.5				0.8		0.4						0.3				3.2		0.7		0.5				118.0	124
47,754	0.3		0.7		19.0		32.0				0.3		0.6		15.5				13.5		0.5		0.5		1.3	84
47,760			135.0			0.8																				136
47,766	64.5		80.0		57.0		112.0		0.3				0.9				4.7				0.5				65.0	385
47,772						0.8														1.8						3
47,778	33.5		0.7		0.6										0.5				8.5		0.7		239.0		0.7	284
47,784													112.0						8.7	1.2						122
47,790	0.2				0.5		0.7		2.5										160.0		1.3		0.8		0.8	167
47,796																				8.3						8
47,802	0.6		0.5		0.5		0.5								0.5				0.5		1.3		1.8		0.5	7
47,808																				1.6		3.5				5
47,814	0.6				0.5		0.5		0.5		0.3								0.7		0.2		2.7		0.5	6
47,826	0.5		0.8		0.5		0.5				113.0		0.3		0.2				0.5		1.2		32.0		35.0	185
47,838	0.5				1.0		0.5		0.7				56.0				1.2		0.5		1.0					61
47,844														1.8												2
47,850	0.6		112.0		4.1		112.0				1.0		56.0		8.0				0.5		0.7		0.5		1.3	297
47,856																11.8										12
47,862	0.5				1.3		0.6		0.3				0.3				56.0		1.0		0.5				83.3	144
47,868																				1.0						1
47,874	0.5		0.5		112.0		0.5				0.4		0.5		0.5						0.3		1.0		0.5	117
47,880						0.7														2.2						3
47,886	0.7				56.0		0.3		0.8				0.5				1.0				0.7		1.0		0.7	62
47,892						0.8														1.3						2
47,898	0.5		0.5		0.5		1.0				0.7		0.6		0.5						0.3		0.5		0.8	6
47,904																				2.3						2
47,910	0.5				0.6		0.5		0.8				0.5				1.0		0.8				1.5		0.8	7
47,916																				2.0						2
47,922	1.3		0.5		0.5		0.6				112.5		1.0		0.5				0.5		0.7		444.0		1.0	563
47,928						0.8																				1
47,934	1.0				1.3				0.7				171.7				0.3		0.5		0.7		1.0		24.0	201

Construction Grout Takes
Gue-70-14.10

Grout Takes are shown as Cubic Yards

Northing	-72	-66	-60	-54	-48	-42	-36	-30	-24	-18	-12	-6	0	6	12	18	24	30	36	42	48	54	60	66	72	Totals
Easting																										
47,940			1.0																							1
47,946	0.7		112.0	0.8	1.0		0.5				56.7		318.5		1.5				0.7		0.5				36.0	529
47,958	0.7				0.5		0.6		0.5				115.0						0.5		0.5		1.2		74.0	194
47,970	0.5		0.5		0.6		0.6				0.6		56.8		1.2		0.5		0.7		0.5		0.5		114.0	177
47,982	0.6						0.5						0.6						0.5		0.5				1.0	4
47,994	0.9		1.5		0.6		0.5				0 6		0.6		0.5				16.0		0.5		64.8		35 0	122
48,000																				1.2						1
48,006	0.6				0.9		0.7						0.5								0.8		2 5		0.7	7
48,018			0.6		0.6		0.7				0.7		0.5		0.7						61.0		0.5		0.3	66
48,024																				0.8						1
48,030	0.6				0.7		0.5						0.7												0.3	3
48,042	201.7		0 6		0.7		0.5				0.5		0.5		0.5				0 7		116 5		81.5		0.3	404
48,054	1.8				0.6		0.5						0.6						0.7		0 5				1.0	6
48,066	0.6		0.5		0.5		0.5				0.5		0.5		0.5				0.7		0.8		0.5		72.0	78
48,078	0.5						0.6						0.8										0.8		0.7	3
48,084																			2.0							2
48,090	0.6		0.5		0.7		0.6				0.9		0 6		0 7				304 0		0.5		0.5		74 0	384
48,096																				0.2						0
48,102	0.8				0.5		0.7						0.7				1.2		1.3				2.2		2.2	10
48,114	0.6		0.7		0 6		1.0				0.6		0 8		0.7		1.0		67.0		0 5		0.5		0.5	74
48,126	0.5				0.7		0.7						1.2						0 7		0.5				0.7	5
48,138	0.7		0.5		0.5		1.0				0.5		0.5		1.4				0.7		0 5		0 5		0.7	8
48,150					0.5		0.5						1 2						0.7		0 5				72.0	75
48,162			0.5		0.7		0.7				0.5		0.6		0.8				1.3		1 0		48.0		1.0	55
48,174	0.5				0.7		0.5						0 5										82.0		40.0	124
48,186	0 8		0 5		0.2		0.6				0.9		1 0		20 5		2 3		2.7		0.5		0.5		108.0	138
48,198	0 8				0.5		1.4						0 3						0 5		0.8		74 0		80.0	158
48,204																				0 7						1
48,210	0.5		1 1		0 5		0 6		0.8		0.7		0.8		0.8						3.8		0.5		0 7	11
48,222	0.8				2 2		272.0						0.8		1 0		42 0				0 2				0 3	319
48,228																				1.3						1
48,234	0 8		0 3		36.0		0.5				1.0		0.3		1 0				0.5		0 8		1.0		0 5	43
48,246	336.0				0.6		0.5						0.8						0.6		76.0		11.7		0.7	427
48,258	0.8		0 6		9.0		0.3				128.5		0.3		0.5		1.2		0.6		1.0		316.7		44.0	503
48,270	72.3		7.8		0.5								0.5						0 4		0.7				68 0	150
48,276						0.7																				1
48,282	54.0		0.6		51.0		0.5				48.0		0.3		69.5				3 9		1.7		0.5		12 0	242
48,288						0.5																				1
48,294	0.8		0.3		1.0		0.5						0 5				3.0		0.6		0.5				0 7	8
48,300						0 7																				1
48,306	76.3				20.0		188.0		0.7		123.0		0.8		8.3		0.3				0.5		0.5		0.7	419
48,312						0.8																				1
48,318	40.5		0.8		1.4		132 0						1.6						1 8		0.5				1.0	180
48,324																				3.3						3
48,330	131.5		62.5		24.0				0.2		84.0		0.7		0.7		0.7		1 3		1.0		0.5		0 7	308
48,336	11 0					0.8														0.5						12
48,342	38.0		3.8		72 0				2.3				0.3						1.0		76.0				0.5	194

Construction Grout Takes
Gue-70-14.10

Grout Takes are shown as Cubic Yards

Northing / Easting	-72	-66	-60	-54	-48	-42	-36	-30	-24	-18	-12	-6	0	6	12	18	24	30	36	42	48	54	60	66	72	Totals
48,348						1.2																				1
48,354	0.8				11.0		4.0		48.0		162.0		0.7		132.5				0.5		0.7		0.5			361
48,360						1.5																				2
48,366	60.5		0.5				32.0		2.0				188.8				0.3		0.7		0.7				0.8	286
48,372		5.5				1.7																				7
48,378	4.0		0.7		0.5		72 0		3.3		0.5		0.7						0 7		0 5		0.5		0.7	84
48,390	17.0				0.7		2 7						0.8				0.5				1.2				1.0	24
48,396						1 7																				2
48,402	1.0		1.3		28.3		1.3				0.5		0.8		0.5				20.0		2.7		0.5		0.7	58
48,408						1.3																			0.7	2
48,414	0.6		14.3		2.5		7.5						0.8				0.7		1.7		0 5				68.0	97
48,420						1.3			0 7						0.5											3
48,426	32.0		0.3		0.5		0.5				0.7		0.5						1.8		0 3		2.0		36.0	75
48,432						1.0			0.5											1.7						3
48,438	28.0		0.8		0.5		112 0				0.3		0 7		0 8				120.0		1.3				0.5	265
48,444	5.0						1.3		2.0																	8
48,450	31.3		2 0				0.5								0.7		0.7		1.7		36.0		0 5		122.0	195
48,456	6.7								3.0																	10
48,462	180.7		2.5				0.5						0 5						0.5				1 2		1.3	187
48,468									1.0											0.7						2
48,474	5.2		122.5				0.5				0 5				0.5		1.3		20.0		111.0		0 5		36 0	298
48,480									1.3																	1
48,486			1 7		0 5		0.5								5.4		1.5		0.5		0 5		0 8		0.7	12
48,492						1.5			0.7																	2
48,498	35.7		16.0				1.0						32.5		0.7				0.8		0 5		106 0		72.0	265
48,504									0 8																	1
48,510	32.5						0.5				0 8		32 5				0.7				0 5				0.5	68
48,516						1.7			0.7																	2
48,522					0.5		0.5				71.0		0.8		0.7				0.7		0.5		0 5		0.7	76
48,528						1 2			0.5																	2
48,534	104 5				2 3								32.6		0 7		0 3		1.3		0.5				0 7	143
48,540						1.5		0.8	0.8																	3
48,546	0.3				0 3		1.3						32 3		0.7				304.0		3.0		0.5		0 7	343
48,552						0.7		1.3	1.5											0.7						4
48,558					0.7		1.3						32 3				1 3		181.0		36.0				1.7	254
48,564						1.0			0.5									0.7		0.7						3
48,570	178.5		1.0		0.3		0.7								248.0				0.5		72.0		0.5		0.7	502
48,576						1 5		1 5	1.3																	4
48,582	108.7		1.2				1 7						32 7						0 5		0 5				0 8	146
48,588						1.3			0.5																	2
48,594	0.5		0.5		63.0		0.7				0.5		32.3		0.5		0.8		0.5		0 2		0 5		1.3	101
48,606	0.5				1.8		0 7						32.4		1.2				1 5		0.5				0.5	39
48,612						0 3			0.5																	1
48,618	53.5		0.3		1.0		1.0				0.5		0.5		152.1		1.0		0.5		0.5		0.5		2.0	213
48,624	72.0					2.5		0.5	1.0																	76
48,630	32.0				0.5		1.0				0 3		0.7		0.5		61.7		0.5		0 5				0.7	98
48,636						1.7		1.7	0.5																	4

6 of 6

Construction Grout Takes
Gue-70-14.10

Grout Takes are shown as Cubic Yards

Northing / Easting	-72	-66	-60	-54	-48	-42	-36	-30	-24	-18	-12	-6	0	6	12	18	24	30	36	42	48	54	60	66	72	Totals
48,642	32.0		40.0		0 5		0.5				44 5		0.5		0.7				52.0		0.5		0.5		0.7	172
48,648								0.2	125.0																	125
48,654	26.0				0.5		0.5				0.5		0.5						0.5		0.5				0.7	30
48,660									0.5																	1
48,666	0.5		0.8		0.5		0.7				0.5		0.5		0 7				0.8		0.5		0.5		0.7	7
48,672									0.7																	1
48,678	0.5				0.8								0.5						0.5		0.5		0.5		0 7	4
48,684									0.5																	1
48,690	0.8				0 8								0.5		0.5								0.5		0.7	4
48,702	0.5				0.6								0.5												0.7	2
48,714	0.5				1.0								1.0												0.7	3
48,726	0.5				0.7																				0.7	2
48,738	0.5				0.9																				0.7	2
48,750	0.5				0 5																				1.0	2
48,762					0 9										0.5										1.0	2
48,774					0 6																				0.7	1
48,786					0 6																				0.7	1
48,798					0 5																				0.7	1
48,810					0 8																				0.7	1
48,822							0.6																		0.7	1
Totals	3,201	38	1,050	8	1,709	42	1,541	7	221	82	1,379	0	1,789	2	874	12	267	1	1,556	62	861	18	1,864	0	2,260	18,844

Construction Grout Types
Gue-70-14.10

Grout Types

1	Barrier	10% cement 65% flyash 25% sand with #57 gravel 4-6" slump
2	Production / Tremmie	10% cement 65% flyash 25% sand 6-9" slump
3	80/20 / Pillar / Pressure / Duplex	80% cement 20% flyash (variable mix to 20% cemnet 80% flyash)

Northing / Easting	-72	-66	-60	-54	-48	-42	-36	-30	-24	-18	-12	-6	0	6	12	18	24	30	36	42	48	54	60	66	72
46,782	3		3		3			3	3								3								3
46,788																									
46,794	3		3				3				3						3								3
46,800																									
46,806	3				3		3										3								3
46,812																									
46,818	3		3		3		2	3			3						3								3
46,824																									
46,830	3						3										3								3
46,836																									
46,842	3				3		3				3						3								3
46,848			3																						
46,854	3				3		3										3								3
46,860																									
46,866	3		3		3						3				3		3		3		3		3		3
46,872																									
46,878					3		3										3		3		3				3
46,884																				3					
46,890	1		3		3		3				3		3		3		3		3		3				1
46,896																									
46,902	1				3		3								3		3		3		3		3		1
46,908																						3			
46,902	1		2		3		3		2		2		3		3		3		2		3		3		
46,896																				2					
46,890	3		2		2								3		3		3		3		3				3
46,932			2			3																			
46,938	3		2		2		3				3		2		3		3		3		3		3		3
46,944																									
46,950	1				3		3		2				3				3		3						3
46,956																									
46,962	3		3		3		2				3		3		3		3								3
46,968				3		3																			
46,974	3		2		2		3										3								3
46,980			2																						
46,986	1		3		3		3				3						3								3
46,992																									
46,998	3				3		3										3				2				3
47,004																									
47,010	3		3		3		3				3						3								3
47,016																									
47,022	3				3		3										3								3
47,028																									
47,034	3		3		2		3				3						3								3
47,040																									
47,046	3																3								3
47,052																									
47,058	3		3								3						3								3
47,064																									
47,070	3																3		3						3
47,076																									
47,082	3		3								3						3								3
47,088																									
47,094	3																3								3
47,100																									
47,106	3		3								3				3		3								3
47,112																									
47,118	3																								3
47,124																									
47,130	3		3								3														3
47,136																									
47,142	3																				3				3
47,148																									
47,154	3		3								3														3
47,160																									
47,166	3																								3
47,172																									
47,178	3														3										3

Construction Grout Types
Gue-70-14.10

Grout Types

1 Barrier — 10% cement 65% flyash 25% sand with #57 gravel 4-6" slump
2 Production / Tremmie — 10% cement 65% flyash 25% sand 6-9" slump
3 80/20 / Pillar / Pressure / Duplex — 80% cement 20% flyash (variable mix to 20% cemnet 80% flyash)

Northing / Easting	-72	-66	-60	-54	-48	-42	-36	-30	-24	-18	-12	-6	0	6	12	18	24	30	36	42	48	54	60	66	72
47,184																									
47,190	3																								3
47,196																									
47,202	3		3								3														3
47,208																									
47,214	3																		3						3
47,220																									
47,226	3		3								3														3
47,232																									
47,238	3																								3
47,244																									
47,250	3		3								3				3										3
47,256																									
47,262	3				3																				3
47,268																									
47,274	3		3		3		3				3														3
47,280																									
47,286	3				3		3														3				3
47,292																									
47,298	3		3		3		3				3														3
47,304																									
47,310	3				3		3																		3
47,316																									
47,322	3		3		3		3				3				3										3
47,328	2																								
47,334	1				3		3						3												3
47,340	1																								
47,346	1		3		3		3				3		3						3		3		3		3
47,352	1																								
47,358	1				2		2						3						3		3				3
47,364	1																								
47,370	1		2		2		3				3		3						3		3		3		3
47,376	1																								
47,382	1		2		2		3						3						3		3				3
47,388	2																								
47,394	3				2		3				3		3		3				3		3		3		3
47,400	1																								
47,406							3						3						3		3				3
47,412																									
47,418	1				3		2				3		3		3						3		3		3
47,424	2			3		3																			
47,430					2	2	2						1						3		3				1
47,436	1	3		3						3										2					
47,442	2		2		2		2				2		2						3				2		1
47,448	1	2		3					2																
47,454	2		2		2												2		3		3				1
47,460									2																3
47,466	3		2		2		3				2		3		3				3		3		2		1
47,472										2										2					
47,478	3		2		3		2						3						2		3				3
47,484	1					2											2								
47,490	1				2		3				3		3		2				3		3		3		3
47,496																				3					3
47,502	1				3		2						1				2		2		3				1
47,508	1																					3			
47,514	1		3		3		2		2		2		3		3		2		2		2				
47,520						2														2		3			
47,526	3		2		2		2						3								2		3		1
47,532							2													2					
47,538	1		2		3		3				3		3		3				2		2		2		3
47,544	1																								
47,550	3				3		3						3						3		3		2		1
47,556																									
47,562	3		3		3		3				3		3		3				3		3		3		3
47,568																									
47,574	3				3		3						3						3				2		3
47,580																									

Construction Grout Types
Gue-70-14.10

Grout Types

1	Barrier	10% cement 65% flyash 25% sand with #57 gravel 4-6" slump
2	Production / Tremmie	10% cement 65% flyash 25% sand 6-9" slump
3	80/20 / Pillar / Pressure / Duplex	80% cement 20% flyash (variable mix to 20% cemnet 80% flyash)

Northing / Easting	-72	-66	-60	-54	-48	-42	-36	-30	-24	-18	-12	-6	0	6	12	18	24	30	36	42	48	54	60	66	72
47,586	3		3		3		3				3		3		3		2		2		2		3		1
47,592																				2					
47,598					3		3												2				2		3
47,604																				2					
47,610	3		3		3		3				3		3		3				3		2	3	2		
47,616																					2				
47,622	3		2		3		3						3						3		2		2		1
47,628																									
47,634	3		3				3				3		3		2				3		3		2		1
47,640																									
47,646	3				3		3						3				2				3				3
47,652																									
47,658	3				3		3				3		3						3		3		3		1
47,664																	2			2					
47,670	3		3		3		3						3								2		2		3
47,676				3																2					
47,682	3		3		3		3				3		3		3				3		2		2		3
47,688																				2					
47,694	3				3		3				2		2						3		2		3		3
47,700																									
47,706	3		3		3		3		2		2				3				3		2		2		1
47,712																									
47,718	3				3		3				2		2		2					2	2		2		2
47,724																									
47,730	3		3		3		3				2		3		2		2		2		3		3		3
47,736																									
47,742	3				3		3						3				2		3		3				1
47,748																									
47,754	3		3		2		2				3		3		2				2		3		3		3
47,760			2			2																			
47,766	1		2		2		2		3				3				2				3				1
47,772						2														2					
47,778	1		3		3										3				2		2		2		3
47,784													2						2	2					
47,790	3				3		3		2										2		2		2		3
47,796																				2					
47,802	3		3		3		3								3				2		2		2		3
47,808																				2		2			
47,814	3				2		3		3		3								3		2		2		3
47,820																									
47,826	3		3		3		3				2		3		2				3		2		2		1
47,832																									
47,838	3				3		3		3				2				2		3		3				
47,844														2											
47,850	3		2		2		2				2		2		2				3		3		3		3
47,856																2									
47,862	3				2		3		3				3				2		2		3				1
47,868																				2					
47,874	3		3		2		2				3		3		3						2		3		3
47,880						2														2					
47,886	3				2		2		2				3				2				2		2		3
47,892						2														2					
47,898	3		3		3		3				3		3		3						2		3		3
47,904																				2					
47,910	3				3		2		3				3				2		2				3		3
47,916																				2					
47,922	3		3		3		3				2		3		2				3		2		2		3
47,928						2																			
47,934	3				2				2				2				2		3		3		2		1
47,940			2																						
47,946	3		2	3	2		3				2		2		2				3		3				1
47,952																									
47,958	3				3		3		3				2						3		3		2		1
47,964																									
47,970	3		3		3		3				3		2		3		2		3		3		3		1
47,976																									
47,982	3						3						3						3		3				3

Construction Grout Types
Gue-70-14.10

Grout Types

1	Barrier	10% cement 65% flyash 25% sand with #57 gravel 4-6" slump
2	Production / Tremmie	10% cement 65% flyash 25% sand 6-9" slump
3	80/20 / Pillar / Pressure / Duplex	80% cement 20% flyash (variable mix to 20% cemnet 80% flyash)

Northing Easting	-72	-66	-60	-54	-48	-42	-36	-30	-24	-18	-12	-6	0	6	12	18	24	30	36	42	48	54	60	66	72
47,988																									
47,994	3		3		3		3				3		3		3				2		3		2		1
48,000																				2					
48,006	3				3		3						3								2		2		3
48,012																									
48,018			3		3		3				3		3		3						2		3		3
48,024																				2					
48,030	3				3		3						3												3
48,036																									
48,042	2		3		3		3				3		3		3				3		2		2		3
48,048																									
48,054	3				3		3						3						3		3				3
48,060																									
48,066	3		3		3		3				3		3		3				3		3		3		1
48,072																									
48,078	3						3						3										2		3
48,084																			2						
48,090	3		3		3		3				3		3		3				2		3		3		1
48,096																				3					
48,102	3				3		3						3				2		3				2		3
48,108																									
48,114	3		3		3		3				3		3		3		2		3		3		3		3
48,120																									
48,126	3				3		3						3						3		3				3
48,132																									
48,138	3		3		3		3				3		3		3				3		3		3		3
48,144																									
48,150					3		3						3						3		3				1
48,156																									
48,162			3		3		3				3		3		3				3		3		2		2
48,168																									
48,174	3				3		3						3										2		1
48,180																									
48,186	3		3		3		3				3		3		2		2		3		3		3		1
48,192																									
48,198	3				3		3						2						3		3		2		1
48,204																				2					
48,210	3		3		3		3		2		2		3		3						2		3		3
48,216																									
48,222	3				3		2						3		3		2				2				3
48,228																				2					
48,234	3		2		2		3				3		2		3				3		2		2		3
48,240																									
48,246	2				3		3						3						3		2		2		3
48,252																									
48,258	3		3		3		2				2		2		3		2		3		3		2		1
48,264																									
48,270	1		3		3								2						3		3				1
48,276						3																			
48,282	1		3		2		2				3		2		3				3		3		3		1
48,288						2																			
48,294	3		2		2		2						2				2		3		3				3
48,300						3																			
48,306	1				2		2		2		2		3		3		2				3		3		3
48,312						2																			
48,318	1		2		3		2						3						2		3				3
48,324																				2					
48,330	1		3		3				2		2		3		3		2		2		2		3		3
48,336	2					2														2					
48,342	1		2		3				2				2						2		2				3
48,348						2																			
48,354	3				3		3		2		3		2		2				3		3		3		
48,360						2																			
48,366	1		2				3		2				2				2		3		3				3
48,372		1				3																			
48,378	2		3		3		2		3		2		3						3		3		3		3
48,384																									

Construction Grout Types
Gue-70-14 10

Grout Types

1	Barrier	10% cement 65% flyash 25% sand with #57 gravel 4-6" slump
2	Production / Tremmie	10% cement 65% flyash 25% sand 6-9" slump
3	80/20 / Pillar / Pressure / Duplex	80% cement 20% flyash (variable mix to 20% cemnet 80% flyash)

Northing / Easting	-72	-66	-60	-54	-48	-42	-36	-30	-24	-18	-12	-6	0	6	12	18	24	30	36	42	48	54	60	66	72
48,390	1				3		2						2				2				3				3
48,396						2																			
48,402	1		2		2		2				2		2		3				2		3		3		3
48,408						2																			2
48,414	2		2		2		2						2				2		3		3				1
48,420						2			2						3										
48,426	1		2		2		2				3		2						3		2		2		1
48,432						2			3											2					
48,438	1		2		3		2				3		3		3				2		3				3
48,444	2						2		2																
48,450	1		2				2								3		2		3		3		3		1
48,456	2								2																
48,462	1		2				2						2						3				2		3
48,468									2											2					
48,474	2		2				3				3				3		2		3		2		3		1
48,480									2																
48,486			2		2		2								3		2		3		3		2		3
48,492						2			3																
48,498	1		2				2						1		3				3		3		2		1
48,504									3																
48,510	1						2				2		1				2				3				3
48,516						2			2																
48,522					2		2				2		3		3				3		3		3		3
48,528						2			3																
48,534	1				2								1		3		2		3		3				3
48,540						3		2	3																
48,546	3				2		2						1		3				2		2		3		3
48,552						2		2	2											2					
48,558					2		2						1				2		2		2				3
48,564						3			2									2		2					
48,570	1		2		3		2								2				3		2		3		3
48,576						2		2	2																
48,582	1		2				2						1						3		3				3
48,588						3			2																
48,594	3		2		2		3				2		1		3		2		3		3		3		3
48,600																									
48,606	3				2		3						1		3				3		3				3
48,612						2			3																
48,618	1		3		2		2				3		3		3		2		3		3		3		3
48,624	1					2		2	2																
48,630	1				2		2				3		3		3		2		2		3				3
48,636						2		2	3																
48,642	1		2		3		2				2		3		3				2		3		3		3
48,648								3	2																
48,654	1				3		3				2		3						3		3				3
48,660									2																
48,666	3		3		3		3				3		3		3				3		3		3		3
48,672									3																
48,678	3				3								3						3		3		3		3
48,684									3																
48,690	3				3								3		3								3		3
48,696																									
48,702	3				3								3												3
48,708																									
48,714	3				3								3												3
48,720																									
48,726	3				3																				3
48,732																									
48,738	3				3																				3
48,744																									
48,750	3				3																				3
48,756																									
48,762					3										3										3
48,768																									
48,774					3																				3
48,780																									
48,786					3																				3

Construction Grout Types
Gue-70-14.10

Grout Types

1	Barrier	10% cement 65% flyash 25% sand with #57 gravel 4-6" slump
2	Production / Tremmie	10% cement 65% flyash 25% sand 6-9" slump
3	80/20 / Pillar / Pressure / Duplex	80% cement 20% flyash (variable mix to 20% cemnet 80% flyash)

Northing	-72	-66	-60	-54	-48	-42	-36	-30	-24	-18	-12	-6	0	6	12	18	24	30	36	42	48	54	60	66	72
Easting																									
48,792																									
48,798					3																				3
48,804																									
48,810					3																				3
48,816																									
48,822							3																		3

GROUT MIXES

DEPTH	0-200	200-300	300-400	400-500	500-600	600-700
Col.Wgt. psi (Max)	202.6	303.6	405.2	506.5	607.8	709.1
Grout Compressive Strength psi	400	600	800	1000	1200	1500

GROUT MIXES FOR DRY MINES

	0-200	200-300	300-400	400-500	500-600	600-700
Cement(#)	282	86-47	376			257
Fly Ash(#)	1800	FLY ASH	450			184
Sand (#)	-0-		1764			1559
Water (gal.)	32		37.5			43

GROUT MIXES FOR WET (FLOODED) MINES

	0-200	200-300	300-400	400-500	500-600	600-700
Cement(#)	188			769		300
Fly Ash(#)	125	22		618		200
Sand(#)	1687	253		576		1500
Bentonite(#)	3.75	165		16		6
Water(gal)	34			48		54.7
Water Red. Agent	*			*		*
CaCl (Flake)	**			**		**
Sodium Silicate		Average use equals 18 oz. per cu.yd. of grout				

* Revert time on WRA should be less than 45 minutes

** CaCl Flake = 2% of Cement weight

*** To reduce foaming and enhance expansion for gas seal, use 1 pound of table salt for every 100 pounds of Cement

**** Sodium Silicate can be used in any environment to restrict excessive grout in large open voids.

WILLIAM C. MORRISON, P.E.
CIVIL ENGINEER

UNITED STATES DEPARTMENT OF THE INTERIOR
OFFICE OF SURFACE MINING
EASTERN TECHNICAL CENTER
DIVISION OF TECHNICAL SERVICES

TEN PARKWAY CENTER COMMERCIAL: (412) 937-

FLY ASH GROUT TESTING PROGRAM

	VARIABLES					ACTUAL QUANTITIES PER CUBIC YARD				FRESH PROPERTIES		COMPRESSIVE STRENGTH				
TRIAL BATCH NO.	FLY ASH SOURCE	CEMENT %	FLY ASH %	SAND %	BENTONITE lbs/yd³	WATER lbs.	CEMENT lbs.	FLY ASH lbs.	BENTONITE lbs.	FLOW sec.	UNIT WT. pcf	7 DAY psi	14 DAY psi	28 DAY psi	91 DAY psi	182 DAY psi
CV-5	CNSVL	5	95	0	4	833	118	2200	4	29.3	116.8	20	–	34	58	..
CV-7	CNSVL	7	93	0	4	846	166	2104	4	20.1	115.4	26	–	70	128	..
CV2-5	CNSVL	5	95	0	2.4	805	122	2268	2.4	32.1	118.2	16	..	48	62	
CV2-7	CNSVL	7	93	0	3.4	806	168	2180	3.4	32.3	116.8	19	..	95	174	
CV2-8	CNSVL	8	92	0	3.8	819	190	2183	3.8	31.4	118.2	35	74			
CV2-9	CNSVL	9	91	0	4.3	801	214	2159	4.3	33.3	117.5	28	–	155	370	

MATERIALS USED:

FLY ASH: CONESVILLE PONDED FLY ASH - CNSVL

CEMENT: MIAMI TYPE I
BENTONITE: QUICK GEL

FLY ASH GROUT TESTING PROGRAM

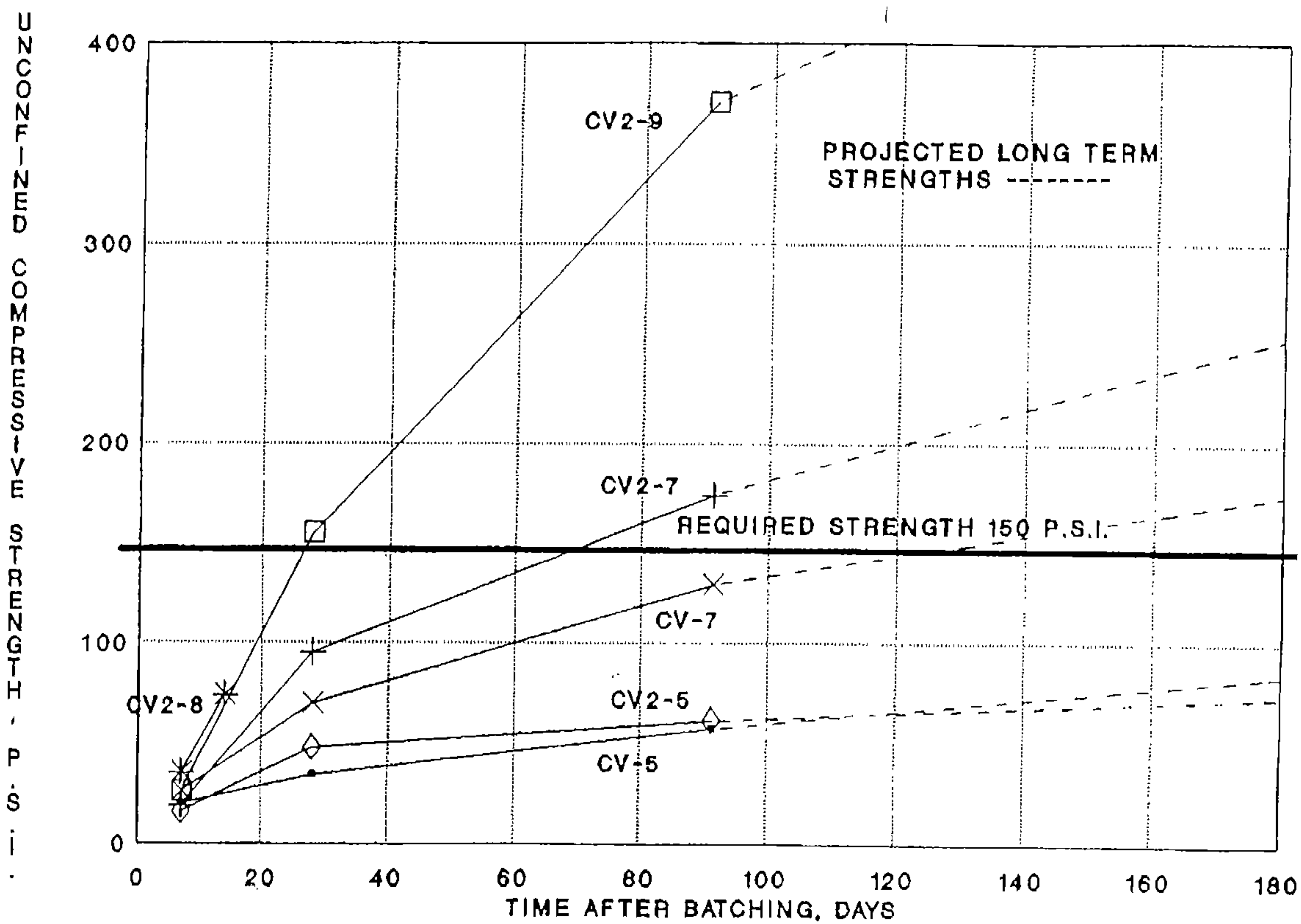
TRIAL BATCH NO.	FLY ASH SOURCE	VARIABLES: CEMENT %	FLY ASH %	SAND %	BENTONITE lbs/yd[3]	ACTUAL QUANTITIES PER CUBIC YARD: WATER lbs.	CEMENT lbs.	FLY ASH lbs.	SAND lbs.	BENTONITE lbs.	FRESH PROPERTIES: FLOW sec.	UNIT WT pcf	COMPRESSIVE STRENGTH: 3 DAY psi	7 DAY psi	28 DAY psi	77 DAY psi	91 DAY psi	182 DAY psi
CV5-85-10	CNSVL	5	85	10	2.4	788	122	2071	250	2.4	33.1	119.7	12	30	45	60		
CV5-75-20	CNSVL	5	75	20	2.5	761	128	1886	515	2.5	31.4	121.8	18	31	51	76		
CV5-65-30	CNSVL	5	65	30	2.7	697	133	1734	819	2.7	33.8	125.3	30	51	79	130		
CV5-55-40	CNSVL	5	55	40	2.8	634	142	1581	1162	2.8	34.2	129.6	50	85	131	238		
CV5-45-50	CNSVL	5	45	50	3.0	568	148	1329	1511	3.0	33.0	131.7	54	101	181	308		
																56 DAY psi		
CV7-85-8	CNSVL	7	85	8	3.5	781	174	2111	203	3.5	34.9	121.1	28	58	104	139		
CV7-75-18	CNSVL	7	75	18	3.6	733	182	1951	479	3.6	32.1	123.9	29	70	140	192		
CV7-65-28	CNSVL	7	65	28	3.8	681	189	1767	775	3.8	33.4	126.0	45	94	151	254		
CV7-55-38	CNSVL	7	55	38	4.0	631	199	1580	1105	4.0	32.8	129.6	78	135	234	360		

'- NON FLOWABLE. WATER AND CEMENT SEPARATES FROM SAND AS SOON AS MIXING STOPS UNABLE TO MAKE TEST SPECIMENS OR RUN TESTS.

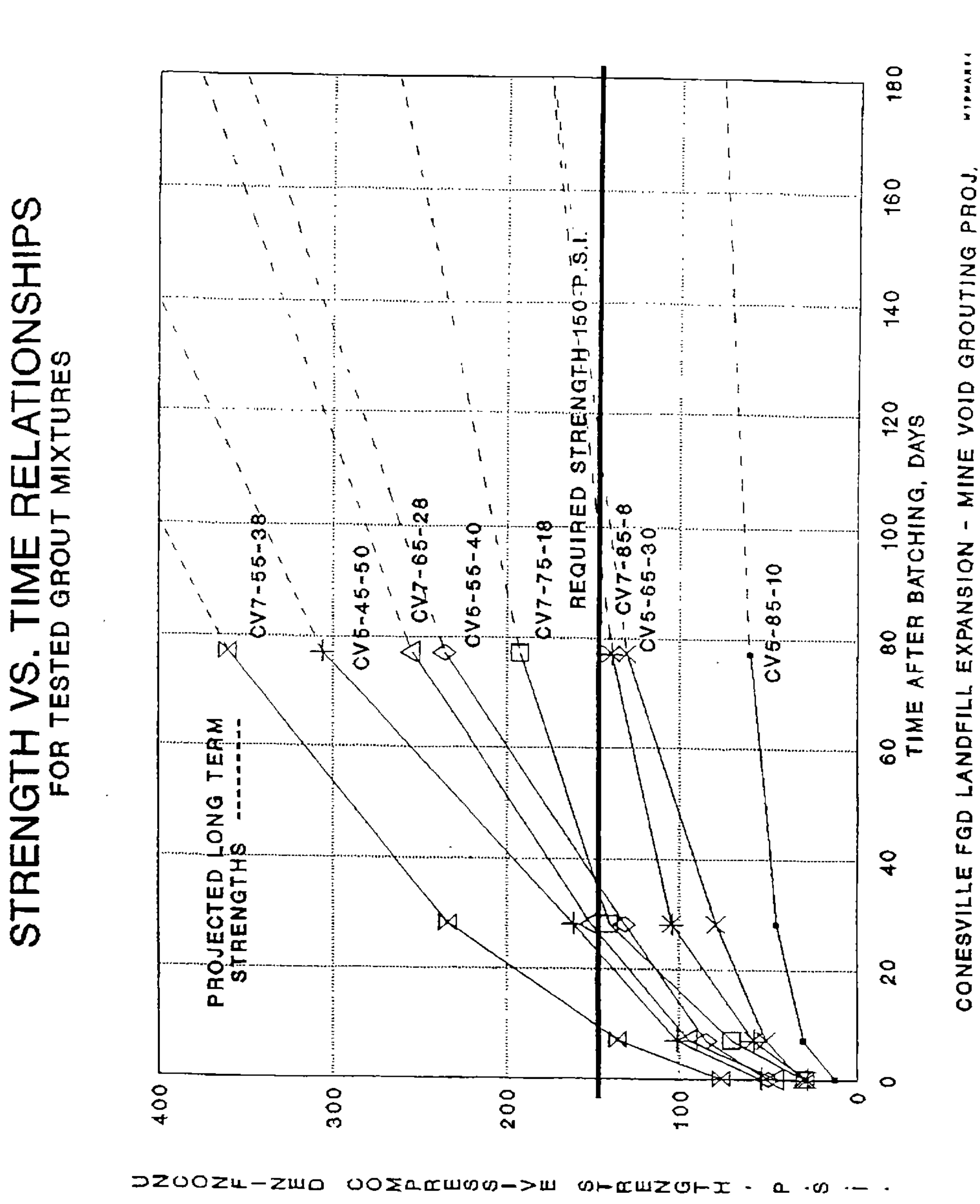
WEIGHT OF BENTONITE IS EQUAL TO 2% OF THE WEIGHT OF CEMENT.

MATERIALS USED: FLY ASH: CONESVILLE PONDED FLY ASH - CNSVL; CEMENT: MIAMI TYPE I; BENTONITE: QUICK GEL

STRENGTH VS. TIME RELATIONSHIPS
FOR TESTED GROUT MIXTURES

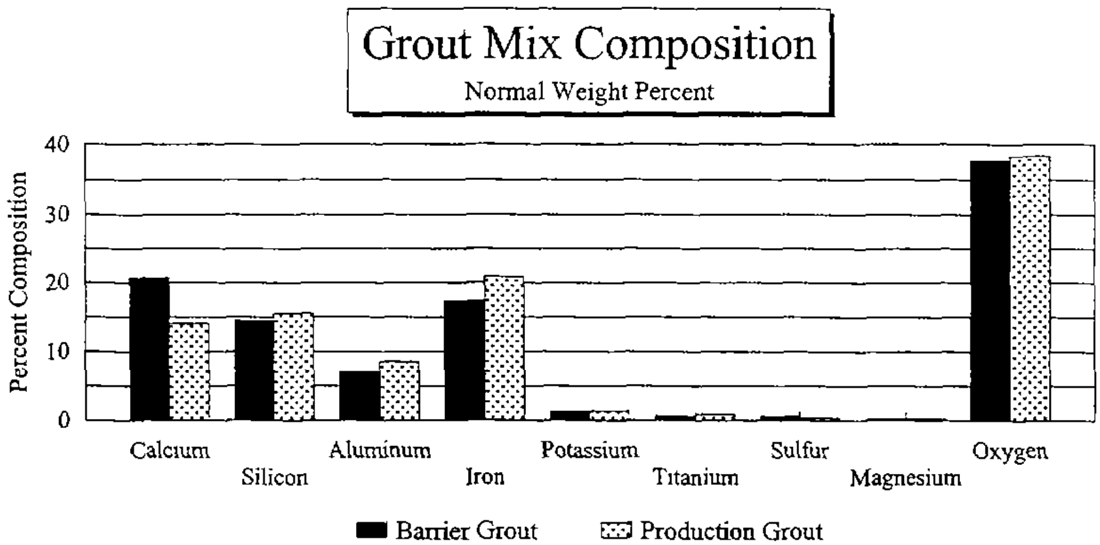


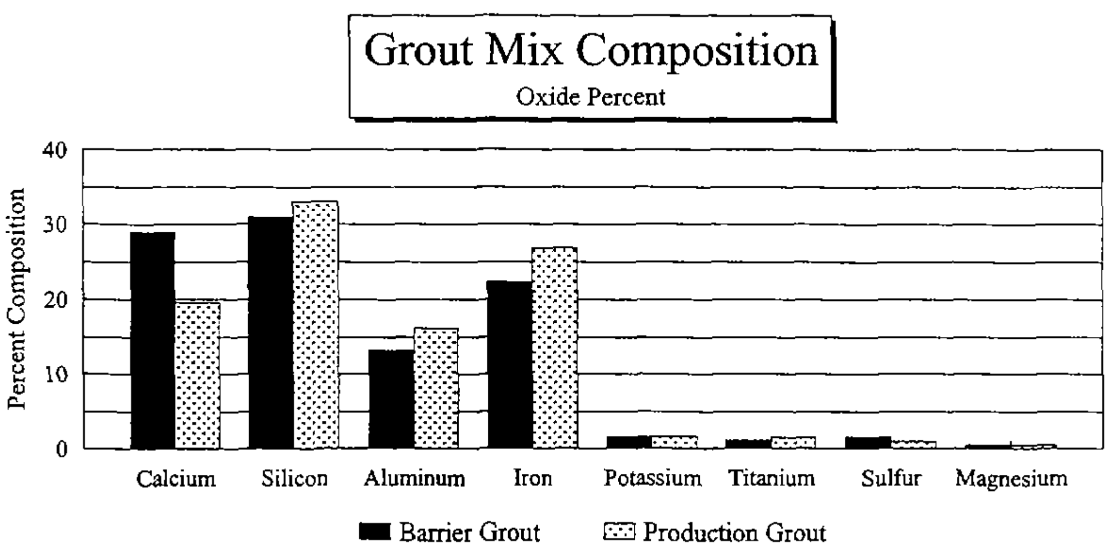
CONESVILLE FGD LANDFILL EXPANSION - MINE VOID GROUTING PROJ.


STRENGTH VS. TIME RELATIONSHIPS
FOR TESTED GROUT MIXTURES
PROJECTED LONG TERM STRENGTHS
CV7-55-38
CV5-45-50
CV7-65-28
CV5-55-40
CV7-75-18
REQUIRED STRENGTH-150 P.S.I.
CV7-85-8
CV5-65-30
CV5-85-10
UNCONFINED COMPRESSIVE STRENGTH, P.S.I.
TIME AFTER BATCHING, DAYS
0
100
200
300
400
0
20
40
60
80
100
120
140
160
180
CONESVILLE FGD LANDFILL EXPANSION - MINE VOID GROUTING PROJ.

Grout Mix Composition
Gue-70-14.10

	Normal Weight Percent		Oxidized Percent	
	Barrier	Production	Barrier	Production
Calcium	20.7	14.0	28.9	19.6
Silicon	14.5	15.5	30.9	33.1
Aluminum	7.0	8.5	13.2	16.1
Iron	17.3	20.8	22.3	26.8
Potassium	1.3	1.3	1.5	1.6
Titanium	0.7	0.9	1.1	1.5
Sulfur	0.6	0.4	1.6	0.9
Magnesium	0.3	0.3	0.5	0.5
Oxygen	37.7	38.4	0.0	0.0





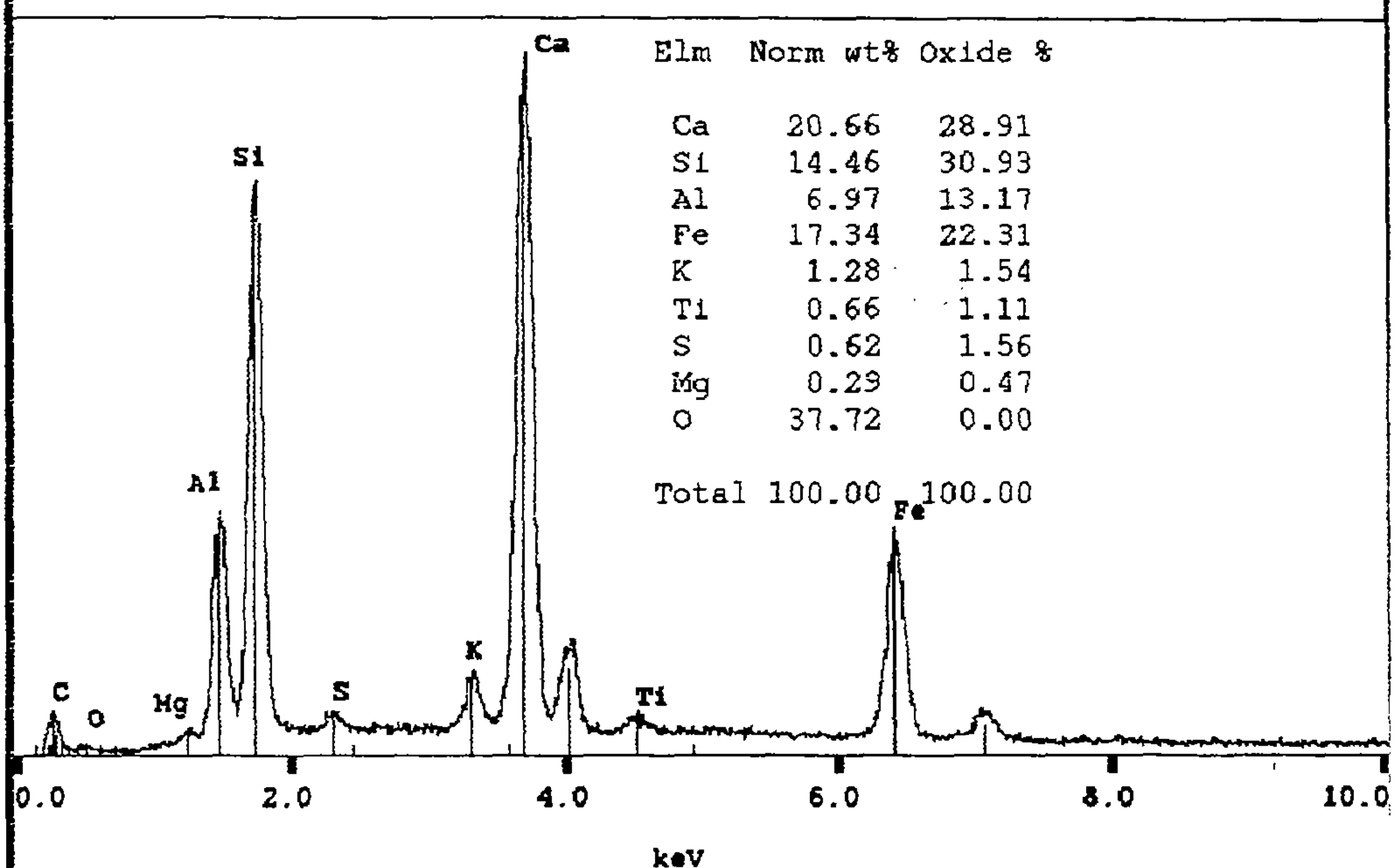
X-ray Display 1

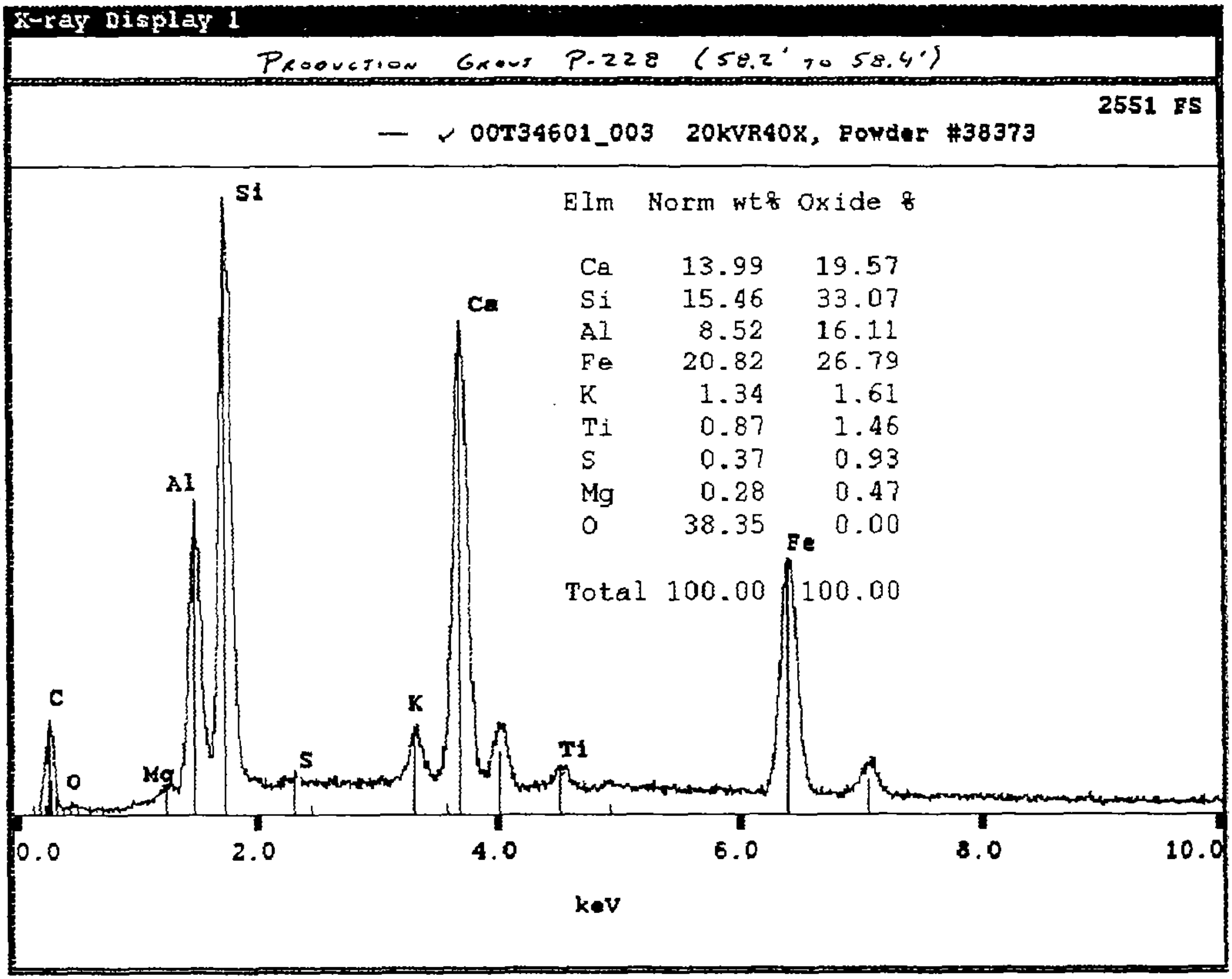
Acquisition completed. Barrier Grout P-221 (62.5' to 63.0')

2506 FS

— ✓ 00T34601_001 20kVR40X, Powder #38370

Elm	Norm wt%	Oxide %
Ca	20.66	28.91
Si	14.46	30.93
Al	6.97	13.17
Fe	17.34	22.31
K	1.28	1.54
Ti	0.66	1.11
S	0.62	1.56
Mg	0.29	0.47
O	37.72	0.00
Total	100.00	100.00




X-ray Display 1
PRODUCTION GROUT P-228 (58.2' TO 58.4')
2551 FS
— ✓ 00T34601_003 20kVR40X, Powder #38373
Elm Norm wt% Oxide %
Ca 13.99 19.57
Si 15.46 33.07
Al 8.52 16.11
Fe 20.82 26.79
K 1.34 1.61
Ti 0.87 1.46
S 0.37 0.93
Mg 0.28 0.47
O 38.35 0.00
Total 100.00 100.00
Si
Ca
Al
Fe
C
K
Ti
S
O
Mg
0.0
2.0
4.0
6.0
8.0
10.0
keV

ADVANCED ANALYTICS LABORATORIES, INC.

1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ber 21, 2000

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
Attn: Chris Hall

AALI ORDER ID:	8843	**DATE COLLECTED:**	8/25/00
APPROVAL #:	EPA Certification 4043	**DATE RECEIVED:**	8/25/00
CLIENT PROJECT:	7000.03	**DATE ANALYZED:**	9/20/00
CLIENT PO NO.:		**DATE REPORTED:**	9/21/00

TEST RESULTS

AALI Sample No.: 38373 Client Sample ID: P-228 (58.2-58.4)

Sample No.	**Result**	**Test Method**	**Detection Limit**
Hardness as $CaCO_3$	52 mg/L	130.2	0.1

Comment: In order to perform analysis on the powder sample, the solid was dissolved in distilled water and stirred for approximately 2 hours. Insoluble materials were filtered before analysis as they interfered with test procedures.

Respectfully submitted.

L. Eve Karnitis

L. Eve Karnitis, President

ADVANCED ANALYTICS LABORATORIES, INC.

1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002

Analysis & Testing - Quality Control Programs - Research & Development

September 21, 2000

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
Attn: Chris Hall

AALI ORDER ID: 8843		**DATE COLLECTED:**	8/25/00
APPROVAL #: EPA Certification 4043		**DATE RECEIVED:**	8/25/00
CLIENT PROJECT: 7000.03		**DATE ANALYZED:**	9/20/00
CLIENT PO NO.:		**DATE REPORTED:**	9/21/00

TEST RESULTS

AALI Sample No.: 38370 Client Sample ID: P-221 (62.5-63.0)

Sample No.	**Result**	**Test Method**	**Detection Limit**
Hardness as CaCO3	66 mg/L	130.2	0.1

Comment: In order to perform analysis on the powder sample, the solid was dissolved in distilled water and stirred for approximately 2 hours. Insoluble materials were filtered before analysis as they interfered with the test procedure and parameters.

Respectfully submitted,

L. Eve Karnitis

L Eve Karnitis, President

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

September 22, 2000

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Chris Hall

AALI ORDER ID: 8843
APPROVAL #: EPA Certification 4043
CLIENT PROJECT: 7000.03
CLIENT PO NO.:

DATE COLLECTED: 8/25/99
DATE RECEIVED: 8/25/99
DATE ANALYZED: 9/21/99
DATE REPORTED: 9/22/99

TEST RESULTS

Test: Calcium
Test Method: 3010a/7140/215.1

AALI Sample Number	Client Sample Identification	Calcium Result
38370	P-221 (62.5-63.0)	8.59%
38373	P-228 (58.2-58.4)	5.17%

Respectfully submitted,

L. Eve Karnitis

L. Eve Karnitis. President

Laboratory Analysis Results of Grout Solubility
Gue-70-14.10

	Analysis Results					Gross Increases					Adjusted Increases				
Date Analyzed	09/13/00	09/20/00	10/20/00	06/03/01	10/26/01	09/13/00	09/20/00	10/20/00	06/03/01	10/26/01	09/13/00	09/20/00	10/20/00	06/03/01	10/26/01
Days Immersed	0	7	37	263	408	0	7	37	263	408	0	7	37	263	408
Barrier Grout (38371)															
Alkalinity, Total as CaC (mg/l)	205	195	160	125	125	0	-10	-45	-80	-80	0	-20	-10	-5	-5
Percent						0.0%	-4.9%	-22.0%	-39.0%	-39.0%	0.0%	-9.8%	-4.9%	-2.4%	-2.4%
Calcium, total (mg/l)	70.0		71.9	24.4	34.0	0.0		1.9	-45.6	-36.0	0.0		0.9		-4.8
Percent						0.0%		2.7%	-65.1%	-51.4%	0.0%		1.3%		-6.9%
Conductivity (uohms/cm)	614	589	540	296	184	0	-25	-74	-318	-431	0	-56	-14	1	-11
Percent						0.0%	-4.1%	-12.1%	-51.8%	-70.1%	0.0%	9.1%	-2.3%	0.2%	-1.7%
Iron, total (mg/l)	0.6		1.7	2.1	3.4	0.0		1.1	1.6	2.8	0.0		0.0		2.5
Percent						0.0%		196.5%	275.4%	489.6%	0.0%		0.0%		434.6%
Hardness as CaCo3 (mg/l)	222	244	192	114	100	0	22	-30	-108	-122	0	16	-2	-8	-28
Percent						0.0%	9.9%	-13.5%	-48.6%	-55.0%	0.0%	7.2%	-0.9%	-3.6%	-12.6%
pH (S.U.)	7.8	7.9	7.9	8.3	8.4	0.0	0.1	0.1	0.5	0.7	0.0	0.1	0.1	0.1	0.3
Percent						0.0%	1.4%	1.7%	6.6%	8.8%	0.0%	0.9%	1.2%	0.6%	3.4%
Total Dissolved Solids (mg/l)	432	453	553	262	200	0	21	121	-170	-232	0	30	93	74	-9
Percent						0.0%	4.9%	28.0%	-39.4%	-53.7%	0.0%	6.9%	21.5%	17.1%	-2.1%
Sulfate (mg/l)	73.2	61.2	74.9	93.0	83.5	0.0	-12.0	1.7	19.8	10.3	0.0	30.6	17.1	22.9	1.0
Percent						0.0%	-16.4%	2.3%	27.0%	14.1%	0.0%	41.8%	23.4%	31.3%	1.4%
Production Grout (38372)															
Alkalinity, Total as CaC (mg/l)	205	185	130	120	120	0	-20	-75	-85	-85	0	-30	-40	-10	-10
Percent						0.0%	-9.8%	-36.6%	-41.5%	-41.5%	0.0%	-14.6%	-19.5%	-4.9%	-4.9%
Calcium, total (mg/l)	70.0		63.3	28.5	42.9	0.0		-6.7	-41.5	-27.1	0.0		-7.7		4.1
Percent						0.0%		-9.6%	-59.3%	-38.7%	0.0%		-11.0%		5.9%
Conductivity (uohms/cm)	614	608	557	284	195	0	-6	-57	-330	-419	0	37	3	-11	1
Percent						0.0%	-1.0%	-9.3%	-53.7%	-68.3%	0.0%	-6.0%	0.5%	-1.8%	0.1%
Iron, total (mg/l)	0.6		1.8	2.1	1.2	0.0		1.3	1.5	0.6	0.0		0.1		0.3
Percent						0.0%		219.3%	268.4%	106.8%	0.0%		22.8%		51.8%
Hardness as CaCo3 (mg/l)	222	240	176	104	92	0	18	-46	-118	-130	0	12	-18	-18	-36
Percent						0.0%	8.1%	-20.7%	-53.2%	-58.6%	0.0%	5.4%	-8.1%	-8.1%	-16.2%
pH (S.U.)	7.8	7.8	7.9	8.3	8.4	0.0	0.0	0.1	0.6	0.6	0.0	0.0	0.1	0.1	0.2
Percent						0.0%	0.6%	1.7%	7.2%	8.1%	0.0%	0.1%	1.2%	1.3%	2.7%
Total Dissolved Solids (mg/l)	432	433	437	234	220	0	1	5	-198	-212	0	10	-23	46	11
Percent						0.0%	0.2%	1.2%	-45.8%	-49.1%	0.0%	2.3%	-5.3%	10.6%	2.5%
Sulfate (mg/l)	73.2	47.1	58.3	84.6	110.0	0.0	-26.1	-14.9	11.4	36.8	0.0	16.5	0.5	14.5	27.5
Percent						0.0%	-35.7%	-20.4%	15.6%	50.3%	0.0%	22.5%	0.7%	19.8%	37.6%
Control Sample (38460)															
Alkalinity, Total as CaC (mg/l)	205	215	170	130	130	0	10	-35	-75	-75					
Percent						0.0%	4.9%	-17.1%	-36.6%	-36.6%					
Calcium, total (mg/l)	70.0		71.0		38.8	0.0		1.0		-31.2					
Percent						0.0%		1.4%		-44.6%					
Conductivity	614	645	554	295	194	0	31	-60	-319	-420					
Percent						0.0%	5.0%	-9.8%	-52.0%	-68.4%					
Iron, total (mg/l)	0.6		1.7		0.9	0.0		1.1		0.3					
Percent						0.0%		196.5%		55.1%					
Hardness as CaCo3 (mg/l)	222	228	194	122	128	0	6	-28	-100	-94					
Percent						0.0%	2.7%	-12.6%	-45.0%	-42.3%					
pH (S.U.)	7.8	7.8	7.8	8.2	8.2	0.0	0.0	0.0	0.5	0.4					
Percent						0.0%	0.5%	0.5%	5.9%	5.4%					
Total Dissolved Solids (mg/l)	432	423	460	188	209	0	-9	28	-244	-223					
Percent						0.0%	-2.1%	6.5%	-56.5%	-51.6%					
Sulfate (mg/l)	73.2	30.6	57.8	70.1	82.5	0.0	-42.6	-15.4	-3.1	9.3					
Percent						0.0%	-58.2%	-21.0%	-4.2%	12.7%					

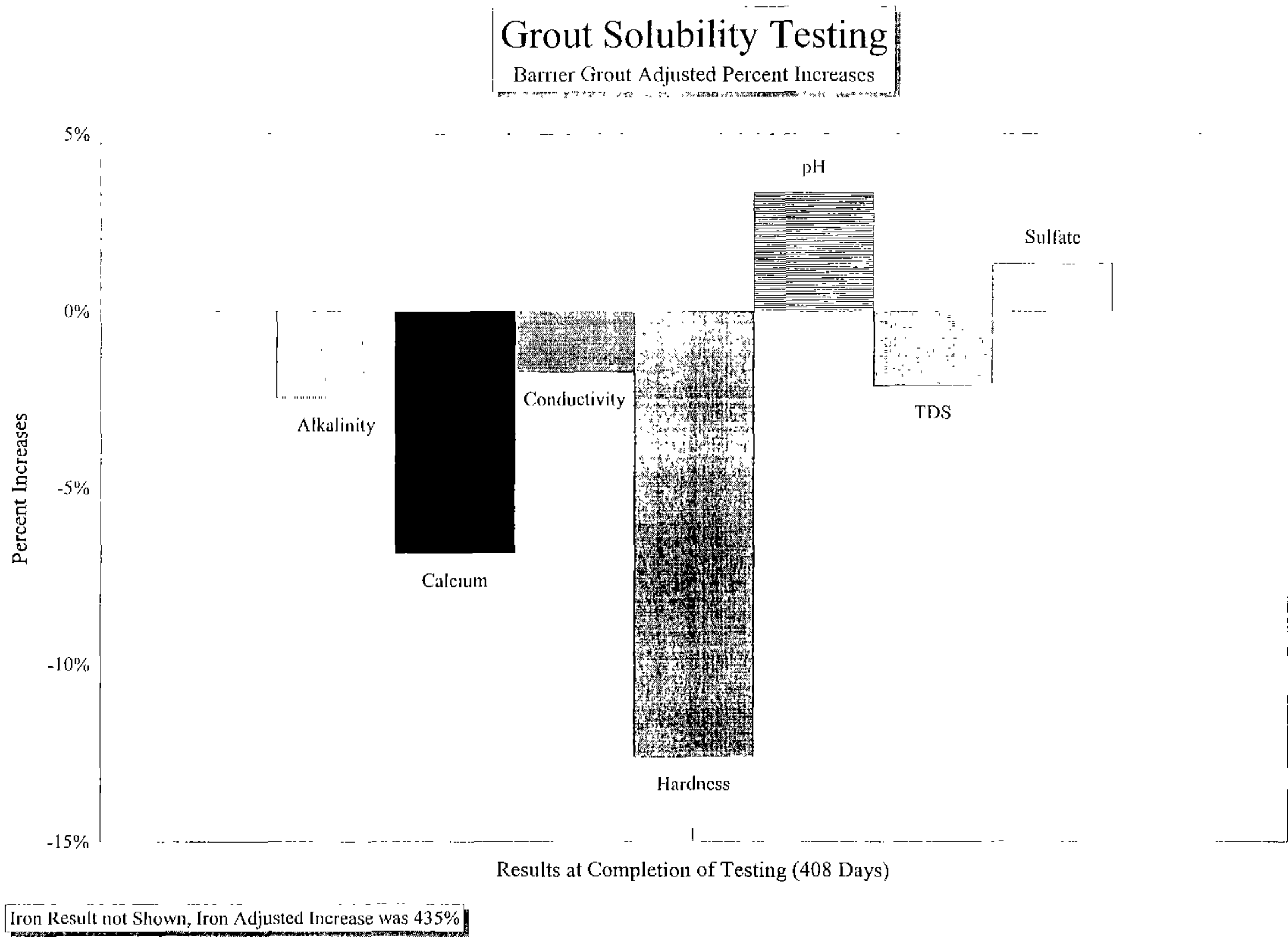
Samples Analyzed

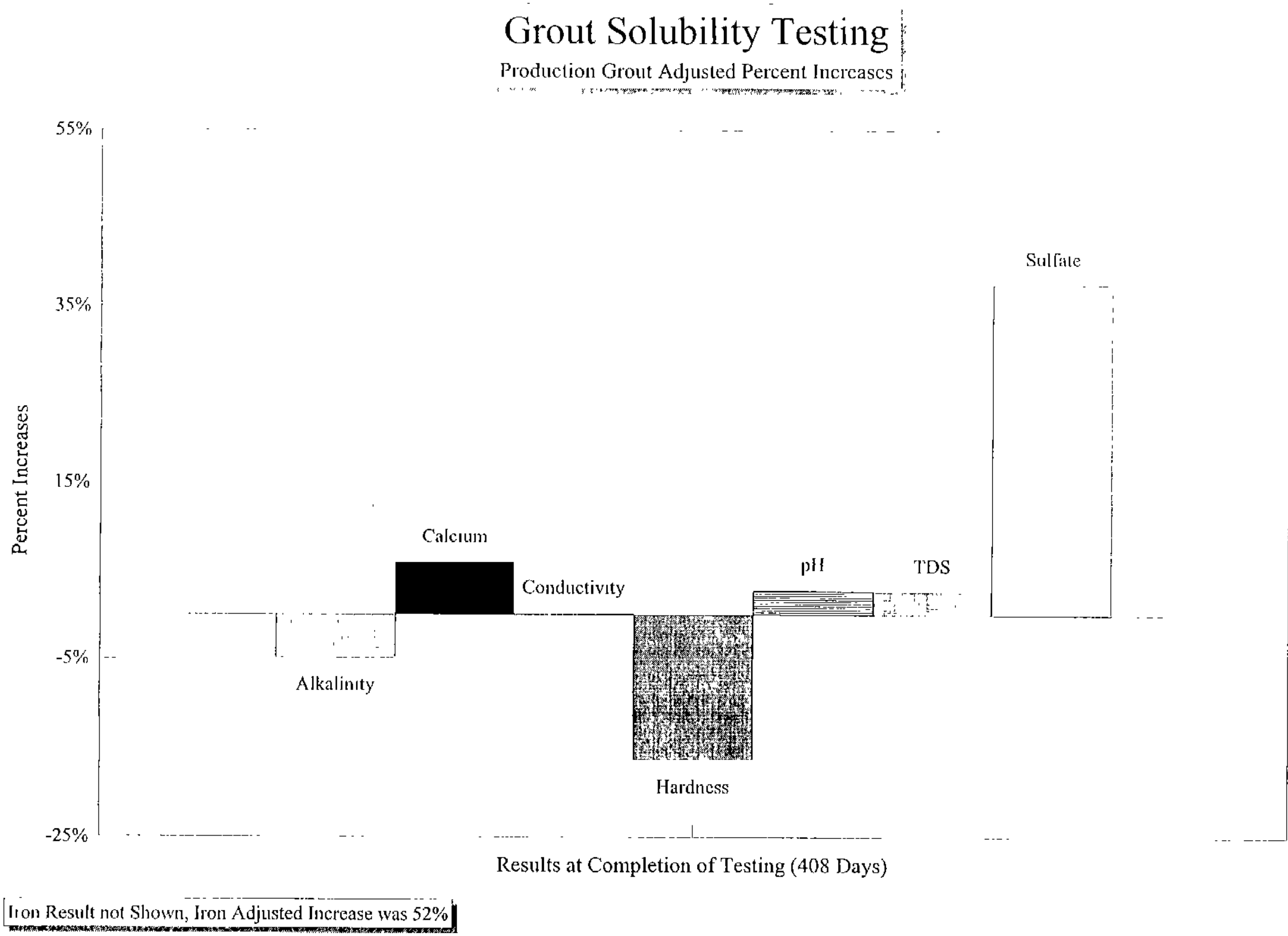
Barrier Grout - Collected from Boring P-221 (62.5' to 63.0')

Production Grout - Collected from Boring P-228 (58.2' to 58.4')

Control Sample is mine water with no grout immersed

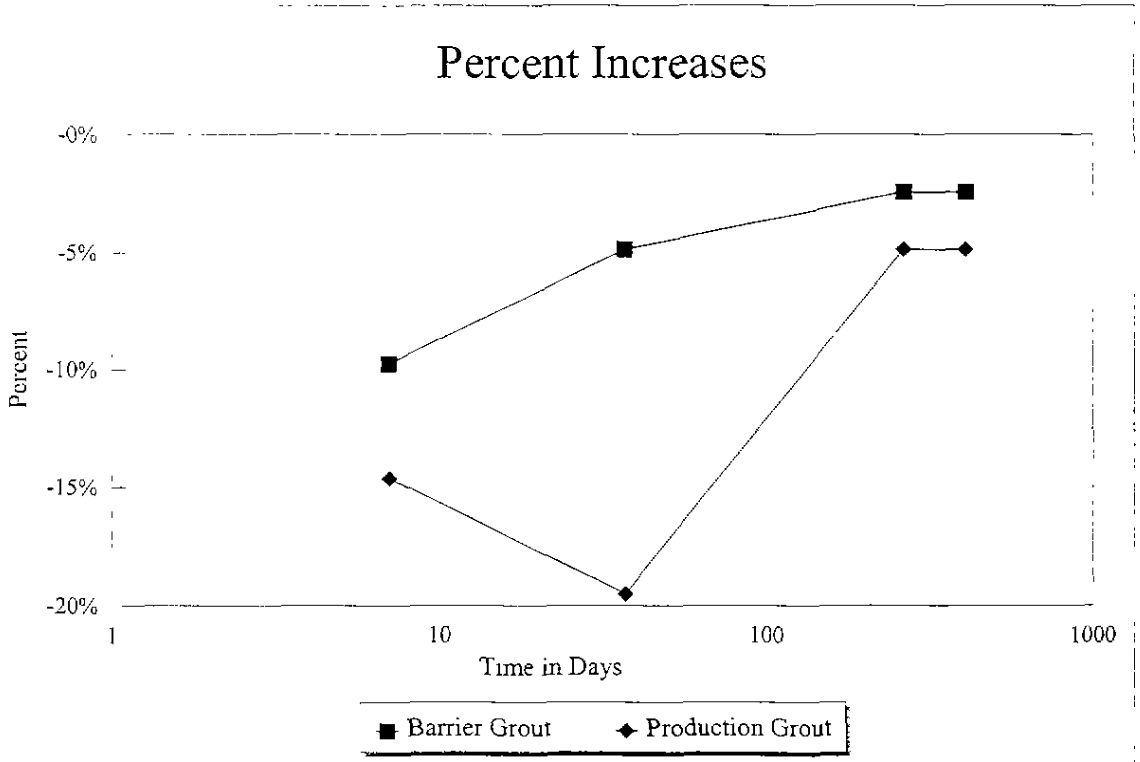
Water for all three samples was obtained from well B-224A, Upgradient coal zone well.

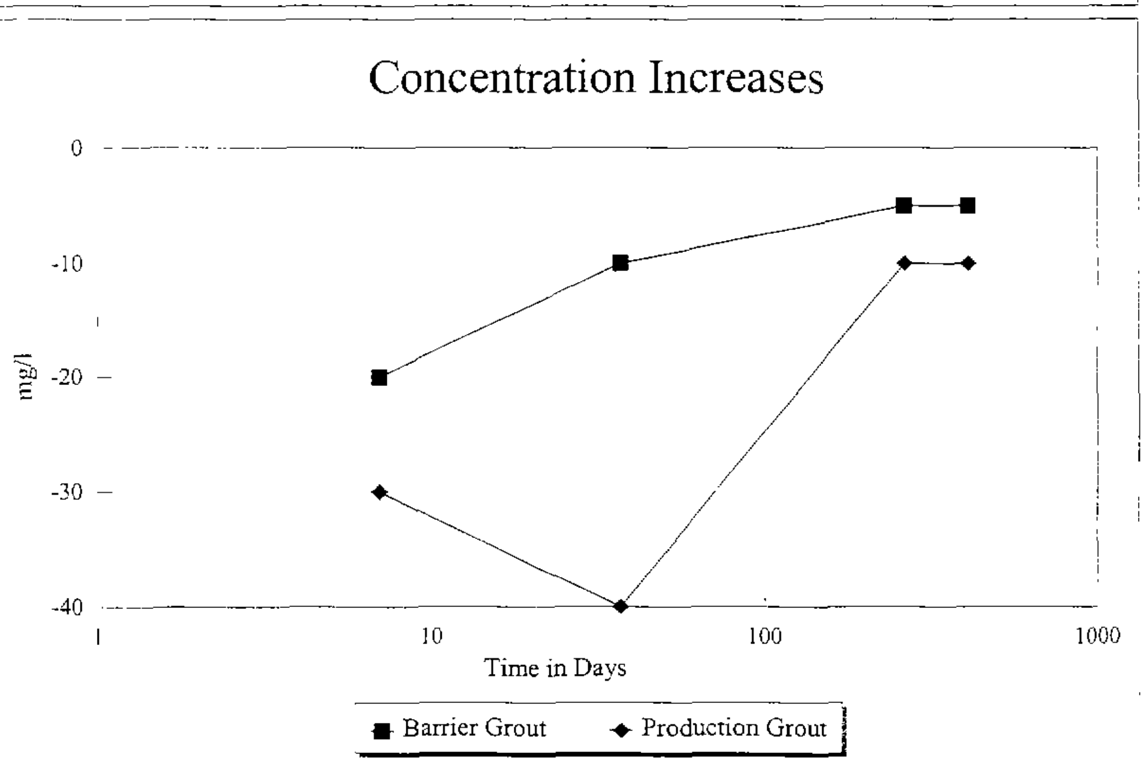

Grout Solubility Testing
Barrier Grout Adjusted Percent Increases
5%
0%
-5%
-10%
-15%
Percent Increases
pH
Sulfate
Alkalinity
Conductivity
TDS
Calcium
Hardness
Results at Completion of Testing (408 Days)
Iron Result not Shown, Iron Adjusted Increase was 435%



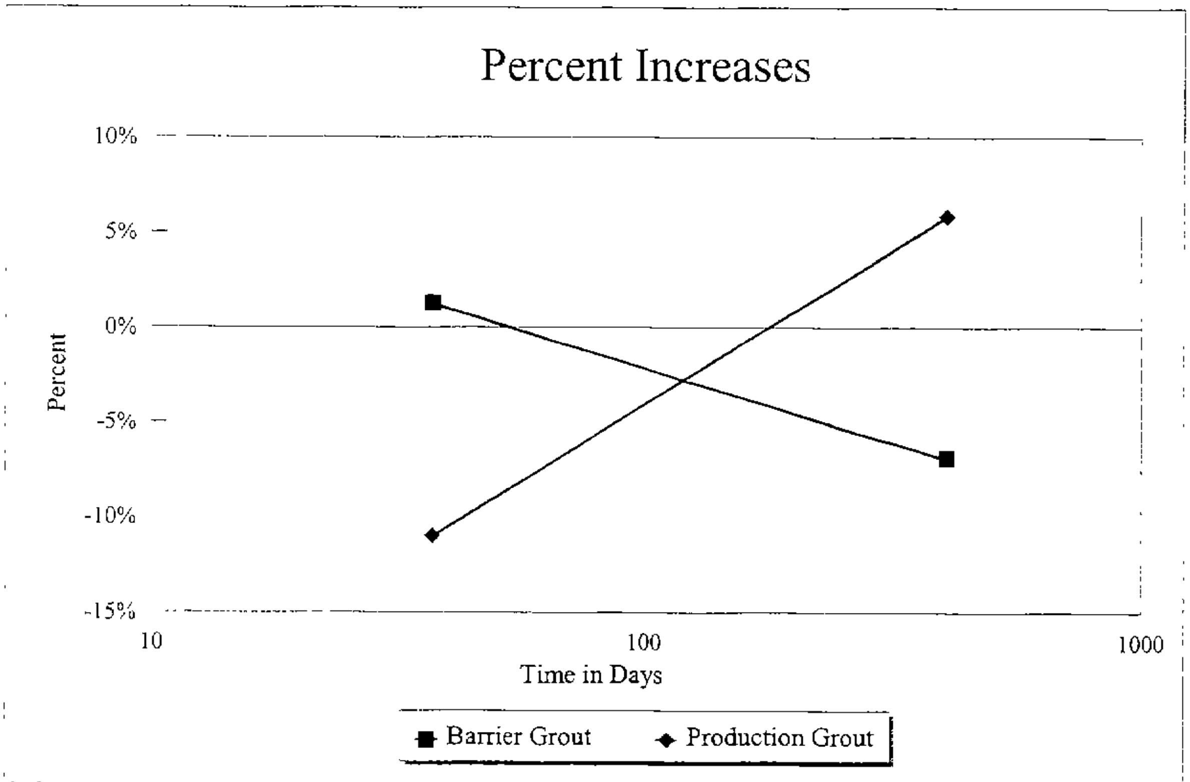
Grout Solubility Testing
Production Grout Adjusted Percent Increases
55%
35%
15%
-5%
-25%
Percent Increases
Calcium
Conductivity
pH
TDS
Sulfate
Alkalinity
Hardness
Results at Completion of Testing (408 Days)
Iron Result not Shown, Iron Adjusted Increase was 52%

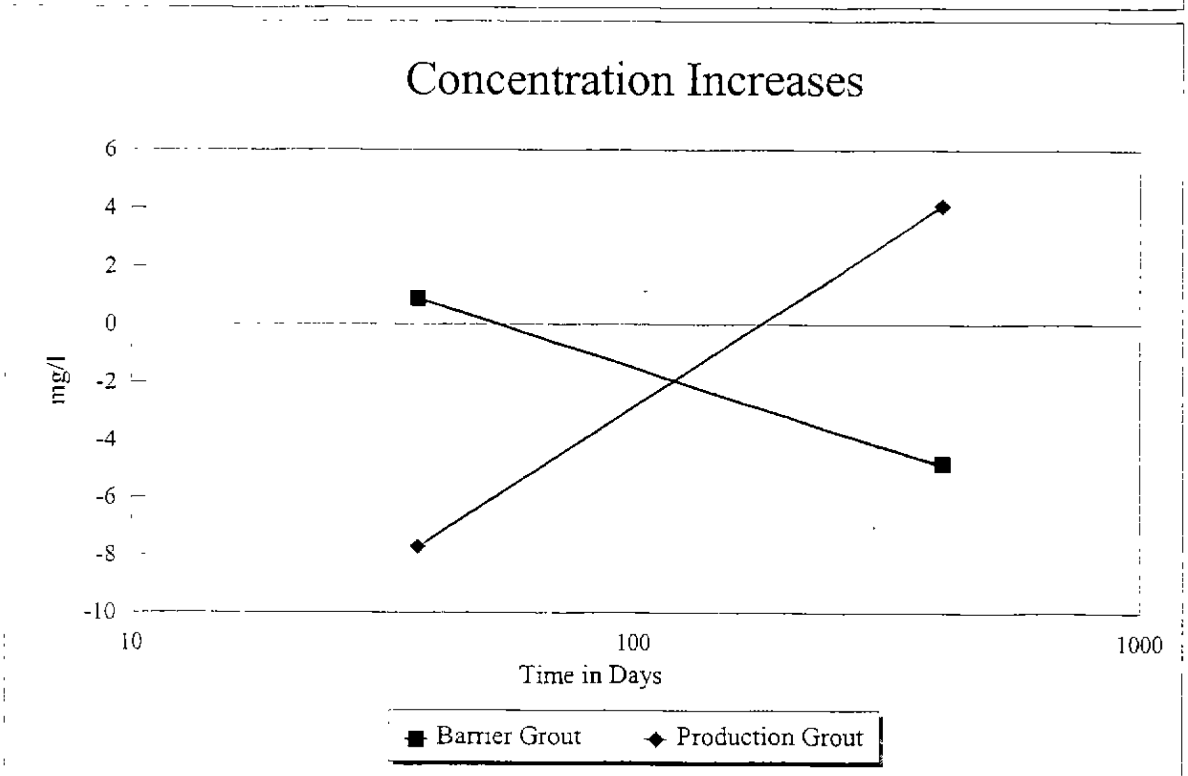
Grout Dissolution Testing
Alkalinity, Adjusted Increases vs Time
Gue-70-14.10



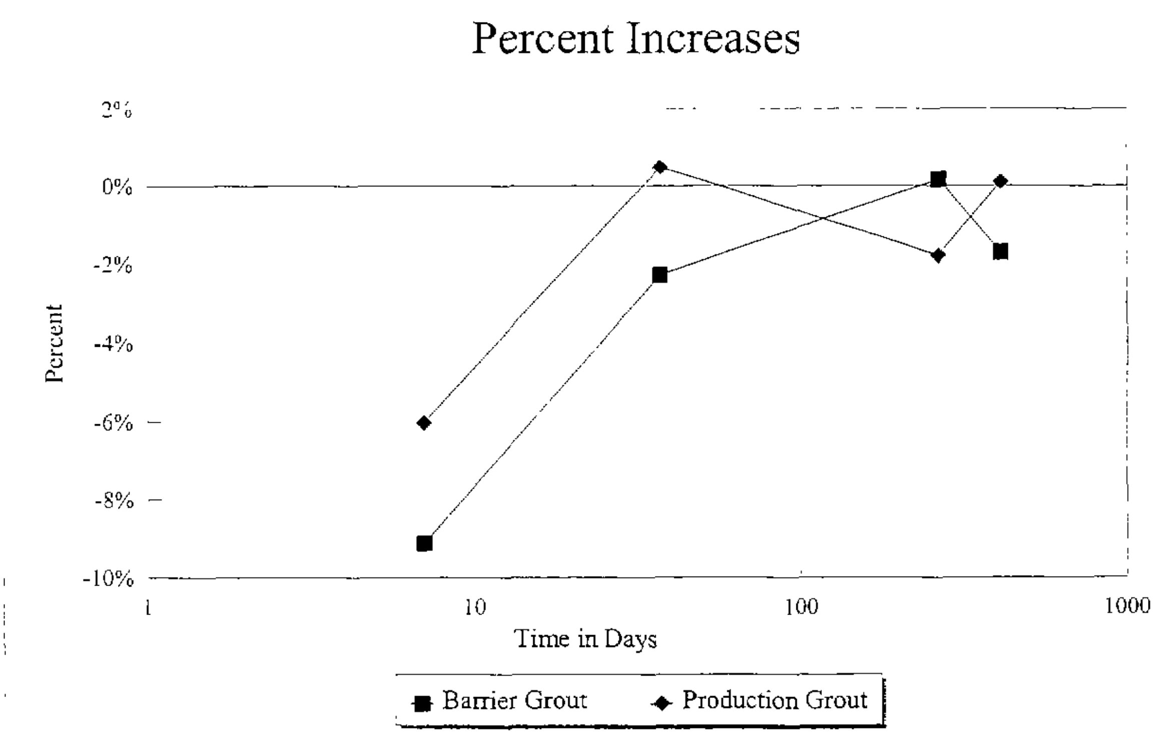


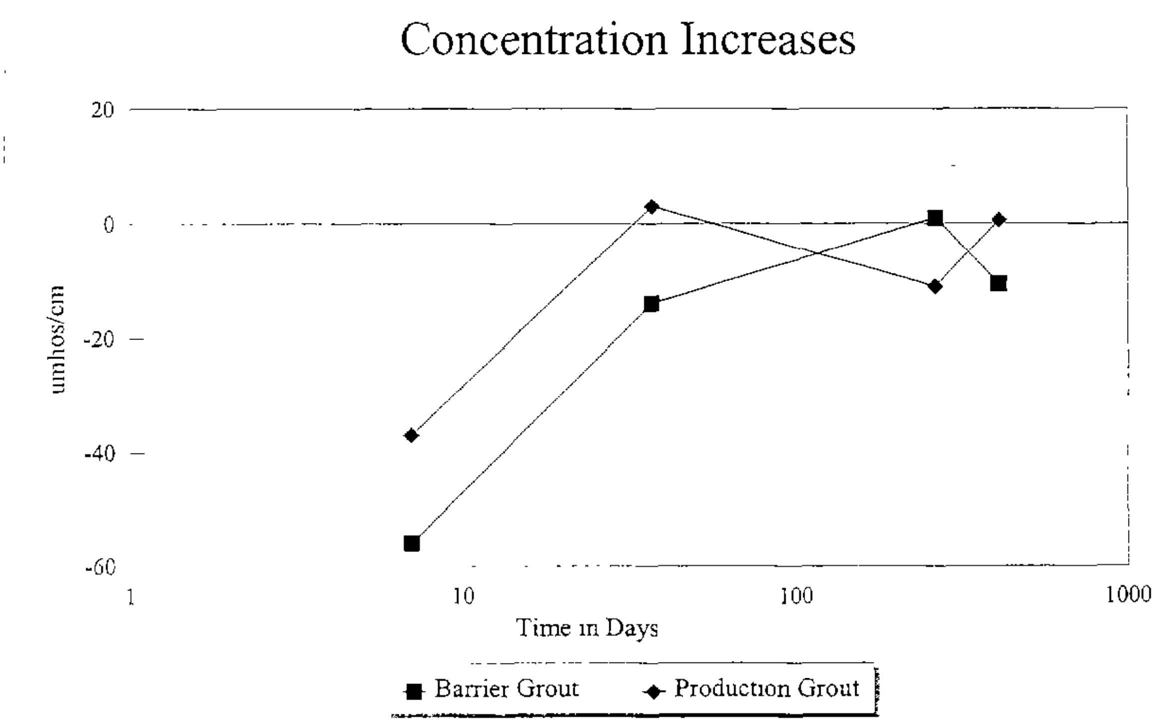
Grout Dissolution Testing
Calcium, Adjusted Increases vs Time
Gue-70-14.10



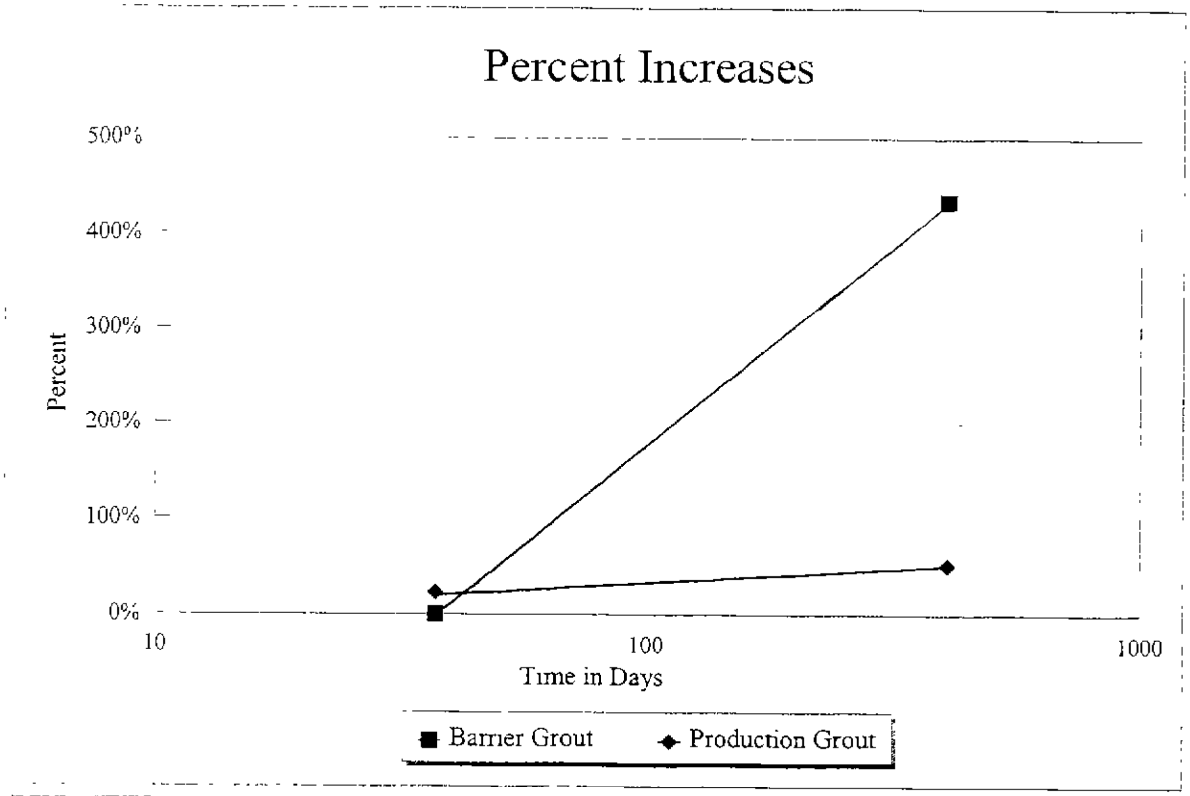


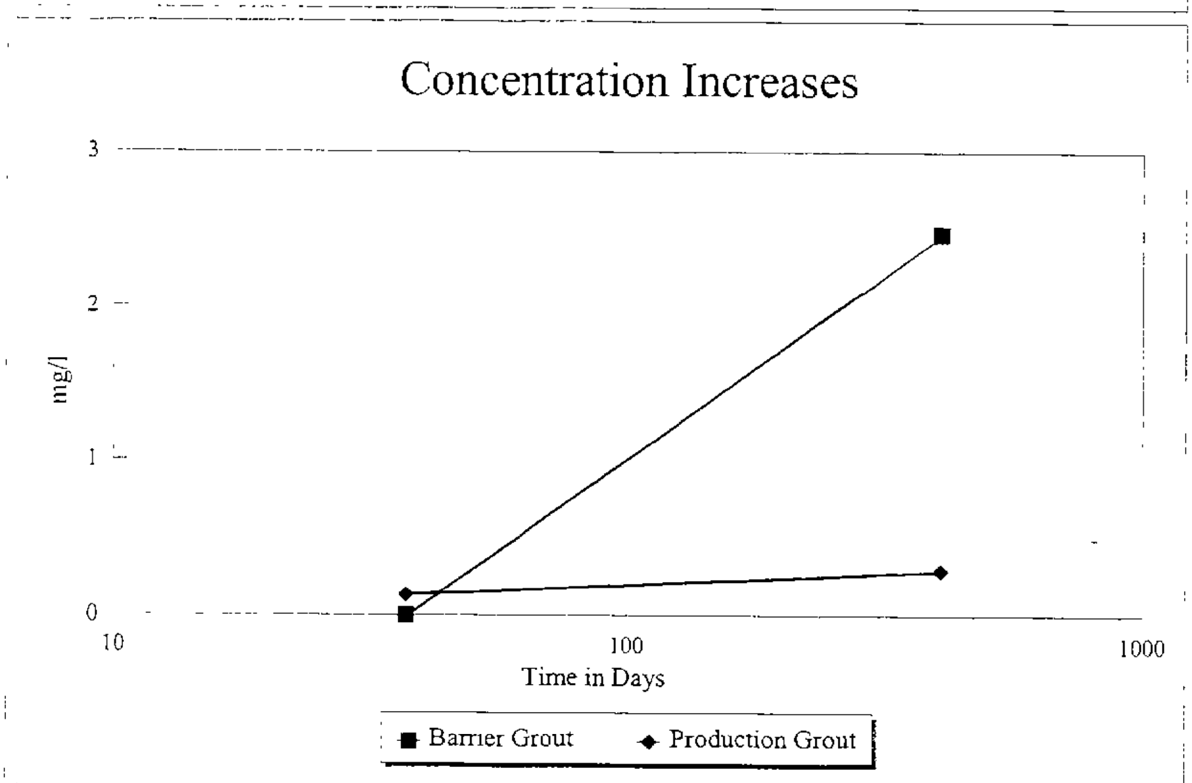
Grout Dissolution Testing
Conductivity, Adjusted Increases vs Time
Gue-70-14.10



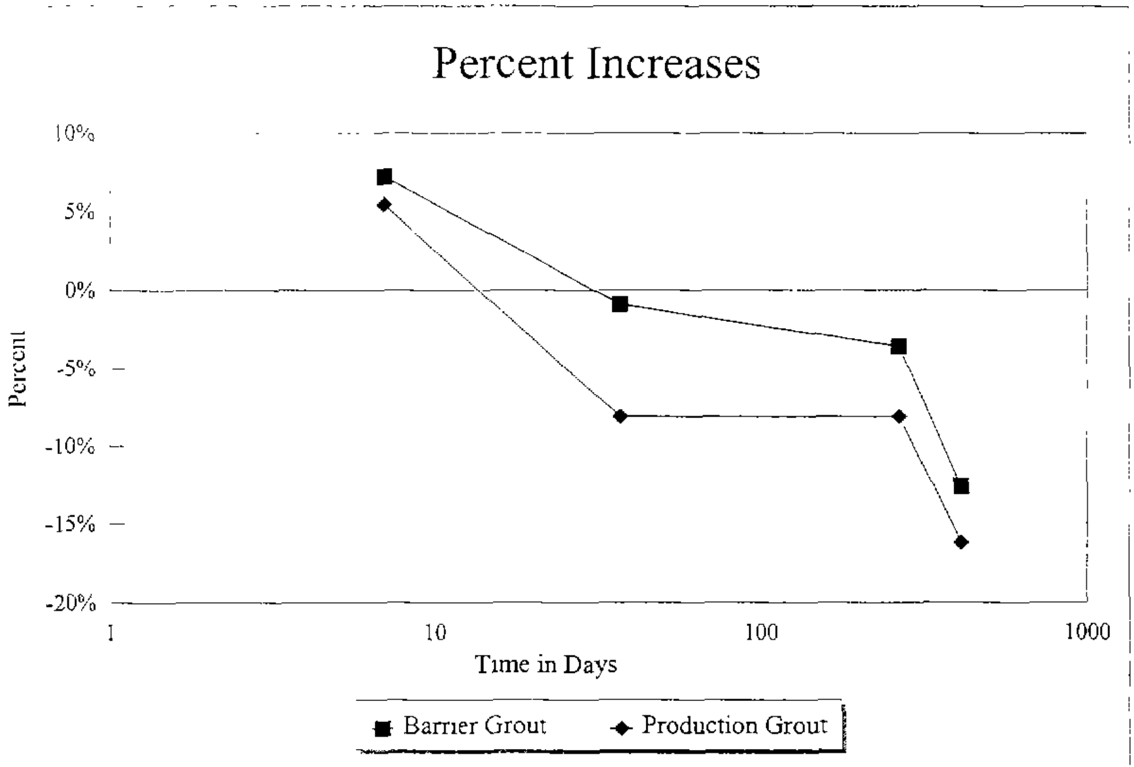


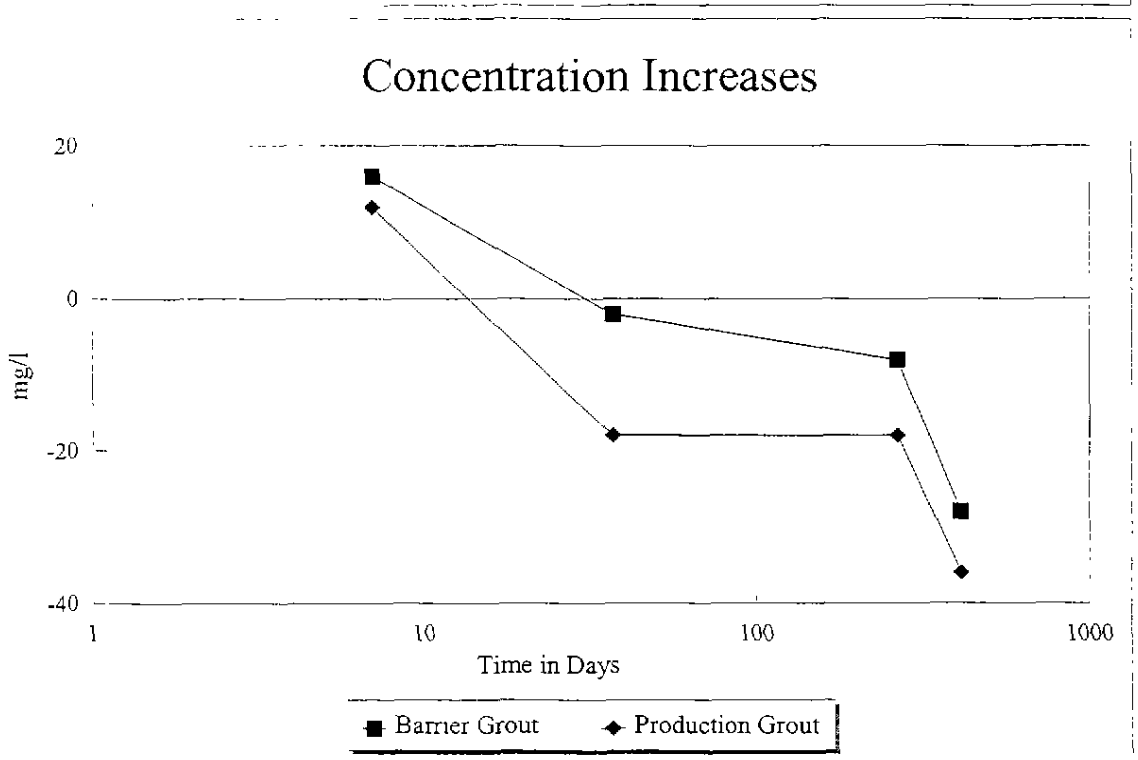
Grout Dissolution Testing
Iron, Adjusted Increases vs Time
Gue-70-14.10



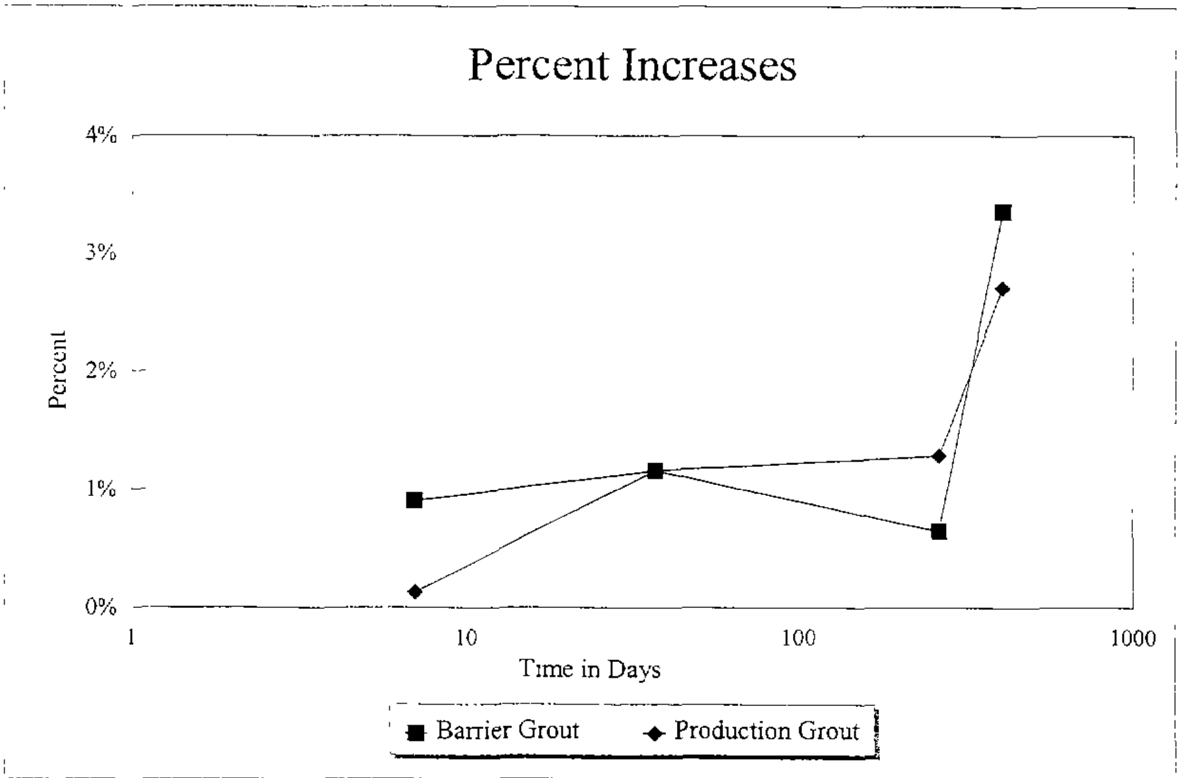


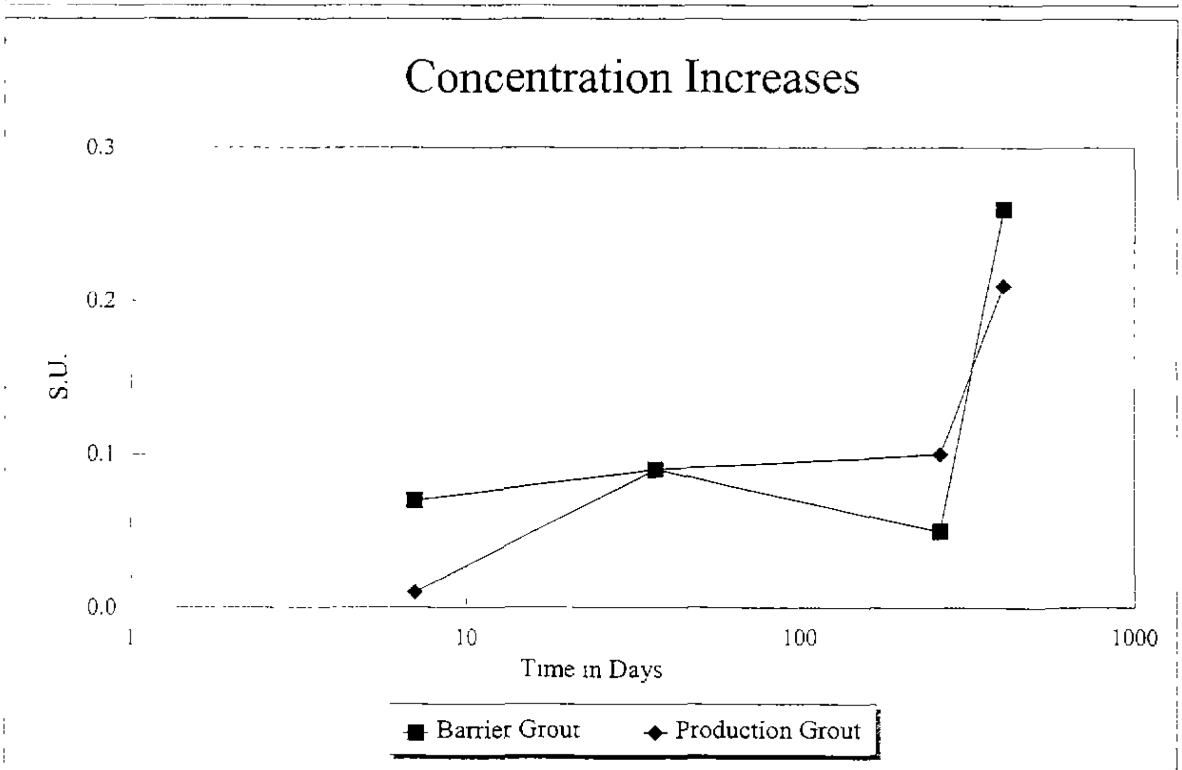
Grout Dissolution Testing
Hardness, Adjusted Increases vs Time
Gue-70-14.10



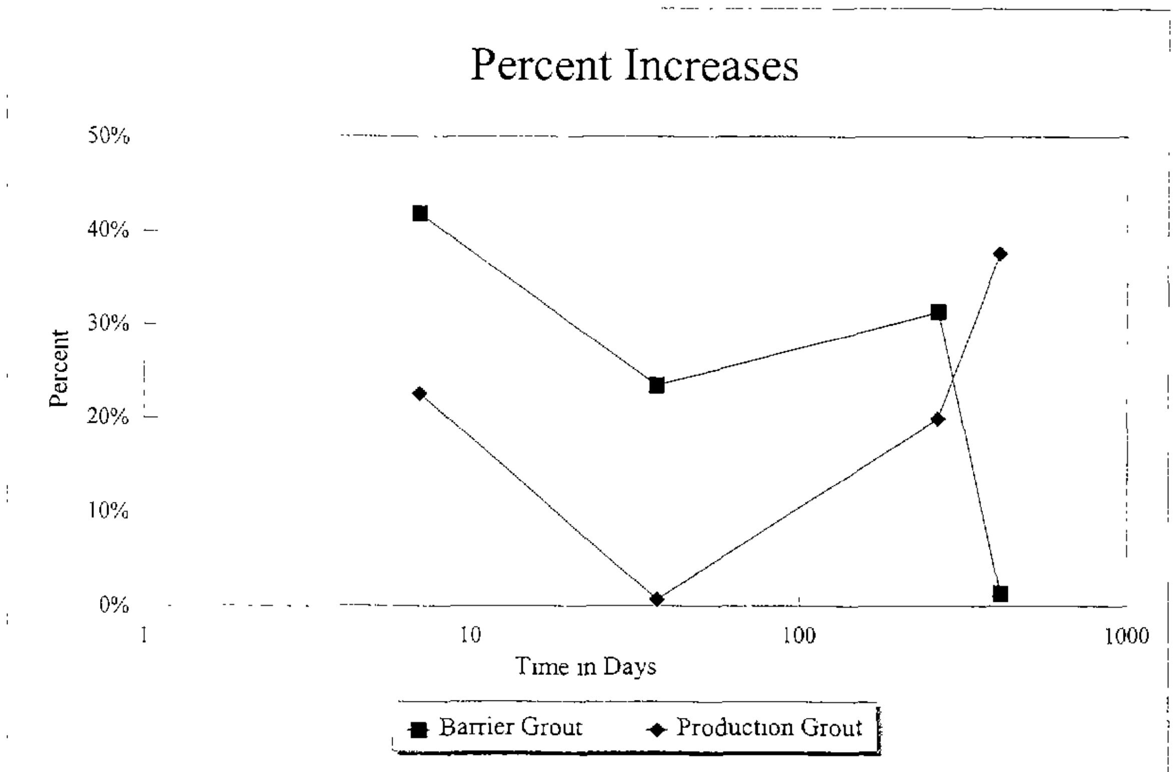


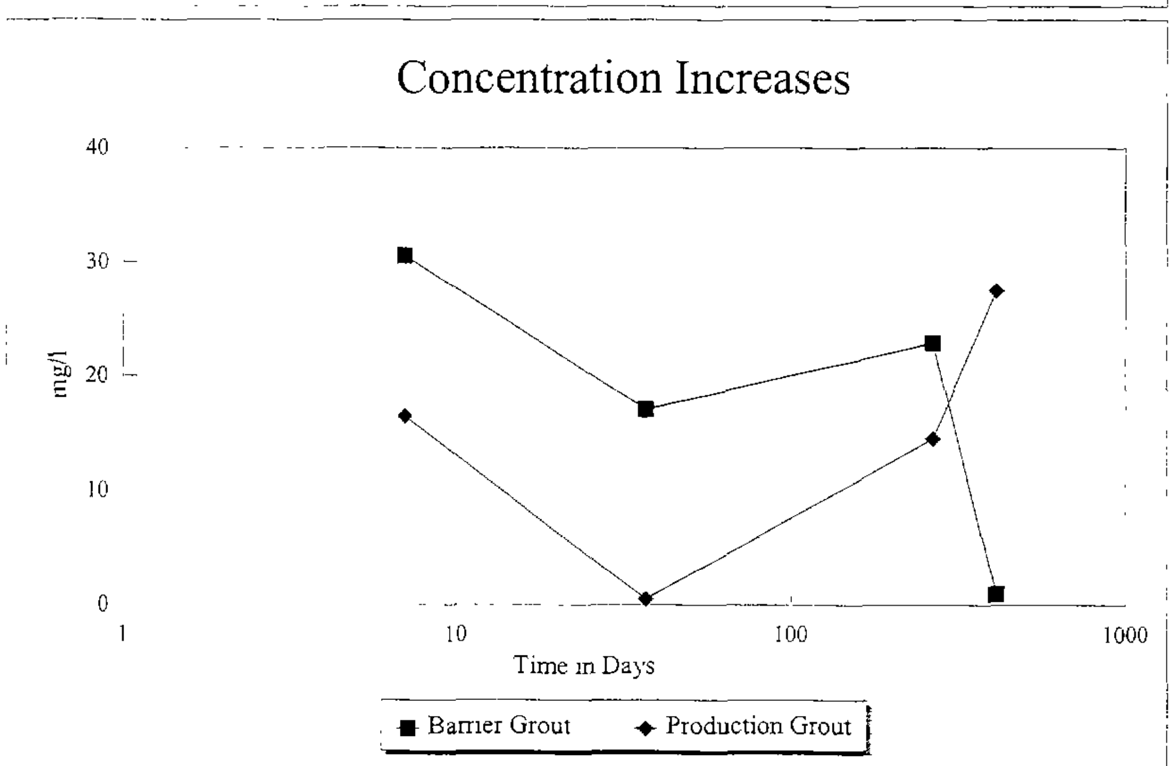
Grout Dissolution Testing
pH, Adjusted Increases vs Time
Gue-70-14.10



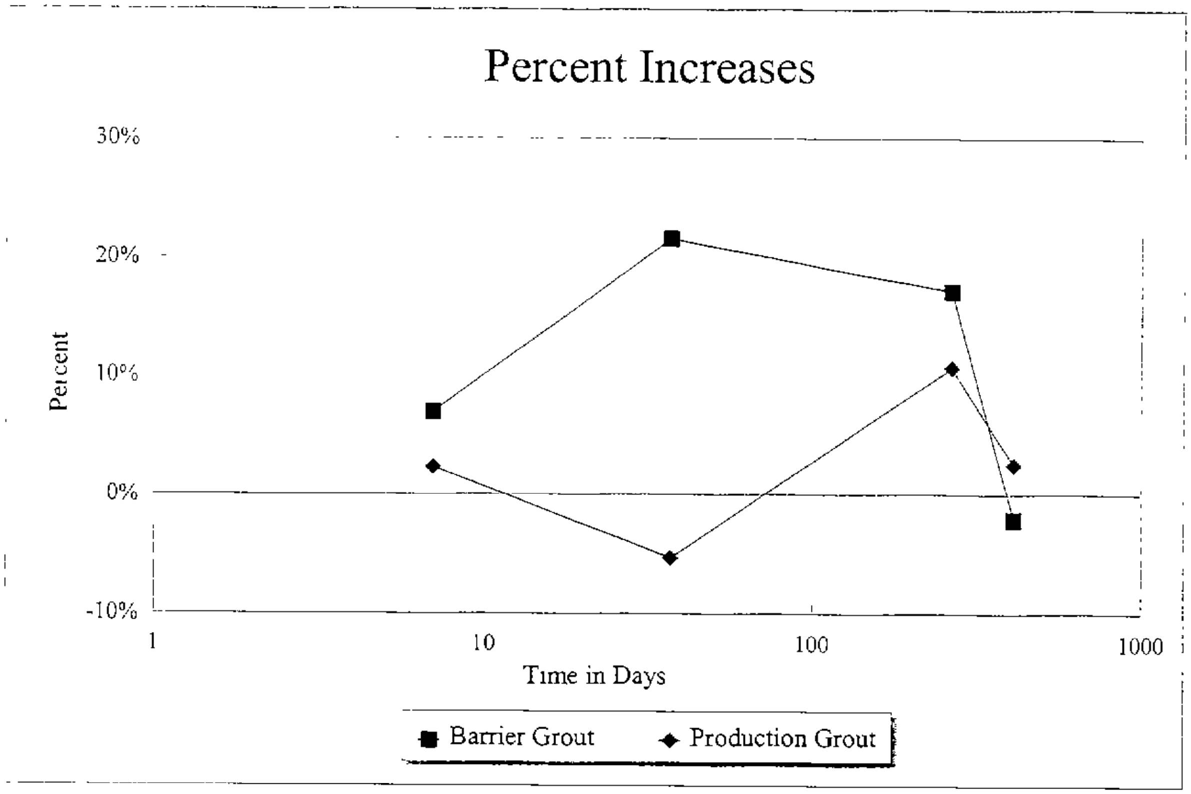


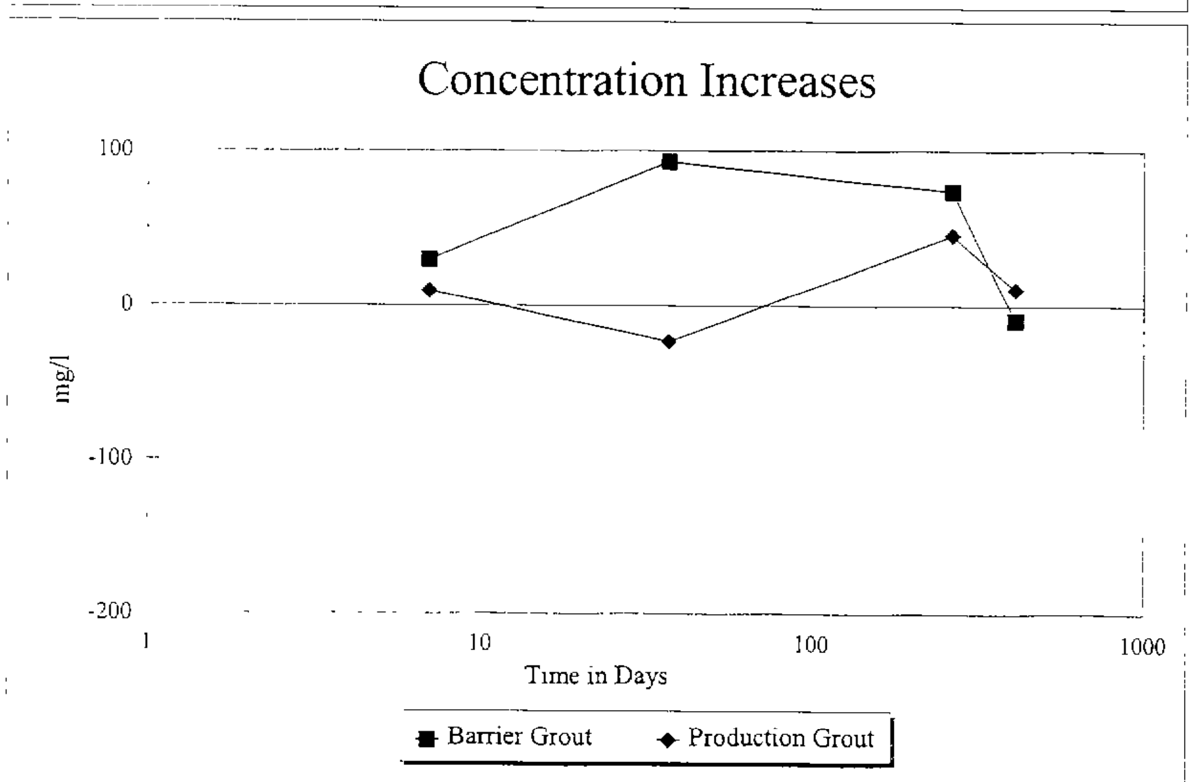
Grout Dissolution Testing
Sulfates, Adjusted Increases vs Time
Gue-70-14.10





Grout Dissolution Testing
Dissolved Solids, Adjusted Increases vs Time
Gue-70-14.10





Leachate Characterization Data for Conesville
Fly Ash Grout Mixtures

Grout Mixture (% Cement/ % Fly Ash/ % Sand)	Curing Time (Days)	Leachate Characterization[1] (μg/l)						
		As	Ba	Cd	Cr	Pb	Hg	Se
5/45/50	28	4	860	<0.5	22	<1	<0.2	17
5/55/40	28	9	898	<0.5	33	<2	<0.2	20
5/65/30	28	14	731	<0.5	33	4	<0.2	13
5/75/20	28	17	832	<0.5	33	<2	<0.2	20
5/85/10	28	19	834	<0.5	28	<2	<0.2	20
7/55/38	28	<4	1040	<0.5	19	<2	<0.2	6
7/65/28	28	<4	1250	<0.5	17	<2	<0.2	8
7/75/18	28	<4	1340	<0.5	20	<2	<0.2	10
7/85/8	28	4	1090	<0.5	22	<2	<0.2	14
5/95/0	41	33	632	<0.5	27	<2	<0.2	51
7/93/0	41	16	767	<0.5	31	<2	<0.2	35
9/91/0	91	<4	1140	<0.5	19	<2	<0.2	9
Upper Protection Level (μg/l)		55	2400	5.5	140	55	2.4	55

1 Analyzed by the modified TCLP Method using deionized water as the extractant.

MATERIAL SAFETY DATA SHEET
FOR COAL ASH (FLY ASH, BOTTOM ASH, AND BOILER SLAG)

WARNING: DO NOT ALLOW THIS PRODUCT OR THE DUSTS FROM THIS PRODUCT

. TO GET INTO THE EYES 2. TO REMAIN ON THE SKIN IF IRRITATION OCCURS 3 TO BE INHALED (BREATHED IN)
-. TO GET INTO MOUTH OR TO BE SWALLOWED

I. MANUFACTURER

A Manufacturer.

AEP system coal fired steam electric generating plants

B. For more information contact Ash Management Section
American Electric Power Service Corporation
P.O. Box 16631
Columbus, Ohio 43216-6631
(614) 223-1388

II. HAZARDOUS CONSTITUENTS (as determined by 29 CFR 1910. 1200 (g) (2) (I) (C) (1))

	APPROXIMATE CONCENTRATION RANGE		APPROXIMATE CONCENTRATION RANGE
Amorphous Silica (SiO_2)	1-65%	Titanium Dioxide (TiO_2)	0-5 %
Crystalline Silica (SiO_2)	0-7 %	Calcium Oxide (CaO)	0-30%
Aluminum Oxide (Al_2O_3)	15-40%	Magnesium Oxide (MgO)	0-6 %
Iron Oxide (Fe_2O_3)	1-60%	Sodium Oxide (Na_2O)	0-2 %
		Potassium Oxide (K_2O)	0-5 %
		Sulfur Trioxide (SO_3)	0-15%
		Phosphorus Pentoxide (P_2O_5)	0-1 %

NOTE. See Part VI regarding trace elements.

III. OSHA PERMISSIBLE EXPOSURE LIMITS (PEL) AND ACGIH THRESHOLD LIMIT VALUES (TLV)

CONSTITUENTS	ACGIH TLV 1990-91 (mg/M^3)	OSHA PEL (mg/M^3)	CONSTITUENTS	ACGIH TLV 1990-91 (mg/M^3)	OSHA PEL (mg/M^3)
Silica (SiO_2)					
A. Quartz	0.1 (Note 1)	0 1 (Note 2)	Aluminum Oxide (Al_2O_3)	10	15
			Iron Oxide (Fe_2O_3)	5	10
B. Cristobalite	.05 (Note 1)	0.05 (Note 2)	Titanium Dioxide (TiO_2)	10	10
			Calcium Oxide (CaO)	2	5
C. Tridymite	.05 (Note 1)	0.05 (Note 2)	Magnesium Oxide (MgO)	10	10
			Arsenic (As)	0.2	0.01
D Amorphous	10	6.0 (Note 2)	Sodium Oxide (Na_2O)	(Note 4)	(Note 3)
			Potassium Oxide (K_2O)	(Note 4)	(Note 3)
			Sulfur Trioxide (SO_3)	(Note 4)	(Note 3)
			Phosphorous Pentoxide (P_2O_5)	(Note 4)	(Note 3)

Note 1: This is the ACGIH adopted value for 1990-91.
Note 2. See OSHA 29 CFR 1910.1000. Table Z-1-A, Z-3

Note 3· The PEL for this constituent does not currently exist.
Note 4· The TLV for this constituent does not currently exist.

IV. PHYSICAL CHARACTERISTICS AND DATA

A. Fly Ash

Fly ash consists principally of minute, separate glass spheres together with some crystalline matter and varying amounts of unburned carbon. It ranges in color from light tan or light gray to almost black depending on the proportions of carbon and iron. The glass spheres vary in size from approximately 0.007 mm (medium silt) to 0.2 mm (fine sand), or 7 to 200 microns.

B. Bottom Ash

Bottom ash is a granular material with about the same upper and lower particle size limits as fine concrete aggregate (concrete sand). The basic particle shape of bottom ash is angular. It ranges in color from a medium brown or medium gray to almost black.

C. Boiler Slag

Boiler slag is also granular and angular with almost the same particle size limits as bottom ash. It is a uniform shiny, black color and resembles crushed coal or black glass.

D General

Fly ash, bottom ash, and boiler slag are comprised of the constituents listed in Section II. The majority of these constituents are fused together in a glassy matrix.

All three ashes are moderately soluble in water and have a specific gravity range of approximately 2-3.

Boiling points, vapor pressure, vapor density, percent volatile, and evaporation rate are not applicable to these solid materials.

V. FIRE AND EXPLOSION HAZARD INFORMATION

Fly ash, bottom ash, and boiler slag are non-flammable and non-explosive. Flash point, flammable limits, extinguishing media, special fire fighting procedures, and unusual fire and explosion hazards are not applicable to these materials.

VI. HEALTH HAZARD INFORMATION

The primary routes of entry are through the respiratory system (inhalation), eyes and skin. Fly ash, bottom ash, and boiler slag are primarily composed of inert dust (irritants to mucous membranes) with low concentrations of calcium oxide (an irritant to mucous membranes and wet skin) and crystalline silica (a pneumoconiosis-producing dust identified by IARC as a carcinogen based on laboratory animal data). Coal ash contains trace amounts of arsenic, barium, lead, strontium, vanadium and zinc. When fly ash is handled in confined areas without adequate ventilation, the OSHA PEL may be exceeded for arsenic which is an OSHA-designated carcinogen.

Exposure may result in irritation to eyes, skin, or the respiratory tract. Persistent exposure to airborne dust may decrease pulmonary functions.

EMERGENCY AND FIRST AID PROCEDURES:

In case of:

1. Eye contact - Immediately flush eyes thoroughly with water.
2. Skin contact - Immediately wash skin with soap and water if irritation occurs.
3. Inhalation - Immediately remove affected person(s) to fresh air from source.
4. Oral intake - rinse mouth out with water

Immediately contact physician or medical personnel if unusual coughing, tightness in chest or shortness of breath occurs after exposure or if skin or eye irritation persists.

VII. REACTIVITY INFORMATION

This product is stable; hazardous polymerization will not occur. There are no chemical incompatabilities or hazardous decomposition products.

VIII. SPILL OR LEAK PROCEDURE

Wetting with water will reduce airborne dust. Material may be disposed of as an inert solid in an appropriate solid waste landfill. See applicable Federal, State, and Local Regulations

IX. SPECIAL PROTECTION INFORMATION

If airborne dust exposure approaches the TLV or PEL, use NIOSH - approved respirators. (See Section III). Provide adequate ventilation. Do not allow these ashes or the dusts from these ashes to get into the eyes, to remain on the skin if irritation occurs, to be inhaled, to get into the mouth or to be swallowed. Contact lenses should not be worn when working with these ashes. Wear appropriate personal protective equipment, such as goggles.

X. SPECIAL PRECAUTIONS

Do not create unnecessary airborne dust when handling. Industrial hygiene surveys of worker exposure in specific ash handling operations are needed to determine the need for engineering controls of airborne dust levels, respiratory protection equipment, and other measures. Under certain conditions, such as handling in confined areas, without adequate ventilation trace metal oxides (including arsenic, iron, and vanadium) may exceed the OSHA permissible exposure levels and require personal protective equipment.

XI. LABELING

Contains Coal Ash (Fly Ash, Bottom Ash, or Boiler Slag)

WARNING: Persistent exposure to airborne dust may harm lungs and decrease pulmonary functions. Exposure may result in irritation to eyes, skin or the respiratory tract. Contains material which may cause cancer based on laboratory animal data. Consult material safety data sheet for special protections and precautionary information.

For further information contact: Ash Management Section
American Electric Power Service Corporation, P.O. Box 16631
Columbus, Ohio 43216 (614) 223-1388

SECTION 9.6 - PROCEDURES DETAILS

SECTION 9.6 - PROCEDURE DETAILS

9.6.1 DRILLING, SAMPLING, and CLASSIFICATION

Field and laboratory procedures used were in accordance with the American Standard of Testing Materials (ASTM). The ASTM procedure designation listed below with the description of the work completed.

9.6.1.1 Drilling and Sampling Methods

Drilling at the site was completed using truck and all-terrain vehicle mounted drill rigs using auger and fluid rotary drilling methods to advance the borings. Disturbed soil samples were attempted at regular intervals using a 2-inch O.D. split-barrel sampler driven by blows from a 140-pound hammer freely falling 30 inches (Standard Penetration Test, ASTM D-1586). Undisturbed samples were obtained by hydraulically pressing thin-walled tube samplers (Shelby Tubes) into the soil at a constant rate of penetration (ASTM D-1587). Split-barrel samples were identified in the field and preserved in air-tight containers. Undisturbed samples were preserved in the sampling tube by removing cuttings from the ends of the tube and sealing the tube with wax. The undisturbed samples were extruded and identified in the laboratory. Bedrock was cored in selected borings and at select depths using a double-tube NXM core barrel with a diamond rock bit using water as the circulating fluid (ASTM D-2113). Recovered rock cores were identified in the field by BBC&M geologists and were preserved in compartmented boxes (ASTM D-5079).

In general, the borings were advanced through the soils using hollow-stem augers and advanced into the bedrock using fluid rotary drilling methods. At locations where instrumentation was to be installed in the borehole after drilling, the hollow-stem augers were removed and replaced with 4, 6, or 8-inch steel casings prior to advancing the borings into the bedrock. At locations where no instrumentation was to be installed, bedrock core was generally obtained by working through the hollow-stem augers. The borings which were advanced into the bedrock without obtaining core were done so using rotary methods and either water or drilling mud as a circulating fluid.

In addition to obtaining subsurface soil samples with the Standard Penetration Test, samples were also collected from a direct-push rig at 22 locations within the pavement across the site. The samples were taken continuously beneath the pavement and base material to the completion depth, identified in the field by BBC&M geologists, and preserved in acetate liners and compartmented boxes.

9.6.1.2 Soil and Bedrock Classification

Soils were classified in the field and in the laboratory into different categories based on several characteristics. The characterization was based on consistency, color, material type, and the percentage of minor components. Soils described in this report have been classified generally in accordance with the Unified Soil Classification System (ASTM D-2487 and D-2488); this system has been augmented by the use of special adjectives to designate the approximate percentages of minor soil components. The soil descriptions coupled with the field and laboratory testing were used to distinguish stratigraphic units.

Bedrock at the site was identified based on the hardness, color, and rock type. In addition, the descriptions include discussion of bedding, fracturing, and minor inclusions or other modifications. Where cores were obtained, measurements of percent recovery and Rock Quality Designation (RQD) were also made. In a number of the borings, rock core was not obtained. It these cases, the rock was identified based on the drill cutting returned to the ground surface in the drilling fluid and based on the drill stem behavior as the boring was advanced using the tricone bit. When these procedures were used, less bedrock information could be obtained, the descriptions on the logs are briefer, and the stratigraphic changes are determined less accurately. Additionally, distinguishing between the grout (medium-hard gray fines) and shale (medium-hard gray fines) based on drill cuttings proved difficult; on this basis most of the bedrock stratigraphy was identified based on bedrock cores.

9.6.1.3 Field and Laboratory Testing

Four types of geotechnical field tests were completed during the drilling of the borings for the project:

1) Visual Identification (soils and bedrock, see previous section)
2) Standard Penetration Tests (soils)
3) Approximation of Unconfined Compressive Strength (soils)
4) Determination of Rock Quality Designation (bedrock)

Standard Penetration Tests are completed by counting the blows per six inch increment as a 140-pound hammer is used to drive a standard split-barrel sampler into the soil. The number of blows per foot is referred to as the N values and is used to approximate the density of granular.

Hand-penetrometer measurements are taken on samples exhibiting cohesion. The resulting "H" value is the approximate unconfined compressive strength of the cohesive portion of the sample.

Rock Quality Designation (RQD) is a measure of the general competency of the bedrock as related to horizontal bedding and fracturing. The RQD (ASTM D-6032) is expressed as a percentage and is determined by summing the length of all core pieces with a length equal to or greater the 2 times the diameter of the core and dividing the sum by the total length of the core run. ASTM uses RQD to designate bedrock into categories as follows:

BEDROCK QUALITY	RQD
VERY POOR	0-25
POOR	25-50
FAIR	50-75
GOOD	75-90
EXCELLENT	90-100

The soil samples were visually identified in the field and then further analyzed in the laboratory. In the laboratory classification testing included:

- visual identifications;
- natural moisture contents (ASTM D-2216);
- Atterberg limit determinations (ASTM D-4318); and,
- gradation analyses (ASTM D-1140 and D-422).

The classification testing was used to confirm the visual identifications completed in the field. Based on the results of the laboratory testing, the field boring logs were modified (if necessary).

One-dimensional consolidation testing was also performed on four representative undisturbed samples (ASTM D-2435). Soil permeability was determined in accordance with Lambe, Soil Testing for Engineers, 1951, from the results of the consolidation tests.

Three triaxial compression test series (ASTM D-4767) were performed to determine the strength and stress-strain relationships of a cylindrical specimen from undisturbed samples of the upper and lower silty clays. Samples are isotopically consolidated and sheared in compression without drainage at a constant rate of axial deformation (strain controlled). Pore pressures are measured to calculate effective stresses.

Unconfined compressive testing was performed on samples of bedrock and grout (ASTM D-2938).

9.6.2 WELL CASING AND INSTALLATION

9.6.2.1 Geophysical Casings and Installation

The borings which were drilled primarily for down-hole and cross-hole geophysical purposes use have been designated as "GC" borings. Geophysical borings were drilled at 28 locations. Borings GC-201 through GC-209 and GC-211 through GC-219 were drilled using 3.25-inch ID hollow-stem augers in soils and 6-inch casings with 5-7/8-inch tricone bits in the bedrock. Borings GC-301 through GC-310, were drilled using 4.25-inch ID hollow-stem augers in soils and 8-inch casings with 7-7/8-inch tricone bits in the bedrock. An attempt was made to advance the borings to a depth of approximately 10 feet beneath the base of the coal zone. Borings GC-202, GC-203, GC-212, GC-213, GC-214, however, were terminated short of this depth.

Borings GC-201 through GC-209 and GC-211 through GC-219 were converted for geophysical use at completion by installing 4-inch diameter, flush-joint, unslotted, PVC casings. The casings were grouted into place using either a neat-cement grout or a 50-50 bentonite-cement grout. Borings GC-301 through GC-310 were converted for geophysical use at completion by installing 5-inch diameter, flush-joint, solid, PVC casings. The casings were grouted into place using a 5% bentonite-cement grout. The casings were installed and grouted generally by completing the following:

1. Connecting an expansion seal (shale trap) to the casing near the bottom or at an elevation slightly above any voids into which drilling fluid loss was evident. The expansion seal served to resist upward buoyant forces as the grout solidified and to prevent grout loss into voids or fractures.
2. Prior to installing the casings into the borings, approximately 20 gallons of grout was placed into the bottom of the boring using tremie methods.
3. The casing was set into the boring which displaced the grout in the bottom of the hole.
4. The installed casing was filled with water to compensate for buoyant forces as the grout solidified.
5. The remainder of the annular space between the casings and the boring wall was filled with grout.

6. The portion of the casing which extended above the ground surface was cut off near the ground surface and a flush mount man-hole type cover was installed in concrete over the casing.

A summary of completion details and a completion diagram for each boring are included in Section 9.2.

9.6.2.2 Groundwater Monitoring Wells

The borings which were drilled primarily for groundwater monitoring have been designated as "P" borings. Monitoring wells were installed at 19 locations (Borings P-221 though P-228 and P-301 through P-311). At locations where cluster wells were installed, the well completed into the coal zone was designated as the "A" well and subsequent shallower wells were designated as "B" and "C" wells. A total of 38 groundwater monitoring wells were installed as part of this investigation. Four additional monitoring wells and one production wells were present on the site prior to this investigation.

At the locations of borings where bedrock wells were installed, the borings were advanced using 3.25-inch hollow-stem augers in soils and NXM core barrels in the bedrock. The bedrock portion of the wells were reamed prior to installing the wells by removing the hollow-stem augers, installing 6-inch casings through the soils, and using a 5-7/8-inch tricone bit and fluid rotary methods through the bedrock. At locations where voids were encountered at the coal zone, the borings were reamed to a depth a few feet above the void using the 5-7/8-inch tricone bit and a 3-1/8-inch tricone bit was used to ream the boring to the final depth. The borings were advanced to a depth of approximately 2 to 3 feet beneath the coal zone.

The shallow offset wells ("B" and "C" Wells) were installed at locations where saturated sands were encountered above the bedrock surface. The offset wells were generally drilled using 4.25-inch I.D. hollow-stem augers, and the wells were installed through the augers.

The wells consist of 2-inch diameter, flush-joint, PVC casings and screens. The well screens are nominal 5-foot lengths with 10 or 20 slot openings. The midpoint of the screen was generally set near the midpoint of the water bearing zone being monitored. The wells were installed by completing the following:

1. Setting the well screen and casing to the appropriate depth.
2. Installing a filter pack of washed quartz sand around the wells screen. The filter packs were installed by pouring the sand from the surface and measuring the level of the sand in the boring using a weighted tape. Borings P-221A and P-225A were completed into mine voids and no filter pack was installed, the grout for these borings was placed above expansion seals set above the mine void.
3. Placing a bentonite seal approximately 2 feet thick above the filter pack, the seal was comprised of 3/8-inch bentonite chips which were poured into the boring from the ground surface; the level of the bentonite was measured using a weighted tape.
4. Filling the remainder of the annular space with bentonite slurry grout (8 mesh Benseal) which was placed using tremie methods.
5. Cutting off the portion of the casing which extended above the ground surface to near the ground surface and installing a flush manhole type cover in concrete over the casing.

A summary of completion details in included in Section 9.2 of this report and a completion diagram for each well are included in Section 10.1 of this report.

The manhole covers for all "A" wells have been painted black, the covers for all of the "B" wells have been painted red, and the covers for all the "C" wells have been painted white. Additionally, brass tags indicating the well designation have been attached to the expansion caps for each well.

The monitoring wells were developed using a combination of airlifting and hand-bailing. The development was performed in order to remove sediment from the screens and casings and in order to sort the filter packs to optimize flow into the wells. Any well which was airlifted as part of development was also hand bailed afterward and was not sampled for a period of weeks after the development.

9.6.3 SURVEYING

The boring locations and elevations shown on the borings logs and on the summary sheets are based on the station and offset used during the grouting program completed at the site. The station and offset have in some cases been converted to a grid system for simplification of computer modeling. This was completed by converting the stationing to an "easting" and the offsets to a "northing". For example, Station 483+50, 25' left has been converted to East 48,350 North 25 and Station 485+00, 60' right has been converted to East 48,500 North -60. On many of the figures in this report the words "northing" and "easting" have not been used, for example a roadway stationing is commonly shown as 48,500 in reference to Station 485+00 or East 48,500.

The PK nail grid installed by ODOT in the test area was used as a reference for the site surveying. The PK nail near Station 483+00, 59' Right was used as the primary site benchmark and presumed to be located at East 48,300.00 North -59.00 and to have an Elevation (as provided by ODOT) of 826.72 feet above msl. Additionally, the row of PK nails installed at approximately 59 feet right were assumed to be located at North -59.00. Linn Engineering, Inc. of Zanesville, Ohio was retained to determine the locations and elevations of the monitoring wells and geophysical borings. The field work for the surveying was completed using an all-station instrument, to an accuracy of +/- 0.01 feet. The locations of other borings drilled at the site for this investigation were determined using measuring tapes and measuring wheels, the accuracy of the locations of these boring is generally believed to be within 5 feet of the reported location. Numerous borings were drilled at the site prior to this investigation by others. The method of determining the locations of these borings is unknown.

9.6.4 AQUIFER TESTING

9.6.4.1 Water Level Measurements

The static water levels in the monitoring wells were measured periodically during the investigation. The groundwater levels from which groundwater flow was calculated are summarized in Section 9.2 of this report. Full sets of water levels (all wells measured during the same day) were obtained during each groundwater sampling event and on two additional dates. The water levels in the wells were measured using an electric tape with markings at each one-hundredth of a foot. The measurements were referenced to the top of the PVC casing which had been surveyed to the nearest one-hundredth of a foot. The static levels, referenced to msl, were determined by subtracting the depth to the water surface from the elevation of the top of the PVC casings. The cumulative potential error due to surveying and water level measurements allows the water level elevations to be accurate to within +/- 0.02 feet. Other methods for measuring water levels during non-sampling events included wetted tapes and pressure transducers.

9.6.4.2 Aquifer Tests

Three methods were used in the field to collect data in an attempt to estimate the hydraulic conductivity (permeability) of the water bearing zones at the site:

1) Specific Capacity
2) Modified Slug Tests
3) Pump Tests

Specific Capacity

The monitoring wells at the site were developed in-part by hand bailing; hand bailing was also used to purge the wells prior to sampling. Data for the calculation of specific capacity were collected based on the change in the water level during the bailing of the wells. A pumping (bailing) rate was calculated by measuring the quantity of water removed and the time required to remove the water. Generally, between 10 and 30 gallons of water were removed during each bailing event. The induced drawdown was determined by lowering the bailer until the bottom touched the water surface prior to bailing. The rope was then marked. When the last bail of water was raised above the water level, the bailer was again lowered until the bottom touched the water surface and the rope again marked. The distance between the two marks was measured and recorded as the drawdown.

Slug Tests

During the test method investigation, modified slug tests were completed by measuring the static water level in the monitoring wells prior to removal of water by hand bailing. Multiple water levels were again measured after bailing had been terminated as the water level returned to a static condition. The post bailing measured levels were recorded with the amount of time that had passed after bailing was stopped. The difference between the measured levels and the initial static level, prior to bailing, is the residual drawdown. The water levels were made to the nearest one-hundredth of a foot using an electronic tape measure, and the times were measured to the nearest second using a stop watch. Generally, the residual water levels were measured for 10 to 30 minutes after bailing was completed. In several of the wells, the water levels had returned to a static condition prior to the first measurement of residual drawdown (30 to 40 seconds). In several other wells, little or no recovery of the static level was observed during the test period. The methods used are believed to be adequate where the permeabilities are less than about 1×10^{-3} cm/sec; where permeabilities are higher, rapid recovery of water level precludes accurate measurement of residual drawdown.

During Phase II of the project, slug test were completed by using a pressure transducer to record water level changes. The water level changes were induced by lowering and removing a solid steel rod into the monitoring wells. The transducer recorded water levels each second and by using a steel rod to displace water upward and downward, the initial change is nearly instantaneous. It is believed that this method provides more accurate test results and permits determination of hydraulic conductivity in more permeable materials.

Regardless of which method was used to induce and record water level changes, permeability was calculated in accordance with the equations detailed by Bauer and Rice (Groundwater, Vol. 27, No. 3, May-June 1989). The Phase I testing is considered modified because rather than plotting residual drawdown vs. time based water level changes from injecting or removing a "slug", residual drawdown vs. time is based on water level recoveries from hand bailing or air lifting.

Both of the tests (specific capacity and slug) described above measure the net permeability of the screened portions of the wells. Both of the tests can be affected by the effects of partial penetration. Partial penetration of the well screen causes water flowing into the screen from above or below the screen to follow a curved path. The effect of the longer curved flow path can increase the recovery time in the well which can cause the calculation of permeability to be slightly lower than the actual permeability. Because the aquifers at the site are relatively thin, most of the wells are nearly fully penetrating, and a single permeability value for each zone based on average test results for each zone was used in the calculation of flows; it is believed that the effects of partial penetration are not significant.

Pump Test

Well PW-1 is a 6-inch diameter well which was installed during the construction grouting program. It is believed that the well is completed in the coal zone and that it was used as a water supply source for the construction grouting. During this investigation, a submersible pump was installed in the well, and the well was used as a water supply source for the drilling operations. Two "mini" pump tests were completed in the well in an attempt to provide another means to calculate permeability and in an attempt to determine if interconnections were present between the coal zone and the water bearing sand zones. Static water levels were measured in the pumping well and in nearby monitoring wells completed in both the coal zone and the sand zones. The pump was then run at approximately 10 gallons per minute for several hours. During the pumping, water levels were periodically measured in both the pumping well and the other nearby wells. Approximately 0.02 feet of drawdown was induced in the pumping well and no measurable change was evident in any of the nearby monitoring wells. The data collected were inadequate for the determination of permeability using text book methods; however, permeability could be estimated based on the specific capacity. Because of the small amount of induced drawdown, interconnections between water-bearing units could not be determined. It is believed that PW-1 is completed in a mine void. Larger capacity pumps would be necessary to complete pump tests in void areas.

9.6.5 GROUNDWATER SAMPLING

Sample Collection

The groundwater samples were collected using hand bailing methods. New disposable bailers and ropes were used to purge and sample each well and were properly disposed of after use. The personnel purging and sampling the wells wore disposable Nitrile gloves which were changed prior to purging and sampling each well. Prior to collecting samples from the wells, the wells were purged by removing three times the volume of water in the wells by hand bailing. After purging the wells, the samples were collected and placed into the sample containers. All sample containers were supplied by the testing laboratory with the proper preservative already in the containers.

Field Analysis

The temperature, pH, and specific conductance of each water sample was measured in the field using a portable Corning Checkmate M-90 meter. Total dissolved solids was measured in the field for the test method phase of the investigation (first 4 sampling events) and in the laboratory during the full site investigation (subsequent 6 sampling events). The field analysis equipment was thoroughly rinsed with distilled water prior to each measurement. The instrument was calibrated in accordance with the manufacturer's specifications prior to use. The measurement of total dissolved solids in the field is a relative measurement and is based on the measurement of specific conductance. Because of the heavy reliance of total dissolved solids for the grout dissolution calculations, it was determined that more accurate measurements were needed and thus the change to laboratory analysis for Phase II of the project.

Laboratory Analysis

Analysis of parameters which could not be efficiently analyzed in the field, was completed by independent chemical laboratories (Advanced Analytics of Columbus, Ohio and Zande Environmental of Columbus, Ohio). Samples were properly preserved, tracked, and the analysis completed within the appropriate holding times. During the first 4 sampling events, the samples were unfiltered and the metals analysis was, therefore, for total metals. For the final 6 sampling events, the fraction of the sample to be analyzed for metals was field filtered using a 0.45 micron disposable filter and a peristaltic pump. The results of the analysis are therefore believed to be representative of the dissolved metals. The change between unfiltered and filtered samples was made to allow the comparison of results to be completed independent of well turbidity and possible secondary reactions as a result of the turbidity.

9.6.6 CROSS-HOLE GROUND PENETRATING RADAR

9.6.6.1 Data Acquisition

Radar measurements can be made in a single borehole (single-hole) or between boreholes (cross-hole). Single-hole measurements are typically made while raising or lowering the antennas with a constant separation (reflection mode). Cross-hole (transmission) measurements between boreholes can be made by raising or lowering transmitter and receiver antennas at the same rate to acquire a constant offset profile (COP). Measurements can also be made by keeping a transmitter antenna at a fixed position in one hole and lowering or raising a receiver antenna in another hole to acquire a multiple offset gather (MOG). Numerous MOG's made with the transmitter antenna located at different depths can be merged and processed to create physical property tomograms (2D models for the media plane between boreholes).

Based on the project objectives, system and antenna characteristics of the employed borehole radar system, and radar signal-attenuating characteristics of the study area geologic media, methods of cross-hole COP and MOG data acquisition were selected for borehole radar surveying in the Project Area. COP and MOG radar measurements were made along the eastbound passing and travel lanes during July and August of 2002. Four regions of the study area were surveyed using cross-hole radar:

1) eastbound travel lane Stations 469+40 to 469+68;
2) eastbound passing lane Stations 483+04 to 483679;
3) eastbound travel lane Stations 483+04 to 483+95; and,
4) eastbound travel lane Stations 485+30 to 486+40.

The boreholes that were used for radar measurements were drilled during either 1999 or 2002 (see Page 70 of Section 9.4).

Radar data were acquired using a commercial borehole radar system, with omni-directional dipole antennas (measured center frequency of 100 MHz in air) located in PVC-cased wells. The radar system employed relied on 98-foot long conductive cables (approximately 2.5 inches in diameter with a dielectric coated surface) for signal transmission between surface-located electronics and the antennas.

Although single-hole measurements have the potential to provide useful information regarding the subsurface, the radar antennas employed were omni-directional, and it was felt that potential anomalies in recorded data could therefore be spatially isolated in a more time-effective manner (with fewer surveys) by acquiring cross-hole measurements. Other factors supporting the decision to acquire cross-hole rather than single-hole data were:

1) physical properties of geologic media between wells could be determined (as a function of both lateral distance and depth) more accurately and in a more time-effective manner using cross-hole measurements; and,
2) the single- hole receiver response is strongly influenced by conductive cable-related affects with the employed radar system; such affects complicate single-hole data analysis.

9.6.6.2 <u>Cross-hole Radar Processing and Imaging</u>

Processing and imaging flows applied to cross-hole radar Constant Offset Profile (COP) and Multiple Offset Gather (MOG) data acquired are summarized in table form in the following sub-sections. Demonstrations of applying the complete flows to COP and MOG field data are presented in Page 71 of Section 9.4, with accompanying discussion provided in the following sub-sections.

9.6.6.2.1 Constant Offset Profile Analysis

After initially applying a dewow correction to suppress the low frequency component of data, true time zero (the time at which the transmitter antenna initially radiates a pulse of energy) was established based on traces that were acquired in air with a known dipole separation. Trace editing, data truncation, and frequency filtering (to suppress high frequency noise) were then conducted.

The average absolute amplitude of each COP trace (unscaled) was calculated across a 200 ns window. A broad window was selected for calculations rather than tightly windowing direct arrivals for two reasons:

3) because radar signal was often highly attenuated in certain geologic media for the surveyed offsets, and because refractions interfered with direct arrivals in the near surface, it was difficult (impossible in some cases) to always accurately window direct arrivals; and,
4) the specification of a broader window would also allow possible trace amplitude anomalies resulting from post-direct arrival scattering to be more easily recognized.

The approach taken allows an assessment (although somewhat qualitative) of relative media attenuation characteristics (related to conductivity and scattering loss) for a given set of measurements to be made, and also provides a means for comparing recorded amplitudes of different traces acquired in similar media types but at different borehole separations (effective penetration distance and recorded amplitude are a function of radar system limitations and other factors in addition to media attenuation characteristics). Traces were normalized after amplitude analysis for direct arrival picking and data display purposes.

Processing step	**Description**
Dewow correction	Suppression of low-frequency data component
Time zero correction	True time zero established based on traces acquired in air
Trace editing	Bad/noisy traces, and traces acquired in air killed
Data truncation	Records truncated to 220 ns
Bandpass filter	Ormsby filter: 0-30-90-120 MHz
Amplitude analysis	Average absolute amplitude calculated across 200 ns window
Trace normalization	Each trace scaled relative to maximum amplitude of the trace
Direct arrival picking	Direct arrival breaks picked for calculation of average media velocities

Data processing and imaging flow for cross-hole constant offset profile (COP) radar measurements.

In order to allow the calculation of average radar propagation velocities for geologic media between boreholes, direct arrivals (direct breaks) were manually picked. Such velocity calculations were based on assumptions that the boreholes did not deviate from vertical with depth, and that velocity was laterally constant throughout media between boreholes. Picked direct arrival times were interpolated across depths where high attenuation of radar signal or refraction interference prevented accurate direct arrival picks from being made. Direct arrival signal was unable to be enhanced through bandpass or *f-k* filtering in cases where near-surface refraction interference occurred. Using quantities from amplitude and direct break analyses, plots of average absolute amplitude and average radar propagation velocity (versus depth) were generated and displayed with processed COP records.

9.6.6.2.2 Multiple Offset Gather Analysis

The processing of MOG data was similar to the processing of COP data in that dewow correction, time zero correction, trace editing, data truncation, bandpass frequency filtering, and direct arrival picking were all conducted (see table below). One difference was that individual MOG's acquired between boreholes were merged together during the MOG data processing flow (Section 9.4, p. 71). Another difference was that inversion was conducted using MOG direct arrival travel time picks for tomographic imaging purposes. The basic idea behind velocity inversion/tomography is that when multiple travel time measurements along different ray paths (i.e. at different viewing angles) through a media plane of interest are obtained, the velocity distribution within the media plane can then be inferred from these measurements, as the spatial relationships of the sources and receivers are known.

Processing step	Description
Dewow correction	Suppression of low-frequency data component
Data merge	Merged individual MOG's into single file
Time zero correction	True time zero established based on traces acquired in air
Trace editing	Bad/noisy traces killed
Data truncation	Records truncated to 220 ns
Bandpass filter	Ormsby filter: 0-30-90-120 MHz
Trace normalization	Each trace scaled relative to maximum amplitude of the trace
Direct arrival picking	Direct arrival breaks picked for travel time inversion
Travel time inversion	Inversion conducted
Tomogram generation	Plotting of calculated velocity distribution between boreholes

Data processing and imaging flow for cross-hole multiple offset gather (MOG) radar measurements.

EM-wave propagation velocity can be approximated for practical purposes in most low loss, non-magnetic geologic media as the speed of light (*c*) divided by the square root of the media relative dielectric permittivity (*k*). For geologic (unconsolidated and consolidated) materials, *k* values typically range from approximately 3 to 25, depending upon mineralogy and water content. Air, quartz, and water have *k* values of 1, 4, and 80 respectively, and water content will therefore have a significant affect on media EM-wave velocity. Water content is related to porosity in fully saturated media, and changes in primary or secondary porosity of fully saturated media will result in EM-wave velocity changes (porosity changes in dry media will result in velocity changes of smaller magnitude). It is reasonable to expect that an increase in secondary porosity due to fracturing and void formation may occur in subsurface media where subsurface subsidence processes have been active. Therefore, it was felt that by determining/imaging lateral and vertical EM-wave velocity distribution using tomography, the potential to accurately locate possible areas of active mine-related subsidence in the subsurface would exist (in addition to the potential for accurately mapping lithologic variations).

The inversion process first involved dividing the media plane between boreholes into a specified grid of cells. Based on the calculated range (from COP measurements) of dominant EM wavelengths in the Project Area subsurface materials (3.0 feet to 4.9 feet; wavelength variation was mainly caused by media electrical property variation), a cell size of 0.67 ft^2 (9.8 inches (0.25 meters) vertically and horizontally) was specified for grids. Each cell within a plane was then assigned an initial velocity value (based on the measured average velocity at the cell depth), and the synthetic travel times through each cell along the portion of ray paths intersecting each cell were calculated. Through a process of comparing the sum of synthetic travel times along straight ray paths with the measured travel times, the velocities assigned to cells were iteratively changed/updated by the program in order to reduce differences between the synthetic model and measured travel times. Through trial inversions, it was determined that by limiting the maximum number of solution iterations to 20, reasonable velocity distribution models would be obtained (i.e. models that indicated media velocity variations between boreholes, but did not suffer from the development of extremely large/unrealistic variations).

Calculated velocity distributions were plotted, and pixel interpolation was then applied to gently smooth images. Although MOG measurements were made from 3.28 feet (1.0 meter) depth to the maximum possible depth for all boreholes surveyed, signal attenuation and refraction interference often prevented tomography attempts in the top several meters of the subsurface.

Concern exists when conducting inversion/tomographic imaging due to the issue of mathematical/solution non-uniqueness. In the case of borehole radar MOG surveying, the travel time measurements obtained through a media plane do not provide complete angular coverage, and therefore do not provide enough information to allow a mathematically unique reconstruction of the velocity distribution within the plane (i.e. an obtained solution is regarded as non-unique, because more than one velocity distribution model could be fit to a given set of travel time measurements). In order to improve the velocity distribution reconstruction process during travel time inversions, only high confidence travel time picks were considered (see above), and constraints (based on calculated ranges of average velocities for the Project Area media types) limiting the range of permissible solutions were specified.

Confidence in EM-wave velocity tomograms that were generated was established in several ways. Trial inversions were conducted using different types of starting models (i.e. mean and horizontal), and images obtained using both types of starting models were found to be quite similar to one another. A unique solution is independent of the type of starting model, and if solutions obtained using different starting models are extremely different from one another, then additional constraints on inversion solutions are necessary to reduce the problem of non-uniqueness. Velocity tomograms were also compared to average velocity versus depth plots that were generated from COP records, and to boring log information that were available for the surveyed boreholes. In all cases, tomogram velocity distributions were found to correlate well with trends in average velocity versus depth plots, and with lithologic boundaries indicated from boring log information (this is apparent from visual inspection of the data that were subsequently presented and discussed in Section 5.14 of this report).

9.6.7 SPECTRAL ANALYSIS OF SURFACE WAVES (SASW)

The SASW method consists of generating surface (Rayleigh) waves at a source point (S) and recording those waves at two receiver points (R1 and R2). The source (S), near receiver (R1) and far receiver (R2) are arranged in line S-R1-R2. Typically, the S-R2 distance is double the S-R1 distance. The common-receivers-midpoint (CRMP) geometry refers to holding the midpoint between the receivers fixed, while the receivers are progressively moved farther apart. The common-source (CS) geometry refers to holding the position of the source fixed, while the receivers are progressively away from the source. S is the source position, and R1 and R2 are the near and far receiver positions, respectively. The S-R2 distance is double the S-R1 distance. For the CS geometry, the source point (S) remains fixed while the receiver points move away to longer and longer horizontal offsets. For the CRMP geometry, the midpoint between receivers remains fixed while the receiver points move farther apart. Typically, the S-R1 and R1-R2 distances are equal, and double for each successive test point. For example, a typical distance progression is 1.6, 3.3, 6.6, 13.1, 26.2, 52.5, 105, and 210 feet (0.5, 1, 2, 4, 8, 16, 32, and 64 meters) for testing to depths of about 164 feet. Locations, offsets and geometry for SASW measurements in the Test Area were as follows:.

Test Number	Station	Offset	Geometry
1	483+18	62' RT	CRMP
2	484+00	62' RT	CRMP
3	484+00	133' RT	CRMP
4	489+71	62' RT	CRMP
5	484+00	66' RT	CRMP
6	484+00	110.5' RT	CRMP
7	484+00	121' RT	CRMP
8	484+00	91.5' RT	CRMP
9	484+00	0'	CRMP
10	483+50	61' RT	CS
11	483+50	61' RT	CS
12	483+50	61' RT	CS
13	483+50	61' RT	CS
14	484+80	62' RT	CRMP

The location, geometry, and spacing of the tests can be grouped as follows:

Tests 1, 2, 4, and 14: conducted parallel to eastbound lane along outside edge of outside shoulder, test 4 outside of remedied area at Station 489+71;

Tests 3, 5 through 8: conducted parallel to eastbound lane at Station 484+00 at various offsets on sloped right-of-way;

Test 9: conducted parallel to eastbound lane at Station 484+00 at center of median; and,

Tests 10 through 13: conducted from a common source location at Station 483+50 near outside edge of outside shoulder of eastbound lane, and along receiver lines 0, 15, 30, and 45 degrees from the longitudinal axis of the eastbound lane.

Typical dispersion curves from the SASW measurements are shown on Pages 106 through 108 of Section 9.4 (Stokoe, et al., 1994). Phase (Rayleigh wave) velocity is on the y-axis. The Rayleigh-wave velocity generally is 89% to 94% of the shear-wave velocity, depending on the Poisson's ratio of the material. Frequency is on the x-axis. In a homogeneous, isotropic earth (that is, no layering), Rayleigh waves are not dispersive; their velocities do not depend on the frequency (or wavelength) of the waves. In a layered earth, Rayleigh waves are dispersive and their velocities depend on the frequency of the waves. This dispersion occurs because waves of different frequency sample different depths in the layered earth; high-frequency (low- wavelength) waves sample shallow layers, while low-frequency (long-wavelength) waves sample deeper layers. So by using Rayleigh waves of many frequencies, a range of depths in the layered earth can be sampled.

9.6.8 SURFACE SEISMIC REFLECTION

9.6.8.1 Data Acquisition and Pre-Processing

Reflection data were acquired in the Project Area during the Fall of 1999 and during the Summer of 2001. This section provides details regarding the recording parameters and geometry of the seismic lines. The seismic data are presented in Section 9.4 of this report.

9.6.8.1.1 Shear-Wave Reflection Survey - 1999

Shear wave seismic reflection profiles were acquired along a 200-foot section of the eastbound lanes during the fall of 1999. Line Test-1 was acquired parallel to and 60 feet south of the southern edge of the eastbound lanes, between Stations 483+00 and 484+00 (100 feet apart), and Line GUE-I70-1 was acquired between Stations 483+00 and 485+00 along the southern edge of the eastbound lane. Seismic survey stations 100 and 300 corresponded to Stations 483+00 and 485+00 respectively.

Detailed information regarding the acquisition and recording parameters for lines Test-1 and GUE-I70-1 (acquired during 1999) is presented in the following table:

Description	Parameters
Spread type	In-line CDP split-spread
Energy source	Micro-Vib by Bay Geophysical Associates Inc., configured to generate preferential shear particle motion transverse to lines
Source interval	1 foot
Source offset	2 feet north of lines (located on soil for line Test-1, and on berm pavement for lines GUE-I70-1)
Source locations	Line Test-1 = Stations 483+25.5 to 483+97.5 (73 source locations), line GUE-I70-1 = Stations 482+95.5 to 484+97.5 (203 source locations)
Sweep type	Linear (start taper = 0.08 sec, end taper = 0.06 sec)
Sweep frequencies	50-400 Hz
Sweep length	4 sec
Record length	0.75 sec (4.75 sec listen time minus 4 sec sweep)
Recording instrument	OYO DAS-1, 24 bit A/D resolution
Recording channels	96 (with an additional 4 AUX channels)
Data format	Recorded in SEG-D 8048 format, converted to SEG-Y format
Field filter and gain	Low cut (3 Hz) to remove system noise, 48 dB constant scaling
Sample interval	0.25 ms
Geophones	Geospace model SMC-70 (40 Hz), one single-component

	horizontal element geophone oriented transverse to the line
Geophone interval	1 foot
Geophone locations	Line Test-1 = Stations 483+05 to 484+00 (all geophones live for each source location), line GUE-I70-1 = Stations 483+01 to 484+92 (roll along began at source location 483+49.5)

Data were acquired using a shear wave vibratory source configured to generate preferential shear particle motion transverse to the seismic lines (sometimes called crossline, or SH), and single component (horizontal element) 40 Hz geophones (Geospace model SMC-70) oriented transverse to the seismic lines. Data were recorded using a 0.25 ms sampling interval (resulting in a 2000 Hz Nyquist frequency) with a 96-channel (with 4 additional AUX channels) OYO Geospace DAS-1 seismograph. The change in surface elevation across the profiles was less than one vertical foot per one hundred lateral feet.

The energy source employed was a non-commercial vibrator (approximate dimensions: X and Z = 1 foot, Y = 2 feet; approximate weight = 300 pounds) that was designed to preferentially generate shear waves. Depending on the orientation of the source, preferential shear particle motion could be generated in-line or transverse to the seismic line. The vibrator consisted of 2 internal masses connected to an exterior box by springs, and was capable of generating frequencies in the range of 1 Hz to 1 GHz. Linear sweeps (up-sweeps) were used to generate frequencies ranging from 50 to 400 Hz for each record acquired. Start and end tapers (linear vibrator power control parameters) were used to facilitate source coupling with the ground at the start and end of the sweep, in an attempt to minimize recorded source-related noise. The source was configured to generate preferential shear particle motion transverse to the azimuths of seismic lines Test-1 and GUE-I70-1.

Reflection data were initially recorded in SEG-D format and subsequently converted to SEG-Y format. Vibrator signals were recorded during data acquisition on four AUX channels:

- the pilot sweep from the vibrator electronics (channel 0);
- source side plate acceleration (channel -1);
- source mass number 1 acceleration (channel -2); and,
- source mass number 2 acceleration (channel -3).

For each record uncorrelated traces were cross-correlated with a sweep signal (either recorded in the field or synthetically generated) to produce correlated records. Cross-correlation produces zero-phase wavelets in correlated traces when the sweep signal matches long wave trains recorded in uncorrelated traces.

9.6.8.1.2 Multi-Component Reflection Survey - 2001

Multi-component seismic reflection profiles were acquired along a 2206-foot section of the eastbound lanes during the summer of 2001 between Stations 466+94 and 489+00. Seismic lines that are referred to as EBTravel and EBPass were acquired along the south and north edges respectively of the eastbound lanes, and seismic lines that are referred to as WBPass and WBTravel were acquired along the south and north edges respectively of the westbound lanes. Seismic survey station 1000 corresponded to Station 489+00, and seismic survey station 3206 corresponded to Station 466+94.

Detailed information regarding the 2001 seismic reflection survey acquisition and recording parameters is presented in the following table.

Description	Parameters
Spread type	In-line C.P. split-spread
Energy source	IVI "Minivib II" buggy, capable of generating preferential shear particle motion in-line and transverse to the line, and preferential compressional particle motion
Source configurations	Line EBTravel: 3 configurations (3, 3-component (3-C) records for each source station), lines EBPass and WBPass: transverse shear configuration (1, 3-C record for each source station), line WBTravel: transverse and in-line shear configurations (2, 3-C records for each source station)
Source interval	For line EBTravel in-line and transverse shear configurations the source interval was 1 foot for Stations 475+58 to 489+00, and 2 feet for Stations 466+94 to 475+56, for line EBTravel compressional source configuration and line EBPass transverse shear configuration the source interval was 2 feet for all stations
Source offset	Source baseplate offset 6 feet from lines on soil (average offset)
Source locations	Stations 466+94 to 489+00
Sweep type	Linear (start taper = 0.1 sec, end taper = 0.1 sec)
Sweep frequencies	50-500 Hz
Sweep, record lengths	4 sec, 1 sec (5 sec listen time minus 4 sec sweep)
Recording instrument	Geometrics 48-channel StrataView and StataVisor modules connected in series, 24 bit A/D resolution
Recording channels	240 total, 80 3-component geophones deployed for each shot (3 channels used geophone, channel 1 of 240 used to record pilot)
Data format	Recorded in SEG-2 format, converted to SEG-Y format
Field filter and gain	No field filters applied, pre-amplifier gain applied as a function of absolute offset (channels 0-30 = 0 dB, channels 30-32 = 24 dB, channels 32 - 240 = 36 dB, channel 240 = 48 dB)
Sample interval	0.25 ms
Geophones	Geospace model GS-20DX (10 Hz), one 3-component geophone with orthogonal elements planted at each station
Geophone interval	2 feet
Geophone locations	Stations 466+94 to 489+00, when the source reached the last geophone the first 16 phones were leapfrogged to the line end

Data were acquired with a single 3-component (orthogonal elements) 10 Hz geophone (Geospace model GS-20DX) planted at each station using a truck-mounted vibratory source (capable of generating preferential shear or compressional particle motion). Data were recorded using a 0.25 ms sampling interval with 4, 48-channel Geometrics StrataView seismographs and one Geometrics

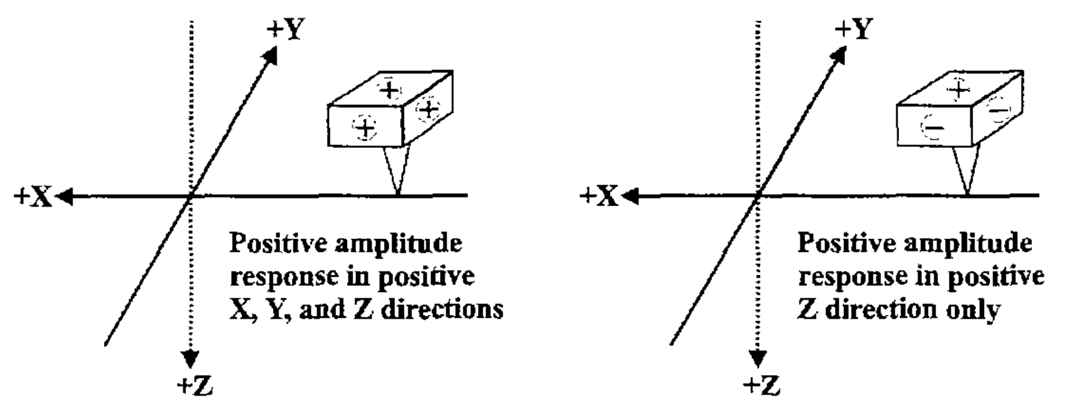
StrataVisor seismograph networked to allow simultaneous 240-channel recording. The change in surface elevation across the profiles was less than one vertical foot per one hundred lateral feet.

The vibratory energy source employed was mounted on an Industrial Vehicles International, Inc. (IVI) "Minivib II" buggy, and was capable (depending on vibrator piston and baseplate orientation) of generating preferential shear particle motion in the direction of the line (sometimes called in-line, or SV) or transverse to the line (sometimes called crossline, or SH), and preferential compressional particle motion (sometimes called vertical, or P). Linear sweeps (up-sweeps) were used to generate frequencies ranging from 50 to 500 Hz for each record acquired. For line eastbound travel (EBTravel) the 3 possible source configurations were used and 9-component (9-C) data were acquired using 3-component (3-C) geophones. For both lines EBPass and WBPass the source was configured to generate preferential shear particle motion transverse to the line, and 3-C data were acquired using 3-C geophones. For line WBTravel two source configurations were used (transverse and in-line shear configurations), and 6-C data were recorded using 3-C geophones. In subsequent sections of this appendix, components of a line will be specified (when referring to data) in terms of orthogonal source and receiver components in a Cartesian system. For example, the component of line EBPass recorded using a source and geophone that were both orientated transverse to line, will be referred to as line EBPassYY (YY refers to the source and geophone arrangements respectively in a Cartesian system).

Reflection data were initially recorded in SEG-2 format and converted to SEG-Y format.

When 3-C geophones with orthogonal elements (one vertical, and two horizontal) arranged in a Cartesian system are employed, a right-handed coordinate system (with X, Y, and Z axes), with the Z-axis pointing downwards is recommended. The Z-axis corresponds to a vertically oriented geophone element, while the X- and Y-axes correspond to horizontal geophone elements, oriented inline and transverse to the seismic line respectively.

Proposed recommendations state that a tap on the top of a geophone case, and taps on the sides of the geophone case in the positive X-axis direction (in the direction of source advancement), and positive Y-axis direction (with a positive rotation angle of +90 degrees from the positive X-axis direction) should all yield consistent initial (positive) amplitudes. For the 2001 multi-component seismic reflection survey conducted in the Project Area, data were acquired for lines EBTravel, EBPass, WBPass, and WBTravel using 3-C geophones, with elements arranged in a Cartesian system. A tap on the case top of the geophone model that was used yielded an initial positive amplitude response, however, taps on the sides of a geophone case in the positive X-axis (west) and Y-axis (north) directions yielded initial negative amplitudes (see figure below), which differ from the proposed multi-component polarity acquisition standards. In order to achieve polarity consistency between components that were recorded during the 2001 survey, the polarity of the Z-axis data components (corresponding to vertical geophone elements) were reversed during data pre-processing. A reverse polarity convention (according to SEG recommendations) is used for display of the 2001 data.



(a) SEG Recommended recording polarities (b) Acquisition polarities for 2001 survey

Seismic lines EBTravel, EBPass, WBPass, and WBTravel were recorded using a 2-foot geophone interval and in-line and split spread C.P. shooting on a nearly horizontal surface (i.e. less than 1 foot elevation change per 100 feet). For each of the profiles 80, 3-component geophones (with orthogonal elements) were deployed at one time along the line (3 recording channels per geophone, with channel 1 of 240 used to record the pilot sweep). When the source reached the last geophone, the first 16 geophones were leapfrogged to the end of the line and source advancement continued down the line.

Truncation (from 1.0 sec to 300 ms) was performed in order to minimize the computational time required for data processing and imaging. Traces recorded using channels 193-240 for low numbered shots (when the source was positioned at survey stations 1000-1158) on line EBTravel (in-line and transverse source records) were eliminated because of data acquisition system problems. Statistical processes were used to eliminate shots containing noisy or bad traces in order to efficiently edit traces.

9.6.8.2 Data Analysis and Processing

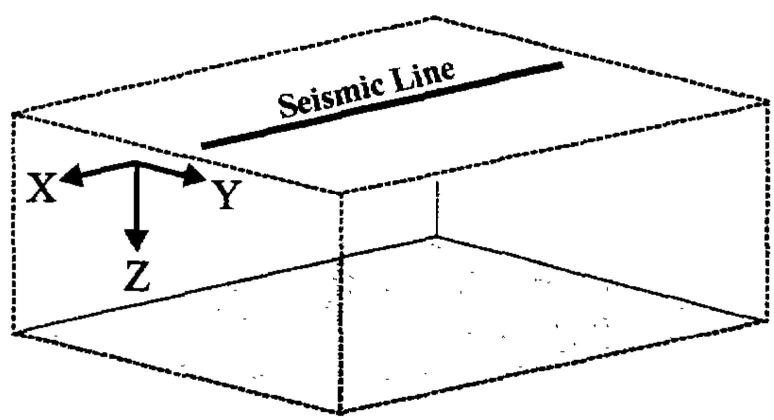
9.6.8.2.1 Overview

This section provides details regarding the analysis and processing of the seismic reflection data acquired at in the Interstate 70 study area. Nomenclature that is used to describe multi-component data, in terms of source and receiver orientations and preferential polarizations, is illustrated on the following page.

S-wave reflections from the bedrock and overburden interface were consistently measured in both the XX component (in-line in-line, or SV-SV) and the YY component (crossline-crossline, or SH-SH) field data. However, noise from surface waves resulted in the optimum reflection window of XX component data being relatively narrow. Stacks of traces that were produced using YY component data had a higher signal-to-noise ratio and imaged the top-of-bedrock better than stacks produced using XX component data.

Source Orientation

Receiver Orientation	In-line Horizontal (X)	Cross-line Horizontal (Y)	Vertical (Z)
In-line Horizontal (X)	XX	YX	ZX
Cross-line Horizontal (Y)	XY	YY	ZY
Vertical (Z)	XZ	YZ	ZZ



Wave reflections from the unsaturated and saturated overburden interface were recorded in ZZ component (vertical-vertical, or P-P) field data, due to a large P-wave velocity increase across this interface. S-wave reflections from this interface however were not o bserved in acquired data components. Arrival times of P-wave reflections and characteristics of recorded noise modes made it challenging to process and use P-wave reflections from the top of the saturated overburden. P-wave events from deeper contrasts in impedance could not be resolved in field data due to the following:

1) surface wave and air wave noise;
2) a high P-wave reflection coefficient at the top of the saturated overburden;
3) low P-wave reflection coefficients at deeper interfaces; and,
4) interference effects and poor resolution.

Calculations that were based on P- and S-wave reflection velocities and dominant wavelengths suggest that the vertical resolution of S-waves in the study area dry overburden was more than 1.7 times the resolution of P-waves, while the resolution of S-waves in the saturated overburden for the study area was more than 4.7 times that of P-waves.

Comparing known subsurface conditions with processed stacked sections indicates that the combined P- and S-wave common-mode reflection information allowed the near-surface geologic sequence to be imaged more effectively than using solely the S-wave or P-wave information. Areas of the subsurface where geologic discontinuities were present were most accurately delineated through the processing and interpretation of YY component data. The mine-subsidence project-related objectives in the study area would not have been met using the traditionally acquired P-P component data.

9.6.8.2.2 XX Data Versus YY Data: Factors Affecting Imaging Potential

In order to produce an accurate image of the subsurface using seismic reflection data, reflection energy (referred to as signal) must first be confidently identified. Random noise and different types of coherent noise (i.e. types non-reflection energy) recorded by geophones can destructively interfere with signal of interest, and this can make accurate seismic imaging difficult or even impossible. A main goal of seismic reflection data processing is to enhance identifiable signal by suppressing noise, and to generate images of the subsurface containing minimal noise-related artifacts.

Traffic noise on the field records was higher for data recorded using X- and Z-oriented receivers, than for data recorded using Y-oriented receivers. Recorded traffic noise was predominantly low frequency (e.g. 5-25 Hz), and was therefore significantly suppressed on all components through the application of a low-cut frequency filter. Air wave noise was present in all data that were acquired using X- and Z-oriented receivers, and could not be suppressed without degrading the reflection signal quality. Air wave noise propagated along the receiver spread before the return of S-wave reflections from the bedrock. Processing procedures to attenuate air wave noise were not necessary to prevent it from severely degrading the S-wave reflection signal in the XX component data.

Detrimental, high amplitude, dispersive Love wave noise was not observed in most of the YY component data. This is because the S-wave velocity structure across the study area was such that near-surface road construction-related fill materials had a higher velocity than underlying overburden materials at most locations. For YY component data at far source-to-receiver offsets where the top-of-bedrock S-wave event was degraded by non-reflected energy, the noise was suppressed through *f-k* filtering and post-NMO stretch muting.

High amplitude Rayleigh wave noise was observed in the data recorded using X- and Z-oriented receivers. Rayleigh waves propagate in the direction of the seismic source with retrograde elliptical particle motion in the vertical plane. Rayleigh waves therefore strongly affect both the X and Z receiver components. Measurements made using acquired field data indicate a representative range for values of V_r (linear group velocity) in the study area of 575 ft/s to 650 ft/s. Rayleigh wave noise tended to mask the top-of-bedrock S-wave reflection that was recorded in XX component data. The

Rayleigh wave noise could not be sufficiently suppressed through frequency filtering, resulting in the optimum reflection window being narrower than the window for the YY component data.

Square root energy coefficients were calculated for the overburden and bedrock interface. Representative P- and S-wave velocities were calculated from the seismic data for the saturated overburden (directly above bedrock) of 5150 ft/s and 700 ft/s respectively. An S-wave velocity of 2750 ft/s for the bedrock, and an approximate P-wave velocity of 5500 ft/s (assuming a *Vp/Vs* ratio of 2.0), were also used for calculations. The P-wave velocity of the bedrock could not be measured directly from the field data. A density contrast of 39 pounds per cubic foot was estimated for the region across the interface between saturated overburden and bedrock for calculations. Results from calculations of the square root energy coefficients using these velocity and density estimates are plotted in Section 9.4 on Page 40 as a function of incidence angle. These calculations are based on assumptions that the interface is planar and that the media are isotropic.

The plots in Section 9.4 on Page 40 show that the magnitude of the S-wave reflection coefficient is high at normal incidence (0.68). The magnitudes of the SV-wave (left) and the SH-wave (right) reflection coefficients are also seen from a qualitative standpoint to be fairly similar to each other for most incidence angles. The maximum incidence angle that is shown roughly corresponds to the likely maximum source-to-receiver offset at which a top-of-bedrock S-wave reflection would be recorded in acquired field data. Energies of reflected and refracted mode-converted waves from an incident SV-wave are relatively low for this geologic situation, and such modes only occur at small (< 8 degrees) incidence angles. The reflected mode-converted P-wave and refracted mode-converted P-wave critical angles are indicated in Section 9.4 on Page 40. Based on the plots and analyses of the data presented in this section, it can be concluded that the possible effects of reflection coefficients on the S-wave imaging potential are likely to be minor relative to the affects of noise recorded in the S-wave data components.

XX component and YY component supergathers (each consisting of 3 smashed CMP gathers) from three locations along line EBTravel are shown in Section 9.4 on Page 48. The gathers are each shown before and after NMO-correction using S-wave stacking velocities calculated from YY component data. For the XX component supergather centered at Station 488+20, the event from the top-of-bedrock is slightly overcorrected (applied velocity was too low) using the YY component-derived velocity. However, traces observed on the dynamic stack function (plotted to the right of the NMO-corrected XX component gather in Section 9.4 on Page 48) indicate the data still stacked reasonably well at the applied velocity. The top-of-bedrock event is corrected and stacks give similar results for both components using supergathers that are centered at the other two locations. Analyses conducted using XX and YY data, suggested that comparable stacks for the two components could be obtained using a velocity field derived from YY component data. It was apparent from these analyses that other factors previously discussed in this section (e.g., optimum reflection windows and signal-to-noise ratios of acquired data) would have a greater impact than the small errors in the applied stacking velocities (i.e., < 3 percent) on the quality of constructed XX and YY component images.

The data processing flow for Line EBTravel S-wave reflection data (XX and YY and components) is summarized in the following table:

Processing step	Description
Vibroseis correlation	Both lines correlated with pilot sweep
Geometry	Defined using field notes and loaded to headers
Data truncation	Records truncated to 300 ms
Trace editing	Bad / noisy traces killed
Trace equalization	150 ms spatially varying window
f-k filter	Non-reflection energy/linear noise suppression
CMP sort	Sorted from shot gathers to midpoint gathers
Velocity analysis	Stacking velocity function derived from YY component through integrated analysis of shot gathers, constant velocity stacks, and semblance plots
NMO correction	Applied based on optimum stacking velocities
Stretch mute	30 percent
Bandpass filter	Zero-phase Ormsby filter: 50-80-160-200 Hz
AGC scaling	100 ms window
CMP ensemble / stack	Summed NMO-corrected CMP gathers

9.6.8.2.3 YY Data Versus ZZ Data: Factors Affecting Imaging Potential

Reflected P-wave energy is indicated on the interpreted records at zero-offset arrival times of about 30 ms. Depth estimates using velocity values that were derived from reflections when correlated with available boring log information indicate that the observed reflections are from the top-of-saturated-overburden (where dry or partially saturated unconsolidated overburden materials become fully saturated). Depth estimates from the events interpreted in Section 9.4 on Page 46, agree with acquired hydrogeologic well data, which indicated that water levels in overburden materials ranged from within 20 to 30 feet (6.1 to 9.1 m) of the ground surface along the eastbound lanes during 1999-2001.

At certain locations along line EBTravel, high amplitude P-wave reflections and refractions from the top-of-saturated overburden were clearly observed, and were well separated in the frequency domain from recorded noise modes. However, at most locations along the line, the arrival times of events and the noise on the data made it challenging to process the data to show the P-wave reflections from the top-of-saturated-overburden. P-wave reflections from geologic interfaces below the top-of-saturated-overburden, were not observed in any of the acquired records (this is subsequently explained).

Reflection and refraction analyses of data acquired in the study area indicated average P-wave velocities for unsaturated overburden around 1900 ft/s, and P-wave velocities around 5150 ft/s for the saturated overburden. Such large contrasts in unconsolidated material P-wave velocities due to water saturation have commonly been observed during near-surface reflection surveys. Acquired S-wave data contained S-wave reflections from the top-of-bedrock, but did not contain events correlating to top of saturated overburden (i.e., changes in overburden saturation could not be inferred using S-waves). This is because P- and S-waves are sensitive to different physical material properties. Despite possible changes in *Vs* related to changes in density or cohesion, the saturation of an unconsolidated material with water generally does not change the S-wave velocity appreciably relative to the change in P-wave velocity.

Square root energy coefficients were calculated for P- and S-waves incident on an interface between unsaturated and saturated overburden using data-derived P- and S-wave velocities, and approximate bulk densities. Results are plotted in Section 9.4 on Page 41 as a function of incidence angle, and are based on assumptions that the interface is planar, and that the media are isotropic. Representative study area media parameters used for the square root energy calculations are presented in the table below. P-wave velocities for the unsaturated and saturated overburden of 1900 ft/s and 5150 ft/s respectively, were used for calculations of the parameters shown in the following table:

	Unsaturated Overburden	Saturated Overburden	Bedrock
Vp (ft/sec)	1900	5150	5500
Vp (m/sec)	579	1570	1676
Vs (ft/sec)	700	700	2750
Vs (m/sec)	213	213	838
VP/VS	2.7	7.3	2.0
Poisson's Ratio	0.42	0.49	0.33
Density (lb/ft^3)	97	120	159
P-wave Reflection Coefficient	0.54	0.08	
S-wave Reflection Coefficient	0.11	0.61	

A variation in S-wave velocity across the unsaturated and saturated overburden interface was not detectable using seismic data, and an S-wave velocity of 700 ft/s was assumed as a representative value for the study area overburden in calculations. A contrast of 23 pounds per cubic foot was assumed as a density contrast at the interface between the unsaturated and saturated overburden. This was based on average density values of 97 lb/ft^3 for dry overburden materials and 120 lb/ft^3 for wet overburden materials.

The plots of the data demonstrate that for this geologic situation:

1) The magnitude of the P-wave reflection coefficient is much larger for all angles of incidence than the magnitude of the SV- or SH-wave reflection coefficients.

2) The energy of the reflected and refracted mode-converted waves from an incident P- or SV-wave are seen to be relatively small for all angles of incidence.

The magnitude of the P-wave reflection coefficient at normal incidence is 0.54, while the magnitude of the S-wave reflection coefficient at normal incidence is 0.11. Using a bedrock S-wave velocity of 2750 ft/s, an approximated bedrock P-wave velocity of 5500 ft/s (assuming a *Vp/Vs* ratio of 2.0), and an average bedrock bulk density of 159 lb/ft^3, normal incidence (cumulative) square root energy coefficients at the underlying overburden-bedrock interface are considered. The cumulative square root energy coefficients of reflected P- and S-waves (from incident P- and S-waves respectively) from the top-of-bedrock are 0.08 and 0.61.

General conclusions can be made based on calculations presented in this section, as follows:

1) P-wave energy reflected from the top-of-saturated-overburden (from an incident P-wave) is large relative to the S-wave energy reflected from this interface (from an incident S-wave).
2) P-wave energy reflected from the top-of-saturated-overburden (from an incident P-wave) is large relative to the P-wave energy reflected from the top-of-bedrock (from an incident P-wave).
3) S-wave energy reflected from the top-of-bedrock (from an incident S-wave) is large relative to the S-wave energy reflected from the top-of- saturated-overburden (from an incident S-wave).
4) S-wave energy reflected from the top-of-bedrock (from an incident S-wave) is large relative to the P-wave energy reflected from the top-of-bedrock (from an incident P-wave).

The air wave and high amplitude Rayleigh wave noise (in data recorded using X- and Z-oriented receivers) had arrival times at the near offsets that were similar to those of P-wave reflections from the top-of-saturated-overburden in the ZZ component data. The noise could not be sufficiently suppressed through frequency filtering without degrading the reflection signal, since the noise existed within the optimum P-wave reflection signal frequency range. A frequency-wavenumber *(f-k)* filter that was applied to the ZZ component data (prior to stacking) suppressed the air wave and the surface wave noise, but the necessity of attenuating the noise resulted in a narrow optimum window to enhance the P-wave event. The YY data S-wave event from the top-of-bedrock was not severely degraded by air wave or surface wave noise. The YY component (top-of-bedrock) S-wave reflection window was wider than the ZZ component (top-of-saturated-overburden) P-wave reflection window. A larger number of traces containing reflection energy could therefore be summed and stacked for the YY component data than for the ZZ component data.

Rayleigh wave noise, air wave noise, and P-wave energy reflected from the top-of-saturated-overburden (from a Z-oriented source), are strongly polarized in the vertical component, and to a lesser extent these sources of energy are also present on the horizontal component in the direction of the line (X-component). An X-directed component of the P-wave reflections are observed with relatively low amplitude in X-oriented receiver gathers, and are not interpretable in Y-oriented receiver gathers. The top-of-saturated-overburden could therefore be most effectively imaged using common-mode P-wave reflections in field gathers acquired using Z-oriented receivers. Reflected (non-converted mode) S-wave energy correlating to the top-of-bedrock, is also observed on certain gathers recorded using X- and Y-oriented receivers (for instance, at about 110 ms in the 487+88 ZX gather), and this resulted from S-wave generation by the Z-oriented source. Seismic sources are not perfectly pure in a polarization sense.

9.6.8.2.4 S-Wave Target Resolution Potential

The ability to distinguish two separate features and to observe detail using reflection data is related to resolution. Both vertical and lateral (horizontal) resolution must be considered in order to assess the potential of data for allowing reflecting horizons to be detected and resolved, reflectors and diffractors to be differentiated, and discontinuities in reflecting horizons to be inferred. Seismic reflection data were acquired with high C.P. (common-depth-point, i.e. the midpoint between a source and receiver) sampling intervals relative to the sampling intervals used for the majority of near-surface reflection surveys that are conducted.

Synthetic shot gathers were generated for comparison with field data and to investigate the resolution potential of field data relative to/ the study area geology. A zero-phase Ricker wavelet was used as the source for each model that was generated, and the source was located at the surface of each model. Reflecting boundary conditions were specified, and it was computationally feasible to extend the model bottom to a depth such that bottom reflections were not recorded during the time range of interest. Grid dispersion was minimized by specifying at least 7 grid points per wavelength in each region (regardless of velocity) of the models (e.g., at a velocity of 670 ft/s and a frequency of 100 Hz, the grid spacing would be at least 0.96 feet).

An S-wave interval velocity model was used to generate synthetic seismograms. The parameters of the model are as follows:

S-wave interval velocity (ft/sec)	Lithology	Layer thickness (feet)
670	Overburden	39
2500	Bedrock (shale)	20.5
2395	Coal (bituminous)	7
2500	Bedrock (shale)	150

The velocity and depth estimates were obtained through analysis of shot gathers. Velocity and depth approximations are also included for a 7-foot thick coal seam, that according to boring log information exists beneath 20.5 feet of bedrock near the location of the shot gather in Section 9.4 on Page 55. Reflections correlating to the top or bottom of the coal seam were not observed in field records and, therefore, the coal's shear velocity could not be directly measured. Instead, to model the Upper Freeport Coal the S-wave velocity of 2395 ft/s was used.

Based on the modeling work completed the following general conclusions are made:

1) The coal seam in the study area subsurface cannot be imaged using acquired SH-wave reflection data due to: a high reflection coefficient at the overburden and bedrock interface, inadequate signal-to-noise ratio of field data, source-related noise, wavelet ringiness, interference and poor resolution.

2) Lateral changes in material properties beneath the overburden and bedrock interface cannot be inferred using field data interference observations and / or amplitude-based criteria. Interference effects from deeper reflections have no evident effect on the top-of-bedrock reflection event at the dominant frequency of acquired field data.

In addition to affecting the potential for imaging reflecting horizons, vertical resolution also affects the potential for inferring discontinuities along reflecting horizons. A generally accepted threshold used to estimate the vertical resolution of reflection data is a quarter of the dominant wavelength. A similar threshold for easily inferring vertical offset along a reflecting horizon is that the offset must be at least equivalent to a quarter of the dominant wavelength.

A synthetic stacked section that was generated using the overburden and bedrock velocity and depth values determined from the field data. Five faults (associated with mine subsidence in this example) across an interface separating overburden and bedrock materials were modeled, with the amount of vertical offset for each fault specified as a fraction of the dominant wavelength. For the modeled center frequency of 80 Hz, the corresponding dominant wavelength in the overburden is 8.4 feet.

Vertical offset of the bedrock interface must be at least a quarter of the dominant wavelength to be easily inferred. In field data with a high signal to noise ratio, inference of offset less than a quarter of the dominant wavelength can be possible using diffractions. The modeled overburden and bedrock boundary was 39 feet deep at C.P. 100 (the modeled C.P. spacing was 0.5 feet), and due to continued downward offset along faults this boundary existed at a depth of 55.3 feet at the location of C.P. 600.

The Fresnel zone diameter can be used to estimate lateral resolution (a smaller diameter corresponds to higher lateral resolution), and therefore to estimate the potential of data to allow reflectors and diffractors to be differentiated. Using field data parameters the diameter of the Fresnel zone for the bedrock interface for a dominant wavelength of 8.4 feet is calculated to be 25.6 feet. Assuming a higher dominant reflection frequency of 100 Hz, the Fresnel zone diameter for this interface would be 22.9 feet. For an increasing overburden thickness or overburden velocity, or a decreasing frequency, the diameter of the Fresnel zone would increase.

Based on the modeling completed, the following general conclusions were made:

1) Vertical offset of the bedrock interface (along mine subsidence-related normal faults) must be at least a quarter of the dominant wavelength to be easily inferred using field data.

2) Reflections will appear to be continuous across a graben feature resulting from bedrock subsidence into a mine room when the feature's spatial extent is much smaller than the size of the Fresnel zone diameter.

9.6.8.2.5 P-Wave Target Resolution Potential

This section focuses on resolution issues related to common-mode P-wave reflection data. Synthetic seismograms were generated in order to investigate the resolution potential of ZZ component data relative to the field study area geology. The P-wave interval velocity model presented in the following table was used to generate the synthetic data presented in this section, and the model was constructed using velocities that were derived through the analysis of ZZ component shot gathers.

P-wave interval velocity (ft/sec)	Lithology	Layer thickness (feet)
1900	Unsaturated Overburden	29.5
5150	Saturated Overburden	11.5
5500	Bedrock (shale)	20
4790	Coal (bituminous)	7
5500	Bedrock (shale)	112

The model contains P-wave velocities for the unsaturated and saturated overburden materials that were derived from NMO and refraction analyses. P-wave velocities for the bedrock and a coal seam beneath the model overburden were approximated for modeling purposes. These quantities were not measurable directly from the data, and were approximated by assuming a *Vp/Vs* ratio of 2.0 for both materials. S-wave bedrock velocities obtained from refraction measurements across the study area ranged from 2500 ft/s to 3000 ft/s, and a P-wave velocity of 5500 ft/s was specified for the model bedrock. A P-wave velocity of 4790 ft/s was specified for the model coal. Boring log data from the site were used to establish representative thicknesses for materials in the model that could not be determined from the seismic data. Synthetic seismograms generated with models containing approximations for material bulk densities did not change the main conclusions that are demonstrated using the modeling results presented in this section.

Based on the work completed and the data processed, the following general conclusions can be made from the analysis of the resolution potential of ZZ component data:

1) P-wave energy reflected from the top-of-saturated-overburden dominates ZZ component synthetic data at all source to receiver offsets.
2) A high reflection coefficient at the top-of-saturated-overburden, lower reflection coefficients at deeper interfaces, noise, interference, and poor resolution prevent the interpretation of reflection events from below the top-of-saturated overburden in ZZ component field records.

Seismic wavelength (*wl*) affects vertical and lateral resolution, and is related to wave velocity (*V*) and frequency (*f*): $wl = V/f$. Using dry overburden average P- and S-wave velocities of 1900 ft/s and 700 ft/s respectively, and average dominant P- and S-wave data frequencies of 125 Hz and 80 Hz respectively, then the quarter-wavelengths (*wl*/4) of P- and S-waves in dry overburden are 3.8 feet and 2.2 feet respectively. Using saturated overburden average P- and S-wave velocities of 5150 ft/s and 700 ft/s respectively, and average dominant P- and S-wave frequencies of 125 Hz and 80 Hz respectively, then *wl*/4 values for P- and S-waves in saturated overburden are 10.3 feet and 2.2 feet respectively. Ignoring other factors that influence resolution potential, these calculations suggest that the resolution that can be achieved using S-waves in the study area dry overburden is more than 1.7 times that which can be achieved using P-waves, and that the resolution of S-waves in the study area saturated overburden is more than 4.7 times that of P-waves.

	Dry Overburden	Saturated Overburden
Average Vp (ft/sec)	1900	5150
Average V's (ft/sec)	700	700
Average Dominant P-Wave Frequency (Hz)	125	125
Average Dominant S-wave Frequency (Hz)	80	80
Quarter Wavelength (*wl*/4) for P-waves (ft)	3.8	10.3
Quarter Wavelength (*wl*/4) for S-waves (ft)	2.2	2.2
P-waves (*wl*/4) / S-waves (*wl*/4)	1.7	4.7

9.6.8.2.6 Data Processing

Common-mode P- and S-wave reflection data processing and imaging operations applied to each of the components (YY and ZZ) were established based on previous analyses of the data. The analysis flows applied to each of these data components are described in the following table.

Processing step	Description
Vibroseis correlation	Both lines correlated with pilot sweep
Geometry	Defined using field notes and loaded to headers
Data truncation	Records truncated to 300 ms
Trace editing	Bad / noisy traces killed
Trace equalization	150 ms spatially varying window
f-k filter	Non-reflection energy/linear noise suppression
CMP sort	Sorted from shot gathers to midpoint gathers
Velocity analysis	Integrated analysis of shot gathers, constant velocity stacks, and semblance plots for YY component, Integrated analysis of shot gathers and constant velocity stacks for ZZ component
NMO correction	Applied based on optimum stacking velocities
Stretch mute	30 percent for line EBTravelYY and 40 percent for line EBTravelZZ
Bandpass filter	Zero-phase Ormsby filters: 50-80-160-200 Hz for YY component, and 80-120-200-240 Hz for ZZ component
AGC scaling	100 ms window
CMP ensemble / stack	Summed NMO-corrected CMP gathers

An event correlating as the top-of-bedrock could consistently be identified in S-wave records acquired in the region east of the roadway collapse. Processing and imaging operations applied to the YY component data presented in this appendix were determined for the purpose of enhancing reflections from this impedance contrast. ZZ component records contained P-wave reflections correlating to depths of the top-of-saturated-overburden, and processing of ZZ component data focused on enhancing reflections from this impedance contrast. As previously mentioned, P-wave reflections from the top-of-saturated overburden were not identifiable on as large of a percentage of shot gathers, as were S-wave reflections from the top-of-bedrock (due to event arrival times and recorded noise characteristics). S-wave data required more accurate stacking velocities than did P-wave data for producing quality stacks. A given deviation from optimum stacking velocity would represent a much larger percentage of the optimum stacking velocity in the S-wave data case, since stacking velocities for S-wave data were much lower than those for P-wave data.

For the common-mode component shot gathers, high amplitude, linear, non-reflected energy remained in records after optimum bandpass frequency filtering. An *f-k* (frequency-wavenumber) filter was therefore evaluated and applied to each of the common-mode component shot records (after amplitude balancing) to suppress coherent, linear non-reflection energy. This processing step was critical for suppressing high amplitude surface wave noise (having arrival times and frequency content at near offsets similar to those of P-wave reflections) recorded in ZZ component data. *f-k* filtering was not as critical of a process for the XX or YY data, as at the arrival times of S-wave reflections linear noise was recorded at far offsets, and could therefore be largely suppressed after NMO corrections by proper stretch muting. However, evaluation of *f-k* filter effects on the XX and YY component data showed that an improvement in stacked signal quality, with minimal artifact generation was obtained.

The effectiveness of *f-k* filtering in improving records (as determined by noise suppression and reflection signal enhancement) prior to CMP sorting and stacking is demonstrated using ZZ and YY component field records from line EBTravel. These data were recorded with the respective source located at Station 486+38, and both records contained identifiable reflections prior to application of *f-k* filters. Bandpass filters and AGC were applied to the gathers before generating the plots, in order to demonstrate non-reflected energy suppression using *f-k* filters across reflection signal bandwidths.

The following general conclusions can be made from the analyses of *f-k* filtering of ZZ component and YY component data:

1) *f-k* filtering applied to the ZZ component and the YY component data is effective for suppressing coherent noise and enhancing reflection signal.

2) Improvement in stacked signal quality of the ZZ and the YY component data can be obtained by *f-k* filtering with minimal artifact generation.

9.6.8.2.7 P- and S-Wave Stacked Section Imaging

The data processing flow for S-wave (YY component) and P-wave (ZZ component) reflection data is summarized in the following table.

Processing Step	**Description**
Vibroseis correlation	Both lines correlated with pilot sweep
Geometry	Defined using field notes and loaded to headers
Data truncation	Records truncated to 300 ms
Trace editing	Bad / noisy traces killed
Trace Equalization	150 ms spatially varying window
f-k filter	Non-reflection energy/linear noise suppression
CMP sort	Sorted from shot gathers to midpoint gathers
Velocity analysis	Integrated analysis of shot gathers, constant velocity stacks, and semblance plots for YY component, Integrated analysis of shot gathers and constant velocity stacks for ZZ component
NMO correction	Applied based on optimum stacking velocities
Stretch mute	30% for line EBTravelYY and 40% for line EBTravelZZ
Bandpass filter	Zero-phase Ormsby filters: 50-80-160-200 Hz for YY component, and 80-120-200-240 Hz for ZZ component
AGC scaling	100 ms window
CMP ensemble/stack	Summed NMO-corrected CMP gathers

A comparison of sections from both (ZZ and YY) components (and consideration of the previous results) indicates that there are specific advantages and disadvantages associated with P- and S-wave reflection data acquired in the study area, as follows:

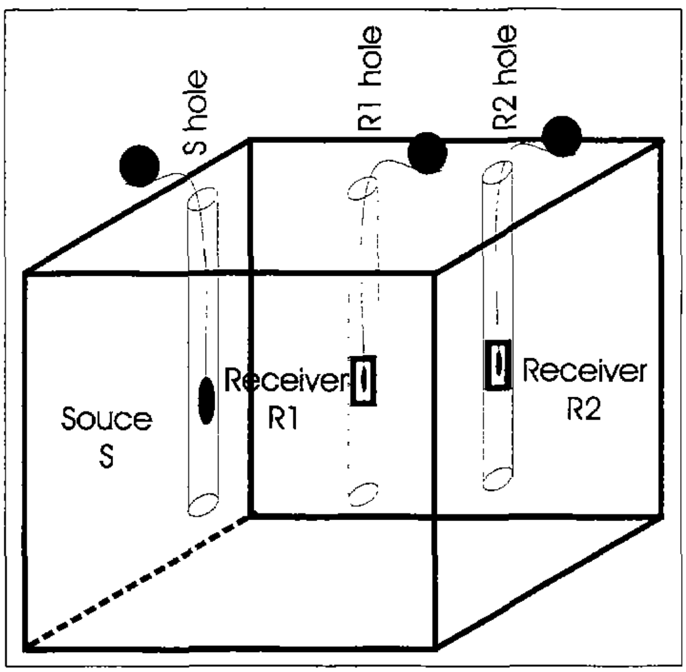
1) The top-of-saturated-overburden served as a detectable impedance contrast for P-waves but not for S-waves.
2) P-wave data cannot be used to image impedance contrasts located below the saturated overburden, while images of the top-of-bedrock can be constructed using S-wave reflections.
3) S-wave data offer the potential for allowing possible areas of the subsurface where subsidence processes have been active, to be identified based on observations of disruptions in the bedrock horizon, whereas P-wave data do not provide this potential.

9.6.9 CROSS-HOLE SEISMIC TESTS

9.6.9.1 Cross-hole Seismic Logging (CSL)

Cross-hole seismic logging (CSL) is a method to estimate the horizontal boring-to- boring seismic P-wave and S-wave velocities directly by measuring the travel-time of the elastic-wave energy between source and receivers located at the same depth. By testing a various depths, a velocity profile can be obtained.

The three-hole cross-hole setup was used (Woods, 1994), to minimize possible inaccuracies resulting from trigger-time measurements, near-field source effects, and coupling of the boreholes to the geologic materials. The borehole arrangement was source (S), near receiver (R1) and far receiver (R2), arranged in line S-R1-R2, as shown below. The nominal hole-to-hole distances were S-R1= 5 feet, S-R2= 15 feet, and R1-R2= 10 feet.



Source and receive designations for cross-hole seismic tests.

Two types of sources were used: an in-hole vertical hammer for generating vertically polarized shear waves (SV waves); and an in-hole, oriented, pneumatic horizontal hammer for generating horizontally polarized shear waves (SH waves). The seismic characteristics were unknown at the beginning of the project so the ASTM D4428/D4428M standard for these cross-hole tests was followed. Once the seismic profile is better established, it is possible to select other sampling frequency / depths based on velocity contrasts, dips of layers, and spacing of boreholes. Figure 11 from Stokoe and Hoar (1978) is a concise chart for determining the potential for refraction of waves in a layered system and, consequently, a means of determining the ideal sampling frequency. The procedure varied from the ASTM standard in three minor ways.

1) The S-R1 distance was 5 feet rather than 10 feet.

2) The measurements were taken going from the bottom to top in the boreholes, rather than from top to bottom and back up again. The bottom-to-top procedure is standard in the oil industry, the best depth control is achieved by keeping tension on the wireline.

3) For the SH velocity measurements, orientation rods were used to orient the source and receivers.

The verticality of each boring was measured using a SINCO Digitilt Inclinometer (Slope Indicator Company, Seattle). Wave propagation velocities were calculated from the differences in arrival times between the two receiver holes, R1 and R2. Arrival times were picked by eye, picking the first break or the first onset of energy. Wave propagation velocity is the distance between R1 and R2 divided by the difference in times measured at R1 and R2.

Three cross-hole seismic test sets conducted in boreholes on the north and south edges of the eastbound lanes near Station 483+00. The three test sets are as follows:

Xh2: South side, vertically-polarized shear wave (SV), source: GC-213, receiver 1: GC-214, receiver 2: GC-215

Xh3: North side, vertically-polarized shear wave (SV), source: GC-204, receiver 1: GC- 203, receiver 2: GC-202

Xh4: North side, horizontally-polarized shear wave (SH), source: GC-204, receiver 1: GC-203, receiver 2: GC-202

The three borehole method used here eliminates the possibility of near-field source effects contaminating the data. To obtain shear-wave velocity in these tests, one measures the *difference* in travel-time between receivers 1 and 2, thus eliminating source effects. Then knowing the distance between receivers 1 and 2, one calculates the shear-wave velocity. This method can also be used to measure anelastic (e.g., attenuation) properties of the inter-boring material.

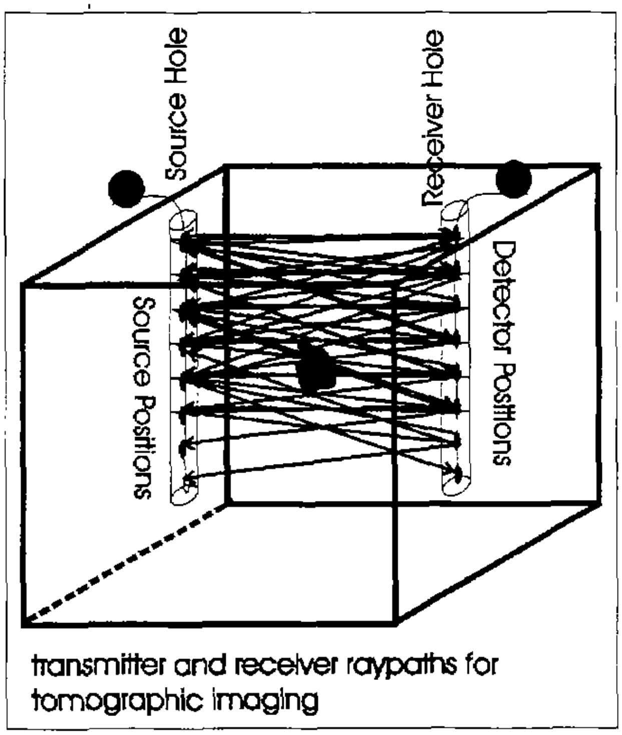
The Xh2 test shows the material from 3 to 33 feet depth to have a SV velocity of 500-1000 feet per second. Below about 35 feet, at the overburden-to-bedrock interface, the velocity jumps to 1500 to 2000 feet per second. Cross-hole tests Xh3 and Xh4 yielded very similar SV and SH velocities, respectively. This result indicates there is little, if any, SH-to-SV anisotropy. Reliable first-arrival picks could not be made below the depth of 35 feet, so shear-wave velocities at these depths could not be calculated. Below 30 feet in the cross-hole tests, the coupling of the borehole casing was suspect. Upon arrival at the site, it was observed and learned from verbal descriptions that the grout surrounding some of the casings for cross-hole tests had settled down from the ground surface after initial grouting. Additional grout was added to bring the grout to the surface. The settling away of grout indicates some potential leakage of grout into voids resulting in a potential for poor coupling. It is also possible that one or more of these borings encountered soil loosened by slumping of the ground above a mine collapse. The poor coupling between PVC casing and virgin ground made selection of seismic wave arrivals very difficult, so difficult that it was judged not possible to determine a shear-wave velocity at that depth.

9.6.9.2 Cross-hole Shear Wave Tomography Measurements

Cross-hole seismic tomography (CST) is a collection of methods for determining the seismic velocity and reflection distribution within a volume using multiple combinations of sources and receivers located around the volume. CST uses two or more boreholes, and sometimes the ground surface, for placement of sources and receivers. For seismic measurements, the spacing of the holes depends on a number of factors. One primary factor in boring spacing is the source strength, or determining the distance that signals could be received with a high signal-to-noise ratio. Spacing also depends on the target, the availability of borings, and in the case of highway work, the width of the highway.

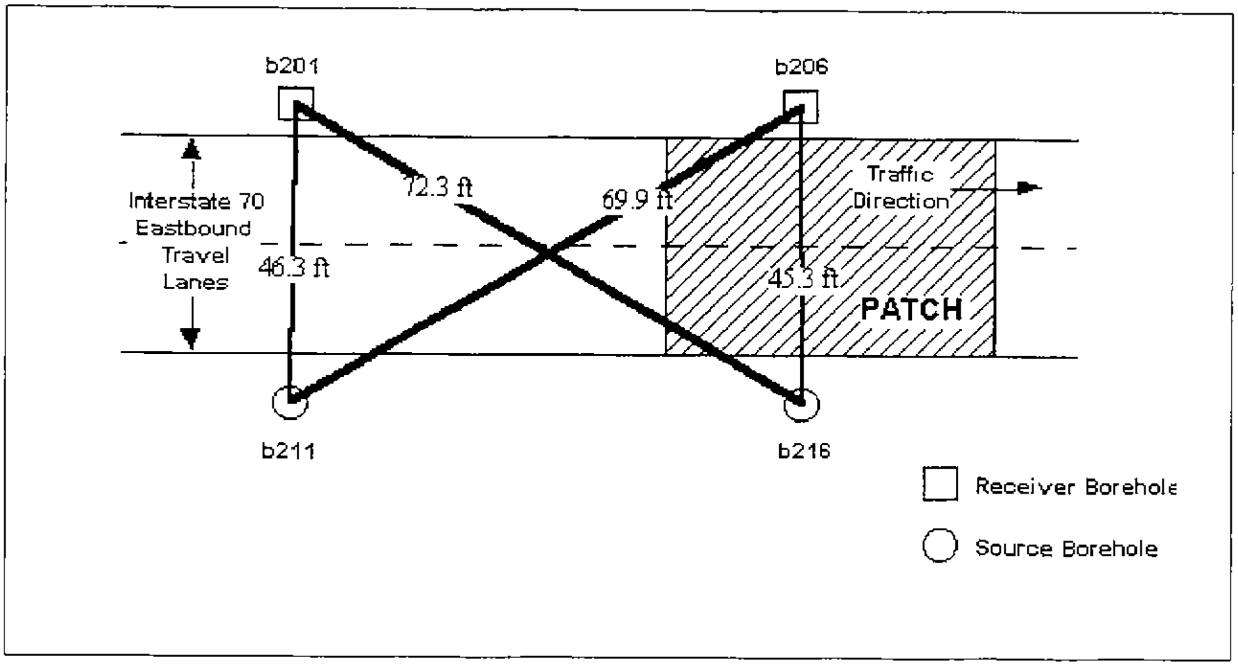
Shear waves are polarized with the vibration direction (particle motion) perpendicular to the propagation direction. SV-waves vibrate in the vertical plane. SH-waves vibrate in the horizontal plane. In an isotropic medium SV and SH waves will have the same velocity. In an anisotropic medium, these two waves will have different velocities; the difference in velocity is called shear-wave birefringence or shear-wave splitting. Polarized shear waves can be used to determine the anisotropic nature of the elastic properties of the subsurface.

Measurements are made at each receiver depth position for each source position. This provides multiple "look angles" across the two borings, which can allow image reconstruction through a process called tomographic imaging. The goal is to provide one or more two- dimensional sections of seismic properties within the rock-mass volume. CST extends CSL; CSL is equivalent to the zero-offset result (source and receiver depths are the same, hence zero offset) from a CST survey.



Cross-hole tomographic arrangement of source and receivers (detector).

A down-hole orbital vibrator (DHOV) source was used (Cole, 1989, 1997; Hardage, 1992; Dong, 1994) and an array of eight three-component geophones to acquire the data. Signals were recorded to nearly 250 Hz across the highway at distances of about 45 to 73 feet. Four low-resolution (source and receiver spacing = 3.3 feet (1 meter)) cross-road surveys were recorded and one high-resolution (source and receiver spacing = 1.09 feet (1/3 meter)) cross-road survey was completed. The plan view locations of the holes used for the cross-hole tomography are shown in the figure below.



Plan view for cross-hole seismic tomography. Four low- resolution (source and receiver spacing= 3.3 feet) cross-road surveys were recorded (B-211 to B-201, B-211 to B-206, and B-216 to B-201) and one high-resolution (source and receiver spacing = 1.09 feet) cross-road survey was completed (B-211to B-201).

SECTION 9.7 - REFERENCES

SECTION 9.7 - REFERENCES

Al-Shayea, N., Woods, R. and Gilmore, P. (1994). *SASW and GPR to Detect Buried Objects*, "Symposium on the Application of Geophysics to Engineering and Environmental Problems" pp. 543-560, Environmental and Engineering Geophysical Society, Boston.

Alvar, B.B. and Luke, B.A. (1999). *Roadside Application of Seismic Surface waves over Abandoned Mines*, "Symposium on the Application of Geophysics to Engineering and Environmental Problems" pp. 31-40, Environmental and Engineering Geophysical Society, Oakland.

Balding, N.C. et al. (editors) (2002) *Annual Book of ASTM Standards*, ASTM International, West Conshohocken, PA.

Bonta, J.V. and Muller, M. (1999). *Evaluation of the Glugla Method for Estimating Evapotranspiration and Groundwater Recharge*, "Hydrological Sciences" 44(5), pp. 743-761.

Bouwer, H. (1989). *The Bouwer and Rice Slug Test - An Update*, "Groundwater" 27(3) pp. 304-309.

Brockman, C.S. (1998). *Physiographic Regions of Ohio*, ODNR Division of Geological Survey, Columbus.

Chapman, C.H. and Pratt, R.G. (1992). *Traveltime Tomography in Anisotropic Media; I, Theory*, "Geophysical Journal International" 109(1), pp. 1-19.

Cole, J.H. (1989). *Downhole Orbital Seismic Source*, United States Patent # 4,874,061.

Cole, J.H. (1987). *The Orbital Vibrator, a New Tool for Characterizing Interwell Reservoir Space*, "The Leading Edge" 16(3), pp. 281-283.

Cotin, J.F., Deletie, P., Jacquet-Francillon, H., Lakshmanan, J., Lemoine, Y. and Sanchez, M. (1986). *Curved Ray Seismic Tomography; Application to the Grand Etang Dam*, "First Break" 4(7), 25-30.

DeLong, R.M. (1983). *Abandoned Underground Mine Map Series, Old Washington Quadrangle, Cambridge Quadrangle*, ODNR Division of Geologic Survey, Columbus.

DeLong, R.M. (1983). *Abandoned Underground Mine Map Series, Cambridge Quadrangle, Cambridge Quadrangle*, ODNR Division of Geologic Survey, Columbus.

DeLong, R.M. (1987). *Abandoned Underground Mine Map Series, Byesville Quadrangle, Cambridge Quadrangle*, ODNR Division of Geologic Survey, Columbus.

DeLong, R.M. (1983). *Abandoned Underground Mine Map Series. Senecaville Quadrangle, Cambridge Quadrangle*, ODNR Division of Geologic Survey, Columbus.

Dumouchelle, D.H. and Schiefer, M.C. (2002), *Use of Streamflow Records and Basin Characteristics to Estimate Ground-Water Recharge Rates in Ohio*, ODNR Division of Water Bulletin 46, Columbus

Dines, K.A. and Lytle, R.J. (1979). *Computerized Geophysical Tomography*, "Proceedings of the Institute of Electrical and Electronic Engineers" 67(7), pp. 1065-1073.

Dong, W. (1994). *A Mathematical Model for the Downhole Orbital Vibrator Source*, "Society of Exploration Geophysicists, International Exposition and 64th Annual Meeting" pp. 90-93.

Driscoll, F.G. (1987). *Groundwater and Wells, 2nd Edition*, Johnson Division, St. Paul.

Gucunski, N., Ganji, V. and Maher, M.H. (1996). *Effects of Obstacles on Rayleigh Waver Dispersion Obtained from the SASW Test*, "Soil Dynamics and Earthquake Engineering" 15(4), pp. 223-231.

Gucunski, N., Ganji, V. and Maher, M.H. (1996). *SASW Test in Location of Buried Objects*, "Symposium on the Application of Geophysics to Engineering and Environmental Problems" pp. 481-486, Environmental and Engineering Geophysical Society, Keystone, Colorado.

Hardage, B.A. (1992). *Crosswell Seismology and Reverse VSP*, Geophysical Press Ltd., London.

Harstine, L.J. (1991). *Hydrologic Atlas for Ohio*, ODNR Division of Water, Columbus.

Hatton, L., Worthington, M.H. and Makin, J. (1986). *Seismic Data Processing Theory and Practice*, Blackwell Scientific Publications, Oxford.

Hoffmann, A.G., Clark, D.M. and Bechtell, T.D. (1995). *Abandoned Deep Mine Subsidence Investigation and Remedial Design, Interstate 70, Guernsey County, Ohio,* Gannett Fleming, Columbus.

Hunt, C.B. (1967). *Physiography of the United States*, W.H. Freeman and Company, San Francisco.

Ivannson, S. (1985). *A Study of Methods for Tomographic Velocity Estimation in the Presence of Low-Velocity Zones*, "Geophysics" 50(6), pp. 969-988.

Ivansson, S. (1986). *Seismic Borehole Tomography: Theory and Computational Methods*, "Proceedings of the Institute of Electrical and Electronics Engineers" 74(2), pp. 328-338.

Kenny, J.R. (1995). *Mine Subsidence Investigation Interstate 70*, Letter Report to ODOT District 5, Gannett Fleming, Columbus.

La Porte, M., Lakshmanan, J., Lavergne, M. and Willm, C. (1973). *Seismic Measurements by Transmission; Application to Civil Engineering*, "Geophysical Prospecting" 21(1), pp. 146-158.

Larsen, G. (1997). *Reconnaissance Bedrock Geology of the Byesville, Ohio Quadrangle*, Open-File Map BG-B2H5, ODNR Division of Geological Survey, Columbus.

Larsen, G. (1997). *Reconnaissance Bedrock Geology of the Senecaville, Ohio Quadrangle*, Open-File Map BG-B2H4, ODNR Division of Geological Survey, Columbus.

Luke, B.A. and Chase, D.S. (1997). *Detecting Caves Using Seismic Surface Waves: A Feasibility Study*, "The Engineering Geology and Hydrogeology of Karst Terranes" pp. 419-424, Balkema, Rotterdam.

Luke, B.A., Begley, C.T., Chase, D.S., Ross, A.J. and Brady, J.E. (1997). *Rapid-Response Geophysical Site Investigations at a Pre-Columbian Settlement in Honduras*, "Symposium on the Application of Geophysics to Engineering and Environmental Problems" pp. 983-992, Environmental and Engineering Geophysical Society, Reno.

Nolet, G. (1987). *Seismic tomography; With Applications in Global Seismology and Exploration Geophysics*, D. Reidel Publishing Co., Dordrecht, Netherlands.

Pettyjohn, W.A. and Henning, R. (1979). *Preliminary Estimate of Ground-Water Recharge Rates, Related Streamflow and Water Quality in Ohio*, US Department of the Interior, Report No. 552.

Pratt, R.G. and Chapman, C.H. (1992). *Traveltime Tomography in Anisotropic Media; II, Application*, "Geophysical Journal International" 109(1), pp. 20-37.

Rector, J.W. (1995). *Special Issue: Crosswell Methods*, "Geophysics" 60(3), pp. 627-920.

Richart, F.E., Hall, J.R. and Woods, R.D. (1970). *Vibrations of Soils and Foundations*, Prentice-Hall Inc., Englewood Clifs, New Jersey.

Stokoe, K.H., and Hoar, R.J. (1978). *Variables Affecting In-Situ Seismic Measurements*, "Proceedings of the Conference on Earthquake Engineering and Soil Dynamics" Vol. 2, pp. 919-939, Geotechnical Engineering Division, ASCE, Pasadena.

Stokoe, K.H., Wright, S.G., Bay, J.A. and Rosset, J.M. (1994). *Characterization of Geotechnical Sites by SASW Method*, "Geophysical Characterization of Sites" pp. 15-25, Oxford and IBH Publishing Co., New Delhi.

Stout, W., Ver Steeg, K. and Lamb, G.F. (1943). *Geology of Water in Ohio*, Geological Survey of Ohio, Bulletin 44, Heer Printing Co, Columbus.

Todd, D.K. (1980). *Groundwater Hydrology, 2nd Edition*, John Wley & Sons, New York.

Tweeton, D. (1999). User Manual for GeoTomCG, GeoTom, L.L.C., Apple Valley, Minnesota.

Walker, A.C. (1991). Ground Water Resources of Guernsey County, ODNR Division of Water, Columbus.

Whittaker, B.N. and Reddish, D.J. (1989). Subsidence - Occurrence, Prediction, and Control, Elsevier Science Publishing, New York.

Winkle, R. (1973). Principal Streams and their Drainage Areas, ODNR Division of Water, Columbus.

Woods, R.D. (1994). Borehole Methods in Shallow Seismic Exploration, "Geophysical Characterization of Sites" pp. 91-100, Oxford and IBH Publishing Company, New Delhi.

SECTION 10 - SUPPORTING DOCUMENTATION - BINDER 2

10.1 - BORING LOGS

10.2 - HYDROGEOLOGIC DATA

10.3 - GEOTECHNICAL DATA (Soils Laboratory Testing)

SECTION 10.1 - BORING LOGS

EXPLANATION OF SYMBOLS AND TERMS USED ON BORING LOGS

SAMPLING DATA

- Blocked-in "SAMPLES" column indicates sample was attempted and recovered within this depth interval.

- Sample was attempted within this interval but not recovered.

2/5/9 - The number of blows required for each 6-inch increment of penetration of a "Standard" 2-inch O.D. split-barrel sampler, driven a distance of 18 inches by a 140-pound hammer freely falling 30 inches. Addition of one of the following symbols indicates the use of a split-barrel other than the 2" O.D. sampler:

$\boxed{\text{2S}}$ - 2½"O.D. split-barrel sampler

$\boxed{\text{3S}}$ - 3" O.D. split-barrel sampler

P - Shelby tube sampler, 3" O.D., hydraulically pushed.

R - Refusal of sampler in very-hard or dense soil, or on a resistant surface.

50-2" - Number of blows (50) to drive a split-barrel sampler a certain number of inches (2), other than the normal 6-inch increment.

S/D - Split-barrel sampler (S) advanced by weight of drill rods (D),

S/H - Split-barrel sampler (S) advanced by combined weight of rods and drive hammer (H).

SOIL DESCRIPTIONS - All soils have been classified basically in accordance with the Unified Soil Classification System, but this system has been augmented by the use of special adjectives to designate the approximate percentages of minor components as follows:

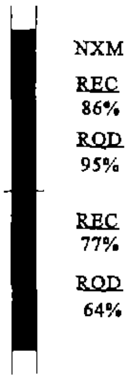
Adjective	Percent by Weight
trace	1 to 10
little	11 to 20
some	21 to 35
"and"	36 to 50

The following terms are used to describe density and consistency of soils:

Term (Granular Soils)	Blows per foot
Very-loose	Less than 5
Loose	5 to 10
Medium-dense	11 to 30
Dense	31 to 50
Very-dense	Over 50
Term (Cohesive Soils)	**Qu (tsf)**
Very-soft	Less than 0.25
Soft	0.25 to 0.5
Medium-stiff	0.5 to 1.0
Stiff	1.0 to 2.0
Very-stiff	2.0 to 4.0
Hard	Over 4.0

EXPLANATION OF SYMBOLS AND TERMS USED ON BORING LOGS FOR SAMPLING AND DESCRIPTION OF ROCK

SAMPLING DATA



When bedrock is encountered and rock core samples are attempted, the "SAMPLING EFFORT" column is used to record the type of core barrel used (NXM), the percentage of core recovered (REC) for each run of the sampler, and the Rock Quality Designation (RQD) value. Rock-core barrels can be of either single- or double-tube construction, and a special series of double-tube barrels, designated by the suffix M, is commonly used to obtain maximum core recovery in very-soft or fractured rock. Three basic groups of barrels are used most often in subsurface investigations for engineering purposes, and these groups and the diameters of the cores obtained are as follows:

AX, AW, AXM, AWM	-	1⅞ inches
BX, BW, BXM, BWM	-	1⅝ inches
NX, NW, NXM, NWM	-	2⅛ inches

Rock Quality Designation (RQD) is expressed as a percentage and is obtained by summing the total length of all core pieces which are at least 4 inches long and then dividing this sum by the total length of core run. It has been found that there is a reasonably good relationship between the RQD value and the general quality of rock for engineering purposes. This relationship is shown as follows:

RQD - %	General Quality
0 - 25	Very-poor
25 - 50	Poor
50 - 75	Fair
75 - 90	Good
90 - 100	Excellent

ROCK HARDNESS

The following terms are used to describe rock hardness:

Term	Meaning	Mohs' Hardness
Very-soft	Rock such as shale can be easily picked apart by the fingers. Sandstone is poorly cemented and very friable. The rock resembles hard clay or dense sand, but has rock structure.	Less than 1
Soft	Rock such as shale, siltstone or limestone can be scratched or powdered by fingernail pressure. Sandstone is mostly poorly cemented, and individual sand grains can be separated from the main rock mass by a fingernail.	1 to 1½
Medium-hard	Rock cannot be scratched by a fingernail, but can be powdered by a knife. Sandstone is mostly well cemented, but individual grains can be removed by scratching with a knife.	2½ to 5½
Hard	Rock is well cemented and cannot be powdered by a knife. Rock can be powdered by a steel file.	5½ to 6½
Very-hard	Rock cannot be scratched by a steel file and the core sample rings when struck with a hammer.	Greater than 6½

BBCM

LOG OF BORING NO. B-402
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: Direct Push

LOCATION: Sta. 470+56, 49' Lt., Anomaly A

COMPLETION DEPTH: 13.0' ELEVATION: 822.8 DATE: 4/8/02

DEPTH, FEET	SAMPLE NO	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S	SILT	CLAY	DESCRIPTION
0											ASPHALT - 9 INCHES
											CONCRETE - 13 INCHES
	1	4.5+									FILL: Hard brown clayey silt, little fine to coarse sand, trace fine to coarse gravel.
5	2	3 1-3 2									Very-stiff gray interbedded with brown clayey silt (lenses ~1" to 2" thick), little fine to coarse sand.
											Very-stiff brown silty clay, little fine to coarse sand.
	3	3.0-3 2									Stiff (est.) gray silty clay, trace fine to coarse sand, slightly organic.
	4	1 1-1.3									Stiff brown mottled with gray silty clay, trace fine sand.
10	5	0 5-1 0									Medium-stiff gray clayey silt, some fine sand.
	6	2.3-2 5									Very-stiff brown mottled with gray silty clay, little fine to coarse sand.
15											- No seepage or groundwater encountered during drilling.
											- Boring capped with Set 45 concrete.
											- Boring backfilled with 5% bentonite/cement grout.
20											

WATER LEVEL: "Dry"

WATER NOTE:

DATE: 4/08/02

BBCM

LOG OF BORING NO. B-403
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: **Direct Push**

LOCATION: **Sta. 474+60, 49' Lt., Anomaly C**

COMPLETION DEPTH: **14.0'** ELEVATION: **824.1** DATE: **4/8/02**

DEPTH FEET	SAMPLE NO	HAND PENETROMETER (tsf)	DESCRIPTION
0			ASPHALT - 9 INCHES
			CONCRETE - 17 INCHES
			FILL: Very-stiff (est.) gray silty clay, little fine to coarse sand, little fine to coarse gravel.
	1	2 2-2.6	Very-stiff becoming hard brown mottled with gray silty clay, trace fine to coarse sand.
5	2	4 5+	
	3	4 5+	Hard brown clayey silt, little fine to coarse sand, trace fine to coarse gravel.
	4	4 5+	
10	5		Stiff (est.) brown clayey silt, little fine to coarse sand, trace fine to coarse gravel.
	6		Medium-dense brown and gray fine to coarse sand, little clayey silt, trace fine to coarse gravel.
15			- Encountered seepage from 12.5' to 12.9'. - Boring capped with Set 45 concrete. - Boring backfilled with 5% bentonite/cement grout
20			

Columns also printed: SAMPLES, SAMPLING EFFORT, MOISTURE CONTENT %, LIQUID LIMIT %, PLASTIC LIMIT %, AGG., C.S., F.S., SILT, CLAY

WATER LEVEL: "Dry"

WATER NOTE:

DATE: 4/08/02

JOB: 01107000.090

BBCM

LOG OF BORING NO. B-404A
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: Direct Push

LOCATION: Sta. 478+25, 49' Lt., Anomaly E

COMPLETION DEPTH: 12.0' ELEVATION: 825.2 DATE: 4/8/02

DEPTH, FEET	SAMPLE NO	HAND PENETROMETER (tsf)	DESCRIPTION
0			ASPHALT - 7 INCHES
			CONCRETE - 19 INCHES
			FILL: Medium-dense (est.) light-brown fine to medium sand.
	1	2 1-2 5	FILL: Very-stiff (est.) gray clayey silt, little fine to coarse sand, trace fine to coarse gravel.
			Very-stiff brown clayey silt, little fine to coarse sand, trace fine to coarse gravel.
5	2	1.4-2 1	Stiff to very-stiff gray silty clay, trace fine sand, slightly organic.
			Stiff to very-stiff gray mottled with brown silty clay, trace fine sand.
	3	1.9-2 5	
	4	1 7-2 4	
10			
	5	2 9-3.1	
15			
20			

Other column headings: SAMPLES, SAMPLING EFFORT, MOISTURE CONTENT (%), LIQUID LIMIT (%), PLASTIC LIMIT (%), AGG., C.S., F.S., SILT, CLAY

- Encountered water at 10.0'.
- Boring capped with Set 45 concrete.
- Boring backfilled with 5% bentonite/cement grout.

WATER LEVEL: 10.0
WATER NOTE:
DATE: 4/08/02

BBCM

LOG OF BORING NO. B-404B
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: Direct Push

LOCATION: Sta. 478+15, 49' Lt., Anomaly E

COMPLETION DEPTH: 12.0' ELEVATION: 825.2 DATE: 4/8/02

DEPTH, FEET	SAMPLE NO.	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0											ASPHALT - 7 INCHES
											CONCRETE - 21 INCHES
											GRANULAR BASE - 2 INCHES
											FILL: Very-stiff to hard (est.) gray silty clay, little fine to coarse sand, trace fine to coarse gravel.
	1	4.5+									FILL: Hard brown clayey silt, little fine to coarse sand, trace fine to coarse gravel, contains iron oxide staining.
5	2	2.4-3.1									Very-stiff gray silty clay, trace fine to coarse sand, slightly organic.
	3	1.9-2.4									Stiff to very-stiff brown mottled with gray clayey silt, little fine to coarse sand, trace fine to coarse gravel.
	4	1.7-1.9									Stiff gray mottled with brown silty clay, trace fine to medium sand.
10	5	3.5-4.5+									Very-stiff to hard gray mottled with brown silty clay, trace fine to medium sand.
15											
20											

- No seepage or groundwater encountered during drilling.
- Boring capped with Set 45 concrete.
- Boring backfilled with 5% bentonite/cement grout.

WATER LEVEL: "Dry"

WATER NOTE:

DATE: 4/08/02

JOB: 01107000.090

BBCM

LOG OF BORING NO. B-405
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: **Direct Push** LOCATION: **Sta. 481+80, 49' Lt., Anomaly G**

COMPLETION DEPTH: **12.0'** ELEVATION: **826.3** DATE: **4/8/02**

DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C S.	F.S	SILT	CLAY	DESCRIPTION
0													ASPHALT - 7 INCHES
													CONCRETE - 19 INCHES
													FILL: Medium-dense (est.) brown fine to medium sand, trace coarse sand, little clayey silt.
	1			2.0-2.2									Stiff (est.) brown clayey silt, little fine to coarse sand.
													Stiff (est.) gray silty clay, trace fine to coarse sand, slightly organic.
													Stiff to very-stiff brown mottled with gray silty clay, trace fine sand.
5	2			2.0-2.3									
	3			1.7-2.2									
	4			1.7-2.5									
10													
	5			1.2-1.9									
15													- No seepage or groundwater encountered during drilling.
													- Boring capped with Set 45 concrete.
													- Boring backfilled with 5% bentonite/cement grout.
20													

WATER LEVEL: ▽ "Dry"

WATER NOTE:

DATE: 4/08/02

JOB: 01107000.090

ODOTLJ 17000090.GPJ BBCM.GDT 11/12/02

BBCM

LOG OF BORING NO. B-407A
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: Direct Push

LOCATION: Sta. 469+74, 60' Rt., Anomaly J

COMPLETION DEPTH: 8.0' ELEVATION: 822.4 DATE: 4/9/02

DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0													ASPHALT - 8 INCHES
	1			4.5+									FILL: Hard brown clayey silt, some fine to coarse sand, trace fine to coarse gravel.
	2			3.5-4.0									FILL: Very-stiff gray clayey silt, little fine to coarse sand, trace fine to coarse gravel.
5	3			3.0-3.5									
	4			1.5-2.0									Stiff to very-stiff gray clayey silt, little fine to coarse sand.
10													
15													- No seepage or groundwater encountered during drilling. - Boring capped with Set 45 concrete. - Boring backfilled with 5% bentonite/cement grout.
20													

WATER LEVEL: "Dry"

WATER NOTE:

DATE: 4/09/02

JOB: 01107000.090

ODOTLI 17000090.GPJ BBCM.GDT 11/12/02

BBCM

LOG OF BORING NO. B-407B
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: **Direct Push**

LOCATION: **Sta. 469+74, 58' Rt., Anomaly J**

COMPLETION DEPTH: **8.0'** ELEVATION: **822.4** DATE: **4/10/02**

DEPTH FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0													ASPHALT - 8 INCHES
	1												FILL: Medium-dense (est.) brown fine to coarse sand, little clayey silt.
													FILL: Very-stiff to hard brown clayey silt, little fine to coarse sand, trace fine to coarse gravel.
	2			2 6-3 4									FILL: Very-stiff gray clayey silt, some fine to coarse sand, trace fine to coarse gravel, contains coal fragments, (possible minespoil).
5	3			2 4-3 0									
	4			2.2-2.6									Very-stiff gray clayey silt, some fine to coarse sand.
10													
15													- No seepage or groundwater encountered during drilling. - Boring capped with Set 45 concrete. - Boring backfilled with 5% bentonite/cement grout.
20													

WATER LEVEL: "Dry"

WATER NOTE:

DATE: 4/10/02

BBCM

LOG OF BORING NO. B-407C
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: **Direct Push** LOCATION: **Sta. 469+75, 58' Rt., Anomaly J**

COMPLETION DEPTH: **8.0'** ELEVATION: **822.4** DATE: **4/10/02**

DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0													ASPHALT - 7 INCHES
	1												FILL: Medium-dense (est.) brown fine to coarse sand, little clayey silt.
													FILL: Very-stiff brown clayey silt, some fine to coarse sand, trace fine to coarse gravel.
	2			2.0-2.4									
													FILL: Very-stiff gray clayey silt, some fine to coarse sand, trace fine to coarse gravel, contains coal fragments, few granular lenses, (possible mine spoils).
5	3												
													Stiff gray silty clay, little fine to medium sand.
	4			1.0-1.1									
10													
15													- No seepage or groundwater encountered during drilling. - Boring capped with Set 45 concrete. - Boring backfilled with 5% bentonite/cement grout.
20													

WATER LEVEL: "Dry"

WATER NOTE:

DATE: 4/10/02

JOB: 01107000.090

ODOT LJ 17000090.GPJ BBCM.GDT 11/12/02

BBCM

LOG OF BORING NO. B-407D
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: **Direct Push** LOCATION: **Sta. 469+78, 58' Rt., Anomaly J**

COMPLETION DEPTH: **8.0'** ELEVATION: **822.4** DATE: **4/10/02**

DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S	F.S.	SILT	CLAY	DESCRIPTION
0													ASPHALT - 8 INCHES
	1			3.6-4 5+									FILL: Medium-dense to dense (est.) brown fine to coarse sand, little clayey silt.
													FILL: Hard brown clayey silt, some fine to coarse sand, trace fine to coarse gravel.
	2			4 5+									
													FILL: Hard gray clayey silt, little fine to coarse sand, trace fine to coarse gravel.
5	3			4 5+									FILL: Hard gray clayey silt, some fine to coarse sand, little fine to coarse gravel, contains coal fragments, (possible mine spoils).
	4												Medium-dense (est.) gray fine sand, "and" clayey silt, trace medium sand.
10													
15													- No seepage or groundwater encountered during drilling. - Boring capped with Set 45 concrete. - Boring backfilled with 5% bentonite/cement grout.
20													

WATER LEVEL: "Dry"
WATER NOTE:
DATE: 4/10/02

BBCM

LOG OF BORING NO. B-407E
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE. **Direct Push**

LOCATION **Sta. 469+80, 58' Rt., Anomaly J**

COMPLETION DEPTH: 8.0' **ELEVATION:** 822.4 **DATE:** 4/10/02

DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG	C S	F.S	SILT	CLAY	DESCRIPTION
0													ASPHALT - 9 INCHES
	1			4 5+									FILL: Medium-dense (est.) brown fine to coarse sand, little clayey silt
													FILL: Very-stiff brown clayey silt, little fine to coarse sand, trace fine to coarse gravel.
	2			3 2-3 5									FILL: Stiff to very-stiff gray mottled with brown silty clay, little fine to coarse sand, contains coal fragments, (possible mine spoils).
5	3			1.5-2.2									
	4			1 5-1.9									Stiff gray silty clay, trace fine to coarse sand.
10													
15													- No seepage or groundwater encountered during drilling. - Boring capped with Set 45 concrete. - Boring backfilled with 5% bentonite/cement grout.
20													

WATER LEVEL: "Dry"
WATER NOTE:
DATE: 4/10/02

BBCM

LOG OF BORING NO. B-407F
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 4-1/2" O.D. Continuous-flight Auger; 2" O.D. Split-barrel Sampler

LOCATION: Sta. 469+74, 55' Rt. Anomaly J

COMPLETION DEPTH: 17.1' ELEVATION: 822.4 DATE: 4/16/02

DEPTH, FEET	SAMPLE NO.	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S	SILT	CLAY	DESCRIPTION
0												ASPHALT - 12 INCHES
	1A	6/4/7										FILL: Loose brown fine to coarse sand, some fine to coarse gravel, trace clayey silt.
	1B	/8	1.1-3 4									FILL: Stiff to very-stiff brown becoming gray silty clay, some fine to coarse sand, trace fine to coarse gravel.
5	2	4/4/4 /7	1 8-3 3									
	3	4/5/3 /4										Medium-stiff to stiff gray organic silty clay, little fine sand, few roots.
	4	2/3/4 /4	0.75-1 8									Very-soft becoming medium-stiff to stiff gray, organic clayey silt, some fine to medium sand, trace coarse sand, few wood fragments.
10	5	S/H=18" /2	0 0-0.2									
	6A	S/H=18"										
	6B	/3	0 5-1 2									Medium-stiff to becoming stiff to very-stiff gray mottled with brown clayey silt, some fine sand, silty organic.
	7	P 250psi	2.8-3 8									Medium-stiff to stiff brown clayey silt, "and" some fine to coarse sand, little fine to coarse gravel.
15	8	3/4/6 /6	0 7-1.6									
20												- Encountered seepage from 9.0' to 12.2'.
												- Boring grouted with 5% bentonite/cement slurry. Surface repaired with Set 45.
25												
30												

WATER LEVEL: ∇ 11.2

WATER NOTE:

DATE: 4/16/02

BBCM

LOG OF BORING NO. B-407G
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; NX Rock Core Barrel

LOCATION: Sta. 469+74, 67' Rt. Anomaly J

COMPLETION DEPTH: 76.7' ELEVATION: 821.6 DATE: 4/18/02

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0	1A	7/5/6										FILL: Medium-dense fine to coarse sand, "and" fine to coarse gravel.
	1B	/10	1.1-2.0									Stiff to very-stiff brown mottled with gray silty clay, little fine to coarse sand, trace fine to coarse gravel, few roots.
	2A	3/3/4	2.0-2.4									
5	2B	/6	1.0-1.8	15	36	23	4	20	12	24	40	Stiff to very-stiff gray organic clayey silt, little fine to medium sand.
	3	7/8/5 /5	1.5-2.5									
	4	1/1/1 /1	0.8									Very-loose to loose gray silt, interbedded with medium-stiff organic clayey silt, little fine sand.
10	5	S/H=24"	0.5-0.7									
	6A	S/H	0.5-1.2									Very-loose brown fine to coarse sand, some silt.
	6B	2/2/1										Medium-stiff to stiff gray silty clay, some fine to medium sand.
	6C											
15	7	3/3/5 /6										Loose brown fine to coarse sand, some fine to coarse gravel, little clayey silt.
	8	3/3/6										
20	9	7/13/16										Medium-dense brown fine to coarse sand. some fine to coarse gravel, trace silt.
25	10	7/16/14										
30	11	1/1/2	1.4-2.0									Medium-stiff to stiff gray silty clay, trace fine to coarse sand, laminated.
35	12	1/4/3	0.6-1.4									
40	13	3/6/11	1.8-2.9									Stiff to very-stiff gray silty clay, interbedded with silt, trace fine sand, few roots.

WATER LEVEL:
WATER NOTE:
DATE:

-CONTINUED-

BBCM

LOG OF BORING NO. B-407G
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: **3-1/4" I.D. Hollow-stem Auger**
2" O.D. Split-barrel Sampler
NX Rock Core Barrel

LOCATION: **Sta. 469+74, 67' Rt.**
Anomaly J

COMPLETION DEPTH: **76.7'** ELEVATION: **821.6** DATE: **4/18/02**

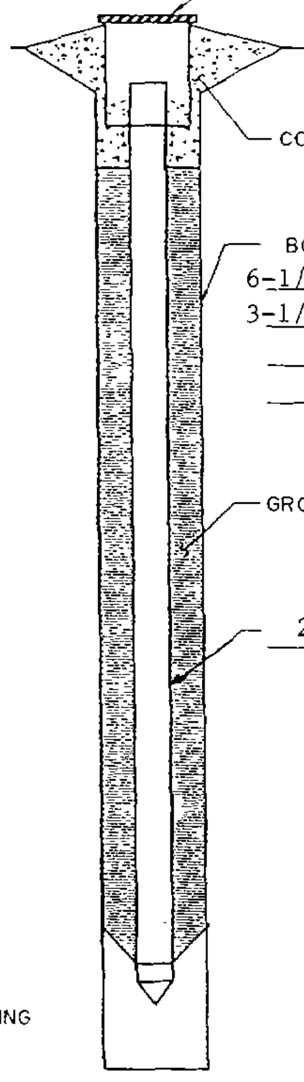
DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
	14	50-2"R										Medium-hard to hard gray siltstone, nearly horizontally bedded, many horizontal fractures, 1/2" to 2.0" layers.
45		REC 99% RQD 63%										Very-soft to soft gray shale, nearly horizontally bedded, highly fractured.
	15											Medium-hard gray shale, nearly horizontally bedded, many horizontal fractures, 1" to 18" layers
50												
		REC 95% RQD 83%										
55	16											
60												VOID
		REC 76% RQD 65%		0								PRODUCTION GROUT: Medium-hard, gray, few horizontal fractures.
				0								BARRIER GROUT: Medium-hard, gray, contains coarse aggregate.
65												VOID
	17											Very-soft to soft gray shale, nearly horizontally bedded, many horizontal fractures, 3" to 8" layers.
70												Medium-hard to hard gray fine to medium-grained sandstone, nearly horizontally bedded, micaceous.
	18	REC 100% RQD 100%										
75												
80												- Encountered seepage from 11.0' to 17.5'. - Geophysical casing installed, see completion diagram.
85												

WATER LEVEL:
WATER NOTE:
DATE:

ODOT1 JOI D 17000090.GPJ BBCM.GDT 1/21/03
JOB: 01107000.090

TCAMWLL4.DWG

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
821.7	-0.1	TOP OF COVER
821.6	0.0	GROUND SURFACE
821.5	0.1	TOP OF PVC
820.7	1.0	TOP OF GROUT
751.6	70.0	BOTTOM OF CASING
744.9	76.7	BORING DEPTH



5 - INCH DIAMETER PROTECTIVE STEEL COVER

CONCRETE

BORING DIAMETER
6-1/2", 0.0' to 44.2'
3-1/8", 44.2' to 76.7'
___", ___' to ___'
___", ___' to ___'

GROUT: Cement Bentonite (5%)

2 - INCH DIAMETER PVC (SLOTTED, SOLID)

GEOPHYSICAL CASING INSTALLATION
(NO SCALE)

PROJECT NAME: GUE-70-14.10

BORING: B-407G

DATE INSTALLED: 04-18-02

BBC & M PROJECT NO: 01107000.090

INSTALLATION NOTES:

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

BBCM

LOG OF BORING NO. B-407H
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: **4-1/4" I.D. Hollow-stem Auger**
2" O.D. Split-barrel Sampler
NX Rock Core Barrel

LOCATION: **Sta. 469+59, 67**
Anomaly J

COMPLETION DEPTH: 76.8' **ELEVATION:** 821.7 **DATE:** 4/23/02 - 4/24

SAMPLE NO	SAMPLING EFFORT	HAND PENE- (tsf)	MOISTURE CONTENT (%)	LIMIT (%)	PLASTIC LIMIT (%)	AGG				
1A	4/5/7									
1B	/7	1.8-3.0	16	38	18	8	14	11	37	30
2A	2/4/5	1.6-2.0								
2B	/7	1.6-2.4								
3	7/7/7 /7	1.3								
4	2/2/2 /3	1.8								
5	S/H S/H /1/1	0.0-0.5	27	35	20	2	3	19	61	15
6A	S/H S/H									
6B	/2/2	0.7-1.2								
7	1/1/2 /4	0.5-1.5	23	37	20	0	2	13	54	31
8	3/5/7									
9	7/13/13		12			21	32	20	17	10
10	10/14/17									
11	2/5/7	1.8								
12	5/3/6		22			15	22	22	26	15
13	3/5/8	2.2-2.8								

DEPTH, FEET: 0, 5, 10, 15, 20, 25, 30, 35, 40

trace fine to coarse gravel.

FILL: Stiff to very-stiff brown mottled with gray clayey s some fine to coarse sand, trace fine to coarse gravel.

Fill: Stiff to very-stiff gray silty clay, little fine to coarse sand, trace fine to coarse gravel.

Very-soft to soft gray organic clayey silt, some fine to medium sand, trace coarse sand.

Medium-stiff to stiff brown clayey silt, little fine to mediu sand.

Medium-dense brown fine to coarse sand, some silty clay little fine to coarse gravel.

Dense gray and brown fine to coarse sand, some clayey s little fine to coarse gravel.

Stiff gray organic clayey silt, little fine sand.

Loose gray fine to coarse sand, some fine to coarse grave "and" silty clay.

Very-stiff gray organic silty clay, trace fine sand, contains decayed roots.

WATER LEVEL:
WATER NOTE:
DATE:

BBCM

LOG OF BORING NO. B-407H
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE	4-1/4" I.D. Hollow-stem Auger	LOCATION:	Sta. 469+59, 67' Rt.
	2" O.D. Split-barrel Sampler		Anomaly J
	NX Rock Core Barrel		

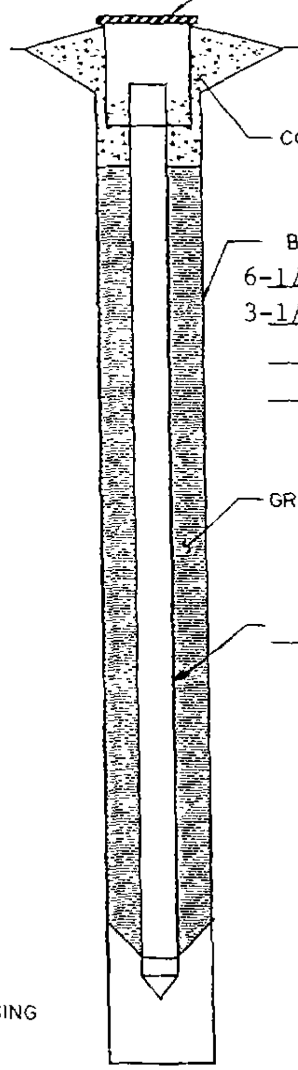
COMPLETION DEPTH: 76.8' **ELEVATION:** 821.7 **DATE:** 4/23/02 - 4/24/02

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOIST. CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
	14	50-1"R										Medium-hard to hard gray siltstone, nearly horizontally bedded, few horizontal fractures.
45	15	REC 90% RQD 54%										
50												
55	16	REC 100% RQD 60%										
60												Medium-hard black coal, nearly horizontally bedded, many horizontal fractures.
65	17	REC 74% RQD 1%										Very-soft to soft gray shale, nearly horizontally bedded, few horizontal fractures, underclay.
70	18	REC 96% RQD 70%										Medium-hard to hard gray fine to medium-grained sandstone nearly horizontally bedded, few horizontal fractures.
75												
80												- Geophysical casing installed, see completion diagram.
85												

WATER LEVEL:
WATER NOTE:
DATE:

JOB: 01107000.090

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
821.8	-0.1	TOP OF COVER
821.7	0.0	GROUND SURFACE
821.6	0.1	TOP OF PVC
820.8	1.0	TOP OF GROUT
745.4	76.3	BOTTOM OF CASING
744.9	76.8	BORING DEPTH



5 - INCH DIAMETER PROTECTIVE STEEL COVER

GROUND SURFACE

CONCRETE

BORING DIAMETER
6-1/2", 0.0' to 45.4'
3-1/8", 45.4' to 76.8'
___", ___' to ___'
___", ___' to ___'

GROUT: Cement Bentonite (5%)

2 - INCH DIAMETER PVC (SLOTTED, SOLID)

GEOPHYSICAL CASING INSTALLATION

(NO SCALE)

PROJECT NAME:	GUE-70-14.10
BORING:	B-407H
DATE INSTALLED:	04-25-02
BBC & M PROJECT NO:	01107000.090

INSTALLATION NOTES:

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

TCAMWLL4.DWG

BBCM

LOG OF BORING NO. B-407I
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 4-1/2" O.D. Continuous-flight Auger; 2" O.D. Split-barrel Sampler

LOCATION: Sta. 469+85, 55' Rt. Anomaly J

COMPLETION DEPTH: 19.5' ELEVATION: 822.5 DATE: 4/16/02

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0												ASPHALT - 14 INCHES
	1A	6/4/4										FILL: Loose brown fine to coarse gravel, "and" fine to coarse sand.
	1B	/7	1.6-2.0	15	35	20	5	14	15	36	30	FILL: Stiff to very-stiff brown silty clay, some fine to coarse sand, trace fine to coarse gravel, contains few fragments of coal.
5	2	4/6/7 /12	2.7-3.9									
	3	3/5/8 /6	3.4-4.0									
	4A	2/2/2	0.6-1.7									Soft to medium-stiff to stiff gray organic clayey silt, some fine to medium sand, few seams fine to coarse sand.
	4B	/2	0.3-0.5									
10	5	P 125psi	0.6-0.9	28 28 29 29	36	21	0	1	25	48	26	Very-soft to soft gray organic clayey silt, some fine to medium sand, contains decayed vegetation.
	6A	S/H S/H	0.0-0.2	32 25	28	21	0	3	26	51	20	Medium-stiff to stiff brown mottled with gray clayey silt, some fine to medium sand.
	6B	4/4	1.1-1.7									
	7A	S/H	0.6-1.0	22	32	18	0	5	20	49	26	Medium-dense brown fine to coarse sand, little fine to coarse gravel, some clayey silt.
15	7B	4/7/7										
	8	2/4/7 /8		13			15	28	28	19	10	
20												
25												
30												

- Encountered slight seepage from 7.9' to 9.1'.

- Encountered seepage from 9.0' to 12.5'.

- Boring grouted with 5% bentonite/cement slurry. Surface repaired with Set 45.

WATER LEVEL: 9.4
WATER NOTE:
DATE: 4/16/02

ODOTLJ 17000090.GPJ BBCM.GDT 11/12/02

JOB: 01107000.090

BBCM

LOG OF BORING NO. B-408A
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: Direct Push

LOCATION: Sta. 473+80, 30' Rt., Anomaly L

COMPLETION DEPTH: 10.0' ELEVATION: 823.5 DATE: 4/11/02

DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG	C.S	F.S.	SILT	CLAY	DESCRIPTION
0													ASPHALT - 15 INCHES
	1												FILL: Medium-dense (est.) brown coarse sand, trace fine to medium sand, trace silt.
	2			4.5+									FILL: Very-stiff to hard brown and gray clayey silt, little fine to coarse sand, trace fine to coarse gravel.
5	3			3.4-4.5+									
	4			1.4-2.2									Stiff to very-stiff gray clayey silt, trace fine to coarse sand.
	5			1.3-1.7									Stiff brown mottled with gray silty clay, trace fine to coarse sand.
10													
15													- No seepage or groundwater encountered during drilling. - Boring capped with Set 45 concrete. - Boring backfilled with 5% bentonite/cement grout.
20													

WATER LEVEL: "Dry"

WATER NOTE:

DATE: 4/11/02

ODOT.LJ 17000090.GPJ BBCM.GDT 11/12/02

JOB: 01107000.090

BBCM

LOG OF BORING NO. B-408B
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: **Direct Push**
LOCATION: **Sta. 471+50, 30' Rt., Anomaly L.**
COMPLETION DEPTH: **10.0'** ELEVATION: **823.5** DATE: **4/11/02**

DEPTH, FEET	SAMPLE NO	HAND PENETROMETER (tsf)	DESCRIPTION
0			ASPHALT - 12 INCHES
	1		FILL: Medium-dense brown fine to coarse sand, trace silt.
			FILL: Medium-stiff to stiff (est.) brown clayey silt, little fine to coarse sand, trace fine to coarse gravel.
	2	3 2-3 4	FILL: Very-stiff brown clayey silt, little fine to coarse sand, trace fine to coarse gravel.
5	3	1 7-2.4	POSSIBLE FILL: Stiff to very-stiff (est.) gray clayey silt, trace fine to coarse sand.
			POSSIBLE FILL: Stiff to very-stiff brown and gray clayey silt, little fine to coarse sand, little fine to coarse gravel.
	4	0 8-1 8	Medium-stiff to stiff gray clayey silt, trace fine to coarse sand, slightly organic.
	5	0 5-0 8	
10			
15			
20			

Column headings: DEPTH, FEET; SAMPLE NO; SAMPLES; SAMPLING EFFORT; HAND PENETROMETER (tsf); MOISTURE CONTENT (%); LIQUID LIMIT (%); PLASTIC LIMIT (%); AGG.; C.S.; F.S; SILT; CLAY; DESCRIPTION

- Encountered slight seepage at 1.6'.
- Boring capped with Set 45 concrete.
- Boring backfilled with 5% bentonite/cement grout.

WATER LEVEL: "Dry"
WATER NOTE:
DATE: 4/11/02

JOB: 01107000.090

BBCM

LOG OF BORING NO. B-408C
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 4-1/2" O.D. Continuous-flight Auger; 2" O.D. Split-barrel Sampler

LOCATION: Sta. 473+80, 34' R; Anomaly L

SAMPLE NO.	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	AG.	C.S.	F.S.	SILT	CLAY
1	2/3/11	3.6-4.5+							
2	6/8/11	3.3-4.5+	17	38	2	14	11	69	4
3	3/7/8	3.0-4.5+							
4A	1/2/5	1.0-1.5	27	45	0	1	5	52	42
4B		1.3-1.9							
5	2/3/6	0.9-2.1							
6A	2/2/4	0.4-0.8							
6B									
7A	2/3/4	1.2-1.5							
7B		0.7-1.1	22	28	0	0	7	70	23
8	4/3/5	1.2-2.2							

DESCRIPTION

ASPHALT - 7 INCHES

CONCRETE - 10 INCHES

GRANULAR BASE: Medium-dense brown fine to medium sand.

FILL: Very-stiff to hard brown and gray clayey silt, some fine to coarse sand, trace fine to coarse gravel.

Stiff gray clayey silt, trace fine to coarse sand.

Stiff gray mottled with brown clayey silt, little fine to medium sand, trace coarse sand.

Stiff brown mottled with gray silty clay, little fine to coarse sand, contains pockets of medium-stiff and very-stiff material.

Very-loose dark-brown and gray fine to medium sand, "and" silty clay.

Loose orange-brown and gray fine to coarse sand, "and" silty clay, trace fine gravel.

Stiff brown mottled with gray clayey silt, trace fine to coarse sand, trace fine to coarse gravel, contains pockets of some to "and" fine to coarse sand.

Medium-stiff to stiff gray clayey silt, trace fine to coarse sand, few pockets of silt.

Stiff to very-stiff silty clay interbedded with silt, few fine to medium and fine to coarse sand seams, (1/8" to 1" thick).

- Encountered slight seepage from 14.7' to 16.5'.

- Boring grouted with 5% bentonite/cement slurry. Surface repaired with Set 45.

WATER LEVEL: 17.2

WATER NOTE:

DATE: 4/17/02

JOB: 01107000.090

BBCM

LOG OF BORING NO. B-409
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE **Direct Push**

LOCATION: **Sta. 475+40, 60' Rt., Anomaly M**

COMPLETION DEPTH: 12.0' **ELEVATION:** 824.1 **DATE:** 4/9/02

DEPTH, FEET	SAMPLE NO	HAND PENETROMETER (tsf)	DESCRIPTION
0			ASPHALT - 8 INCHES
	1	2 9-3 0	FILL: Medium-dense brown fine to coarse sand, little clayey silt.
			FILL. Very-stiff brown and gray clayey silt, little fine to coarse sand.
	2	2.4-3 2	
5	3	1 3-1 7	Stiff gray silty clay, trace fine to coarse sand, few organics.
	4	1 5-2 2	Stiff to very-stiff brown and gray silty clay interbedded with clayey silt, trace fine to coarse sand.
	5	4 5+	
10			
	6	1 5-2.0	
15			
20			

Column headings: DEPTH, FEET; SAMPLE NO; SAMPLES; SAMPLING EFFORT; HAND PENETROMETER (tsf); MOISTURE CONTENT (%); LIQUID LIMIT (%); PLASTIC LIMIT (%); AGG. C.S F.S. SILT CLAY

- No seepage or groundwater encountered during drilling.

- Boring capped with Set 45 concrete.

- Boring backfilled with 5% bentonite/cement grout.

WATER LEVEL: "Dry"
WATER NOTE:
DATE: 4/09/02

JOB: 01107000.090

BBCM

LOG OF BORING NO. B-410A
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: **Direct Push**

LOCATION: **Sta. 477+85, 30' Rt., Anomaly N**

COMPLETION DEPTH: **10.0'** ELEVATION: **824.7** DATE: **4/11/02**

DEPTH, FEET	SAMPLE NO	HAND PENETROMETER (tsf)	DESCRIPTION
0			ASPHALT - 9 INCHES
	1		FILL: Medium-dense brown fine to coarse sand, trace fine to coarse gravel, little clayey silt.
	2	1.8-2.3	FILL: Stiff to very-stiff brown becoming gray clayey silt, little fine to coarse sand, little fine to coarse gravel.
5	3	2.1-2.6	Stiff (est.) gray silty clay, trace fine to coarse sand, slightly organic.
	4	0.5-1.1	Medium-stiff to stiff (est.) gray silty clay, trace fine sand.
	5	1.8-2.9	Stiff becoming very-stiff gray mottled with brown silty clay, trace fine to coarse sand.
10			
15			
20			

Column headings also printed: SAMPLES, SAMPLING EFFORT, MOISTURE CONTENT (%), LIQUID LIMIT (%), PLASTIC LIMIT (%), AGG., C.S., F.S, SILT, CLAY.

- Encountered slight seepage at 2.0'.
- Boring capped with Set 45 concrete.
- Boring backfilled with 5% bentonite/cement grout.

WATER LEVEL: "Dry"

WATER NOTE:

DATE: 4/11/02

JOB: 01107000.090

ODOTLI 17000090.GPJ BBCM.GDT 11/12/02

BBCM

LOG OF BORING NO. B-410B
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: Direct Push

LOCATION: Sta. 478+10, 30' Rt., Anomaly N

COMPLETION DEPTH: 10.0' ELEVATION: 825.0 DATE: 4/11/02

DEPTH, FEET	SAMPLE NO.	HAND PENETROMETER (tsf)	DESCRIPTION
0			ASPHALT - 10 INCHES
	1		FILL: Medium-dense (est.) brown fine to coarse sand, trace fine to coarse gravel, little clayey silt.
	2	2.2-2 7	FILL: Very-stiff brown becoming gray clayey silt, little fine to coarse sand, little fine to coarse gravel.
5	3	0 8-1 3	Medium-stiff to stiff gray silty clay, trace fine to coarse sand, few organics.
	4	0.7-1.5	Medium-stiff to stiff gray mottled with brown silty clay, trace fine to coarse sand.
	5	1 2-1.4	
10			
15			- No seepage or groundwater encountered during drilling - Boring capped with Set 45 concrete. - Boring backfilled with 5% bentonite/cement grout.
20			

Column headings: DEPTH, FEET; SAMPLE NO.; SAMPLES; SAMPLING EFFORT; HAND PENE-TROMETER (tsf); MOISTURE CONTENT (%); LIQUID LIMIT (%); PLASTIC LIMIT (%); AGG; C S.; F.S.; SILT; CLAY; DESCRIPTION

WATER LEVEL: "Dry"
WATER NOTE:
DATE: 4/11/02

JOB: 01107000.090

BBCM

LOG OF BORING NO. B-410C
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: **Direct Push**

LOCATION: **Sta. 477+75, 30' Rt., Anomaly N**

DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG	.S	S	DESCRIPTION
0											
											FILL: Loose (est.) brown fine to coarse sand, little silt, trace fine to coarse gravel
											FILL: Very-stiff brown becoming gray clayey silt, little fine to coarse sand, little fine to coarse gravel.
	2			2.7-3 8							
5	3			0 8-1 1							Medium-stiff to stiff gray silty clay, trace fine to coarse sand, slightly organic.
	4			0 5-1 0							Medium-stiff to stiff gray mottled with brown silty clay, trace fine sand.
	5			2 1-2 4							
10											
15											- Encountered seepage at 2.0'. - Boring capped with Set 45 concrete. - Boring backfilled with 5% bentonite/cement grout.
20											

WATER LEVEL: "Dry"

WATER NOTE:

DATE: 4/11/02

JOB: 01107000.090

BBCM

LOG OF BORING NO. B-411
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: **Direct Push** LOCATION: **Sta. 482+48, 60' F** **Anomaly P**

COMPLETION DEPTH: 10.0' ELEVATION: 828.2 DATE: 4/9/02

DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0													ASPHALT - 9 INCHES
	1												FILL: Very-stiff brown clayey silt, little fine to coarse sand, trace fine to coarse gravel.
	2			2.1-2.6									
5	3			3.5-3.9									Very-stiff gray clayey silt, trace fine to coarse sand, slightly organic.
													Stiff to very-stiff gray mottled with brown clayey silt, trace fine to coarse sand.
				3.1-3.3									
	5			1.3-1.6									
10													
15													- No seepage or groundwater encountered during drilling. - Boring capped with Set 45 concrete. - Boring backfilled with 5% bentonite/cement grout.
20													

WATER LEVEL: "Dry"
WATER NOTE:
DATE: 4/09/02

JOB: 01107000.090

BBCM

LOG OF BORING NO. B-412A
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE. **Direct Push**

LOCATION **Sta. 483+35, 60' Rt., Anomaly Q**

COMPLETION DEPTH: 10.0' **ELEVATION:** 826.9 **DATE:** 4/9/02

DEPTH, FEET	SAMPLE NO	HAND PENE-TROMETER (tsf)	DESCRIPTION
0			ASPHALT - 11 INCHES
	1		FILL: Medium-dense brown fine to medium sand, trace coarse sand, little clayey silt, trace face to coarse gravel.
	2	1.9-2 3	FILL: Stiff to very-stiff brown clayey silt, little fine to coarse sand, trace fine to coarse gravel.
5	3	1.9-2 4	
	4	1 7-2.1	Stiff to very-stiff gray silty clay, trace fine to coarse sand, slightly organic.
	5	1.5-1 7	
10			
15			- No seepage or groundwater encountered during gravel. - Boring capped with Set 45 concrete. - Boring backfilled with 5% bentonite/cement grout.
20			

Other columns (blank): SAMPLES, SAMPLING EFFORT, MOISTURE CONTENT (%), LIQUID LIMIT (%), PLASTIC LIMIT (%), AGG., C.S., F S., SILT, CLAY

WATER LEVEL: "Dry"
WATER NOTE:
DATE: 4/09/02

ODOTLJ 17000090 GPJ BBCM GDT 11/12/02

JOB: 01107000.090

BBCM

LOG OF BORING NO. B-412B
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: **Direct Push**

LOCATION: **Sta. 483+90, 60' Rt., Anomaly Q**

COMPLETION DEPTH: **10.0'** ELEVATION: **827.2** DATE: **4/9/02**

DEPTH, FEET	SAMPLE NO.	HAND PENE-TROMETER (tsf)	DESCRIPTION
0			ASPHALT - 9 INCHES
	1	4.5+	FILL: Medium-dense (est.) brown fine to coarse sand, little fine to medium gravel, trace coarse gravel.
			FILL: Hard gray silty clay, trace medium to coarse sand.
	2	2.9-3.1	FILL: Very-stiff brown clayey silt, little fine to coarse sand, trace fine to coarse gravel.
5	3	2.3-2.6	
			Very-stiff gray silty clay, trace fine to coarse sand, slightly organic.
	4	1.2-2.4	Stiff to very-stiff gray mottled with brown silty clay, trace fine to coarse sand.
	5	0.25-0.8	
10			
15			- No seepage or groundwater encountered during drilling.
			- Boring capped with Set 45 concrete.
			- Boring backfilled with 5% bentonite/cement grout.
20			

Other column headings (no entries): SAMPLES; SAMPLING EFFORT; MOISTURE CONTENT (%); LIQUID LIMIT (%); PLASTIC LIMIT (%); AGG.; C.S.; F.S.; SILT; CLAY.

WATER LEVEL: "Dry"
WATER NOTE:
DATE: 4/09/02

JOB: 01107000.090

BBCM

LOG OF BORING NO. B-412C
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 4-1/2" O.D. Continuous-flight Auger; 2" O.D. Split-barrel Sampler
LOCATION: Sta. 483+40, 34' Rt. Anomaly Q
COMPLETION DEPTH: 20.0' ELEVATION: 827.1 DATE: 4/17/02

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0												ASPHALT - 13 INCHES
	1	13/21/6/5										GRANULAR BASE: Brown and gray fine to coarse gravel, some clayey silt, little fine to coarse sand, contains few asphalt fragments.
	2	5/5/7/14	3 4-4 5+									FILL: Very-stiff to hard brown mottled with gray silty clay, some fine to coarse sand, little fine to coarse gravel, few pockets of fine to coarse sand.
5	3	4/3/4/6	1.4-1 6									Stiff gray becoming dark-brown mottled with gray silty clay, little fine to coarse sand. - Becoming 8.0' very-stiff.
	4	2/4/6/8	1 8-3 0									
10	5A	2/2/4/4	1.7-2.2									
	5B		0.7-1.2									Medium-stiff to stiff orange-brown mottled with gray clayey silt, "and" fine sand, trace medium to coarse sand.
	5C		1 5-1 9									Stiff brown clayey silt, some fine to coarse sand, trace fine to coarse gravel.
	6	2/2/4/3	1.4-2 8									Stiff to very-stiff orange-brown mottled with gray clayey silt, trace fine to coarse sand, few pockets of silt.
15	7	1/7/2/4	0 6-1 2									Medium-stiff to stiff gray silty clay, trace fine to coarse sand. - At 18.4', 1" seam fine to coarse sand.
20	8	1/2/3/4	0 7-1.5									
25												- Encountered slight seepage from 11.5' to 13.7'. - Boring grouted with 5% bentonite/cement slurry. Surface repaired with Set 45.
30												

WATER LEVEL: "Dry"
WATER NOTE:
DATE: 4/17/02

ODOTLJ 17000090.GPJ BBCM.GDT 11/12/02
JOB: 01107000.090

BBCM

LOG OF BORING NO. B-412D
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 4-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; NX Rock Core Barrel

LOCATION: Sta. 483+38, 21' Rt. Anomaly Q

COMPLETION DEPTH: 82.8' ELEVATION: 826.6 DATE: 4/25/02 - 4/26/02

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG	C.S	F.S.	SILT	CLAY	DESCRIPTION
0	1A	10/6/8										FILL: Loose to medium-dense brown fine to coarse sand, some fine to coarse gravel.
	1B	/10	3.7-4.2									FILL: Very-stiff to hard brown silty clay, some fine to coarse sand, trace fine to coarse gravel.
5	2	4/5/7/8	3.9-4.5									
	3	7/8/9/10	1.2-2.5									Stiff to very-stiff brown-gray silty clay, little fine to coarse sand.
	4	3/4/6/8	1.9-3.2									- Below 9.0', medium-stiff to stiff.
10	5A	1/2/5	0.8-1.5									
	5B	/5										Medium-dense brown fine to coarse sand, "and" clayey silt, trace fine to coarse gravel.
	6	9/8/5/6										
15	7 / 2S	1/1/2/2										Very-loose to loose gray silt interbedded with medium-stiff to stiff silty clay, trace fine to medium sand.
	8	S/H/1/4										
20	9	1/3/5										
25	10A	4/5/2										
	10B											Loose brown fine to coarse sand, some silty clay, little fine gravel.
												Loose gray silt, trace fine sand, many seams silty clay.
30	11	1/2/4										
35	12	1/3/4										
												Very-dense gray fine to coarse sand, some clayey silt, trace fine gravel.
40	13	19/21/42										
												Stiff gray silty clay, little fine to coarse sand, soft medium to very-soft shale.
45	14A	8/20/50	1.0-1.5									
	14B											Soft to medium-hard gray shale.
	15	REC 78% RQD 0%										Medium-hard gray siltstone interbedded with fine-grained sandstone and soft to very-soft shale, nearly horizontally bedded, 1/4" to 3" layers, many horizontal fractures.
50												

WATER LEVEL:
WATER NOTE:
DATE:

JOB: 01107000.090

-CONTINUED-

BBCM

LOG OF BORING NO. B-412D
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 4-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; NX Rock Core Barrel

LOCATION: Sta. 483+38, 21' Rt. Anomaly Q

COMPLETION DEPTH: 82.8' ELEVATION: 826.6 DATE: 4/25/02 - 4/26/02

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	S.	F.S	SILT	CLAY	DESCRIPTION - CONTINUED
55	16	REC 30% RQD 0%										Medium-hard to hard gray siltstone, highly fractured, coarse gravel size pieces.
60	17	REC 88% RQD 33%										Medium-hard to hard gray siltstone, nearly horizontally bedded, 1" to 12" layers, many horizontal fractures, few seams of soft gray shale.
65												
70	18	REC 64% RQD 0%										Very-soft to soft gray shale.
75	19	REC 100% RQD 57%										Coal.
												Very-soft to soft gray shale, underclay.
80												Medium-hard to hard gray fine-grained sandstone, nearly horizontally bedded, 2" to 24" layers, few to many horizontal fractures.
85												
90												
95												
100												

- Encountered seepage from 13.0' to 16.0'.

- Encountered water from 36.0' to 40.8'.

- Began rock core at 45.5'.

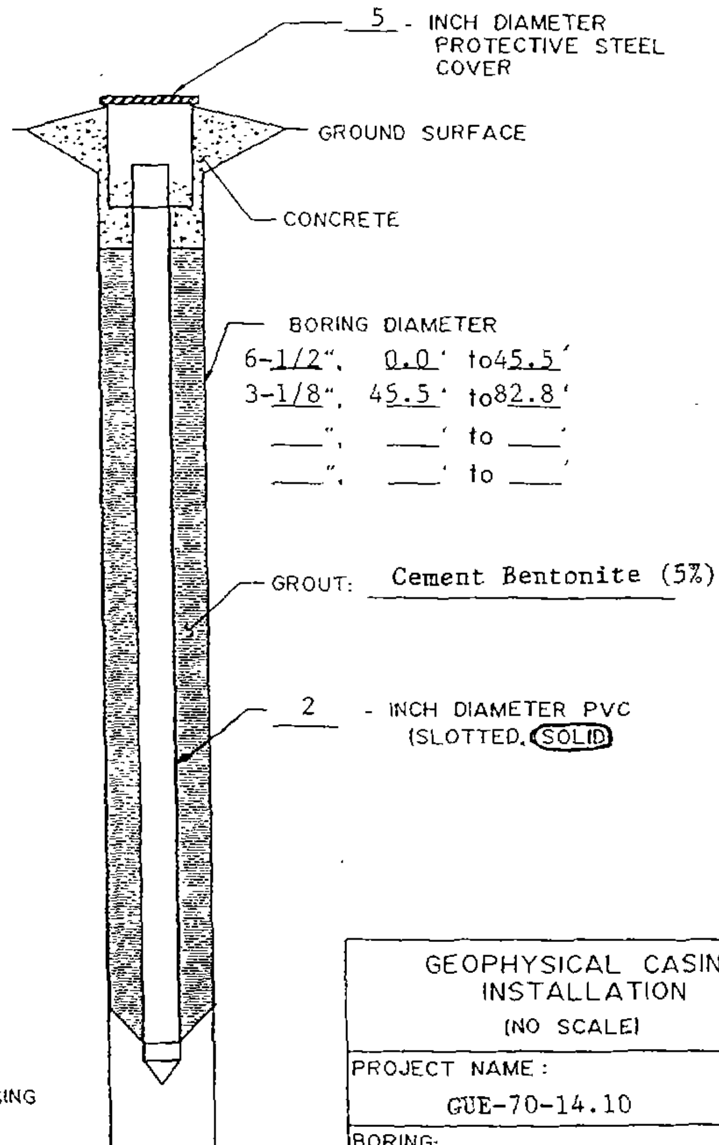
- Lost water circulation at 51.0'.

- Installed 2" diameter geophysical casing. See completion diagram.

WATER LEVEL:
WATER NOTE:
DATE:

JOB: 01107000.090

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
826.7	-0.1	TOP OF COVER
826.6	0.0	GROUND SURFACE
826.5	0.1	TOP OF PVC
825.7	1.0	TOP OF GROUT
744.5	82.1	BOTTOM OF CASING
743.8	82.8	BORING DEPTH



GEOPHYSICAL CASING INSTALLATION
(NO SCALE)

PROJECT NAME: GUE-70-14.10

BORING: B-412D

DATE INSTALLED: 04-26-02

BBC & M PROJECT NO: 01107000.090

INSTALLATION NOTES:

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

TCAMWLL4.DWG

BBCM

LOG OF BORING NO. B-412E
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 4-1/2" O.D. Continuous-flight Auger; 2" O.D. Split-barrel Sampler; NX Rock Core Barrel

LOCATION: Sta. 483+93, 65' Rt. Anomaly Q

COMPLETION DEPTH: 86.2' ELEVATION: 826.6 DATE: 4/19/02

DEPTH, FEET	SAMPLE NO.	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0	1A											FILL: Medium-dense brown fine to coarse sand.
	1B	4/3/7/5	2.0-3.6	17	34	18	2	15	12	41	30	FILL: Stiff to very-stiff brown mottled with gray clayey silt, some fine to coarse sand, trace fine to coarse gravel.
	2	3/6/7/10	3.0-3.8	19	42	21	2	3	11	84		
5	3A	2/3/3/7	2.0-2.8									
	3B		0.75-2.0									Medium-stiff to stiff gray organic clayey silt, interbedded with silt.
	4A	2/3/3/6	1.0-1.8									
	4B		0.8-1.5	29	70	23	0	1	2	39	58	Medium-stiff to stiff gray mottled with brown silty clay, trace fine to coarse sand.
10	5	2/2/8/9	1.2-2.2									
	6	S/H 1/2/3	0.2-1.0									
	7	1/1/2/4	0.5-1.2									Very-loose to loose brown mottled gray silt interbedded with silty clay, little fine to medium sand.
15	8	1/2/2	0.6-1.0									Medium-stiff brown mottled with gray silty clay, trace fine to medium sand, few seams silt.
	9	S/H 2/3	0.6-0.8									Medium-stiff gray silty clay, interbedded with silt and clayey silt.
20												Loose gray fine to coarse sand, "and" silty clay, little fine to coarse gravel.
	10	2/4/4	1.0-1.5									
25												
	11	2/2/		19	30	22	1	23	25	30	18	
30												Very-loose gray silt, interbedded with silty clay, trace fine to medium sand, slightly organic.
	12	S/H=12/1										
35												
	13A	3/4/6										Loose brown fine to coarse sand, some fine to coarse gravel, little clayey silt.
40	13B											
											38	
	14	2/3/3		16			28	24	21	18	9	
45												

WATER LEVEL: ▽ 16.9

WATER NOTE: Before Coring

DATE: 4/19/02

JOB: 01107000.090

-CONTINUED-

TYPE: 4-1/2" O.D. Continuous-flight Auger; 2" O.D. Split-barrel Sampler; NX Rock Core Barrel

LOCATION: Sta. 483+93, 65' Rt, Anomaly Q

COMPLETION DEPTH: 86.2' ELEVATION: 826.6 DATE: 4/19/02

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	DESCRIPTION - CONTINUED
				Very-soft to soft gray shale, interbedded with medium-hard siltstone, nearly horizontally bedded
50	15	12/13/15	4.5+	
	16	REC 39% RQD 7%		Medium-hard gray siltstone, nearly horizontally bedded, fractured.
55				Medium-hard gray siltstone, nearly horizontally bedded, many horizontal fractures.
60	17	REC 77% RQD 23%		
				Medium-hard gray fine-grained sandstone, nearly horizontally bedded, 1/2" to 3" layers, micaceous, few horizontal fractures.
65				Medium-hard gray siltstone, nearly horizontally bedded, 1/4" to 3" layers, many horizontal fractures.
	18	REC 68% RQD 31%		Medium-hard gray shale, nearly horizontally bedded, many horizontal fractures.
70				Medium-hard gray siltstone, nearly horizontally bedded.
				Very-soft to soft gray shale, nearly horizontally bedded, few horizontal fractures, underclay.
75				Medium-hard to hard gray siltstone, nearly horizontally bedded, 1" to 3" layers, few horizontal fractures, interbedded with few seams of fine-grained sandstone.
80	19	REC 98% RQD 87%		
85				
90				- Encountered water from 26.0' to 32.1'.
				- Geophysical casing installed. See completion diagram

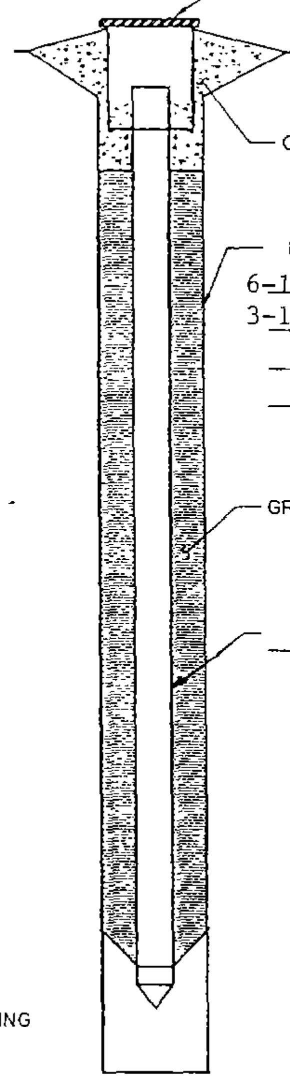
Other column headings: SAMPLES, MOISTURE CONTENT %, LIQUID LIMIT %, PLASTIC LIMIT %, AGG., C.S., F.S., SILT, CLAY.

WATER LEVEL: 16.9

WATER NOTE: Before Coring

DATE: 4/19/02

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
826.7	0.0	TOP OF COVER
826.7	0.0	GROUND SURFACE
826.6	0.1	TOP OF PVC
825.7	1.0	TOP OF GROUT
741.1	85.5	BOTTOM OF CASING
740.4	86.2	BORING DEPTH



5 - INCH DIAMETER PROTECTIVE STEEL COVER

GROUND SURFACE

CONCRETE

BORING DIAMETER
6-1/2", 0.0' to 52.9'
3-1/8", 52.9' to 86.2'
___", ___' to ___'
___", ___' to ___'

GROUT: Cement Bentonite (5%)

2 - INCH DIAMETER PVC (SLOTTED, SOLID)

GEOPHYSICAL CASING INSTALLATION (NO SCALE)
PROJECT NAME: GUE-70-14.10
BORING: B-412E
DATE INSTALLED: 04-19-02
BBC & M PROJECT NO: 01107000.090

INSTALLATION NOTES:

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

TCAMWLL4.DWG

BBCM

LOG OF BORING NO. B-413A
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE. **Direct Push**

LOCATION: **Sta. 485+00, 60' Rt., Anomaly R'**

COMPLETION DEPTH: 12.0' ELEVATION: 827.7 DATE: 4/9/02

DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0													ASPHALT - 7 INCHES
	1			4 5+									FILL: Medium-dense (est.) brown fine to coarse sand, some clayey silt.
													FILL: Hard brown clayey silt, little fine to coarse sand, trace fine to coarse gravel.
	2			4.5+									
5	3			2.0-3.5									Stiff to very-stiff (est.) gray silty clay, trace fine to coarse sand, slightly organic.
													Very-stiff brown mottled with gray silty clay, trace fine to coarse sand.
	4			3 0-3 8									Very-stiff brown mottled with gray silty clay, trace fine to coarse sand.
	5			2 9-3.1									Very-stiff brown clayey silt, little fine to coarse sand, trace fine to coarse gravel.
10	6			2.2-2.5									Very-stiff brown mottled with gray silty clay, trace fine to coarse sand.
15													- No seepage or groundwater encountered during drilling.
													- Boring capped with Set 45 concrete.
													- Boring backfilled with 5% bentonite/cement grout.
20													

WATER LEVEL: "Dry"
WATER NOTE:
DATE: 4/09/02

JOB: 01107000.090

BBCM

LOG OF BORING NO. B-413B
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE. **Direct Push** LOCATION: **Sta. 486+00, 60' Rt., Anomaly R'**

COMPLETION DEPTH: 12.0' ELEVATION: 828.5 DATE: 4/9/02

DEPTH, FEET	SAMPLE NO.	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0											ASPHALT - 8 INCHES
											FILL: Medium-dense brown fine to coarse sand, little clayey silt.
	1	4 5+									FILL: Very-stiff to hard brown clayey silt, little fine to coarse sand, trace fine to coarse gravel.
	2	3 5-4 5+									
											Very-stiff (est.) gray clayey silt, trace fine to coarse sand, slightly organic.
											Very-stiff gray mottled with brown silty clay, trace fine to coarse sand.
5	3	2 5-3 0									
											Hard brown clayey silt, little fine to coarse sand, trace fine to coarse gravel.
	4	4.5+									
											Stiff to very-stiff brown clayey silt, little fine to coarse sand, trace fine to coarse gravel.
	5	1.0-1.5									
10											
	6	1 5-2 0									
15											- No seepage or groundwater encountered during drilling.
											- Boring capped with Set 45 concrete.
											- Boring backfilled with 5% bentonite/cement grout.
20											

WATER LEVEL: ▽ "Dry"

WATER NOTE:

DATE: 4/09/02

JOB: 01107000.090

ODOT LJ 17000090.GPJ BBCM.GDT 11/12/02

BBCM

LOG OF BORING NO. B-413C
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: **Direct Push**

LOCATION: **Sta. 486+15, 58' Rt., Anomaly R'**

COMPLETION DEPTH: **12.0'** ELEVATION: **828.6** DATE: **4/10/02**

DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0													ASPHALT - 8 INCHES
				4.5+									FILL: Medium-dense brown fine to coarse sand, little clayey silt.
													FILL. Hard brown clayey silt, little fine to coarse sand, trace fine to coarse gravel.
				2.4-4.5+									FILL: Dense (est.) gray fine to coarse gravel (limestone), trace fine to coarse sand, trace silt.
													Very-stiff to hard brown mottled with gray clayey silt, trace fine to coarse sand.
5				1.0-2.2									Stiff to very-stiff brown silty clay, little fine to coarse sand, trace fine to coarse gravel.
				2.9-3.3									
				2.6-3.4									
10													Very-stiff to hard brown clayey silt, little fine to coarse sand, little fine to coarse gravel.
				3.4-4.5+									
15													- No seepage or groundwater encountered during drilling.
													- Boring capped with Set 45 concrete.
													- Boring backfilled with 5% bentonite/cement grout.
20													

WATER LEVEL: "Dry"

WATER NOTE:

DATE: 4/10/02

BBCM

LOG OF BORING NO. B-413D
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 4-1/2" O.D. Continuous-flight Auger; 2" O.D. Split-barrel Sampler

LOCATION: Sta. 486+06, 55' Rt. Anomaly R

COMPLETION DEPTH: 15.5' ELEVATION: 828.7 DATE: 4/16/02

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0												ASPHALT - 15 INCHES
	1A	6/4/7/10										GRANULAR BASE: Loose brown fine to coarse sand, little clayey silt.
	1B		3.0-4.5+									FILL: Very-stiff to hard brown silty clay, little fine to coarse sand, trace fine to coarse gravel.
5	2	8/7/9/9	2.1-4.5+									Hard becoming stiff to very-stiff brown mottled with gray silty clay, little fine to coarse sand, trace fine gravel. - Slightly organic from 2.8' to 3.2'.
	3A	3/3/5/6	1.7-2.3									
	3B		3.7-4.5+									
	3C		1.9-2.5									
	4	2/5/5/11	1.8-2.4									
10	5	4/5/7/9	1.5-2.8									Very-stiff with pockets of stiff brown mottled with gray silty clay, some fine to coarse sand, trace fine to coarse gravel, few pockets of fine to medium sand.
	6	4/6/8/14	1.8-2.8									
	7A	5/9/8/9	3.4-4.5+									Very-stiff to hard brown silty clay, "and" fine to coarse sand, trace fine to coarse gravel.
15	7B		1.7-2.6									Stiff with pockets of very-stiff gray silty clay, trace fine to coarse sand.
20												- No seepage or groundwater encountered during drilling. - Boring grouted with 5% bentonite/cement slurry. Surface repaired with Set 45.
25												
30												

WATER LEVEL: "Dry"
WATER NOTE:
DATE: 4/16/02

ODOTLJ 17000090.GPJ BBCM.GDT 11/12/02

JOB: 01107000.090

LOG OF BORING NO. B-413E
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 4-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; NX Rock Core Barrel

LOCATION: Sta. 486+38, 66' Rt., Anomaly R'

COMPLETION DEPTH: 81.0' ELEVATION: 828.5 DATE: 4/22/02

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENETROMETER (tsf)	DESCRIPTION
0	1A	8/5/6/7	4.0-4.5	FILL: Medium-dense fine to coarse sand, "and" fine to coarse gravel, clayey silt.
	1B		4.0-4.5	Hard brown mottled with gray silty clay, trace fine to coarse sand.
	2A	3/5/7/7	4.0-4.5	
	2B		1.5-3.0	Stiff to very-stiff brown mottled with gray silty clay, little fine to coarse sand, trace fine to coarse gravel, few seams silt.
5	3	9/9/10/9	1.2-2.7	
	4	2/5/7/8	1.1-2.1	
10	5	1/2/7/8	1.8-2.9	
	6	2/2/5/6	1.0-1.6	Stiff brown silty clay, trace fine to coarse sand.
	7	2/4/5/7	1.0-2.0	
15	8	4/7/10	2.5-3.2	Very-stiff with "and" fine to coarse sand.
	9	3/3/7	1.6-2.2	
20				Loose brown fine to coarse sand, some clayey silt, little fine gravel.
	10	3/4/4		
25				
	11	S/H/1/2		Very-loose gray silt interbedded with silty clay, trace fine sand.
30				
	12A	6/3/16		
35	12B			Medium-dense gray fine to coarse sand, some clayey silt, some fine to coarse gravel.
	13	21/33/40		Very-dense gray fine to coarse sand, some clayey silt, "and" fine to coarse gravel.
40	14	REC 30% RQD 0.6%		Medium-hard to hard gray siltstone, nearly horizontally bedded, 1/2" to 4" layers, many horizontal fractures, few seams of very-soft gray shale.
45				

Column headings also include: CONTENT (%), LIQUID LIMIT (%), PLASTIC LIMIT (%), AGG., C.S., F.S., SILT, CLAY.

WATER LEVEL:
WATER NOTE:
DATE:

LOG OF BORING NO. B-413E
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 4-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; NX Rock Core Barrel

LOCATION: Sta. 486+38, 66' Rt., Anomaly R'

COMPLETION DEPTH: 81.0' ELEVATION: 828.5 DATE: 4/22/02

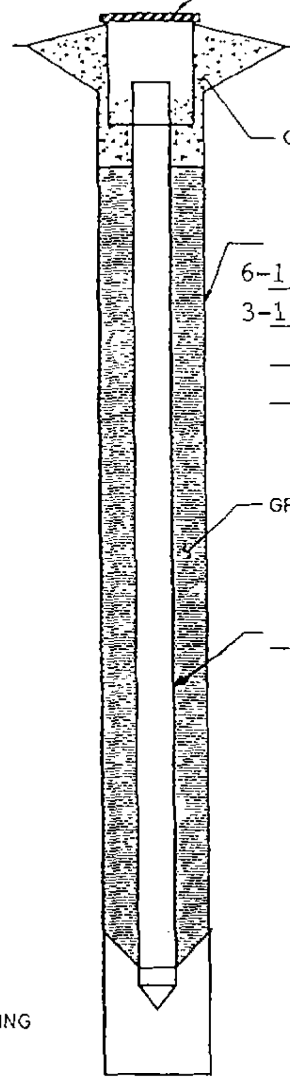
DEPTH, FEET	SAMPLE NO.	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
	15	REC 90% RQD 52%										Medium-hard to hard gray siltstone, nearly horizontally bedded, few horizontal fractures.
50												Soft gray shale, nearly horizontally bedded, many horizontal fractures.
												Medium-hard to hard gray siltstone, nearly horizontally bedded, few horizontal fractures.
55	16	REC 97% RQD 81%										Medium-hard to hard gray fine-grained sandstone, nearly horizontally bedded, 9" layers.
												Medium-hard to hard gray siltstone, nearly horizontally bedded, few seams soft shale, few horizontally fragments
60												
65	17	REC 70% RQD 54%										GROUT: Medium-hard dark-gray.
												Medium-hard to hard gray siltstone, few fractures.
70												Very-soft to soft gray shale, underclay.
75	18	REC 91% RQD 80%										Medium-hard to hard gray fine-grained sandstone, nearly horizontally bedded, 3" to 16" layers, few horizontal fractures.
80												
85												- Geophysical casing installed. See Completion Diagram.
90												

WATER LEVEL:

WATER NOTE:

DATE:

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
828.6	-0.1	TOP OF COVER
828.5	0.0	GROUND SURFACE
828.5	0.0	TOP OF PVC
827.6	1.0	TOP OF GROUT
748.7	79.8	BOTTOM OF CASING
747.5	81.0	BORING DEPTH



5 - INCH DIAMETER PROTECTIVE STEEL COVER

GROUND SURFACE

CONCRETE

BORING DIAMETER
6-1/2", 0.0' to 40.5'
3-1/8", 40.5' to 81.0'
___", ___' to ___'
___", ___' to ___'

GROUT: Cement Bentonite (5%)

2 - INCH DIAMETER PVC (SLOTTED, SOLID)

GEOPHYSICAL CASING INSTALLATION (NO SCALE)
PROJECT NAME: GUE-70-14.10
BORING: B-413E
DATE INSTALLED: 04-24-02
BBC & M PROJECT NO. 01107000.090

INSTALLATION NOTES:

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

TCAMWLL4.DWG

BBCM

LOG OF BORING NO. B-413F
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; NX Rock Core Barrel

LOCATION: Sta. 486+02, 66' Rt. Anomaly R'

COMPLETION DEPTH: 81.7' ELEVATION: 828.2 DATE: 4/23/02

DEPTH, FEET	SAMPLE NO.	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0												FILL: Loose brown fine to coarse gravel, "and" fine to coarse sand.
	1	4/6/3/5										FILL: Very-stiff to hard brown fine to coarse sand.
	2A	3/7/9/8	3.8-4.5+									Very-stiff gray clayey silt, little fine to medium sand.
	2B		2.5									
5	2C		1.9-3.0									Stiff to very-stiff gray mottled with brown silty clay, trace fine sand.
	3A	7/9/10/10	1.0-1.5									
	3B		0.7-1.7									Medium stiff to stiff gray silty clay, little fine sand.
	4	2/5/8/11	2.6-3.7									Stiff to very-stiff brown silty clay, trace fine to coarse sand.
10	5	5/4/5/9	1.3-2.4									
	6	3/4/6/8	1.3-2.7									
	7	3/4/5/8	1.0-1.9									Medium-stiff to stiff brown silty clay, little fine to medium sand, few seams silt.
15	8	4/5/7	1.5-2.0									Stiff to very-stiff brown silty clay, some fine to coarse sand, trace fine to coarse gravel.
	9	2/4/4	1.2-1.9									
20												
	10	3/4/4	1.7-2.1									
25												
	11A	S/H/1/2										Very-loose brown fine to coarse sand, some clayey silt.
30	11B											Very-loose gray silt, interbedded with silty clay, trace fine to coarse sand.
												- Below 32.0 becoming medium-dense.
	12A	5/8/12										
35	12B											Medium-dense brown fine to coarse sand, some clayey silt, "and" fine to coarse gravel.
												Very-dense gray fine to coarse sand, some clayey silt, little fine to coarse gravel.
40	13	28/30/45										

WATER LEVEL:	29.7					
WATER NOTE:	Before Coring					
DATE:	4/23/02					

ODOTLJ 17000090.GPJ BBCM.GDT 11/12/02

JOB: 01107000.090

-CONTINUED-

BBCM

LOG OF BORING NO. B-413F
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger
2" O.D. Split-barrel Sampler
NX Rock Core Barrel

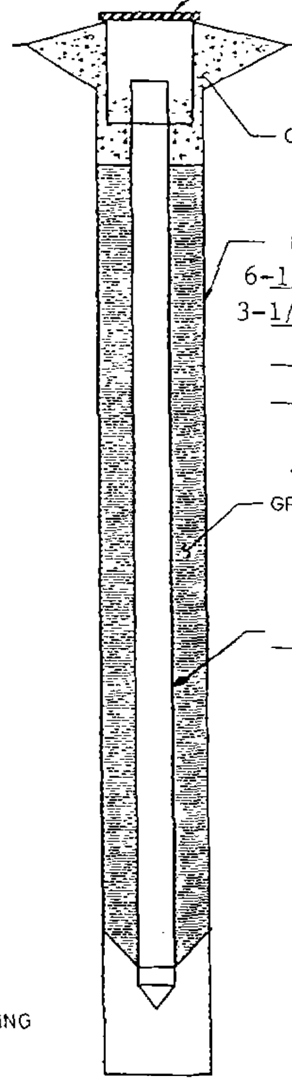
LOCATION: Sta. 486+02, 66' Rt.
Anomaly R'

COMPLETION DEPTH: 81.7' ELEVATION: 828.2 DATE: 4/23/02

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	GG	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
45	14		REC 97% RQD 34%										Soft to medium-hard gray shale (1/2" to 3" layers) interbedded with siltstone (1" layers), many horizontal fractures.
													Medium-hard to hard gray siltstone, nearly horizontally bedded, 1' to 8" layers, few fractures, contains seams of soft gray shale at 47.0' to 47.2' and 47.7' to 48.5'.
50–55	15		REC 100% RQD 97%										Medium-hard to hard gray siltstone, nearly horizontally bedded, 4" to 24" layers, few horizontal fractures, interbedded with seams of fine-grained sandstone.
60–65	16		REC 96% RQD 49%										Medium-hard black coal, nearly horizontally bedded, many horizontal fractures.
													Very-soft to soft gray shale, underclay.
70													PRODUCTION GROUT
													Very-soft to soft gray shale, underclay.
75	17		REC 100% RQD 72%										Medium-hard to hard fine-grained sandstone interbedded with siltstone, nearly horizontally bedded, few horizontal fractures.
80–85													- Geophysical casing installed, see Completion Diagram.

WATER LEVEL: 29.7
WATER NOTE: Before Coring
DATE: 4/23/02

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
828.1	0.0	TOP OF COVER
828.1	0.0	GROUND SURFACE
827.8	0.3	TOP OF PVC
827.1	1.0	TOP OF GROUT
747.2	81.0	BOTTOM OF CASING
746.5	81.7	BORING DEPTH



BORING DIAMETER
6-1/2", 0.0' to 43.2'
3-1/8", 43.2' to 81.7'
___", ___' to ___'
___", ___' to ___'

GROUT: Cement Bentonite (5%)

2 - INCH DIAMETER PVC (SLOTTED, SOLID)

GEOPHYSICAL CASING INSTALLATION (NO SCALE)
PROJECT NAME: GUE-70-14.10
BORING: B-413F
DATE INSTALLED 04-23-02
BBC & M PROJECT NO: 01107000.090

INSTALLATION NOTES:

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

TCAMWLL4.DWG

BBCM

LOG OF BORING NO. B-413G
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE. **4-1/2" O.D. Continuous-flight Auger**
2" O.D. Split-barrel Sampler

LOCATION **Sta. 485+40, 55' Rt.**

COMPLETION DEPTH: 15.5' **ELEVATION: 828.3** **DATE: 4/16/02**

FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	DESCRIPTION
0							ASPHALT - 11 INCHES
	1A	7/6/5					GRANULAR BASE: Medium-dense brown and gray fine to coarse sand, trace fine gravel, little clayey silt.
	1B	/1	4.3-4.5+				FILL: Hard brown silty clay, little fine to coarse sand, trace fine to coarse gravel, below 3.8' becoming very-stiff.
	2A	7/6/11	2.4-4.5+				
5	2B	/7	2.5-3.5				Very-stiff gray mottled with brown clayey silt, little fine to coarse sand, trace fine gravel.
	3	4/4/6 /7	2.2-2.4				Very-stiff brown mottled with gray silty clay, little fine to coarse sand, trace fine gravel, becoming stiff below 7.3'.
	4A	2/4/6	1.2-2.0				
	4B	/8	2.4-3.2				Very-stiff brown silty clay, "and" fine to coarse sand, trace fine to coarse gravel.
10	5A	4/4/5	3.7-4.5+				Very-stiff to hard brown silty clay, little fine to medium sand, trace coarse sand.
	5B	/6	1.3-2.1				Stiff to very-stiff brown clayey silt, little fine to coarse sand, trace fine to coarse gravel.
	6	2/3/5 /6	1.3-1.9				Stiff brown silty clay, little fine to coarse sand, trace fine to coarse gravel, contains pockets of very-stiff material.
15	7	3/4/6 /10	1.3-2.2				
20							
25							
30							

Gradation columns: AGG. | C S | F S | SILT | CLAY

- Slight seepage from 3.8' to 4.5' and 10.4' to 11.5'.

- Boring grouted with 5% Bentonite/Cement slurry. Surface repaired with Set 45.

WATER LEVEL: "Dry"
WATER NOTE:
DATE: 4/16/02

JOB: 01107000.090

BBCM

LOG OF BORING NO. B-413H
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 4-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; NX Rock Core Barrel

LOCATION: Sta. 485+37, 67' Rt.

COMPLETION DEPTH: 81.6' ELEVATION: 827.5 DATE: 4/22/02

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0	1A	6/5/7/9	3.5-4.2									FILL. Very-stiff to hard brown fine to coarse sand, some silty clay, trace fine to coarse gravel.
	1B		3.9-4.5									FILL: Stiff to very-stiff brown mottled with gray silty clay, some fine to coarse sand, trace fine to coarse gravel, few coal fragments.
	2	5/6/7/10	1.6-2.8	18	38	20	1	3	8	51	37	
5	3	3/3/6/9	1.2-2.1									Stiff to very-stiff gray mottled with brown silty clay, little fine to coarse sand.
	4	1/3/4/7	0.6-1.5									Medium-stiff to stiff brown mottled with gray silty clay, trace fine to coarse sand, many thin seams silt, "and" fine sand.
10	5	1/4/5/6	0.7-1.9									
	6	1/3/3/3	0.6-1.2									
	7	2/3/3/5	0.5-0.9									
15	8	3/5/7	0.8-1.8									Medium-stiff to stiff gray clayey silt, little fine to medium sand, slightly organic, contains decayed vegetation.
20	9	2/3/6	1.2-2.0									
	10	4/3/5										Medium-dense brown fine to coarse sand, some clayey silt, some fine to coarse gravel.
25												
	11	1/2/2	0.4-0.6									Loose gray silt, interbedded with silty clay, trace fine to coarse sand.
30												
	12A	2/4/28	0.4-1.0									
35	12B											Dense gray fine to coarse sand, some fine to coarse gravel, some clayey silt, few seams of silty clay.
	13	18/20/50-4"R										
40												
	14	32/50-2"R										Very-soft gray shale.
45												

WATER LEVEL: ▽
WATER NOTE: Before Coring
DATE: 4/22/02

JOB: 01107000.090

-CONTINUED-

BBCM

LOG OF BORING NO. B-413H
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 4-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; NX Rock Core Barrel

LOCATION: Sta. 485+37, 67' Rt.

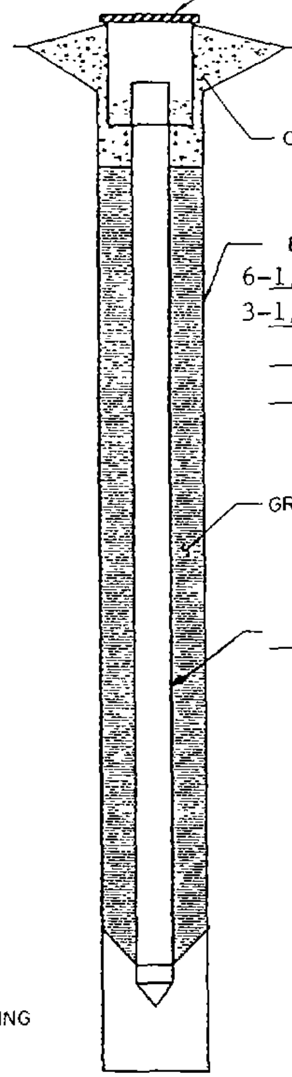
COMPLETION DEPTH: 81.6' ELEVATION: 827.5 DATE: 4/22/02

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
	15	REC 95% RQD 44%										Medium-hard to hard gray siltstone, nearly horizontally bedded, 1/4" to 6" layers, many horizontal fractures.
50												
	16	REC 100% RQD 70%										Medium-hard to hard gray siltstone, nearly horizontally bedded, 2" to 14" layers, many horizontal fractures, few seams of fine-grained sandstone.
55												
												- 58.9-59.0 soft gray shale
60												
	17	REC 94% RQD 50%		0								PRODUCTION GROUT: Medium-hard to hard gray.
65												
												Soft gray shale, underclay.
70												
	18	RQD 98% RQD										Medium-hard to hard gray fine-grained sandstone, micaceous.
75												
80												
85												- Geophysical casing installed. See completion diagram.
90												

WATER LEVEL:	▽	▼	▽	▽	▽	▽
WATER NOTE:	Before Coring					
DATE:	4/22/02					

TCAMWLL4.DWG

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
827.6	-0.1	TOP OF COVER
827.5	0.0	GROUND SURFACE
827.4	0.1	TOP OF PVC
826.6	1.0	TOP OF GROUT
745.9	81.6	BOTTOM OF CASING
745.9	81.6	BORING DEPTH



5 - INCH DIAMETER PROTECTIVE STEEL COVER

GROUND SURFACE

CONCRETE

BORING DIAMETER
6-1/2", 0.0' to 45.3'
3-1/8", 45.3' to 81.6'
___", ___' to ___'
___", ___' to ___'

GROUT: Cement Bentonite (5%)

2 - INCH DIAMETER PVC (SLOTTED, SOLID)

GEOPHYSICAL CASING INSTALLATION (NO SCALE)
PROJECT NAME: GUE-70-14.10
BORING: B-413 H
DATE INSTALLED: 4/22/02
BBC & M PROJECT NO. 01107000.090

INSTALLATION NOTES:

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-201
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; 5-5/8" Tricone Bit

LOCATION: Sta. 483+04.0, 20.3' Rt.

COMPLETION DEPTH: 90.7' ELEVATION: 826.2 DATE: 9/30/99 - 10/8/99

Sample No.	Sampling Effort	Hand Penetrometer (tsf)	Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	AGG.	C.S.	F.S.	SILT	CLAY
1	3/5/6	3.2-4.3								
2	3/3/5	2.6-3.6								
3	1/2/2	0.5-1.3								
4	S/H/1/2	0.3-0.7								
5A	1/3/3	1.5-2.4								
5B		0.5-1.5								
6	3/6/8	1.1-2.2				31	13	17	39	
7	S/H/S/H/2	0.4-0.8								
8A	S/H/3/13	0.7-1.7								
8B										
9A	8/13/17	3.5-3.8								
9B										

DESCRIPTION (Depth, feet: 0 to 40)

TOPSOIL - 6 INCHES

FILL: Very-stiff to hard brown-gray silty clay, little fine to coarse sand, trace fine to coarse gravel.

POSSIBLE FILL: Very-stiff brown mottled with gray silty clay, trace fine to coarse sand, trace fine to coarse gravel.

Medium-stiff to stiff brown mottled with gray and dark-gray silty clay, little fine to coarse sand, trace fine to coarse gravel.

Soft to medium-stiff gray silty clay, trace fine sand.

- Below 16.0' becoming stiff to very-stiff.

Medium-stiff to stiff brown silty clay, little fine to coarse sand, trace fine gravel.

Medium-dense brown mottled with gray fine to coarse sand, "and" clayey silt, some fine to coarse gravel.

Soft to medium-stiff brown becoming gray silty clay, trace fine to coarse sand.

- Below 32.0' becoming medium-stiff to stiff.

Medium-dense gray and dark-gray fine to coarse sand, some fine to coarse gravel, little clayey silt.

- From 38.9' to 39.3' very-stiff clayey silt.

WATER LEVEL:
WATER NOTE:
DATE:

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-201
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; 5-5/8" Tricone Bit

LOCATION: Sta. 483+04.0, 20.3' Rt.

COMPLETION DEPTH: 90.7' ELEVATION: 826.2 DATE: 9/30/99 - 10/8/99

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
40	9C											
												Hard gray silty clay, some fine to coarse sand, trace fine to coarse gravel.
	10	16/50-5"R	4.2-4.3									
45												Very-soft gray shale, nearly horizontally bedded.
	11	50-1"R										Soft to medium-hard gray and dark-gray shale.
50												
55												
60												
65												
70												
75												
80												

WATER LEVEL:
WATER NOTE:
DATE:

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-201
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE. 3-1/4" I.D. Hollow-stem Auger
2" O.D. Split-barrel Sampler
5-5/8" Tricone Bit

LOCATION: Sta. 483+04.0, 20.3' Rt.

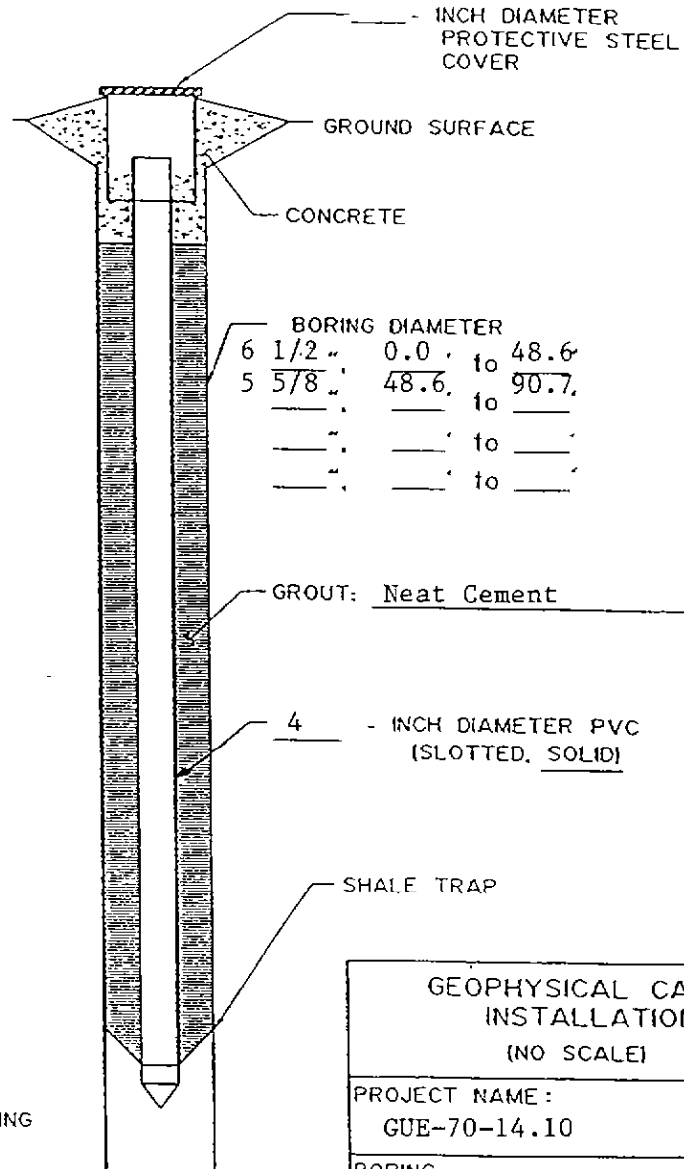
COMPLETION DEPTH: 90.7' ELEVATION: 826.2 DATE: 9/30/99 - 10/8/99

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
80													Soft to medium-hard gray and dark-gray shale.
85													
90													
95													- Encountered water from 34.5' to 41.0'. - Below 48.6' boring advanced using rotary methods. Stratigraphy identification based on cuttings. - At completion 4" diameter casing installed for geophysical use, see completion diagram.
100													
105													
110													
115													
120													

WATER LEVEL:
WATER NOTE:
DATE:

JOB: 7000.030

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
826.26	0.0	
826.16	0.0	TOP OF COVER
825.53	0.6	GROUND SURFACE
	2.0	TOP OF PVC
824.2		TOP OF GROUT
755.2	71.0	SHALE TRAP
747.0	79.2	BOTTOM OF CASING
745.19	81.0	BORING DEPTH



GEOPHYSICAL CASING INSTALLATION

(NO SCALE)

PROJECT NAME: GUE-70-14.10

BORING: GC-201

DATE INSTALLED: 10-12-99

BBC & M PROJECT NO: 7000.03

INSTALLATION NOTES:

* FEET ABOVE MSL

BBC&M ENGINEERING INC.

LOG OF BORING NO. GC-202
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

BBC&M ENGINEERING, INC.

TYPE. 3-1/4" I.D. Hollow-stem Auger
5-5/8" Tricone Bit

LOCATION: Sta. 483+14.6, 19.5' Rt.

COMPLETION DEPTH: 58.0' ELEVATION: 826.1 DATE: 10/13/99 - 10/19/99

DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0													
5													No Soil Samples Collected See Boring Log GC-201
10													
15													
20													
25													
30													
35													
40													

WATER LEVEL:
WATER NOTE:
DATE:

ODOTLJ 17000030.GPJ BBCM.GDT 10/27/00

JOB: 7000.030

-CONTINUED-

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-202
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger
5-5/8" Tricone Bit

LOCATION: Sta. 483+14.6, 19.5' Rt.

COMPLETION DEPTH: 58.0' ELEVATION: 826.1 DATE: 10/13/99 - 10/19/99

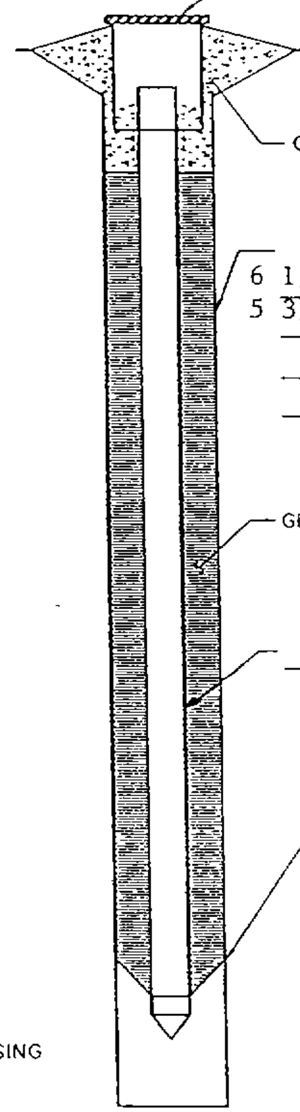
DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
40													See Boring Log GC-201
45													Very-soft brown and gray shale.
50													Void (lost all water return).
													Medium-hard with seams of soft gray shale.
55													
60													- Encountered water at 34.5'. - Below 45.0' boring advanced using rotary methods. Stratigraphy identification based on cuttings. - At completion 4" diameter casing installed for geophysical use, see completion diagram.
65													
70													
75													
80													

WATER LEVEL:
WATER NOTE:
DATE:

JOB: 7000.030

ODOTLJ 17000030.GPJ BBCM.GDT 10/27/00

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
826.33	-0.1	TOP OF COVER
826.13	0.0	GROUND SURFACE
825.67	0.5	TOP OF PVC
824.6	1.6	TOP OF GROUT
776.2	50.0	SHALE TRAP
771.5	54.7	BOTTOM OF CASING
768.2	58.0	BORING DEPTH



GEOPHYSICAL CASING INSTALLATION (NO SCALE)
PROJECT NAME: GUE-70-14.10
BORING: GC-202
DATE INSTALLED: 10-19-99
BBC & M PROJECT NO: 7000.03

INSTALLATION NOTES.

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-203
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; 5-5/8" Tricone Bit

LOCATION: Sta. 483+23.8, 19.3' Rt.

COMPLETION DEPTH: 56.0' **ELEVATION:** 826.3 **DATE:** 10/20/99 - 10/21/99

DEPTH, FEET	SAMPLE NO.	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0												TOPSOIL - 7 INCHES
												FILL: Hard to very-stiff brown and gray silty clay, trace fine to coarse sand, occasional coal fragments.
	1	7/10/11	4.0-4.5+									
5	2	3/6/9	2.0-3.5	26	62	21	0	1	3	44	52	
												Stiff to very-stiff gray and brown silty clay, trace fine to coarse sand, few silty clay seams.
10	3	2/4/5	1.0-4.0									
												Medium-stiff to stiff gray clayey silt, little fine sand.
15	4	S/H/2/3	0.5-1.5	24	27	18	0	0	13	64	23	
												Stiff to very-stiff brown and gray silty clay, trace fine sand.
20	5	1/5/6	1.5-2.25									
												Medium-dense brown fine to coarse sand, "and" clayey silt, little fine to coarse gravel.
25	6	4/10/12										
												Medium-stiff to stiff gray silty clay interbedded with clayey silt, trace fine sand, few thin seams of silt and fine sand.
30	7	1/3/4	0 5-1.5									
	8A 8B	1/4/30	0 75-1.5									
35												Dense to very-dense gray fine to coarse sand, "and" fine to coarse gravel, little clayey silt.
	9	24/35/34					35	27	25	13		
40												

WATER LEVEL:
WATER NOTE:
DATE:

LOG OF BORING NO. GC-203
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE. 3-1/4" I.D. Hollow-stem Auger
2" O.D. Split-barrel Sampler
5-5/8" Tricone Bit

LOCATION. Sta. 483+23.8, 19.3' Rt.

COMPLETION DEPTH: 56.0' ELEVATION: 826.3 DATE: 10/20/99 - 10/21/99

DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
40													
													Medium-dense gray fine to coarse sand, trace fine gravel, trace clayey silt.
	10		9/16/13										
45													
													Very-soft to soft gray shale, nearly horizontally bedded.
	11		50-5"R										
50													
													Void (lost all water return).
55													Medium-hard gray shale.
60													
65													
70													
75													
80													

- Encountered water 23.5' to 26.5'.

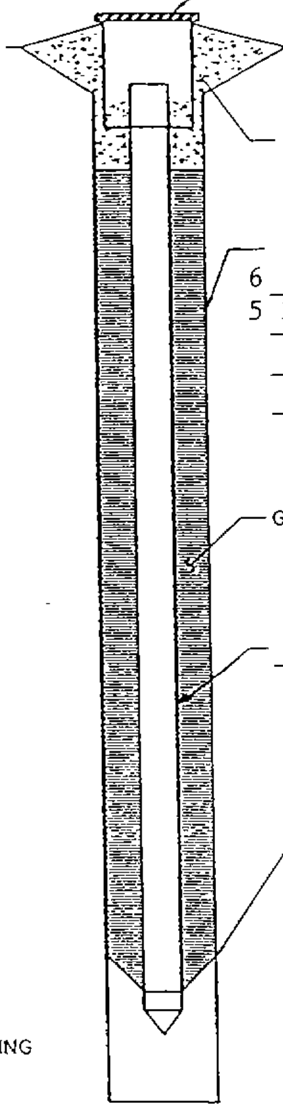
- Encountered water 34.4' to 47.5'.

- Below 48.9' boring advanced using rotary methods. Stratigraphy identification based on cuttings.

- At completion 4" diameter casing installed for geophysical use, see completion diagram.

WATER LEVEL:
WATER NOTE:
DATE:

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
826.29	0.1	TOP OF COVER
826.26	0.0	GROUND SURFACE
825.67	0.4	TOP OF PVC
824.7	1.5	TOP OF GROUT
776.0	50.4	SHALE TRAP
771.0	55.4	BOTTOM OF CASING
770.4	56.0	BORING DEPTH



9 - INCH DIAMETER PROTECTIVE STEEL COVER

GROUND SURFACE

CONCRETE

BORING DIAMETER
6 1/2", 0.0' to 49.0'
5 3/8", 49.0' to 56.0'
___", ___' to ___'
___", ___' to ___'
___", ___' to ___'

GROUT: Neat Cement

4 - INCH DIAMETER PVC (SLOTTED, SOLID)

SHALE TRAP

GEOPHYSICAL CASING INSTALLATION (NO SCALE)
PROJECT NAME: GUE-70-14.10
BORING: GC-203
DATE INSTALLED: 10-21-99
BBC & M PROJECT NO: 7000.03

INSTALLATION NOTES:

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-204
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger
NX Rock-core Barrel
5-5/8" Tricone Bit

LOCATION: Sta. 483+28.8, 19.5' Rt.

COMPLETION DEPTH: 65.9' ELEVATION: 826.3 DATE: 10/21/99 - 10/26/99

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER	MOISTURE CONTENT	LIQUID LIMIT	PLASTIC LIMIT	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
				tsf	%	%	%						
0													
5													No Soil Samples Collected See Boring Log GC-203
10													
15													
20													
25													
30													
35													
40													

WATER LEVEL:
WATER NOTE:
DATE:

ODOTLJ 17000030.GPJ BBCM.GDT 10/27/00

JOB: 7000.030

-CONTINUED-

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-204
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; NX Rock-core Barrel; 5-5/8" Tricone Bit

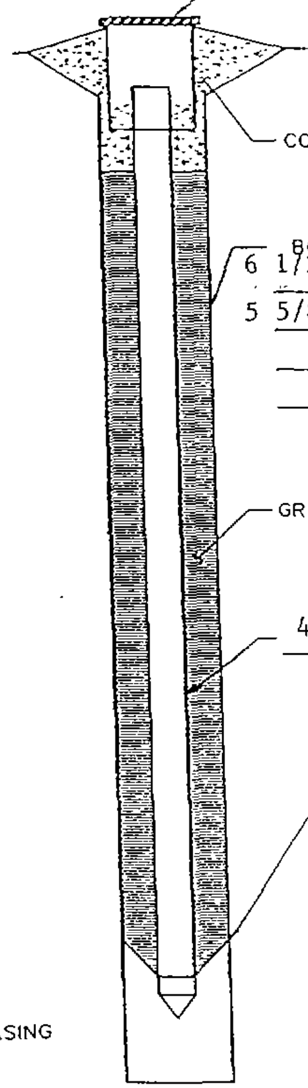
LOCATION: Sta. 483+28.8, 19.5' Rt.

COMPLETION DEPTH: 65.9' ELEVATION: 826.3 DATE: 10/21/99 - 10/26/99

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
40												See Boring Log GC-203
55	1	NXM REC 88% RQD 0%										Medium-hard gray shale, nearly horizontally bedded, many horizontal fractures
60	2	NXM REC 56% RQD 18%										Void
												Medium-hard gray shale, nearly horizontally bedded, few horizontal fractures, interbedded with medium-grained sandstone.
	3	NXM REC 76% RQD 15%										
65												
70												
75												- At completion 4" diameter casing installed for geophysical use, see completion diagram.
80												

WATER LEVEL:
WATER NOTE:
DATE:

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
826.39	-0.1	TOP OF COVER
826.26	0.0	GROUND SURFACE
825.95	0.2	TOP OF PVC
823.3	3.0	TOP OF GROUT
764.1	62.2	SHALE TRAP
754.3	72.0	BOTTOM OF CASING
750.9	75.4	BORING DEPTH



9 - INCH DIAMETER PROTECTIVE STEEL COVER

GROUND SURFACE

CONCRETE

BORING DIAMETER

6 1/2" 0.0' to 55.0'

5 5/8" 55.0' to 75.4'

___" ___' to ___'

___" ___' to ___'

GROUT: Cement/Bentonite Grout

4 - INCH DIAMETER PVC (SLOTTED, SOLID)

SHALE TRAP

GEOPHYSICAL CASING INSTALLATION

(NO SCALE)

PROJECT NAME:	GUE-70-14.10
BORING:	GC-204
DATE INSTALLED:	10-26-99
BBC & M PROJECT NO:	7000.03

INSTALLATION NOTES:

* FEET ABOVE MSL

LOG OF BORING NO. GC-205
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

BBC&M ENGINEERING, INC.

TYPE: 3-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; 5-5/8" Tricone Bit

LOCATION: Sta. 483+40.2, 20.1' Rt.

COMPLETION DEPTH: 81.5' ELEVATION: 826.5 DATE: 11/16/99 - 11/19/99

DEPTH, FEET	SAMPLE NO.	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0												TOPSOIL - 2 INCHES
												FILL: Very-stiff brown mottled with gray silty clay, trace fine to coarse sand, trace fine to coarse gravel.
	1	5/7/10	2.3-2.6									
5												
	2	5/6/6	2.1-3.6									
	3	4/5/5	0.5-1.5									Medium-stiff to stiff brown mottled with gray silty clay, little becoming some fine to coarse sand.
10												
												Medium-stiff to stiff gray and brown silty clay, trace fine sand, contains few lenses of silt less than 2" thick.
	4	1/1/3	0.5-1.1									
15												
	5	3/4/7	1.5-1.8									
20												
												Medium-dense gray fine to coarse sand, some fine to coarse gravel, "and" silty clay.
	6	3/7/10					27	16	21	36		
25												
												Medium-stiff to stiff gray silty clay, trace fine sand, few sand lenses less than 1" thick.
	7	3/5/6	0.6-1.6									
30												
	8A 8B	2/4/23	1.1-1.6									
35												Dense to very-dense fine to coarse sand, some fine to coarse gravel, little clayey silt.
	9	17/32/19										
40												

WATER LEVEL:
WATER NOTE:
DATE:

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-205
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger
2" O.D. Split-barrel Sampler
5-5/8" Tricone Bit

LOCATION: Sta. 483+40.2, 20.1' Rt.

COMPLETION DEPTH: 81.5' ELEVATION: 826.5 DATE: 11/16/99 - 11/19/99

DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
40–50	10	■	27 50-5"R										Very-soft to soft gray shale, nearly horizontally bedded, interbedded with fine grained sandstone.
50–72													Interlayered grout and shale.
72–73													Very-soft gray shale (underclay).
73–80													Soft to medium-hard gray shale.

WATER LEVEL:
WATER NOTE:
DATE:

JOB: 7000.030

-CONTINUED-

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-205
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: **3-1/4" I.D. Hollow-stem Auger**
2" O.D. Split-barrel Sampler
5-5/8" Tricone Bit

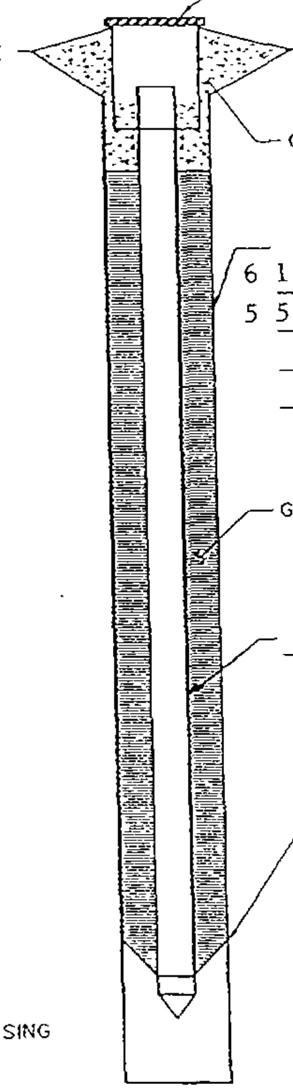
LOCATION: **Sta. 483+40.2, 20.1' Rt.**

COMPLETION DEPTH: **81.5'** **ELEVATION:** **826.5** **DATE:** **11/16/99 - 11/19/99**

DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
80													- Encountered seepage at 12.0'. - Encountered water 22.0' to 41.0'. - Below 45.0' boring advanced using rotary methods. Stratigraphy identification based on cuttings. - At completion 4" diameter casing installed for geophysical use, see completion diagram.
85													
90													
95													
100													
105													
110													
115													
120													

WATER LEVEL:
WATER NOTE:
DATE:

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
826.69	-0.2	TOP OF COVER
826.51	0.0	GROUND SURFACE
826.25	0.2	TOP OF PVC
825.5	1.0	TOP OF GROUT
748.4	78.1	SHALE TRAP
747.2	79.3	BOTTOM OF CASING
745.0	81.5	BORING DEPTH



9 - INCH DIAMETER PROTECTIVE STEEL COVER

GROUND SURFACE

CONCRETE

BORING DIAMETER
6 1/2" 0.0' to 45.0'
5 5/8" 45.0' to 81.5'
" ' to '
" ' to '

GROUT: Cement/Bentonite

4 - INCH DIAMETER PVC (SLOTTED, SOLID)

SHALE TRAP

GEOPHYSICAL CASING INSTALLATION
(NO SCALE)

PROJECT NAME: GUE-70-14.10

BORING: GC-205

DATE INSTALLED: 11-19-99

BBC & M PROJECT NO: 7000.03

INSTALLATION NOTES:

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

BBC&M ENGINEERING, INC

LOG OF BORING NO. GC-206
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; 5-5/8" Tricone Bit

LOCATION: Sta. 483+57.1, 20.6' Rt.

COMPLETION DEPTH: 83.0' ELEVATION: 826.4 DATE: 11/8/99 - 11/10/99

SAMPLE NO	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
											TOPSOIL - 4 INCHES
											FILL: Stiff to very-stiff brown mottled with gray silty clay, little fine to coarse sand, trace fine gravel.
1	3/6/5	2.3-3.6	21	44	22	1	3	10	42	44	
2	2/4/6	1.9-3.0									
3A	2/3/3	1.3-1.7									Medium-stiff to stiff gray mottled with brown clayey silt, little fine to coarse sand, trace fine to coarse gravel.
3B		0.7-1.3									
											Medium-stiff to stiff gray silty clay, trace fine sand.
4	1/1/2	0.5-1.3	25	37	18	0	0	0	57	43	
											- Below 17.0' becoming stiff to very-stiff brown.
5	3/5/6	2.2-2.9									
6A	2/4/7	1.2-1.8									
6B						27	16	22	35		Loose brown fine to coarse sand, "and" clayey silt, some fine to coarse gravel.
											Medium-stiff to stiff gray silty clay, trace fine sand, contains many thin silt lenses.
7	2/4/5	0.7-0.9									
8A	3/16/31	0.7-1.4									
8B											Dense brown fine to coarse sand, some fine to coarse gravel, trace clayey silt.
9A	14/18/15										
9B		2.2-2.4									

WATER LEVEL:
WATER NOTE:
DATE:

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-206
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; 5-5/8" Tricone Bit

LOCATION: Sta. 483+57.1, 20.6' Rt.

COMPLETION DEPTH: 83.0' ELEVATION: 826.4 DATE: 11/8/99 - 11/10/99

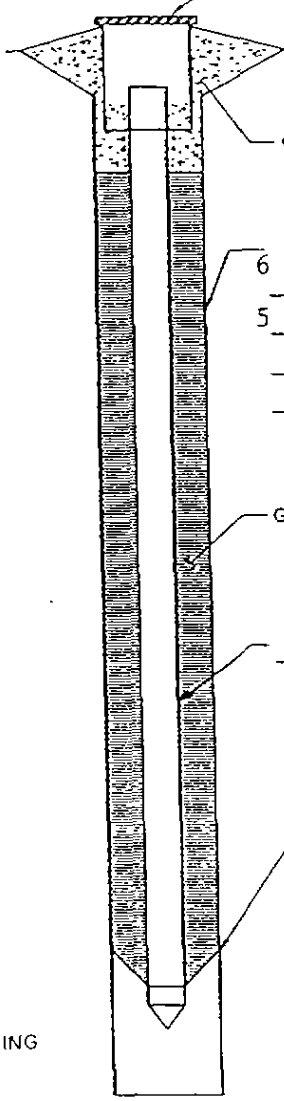
DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
40													Very-stiff gray silty clay, trace fine sand, contains many silt lenses.
	10	■	50-5"R										Very-soft gray shale, similar to silty clay, nearly horizontally bedded, arenaceous.
45													
													Medium-hard gray shale interbedded with fine-grained sandstone.
50													
55													
60													
65													
													Medium-hard black coal.
70													
													Very-soft gray shale (underclay).
													Soft gray shale.
75													
80													

WATER LEVEL: ▽ ▼ ▼ ▼ ▽ ▼

WATER NOTE:

DATE:

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
826.71	-0.1	TOP OF COVER
826.45	0.0	GROUND SURFACE
826.42	0.1	TOP OF PVC
825.6	1.0	TOP OF GROUT
746.8	79.8	SHALE TRAP
745.4	81.2	BOTTOM OF CASING
743.6	83.0	BORING DEPTH



9 - INCH DIAMETER PROTECTIVE STEEL COVER

GROUND SURFACE

CONCRETE

BORING DIAMETER
6 1/2 " 0.0 ' to 45.0 '
5 5/8 " 45.0 ' to 83.0 '
___ " ___ ' to ___ '
___ " ___ ' to ___ '

GROUT: Cement/Bentonite

4 - INCH DIAMETER PVC (SLOTTED, SOLID)

SHALE TRAP

GEOPHYSICAL CASING INSTALLATION (NO SCALE)
PROJECT NAME: GUE-70-14.10
BORING: GC-206
DATE INSTALLED: 11-10-99
BBC & M PROJECT NO: 7000.03

INSTALLATION NOTES:

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-207
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger
2" O.D. Split-barrel Sampler
5-5/8" Tricone Bit

LOCATION: Sta. 483+78.9, 20.5' Rt.

COMPLETION DEPTH: 82.5' ELEVATION: 826.7 DATE: 11/12/99 - 11/16/99

DEPTH, FEET	SAMPLE NO.	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0												TOPSOIL - 2 INCHES
												FILL: Very-stiff brown mottled with gray silty clay, little fine to coarse sand, trace fine to coarse gravel, few pockets of fine to coarse sand.
	1	6/7/7	3.7-3.9									
5												POSSIBLE FILL: Very-stiff brown mottled with gray silty clay, trace fine to coarse sand.
	2	3/5/6	2.3-3.5									
												Medium-stiff to stiff with pockets of soft brown mottled with gray silty clay, trace fine to coarse sand, interbedded with clayey silt.
	3	2/2/2	0.4-1.7									
10												Medium-stiff orange-brown silty clay, little fine to coarse sand, trace fine gravel.
	4	2/2/4	0.5-0.8									
15												Stiff to very-stiff brown silty clay, trace fine sand.
	5	2/4/3	1.4-2.2									
20												Medium-dense brown fine to coarse sand, trace fine to coarse gravel, some silty clay.
	6	2/6/6										
25												Soft to medium-stiff with pockets of stiff gray silty clay, trace to little fine sand.
	7	2/3/3	0.3-0.7		37	22	0	0	0	69	31	
30												
	8	150 - 250 psi	1.1-1.6	31	27	18	0	0	0	45	55	
				23	32	19	0	0	13	66	21	
35												Dense gray fine sand, little silt.
	9A	16/20/14										
	9B											
40												

WATER LEVEL:
WATER NOTE:
DATE:

ODOTLJ 17000030.GPJ BBCM.GDT 10/27/00

JOB: 7000.030

-CONTINUED-

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-207
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger
2" O.D. Split-barrel Sampler
5-5/8" Tricone Bit

LOCATION: Sta. 483+78.9, 20.5' Rt.

COMPLETION DEPTH: 82.5' ELEVATION: 826.7 DATE: 11/12/99 - 11/16/99

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
40													Dense gray fine to coarse sand, little fine to coarse gravel, trace silt.
													Very-soft to soft gray shale, interbedded with fine grained sandstone.
45													Medium-hard gray shale, interbedded with fine-grained sandstone.
50													
55													
60													
65													Medium-hard black coal.
70													Very-soft gray shale (underclay).
													Medium-hard gray shale.
75													
80													

WATER LEVEL:
WATER NOTE:
DATE:

ODOTLJ 17000030.GPJ BBCM.GDT 10/27/00

JOB: 7000.030

CONTINUED

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-207
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; 5-5/8" Tricone Bit

LOCATION: Sta. 483+78.9, 20.5' Rt.

COMPLETION DEPTH: 82.5' ELEVATION: 826.7 DATE: 11/12/99 - 11/16/99

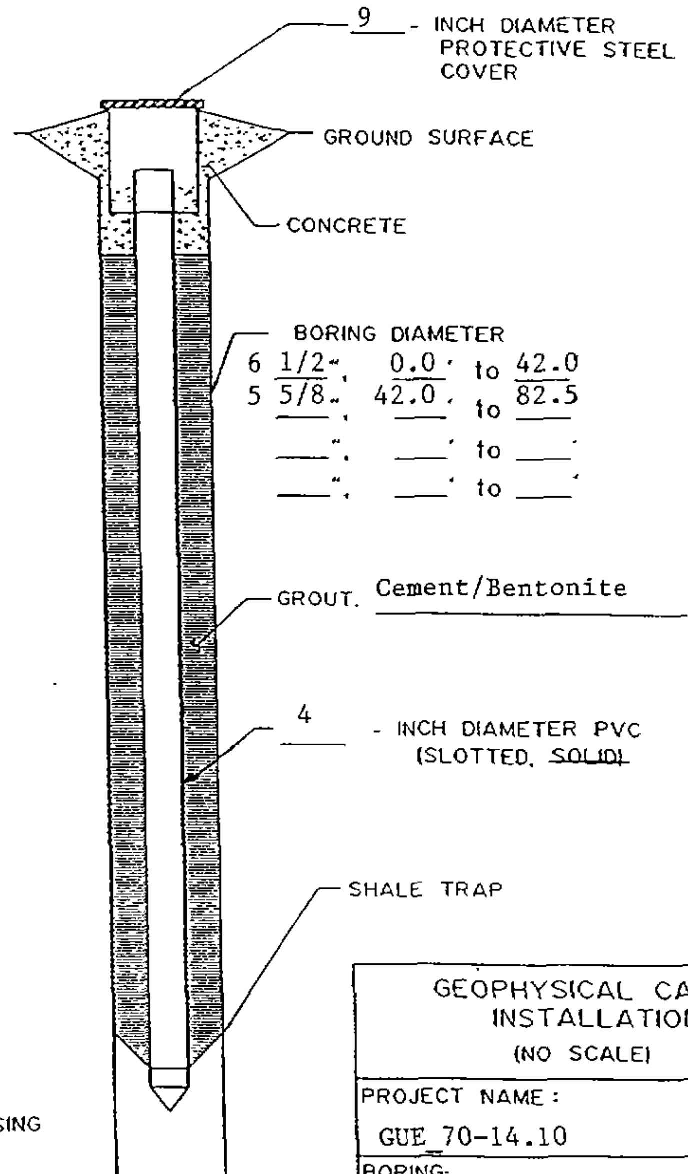
DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
80													
85													- Encountered water 22.0' to 27 0'. - Encountered water 36.0' to 43.5'. - Below 42.0' boring advanced using rotary methods. Stratigraphy identification based on cuttings.
90													- At completion 4" diameter casing installed for geophysical uses, see completion diagram. - Consolidation testing completed on sample S-8.
95													
100													
105													
110													
115													
120													

WATER LEVEL:

WATER NOTE:

DATE:

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
826.82	-0.2	TOP OF COVER
826.71	0.0	GROUND SURFACE
826.26	0.4	TOP OF PVC
825.7	1.0	TOP OF GROUT
747.3	79.4	SHALE TRAP
745.8	80.9	BOTTOM OF CASING
744.2	82.5	BORING DEPTH



GEOPHYSICAL CASING INSTALLATION (NO SCALE)
PROJECT NAME: GUE 70-14.10
BORING: GC-207
DATE INSTALLED: 11-16-99
BBC & M PROJECT NO: 7000.03

INSTALLATION NOTES:

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-208
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; NX Rock-core Barrel, 5-5/8" Tricone Bit

LOCATION: Sta. 484+18.8, 19.3' Rt.

COMPLETION DEPTH: 81.0' ELEVATION: 826.4 DATE: 11/19/99 - 11/29/99

DEPTH, FEET	SAMPLE NO.	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S	F.S.	SILT	CLAY	DESCRIPTION
0												TOPSOIL - 2 INCHES
												FILL: Stiff to very-stiff brown mottled with gray silty clay, trace fine sand.
	1	6/6/6	1.2-2.5									
5	2A	3/3/5	1.5-2 2									
	2B		0 4-0.9									Soft to medium-stiff brown mottled with gray silty clay, trace fine sand.
												Stiff to very-stiff orange-brown silty clay, some fine to coarse sand, trace fine to coarse gravel.
	3	/ /	1.5-2.5									
10												
	4A	2/2/4	1 1-1 5	27	28	19		0	4	73	23	Stiff to very-stiff brown clayey silt, trace fine sand, many thin seams of silty clay.
	4B		1.2-2.4									
15												
	5	2/4/5	1 1-1.9									Stiff brown silty clay, trace fine sand.
20												
	6	7/6/8										Medium-dense fine to coarse sand, trace fine to coarse gravel, little clayey silt.
25												Soft to medium-stiff gray silty clay, trace fine sand.
	7	3/3/4	0.3-0.8									
30												Very-dense to gray fine to coarse sand, little fine to coarse gravel, little clayey silt.
	8	70 50-5"R										
35												Medium-stiff to stiff gray silty clay, little fine to coarse sand.
	9A	2/5/28	0.8-1.6									
40												

WATER LEVEL:
WATER NOTE:
DATE:

ODOTLI 17000030.GPJ BBCM.GDT 10/27/00

JOB: 7000.030

-CONTINUED-

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-208
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; NX Rock-core Barrel, 5-5/8" Tricone Bit

LOCATION: Sta. 484+18.8, 19.3' Rt.

COMPLETION DEPTH: 81.0' ELEVATION: 826.4 DATE: 11/19/99 - 11/29/99

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
40	9B											Dense gray fine to coarse sand, little fine to coarse gravel, trace clayey silt.
45	10	NX REC 100% RQD 47%										Soft to medium-hard with seams of very-soft gray shale, nearly horizontally bedded, few horizontal fractures.
50												
55	11	NX REC 100% RQD 75%										
60	12	NX REC 93% RQD 49%										
65	13	NX REC 100% RQD 42%										Soft to medium-hard black coal, highly fractured from 65.7' to 69.0'.
70												Very-soft gray shale (underclay).
	14	NX REC 57% RQD 38%										Soft to medium-hard gray shale, partly similar to siltstone, nearly horizontally bedded, sandy.
75												
80												

WATER LEVEL:
WATER NOTE:
DATE:

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-208

GUE - 70 - 14.10

GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; NX Rock-core Barrel, 5-5/8" Tricone Bit

LOCATION: Sta. 484+18.8, 19.3' Rt.

COMPLETION DEPTH: 81.0' ELEVATION: 826.4 DATE: 11/19/99 - 11/29/99

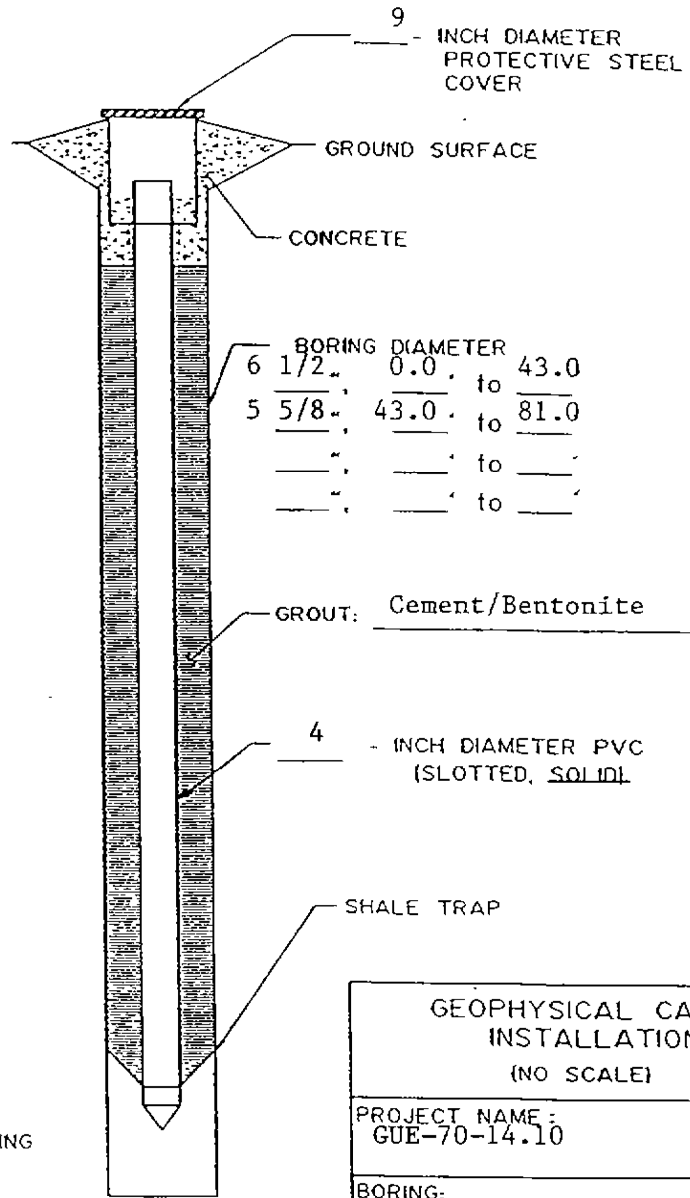
DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER	MOISTURE CONTENT	LIQUID LIMIT	PLASTIC LIMIT	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
				tsf	%	%	%						
80													- Encountered water 24.5' to 27.0'. - Encountered water 31.0' to 43.0'. - At completion 4" diameter casing installed for geophysical use, see completion diagram.
85													
90													
95													
100													
105													
110													
115													
120													

WATER LEVEL:

WATER NOTE:

DATE:

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
826.55	0.0	
826.5	0.0	TOP OF COVER
826.19	0.3	GROUND SURFACE
825.5	1.0	TOP OF PVC
		TOP OF GROUT
748.2	78.3	SHALE TRAP
747.3	79.2	BOTTOM OF CASING
746.2	81.0	BORING DEPTH



GEOPHYSICAL CASING INSTALLATION (NO SCALE)
PROJECT NAME: GUE-70-14.10
BORING: GC-208
DATE INSTALLED: 11-29-99
BBC & M PROJECT NO: 7000.03

INSTALLATION NOTES:

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-209
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger
2" O.D. Split-barrel Sampler
5-5/8" Tricone Bit

LOCATION: Sta. 484+59.3, 20.8' Rt.

COMPLETION DEPTH: 81.0' ELEVATION: 827.1 DATE: 11/19/99 - 11/23/99

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0												TOPSOIL - 2 INCHES
												FILL: Very-stiff to hard brown mottled with gray silty clay, little fine to coarse sand.
	1A	8/13/72	3.9-4.3									
	1B		4.5+									FILL: Hard gray clayey silt, little fine to coarse sand.
5												Stiff to very-stiff brown mottled with gray silty clay, little fine to coarse sand, trace fine to coarse gravel.
	2	6/8/12	1.7-2.4									
	3	4/7/11	2.9-3.6									
10												
	4	3/7/10	1.8-3 4	18	39	20	3	6	13	35	43	
15												
												Stiff brown silty clay, trace fine sand, few thin silt seams.
	5	3/5/6	1.3-1 8									
20												
	6A	2/4/7	1.0-1.1									
	6B						30	14	22	34		Loose brown fine to coarse sand, some fine to coarse gravel, some clayey silt.
25												
												Soft to medium-stiff gray silty clay, trace fine sand.
	7	1/3/2	0 3-0.8	29	34	22		0	0	69	31	
30												
	8	4/19/41										Very-dense gray fine to coarse sand, little fine to coarse gravel, some clayey silt.
35												
	9	16/6/7										
40												

WATER LEVEL:
WATER NOTE:
DATE:

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-209
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; 5-5/8" Tricone Bit

LOCATION: Sta. 484+59.3, 20.8' Rt.

COMPLETION DEPTH: 81.0' ELEVATION: 827.1 DATE: 11/19/99 - 11/23/99

DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
40													
	10		39/ 50-1"R										
45													Soft to medium-hard gray shale.
50													
55													
60													
65													
70													Very-soft gray shale (underclay).
													Soft to medium-hard gray shale, few fractures.
75													
80													

WATER LEVEL: ∇ ▼ ∇ ▼ ∇ ▼

WATER NOTE:

DATE:

ODOTLJ 17000030.GPJ BBCM.GDT 10/27/00

JOB: 7000.030

-CONTINUED-

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-209
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; 5-5/8" Tricone Bit

LOCATION: Sta. 484+59.3, 20.8' Rt.

COMPLETION DEPTH: 81.0' ELEVATION: 827.1 DATE: 11/19/99 - 11/23/99

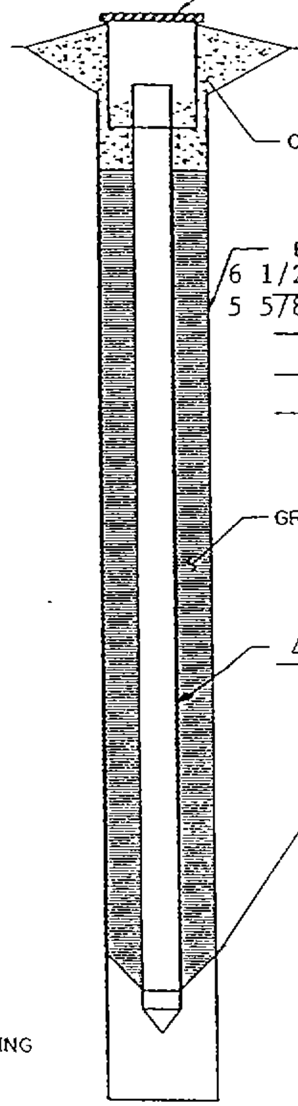
DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
80													- Below 44.0' boring advanced using rotary methods. Stratigraphy identification based on cuttings. - At completion 4" diameter casing installed for geophysical use, see completion diagram.
85													
90													
95													
100													
105													
110													
115													
120													

WATER LEVEL:
WATER NOTE:
DATE:

ODOTLJ 17000030.GPJ BBCM.GDT 10/27/00

JOB: 7000.030

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
827.12	0.0	
827.08	0.0	TOP OF COVER
		GROUND SURFACE
826.86	0.3	TOP OF PVC
826.2	1.0	
		TOP OF GROUT
748.8	78.4	SHALE TRAP
747.5	79.7	BOTTOM OF CASING
746.2	81.0	BORING DEPTH



9 - INCH DIAMETER PROTECTIVE STEEL COVER

GROUND SURFACE

CONCRETE

BORING DIAMETER
6 1/2 " 0.0 ' to 45.0 '
5 5/8 " 45.0 ' to 81.0 '
___ " ___ ' to ___ '
___ " ___ ' to ___ '
___ " ___ ' to ___ '

GROUT: Neat Cement

4 - INCH DIAMETER PVC (SLOTTED, SOLID)

SHALE TRAP

GEOPHYSICAL CASING INSTALLATION (NO SCALE)
PROJECT NAME: GUE-70-14.10
BORING: GC-209
DATE INSTALLED: 11-23-99
BBC & M PROJECT NO: 7000.03

INSTALLATION NOTES:

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-211
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; 5-5/8" Tricone Bit

LOCATION: Sta. 483+04.5, 66.6' Rt.

COMPLETION DEPTH: 78.7' ELEVATION: 826.1 DATE: 10/12/99 - 10/14/99

DEPTH, FEET	SAMPLE NO.	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0												FILL: Very-stiff to hard brown mottled with gray silty clay, little fine to coarse sand, trace fine to coarse gravel, few cobbles.
	1	6/9/10	3.5-4.5+									
5												
	2	2/2/3	2.0-2.5									POSSIBLE FILL: Very-stiff gray silty clay, trace fine to coarse sand.
	3	2/3/5	2.0-3.5									Very-stiff gray mottled with brown silty clay, trace fine to coarse sand.
10												
	4	2/4/3	1.5-2.0									Stiff gray mottled with brown clayey silt, trace fine to coarse sand, trace fine to coarse gravel.
15												
	5	2/2/4	1.5-2.5									Stiff to very-stiff grayish-brown silty clay, trace fine to coarse sand.
20												
	6	3/4/5	2.5-4.5+									Very-stiff to hard brown silty clay, some fine to coarse sand, little fine to coarse gravel.
25												
	7A	2/3/4	1.5-2.0									Stiff gray silty clay, trace fine sand.
	7B		1.0-2.0									
30												
	8	9/9/20					42	19	21	18		Medium-dense gray fine to coarse gravel, "and" fine to coarse sand, little silty clay, few shale and sandstone fragments.
35												
	9	9/15/10										
40												

WATER LEVEL:
WATER NOTE:
DATE:

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-211
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; 5-5/8" Tricone Bit

LOCATION: Sta. 483+04.5, 66.6' Rt.

COMPLETION DEPTH: 78.7'   ELEVATION: 826.1   DATE: 10/12/99 - 10/14/99

DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
40													
	10		50-4"R										Very-soft to soft with seams of medium-hard gray shale, nearly horizontally bedded.
45													Medium-hard gray shale, occasional seam of very-soft to soft.
50													
55													
60													Medium-hard dark-gray carbonaceous shale.
65													Mine timber.
70													Very-soft gray shale (underclay).
													Medium-hard gray shale.
75													
80													

WATER LEVEL:
WATER NOTE:
DATE:

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-211

GUE - 70 - 14.10

GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger
2" O.D. Split-barrel Sampler
5-5/8" Tricone Bit

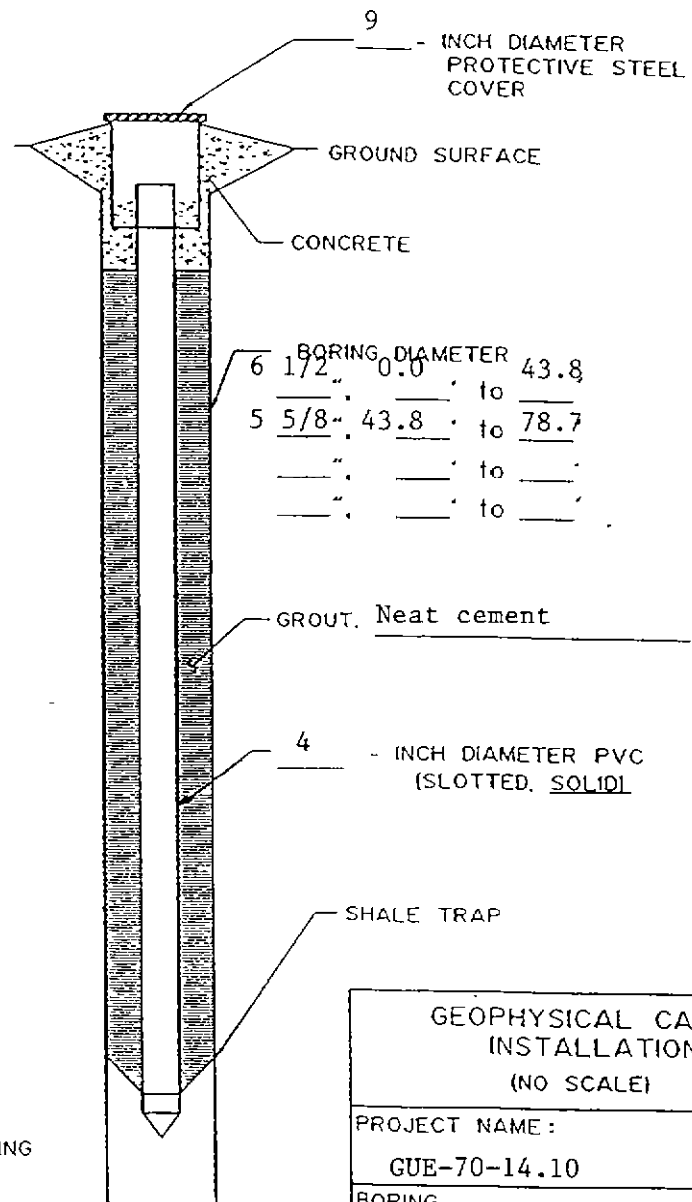
LOCATION: Sta. 483+04.5, 66.6' Rt.

COMPLETION DEPTH: 78.7' ELEVATION: 826.1 DATE: 10/12/99 - 10/14/99

DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER tsf	MOISTURE CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
80													- Encountered water 33.0' to 42.0. - Below 45.0' boring advanced using rotary methods. Stratigraphy identification based on cuttings. - At completion 4" diameter casing installed for geophysical use, see completion diagram.
85													
90													
95													
100													
105													
110													
115													
120													

WATER LEVEL: ▽ ▼ ▽ ▼ ▽ ▼
WATER NOTE:
DATE:

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
826.25	-0.1	TOP OF COVER
826.06	0.0	GROUND SURFACE
825.96	0.2	TOP OF PVC
824.1	2.0	TOP OF GROUT
761.3	64.8	SHALE TRAP
751.3	74.8	BOTTOM OF CASING
747.4	78.7	BORING DEPTH



GEOPHYSICAL CASING INSTALLATION

(NO SCALE)

PROJECT NAME: GUE-70-14.10

BORING. GC-211

DATE INSTALLED: 10-14-99

BBC & M PROJECT NO: 7000.03

INSTALLATION NOTES.

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-212
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE. 3-1/4" I.D. Hollow-stem Auger
2" O.D. Split-barrel Sampler
5-5/8" Tricone Bit

LOCATION: Sta. 483+15.8, 66.1' Rt.

COMPLETION DEPTH: 65.1' ELEVATION: 826.3 DATE: 10/15/99 - 10/19/99

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER tsf	MOISTURE CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0													
5													No Soil Samples Collected See Boring Log GC-211
10													
15													
20													
25													
30													
35													
40													

WATER LEVEL:
WATER NOTE:
DATE:

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-212
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger
2" O.D. Split-barrel Sampler
5-5/8" Tricone Bit

LOCATION: Sta. 483+15.8, 66.1' Rt.

COMPLETION DEPTH: 65.1' ELEVATION: 826.3 DATE: 10/15/99 - 10/19/99

DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
40–43.5													See Boring Log GC-211
43.5–61.5													Soft to medium-hard gray shale.
61.5–64.8													Void (lost all water)
65	1	■	20-50-4"R										Soft to medium-hard gray shale fragments, possible grout fragments.

- Below 43.5' boring advanced using rotary methods. Stratigraphy identification based on cuttings.

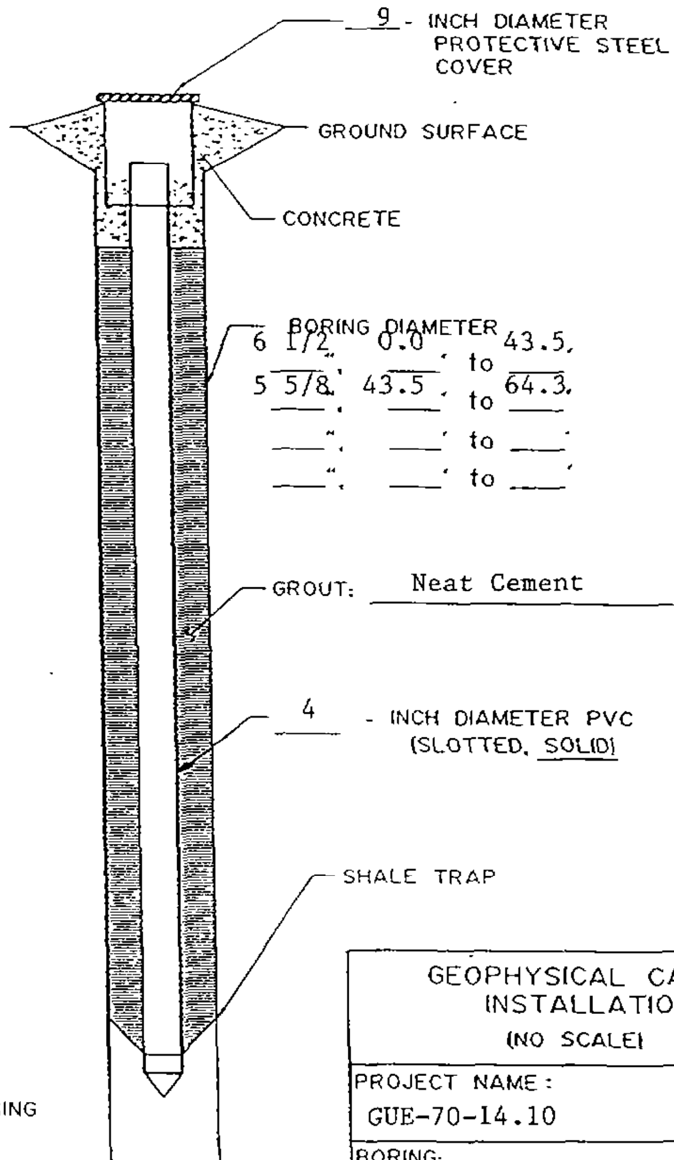
- At completion 4" diameter casing installed for geophysical use, see completion diagram.

WATER LEVEL:
WATER NOTE:
DATE:

JOB: 7000.030

ODOTLJ 17000030.GPJ BBCM.GDT 10/27/00

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
826.56	-0.2	
826.31	0.0	TOP OF COVER
826.23	0.1	GROUND SURFACE
824.3	2.0	TOP OF PVC
		TOP OF GROUT
766.4	59.9	SHALE TRAP
762.4	63.9	BOTTOM OF CASING
762.0	64.3	BORING DEPTH



GEOPHYSICAL CASING INSTALLATION (NO SCALE)
PROJECT NAME: GUE-70-14.10
BORING: GC-212
DATE INSTALLED: 10-19-99
BBC & M PROJECT NO: 7000.03

INSTALLATION NOTES:

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-213
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger
2" O.D. Split-barrel Sampler

LOCATION: Sta. 483+26.0, 66.7' Rt.

COMPLETION DEPTH: 73.0' ELEVATION: 826.4 DATE: 10/20/99 - 10/22/99

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0												FILL: Hard brown and gray silty clay, trace to little fine to coarse sand, trace fine to coarse gravel.
	1	7/11/11	4.5+									
5												Stiff to very-stiff gray mottled with brown silty clay, trace fine to coarse sand.
	2	4/4/6	1.5-3.0									
	3	4/6/7	1.5-3.0									
10												
	4	2/3/4	1.0-1.5									
15												
	5	2/3/5	1.0-1.5									
20												
												Medium-dense brown fine to coarse sand, "and" clayey silt, little fine to coarse gravel.
	6	3/4/8										
25												
												Stiff gray silty clay, trace fine sand.
	7	3/4/5	1.5	27	33	22	0	0	2	69	29	
30												
												Dense to medium-dense gray fine to coarse sand, some fine to coarse gravel, little clayey silt.
	8	4/15/17										
35												
	9	10/9/8										
40												

WATER LEVEL:
WATER NOTE:
DATE:

ODOTLJ 17000030.GPJ BBCM.GDT 10/27/00

JOB: 7000.030

-CONTINUED-

TYPE: 3-1/4" I.D. Hollow-stem Auger
2" O.D. Split-barrel Sampler

LOCATION: Sta. 483+26.0, 66.7' Rt.

COMPLETION DEPTH: 73.0' ELEVATION: 826.4 DATE: 10/20/99 - 10/22/99

DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
40													Stiff gray clayey silt, trace fine to coarse sand.
													Soft to medium-hard gray shale, nearly horizontally bedded.
45													
50													
55													
													Void (minor water loss)
60													Grout.
													Soft to medium-hard gray shale.
65													
70													
75													- Encountered water 23.5' to 27.0'. - Encountered water 32.0' to 39.5'. - Below 43.4' boring advanced using rotary methods. Stratigraphy identification based on cuttings.
80													

WATER LEVEL:
WATER NOTE:
DATE:

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-213
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE. 3-1/4" I.D. Hollow-stem Auger
2" O.D. Split-barrel Sampler

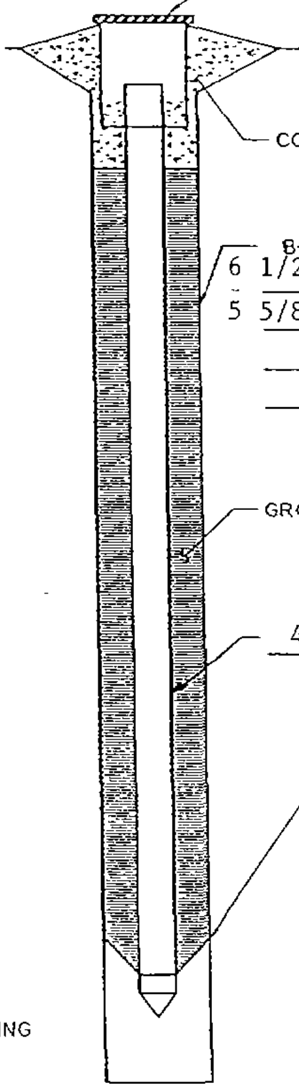
LOCATION. Sta. 483+26.0, 66.7' Rt.

COMPLETION DEPTH: 73.0' ELEVATION: 826.4 DATE: 10/20/99 - 10/22/99

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
80													- At completion 4" diameter casing installed for geophysical use, see completion diagram.
85													
90													
95													
100													
105													
110													
115													
120													

WATER LEVEL:
WATER NOTE:
DATE:

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
826.53	-0.1	
826.38	0.0	TOP OF COVER
826.31	0.1	GROUND SURFACE
826.0	0.4	TOP OF PVC
		TOP OF GROUT
769.8	56.6	
753.6	72.8	SHALE TRAP
753.4	73.0	BOTTOM OF CASING
		BORING DEPTH



9 - INCH DIAMETER PROTECTIVE STEEL COVER

GROUND SURFACE

CONCRETE

BORING DIAMETER

6 1/2 " 0.0 ' to 43.4 '

5 5/8 " 43.4 ' to 73.0 '

___" ___' to ___'

___" ___' to ___'

GROUT: Cement/Bentonite

4 - INCH DIAMETER PVC (SLOTTED, SOLID)

SHALE TRAP

GEOPHYSICAL CASING INSTALLATION (NO SCALE)
PROJECT NAME: GUE-70-14.10
BORING. GC-213
DATE INSTALLED: 10-22-99
BBC & M PROJECT NO: 7000.03

INSTALLATION NOTES:

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-214
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger

LOCATION: Sta. 483+30.5, 66.0' Rt.

COMPLETION DEPTH: 67.5' ELEVATION: 826.4 DATE: 10/22/99 - 10/27/99

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER	MOISTURE CONTENT	LIQUID LIMIT	PLASTIC LIMIT	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
				tsf	%	%	%						
0–40													No Soil Samples Collected See Boring Log GC-213

WATER LEVEL:
WATER NOTE:
DATE:

BBC&M ENGINEERING INC.

LOG OF BORING NO. GC-214
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger

LOCATION: Sta. 483+30.5, 66.0' Rt.

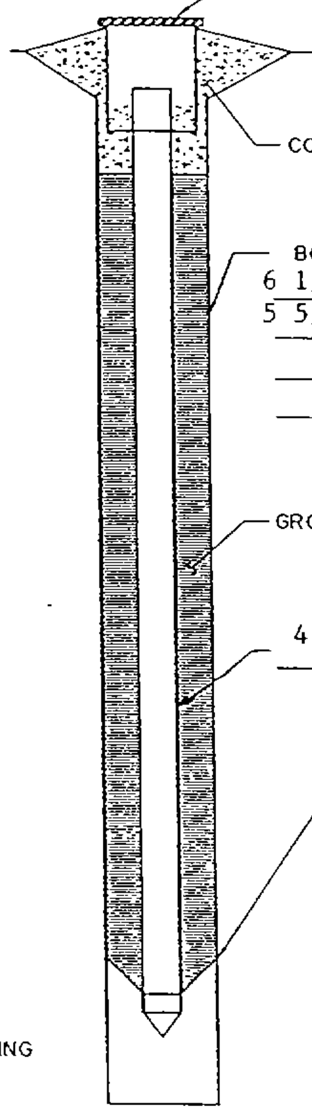
COMPLETION DEPTH: 67.5' ELEVATION: 826.4 DATE: 10/22/99 - 10/27/99

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
40													Medium-hard gray shale.
55													Void
57													Medium-hard dark-gray shale interlayered with grout, contains wood fragments.
67.5													- Below 40.0' boring advanced using rotary methods. Stratigraphy identification based on cuttings. - At completion 4" diameter casing installed for geophysical use, see completion diagram.
80													

WATER LEVEL:
WATER NOTE:
DATE:

JOB: 7000.030

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
826.53	-0.1	TOP OF COVER
826.44	0.0	GROUND SURFACE
826.18	0.2	TOP OF PVC
823.4	3.0	TOP OF GROUT
762.2	64.2	SHALE TRAP
761.6	64.8	BOTTOM OF CASING
758.9	67.5	BORING DEPTH



GEOPHYSICAL CASING INSTALLATION (NO SCALE)
PROJECT NAME: GUE-70-14.10
BORING: GC-214
DATE INSTALLED: 10-28-99
BBC & M PROJECT NO: 7000.03

INSTALLATION NOTES:

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-215
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 5-5/8" Tricone Bit; 2" O.D. Split-barrel Sampler

LOCATION: Sta. 483+40.3, 67.0' Rt.

COMPLETION DEPTH: 81.5' ELEVATION: 826.4 DATE: 10/28/99 - 11/4/99

DEPTH, FEET	SAMPLE NO.	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0												FILL: Very-stiff to hard brown mottled with gray silty clay, little fine to coarse sand, trace fine gravel, desiccated.
	1	3/5/7	3.5-4.5+									
5	2	2/6/7	3.0-4.5									Very-stiff to hard gray organic clayey silt, little fine to coarse sand, desiccated, roots.
	3	2/5/5	1.5-2.5	22	39	19	8	3	7	53	29	Stiff to very-stiff brown mottled with gray silty clay, trace fine to coarse sand, trace fine gravel, desiccated.
10												
	4	1/1/3	0.25-1.0									Soft to medium-stiff gray mottled with brown silty clay, trace fine sand, few seams of silt to fine sand.
15	5A	25 - 175 psi		22	36	18	0	0	3	55	42	
	5B		1.25-2.5									- Below 16.0' becoming stiff to very-stiff.
	6	2/4/4	1.0-2.5									
20												
	7A	3/5/9	2.5									
25	7B						25	18	20	37		Medium-dense brown fine to coarse sand, "and" silty clay, some fine to coarse gravel.
												Medium-stiff to stiff gray silty clay, trace fine sand, many silt seams less than 1/16" thick.
	8	1/2/3	0.75-1.0									
30												
												Dense brown and gray fine to coarse sand, little fine to coarse gravel, little clayey silt, few shale fragments, few seams of silty clay less than 1" thick.
35	9	2/12/23										
	10	25/21/27										
40												

WATER LEVEL:
WATER NOTE:
DATE:

ODOT LJ 17000030 GPJ BBCM GDT 10/27/00

JOB: 7000.030

CONTINUED

TYPE: 3-1/4" I.D. Hollow-stem Auger; 5-5/8" Tricone Bit; 2" O.D. Split-barrel Sampler

LOCATION: Sta. 483+40.3, 67.0' Rt.

COMPLETION DEPTH: 81.5' ELEVATION: 826.4 DATE: 10/28/99 - 11/4/99

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
40													
	11		28, 50-2"R										Soft to medium-hard with seams of soft gray shale, nearly horizontally bedded.
45													
50													
55													
60													
65													Medium-hard black coal.
70													Very-soft gray shale (underclay).
													Medium-hard gray shale interbedded with sandstone.
75													
80													

WATER LEVEL:
WATER NOTE:
DATE:

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-215
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 5-5/8" Tricone Bit; 2" O.D. Split-barrel Sampler

LOCATION: Sta. 483+40.3, 67.0' Rt.

COMPLETION DEPTH: 81.5' ELEVATION: 826.4 DATE: 10/28/99 - 11/4/99

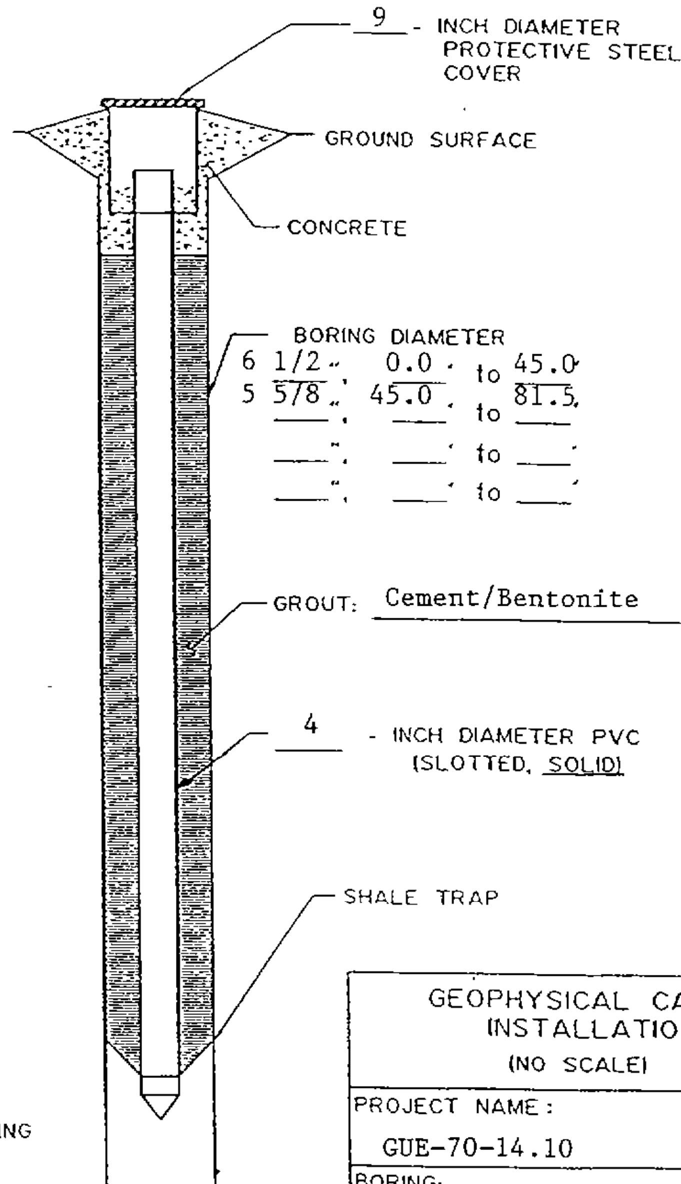
DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
80													- Encountered water below 26.5'. - Below 44.2' boring advanced using rotary methods. Stratigraphy identification based on cuttings. - At completion 4" diameter casing installed for geophysical use, see completion diagram. - Consolidation testing completed on sample S-5A.
85													
90													
95													
100													
105													
110													
115													
120													

WATER LEVEL:

WATER NOTE:

DATE:

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
826.61	-0.3	TOP OF COVER
826.39	0.0	GROUND SURFACE
826.36	-0.1	TOP OF PVC
825.3	1.0	TOP OF GROUT
760.6	65.7	SHALE TRAP
759.9	66.4	BOTTOM OF CASING
744.8	81.5	BORING DEPTH



GEOPHYSICAL CASING INSTALLATION
(NO SCALE)

PROJECT NAME: GUE-70-14.10

BORING: GC-215

DATE INSTALLED: 11-10-99

BBC & M PROJECT NO: 7000.03

INSTALLATION NOTES:

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-216
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger, 2" O.D. Split-barrel and Shelby-tube Samplers

LOCATION: Sta. 483+60.2, 65.8' Rt.

COMPLETION DEPTH: 81.0' ELEVATION: 826.4 DATE: 10/14/99 - 10/18/99

DEPTH, FEET	SAMPLE NO.	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0												FILL: Hard brown and gray silty clay, little fine to coarse sand, trace fine to coarse gravel, few coal fragments and cobbles.
	1	8/8/48	4.5+									
5												Very-stiff to hard gray silty clay, trace fine to coarse sand, trace fine gravel.
	2	4/5/6	4.5+									
	3	5/5/8	2.5-3.5									
10												Stiff to very-stiff brown mottled with gray clayey silt, little fine to coarse sand, trace fine gravel, few seams of silty clay.
	3S	700 psi	1.5-2.5	20 20 20 20 23 23	29	19	5	4	11	59	21	
	4	2/2/3	1.5-4.0									
15												Stiff to very-stiff brown silty clay, little fine to coarse sand, trace fine gravel, few coal fragments.
	5	2/5/6	1.25-2.5									
20												Very-stiff to hard brown clayey silt, some fine to coarse sand, trace fine gravel, few seams of silty clay, few cobbles.
	6	4/6/8	3.0-4.5+									
25												Medium-stiff to stiff gray silty clay, trace fine sand, few silt seams.
	7	2/3/4	0.5-1.5									
30	7A	500 psi	0.5-1.5	26 26 29 29 29 29	37	23	0	0	0	68	32	
	8	4/16/50										Very-dense gray fine to coarse sand, "and" fine to coarse gravel, little silty clay, few shale and sandstone fragments.
35												
	9	30/37/31										
40												

WATER LEVEL: ▽ ▼ ▽ ▽ ▽ ▼

WATER NOTE:

DATE:

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-216
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel and Shelby-tube Samplers

LOCATION: Sta. 483+60.2, 65.8' Rt.

COMPLETION DEPTH: 81.0' ELEVATION: 826.4 DATE: 10/14/99 - 10/18/99

DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
40													
													Very-soft to soft gray shale, nearly horizontally bedded.
	10	■	50-5"R										
45													
													Medium-hard gray shale.
50													
55													
60													
65													
													Medium-hard black coal.
70													
													Very-soft gray shale (underclay).
													Medium-hard gray shale.
75													
80													

WATER LEVEL:
WATER NOTE:
DATE:

JOB: 7000.030

ODOTL1 17000030.GPJ BBCM.GDT 10/27/00

-CONTINUED-

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-216
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE 3-1/4" I.D. Hollow-stem Auger 2" O.D. Split-barrel and Shelby-tube Samplers

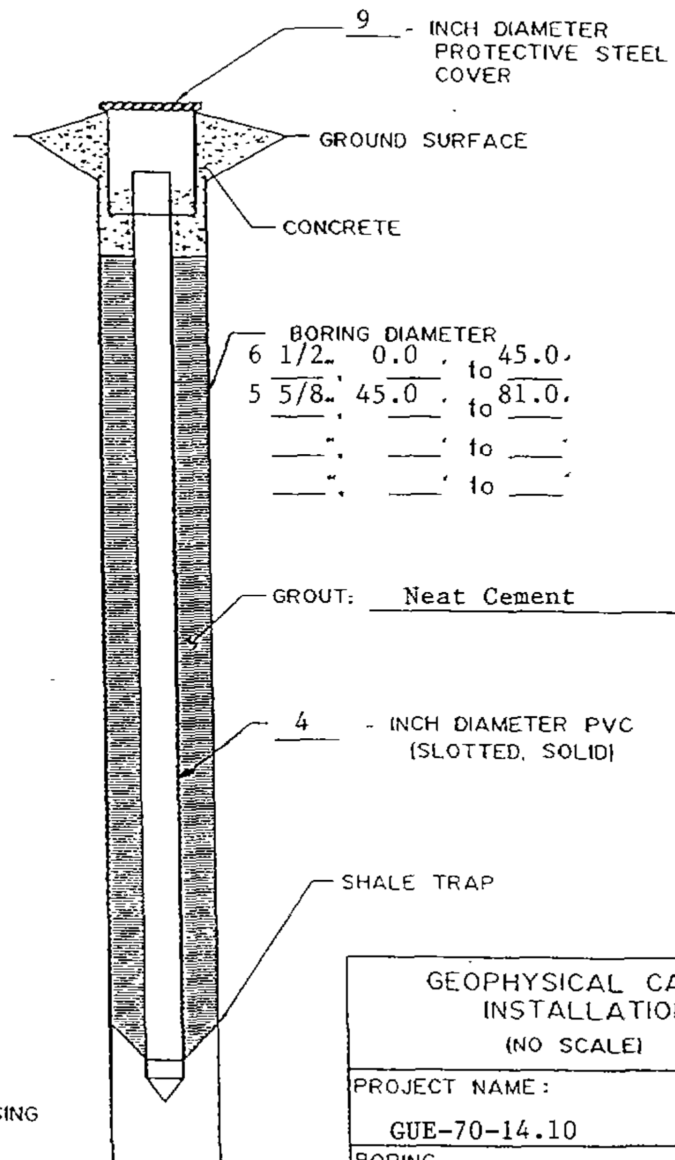
LOCATION: Sta. 483+60.2, 65.8' Rt.

COMPLETION DEPTH: 81.0' ELEVATION: 826.4 DATE: 10/14/99 - 10/18/99

DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER	MOISTURE CONTENT	LIQUID LIMIT	PLASTIC LIMIT	AGG.	C.S.	F.S	SILT	CLAY	DESCRIPTION - CONTINUED
				tsf	%	%	%						
80													- Encountered water 33.5' to 41.0'. - Below 43.9' boring advanced using rotary methods. Stratigraphy identification based on cuttings. - At completion 4" diameter casing installed for geophysical use, see completion diagram. - Triaxial compression testing completed on samples S-3A and S-7A.
85													
90													
95													
100													
105													
110													
115													
120													

WATER LEVEL:
WATER NOTE:
DATE:

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
826.48	-0.2	
826.40	0.0	TOP OF COVER
826.40	-0.1	GROUND SURFACE
		TOP OF PVC
824.3	2.0	
		TOP OF GROUT
755.6	70.7	SHALE TRAP
746.6	79.7	BOTTOM OF CASING
745.3	81.0	BORING DEPTH



GEOPHYSICAL CASING INSTALLATION

(NO SCALE)

PROJECT NAME: GUE-70-14.10

BORING: GC-216

DATE INSTALLED: 10-18-99

BBC & M PROJECT NO: 7000.03

INSTALLATION NOTES.

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-217
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

BBC&M ENGINEERING, INC.

TYPE: 3-1/4" I.D. Hollow-stem Auger; 5-5/8" Tricone Bit; 2" O.D. Split-barrel Sampler

LOCATION: Sta. 483+80.2, 65.9' Rt.

COMPLETION DEPTH: 80.0' ELEVATION: 826.6 DATE: 11/10/99 - 11/12/99

DEPTH, FEET	SAMPLE NO.	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0												FILL: Stiff to very-stiff brown mottled with gray silty clay, little fine to coarse sand, trace fine to coarse gravel.
	1	8/8/12	2.6-3.4	20	44	20	4	4	10	45	37	
5												
	2	4/7/8	1.0-2.2									
												Stiff to very-stiff gray mottled with brown silty clay, trace fine to coarse sand, trace fine gravel.
	3	4/7/7	1.6-2.9									
10												
												- 12.0' to 20.0' medium-stiff to stiff.
	4	2/4/5	0.7-1.7									
15												
	5	3/3/6	0.7-1.1									
20												
	6	100-425 psi	2.2-2.4									
												Medium-dense brown fine to coarse sand, "and" clayey silt, little fine to coarse gravel.
	7	9/9/10										
25												
												Medium-stiff to stiff gray silty clay, interbedded with clayey silt, trace fine sand.
	8	S/H/3/3	0.7-0.9									
30												
	9A	3/8/26	1.4-1.8									
	9B											Dense to very-dense brown fine to coarse sand, some fine to coarse gravel, little clayey silt.
35												
	10	26/31/21										
40												

WATER LEVEL:
WATER NOTE:
DATE:

JOB: 7000.030

-CONTINUED-

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-217
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 5-5/8" Tricone Bit; 2" O.D. Split-barrel Sampler

LOCATION: Sta. 483+80.2, 65.9' Rt.

COMPLETION DEPTH: 80.0' ELEVATION: 826.6 DATE: 11/10/99 - 11/12/99

DEPTH, FEET	SAMPLE NO.	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S	SILT	CLAY	DESCRIPTION - CONTINUED
40												
												Very-soft to soft gray shale interbedded with fine-grained sandstone.
	11	3 S/H-12"										- 44.0' to 45.0' Void.
45												
												- 48.5' to 49.0' Void
50	12	10/11/50										
55												Soft to medium-hard gray shale with seams of fine-grained sandstone.
60												
												Grout.
65												
												Very-soft gray shale (underclay).
												Medium-hard gray shale.
70												
75												
80												

WATER LEVEL:
WATER NOTE:
DATE:

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-217
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 5-5/8" Tricone Bit; 2" O.D. Split-barrel Sampler

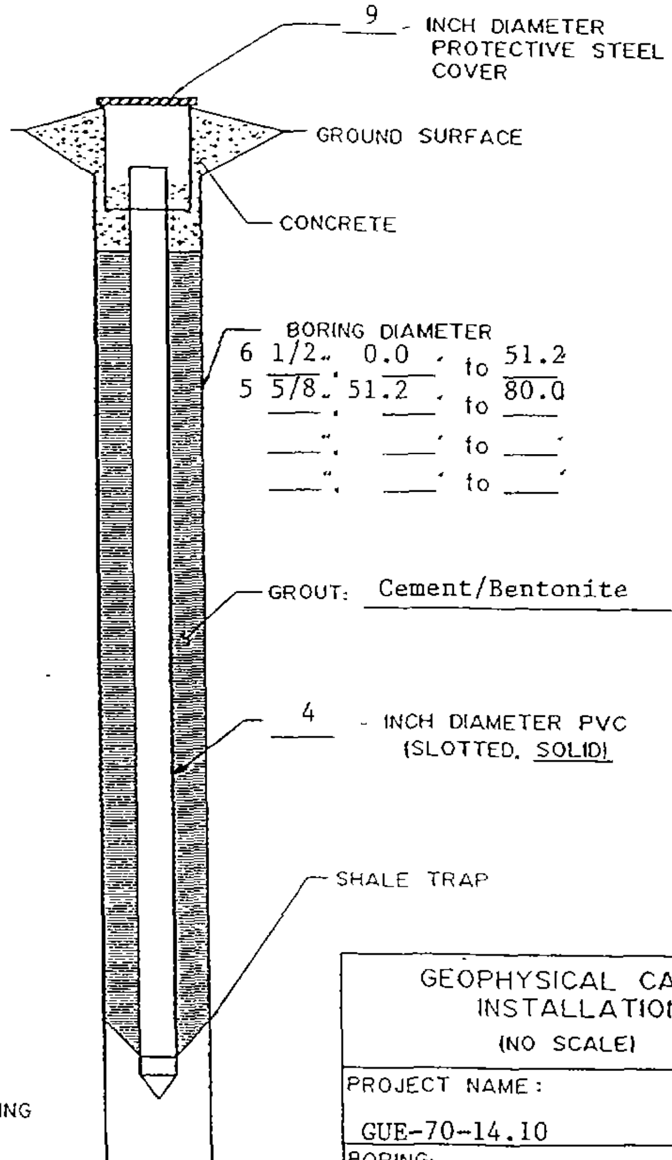
LOCATION: Sta. 483+80.2, 65.9' Rt.

COMPLETION DEPTH: 80.0' ELEVATION: 826.6 DATE: 11/10/99 - 11/12/99

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER	MOISTURE CONTENT	LIQUID LIMIT	PLASTIC LIMIT	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
				tsf	%	%	%						
80													- Encountered water 23.0' to 26.0'. - Encountered water 34.2' to 41.0'. - Below 51.2' boring advanced using rotary methods. Stratigraphy identification based on cuttings. - At completion 4" diameter casing installed for geophysical use, see completion diagram.
85													
90													
95													
100													
105													
110													
115													
120													

WATER LEVEL:
WATER NOTE:
DATE:

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
826.74	-0.1	TOP OF COVER
826.58	0.0	GROUND SURFACE
826.36	0.3	TOP OF PVC
825.7	1.0	TOP OF GROUT
758.3	68.4	SHALE TRAP
756.9	69.8	BOTTOM OF CASING
746.7	80.0	BORING DEPTH



GEOPHYSICAL CASING INSTALLATION
(NO SCALE)

PROJECT NAME: GUE-70-14.10

BORING: GC-217

DATE INSTALLED: 11-11-99

BBC & M PROJECT NO: 7000.03

INSTALLATION NOTES.

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-218
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 5-5/8" Tricone Bit; 2" O.D. Split-barrel Sampler

LOCATION: Sta. 484+20.5, 66.2' Rt.

COMPLETION DEPTH: 76.5' ELEVATION: 826.6 DATE: 11/11/99 - 11/17/99

DEPTH, FEET	SAMPLE NO.	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0												FILL: Stiff to hard brown mottled with gray silty clay, little fine to coarse sand.
	1	8/11/14	3.0-4.5+									
5	2A	4/7/8	1.5-2.5									
	2B		1.7-3.7									Stiff to very-stiff gray mottled with brown silty clay, trace fine to coarse sand, interbedded with clayey silt, trace fine sand.
	3	100-275 psi	1.5-3.5	23	56	21	0	1	1	50	48	
10												- Below 12.0' becoming medium-stiff to stiff.
	4	3/3/6	0.7-1.9									
15												Soft to medium-stiff with pockets of very-soft gray silty clay, trace fine sand.
	5	S/H/2/3	0.2-0.6									
20												Medium-dense gray fine to coarse gravel, "and" fine to coarse sand, some clayey silt.
	6	8/10/10					41	15	23	21		
25												Soft to medium-stiff with pockets of stiff gray silty clay interbedded with clayey silt, trace fine to coarse sand, trace fine gravel.
	7	1/3/4	0.25-1.2									
30												
	8	2/4/7	0.7-1.4									
35												Very-dense gray fine to coarse sand, "and" fine to coarse gravel, little clayey silt.
	9	21/37/42										
40												

WATER LEVEL:
WATER NOTE:
DATE:

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-218
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 5-5/8" Tricone Bit; 2" O.D. Split-barrel Sampler

LOCATION: Sta. 484+20.5, 66.2' Rt.

COMPLETION DEPTH: 76.5' ELEVATION: 826.6 DATE: 11/11/99 - 11/17/99

DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
40													
42													Very-soft to soft gray shale, slightly arenaceous, interbedded with fine-grained sandstone.
43	10	■	50-5"R										
50													Soft to medium-hard gray shale interlayered with grout.
70													Very-soft gray shale (underclay).
71													Medium-hard gray shale.
76.5													- Encountered water 22.0' to 28.0'. - Encountered water 36.0' to 42.0'.
80													

WATER LEVEL:

WATER NOTE:

DATE:

ODOTLJ 17000030.GPJ BBCM.GDT 10/27/00

JOB: 7000.030

-CONTINUED-

BBC&M ENGINEERING INC.

LOG OF BORING NO. GC-218
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 5-5/8" Tricone Bit; 2" O.D. Split-barrel Sampler

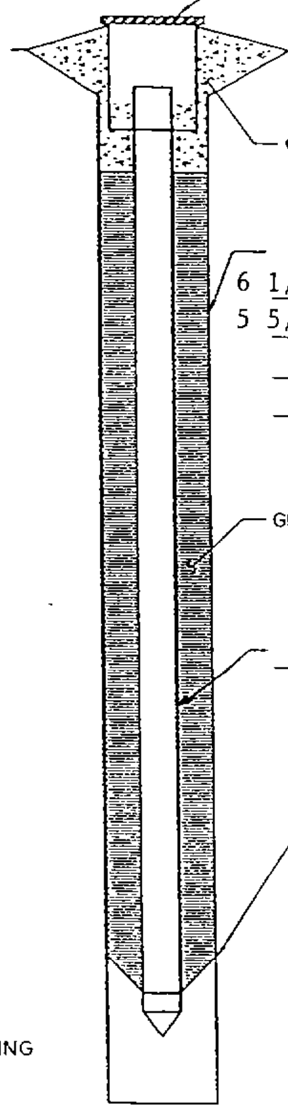
LOCATION: Sta. 484+20.5, 66.2' Rt.

COMPLETION DEPTH: 76.5' ELEVATION: 826.6 DATE: 11/11/99 - 11/17/99

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
80													- Below 45.5' boring advanced using rotary methods. Stratigraphy identification based on cuttings. - At completion 4" diameter casing installed for geophysical use, see completion diagram. - Consolidation testing completed on sample S-3.
85													
90													
95													
100													
105													
110													
115													
120													

WATER LEVEL:
WATER NOTE:
DATE:

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
826.92	-0.1	TOP OF COVER
826.60	0.0	GROUND SURFACE
826.67	0.1	TOP OF PVC
825.9	1.0	TOP OF GROUT
752.4	74.5	SHALE TRAP
751.5	75.4	BOTTOM OF CASING
750.4	76.5	BORING DEPTH



9 - INCH DIAMETER PROTECTIVE STEEL COVER

GROUND SURFACE

GROUND SURFACE

CONCRETE

BORING DIAMETER
6 1/2 ", 0.0 ' to 45.5'
5 5/8 ", 45.5 ' to 76.5'
___", ___' to ___'
___", ___' to ___'

GROUT: Cement/Bentonite

4 - INCH DIAMETER PVC (SLOTTED, SOLID)

SHALE TRAP

GEOPHYSICAL CASING INSTALLATION (NO SCALE)
PROJECT NAME: GUE-70-14.10
BORING: GC-218
DATE INSTALLED: 11-17-99
BBC & M PROJECT NO: 7000.03

INSTALLATION NOTES:

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-219
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 5-7/8" Tricone Bit; 2" O.D. Split-barrel Sampler

LOCATION: Sta. 484+60.0, 65.1' Rt.

COMPLETION DEPTH: 81.0' ELEVATION: 827.2 DATE: 11/17/99 - 11/19/99

DEPTH, FEET	SAMPLE NO.	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0												FILL: Very-stiff to hard brown mottled with gray silty clay, little fine to coarse sand, trace fine to coarse gravel.
	1	10/11/13	2.3-4.2									
5												POSSIBLE FILL: Very-stiff gray mottled with brown silty clay, trace fine to coarse sand, trace fine gravel.
	2	4/8/13	2 1-3.5									
	3	6/7/10	2.1-3 9									
10												Medium-stiff to stiff gray silty clay, trace fine sand.
	4	2/3/4	0 6-1.5									
15												
	5	2/3/5	0 6-1 2									
20												Loose fine to coarse sand, little fine to coarse gravel, trace clayey silt.
	6	2/4/3										
25												Soft to medium-stiff gray silty clay, trace fine sand.
	7	2/2/2	0.3-0.6									
30												- Below 31.0' becoming medium-stiff to stiff.
	8A	2/9/25	0.5-1.5									
35	8B											Dense to very-dense gray fine to coarse sand, little fine to coarse gravel, some clayey silt.
	9	17/32/18										
40												

WATER LEVEL:
WATER NOTE:
DATE:

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-219
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 5-7/8" Tricone Bit; 2" O.D. Split-barrel Sampler

LOCATION: Sta. 484+60.0, 65.1' Rt.

COMPLETION DEPTH: 81.0' ELEVATION: 827.2 DATE: 11/17/99 - 11/19/99

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
40													
													Very-soft to soft gray shale, nearly horizontally bedded, interbedded with fine sandstone.
	10	■	50-4"R										
45													
50													Soft to medium-hard gray shale interlayered with grout.
55													
60													
65													
70													
													Very-soft gray shale (underclay).
													Soft to medium-hard gray shale.
75													
80													

WATER LEVEL:
WATER NOTE:
DATE:

BBC&M ENGINEERING, INC.

LOG OF BORING NO. GC-219
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 5-7/8" Tricone Bit; 2" O.D. Split-barrel Sampler

LOCATION: Sta. 484+60.0, 65.1' Rt.

COMPLETION DEPTH: 81.0' ELEVATION: 827.2 DATE: 11/17/99 - 11/19/99

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
80													
85													
90													
95													
100													
105													
110													
115													
120													

- Encountered water 21.0' to 26.0'.

- Encountered water 34.2' to 41.0'

- Below 44.0' boring advanced using rotary methods. Stratigraphy identification based on cuttings.

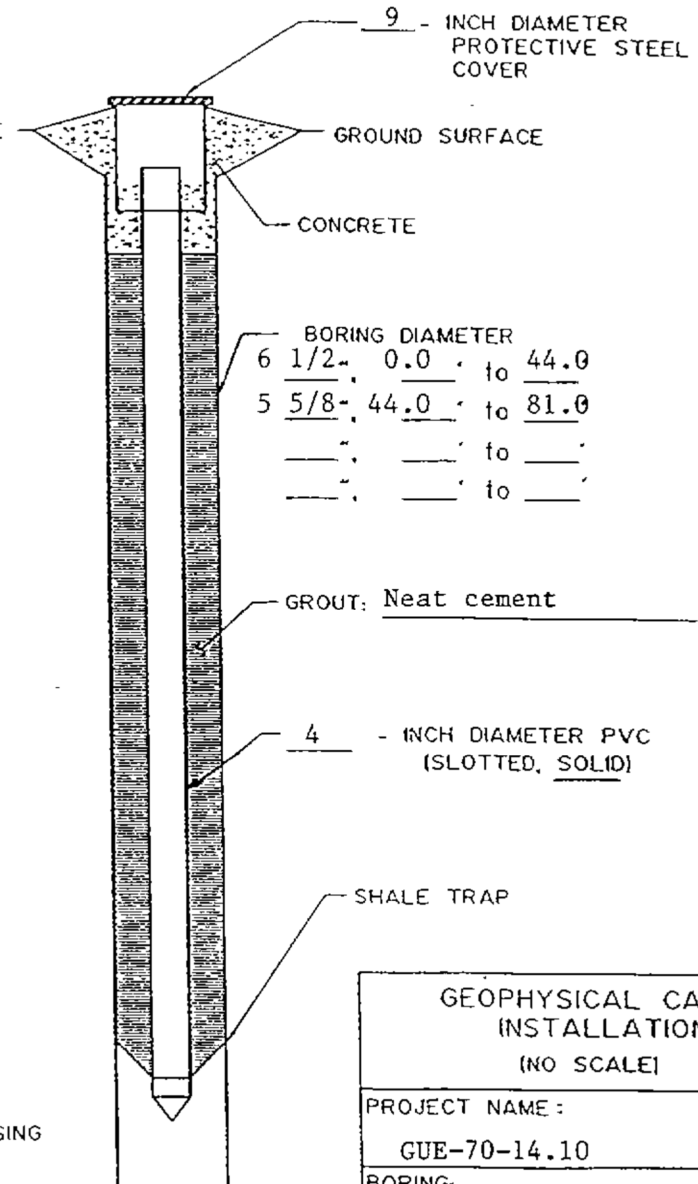
- At completion 4" diameter casing installed for geophysical use, see completion diagram.

WATER LEVEL:
WATER NOTE:
DATE:

ODOTLJ 17000030.GPJ BBCM.GDT 10/27/00

JOB: 7000.030

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
827.30	-0.1	TOP OF COVER
827.21	0.0	GROUND SURFACE
826.91	0.3	TOP OF PVC
826.2	1.0	TOP OF GROUT
748.5	78.7	SHALE TRAP
747.4	79.8	BOTTOM OF CASING
746.2	81.0	BORING DEPTH



GEOPHYSICAL CASING INSTALLATION

(NO SCALE)

PROJECT NAME: GUE-70-14.10

BORING: GC-219

DATE INSTALLED: 11-19-99

BBC & M PROJECT NO: 7000.03

INSTALLATION NOTES:

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

BBCM

LOG OF BORING NO. GC-301
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 7-7/8" Tricone Bit; 2" O.D. Split-barrel Sampler; NQ Rock Core Barrel

LOCATION: Sta. 485+30, 65' Rt.

COMPLETION DEPTH: 89.0' ELEVATION: 827.7 DATE: 5/6/02

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0	1	4/8/6/5										FILL: Medium-dense brown fine to coarse sand, little fine to coarse gravel, trace clayey silt.
	2	1/3/5/9	3.2-4.5+	17	42	22	4	7	14	36	39	FILL: Very-stiff to hard brown silty clay, some fine to coarse sand, trace fine to coarse gravel.
5	3	3/6/6/10	2.4-3.2									FILL: Very-stiff to hard brown mottled with gray silty clay, trace fine to coarse sand.
	4	3/4/5/5	2.2-4.2									
	5	2/5/5/7	1.6-2.7									POSSIBLE FILL: Stiff to very-stiff brown mottled with gray clayey silt, little fine to coarse sand.
10	6	3/4/5/6	0.9-1.9									Medium-stiff to stiff brown mottled with gray silty clay, little fine to coarse sand, trace fine gravel, few thin silt seams.
	7	5/6/6	1.2-2.0									
	8	1/1/4	0.9-1.2									Medium-stiff to stiff brown becoming gray silty clay, trace fine to medium sand, slightly organic.
15	9	4/6/8	1.7-1.9									
	10	5/6/8	2.1-2.4									Very-stiff gray silty clay, little fine to coarse sand, trace fine to coarse gravel, few coal fragments.
20												Loose brown fine to coarse sand, some fine to coarse gravel, some clayey silt.
25	11	3/3/3										
												Soft to medium-stiff gray silty clay, contains many silt lenses (<1" thick).
30	12	2/3/3	0.4-0.6									
35	13	2/2/6	0.4-0.6									

WATER LEVEL: 22.0

WATER NOTE:

DATE: 5/06/02

JOB: 01107000.090

ODOTLOLD 17000090.GPJ BBCM.GDT 1/21/03

-CONTINUED-

BBCM

LOG OF BORING NO. GC-301
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: **3-1/4" I.D. Hollow-stem Auger; 7-7/8" Tricone Bit; 2" O.D. Split-barrel Sampler; NQ Rock Core Barrel**

LOCATION: **Sta. 485+30, 65' Rt.**

COMPLETION DEPTH: **89.0'** ELEVATION: **827.7** DATE: **5/6/02**

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
35												Medium-dense gray fine to coarse sand, some fine to coarse gravel, some clayey silt.
40	14	19/32/50-5"R										
	15	REC 85% RQD 53%										Soft gray shale interbedded with fine-grained sandstone, nearly horizontally bedded, few horizontal fractures.
45												Medium-hard gray becoming dark-gray shale interbedded with fine-grained sandstone, nearly horizontally bedded, few horizontal fractures.
50	16	REC 98% RQD 96%										
55												
60	17	REC 100% RQD 100%		0								
65												GROUT
70	18	REC 48% RQD 42%										MINE GOB: Did not lose water pressure, but no recovery. Drilled similar to void.

WATER LEVEL: 22.0
WATER NOTE:
DATE: 5/06/02

BBCM

LOG OF BORING NO. GC-301
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 7-7/8" Tricone Bit; 2" O.D. Split-barrel Sampler; NQ Rock Core Barrel

LOCATION: Sta. 485+30, 65' Rt.

COMPLETION DEPTH: 89.0' ELEVATION: 827.7 DATE: 5/6/02

DEPTH, FEET	SAMPLE NO	SAMPLES SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S	SILT	CLAY	DESCRIPTION - CONTINUED
70		REC 100% RQD 100%										Very-soft to soft gray shale (underclay).
75	19											Medium-hard gray sandstone, many lenses of shale, nearly horizontally bedded.
80				0								
85												
90												- Placed 88.5' of 5" diameter PVC casing. - Grouted with 5% bentonite/cement slurry.
95												
100												
105												

WATER LEVEL: 22.0

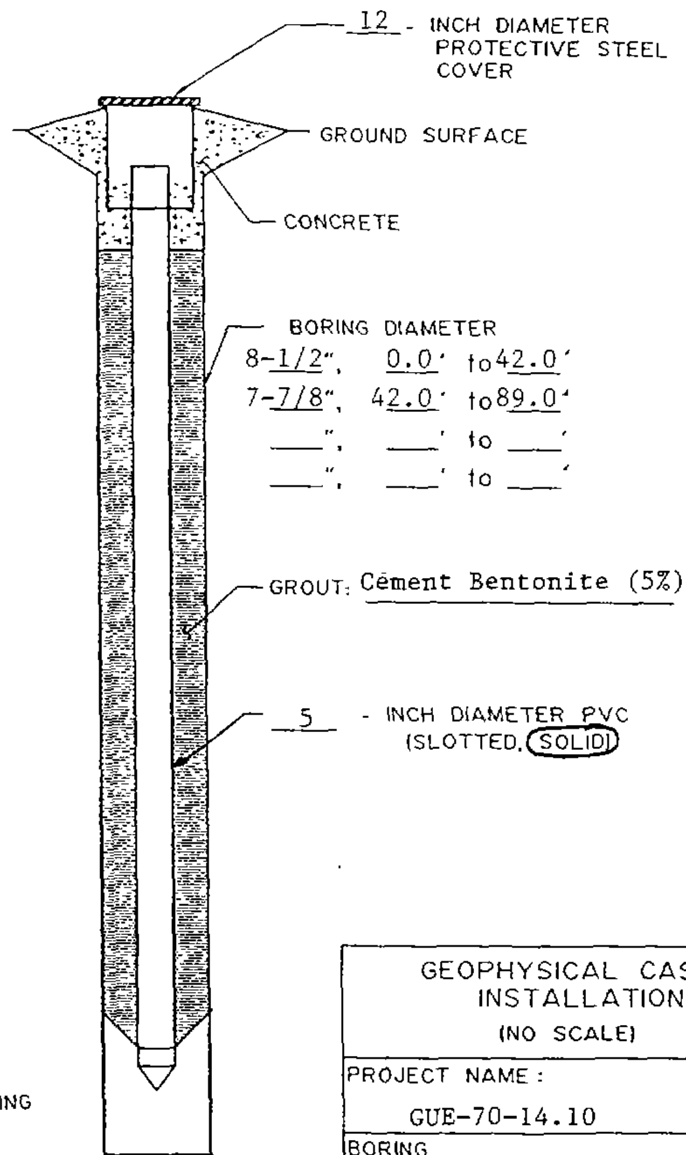
WATER NOTE:

DATE: 5/06/02

ODOTLOLD 17000090.GPJ BBCM.GDT 1/21/03

JOB: 01107000.090

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
827.7	0.0	TOP OF COVER
827.7	0.0	GROUND SURFACE
827.3	0.4	TOP OF PVC
826.7	1.0	TOP OF GROUT
739.2	88.5	BOTTOM OF CASING
738.7	89.0	BORING DEPTH



GEOPHYSICAL CASING INSTALLATION
(NO SCALE)

PROJECT NAME: GUE-70-14.10

BORING: GC-301

DATE INSTALLED: 05-15-02

BBC & M PROJECT NO: 01107000.090

INSTALLATION NOTES:

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

TCAMWLL4.DWG

BBCM

LOG OF BORING NO. GC-302
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 7-7/8" Tricone Bit; 2" O.D. Split-barrel Sampler; NQ Rock Core Barrel

LOCATION: Sta. 486+16, 66' Rt.

COMPLETION DEPTH: 89.0' ELEVATION: 828.3 DATE: 5/7/02

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0	1	20/9/8 /6										FILL: Medium-dense brown fine to coarse sand, some clayey silt, little fine to coarse gravel.
	2	12/11/20 /6	3.4-4.5+	16	37	21	1	4	10	48	37	FILL: Very-stiff to hard brown and gray silty clay, little fine to coarse sand, trace fine to coarse gravel.
	3A	5/5/11 /8	2.2-3.7									Very-stiff brown mottled with gray silty clay, trace fine to coarse sand, trace fine to coarse gravel.
5	3B		2.2-4.3									Very-stiff to hard brown silty clay, some fine to coarse sand, little fine to coarse gravel.
	4	2/5/8 /11	2.4-3.7									
	5	3/5/7 /8	2.2-3.1									Stiff to very-stiff brown mottled with gray silty clay, trace fine to coarse sand, trace fine gravel.
10	6	3/5/8 /7	2.1-2.7									
	7	3/3/4	1.4-1.9									
	8	3/4/6	1.9-2.3									
15	9A	3/5/8	1.9-2.2									
	9B		2.7-3.2									Very-stiff brown becoming gray clayey silt, little fine to coarse sand, trace fine to coarse gravel.
	10	3/4/5	1.4-2.1									Stiff to very-stiff gray silty clay, trace fine to coarse sand, trace fine gravel, slightly organic.
20												Loose brown fine to coarse sand, some fine to coarse gravel, little clayey silt.
	11	3/2/2										
25												Soft to medium-stiff gray silty clay, trace fine to coarse sand, slightly organic, many seams (<1/2") of silt.
	12	2/2/2	0.4-0.6									
30												
	13A	3/5/8	0.6-0.8									
35	13B											

WATER LEVEL: ∇ 23.0

WATER NOTE:

DATE: 5/07/02

JOB: 01107000.090

-CONTINUED-

BBCM

LOG OF BORING NO. GC-302
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 7-7/8" Tricone Bit; 2" O.D. Split-barrel Sampler; NQ Rock Core Barrel
LOCATION: Sta. 486+16, 66' Rt.
COMPLETION DEPTH: 89.0' ELEVATION: 828.3 DATE: 5/7/02

DEPTH, FEET	SAMPLE NO	SAMPLES / SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S	SILT	CLAY	DESCRIPTION - CONTINUED
35												Medium-dense gray fine to coarse sand, some fine to coarse gravel, some clayey silt.
	14	19/31/50-4"R										
40	15	REC 13% RQD 0%										Medium-hard gray sandstone interbedded with dark-gray medium-hard shale and very-soft shale, nearly horizontally bedded, numerous horizontal fractures.
45	16	REC 80% RQD 54%										
												Medium-hard gray shale interbedded with fine-grained sandstone, nearly horizontally bedded, few horizontal fractures.
50	17	REC 96% RQD 88%										
55	18	REC 94% RQD 81%										
60												
												Medium-hard black coal.
65	19	RQD 100% RQD 57%										
												Very-soft to soft gray shale (underclay), nearly horizontally bedded.
70												

WATER LEVEL:	∇ 23.0	▼	∇	∇	∇	▼
WATER NOTE:						
DATE:	5/07/02					

BBCM

LOG OF BORING NO. GC-302
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger
7-7/8" Tricone Bit
2" O.D. Split-barrel Sampler
NQ Rock Core Barrel

LOCATION: Sta. 486+16, 66' Rt.

COMPLETION DEPTH: 89.0' ELEVATION: 828.3 DATE: 5/7/02

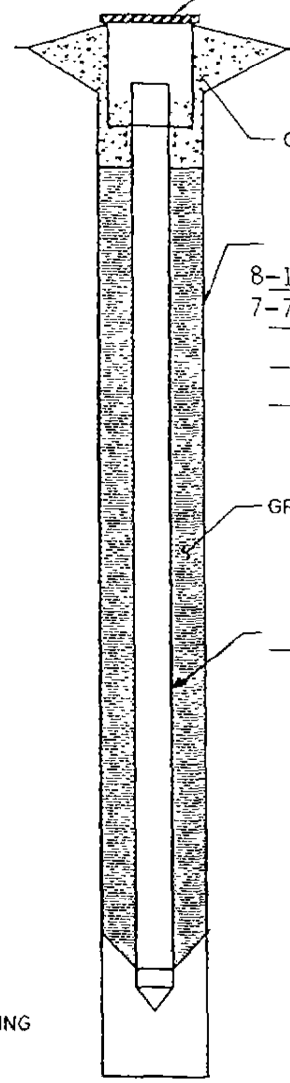
DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
70													Very-soft to soft gray shale (underclay), nearly horizontally bedded.
			REC 63% RQD 60%										Medium-hard gray fine-grained sandstone, nearly horizontally bedded, few irregular fractures, many horizontal fractures.
75	20												
80													
85													
90													- Placed 88.5' of 5" diameter PVC casing. - Grouted with 5% bentonite/cement slurry.
95													
100													
105													

WATER LEVEL: 23.0
WATER NOTE:
DATE: 5/07/02

JOB: 01107000.090

ODOTLIOLD 17000090.GPJ BBCM.GDT 1/21/03

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
828.3	0.0	TOP OF COVER
828.3	0.0	GROUND SURFACE
828.1	0.2	TOP OF PVC
827.3	1.0	TOP OF GROUT
739.8	88.5	BOTTOM OF CASING
739.3	89.0	BORING DEPTH



12 - INCH DIAMETER PROTECTIVE STEEL COVER

GROUND SURFACE

CONCRETE

BORING DIAMETER

8-1/2",	0.0'	to	40.0'
7-7/8",	40.0'	to	89.0'
___",	___'	to	___'
___",	___'	to	___'

GROUT Cément Bentonite (5%)

5 - INCH DIAMETER PVC (SLOTTED, SOLID)

GEOPHYSICAL CASING INSTALLATION (NO SCALE)
PROJECT NAME: GUE-70-14.10
BORING: GC-302
DATE INSTALLED: 05-09-02
BBC & M PROJECT NO: 01107000.090

INSTALLATION NOTES:

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

TCAMWLL4.DWG

BBCM

LOG OF BORING NO. GC-303
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 7-7/8" Tricone Bit; 2" O.D. Split-barrel Sampler; NQ Rock Core Barrel

LOCATION: Sta. 485+49, 65' Rt.

COMPLETION DEPTH: 89.0' ELEVATION: 827.9 DATE: 5/7/02

DEPTH, FEET	SAMPLE NO.	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S	F.S.	SILT	CLAY	DESCRIPTION
0	1	10/7/4/5										FILL: Medium-dense brown fine to coarse sand, little fine to coarse gravel, trace clayey silt.
	2	5/5/7/10	3 1-3.7									FILL: Very-stiff to hard brown clayey silt, little fine to coarse sand, trace fine to coarse gravel.
5	3	4/6/6/7	2 0-4 3									
	4	2/3/4/9	1 7-3 2									Stiff to very-stiff brown mottled with gray clayey silt, little fine to coarse sand, trace fine to coarse gravel.
	5	3/4/4/5	1 6-2 4									
10	6	2/4/4/6	1 2-2.3									
	7	3/4/6	1 4-2 7									Stiff to very-stiff brown clayey silt, "and" fine to coarse sand, little fine to coarse gravel.
	8	4/5/6	1 4-2 6									Stiff to very-stiff brown silty clay, little fine to coarse sand, trace fine gravel.
15	9	4/6/7	1.9-2 7									
	10	4/7/9	2.2-3 2									
20												
												Loose brown fine to coarse sand, some fine to coarse gravel, little clayey silt.
	11	3/4/5										
25												Soft to medium-stiff gray clayey silt, trace fine sand, contains many silt lenses (<1" thick).
	12	1/1/2	0 4-0.7									
30												
	13	8/23/50										Dense gray fine to coarse sand, some fine to coarse gravel, little clayey silt.
35												

WATER LEVEL: 22.0

WATER NOTE:

DATE: 5/07/02

JOB: 01107000.090

ODOTLJ 17000090.GPJ BBCM.GDT 11/12/02

-CONTINUED-

BBCM

LOG OF BORING NO. GC-303
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger
7-7/8" Tricone Bit
2" O.D. Split-barrel Sampler
NQ Rock Core Barrel

LOCATION: Sta. 485+49, 65' Rt.

COMPLETION DEPTH: 89.0' ELEVATION: 827.9 DATE: 5/7/02

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
35												Dense gray fine to coarse sand, some fine to coarse gravel, little clayey silt.
												Very-stiff gray clayey silt, trace fine to coarse sand, contains many silt lenses (<1" thick), slightly organic.
	14A 14B	7/23/50-4"R	2 2-3 2									
40												Dense gray fine to coarse sand, some fine to coarse gravel, little clayey silt, few cobbles.
	15	REC 55% RQD 43%										
												Very-soft to soft gray shale interbedded with fine-grained sandstone, nearly horizontally bedded, few horizontal fractures.
45		REC 100% RQD 89%										
												Medium-hard gray becoming dark-gray shale interbedded with fine-grained sandstone, nearly horizontally bedded, few horizontal fractures along bedding planes, few irregular fractures.
	16											
50												
		REC 100% RQD 100%										
55												
	17											
60												
		REC 100% RQD 43%										
												Medium-hard black coal.
65												
	18											
70												

WATER LEVEL: ▽ 22.0
WATER NOTE:
DATE: 5/07/02

ODOTLJ 17000090.GPJ BBCM.GDT 11/12/02

JOB: 01107000.090

-CONTINUED-

BBCM

LOG OF BORING NO. GC-303
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 7-7/8" Tricone Bit; 2" O.D. Split-barrel Sampler; NQ Rock Core Barrel

LOCATION: Sta. 485+49, 65' Rt.

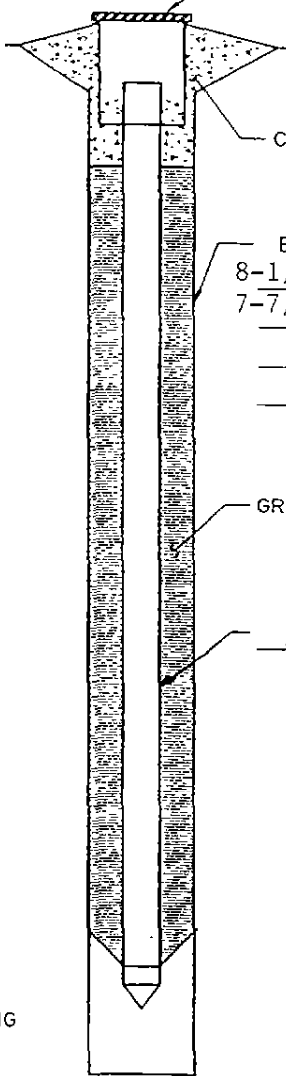
COMPLETION DEPTH: 89.0' ELEVATION: 827.9 DATE: 5/7/02

DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
70			REC 100% RQD 94%										Very-soft to soft dark-gray and gray shale (underclay), few fractures.
													Medium-hard gray fine-grained sandstone interbedded with shale, nearly horizontally bedded, few horizontal fractures.
75	19												
80													
85													- Encountered water from 22.0' to 27.0' and 33.5' to 37.0'. - Placed 5" diameter PVC casing to 88.5'. - Grouted with 5% bentonite/cement slurry.
90													
95													
100													
105													

WATER LEVEL: 22.0
WATER NOTE:
DATE: 5/07/02

JOB: 01107000.090

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
827.9	0.0	TOP OF COVER
827.9	0.0	GROUND SURFACE
827.5	0.4	TOP OF PVC
826.9	1.0	TOP OF GROUT
739.4	88.5	BOTTOM OF CASING
738.9	89.0	BORING DEPTH



12 - INCH DIAMETER PROTECTIVE STEEL COVER

GROUND SURFACE

CONCRETE

BORING DIAMETER

8-1/2"	0.0'	to	40.0'
7-7/8"	40.0'	to	89.0'
___"	___'	to	___'
___"	___'	to	___'
___"	___'	to	___'

GROUT: Cement Bentonite (5%)

5 - INCH DIAMETER PVC (SLOTTED, SOLID)

GEOPHYSICAL CASING INSTALLATION

(NO SCALE)

PROJECT NAME: GUE-70-14.10

BORING: GC-303

DATE INSTALLED: 05-14-02

BBC & M PROJECT NO: 01107000.090

INSTALLATION NOTES:

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

TCAMWLL4.DWG

BBCM

LOG OF BORING NO. GC-304
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger
7-7/8" Tricone Bit
2" O.D. Split-barrel Sampler
NQ Rock Core Barrel

LOCATION: Sta. 485+81, 65' Rt.

COMPLETION DEPTH: 89.0' ELEVATION: 828.2 DATE: 5/8/02

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S	SILT	CLAY	DESCRIPTION
0	1	10/8/4/3										FILL: Medium-dense brown fine to coarse fine to coarse sand, some fine to coarse gravel, trace clayey silt.
	2	11/6/10/10	3.4-4.2	18	41	22	1	2	15	40	42	FILL: Very-stiff to hard brown and gray silty clay, little fine to coarse sand, trace fine to coarse gravel, few organics.
5	3	4/6/6/7	2.4-3.2									Very-stiff brown mottled with gray silty clay, trace fine to coarse sand, trace fine gravel.
	4A	1/2/6/7	0.25-0.6									Soft to medium-stiff brown mottled with gray silty clay, trace fine to coarse sand, many thin seams of silt
	4B		3.5-4.5+									Very-stiff to hard brown mottled with gray silty clay, trace fine to coarse sand, trace fine gravel.
	5	4/6/8/9	3.2-3.8									
10	6	3/5/7/9	2.2-3.0									
	7	2/6/7	2.4-3.4									
	8	5/7/9	2.7-3.4									
15	9	2/4/7	1.2-2.3									Stiff to very-stiff brown silty clay, trace fine sand, few thin (<1/4") seams of silt.
20	10	2/3/5	1.2-2.1									
	11	3/4/6										Loose brown fine to coarse sand, some fine to coarse gravel, some clayey silt.
25	12	3/3/3	0.8-1.5									Medium-stiff to stiff gray silty clay, trace fine sand, contains many silt lenses (<1" thick).
30	13	6/23/50-4"R										Very-dense gray and greenish-gray fine to coarse sand, "and" fine to coarse gravel, little clayey silt, few cobbles.
35												

WATER LEVEL: 22.0
WATER NOTE:
DATE: 5/08/02

JOB: 01107000.090

-CONTINUED-

BBCM

LOG OF BORING NO. GC-304
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE	3-1/4" I.D. Hollow-stem Auger 7-7/8" Tricone Bit 2" O.D. Split-barrel Sampler NQ Rock Core Barrel	LOCATION	Sta. 485+81, 65' Rt.
COMPLETION DEPTH:	89.0'	ELEVATION: 828.2	DATE: 5/8/02

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
35												Very-dense gray and greenish-gray fine to coarse sand, "and" fine to coarse gravel, little clayey silt, few cobbles.
	14	25/42/45										
40												
	15	REC 60% RQD 50%										Very-soft to soft gray shale, nearly horizontally bedded, few fractures.
45		REC 100% RQD 93%										Medium-hard gray becoming dark-gray shale interbedded with sandstone, nearly horizontally bedded, occasional horizontal fractures.
	16											
50		REC 100% RQD 100%										
55	17											
60		REC 58% RQD 50%										
												GROUT
65	18											
												Very-soft to soft gray shale, nearly horizontally bedded, few fractures.
70												

WATER LEVEL:	22.0					
WATER NOTE:						
DATE:	5/08/02					

JOB: 01107000.090 -CONTINUED-

BBCM

LOG OF BORING NO. GC-304
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 7-7/8" Tricone Bit; 2" O.D. Split-barrel Sampler; NQ Rock Core Barrel

LOCATION: Sta. 485+81, 65' Rt.

COMPLETION DEPTH: 89.0' ELEVATION: 828.2 DATE: 5/8/02

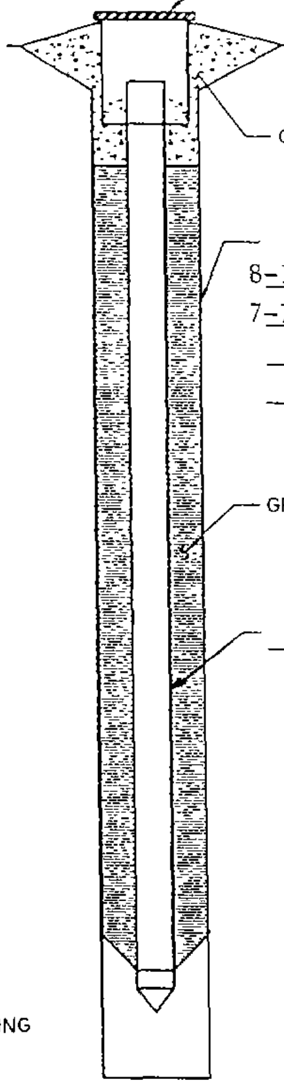
DEPTH FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
70			RQC 100% RQD 100%										Very-soft to soft gray shale, nearly horizontally bedded, few fractures.
													Medium-hard gray sandstone interbedded with thin lenses of shale, nearly horizontally bedded, occasional horizontal fractures.
75	19												
80													
85													
90													- Encountered water from 22.0' to 27.0' and from 31.0' to 42.0'. - Placed 5" diameter PVC casing to 88.5'. - Grouted with 5% bentonite/cement slurry.
95													
100													
105													

WATER LEVEL: 22.0
WATER NOTE:
DATE: 5/08/02

JOB: 01107000.090

TCAMWLL4.DWG

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
828.2	0.0	TOP OF COVER
828.2	0.0	GROUND SURFACE
827.7	0.5	TOP OF PVC
827.2	1.0	TOP OF GROUT
739.7	88.5	BOTTOM OF CASING
739.2	89.0	BORING DEPTH



GEOPHYSICAL CASING INSTALLATION (NO SCALE)
PROJECT NAME: GUE-70-14.10
BORING: GC-304
DATE INSTALLED: 05-13-02
BBC & M PROJECT NO: 01107000.090

INSTALLATION NOTES:

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

BBCM

LOG OF BORING NO. GC-305
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 7-7/8" Tricone Bit; 2" and 2-1/2" O.D. Split-barrel Sampler; NQ Rock Core Barrel

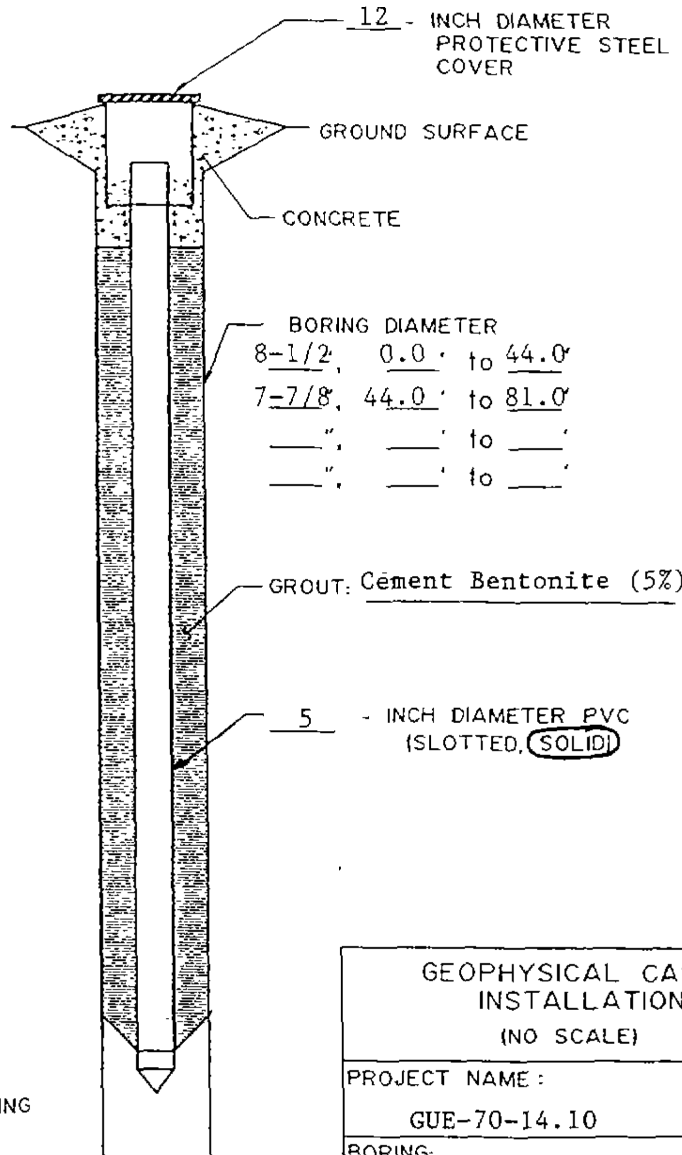
LOCATION: Sta. 469+69, 65' Rt.

COMPLETION DEPTH: 81.0' ELEVATION: 821.8 DATE: 5/9/02

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0	1	7/7/5/4										FILL: Medium-dense brown fine to coarse sand, some fine to coarse gravel, trace clayey silt.
	2A	4/3/5/5	4.5+	24	45	23	1	2	7	49	41	FILL: Hard yellow-brown clayey silt, little fine to coarse sand, trace fine to coarse gravel.
	2B		1.7-2.1									Stiff to very-stiff gray silty clay, trace fine to medium sand, few organics.
5	3	2/3/5/6	1.4-3.4									
	4	3/4/4/4	1.1-3.4									
	5	1/1/1/1	0.25-0.5									Soft to medium-stiff gray clayey silt, little fine to coarse sand, many seams (<1") of organic silt.
10	6A	1/1/3/3	0.25-0.5									
	6B		1.2-2.1									Stiff to very-stiff orange-brown mottled with gray clayey silt, some fine to coarse sand.
	7	S/H=18"	0.5-0.9	21	30	18	0	3	29	43	25	Medium-stiff orange-brown mottled with gray silty clay, little fine to coarse sand.
	8	2/2/3	1.4-2.2									Stiff to very-stiff brown clayey silt, "and" fine to coarse sand, trace fine to coarse gravel.
15	9	3/5/5										Loose becoming medium-dense brown fine to coarse sand, some fine to coarse gravel, little clayey silt.
20	10	10/12/13										
25	11	7/9/13										
												Medium-dense gray fine to coarse sand, some fine to coarse gravel, little clayey silt.
30	12	9/6/7										
												Medium-stiff to stiff gray silty clay, little fine to coarse sand, trace fine to coarse gravel.
35	13	3/5/6	0.7-1.4									
	2S											

WATER LEVEL: 10.0
WATER NOTE:
DATE: 5/09/02

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
821.8	0.0	TOP OF COVER
821.8	0.0	GROUND SURFACE
821.6	0.2	TOP OF PVC
820.8	1.0	TOP OF GROUT
741.0	80.8	BOTTOM OF CASING
740.8	81.0	BORING DEPTH



GEOPHYSICAL CASING INSTALLATION

(NO SCALE)

PROJECT NAME: GUE-70-14.10

BORING: GC-305

DATE INSTALLED: 05-21-02

BBC & M PROJECT NO. 01107000.090

INSTALLATION NOTES:

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

TCAMWLL4.DWG

LOG OF BORING NO. GC-306
GUE-70-14.10
GUERNSEY COUNTY, OHIO

BBCM

TYPE: 3-1/4" I.D. Hollow-stem Auger; 7-7/8" Tricone Bit; 2" O.D. Split-barrel Sampler; NQ Rock Core Barrel

LOCATION: Sta. 469+46, 65' Rt.

COMPLETION DEPTH: 81.0' ELEVATION: 821.9 DATE: 5/10/02

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0	1	9/5/4/4										FILL: Loose brown fine to coarse sand, little fine to coarse gravel, trace clayey silt.
	2A	4/7/6/8	4.5+									FILL: Very-stiff to hard brown and gray silty clay, some fine to coarse sand, trace fine to coarse gravel, many pockets of organic silt.
	2B		3.4-4.5+	19	33	21	1	4	7	52	36	
5	3	3/11/4/3	2.2-2.4									
	4	3/5/4/3	0.7-1.2									Medium-stiff to stiff gray organic clayey silt, little fine to coarse sand, trace fine to coarse gravel, contains coal fragments.
	5	S/H=24"	0.25-0.4	26	31	20	0	1	15	59	25	Very-soft to soft gray mottled with orange-brown clayey silt, trace fine to coarse sand, many organics.
10	6	S/H=18" /5	0.4-0.7	27	31	19	0	3	41	33	23	Soft to medium-stiff orange-brown mottled with gray silty clay, some fine to medium sand, trace coarse sand.
	7	2/3/3	0.5-1.0									- Below 13.0', few seams of silt.
	8	S/H=12" /3	0.4-1.0									
15 ▽	9	7/8/9										Medium-dense brown fine to coarse gravel, "and" fine to coarse sand, some clayey silt.
	10	9/12/13										
20												
	11	8/12/13										
25												Medium-dense gray fine to coarse sand, some fine to coarse gravel, little clayey silt.
	12	3/3/9										
30												
	13	4/5/9	1.9-2.4									
35												

WATER LEVEL:	▽ 15.5	▼	▽	▼	▽	▼
WATER NOTE:						
DATE:	5/10/02					

ODOTLJOLD 17000090.GPJ BBCM.GDT 1/21/03

JOB: 01107000.090

-CONTINUED-

BBCM

LOG OF BORING NO. GC-306
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 7-7/8" Tricone Bit; 2" O.D. Split-barrel Sampler; NQ Rock Core Barrel

LOCATION: Sta. 469+46, 65' Rt.

COMPLETION DEPTH: 81.0' ELEVATION: 821.9 DATE: 5/10/02

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S	F S.	SILT	CLAY	DESCRIPTION - CONTINUED
35												Stiff to hard gray silty clay, trace fine to coarse sand, trace fine to coarse gravel, few thin silt seams, contains pockets of organic material.
	14A	4/10/22	4 1-4 5+									
40	14B		4 5+									Dense gray fine to coarse gravel, some fine to coarse sand, some clayey silt, highly fractured bedrock with clayey silt filled fractures.
	15	50-1"R										Medium-hard gray shale, many sandstone lenses, nearly horizontally bedded, few horizontal fractures.
45		REC 97% RQD 84%										
	16											
50		REC 94% RQD 94%										
55	17											
60												GROUT
		REC 86% RQD 86%		0								
	18											
65		REC 100% RQD 62%										Very-soft to soft gray shale (underclay), nearly horizontally bedded, few fractures.
	19											
70												

WATER LEVEL: 15.5
WATER NOTE:
DATE: 5/10/02

LOG OF BORING NO. GC-306
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 7-7/8" Tricone Bit; 2" O.D. Split-barrel Sampler; NQ Rock Core Barrel

LOCATION: Sta. 469+46, 65' Rt.

COMPLETION DEPTH: 81.0' ELEVATION: 821.9 DATE: 5/10/02

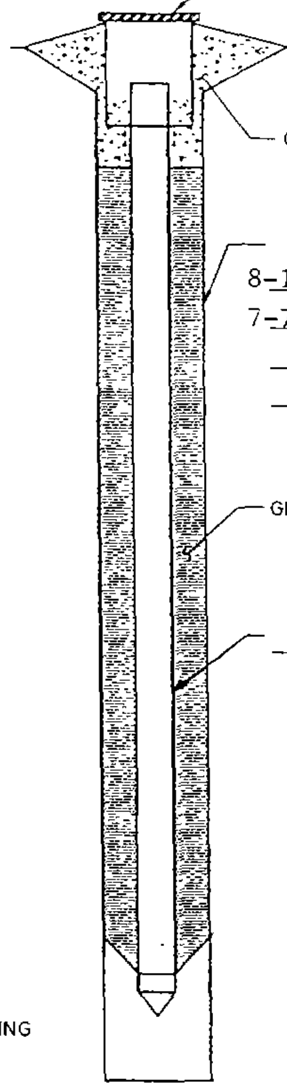
DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S	SILT	CLAY	DESCRIPTION - CONTINUED
70													Medium-hard brown limestone interbedded with brown and gray shale, few fractures.
			REC 100% RQD 97%										Medium-hard gray fine-grained sandstone, nearly horizontally bedded, occasional horizontal fractures.
75	20												
80													
85													- Encountered water from 15.5' to 33.0'.
													- Placed 5" diameter PVC casing to 80.8'.
													- Grouted with 5% bentonite/cement slurry.
90													
95													
100													
105													

WATER LEVEL: 15.5
WATER NOTE:
DATE: 5/10/02

ODOT1 OLD 17000090.GPJ BBCM.GDT 1/21/03

JOB: 01107000.090

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
821.8	0.1	TOP OF COVER
821.9	0.0	GROUND SURFACE
821.5	0.4	TOP OF PVC
820.8	1.0	TOP OF GROUT
821.9	80.8	BOTTOM OF CASING
821.5	81.0	BORING DEPTH



GEOPHYSICAL CASING INSTALLATION (NO SCALE)
PROJECT NAME: GUE-70-14.10
BORING: GC-306
DATE INSTALLED: 05-16-02
BBC & M PROJECT NO: 01107000.090

INSTALLATION NOTES:

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

TCAMWLL4.DWG

BBCM

LOG OF BORING NO. GC-307
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 7-7/8" Tricone Bit; 2" O.D. Split-barrel Sampler; NQ Rock Core Barrel

LOCATION: Sta. 469+53, 65' Rt.

COMPLETION DEPTH: 83.0' ELEVATION: 821.9 DATE: 5/13/02

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG	C.S	F.S.	SILT	CLAY	DESCRIPTION
0	1	7/7/9/9										FILL: Medium-dense brown fine to coarse sand, some fine to coarse gravel, trace clayey silt.
	2A	8/7/8/8	3 5-4 1									FILL: Stiff to hard brown and gray silty clay, some fine to coarse sand, trace fine to coarse gravel, few pockets of organic silt, few coal fragments.
	2B		1.9-2 7									
5	3	2/5/5/5	2 2-4 5+	18	40	23	2	7	13	45	33	
	4	1/2/2/3	0 4-0.9									Soft to medium-stiff gray clayey silt, little fine to coarse sand, trace fine to coarse gravel, contains coal fragments, many organics.
	5	S/H=18"/1	0 4-0 9									
10	6	S/H=18"/1	0.25-0 5									Very-soft to soft gray mottled with brown organic clayey silt, "and" fine sand, trace medium to coarse sand.
	7	2/3/4	0 8-1 2									Medium-stiff to stiff brown clayey silt, some fine to coarse sand.
	8	1/2/4	0 2-0 9									Very-soft to medium-stiff brown mottled with gray silty clay, little fine to coarse sand, many thin silt seams.
15 ∇												Loose becoming medium-dense brown fine to coarse sand, some fine to coarse gravel, trace clayey silt.
	9	3/5/5										
	10	5/11/11										
20												Medium-dense gray fine to coarse sand, some fine to coarse gravel. little clayey silt.
	11	7/13/17										
25												Stiff to very-stiff gray silty clay interbedded with clayey silt and silt, trace fine to coarse sand, contains organic material.
	12	3/3/7	1 2-1.7									
30												
	13	4/6/8	1.7-1.9									
35												

WATER LEVEL: ∇ 15.5
WATER NOTE:
DATE: 5/13//02

ODOTLJOLD 17000090 GPJ BBCM GDT 1/21/03

JOB: 01107000.090

-CONTINUED-

BBCM

LOG OF BORING NO. GC-307
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 7-7/8" Tricone Bit; 2" O.D. Split-barrel Sampler; NQ Rock Core Barrel

LOCATION: Sta. 469+53, 65' Rt.

COMPLETION DEPTH: 83.0' ELEVATION: 821.9 DATE: 5/13/02

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
35												Stiff to very-stiff gray silty clay interbedded with clayey silt and silt, trace fine to coarse sand, contains organic material.
	14	4/7/12	2.6-2.8									
40												
	15	REC 100% RQD 96%										Medium-dense gray becoming dark-gray shale, many sandstone lenses, nearly horizontally bedded, occasional horizontal fractures.
45												
50												
	16	REC 100% RQD 84%										
55												
60												Medium-hard black coal, highly fractured.
	17	REC 100% RQD 0%										
65												
	18	REC 100% RQD 60%										Very-soft to soft gray shale, nearly horizontally bedded, many fractures from 68.0' to 69.0'.
70												

WATER LEVEL: 15.5
WATER NOTE:
DATE: 5/13//02

JOB: 01107000.090

-CONTINUED-

BBCM

LOG OF BORING NO. GC-307
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE. 3-1/4" I.D. Hollow-stem Auger
7-7/8" Tricone Bit
2" O.D. Split-barrel Sampler
NQ Rock Core Barrel

LOCATION Sta. 469+53, 65' Rt.

COMPLETION DEPTH: 83.0' ELEVATION: 821.9 DATE: 5/13/02

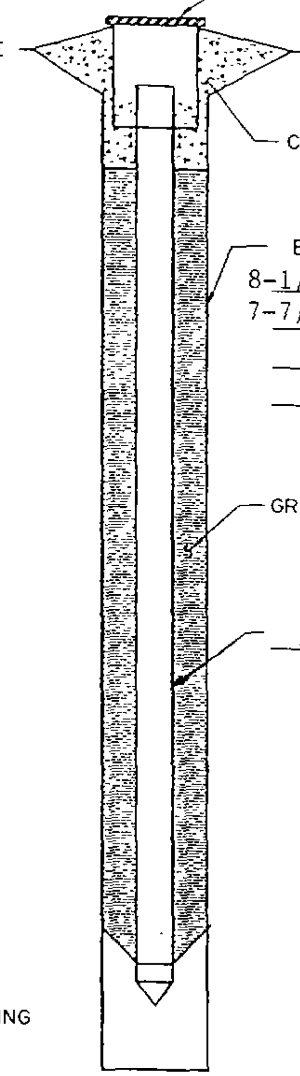
DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F S.	SILT	CLAY	DESCRIPTION - CONTINUED
70	19		REC 100% RQD 100%										Medium-hard gray fine-grained sandstone, nearly horizontally bedded, occasional horizontal fractures.
75													
80													
85													- Encountered water from 15.5' to 27.0'. - Placed 5" diameter PVC casing to 81.5'. - Grouted with 5% bentonite/cement slurry.
90													
95													
100													
105													

WATER LEVEL: 15.5
WATER NOTE:
DATE: 5/13//02

JOB: 01107000.090

ODOT.JOLD 17000090.GPJ BBCM.GDT 1/21/03

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
821.8	0.1	TOP OF COVER
821.9	0.0	GROUND SURFACE
821.4	0.5	TOP OF PVC
820.8	1.0	TOP OF GROUT
740.4	81.5	BOTTOM OF CASING
738.9	83.0	BORING DEPTH



GEOPHYSICAL CASING INSTALLATION (NO SCALE)
PROJECT NAME: GUE-70-14.10
BORING: GC-307
DATE INSTALLED: 05-20-02
BBC & M PROJECT NO: 01107000.090

INSTALLATION NOTES:

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

TCAMWLL4.DWG

BBCM

LOG OF BORING NO. GC-308
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger
7-7/8" Tricone Bit
2" O.D. Split-barrel Sampler
NQ Rock Core Barrel

LOCATION: Sta. 485+29, 21' Rt.

COMPLETION DEPTH: 87.0' ELEVATION: 827.5 DATE: 5/22/02

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0	1A	9/6/6	4.5+									FILL: Medium-dense brown fine to coarse gravel, little fine to coarse sand, trace clayey silt.
	1B	/8										FILL: Hard orange-brown clayey silt, little fine to coarse sand, trace fine to coarse gravel.
	2	5/9/15 /18	3.7-4.5+	12	38	19	1	4	11	46	38	FILL: Very-stiff to hard orange-brown mottled with gray clayey silt, little fine to coarse sand, trace fine to coarse gravel, few pockets of silt.
5	3	2/5/6 /9	2.5-3.3									
	4	2/3/5 /10	1.4-3.3									FILL. Stiff to very-stiff orange-brown mottled with gray clayey silt, trace fine to coarse sand, trace fine to coarse gravel
	5	2/5/6 /10	2.4-3.2									
10	6	2/5/5 /8	0.5-1.5									Medium-stiff to stiff orange-brown mottled with gray silty clay, trace fine to coarse sand, few thin seams of silt.
	7	3/8/6	2.3-3.3									Stiff to very-stiff orange-brown mottled with gray silty clay, trace fine to coarse sand, trace fine to coarse gravel, few thin seams of organic silt.
	8	4/3/7	2.4-3.3									
15	9	2/4/6	2.4-3.1									
	10	2/4/5	1.8-2.1									
20												
	11	4/7/10										Medium-dense brown fine to coarse sand, little clayey silt, little fine to coarse gravel.
25												
												Soft to medium-stiff gray clayey silt interbedded with silty clay and silt, trace fine to medium sand, slightly organic.
	12	1/2/3	0.4-0.6									
30												
	13A	4/12/25	0.3-0.6									
35	13B											

WATER LEVEL: ▽ 27.0
WATER NOTE:
DATE: 5/22/02

JOB: 01107000.090

-CONTINUED-

TYPE:	3-1/4" I.D. Hollow-stem Auger 7-7/8" Tricone Bit 2" O.D. Split-barrel Sampler NQ Rock Core Barrel	LOCATION	Sta. 485+29, 21' Rt.
COMPLETION DEPTH: 87.0'	ELEVATION: 827.5	DATE:	5/22/02

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S	SILT	CLAY	DESCRIPTION - CONTINUED
35													Dense to very-dense gray fine to coarse sand, some fine to coarse gravel, little clayey silt.
	14		14/30/ 50-2"R										
40	15		REC 40% RQD 0%										Very-soft to soft gray shale interbedded with fine-grained sandstone, nearly horizontally bedded, many fractures.
45	16		REC 92% RQD 26%										Soft to medium-hard gray becoming dark-gray shale interbedded with fine-grained sandstone, nearly horizontally bedded, many horizontal fractures.
50			REC 95% RQD 53%										
	17												
55													
60			REC 93% RQD 47%										
	18												
65													Medium-hard black coal.
			REC 80% RQD										Very-soft to soft gray shale (underclay), nearly horizontally bedded, few fractures.
70													

WATER LEVEL:	▽ 27.0	▼	▽	▼	▽	▼
WATER NOTE:						
DATE:	5/22/02					

BBCM

LOG OF BORING NO. GC-308
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger
7-7/8" Tricone Bit
2" O.D. Split-barrel Sampler
NQ Rock Core Barrel

LOCATION: Sta. 485+29, 21' Rt.

COMPLETION DEPTH: 87.0' ELEVATION: 827.5 DATE: 5/22/02

DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
70	19		62%										Very-soft to soft gray shale (underclay), nearly horizontally bedded, few fractures.
			REC 94% RQD 86%		0								Medium-hard gray fine-grained sandstone, nearly horizontally bedded, few horizontal fractures.
75													
	20												
80													
85													
90													- Encountered water from 23.0' to 27.0' and 34.0' to 39.7'. - Placed 5" diameter PVC casing to 86.0'. - Grouted with 5% bentonite/cement slurry.
95													
100													
105													

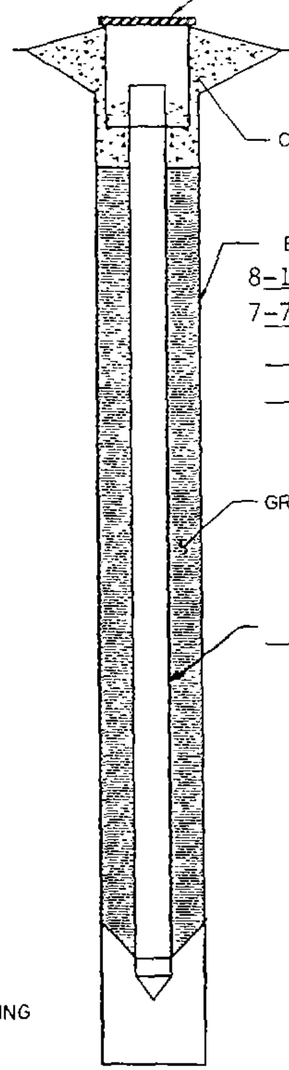
WATER LEVEL: ▽ 27.0
WATER NOTE:
DATE: 5/22/02

ODOTLOID 17000090.GPJ BBCM.GDT 1/21/03

JOB: 01107000.090

TCAMWLL4.DWG

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
827.8	-0.3	TOP OF COVER
827.5	0.0	GROUND SURFACE
827.5	0.0	TOP OF PVC
826.8	1.0	TOP OF GROUT
741.5	86.0	BOTTOM OF CASING
740.5	87.0	BORING DEPTH



12 - INCH DIAMETER PROTECTIVE STEEL COVER

GROUND SURFACE

CONCRETE

BORING DIAMETER
8-1/2", 0.0' to 40.0'
7-7/8", 40.0' to 87.0'
___", ___' to ___'
___", ___' to ___'

GROUT: Cément Bentonite (5%)

5 - INCH DIAMETER PVC (SLOTTED, SOLID)

GEOPHYSICAL CASING INSTALLATION (NO SCALE)
PROJECT NAME: GUE-70-14.10
BORING: GC-308
DATE INSTALLED: 05-28-02
BBC & M PROJECT NO: 01107000.090

INSTALLATION NOTES.

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

BBCM

LOG OF BORING NO. GC-309
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 7-7/8" Tricone Bit; 2" O.D. Split-barrel Sampler; NQ Rock Core Barrel

LOCATION: Sta. 485+50, 22' Rt.

COMPLETION DEPTH: 86.0' ELEVATION: 827.8 DATE: 5/23/02 - 5/28/02

SAMPLE NO	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
1A	6/8/7										FILL: Medium-dense brown fine to coarse sand, little fine to coarse gravel, trace silt.
1B	/11	3.7-4.5+									FILL: Very-stiff to hard brown and gray silty clay, some fine to coarse sand, trace fine to coarse gravel.
2	12/11/10/14	4.5+	18	41	19	1	3	7	49	40	
3	3/3/6/9	3.0-3.4									
4	3/4/6/9	2.2-4.2									
5	3/2/4/6	1.9-2.7									Stiff to very-stiff brown silty clay, trace fine to coarse sand.
6	4/4/6/8	2.2-2.7									
7	4/6/6	2.3-3.3									- Below 12.0', few thin (<1/8") seams of silt.
8	4/6/8	2.5-3.4									
9	6/6/8	2.5-3.2									
10	4/6/8	1.5-2.3									Stiff to very-stiff gray mottled with brown silty clay, trace fine to coarse sand, few thin silt seams.
11	3/4/6	1.7-2.1									
12	1/1/1	0.25-0.5									Soft to medium-stiff gray organic clayey silt, trace fine sand.
13A	5/8/12	1.0-1.4									Stiff gray organic silty clay, trace fine sand, many silt seams.

Depth scale (feet): 0, 5, 10, 15, 20, 25, 30, 35

WATER LEVEL:	26.0
WATER NOTE:	Before Coring
DATE:	5/23/02

ODOTLJOLD 17000090.GPJ BBCM.GDT 1/21/03

JOB: 01107000.090

-CONTINUED-

BBCM

LOG OF BORING NO. GC-309
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 7-7/8" Tricone Bit; 2" O.D. Split-barrel Sampler; NQ Rock Core Barrel
LOCATION: Sta. 485+50, 22' Rt.
COMPLETION DEPTH: 86.0' ELEVATION: 827.8 DATE: 5/23/02 - 5/28/02

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
35	13B											Medium-dense becoming very-dense gray fine to coarse sand, little fine to coarse gravel, some clayey silt.
		24/36/38										
	14											
40		REC 93% RQD 23%										Very-soft to soft gray shale, nearly horizontally bedded, many horizontal fractures.
	15											
45		REC 41% RQD 15%										Soft to medium-hard gray becoming dark-gray shale, nearly horizontally bedded, numerous horizontal fractures, many fine-grained sandstone lenses.
	16											
50												
55		REC 95% RQD 44%										
	17											
60												
65		REC 100% RQD 16%										Medium-hard black coal.
	18											
70												

WATER LEVEL: ∇ 26.0
WATER NOTE: Before Coring
DATE: 5/23/02

JOB: 01107000.090

-CONTINUED-

ODOT1 JOLD 17000090.GPJ BBCM.GDT 1/21/03

BBCM

LOG OF BORING NO. GC-309
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE. 3-1/4" I.D. Hollow-stem Auger; 7-7/8" Tricone Bit; 2" O.D. Split-barrel Sampler; NQ Rock Core Barrel

LOCATION: Sta. 485+50, 22' Rt.

COMPLETION DEPTH: 86.0' ELEVATION: 827.8 DATE: 5/23/02 - 5/28/02

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F S.	SILT	CLAY	DESCRIPTION - CONTINUED
70													Medium-hard black coal.
													Very-soft to soft gray shale, nearly horizontally bedded, many fractures.
75			REC 98% RQD 45%										Medium-hard gray sandstone interbedded with soft to medium-hard gray shale, nearly horizontally bedded, few horizontal fractures.
80	19												
85													
90													- Encountered water from 34.5' to 40.0'. - Placed 5' diameter PVC casing to 85.0'. - Grouted with 5% bentonite/cement slurry.
95													
100													
105													

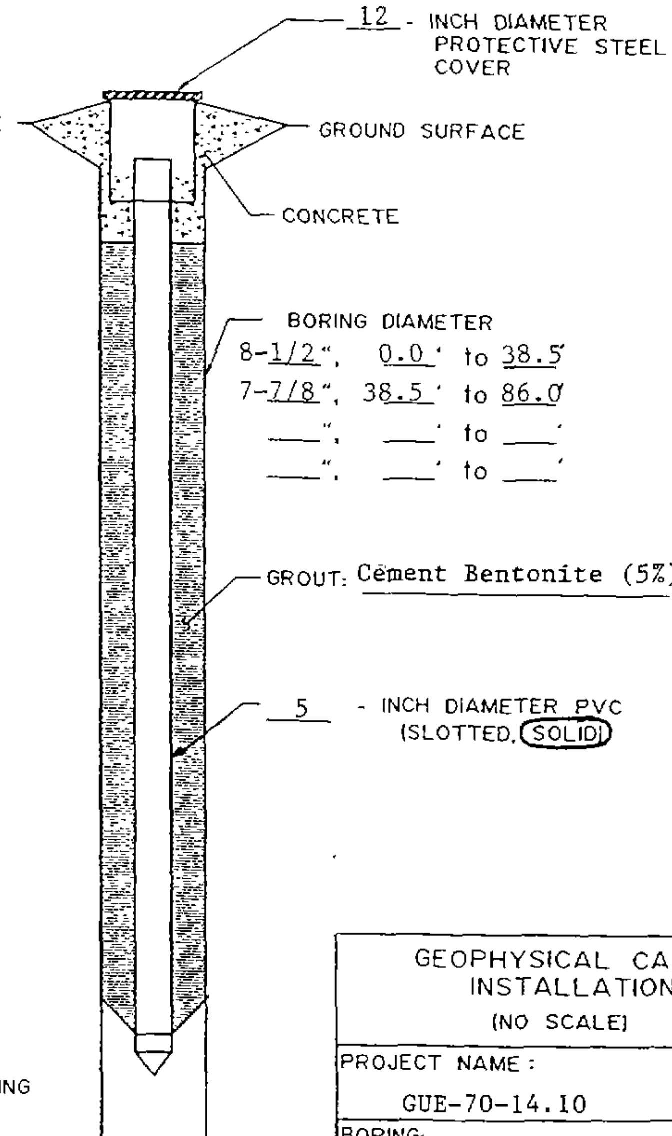
WATER LEVEL:	26.0					
WATER NOTE:	Before Coring					
DATE:	5/23/02					

ODOTLJOLD 17000090.GPJ BBCM.GDT 1/21/03

JOB: 01107000.090

TCAMWLL4.DWG

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
828.1	-0.3	TOP OF COVER
827.8	0.0	GROUND SURFACE
827.7	0.1	TOP OF PVC
827.1	1.0	TOP OF GROUT
742.8	85.0	BOTTOM OF CASING
741.8	86.0	BORING DEPTH



GEOPHYSICAL CASING INSTALLATION (NO SCALE)
PROJECT NAME: GUE-70-14.10
BORING: GC-309
DATE INSTALLED: 05-28-02
BBC & M PROJECT NO: 01107000.090

INSTALLATION NOTES:

* FEET ABOVE MSL

BBCM

LOG OF BORING NO. GC-310
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 7-7/8" Tricone Bit; 2" O.D. Split-barrel Sampler; NQ Rock Core Barrel

LOCATION: Sta. 486+08, 22' Rt.

COMPLETION DEPTH: 86.0' ELEVATION: 828.2 DATE: 5/29/02 - 5/30/02

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0	1A	6/6/6										FILL: Medium-dense brown fine to coarse gravel, some fine to coarse sand, trace silt.
	1B	/7	3.7-4.5+									FILL: Stiff to hard brown silty clay mixed with clayey silt, little fine to coarse sand, trace fine to coarse gravel, few pockets of organic material.
	2	6/6/6 /9	2.7-4.5+									
5	3	4/6/7 /10	1.8-3.3									
	4	4/5/7 /10	2.3-3.0									
	5	7/6/7 /11	2.3-2.9									Very-stiff brown silty clay, trace fine to coarse sand, trace fine to coarse gravel, few thin seams of silt.
10	6	5/5/6 /8	2.3-3.1									
	7	4/5/6	2.0-2.7									
	8	5/7/8	2.2-3.0									
15	9	2/3/5	1.8-2.4									Stiff to very-stiff gray silty clay, trace fine to coarse sand, few thins seams of silt.
	10	2/3/4	1.6-2.6									
20												
	▽11A	1/3/5	0.8-1.7									Medium-stiff to stiff gray silty clay, trace fine to coarse sand.
25	11B											Loose gray fine to coarse sand, some fine to coarse gravel, little clayey silt.
												Medium-stiff to stiff gray silty clay, trace fine to coarse sand.
		3/3/5										
30												Medium-stiff to stiff gray silty clay, trace fine to coarse sand, few seams of silt and organic clayey silt.
	12	4/5/6	0.8-1.4									
35												

WATER LEVEL: ▽ 24.3
WATER NOTE: Before Coring
DATE: 5/29/02

ODOTLJ 17000090.GPJ BBCM.GDT 11/12/02

JOB: 01107000.090 -CONTINUED-

BBCM

LOG OF BORING NO. GC-310
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger, 7-7/8" Tricone Bit, 2" O.D. Split-barrel Sampler, NQ Rock Core Barrel

LOCATION: Sta. 486+08, 22' Rt.

COMPLETION DEPTH: 86.0' ELEVATION: 828.2 DATE: 5/29/02 - 5/30/02

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
35												Medium-stiff to stiff gray silty clay, trace fine to coarse sand, few seams of silt and organic clayey silt.
												Very-dense gray fine to coarse sand, "and" fine to coarse gravel, little clayey silt.
40	13	26/37/35										
	14	9/30/50-3"R										Soft to medium-hard gray shale interbedded with fine-grained sandstone, nearly horizontally bedded, many horizontal fractures.
45	15	REC 47% RQD 0%										
50		REC 67% RQD 0%										
55	16											
60		REC 96% RQD 31%										
65	17											Medium-hard black coal.
70												

WATER LEVEL:	24.3					
WATER NOTE:	Before Coring					
DATE:	5/29/02					

ODOT1 17000090.GPJ BBCM.GDT 11/12/02

JOB: 01107000.090

-CONTINUED-

BBCM

LOG OF BORING NO. GC-310
GUE-70-14.10
GUERNSEY COUNTY, OHIO

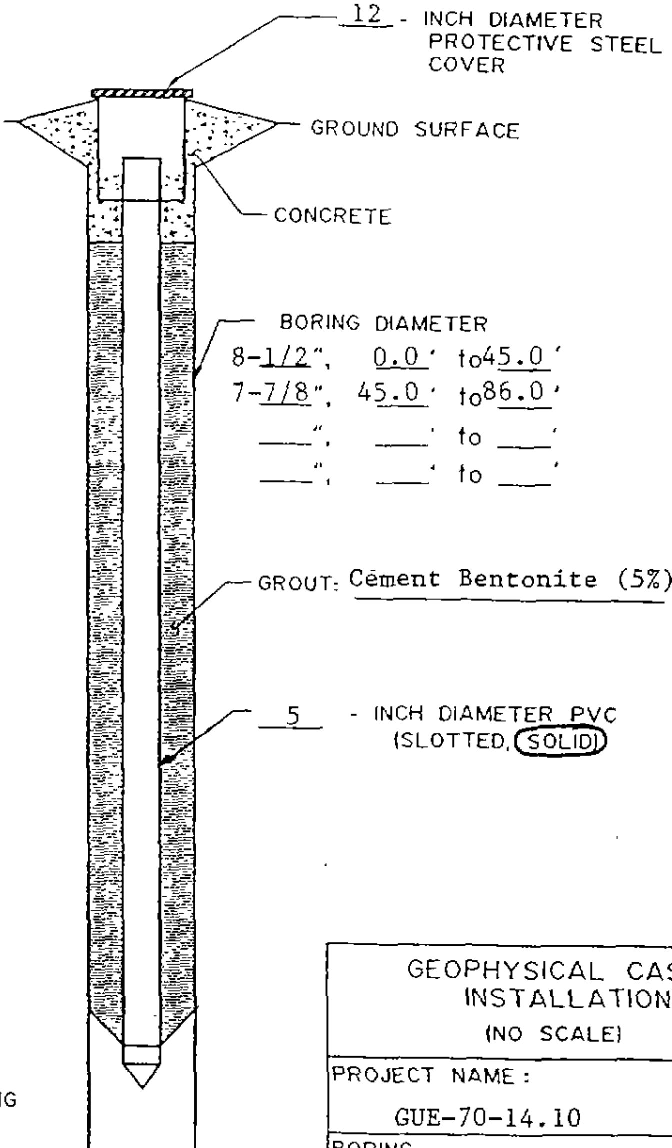
TYPE:	3-1/4" I.D. Hollow-stem Auger
	7-7/8" Tricone Bit
	2" O.D. Split-barrel Sampler
	NQ Rock Core Barrel
LOCATION:	Sta. 486+08, 22' Rt.
COMPLETION DEPTH:	86.0'
ELEVATION:	828.2
DATE:	5/29/02 - 5/30/02

DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
70			REC 87% RQD 74%										Very-soft to soft gray shale, nearly horizontally bedded, few fractures.
													Medium-hard gray fine-grained sandstone, nearly horizontally bedded, few horizontal fractures.
75	18												
80	19		REC 49% RQD 38%										
85													
90													- Encountered water from 24.3' to 27.0' and 37.0' to 43.5'. - Placed 5" diameter PVC casing to 85.5'. - Grouted with 5% bentonite/cement slurry.
95													
100													
105													

WATER LEVEL:	24.3					
WATER NOTE:	Before Coring					
DATE:	5/29/02					

JOB: 01107000.090

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
828.5	-0.3	TOP OF COVER
828.2	0.0	GROUND SURFACE
828.2	0.0	TOP OF PVC
827.5	1.0	TOP OF GROUT
742.7	85.5	BOTTOM OF CASING
742.2	86.0	BORING DEPTH



GEOPHYSICAL CASING INSTALLATION (NO SCALE)
PROJECT NAME: GUE-70-14.10
BORING: GC-310
DATE INSTALLED: 05-30-02
BBC & M PROJECT NO: 01107000.090

INSTALLATION NOTES.

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

TCAMWLL4.DWG

BBC&M ENGINEERING, INC.

LOG OF BORING NO. P-221A
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 3-1/8" Tricone Bit 2" O.D. Split-barrel Sampler; Rock Core Barrel

LOCATION: Sta. 484+99.6, 66.1' Rt.

COMPLETION DEPTH: 71.9' ELEVATION: 826.9 DATE: 11/3/99 - 11/4/99

DEPTH, FEET	SAMPLE NO.	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0												FILL: Very-stiff to hard brown and gray silty clay, little fine to coarse sand, trace fine to coarse gravel.
	1A	3/10/9	4.5+									
	1B		2.5-4.5									
5												Very-stiff to hard gray mottled with brown silty clay, some fine to coarse sand, trace fine to coarse gravel, desiccated.
	2	4/7/11	2.0-2.5									
	3	5/6/9	2.5-4.0									
10												
	4	S/H/3/3	0.25-0.75									Soft to medium-stiff gray silty clay, trace fine to coarse sand.
15												
	5	2/4/5	1.0-1.5									- Below 18.0' becoming stiff.
20												
	6	5/6/6					41	13	24	22		Medium-dense brown and red-brown fine to coarse gravel, "and" fine to coarse sand, some silty clay.
25												Medium-stiff to stiff gray silty clay, trace fine sand, few thin seams of silt.
	7	1/2/2	0.5-1.0	28	34	20	0	0	1	69	30	
30												Very-dense gray and red-brown fine to coarse gravel, some fine to coarse sand, some silty clay.
	8	10/25/31					44	19	15	22		
35												
	9A	10/34/										Medium-dense gray fine sand, some silt.
	9B	50-5"R										Very-dense gray fine to coarse sand, some fine to coarse
40												

WATER LEVEL: ∇ 19.0

WATER NOTE: Before Coring

DATE: 11/3/99

BBC&M ENGINEERING, INC.

LOG OF BORING NO. P-221A
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 3-1/8" Tricone Bit 2" O.D. Split-barrel Sampler; Rock Core Barrel

LOCATION: Sta. 484+99.6, 66.1' Rt.

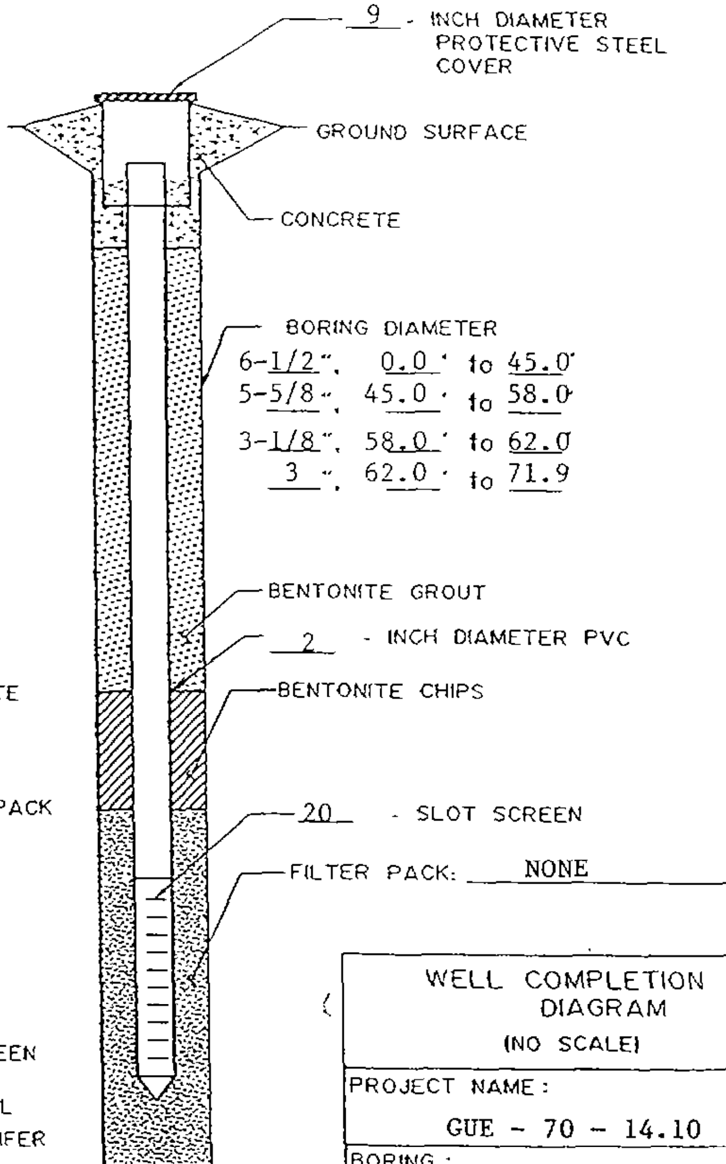
COMPLETION DEPTH: 71.9' ELEVATION: 826.9 DATE: 11/3/99 - 11/4/99

DEPTH, FEET	SAMPLE NO.	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
40												gravel, little silty clay.
												Very-soft gray shale, nearly horizontally bedded.
	10	50-3"R										
45		NXM REC 94.6% RQD 20%										Medium-hard gray shale, interbedded with fine-grained sandstone, nearly horizontally bedded.
	11											
50												
55		NXM REC 99% RQD 95%										
	12											
60												Grout.
		NXM REC 63% RQD 34%										Medium-hard gray shale, many grout-filled fractures.
65												
	13											
70												Very-soft gray shale (under clay).
75												- Encountered water 31.0' to 42.0'. - Boring converted to a groundwater monitoring well, see completion diagram.
80												

WATER LEVEL:	19.0					
WATER NOTE:	Before Coring					
DATE:	11/3/99					

JOB: 7000.030

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
827.29	-0.4	TOP OF COVER
826.9	0.0	GROUND SURFACE
823.92	0.0	TOP OF PVC
825.3	2.0	TOP OF GROUT
775.1	52.0	TOP OF BENTONITE
--	-	TOP OF FILTER PACK
767.2	59.7	TOP OF AQUIFER
~~771.8~~	~~55.1~~	TOP OF SCREEN OPENINGS
767.8	59.1	BOTTOM OF SCREEN OPENINGS
765.8	61.1	BOTTOM OF WELL
755.7	71.2	BOTTOM OF AQUIFER
755.0	71.9	BORING DEPTH



WELL COMPLETION DIAGRAM (NO SCALE)
PROJECT NAME: GUE - 70 - 14.10
BORING: P-221A
DATE WELL INSTALLED: 11-04-99
BBC & M PROJECT NO: 7000.03

STATIC WATER LEVEL *	17.40			
DATE:	1/05/00			

WELL DEVELOPMENT: 30 gal. purged clear water

Believe possibly have another small void at approximately 53.0'; while reaming hole, had problems with plugging at 53.0', also Bentonite pellets stopped in the hole at 53.0'.

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

DNR 7802.94
TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Divison of Water, 1939 Fountain Square Drive
Columbus, Ohio 43224 Phone (614) 265-6739

813939

Permit Number ~~02504~~

COUNTY Guernsey TOWNSHIP Center SECTION/LOT No. 18

OWNER/BUILDER (Circle One or Both) ODOT First Last PROPERTY ADDRESS (Address of well location) Station 484+99.6 66.1' Rt Number Street City

LOCATION OF PROPERTY Mile Marker 184 on I-70 Zip Code + 4

CONSTRUCTION DETAILS

CASING *(Length below grade) Borehole Diameter 3 1/8 in.
[X] 1 Diameter 2 in. Length* 61.1 ft. Wall Thickness 1/8 in.
2 Diameter ____ in. Length* ____ ft. Wall Thickness ____ in.
Type: 1/2 Steel 1/2 Galv. [X] PVC 2 Other ____
Joints: [X] Threaded 1/2 Welded 1/2 Solvent 2 Other ____
Liner Length — Type — Wall Thickness — in.

SCREEN
Type (wire wrapped, louvered, etc.) machine slotted Material PVC
Length 4 ft Diameter 2 in.
Set between 55.1 ft and 59.1 ft. Slot 20

GROUT
Material Benseal Volume used ____
Method of installation Tremmie
Depth placed from 52.0 ft to 52.0 ft.

GRAVEL PACK (Filter Pack)
Material none Volume used —
Method of installation —
Depth: placed from — ft to — ft.

Pitless Device ☐ Adapter ☐ Preassembled unit
Use of Well Ground water Monitoring
[X] Rotary ☐ Cable [X] Augered ☐ Driven ☐ Dug ☐ Other ____
Date of Completion 11-04-99

WELL LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.
Show color, texture, hardness, and formation. sandstone, shale, limestone, gravel, clay, sand, etc.

	From	To
Brown / ~~Gr~~ Gray Silty Clay	0.0	22.0
Brown Gravel, Sand, + Silt	22.0	26.0
Gray ~~Silt~~ Silty Clay	26.0	31.0
Gray/Brown Gravel, Sand, Clay	31.0	36.0
Gray Sand	36.0	~~38.0~~ 42.0
	~~38.0~~	
Gray Shale	42.0	60.0
Grout	60.0	64.0
Shale / Grout	64.0	72.0
Under Clay	72.0	72.0
		End

* Water @ 22.0'
* Water @ 31.0-42.0'

WELL TEST

[X] Bailing ☐ Pumping* ☐ Other ____
Test rate ____ gpm Duration of test ____ hrs.
Drawdown ____ ft.
Measured from: [X] top of casing ☐ ground level ☐ Other ____
Static Level (depth to water) 17.40 ft. Date 01/05/00
Quality (clear, cloudy, taste, odor) ____

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

PUMP

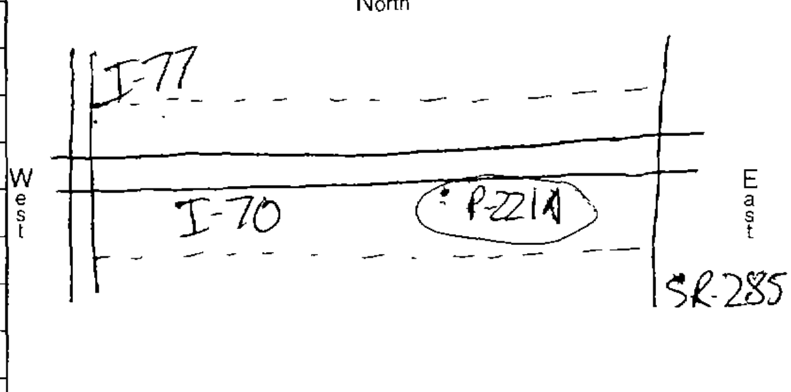
Type of pump — Capacity — gpm
Pump set at — ft.
Pump installed by —

WELL LOCATION

Location of well in State Plane coordinates, if available:
Zone ____ x ____ y ____
Elevation of well 823.920 ft/m. Datum plain: ☐ NAD27 [X] NAD83
Source of coordinates: ☐ GPS [X] Survey ☐ Other ____

Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks.

North



South

*(If additional space is needed to complete well log, use next consecutively numbered form.)

Drilling Firm BBC+M Engineering
Address 6190 Enterprise Ct
City, State, Zip Dublin, OH, 43016

I hereby certify the information given is accurate and correct to the best of my knowledge
Signed ____
Date 04-25-02
ODH Registration Number 02504

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling
ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224
Blue - Customer's copy Pink - Driller's copy Green - Local Health Dept. copy

BBC&M ENGINEERING, INC.

LOG OF BORING NO. P-221B
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 4-1/2" O.D. Continuous-flight Auger

LOCATION: Sta. 484+99.2, 68.0' Rt.

COMPLETION DEPTH: 42.5' ELEVATION: 826.9 DATE: 11/23/99

DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C S.	F.S.	SILT	CLAY	DESCRIPTION
0													- Boring drilled for installation of groundwater monitoring well, see completion diagram. - No samples collected, see log of boring P-221A.
5													
10													
15													
20													
25													
30													
35													
40													

WATER LEVEL: ▽ ▼ ▽ ▽ ▽ ▼
WATER NOTE:
DATE:

JOB: 7000.030

ODOTLJ 17000030.GPJ BBCM.GDT 10/27/00

-CONTINUED-

BBC&M ENGINEERING, INC.

LOG OF BORING NO. P-221B

GUE - 70 - 14.10

GUERNSEY COUNTY, OHIO

TYPE: 4-1/2" O.D. Continuous-flight Auger

LOCATION: Sta. 484+99.2, 68.0' Rt.

COMPLETION DEPTH: 42.5' ELEVATION: 826.9 DATE: 11/23/99

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER	MOISTURE CONTENT	LIQUID LIMIT	PLASTIC LIMIT	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
				tsf	%	%	%						
40													- Boring drilled for installation of groundwater monitoring well, see completion diagram. - No samples collected, see log of boring P-221A.
45													
50													
55													
60													
65													
70													
75													
80													

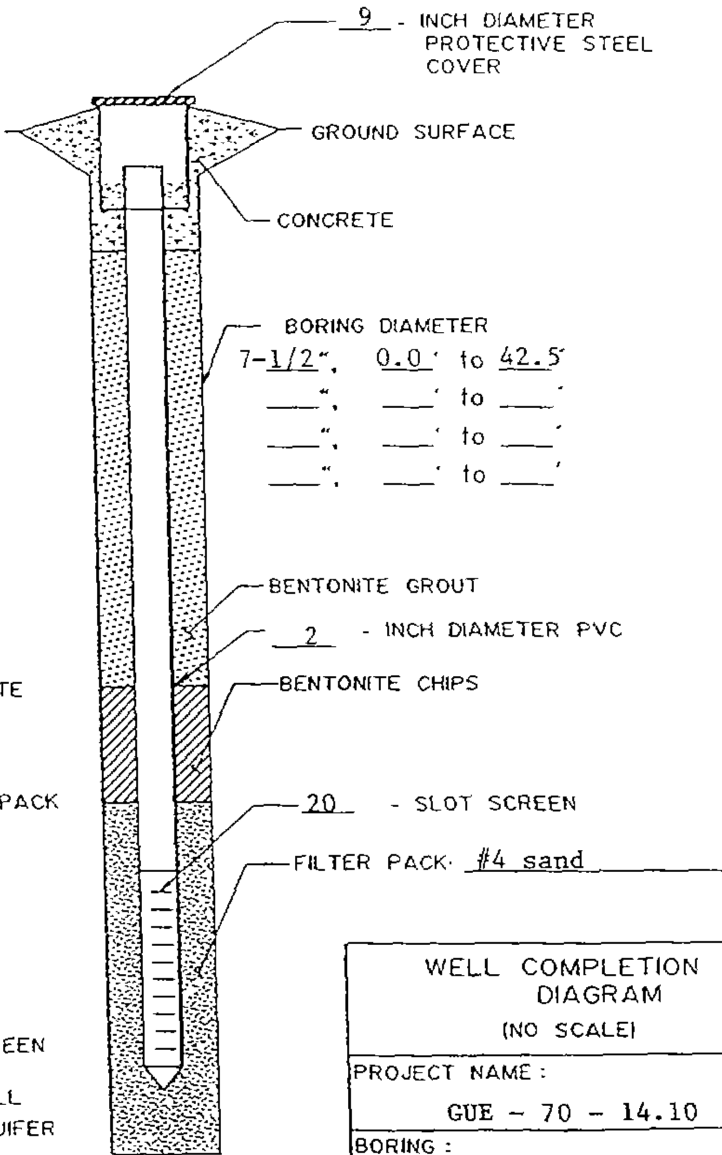
WATER LEVEL:

WATER NOTE:

DATE:

JOB: 7000.030

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
827.03	-0.1	TOP OF COVER
826.9	0.0	GROUND SURFACE
826.76	0.1	TOP OF PVC
826.1	0.8	TOP OF GROUT
796.3	30.6	TOP OF BENTONITE
792.1	34.8	TOP OF FILTER PACK
795.9	31.0	TOP OF AQUIFER
789.5	37.4	TOP OF SCREEN OPENINGS
785.5	41.4	BOTTOM OF SCREEN OPENINGS
784.4	42.3	BOTTOM OF WELL
784.9	42.0	BOTTOM OF AQUIFER
784.4	42.5	BORING DEPTH



WELL COMPLETION DIAGRAM

(NO SCALE)

PROJECT NAME: GUE - 70 - 14.10

BORING: P-221B

DATE WELL INSTALLED: 11-23-99

BBC & M PROJECT NO: 7000.03

STATIC WATER LEVEL *	17.19			
DATE:	1/05/00			

WELL DEVELOPMENT: 13 gal. purged, very silty water

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

DNR 7802.94
TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Divison of Water, 1939 Fountain Square Drive
Columbus, Ohio 43224 Phone (614) 265-6739

813940

Permit Number ______

COUNTY Guernsey TOWNSHIP Center SECTION/LOT No. 18

OWNER/BUILDER (Circle One or Both) ODOT First Last PROPERTY ADDRESS (Address of well location) Station 484+99.2, 68.0' Rt Number Street City

LOCATION OF PROPERTY Mile Marker 184 on I-70 Zip Code + 4

CONSTRUCTION DETAILS

CASING *(Length below grade) Borehole Diameter 7 1/2 in

X Diameter 2 in Length* 42.3 ft. Wall Thickness 1/8 in.

2 Diameter ______ in. Length* ______ ft Wall Thickness ______ in

Type: 1 Steel 2 Galv. X PVC 2 Other ______

Joints: X Threaded 2 Welded 1 Solvent 2 Other ______

Liner: Length — Type — Wall Thickness — in.

SCREEN machine slotted

Type (wire wrapped, louvered, etc.) ______ Material PVC

Length 4 ft. Diameter 2 in.

Set between ~~[illegible]~~ 37.4 ft. and ~~[illegible]~~ 41.4 ft. Slot 20

GROUT

Material Benseal Volume used ______

Method of installation Tremmie

Depth: placed from ~~[illegible]~~ 0.8 ft. to ~~[illegible]~~ 30.6 ft.

GRAVEL PACK (Filter Pack)

Material #4 Sand Volume used ______

Method of installation ______

Depth: placed from ~~[illegible]~~ 34.8 ft. to ~~[illegible]~~ 42.3 ft.

Pitless Device ☐ Adapter ☐ Preassembled unit

Use of Well Ground water Monitoring

☐ Rotary ☐ Cable X Augered ☐ Driven ☐ Dug ☐ Other ______

Date of Completion 11-23-99

WELL LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Show color, texture, hardness, and formation sandstone, shale, limestone, gravel, clay, sand, etc.

	From	To
Brown/Gray Silty Clay	0.0	22.0
Brown Gravel, Sand, Silt	22.0	26.0
Gray Silty Clay	26.0	31.0
Gray/Brown Gravel, Sand, Clay	31.0	38.0
Gray Sand	38.0	42.5
		End

X Water @ 31.0'

*(If additional space is needed to complete well log, use next consecutively numbered form.)

WELL TEST

☐ Bailing ☐ Pumping* ☐ Other ______

Test rate ______ gpm Duration of test ______ hrs.

Drawdown ______ ft

Measured from: X top of casing ☐ ground level ☐ Other

Static Level (depth to water) 17.19 ft Date: 01-05-00

Quality (clear, cloudy, taste, odor) ______

*(Attach a copy of the pumping test record. per section 1521.05, ORC)

PUMP

Type of pump — Capacity — gpm

Pump set at — ft.

Pump installed by —

WELL LOCATION

Location of well in State Plane coordinates, if available

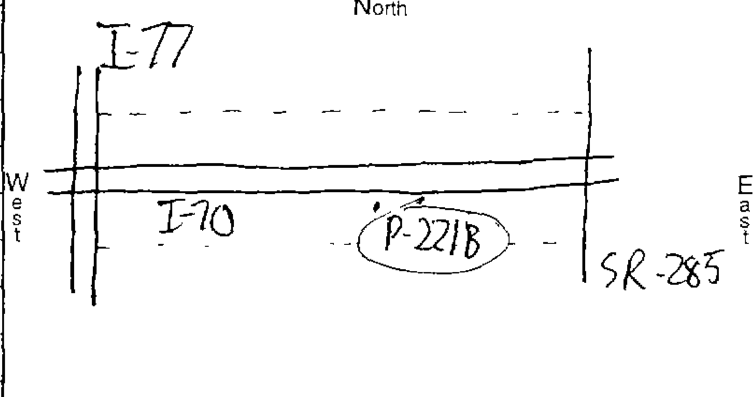
Zone ______ x ______ y ______

Elevation of well 826.76 ft./m. Datum plain: ☐ NAD27 X NAD83

Source of coordinates: ☐ GPS X Survey ☐ Other ______

Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks.

North



West East

South

I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm BBC+M Engineering Signed ______

Address 6190 Enterprise Ct. Date 04-26-02

City, State, Zip Dublin, OH 43016 ODH Registration Number 02504

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224

Blue - Customer's copy Pink - Driller's copy Green - Local Health Dept. copy

BBC&M ENGINEERING, INC.

LOG OF BORING NO. P-221C
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 4-1/4" I.D. Hollow-stem Auger

LOCATION: Sta. 484+99.0, 70.3' Rt.

COMPLETION DEPTH: 27.5' ELEVATION: 826.9 DATE: 11/23/99

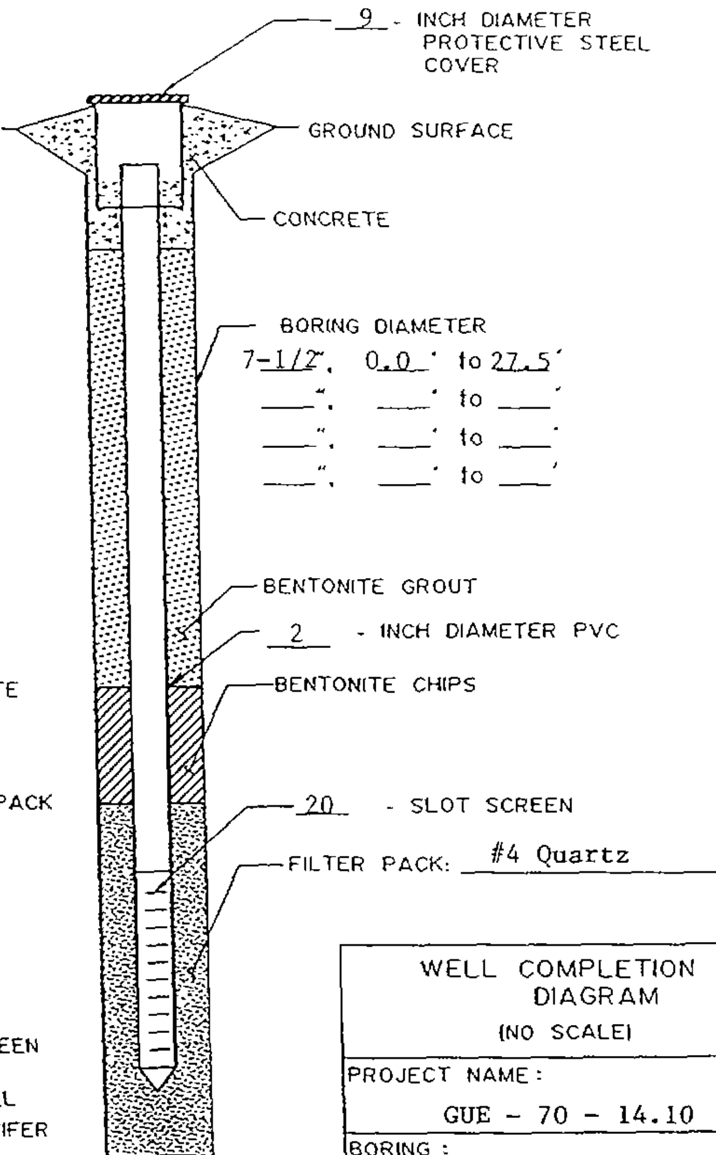
DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER	MOISTURE CONTENT	LIQUID LIMIT	PLASTIC LIMIT	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
				tsf	%	%	%						
0													- Boring drilling for installation of monitoring well P-222C, see well completion diagram. - No samples collected, see log of boring P-221A.
5													
10													
15													
20													
25													
30													
35													
40													

WATER LEVEL:
WATER NOTE:
DATE:

ODOTLJ 17000030.GPJ BBCM.GDT 10/27/00

JOB: 7000.030

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
826.91	-0.1	TOP OF COVER
826.8	0.0	GROUND SURFACE
826.38	0.4	TOP OF PVC
819.7	1.0	TOP OF GROUT
802.7	18.0	TOP OF BENTONITE
805.6	21.2	TOP OF FILTER PACK
804.8	22.0	TOP OF AQUIFER
804.3	22.5	TOP OF SCREEN OPENINGS
800.3	26.5	BOTTOM OF SCREEN OPENINGS
793.4	27.4	BOTTOM OF WELL
800.8	26.0	BOTTOM OF AQUIFER
799.3	27.5	BORING DEPTH



WELL COMPLETION DIAGRAM

(NO SCALE)

PROJECT NAME: GUE - 70 - 14.10

BORING: P-221C

DATE WELL INSTALLED: 11-23-99

BBC & M PROJECT NO: 7000.03

STATIC WATER LEVEL *	12.13			
DATE:	1-05-00			

WELL DEVELOPMENT: 8 gal. purged, clear water

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

DNR 7802.94
TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Divison of Water, 1939 Fountain Square Drive
Columbus, Ohio 43224 Phone (614) 265-6739

813947

Permit Number ______

COUNTY Guernsey TOWNSHIP Center SECTION/LOT No 18 (Circle One)

OWNER/BUILDER (Circle One or Both) ODOT First Last PROPERTY ADDRESS (Address of well location) Station 484+99.0 70.3' Rt Number Street City

LOCATION OF PROPERTY Mile Marker 184 on I-70 Zip Code + 4

CONSTRUCTION DETAILS

CASING *(Length below grade) Borehole Diameter ~~3.37~~ 7¼ in.

GROUT

X Diameter 2 in. Length* 27.5 ft. Wall Thickness 1/8 in Material Penseal Volume used ______

2 Diameter ______ in Length* ______ ft. Wall Thickness ______ in Method of installation Tremmie

Type: 1 Steel 2 / 1 Galv 2 / X PVC 2 / 1 2 Other ______ Depth: placed from 1.0 ft to 21.2 ft

GRAVEL PACK (Filter Pack)

Joints X Threaded 2 / 1 Welded 2 / 1 Solvent 2 / 1 2 Other ______ Material #4 Sand Volume used ______

Method of installation ______

Liner: Length — Type — Wall Thickness — in Depth placed from 21.2 ft to 27.5 ft

SCREEN Pitless Device ☐ Adapter ☐ Preassembled unit

Type (wire wrapped, louvered, etc.) machine slotted Material PVC Use of Well Ground water Monitoring

Length 4 ft Diameter 2 in ☐ Rotary ☐ Cable X Augered ☐ Driven ☐ Dug ☐ Other ______

Set between 22.5 ft. and 26.5 ft. Slot #20 Date of Completion 11-23-99

WELL LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc.

	From	To
Brown/Gray Silty Clay	0.0	22.0
Brown, Gravel, Sand, + Silt	22.0	26.0
Gray Silty Clay	26.0	27.5
		↑ End

X water@ 22.0'

WELL TEST

☐ Bailing ☐ Pumping* ☐ Other ______

Test rate ______ gpm Duration of test ______ hrs.

Drawdown ______ ft.

Measured from X top of casing ☐ ground level ☐ Other ______

Static Level (depth to water) 12.13 ft. Date 01-05-00

Quality (clear, cloudy, taste, odor) ______

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

PUMP

Type of pump — Capacity — gpm

Pump set at — ft.

Pump installed by —

WELL LOCATION

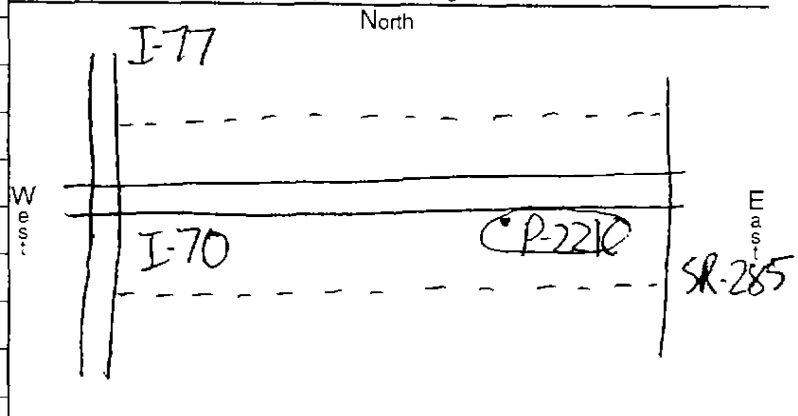
Location of well in State Plane coordinates, if available:

Zone ______ x ______ y ______

Elevation of well 826.38 ft./m Datum plain: ☐ NAD27 X NAD83

Source of coordinates: ☐ GPS X Survey ☐ Other ______

Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks.



*(If additional space is needed to complete well log, use next consecutively numbered form.)

Drilling Firm BBC+M Engineering

Address 6190 Enterprise Ct

City, State, Zip Dublin, OH, 43016

I hereby certify the information given is accurate and correct to the best of my knowledge

Signed ______

Date 04-25-02

ODH Registration Number 02504

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling

ORIGINAL COPY TO - ODNR. DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224

BBC&M ENGINEERING, INC.

LOG OF BORING NO. P-222A
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; NX Rock Core Barrel

LOCATION: Sta. 482+27.6, 128.8' Rt.

COMPLETION DEPTH: 70.8' ELEVATION: 820.6 DATE: 11/2/99 - 11/3/99

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0												TOPSOIL - 1 INCH
												FILL: Very-stiff to hard brown mottled with gray silty clay, little fine to coarse sand, trace fine gravel, few roots.
	1	6/8/11	3.0-4.5+									
5	2	5/8/10	2 5-4 5+									
	3	5/7/9					34	16	22	18	10	Medium-dense to dense brown and gray fine to coarse sand, some fine to coarse gravel, some clayey silt.
10												
												Hard brown mottled with gray and red-brown silty clay, some fine to coarse sand, trace fine to coarse gravel.
	4	18/18/14										
15												
	5	12/17/20	4 5+									
20												
												Stiff gray silty clay, trace fine sand.
	6	2/3/5	1.5-2.0									
25												
												Dense gray-blue fine to coarse sand, little fine to coarse gravel, some clayey silt, few lenses of silty clay.
	7	9/20/20										
30												
	8	10/20/21										
35												Very-soft to soft gray shale
	9	50-1"R										
40												

WATER LEVEL:
WATER NOTE:
DATE:

ODOTLJ 17000030.GPJ BBCM.GDT 10/27/00

JOB: 7000.030

CONTINUED

BBC&M ENGINEERING, INC.

LOG OF BORING NO. P-222A
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE. 3-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; NX Rock Core Barrel

LOCATION: Sta. 482+27.6, 128.8' Rt.

COMPLETION DEPTH: 70.8' ELEVATION: 820.6 DATE: 11/2/99 - 11/3/99

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	DESCRIPTION - CONTINUED
40			
45	10	NX REC 96% RQD 67%	Soft to medium-hard gray shale, interbedded with fine-grained sandstone, few horizontal fractures.
50–55	11	NX REC 100% RQD 99%	Medium-hard gray argillaceous sandstone, interbedded with dark-gray, arenaceous shale, occasional horizontal fracture.
60–65	12	NX REC 100% RQD 47%	Medium-hard black coal, many horizontal and vertical fractures.
			Very-soft gray shale (underclay).
70	13	NX REC 96% RQD 76%	Medium-hard gray fine-grained sandstone.
75–80			

Column headings also printed (no data): HAND PENETROMETER (tsf), MOISTURE CONTENT (%), LIQUID LIMIT (%), PLASTIC LIMIT (%), AGG., C.S., F.S., SILT, CLAY.

- Encountered seepage 8.0' to 12.0'.

- Encountered water 28.0' to 35.5'.

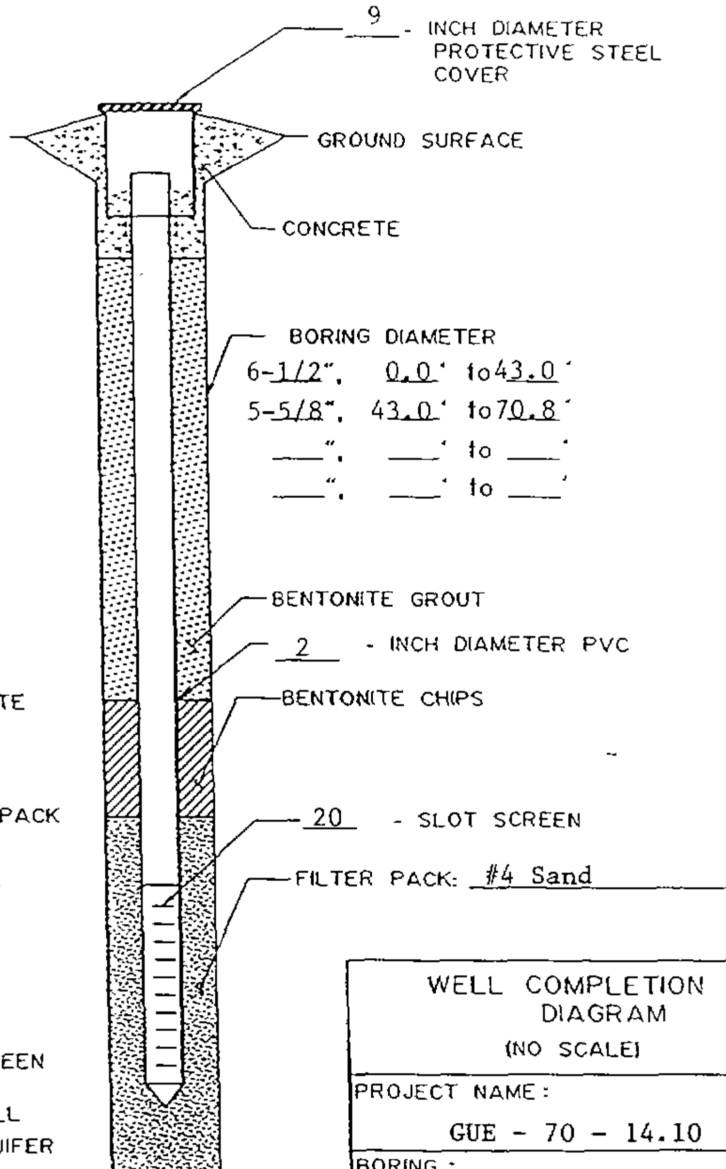
- Boring converted to groundwater monitoring well, see completion diagram.

WATER LEVEL:
WATER NOTE:
DATE:

ODOTLJ 17000030.GPJ BBCM.GDT 10/27/00

JOB: 7000.030

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
820.82	-0.2	TOP OF COVER
820.6	0.0	GROUND SURFACE
820.56		TOP OF PVC
819.7	1.0	TOP OF GROUT
766.4	54.3	TOP OF BENTONITE
761.7	58.9	TOP OF FILTER PACK
760.0	60.6	TOP OF AQUIFER
757.2	63.4	TOP OF SCREEN OPENINGS
753.3	67.3	BOTTOM OF SCREEN OPENINGS
752.4	68.2	BOTTOM OF WELL
753.3	67.3	BOTTOM OF AQUIFER
749.8	70.8	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: GUE - 70 - 14.10

BORING: P-222A

DATE WELL INSTALLED: 12-03-99

BBC & M PROJECT NO: 7000.03

STATIC WATER LEVEL *	11.05			
DATE:	1/05/00			

WELL DEVELOPMENT: 29 gal. purged, nearly clear water

* FEET ABOVE MSL

BBC&M ENGINEERING. INC.

DNR 7802.94
TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Divison of Water, 1939 Fountain Square Drive
Columbus, Ohio 43224 Phone (614) 265-6739

813946

Permit Number

COUNTY Guernsey TOWNSHIP Center SECTION/LOT No. 18 (Circle One)

OWNER/BUILDER (Circle One or Both) ODOT (First / Last) PROPERTY ADDRESS (Address of well location) Station 482+27.6 128.8' RT (Number / Street / City)

LOCATION OF PROPERTY Mile Marker 184 on I-70 Zip Code + 4

CONSTRUCTION DETAILS

CASING *(Length below grade) Borehole Diameter 5 7/8 in

X Diameter 2 in Length* 68.2 ft. Wall Thickness 1/8 in

2 Diameter ___ in. Length* ___ ft Wall Thickness ___ in.

Type: Steel / Galv. / X PVC / Other

Joints: X Threaded / Welded / Solvent / Other

Liner Length — Type — Wall Thickness — in.

SCREEN

Type (wire wrapped, louvered, etc.) machine slotted Material PVC

Length 3.9 ft. Diameter 2 in.

Set between 63.4 ft. and 67.3 ft Slot #20

GROUT

Material Benseal Volume used

Method of installation Tremmie

Depth: placed from 1.0 ft. to 58.9 ft.

GRAVEL PACK (Filter Pack)

Material #4 Sand Volume used

Method of installation

Depth placed from 58.9 ft. to 70.8 ft.

Pitless Device ☐ Adapter ☐ Preassembled unit

Use of Well Ground water Monitoring

X Rotary ☐ Cable ☐ Augered ☐ Driven ☐ Dug ☐ Other

Date of Completion 12-03-99

WELL LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc

	From	To
Brown/Gray Silty Clay	0.0	8.0
Brown/Gray Sand, Gravel, Clay	8.0	12.0
Brown/Gray Silty Clay	12.0	28.5
Gray Sand, Gravel, Silt, Clay	28.5	36.0
Gray Shale	36.0	48.0
Gray Sandstone	48.0	61.0
Coal	61.0	67.5
Under Clay	67.5	69.5
~~Blue~~ Gray Sandstone	69.5	70.8
		End

*Water 8.0-12.0

*water 28.0-35.5

WELL TEST

☐ Bailing ☐ Pumping* ☐ Other

Test rate ___ gpm Duration of test ___ hrs.

Drawdown ___ ft.

Measured from: X top of casing ☐ ground level ☐ Other

Static Level (depth to water) 11.07 ft. Date 01-05-00

Quality (clear, cloudy, taste, odor)

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

PUMP

Type of pump — Capacity — gpm

Pump set at — ft

Pump installed by —

WELL LOCATION

Location of well in State Plane coordinates, if available:

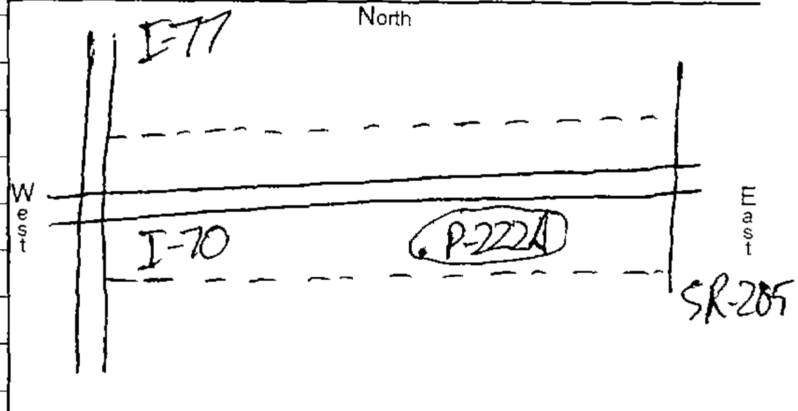
Zone ___ x ___ y ___

Elevation of well 820.56 ft./m. Datum plain: ☐ NAD27 X NAD83

Source of coordinates ☐ GPS X Survey ☐ Other

Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks

North



West East

South

*(If additional space is needed to complete well log, use next consecutively numbered form.)

I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm BBC&M Engineering

Address 6190 Enterprise Ct.

City, State, Zip Dublin, OH, 43016

Signed

Date 04-26-02

ODH Registration Number 02504

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224

Blue - Customer's copy Pink - Driller's copy Green - ...

BBC&M ENGINEERING, INC.

LOG OF BORING NO. P-222B
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 4-1/4" I.D. Hollow-stem Auger

LOCATION: Sta. 482+22.6, 129.0' Rt.

COMPLETION DEPTH: 38.9' ELEVATION: 820.7 DATE: 11/29/99

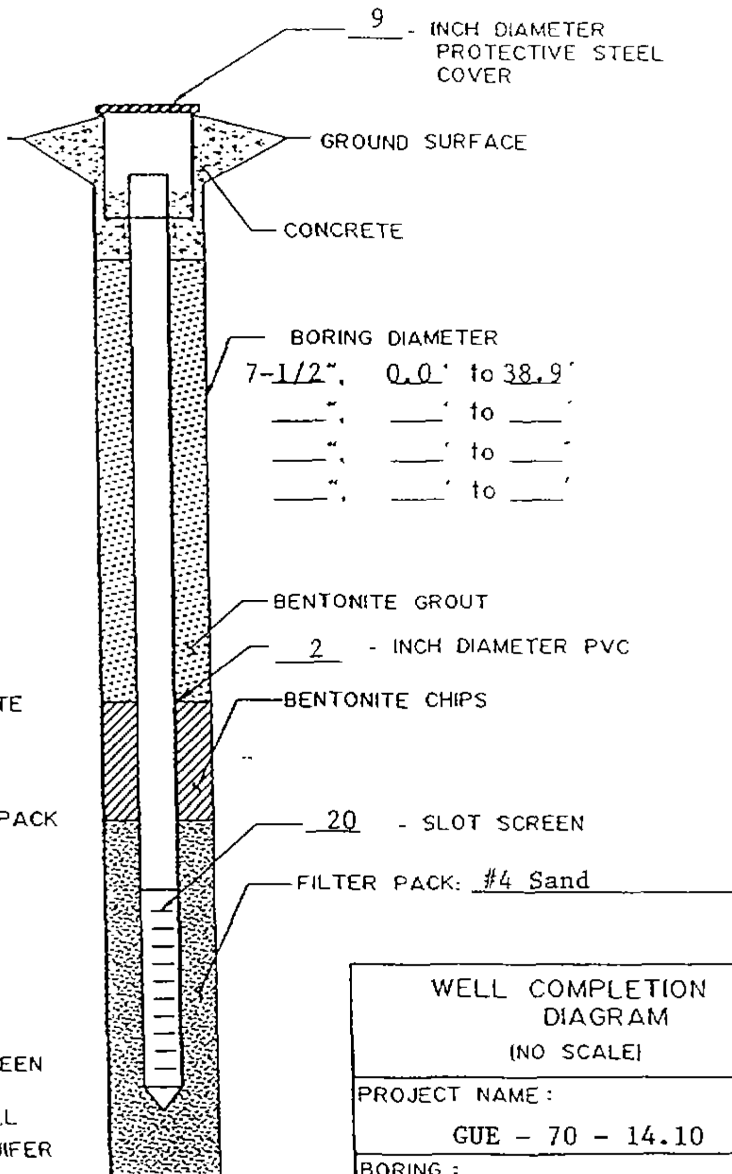
DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER	MOISTURE CONTENT	LIQUID LIMIT	PLASTIC LIMIT	AGG.	C S.	F.S.	SILT	CLAY	DESCRIPTION
				tsf	%	%	%						
0													- Boring drilling for installation of monitoring well P-222B, see well completion diagram. - No samples collected, see log of boring P-222A.
5													
10													
15													
20													
25													
30													
35													
40													

WATER LEVEL:
WATER NOTE:
DATE:

ODOTL1 17000030.GPJ BBCM.GDT 10/27/00

JOB: 7000.030

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
820.91	-0.2	TOP OF COVER
820.7	0.0	GROUND SURFACE
820.52	0.2	TOP OF PVC
819.8	1.0	TOP OF GROUT
794.1	26.7	TOP OF BENTONITE
791.5		
	29.2	TOP OF FILTER PACK
792.7	28.0	TOP OF AQUIFER
790.9	29.8	TOP OF SCREEN OPENINGS
787.0	33.7	BOTTOM OF SCREEN OPENINGS
786.2	34.6	BOTTOM OF WELL
785.2	35.5	BOTTOM OF AQUIFER
781.8	38.9	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: GUE - 70 - 14.10

BORING: P-222B

DATE WELL INSTALLED: 11-29-99

BBC & M PROJECT NO: 7000.03

STATIC WATER LEVEL *	11.16			
DATE:	1-05-00			

WELL DEVELOPMENT: 12.5 gal. purged, slightly silty water

Hole plug from 35.1' to 38.9'

* FEET ABOVE MSL

BBC&M ENGINEERING. INC.

DNR 7802.94
TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Divison of Water, 1939 Fountain Square Drive
Columbus, Ohio 43224 Phone (614) 265-6739

813945

Permit Number

COUNTY Guernsey TOWNSHIP Center SECTION/LOT No (Circle One) 18

OWNER/BUILDER (Circle One or Both) ODOT First Last PROPERTY ADDRESS (Address of well location) Station 482+22.6 129' Rt Number Street City

LOCATION OF PROPERTY Mile Marker 184 on I-70 Zip Code – 4

CONSTRUCTION DETAILS

CASING *(Length below grade) Borehole Diameter 7½ in.
X Diameter 2 in. Length* 34.6 ft. Wall Thickness 1/8 in.
2 Diameter ___ in. Length* ___ ft. Wall Thickness ___ in.
Type: 1 2 Steel 1 2 Galv. X 2 PVC 1 2 Other
Joints: X 2 Threaded 1 2 Welded 1 2 Solvent 1 2 Other
Liner: Length — Type — Wall Thickness — in

GROUT Material Benseal Volume used
Method of installation Tremmie
Depth: placed from 1.0 ft. to 29.2 ft

GRAVEL PACK (Filter Pack) Material #4 Sand Volume used
Method of installation
Depth: placed from 29.2 ft. to 38.9 ft.

SCREEN
Type (wire wrapped, louvered, etc.) Machine Slotted Material PVC
Length 3.9 ft. Diameter 2 in
Set between 29.8 ft and 33.7 ft Slot #20

Pitless Device ☐ Adapter ☐ Preassembled unit
Use of Well Ground Water Monitoring
☐ Rotary ☐ Cable X Augered ☐ Driven ☐ Dug ☐ Other
Date of Completion 11-29-99

WELL LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.
Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc

	From	To
Brown/Gray Silty Clay	0.0	8.0
Brown/Gray Sand, Gravel, Clay	8.0	12.0
Brown/Gray Silty Clay	12.0	28.5
Gray Sand, Gravel, Silt, Clay	28.5	34.6
		End

* Water 28.0-34.6

*(If additional space is needed to complete well log, use next consecutively numbered form.)

WELL TEST

☐ Bailing ☐ Pumping* ☐ Other
Test rate ___ gpm Duration of test ___ hrs.
Drawdown ___ ft.
Measured from: X top of casing ☐ ground level ☐ Other
Static Level (depth to water) 11.16 ft Date: 06-05-00
Quality (clear, cloudy, taste, odor)

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

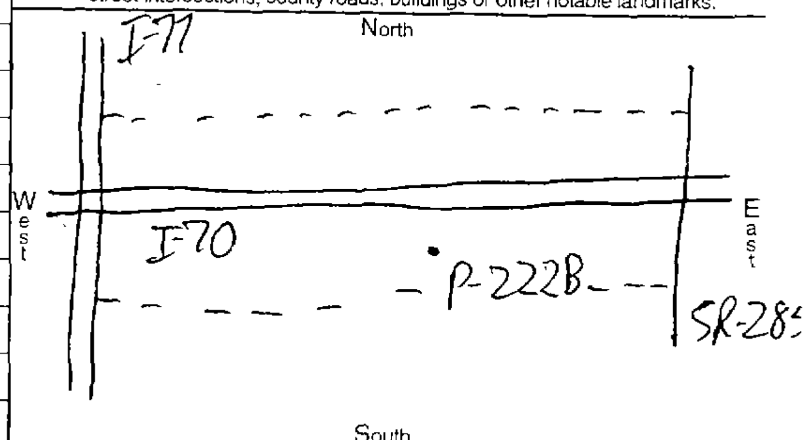
PUMP

Type of pump — Capacity — gpm
Pump set at — ft
Pump installed by —

WELL LOCATION

Location of well in State Plane coordinates, if available:
Zone ___ x ___ y ___
Elevation of well 820.52 ft./m. Datum plain: ☐ NAD27 ☐ NAD83
Source of coordinates: ☐ GPS X Survey ☐ Other

Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks.



Drilling Firm BBC&M Engineering
Address 6190 Enterprise Ct.
City, State, Zip Dublin, OH 43016

I hereby certify the information given is accurate and correct to the best of my knowledge
Signed
Date 04-26-02
ODH Registration Number 02504

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.
ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224

LOG OF BORING NO. P-222C
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

BBC&M ENGINEERING, INC.

TYPE: **4-1/4" I.D. Hollow-stem Auger**

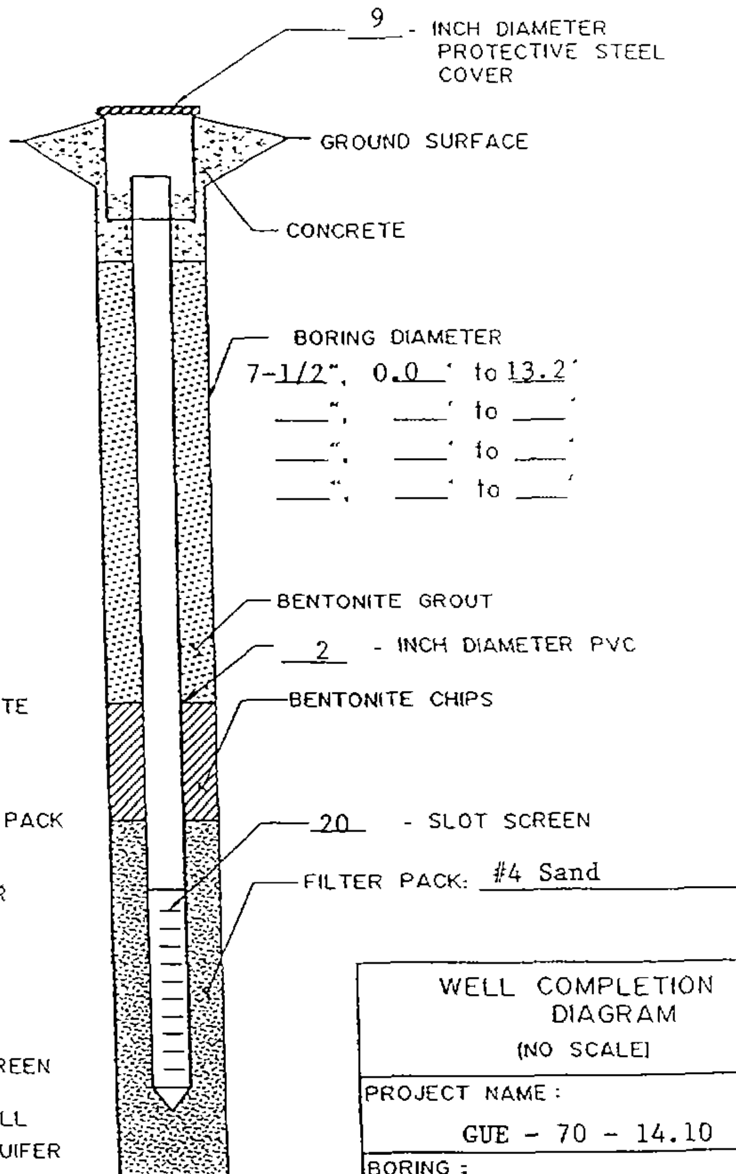
LOCATION: **Sta. 482+25.9, 129.3' Rt.**

COMPLETION DEPTH: 13.0' **ELEVATION:** 820.7 **DATE:** 11/29/99 - 11/30/99

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S	SILT	CLAY	DESCRIPTION
0													- Boring drilling for installation of monitoring well P-222C, see well completion diagram. - No samples collected, see log of boring P-222A.
5													
10													
15													
20													
25													
30													
35													
40													

WATER LEVEL:
WATER NOTE:
DATE:

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
820.81	-0.1	TOP OF COVER
820.7	0.0	GROUND SURFACE
820.53	0.2	TOP OF PVC
819.8	1.0	TOP OF GROUT
815.1	5.7	TOP OF BENTONITE
812.6	8.0	TOP OF FILTER PACK
809.7	11.0	TOP OF AQUIFER
812.2	8.5	TOP OF SCREEN OPENINGS
808.3	12.4	BOTTOM OF SCREEN OPENINGS
807.5	13.2	BOTTOM OF WELL
808.7	12.0	BOTTOM OF AQUIFER
807.5	13.2	BORING DEPTH



WELL COMPLETION DIAGRAM (NO SCALE)	
PROJECT NAME:	GUE - 70 - 14.10
BORING:	P-222C
DATE WELL INSTALLED	11-30-99
BBC & M PROJECT NO	7000.03

STATIC WATER LEVEL *	2.87			
DATE:	1-05-00			

WELL DEVELOPMENT: 5.5 gal. purged, very silty water

* FEET ABOVE MSL

DNR 7802 94

TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Divison of Water, 1939 Fountain Square Drive
Columbus, Ohio 43224 Phone (614) 265-6739

813944

Permit Number ______

COUNTY Guernsey TOWNSHIP Center SECTION/LOT No (Circle One) 18

OWNER/BUILDER (Circle One or Both) ODOT (First / Last) PROPERTY ADDRESS (Address of well location) 482+25.9, 129.3' Rt (Number / Street / City)

LOCATION OF PROPERTY Mile Marker 184 on I-70 Zip Code + 4 ______

CONSTRUCTION DETAILS

CASING *(Length below grade) Borehole Diameter 7 1/2 in.

[X] 1 Diameter 2 in. Length* 13.2 ft Wall Thickness 1/8 in.

2 Diameter ______ in. Length* ______ ft Wall Thickness ______ in.

Type: 1/2 Steel 1/2 Galv [X] PVC 1/2 Other ______

Joints: [X] Threaded 1/2 Welded 1/2 Solvent 1/2 Other ______

Liner: Length — Type — Wall Thickness — in.

SCREEN Type (wire wrapped, louvered, etc.) machine Slotted Material PVC

Length 3.9 ft. Diameter 2 in.

Set between 8.5 ft. and 12.4 ft. Slot #20

GROUT Material Benseal Volume used ______

Method of installation tremmie

Depth placed from 1.0 ft to 8.0 ft

GRAVEL PACK (Filter Pack) Material #4 Sand Volume used ______

Method of installation ______

Depth: placed from 8.0 ft to 13.2 ft.

Pitless Device ☐ Adapter ☐ Preassembled unit

Use of Well Ground Water Monitoring

☐ Rotary ☐ Cable [X] Augered ☐ Driven ☐ Dug ☐ Other ______

Date of Completion ______

WELL LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED

Show color, texture, hardness, and formation sandstone, shale, limestone, gravel, clay, sand, etc.	From	To
Brown/Gray Silty Clay	0.0	8.0
Brown/Gray Sand, Gravel, Clay	8.0	12.0
Brown/Gray Silty Clay	12.0	13.2
		End

* water @ 8.0'

WELL TEST

☐ Bailing ☐ Pumping* ☐ Other ______

Test rate ______ gpm Duration of test ______ hrs.

Drawdown ______ ft.

Measured from: [X] top of casing ☐ ground level ☐ Other ______

Static Level (depth to water) ~~2.85~~ 2.87 ft. Date: 01-05-00

Quality (clear, cloudy, taste, odor) ______

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

PUMP

Type of pump — Capacity — gpm

Pump set at ______ ft.

Pump installed by —

WELL LOCATION

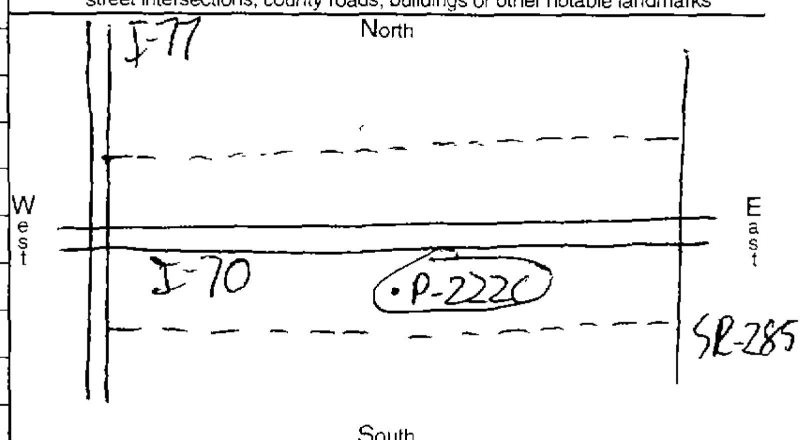
Location of well in State Plane coordinates, if available.

Zone ______ x ______ y ______

Elevation of well 820.53 ft./m. Datum plain: ☐ NAD27 [X] NAD83

Source of coordinates: ☐ GPS [X] Survey ☐ Other ______

Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks



*(If additional space is needed to complete well log, use next consecutively numbered form.)

I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm BBC&M Engineering Signed ______

Address 6190 Enterprise Ct. Date 04-26-02

City, State, Zip Dublin, OH 43016 ODH Registration Number 02504

Completion of this form is required by section 1521 05, Ohio Revised Code - file within 30 days after completion of drilling

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224

BBC&M ENGINEERING, INC.

LOG OF BORING NO. P-223A
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger, 2" O.D. Split-barrel Sampler and NQ Rock-core Barrel

LOCATION: Sta. 483+97.4, 67.7' Lt.

COMPLETION DEPTH: 74.5' ELEVATION: 826.5 DATE: 9/21/99 - 9/24/99

DEPTH, FEET	SAMPLE NO.	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0												FILL: Fine to coarse gravel, trace fine sand.
												FILL: fine to coarse sand, little to some fine to coarse gravel.
												FILL: Very-stiff brown silty clay, trace fine to coarse sand, desiccated.
	1A	1/3/3	H=3 2-3 5									
	1B		H=0.5-1.75									Medium-stiff to stiff brown mottled with gray silty clay, trace fine to coarse sand, trace fine gravel, desiccated, few seams of sand.
5	2	1/2/2	H=0.5-1.2									
10	3	S/H/1/2	H=0.3-1.5									
												Stiff to very-stiff brown silty clay, trace fine sand, few silt seams.
	4	1/2/4	H=1 3-2 5									
15												
20	5	S/H/2/3	H=1.5-2.0									
												Loose dark-gray and red-brown fine to coarse sand, little silty clay, little fine to coarse gravel.
25	6	3/4/5										
												Hard gray mottled with brown silty clay, similar to shale.
30	7	4/8/11	H=4.5+									
												Very-soft to soft gray shale.
35	8	33/43/50-5"R										
	9	50-1"R										
40												

WATER LEVEL:	14.0					
WATER NOTE:	Before Coring					
DATE:	9/21/99					

BBC&M ENGINEERING, INC.

LOG OF BORING NO. P-223A
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler and NQ Rock-core Barrel

LOCATION: Sta. 483+97.4, 67.7' Lt.

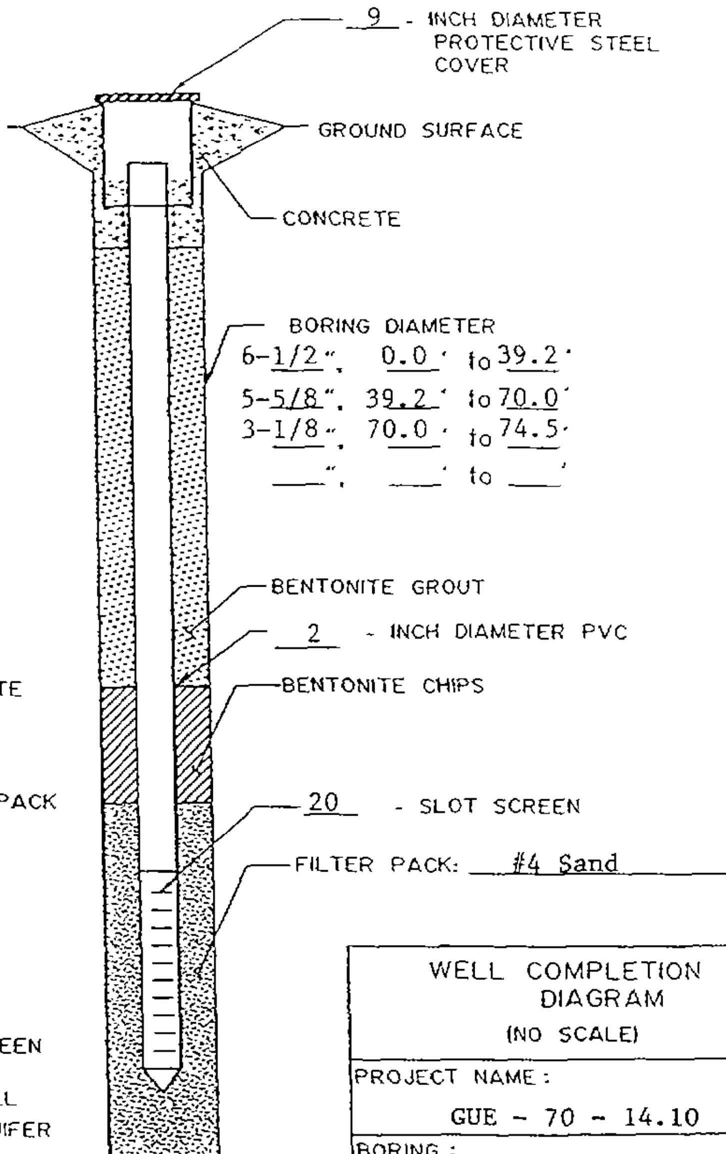
COMPLETION DEPTH: 74.5' ELEVATION: 826.5 DATE: 9/21/99 - 9/24/99

DEPTH, FEET	SAMPLE NO.	SAMPLING EFFORT	DESCRIPTION - CONTINUED
40	10	NXM REC 85.7% RQD 0%	Soft gray shale with many thin medium-hard sandstone seams, nearly horizontally bedded, many horizontal fractures.
45			- 45.0' to 45.3' void.
50	11	NXM REC 54.5% RQD 13.3%	
55			- 57.0' to 57.5' coal. - Below 57.5' highly fractured.
60			
65			
			Coal.
70	12	NXM REC 55.5% RQD 0%	Medium-hard gray sandstone, nearly horizontally bedded.
			Coal.
			Very-soft gray shale (underclay).
75			- Encountered seepage 23.0' to 31.0'. - Encountered water 31.0'. - Boring converted to groundwater monitoring well, see completion diagram.
80			

Column headings also printed: HAND PENE-TROMETER (tsf), MOISTURE CONTENT (%), LIQUID LIMIT (%), PLASTIC LIMIT (%), AGG., C.S., F.S, SILT, CLAY.

WATER LEVEL: 14.0
WATER NOTE: Before Coring
DATE: 9/21/99

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
826.81	-0.3	TOP OF COVER
826.5	0.0	GROUND SURFACE
826.43	0.1	TOP OF PVC
825.6	1.0	TOP OF GROUT
762.2	64.4	TOP OF BENTONITE
759.9	66.6	TOP OF FILTER PACK
758.5	68.0	TOP OF AQUIFER
757.9	68.6	TOP OF SCREEN OPENINGS
753.1	73.4	BOTTOM OF SCREEN OPENINGS
752.8	73.7	BOTTOM OF WELL
755.1	71.4	BOTTOM OF AQUIFER
752.0	74.5	BORING DEPTH



WELL COMPLETION DIAGRAM (NO SCALE)
PROJECT NAME: GUE - 70 - 14.10
BORING: P-223A
DATE WELL INSTALLED 9-27-99
BBC & M PROJECT NO 7000.03

STATIC WATER LEVEL *	18.21			
DATE:	1-05-00			

WELL DEVELOPMENT: 28.5 gal. purged, clear water

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

DNR 7802.94
TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Divison of Water, 1939 Fountain Square Drive
Columbus, Ohio 43224 Phone (614) 265-6739

813943

Permit Number

COUNTY Guernsey TOWNSHIP Center SECTION/LOT No. (Circle One) 18

OWNER/BUILDER (Circle One or Both) ODOT First Last PROPERTY ADDRESS (Address of well location) Station 483+97, 67.7 Lt. Number Street City

LOCATION OF PROPERTY Mile Marker 184 on I-70 Zip Code + 4

CONSTRUCTION DETAILS

CASING *(Length below grade) Borehole Diameter 3 1/8 in.
[X] 1 Diameter 2 in Length* 73.7 ft. Wall Thickness 1/8 in
2 Diameter ___ in Length* ___ ft. Wall Thickness ___ in.
Type: 1 Steel 2 ; 1 Galv. 2 ; [X] 1 PVC 2 ; 1 2 Other ___
Joints: [X] 1 Threaded 2 ; 1 Welded 2 ; 1 Solvent 2 ; 1 2 Other ___
Liner: Length — Type — Wall Thickness — in

SCREEN
Type (wire wrapped, louvered, etc.) machine Slotted Material PVC
Length 4.8 ft Diameter ___ in.
Set between 68.6 ft. and 73.4 ft. Slot #20

GROUT
Material Benseal Volume used ___
Method of installation Tremmie
Depth placed from 1.0 ft. to 66.6 ft.

GRAVEL PACK (Filter Pack)
Material #4 Sand Volume used ___
Method of installation ___
Depth. placed from 66.6 ft to 74.3 ft.

Pitless Device ☐ Adapter ☐ Preassembled unit
Use of Well Groundwater Monitoring
[X] Rotary ☐ Cable ☐ Augered ☐ Driven ☐ Dug ☐ Other ___
Date of Completion 09-27-99

WELL LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.
Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc.

	From	To
Sand & Gravel	0.0	2.5
Brown Silty Clay	2.5	23.5
Brown Sand, Clay, Gravel	23.5	26.5
Brown Silty Clay	26.5	31.0
Gray Shale	31.0	45.0
Void	45.0	45.3
Gray Shale (Fractured)	45.3	68.0
Coal	68.0	72.0
under clay	72.0	74.5
		End

* Water 23.0-31.0

*(If additional space is needed to complete well log, use next consecutively numbered form.)

WELL TEST

☐ Bailing ☐ Pumping* ☐ Other ___
Test rate ___ gpm Duration of test ___ hrs
Drawdown ___ ft.
Measured from: [X] top of casing ☐ ground level ☐ Other ___
Static Level (depth to water) 18.21 ft. Date: 01-05-00
Quality (clear, cloudy, taste, odor) ___

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

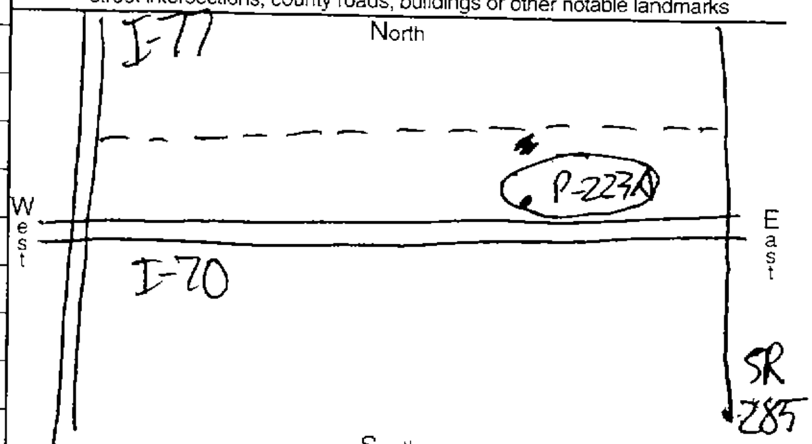
PUMP

Type of pump — Capacity — gpm
Pump set at — ft.
Pump installed by —

WELL LOCATION

Location of well in State Plane coordinates, if available:
Zone ___ y ___
Elevation of well 826.43 ft /m Datum plain ☐ NAD27 [X] NAD83
Source of coordinates: ☐ GPS [X] Survey ☐ Other ___

Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks



I hereby certify the information given is accurate and correct to the best of my knowledge

Drilling Firm BBC&M Engineering
Address 6190 Enterprise Ct.
City, State, Zip Dublin, OH 43016

Signed ___
Date 04-26-02
ODH Registration Number 02504

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224

BBC&M ENGINEERING, INC.

LOG OF BORING NO. P-223B
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger

LOCATION: Sta. 483+97.8, 70.1' Lt.

COMPLETION DEPTH: 27.5' ELEVATION: 826.3 DATE: 9/27/99 - 9/28/99

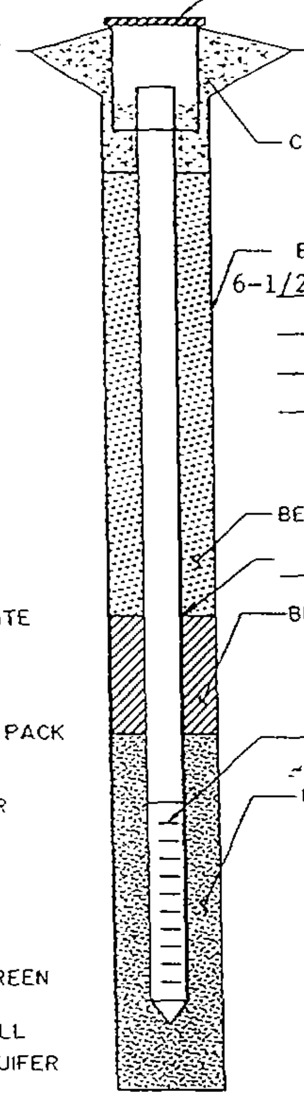
DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0													- Boring drilled for installation of monitoring well P-223B, see completion diagram. - No samples collected, see log of boring P-223A.

WATER LEVEL: 15.1
WATER NOTE:
DATE: 9/30/99

ODOTLJ 17000030.GPJ BBCM.GDT 10/27/00

JOB: 7000.030

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
826.52	-0.2	TOP OF COVER
826.3	0.0	GROUND SURFACE
826.19	0.1	TOP OF PVC
821.3	5.1	TOP OF GROUT
808.3	18.1	TOP OF BENTONITE
806.2	20.1	TOP OF FILTER PACK
803.3	23.0	TOP OF AQUIFER
804.5	21.8	TOP OF SCREEN OPENINGS
799.7	26.6	BOTTOM OF SCREEN OPENINGS
799.3	27.1	BOTTOM OF WELL
800.3	26.0	BOTTOM OF AQUIFER
798.8	27.5	BORING DEPTH



WELL COMPLETION DIAGRAM

(NO SCALE)

PROJECT NAME: GUE - 70 - 14.10

BORING: P-223B

DATE WELL INSTALLED: 9-28-99

BBC & M PROJECT NO: 7000.03

STATIC WATER LEVEL *	11.49			
DATE:	1-05-00			

WELL DEVELOPMENT: 8.5 gal. purged, slightly silty water

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

DNR 7802 94

TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Divison of Water, 1939 Fountain Square Drive
Columbus, Ohio 43224 Phone (614) 265-6739

813942

Permit Number

COUNTY Guernsey TOWNSHIP Center SECTION/LOT No. 18 (Circle One)

OWNER/BUILDER (Circle One or Both) ODOT (First / Last) PROPERTY ADDRESS (Address of well location) Station 483+97.8, 70 Lt. (Number / Street / City)

LOCATION OF PROPERTY Mile Marker 184 on I-70 Zip Code + 4

CONSTRUCTION DETAILS

CASING *(Length below grade) Borehole Diameter 6 1/2 in.

X Diameter 2 in. Length* 27.1 ft Wall Thickness 1/6 in.

2 Diameter ___ in. Length* ___ ft. Wall Thickness ___ in.

Type: 1/2 Steel 1/2 Galv. X PVC 1/2 Other

Joints: X Threaded 1/2 Welded 1/2 Solvent 1/2 Other

Liner: Length — Type — Wall Thickness — in.

SCREEN

Type (wire wrapped, louvered, etc.) Machine Slotted Material PVC

Length 4.8 ft Diameter 2 in.

Set between 21.8 ft and 26.6 ft. Slot #20

GROUT Material Benseal Volume used

Method of installation tremmie

Depth: placed from 5.1 ft. to 20.1 ft.

GRAVEL PACK (Filter Pack) Material #4 Sand Volume used

Method of installation

Depth: placed from 20.1 ft. to 27.5 ft.

Pitless Device ☐ Adapter ☐ Preassembled unit

Use of Well Ground water monitoring

☐ Rotary ☐ Cable X Augered ☐ Driven ☐ Dug ☐ Other

Date of Completion 09-28-99

WELL LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Show color, texture, hardness, and formation. sandstone, shale, limestone, gravel, clay, sand, etc.

	From	To
Sand & Gravel	0.0	2.5
Brown Silty Clay	2.5	23.5
Brown Sand, Clay, Gravel	23.5	26.5
Brown Silty Clay	26.5	27.5
		↑ End

X water @ 23.5'

WELL TEST

☐ Bailing ☐ Pumping* ☐ Other

Test rate ___ gpm Duration of test ___ hrs.

Drawdown ___ ft.

Measured from: X top of casing ☐ ground level ☐ Other

Static Level (depth to water) 11.49 ft Date: 01-05-00

Quality (clear, cloudy, taste, odor)

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

PUMP

Type of pump — Capacity — gpm

Pump set at — ft.

Pump installed by —

WELL LOCATION

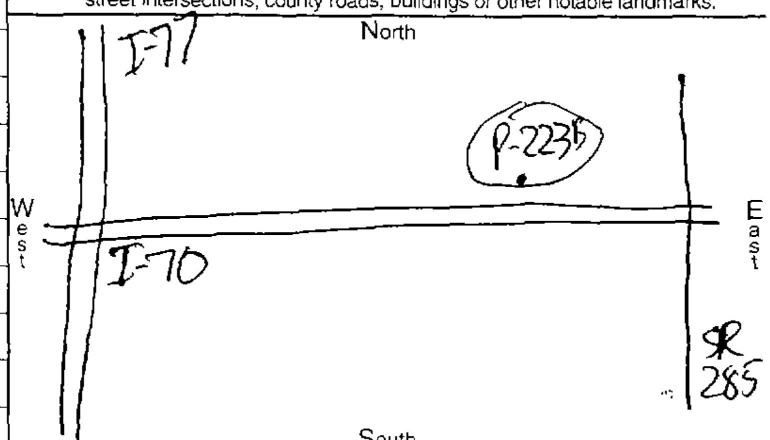
Location of well in State Plane coordinates, if available:

Zone ___ x ___ y ___

Elevation of well 826.19 ft./m Datum plain ☐ NAD27 X NAD83

Source of coordinates: ☐ GPS X Survey ☐ Other

Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks.



*(If additional space is needed to complete well log, use next consecutively numbered form.)

I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm BBC&M Engineering Signed

Address 6190 Enterprise Ct. Date 04-26-02

City, State, Zip Dublin, OH 43016 ODH Registration Number 02504

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224

BBC&M ENGINEERING, INC.

LOG OF BORING NO. P-224A
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; NQ Rock Core Barrel

LOCATION: Sta. 483+44.7, 238.1' Rt.

COMPLETION DEPTH: 67.7' ELEVATION: 821.7 DATE: 12/23/99 - 1/4/00

DEPTH, FEET	SAMPLE NO.	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0												TOPSOIL - 8 INCHES
												Stiff to very-stiff with occasional pockets of medium-stiff brown mottled with gray silty clay, little fine to medium sand.
	1	3/5/7	0.7-3 2									
5	2	P/7/9	1.5-2.2									Stiff to very-stiff gray mottled with brown silty clay, trace fine to medium sand.
	3	W/H/2/3	0.2-0.9									Soft to medium-stiff brown becoming gray silty clay, little fine to coarse sand, occasional pockets of very-soft material.
10												Medium-dense to dense brown fine to coarse sand, little fine to coarse gravel, little clayey silt.
	4	12/13/16										
15												
	5	14/17/17										
20												- Below 22.0' becoming very-dense gray.
	6	22/50-4"R										
25												
	7A 7B	4/6/7	1 9-3.6									Stiff to very-stiff gray silty clay, trace fine sand.
30												
	8	50-3"R	4.0+									Soft to medium hard gray shale interbedded with fine-grained sandstone, few horizontal fractures, occasional vertical fracture.
35		NQ REC 91% RQD 71%										
	9											
40												

WATER LEVEL: 12.0

WATER NOTE: Before Coring

DATE: 12/23/99

BBC&M ENGINEERING, INC.

LOG OF BORING NO. P-224A
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; NQ Rock Core Barrel

LOCATION: Sta. 483+44.7, 238.1' Rt.

COMPLETION DEPTH: 67.7' ELEVATION: 821.7 DATE: 12/23/99 - 1/4/00

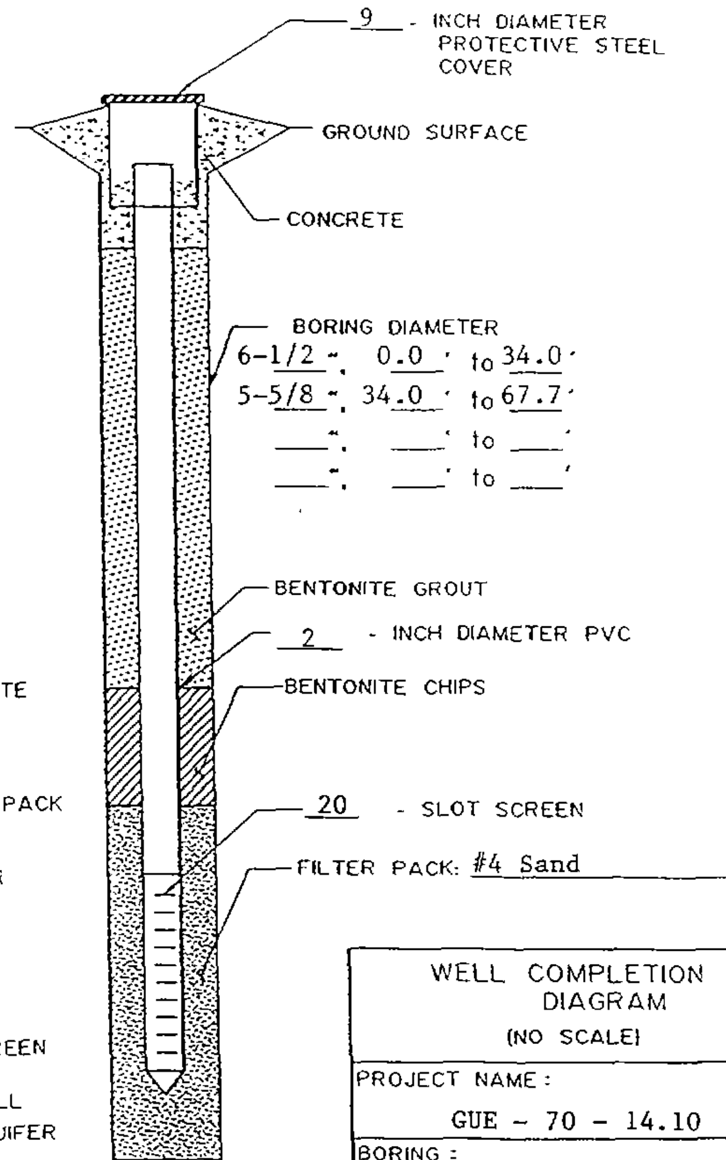
DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
40												
45	10	NQ REC 99% RQD 87%										
50												
55	11	NQ REC 83% RQD 70%										- Below 54.0' becoming dark-gray.
60												Medium-hard black coal.
65												Very-soft gray shale (underclay).
70												- Encountered water 10.0' to 28.7'. - Boring converted to groundwater monitoring well, see completion diagram.
75												
80												

WATER LEVEL:	12.0					
WATER NOTE:	Before Coring					
DATE:	12/23/99					

JOB: 7000.030

ODOTLJ 17000030.GPJ BBCM.GDT 10/27/00

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
821.85	-0.2	TOP OF COVER
821.7	0.0	GROUND SURFACE
821.58	0.1	TOP OF PVC
820.7	1.0	TOP OF GROUT
759.8	61.9	TOP OF BENTONITE
758.9	62.8	TOP OF FILTER PACK
761.0	60.7	TOP OF AQUIFER
758.8	62.8	TOP OF SCREEN OPENINGS
755.0	66.7	BOTTOM OF SCREEN OPENINGS
754.3	67.4	BOTTOM OF WELL
754.7	67.0	BOTTOM OF AQUIFER
754.0	67.7	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: GUE - 70 - 14.10

BORING: P-224A

DATE WELL INSTALLED: 1-03-00

BBC & M PROJECT NO: 7000.03

STATIC WATER LEVEL *	12.08			
DATE:	1-05-00			

WELL DEVELOPMENT:

30 gal. purged, clear water

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

DNR 7802.94

TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Divison of Water, 1939 Fountain Square Drive
Columbus, Ohio 43224 Phone (614) 265-6739

813941

Permit Number

COUNTY Guernsey TOWNSHIP Center SECTION/LOT No 18 (Circle One)

OWNER/BUILDER (Circle One or Both) ODOT (First, Last) PROPERTY ADDRESS (Address of well location) Station 483+44.7 238.1' Rt (Number, Street, City)

LOCATION OF PROPERTY Mile Marker 184 on I-70 Zip Code + 4

CONSTRUCTION DETAILS

CASING *(Length below grade) Borehole Diameter 5 7/8 in.

X Diameter 2 in Length* 67.4 ft Wall Thickness 1/8 in.

2 Diameter ___ in. Length* ___ ft. Wall Thickness ___ in.

Type: Steel / Galv. / X PVC / Other

Joints: X Threaded / Welded / Solvent / Other

Liner Length — Type — Wall Thickness — in.

SCREEN

Type (wire wrapped, louvered, etc.) machine slotted Material PVC

Length 4.9 ft. Diameter 2 in.

Set between 62.8 ft. and 67.7 ft. Slot #20

GROUT

Material Benseal Volume used

Method of installation Tremmie

Depth placed from 1.0 ft to 62.8 ft.

GRAVEL PACK (Filter Pack)

Material #4 Sand Volume used

Method of installation

Depth placed from 62.8 ft to 67.7 ft.

Pitless Device ☐ Adapter ☐ Preassembled unit

Use of Well Ground water monitoring

X Rotary ☐ Cable ☐ Augered ☐ Driven ☐ Dug ☐ Other

Date of Completion 01-03-00

WELL LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Show color, texture, hardness, and formation. sandstone, shale, limestone, gravel, clay, sand, etc.

	From	To
Topsoil	0.0	0.7
Brown/Gray Silty Clay	0.7	10.0
Brown Sand, Gravel, Silt	10.0	28.5
Gray Silty Clay	28.5	33.5
Gray Shale	33.5	61.0
Coal	61.0	67.0
UnderClay	67.0	67.7
		End

X Water 10.0-28.7'

*(If additional space is needed to complete well log, use next consecutively numbered form.)

WELL TEST

☐ Bailing ☐ Pumping* ☐ Other

Test rate ___ gpm Duration of test ___ hrs.

Drawdown ___ ft.

Measured from: X top of casing ☐ ground level ☐ Other

Static Level (depth to water) 12.08 ft. Date: 01-05-00

Quality (clear, cloudy, taste, odor)

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

PUMP

Type of pump — Capacity — gpm

Pump set at — ft

Pump installed by —

WELL LOCATION

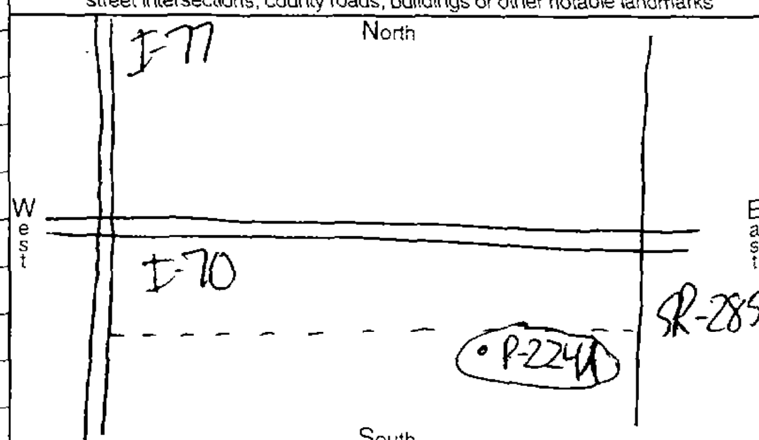
Location of well in State Plane coordinates, if available

Zone ___ x ___ y ___

Elevation of well 821.58 ft./m. Datum plain ☐ NAD27 X NAD83

Source of coordinates: ☐ GPS X Survey ☐ Other

Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks



Drilling Firm BBC&M Engineering

Address 6140 Enterprise Ct.

City, State, Zip Dublin, OH 43016

I hereby certify the information given is accurate and correct to the best of my knowledge.

Signed

Date 04-26-02

ODH Registration Number 02504

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224

Blue - Customer's copy Pink - Driller's copy Green - Local Health Dept. copy

BBC&M ENGINEERING, INC.

LOG OF BORING NO. P-224B
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 4-1/4" I.D. Hollow-stem Auger

LOCATION: Sta. 483+40.6, 239.1' Rt.

COMPLETION DEPTH: 30.0' ELEVATION: 821.8 DATE: 12/27/99 - 1/04/00

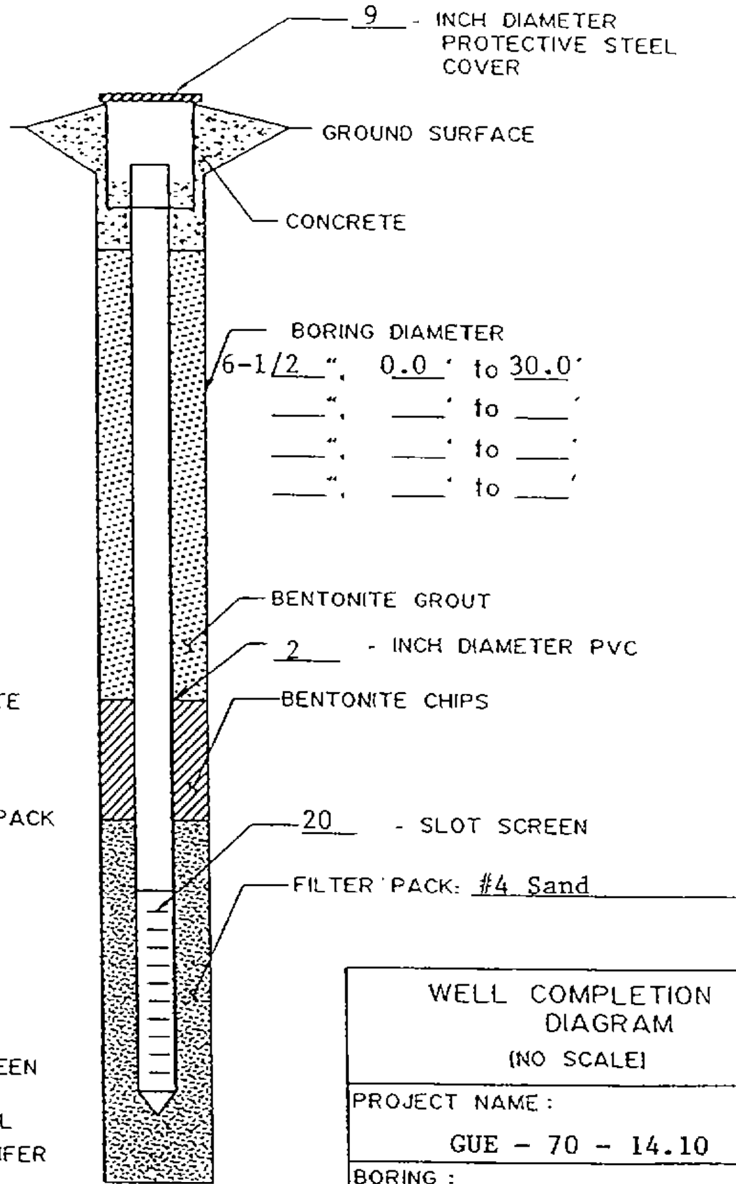
DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S	F.S.	SILT	CLAY	DESCRIPTION
0													- Boring drilled for installation of monitoring well P-224B, see completion diagram. - No samples collected, see log of boring P-224A.
5													
10													
15													
20													
25													
30													
35													
40													

WATER LEVEL: 8.9
WATER NOTE:
DATE: 1/04/00

JOB: 7000.030

ODOTLJ 17000030.GPJ BBCM.GDT 10/27/00

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
821.98	-0.2	TOP OF COVER
821.8	0.0	GROUND SURFACE
821.6	0.2	TOP OF PVC
820.7	1.0	TOP OF GROUT
802.0	19.7	TOP OF BENTONITE
798.3	23.5	TOP OF FILTER PACK
811.8	10.0	TOP OF AQUIFER
797.7	24.1	TOP OF SCREEN OPENINGS
793.8	28.0	BOTTOM OF SCREEN OPENINGS
793.1	28.7	BOTTOM OF WELL
793.1	28.7	BOTTOM OF AQUIFER
791.8	30.0	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: GUE - 70 - 14.10

BORING: P-224B

DATE WELL INSTALLED: 12-27-99

BBC & M PROJECT NO: 7000.03

STATIC WATER LEVEL *	8.94			
DATE:	1-05-00			

WELL DEVELOPMENT:

11 gal. purged, slightly silty water

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

DNR 7802 92
TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources, Divison of Water
1939 Fountain Square Drive, Columbus, Ohio 43224 Phone (614) 265-6739

760608
Permit Number ______

COUNTY Guernsey TOWNSHIP Center SECTION/LOT No. (CIRCLE ONE) 18

OWNER/BUILDER (CIRCLE ONE OR BOTH) ODOT PROPERTY ADDRESS Station 483+40.6 239.1' Rt (ADDRESS OF WELL LOCATION A)

LOCATION OF PROPERTY Mile Marker 184 on I-70

CONSTRUCTION DETAILS

CASING Borehole Diameter ~~8.7~~ 6 1/2 in.
[X] 1 Diameter 2 in Length 28.7 ft Wall Thickness 1/8 in
2 Diameter ____ in. Length ____ ft Wall Thickness ____ in.
Type: Steel / Galv. / [X] PVC / Other ____
Joints: [X] Threaded / Welded / Solvent / Other ____
Liner: Length — Type — Wall Thickness — in

SCREEN
Type (wire wrapped, louvered, etc.) Machine Slotted Material PVC
Length 3.9 ft Diameter 2 in
Set between 24.1 ft. and 28.0 ft. Slot #20

GROUT
Material Bensal Volume used ____
Method of installation Tremmie
Depth: placed from 1.0 ft. to 23.5 ft.

GRAVEL PACK (Filter Pack)
Material #4 Sand Volume used ____
Method of installation ____
Depth: placed from 23.5 ft. to 30.0 ft.

Pitless Device ☐ Adapter ☐ Reassembled unit
Use of Well Ground Water Monitoring
☐ Rotary ☐ Cable [X] Augered ☐ Driven ☐ Dug ☐ Other ____
Date of Completion 12-27-99

WELL LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.
Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc.

	From	To
Topsoil	0.0	0.7
Brown/Gray Silty Clay	0.7	10.0
Brown Sand, Gravel, Silt	10.0	28.5
Gray Silty Clay	28.5	30.0
		End

* Water 10.0-28.7

*If additional space is needed to complete well log, use next consecutively numbered form.

WELL TEST

☐ Bailing ☐ Pumping* ☐ Other ____
Test rate ____ gpm Duration of test ____ hrs.
Drawdown ____ ft.
Measured from [X] top of casing ☐ ground level ☐ Other ____
Static Level (depth to water) 8.94 ft. Date 01-05-00
Quality (clear, cloudy, taste, odor) ____

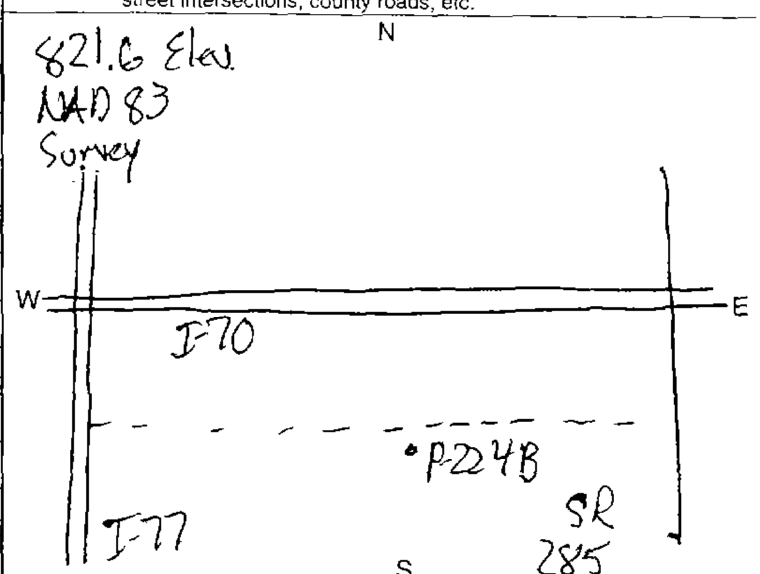
*(Attach a copy of the pumping test record, per section 1521.05, ORC)

PUMP

Type of pump — Capacity — gpm
Pump set at — ft
Pump installed by —

SKETCH SHOWING WELL LOCATION

Show distances well lies from numbered state highways, street intersections, county roads, etc.



Drilling Firm BBC+M Engineering
Address 6190 Enterprise Ct.
City, State, Zip Dublin, OH, 43016

I hereby certify the information given is accurate and correct to the best of my knowledge.
Signed ____
Date 04-26-02
ODH Registration Number 02504

Completion of this form is required by section 1521 05, Ohio Revised Code - file within 30 days after completion of drilling.

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224

Blue - Customer's copy Pink - Driller's copy Green - Local Health Dept. ...

BBC&M ENGINEERING, INC.

LOG OF BORING NO. P-225A
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; NQ Rock Core Barrel

LOCATION: Sta. 484+27.2, 322.8' Lt.

COMPLETION DEPTH: 86.9' ELEVATION: 838.9 DATE: 12/6/99 - 12/9/99

DEPTH, FEET	SAMPLE NO.	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0												TOPSOIL - 3 INCHES
												Very-stiff brown mottled with gray silty clay, trace fine sand.
	1	2/5/7	2.0-3 5									
5	2	4/7/9	2.0-4.5+									Very-stiff to hard gray mottled with brown silty clay, trace fine sand.
	3	4/5/6	3 5-4.5+									Very-stiff to hard gray mottled with brown clayey silt, trace fine sand, desiccated.
10												Hard gray mottled with brown clayey silt, some fine to coarse sand, trace fine to coarse gravel.
	4	5/5/7	4.5+									
15												
	5	5/6/9	4 5+									
20												Very-soft to soft dark-gray shale, carbonaceous, partly similar to soil, nearly horizontally bedded.
	6	50-3"R										
25												
	7	50-3"R										
30												
	8	50-1"R										
35												
	9	50-4"R										
40												

WATER LEVEL:
WATER NOTE:
DATE:

ODOT LJ 17000030.GPJ BBCM.GDT 10/27/00

JOB: 7000.030

-CONTINUED-

BBC&M ENGINEERING, INC.

LOG OF BORING NO. P-225A
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE. 3-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; NQ Rock Core Barrel

LOCATION. Sta. 484+27.2, 322.8' Lt.

COMPLETION DEPTH: 86.9'   ELEVATION: 838.9   DATE: 12/6/99 - 12/9/99

DEPTH, FEET	SAMPLE NO.	SAMPLING EFFORT	DESCRIPTION - CONTINUED
40			Soft light gray shale, nearly horizontally bedded.
	10	50-3"R	
45			
		NQ REC 100% RQD 68%	Medium-hard gray shale, nearly horizontally bedded, silty in parts, occasional sandstone layer, few horizontal fractures.
50			
	11		
55			
		NQ REC 100% RQD 60%	
60			
	12		
65			Medium-hard gray siltstone, partly similar to fine grained sandstone, many horizontal fractures, vertical fractures from 65.1' to 68.3', micaceous.
		NQ REC 100% RQD 83%	
70			
	13		
75			
			VOID
80			

Column headings: HAND PENETROMETER (tsf), MOISTURE CONTENT (%), LIQUID LIMIT (%), PLASTIC LIMIT (%), AGG., C.S., F.S., SILT, CLAY

WATER LEVEL:
WATER NOTE:
DATE:

ODOTLJ 17000030.GPJ BBCM GDT 10/27/00

JOB: 7000.030

-CONTINUED

BBC&M ENGINEERING, INC.

LOG OF BORING NO. P-225A
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger
2" O.D. Split-barrel Sampler
NQ Rock Core Barrel

LOCATION: Sta. 484+27.2, 322.8' Lt.

COMPLETION DEPTH: 86.9' ELEVATION: 838.9 DATE: 12/6/99 - 12/9/99

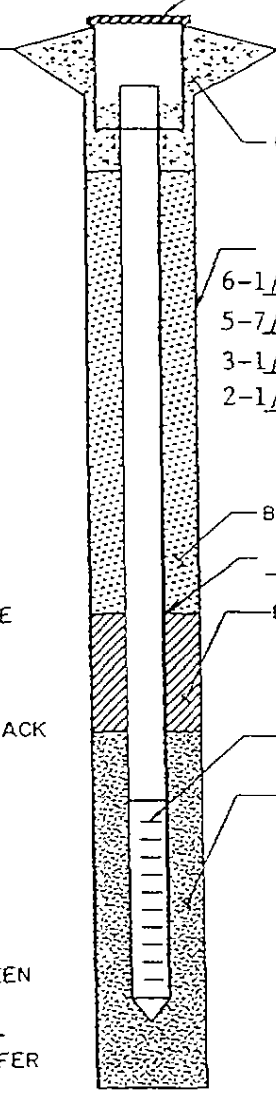
DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
80													
	14		NQ REC 36% RQD 12%										Roof collapse material or spoil.
85													Very-soft gray shale (underclay).
													- Encountered water at 17.5'.
90													- Boring converted to groundwater monitoring well, see completion diagram.
95													
100													
105													
110													
115													
120													

WATER LEVEL:
WATER NOTE:
DATE:

ODOTLJ 17000030.GPJ BBCM.GDT 10/27/00

JOB: 7000.030

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
839.01	-0.1	TOP OF COVER
838.9	0.0	GROUND SURFACE
838.70	0.2	TOP OF PVC
838.3	0.8	TOP OF GROUT
771.7	67.4	TOP OF BENTONITE
765.9	73.0	TOP OF FILTER PACK
762.2	76.7	TOP OF AQUIFER
763.6	75.3	TOP OF SCREEN OPENINGS
759.6	79.3	BOTTOM OF SCREEN OPENINGS
754.0	84.9	BOTTOM OF WELL
754.0	84.9	BOTTOM OF AQUIFER
752.0	86.9	BORING DEPTH



WELL COMPLETION DIAGRAM

(NO SCALE)

PROJECT NAME: GUE - 70 - 14.10

BORING: P-225A

DATE WELL INSTALLED: 12-09-99

BBC & M PROJECT NO: 7000.03

STATIC WATER LEVEL *	30.60			
DATE:	1-05-00			

WELL DEVELOPMENT:

30 gal. purged, nearly clear water

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

DNR 7802 92
TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources, Divison of Water
1939 Fountain Square Drive, Columbus, Ohio 43224 Phone (614) 265-6739

760609

Permit Number

COUNTY Guernsey TOWNSHIP Center SECTION/LOT No (CIRCLE ONE) 18

OWNER/BUILDER (CIRCLE ONE OR BOTH) ODOT PROPERTY ADDRESS Station 484+27.2 322.8' (ADDRESS OF WELL LOCATION A)

LOCATION OF PROPERTY Mile Marker 184 on I-70

CONSTRUCTION DETAILS

CASING Borehole Diameter 3 1/8 in

[1] Diameter 2 in Length 84.9 ft. Wall Thickness 1/8 in

[2] Diameter ___ in. Length ___ ft. Wall Thickness ___ in

Type: [1] [2] Steel [1] [2] Galv. [X] [2] PVC [1] [2] Other ___

Joints: [X] [2] Threaded [1] [2] Welded [1] [2] Solvent [1] [2] Other ___

Liner. Length — Type — Wall Thickness — in

SCREEN

Type (wire wrapped, louvered, etc.) machine Slotted Material PVC

Length 4.0 ft Diameter 2 in.

Set between 75.3 ft. and 79.3 ft. Slot #20

GROUT

Material Benseal Volume used ___

Method of installation Tremmie

Depth. placed from 0.8 ft to 73.0 ft.

GRAVEL PACK (Filter Pack)

Material #4 Sand Volume used ___

Method of installation ___

Depth: placed from 73.0 ft to ___ ft

Pitless Device ☐ Adapter ☐ Preassembled unit

Use of Well Groundwater Monitoring

[X] Rotary ☐ Cable ☐ Augered ☐ Driven ☐ Dug ☐ Other ___

Date of Completion 12-07-99

WELL LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Show color, texture, hardness, and formation. sandstone, shale, limestone, gravel, clay, sand, etc.

	From	To
Topsoil	0.0	0.3
Gray / Brown Silty Clay	0.3	21.0
Gray Shale	21.0	64.5
Gray Siltstone	64.5	76.5
Void	76.5	81.0
Roof Collapse (Gray Siltstone/Shale)	81.0	85.0
Under Clay	85.0	86.9
		↑
*Encountered water @ 17.5'		End

WELL TEST

☐ Bailing ☐ Pumping* ☐ Other ___

Test rate ___ gpm Duration of test ___ hrs.

Drawdown ___ ft.

Measured from: [X] top of casing ☐ ground level ☐ Other ___

Static Level (depth to water) 30.6 ft. Date ___

Quality (clear, cloudy, taste, odor) ___

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

PUMP

Type of pump — Capacity — gpm

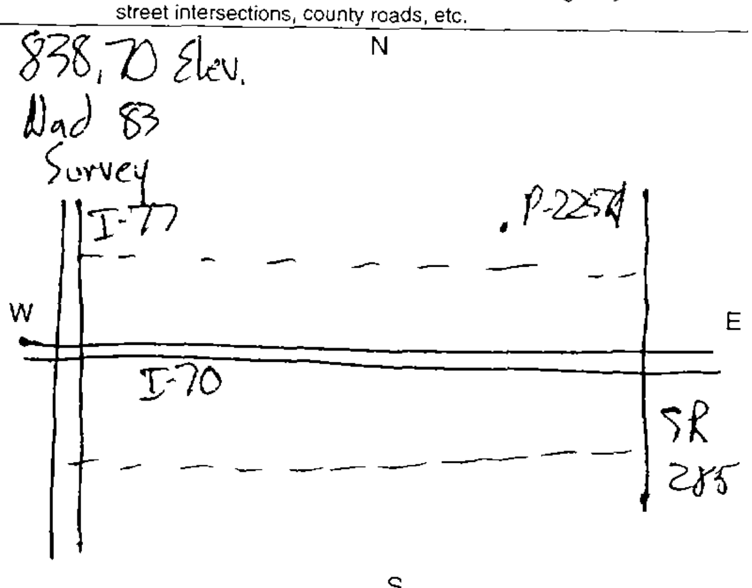
Pump set at ___ ft.

Pump installed by —

SKETCH SHOWING WELL LOCATION

Show distances well lies from numbered state highways. street intersections, county roads, etc.

838.70 Elev.
Nad 83
Survey



*If additional space is needed to complete well log, use next consecutively numbered form.

I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm BBC&M Engineering

Address 6190 Enterprise Ct

City, State, Zip Dublin, OH 43016

Signed ___

Date 04-26-02

ODH Registration Number 02504

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224

LOG OF BORING NO. P-225B
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

BBC&M ENGINEERING, INC.

TYPE. 4-1/4" I.D. Hollow-stem Auger

LOCATION: Sta. 484+25.6, 320.6' Lt.

COMPLETION DEPTH: 20.0' ELEVATION: 838.8 DATE: 12/9/99

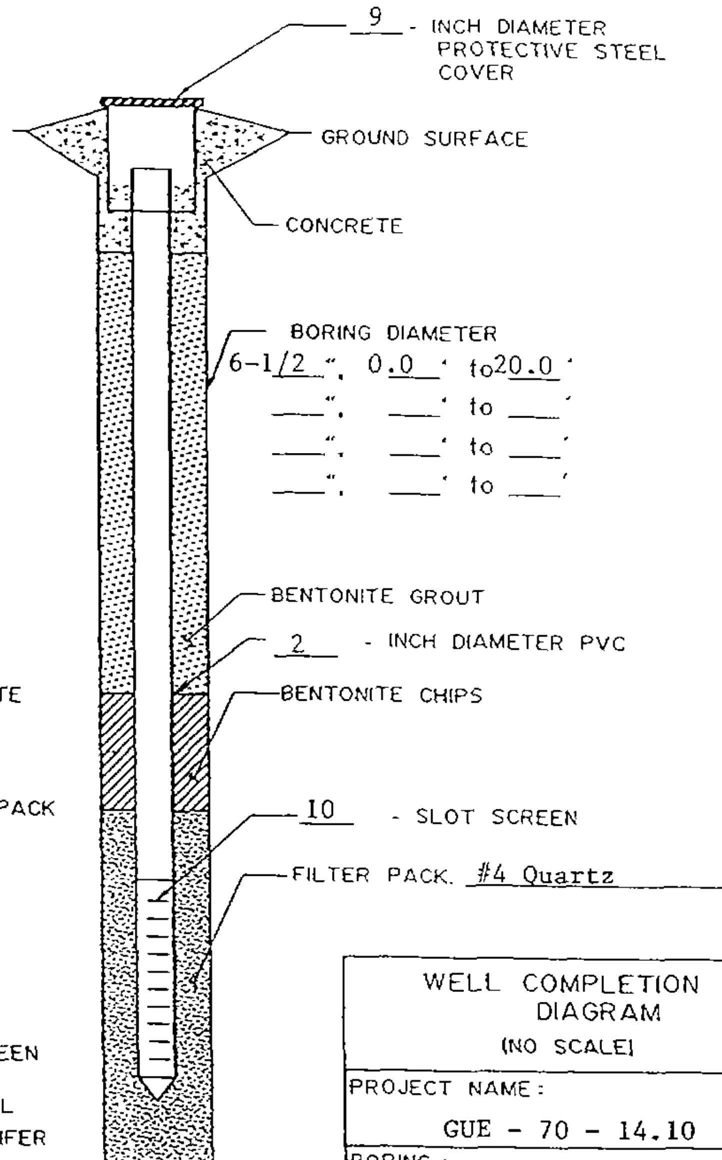
DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0													- Boring and drilling for installation of monitoring well P-225B, see completion diagram. - No samples collected, see log of boring P-225A.
5													
10													
15													
20													
25													
30													
35													
40													

WATER LEVEL:

WATER NOTE:

DATE:

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
838.94	-0.0	TOP OF COVER
838.8	0.0	GROUND SURFACE
838.5	0.0	TOP OF PVC
837.74	1.0	TOP OF GROUT
830.4	8.3	TOP OF BENTONITE
825.9	12.9	TOP OF FILTER PACK
821.3	17.5	TOP OF AQUIFER
823.2	15.6	TOP OF SCREEN OPENINGS
819.2	19.6	BOTTOM OF SCREEN OPENINGS
818.8	20.0	BOTTOM OF WELL
820.8	18.0	BOTTOM OF AQUIFER
818.8	20.0	BORING DEPTH



WELL COMPLETION DIAGRAM

(NO SCALE)

PROJECT NAME: GUE - 70 - 14.10

BORING: P-225B

DATE WELL INSTALLED: 12-09-99

BBC & M PROJECT NO: 7000.03

STATIC WATER LEVEL *	2.10			
DATE:	1-05-00			

WELL DEVELOPMENT:

9 gal. purged, very silty water

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

DNR 7802.92
TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources, Divison of Water
1939 Fountain Square Drive, Columbus, Ohio 43224 Phone (614) 265-6739

760610

Permit Number ______

COUNTY Guernsey TOWNSHIP Center SECTION/LOT No 18 (CIRCLE ONE)

OWNER/BUILDER (CIRCLE ONE OR BOTH) ODOT PROPERTY ADDRESS (ADDRESS OF WELL LOCATION) Station 484+25.6 320.6 Lt.

LOCATION OF PROPERTY Mile Marker 184 on I-70

CONSTRUCTION DETAILS

CASING 2 Borehole Diameter 6½ in

X Diameter 2 in. Length 20.0 ft Wall Thickness 18 in

2 Diameter ______ in Length ______ ft Wall Thickness ______ in.

Type: 1 2 Steel; 1 2 Galv.; X 2 PVC; 1 2 Other ______

Joints: X 2 Threaded; 1 2 Welded; 1 2 Solvent; 1 2 Other ______

Liner. Length — Type — Wall Thickness — in.

SCREEN machine slotted

Type (wire wrapped, louvered, etc.) ______ Material PVC

Length 4.4 ft Diameter 2 in

Set between 15.6 ft. and 19.6 ft Slot #20

GROUT

Material Benseal Volume used ______

Method of installation Tremmie

Depth placed from 1.0 ft to 12.9 ft.

GRAVEL PACK (Filter Pack)

Material #4 Sand Volume used ______

Method of installation ______

Depth placed from 12.9 ft to 20.0 ft.

Pitless Device ☐ Adapter ☐ Preassembled unit

Use of Well Groundwater Monitoring

☐ Rotary ☐ Cable X Augered ☐ Driven ☐ Dug ☐ Other ______

Date of Completion ______

WELL LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED

Show color, texture, hardness, and formation sandstone, shale, limestone, gravel, clay, sand, etc.	From	To
Topsoil	0.0	0.3
Gray / Brown Silty Clay	0.3	20.0
~~Gray Shale~~		
~~Gray Silt~~		End
* water @ 17.5		

WELL TEST

☐ Bailing ☐ Pumping* ☐ Other ______

Test rate ______ gpm Duration of test ______ hrs

Drawdown ______ ft.

Measured from X top of casing ☐ ground level ☐ Other ______

Static Level (depth to water) 2.10 ft. Date 01-05-00

Quality (clear, cloudy, taste, odor) ______

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

PUMP

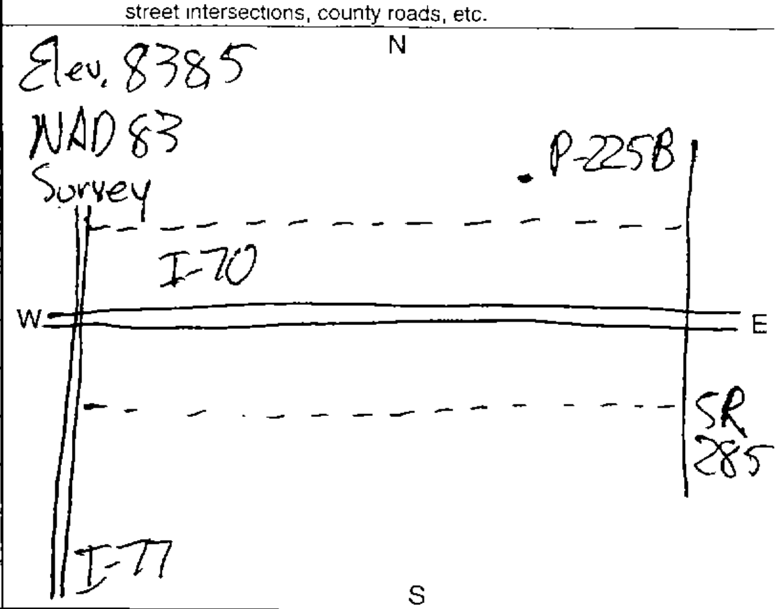
Type of pump — Capacity — gpm

Pump set at — ft.

Pump installed by —

SKETCH SHOWING WELL LOCATION

Show distances well lies from numbered state highways, street intersections, county roads, etc.



*If additional space is needed to complete well log, use next consecutively numbered form

I hereby certify the information given is accurate and correct to the best of my knowledge

Drilling Firm BBC&M Engineering

Address 6190 Enterprise Ct

City, State, Zip Dublin OH 43012

Signed ______

Date 04-26-02

ODH Registration Number 02504

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224

Blue - Customer's copy Pink - Driller's copy Green - Local Health Dept copy

BBC&M ENGINEERING, INC.

LOG OF BORING NO. P-226A
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 5-7/8" Tricone Bit; 2" O.D. Split-barrel Sampler; NX Rock Core Barrel

LOCATION: Sta. 482+18.9, 128.6' Lt.

COMPLETION DEPTH: 80.0' ELEVATION: 827.6 DATE: 12/3/99 - 12/6/99

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0												TOPSOIL - 4 INCHES
												Very-stiff brown mottled with gray silty clay, trace fine to coarse sand, desiccated.
	1	3/5/7	3.0-4.5+									
5												Stiff to very-stiff gray silty clay, little fine to coarse sand.
	2	3/6/7	1.5-4.0									
												Very-soft to soft gray mottled with brown silty clay, trace fine to coarse sand.
	3	1/1/1	0.0-0.5									
10												
	4	S/H-6" 1/2	0.5-1.0									
15												
												Stiff to very-stiff brown mottled with gray silty clay, trace fine to coarse sand
	5	2/5/6	1.5-2.5									
20												Hard gray clayey silt, some fine to coarse sand, trace fine to coarse gravel, occasional cobble.
	6	8/8/10	4.5+									
25												
	7	7/8/18	4.5+									
30												Soft to medium-hard gray and brown sandstone, fine to coarse grained, few horizontal fractures, iron stained at fractures.
35	8	NX REC 92% RQD 40%										
		NX REC										Soft to medium-hard with thin seams of very-soft gray shale, nearly horizontally bedded, few horizontal fractures.
40												

WATER LEVEL: "Dry"
WATER NOTE: Before Coring
DATE: 12/8/99

ODOTLJ 17000030.GPJ BBCM.GDT 10/27/00

JOB: 7000.030

-CONTINUED-

BBC&M ENGINEERING, INC.

LOG OF BORING NO. P-226A
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 5-7/8" Tricone Bit; 2" O.D. Split-barrel Sampler; NX Rock Core Barrel

LOCATION: Sta. 482+18.9, 128.6' Lt.

COMPLETION DEPTH: 80.0' ELEVATION: 827.6 DATE: 12/3/99 - 12/6/99

DEPTH, FEET	SAMPLE NO.	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F S.	SILT	CLAY	DESCRIPTION - CONTINUED
40	9	100% RQD 73%										
45–47												Medium-hard gray shale, similar to siltstone, occasional sandy seams, nearly horizontally bedded, occasional horizontal fractures.
48	10	NX REC 100% RQD 95%										
58	11	NX REC 100% RQD 100%										
68	12	NX REC 100% RQD 68%										Medium-hard black coal, few highly fractured zones.
76.5												Very-soft gray shale (underclay).
80												

WATER LEVEL: "Dry"
WATER NOTE: Before Coring
DATE: 12/8/99

JOB: 7000.030

ODOTLJ 17000030.GPJ BBCM.GDT 10/27/00

CONTINUED

BBC&M ENGINEERING, INC.

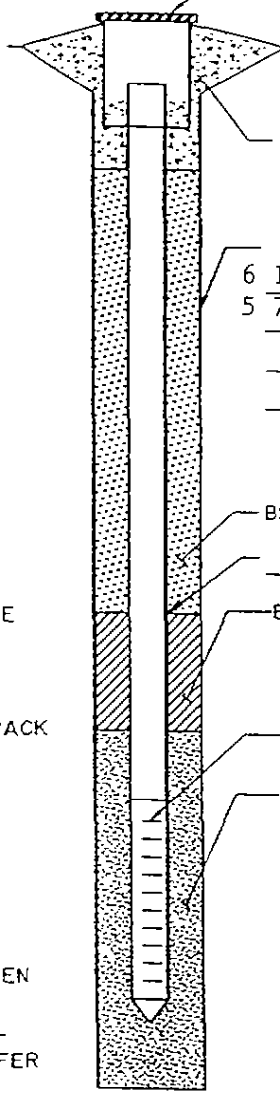
LOG OF BORING NO. P-226A
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE.	3-1/4" I.D. Hollow-stem Auger 5-7/8" Tricone Bit 2" O.D. Split-barrel Sampler NX Rock Core Barrel
LOCATION	Sta. 482+18.9, 128.6' Lt.
COMPLETION DEPTH:	80.0'
ELEVATION:	827.6
DATE:	12/3/99 - 12/6/99

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
80													- Boring converted to groundwater monitoring well, see completion diagram.
85													
90													
95													
100													
105													
110													
115													
120													

WATER LEVEL:	"Dry"					
WATER NOTE:	Before Coring					
DATE:	12/8/99					

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
827.74	-0.1	TOP OF COVER
827.6	0.0	GROUND SURFACE
827.15	0.4	TOP OF PVC
827.0	0.7	TOP OF GROUT
762.9	64.8	TOP OF BENTONITE
758.6	69.0	TOP OF FILTER PACK
759.1	68.5	TOP OF AQUIFER
756.2	71.4	TOP OF SCREEN OPENINGS
752.2	75.4	BOTTOM OF SCREEN OPENINGS
751.6	76.0	BOTTOM OF WELL
751.7	75.9	BOTTOM OF AQUIFER
747.6	80.0	BORING DEPTH



9 - INCH DIAMETER PROTECTIVE STEEL COVER

GROUND SURFACE

CONCRETE

BORING DIAMETER

6 1/2"	0.0'	to	31.5'
5 7/8"	31.5'	to	80.0'
"	'	to	'
"	'	to	'
"	'	to	'

BENTONITE GROUT

2 - INCH DIAMETER PVC

BENTONITE CHIPS

10 - SLOT SCREEN

FILTER PACK: #4 Quartz

WELL COMPLETION DIAGRAM (NO SCALE)
PROJECT NAME: GUE - 70 - 14.10
BORING: P-226A
DATE WELL INSTALLED: 12-7-99
BBC & M PROJECT NO 7000.03

STATIC WATER LEVEL *	19.10			
DATE:	01/05/00			

WELL DEVELOPMENT: 30 Gals. purged, nearly clear water
#4 sand from 80.0-76.0

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

DNR 7802.92
TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

760611

Ohio Department of Natural Resources, Divison of Water
1939 Fountain Square Drive, Columbus, Ohio 43224 Phone (614) 265-6739

Permit Number

COUNTY Guernsey TOWNSHIP Center SECTION/LOT No (CIRCLE ONE)

OWNER/BUILDER (CIRCLE ONE OR BOTH) ODOT PROPERTY ADDRESS Station 482+18.9, 128 6 Lt (ADDRESS OF WELL LOCATION AT)

LOCATION OF PROPERTY Mile Marker 184 on I-70

CONSTRUCTION DETAILS

CASING 2 Borehole Diameter 5 7/8 in.
X 1 Diameter 2 in. Length 75.6 ft Wall Thickness 1/8 in.
2 Diameter in. Length ft Wall Thickness in

Type: 1 2 Steel; 1 2 Galv.; X PVC; 1 2 Other

Joints: X Threaded; 1 2 Welded; 1 2 Solvent; 1 2 Other

Liner: Length — Type — Wall Thickness — in.

GROUT Material Benseal Volume used
Method of installation Tremmie
Depth placed from 0.7 ft. to 69.0 ft.

GRAVEL PACK (Filter Pack) Material #4 Sand Volume used
Method of installation
Depth placed from 69.0 ft to 80.0 ft.

SCREEN
Type (wire wrapped, louvered, etc.) machine Slotted Material PVC
Length 4 ft. Diameter 2 in.
Set between 71.4 ft. and 75.4 ft. Slot #20

Pitless Device ☐ Adapter ☐ Preassembled unit
Use of Well ground water monitoring
X Rotary ☐ Cable ☐ Augered ☐ Driven ☐ Dug ☐ Other
Date of Completion

WELL LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED

Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc	From	To
Topsoil	0.0	0.3
Brown / Gray Silty Clay	0.3	30.5
Gray Shale	30.5	69.0
Coal	69.0	76.0
underclay	76.0	80.0
		↑ End

*No water encountered before coring

*If additional space is needed to complete well log, use next consecutively numbered form.

WELL TEST

☐ Bailing ☐ Pumping* ☐ Other
Test rate gpm Duration of test hrs.
Drawdown ft.
Measured from: X top of casing ☐ ground level ☐ Other
Static Level (depth to water) 19.10 ft Date: 01-05-00
Quality (clear, cloudy, taste, odor)

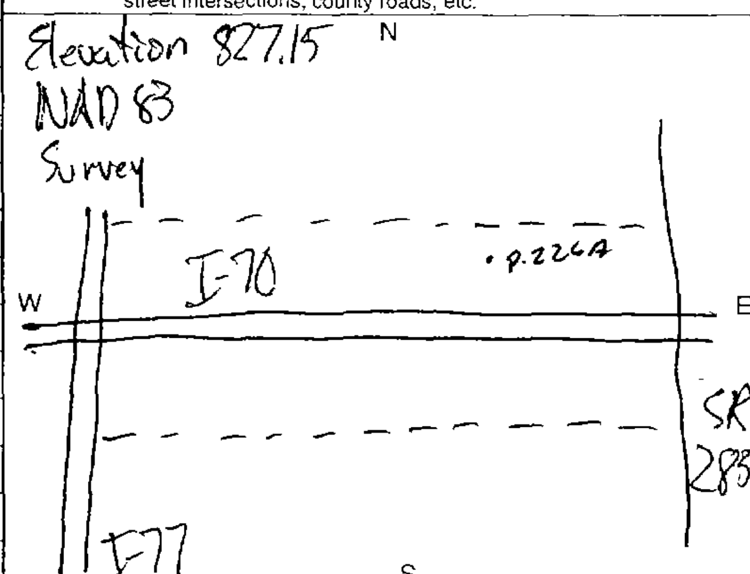
*(Attach a copy of the pumping test record, per section 1521.05, ORC)

PUMP

Type of pump — Capacity — gpm
Pump set at — ft
Pump installed by —

SKETCH SHOWING WELL LOCATION

Show distances well lies from numbered state highways, street intersections, county roads, etc.



I hereby certify the information given is accurate and correct to the best of my knowledge

Drilling Firm BBC&M Engineering
Address 6190 Enterprise Ct.
City, State, Zip Dublin, OH 43016

Signed
Date 04-26-02
ODH Registration Number 02504

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224

BBC&M ENGINEERING, INC.

LOG OF BORING NO. P-227A
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler and NQ Rock-core Barrel

LOCATION: Sta. 483+98.2, 128.0' Lt.

COMPLETION DEPTH: 79.9' ELEVATION: 830.6 DATE: 9/28/99 - 10/6/99

DEPTH, FEET	SAMPLE NO.	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0												TOPSOIL - 6 INCHES
												Very-stiff gray mottled with brown silty clay, little fine to coarse sand
	1	3/4/5	H=2.5-3.5									
5	2A	2/1/2	H=2.0-2.5									
	2B		H=0.3-1.3									Soft to stiff gray mottled with brown silty clay, little fine to coarse sand, few thin silt seams.
	3A	2/1/4	H=0.5-2.1									
10	3B		H=2.1-3.2									Very-stiff brown mottled with gray silty clay, some fine to coarse sand, trace fine gravel.
												Stiff to very-stiff brown silty clay, little fine to coarse sand.
	4	1/3/5	H=1.5-2.4									
15												- Below 16.0' becoming medium-stiff to stiff.
	5	1/2/3	H=0.7-1.3									
20												Stiff to very-stiff gray silty clay, little fine to coarse sand, trace fine to coarse gravel.
	6	1/3/4	H=1.3-2.5									
25												- Below 28.0' becoming very-stiff to hard.
	7	10/21/22	H=3.5-4.5+									
30												Very-soft to soft gray shale, nearly horizontally bedded.
	8	82-6"R										
35												
	9	50-1"R										
40												Soft to medium-hard gray shale, nearly horizontally bedded,

WATER LEVEL:
WATER NOTE:
DATE:

BBC&M ENGINEERING, INC.

LOG OF BORING NO. P-227A
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger
2" O.D. Split-barrel Sampler and NQ
Rock-core Barrel

LOCATION: Sta. 483+98.2, 128.0' Lt.

COMPLETION DEPTH: 79.9' ELEVATION: 830.6 DATE: 9/28/99 - 10/6/99

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
40	10		NXM REC 90% RQD 85%										many horizontal fractures along bedding planes, thinly bedded, occasional vertical fractures, few clay filled seams.
45	11		NXM REC 62% RQD 27%										
50													
55	12		NXM REC 93% RQD 70%										Soft to medium-hard dark-gray carbonaceous shale, nearly horizontally bedded, few horizontal fractures, thinly bedded, few thin sandstone seams.
60													
65	13		NXM REC 100% RQD 52%										
70	14		NXM REC 100% RQD 25%										Medium-hard black coal, nearly horizontally bedded, numerous horizontal and vertical fractures.
75	15		NXM REC 97% RQD 7%										Very-soft gray shale (underclay).
80	16		NXM REC										Soft to medium-hard gray shale, nearly horizontally bedded, few horizontal fractures.

WATER LEVEL:
WATER NOTE:
DATE:

ODOTLJ 17000030.GPJ BBCM.GDT 10/27/00

JOB: 7000.030

CONTINUED

BBC&M ENGINEERING, INC.

LOG OF BORING NO. P-227A
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: **3-1/4" I.D. Hollow-stem Auger 2" O.D. Split-barrel Sampler and NQ Rock-core Barrel**

LOCATION: **Sta. 483+98.2, 128.0' Lt.**

COMPLETION DEPTH: 79.9' **ELEVATION:** 830.6 **DATE:** 9/28/99 - 10/6/99

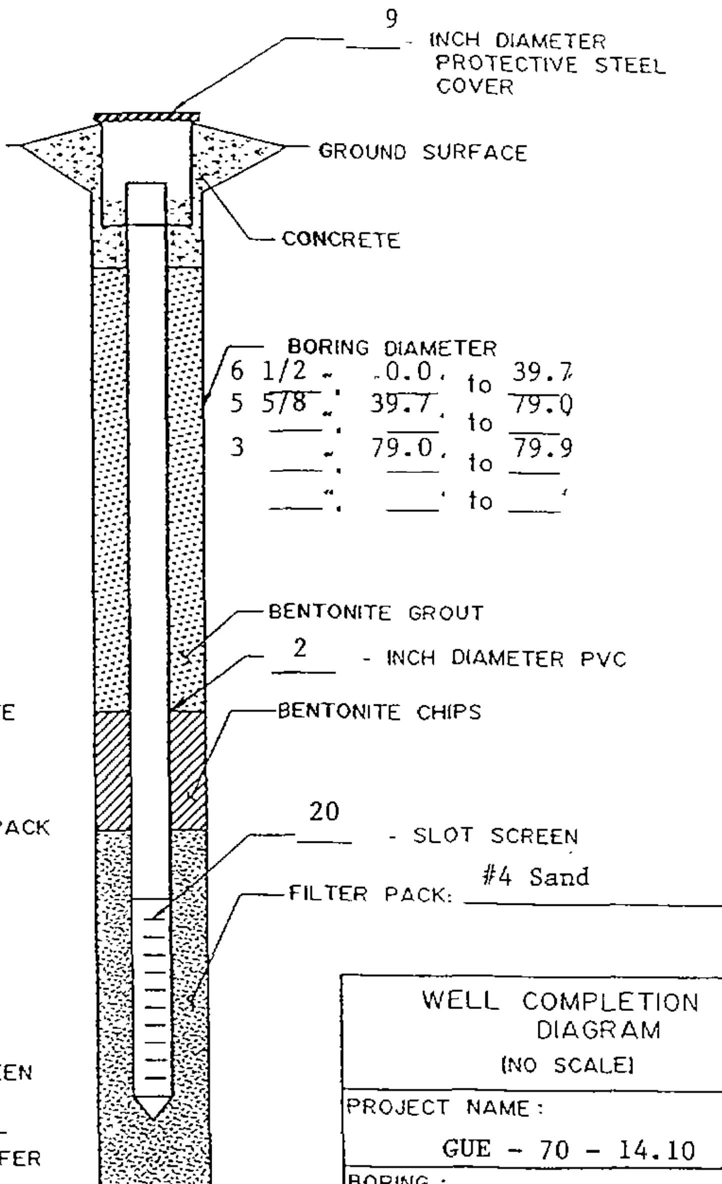
DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
80			67% RQD 16%										- Encountered seepage at 32.0'. - Boring converted to groundwater monitoring well, see completion diagram.
85													
90													
95													
100													
105													
110													
115													
120													

WATER LEVEL:
WATER NOTE:
DATE:

ODOTLJ 17000030.GPJ BBCM.GDT 10/27/00

JOB: 7000.030

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
830.97	-0.4	TOP OF COVER
830.6	0.0	GROUND SURFACE
830.66	- 0.1	TOP OF PVC
829.6	1.0	TOP OF GROUT
766.3	64.3	TOP OF BENTONITE
760.8	69.8	TOP OF FILTER PACK
760.1	70.5	TOP OF AQUIFER
758.8	71.8	TOP OF SCREEN OPENINGS
754.8	75.8	BOTTOM OF SCREEN OPENINGS
753.7	76.9	BOTTOM OF WELL
753.6	77.0	BOTTOM OF AQUIFER
750.7	79.9	BORING DEPTH



STATIC WATER LEVEL *	22.62				DATE WELL INSTALLED 10/6/99
DATE:	01/05/00				BBC & M PROJECT NO 7000.03

WELL COMPLETION DIAGRAM (NO SCALE)

PROJECT NAME: GUE - 70 - 14.10

BORING: P-227A

WELL DEVELOPMENT: 30 Gals. purged, slightly silty water

* FEET ABOVE MSL

BBC&M ENGINEERING INC.

DNR 7802.92
TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources, Divison of Water
1939 Fountain Square Drive, Columbus, Ohio 43224 Phone (614) 265-6739

760612

Permit Number ______

COUNTY Guernsey TOWNSHIP Center SECTION/LOT No 18 (CIRCLE ONE)

OWNER/BUILDER (CIRCLE ONE OR BOTH) ODOT PROPERTY ADDRESS Station 483+982, 128Lt (ADDRESS OF WELL LOCATION A)

LOCATION OF PROPERTY Mile Marker 184 on I-70

CONSTRUCTION DETAILS

CASING Borehole Diameter 3 1/8 in

X Diameter 2 in. Length 68 ft Wall Thickness 1/8 in

2 Diameter ______ in Length ______ ft Wall Thickness ______ in

Type: 1 2 Steel 1 2 Galv. X PVC 1 2 Other ______

Joints: X Threaded 1 2 Welded 1 2 Solvent 1 2 Other ______

Liner. Length — Type — Wall Thickness — in.

SCREEN

Type (wire wrapped, louvered, etc.) machine slotted Material PVC

Length 10.0 ft. Diameter 2 in

Set between 71.8 ft and 75.8 ft. Slot #20

GROUT

Material Benseal Volume used ______

Method of installation tremmie

Depth: placed from 1.0 ft to 69.8 ft.

GRAVEL PACK (Filter Pack)

Material #4 Sand Volume used ______

Method of installation ______

Depth: placed from 69.8 ft to 79.9 ft.

Pitless Device ☐ Adapter ☐ Preassembled unit

Use of Well ~~Both~~ Groundwater monitoring

X Rotary ☐ Cable ☐ Augered ☐ Driven ☐ Dug ☐ Other ✓

Date of Completion ______

WELL LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc	From	To
Topsoil	0.0	0.5
Gray / Brown Silty Clay	0.5	32.0
Gray Shale	32.0	70.5
Coal	70.5	77.0
under clay	77.0	78.0
Gray Shale	78.0	79.9
		↑ End

X water @ 32.0'

*If additional space is needed to complete well log, use next consecutively numbered form.

WELL TEST

☐ Bailing ☐ Pumping* ☐ Other ______

Test rate ______ gpm Duration of test ______ hrs

Drawdown ______ ft.

Measured from: X top of casing ☐ ground level ☐ Other ______

Static Level (depth to water) 22.62 ft Date: 01-05-00

Quality (clear, cloudy, taste, odor) ______

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

PUMP

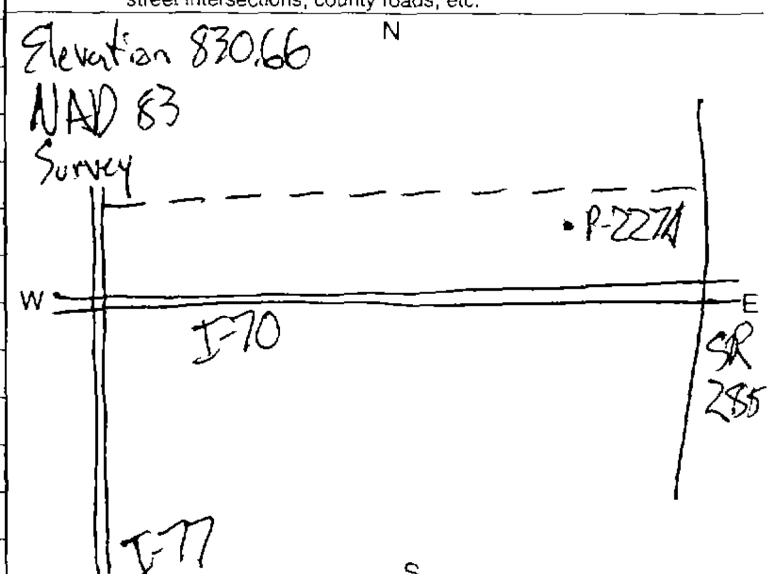
Type of pump — Capacity — gpm

Pump set at — ft.

Pump installed by ______

SKETCH SHOWING WELL LOCATION

Show distances well lies from numbered state highways, street intersections, county roads, etc.



I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm BBC&M Engineering

Address 6190 Enterprise Ct.

City, State, Zip Dublin, OH 43016

Signed ______

Date 04-26-02

ODH Registration Number 02504

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling

ORIGINAL COPY TO - ODNR. DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224

Blue - Customer's copy Pink - Driller's copy ...

BBC&M ENGINEERING, INC.

LOG OF BORING NO. P-227B
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger

LOCATION: Sta. 483+97.8, 129.2' Lt.

COMPLETION DEPTH: 33.0'   ELEVATION: 830.7   DATE: 9/29/99 - 9/30/99

DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0													- Boring drilled for installation of monitoring well P-227B, see completion diagram. - No samples collected, see log of boring P-227A.
5													
10													
15													
20													
25													
30													
35													
40													

WATER LEVEL:

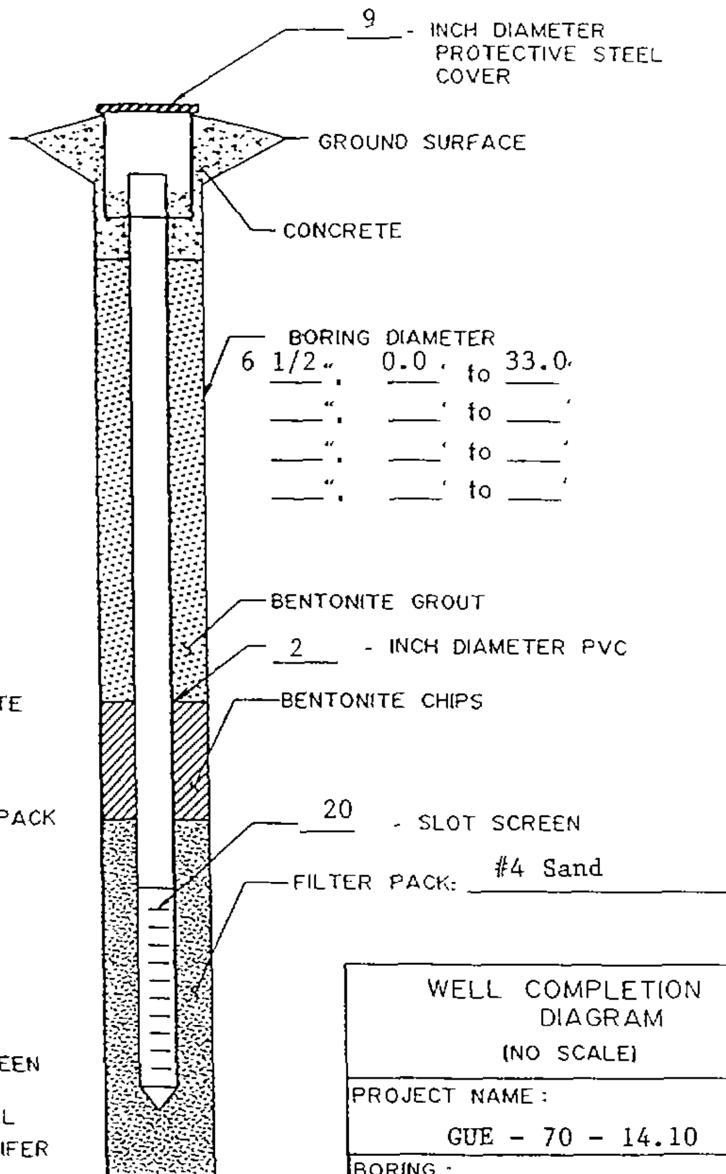
WATER NOTE:

DATE:

ODOTLJ 17000030.GPJ BBCM.GDT 10/27/00

JOB: 7000.030

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
830.88	-0.2	TOP OF COVER
830.7	0.0	GROUND SURFACE
830.47	0.2	TOP OF PVC
829.1	1.6	TOP OF GROUT
808.6	22.1	TOP OF BENTONITE
805.0	24.7	TOP OF FILTER PACK
--	N/A	TOP OF AQUIFER
804.0	26.7	TOP OF SCREEN OPENINGS
799.4	31.3	BOTTOM OF SCREEN OPENINGS
798.4	31.3	BOTTOM OF WELL
N/A	N/A	BOTTOM OF AQUIFER
797.7	33.0	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: GUE - 70 - 14.10

BORING: P-227B

DATE WELL INSTALLED: 9/29/99

BBC & M PROJECT NO: 7000.03

STATIC WATER LEVEL *	11.11			
DATE:	01/05/00			

WELL DEVELOPMENT: 11.5 Gals. purged, very silty water

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

DNR 7802.92
TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources, Divison of Water
1939 Fountain Square Drive, Columbus, Ohio 43224 Phone (614) 265-6739

760613

Permit Number ____

COUNTY Guernsey TOWNSHIP Center SECTION/LOT No. (CIRCLE ONE) 18

OWNER/BUILDER (CIRCLE ONE OR BOTH) ODOT PROPERTY ADDRESS Station 438978, 129,264 (ADDRESS OF WELL LOCATION A)

LOCATION OF PROPERTY Mile Marker 184 on I-70

CONSTRUCTION DETAILS

CASING

X 1 Diameter 2 in Length 31.1 ft Wall Thickness 1/8 in

2 Diameter ____ in. Length ____ ft. Wall Thickness ____ in.

Borehole Diameter 6 1/2 in

Type: 1 2 Steel; 1 2 Galv.; X PVC; 2 Other ____

Joints: X Threaded; 1 2 Welded; 1 2 Solvent; 2 Other ____

Liner: Length – Type – Wall Thickness – in.

SCREEN

Type (wire wrapped, louvered, etc.) machine slotted Material PVC

Length 3.6 ft. Diameter 2 in.

Set between 26.7 ft. and 31.3 ft Slot #20

GROUT

Material Benseal Volume used ____

Method of installation Tremmie

Depth placed from 1.6 ft to 24.7 ft.

GRAVEL PACK (Filter Pack)

Material #4 Sand Volume used ____

Method of installation ____

Depth placed from 24.7 ft. to 33.0 ft.

Pitless Device ☐ Adapter ☐ Preassembled unit

Use of Well Ground water monitoring

☐ Rotary ☐ Cable X Augered ☐ Driven ☐ Dug ☐ Other ____

Date of Completion 09-29-99

WELL LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc

	From	To
~~Topsoil~~	~~0.0~~	~~0.4~~
~~Brown/Gray Silty Clay~~	~~0.4~~	~~43.0~~
~~Gr Silt, Sand~~	~~43.0~~	~~48.0~~
~~Gray Shale~~	~~48.0~~	~~56.5~~
~~Grout, Shale, Voids~~	~~56.5~~	~~61.5~~
~~Shale (Gray)~~	~~61.5~~	~~75.0~~
~~Under clay~~	~~75.0~~	~~76.0~~
~~Gray Shale~~	~~76.0~~	~~79.5~~
		↑ End

~~Seepage~~
~~X water 13.0-43.0~~
~~X water 43.0-48.0~~

	From	To
Topsoil	0.0	0.5
Gray/Brown Silty Clay	0.5	32.0
Gray Shale	32.0	38.0

X Water @ 32.0

↑ End

*If additional space is needed to complete well log, use next consecutively numbered form

WELL TEST

☐ Bailing ☐ Pumping* ☐ Other ____

Test rate ____ gpm Duration of test ____ hrs

Drawdown ____ ft

Measured from: X top of casing ☐ ground level ☐ Other ____

Static Level (depth to water) 11.1 ft. Date: 01-05-00

Quality (clear, cloudy, taste, odor) ____

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

PUMP

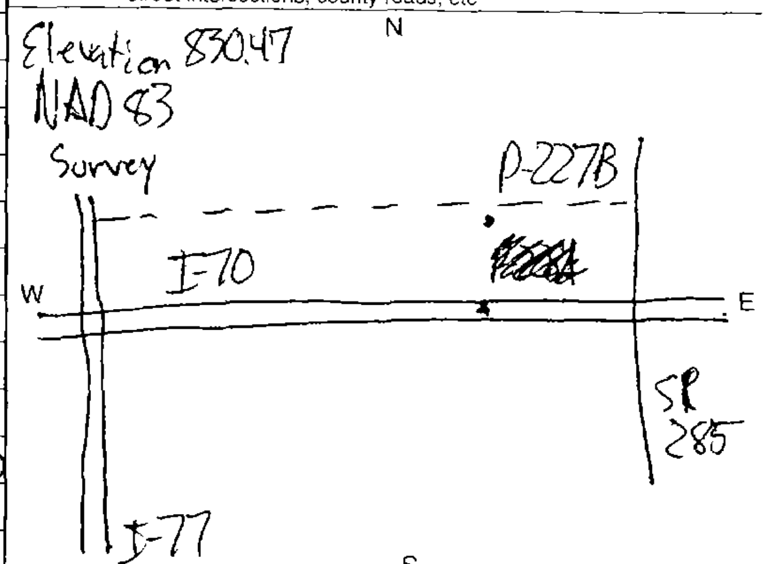
Type of pump – Capacity – gpm

Pump set at – ft.

Pump installed by –

SKETCH SHOWING WELL LOCATION

Show distances well lies from numbered state highways, street intersections, county roads, etc



Drilling Firm BBC+M Engineering

Address 6190 Enterprise Ct.

City, State, Zip Dublin, OH 43016

I hereby certify the information given is accurate and correct to the best of my knowledge.

Signed ____

Date 04-26-02

ODH Registration Number 02504

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224

Blue - Customer's copy Pink - Driller's copy ...

BBC&M ENGINEERING, INC.

LOG OF BORING NO. P-228A
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 4-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; NX Rock Core Barrel

LOCATION: Sta. 483+49.7, 0.8' Rt.

COMPLETION DEPTH: 79.5' ELEVATION: 828.6 DATE: 11/30/99 - 12/1/99

DEPTH, FEET	SAMPLE NO.	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0												TOPSOIL - 5 INCHES
												FILL: Very-stiff to hard brown silty clay, little fine to coarse sand, trace fine to coarse gravel.
	1	9/14/14	4.5+									
5	2	7/6/8	2.0-4.5+									
	3	3/6/7	2.0-3.5	25	54	20		0	1	54	45	Very-stiff brown mottled with gray silty clay, trace to fine to medium sand.
10												
	4A	S/H-18"	0.5-1.5	24								Medium-stiff to stiff gray silty clay, trace to little fine to coarse sand (% varies), trace fine gravel, few thin silt seams.
	4B			25								
15												
	5A	S/H-12"/3	0.5-1.2	25								
	5B		1.0-1.2	27								
20												- Below 21.0' becoming soft to medium-stiff.
	6	S/H-18"	0.25-0.75	21	37	19	3	1	11	46	39	
25												- At 26.0' to 27.0' possible fine to coarse sand seam.
												Soft gray clayey silt, trace fine to coarse sand, trace fine to coarse gravel.
	7	S/D-18"	0.25-0.50									
30												Very-soft gray clayey silt, some fine to coarse sand, little fine to coarse gravel.
	8	S/D-18"	0.0-0.25									- At. 34.3' 1" seam of fine to coarse sand.
35												
	9	S/D-18"	0.0-0.25	27	34	19	14	8	13	39	26	
40												

WATER LEVEL: 13.0

WATER NOTE: Before Coring

DATE: 12/3/99

ODOTLJ 17000030.GPJ BBCM.GDT 10/27/00

JOB: 7000.030

CONTINUED

BBC&M ENGINEERING, INC.

LOG OF BORING NO. P-228A
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 4-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; NX Rock Core Barrel

LOCATION: Sta. 483+49.7, 0.8' Rt.

COMPLETION DEPTH: 79.5' ELEVATION: 828.6 DATE: 11/30/99 - 12/1/99

DEPTH, FEET	SAMPLE NO.	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
40	4B		0.5-1.0									
	10	50-5"R										Very-dense dark-gray silt, little fine to medium sand.
45												
	11	50-3"R										Very-soft to soft gray shale.
50												Medium-hard gray sandy shale, nearly horizontally bedded, some bedding appears to dip but is most likely collapsed feature, highly fractured.
	12	NX REC 100% RQD 0%										
55												Interlayered grout, shale, and small voids.
	13	NX REC 79% RQD 16%										
60												Soft to medium-hard gray to dark-gray shale, interbedded with siltstone, nearly horizontally bedded, contains light-gray silty clay seams (flyash?), numerous horizontal and vertical fractures.
65	14	NX REC 91% RQD 13%										
70	15	NX REC 86% RQD 32%										
75												Very-soft gray shale (underclay).
												Soft to medium-hard gray shale.
80												

WATER LEVEL:	13.0					
WATER NOTE:	Before Coring					
DATE:	12/3/99					

BBC&M ENGINEERING, INC.

LOG OF BORING NO. P-228A
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 4-1/4" I.D. Hollow-stem Auger
2" O.D. Split-barrel Sampler
NX Rock Core Barrel

LOCATION: Sta. 483+49.7, 0.8' Rt.

COMPLETION DEPTH: 79.5' ELEVATION: 828.6 DATE: 11/30/99 - 12/1/99

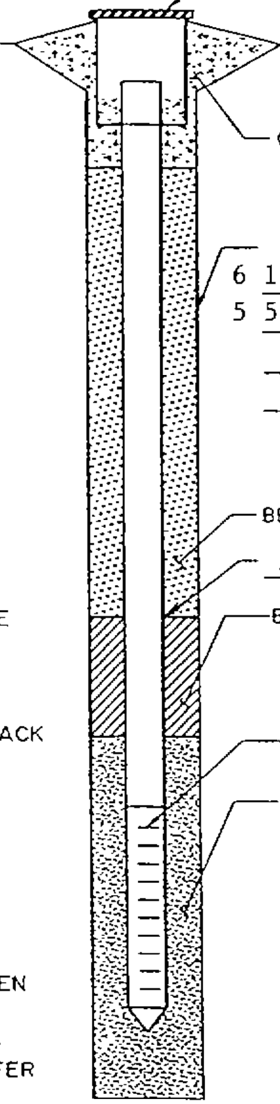
DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
80													- Encountered slight seepage 13.0' to 21.0' - Encountered seepage 21.0' to 43.0'. - Encountered water 43.0' to 48.0'. - Boring converted to groundwater monitoring well, see completion diagram.
85													
90													
95													
100													
105													
110													
115													
120													

WATER LEVEL:	13.0					
WATER NOTE:	Before Coring					
DATE:	12/3/99					

ODOT.LJ 17000030.GPJ BBCM.GDT 10/27/00

JOB: 7000.030

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
828.69	-0.1	TOP OF COVER
828.6	0.0	GROUND SURFACE
828.4	0.2	TOP OF PVC
827.7	1.0	TOP OF GROUT
766.0	62.7	TOP OF BENTONITE
759.3	69.3	TOP OF FILTER PACK
760.6	68.0	TOP OF AQUIFER
757.0	71.6	TOP OF SCREEN OPENINGS
753.1	75.5	BOTTOM OF SCREEN OPENINGS
752.3	76.3	BOTTOM OF WELL
754.1	74.5	BOTTOM OF AQUIFER
749.1	79.5	BORING DEPTH



9 - INCH DIAMETER PROTECTIVE STEEL COVER

GROUND SURFACE

CONCRETE

BORING DIAMETER
6 1/2" 0.0' to 51.0'
5 5/8" 51.0' to 79.5'
___" ___' to ___'
___" ___' to ___'

BENTONITE GROUT

2 - INCH DIAMETER PVC

BENTONITE CHIPS

10 - SLOT SCREEN

FILTER PACK: #4 Sand

WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: GUE - 70 - 14.10

BORING: P-228A

DATE WELL INSTALLED: 12/1/99

BBC & M PROJECT NO: 7000.03

STATIC WATER LEVEL *	18.79			
DATE:	1/5/00			

WELL DEVELOPMENT: 30 Gals. purged, nearly clear water

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

DNR 7802 92
TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources, Divison of Water
1939 Fountain Square Drive, Columbus, Ohio 43224 Phone (614) 265-6739

760614

Permit Number ______

COUNTY Guernsey TOWNSHIP Center SECTION/LOT No. 18 (CIRCLE ONE)

OWNER/BUILDER (CIRCLE ONE OR BOTH) ODOT PROPERTY ADDRESS (ADDRESS OF WELL LOCATION) Station 483+49.7, 0.8 Rt

LOCATION OF PROPERTY Mile Marker 184 on I-70

CONSTRUCTION DETAILS

CASING
X Diameter 2 in Length 76.1 ft. Borehole Diameter 5 5/8 in. Wall Thickness 1/8 in.
2 Diameter ____ in Length ____ ft. Wall Thickness ____ in.
Type: Steel / Galv. / X PVC / Other ____
Joints: X Threaded / Welded / Solvent / Other ____
Liner: Length – Type – Wall Thickness – in

GROUT
Material Benseal Volume used ____
Method of installation Tremmie
Depth placed from 1.0 ft to 69.3 ft

GRAVEL PACK (Filter Pack)
Material #4 Sand Volume used ____
Method of installation ~~69.3~~
Depth placed from 69.3 ft to 79.5 ft.

SCREEN
Type (wire wrapped, louvered, etc.) machine slotted Material PVC
Length ____ ft Diameter ____ in.
Set between 71.6 ft. and 75.5 ft Slot #20

Pitless Device ☐ Adapter ☐ Preassembled unit
Use of Well Ground water monitoring
X Rotary ☐ Cable ☐ Augered ☐ Driven ☐ Dug ☐ Other ____
Date of Completion 12-1-99

WELL LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Show color, texture, hardness, and formation sandstone, shale, limestone, gravel, clay, sand, etc.

	From	To
Topsoil	0.0	0.4
Brown / Gray Silty Clay	0.4	43.0
Gray Silt, Sand	43.0	48.0
Gray Shale	48.0	56.5
Grout, Shale, Voids	56.5	61.5
Gray Shale	61.5	75.0
under Clay	75.0	76.0
Gray Shale	76.0	79.5
		↑ End

X Seepage 13.0 43.0

X Water 43.0 - 48.0

*If additional space is needed to complete well log, use next consecutively numbered form

WELL TEST

☐ Bailing ☐ Pumping* ☐ Other ____
Test rate ____ gpm Duration of test ____ hrs.
Drawdown ____ ft
Measured from: X top of casing ☐ ground level ☐ Other ____
Static Level (depth to water) 18.79 ft. Date: 01-05-00
Quality (clear, cloudy, taste, odor) ____

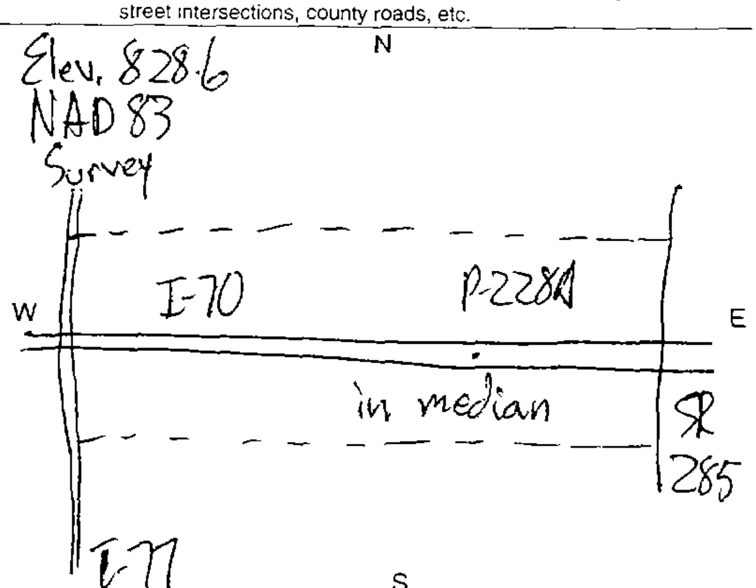
*(Attach a copy of the pumping test record, per section 1521.05, ORC)

PUMP

Type of pump – Capacity – gpm
Pump set at – ft
Pump installed by –

SKETCH SHOWING WELL LOCATION

Show distances well lies from numbered state highways, street intersections, county roads, etc.



I hereby certify the information given is accurate and correct to the best of my knowledge

Drilling Firm BBC&M Engineering
Address 6190 Enterprise Ct.
City, State, Zip Dublin, OH 43016

Signed ____
Date 04-26-02
ODH Registration Number 02504

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224

Blue - Customer's copy Pink - Driller's copy Green - Local Health Dept. copy

BBC&M ENGINEERING, INC.

LOG OF BORING NO. P-228B
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 4-1/4" I.D. Hollow-stem Auger

LOCATION: Sta. 483+52.7, 0.8' Rt.

COMPLETION DEPTH: 48.2' ELEVATION: 828.3 DATE: 12/3/99

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0													- Boring drilled for installation of monitoring well P-228B, see completion diagram. - No samples collected, see log of boring P-228A.
5													
10													
15													
20													
25													
30													
35													
40													

WATER LEVEL:
WATER NOTE:
DATE:

ODOTLJ 17000030.GPJ BBCM.GDT 10/27/00

JOB: 7000.030

-CONTINUED-

BBC&M ENGINEERING, INC.

LOG OF BORING NO. P-228B
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 4-1/4" I.D. Hollow-stem Auger

LOCATION: Sta. 483+52.7, 0.8' Rt.

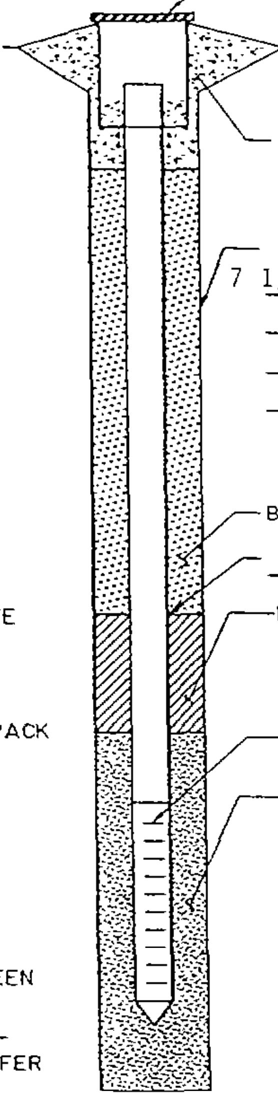
COMPLETION DEPTH: 48.2' ELEVATION: 828.3 DATE: 12/3/99

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
40													- Boring drilled for installation of monitoring well P-228B, see completion diagram. - No samples collected, see log of boring P-228A.
45													
50													
55													
60													
65													
70													
75													
80													

WATER LEVEL:
WATER NOTE:
DATE:

JOB: 7000.030

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
828.46	-0.2	TOP OF COVER
828.3	0.0	GROUND SURFACE
828.15	0.2	TOP OF PVC
827.4	1.0	TOP OF GROUT
794.6	33.8	TOP OF BENTONITE
791.3	37.0	TOP OF FILTER PACK
789.8	38.5	TOP OF AQUIFER
785.0	43.3	TOP OF SCREEN OPENINGS
781.1	47.2	BOTTOM OF SCREEN OPENINGS
780.2	48.1	BOTTOM OF WELL
780.1	48.2	BOTTOM OF AQUIFER
780.1	48.2	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: GUE - 70 - 14.10

BORING: P-228B

DATE WELL INSTALLED: 12/3/99

BBC & M PROJECT NO: 7000.03

STATIC WATER LEVEL *	19.18			
DATE:	1/5/00			

WELL DEVELOPMENT: 7 Gals. purged, very silty water

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

DNR 7802 92
TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources, Division of Water
1939 Fountain Square Drive, Columbus, Ohio 43224 Phone (614) 265-6739

760615

Permit Number ______

COUNTY Guernsey TOWNSHIP Center SECTION/LOT No 18 (CIRCLE ONE)

OWNER/BUILDER (CIRCLE ONE OR BOTH) ODOT PROPERTY ADDRESS (ADDRESS OF WELL LOCATION A) Station 483+52.7, 0.8Rt

LOCATION OF PROPERTY Mile Marker 184 on I-70

CONSTRUCTION DETAILS

CASING Borehole Diameter 7 1/2 in.

X 1 Diameter 2 in. Length 47.9 ft Wall Thickness 1/8 in.

2 Diameter ______ in. Length ______ ft Wall Thickness ______ in.

Type: 1/2 Steel; 1/2 Galv.; X PVC; 1/2 Other ______

Joints: X Threaded; 1/2 Welded; 1/2 Solvent; 1/2 Other ______

Liner: Length — Type — Wall Thickness — in.

SCREEN

Type (wire wrapped, louvered, etc.) Machine slotted Material PVC

Length 3.9 ft. Diameter 2 in.

Set between 43.3 ft. and 47.2 ft. Slot #20

GROUT Material Benseal Volume used ______

Method of installation tremmie

Depth: placed from 1.0 ft. to 37.0 ft

GRAVEL PACK (Filter Pack)

Material #4 Sand Volume used ______

Method of installation ______

Depth: placed from 37.0 ft. to 48.2 ft.

Pitless Device ☐ Adapter ☐ Preassembled unit

Use of Well Groundwater monitoring

☐ Rotary ☐ Cable X Augered ☐ Driven ☐ Dug ☐ Other ______

Date of Completion 12-3-99

WELL LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Show color, texture, hardness, and formation sandstone, shale, limestone, gravel, clay, sand, etc

	From	To
Topsoil	0.0	0.4
Brown/Gray Silty Clay	0.4	43.0
Gray Silt, Sand	43.0	48.0
~~[illegible]~~	~~48.0~~	

* Water @ 43.0-48.0

WELL TEST

☐ Bailing ☐ Pumping* ☐ Other ______

Test rate ______ gpm Duration of test ______ hrs.

Drawdown ______ ft.

Measured from: X top of casing ☐ ground level ☐ Other ______

Static Level (depth to water) 19.18 ft Date: 01-05-00

Quality (clear, cloudy, taste, odor) ______

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

PUMP

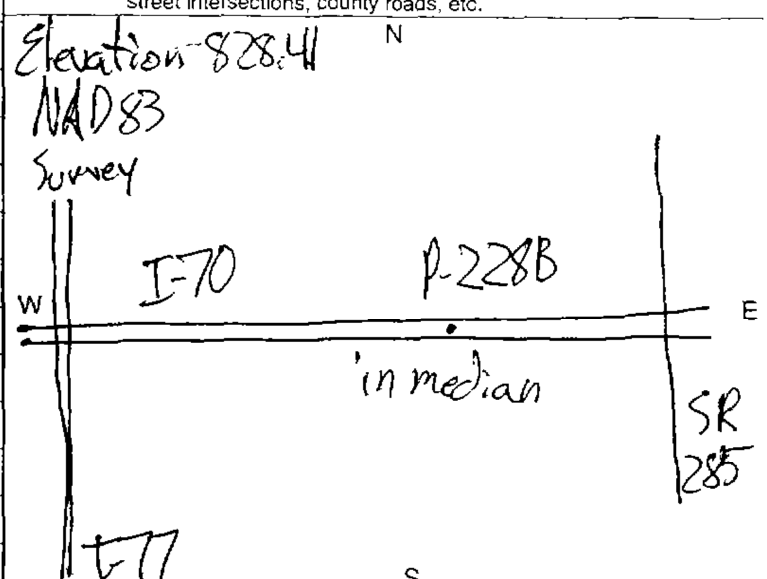
Type of pump — Capacity — gpm

Pump set at — ft.

Pump installed by —

SKETCH SHOWING WELL LOCATION

Show distances well lies from numbered state highways, street intersections, county roads, etc.



*If additional space is needed to complete well log, use next consecutively numbered form

Drilling Firm BBC+M Engineering

Address 6190 Enterprise Ct.

City, State, Zip Dublin, OH 43026

I hereby certify the information given is accurate and correct to the best of my knowledge

Signed ______

Date 04-26-02

ODH Registration Number 02504

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224

BBC&M ENGINEERING, INC.

LOG OF BORING NO. P-228C
GUE - 70 - 14.10
GUERNSEY COUNTY, OHIO

TYPE: 4-1/4" I.D. Hollow-stem Auger

LOCATION: Sta. 483+46.2, 0.7' Rt.

COMPLETION DEPTH: 30.0' ELEVATION: 828.6 DATE: 12/8/99

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0													- Boring drilled for installation of monitoring well P-228C, see completion diagram. - No samples collected, see log of boring P-228A.
5													
10													
15													
20													
25													
30													
35													
40													

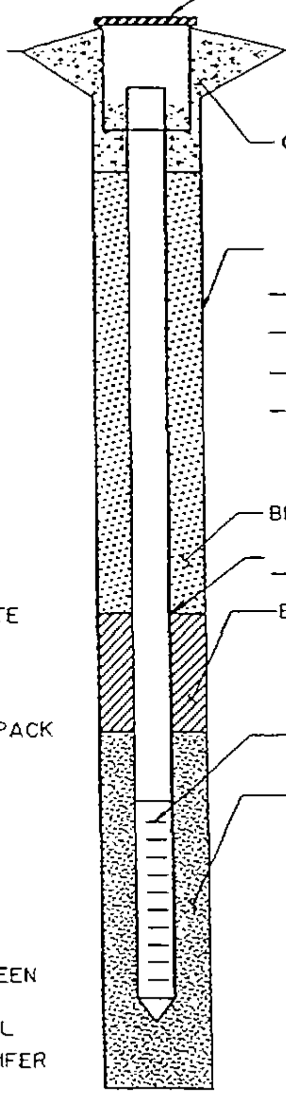
WATER LEVEL:

WATER NOTE:

DATE:

JOB: 7000.030

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
828.71	-0.1	TOP OF COVER
828.6	0.0	GROUND SURFACE
828.41	0.2	TOP OF PVC
827.7	1.0	TOP OF GROUT
810.0	18.7	TOP OF BENTONITE
805.6	23.0	TOP OF FILTER PACK
802.6	26.0	TOP OF AQUIFER
803.7	24.9	TOP OF SCREEN OPENINGS
798.9	29.7	BOTTOM OF SCREEN OPENINGS
798.6	30.0	BOTTOM OF WELL
801.6	27.0	BOTTOM OF AQUIFER
798.6	30.0	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME: GUE - 70 - 14.10

BORING: P-228C

DATE WELL INSTALLED: 12/8/99

BBC & M PROJECT NO 7000.03

STATIC WATER LEVEL *	13.66			
DATE:	1/5/00			

WELL DEVELOPMENT: 10 Gals. purged, very silty water

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

DNR 7802 92
TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources, Divison of Water
1939 Fountain Square Drive, Columbus, Ohio 43224 Phone (614) 265-6739

760616
Permit Number

COUNTY Guernsey TOWNSHIP Center SECTION/LOT No. (CIRCLE ONE) 18

OWNER/BUILDER (CIRCLE ONE OR BOTH) ODOT PROPERTY ADDRESS (ADDRESS OF WELL LOCATION) Station 483+46.2, 0.7Rt

LOCATION OF PROPERTY Mile Marker 184 on I-70

CONSTRUCTION DETAILS

CASING Borehole Diameter 6 1/2 in.
[1] Diameter 2 in Length ___ ft Wall Thickness 18 in.
[2] Diameter ___ in Length ___ ft. Wall Thickness ___ in

Type: [1][2] Steel [1][2] Galv [X] PVC [1][2] Other ___
Joints [X] Threaded [1][2] Welded [1][2] Solvent [1][2] Other ___
Liner: Length — Type — Wall Thickness — in.

SCREEN
Type (wire wrapped, louvered, etc.) machine Slotted Material PVC
Length 4.8 ft. Diameter 2 in
Set between 24.9 ft. and 29.7 ft. Slot #20

GROUT
Material Benseal Volume used ___
Method of installation tremmie
Depth, placed from 1.0 ft. to 23.0 ft.

GRAVEL PACK (Filter Pack)
Material #4 Sand Volume used ___
Method of installation ___
Depth placed from 23.0 ft. to 30.0 ft

Pitless Device ☐ Adapter ☐ Preassembled unit
Use of Well Groundwater Monitoring
☐ Rotary ☐ Cable ☒ Augered ☐ Driven ☐ Dug ☐ Other ___
Date of Completion 12-08-99

WELL LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc.	From	To
Topsoil	0.0	0.4
Brown / Gray Silty Clay	0.4	30.0
		End
* encountered water @ 21.0		

*If additional space is needed to complete well log, use next consecutively numbered form

WELL TEST

☐ Bailing ☐ Pumping* ☐ Other ___
Test rate ___ gpm Duration of test ___ hrs.
Drawdown ___ ft.
Measured from: ☒ top of casing ☐ ground level ☐ Other ___
Static Level (depth to water) 13.66 ft. Date: 01-05-00
Quality (clear, cloudy, taste, odor) ___

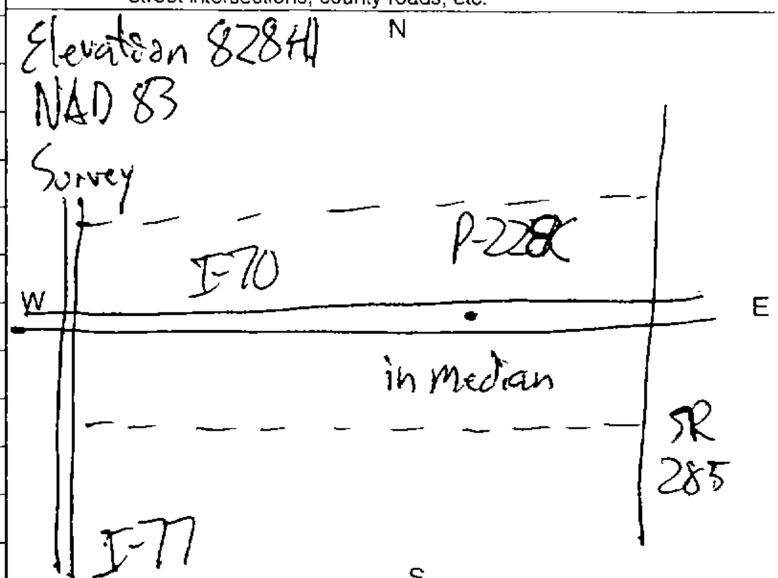
*(Attach a copy of the pumping test record, per section 1521 05, ORC)

PUMP

Type of pump — Capacity — gpm
Pump set at — ft.
Pump installed by —

SKETCH SHOWING WELL LOCATION

Show distances well lies from numbered state highways, street intersections, county roads, etc.



Drilling Firm BBC&M Engineering
Address 6190 Enterprise Ct.
City, State, Zip Dublin, OH 43016

I hereby certify the information given is accurate and correct to the best of my knowledge
Signed ___
Date 04-26-00
ODH Registration Number 02504

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224

BBCM

LOG OF BORING NO. P-301A
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; NX Rock Core Barrel

LOCATION: Sta. 468+76, 129' Lt.

COMPLETION DEPTH: 63.0' ELEVATION: 816.1 DATE: 4/26/01 - 4/27/01

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY
	1	3/4/6	1.4-2.6								
	2A	2/5/9	0.5-1.5								
	2B		2.4-3.4								
	3	2/3/3	0.5-1.5								
	4	3/4/6									
	5	4/8/13	2.2-3.1								
	6	4/6/10	1.4-2.4								
	7	3/5/8	1.5-2.6								
	8	18/24/14					39	20	17	24	
	9	2/14/14	0.6-0.9								
	10	18/38/50-3"R	4.5+								

DESCRIPTION

TOPSOIL - 3 INCHES

Stiff to very-stiff brown mottled with gray silty clay, trace fine to coarse sand.

Medium-stiff to stiff brown mottled with gray silty clay, little fine to coarse sand.

Very-stiff brown mottled with gray silty clay, little fine to coarse sand.

Medium-stiff to stiff brown mottled with gray becoming gray silty clay, little fine to coarse sand, trace fine gravel (coal fragments).

Loose gray fine to medium sand, trace coarse sand, trace fine to coarse gravel, little silt.

Very-stiff brown silty clay, trace fine to coarse sand.

Stiff to very-stiff brown becoming gray silty clay, little fine to coarse sand, trace fine gravel, sandstone, siltstone and shale fragments

Dense brown and gray fine to coarse sand, some clayey silt, some fine to coarse gravel.

Medium-stiff gray clayey silt, little fine sand.

Hard gray silty clay, little fine to coarse sand, trace fine to coarse gravel.

WATER LEVEL: 3.0

WATER NOTE:

DATE: 4/26/01

ODOTLJ 17000090.GPJ BBCM.GDT 12/13/02

JOB: 01107000.090

-CONTINUED-

BBCM

LOG OF BORING NO. P-301A
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; NX Rock Core Barrel

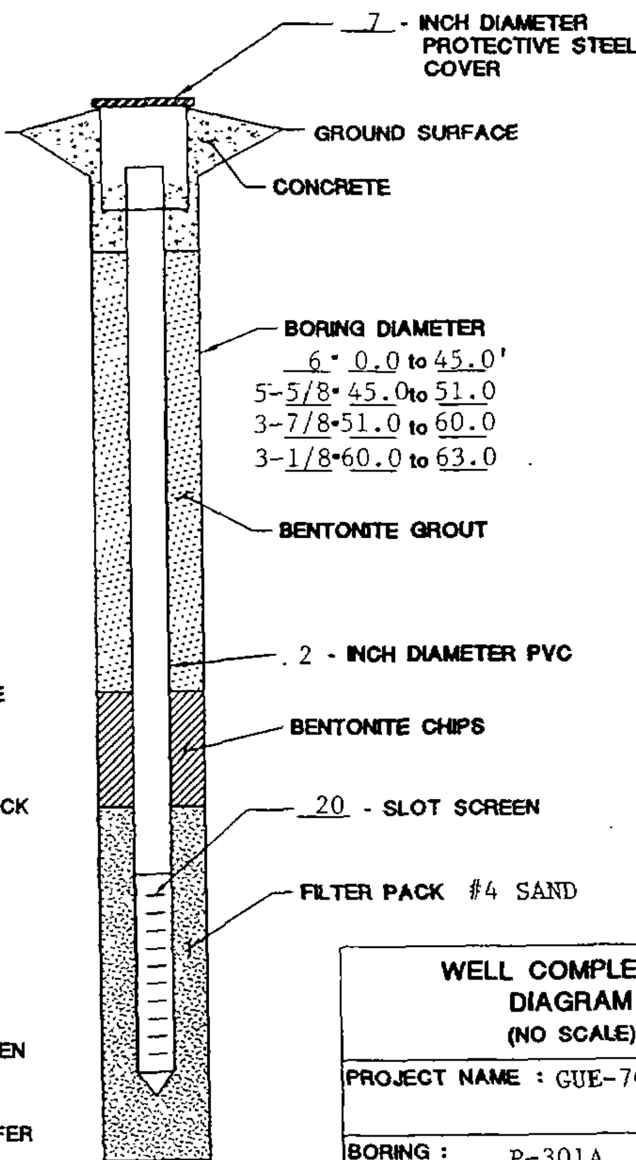
LOCATION: Sta. 468+76, 129' Lt.

COMPLETION DEPTH: 63.0' ELEVATION: 816.1 DATE: 4/26/01 - 4/27/01

DEPTH, FEET	SAMPLE NO	SAMPLES / SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
45		NX REC 96% RQD 14%										Soft to medium-hard gray shale, nearly horizontally bedded, numerous horizontal fractures along bedding planes, interbedded with medium-hard gray sandstone.
50	11											
												COAL
55		NX REC 86% RQD 60%										
	12											Very-soft to soft gray shale, undulatory bedding, few fractures.
60												
65												- Encountered water at 13.0'.
												- 6" steel casing from 0.0' to 45.0'.
												- Used 5-7/8" Tricone bit from 45.0' to 51.0'
70												- Used 3-7/8" Tricone bit from 51.0' to 60.0'.
												- Offset well at 17.0', 2.0' down station, labeled P-301B.
75												
80												
85												
90												

WATER LEVEL: 3.0
WATER NOTE:
DATE: 4/26/01

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
816.0	0.1	TOP OF COVER
816.1	0.0	GROUND SURFACE
815.7	0.3	TOP OF PVC
815.1	1.0	TOP OF GROUT
770.0	46.1	TOP OF BENTONITE
766.1	50.0	TOP OF FILTER PACK
765.1	51.0	TOP OF AQUIFER
764.0	52.1	TOP OF SCREEN OPENINGS
759.2	56.9	BOTTOM OF SCREEN OPENINGS
758.8	57.3	BOTTOM OF WELL
758.1	58.0	BOTTOM OF AQUIFER
753.1	63.0	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME : GUE-70-14.10

BORING : P-301A

DATE WELL INSTALLED : 04/27/01

BBC & M PROJECT NO : 01107000.090

STATIC WATER LEVEL *	7.73			
DATE:	5/21/01			

WELL DEVELOPMENT :

* FEET ABOVE MSL

BBC&M DRAWING NO: TCAMWEL6.DWG

BBC&M ENGINEERING, INC.

DNR 7802 92
TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources, Divison of Water
1939 Fountain Square Drive, Columbus, Ohio 43224 Phone (614) 265-6739

760617
Permit Number

COUNTY Guernsey TOWNSHIP Center SECTION/LOT No. (CIRCLE ONE) 18

OWNER/BUILDER (CIRCLE ONE OR BOTH) ODOT PROPERTY ADDRESS Station 467+86 (ADDRESS OF WELL LOCATION A)

LOCATION OF PROPERTY Mile Marker 184 on I-70

CONSTRUCTION DETAILS

CASING 2 Borehole Diameter 3 1/8 in.
X Diameter 2 in. Length 57.9 ft Wall Thickness 1/8 in.
2 Diameter ___ in Length ___ ft Wall Thickness ___ in.
Type. 1 Steel 1 Galv X PVC 1 2 Other
Joints. X Threaded 1 Welded 1 Solvent 1 2 Other
Liner. Length — Type — Wall Thickness — in.

SCREEN
Type (wire wrapped, louvered, etc.) Machine slotted Material PVC
Length 4.8 ft. Diameter 2 in
Set between 52.1 ft. and 56.9 ft. Slot #20

GROUT
Material Bentonite Volume used ___
Method of installation tremmie
Depth placed from 1.0 ft. to ~~63.0~~ 50.0 ft.

GRAVEL PACK (Filter Pack)
Material #4 Sand Volume used ___
Method of installation ___
Depth: placed from 50.0 ft to 63.0 ft.

Pitless Device ☐ Adapter ☐ Preassembled unit
Use of Well Groundwater monitoring
X Rotary ☐ Cable ☐ Augered ☐ Driven ☐ Dug ☐ Other
Date of Completion 04-27-01

WELL LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED

Show color, texture, hardness, and formation, sandstone, shale, limestone, gravel, clay, sand, etc.	From	To
Topsoil	0.0	0.3
Brown / Gray Silty Clay	0.3	13.0
~~Ex~~ Gray Sand, Gravel, Silt.	13.0	16.0
Brown / Gray Silty Clay	16.0	31.0
Gray Sand, Clayey Silt, Gravel	31.0	36.0
Gray Clay, Silt, Sand, Gravel	36.0	45.0
Gray Shale	45.0	51.0
Coal	51.0	58.5
underclay	58.5	63.0
		End

* Encountered water 13.0

*If additional space is needed to complete well log, use next consecutively numbered form.

WELL TEST

☐ Bailing ☐ Pumping* ☐ Other
Test rate ___ gpm Duration of test ___ hrs.
Drawdown ___ ft.
Measured from. X top of casing ☐ ground level ☐ Other
Static Level (depth to water) 7.73 ft Date: 05-21-01
Quality (clear, cloudy, taste odor)

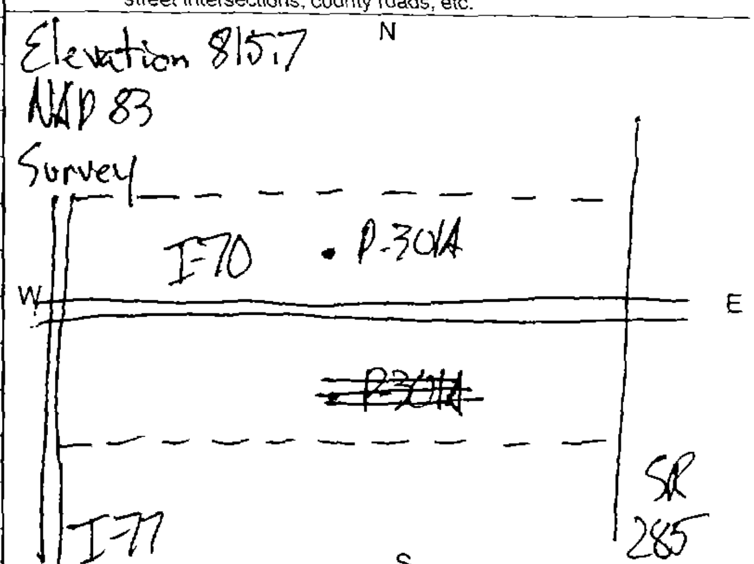
*(Attach a copy of the pumping test record, per section 1521 05, ORC)

PUMP

Type of pump — Capacity — gpm
Pump set at — ft
Pump installed by —

SKETCH SHOWING WELL LOCATION

Show distances well lies from numbered state highways, street intersections, county roads, etc.



Drilling Firm BBC+M Engineering
Address 6190 Enterprise Ct.
City, State, Zip Dublin, OH ~~43022~~ 43016

I hereby certify the information given is accurate and correct to the best of my knowledge.
Signed ___
Date 05-02-02
ODH Registration Number 02504

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224

BBCM

LOG OF BORING NO. P-301B
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 4-1/4" I.D. Hollow-stem Auger

LOCATION: Sta. 468+74, 129' Lt.

COMPLETION DEPTH: 17.0' ELEVATION: 816.2 DATE: 4/30/01

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER	MOISTURE CONTENT	LIQUID LIMIT	PLASTIC LIMIT	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
				tsf	%	%	%						
0													- Boring drilled for installation of monitoring well P-301B. See completion diagram. - No samples collected see log of boring P-301A.
5													
10													
15													
20													
25													
30													
35													
40													

WATER LEVEL:

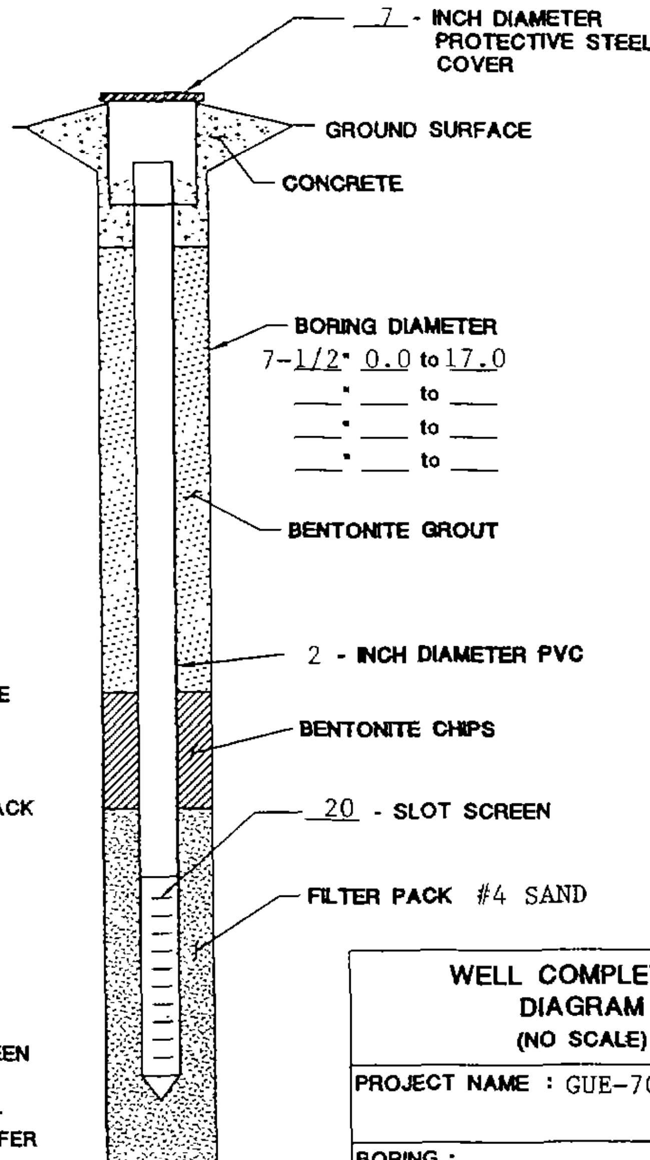
WATER NOTE:

DATE:

JOB: 01107000.090

ODOTLJ 17000090.GPJ BBCM.GDT 12/13/02

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
816.1	0.1	TOP OF COVER
816.2	0.0	GROUND SURFACE
815.8	0.4	TOP OF PVC
815.2	1.0	TOP OF GROUT
809.5	6.7	TOP OF BENTONITE
806.5	9.7	TOP OF FILTER PACK
805.2	11.0	TOP OF AQUIFER
804.9	11.3	TOP OF SCREEN OPENINGS
800.1	16.1	BOTTOM OF SCREEN OPENINGS
799.8	16.4	BOTTOM OF WELL
800.2	16.0	BOTTOM OF AQUIFER
799.2	17.0	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME : GUE-70-14.10

BORING : P-301B

DATE WELL INSTALLED : 4/30/01

BBC & M PROJECT NO : 01107000.090

STATIC WATER LEVEL *	2.36			
DATE:	5/21/01			

WELL DEVELOPMENT :

* FEET ABOVE MSL

BBC&M DRAWING NO: TCAMWEL80WG

BBC&M ENGINEERING, INC.

DNR 7802 92
TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources, Divison of Water
1939 Fountain Square Drive, Columbus, Ohio 43224 Phone (614) 265-6739

760618
Permit Number

COUNTY Guernsey TOWNSHIP Center SECTION/LOT No. 18 (CIRCLE ONE)

OWNER/BUILDER (CIRCLE ONE OR BOTH) ODOT PROPERTY ADDRESS (ADDRESS OF WELL LOCATION) Station, ~~[illegible]~~ 46+84, 1294

LOCATION OF PROPERTY Mile Marker 184 on I-70

CONSTRUCTION DETAILS

CASING Borehole Diameter 7 1/2 in
X 1 Diameter 2 in. Length 17.0 ft. Wall Thickness 1/8 in.
2 Diameter ___ in Length ___ ft Wall Thickness ___ in
Type: 1/2 Steel; 1/2 Galv.; X PVC; 1/2 Other
Joints: X Threaded; 1/2 Welded; 1/2 Solvent; 1/2 Other
Liner Length — Type — Wall Thickness — in.

SCREEN
Type (wire wrapped, louvered, etc.) machine Slotted Material PVC
Length 4.8 ft Diameter 2 in
Set between 11.3 ft. and 16.1 ft. Slot #20

GROUT
Material Benseal Volume used
Method of installation tremmie
Depth: placed from 1.0 ft to 6.7 ft

GRAVEL PACK (Filter Pack)
Material #4 Sand Volume used
Method of installation
Depth: placed from 9.7 ft. to 17.0 ft.

Pitless Device ☐ Adapter ☐ Preassembled unit
Use of Well Ground water monitoring
☐ Rotary ☐ Cable X Augered ☐ Driven ☐ Dug ☐ Other
Date of Completion 04-30-01

WELL LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc	From	To
Topsoil	0.0	0.3
Brown / Gray Silty Clay	0.3	13.0
Gray Sand Gravel Silt	13.0	16.0
Brown / Gray Silty Clay	16.0	17.0
		End
* Encountered water @ 13.0		

*If additional space is needed to complete well log, use next consecutively numbered form

WELL TEST

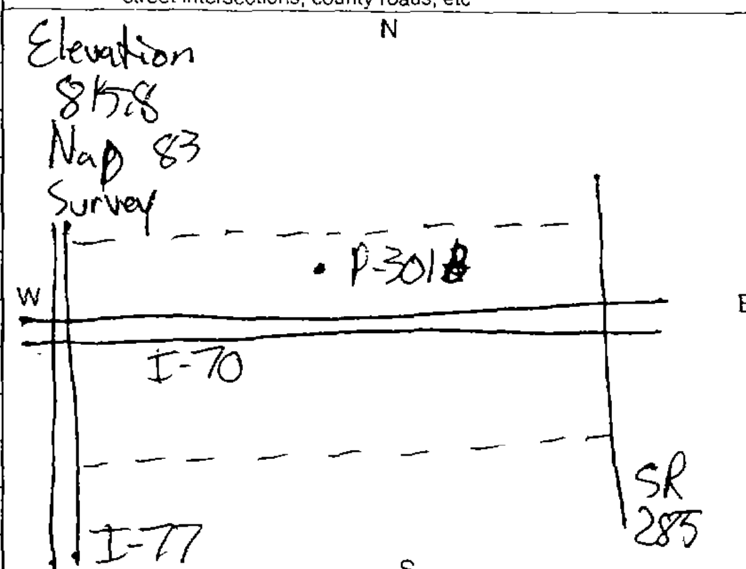
☐ Bailing ☐ Pumping* ☐ Other
Test rate ___ gpm Duration of test ___ hrs.
Drawdown ___ ft.
Measured from: X top of casing ☐ ground level ☐ Other
Static Level (depth to water) ~~[illegible]~~ 2.36 ft. Date 05-21-01
Quality (clear, cloudy, taste, odor)
*(Attach a copy of the pumping test record, per section 1521.05, ORC)

PUMP

Type of pump — Capacity — gpm
Pump set at — ft.
Pump installed by —

SKETCH SHOWING WELL LOCATION

Show distances well lies from numbered state highways, street intersections, county roads, etc



I hereby certify the information given is accurate and correct to the best of my knowledge

Drilling Firm BBC&M Engineering
Address 6190 Enterprise Ct.
City, State, Zip Dublin, OH 43016

Signed
Date ~~[illegible]~~ 06-12-02
ODH Registration Number 02504

Completion of this form is required by section 1521 05, Ohio Revised Code - file within 30 days after completion of drilling

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224

BBCM

LOG OF BORING NO. P-302A
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; NX Rock Core Barrel

LOCATION: Sta. 469+80, 137' Rt.

COMPLETION DEPTH: 68.3' ELEVATION: 816.4 DATE: 4/9/01 - 4/19/01

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S	SILT	CLAY	DESCRIPTION
0												TOPSOIL - 4 INCHES
												Fill or possible mine spoils, very-soft to soft brown clayey silt, little fine to coarse sand, trace fine to coarse gravel (coal fragments).
	1A	W/H/1/1	0.25-0.3									
	1B		0.25-0.3									Fill or possible mine spoils, very-soft to soft gray silty clay with pockets of clayey silt, little fine to coarse sand, trace fine to coarse gravel (coal fragments).
5												
	2	2/3/2	0.25-0.5	18	29	19	6	15	37	26	16	Loose dark-brown and gray fine to medium sand, trace coarse sand, trace fine gravel, "and" clayey silt.
	3	1/2/3					40	13	18	29		Loose brown and gray fine to coarse sand, some silty clay, some fine to coarse gravel.
10												Medium-dense brown and gray fine to coarse sand, some fine to coarse gravel, some silty clay.
	4	3/7/12										
15												
	5	9/11/14										
20												Medium-dense gray fine to coarse sand, some silty clay, some fine to coarse gravel.
	6	5/10/16					39	17	20	24		
25												Very-stiff gray silty clay, trace fine to coarse sand.
	7	4/9/13	2.9-3.1									
30												Medium-dense gray fine to coarse sand, "and" clayey silt, little fine to coarse gravel.
	8	9/17/42										
35												Soft to medium-hard gray shale, nearly horizontally bedded, interbedded with medium-hard gray sandstone.
	9	50-3"R										
40		NX REC 94% RQD 88%										Soft to medium-hard dark-gray shale, nearly horizontally bedded, occasional horizontal fractures along bedding planes, interbedded with medium-hard gray sandstone.
	10											
45												

WATER LEVEL: 4.0
WATER NOTE:
DATE: 4/9/01

ODOTLJ 17000090.GPJ BBCM.GDT 12/13/02

JOB: 01107000.090

-CONTINUED-

BBCM

LOG OF BORING NO. P-302A
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: **3-1/4" I.D. Hollow-stem Auger**; **2" O.D. Split-barrel Sampler**; **NX Rock Core Barrel**

LOCATION: **Sta. 469+80, 137' Rt.**

COMPLETION DEPTH: 68.3' **ELEVATION: 816.4** **DATE: 4/9/01 - 4/19/01**

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	DESCRIPTION - CONTINUED
45–55	11	NX REC 100% RQD 89%	Soft to medium-hard dark-gray shale, nearly horizontally bedded, occasional horizontal fractures along bedding planes, interbedded with medium-hard gray sandstone.
	12	NX REC 100% RQD 100%	
55–62		VOID	VOID
62–68.3	13	NX REC 46% RQD 26%	Very-soft to soft dark-gray becoming gray shale, undulatory bedding, few irregular fractures.

Column headings: HAND PENE-TROMETER (tsf); MOISTURE CONTENT (%); LIQUID LIMIT (%); PLASTIC LIMIT (%); AGG.; C.S.; F.S.; SILT; CLAY

- Encountered water at 8.0'.

- 6" PVC casing from 0.0' to 38.7'.

- Used 5-7/8" Tricone bit from 38.5' to 54.0'.

- Used 3-7/8" Tricone bit from 54.0' to 65.0'.

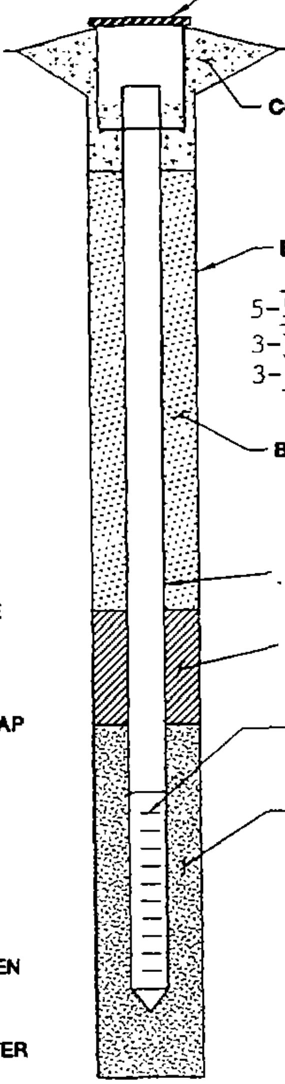
- Offset well at 14.2', 2.0' up station, labeled P-302B.

WATER LEVEL: 4.0
WATER NOTE:
DATE: 4/9/01

ODOTLJ 17000090.GPJ BBCM.GDJ 12/13/02

JOB: 01107000.090

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
816.9	-0.4	TOP OF COVER
816.5	0.0	GROUND SURFACE
816.5	0.0	TOP OF PVC
815.5	1.0	TOP OF GROUT
768.4	48.1	TOP OF BENTONITE
762.3	54.2	TOP OF SHALE TRAP
760.8	55.7	TOP OF AQUIFER
757.2	59.3	TOP OF SCREEN OPENINGS
752.4	64.1	BOTTOM OF SCREEN OPENINGS
752.0	64.5	BOTTOM OF WELL
754.2	62.3	BOTTOM OF AQUIFER
748.2	68.3	BORING DEPTH



7 - INCH DIAMETER PROTECTIVE STEEL COVER

GROUND SURFACE

CONCRETE

BORING DIAMETER
6 - 0.0 to 38.7
5-5/8 - 38.7 to 54.0
3-7/8 - 54.0 to 65.0
3-1/8 - 65.0 to 68.3

BENTONITE GROUT

2 - INCH DIAMETER PVC

BENTONITE CHIPS

20 - SLOT SCREEN

FILTER PACK NONE

WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME : GUE-70-14.10

BORING : P-302A

DATE WELL INSTALLED : 4/19/01

BBC & M PROJECT NO : 01107000.090

STATIC WATER LEVEL *	7.25			
DATE:	5/21/01			

WELL DEVELOPMENT :

* FEET ABOVE MSL

BBC&M DRAWING NO. TCAMWEL8.DWG

BBC&M ENGINEERING, INC.

DNR 7802 92
*TYPE OR USE PEN SELF TRANSCRIBING PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources, Divison of Water
1939 Fountain Square Drive, Columbus, Ohio 43224 Phone (614) 265-6739

760619
Permit Number ____

COUNTY Guernsey TOWNSHIP Center SECTION/LOT No (CIRCLE ONE) 18

OWNER/BUILDER (CIRCLE ONE OR BOTH) ODOT PROPERTY ADDRESS (ADDRESS OF WELL LOCATION A) Station ~~43~~ 469+80, 137RT

LOCATION OF PROPERTY Mile Marker 184 on I-70

CONSTRUCTION DETAILS

CASING Borehole Diameter 6" in.
X Diameter 2 in. Length 64.5 ft Wall Thickness 1/8 in
2 Diameter ____ in. Length ____ ft. Wall Thickness ____ in
Type: 1 2 Steel 1 2 Galv. X 2 PVC 1 2 Other ____
Joints: X 2 Threaded 1 2 Welded 1 2 Solvent 1 2 Other ____
Liner: Length — Type — Wall Thickness — in.

SCREEN
Type (wire wrapped, louvered, etc.) machine slotted Material PVC
Length 4.8 ft Diameter ____ in.
Set between 59.3 ft and 64.1 ft Slot #20

GROUT
Material Benseal Volume used ____
Method of installation Tremmie
Depth: placed from 1.0 ft. to 48.1 ft

GRAVEL PACK (Filter Pack)
Material #4 Sand Volume used ____
Method of installation ____
Depth placed from 54.2 ft. to 68.3 ft.

Pitless Device ☐ Adapter ☐ Preassembled unit
Use of Well Groundwater monitoring
☐ Rotary ☐ Cable X Augered ☐ Driven ☐ Dug ☐ Other ____
Date of Completion 04-19-01

WELL LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED

Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc.	From	To
Topsoil	0.0	0.3
Fill	0.3	5.5
Brown/Gray Sand, Gravel, Silt	5.5	26.0
Gray Silty Clay, Sand	26.0	31.0
Gray Sand, Clayey Silt, Gravel	31.0	37.0
Gray Shale	37.0	55.5
Void	55.5	62.5
Gray Claystone	62.5	68.3
		End

Water @ 8.0'

WELL TEST

☐ Bailing ☐ Pumping* ☐ Other ____
Test rate ____ gpm Duration of test ____ hrs
Drawdown ____ ft.
Measured from X top of casing ☐ ground level ☐ Other ____
Static Level (depth to water) 7.25 ft. Date 05-21-01
Quality (clear, cloudy, taste, odor) ____

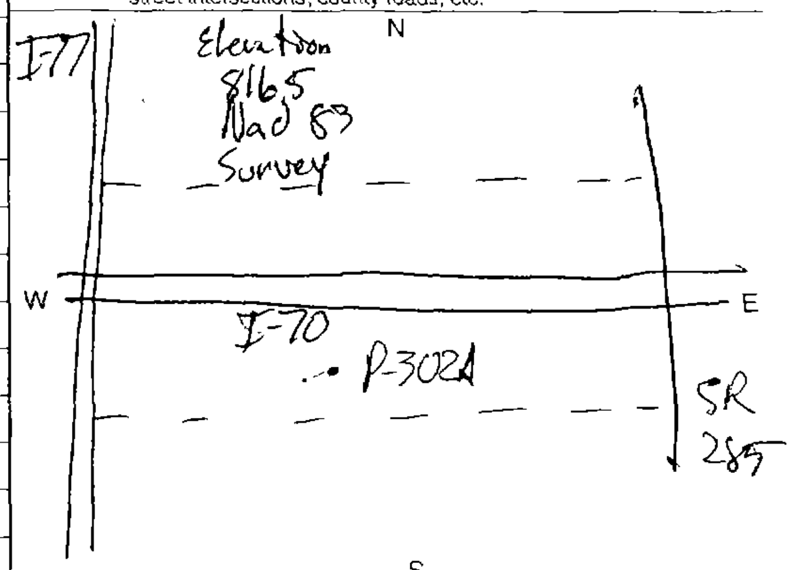
*(Attach a copy of the pumping test record, per section 1521 05, ORC)

PUMP

Type of pump — Capacity — gpm
Pump set at — ft.
Pump installed by —

SKETCH SHOWING WELL LOCATION

Show distances well lies from numbered state highways, street intersections, county roads, etc.



*If additional space is needed to complete well log, use next consecutively numbered form

Drilling Firm BBC&M Engineering
Address 6190 Enterprise Ct.
City, State, Zip Dublin, OH. 43016

I hereby certify the information given is accurate and correct to the best of my knowledge
Signed ____
Date 06-12-02
ODH Registration Number 02504

Completion of this form is required by section 1521 05, Ohio Revised Code - file within 30 days after completion of drilling.

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224

Blue - Customer's copy Pink - Driller's copy Green - Local Health Dept

BBCM

LOG OF BORING NO. P-302B
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE **4-1/4" I.D. Hollow-stem Auger** LOCATION **Sta. 469+82, 137' Rt.**

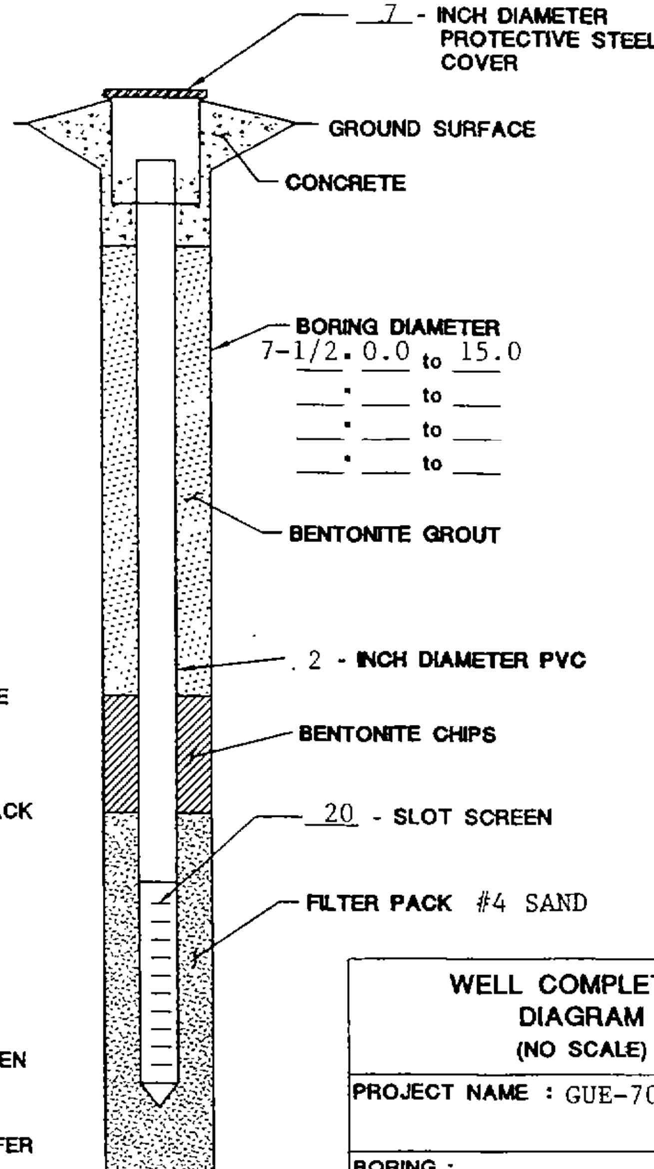
COMPLETION DEPTH: **14.2'** ELEVATION: **876.4** DATE: **4/19/01**

DEPTH, FEET	SAMPLE NO.	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C S	F.S.	SILT	CLAY	DESCRIPTION
0													- Boring drilled for installation of monitoring well P-302B. See completion diagram. - No samples collected see log of boring P-302A.
5													
10													
15													
20													
25													
30													
35													
40													

WATER LEVEL:
WATER NOTE:
DATE:

JOB: 01107000.090

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
816.5	-0.1	TOP OF COVER
816.4	0.0	GROUND SURFACE
816.3	0.1	TOP OF PVC
815.4	1.0	TOP OF GROUT
811.1	5.3	TOP OF BENTONITE
808.4	8.0	TOP OF FILTER PACK
808.4	8.0	TOP OF AQUIFER
807.4	9.0	TOP OF SCREEN OPENINGS
802.6	13.8	BOTTOM OF SCREEN OPENINGS
802.2	14.2	BOTTOM OF WELL
795.4	21.0	BOTTOM OF AQUIFER
801.4	15.0	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME : GUE-70-14.10

BORING : P-302B

DATE WELL INSTALLED : 4/19/01

BBC & M PROJECT NO : 01107000.090

STATIC WATER LEVEL *	2.03			
DATE:	5/21/01			

WELL DEVELOPMENT :

* FEET ABOVE MSL

BBC&M DRAWING NO: TCAMWELB.DWG

BBC&M ENGINEERING, INC.

DNR 7802 92
TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

760620

Ohio Department of Natural Resources, Divison of Water
1939 Fountain Square Drive, Columbus, Ohio 43224 Phone (614) 265-6739

Permit Number

COUNTY Guernsey County TOWNSHIP Center SECTION/LOT No. 18 (CIRCLE ONE)

OWNER/BUILDER (CIRCLE ONE OR BOTH) ODOT PROPERTY ADDRESS Station 469+82, 137' Rt. (ADDRESS OF WELL LOCATION)

LOCATION OF PROPERTY Mile Marker 184 on I-70

CONSTRUCTION DETAILS

CASING Borehole Diameter 7 1/2 in.
X 1 Diameter 2 in Length 14.2 ft Wall Thickness 1/8 in.
2 Diameter in Length ft Wall Thickness in

Type: Steel Galv X PVC Other

Joints: X Threaded Welded Solvent Other

Liner: Length — Type — Wall Thickness — in

SCREEN
Type (wire wrapped, louvered, etc.) Machine Slotted Material PVC
Length 4.8 ft. Diameter 2 in.
Set between 9.0 ft. and 13.8 ft Slot 20

GROUT
Material Benseal Volume used
Method of installation tremmie
Depth placed from 1.0 ft. to 5.3 ft.

GRAVEL PACK (Filter Pack)
Material #4 Sand Volume used
Method of installation
Depth: placed from 8.0 ft. to 15.0 ft.

Pitless Device ☐ Adapter ☐ Preassembled unit

Use of Well Ground water Monitoring

☐ Rotary ☐ Cable X Augered ☐ Driven ☐ Dug ☐ Other

Date of Completion 04-19-01

WELL LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED

Show color, texture, hardness, and formation sandstone, shale, limestone, gravel, clay, sand, etc.

	From	To
~~Topsoil~~	~~0.0~~	~~0.3~~
~~Brown/Gray Silty Clay~~	~~0.3~~	~~13.0~~
~~Gray Sand Gravel Silt~~	~~13.0~~	~~15.0~~
Topsoil	0.0	0.3
Fill	0.3	5.5
Brown/Gray Sand, Gravel, Silt	5.5	15.0
		End
Encountered water @ 8.0		

WELL TEST

☐ Bailing ☐ Pumping* ☐ Other

Test rate gpm Duration of test hrs.

Drawdown ft.

Measured from: X top of casing ☐ ground level ☐ Other

Static Level (depth to water) 2.03 ft. Date:

Quality (clear, cloudy, taste, odor)

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

PUMP

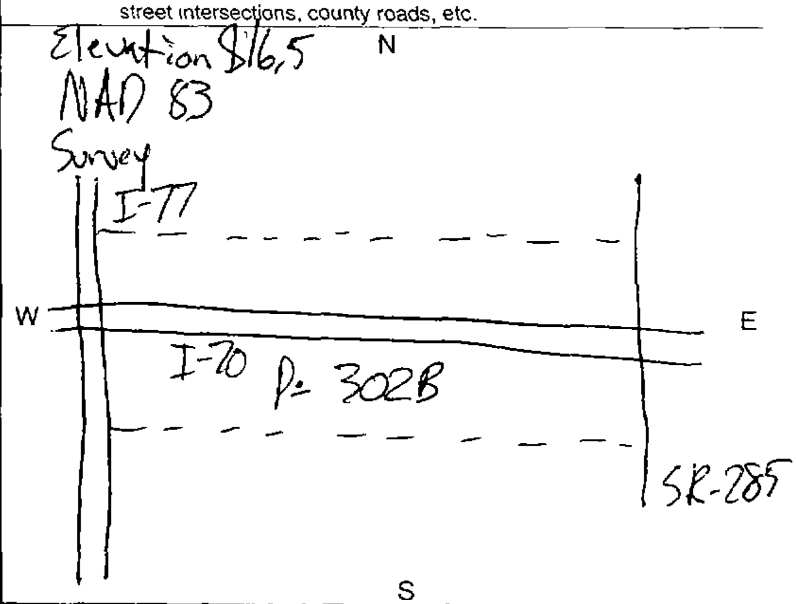
Type of pump Capacity gpm

Pump set at ft.

Pump installed by

SKETCH SHOWING WELL LOCATION

Show distances well lies from numbered state highways, street intersections, county roads, etc.



*If additional space is needed to complete well log, use next consecutively numbered form

Drilling Firm BBCM Engineering

Address 6190 Enterprise Ct.

City, State, Zip Dublin, OH 43016

I hereby certify the information given is accurate and correct to the best of my knowledge.

Signed

Date 04-25-02

ODH Registration Number 02504

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling

ORIGINAL COPY TO - ODNR DIVISION OF WATER 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224

BBCM

LOG OF BORING NO. P-303A
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; NX Rock Core Barrel

LOCATION: Sta. 474+49, 124' Lt.

COMPLETION DEPTH: 73.0' ELEVATION: 823.4 DATE: 4/30/01 - 5/2/01

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0												TOPSOIL - 4 INCHES
												Stiff to very-stiff brown mottled with gray silty clay, little fine to medium sand, contains many lenses of fine to medium sand.
	1	4/7/10	1.6-2.7									
5												
	2	3/6/6	1.2-2.9									
												Very-soft to medium-stiff brown mottled with gray silty clay interbedded with silt, little fine to coarse sand.
	3	2/2/4	0.4-0.7									
10												
												Medium-stiff to stiff gray silty clay, trace fine to medium sand, occasional pockets of very-stiff material.
	4	1/4/5	0.5-2.2									
15												
												Stiff to very-stiff gray silty clay, trace fine to coarse sand.
	5	4/7/7	1.7-2.4									
20 ▽												
												Medium-stiff to stiff brown silty clay, trace fine to coarse sand, trace fine gravel, few lenses of silt.
	6	3/5/7	0.9-1.9									
25												
												Very-soft to medium-stiff gray silty clay, trace fine to medium sand.
	7	2/2/3	0.25									
30												
	8	2/2/3	0.25-0.3	31	39	20		0	1	56	43	
35												
												Medium-dense gray fine to coarse sand, trace fine to coarse gravel, some clayey silt.
	9	13/5/6										
40												
												Dense to very-dense brown and gray fine to coarse sand, little fine gravel, some clayey silt.
	10	13/28/36					36	21	17	26		
45												

WATER LEVEL:	▽ 20.0	▼	▽	▽	▽	▼
WATER NOTE:						
DATE:	4/30/01					

BBCM

LOG OF BORING NO. P-303A
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: **3-1/4" I.D. Hollow-stem Auger**
2" O.D. Split-barrel Sampler
NX Rock Core Barrel

LOCATION: **Sta. 474+49, 124' Lt.**

COMPLETION DEPTH: 73.0' **ELEVATION: 823.4** **DATE: 4/30/01 - 5/2/01**

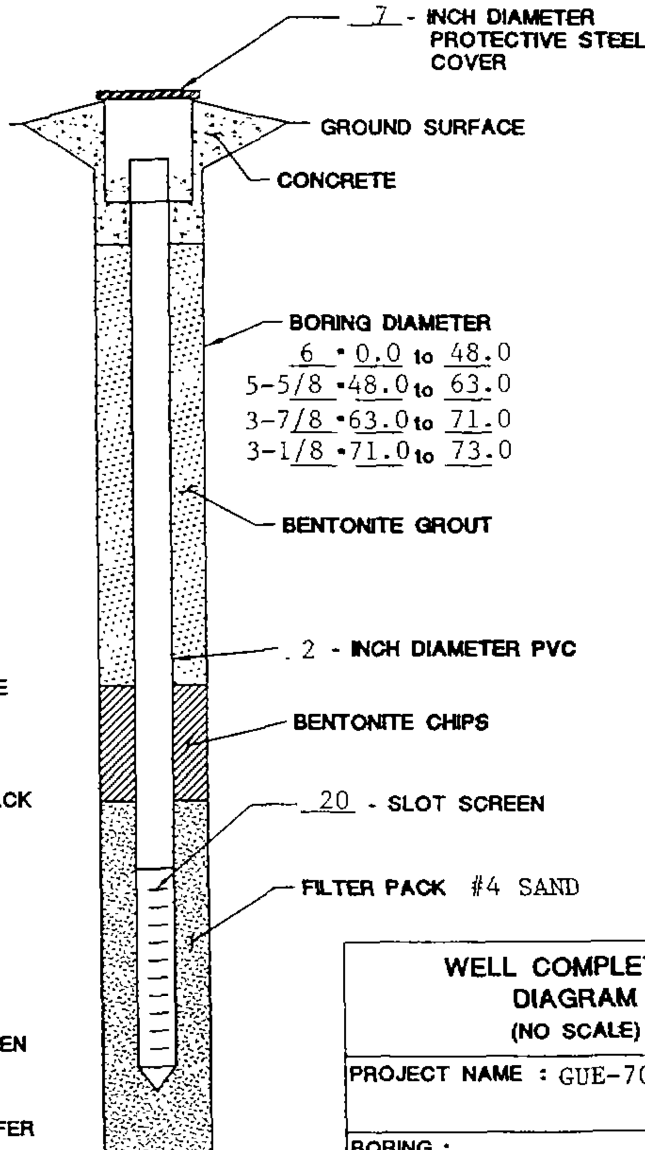
DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
45													Dense to very-dense brown and gray fine to coarse sand, little fine gravel, some clayey silt.
50	11		NX REC 97% RQD 97%										Medium-hard gray shale, nearly horizontally bedded, few natural horizontal fractures along bedding planes, interbedded with medium-hard gray sandstone.
60	12		NX REC 100% RQD 46%										
65													COAL
70	13		NX REC 100% RQD 36%										Very-soft to soft gray shale (claystone), undulatory bedding, many to few irregular fractures.
75													- Encountered water at 28.5'. - 6" steel casing from 0.0' to 48.0'. - Used 5-7/8" Tricone bit from 48.0' to 63.0'. - Used 3-7/8" Tricone bit from 63.0' to 71.0'. - Offset well at 33.5', 2.0' up station, labeled P-303B.
80													
85													
90													

WATER LEVEL:	∇ 20.0	▼	∇	∇	∇	▼
WATER NOTE:						
DATE:	4/30/01					

JOB: 01107000.090

ODOT LT 17000090.GPJ BBCM.GDT 12/13/02

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
823.2	0.2	TOP OF COVER
823.4	0.0	GROUND SURFACE
822.8	0.6	TOP OF PVC
822.4	1.0	TOP OF GROUT
768.2	55.2	TOP OF BENTONITE
763.4	60.0	TOP OF FILTER PACK
760.4	63.0	TOP OF AQUIFER
758.2	65.2	TOP OF SCREEN OPENINGS
754.4	69.0	BOTTOM OF SCREEN OPENINGS
754.1	69.3	BOTTOM OF WELL
754.4	69.0	BOTTOM OF AQUIFER
750.4	73.0	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME : GUE-70-14.10

BORING : P-303A

DATE WELL INSTALLED : 5/01/01

BBC & M PROJECT NO : 01107000.090

STATIC WATER LEVEL *	14.87			
DATE:	5/21/01			

WELL DEVELOPMENT :

* FEET ABOVE MSL

BBC&M DRAWING NO- TCAMWEL5.DWG

BBC&M ENGINEERING, INC.

DNR 7802.92

TYPE OR USE PEN SELF TRANSCRIBING PRESS HARD

WELL LOG AND DRILLING REPORT

760621

Ohio Department of Natural Resources, Divison of Water
1939 Fountain Square Drive, Columbus, Ohio 43224 Phone (614) 265-6739

Permit Number

COUNTY Guernsey TOWNSHIP Center SECTION/LOT No. 18 (CIRCLE ONE)

OWNER/BUILDER (CIRCLE ONE OR BOTH) ODOT PROPERTY ADDRESS Station 47449, 124'4 (ADDRESS OF WELL LOCATION)

LOCATION OF PROPERTY Mile Marker 184 on I-70

CONSTRUCTION DETAILS

CASING Borehole Diameter 5 7/8 in

1 Diameter 2 in Length 69.3 ft Wall Thickness 1/8 in.

2 Diameter in. Length ft. Wall Thickness in.

Type: 1/2 Steel; 1/2 Galv; 1/2 PVC (X); 1/2 Other

Joints: 1/2 Threaded (X); 1/2 Welded; 1/2 Solvent; 1/2 Other

Liner: Length — Type — Wall Thickness — in.

SCREEN Type (wire wrapped, louvered, etc.) machine Slotted Material PVC

Length 3.8 ft. Diameter 2 in.

Set between 65.2 ft and 69.0 ft. Slot #20

GROUT Material ~~Tremmie~~ Benseal Volume used

Method of installation Tremmie

Depth placed from 1.0 ft. to 55.2 ft

GRAVEL PACK (Filter Pack) Material #4 Sand Volume used

Method of installation

Depth placed from 60.0 ft. to 73.0 ft.

Pitless Device ☐ Adapter ☐ Preassembled unit

Use of Well Groundwater monitoring

☐ Rotary ☐ Cable ☒ Augered ☐ Driven ☐ Dug ☐ Other

Date of Completion 05-01-01

WELL LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED

Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc.	From	To
Top Soil	0.0	0.3
Brown/Gy Silty Clay	0.3	36.0
Gray Sand, Gravel, Silt	36.0	48.0
Gray Shale	48.0	63.0
Coal	63.0	69.0
Claystone	69.0	73.0
		End

Water @ 28.5'

*If additional space is needed to complete well log, use next consecutively numbered form

WELL TEST

☐ Bailing ☐ Pumping* ☐ Other

Test rate gpm Duration of test hrs.

Drawdown ft.

Measured from: ☒ top of casing ☐ ground level ☐ Other

Static Level (depth to water) 14.87 ft Date: 05-21-01

Quality (clear, cloudy, taste, odor) —

*(Attach a copy of the pumping test record, per section 1521.05. ORC)

PUMP

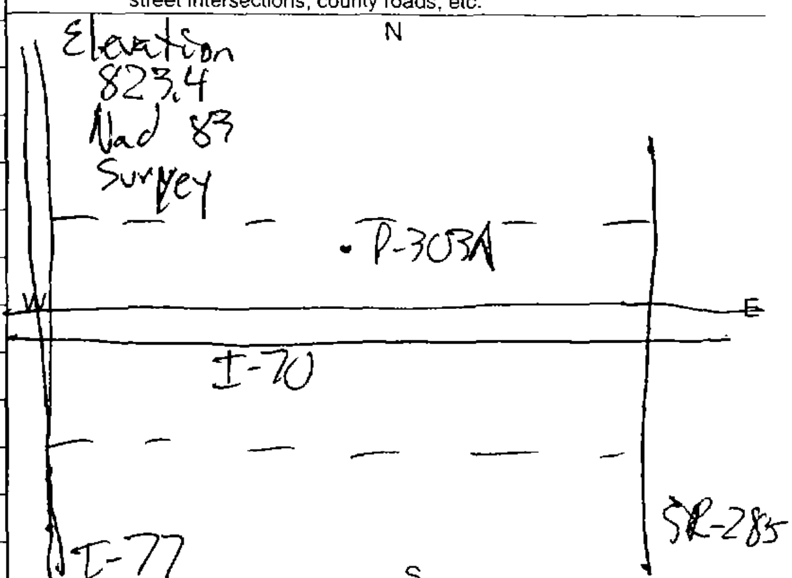
Type of pump — Capacity — gpm

Pump set at — ft.

Pump installed by —

SKETCH SHOWING WELL LOCATION

Show distances well lies from numbered state highways, street intersections, county roads, etc.



I hereby certify the information given is accurate and correct to the best of my knowledge

Drilling Firm BBC&M Engineering

Address 6190 Enterprise Ct.

City, State, Zip Dublin, OH 43016

Signed

Date 06-12-02

ODH Registration Number 02504

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224

LOG OF BORING NO. P-303B
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 4-1/4" I.D. Hollow-stem Auger

LOCATION: Sta. 474+51, 124' Lt.

COMPLETION DEPTH: 53.5' ELEVATION: 823.4 DATE: 5/1/01

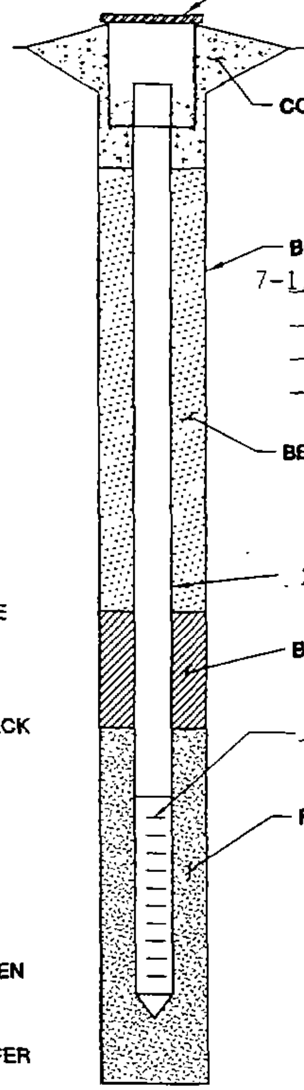
DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S	SILT	CLAY	DESCRIPTION
0													- Boring drilled for installation of monitoring well P-303B. See completion diagram. - No samples collected see log of boring P-303A.
5													
10													
15													
20													
25													
30													
35													
40													

WATER LEVEL:
WATER NOTE:
DATE:

ODOTLJ 17000090.GPJ BBCM.GDT 12/13/02

JOB: 01107000.090

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
823.5	-0.1	TOP OF COVER
823.4	0.0	GROUND SURFACE
823.2	0.2	TOP OF PVC
822.4	1.0	TOP OF GROUT
799.1	24.3	TOP OF BENTONITE
796.9	26.5	TOP OF FILTER PACK
794.9	28.5	TOP OF AQUIFER
795.2	28.2	TOP OF SCREEN OPENINGS
791.0	32.4	BOTTOM OF SCREEN OPENINGS
790.3	33.1	BOTTOM OF WELL
787.4	36.0	BOTTOM OF AQUIFER
790.4	33.0	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME : GUE-70-14.10

BORING : P-303B

DATE WELL INSTALLED : 5/02/01

BBC & M PROJECT NO : 01107000.090

STATIC WATER LEVEL *	9.93			
DATE:	5/21/01			

WELL DEVELOPMENT :

* FEET ABOVE MSL

BBC&M DRAWING NO: TCAMWELB.DWG

BBC&M ENGINEERING, INC.

DNR 7802 92

TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources, Divison of Water
1939 Fountain Square Drive, Columbus, Ohio 43224 Phone (614) 265-6739

760622

Permit Number ______

COUNTY Guernsey TOWNSHIP Center SECTION/LOT No 18 (CIRCLE ONE)

OWNER/BUILDER (CIRCLE ONE OR BOTH) ODOT PROPERTY ADDRESS Station 47,449.5 124' Lt. (ADDRESS OF WELL LOCATION)

LOCATION OF PROPERTY Mile Marker 184 on I-70

CONSTRUCTION DETAILS

CASING 2 Borehole Diameter 7 1/2 in

1 Diameter 2 in Length 33.5 ft. Wall Thickness 1/8 in.

2 Diameter ______ in Length ______ ft. Wall Thickness ______ in

Type: Steel / Galv. / [X] PVC / Other ______

Joints: [X] Threaded / Welded / Solvent / Other ______

Liner Length — Type — Wall Thickness — in

GROUT Material Benseal Volume used ______

Method of installation Tremmie

Depth: placed from 1.0 ft to 29.3 ft.

GRAVEL PACK (Filter Pack) Material #4 Sand Volume used ______

Method of installation ______

Depth: placed from 26.5 ft to ~~32.4~~ 33 ft.

SCREEN Type (wire wrapped, louvered, etc.) machine slotted Material PVC

Length 4.2 ft. Diameter 2 in.

Set between 28.2 ft and 32.4 ft Slot #20

Pitless Device ☐ Adapter ☐ Preassembled unit

Use of Well Groundwater monitoring

☐ Rotary ☐ Cable [X] Augered ☐ Driven ☐ Dug ☐ Other ______

Date of Completion 05-02-01

WELL LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc.

	From	To
Topsoil	0.0	0.3
Brown/Gy Silty Clay	0.3	33.5
		↑ End
Encountered water @ 28.5		

WELL TEST

☐ Bailing ☐ Pumping* ☐ Other ______

Test rate ______ gpm Duration of test ______ hrs.

Drawdown ______ ft.

Measured from: [X] top of casing ☐ ground level ☐ Other ______

Static Level (depth to water) 9.93 ft. Date: 05-26-01

Quality (clear, cloudy, taste, odor) ______

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

PUMP

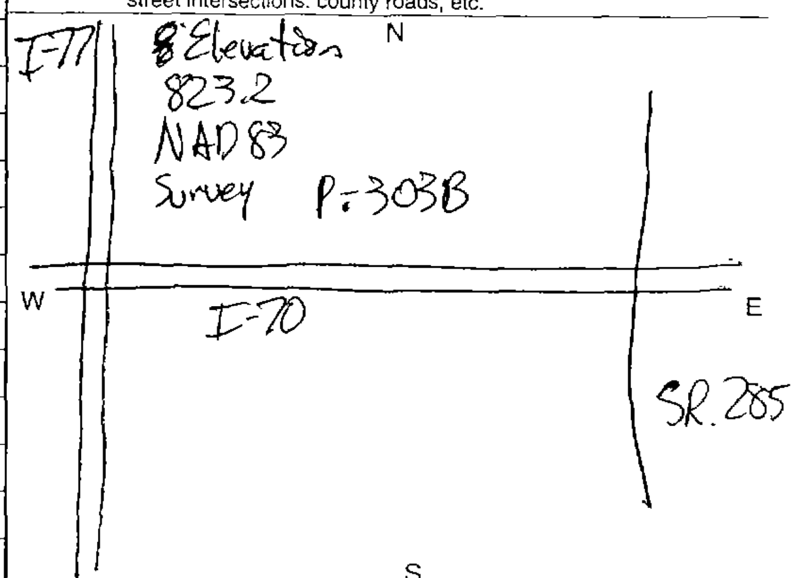
Type of pump — Capacity — gpm

Pump set at — ft.

Pump installed by —

SKETCH SHOWING WELL LOCATION

Show distances well lies from numbered state highways, street intersections, county roads, etc.



*If additional space is needed to complete well log, use next consecutively numbered form.

Drilling Firm BBC+M Engineering

Address 6190 Enterprise Ct.

City, State, Zip Dublin, OH 43016

I hereby certify the information given is accurate and correct to the best of my knowledge

Signed ______

Date 06-12-02

ODH Registration Number 02504

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224

BBCM

LOG OF BORING NO. P-304A
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; NX Rock Core Barrel

LOCATION: Sta. 475+40, 136' Rt.

COMPLETION DEPTH: 72.6' ELEVATION: 818.4 DATE: 4/17/01 - 4/19/01

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S	SILT	CLAY	DESCRIPTION
0												TOPSOIL - 4 INCHES
												POSSIBLE FILL. Very-soft to soft brown mottled with gray silty clay, some fine sand, trace medium sand, few seams of fine sand.
	1	1/1/2	0.25-0.3	27	35	22	0	1	21	53	25	
5												POSSIBLE FILL: Very-soft to medium-stiff brown mottled with gray silty clay, some fine sand.
	2A	1/2/3	0.25-0.9									
	2B		0.7-1.4									Medium-stiff to stiff brown mottled with gray silty clay, trace fine to coarse sand, natural.
	3	2/2/2	0.25-0.9	21	25	20	0	2	16	63	19	Soft to medium-stiff gray clayey silt, little fine sand, trace medium to coarse sand, many lenses of silt, occasional pockets of very-soft material.
10 ▽												
												Soft to medium-stiff gray silty clay interbedded with silt, little fine sand, occasional pockets of very-soft material.
	4	1/1/2	0.25-0.9									
15												Loose gray fine to coarse sand, some clayey silt, trace fine to coarse gravel.
	5A	3/2/3										
	5B		0.4-1.4									Medium-stiff to stiff gray silty clay, trace fine to medium sand, lense of clayey silt, approximately 1" thick, occasional pockets of soft material.
20												Loose brown fine to coarse gravel, little silty clay, "and" fine to coarse sand.
	6	6/3/2					58	11	13	18		
25												Medium-stiff to stiff gray clayey silt, little fine to coarse sand, trace fine to coarse gravel.
	7	2/4/5	0.7-1.4									
30												Stiff to very-stiff brown mottled with gray silty clay, some fine to coarse sand, some fine to coarse gravel.
	8	4/9/12	1.6-3.1									
35												Hard gray clayey silt, little fine to coarse sand, little fine to coarse gravel.
	9	50-5"R	4.5+									Medium-hard dark-gray shale, nearly horizontally bedded, numerous horizontal fractures, few horizontal fractures, interbedded with medium-hard gray sandstone.
40		NX REC 96% RQD 73%										
	10											
45												

WATER LEVEL: ▽ 10.0

WATER NOTE:

DATE: 4/18/01

ODOT LJ 17000090.GPJ BBCM.GDT 12/13/02

JOB: 01107000.090

-CONTINUED-

BBCM

LOG OF BORING NO. P-304A
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE. 3-1/4" I.D. Hollow-stem Auger
2" O.D. Split-barrel Sampler
NX Rock Core Barrel

LOCATION Sta. 475+40, 136' Rt.

COMPLETION DEPTH: 72.6' ELEVATION: 818.4 DATE: 4/17/01 - 4/19/01

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	DESCRIPTION - CONTINUED
45–60	11	NX REC 99% RQD 94%	Medium-hard dark-gray shale, nearly horizontally bedded, numerous horizontal fractures, few horizontal fractures, interbedded with medium-hard gray sandstone.
	12	NX REC 56% RQD 56%	
61–68		VOID	VOID
68–72.6	13	NX REC 94% RQD 62%	Very-soft to soft dark-gray becoming gray shale, undulatory bedding, few irregular fractures.

Column headings (no data): HAND PENE-TROMETER (tsf), MOISTURE CONTENT (%), LIQUID LIMIT (%), PLASTIC LIMIT (%), AGG., C.S., F S., SILT, CLAY

- Encountered water at 14.0'.

- 6" steel casing from 0.0' to 39.0'.

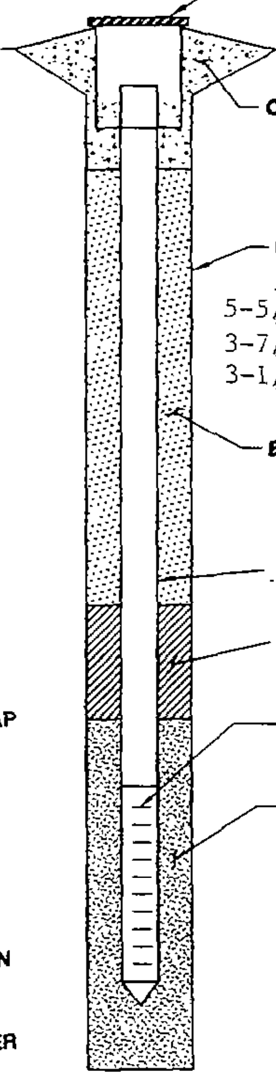
- Used 5-7/8" Tricone bit from 39.0' to 58.0'.

- Used 3-7/8" Tricone bit from 58.0' to 70.0'.

- Offset well at 19.4', 2.0' up station, labeled P-304B.

WATER LEVEL: 10.0
WATER NOTE:
DATE: 4/18/01

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
818.5	-0.1	TOP OF COVER
818.4	0.0	GROUND SURFACE
818.3	0.5	TOP OF PVC
817.4	1.0	TOP OF GROUT
765.2	53.2	TOP OF BENTONITE
760.4	58.0	TOP OF SHALE TRAP
757.1	61.3	TOP OF AQUIFER
756.0	62.4	TOP OF SCREEN OPENINGS
751.2	67.2	BOTTOM OF SCREEN OPENINGS
750.8	67.6	BOTTOM OF WELL
750.8	67.8	BOTTOM OF AQUIFER
745.8	72.6	BORING DEPTH



7 - INCH DIAMETER PROTECTIVE STEEL COVER

GROUND SURFACE

CONCRETE

BORING DIAMETER
6 • 0.0 to 39.0
5-5/8 • 39.0 to 58.0
3-7/8 • 58.0 to 70.0
3-1/8 • 70.0 to 72.6

BENTONITE GROUT

2 - INCH DIAMETER PVC

BENTONITE CHIPS

20 - SLOT SCREEN

FILTER PACK NONE

WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME : GUE-70-14.10

BORING : P-304A

DATE WELL INSTALLED : 4/19/01

BBC & M PROJECT NO : 01107000.090

STATIC WATER LEVEL *	8.54			
DATE:	5/21/01			

WELL DEVELOPMENT :

* FEET ABOVE MSL

BBC&M DRAWING NO. TCAMWELB.DWG

BBC&M ENGINEERING, INC.

DNR 7802 92
TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources, Divison of Water
1939 Fountain Square Drive, Columbus, Ohio 43224 Phone (614) 265-6739

760623

Permit Number ______

COUNTY Guernsey TOWNSHIP Center SECTION/LOT No 18 (CIRCLE ONE)

OWNER/BUILDER (CIRCLE ONE OR BOTH) ODOT PROPERTY ADDRESS Station 47540, 136' Rt. (ADDRESS OF WELL LOCATION A)

LOCATION OF PROPERTY Mile Marker 184 on I-70

CONSTRUCTION DETAILS

CASING Borehole Diameter 6" in.

1 Diameter 2 in. Length 66.6 ft. Wall Thickness 1/8 in.

2 Diameter ______ in. Length ______ ft Wall Thickness ______ in

Type: 1/2 Steel 1/2 Galv. 1/2 PVC (X) 1/2 Other ______

Joints: 1/2 Threaded (X) 1/2 Welded 1/2 Solvent 1/2 Other ______

Liner: Length — Type — Wall Thickness — in

SCREEN
Type (wire wrapped, louvered, etc.) Machine Slotted Material PVC
Length 4.8 ft Diameter 2 in.
Set between 62.4 ft and 67.2 ft. Slot #20

GROUT
Material Benseal Volume used ______
Method of installation Tremmie
Depth placed from 1.0 ft to 53.2 ft

GRAVEL PACK (Filter Pack)
Material #4 Sand Volume used ______
Method of installation ______
Depth, placed from 58.0 ft to 72.6 ft.

Pitless Device ☐ Adapter ☐ Preassembled unit
Use of Well Ground Water Monitoring
☐ Rotary ☐ Cable (X) Augered ☐ Driven ☐ Dug ☐ Other ______
Date of Completion 04-19-01

WELL LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Show color, texture, hardness, and formation sandstone, shale, limestone, gravel, clay, sand, etc.

	From	To
Top Soil	0.0	0.3
Fill	0.3	7.0
Brown/Gray Silty Clay	7.0	16.0
Gray Sand, Silty Clay, Gravel	16.0	19.0
Gray Silty Clay	19.0	21.0
Gray Gravel, Silty Clay, Sand	21.0	26.0
Gray Silty Clay	26.0	39.0
Gray Shale	39.0	60.5
Void	60.5	67.5
Gray Claystone	67.5	72.6
		↑ End

Encountered Water @ 14.0

*If additional space is needed to complete well log, use next consecutively numbered form.

WELL TEST

☐ Bailing ☐ Pumping* ☐ Other ______
Test rate ______ gpm Duration of test ______ hrs
Drawdown ______ ft.
Measured from: (X) top of casing ☐ ground level ☐ Other ______
Static Level (depth to water) 8.54 ft. Date 05-21-01
Quality (clear, cloudy, taste odor) —

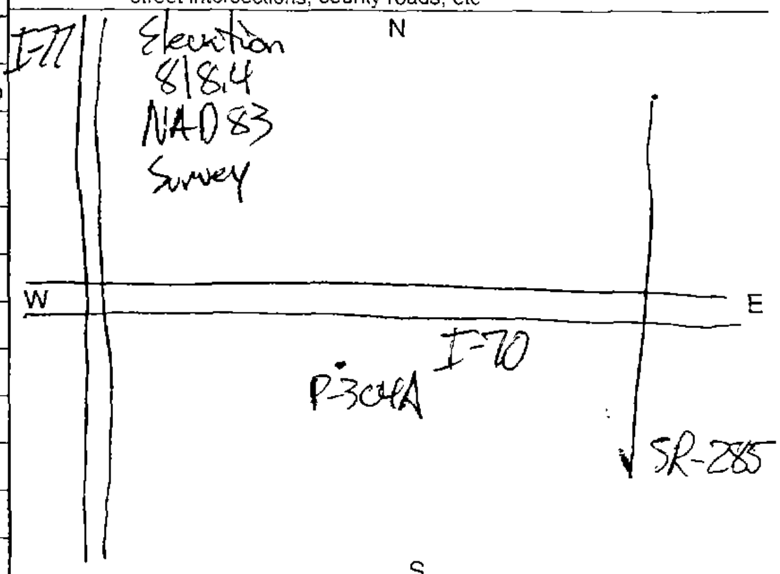
*(Attach a copy of the pumping test record, per section 1521.05, ORC)

PUMP

Type of pump — Capacity — gpm
Pump set at — ft.
Pump installed by ______

SKETCH SHOWING WELL LOCATION

Show distances well lies from numbered state highways, street intersections, county roads, etc



Drilling Firm BBC&M Engineering
Address 6190 Enterprise Ct.
City, State, Zip Dublin, OH 43016

I hereby certify the information given is accurate and correct to the best of my knowledge

Signed ______
Date ~~02504~~ 06-12-02
ODH Registration Number 02504

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224

BBCM

LOG OF BORING NO. P-304B
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: **4-1/4" I.D. Hollow-stem Auger**

LOCATION: **Sta. 475+42, 136' Rt.**

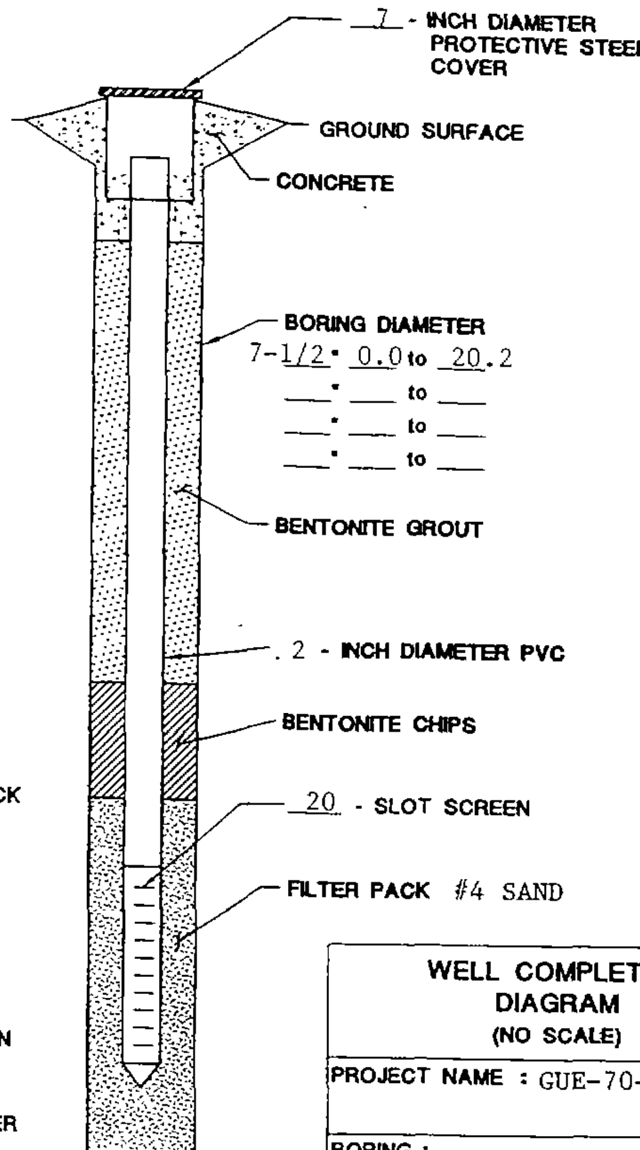
COMPLETION DEPTH: **20.2'** ELEVATION: **818.5** DATE: **4/19/01**

DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S	F S.	SILT	CLAY	DESCRIPTION
0													- Boring drilled for installation of monitoring well P-304B. See completion diagram. - No samples collected see log of boring P-304A.
5													
10													
15													
20													
25													
30													
35													
40													

WATER LEVEL:
WATER NOTE:
DATE:

JOB: 01107000.090

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
818.5	0.0	TOP OF COVER
818.5	0.0	GROUND SURFACE
818.0	0.5	TOP OF PVC
817.5	1.0	TOP OF GROUT
808.1	10.4	TOP OF BENTONITE
805.4	13.1	TOP OF FILTER PACK
802.5	16.0	TOP OF AQUIFER
804.1	14.4	TOP OF SCREEN OPENINGS
799.3	19.2	BOTTOM OF SCREEN OPENINGS
799.1	19.4	BOTTOM OF WELL
799.4	19.1	BOTTOM OF AQUIFER
798.5	20.2	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME : GUE-70-14.10

BORING : P-304B

DATE WELL INSTALLED : 4/19/01

BBC & M PROJECT NO : 01107000.090

STATIC WATER LEVEL *	2.54			
DATE:	5/21/01			

WELL DEVELOPMENT :

* FEET ABOVE MSL

BBC&M DRAWING NO: TCAMWEL8.DWG

BBC&M ENGINEERING, INC.

DNR 7802.96

TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Divison of Water, 1939 Fountain Square Drive
Columbus, Ohio 43224-9971 Voice (614) 265-6739 Fax (614) 447-9503

946526

WELL LOCATION

County Guernsey Township Center

Owner/Builder (Circle One or Both) ODOT
First Last

Address of Well Location Station 47542, 136' Rt
Number Street Name

City ______ Zip Code +4 ______

Permit No. ______ Section/Lot No. (Circle One or Both) 18

Location of Well in State Plane coordinates, if available: Use of Well Groundwater Monitor

☐ N X ______ . ______ +/- ______ ft. or m

☐ S Y ______ . ______ +/- ______ ft. or m

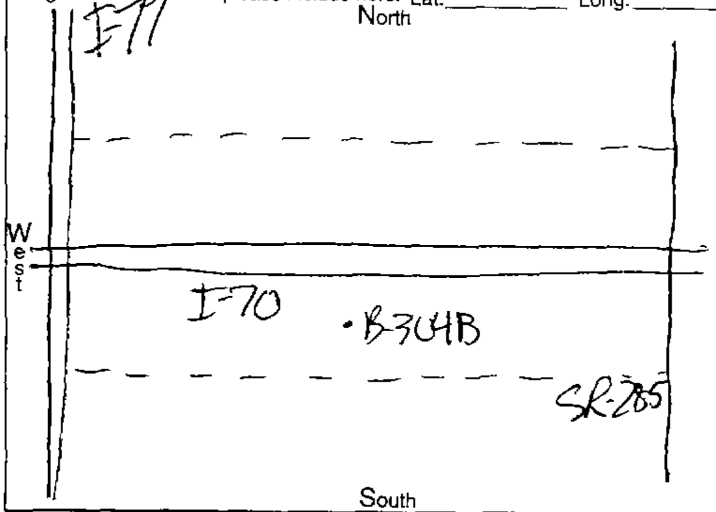
Elevation of Well 818 . 0 +/- ______ ft. or m (ft. circled)

Datum Plain: ☐ NAD27 ☒ NAD83 Elevation Source ______

Source of Coordinates. ☐ GPS ☒ Survey ☐ Other ______

Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks. If latitude and longitude are available please include here: Lat: ______ Long. ______

North



West East

South

WELL TEST*

Pre-Pumping Static Level 2.54 ft. Date 05-21-01

Measured from: ☒ Top of Casing ☐ Ground Level ☐ Other ______

☐ Air ☐ Bailing ☐ Pumping* ☐ Other ______

Test Rate ______ gpm Duration of Test ______ hrs.

Feet of Drawdown ______ ft. Sustainable Yield ______ gpm

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

Is Copy Attached? ☐ Yes ☐ No Flowing Well? ☐ Yes ☐ No

Quality ______

PUMP/PITLESS

Type of pump — Capacity — gpm

Pump set at ______ ft. Pitless Type —

Pump installed by —

I hereby certify the information given is accurate and correct to the best of my knowledge

Drilling Firm BBC&M Engineering

Address 6190 Enterprise Ct.

City, State, Zip Dublin OH, 43016

Signed ______ Date 06-13-02

ODH Registration Number 02504

CONSTRUCTION DETAILS

☐ Rotary ☐ Cable ☒ Augered ☐ Driven ☐ Other ______

BOREHOLE/CASING (measured from ground surface)

1☒ Borehole Diameter 7½ inches Depth 20.2 ft.
Casing Diameter 2 in. Length 20.2 ft. Thickness ______ in.

2☐ Borehole Diameter ______ inches Depth ______ ft
Casing Diameter ______ in. Length ______ ft Thickness ______ in.

Casing Height Above Ground ~0.5 ft

Type 1☐ 2☐ Steel 1☐ 2☐ Galv. 1☒ 2☐ PVC 1☐ 2☐ Other ______

Joints 1☒ 2☐ Threaded 1☐ 2☐ Welded 1☐ 2☐ Solvent 1☐ 2☐ Other ______

SCREEN

Diameter 2" Slot Size #20 Screen Length 4.8 ft.

Type ~~PVC~~ machine slotted Material ~~[illegible]~~ PVC

Set Between 14.4 ft. and 19.2 ft.

GRAVEL PACK (Filter Pack)

Material/Size #4 Sand Volume/Weight Used ______

Method of Installation ______

Depth: Placed FROM 13.1 ft. TO 20.2 ft.

GROUT

Material Benseal Volume/Weight Used ______

Method of Installation Tremmie

Depth: Placed FROM 6.0 ft. TO 10.4 ft.

DRILLING LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED. Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc.	From	To
Topsoil	0.0	0.3
Possible Fill	0.3	6.5
Brown Gray, Clayey Silt, Soft to Medium Stiff	6.5	16.0
Gray, Sand, Loose	16.0	19.0
Gray Clayey Silt, Medium-Stiff	19.0	20.2
		↓ End
water @ 4.0'		

*(If more space is needed to complete drilling log, use next consecutively numbered form.)

Date of Well Completion 04-19-01 Total Depth of Well ~~20.2~~ 19.4 ft.

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224-9971

Blue - Customer's copy Pink - Driller's copy Green - Local Health Dept. copy

BBCM

LOG OF BORING NO. P-305A
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; NX Rock Core Barrel

LOCATION: Sta. 479+32, 128' Lt.

COMPLETION DEPTH: 73.0' ELEVATION: 823.0 DATE: 5/2/01 - 5/4/01

SAMPLE NO.	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C. S.	F. S.	SILT	CLAY
1	W/T=18"	0.25								
2	0/2/2	0.4-0.6								
3	2/3/2	0.5-1.2	21	35	19	3	6	18	37	36
4	1/3/4	0.5-1.3								
5	1/3/3	0.6-0.9								
6	2/4/3					30	16	20	34	
7	1/2/2	0.25-0.6								
8	1/3/6	0.25-0.6	31	44	22		0	1	46	53
9	2/2/3	0.25-0.4								
10	50-5"R									

DEPTH, FEET: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45

DESCRIPTION

TOPSOIL - 4 INCHES

FILL: Very-soft gray and brown silty clay, trace fine to coarse sand.

FILL: Soft to medium-stiff brown mottled with gray silty clay, trace fine sand.

Medium-stiff to stiff brown and gray silty clay, some fine to coarse sand, trace fine gravel, few coal fragments.

Medium-stiff to stiff brown interbedded with gray silty clay, trace fine sand.

Medium-stiff brown mottled with gray silty clay, trace fine sand, few lenses of silt.

Loose brown and gray fine to coarse sand, some silty clay, little fine gravel.

Very-soft to medium-stiff gray silty clay interbedded with organic silt, trace fine to coarse sand.

Very-soft to soft gray shale, bedding dips (probably due to mine collapse).

WATER LEVEL: 3.0
WATER NOTE:
DATE: 5/2/01

ODOTLT 17000090.GPJ BBCM.GDT 12/13/02

JOB: 01107000.090

-CONTINUED-

BBCM

LOG OF BORING NO. P-305A
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; NX Rock Core Barrel

LOCATION: Sta. 479+32, 128' Lt.

COMPLETION DEPTH: 73.0' ELEVATION: 823.0 DATE: 5/2/01 - 5/4/01

DEPTH, FEET	SAMPLE NO.	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
45	11	NX REC 73% RQD 45%										Medium-hard gray sandstone, bedding dips due to mine collapse, many voids, many fractures along bedding planes due to mine collapse and mechanical, interbedded with medium-hard gray shale.
50												
55	12	NX REC 31% RQD 6%										Medium-hard gray shale, bedding dips due to mine collapse, many voids, numerous fractures due to mine collapse, interbedded with medium-hard gray sandstone.
60												
65	13	NX REC 64% RQD 6%										
70	14	NX REC 100% RQD 82%										Very-soft to soft gray shale, undulatory bedding, few irregular fractures.
75												- Encountered water at 3.0'. - Water loss at 47.0'. - 6" steel casing. - Used 5-7/8" Tricone bit from 44.0' to 45.0'. - Used 3-7/8" Tricone bit from 45.0' to 70.0'.
80												
85												
90												

WATER LEVEL: ▽ 3.0

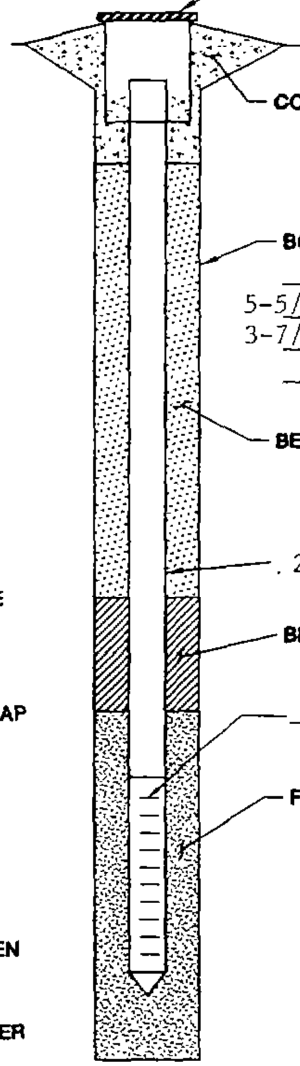
WATER NOTE:

DATE: 5/2/01

ODOT.LJ 17000090.GPJ BBCM.GDT 12/13/02

JOB: 01107000.090

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
822.9	0.1	TOP OF COVER
823.0	0.0	GROUND SURFACE
822.6	0.4	TOP OF PVC
822.0	1.0	TOP OF GROUT
781.5	41.5	TOP OF BENTONITE
778.5	44.5	TOP OF SHALE TRAP
761.2	61.8	TOP OF AQUIFER
761.7	61.3	TOP OF SCREEN OPENINGS
756.9	66.1	BOTTOM OF SCREEN OPENINGS
756.5	66.5	BOTTOM OF WELL
755.2	67.8	BOTTOM OF AQUIFER
750.0	73.0	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME : GUE-70-14.10

BORING : P-305A

DATE WELL INSTALLED : 5/04/01

BBC & M PROJECT NO : 01107000.090

STATIC WATER LEVEL *	14.63			
DATE:	5/21/01			

WELL DEVELOPMENT :

* FEET ABOVE MSL

BBCBM DRAWING NO: TCAMWEL8.DWG

BBC&M ENGINEERING, INC.

DNR 7802.96

TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Divison of Water, 1939 Fountain Square Drive
Columbus, Ohio 43224-9971 Voice (614) 265-6739 Fax (614) 447-9503

946535

WELL LOCATION

County: Guernsey   Township: Center

Owner/Builder (Circle One or Both): ODOT (First / Last)

Address of Well Location: Station 47932+128'Lt (Number / Street Name)

City: ____ Zip Code +4: ____

Permit No: ____ Section/Lot No. (Circle One or Both): 18

Location of Well in State Plane coordinates, if available: ____ Use of Well: Water monitoring

☐ N X ____ . ____ +/- ____ ft. or m

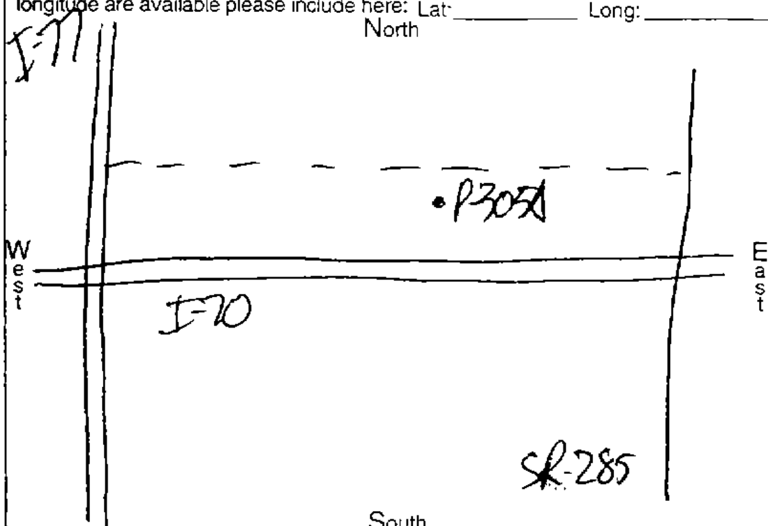
☐ S Y ____ . ____ +/- ____ ft. or m

Elevation of Well: 823 . 0 +/- ____ (ft) or m

Datum Plain: ☐ NAD27 ☒ NAD83 Elevation Source ____

Source of Coordinates: ☐ GPS ☒ Survey ☐ Other ____

Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks. If latitude and longitude are available please include here: Lat: ____ Long: ____



WELL TEST*

Pre-Pumping Static Level: 14.63 ft Date: 05-21-01

Measured from: ☒ Top of Casing ☐ Ground Level ☐ Other ____

☐ Air ☐ Bailing ☐ Pumping* ☐ Other ____

Test Rate ____ gpm Duration of Test ____ hrs.

Feet of Drawdown ____ ft. Sustainable Yield ____ gpm

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

Is Copy Attached? ☐ Yes ☐ No Flowing Well? ☐ Yes ☐ No

Quality ____

PUMP/PITLESS

Type of pump: — Capacity: — gpm

Pump set at: — ft. Pitless Type: —

Pump installed by: —

I hereby certify the information given is accurate and correct to the best of my knowledge

Drilling Firm: BBC&M Engineering

Address: 6190 Enterprise Ct.

City, State, Zip: Dublin, OH 43016

Signed ____ Date: 06-13-02

ODH Registration Number: 02504

CONSTRUCTION DETAILS

☐ Rotary ☐ Cable ☒ Augered ☐ Driven ☐ Other ____

BOREHOLE/CASING (measured from ground surface)

1 ☒ Borehole Diameter: 6" inches Depth: 73.0 ft.
Casing Diameter: 2 in Length: 73.0 ft. Thickness ____ in.

2 ☐ Borehole Diameter ____ inches Depth ____ ft.
Casing Diameter ____ in. Length ____ ft. Thickness ____ in.

Casing Height Above Ground ____ ft.

Type: 1 ☐ 2 ☐ Steel; 1 ☐ 2 ☐ Galv; 1 ☒ 2 ☐ PVC; 1 ☐ 2 ☐ Other ____

Joints: 1 ☒ 2 ☐ Threaded; 1 ☐ 2 ☐ Welded; 1 ☐ 2 ☐ Solvent; 1 ☐ 2 ☐ Other ____

SCREEN

Diameter: 2" Slot Size: #20 Screen Length: 4.2 ft.

Type: ~~PVC~~ machine slotted Material: PVC

Set Between: 61.3 ft. and 66.5 ft.

GRAVEL PACK (Filter Pack)

Material/Size: #4 Sand Volume/Weight Used ____

Method of Installation ____

Depth: Placed FROM 44.5 ft TO 73.0 ft.

GROUT

Material: Benseal Volume/Weight Used ____

Method of Installation: Tremmie

Depth: Placed FROM 1.0 ft TO 41.5 ft.

DRILLING LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED. Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc.	From	To
Topsoil	0.0	0.3
Fill	0.3	8.0
Med. Stiff to Stiff Brown and Gray Silty Clay, Sand, Silt	8.0	21.0
Loose Gray Sand, Silty Clay, Gravel	21.0	27.0
Very Soft to Medium Stiff Silty Clay, Silt, Sand	27.0	43.0
Very Soft Gray Shale	43.0	44.0
Med. Hard Gray Sandstone interbedded w/Shale many voids	44.0	68.0
Very Soft to Soft Gray Claystone	68.0	73.0
		End
water@ 30'		

*(If more space is needed to complete drilling log, use next consecutively numbered form.)

Date of Well Completion: 05-04-01 Total Depth of Well: ~~73.0~~ 66.5 ft.

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224-9971

Blue - Customer's copy Pink - Driller's copy Green - Local Health Dept. copy

BBCM

LOG OF BORING NO. P-306A
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; NX Rock Core Barrel

LOCATION: Sta. 479+27, 134' Lt.

COMPLETION DEPTH: 76.3' ELEVATION: 819.2 DATE: 4/16/01 - 4/17/01

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0												TOPSOIL - 4 INCHES
												Very-soft to brown clayey silt, little fine to coarse sand, contains a few roots.
	1	W/H/2/1	0 25									
5 ▽												
	2A	1/2/5	0 4-0 5									Soft to medium-stiff brown mottled with gray silty clay, little fine to coarse sand.
	2B											Loose brown fine to coarse sand, some fine gravel, some clayey silt.
	3	3/5/4					43	17	19	21		
10												
												Medium-dense brown and gray fine to coarse sand, some fine gravel, some clayey silt.
	4	4/10/14					38	16	17	29		
15												
												Medium-stiff to stiff gray mottled with brown silty clay, some fine to coarse sand, trace fine gravel, contains clayey silt lenses, contains occasional medium-stiff and very-stiff pockets of silty clay.
	5	3/4/8	0 4-3 2	22	31	19	1	3	17	58	21	
20												
												Loose gray fine to coarse sand, trace fine to coarse gravel, trace clayey silt.
	6A	8/3/4	1 2-2 9									
25	6B		4.5+									Stiff to very-stiff gray silty clay, trace fine sand, few lenses of silt (<1/8" thick).
												Dense brown and gray fine to coarse sand, some clayey silt, some fine to coarse gravel.
	7	7/18/24	4 5+									
30												
												Soft to medium-hard gray shale, nearly horizontally bedded, interbedded with medium-hard gray shale.
	8	50-3"R	4 5+									
35												
	9	50-1"R	4 5+									
40												Medium-hard gray sandstone, nearly horizontally bedded, interbedded with medium-hard gray shale, occasional natural horizontal fractures.
		NX REC 96%										
45												

WATER LEVEL: ▽ 5.0

WATER NOTE:

DATE: 4/16/01

ODOTLJ 17000090.GPJ BBCM.GDT 12/13/02

JOB: 01107000.090

-CONTINUED-

BBCM

LOG OF BORING NO. P-306A
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger
2" O.D. Split-barrel Sampler
NX Rock Core Barrel

LOCATION: Sta. 479+27, 134' Lt.

COMPLETION DEPTH: 76.3' ELEVATION: 819.2 DATE: 4/16/01 - 4/17/01

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG	C S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
45	10	RQD 90%										Medium-hard gray shale, nearly horizontally bedded, interbedded with medium-hard gray sandstone, numerous horizontal fractures.
50		NX REC 63% RQD 25%										
	11											VOID
55												Medium-hard gray shale, bedding approximately 45 degree dip, (collapsed rock above coal zone), interbedded with gray sandstone, few diagonal fractures along bedding planes.
60		NX REC 37% RQD 23%										
	12											
65												Medium-hard gray shale, nearly horizontally bedded, interbedded with gray sandstone, possible mine floor, few horizontal fractures.
												Soft gray shale (claystone), nearly horizontally bedded, similar to hard soil, numerous irregular fractures at 67.3' to 70.0'., occasional irregular fractures at 66.5' to 67.3', 70.0' to 73.5'.
70		NX REC 100% RQD 66%										
	13											Soft to medium-hard gray shale, nearly horizontally bedded, interbedded with very-soft gray shale (claystone), occasional irregular fractures.
75												
80												
85												
90												

- Encountered water at 5.0'.

- 6" steel casing from 0.0' to 42.0'.

- Used 5-7/8" Tricone bit from 42.0' to 49.0'.

- Used 3-7/8" Tricone bit from 49.0' to 68.0'.

- Water loss at 50.5'.

- Few small voids between 50.5' and 52.0', large voids at 52.5' to 55.0', numerous voids between 60.0' and 66.0'.

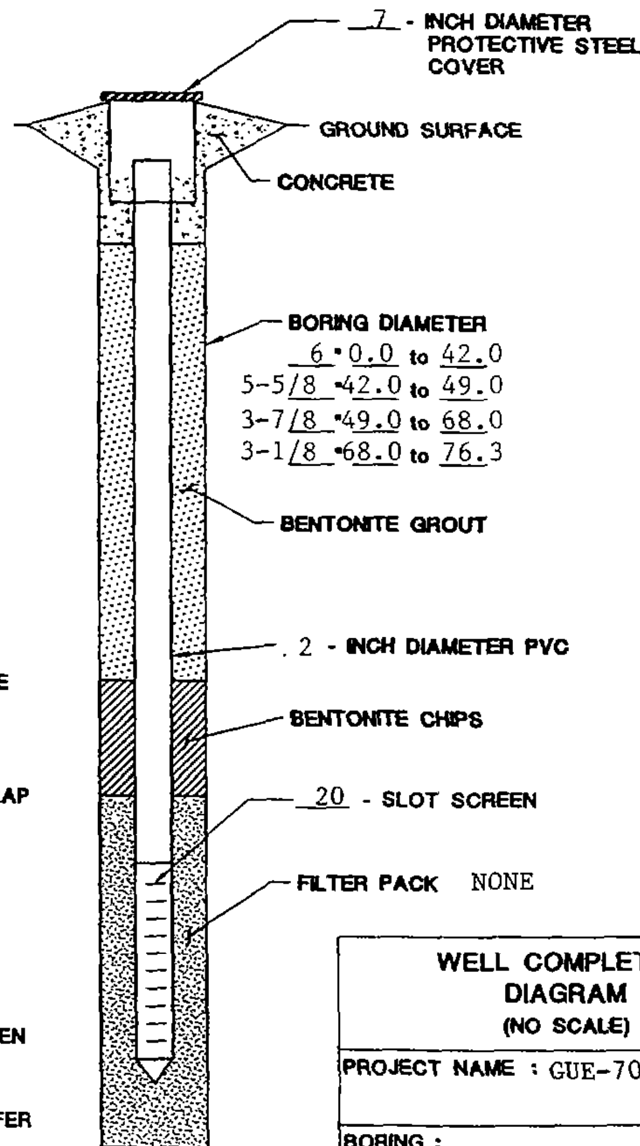
- Offset hole set at 10.3', 2.0' up station labeled P-306B.

WATER LEVEL:	5.0					
WATER NOTE:						
DATE:	4/16/01					

ODOT LJ 17000090.GPJ BBCM.GDT 12/13/02

JOB: 01107000.090

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
819.2	0.0	TOP OF COVER
819.2	0.0	GROUND SURFACE
818.6	0.6	TOP OF PVC
818.2	1.0	TOP OF GROUT
773.6	45.6	TOP OF BENTONITE
770.6	48.6	TOP OF SHALE TRAP
770.6	48.6	TOP OF AQUIFER
759.4	59.8	TOP OF SCREEN OPENINGS
754.6	64.6	BOTTOM OF SCREEN OPENINGS
754.2	65.0	BOTTOM OF WELL
753.2	66.0	BOTTOM OF AQUIFER
742.9	76.3	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME : GUE-70-14.10

BORING : P-306A

DATE WELL INSTALLED : 4/17/01

BBC & M PROJECT NO : 01107000.090

STATIC WATER LEVEL *	9.56			
DATE:	5/21/01			

WELL DEVELOPMENT :

* FEET ABOVE MSL

BBCBM DRAWING NO: TCAMWEL8.DWG

BBC&M ENGINEERING, INC.

DNR 7802.96

TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Divison of Water, 1939 Fountain Square Drive
Columbus, Ohio 43224-9971 Voice (614) 265-6739 Fax (614) 447-9503

946527

WELL LOCATION

County Guernsey Township Center

Owner/Builder (Circle One or Both) ODOT First Last

Address of Well Location Station 47,932, 128' Rt. Number Street Name

City ____ Zip Code +4 ____

Permit No. ____ Section/Lot No. (Circle One or Both) 18

Location of Well in State Plane coordinates, if available: Use of Well Water Monitoring

N ☐ X ____ . ____ +/- ____ ft or m

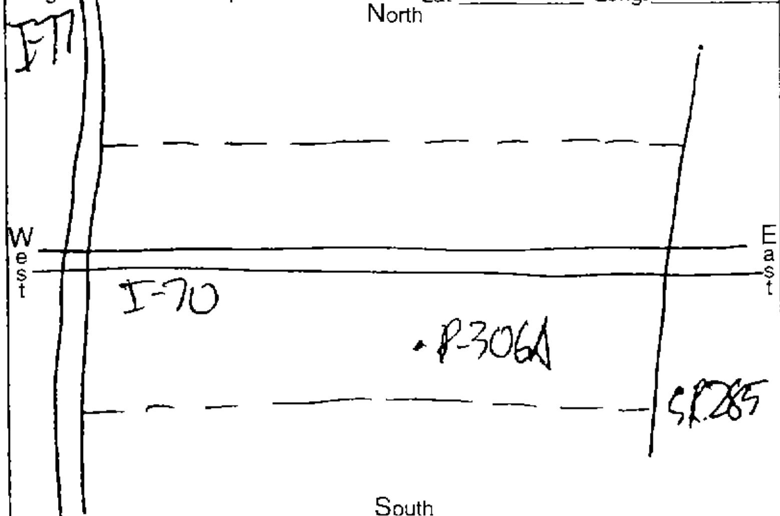
S ☐ Y ____ . ____ +/- ____ ft or m

Elevation of Well ____ . ____ +/- ____ ft or m

Datum Plain. ☐ NAD27 ☒ NAD83 Elevation Source ____

Source of Coordinates: ☐ GPS ☒ Survey ☐ Other ____

Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks. If latitude and longitude are available please include here: Lat ____ Long: ____



WELL TEST*

Pre-Pumping Static Level 9.56 ft. Date 05-21-01

Measured from: ☒ Top of Casing ☐ Ground Level ☐ Other ____

☐ Air ☐ Bailing ☐ Pumping* ☐ Other ____

Test Rate ____ gpm Duration of Test ____ hrs.

Feet of Drawdown ____ ft Sustainable Yield ____ gpm

*(Attach a copy of the pumping test record, per section 1521.05. ORC)

Is Copy Attached? ☐ Yes ☐ No Flowing Well? ☐ Yes ☐ No

Quality ____

PUMP/PITLESS

Type of pump — Capacity — gpm

Pump set at — ft Pitless Type ____

Pump installed by —

I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm BBC&M Engineering

Address 6190 Enterprise Ct.

City, State, Zip Dublin, OH 43228

Signed ____ Date 06-13-02

ODH Registration Number 02504

CONSTRUCTION DETAILS

☐ Rotary ☐ Cable ☒ Augered ☐ Driven ☐ Other ____

BOREHOLE/CASING (measured from ground surface)

1☒ Borehole Diameter 6" inches Depth 76.3 ft.
Casing Diameter 2 in. Length 76.3 ft. Thickness ____ in.

2☐ Borehole Diameter ____ inches Depth ____ ft.
Casing Diameter ____ in. Length ____ ft. Thickness ____ in.

Casing Height Above Ground ____ ft

Type: 1☐ 2☐ Steel; 1☐ 2☐ Galv; 1☒ 2☐ PVC; 1☐ 2☐ Other ____

Joints: 1☒ 2☐ Threaded; 1☐ 2☐ Welded; 1☐ 2☐ Solvent; 1☐ 2☐ Other ____

SCREEN

Diameter 2 Slot Size #30 Screen Length ____ ft.

Type ~~[illegible]~~ machine Slotted Material PVC

Set Between 57.8 ft. and 64.6 ft.

GRAVEL PACK (Filter Pack)

Material/Size #4 Sand Volume/Weight Used ____

Method of Installation ____

Depth: Placed FROM 48.6 ft. TO 76.3 ft.

GROUT

Material Benseal Volume/Weight Used ____

Method of Installation Tremmie

Depth: Placed FROM 1.0 ft. TO 45.6 ft

DRILLING LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc	From	To
Topsoil	0.0	0.3
Very Soft to Soft Brown/Gray Silty Clay, Sand	0.3	6.5 ~~[illegible]~~
Loose Brown Sand, Gravel, Clayey + Silt	~~[illegible]~~ 6.5	11.0
Medium Dense Gray, Sand, Gravel, Silt	11.0	16.0
Med. Stiff - Stiff Gray Silty Clay Sand, Grav	16.0	22.0
Loose Gray Sand Gravel Silt	22.0	24.0
Stiff - Very Stiff, Gray Silty Clay Sand	24.0	27.0
Dense Gray Sand, Silt, Gravel	27.0	32.0
Soft - Med Hd - gray Shale + Sandstone	32.0	52.0
Void	52.0	55.0
Md-Hard-Gray Shale	55.0	66.0
Med. Hd Gray Shale	66.0	73.0
Soft - Med hard Gray Claystone	73.0	76.3
water @ 5.0		End

*(If more space is needed to complete drilling log, use next consecutively numbered form.)

Date of Well Completion 04-17-02 Total Depth of Well ~~[illegible]~~ 76.3 ft.

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224-9971

Blue - Customer's copy Pink - Driller's copy Green - Local Health Dept. copy

BBCM

LOG OF BORING NO. P-306B
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 4-1/4" I.D. Hollow-stem Auger

LOCATION: Sta. 479+29, 134' Lt.

COMPLETION DEPTH: 10.3' ELEVATION: 819.9 DATE: 4/17/01

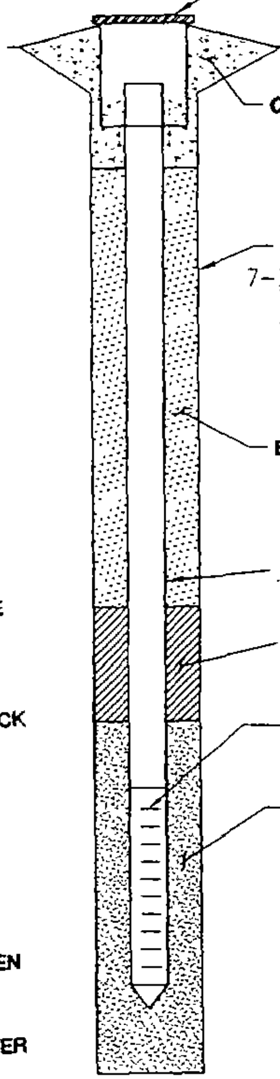
DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F S.	SILT	CLAY	DESCRIPTION
0													- Boring drilled for installation of monitoring well P-306B. See completion diagram. - No samples collected see log of boring P-306A.
5													
10													
15													
20													
25													
30													
35													
40													

WATER LEVEL:
WATER NOTE:
DATE:

JOB: 01107000.090

ODOTLJ 17000090.GPJ BBCM.GDT 12/13/02

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
819.3	0.6	TOP OF COVER
819.9	0.0	GROUND SURFACE
819.0	0.6	TOP OF PVC
818.9	1.0	TOP OF GROUT
818.9	1.0	TOP OF BENTONITE
815.9	4.0	TOP OF FILTER PACK
813.5	6.4	TOP OF AQUIFER
814.8	5.1	TOP OF SCREEN OPENINGS
810.0	9.9	BOTTOM OF SCREEN OPENINGS
809.6	10.3	BOTTOM OF WELL
808.9	11.0	BOTTOM OF AQUIFER
808.9	11.0	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME : GUE-70-14.10

BORING : P-306B

DATE WELL INSTALLED : 4/17/01

BBC & M PROJECT NO : 01107000.090

STATIC WATER LEVEL *	1.00			
DATE:	5/21/01			

WELL DEVELOPMENT :

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

BBC&M DRAWING NO: TCAMWELB.DWG

DNR 7802.96

TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Divison of Water, 1939 Fountain Square Drive
Columbus, Ohio 43224-9971 Voice (614) 265-6739 Fax (614) 447-9503

946528

WELL LOCATION

County Guernsey Township Center

Owner/Builder (Circle One or Both) ODOT

Address of Well Location: Number / First: Station 4793~~4~~ Last / Street Name: 128' Rt.

City ______ Zip Code +4 ______

Permit No. ______ Section/Lot No. (Circle One or Both) 18

Location of Well in State Plane coordinates, if available: Use of Well Water Monitoring

N ☐ X ______ . ______ +/- ______ ft. or m

S ☐ Y ______ . ______ +/- ______ ft. or m

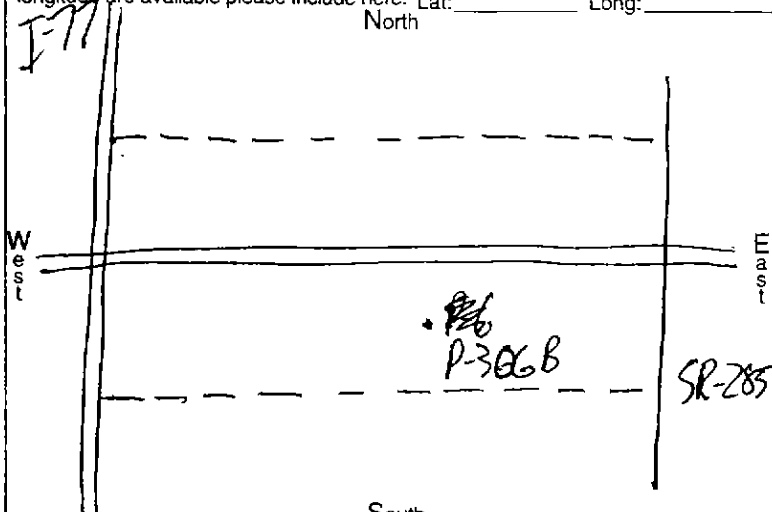
Elevation of Well ______ . ______ +/- ______ ft. or m

Datum Plain: ☐ NAD27 ☒ NAD83 Elevation Source ______

Source of Coordinates: ☐ GPS ☒ Survey ☐ Other ______

Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks. If latitude and longitude are available please include here: Lat: ______ Long: ______

North



South

WELL TEST*

Pre-Pumping Static Level 100 ft. Date 05-21-01

Measured from: ☒ Top of Casing ☐ Ground Level ☐ Other ______

☐ Air ☐ Bailing ☐ Pumping* ☐ Other ______

Test Rate ______ gpm Duration of Test ______ hrs.

Feet of Drawdown ______ ft. Sustainable Yield ______ gpm

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

Is Copy Attached? ☐ Yes ☐ No Flowing Well? ☐ Yes ☐ No

Quality ______

PUMP/PITLESS

Type of pump — Capacity — gpm

Pump set at — ft. Pitless Type —

Pump installed by ______

I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm BBC&M Engineering

Address 6190 Enterprise Ct.

City, State, Zip Dublin, OH 43016

Signed ______ Date 06-13-02

ODH Registration Number 02504

CONSTRUCTION DETAILS

☐ Rotary ☐ Cable ☒ Augered ☐ Driven ☐ Other ______

BOREHOLE/CASING (measured from ground surface)

1☒ Borehole Diameter 7½ inches Depth 11.0 ft.

Casing Diameter 2 in. Length 11.0 ft. Thickness ______ in.

2☐ Borehole Diameter ______ inches Depth ______ ft.

Casing Diameter ______ in. Length ______ ft. Thickness ______ in.

Casing Height Above Ground ______ ft.

Type: 1☐ 2☐ Steel; 1☐ 2☐ Galv.; 1☒ 2☐ PVC; 1☐ 2☐ Other ______

Joints: 1☒ 2☐ Threaded; 1☐ 2☐ Welded; 1☐ 2☐ Solvent; 1☐ 2☐ Other ______

SCREEN

Diameter 2" Slot Size #20 Screen Length 4.8 ft.

Type ~~PVC~~ machine slotted Material PVC

Set Between 5.1 ft. and 9.9 ft.

GRAVEL PACK (Filter Pack)

Material/Size #4 Sand Volume/Weight Used ______

Method of Installation ______

Depth: Placed FROM 4.0 ft. TO 11.0 ft.

GROUT

Material Benseal Volume/Weight Used ______

Method of Installation Tremmie

Depth: Placed FROM 1.0 ft. TO 4.0 ft.

DRILLING LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc.	From	To
Topsoil	0.0	0.3
Very Soft to Soft Brown/Gray Silty Clay	0.3	6.5
Loose Brown Sand, Gravel, Clayey Silt	6.5	11.0
		EW
Water @ 5.0'		

*(If more space is needed to complete drilling log, use next consecutively numbered form.)

Date of Well Completion 04-17-01 Total Depth of Well ~~11.0~~ 10.3 ft.

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224-9971

Blue - Customer's copy Pink - Driller's copy Green - Local Health Dept. copy

BBCM

LOG OF BORING NO. P-307A
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; NX Rock Core Barrel

LOCATION: Sta. 468+75, 65' Lt.

COMPLETION DEPTH: 73.0' ELEVATION: 821.4 DATE: 4/10/01 - 4/26/01

SAMPLE NO	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY
1A / 1B	3/6/8	1.6-2.2								
2	5/5/5									
3	3/4/3									
4	3/4/6									
5	1/3/1	1.5-2.1								
6	W/H-12"/1	0.25-0.4								
7	1/1/2	0.4-0.9								
8	2/2/6	0.7-1.1								
9A / 9B	12/13/18					3	10	76	11	
10	2/5/7	0.5-1.1								

DESCRIPTION

GRAVEL - 3 INCHES

FILL: Stiff to very-stiff brown and gray silty clay, little fine to coarse sand, trace fine gravel.

FILL: Medium-dense brown fine to coarse gravel, "and" fine to coarse sand, little silty clay.

Loose brown and gray fine to coarse gravel, "and" fine to coarse sand, little silty clay.

Loose brown and gray fine to coarse gravel, some fine to coarse sand, some silty clay.

Stiff to very-stiff gray silty clay, trace fine to coarse sand.

Very-soft to soft gray organic clayey silt, some fine to coarse sand, some fine to coarse gravel.

Soft to medium-stiff brown and gray silty clay, little fine to coarse sand, trace fine to coarse gravel.

Medium-stiff to stiff gray silty clay, little fine to coarse sand.

Medium-dense (est.) brown and gray fine to medium sand, trace coarse sand, little silt, trace fine to coarse gravel.

Medium-dense gray fine to coarse sand, little fine to coarse gravel, some clayey silt.

Medium-stiff to stiff gray silty clay, trace fine sand, contains lenses of silt.

DEPTH, FEET: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45

WATER LEVEL: ∇ 5.0
WATER NOTE:
DATE: 4/10/01

ODOTLJ 17000090.GPJ BBCM.GDT 12/13/02

JOB: 01107000.090

-CONTINUED-

LOG OF BORING NO. P-307A
GUE-70-14.10
GUERNSEY COUNTY, OHIO

BBCM

TYPE: 3-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; NX Rock Core Barrel

LOCATION: Sta. 468+75, 65' Lt.

COMPLETION DEPTH: 73.0' ELEVATION: 821.4 DATE: 4/10/01 - 4/26/01

DEPTH, FEET	SAMPLE NO.	SAMPLING EFFORT	DESCRIPTION - CONTINUED
45–48			Medium-dense brown and gray fine to coarse sand, "and" silty clay, trace fine to coarse gravel.
48–55	11	NX REC 75% RQD 30%	Medium-hard gray shale, nearly horizontally bedded, interbedded with medium-hard gray sandstone, numerous horizontal fractures along bedding planes.
55–62.5	12	NX REC 47% RQD 10%	GROUT
			Medium-hard gray shale, bedding dips due to mine collapse, numerous fractures due to mine collapse.
62.5–70	13	NX REC 75% RQD 55%	Very-soft to soft gray shale (claystone), undulatory bedding, few irregular fractures.
70–73			Medium-hard gray sandstone, massively bedded, well-cemented.

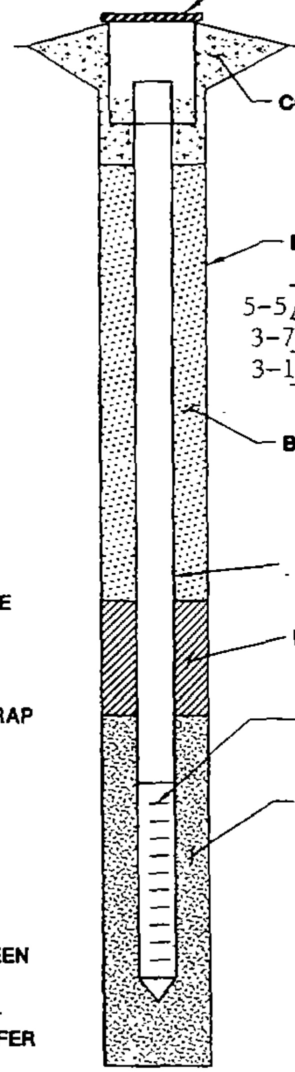
Column headings also printed: HAND PENE-TROMETER (tsf), MOISTURE CONTENT (%), LIQUID LIMIT (%), PLASTIC LIMIT (%), AGG., C.S., F.S, SILT, CLAY.

- Encountered water at 5.0'.
- 6" steel casing from 0.0' to 48.0'.
- Used 5-7/8" Tricone bit from 48.0' to 57.0'.
- Used 3-7/8" Tricone bit from 57.0' to 66.0'.
- Offset hole set at 40.0', 2.0' down station labeled P-307B.

WATER LEVEL: 5.0
WATER NOTE:
DATE: 4/10/01

JOB: 01107000.090

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
821.5	0.1	TOP OF COVER
821.4	0.0	GROUND SURFACE
821.1	0.3	TOP OF PVC
820.4	1.0	TOP OF GROUT
772.0	49.4	TOP OF BENTONITE
769.0	52.4	TOP OF SHALE TRAP
766.4	55.0	TOP OF AQUIFER
765.3	56.1	TOP OF SCREEN OPENINGS
760.5	60.9	BOTTOM OF SCREEN OPENINGS
760.6	61.3	BOTTOM OF WELL
758.8	62.6	BOTTOM OF AQUIFER
748.4	73.0	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME : GUE-70-14.10

BORING : P-307A

DATE WELL INSTALLED : 4/26/01

BBC & M PROJECT NO : 01107000.090

STATIC WATER LEVEL *	13.14			
DATE:	5/21/01			

WELL DEVELOPMENT :

* FEET ABOVE MSL

BBC&M DRAWING NO: TCAMWELS.DWG

BBC&M ENGINEERING, INC.

DNR 7802.96

TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Divison of Water, 1939 Fountain Square Drive
Columbus, Ohio 43224-9971 Voice (614) 265-6739 Fax (614) 447-9503

946529

WELL LOCATION

County Guernsey Township Center

Owner/Builder (Circle One or Both) ODOT First Last

Address of Well Location Station 46,875 65' Left (Number, Street Name)

City ____ Zip Code +4 ____

Permit No ____ Section/Lot No. (Circle One or Both) 18

Location of Well in State Plane coordinates, if available: Use of Well Water Monitoring

N ☐ X ____ . ____ +/- ____ ft. or m

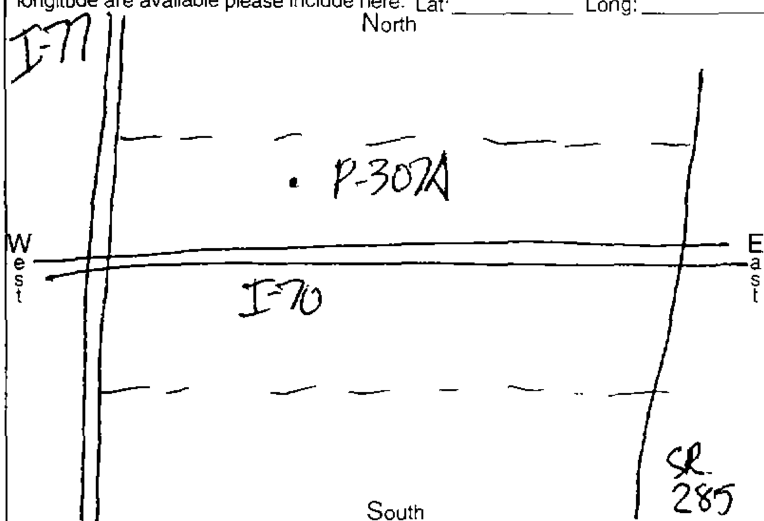
S ☐ Y ____ . ____ +/- ____ ft. or m

Elevation of Well ____ . ____ +/- ____ ft. or m

Datum Plain: ☐ NAD27 ☒ NAD83 Elevation Source ____

Source of Coordinates: ☐ GPS ☒ Survey ☐ Other ____

Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks. If latitude and longitude are available please include here: Lat: ____ Long: ____



WELL TEST*

Pre-Pumping Static Level 13.14 ft. Date 05-21-01

Measured from: ☒ Top of Casing ☐ Ground Level ☐ Other ____

☐ Air ☐ Bailing ☐ Pumping* ☐ Other ____

Test Rate ____ gpm Duration of Test ____ hrs.

Feet of Drawdown ____ ft. Sustainable Yield ____ gpm

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

Is Copy Attached? ☐ Yes ☐ No Flowing Well? ☐ Yes ☐ No

Quality ____

PUMP/PITLESS

Type of pump — Capacity — gpm

Pump set at — ft. Pitless Type —

Pump installed by —

I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm BBC&M Engineering

Address 6190 Enterprise Ct.

City, State, Zip Dublin, OH ~~43~~ 43016

Signed ____ Date 06-14-02

ODH Registration Number 02504

CONSTRUCTION DETAILS

☐ Rotary ☐ Cable ☒ Augered ☐ Driven ☐ Other ____

BOREHOLE/CASING (measured from ground surface)

1 ☒ Borehole Diameter 2 inches Depth 73.0 ft

Casing Diameter 2 in. Length 73.0 ft. Thickness ____ in.

2 ☐ Borehole Diameter ____ inches Depth ____ ft.

Casing Diameter ____ in. Length ____ ft Thickness ____ in.

Casing Height Above Ground ____ ft

Type: 1 ☐ 2 ☐ Steel; 1 ☐ 2 ☐ Galv.; 1 ☒ 2 ☐ PVC; 1 ☐ 2 ☐ Other ____

Joints: 1 ☒ 2 ☐ Threaded; 1 ☐ 2 ☐ Welded; 1 ☐ 2 ☐ Solvent; 1 ☐ 2 ☐ Other ____

SCREEN

Diameter 2" Slot Size #20 Screen Length 48 ft.

Type machine slotted Material PVC

Set Between 56.1 ft and 69.9 ft.

GRAVEL PACK (Filter Pack)

Material/Size #4 Sand Volume/Weight Used ____

Method of Installation ____

Depth: Placed FROM 52.4 ft TO 73.0 ft

GROUT

Material Bentonite Volume/Weight Used ____

Method of Installation tremmie

Depth Placed FROM 1.0 ft. TO 49.4 ft.

DRILLING LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc.	From	To
Gravel	0.0	0.3
Fill	0.3	4.0
Loose Brown Sand, Gravel, Silty Clay	4.0	16.0
Very Soft - Very Stiff Brown/Gray Silty Clay / Clayey Silt with Sand & Gravel	16.0	37.0
Med. Dense Gray Sand Gravel	37.0	42.0
Med. Stiff to Stiff Gray Silty Clay	42.0	46.0
Med. Dense Br and Gray / Sand/Clay/Gravel	46.0	48.0
Med Hard Gray Shale / Sandstone	48.0	55.0
Grout	55.0	62.0
Med Hard Gray Shale	62.0	63.0
Very Soft to Soft Shale (gray	63.0	69.5
Med-Hd Gray Sandstone	69.5	73.0
		End
water@ 5.0'		

*(If more space is needed to complete drilling log, use next consecutively numbered form.)

Date of Well Completion 04-26-01 Total Depth of Well 73 ft

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224-9971

Blue - Customer's copy Pink - Driller's copy Green - Local Health Dept. copy

BBCM

LOG OF BORING NO. P-307B
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: **4-1/4" I.D. Hollow-stem Auger**

LOCATION: **Sta. 468+73, 65' Lt.**

COMPLETION DEPTH: **40.0'** ELEVATION: **821.3** DATE: **4/24/01**

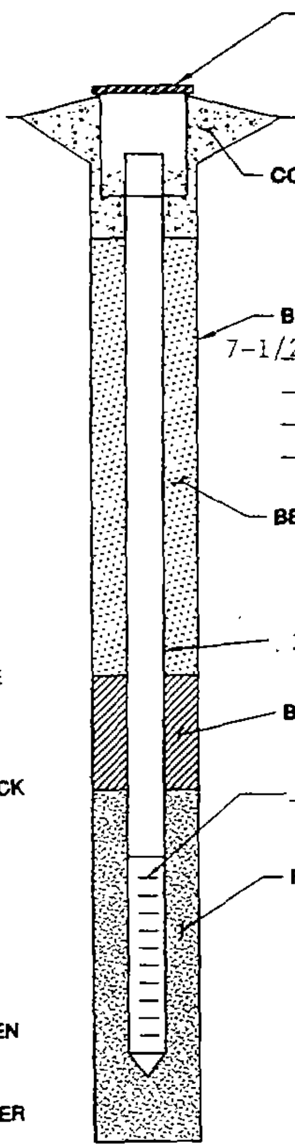
DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0													- Boring drilled for installation of monitoring well P-307B. See completion diagram. - No samples collected see log of boring P-307A.
5													
10													
15													
20													
25													
30													
35													
40													End of Boring at 40.0'

WATER LEVEL:
WATER NOTE:
DATE:

JOB: 01107000.090

ODOT LJ 17000090.GPJ BBCM.GDT 12/13/02

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
821.4	-0.1	TOP OF COVER
821.3	0.0	GROUND SURFACE
821.1	0.2	TOP OF PVC
820.3	1.0	TOP OF GROUT
793.8	27.5	TOP OF BENTONITE
790.8	30.5	TOP OF FILTER PACK
784.3	37.0	TOP OF AQUIFER
787.5	33.8	TOP OF SCREEN OPENINGS
782.7	38.6	BOTTOM OF SCREEN OPENINGS
782.3	39.0	BOTTOM OF WELL
782.4	38.9	BOTTOM OF AQUIFER
781.3	40.0	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME : GUE-70-14.10

BORING : P-307B

DATE WELL INSTALLED : 4/24/01

BBC & M PROJECT NO : 01107000.090

STATIC WATER LEVEL *	10.43			
DATE:	5/21/01			

WELL DEVELOPMENT :

* FEET ABOVE MSL

BBC&M DRAWING NO: TCAMWELBDWG

BBC&M ENGINEERING, INC.

DNR 7802.96

TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Divison of Water, 1939 Fountain Square Drive
Columbus, Ohio 43224-9971 Voice (614) 265-6739 Fax (614) 447-9503

946530

WELL LOCATION

County: Guernsey Township: Center

Owner/Builder (Circle One or Both): ODOT (First / Last)

Address of Well Location: Station 46873 65' left (Number / Street Name)

City: ________ Zip Code +4: ________

Permit No.: ________ Section/Lot No (Circle One or Both): 18

Location of Well in State Plane coordinates, if available: Use of Well: Water Monitoring

N ☐ X ________ . ________ +/- ________ ft. or m

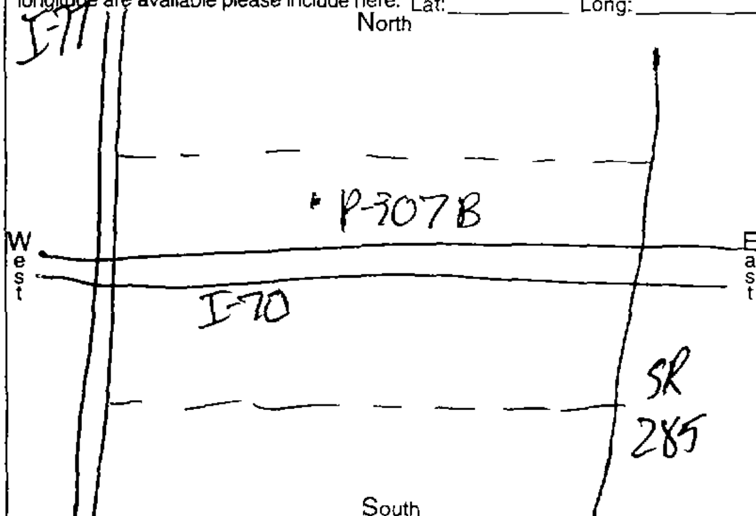
S ☐ Y ________ . ________ +/- ________ ft. or m

Elevation of Well ________ . ________ +/- ________ ft. or m

Datum Plain: ☐ NAD27 ☒ NAD83 Elevation Source ________

Source of Coordinates: ☐ GPS ☒ Survey ☐ Other ________

Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks. If latitude and longitude are available please include here: Lat: ________ Long: ________



WELL TEST*

Pre-Pumping Static Level 10.43 ft. Date 05-21-01

Measured from: ☒ Top of Casing ☐ Ground Level ☐ Other ________

☐ Air ☐ Bailing ☐ Pumping* ☐ Other ________

Test Rate ________ gpm Duration of Test ________ hrs.

Feet of Drawdown ________ ft. Sustainable Yield ________ gpm

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

Is Copy Attached? ☐ Yes ☐ No Flowing Well? ☐ Yes ☐ No

Quality ________

PUMP/PITLESS

Type of pump — Capacity — gpm

Pump set at — ft. Pitless Type —

Pump installed by —

I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm: BBC&M Engineering

Address: 6190 Enterprise Ct.

City, State, Zip: Dublin, OH 43106

Signed ________ Date 06-11-02

ODH Registration Number 02504

CONSTRUCTION DETAILS

☐ Rotary ☐ Cable ☒ Augered ☐ Driven ☐ Other ________

BOREHOLE/CASING (measured from ground surface)

1 ☒ Borehole Diameter 7 1/2 inches Depth 40.0 ft.

Casing Diameter 2 in. Length 40 ft. Thickness ________ in.

2 ☐ Borehole Diameter ________ inches Depth ________ ft.

Casing Diameter ________ in. Length ________ ft Thickness ________ in.

Casing Height Above Ground ________ ft.

Type: 1 ☐ 2 ☐ Steel; 1 ☐ 2 ☐ Galv.; 1 ☒ 2 ☐ PVC; 1 ☐ 2 ☐ Other ________

Joints: 1 ☒ 2 ☐ Threaded; 1 ☐ 2 ☐ Welded; 1 ☐ 2 ☐ Solvent; 1 ☐ 2 ☐ Other ________

SCREEN

Diameter 2" Slot Size #20 Screen Length 4.8 ft.

Type machine Slotted Material PVC

Set Between 33.8 ft. and 38.6 ft.

GRAVEL PACK (Filter Pack)

Material/Size #4 Sand Volume/Weight Used ________

Method of Installation ________

Depth: Placed FROM 30.5 ft. TO 40.0 ft.

GROUT

Material Benseal Volume/Weight Used ________

Method of Installation Tremie

Depth: Placed FROM 0 ft. TO 27.5 ft.

DRILLING LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED. Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc.	From	To
Gravel	0.0	0.3
Fill	0.3	4.0
Loose Brown Sand, Gravel, Clay	4.0	16.0
Very Soft - Very Stiff Brown/Gray Silty Clay/Clayey Silt with Sand & Gravel	16.0	37.0
Med. Dense Gray Sand Gravel	37.0	40.0
		EW
water @ 5.0'		

*(If more space is needed to complete drilling log, use next consecutively numbered form.)

Date of Well Completion 04-24-01 Total Depth of Well ~~40.0~~ 39.0 ft.

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224-9971

Blue - Customer's copy Pink - Driller's copy Green - Local Health Dept. copy

BBCM

LOG OF BORING NO. P-308A
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; NX Rock Core Barrel

LOCATION: Sta. 475+47, 71' Rt.

COMPLETION DEPTH: 76.7' ELEVATION: 823.3 DATE: 4/24/01 - 4/27/01

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0												TOPSOIL - 3 INCHES
												FILL: Hard brown and gray silty clay, trace fine to coarse sand
	1	5/8/8	4 5+									
5												POSSIBLE FILL: Stiff to very-stiff gray and brown silty clay, trace fine to coarse sand.
	2	3/4/6	1 9-2 6									
	3A	4/4/6	2.7-3.4									
10	3B		1 7-3 5									Stiff to very-stiff gray and brown clayey silt, trace fine sand.
												Loose gray and brown fine to medium sand, trace coarse sand, trace fine gravel, "and" silt, trace clay.
15	4	1/2/4										
												Medium-dense gray and brown fine to coarse sand, trace clayey silt, some fine to coarse gravel.
20	5	3/5/6										
												Very-soft to soft gray mottled with brown silty clay, little fine to medium sand, contains many silt lenses, occasional pockets of medium-stiff material.
25	6	1/2/2	0 25-0 7	24	32	20	0	1	11	85	3	
												Stiff to very-stiff gray clayey silt, similar becoming "and" fine to coarse sand.
30	7	3/4/6	1 2-2.2									
												Soft to medium-stiff gray silty clay, trace fine sand, occasional pockets of very-soft material.
35	8	W/H/2/4	0 25-0.6									
												Stiff to very-stiff gray silty clay, little fine to medium sand, occasional pockets of medium-stiff material.
	9A	2/2/4	0.6-2 3									
40	9B											Loose gray fine to coarse sand, little clayey silt.
												Dense gray fine to coarse sand, some fine to coarse gravel, some clayey silt.
	10A	17/18/										
45	10B	50-5"R	4 5+									

WATER LEVEL: 10.0
WATER NOTE:
DATE: 4/24/01

JOB: 01107000.090

-CONTINUED-

BBCM

LOG OF BORING NO. P-308A
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; NX Rock Core Barrel

LOCATION: Sta. 475+47, 71' Rt.

COMPLETION DEPTH: 76.7' ELEVATION: 823.3 DATE: 4/24/01 - 4/27/01

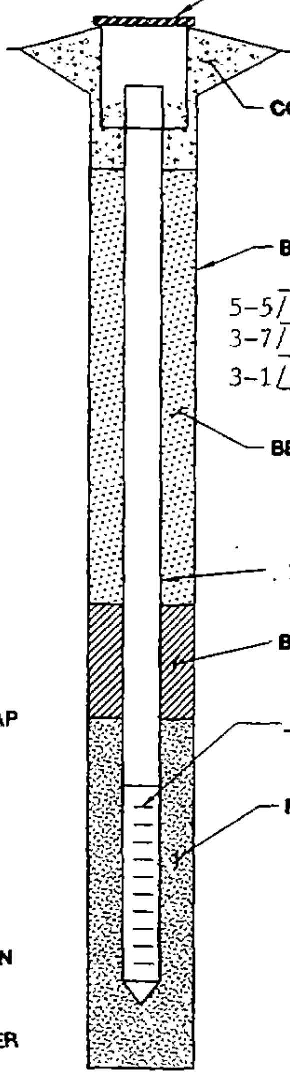
DEPTH, FEET	SAMPLE NO.	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
45												Hard gray clayey silt, little fine to coarse sand, trace fine to coarse gravel.
	11	50-1"R										Medium-hard gray and dark-gray shale interbedded with medium-hard gray sandstone, nearly horizontally bedded, many horizontal fractures along bedding planes.
50	12	NX REC 88% RQD 33%										
55	13	NX REC 90% RQD 58%										
60												
65												Grout, void, mine timber.
70	14	NX REC 89% RQD 82%										Very-soft to soft gray shale (claystone), occasional irregular fractures.
75												
80												- Encountered water at 14.0'. - 6" steel casing - Used 5-7/8" Tricone bit from 48.5' to 64.0'. - Used 3-7/8" Tricone bit from 64.0' to 74.0'. - Offset hole set at 20.7', 2.0' up station labeled P-308B.
85												
90												

WATER LEVEL: 10.0
WATER NOTE:
DATE: 4/24/01

ODOTLJ 17000090.GPJ BBCM.GDT 12/13/02

JOB: 01107000.090

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
823.3	0.0	TOP OF COVER
823.3	0.0	GROUND SURFACE
822.8	0.5	TOP OF PVC
822.3	1.0	TOP OF GROUT
762.3	61.0	TOP OF BENTONITE
759.3	64.0	TOP OF SHALE TRAP
757.9	65.4	TOP OF AQUIFER
758.0	65.3	TOP OF SCREEN OPENINGS
753.2	70.1	BOTTOM OF SCREEN OPENINGS
752.8	70.5	BOTTOM OF WELL
752.4	70.9	BOTTOM OF AQUIFER
746.6	76.7	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME : GUE-70-14.10

BORING : P-308A

DATE WELL INSTALLED : 4/27/01

BBC & M PROJECT NO : 01107000.090

STATIC WATER LEVEL *	13.52			
DATE:	5/21/01			

WELL DEVELOPMENT :

* FEET ABOVE MSL

BBC&M DRAWING NO. TCAMWEL6.DWG

BBC&M ENGINEERING, INC.

DNR 7802.96

TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Divison of Water, 1939 Fountain Square Drive
Columbus, Ohio 43224-9971 Voice (614) 265-6739 Fax (614) 447-9503

946531

WELL LOCATION

County: Guernsey Township: Center

Owner/Builder (Circle One or Both): ODOT (First / Last)

Address of Well Location: Station 47,547 71' Right (Number / Street Name)

City: ______ Zip Code +4: ______

Permit No.: ______ Section/Lot No (Circle One or Both): 18

Location of Well in State Plane coordinates, if available: Use of Well: Water Monitoring

N ☐ X ______ . ______ +/- ______ ft. or m

S ☐ Y ______ . ______ +/- ______ ft. or m

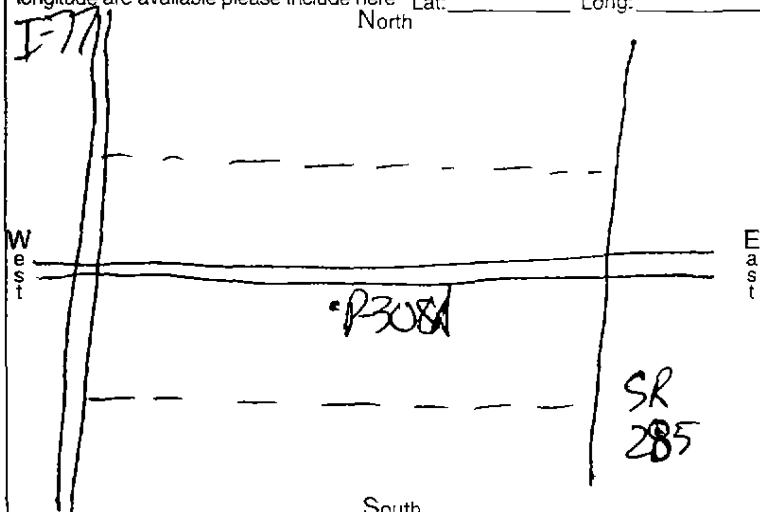
Elevation of Well ______ . ______ +/- ______ ft. or m

Datum Plain: ☐ NAD27 ☒ NAD83 Elevation Source ______

Source of Coordinates: ☐ GPS ☒ Survey ☐ Other ______

Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks. If latitude and longitude are available please include here: Lat: ______ Long: ______

North



South

WELL TEST*

Pre-Pumping Static Level: 13.52 ft. Date: 05-21-02

Measured from: ☒ Top of Casing ☐ Ground Level ☐ Other ______

☐ Air ☐ Bailing ☐ Pumping* ☐ Other ______

Test Rate ______ gpm Duration of Test ______ hrs.

Feet of Drawdown ______ ft. Sustainable Yield ______ gpm

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

Is Copy Attached? ☐ Yes ☐ No Flowing Well? ☐ Yes ☐ No

Quality ______

PUMP/PITLESS

Type of pump: — Capacity: — gpm

Pump set at: — ft. Pitless Type: —

Pump installed by ______

I hereby certify the information given is accurate and correct to the best of my knowledge

Drilling Firm: BBC&M Engineering

Address: 6190 Enterprise Ct.

City, State, Zip: Dublin, OH 43016

Signed ______ Date: 06-14-02

ODH Registration Number: 02504

CONSTRUCTION DETAILS

☐ Rotary ☐ Cable ☒ Augered ☐ Driven ☐ Other ______

BOREHOLE/CASING (measured from ground surface)

1☒ Borehole Diameter: 6" inches Depth: 76.7 ft.
Casing Diameter: 2 in. Length: 76.7 ft. Thickness ______ in.

2☐ Borehole Diameter ______ inches Depth ______ ft.
Casing Diameter ______ in. Length ______ ft. Thickness ______ in.

Casing Height Above Ground ______ ft.

Type: 1☐ 2☐ Steel; 1☐ 2☐ Galv; 1☒ 2☐ PVC; 1☐ 2☐ Other ______

Joints: 1☒ 2☐ Threaded; 1☐ 2☐ Welded; 1☐ 2☐ Solvent; 1☐ 2☐ Other ______

SCREEN

Diameter: 2" Slot Size: #20 Screen Length ______ ft.

Type: machine slotted Material: PVC

Set Between: 65.3 ft. and 70.1 ft.

GRAVEL PACK (Filter Pack)

Material/Size: #4 Sand Volume/Weight Used ______

Method of Installation ______

Depth: Placed FROM 64.0 ft. TO 76.7 ft.

GROUT

Material: Benseal Volume/Weight Used ______

Method of Installation: Tremmie

Depth: Placed FROM 1.0 ft. TO 61.0 ft.

DRILLING LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED. Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand etc.	From	To
Topsoil	0.0	0.3
Fill	0.3	9.0
Stiff to Very Stiff gray/Brown Cl Si. ~~Bro~~ Sand	9.0	11.0
Loose Br Sand, Gravel, Clay	11.0	16.0
Med. Dense Gray Sand Silt, Gravel	16.0	21.0
Very Soft to Very Stiff Gray Clay Silt Sand, Silt	21.0	39.0
Loose to Dense Sand, Gravel, Clay Silt	39.0	48.5
Med. Hard Gray Shale	48.5	65.0
Grout Void Mine Timber	65.0	71.0
Very Soft to Soft Gray Shale	71.0	76.7
Water @ 40'		End

*(If more space is needed to complete drilling log, use next consecutively numbered form.)

Date of Well Completion: 04-27-02 Total Depth of Well: 70.5 ft.

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224-9971

Blue - Customer's copy Pink - Driller's copy Green - Local Health Dept. copy

BBCM

LOG OF BORING NO. P-308B
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 4-1/4" I.D. Hollow-stem Auger

LOCATION: Sta. 475+49, 71' Rt.

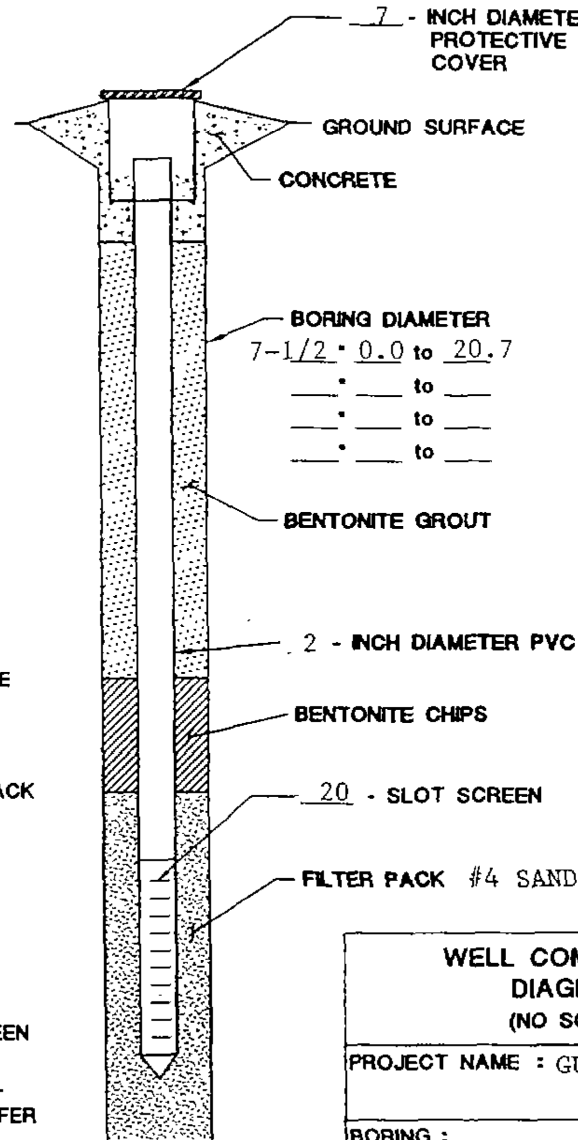
COMPLETION DEPTH: 20.7' ELEVATION: 823.3 DATE: 4/27/01

DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENETROMETER tsf	MOISTURE CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0													- Boring drilled for installation of monitoring well P-308B. See completion diagram. - No samples collected see log of boring P-308A.
5													
10													
15													
20													
25													
30													
35													
40													

WATER LEVEL:
WATER NOTE:
DATE:

JOB: 01107000.090

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
823.2	0.1	TOP OF COVER
823.3	0.0	GROUND SURFACE
823.0	0.3	TOP OF PVC
822.3	1.0	TOP OF GROUT
815.3	8.0	TOP OF BENTONITE
812.1	11.2	TOP OF FILTER PACK
812.3	11.0	TOP OF AQUIFER
808.4	14.7	TOP OF SCREEN OPENINGS
803.6	19.7	BOTTOM OF SCREEN OPENINGS
803.2	20.1	BOTTOM OF WELL
802.3	21.0	BOTTOM OF AQUIFER
802.6	20.7	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME : GUE-70-14.10

BORING : P-308B

DATE WELL INSTALLED : 4/27/01

BBC & M PROJECT NO : 01107000.090

STATIC WATER LEVEL *	7.18				
DATE:	5/21/01				

WELL DEVELOPMENT :

* FEET ABOVE MSL

BBC&M DRAWING NO: TCAMWELB.DWG

BBC&M ENGINEERING, INC.

DNR 7802.96

TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Divison of Water, 1939 Fountain Square Drive
Columbus, Ohio 43224-9971 Voice (614) 265-6739 Fax (614) 447-9503

946532

WELL LOCATION

County: Guernsey Township: Center

Owner/Builder (Circle One or Both): ODOT (First / Last)

Address of Well Location: Station 47549 71' Right (Number / Street Name)

City: ______ Zip Code +4: ______

Permit No.: ______ Section/Lot No. (Circle One or Both): 18

Location of Well in State Plane coordinates, if available: Use of Well ______

☐ N X ______ . ______ +/- ______ ft. or m

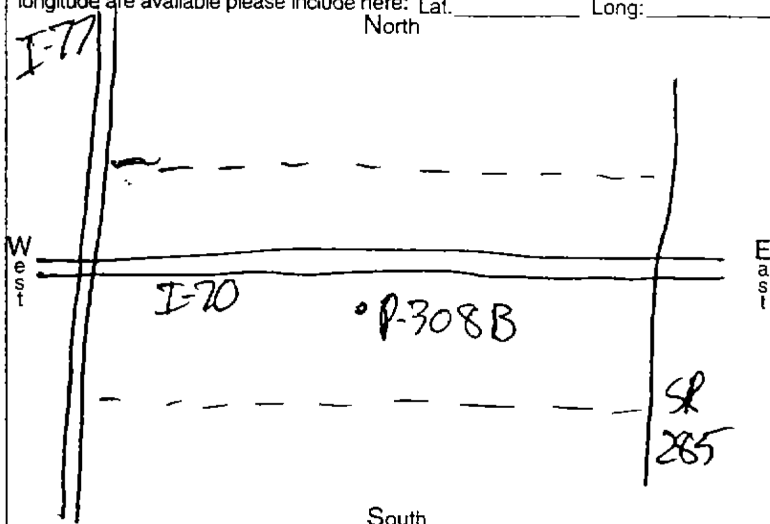
☐ S Y ______ . ______ +/- ______ ft. or m

Elevation of Well ______ . ______ +/- ______ ft. or m

Datum Plain: ☐ NAD27 ☒ NAD83 Elevation Source ______

Source of Coordinates: ☐ GPS ☒ Survey ☐ Other ______

Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks. If latitude and longitude are available please include here: Lat. ______ Long. ______



WELL TEST*

Pre-Pumping Static Level: 7.18 ft. Date: 05-21-02

Measured from: ☒ Top of Casing ☐ Ground Level ☐ Other ______

☐ Air ☐ Bailing ☐ Pumping* ☐ Other ______

Test Rate ______ gpm Duration of Test ______ hrs.

Feet of Drawdown ______ ft. Sustainable Yield ______ gpm

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

Is Copy Attached? ☐ Yes ☐ No Flowing Well? ☐ Yes ☐ No

Quality ______

PUMP/PITLESS

Type of pump: — Capacity: — gpm

Pump set at: — ft. Pitless Type: —

Pump installed by: —

I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm: BBC&M Engineering

Address: 6190 Enterprise Ct

City, State, Zip: Dublin OH 43016

Signed ______ Date: 06-14-02

ODH Registration Number: 02504

CONSTRUCTION DETAILS

☐ Rotary ☐ Cable ☒ Augered ☐ Driven ☐ Other ______

BOREHOLE/CASING (measured from ground surface)

1☒ Borehole Diameter: 7 1/2 inches Depth: 20.7 ft

Casing Diameter: 2 in. Length: 20.7 ft. Thickness ______ in.

2☐ Borehole Diameter ______ inches Depth ______ ft

Casing Diameter ______ in. Length ______ ft. Thickness ______ in.

Casing Height Above Ground ______ ft.

Type: 1☐ 2☐ Steel 1☐ 2☐ Galv. 1☒ 2☐ PVC 1☐ 2☐ Other ______

Joints: 1☒ 2☐ Threaded 1☐ 2☐ Welded 1☐ 2☐ Solvent 1☐ 2☐ Other ______

SCREEN

Diameter: 2" Slot Size: #20 Screen Length: 4.8 ft.

Type: machine Slotted Material: PVC

Set Between: 14.9 ft. and 19.7 ft.

GRAVEL PACK (Filter Pack)

Material/Size: #4 Sand Volume/Weight Used ______

Method of Installation ______

Depth: Placed FROM 11.2 ft. TO 20.7 ft.

GROUT

Material: Benseal Volume/Weight Used ______

Method of Installation: tremmie

Depth: Placed FROM 1.0 ft. TO 8.0 ft.

DRILLING LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED. Show color, texture, hardness, and formation sandstone, shale, limestone, gravel, clay, sand, etc.	From	To
Topsoil	0.0	0.3
Fill	0.3	9.0
Stiff to Very Stiff Gray Brown Cl Silt	9.0	11.0
Loose Brown Sand, Gravel, Clay	11.0	16.0
Med. Dense Gray Sand, Silt, Gravel	16.0	20.7
		End
water @ 11.0'		

*(If more space is needed to complete drilling log, use next consecutively numbered form.)

Date of Well Completion: 04-22-01 Total Depth of Well: 20.1 ft.

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224-9971

Blue - Customer's copy Pink - Driller's copy Green - Local Health Dept. copy

BBCM

LOG OF BORING NO. P-309A
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger
2" O.D. Split-barrel Sampler
NX Rock Core Barrel

LOCATION: Sta. 469+20, 1' Rt.

COMPLETION DEPTH: 70.6' ELEVATION: 823.3 DATE: 5/3/01 - 5/7/01

SAMPLE NO.	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S	F.S.	SILT	CLAY	DESCRIPTION
											TOPSOIL - 3 INCHES
1	4/5/9	4.5+									FILL: Very-stiff to hard brown mottled with gray silty clay, some fine to coarse sand, little fine to coarse gravel, few coal fragments.
2	4/8/6	2.7-4.2									
3	2/3/4	0.7-1.9	28	44	22	1	1	1	53	44	Medium-stiff to stiff gray silty clay, trace fine to coarse sand, few decayed wood fragments, organic odor.
4	W/H-12"/3	0.25-0.7	23	26	19	1	1	42	36	20	Very-soft to medium-stiff brown mottled with gray silty clay, "and" fine sand, trace medium to coarse sand, contains iron oxide staining, organic.
5	2/4/5					46	20	12	22		Loose brown fine to coarse sand, some fine to coarse gravel, some silty clay.
6	11/14/21										Medium-dense gray fine to coarse sand, little fine to coarse gravel, some silty clay.
7	3/4/5	1.2-1.3									Stiff dark-gray mottled with gray organic clayey silt, little fine sand, contains many lenses of organic silt.
8A	6/6/8	1.2-1.3									Medium-dense gray fine to coarse sand, "and" silty clay, trace fine to coarse gravel.
8B											Stiff brown interbedded with gray silty clay, trace fine sand.
9	4/6/11					34	15	14	37		Medium-dense brown and gray fine to coarse sand, "and" silty clay, some fine to coarse gravel.
10	18/30/50-4"R	4.5+									Hard gray silty clay, some fine to coarse sand, trace fine to coarse gravel.

WATER LEVEL: 18.0
WATER NOTE:
DATE: 5/3/01

ODOT LJ 17000090.GPJ BBCM.GDT 12/13/02

JOB: 01107000.090

-CONTINUED-

BBCM

LOG OF BORING NO. P-309A
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: **3-1/4" I.D. Hollow-stem Auger**, **2" O.D. Split-barrel Sampler**, **NX Rock Core Barrel**

LOCATION: **Sta. 469+20, 1' Rt.**

COMPLETION DEPTH: 70.6' **ELEVATION: 823.3** **DATE: 5/3/01 - 5/7/01**

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	DESCRIPTION - CONTINUED
45–52	11	NX REC 81% RQD 32%	Medium-hard gray sandstone, nearly horizontally bedded, interbedded with medium-hard gray shale, numerous horizontal and irregular fractures.
52–60	12	NX REC 100% RQD 38%	Medium-hard gray shale, nearly horizontally bedded, numerous horizontal fractures along bedding planes.
60–66	13	NX REC 100% RQD 61%	COAL
66–70			Very-soft to soft gray shale (claystone), undulatory bedding, few irregular fractures.

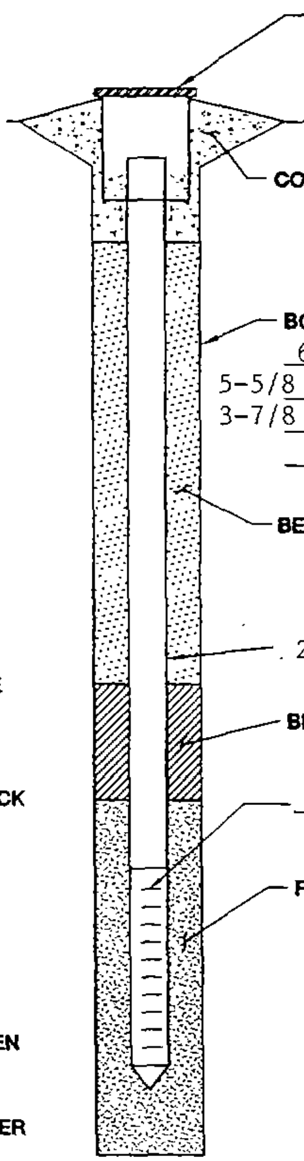
Column headings (no data recorded): HAND PENE-TROMETER (tsf), MOISTURE CONTENT (%), LIQUID LIMIT (%), PLASTIC LIMIT (%), AGG., C.S., F.S., SILT, CLAY

- Encountered water at 20.0'.
- 6" steel casing
- Used 5-7/8" Tricone bit from 45.0' to 60.1'.
- Used 3-7/8" Tricone bit from 60.1' to 69.0'.
- Offset hole set at 22.0', 2.0' down station labeled P-309B.

WATER LEVEL:	18.0					
WATER NOTE:						
DATE:	5/3/01					

JOB: 01107000.090

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
823.4	-0.1	TOP OF COVER
823.3	0.0	GROUND SURFACE
823.1	0.2	TOP OF PVC
822.3	1.0	TOP OF GROUT
769.9	53.4	TOP OF BENTONITE
763.6	59.7	TOP OF FILTER PACK
763.2	60.1	TOP OF AQUIFER
761.9	61.4	TOP OF SCREEN OPENINGS
757.3	66.0	BOTTOM OF SCREEN OPENINGS
756.9	66.4	BOTTOM OF WELL
757.3	66.0	BOTTOM OF AQUIFER
752.7	70.6	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME : GUE-70-14.10

BORING : P-309A

DATE WELL INSTALLED : 5/07/01

BBC & M PROJECT NO : 01107000.090

STATIC WATER LEVEL *	14.29			
DATE:	5/21/01			

WELL DEVELOPMENT :

* FEET ABOVE MSL

BBC&M ENGINEERING, INC.

BBCBM DRAWING NO: TCAMWEL8.DWG

DNR 7802.96

TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Divison of Water, 1939 Fountain Square Drive
Columbus, Ohio 43224-9971 Voice (614) 265-6739 Fax (614) 447-9503

946533

WELL LOCATION

County: Guernsey Township: Center

Owner/Builder (Circle One or Both): ODOT (First / Last)

Address of Well Location: Station 46920 1' Right (Number / Street Name)

City: ____ Zip Code +4: ____

Permit No: ____ Section/Lot No (Circle One or Both): 18

Location of Well in State Plane coordinates, if available: Use of Well ____

☐ N X ____ . ____ +/- ____ ft. or m

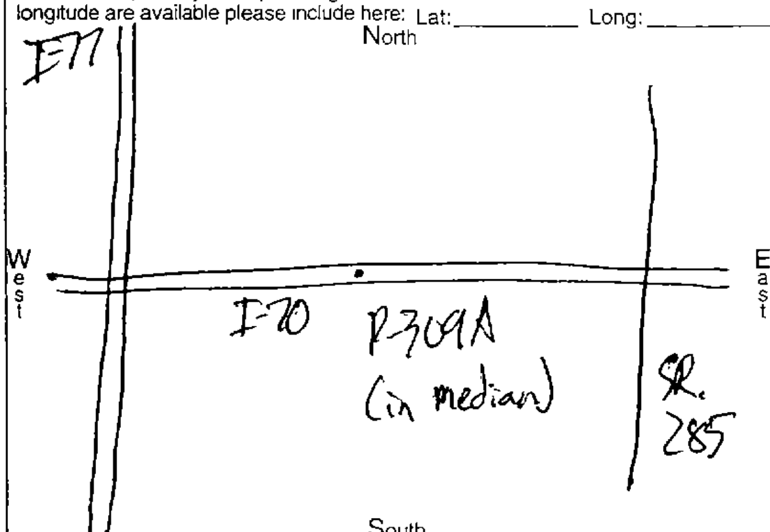
☐ S Y ____ . ____ +/- ____ ft. or m

Elevation of Well ____ . ____ +/- ____ ft. or m

Datum Plain: ☐ NAD27 ☒ NAD83 Elevation Source ____

Source of Coordinates: ☐ GPS ☒ Survey ☐ Other ____

Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks. If latitude and longitude are available please include here: Lat: ____ Long: ____



WELL TEST*

Pre-Pumping Static Level ~~[illegible]~~ 14.29 ft. Date 05-21-02

Measured from: ☒ Top of Casing ☐ Ground Level ☐ Other ____

☐ Air ☐ Bailing ☐ Pumping* ☐ Other ____

Test Rate ____ gpm Duration of Test ____ hrs

Feet of Drawdown ____ ft. Sustainable Yield ____ gpm

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

Is Copy Attached? ☐ Yes ☐ No Flowing Well? ☐ Yes ☐ No

Quality ____

PUMP/PITLESS

Type of pump — Capacity — gpm

Pump set at — ft. Pitless Type —

Pump installed by —

I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm: BBC&M Engineering

Address: 6190 Enterprise Ct.

City, State, Zip: Dublin, OH 43016

Signed ____ Date 06-14-02

ODH Registration Number 02504

CONSTRUCTION DETAILS

☐ Rotary ☐ Cable ☒ Augered ☐ Driven ☐ Other ____

BOREHOLE/CASING (measured from ground surface)

1 ☒ Borehole Diameter 6 inches Depth 70.6 ft.
Casing Diameter 2 in. Length 70.6 ft Thickness ____ in.

2 ☐ Borehole Diameter ____ inches Depth ____ ft.
Casing Diameter ____ in. Length ____ ft. Thickness ____ in.

Casing Height Above Ground ____ ft.

Type: 1 ☐ 2 ☐ Steel; 1 ☐ 2 ☐ Galv.; 1 ☒ 2 ☐ PVC; 1 ☐ 2 ☐ Other ____

Joints: 1 ☒ 2 ☐ Threaded; 1 ☐ 2 ☐ Welded; 1 ☐ 2 ☐ Solvent; 1 ☐ 2 ☐ Other ____

SCREEN

Diameter 2" Slot Size #20 Screen Length 4.6 ft.

Type machine slotted Material PVC

Set Between 61.4 ft and 66.0 ft.

GRAVEL PACK (Filter Pack)

Material/Size #4 Sand Volume/Weight Used ____

Method of Installation ____

Depth: Placed FROM 59.7 ft. TO 70.6 ft.

GROUT

Material Benseal Volume/Weight Used ____

Method of Installation Tremmie

Depth: Placed FROM 1.0 ft. TO 53.4 ft.

DRILLING LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc.	From	To
Topsoil	0.0	0.3
Fill	0.3	8.0
Soft to Stiff Brown/Gray Silty Clay Sand,	8.0	17.0
Loose to Med. Dense Gray Sand, Gravel, Clay	17.0	27.0
Stiff Gray Clayey Silt, Sand	27.0	32.0
Med. Dense Gray Sand, Clay, Gravel	32.0	34.0
Stiff Brown/Gray Silty Clay, Sand	34.0	36.5
Med Dense Gray Sand, Clay, Gravel	36.5	41.0
Hard Gray Silty Clay, Sand, Gravel	41.0	44.0
Med. Hard Sandstone/Shale	44.0	60.0
Coal	60.0	66.0
Very Soft to Soft Gray Shale	66.0	70.6
		End
Water @ 20.0'		

*(If more space is needed to complete drilling log, use next consecutively numbered form.)

Date of Well Completion 05-07-01 Total Depth of Well 66.4 ft.

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224-9971

Blue - Customer's copy Pink - Driller's copy Green - Local Health Dept. copy

BBCM

LOG OF BORING NO. P-309B
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE. **4-1/4" I.D. Hollow-stem Auger** LOCATION. **Sta. 469+18, 10' Rt.**

COMPLETION DEPTH: 22.0' ELEVATION: 823.4 DATE: 5/7/01

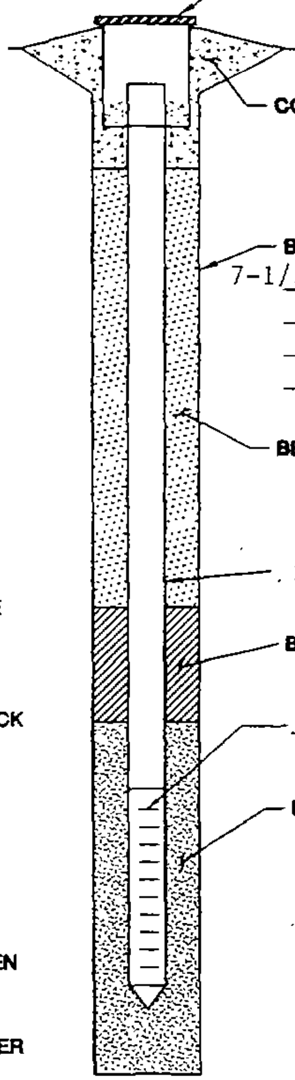
DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG	C.S.	F.S	SILT	CLAY	DESCRIPTION
0													- Boring drilled for installation of monitoring well P-309B. See completion diagram. - No samples collected see log of boring P-309A.
5													
10													
15													
20													
25													
30													
35													
40													

WATER LEVEL:
WATER NOTE:
DATE:

ODOTLJ 17000090.GPJ BBCM.GDT 12/13/02

JOB: 01107000.090

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
823.7	-0.3	TOP OF COVER
823.4	0.0	GROUND SURFACE
823.4	0.0	TOP OF PVC
822.4	1.0	TOP OF GROUT
810.3	13.1	TOP OF BENTONITE
807.6	15.8	TOP OF FILTER PACK
806.0	17.4	TOP OF AQUIFER
806.0	16.8	TOP OF SCREEN OPENINGS
802.0	21.4	BOTTOM OF SCREEN OPENINGS
801.7	21.7	BOTTOM OF WELL
802.4	21.0	BOTTOM OF AQUIFER
801.4	22.0	BORING DEPTH



7 - INCH DIAMETER PROTECTIVE STEEL COVER

GROUND SURFACE

CONCRETE

BORING DIAMETER

7-1/2 " 0.0 to 22.0

___" ___ to ___

___" ___ to ___

___" ___ to ___

BENTONITE GROUT

2 - INCH DIAMETER PVC

BENTONITE CHIPS

20 - SLOT SCREEN

FILTER PACK #4 SAND

WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME : GUE-70-14.10

BORING : P-309B

DATE WELL INSTALLED : 5/08/01

BBC & M PROJECT NO : 01107000.090

STATIC WATER LEVEL *	9.97			
DATE:	5/21/01			

WELL DEVELOPMENT :

* FEET ABOVE MSL

BBC&M DRAWING NO: TCAMWELB.DWG

BBC&M ENGINEERING, INC.

DNR 7802.96

TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Divison of Water, 1939 Fountain Square Drive
Columbus, Ohio 43224-9971 Voice (614) 265-6739 Fax (614) 447-9503

946534

WELL LOCATION

County: Guernsey Township: Center

Owner/Builder (Circle One or Both): ODOT (First / Last)

Address of Well Location: Station 469+18 1' RT (Number / Street Name)

City: ______ Zip Code +4: ______

Permit No.: ______ Section/Lot No. (Circle One or Both): 18

Location of Well in State Plane coordinates, if available: Use of Well: ______

N ☐ X ______ . ______ +/- ______ ft or m

S ☐ Y ______ . ______ +/- ______ ft. or m

Elevation of Well ______ . ______ +/- ______ ft or m

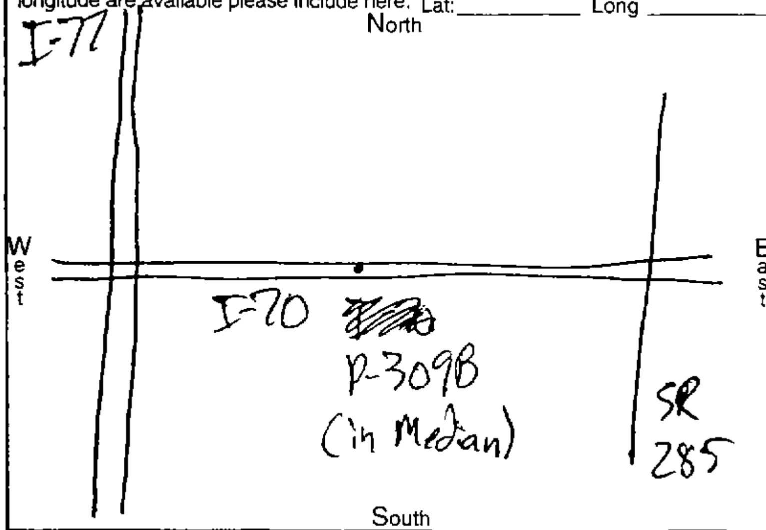
Datum Plain: ☐ NAD27 ☒ NAD83 Elevation Source ______

Source of Coordinates: ☐ GPS ☒ Survey ☐ Other ______

Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks. If latitude and longitude are available please include here: Lat: ______ Long ______

North

West



East

South

WELL TEST*

Pre-Pumping Static Level 9.97 ft. Date 05-21-02

Measured from: ☒ Top of Casing ☐ Ground Level ☐ Other ______

☐ Air ☐ Bailing ☐ Pumping* ☐ Other ______

Test Rate ______ gpm Duration of Test ______ hrs.

Feet of Drawdown ______ ft Sustainable Yield ______ gpm

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

Is Copy Attached? ☐ Yes ☐ No Flowing Well? ☐ Yes ☐ No

Quality ______

PUMP/PITLESS

Type of pump — Capacity — gpm

Pump set at — ft. Pitless Type —

Pump installed by ______

I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm: BBC&M Engineering

Address: 6190 Enterprise Ct.

City, State, Zip: Dublin, OH 43016

Signed ______ Date 06-14-02

ODH Registration Number 02504

CONSTRUCTION DETAILS

☐ Rotary ☐ Cable ☒ Augered ☐ Driven ☐ Other ______

BOREHOLE/CASING (measured from ground surface)

1☒ Borehole Diameter 7 1/2 inches Depth 22.0 ft
Casing Diameter 2 in. Length 22.0 ft. Thickness ______ in.

2☐ Borehole Diameter ______ inches Depth ______ ft.
Casing Diameter ______ in. Length ______ ft. Thickness ______ in

Casing Height Above Ground ______ ft.

Type: 1☐ 2☐ Steel; 1☐ 2☐ Galv; 1☒ 2☐ PVC; 1☐ 2☐ Other ______

Joints: 1☒ 2☐ Threaded; 1☐ 2☐ Welded; 1☐ 2☐ Solvent; 1☐ 2☐ Other ______

SCREEN

Diameter 2" Slot Size #20 Screen Length ______ ft.

Type machine slotted Material PVC

Set Between 16.8 ft. and 21.4 ft.

GRAVEL PACK (Filter Pack)

Material/Size #4 Sand Volume/Weight Used ______

Method of Installation ______

Depth: Placed FROM 15.8 ft. TO 22.0 ft.

GROUT

Material Benseal Volume/Weight Used ______

Method of Installation tremmie

Depth: Placed FROM 1.0 ft TO 13.4 ft.

DRILLING LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc.	From	To
Topsoil	0.0	0.3
Fill	0.3	8.0
Soft to Stiff Brown/Gray Silty Cl. Sand	8.0	17.0
Loose to Med Dense Gray, Sand, Gravel, Clay	17.0	22.0
		T End
water @ 22.0		

*(If more space is needed to complete drilling log, use next consecutively numbered form.)

Date of Well Completion 05-08-01 Total Depth of Well 21.7 ft.

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224-9971

Blue - Customer's copy Pink - Driller's copy Green - Local Health Dept. copy

BBCM

LOG OF BORING NO. P-310A
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger; 2" O.D. Split-barrel Sampler; NX Rock Core Barrel

LOCATION: Sta. 474+90, 2.0' Rt.

COMPLETION DEPTH: 77.5' ELEVATION: 825.3 DATE: 4/30/01 - 5/2/01

DEPTH, FEET	SAMPLE NO.	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION
0												TOPSOIL - 4 INCHES
												FILL: Brown clayey silt, trace fine to coarse sand, few roots, few coal fragments.
	1	4/3/3	4.5+									
5												Very-stiff brown mottled with gray silty clay, trace fine to medium sand.
	2	3/5/8	2 0-2 8									
	3	4/5/7	2 0-3 4									
10												Loose brown fine sand, some medium to coarse sand, little clayey silt.
	4	2/2/2										
15												Very-soft to medium-stiff gray silty clay, trace fine sand.
	5	W/H/1/2	0 25-0 7									
20												Medium-stiff to stiff gray clayey silt (very silty), little fine sand.
	6	2/2/3	0.7-1 4									
25												Medium-dense brown and gray fine to coarse sand, trace clayey silt
	7	3/4/7										
30												Medium-stiff gray clayey silt (very silty), trace fine sand.
	8	W/H/2/2	0 7-1 0									
35												Very-dense gray fine to coarse sand, little fine to coarse gravel, little clayey silt.
	9	12/23/35										
40												Medium-stiff to stiff gray clayey silt, trace fine sand.
	10	1/4/7	0 9-1.1									
45												

WATER LEVEL: ▽ 28.5
WATER NOTE:
DATE: 4/30/01

ODOT.LJ 17000090 GPJ BBCM GDT 12/13/02

JOB: 01107000.090 -CONTINUED-

BBCM

LOG OF BORING NO. P-310A
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: **3-1/4" I.D. Hollow-stem Auger**; **2" O.D. Split-barrel Sampler**; **NX Rock Core Barrel**

LOCATION: **Sta. 474+90, 2.0' Rt.**

COMPLETION DEPTH: 77.5' **ELEVATION:** 825.3 **DATE:** 4/30/01 - 5/2/01

DEPTH, FEET	SAMPLE NO	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
45												Medium-stiff to stiff gray clayey silt, trace fine sand.
	11	21/ 50-4"R	4.5+									Hard gray clayey silt, little fine to coarse sand, contains many sandstone and shale fragments.
50	12	NX REC 98% RQD 82%										Medium-hard gray shale, nearly horizontally bedded, interbedded with medium-hard gray sandstone, few horizontal fractures.
60	13	NX REC 95% RQD 57%										
65												COAL
70	14	NX REC 75% RQD 50%										Very-soft to soft gray shale (claystone), undulatory bedding, few irregular fractures, occasional slickensides.
80												
85												
90												

- Encountered water at 28.0'.
- 6" steel casing
- Used 5-7/8" Tricone bit from 50.5' to 65.0'.
- Used 3-7/8" Tricone bit from 65.0' to 75.0'.
- Offset hole drilled, but no water encountered, 2.0' up station.

WATER LEVEL: 28.5
WATER NOTE:
DATE: 4/30/01

ODOT.LJ 17000090.GPJ BBCM.GDT 12/11/02

JOB: 01107000.090

WELL COMPLETION DIAGRAM
(NO SCALE)

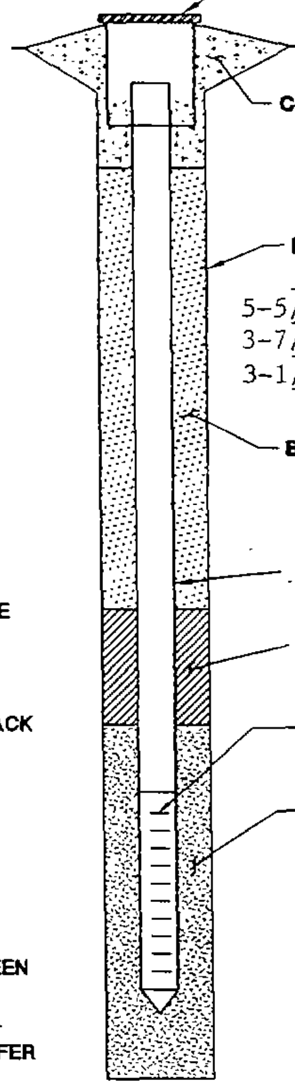
PROJECT NAME : GUE-70-14.10

BORING : P-310A

DATE WELL INSTALLED : 5/02/01

BBC & M PROJECT NO : 01107000.090

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
825.3	0.0	TOP OF COVER
825.3	0.0	GROUND SURFACE
825.0	0.3	TOP OF PVC
824.3	1.0	TOP OF GROUT
766.9	58.4	TOP OF BENTONITE
761.3	64.0	TOP OF FILTER PACK
760.3	65.0	TOP OF AQUIFER
758.9	66.4	TOP OF SCREEN OPENINGS
754.1	71.2	BOTTOM OF SCREEN OPENINGS
753.8	71.5	BOTTOM OF WELL
754.1	71.2	BOTTOM OF AQUIFER
747.8	77.5	BORING DEPTH



STATIC WATER LEVEL *	16.38			
DATE:	5/21/01			

WELL DEVELOPMENT :

* FEET ABOVE MSL

BBC&M DRAWING NO: TCAMWEL8.DWG

DNR 7802 96

TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Divison of Water, 1939 Fountain Square Drive
Columbus, Ohio 43224-9971 Voice (614) 265-6739 Fax (614) 447-9503

958625

WELL LOCATION

County: Guernsey Township: Center

Owner/Builder (Circle One or Both): ODOT (First / Last)

Address of Well Location: Sta. 2'49+20 1' Rt (Number / Street Name)

City: ____ Zip Code +4: ____

Permit No. ____ Section/Lot No. (Circle One or Both): 18

Location of Well in State Plane coordinates, if available: ____ Use of Well: groundwater Monitoring

N ☐ X ____ . ____ +/- ____ ft. or m

S ☐ Y ____ . ____ +/- ____ ft. or m

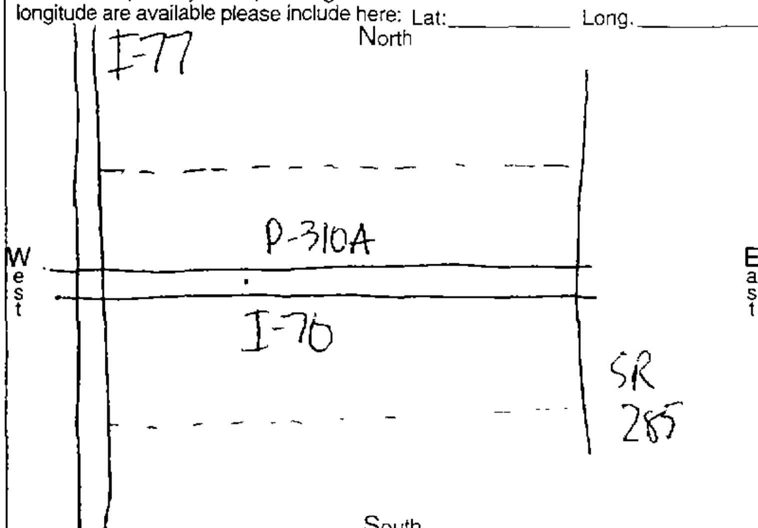
Elevation of Well: 825 . 3 +/- ____ ft or m

Datum Plain: ☐ NAD27 ☒ NAD83 Elevation Source ____

Source of Coordinates: ☐ GPS ☒ Survey ☐ Other ____

Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks. If latitude and longitude are available please include here: Lat: ____ Long. ____

North



West — East

South

WELL TEST*

Pre-Pumping Static Level: 16.38 ft. Date: 05-21-01

Measured from: ☒ Top of Casing ☐ Ground Level ☐ Other ____

☐ Air ☐ Bailing ☐ Pumping* ☐ Other ____

Test Rate ____ gpm Duration of Test ____ hrs.

Feet of Drawdown ____ ft. Sustainable Yield ____ gpm

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

Is Copy Attached? ☐ Yes ☐ No Flowing Well? ☐ Yes ☐ No

Quality ____

PUMP/PITLESS

Type of pump: — Capacity: — gpm

Pump set at: — ft Pitless Type: —

Pump installed by: —

I hereby certify the information given is accurate and correct to the best of my knowledge

Drilling Firm: BBC&M Engineering

Address: 6190 Enterprise Ct.

City, State, Zip: Dublin, OH 43016

Signed ____ Date: 06-14-02

ODH Registration Number: 02504

CONSTRUCTION DETAILS

☐ Rotary ☐ Cable ☒ Augered ☐ Driven ☐ Other ____

BOREHOLE/CASING (measured from ground surface)

1☒ Borehole Diameter: 6 inches Depth: 77.5 ft.
Casing Diameter: 2 in Length: 77.5 ft. Thickness ____ in.

2☐ Borehole Diameter ____ inches Depth ____ ft.
Casing Diameter ____ in. Length ____ ft Thickness ____ in.

Casing Height Above Ground: 0.3 ft.

Type: 1☐ 2☐ Steel 1☐ 2☐ Galv. 1☐ 2☐ PVC 1☐ 2☐ Other ____

Joints: 1☒ 2☐ Threaded 1☐ 2☐ Welded 1☐ 2☐ Solvent 1☐ 2☐ Other ____

SCREEN

Diameter: 2" Slot Size: #20 Screen Length: 4.8 ft.

Type: machine Slot Material: PVC

Set Between: 66.4 ft. and 71.2 ft.

GRAVEL PACK (Filter Pack)

Material/Size: #4 Sand Volume/Weight Used ____

Method of Installation ____

Depth Placed FROM 64.0 ft. TO 77.5 ft.

GROUT

Material: Benseal Volume/Weight Used ____

Method of Installation: Tremmie

Depth. Placed FROM 1.0 ft. TO 58.9 ft.

DRILLING LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED. Show color, texture, hardness, and formation, sandstone, shale, limestone, gravel, clay, sand, etc	From	To
Fill	0.0	5.0
Brown/Gray Silty Clay	5.0	11.0
Br Fine Sand	11.0	17.0
Gray Clayey Silt	17.0	27.0
Br/Gy fine to Coarse Sand	27.0	31.0
Gray Clayey Silt	31.0	37.0
Gray ~~Fi~~ Fine to coarse Sand	37.0	41.0
Gray Clayey Silt	41.0	47.0
Gray Clayey Silt	47.0	50.5
Shale	50.5	65.0
Coal	65.0	71.0
Shale	71.0	77.5
		↑
water 28.0		End

*(If more space is needed to complete drilling log, use next consecutively numbered form.)

Date of Well Completion: 05-02-01 Total Depth of Well: 77.5 ft.

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224-9971

Blue - Customer's copy Pink - Driller's copy Green - Local Health Dept. copy

BBCM

LOG OF BORING NO. P-311B
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 4-1/2" O.D. CFA & 4-1/4" I.D. HSA
2" O.D. Split-barrel Sampler

LOCATION: Sta. 474+67, 66' Lt.
Anomaly C

COMPLETION DEPTH: 48.7' ELEVATION: 823.6 DATE: 4/16/02 - 4/17/02

SAMPLE NO	SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C S.	F S.	SILT	CLAY
1A	7/5/2									
1B	/4	1.4-1.8	21	41	19	2	3	4	57	34
2	8/5/8 /11	2.2-3.2	20	34	17	0	2	10	59	29
3	5/5/9 /13									
4	2/2/4 /5	0.75-2.0								
5	2/4/4 /7	1.3-2.0								
6	4/5/7 /7									
7A	3/5/2									
7B	/3									
8A	2/2/1									
8B	/1	0.0	21	31	18	1	2	13	55	29
9	2/2/1 /1	0.0-0.1								
10A	S/R									
10B	S/H 4/7	0.8								
10C		0.8-0.9	19	27	17	1	12	56	10	21
11	S/H=18" /4									

DEPTH, FEET: 0, 5, 10, 15, 20, 25, 30

DESCRIPTION

- FILL: Loose gray and brown fine to coarse sand, some fine gravel, "and" silty clay.
- Stiff to very-stiff brown silty clay, little fine to coarse sand, trace fine to coarse gravel.
- Loose brown silt interbedded with fine to medium sand and medium-stiff to stiff silty clay, trace coarse sand, trace fine gravel.
- Medium-dense brown fine to coarse sand, some fine to coarse gravel, little clayey silt.
- Very-loose to loose brown and gray fine to coarse sand, some clayey silt, little fine to coarse gravel.
- Very-soft gray silty clay, trace fine to coarse sand, trace fine to coarse gravel, few becoming many seams silt.
- Medium-stiff gray silty clay, trace fine to coarse sand, trace fine to coarse gravel, few becoming many silt seams
- Medium-stiff with pockets of stiff gray organic clayey silt, little fine to medium sand, contains decayed vegetation.
- Very-loose gray silt, trace fine to medium sand, few thin seams of silty clay.

WATER LEVEL:	▽ 4.6	▼ 13.3				
WATER NOTE:						
DATE:	4/17/02	4/18/02				

ODOT.LJ 17000090.GPJ BBCM.GDT 12/13/02

JOB: 01107000.090

-CONTINUED-

BBCM

LOG OF BORING NO. P-311B
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 4-1/2" O.D. CFA & 4-1/4" I.D. HSA
2" O.D. Split-barrel Sampler

LOCATION: Sta. 474+67, 66' Lt.
Anomaly C

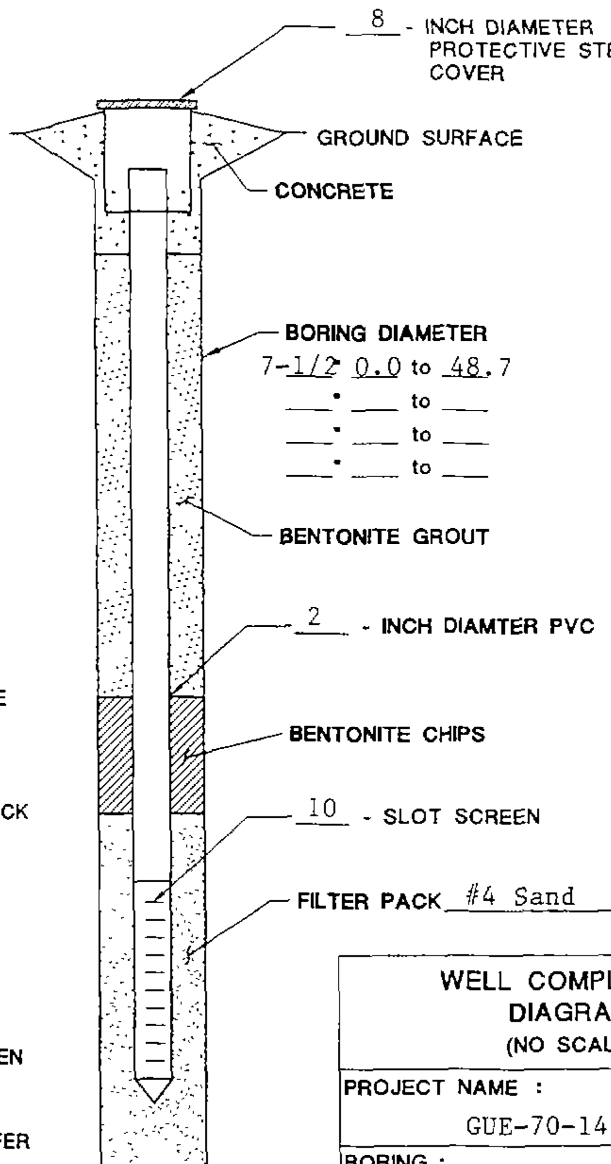
COMPLETION DEPTH: 48.7' ELEVATION: 823.6 DATE: 4/16/02 - 4/17/02

DEPTH, FEET	SAMPLE NO	SAMPLES / SAMPLING EFFORT	HAND PENETROMETER (tsf)	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	AGG.	C.S.	F.S.	SILT	CLAY	DESCRIPTION - CONTINUED
												Very-soft gray silty clay, trace fine to medium sand, many thin seams of silt.
35	12	S/H=12" / 1/4	0.0-0.2									
												Very-loose gray fine to coarse sand, little fine gravel, trace silt.
	13A 13B	2/2/2										Loose gray silt, some fine sand, little clay.
40	13C	/4										Dense gray fine to coarse sand, some clayey silt, little fine to coarse gravel
45	14	19/20/21 /35										
												Soft gray shale, nearly horizontally bedded, silty.
	15	50-2"R										
50												
55												- Encountered seepage from 13.6' to 17.0'. - Encountered water from 16.0' to 21.0'. - Boring converted to groundwater monitoring well. See well completion diagram.
60												

WATER LEVEL:	4.6	13.3				
WATER NOTE:						
DATE:	4/17/02	4/18/02				

JOB: 01107000.090

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
823.6	0.0	TOP OF COVER
823.6	0.0	GROUND SURFACE
823.3	0.3	TOP OF PVC
822.4	1.2	TOP OF GROUT
784.1	39.5	TOP OF BENTONITE
783.4	40.2	TOP OF FILTER PACK
784.7	38.9	TOP OF AQUIFER
780.7	42.9	TOP OF SCREEN OPENINGS
776.2	47.4	BOTTOM OF SCREEN OPENINGS
775.7	47.9	BOTTOM OF WELL
776.4	47.2	BOTTOM OF AQUIFER
774.9	48.7	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME : GUE-70-14.10

BORING : P-311B

DATE WELL INSTALLED : 04-17-02

BBC & M PROJECT NO : 01107000.090

STATIC WATER LEVEL *	13.3			
DATE:	4/17/02			

WELL DEVELOPMENT :

* FEET ABOVE MSL

BBC&M DRAWING NO TCAMWEL9.DWG

BBC&M ENGINEERING, INC.

DNR 7802 96

TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Divison of Water, 1939 Fountain Square Drive
Columbus, Ohio 43224-9971 Voice (614) 265-6739 Fax (614) 447-9503

958624

WELL LOCATION

County Guernsey Township Center

Owner/Builder (Circle One or Both) ODOT
First Last

Address of Well Location Station 474+67 66'Lt.
Number Street Name

City ______ Zip Code +4 ______

Permit No. ______ Section/Lot No. (Circle One or Both) 18

Location of Well in State Plane coordinates, if available: Use of Well Groundwater Monitoring

N ☐ X ______ . ______ +/- ______ ft. or m

S ☐ Y ______ . ______ +/- ______ ft. or m

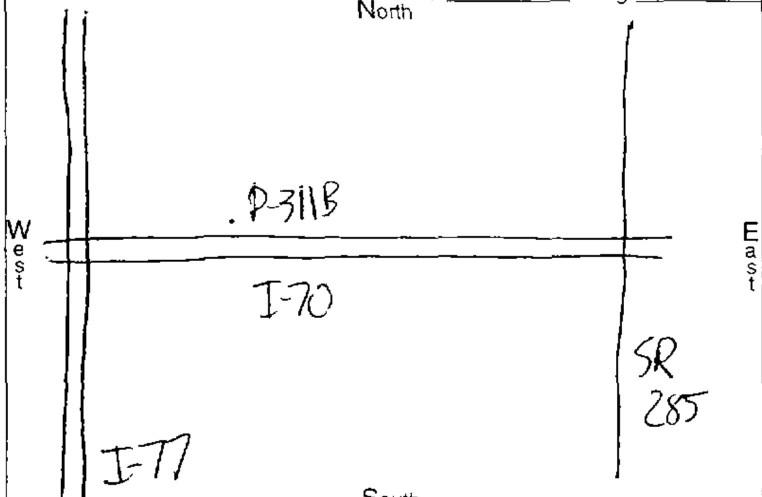
Elevation of Well 823 . 6 +/- ______ ft. or m

Datum Plain: ☐ NAD27 ☒ NAD83 Elevation Source ______

Source of Coordinates: ☐ GPS ☒ Survey ☐ Other ______

Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks. If latitude and longitude are available please include here Lat. ______ Long. ______

North



West / East

South

WELL TEST*

Pre-Pumping Static Level 34 ft. Date 4-17-02

Measured from: ☒ Top of Casing ☐ Ground Level ☐ Other ______

☐ Air ☐ Bailing ☐ Pumping* ☐ Other ______

Test Rate ______ gpm Duration of Test ______ hrs.

Feet of Drawdown ______ ft. Sustainable Yield ______ gpm

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

Is Copy Attached? ☐ Yes ☐ No Flowing Well? ☐ Yes ☐ No

Quality ______

PUMP/PITLESS

Type of pump — Capacity — gpm

Pump set at — ft Pitless Type —

Pump installed by ______

I hereby certify the information given is accurate and correct to the best of my knowledge

Drilling Firm BBC&M Engineering

Address 6190 Enterprise Ct

City, State, Zip Dublin, OH 43016

Signed ______ Date 06-13-02

ODH Registration Number 02504

CONSTRUCTION DETAILS

☐ Rotary ☐ Cable ☒ Augered ☐ Driven ☐ Other ______

BOREHOLE/CASING (measured from ground surface)

1☒ Borehole Diameter 7 1/2 inches Depth 48.7 ft.
Casing Diameter 2 in. Length 47.9 ft. Thickness ______ in.

2☐ Borehole Diameter ______ inches Depth ______ ft.
Casing Diameter ______ in. Length ______ ft Thickness ______ in

Casing Height Above Ground -0.3 ft.

Type: 1☐ 2☐ Steel; 1☐ 2☐ Galv.; 1☒ 2☐ PVC; 1☐ 2☐ Other ______

Joints: 1☒ 2☐ Threaded; 1☐ 2☐ Welded; 1☐ 2☐ Solvent; 1☐ 2☐ Other ______

SCREEN

Diameter 2" Slot Size #20 Screen Length ______ ft.

Type machine slotted Material PVC

Set Between ~~47.3~~ 42.9 ft. and 47.4 ft.

GRAVEL PACK (Filter Pack)

Material/Size #4 Sand Volume/Weight Used ______

Method of Installation ______

Depth: Placed FROM 40.2 ft. TO 48.7 ft.

GROUT

Material Benseal Volume/Weight Used ______

Method of Installation tremmie

Depth. Placed FROM 1.2 ft TO 39.5 ft.

DRILLING LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc.	From	To
Fill	0.0	1.7
Clayey Silt	1.7	4.9
~~Fi~~ Sand	4.9	7.0
Clayey Silt	7.0	10.6
Fine to Carse Gravel	10.6	13.0
Fine to Carse Sand	13.0	13.8
~~Fine~~ Fine to Carse Sand	13.8	17.0
Fine to Carse Sand	17.0	21.0
Silt	21.0	23.9
Silty Clay	23.9	24.3
Fine to Carse Sand	24.3	28.0
Silt and Clay	28.0	31.0
Silty Clay	31.0	37.0
		End

*(If more space is needed to complete drilling log, use next consecutively numbered form.)

Date of Well Completion 04-18-02 Total Depth of Well ~~47.3~~ 48.7 ft.

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224-9971

Blue - Customer's copy Pink - Driller's copy Green - Local Health Dept. copy

BBCM

LOG OF BORING NO. P-311C
GUE-70-14.10
GUERNSEY COUNTY, OHIO

TYPE: 3-1/4" I.D. Hollow-stem Auger

LOCATION: Sta. 474+63, 65' Lt. Anomaly C

COMPLETION DEPTH: 16.5' ELEVATION: 823.6 DATE: 4/17/02

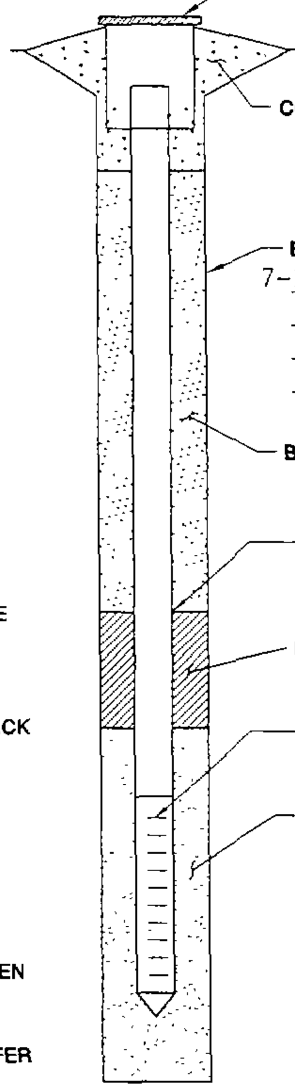
DEPTH, FEET	SAMPLE NO	SAMPLES	SAMPLING EFFORT	HAND PENE-TROMETER tsf	MOISTURE CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	AGG.	C.S.	F.S	SILT	CLAY	DESCRIPTION
0													SEE LOG OF BORING P-311B
5													
10													
15													
20													- Boring converted to groundwater monitoring well. See well completion diagram.
25													
30													

WATER LEVEL: 8.9
WATER NOTE:
DATE: 4/16/02

JOB: 01107000.090

ODOT LJ 17090090.GPJ BBCM.GDT 12/13/02

ELEV. *	DEPTH BELOW GROUND SURFACE (FEET)	
823.6	0.0	TOP OF COVER
823.6	0.0	GROUND SURFACE
823.4	0.2	TOP OF PVC
822.8	0.8	TOP OF GROUT
818.0	5.6	TOP OF BENTONITE
813.6	10.0	TOP OF FILTER PACK
809.8	13.8	TOP OF AQUIFER
812.4	11.2	TOP OF SCREEN OPENINGS
807.9	15.7	BOTTOM OF SCREEN OPENINGS
807.4	16.2	BOTTOM OF WELL
806.6	17.0	BOTTOM OF AQUIFER
807.1	16.5	BORING DEPTH



WELL COMPLETION DIAGRAM
(NO SCALE)

PROJECT NAME : GUE-70-14.10

BORING : P-311C

DATE WELL INSTALLED : 04-17-02

BBC &M PROJECT NO : 01107000.090

STATIC WATER LEVEL *	8.9			
DATE:	4/17/02			

WELL DEVELOPMENT :

* FEET ABOVE MSL

BBC&M ENGINEERING INC.

BBCBM DRAWING NO TCAMWELS.DWG

DNR 7802.96

TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Divison of Water, 1939 Fountain Square Drive
Columbus, Ohio 43224-9971 Voice (614) 265-6739 Fax (614) 447-9503

958623

WELL LOCATION

County Guernsey Township Center

Owner/Builder (Circle One or Both) ODOT
First Last

Address of Well Location Station 474+58 64' Lt.
Number Street Name

City ______ Zip Code +4 ______

Permit No. ______ Section/Lot No. (Circle One or Both) 18

Location of Well in State Plane coordinates, if available Use of Well Groundwater Monitoring

N ☐ X ______ . ______ +/- ______ ft or m

S ☐ Y ______ . ______ +/- ______ ft or m

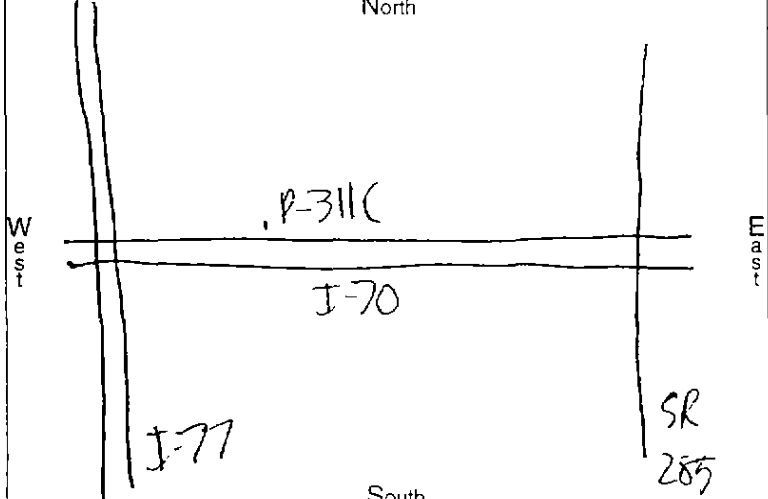
Elevation of Well 823 . 6 +/- ______ ft. or m

Datum Plain: ☐ NAD27 ☒ NAD83 Elevation Source ______

Source of Coordinates: ☐ GPS ☒ Survey ☐ Other ______

Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks If latitude and longitude are available please include here Lat. ______ Long: ______

North



South

CONSTRUCTION DETAILS

☐ Rotary ☐ Cable ☒ Augered ☐ Driven ☐ Other ______

BOREHOLE/CASING (measured from ground surface)

1☒ Borehole Diameter 7½ inches Depth ~~[illegible]~~ 16.5 ft.
Casing Diameter 2 in. Length 4.9 ft. Thickness ______ in.

2☐ Borehole Diameter ______ inches Depth ______ ft.
Casing Diameter ______ in Length ______ ft Thickness ______ in.

Casing Height Above Ground -0.3 ft.

Type: 1☐ 2☐ Steel; 1☐ 2☐ Galv.; 1☒ 2☐ PVC; 1☐ 2☐ Other ______

Joints: 1☒ 2☐ Threaded; 1☐ 2☐ Welded; 1☐ 2☐ Solvent; 1☐ 2☐ Other ______

SCREEN

Diameter 2" Slot Size #20 Screen Length ______ ft

Type Machine Sloted Material PVC

Set Between 11.2 ft and 15.7 ft.

GRAVEL PACK (Filter Pack)

Material/Size #4 Sand Volume/Weight Used ______

Method of Installation ______

Depth: Placed FROM 10.0 ft. TO 16.5 ft.

GROUT

Material Benseal Volume/Weight Used ______

Method of Installation Tremmie

Depth: Placed FROM 0.8 ft. TO 5.6 ft.

DRILLING LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED. Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc.	From	To
Fill	0.0	1.7
Clayey Silt	1.7	4.9
Fine Sand	4.9	7.0
Clayey Silt	7.0	10.6
Fine to Coarse Gravel	10.6	13.0
Fine to Coarse Sand	13.0	13.8
Fine to Coarse Sand	13.8	~~[illegible]~~ 16.5
~~Fine to Coarse Gravel~~	~~[illegible]~~	~~[illegible]~~
	~~[illegible]~~	~~[illegible]~~
	~~[illegible]~~	End

*(If more space is needed to complete drilling log, use next consecutively numbered form.)

Date of Well Completion 04-18-02 Total Depth of Well 16.5 ft.

WELL TEST*

Pre-Pumping Static Level 8.9 ft. Date 04-17-02

Measured from: ☒ Top of Casing ☐ Ground Level ☐ Other ______

☐ Air ☐ Bailing ☐ Pumping* ☐ Other ______

Test Rate ______ gpm Duration of Test ______ hrs.

Feet of Drawdown ______ ft. Sustainable Yield ______ gpm

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

Is Copy Attached? ☐ Yes ☐ No Flowing Well? ☐ Yes ☐ No

Quality ______

PUMP/PITLESS

Type of pump — Capacity — gpm

Pump set at — ft. Pitless Type —

Pump installed by —

I hereby certify the information given is accurate and correct to the best of my knowledge

Drilling Firm BBC&M Engineering

Address 6190 Enterprise Ct.

City, State, Zip Dublin, OH 43016

Signed ______ Date 06-13-02

ODH Registration Number 02504

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224-9971

Blue - Customer's copy Pink - Driller's copy Green - Local Health Dept. copy

B-001 1/2

State of Ohio
Department of Transportation
Office of Materials Management

ENGLISH PROJECT

LOG OF BORING

Date Started 5/28/96 Sampler: Type SS Dia. 1⅜' Water Elev. -
Date completed 5/28/96
Boring No. B-1 Station & Offset 470+22, 36' RT. Surface Elev. 822.5'

Project Identification: GUERNSEY
GUE-70-14.10
MINE SUBSIDENCE
SUBSURFACE INVESTIGATION

Elev.	Depth	Std. Pen. (N)	Rec. ft	Loss ft	Description	Sample No.	% Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
822.5	0														
822.3		AUGERED			ASPHALT										VISUAL
820.0	2														
819.4	4	1 *			BROWN SILTY CLAY W/ASPHALT & GROUT FRAGS.	1	-	-	-	-	-	-	-	16	VISUAL
	6														
	8														
	10				3.1' TO 20.0' VOID										
	12														
	14														
	16														
	18														
802.5	20														
801.0	22	4/5/10			DARK GRAY GROUT FRAGS. & SILT	2	-	-	-	-	-	-	-	60	VISUAL
799.5	24	4/10/14			BROWN SILT AND CLAY & GROUT FRAGS.	3	-	-	-	-	-	-	-	22	VISUAL
798.0		5/28/52			DK. GR. BROKEN & JOINTED GROUT W/BR. CLAYEY SILT	4	-	-	-	-	-	-	-	41	VISUAL
796.5	26	26/16/15			DARK GRAY BROKEN AND JOINTED GROUT	5	-	-	-	-	-	-	-	25	VISUAL
795.0	28	19/11/10			BROWN CLAYEY SILT W/GROUT FRAGS.	6	-	-	-	-	-	-	-	22	VISUAL
793.5	30	42/28/29			BR. & GR. CLAYEY SILT W/ST. FRAGS. OVERLAIN BY GROUT FRAGS.	7	-	-	-	-	-	-	-	22	VISUAL
792.0		8/7/6			BROWN & GRAY SANDY CLAY W/COAL BLOSSOM	8	-	-	-	-	-	-	-	20	VISUAL
790.5	32	2/4/4			BROWNISH GRAY SILTY CLAY W/STONE FRAGS.	9	-	-	-	-	-	-	-	22	VISUAL
789.0	34	3/4/6			BROWN SILTY CLAY	10	-	-	-	-	-	-	-	28	VISUAL
787.5	36	3/7/10			BROWN SILTY CLAY	11	-	-	-	-	-	-	-	26	VISUAL

* PENETRATED 6" BY WEIGHT OF TOOL

Particle Sizes: Agg= >2.00mm, Coarse Sand= 2.00-0.42mm, Fine Sand= 0.42-0.074mm, Silt= 0.074-0.005mm, Clay= <0.005mm

Form TE-151 Revised 9/95

B-001 2/2

Boring No. B-1 Station & Offset 470+22, 36' RT. Surface Elev. 822.5' Project GUE-70-14.10

Elev.	Depth	Std. Pen. (N)	Rec. ft	Loss ft	Description	Sample No.	% Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
786.0		1/3/5			GRAYISH BROWN SILTY CLAY	12	-	-	-	-	-	-	-	25	VISUAL
784.5	38	1/3/5			GRAY SILTY CLAY	13	-	-	-	-	-	-	-	28	VISUAL
783.0	40	3/3/6			BROWNISH GRAY SILTY CLAY	14	-	-	-	-	-	-	-	26	VISUAL
781.5		3/6/9			BROWN AND GRAY SILT AND CLAY	15	-	-	-	-	-	-	-	22	VISUAL
					TOP OF ROCK										
	42														
780.0		8/22/56			BR. & GR. JOINTED SHALE OVERLAIN BY CLAYEY SAND	16	-	-	-	-	-	-	-	14	VISUAL
779.7	44	60(0.3)			OLIVE, ARENACEOUS HIGHLY WEATHERED SHALE	17	-	-	-	-	-	-	-	6	VISUAL
					WEATHERED SHALE	-	-	-	-	-	-	-	-	-	VISUAL
776.5	46														
	48		4.0	0.0	SANDSTONE, GRAY, FIRM, MICACEOUS, FINE-GRAINED, THIN-BEDDED, W/SCATTERED THIN CLAY SEAMS, JOINTED IN PLACES; INTERBEDDED W/NUMEROUS LAMINAE AND MEDIUM TO THICK SEAMS OF BLACK CARBONACEOUS SHALE. NO CORE LOSS.										
773.1	50														
	52		5.0	0.0											
	54														
	56				SHALE, BLACK, FIRM, ARENACEOUS, JOINTED IN PLACES; W/SCATTERED LAMINAE AND A 0.3' THICK INTERVAL NEAR THE TOP OF GRAY, FIRM, MICACEOUS, FINE-GRAINED SANDSTONE. NO CORE LOSS.										
	58		5.0	0.0											
	60														
761.8															
	62														
			5.0	0.0	COAL, BLACK, BITUMINOUS, VITEROUS, BROKEN AND JOINTED TO HIGHLY BROKEN AND JOINTED. NO CORE LOSS.										
	64														
757.5					BOTTOM OF BORING										

Particle Sizes: Agg= >2.00mm, Coarse Sand= 2.00-0.42mmFine Sand= 0.42-0.074mm, Silt= 0.074-0.005mm, Clay= <0.005mm

Form TE-15L Revised 9/95

B002 1/2

State of Ohio
Department of Transportation
Office of Materials Management

ENGLISH PROJECT

LOG OF BORING

Date Started 7/1/96 Sampler: Type SS Dia. 1⅜" Water Elev. -
Date completed 7/1/96
Boring No. B-2 Station & Offset 473+70, 58' LT. Surface Elev. 823.8'

Project Identification: GUERNSEY
GUE-70-14.10
MINE SUBSIDENCE
SUBSURFACE INVESTIGATION

Elev.	Depth	Std. Pen. (N)	Rec. ft	Loss ft	Description	Sample No.	% Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
823.8	0				VOID										
	2														
	4														
	6														
	8														
	10														
	12														
	14														
	16														
	18														
	20														
	22														
799.8	24														
798.8		AUGERED			BROWN SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
	26														
	28	AUGERED			BROWN SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
793.8	30														
	32	AUGERED			BROWN SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
	34														
788.8	36														

Particle Sizes: Agg= >2.00mm, Coarse Sand= 2.00-0.42mm Fine Sand= 0.42-0.074mm, Silt= 0.074-0.005mm, Clay= <0.005mm

Form TE-15 Revised 9/95

B-002 2/2

Boring No. B-2 Station & Offset 473+70, 58' LT. Surface Elev. 823.8' Project GUE-70-14.10

Elev.	Depth	Std. Pen. (N)	Rec. ft	Loss ft	Description	Sample No.	% Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
	38	AUGERED			BROWN SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
783.8	40														
	42	AUGERED			BROWN SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
	44				TOP OF ROCK (DRILLER'S DESCRIPTION)										
777.8	46														
	48														
773.8	50														
	52		5.0	0.0	SHALE, BLACK, FIRM, CARBONACEOUS, ARENACEOUS, SLIGHTLY MICACEOUS, W/CLAY SEAMS, JOINTED IN PART IN THE TOP HALF, RUBBLEIZED IN THE MIDDLE; INTERBEDDED W/NUMEROUS THIN SEAMS AND INTERVALS RANGING UP TO 0.3' THICK OF GRAY, FIRM, MICACEOUS, FINE-GRAINED SANDSTONE. NO CORE LOSS.										
	54														
	56														
	58		5.0	0.0											
	60														
	62														
761.0	64		5.0	0.0	COAL, BLACK, BITUMINOUS, VITREOUS, BROKEN AND JOINTED. NO CORE LOSS.										
758.8					BOTTOM OF BORING										

Particle Sizes: Agg= >2.00mm, Coarse Sand= 2.00-0.42mm, Fine Sand= 0.42-0.074mm, Silt= 0.074-0.005mm, Clay= <0.005mm

Form TE-151 Revised 9/95

FIELD DATA - SOIL LOG

Project Code:

Project Identification: GUE 70-784.2

Co., Rt., Br.No./Sec.No.

Station: 475+22. Offset: 73 LT

Order Code:

Location No. TB 5 Over: MINE

Pier-Abut. SHAFT

Started: 9-28-94 Equipment: SOIL MAX

Completed: Water Level:

Depth Feet	Samples	Elevation	Description
0			
5			BRN. CLAY 0.0 - 5.0
10			BRN. SILTY CLAY 5.0 - 10.0
15			BRN. SILTY CLAY W/STN. FRAGS 10.0 - 15.0
20			BRN-GREY CLAY W/STN. FRAGS 15.0 - 20.0
25			GREY SILTY CLAY 20.0 - 25.0

Form TE-6
DOT-Revised 1/92

B-003 1/1

Depth Feet	Samples	Elevation	Description
25			
30			GREY SILTY CLAY (WET) 25.0 - 30.0
35			GREY SILTY CLAY 30.0 - 35.0
40			GREY SILTY CLAY (SOFT - WET) 35.0 - 40.0
45			WEAK SHALEY CLAY AT 43.0' 40.0 - 45.0' HIT ROCK AT 49.0'
50			(ROLLER BIT) GREY SHALE 45.0 - 50.0
55			GREY SHALE (ROLLER BIT) 50.0 - 55.0
60			

Remarks: 55.0 - 60.0

HIT SHAFT A 58.0

Party: BTTM OF SHAFT 64.0

Chief of Party:

B-004 (1/2)

FIELD DATA - SOIL LOG

Project Code:

Project Identification: GUE-70-14.10

Co., Rt., Br.No./Sec.No.

Station: 483+63. Offset: 25 R

Order Code: 01

Location No. B-4 Over: RT 70 LANDSLIDE

Pier-Abut.

Started: 3-21-95 Equipment: SOIL MAX

Completed: 3/22/95 Water Level:

Depth Feet	Samples	Elevation	Description
0			
	30		BRN-GRAY CLAY STONE FRAG 2.5 - 4.0 B - 6.8.10
5	31		BRN. GRAY CLAY 5.0 - 6.5 B - 6.10.17
	32		BRN GRAY CLAY 7.5 - 9.0 B - 5.5.9
10	33		BRN-GRAY CLAY 10.0 - 11.5 B - 3.4.5
	34		BRN TO GRAY MOIST CLAY 12.5 - 14.0 B - 2.2.4
15	35		MOIST GRAY CLAY 15.0 - 16.5 B - 2.3.5
	36		GRAY TO BRN CLAY 17.5 - 19.0 B - 6.9.13
20	37		BRN CLAY 20.0 - 21.5 B - 2.9.6
	38		BRN CLAY TO COMG. SAND 22.5 - 24.0 B - 4.8.14
25			
25	39		COMG SAND TO GRAY CLAY 25.0 - 26.5 B - 4.8.9
	40		SILTY GRAY CLAY TURF WET AT 29' 27.5 - 29.0 B - 5.5.6
30	41		GRAY SILTY CLAY 30.0 - 31.5 B - 4.4.6
	42		SILTY CLAY TO COMG SAND 32.5 - 34.0 B - 3.10.51
35	43		COMG SAND 35.0 - 35.5 B - 52
	44		COMG SAND TO SILTY CLAY 37.5 - 39.0 B - 28.22.22
40	45		COMG SAND + STONE FRAG 40.0 - 40.5 B - 70
	46		COMG SAND TO GRAY SHALE 42.5 - 43.0 B 70
45	47		WEAK SHALE CLAY 45.0 - 45.3 B 60
			PUT BARREL IN 47.5 RAN 2½' RECOVER 2½' GRAY SHALE CLAY SEAMS
50			Shale w/clay seams "Sa" Run 5.0 Rec 3.0
55			VOID 53' - 58.5' Shale/Clay Shale - clay Seams Run 5.0 Rec 1.3
60			

Remarks:

Party: Lewis Valine

Chief of Party: Hopkins

Form TE-6
DOT-Revised 1/92

Log 1 of 2

B-004 (2/2)

FIELD DATA - SOIL LOG

Project Code:

Project Identification: Gue-70-14.0
Co., Rt., Br.No./Sec.No.

Station: 483+631. Offset: 25R

Order Code:

Location No. B-4 Over:

Pier-Abut.

Started: 3/01/95 Equipment: Soil May

Completed: Water Level:

Depth Feet	Samples	Elevation	Description
0			
			Barrel Blocked Twice - had to
			pull - outer barrel broke - had to pull
65			Shale - partially broken - w/clay seams
			Run 5.0 Rec 2.8
			Void 67-68'
			Void 69-70
70			Sandy Shale w/clay seams - Fireclay at 70
			Run 5.0 Rec 1.9
			E.O.B 70'
15			
20			
25			

Depth Feet	Samples	Elevation	Description
25			
30			
35			
40			
45			
50			
55			
60			

Remarks:

Party: Lewis Valine
Chief of Party: Hopkins

Form TE-6
DOT-Revised 1/92

Log 2 of 2

B-005 1/1

ATAG

FIELD DATA - SOIL LOG

Project Code:

Project Identification: GUE 70 - 18.42
Co., Rt., Br.No./Sec.No.

Station: 469+79 . Offset: 72 RT

Order Code:

Location No. TB 6 Over: MINE SHAFT

Pier-Abut.

Started: 9-28-94 Equipment: SOIL MAX

Completed: 9-28-94 Water Level:

Depth Feet	Samples	Elevation	Description
0			
5			GREY CLAY 0.0-5.0
10			GREY CLAY 5.0 - 10.0
15			BRN. CLAY W/STN. FRAGS 10.0 - 15.0
20			BRN. CLAY W/STN. FRAGS 15.0 - 20.0
25			BRN. CLAY W/GRAVEL 20.0 - 25.0
30			GREY CLAY W/SML. GRAVEL (WET) 25.0 - 30.0
35			GREY CLAY (SILTY) 30.0 - 35.0
40			GREY CLAY 35.0 - 40.0
45			GREY CLAY W/STN. FRAGS 40.0 - 45.0
			PUT ROLLER BIT IN AT 45.0' HIT ROCK AT 48.0'
50			45.0 - 50.0
55			ROLLER BIT GREY SHALE 50.0 - 55.0
			HIT MINE SHAFT AT 59.5' APPROX 5.0' VOID 55.0 - 60.0
60			

Remarks: ~~PUT P.V.C PIPE IN HOLE~~

Party:

Chief of Party:

Form TE-6
DOT-Revised 1/92

B-006 ½

State of Ohio
Department of Transportation
Office of Materials Management

ENGLISH PROJECT

LOG OF BORING

Date Started 5/29/96 Sampler: Type SS Dia. 1⅜" Water Elev. -
Date completed 5/29/96
Boring No. B-6★ Station & Offset 479+71, 37' RT. Surface Elev. 826.1'

Project Identification: GUERNSEY
GUE-70-14.10
MINE SUBSIDENCE
SUBSURFACE INVESTIGATION

Elev.	Depth	Std. Pen. (N)	Rec. ft	Loss ft	Description	Sample No.	% Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
862.1	0				VOID										
	2														
	4														
	6														
	8														
	10														
	12														
	14														
	16														
	18														
	20														
	22														
	24														
	26														
	28														
	30														
	32														
	34														
	36														

Particle Sizes: Agg= >2.00mm, Coarse Sand= 2.00-0.42mm, Fine Sand= 0.42-0.074mm, Silt= 0.074-0.005mm, Clay= <0.005mm

Form TE-15 Revised 5/95

B-006 2/2

Boring No. B-6 Station & Offset 479+71, 37' RT. Surface Elev. 826.1' Project GUE-70-14.10

Elev.	Depth	Std. Pen. (N)	Rec. ft	Loss ft	Description	Sample No.	% Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
786.1	38 40				VOID TOP OF ROCK										
781.1	42 44				GRAY CLAY-SHALE (DRILLER'S DESCRIPTION) 40.0' TO 45.0'	-	-	-	-	-	-	-	-	-	VISUAL
780.6	—	82(0.5)			GRAY ARENACEOUS HIGHLY WEATHERED SHALE BOTTOM OF BORING	19	-	-	-	-	-	-	-	8	VISUAL

Particle Sizes: Agg= >2.00mm, Coarse Sand= 2.00-0.42mm Fine Sand= 0.42-0.074mm, Silt= 0.074-0.005mm, Clay= <0.005mm

Form TE-15 Revised 9/95

B-007 1/1

FIELD DATA - SOIL LOG

Project Code:

Project Identification: GUE. 70-18.42
Co., Rt., Br.No./Sec.No.

Station: 474+19. Offset: 72 RT

Order Code:

Location No. TB 7 Over: MINE

Pier-Abut. SHAFT

Started: 9-30-94 Equipment: SOIL MAR

Completed: Water Level: -53.0

Depth Feet	Samples	Elevation	Description
0			
5			BRN. CLAY W/STN. FRAGS 0.0-5.0
10			GREY CLAY 5.0-7.0 BRN. CLAY 7.0'-10.0' 5.0-10.0
15			BRN. SILTY CLAY 10.0-15.0
20			GREY SILTY CLAY 15.0-20.0
25			GREY CLAY W/SML. STN. FRAGS 20.0-25.0
30			GREY CLAY W/SML. STN. FRAGS 25.0-30.0
35			GREY CLAY 30.0-35.0
40			GREY CLAY W/SML. STN. FRAGS 35.0-40.0
45			GREY CLAY W/SML. STN. FRAGS. 40.0-45.0
50			45.0-47.5 GREY CLAY 47.5-50.0 ROCK AUGERED TO 50.0 45.0-50.0
55			PUT ROLLER BIT IN AT 50.0 GREY SHALE 50.0-55.0
60			GREY SHALE 55.0-60.0

Remarks:
HIT VOID AT 62.5' 5.0' VOID

Party: 53' TOP OF AUGERS

Chief of Party:

Form TE-6
DOT-Revised 1/92

State of Ohio
Department of Transportation
Office of Materials Management

ENGLISH PROJECT

B-008 1/2

LOG OF BORING

Date Started 7/1/96 Sampler: Type SS Dia. 1 3/8" Water Elev. -
Date completed 7/2/96
Boring No. B-8 Station & Offset 484+50, 49 LT. Surface Elev. 827.7'

Project Identification: GUERNSEY
GUE-70-14.10
MINE SUBSIDENCE
SUBSURFACE INVESTIGATION

Elev.	Depth	Std. Pen. (N)	Rec. ft	Loss ft	Description	Sample No.	% Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
827.7	0														
827.2		AUGERED			ASPHALT	-	-	-	-	-	-	-	-	-	VISUAL
	2, 4	AUGERED			GROUT (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
822.7	6, 8	AUGERED			SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
817.7	10, 12, 14	AUGERED			SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
812.7	16, 18	AUGERED			SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
807.7	20, 22, 24	AUGERED			SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
802.7	26, 28	AUGERED			SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
797.7	30, 32, 34	AUGERED			SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
792.7	36														

Particle Sizes: Agg= >2.00mm, Coarse Sand= 2.00-0.42mm, Fine Sand= 0.42-0.074mm, Silt= 0.074-0.005mm, Clay= <0.005mm

Form TE-15L Revised 9/95

B-008-2/2

Boring No. B-8 Station & Offset 484+50, 49 LT. Surface Elev. 827.7′ Project GUE-70-14.10

Elev.	Depth	Std. Pen. (N)	Rec. ft	Loss ft	Description	Sample No.	% Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
	38	AUGERED			SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
787.7	40				TOP OF ROCK (DRILLER'S DESCRIPTION)										
786.7	42				NO DESCRIPTION - DRILLERS USED ROLLER BIT.										
	44														
	46														
	48														
	50														
	52														
	54														
	56														
	58														
767.1	60														
	62		5.0	0.0	SHALE, BLACK, FIRM, ARENACEOUS, CARBONACEOUS, WITH SCATTERED CLAY SEAMS; INTERBEDDED WITH NUMEROUS SEAMS OF GRAY, FIRM, FINE-GRAINED, MICACEOUS SANDSTONE. NO CORE LOSS.										
	64														
761.6	66														
	68		5.0	0.0	COAL, BLACK, BITUMINOUS, VITREOUS, HIGHLY BROKEN AND JOINTED. NO CORE LOSS.										
757.7	70														

BOTTOM OF BORING

Particle Sizes: Agg= >2.00mm, Coarse Sand= 2.00-0.42mm Fine Sand= 0.42-0.074mm, Silt= 0.074-0.005mm, Clay= <0.005mm

Form TE-15 Revised 9/95

B-C09 1/2

State of Ohio
Department of Transportation
Office of Materials Management

ENGLISH PROJECT

LOG OF BORING

Date Started 6/11/96 Sampler: Type SS Dia. 1 3/8" Water Elev. -
Date completed 6/11/96
Boring No. B-9 Station & Offset 484+60, 65' LT. Surface Elev. 827.7'

Project Identification: GUERNSEY
GUE-70-14.10
MINE SUBSIDENCE
SUBSURFACE INVESTIGATION

Elev.	Depth	Std. Pen. (N)	Rec. ft	Loss ft	Description	Sample No.	% Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
827.7	0														
	2														
	4														
	6														
	8														
	10				VOID										
	12														
	14														
	16														
	18														
807.7	20														
	22	4/5/5			BROWN SILTY CLAY	34	-	-	-	-	-	-	-	29	VISUAL
	24														
802.7	26	7/10/12			BROWN W/GRAY SILTY CLAY	35	-	-	-	-	-	-	-	28	VISUAL
	28														
797.7	30														
	32	5/8/14			BROWN SILTY CLAY W/GRAY SILTY SAND	36	-	-	-	-	-	-	-	22	VISUAL
	34				TOP OF ROCK										
792.7															
791.7	36	20/50			GRAYISH OLIVE ARENACEOUS HIGHLY WEATHERED SHALE	37	-	-	-	-	-	-	-	6	VISUAL

Particle Sizes: Agg= >2.00mm, Coarse Sand= 2.00-0.42mm, Fine Sand= 0.42-0.074mm, Silt= 0.074-0.005mm, Clay= <0.005mm

Form TE-15 Revised 9/95

B-009 2/2

Boring No. B-9 Station & Offset 484+60, 65' LT. Surface Elev. 827.7' Project GUE-70-14.10

Elev.	Depth	Std. Pen. (N)	Rec. ft	Loss ft	Description	Sample No.	% Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
790.6	38		4.0	0.0	SHALE, SLIGHTLY TO MEDIUM WEATHERED, DARK GRAY, OLIVE, FIRM, CARBONACEOUS, W/NUMEROUS THIN CLAY SEAMS, JOINTED. NO CORE LOSS.										
	40 42 44		5.0	0.0											
	46 48 50		5.0	0.0											
	52 54		5.0	0.0	SHALE, BLACK, FIRM, CARBONACEOUS, ARENACEOUS TO HIGHLY ARENACEOUS IN THE UPPER PORTION, WITH SCATTERED FERRUGINOUS NODULES, COALY AT THE BOTTOM, WITH SCATTERED THIN TO THICK CLAY SEAMS, *JOINTED IN THE UPPER PORTION; INTERBEDDED* WITH LAMINAE, SEAMS AND A 0.7' THICK INTERVAL IN THE MIDDLE OF GRAY, FIRM, MICACEOUS, FINE-GRAINED SANDSTONE, AND WITH A 0.3' THICK INTERVAL IN THE TOP HALF OF GRAY, FIRM, LIMESTONE. NO CORE LOSS.										
	56 58 60		5.0	0.0											
	62 64		5.0	0.0											
761.5	66 68		4.5	0.5	GROUT, BLACK, FIRM TO HARD, LITHIC, WHOLE. CORE LOSS 10%										
756.5	70 72		2.5	0.0	GROUT, BROWN, SOFT, HIGHLY FRIABLE, WHOLE. NO CORE LOSS.										
755.7 755.5					*										
755.2					BOTTOM OF BORING										

* 72.0' TO 72.2' SHALE, BLACK, FIRM, CARBONACEOUS. NO CORE LOSS.
72.2' TO 72.5 UNDERCLAY, OLIVE, SOFT, HIGHLY SLICKENSIDED. NO CORE LOSS.

Particle Sizes: Agg= >2.00mm, Coarse Sand= 2.00-0.42mm Fine Sand= 0.42-0.074mm, Silt= 0.074-0.005mm, Clay= <0.005mm

Form TE-15L Revised 9/95

B012 1/1

FIELD DATA - SOIL LOG

Project Code:

Project Identification: GUE. 70-184.2
Co., Rt., Br.No./Sec.No.

Station: 477+69. Offset: 87 RT

Order Code:

Location No. TB 8 Over: MINE SHAFT

Pier-Abut.

Started: 9-29-94 Equipment: SOIL MAX

Completed: Water Level:

Depth Feet	Samples	Elevation	Description
0			
5			BRN. SANDY CLAY 0.0-5.0
10			BRN. CLAY W/STN. FRAGS 5.0-10.0
15			10.0-15.0 GREY SILTY CLAY
20			GREY SILTY CLAY 15.0-20.0
25			GREY SILTY CLAY 20.0-25.0
30			GREY CLAY 25.0-30.0
35			GREY CLAY 30.0-35.0
40			GREY CLAY WET AT 39.0' 35.0-40.0
45			GREY SHALEY CLAY 40.0-45.0
50			PUT ROLLER BIT IN AT 45.0 GREY SHALE 45.0-50.0
55			GREY SHALE 50.0-55.0
60			GREY SHALE 55.0-60.0

Remarks: HIT COAL AT 63.0' NO VOID

Party:

Chief of Party: [illegible]

Form TE-6
DOT-Revised 1/92

FIELD DATA - SOIL LOG

B-013 1/1

Project Code:

Project Identification: GUE. 70- 184.2
Co., Rt., Br.No./Sec.No.

Station: 477+97. Offset: 85 LT

Order Code:

Location No. TB3 Over: MINE
Pier-Abut. SHAFT

Started: 9-26-94 Equipment: SOIL MAX
Completed: Water Level: -10.0

Depth Feet	Samples	Elevation	Description
0			DRILLED IN BERM.
			BRN. CLAY
	37		2.5 - 4.0 AUGER SAMPLE
5			BRN + GREY CLAY
	38		5.0 - 6.5 B 5-5-7
			BRN. + GREY SILTY CLAY
	39		7.5 - 9.0 B 6-6-8
10			BRN. CLAY
	40		10.0 - 11.5 B 2-4-5
			GREY SILTY CLAY
	41		12.5 - 14.0 B 1-2-3
15			GREY SANDY SILTY CLAY
	42		15.0 - 16.5 B 1-3-4
20			GREY CLAY
	43		20.0 - 21.5 B 7-8-15
25			GREY SILTY CLAY
	44		25.0 - 26.5 B 4-6-8
30			GREY SILTY CLAY
	45		30.0 - 31.5 B 3-5-6
35			GREY SANDY CLAY W/SAL. STN. FRAGS
	46		35.0 - 36.5 B 9-16-14
40			GREY CLAY + ROCK FRAGS
	47		40.0 - 40.5 B 60
45			GREY SANDY SHALE
	48		45.0 - 45.2 B 65
50			1.5' SANDSTONE 3.3' GREY SHALE
			CORED FROM 45.2 - 50.0 REC 4.8'
55			GREY SHALE
			CORED FROM 50.0 - 55.0 REC 5.0'
60			SANDY GREY SHALE
			CORED FROM 55.0 - 60.0 REC 5.0'

Remarks:

65 .3 GREY SHALE 4.7' COAL
CORED FROM 60.0 - 65.0 REC 5.0'

Party:

Chief of Party:

Form TE-6
DOT-Revised 1/92

B-014 ½

FIELD DATA - SOIL LOG

Project Code:

Project Identification: GUE. 70-18.2
Co., Rt., Br.No./Sec.No.

Station: 478+25 . Offset: 85' LT

Order Code:

Location No. TB 4 Over: MINE

Pier-Abut. SHAFT

Started: 9-27-94 Equipment: SOIL MAX

Completed: 9-27-94 Water Level: -10.0

Depth Feet	Samples	Elevation	Description
0			
5			BRN + GREY CLAY 0.0-5.0
10			BRN.+GREY SILTY CLAY 5.0-10.0
15			GREY SANDY SILTY CLAY 10.0-15.0
20			GREY SILTY CLAY 15.0-20.0
25			GREY SILTY CLAY 20.0-25.0
30			GREY SILTY CLAY 25.0-30.0
35			WET AT 37.0' SANDY GREY SILT W/STN. FRAGS 30.0-35.0
40			GREY CLAY SILT W/STN. FRAGS 35.0-40.0
45			GREY CLAY + ROCK FRAGS. 40.0-45.0
50			GREY SHALE CORED FROM 45.0-50.0, REC 5.0' PUT CORE BARREL IN AT 45.0
55			GREY SHALE CORED FROM 50.0-55.0 REC 5.0
60			GREY SHALE CORED FROM 55.0-60.0 REC. 5.0'

Remarks:

.3 GREY SHALE 4.7 COAL

Party: CORED FROM 60.0-65.0 REC 5.0

Chief of Party:

Form TE-6
DOT-Revised 1/92

B-015 1/1

ENGINEER'S FIELD BORING LOG

PROJECT NAME: ODOT I-70 Mine Subsid BORING NO.: B-15

ROUTE/SECTION: GUE - 070 - 14.10 COUNTY: Guernsey SHEET 1 OF 1

STATION: 474+25 OFFSET: 65' Rt. MUNICIPALITY: Center Township DATE: START: 10/20/94

SURFACE ELEVATION: 823.5 RIG TYPE: CME-75 Truck CORE SIZE: - FINISH: 10/20/94

SAMPLER: TYPE Split-Spoon O.D. 2½ (in.) I.D. 1⅜ (in.) Length 24 in.)

DRILLER/REPRESENTING: D. McKnight/CTL SAMPLER HAMMER WT.: 140 (lbs.)

INSPECTOR/REPRESENTING: D. Clark/ Gannett Fleming, Inc. SAMPLER HAMMER DROP: 30 (in.)

CHECKED BY: A. Welker /Gannett Fleming, Inc. DATE: 1/95

AUGER: TYPE Solid Stem O.D. 4¼ (in.) I.D. - (in.)

CASING SIZE: - DEPTH: - CORE BARREL: TYPE -

DIRECTION OF HOLE: ✓ VERTICAL - INCLINED - DEGREE(S) FROM VERTICAL

WATER LEVEL DEPTH: 18.9 FEET - TIME: 11:00 DATE: 10/20/94

14.5 FEET - TIME: 13:00 DATE: 10/21/94

DRILLING METHODS: Continuous Flight Augers

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
1.5	-	-	-	-	-	-	Bituminous Pavement 0.8'	El. 822.7
3.0	S-1	3-3-6	1.0	-	-	-	Brown M SAND, damp 2.5'	El. 821.0
4.5	S-2	4-6-8	1.0	-	-	-	Brown and Gray Clayey SILT, some Rock Fragments, damp (fill)	
6.0	S-3	4-4-5	0.8	-	-	-	6.5'	El. 817.0
7.5	S-4	3-3-5	1.3	-	-	-	Gray SILT and CLAY, trace Shale Fragments, organics, moist 8.0'	El. 815.5
9.0	S-5	3-4-3	1.3	-	-	-	Gray Silty CLAY, trace Rock Fragments, slightly mottled brown, moist	
10.5	S-6	3-3-4	1.3	-	-	-		
12.0	S-7	3-4-5	1.3	-	-	-	12.3'	El. 811.2
13.5	S-8	3-4-4	1.4	-	-	-	Brown and Gray Silty CLAY, trace Sand, moist (+)	
15.0	S-9	1-2-2	0.7	-	-	-		
16.5	S-10	2-3-4	1.3	-	-	-	16.2'	El. 807.3
18.0	S-11	4-3-7	1.2	-	-	-	Gray and Brown Clayey M SAND, trace Rock Fragments, wet	24 hour water level at El. 804.6
19.5	S-12	3-6-11	1.3	-	-	-	19.2'	El. 804.3
21.0	S-13	2-2-3	1.2	-	-	-	Greenish Gray Clayey M SAND, some Sandstone Fragments, wet 20.5'	El. 803.0
							Gray Silty CLAY, wet 21.0'	El. 802.5
							Boring Terminated at 21.0'	

-5 -10 -15 -20 -25

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 30, 1995 GU 11-0 3/4/91

B016 1/1

ENGINEER'S FIELD BORING LOG

PROJECT NAME: ODOT I-70 Mine Subsid

BORING NO.: B-16

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey

SHEET 1 OF 1

STATION: 474+50 OFFSET: 60' Rt. MUNICIPALITY: Center Township

DATE: START: 10/20/94

SURFACE ELEVATION: 823.5 RIG TYPE: CME - 75 Truck CORE SIZE: -

FINISH: 10/20/94

SAMPLER: TYPE Split-Spoon O.D. 2½ (in.) I.D. 1⅜ (in.) Length 24 in.)

DRILLER/REPRESENTING: D.McKnight/CTL SAMPLER HAMMER WT.: 140 (lbs.)

INSPECTOR/REPRESENTING: D. Clark/Gannett Fleming, Inc. SAMPLER HAMMER DROP: 30 (in.)

CHECKED BY: A. Welker/Gannett Fleming, Inc. DATE: 12/94

AUGER: TYPE Solid Stem O.D. 4¼ (in.) I.D. (in.)

CASING SIZE: - DEPTH: - CORE BARREL: TYPE -

DIRECTION OF HOLE: ✓ VERTICAL INCLINED DEGREE(S) FROM VERTICAL

WATER LEVEL DEPTH: Dry FEET - TIME: 17:00 DATE: 10/20/94

Caved FEET - TIME: 13:00 DATE: 10/21/94

DRILLING METHODS: Continuous Flight Augers

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
1.5	-	-	-	-	-	-	Pavement and Basecourse 1.5'	El. 822.0
3.0	S-1	11-10-5	0.7	-	-	-	Brown SAND, CLAY and ROCK FRAGMENTS, some Brick, dry (fill)	
4.5	S-2	6-5-14	1.2	-	-	-		
6.0	S-3	8-11-12	0.8	-	-	-		
7.5	S-4	4-5-9	0.3	-	-	-		
9.0	S-5	5-6-2	0.4	-	-	-	9.0'	El. 814.5
10.5	S-6	2-2-8	1.0	-	-	-	Brown SILT and CLAY, some Rock Fragments, moist (fill)	
12.0	S-7	2-2-2	0.8	-	-	-	12.0'	El. 811.5
13.5	S-8	6-14-20	0.9	-	-	-	Green M SANDSTONE, soft, severely weathered, moist (fill)	
15.0	S-9	22-9-3	0.4	-	-	-	15.0'	El. 808.5
10.5	S-10	2-2-3	0.4	-	-	-	Brown SILT and CLAY, some Rock Fragments, moist (fill)	
18.0	S-11	1-2-2	1.0	-	-	-		
19.5	S-12	5-10-5	0.7	-	-	-	19.5'	El. 804.0
							Boring Terminated at 19.5'	

-5 -10 -15 -20

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 11, 1995

GU 11-0 3/4/91

B-017 1/1

ENGINEER'S FIELD BORING LOG

PROJECT NAME: ODOT I-70 Mine Subsi e BORING NO.: B-17
ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey SHEET 1 OF 1
STATION: 483+50 OFFSET: 60' Rt. MUNICIPALITY: Center Township DATE: START: 10/20/94
SURFACE ELEVATION: 826.9 RIG TYPE: CME - 75 Truck CORE SIZE: - FINISH: 10/20/94
SAMPLER: TYPE Split-Spoon O.D. 2½ (in.) I.D. 1⅜ (in.) Length 24 in.)
DRILLER/REPRESENTING: D. McKnight/CTL SAMPLER HAMMER WT.: 140 (lbs.)
INSPECTOR/REPRESENTING: D. Clark/Gannett Fleming, Inc. SAMPLER HAMMER DROP: 30 (in.)
CHECKED BY: A. Welker/Gannett Fleming, Inc. DATE: 12/94
AUGER: TYPE Solid Stem O.D. 4¼ (in.) I.D. - (in.)
CASING SIZE: - DEPTH: - CORE BARREL: TYPE -
DIRECTION OF HOLE: ✓ VERTICAL INCLINED DEGREE(S) FROM VERTICAL
WATER LEVEL DEPTH: Dry FEET - TIME: 13:00pm DATE: 10/20/94
13.6 FEET - TIME: 13:00pm DATE: 10/21/94
DRILLING METHODS: Continuous Flight Augers

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
1.5	-	-	-	-	-	-	Bituminous Pavement 1.0'	El. 825.9
3.0	S-1	2-5-6	1.1	-	-	-	Brown SILT and CLAY, some Rock Fragments, damp 3.0'	El. 823.9
4.5	S-2	4-5-8	1.0	-	-	-	Brown and Gray SILT and CLAY, little Rock Fragments, damp (fill)	
6.0	S-3	4-6-12	1.0	-	-	-		
7.5	S-4	3-5-5	0.7	-	-	-		
9.0	S-5	3-4-6	1.2	-	-	-		
10.5	S-6	3-4-6	1.3	-	-	-		
12.0	S-7	3-3-4	1.4	-	-	-	12.5'	El. 814.4
13.5	S-8	2-3-4	1.3	-	-	-	Gray Clayey SILT, damp	24 hour water level at El. 813.3
15.0	S-9	2-1-3	1.2	-	-	-		
16.5	S-10	1-2-3	1.2	-	-	-		
18.0	S-11	2-2-2	1.3	-	-	-		
19.5	S-12	2-3-4	1.1	-	-	-	19.5'	El. 807.4
							Boring Terminated at 19.5'	

-5 -10 -15 -20 -25

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 11, 1995

GU 11-0 3/4/91

B018 1/1

ENGINEER'S FIELD BORING LO.

PROJECT NAME: ODOT I-70 Mine Subsidence
BORING NO.: B-18
ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey
SHEET 1 OF 1
STATION: 480+98 OFFSET: 125' Rt. MUNICIPALITY: Center Township
DATE: START: 10/24/94
SURFACE ELEVATION: 818.8 RIG TYPE: CME - 75 Truck CORE SIZE: -
FINISH: 10/24/94
SAMPLER: TYPE Split-Spoon O.D. 2½ (in.) I.D. 3-¼ (in.) Length 24 (in.)
DRILLER/REPRESENTING: C. Martin/CTL SAMPLER HAMMER WT.: 140 (lbs.)
INSPECTOR/REPRESENTING: D. Clark/Gannett Fleming, Inc. SAMPLER HAMMER DROP: 30 (in.)
CHECKED BY: A. Welker/Gannett Fleming, Inc. DATE: 12/94
AUGER: TYPE Solid Stem O.D. ____ (in.) I.D. ____ (in.)
CASING SIZE: - DEPTH: - CORE BARREL: TYPE -
DIRECTION OF HOLE: ✓ VERTICAL ____ INCLINED ____ DEGREE(S) FROM VERTICAL
WATER LEVEL DEPTH: Caved FEET - TIME: ____ DATE: ____
____ FEET - TIME: ____ DATE: ____
DRILLING METHODS: Continuous Flight Augers

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
1.5	S-1	2-4-4	1.0	-	-	-	Brown and Gray SILT and CLAY, trace Sand, damp	
3.0	S-2	2-3-3	1.2	-	-	-		
4.5	S-3	2-2-3	1.2	-	-	-	5.0'	El. 813.8
6.0	S-4	3-7-8	1.2	-	-	-	Brown and Gray SAND, CLAY and ROCK FRAGMENTS, wet	
7.5	S-5	4-5-6	1.2	-	-	-		
9.0	S-6	6-8-10	1.2	-	-	-	10.0'	El. 808.8
10.5	S-7	8-8-10	1.4	-	-	-	Gray and Green M SAND and GRAVEL, trace Clay, wet	
12.0	S-8	10-15-17	1.2	-	-	-		
13.5	S-9	11-13-14	1.4	-	-	-	14.0'	El. 804.8
15.0	S-10	13-3-4	1.3	-	-	-	Gray Silty CLAY, trace Sand, moist 15.7'	Water level 15' El. 803.1
16.5	S-11	3-5-7	1.2	-	-	-	Gray SAND and GRAVEL, wet 16.4'	El. 802.4
18.0	S-12	4-5-7	1.4	-	-	-	Gray Silty CLAY, trace Rock Fragments, trace Organics, wet 18.5'	El. 800.3
19.5	S-13	13-9-11	1.3	-	-	-	Gray and Green SAND and GRAVEL, wet 19.5'	El. 799.3
							Boring Terminated at 19.5'	

-5 -10 -15 -20 -25

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 31, 1995 GU 11-0 3/4/91

B-019 ½

ENGINEER'S FIELD BORING LOG

PROJECT NAME: ODOT I-70 Mine Subsidence — BORING NO.: B-19
ROUTE/SECTION: GUE-070-14.10 — COUNTY: Guernsey — SHEET 1 OF 2
STATION: 468+65 — OFFSET: 60' Lt. — MUNICIPALITY: Center Twp. — DATE: START: 10/21/94
SURFACE ELEVATION: 821.5 — RIG TYPE: CME - 75 Truck — CORE SIZE: - — FINISH: 10/21/94
SAMPLER: TYPE Split-Spoon — O.D. 2½ (in.) I.D. 1½ (in.) Length 24 in.)
DRILLER/REPRESENTING: D. McKnight/CTL — SAMPLER HAMMER WT.: 140 (lbs.)
INSPECTOR/REPRESENTING: D. Clark/Gannett Fleming, Inc. — SAMPLER HAMMER DROP: 30 (in.)
CHECKED BY: A. Welker/Gannett Fleming, Inc. — DATE: 12/94
AUGER: TYPE Solid Stem — O.D. 4½ (in.) I.D. - (in.)
CASING SIZE: - — DEPTH: - — CORE BARREL: TYPE -
DIRECTION OF HOLE: ✓ VERTICAL ___ INCLINED ___ DEGREE(S) FROM VERTICAL
WATER LEVEL DEPTH: Dry FEET - TIME: 12:30 DATE: 10/21/94
FEET - TIME: ___ DATE: ___
DRILLING METHODS: Continuous Flight Augers

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
1.5	-	-	-	-	-	-	Pavement 1.0'	El. 820.5
3.0	S-1	4-4-6	0.7	-	-	-	Brown M SAND (fill) 2.5'	El. 819.0
4.5	S-2	3-5-6	1.0	-	-	-	Brown and Gray SILT and CLAY, trace Rock Fragments, damp (fill)	
6.0	S-3	3-4-10	1.3	-	-	-	6.0'	El. 815.5
7.5	S-4	11-9-11	1.3	-	-	-	Brown and Gray SAND, CLAY and ROCK FRAGMENTS, damp (fill) 8.0'	El. 813.5
9.0	S-5	3-4-3	1.0	-	-	-	Brown and Gray Silty CLAY, trace Sand, trace Organics, moist	
10.5	S-6	2-2-2	1.2	-	-	-		
12.0	S-7	1-1-1	1.5	-	-	-		
13.5	S-8	1-2-3	1.4	-	-	-		
15.0	S-9	2-3-3	1.4	-	-	-		
16.5	S-10	3-2-3	1.3	-	-	-	16.5'	El. 805.0
18.0	S-11	4-2-3	1.0	-	-	-	Brown and Gray CLAY, SILT and ROCK FRAGMENTS, trace Coal Fragments, moist	
19.5	S-12	5-8-9	1.2	-	-	-	19.5'	El. 802.0
21.0	S-13	8-8-7	1.5	-	-	-	Brown and Green SAND and GRAVEL, trace Clay, moist	
22.5	S-14	7-9-11	1.4	-	-	-		
24.0	S-15	11-13-11	1.2	-	-	-		S-16 wet
25.5	S-16	9-11-12	1.4	-	-	-		

-5 -10 -15 -20 -25

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 30, 1995 GU 11-03/4/91

B-019 2/2

ENGINEER'S FIELD BORING LOG

ROUTE/SECTION: GUE 070-14.10 COUNTY: Guerns BORING NO.: B-19

SHEET 2 OF 2

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
25.5								
							26.8'	EL. 794.7
27.0	S-17	4-8-4	1.3	-	-	-	Gray CLAY and SILT, moist	
28.5	S-18	3-4-5	1.1	-	-	-	28.5'	El. 793.0
							Boring Terminated at 28.5'	

4/94

-30 -35 -40 -45 -50 -55 -60

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 30, 1995

GU 11-03/4/91

B-020 1/1

ENGINEER'S FIELD BORING LOG

PROJECT NAME: ODOT I-70 Mine Subsic : BORING NO.: B-20
ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey SHEET 1 OF 1
STATION: 470+13 OFFSET: 60' Rt. MUNICIPALITY: Center Township DATE: START: 10/20/94
SURFACE ELEVATION: 822.5 RIG TYPE: CME - 75 Truck CORE SIZE: - FINISH: 10/20/94
SAMPLER: TYPE Split-Spoon O.D. 2½ (in.) I.D. 1⅜ (in.) Length 24 in.)
DRILLER/REPRESENTING: D. McKnight/CTL SAMPLER HAMMER WT.: 140 (lbs.)
INSPECTOR/REPRESENTING: D. Clark/Gannett Fleming, Inc. SAMPLER HAMMER DROP: 30 (in.)
CHECKED BY: A. Welker/Gannett Fleming, Inc. DATE: 12/94
AUGER: TYPE Solid Stem O.D. 4¼ (in.) I.D. (in.)
CASING SIZE: - DEPTH: - CORE BARREL: TYPE -
DIRECTION OF HOLE: ✓ VERTICAL INCLINED DEGREE(S) FROM VERTICAL
WATER LEVEL DEPTH: Dry FEET - TIME: 15:00 DATE: 10/20/94
Dry FEET - TIME: 13:00 DATE: 10/21/94
DRILLING METHODS: Continuous Flight Augers

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
1.5	-	-	-	-	-	-	Pavement and Subgrade 1.5'	El. 821.0
3.0	S-1	2-5-4	0.8	-	-	-	Brown SAND and CLAY, some Rock Fragments, dry (fill) 3.0'	El. 819.5
4.5	S-2	3-6-5	1.0	-	-	-	Brown and Gray CLAY and SILT, little Rock Fragments, damp (fill)	
6.0	S-3	3-9-6	0.9	-	-	-		
7.5	S-4	6-4-5	0.8	-	-	-	7.5'	El. 815.0
9.0	S-5	3-2-3	1.2	-	-	-	Gray Silty CLAY, little Sand, trace Organics, moist	
10.5	S-6	2-2-1	0.8	-	-	-		
12.0	S-7	1-1-2	1.4	-	-	-		
13.5	S-8	1-2-2	1.2	-	-	-		
15.0	S-9	2-1-2	0.8	-	-	-	15.0'	El. 807.5
16.5	S-10	5-7-6	1.2	-	-	-	Brown SAND and CLAY, some Rock Fragments, moist	
18.0	S-11	5-5-6	1.1	-	-	-		
19.5	S-12	7-7-9	1.2	-	-	-	19.5'	El. 803.0
							Boring Terminated at 19.5'	

-5 -10 -15 -20 -25

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 11, 1995 GU 11-0 3/4/91

B021 1/1

ENGINEER'S FIELD BORING LOG

PROJECT NAME: ODOT I-70 Mine Subsid.

BORING NO.: B-21

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey

SHEET 1 OF 1

STATION: 476+82 OFFSET: 58' Lt. MUNICIPALITY: Center Township

DATE: START: 10/21/94

SURFACE ELEVATION: 824.4 RIG TYPE: CME - 75 Truck CORE SIZE:

FINISH: 10/21/94

SAMPLER: TYPE Split-Spoon O.D. 2 (in.) I.D. 1½ (in.) Length 24 in.)

DRILLER/REPRESENTING: D. McKnight/CTL SAMPLER HAMMER WT.: 140 (lbs.)

INSPECTOR/REPRESENTING: D. Clark/Gannett Fleming, Inc. SAMPLER HAMMER DROP: 30 (in.)

CHECKED BY: A. Welker/Gannett Fleming, Inc. DATE: 1/95

AUGER: TYPE Solid Stem O.D. 4½ (in.) I.D. - (in.)

CASING SIZE: - DEPTH: - CORE BARREL: TYPE -

DIRECTION OF HOLE: ✓ VERTICAL INCLINED DEGREE(S) FROM VERTICAL

WATER LEVEL DEPTH: Dry FEET - TIME: 11:00 DATE: 10/21/94

FEET - TIME: DATE:

DRILLING METHODS: Continuous Flight Augers

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
1.5	-	-	-	-	-	-	Pavement 1.0'	El. 823.4
3.0	S-1	5-4-4	0.8	-	-	-	Brown M SAND, dry (fill) 2.5'	El. 821.9
4.5	S-2	2-3-4	0.6	-	-	-	Brown and Gray Silty CLAY, trace Rock Fragments, moist (fill) 3.5'	El. 820.9
6.0	S-3	3-2-3	1.2	-	-	-	Brown Silty CLAY, little Sand, moist	
7.5	S-4	3-2-3	1.2	-	-	-		
9.0	S-5	2-2-3	1.2	-	-	-		
10.5	S-6	2-4-4	1.3	-	-	-		
12.0	S-7	3-3-2	1.2	-	-	-	11.5'	El. 812.9
13.5	S-8	1-4-5	1.3	-	-	-	Brown M SAND, some Clay and Silt, trace Rock Fragments, moist 13.5'	El. 810.9
15.0	S-9	4-5-8	1.3	-	-	-	Brown M SAND and GRAVEL, little Clay, moist	
16.5	S-10	8-10-11	1.4	-	-	-	17.0'	El. 807.4
18.0	S-11	2-2-3	1.3	-	-	-	Gray CLAY and SILT, trace Sand, moist	
19.5	S-12	2-4-5	1.2	-	-	-	19.5'	El. 804.2
							Boring Terminated at 19.5'	

-5

-10

-20

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 30, 1995

GU 11-0 3/4/91

B-022 1/1

ENGINEER'S FIELD BORING LOG

PROJECT NAME: ODOT I-70 Mine Subsidence   BORING NO.: B-22
ROUTE/SECTION: GUE-070-14.10   COUNTY: Guernsey   SHEET 1 OF 1
STATION: 484+09   OFFSET: 56' Lt.   MUNICIPALITY: Center Township   DATE: START: 10/24/94
SURFACE ELEVATION: 827.3   RIG TYPE: CME - 75 Truck   CORE SIZE: FINISH: 10/24/94
SAMPLER: TYPE Split-Spoon   O.D. 2½ (in.) I.D. 1½ (in.) Length 24 in.)
DRILLER/REPRESENTING: Dan McKnight/CTL   SAMPLER HAMMER WT.: 140 (lbs.)
INSPECTOR/REPRESENTING: D. Clark/Gannett Fleming, Inc.   SAMPLER HAMMER DROP: 30 (in.)
CHECKED BY: A. Welker/Gannett Fleming, Inc.   DATE: 12/94
AUGER: TYPE Solid Stem   O.D. 4¼ (in.) I.D. - (in.)
CASING SIZE: -   DEPTH: -   CORE BARREL: TYPE -
DIRECTION OF HOLE: ✓ VERTICAL   INCLINED   DEGREE(S) FROM VERTICAL
WATER LEVEL DEPTH: Dry   FEET - TIME: 11:00   DATE: 10/24/94
FEET - TIME: DATE:
DRILLING METHODS: Continuous Flight Augers

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS	
1.5	-	-	-	-	-	-	Pavement 1.0'	El. 826.3	
3.0	S-1	6-6-3	0.7	-	-	-	Brown M SAND, damp 2.5'	El. 824.8	
4.5	S-2	2-6-9	1.1	-	-	-	Brown Silty CLAY, moist 4.0'	El. 823.3	
6.0	S-3	5-5-6	1.0	-	-	-	Brown M SAND, damp 5.5' Brown GRAVEL, trace Sand, damp 6.0'	El. 821.8 El. 821.3	-5
7.5	S-4	3-3-4	1.5	-	-	-	Brown and Gray SILT and CLAY, trace Sand, trace Rock Fragments damp		
9.0	S-5	3-5-5	1.2	-	-	-	9.0'	El. 818.3	
10.5	S-6	2-3-3	1.0	-	-	-	Reddish Brown CLAY and SILT, trace Rock Fragments, damp		-10
12.0	S-7	2-3-3	1.2	-	-	-			
13.5	S-8	2-3-4	1.2	-	-	-			
15.0	S-9	3-4-6	1.3	-	-	-	15.0'	El. 812.3	-15
16.5	S-10	3-5-8	1.4	-	-	-	Reddish Brown Silty CLAY, moist		
18.0	S-11	3-4-5	1.1	-	-	-			
19.5	S-12	2-3-4	1.2	-	-	-	19.0'	El. 808.3	
21.0	S-13	2-3-4	1.2	-	-	-	Gray CLAY and SILT, moist 21.0'	El. 806.3	-20
							Boring Terminated at 21.0'		-25

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 30, 1995   GU 11-0 3/4/91

B023 1/1

ENGINEER'S FIELD BORING LOG

PROJECT NAME: ODOT I-70 Mine Subsid. BORING NO.: B-23

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey SHEET 1 OF 1

STATION: 475+20 OFFSET: 30' Lt. MUNICIPALITY: Center Township DATE: START: 10/24/94

SURFACE ELEVATION: 824.0 RIG TYPE: CME - 75 Truck CORE SIZE: - FINISH: 10/24/94

SAMPLER: TYPE Split-Spoon O.D. 2½ (in.) I.D. 1½ (in.) Length 24 in.)

DRILLER/REPRESENTING: D. McKnight/CTL SAMPLER HAMMER WT.: 140 (lbs.)

INSPECTOR/REPRESENTING: D. Clark/Gannett Fleming, Inc. SAMPLER HAMMER DROP: 30 (in.)

CHECKED BY: A. Welker/Gannett Fleming, Inc. DATE: 12/94

AUGER: TYPE Solid Stem O.D. 4½ (in.) I.D. - (in.)

CASING SIZE: - DEPTH: - CORE BARREL: TYPE -

DIRECTION OF HOLE: ✓ VERTICAL INCLINED DEGREE(S) FROM VERTICAL

WATER LEVEL DEPTH: Dry FEET - TIME: 12:30 DATE: 10/24/94

FEET - TIME: DATE:

DRILLING METHODS: Continuous Flight Augers

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO
1.5	S-1	6-4-4	1.3	-	-	-
3.0	S-2	4-5-4	1.0	-	-	-
4.5	S-3	4-4-7	1.0	-	-	-
6.0	S-4	3-3-4	1.2	-	-	-
7.5	S-5	4-5-7	1.2	-	-	-
9.0	S-6	5-4-5	1.4	-	-	-
10.5	S-7	5-5-5	1.3	-	-	-
12.0	S-8	4-3-3	1.3	-	-	-
13.5	S-9	3-2-4	1.2	-	-	-
15.0	S-10	3-4-6	1.3	-	-	-
16.5	S-11	2-2-3	1.3	-	-	-
18.0	S-12	2-1-2	1.3	-	-	-
19.5	S-13	2-3-7	1.3	-	-	-

DESCRIPTION	DEPTH	REMARKS
Gray GRAVEL and SAND	1.0'	El. 823.0
Gray and Brown CLAY, Silt and Rock Fragments, damp (fill)	3.5'	El. 820.5
Brown and Gray SILT and CLAY, some Sand, trace Rock Fragments, damp	11.5'	El. 812.5
Brown FM SAND, some Clay, trace Gravel, moist	14.6'	El. 809.4
Greenish Gray SAND and GRAVEL, moist	15.0'	El. 809.0
Gray CLAY and SILT, trace Sand, moist	17.5'	El. 806.5
Gray M SAND, some Clay, moist	19.0'	El. 805.0
Brown M SAND and GRAVEL, little Clay, wet	19.5'	El. 804.5
Boring Terminated at 19.5'		

Depth scale: -5, -10, -15, -20

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 30, 1995

GU 11-0 3/4/91

B-024 1/2

ENGINEER'S FIELD BORING LOG

PROJECT NAME: ODOT I-70 Mine Subsi[illegible] BORING NO.: B-24

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey SHEET 1 OF 2

STATION: 468+80 OFFSET: 30' Lt. MUNICIPALITY: Center Twp. DATE: START: 10/24/94

SURFACE ELEVATION: 822.0 RIG TYPE: CME - 75 Truck CORE SIZE: - FINISH: 10/24/94

SAMPLER: TYPE Split-Spoon O.D. 2¼ (in.) I.D. 1¼ (in.) Length 24 in.)

DRILLER/REPRESENTING: D. McKnight/CTL SAMPLER HAMMER WT.: 140 (lbs.)

INSPECTOR/REPRESENTING: D. Clark/Gannett Fleming, Inc. SAMPLER HAMMER DROP: 30 (in.)

CHECKED BY: A. Welker/Gannett Fleming, Inc. DATE: 12/94

AUGER: TYPE Solid Stem O.D. 4¼ (in.) I.D. - (in.)

CASING SIZE: - DEPTH: - CORE BARREL: TYPE -

DIRECTION OF HOLE: ✓ VERTICAL INCLINED DEGREE(S) FROM VERTICAL

WATER LEVEL DEPTH: Dry FEET - TIME: 3:30 DATE: 10/24/94

FEET - TIME: DATE:

DRILLING METHODS: Continuous Flight Augers

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
							Gray SAND and GRAVEL 1.0'	El. 821.0
1.5	S-1	4-4-5	1.0	-	-	-	Brown SAND, CLAY and ROCK FRAGMENTS, damp (fill)	
3.0	S-2	4-6-6	1.0	-	-	-		
4.5	S-3	2-5-6	0.8	-	-	-		
6.0	S-4	2-7-11	1.0	-	-	-		
7.5	S-5	11-30-14	1.0	-	-	-	7.5'	El. 814.5
9.0	S-6	3-3-3	1.4	-	-	-	Gray CLAY and SILT, trace Sand, damp	
10.5	S-7	1-2-2	1.0	-	-	-	10.5'	El. 811.5
12.0	S-8	2-2-2	1.0	-	-	-	Brown and Gray SILT and CLAY, trace Sand, trace Rock Fragments, moist	
13.5	S-9	1-3-3	0.6	-	-	-		
15.0	S-10	2-2-2	0.6	-	-	-		
16.5	S-11	2-3-3	0.7	-	-	-	16.5'	El. 805.5
18.0	S-12	5-6-9	1.0	-	-	-	Brown and Gray SAND, CLAY and ROCK FRAGMENTS	
19.5	S-13	5-6-6	1.1	-	-	-		
							20.5'	El. 801.5
21.0	S-14	6-8-7	1.4	-	-	-	Gray and Green SAND, CLAY and GRAVEL, moist	
22.5	S-15	13-16-14	1.4	-	-	-		
24.0	S-16	14-16-19	1.4	-	-	-		
	S-17	12-12-16	1.3	-	-	-		

-5 -10 -15 -20 -25

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 11, 1995 GU 11-03/4/91

B-024 3/2

ENGINEER'S FIELD BORING LOG

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guerr BORING NO.: B-24

SHEET 2 OF 2

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
25.5							26.5'	El. 795.5
27.0	S-18	14-11-4	1.5	-	-	-	Gray CLAY and SILT, moist 27.0'	El. 795.0
							Boring Terminated at 27.0'	

-30

-35

-40

-45

-50

-55

-60

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 11, 1995

GU 11-03/4/91

B-025-1/3

ENGINEER'S FIELD BORING LOG

PROJECT NAME: ODOT I-70 Mine Subsi e BORING NO.: B-25

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey SHEET 1 OF 3

STATION: 469+90 OFFSET: 60' Lt. MUNICIPALITY: Center Twp. DATE: START: 12/02/94

URFACE ELEVATION: 822.0 RIG TYPE: Acker CORE SIZE: NQ2 FINISH: 12/02/94

SAMPLER: TYPE Split-Spoon O.D. 2½ (in.) I.D. 1⅜ (in.) Length 24 in.)

DRILLER/REPRESENTING: T. England/Ed Hill/ CTL SAMPLER HAMMER WT.: 140 (lbs.)

INSPECTOR/REPRESENTING: B. Roman/Gannett Fleming, Inc. SAMPLER HAMMER DROP: 30 (in.)

CHECKED BY: A. Welker/Gannett Fleming, Inc. DATE: 12/94

AUGER: TYPE Hollow Stem Continuous Flight O.D. 6½ (in.) I.D. 3¼ (in.)

CASING SIZE: 4" PVC DEPTH: 47.5' CORE BARREL: TYPE NQ2

DIRECTION OF HOLE: ✓ VERTICAL - INCLINED - DEGREE(S) FROM VERTICAL

WATER LEVEL DEPTH: 6.9 FEET - TIME: 13:50 DATE: 12/02/94

42.2 FEET - TIME: 16:50 DATE: 12/05/94

DRILLING METHODS: SPT, Hollow Stem Auger, Wireline Rock Coring

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS	
							Brown and Gray Sandy SILT with Gravel (ml) (fill) 1.5'	El. 820.5	
3.0							Gray, Brown & Olive Clayey SILT (ml), medium to stiff, moist (fill)		
4.5	S-1	8-6-8	1.1	-	2.0	-		S-1 had some ice in it	
6.0									-5
7.5	S-2	4-4-4	0.7	-	1.5	-			
9.0							9.0'	El. 813.0	
10.5	S-3	3-3-4	1.5	-	<0.2	-	Mottled Brown & Gray Clayey SILT (ml), medium to stiff, moist Trace of black weathered coal particles & F Sand	Sediments coarsen downward from S-3 to S-6	-10
12.0									
13.5	S-4	4-5-4	1.2	-	2.0	-	S-4: Same		
15.0							S-5: Same, trace (+) Sand F Gravel		-15
16.5	S-5	5-5-5	1.3	-	<0.2	-	16.5'	El. 805.5	
18.0							Brown, Gray, Red, Black, Olive, Silty F SAND with F Gravel (sm) medium dense, moist	Colluvium from 16.5' to 24.0'	
19.5	S-6	5-6-6	1.0	-	-	-			
21.0							Gravel is mostly angular to sub-angular, some finer pieces are sub-rounded. Gravel is multi-colored and includes black coal particles		-20
22.5	S-7	7-6-9	0.8	-	-	-			
24.0							24.0'	El. 798.0	
25.5	S-8	5-5-7	0.8	-	1.7	-	Brown & Gray, varved Clayey SILT (ml)	Lacustrine sediments	-25
								24.0' to 27.0'	

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 30, 1995

GU 11-03/4/91

B025 2/3

ENGINEER'S FIELD BORING LOG

ROUTE/SECTION: GUE-070-14 COUNTY: Guernsey BORING NO.: B-25

SHEET 2 OF 3

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS	
27.0							27.0'	El. 795.0	
28.5	S-9	2-3-5	0.8	-	1.0*	-	Brown & Gray Silty SAND with Gavel (sm), loose, wet 28.0'	El. 794.0	
30.0							Gray Clayey SILT (ml), medium to stiff, wet	* Clayey SILT Layer	-30
31.5	S-10	3-3-4	1.5	-	<0.1	-			
33.0									
34.5	S-11	6-5-6	1.5	-	0.25	-			
36.0							36.0'	El. 786.0	-35
37.5	S-12	5-6-9	1.5	-	0.75	-	Gray & Reddish-Brown, Varved Clayey SILT (ml), very stiff, moist,	Lacustrine sediments 36.0' to 39.5'	
39.0							S-12: Silty-CLAY (cl), moist S-13a: Clayey-SILT (ml), wet 39.5'	El. 782.5	
40.5	S-13A S-13B S-13C	15-4-7	1.5	-	0.2	-	Gray, Brown, Olive, Red, Black Silty GRAVEL with Sand (gm), loose, moist 40.0'	Colluvium 39.5' to 40.0' El. 782.0	-40
42.0							Gray Clayey SILT (ml), stiff to very stiff, moist	24 hour water level at El. 779.8	
43.5	S-14	9-9-14	1.5	-	1.0	-			
45.0							45.0'	El. 770.0	-45
46.5	S-15	27-31-31	1.5	-	-	-	Silty SAND with Gravel (sm), very dense, moist	Auger Refusal at 47.5'	
47.5							47.5'	El. 774.5	
	R-1	-	0.7/2.5	28%.0%	-	-	Gray SHALE, very soft to soft, moderately to slightly weathered, very closely to closely spaced bedding joints		
50.0									-50
	R-2	-	5.0/5.0	100%/0%	-	-	RQD=0%		
55.0								Lost recovery apparently occurred at shale/coal contact	-55
	R-3	-	4.5/5.0	90%/0%	-	-	58.7'	El. 763.3	
60.0								Upper Freeport Coal	-60

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 30, 1995

GU 11-03/4/91

B-025 3/3

ENGINEER'S FIELD BORING LOG

ROUTE/SECTION: GUE-070-14 COUNTY: Guernsey BORING NO.: B-25

SHEET 3 OF 3

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
	R-4	-	5.0/5.0	100%/0%	-	-		
							64.6′	El. 757.4
65.0							Gray CLAYSTONE, very soft, RQD=0% 65.0′	El. 757.0
							Boring terminated at 65.0′	

-65 -70 -75 -80 -85 -90 -95

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY.

GU 11-0 3/4/91

B026 1/3

ENGINEER'S FIELD BORING LO~

PROJECT NAME: ODOT I-70 Mine Subsic .e BORING NO.: B-26

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey SHEET 1 OF 3

STATION: 476+14 OFFSET: 66' Rt. MUNICIPALITY: Center Twp. DATE: START: 11/29/94

SURFACE ELEVATION: 823.6 RIG TYPE: Acker AD-2/S&H 20 MH CORE SIZE: NX FINISH: 11/29/94

SAMPLER: TYPE Split-Spoon O.D. 2½ (in.) I.D. 1½ (in.) Length 24 in.)

DRILLER/REPRESENTING: T. England /CTL SAMPLER HAMMER WT.: 140 (lbs.)

INSPECTOR/REPRESENTING: D. Clark/Gannett Fleming, Inc. SAMPLER HAMMER DROP: 30 (in.)

CHECKED BY: A. Welker/Gannett Fleming, Inc. DATE: 1/95

AUGER: TYPE Hollow Stem O.D. 6½ (in.) I.D. 3¼ (in.)

CASING SIZE: 4"PVC DEPTH: 45.5 CORE BARREL: TYPE NQ2

DIRECTION OF HOLE: ✓ VERTICAL INCLINED DEGREE(S) FROM VERTICAL

WATER LEVEL DEPTH: 11.1 FEET - TIME: 17:00 DATE: 11/29/94

22.9 FEET - TIME: 17:05 DATE: 11/30/94

DRILLING METHODS: SPT, Hollow Stem Auger, Wireline Rock Coring

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
3.0							Brown, Silty CLAY, some Rock Fragments, moist (fill)	
4.5	S-1	6-6-8	0.5	-	-	-		
6.0								
7.5	S-2	5-6-10	0.9	-	-	-	8.0'	El. 815.6'
9.0							Brown and Gray Clayey SILT, some M Sand, moist (+)	
10.5	S-3	6-7-7	1.2	-	-	-		
12.0								
13.5	S-4	2-3-3	1.4	-	-	-		
15.0								
16.5	S-5	2-4-4	1.1	-	-	-	17.0'	El. 806.6'
18.0							Brown and Gray Silty CLAY, moist	
19.5	S-6	5-6-7	1.4	-	-	-	20.5'	El. 803.1'
21.0							Gray SILT and CLAY, moist	
22.5	S-7	4-4-5	1.4	-	-	-		24 hour water level at El. 800.7
24.0								
	S-8	5-8-7	1.5	-	-	-		

-5 -10 -15 -20

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 30, 1995

GU 11-03/4/91

B-026 2/3

ENGINEER'S FIELD BORING LOG

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey BORING NO.: B-26

SHEET 2 OF 3

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
25.5								
27.0								
28.5	S-9	3-5-6	1.3	-	-	-		
30.0								
31.5	S-10	4-5-5	1.5	-	-	-		
33.0								
34.5	S-11	4-4-5	1.5	-	-	-	35.0'	El. 788.1'
36.0							Gray SAND and GRAVEL, trace Clay, moist	
37.5	S-12	20-40-45	1.5	-	-	-	38.0'	El. 785.6'
39.0							Gray SILT and CLAY, trace Sand and Gravel, moist	
40.5	S-13	5-6-6	1.5	-	-	-	41.0'	El. 782.6'
42.0							Gray SAND and GRAVEL, trace Clay, moist	
43.3	S-14	25-43-50/0.3	0.9	-	-	-		
45.0							45.5'	El. 778.1'
45.5	S-15	50/0.5	0.5	-	-	-	Gray Sandy SHALE, very soft, moderately to highly weathered, very closely to closely spaced bedding Joints	
	R-1	-	3.5/5.0	78%/10%	-	-	RQD=15% 48.5'	El. 775.1'
50.0							Gray Shaley SANDSTONE, soft to hard, slightly weathered to fresh, very closely to medium spaced bedding joints	
	R-2	-	5.0/5.0	100%/30%	-	-	RQD=40%	
55.0								
	R-3	-	5.0/5.0	100%/83%	-	-		
60.0							60.2'	El. 763.4'

-30 -35 -40 -45 -50 -55 -60

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 30, 1995 GU 11-03/4/91

B-026 3/3

ENGINE[illegible]RS'S FIELD BORING LOG

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey BORING NO.: B-26

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
65.0	R-4	-	4.5/5.0	90%/80%	-	-	Gray Sandy SHALE, soft to hard, slightly weathered to fresh, very closely to medium spaced bedding joints RQD=86% 65.8'	El. 757.8'
70.0	R-5	-	5.0/5.0	100%/16%	-	-	Black bituminous COAL RQD=0% 71.5'	Upper Freeport Coal El. 752.1'
75.0	R-6	-	5.0/5.0	100%/40%	-	-	Gray CLAYSTONE, very soft, slightly weathered to fresh, closely spaced bedding joints RQD=57% 75.0'	El. 748.6'
							Boring Terminated at 75.0'	

-65 -70 -75 -80 -85 -90 -95

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 30, 1995

GU 11-03/4/91

B-027 1/3

ENGINEER'S FIELD BORING LOG

PROJECT NAME: ODOT I-70 Mine Subsidence | BORING NO.: B-27
ROUTE/SECTION: GUE-070-14.10 | COUNTY: Guernsey | SHEET 1 OF 3
STATION: 481+75 | OFFSET: 68'Lt. | MUNICIPALITY: Center Twp. | DATE: START: 12/02/94
SURFACE ELEVATION: 825.6 | RIG TYPE: Acker AD2/S&H 20 MH | CORE SIZE: NQ2 | FINISH: 12/06/94
SAMPLER: TYPE Split-Spoon | O.D. 2½ (in.) I.D. 1½ (in.) Length 24 in.
DRILLER/REPRESENTING: T. England & E. Hill/CTL | SAMPLER HAMMER WT.: 140 (lbs.)
INSPECTOR/REPRESENTING: B. Roman/Gannett Fleming, Inc. | SAMPLER HAMMER DROP: 30 (in.)
CHECKED BY: A. Welker/Gannett Fleming, Inc. | DATE: 1/95
AUGER: TYPE Hollow Stem Continuous Flight | O.D. 6½ (in.) I.D. 3¼ (in.)
CASING SIZE: 4" | DEPTH: 38.0' | CORE BARREL: TYPE NQ2
DIRECTION OF HOLE: ✓ VERTICAL - INCLINED - DEGREE(S) FROM VERTICAL
WATER LEVEL DEPTH: 39.7 FEET - TIME: 14:00 DATE: 12/06/94
50± FEET - TIME: 15:30 DATE: 12/07/94
DRILLING METHODS: SPT, Hollow Stem Auger, Wireline Rock Coring, Tri-Cone Roller

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
							Gray and Brown Silty GRAVEL with Sand (gm), moist (fill) 2.0'	El. 823.6'
3.0							Mottled Orange Brown and Gray Clayey SILT (ml), stiff to very stiff, moist	
4.5	S-1	3-4-7	0.8	-	1.7	-	S-2: Same	
6.0							(fill)	
7.5	S-2	5-8-10	1.5	-	2.0	-		
9.0							9.5'	El. 816.1'
10.5	S-3	2-3-4	1.3	-	0.8	-	Gray Clayey SILT (ml)	
12.0							12.0'	El. 813.6'
13.5	S-4	3-6-5	0.8	-	0.6	-	Gray and Brown, Red-Brown and Green Sandy Clayey SILT (ml), stiff, moist (+)	Material coarsens downward from 9.5' to 28.5' colluvium 12.0' to 28.5'
15.0							Trace F Gravel (subangular gray sandstone and shale fragments)	
16.5	S-5	2-4-6	1.0	-	0.7	-		
18.0								
19.5	S-6	10-9-8	1.3	-	1.75	-		
21.0							21.0'	El. 804.6'
22.5	S-7	4-7-11	1.0	-	-	-	Brown and Gray Silty SAND with Gravel (sm), medium dense, moist to wet	
24.0							S-8: Same Gravel consists of angular to subangular multicolored sandstone and shale fragments	
25.5	S-8	4-6-7	1.2	-	-	-		

-5 -10 -15 -20 -25

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 30, 1995

GU 11-03/4/91

B-027 2/3

ENGINEER'S FIELD BORING LOG

ROUTE/SECTION: GUE-070-14 COUNTY: Guernsey BORING NO.: B-27

SHEET 2 OF 3

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
27.0							Same, trace (+) Clay, wet	
28.5	S-9	5-5-5	0.8	-	-	-	28.5'	El. 797.1'
30.0							Gray, Reddish Brown Varved Clayey SILT (ml), stiff to very stiff, moist (+)	Lacustrine Sediments 28.5' to 35.5'
31.5	S-10	5-5-5	1.0	-	<0.1	-	S-11: Same, trace F Gravel (Subrounded Sandstone and shale fragments)	
33.0								
34.5	S-11	3-8-8	1.0	-	0.25	-	34.5'	El. 791.1'
36.0							Gray, Brown, Black Silty SAND with Gravel (sm), very dense, moist, Gravel consists of subangular Sandstone and Shale fragments	Colluvium 34.5' to 38.0' Augur refusal at 38.0'
37.5	S-12	25-30-44	1.5	-	-	-		
38.0							38.0'	El. 787.6'
45.0	R-1	-	0.3/7.0	-	4%/0%	-	Gray Sandy SHALE, very soft to soft, highly to moderately weathered, very close to closely spaced bedding joints, gray clay seams RQD=17%	
50.0	R-2	-	5.0/5.0	-	100%/33%	-		Rough subvertical joint at 49.6' 24 hour water level at El. 775.6
							51.5'	El. 774.1'
55.0	R-3	-	5.0/5.0	-	100%/75%	-	Gray to Black Sandy SHALE, soft to hard, slightly weathered to fresh, very close to medium spaced bedding joints	Laminated Siltstone and fine Sandstone Rough subvertical joints at 52.1' and 52.5'
60.0	R-4	-	5.0/5.0	-	100%/75%	-	RQD=80%	

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 30, 1995

GU 11-03/4/91

B-027 3/3

ENGINEER'S FIELD BORING LOG

ROUTE/SECTION: GUE-070-14 COUNTY: Guernsey BORING NO.: B-27

SHEET 3 OF 3

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS	
65.0	R-5	-	5.0/5.0	100%/86%	-	-	65.4'	El. 760.2'	-65
	R-6	-	2.7/10.0	27%/13%	-	-	VOID 70.5'	Upper Freeport Coal mined out. Tools lowered from 65.4' to 70.5' with no resistance El. ~~775~~ 755.1'	-70
							MINE GOB 72.7'	Drilling Resistance, but no recovery (assumed mine gob) El. 752.9'	
75.0							Gray UNDERCLAY and CLAYSTONE, very soft RQD=57% 75.0'	El. 750.6'	-75
							Boring Terminated at 75.0'		-80 -85 -90 -95

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY.

GU 11-0 3/4/91

B-027A 1/1

ENGINEER'S FIELD BORING LO

PROJECT NAME: ODOT I-70 Mine Subsic e

BORING NO.: B-27A

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey

SHEET 1 OF 1

STATION: 481+75 OFFSET: 65' Lt. MUNICIPALITY: Center Township

DATE: START: 12/12/94

SURFACE ELEVATION: 825.5' RIG TYPE: ACKER AD-2 CORE SIZE: -

FINISH: 12/12/94

SAMPLER: TYPE - O.D. - (in.) I.D. - (in.) Length in.)

DRILLER/REPRESENTING: T. England/CTL SAMPLER HAMMER WT.: - (lbs.)

INSPECTOR/REPRESENTING: D. Clark/Gannett Fleming, Inc. SAMPLER HAMMER DROP: - (in.)

CHECKED BY: A. Welker/Gannett Fleming, Inc. DATE: 1/95

AUGER: TYPE Hollow Stem O.D. 5⅝ (in.) I.D. 3¼ (in.)

CASING SIZE: 4" PVC DEPTH: 38' CORE BARREL: TYPE -

DIRECTION OF HOLE: ✓ VERTICAL INCLINED DEGREE(S) FROM VERTICAL

WATER LEVEL DEPTH: 56.5 FEET - TIME: 14:00 DATE: 12/13/94

56.6 FEET - TIME: 9:00 DATE: 12/14/94

DRILLING METHODS: Continuous Flight Augers, Tri-Cone Roller Wash Boring

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
							Augered to 38.0' Roller bit 38.0' - 72.0' Void 66.5' - 72.0' Boring Terminated at 72.0'	
								24 hour water level at El. 768.9

-5

-10

-20

-25

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 12, 1995

GU 11-0 3/4/91

B028 1/3

ENGINEER'S FIELD BORING LOG

PROJECT NAME: ODOT I-70 Mine Subsidence BORING NO.: B-28

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey SHEET 1 OF 3

STATION: 481+17 OFFSET: 131' Rt. MUNICIPALITY: Center Twp. DATE: START: 11/30/94

SURFACE ELEVATION: 819.3 RIG TYPE: CME Truck/S&H 20 MH CORE SIZE: NQ2 FINISH: 12/02/94

SAMPLER: TYPE Split-Spoon O.D. 2½ (in.) I.D. 1⅜ (in.) Length 24 in.)

DRILLER/REPRESENTING: E. Hill/R. Hill/CTL SAMPLER HAMMER WT.: 140 (lbs.)

INSPECTOR/REPRESENTING: B. Roman/Gannett Fleming, Inc. SAMPLER HAMMER DROP: 30 (in.)

CHECKED BY: A. Welker/Gannett Fleming, Inc. DATE: 1/95

AUGER: TYPE Hollow Stem Continuous Flight O.D. 7¾ (in.) I.D. 4¼ (in.)

CASING SIZE: 4" PVC DEPTH: 33.2' CORE BARREL: TYPE NQ2

DIRECTION OF HOLE: ✓ VERTICAL - INCLINED - DEGREE(S) FROM VERTICAL

WATER LEVEL DEPTH: 14.0 FEET - TIME: 11:35 DATE: 12/02/94

23.2 FEET - TIME: 17:00 DATE: 12/05/94

DRILLING METHODS: SPT, Hollow Stem Auger, Wireline Rock Coring

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
3.0							Brown and Gray Clayey SILT with Sand (ml), stiff to very stiff, moist (fill)	
4.5	S-1	6-8-10	1.5	-	0.75	-		Encountered water table at 9.75'
6.0								
7.5	S-2	3-5-8	1.5	-	1.0	-	7.0'	El. 812.3'
9.0							Brown and Gray Sandy SILT (ml), stiff to very stiff, moist to wet	
10.5	S-3	2-6-7	1.3	-	0.8	-	trace (+) F Gravel (Subangular Gray Sandstone and Shale Fragments)	Floodplain deposits 7.0' to 24.0'
12.0								
13.5	S-4	7-7-11	1.3	-	0.8	-	S-5: Clayey, mottled Gray and Brown. Trace of Black Coal Particles	
15.0								
16.5	S-5	10-12-17	0.8	-	2.0	-		Sassafras root in S-5
18.0								
19.5	S-6	7-7-8	1.5	-	<0.1	-		
21.0								Wet to 21.7' El. 797.6'
22.5	S-7	6-9-8	1.5	-	<0.1 1.4	-	21.7' Gray Silty CLAY (cl), very stiff, moist 24.0'	24 hour water level El. 796.1' El. 795.3'
24.0							Brown and Gray Clayey SILT with Sand, very stiff to hard, trace (+) F Gravel, Gray, Green, Red, Shale and Sandstone Fragments	
25.5	S-8	6-14-12	1.3	-	0.5	-		Samples S-8 and S-9 very heterogeneous fragments are randomly oriented

Depth scale: -5, -10, -15, -20

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 31, 1995

GU 11-03/4/91

B-028 2/3

ENGINEER'S FIELD BORING LO[illegible]

BORING NO.: 5-28

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey SHEET 2 OF 3

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS	
27.0							28.0'	Ancient colluvium 24.0' to 28.0' El. 791.3'	
28.5	S-9	10-20-34	1.2	-	-	-	Brown and Gray Gravelly Clayey SILT with Sand (ml), hard, moist to wet		
30.6							S-10 included numerous gray fine Sandstone Fragments		-30
31.5	S-10	26-41-50	0.8	-	-	-	(completely to highly weathered Sandy Shale)		
33.0							33.2'	El. 786.1'	
33.2	S-11	50/0.2	0.2	-	-	-	No Recovery	Driller ground up core from 33.2' to 36.4' NO VOIDS	-35
36.4	R-1	-	0.0/3.2	0%/0%	-	-	36.4'	El. 782.9'	
40.0	R-2	-	3.5/3.6	97%/39%	-	-	Gray Shaley SANDSTONE, soft to hard, slightly weathered to fresh, very close to medium spaced bedding joints		-40
45.0	R-3	-	5.0/5.0	100%/87%	-	-	RQD=70%		-45
							46.4'	El. 772.9'	
50.0	R-4	-	4.9/5.0	98%/82%	-	-	Gray Sandy SHALE, soft to hard, slightly weathered to fresh, very close to closely spaced bedding joints	Laminated Siltstone and F Sandstone	-50
55.0	R-5	-	5.0/5.0	100%/55%	-	-	RQD=63%		-55
60.0	R-6	-	4.9/5.0	98%/43%	-	-	58.7'	El. 720.6'	
							Gray CLAYSTONE, very soft, slightly weathered to fresh RQD=0%		-60

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 30, 1995

GU 11-03/4/9'

B-028-3/3

ENGINEER'S FIELD BORING LOG

BORING NO.: B-28

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey SHEET 3 OF 3

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
							60.8'	El. 758.5'
65.0	R-7	-	4.0/5.0	80%/0%	-	-	Black Bituminous Coal RQD=0%	Upper Freeport Coal
							67.5'	El. 751.8'
70.0	R-8	-	4.9/5.0	98%/0%	-	-	Gray UNDERCLAY, very soft RQD=0% 70.0'	El. 749.3'
							Boring Terminated at 70.0'	

-65 -70 -75 -80 -85 -90 -95

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY.

GU 11-0 3/4/91

B-029 1/3

ENGINEER'S FIELD BORING LOG

PROJECT NAME: ODOT I-70 Mine Subside
BORING NO.: B-29
ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey
SHEET 1 OF 3
STATION: 468+10 OFFSET: 60' Rt. MUNICIPALITY: Center Twp.
DATE: START: 11/28/94
SURFACE ELEVATION: 821.5 RIG TYPE: ACKER AD-2/S&H 20HH CORE SIZE: NX
FINISH: 11/29/94
SAMPLER: TYPE Split-Spoon O.D. 2⅜ (in.) I.D. 1⅜ (in.) Length 24 in.)
DRILLER/REPRESENTING: T. England/E. Hill/CTL SAMPLER HAMMER WT.: 140 (lbs.)
INSPECTOR/REPRESENTING: D. Clark/Gannett Fleming, Inc. SAMPLER HAMMER DROP: 30 (in.)
CHECKED BY: A. Welker/Gannett Fleming, Inc. DATE: 1/95
AUGER: TYPE Hollow Stem O.D. 6½ (in.) I.D. 3¼ (in.)
CASING SIZE: 4"ID PVC DEPTH: 45.3' CORE BARREL: TYPE NQ2
DIRECTION OF HOLE: ✓ VERTICAL - INCLINED - DEGREE(S) FROM VERTICAL
WATER LEVEL DEPTH: 10.1 FEET - TIME: 15:20 DATE: 11/29/94
25.5 FEET - TIME: 16:15 DATE: 12/01/94
DRILLING METHODS: SPT, Hollow Stem Auger, Wireline Rock Coring

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
							Pavement 1.0'	El. 820.5'
3.0							Brown and Gray SILT, CLAY and ROCK FRAGMENTS, dry (fill)	
4.5	S-1	12-12-12	1.0	-	-	-		
6.0								
7.5	S-2	7-7-8	1.0	-	-	-		
9.0								
10.5	S-3	8-5-4	0.5	-	-	-		
12.0							11.5'	El. 810.0'
13.5	S-4	4-2-3	0.9	-	-	-	Brown and Gray Silty CLAY, trace Sand and Rock Fragments, moist	
15.0								
16.5	S-5	3-2-3	1.2	-	-	-	17.0'	El. 804.5'
18.0							Brown and Gray SILT and CLAY, some Sand, trace Rock Fragments, moist	
19.5	S-6	9-9-8	1.4	-	-	-	20.0'	El. 801.5'
21.0							Brown M SAND and GRAVEL, little Clay, damp	
22.5	S-7	8-8-11	1.4	-	-	-		
24.0								
	S-8	8-9-9	1.5	-	-	-		

-5
-10
-15
-20

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 24, 1995
GU 11-03/4/91

B-029 2/3

ENGINEER'S FIELD BORING LOG

BORING NO.: B-29

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey SHEET 2 OF 3

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
25.5							Same, wet	24 hour water level at El. 796.0
27.0								water at 27.0'
28.5	S-9	8-10-10	1.1	-	-	-		
30.0							30.0'	El. 791.5'
31.5	S-10	7-21-15	1.5	-	-	-	Gray and Green GRAVEL and SAND, little Clay, wet	
33.0								
34.5	S-11	30-33-50/0.5	0.9	-	-	-		
36.0							36.0'	El. 785.5'
37.5	S-12	5-7-7	1.5	-	-	-	Gray Silty CLAY, little Sand and Gravel, wet	
39.0								
40.5	S-13	2-12-10	0.7	-	-	-		
42.0							42.5'	El. 779.0'
43.5	S-14	7-25-32	1.5	-	-	-	Gray M SAND and GRAVEL, some Silt and Clay, moist (+)	
45.0							44.5'	El. 777.0'
45.3	S-15	50/0.3	0.3	-	-	-	Gray M SANDSTONE, slightly shaley, moderately hard 45.5'	El. 776.0'
50.0	R-1	-	5.0	100%/62%	-	-	Dark Gray Sandy SHALE, medium hard, closely jointed, slightly weathered, little sandstone interbeds	
55.0	R-2	-	5.0	100%/60%	-	-	56.2'	El. 765.3'
60.0	R-3	-	5.0	100%/24%	-	-	Gray SHALE, soft, closely jointed 57.1'	El. 764.4'
							Black COAL, medium hard, very closely to closely jointed	

-30 -35 -40 -45 -50 -55 -60

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 24, 1995 GU 11-03/4/91

B-029 3/3

ENGINEER'S FIELD BORING LOG

BORING NO.: B-29

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey SHEET 3 OF 3

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
	R-4	-	5.0	100%/14%	-	-	63.5'	El. 758.0'
65.0							Gray CLAYSTONE, soft, very closely jointed, moderately weathered 65.0'	El. 756.5'
							Boring Terminated at 65.0'	

-65 -70 -75 -80 -85 -90 -95

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY.

GU 11-0 3/4/91

B-030 1/3

ENGINEER'S FIELD BORING LOG

PROJECT NAME: ODOT I-70 Mine Subsidence BORING NO.: B-30

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey SHEET 1 OF 3

STATION: 472+10 OFFSET: 60' Rt. MUNICIPALITY: Center Twp. DATE: START: 11/29/94

SURFACE ELEVATION: 823.0 RIG TYPE: ACKER AD-2/S&H 20MH CORE SIZE: NX FINISH: 11/29/94

SAMPLER: TYPE Split-Spoon O.D. 2½ (in.) I.D. 1⅜ (in.) Length 24 in.)

DRILLER/REPRESENTING: T. England/E. Hill/ CTL SAMPLER HAMMER WT.: 140 (lbs.)

INSPECTOR/REPRESENTING: D. Clark/Gannett Fleming, Inc. SAMPLER HAMMER DROP: 30 (in.)

CHECKED BY: A. Welker/Gannett Fleming, Inc. DATE: 1/95

AUGER: TYPE Hollow Stem O.D. 6½ (in.) I.D. 3¼ (in.)

CASING SIZE: 4" ID PVC DEPTH: 42.3 CORE BARREL: TYPE NQ2

DIRECTION OF HOLE: ✓ VERTICAL - INCLINED - DEGREE(S) FROM VERTICAL

WATER LEVEL DEPTH: 53.8 FEET - TIME: 15:20 DATE: 11/29/94

53.7 FEET - TIME: 17:20 DATE: 11/30/94

DRILLING METHODS: SPT, Hollow Stem Auger, Wireline Rock Coring

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS	
							Pavement 1.0'	El. 822.0'	
3.0							Brown and Gray Silty CLAY, trace Sand and Rock Fragments, damp		
4.5	S-1	8-6-10	1.0	-	-	-			
6.0									-5
7.5	S-2	5-6-5	0.9	-	-	-			
9.0							9.0'	El. 814.0'	
10.5	S-3	2-2-2	1.3	-	-	-	Brown MF SAND, little Clay, moist (+)		-10
12.0							11.5'	El. 811.5'	
13.5	S-4	3-4-7	-	-	-	-	Brown Silty CLAY, some Sand, moist (+) 14.0'	El. 809.0'	
15.0							Brown and Gray CLAY, M Sand		-15
16.5	S-5	2-4-5	-	-	-	-			
18.0									
19.5	S-6	7-12-12	0.9	-	-	-			
21.0									-20
22.5	S-7	5-5-8	1.3	-	-	-			
24.0							23.5'	El. 799.5'	
	S-8	4-6-7	1.0	-	-	-	Brown and Gray SILT and CLAY, some Sand and Gravel, wet		-25

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 30, 1995 GU 11-03/4/91

B-030-2/3

ENGINEER'S FIELD BORING LOG

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey

BORING NO.: B-30
SHEET 2 of 3

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & ROD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
25.5								
27.0								
28.5	S-9	9-6-9	1.5	-	-	-	29.0'	El. 794.0'
30.0							Gray SILT and CLAY, moist	
31.5	S-10	5-6-6	1.5	-	-	-		
32.0								
34.5	S-11	5-6-9	1.5	-	-	-		
36.0								
37.4	S-12	7-7-8	1.5	-	-	-		
39.0								
40.5	S-13	9-10-17	1.5	-	-	-	41.0'	El. 782.0'
42.0							Gray SILT and CLAY, trace Sand and Gravel, moist	
42.3	S-14	50/0.3	0.3	-	-	-	42.3'	El. 780.7'
44.5							Light Gray Shaley MF SANDSTONE, moderately hard, very closely to closely jointed, slightly weathered, some shale interbeds	
45.0	R-1	-	0.5	100%/0%	-	-		
	R-2	-	5.0	100%/22%	-	-		Angular and vertical fractures 46.5' to 47.1'
50.0							51.7'	El. 771.3'
	R-3	-	5.0	100%/76%	-	-	Gray Sandy SHALE, medium hard, closely jointed, trace sandstone interbeds	24 hour water level at El. 769.3' lost water at 54.5'
55.0								Very broken and weathered 54.8' to 55.9'
	R-4	-	5.0	100%/78%	-	-		Several weathered fractures 57.0', 57.2', 57.9'
60.0								

-30 -35 -40 -45 -50 -55 -60

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 30, 1995

GU 11-03/4/91

B-030 3/3

ENGINEERS FIELD BORING LOG

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey BORING NO.: B-30 SHEET 3 OF 3

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
							60.5'	El. 762.5'
	R-5	-	5.0	100%/40%	-	-	Gray SHALE, soft, closely jointed 62.2'	El. 760.8'
65.0							Black COAL, medium hard, very closely to closely jointed	
	R-6	-	5.0	100%/0%	-	-	68.7'	El. 754.3'
70.0							Gray CLAYSTONE, soft, very closely jointed, moderately weathered 70.0'	El. 753.0'
							Boring Terminated at 70.0'	

-65 -70 -75 -80 -85 -90 -95

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 30, 1995 GU 11-03/4/91

B-032 1/3

ENGINEER'S FIELD BORING LOG

PROJECT NAME: ODOT I-70 Mine Subside

BORING NO.: B-32

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey

SHEET 1 OF 3

STATION: 477+22 OFFSET: 60' Rt. MUNICIPALITY: Center Twp.

DATE: START: 11/29/94

SURFACE ELEVATION: 824.2 RIG TYPE: ACKER AD-2/S&H 20 MH CORE SIZE: NX

FINISH: 11/30/94

SAMPLER: TYPE Split-Spoon O.D. 2 (in.) I.D. 1⅜ (in.) Length 24 in.)

DRILLER/REPRESENTING: T.England/E. Hill/CTL SAMPLER HAMMER WT.: 140 (lbs.)

INSPECTOR/REPRESENTING: B. Roman/Gannett Fleming, Inc. SAMPLER HAMMER DROP: 30 (in.)

CHECKED BY: A. Welker/Gannett Fleming, Inc. DATE: 1/95

AUGER: TYPE Hollow Stem Continuous Flight O.D. 6½ (in.) I.D. 3¼ (in.)

CASING SIZE: 4" PVC DEPTH: 47.5 CORE BARREL: TYPE HQ2

DIRECTION OF HOLE: ✓ VERTICAL - INCLINED - DEGREE(S) FROM VERTICAL

WATER LEVEL DEPTH: 7.5 FEET - TIME: 16:35 DATE: 11/30/94

28.4 FEET - TIME: 16:35 DATE: 12/01/94

DRILLING METHODS: SPT, Hollow Stem Auger, Wireline Rock Coring

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
							Brown and Gray Silty GRAVEL with Sand (gm), moist (fill) 2.0'	Augered through shoulder material to 3.0' without sampling El. 822.2'
3.0							Brown and Gray Clayey SILT with Sand (ml), stiff, moist	
4.5	S-1	6-5-10	1.2	-	3.5			
6.0							Trace of F GRAVEL (subangular gray sandstone fragments) in S-1, S-2, and S-3	
7.5	S-2	3-8-5	0.9	-	1.5		(fill)	
9.0								
10.5	S-3	4-6-8	1.4	-	1.5			
12.0							12.0'	El. 812.2'
13.5	S-4	4-3-4	1.2	-	0.6		Brown and Gray Clayey SILT (ml), medium, moist	
15.0							S-4: mostly Brown Silt 15.0'	El. 809.2'
16.5	S-5	4-3-4	1.5	-	0.25		Gray Clayey SILT (ml), medium to stiff, moist	
18.0								
19.5	S-6	5-5-5	1.5	-	0.6			
21.0								
22.5	S-7	5-5-7	1.4	-	0.75			
24.0							24.0'	El. 800.2'
25.5	S-8	7-8-8	1.5	-	0.5		Gray Clayey SILT with Sand (ml) stiff to hard, moist	

-5 -10 -15 -20 -25

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 26, 1995

GU 11-03/4/91

B-032 2/3

ENGINEER'S FIELD BORING LOG

BORING NO.: B-32

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey SHEET 2 OF 3

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
27.0								24 hour water at El. 795.8
28.5	S-9	8-9-9	1.5	-	1.2			
30.0								
31.5	S-10	8-7-7	1.5	-	0.75		S-10: Trace F Gravel (subangular gray F sandstone fragments)	
34.0								
33.5	S-11	7-6-11	1.5	-	0.8		S-11: Mostly Gray Silt	
36.0								
37.5	S-12	5-15-23	1.1	-	0.5		S-12: Trace (+) F Gravel	
39.0								
40.5	S-13	5-4-4	1.1	-	<0.2		S-13: Gray Clayey Silt, very moist	
42.0							42.0'	El. 782.2'
43.5	S-14	21-31-25	1.1	-	-		Gray Sandy SILT with Gravel (ml), hard, moist	Spoon refusal at 46.4'
45.0							(completely weathered sandy shale)	
46.4	S-15	13-19-50/0.4	1.0	-	-		46.4'	El. 777.8'
47.5	-	-	-	-	-	-	Gray Sandy SHALE, very soft to soft, moderately to slightly weathered, very closely to closely spaced bedding joints	Augered without sampling from 46.4' to 47.5' Laminated Siltstone and Sandstone 46.4' to 63.0'
50.0	R-1	-	2.5/2.5	-	100%/11%		RQD=7% 50.4'	El. 773.8'
55.0	R-2	-	5.0/5.0	-	100%/21%		Gray Shaley SANDSTONE, soft to hard, slightly weathered to fresh, very closely to closely spaced bedding joints RQD=44%	
60.0	R-3	-	5.0/5.0	-	100%/63%		60.0'	El. 764.2'

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 26, 1995 GU 11-03/4/91

B-032 3/3

ENGINEER'S FIELD BORING LOG

BORING NO : B-32

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey SHEET 3 OF 3

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
	R-4	-	5.0/5.0	-	100%/60%		Gray Sandy SHALE, soft, slightly weathered to fresh, very closely to closely spaced bedding joints RQD=75% 63.0'	El. 761.2'
65.0							Gray Clayey SHALE, very soft, slightly weathered to fresh RQD=50% 64.5'	El. 759.7'
	R-5	-	5.0/5.0	-	100%/0%		Black Bituminous COAL RQD=0%	Upper Freeport Coal
70.0							70.7'	El. 753.5'
	R-6	-	5.0/5.0	-	100%/40%		Gray CLAYSTONE, very soft, slightly weathered to fresh RQD=47%	
75.0							75.0'	El. 749.2'
							Boring Terminated at 75.0'	After coring to 75.0' water level=19.7' inside NQ drillrods which extend to 75' but 7.5' inside 4" PVC casing which extends to 45'

-65 -70 -75 -80 -85 -90 -95

(32)

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY.

GU 11-0 3/4/91

B-033 1/3

ENGINEER'S FIELD BORING LOG

PROJECT NAME: ODOT I-70 Mine Subsidence BORING NO.: B-33
ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey SHEET 1 OF 3
STATION: 479+76 OFFSET: 60' Rt. MUNICIPALITY: Center Twp. DATE: START: 11/30/94
SURFACE ELEVATION: 825.0 RIG TYPE: ACKER AD2/S&H 20 MH CORE SIZE: NX FINISH: 11/30/94
SAMPLER: TYPE Split-Spoon O.D. 2" (in.) I.D. 1⅜ (in.) Length 24 in.)
DRILLER/REPRESENTING: T. England/CTL SAMPLER HAMMER WT.: 140 (lbs.)
INSPECTOR/REPRESENTING: B. Roman/Gannett Fleming, Inc. SAMPLER HAMMER DROP: 30 (in.)
CHECKED BY: A. Welker/Gannett Fleming, Inc. DATE: 1/95
AUGER: TYPE Hollow Stem Continuous Flight O.D. 6½ (in.) I.D. 3¼ (in.)
CASING SIZE: 4" PVC DEPTH: 45.0' CORE BARREL: TYPE NQ2
DIRECTION OF HOLE: ✓ VERTICAL - INCLINED - DEGREE(S) FROM VERTICAL
WATER LEVEL DEPTH: 13.1 FEET - TIME: 15:20 (1.5 hr.) DATE: 11/30/94
15.7 FEET - TIME: 16:38 (26.5 hr.) DATE: 12/01/94
DRILLING METHODS: SPT, Hollow Stem Auger, Wireline Rock Coring

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
							Brown and Gray Silty GRAVEL with Sand (gm), moist (fill) 2.0'	Augered without sampling to 3.0' El. 823.0'
3.0							Brown and Gray Gravelly SILT with Sand (ml), very stiff, moist	
4.5	S-1	5-8-17	0.5	-	0.3	-	Gravel consists of angular Gray Sandstone fragments	
6.0							(fill)	
7.5	S-2	5-3-3	0.5	-	0.7	-		
9.0							9.0'	El. 816.0'
10.5	S-3	3-3-5	0.8	-	0.5	-	Brown and Gray SILT with Sand (ml), medium, moist, trace of fine gravel-angular Sandstone fragments	
12.0							(fill) 12.0'	El. 813.0'
13.5	S-4	3-2-3	1.0	-	<0.1	-	Gray Clayey SILT (ml), soft to medium, moist	
15.0								
16.5	S-5	1-2-4	1.0	-	<0.1	-		
18.0								24 hour water level at El. 809.3'
19.5	S-6	5-5-4	0.7	-	<0.1	-		
21.0								
22.5	S-7	4-4-7	1.5	-	0.1	-		
24.0							S-8 included F Sand and trace (+) F Gravel (angular shale fragments and black coal particles)	
25.5	S-8	4-6-8	1.5	-	0.3	-		

-5
-10
-1
-20
-25

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 26, 1995 GU 11-03/4/91

B-033 2/3

ENGINEERS FIELD BORING LOGS

BORING NO.: B-33

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey SHEET 2 OF 3

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
27.0								
28.5	S-9	4-5-5	1.5	-	<0.1	-		
30.0								
31.5	S-10	4-4-4	1.5	-	<0.1	-		
33.0								
34.5	S-11	4-4-7	1.2	-	0.5	-	34.5'	El. 790.5'
36.0							Gray Sandy SILT with Gravel (ml), hard, moist	
37.5	S-12	10-20-25	0.7	-	-	-	Gravel consists of angular Gray F Sandstone fragments	
39.0							39.0'	El. 786.0'
40.5	S-13	3-3-4	1.3	-	0.5	-	Gray Clayey SILT (ml), medium moist	
42.0							42.0'	El. 783.0'
43.3	S-14	14-16-50/0.3	0.8	-	-	-	Gray and Olive Brown Sandy SILT with Gravel (ml), hard, moist Gravel consists of angular gray Shale and F Sandstone fragments (Completely	Spoon refusal at 43.3' Augered to 45.0'
45.0							weathered sandy shale) 45.0'	El. 780.0'
	R-1	-	4.8/5.0	-	97%/48%	-	Gray Sandy SHALE, very soft to hard, moderately to slightly weathered, Very closely to closely spaced bedding joints RQD=37% 49.1'	Bedrock above coal is generally laminated gray siltstone and light gray fine sandstone El. 775.9'
50.0							Gray Shaley SANDSTONE, soft to hard, slightly weathered to fresh, very closely to medium spaced bedding joints RQD=78% 51.8'	El. 773.2'
	R-2	-	4.8/5.0	-	96%/50%	-	Gray Sandy SHALE, soft to hard, slightly weathered to fresh, very closely to medium spaced bedding joints RQD=83%	Bedding joints develop in core with exposure to atmosphere
55.0								
	R-3	-	5.0/5.0	-	100%/95%	-		
60.0								

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 26, 1995

GU 11-03/4/9"

B-033 3/3

ENGINEER'S FIE' ᄀ BORING LOG

BORING NO.: B-33

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey SHEET 3 OF 3

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
	R-4	-	4.9/5.0	-	98%/98%	-	Clayey SHALE above coal 64.3' to 65.0'	
65.0							65.0'	El. 760.0'
	R-5	-	5.0/5.0	-	100%/0%	-	Black Bituminous COAL	Upper Freeport Coal
70.0							RQD=0%	
							71.4'	El. 753.6'
	R-6	-	5.0/5.0	-	100%/66%	-	Gray CLAYSTONE, very soft, slightly weathered to fresh, closely to medium spaced bedding joints	
75.0							RQD=92% 75.0'	El. 750.0'
							Boring Terminated at 75.0'	

-65 -70 -75 -80 -90 -95

B-33

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY.

GU 11-0 3/4/91

B-034 1/3

ENGINEER'S FIELD BORING LOG

PROJECT NAME: ODOT I-70 Mine Subsidence
BORING NO.: B-34

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey
SHEET 1 OF 3

STATION: 483+50 OFFSET: 65' Lt. MUNICIPALITY: Center Twp.
DATE: START: 12/01/94

SURFACE ELEVATION: 826.5' RIG TYPE: Acker AD2 Truck Rig CORE SIZE: NQ2
FINISH: 12/01/94

SAMPLER: TYPE Split-Spoon O.D. 2½ (in.) I.D. 1⅜ (in.) Length 24 in.)

DRILLER/REPRESENTING: E. Hill/CTL SAMPLER HAMMER WT.: 140 (lbs.)

INSPECTOR/REPRESENTING: B. Roman/Gannett Fleming, Inc. SAMPLER HAMMER DROP: 30 (in.)

CHECKED BY: A. Welker/Gannett Fleming, Inc. DATE: 1/95

AUGER: TYPE Hollow Stem Continuous Flight O.D. 6¼ (in.) I.D. 3¼ (in.)

CASING SIZE: 4" PVC DEPTH: 36.3 CORE BARREL: TYPE NQ2

DIRECTION OF HOLE: ✓ VERTICAL - INCLINED - DEGREE(S) FROM VERTICAL

WATER LEVEL DEPTH: 9.9 FEET - TIME: 15:40 DATE: 12/01/94

FEET - TIME: DATE:

DRILLING METHODS: SPT, Hollow Stem Auger, Wireline Rock Coring

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
							Brown and Gray Silty GRAVEL with Sand (gm), moist (Fill) 2.0'	El. 824.5'
3.0							Mottled Brown, Gray and Black Clayey Silt (ml), medium to stiff, moist	
4.5	S-1	2-5-7	0.6	-	1.5	-		
6.0								
7.5	S-2	2-6-6	1.2	-	1.5	-	S-2: Same	
9.0								
10.5	S-3	2-3-3	1.0	-	0.5	-	S-3: More Clay	0 hour water level reading at El. 816.6'
12.0							S-4: trace (+) F Gravel (Gray angular F Sandstone fragments and Coal particles)	
13.5	S-4	3-3-4	0.9	-	0.25	-	(Fill) 13.5'	El. 813.0'
15.0							Reddish Brown and Gray Clayey SILT (ml), medium to stiff, moist	Sample slipped out of spoon on S-5 which is just below water table
16.5	S-5	3-4-5	0.0	-	-	-		
18.0								Brown to gray color change at 21.8'
19.5	S-6	4-5-7	1.1	-	0.75	-		
21.0								Floodplain deposits 13.5' to 22.5'
22.5	S-7	2-3-4	1.3	-	0.5	-	22.5'	El. 804.0'
24.0							Gray and Brown Sandy SILT with Gravel (ml), medium, moist to wet, Gravel consists of subangular to subrounded sandstone and shale fragments and coal particles	Ancient colluvium 22.5' to 25.5'
25.5	S-8	3-7-8	1.3	-	-	-	25.5'	El. 801.0'

-5
-10
-15
-20

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 27, 1995

GU 11-03/4/91

B-034 2/3

ENGINEER'S FIELD BORI[illegible] LOG

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey BORING NO.: B-34 SHEET 2 of 3

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
27.0							Gray Silty CLAY (cl), medium to very stiff, moist to wet	Lacustrine sediments 25.5' to 36.3'
28.5	S-9	2-3-3	1.2	-	0.1	-		
30.0							S-10: Same	
31.5	S-10	3-4-4	1.5	-	<0.1	-	S-11: Same	
33.0							S-12: Same to 36.3' then highly weathered gray SHALE	Spoon refusal at 36.8'
34.5	S-11	5-8-12	1.5	-	<0.1	-		
36.0							36.3'	El. 790.2'
36.8	S-12	25-50/0.3	0.8	-	-	-	Gray SHALE with calcareous nodules, very soft to soft, highly to moderately weathered	Calcareous nodules: 36.8' to 37.1' 37.7' to 38.0' 38.6' to 38.7' 38.9' to 39.0' 39.9' to 40.0' 40.1' to 40.2' 40.4' to 40.6' 40.7' to 41.2' 41.4' to 41.9' 46.6' to 46.7'
40.0	R-1	-	1.2/3.2	-	38%/0%	-		
45.0	R-2	-	5.0/5.0	-	100%/19%	-	RQD=13% 46.7'	El. 779.8'
50.0	R-3	-	5.0/5.0	-	100%/31%	-	Gray SHALE, soft, slightly weathered to fresh, very closely to closely spaced bedding joints RQD=31% 50.4'	El. 776.1'
55.0	R-4	-	4.0/5.0	-	80%/58%	-	Gray SANDSTONE, hard, slightly weathered to fresh RQD=100% 51.7' Gray SHALE with laminations of fine Sandstone, soft, slightly weathered to fresh	Very thin siltstone Laminations El. 774.8' Recovery loss probably occurred at clay seam between sandstone and shale
60.0	R-5	-	4.2/5.0	-	84%/82%	-	RQD=70%	

-30 -35 -40 -45 -50 -55 -60

B-34 2/3

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 31, 1995

GU 11-03/4/91

B-034 3/3

'GINEER'S FIELD BORING LOG

BORING NO.: B-34

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey SHEET 3 OF 3

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
65.0	R-6	-	5.0/5.0	-	100%/65%	-		Gray clay seam 65.7' to 66.0'. Few clay seams above coal
70.0	R-7	-	5.0/5.0	-	100%/12%	-	67.3'	El. 759.2'
							Black Bituminous COAL RQD=0%	Upper Freeport Coal
75.0	R-8	-	5.0/5.0	-	100%/0%	-	73.5'	El. 753.0'
							Gray UNDERCLAY, very soft RQD=0% 75.0'	El. 751.5'
							Boring Terminated at 75.0'	

-65 -70 -75 -80 -85 -90 -95

B-34 3/3

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY.

GU 11-0 3/4/91

B-035 1/3

ENGINEER'S FIELD BORING LO[illegible]

PROJECT NAME: ODOT I-70 Mine Subs[illegible] [illegible]e BORING NO.: B-35
ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey SHEET 1 OF 3
STATION: 475+26 OFFSET: 60' Rt. MUNICIPALITY: Center Twp. DATE: START: 12/05/94
SURFACE ELEVATION: 824.0 RIG TYPE: Acker AD2/S&H 20 MH CORE SIZE: NQ2 FINISH: 12/07/94
SAMPLER: TYPE Split-Spoon O.D. 2½ (in.) I.D. 1½ (in.) Length 24 in.)
DRILLER/REPRESENTING: T. England/E. Hill/CTL SAMPLER HAMMER WT.: 140 (lbs.)
INSPECTOR/REPRESENTING: D.Clark/B.Roman/Gannett Fleming,Inc. SAMPLER HAMMER DROP: 30 (in.)
CHECKED BY: A. Welker/Gannett Fleming, Inc. DATE: 1/95
AUGER: TYPE Hollow Stem O.D. 5½ (in.) I.D. 3¼ (in.)
CASING SIZE: 4" PVC DEPTH: 45.0 CORE BARREL: TYPE -
DIRECTION OF HOLE: ✓ VERTICAL - INCLINED - DEGREE(S) FROM VERTICAL
WATER LEVEL DEPTH: 9.7 FEET - TIME: 15:30 DATE: 12/2/94
FEET - TIME: DATE:
DRILLING METHODS: SPT, Hollow Stem Auger, Wireline Rock Coring

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
3.0							Brown and Gray Silty CLAY and ROCK FRAGMENTS, damp (Fill)	
4.5	S-1	6-8-8	0.3	-	-	-	5.0'	El. 819.0'
6.0							Brown CLAY and SILT, some Sand and Gravel, moist (Fill)	
7.5	S-2	4-5-5	0.4	-	-	-	8.0'	El. 816.0'
9.0							Brown and Gray Clayey SILT, trace Rock Fragments, damp	24 hour water level at El. 814.3'
10.5	S-3	5-6-9	1.5	-	-	-	11.0'	El. 813.0'
12.0							Brown and Gray SILT and CLAY, moist	
13.5	S-4	3-3-4	0.9	-	-	-		
15.0							S-4: Some Sand and Gravel	
16.5	S-5	5-6-8	1.0	-	-	-	17.0'	El. 807.0'
18.0							Brown MC SAND and GRAVEL, little Clay, moist	
19.5	S-6	8-8-7	1.0	-	-	-	20.0'	El. 804.0'
21.0							Gray CLAY and SILT, trace Gravel, wet	Water at 21.5'
22.5	S-7	4-5-4	1.5	-	-	-		
24.0								
25.5	S-8	3-6-7	1.5	-	-	-		

Depth scale: -5, -10, -15, -20, -25

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 30, 1995

GU 11-03/4/91

B-035 2/3

ENGINEER'S FIELD BORING LC

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey

BORING NO.: B-35
SHEET 2 OF 3

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
							26.0'	El. 798.0'
27.0							Gray CLAY, stiff, moist	
28.5	S-9	5-7-10	1.5	-	-	-	29.0'	El. 795.0'
30.0							Gray SAND and GRAVEL, some Silt and Clay, moist	
31.5	S-10	7-7-7	1.5	-	-	-	31.0'	El. 793.0'
33.0							Reddish Gray Silty CLAY, moist	
34.5	S-11	6-7-7	1.5	-	-	-		
36.0								
37.5	S-12	7-10-16	1.5	-	-	-	37.5'	El. 786.5'
39.0							Gray Silty CLAY, trace Sand and Gravel, moist	
40.5	S-13	4-7-12	1.5	-	-	-		
42.0								
43.5	S-14	14-22-39	1.5	-	-	-	43.0'	El. 781.0'
45.0							Gray SAND and GRAVEL, trace Clay, moist 45.0'	El. 779.0'
50.0	R-1	-	4.7/5.0	94%/16%	-	-	Greenish-Gray SHALE, very soft to soft, highly to moderately weathered, very closely to closely spaced bedding joints RQD=13% 48.0'	El. 776.0'
							Gray and Black Sandy SHALE, soft to hard, fresh to slightly weathered, very close to closely spaced bedding joints	Gray Clay Seam 50.7' to 50.9'
55.0	R-2	-	4.9/5.0	98%/37%	-	-	RQD=51%	
60.0	R-3	-	5.0/5.0	100%/70%	-	-		

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 30, 1995

GU 11-03/4/91

B-035 3/3

ENGINEER'S FIELD BORING LOG

BORING NO.: B-35

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey SHEET 3 OF 3

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
							60.7'	El. 763.3'
	R-4	-	5.0/5.0	100%/90%	-	-	Black and Gray SHALE, fresh to slightly weathered, very closely to closely spaced bedding joints RQD=93%	
65.0							64.8'	El. 759.2'
	R-5	-	5.0/5.0	100%/0%	-	-	Black Bituminous COAL RQD=0%	Upper Freeport Coal
70.0							70.0'	El. 754.0'
							Boring Terminated at 70.0'	

-65 -70 -75 -80 -85 -90 -95

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY.

GU 11-0 3/4/91

B-035A 1/3

ENGINEER'S FIELD BORING LOG

PROJECT NAME: ODOT I-70 Mine Subside...

BORING NO.: B-35A

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey

SHEET 1 OF 3

STATION: 475+16 OFFSET: 60' Rt. MUNICIPALITY: Center Twp.

DATE: START: 12/07/94 FINISH: 12/08/94

SURFACE ELEVATION: 824.0 RIG TYPE: Acker AD2 CORE SIZE: -

SAMPLER: TYPE - O.D. - (in.) I.D. - (in.) Length - in.)

DRILLER/REPRESENTING: T. England /CTL SAMPLER HAMMER WT.: - (lbs.)

INSPECTOR/REPRESENTING: B. Roman/Gannett Fleming, Inc. SAMPLER HAMMER DROP: - (in.)

CHECKED BY: A. Welker/Gannett Fleming, Inc. DATE: 1/95

AUGER: TYPE - O.D. 6½ (in.) I.D. 3¼ (in.)

CASING SIZE: 4" PVC DEPTH: 46.0 CORE BARREL: TYPE NQ2

DIRECTION OF HOLE: ✓ VERTICAL ____ INCLINED ____ DEGREE(S) FROM VERTICAL

WATER LEVEL DEPTH: 36.6 FEET - TIME: 14:00 DATE: 12/09/94

36.8 FEET - TIME: 15:00 DATE: 12/12/94

DRILLING METHODS: SPT, Hollow Stem Auger, Wireline Rock Coring

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
							Augered without sampling to 46.0' See log of B-35 for description from 0.0' to 46.0'	

-5

-10

-15

-20

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 30, 1995

GU 11-03/4/91

B-035A 2/3

ENGINEER'S FIELD BORING LOG

BORING NO.: B-35A

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey SHEET 2 OF 3

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
								24 hour water level at El. 787.2'
46.0							46.0'	El. 778.0'
50.0	R-1	-	4.0	100%/10%	-	-	Gray Sandy SHALE, very soft to soft, severely to moderately weathered, very closely jointed RQD=18% 51.1'	El. 772.9'
55.0	R-2	-	5.0	100%/60%	-	-	Gray F SANDSTONE, shaley, medium hard, slightly weathered, closely jointed, trace Sandy Shale interbeds RQD=80% 57.1'	El. 766.9'
60.0	R-3	-	5.0	100%/90%	-	-	Gray Sandy SHALE, medium hard, closely to moderately closely jointed, trace Sandstone interbeds	

Depth scale: -30, -35, -40, -45, -50, -55, -60

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 30, 1995 GU 11-03/4/91

B-035A 3/3

ENGINEER'S FIELD BORING LO

BORING NO.: B-35A

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey SHEET 3 OF 3

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
	R-4	-	5.0	100%/70%	-	-	63.2'	El. 760.8'
65.0							Dark Gray SHALE, medium hard, moderately closely jointed RQD=100% 64.4'	El. 759.6'
	R-5	-	5.0	100%/0%	-	-	Black Bituminous COAL RQD=0%	
70.0							70.4'	El. 753.6'
72.0	R-6	-	2.0	100%/55%	-	-	Dark Gray CLAYSTONE, soft, moderately weathered, closely jointed RQD=69% 72.0'	El. 752.0'
							Boring Terminated at 72.0'	

-65 -70 -75 -80 -85 -90 -95

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY.

GU 11-0 3/4/91

BB36 1/3

ENGINEER'S FIELD BORING LO

PROJECT NAME: ODOT I-70 Mine Subsid. e

BORING NO.: B-36

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey

SHEET 1 OF 3

STATION: 477+74 OFFSET: 65' Lt. MUNICIPALITY: Center Twp.

DATE: START: 12/06/94

SURFACE ELEVATION: 824.5 RIG TYPE: Acker AD21 CORE SIZE: NQ2

FINISH: 12/06/94

SAMPLER: TYPE Split-Spoon O.D. 2½ (in.) I.D. 1⅜ (in.) Length 24 in.)

DRILLER/REPRESENTING: C. Workman/E. Hill/CTL SAMPLER HAMMER WT.: 140 (lbs.)

INSPECTOR/REPRESENTING: B. Roman/Gannett Fleming, Inc. SAMPLER HAMMER DROP: 30 (in.)

CHECKED BY: A. Welker/Gannett Fleming, Inc. DATE: 1/95

AUGER: TYPE Hollow Stem Continuous Flight O.D. 6¼ (in.) I.D. 3¼ (in.)

CASING SIZE: 4" PVC DEPTH: 43.0 CORE BARREL: TYPE -

DIRECTION OF HOLE: ✓ VERTICAL - INCLINED - DEGREE(S) FROM VERTICAL

WATER LEVEL DEPTH: 55.2 FEET - TIME: 16:30 DATE: 12/06/94

55.0 FEET - TIME: 15:30 DATE: 12/07/94

DRILLING METHODS: SPT, Hollow Stem Auger, Wireline Rock Coring

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
							Gray and Brown Silty GRAVEL with Sand (gm), moist 2.0'	El. 822.5'
3.0							Mottled Brown and Gray Clayey SILT with Sand (ml), stiff, moist, trace(+) fine Gravel	Gravel consists of angular sandstone & shale fragments
4.5	S-1	4-4-7	0.8	-	1.0	-	4.5'	El. 820.0'
6.0							Brown and Gray Clayey SILT (ml), medium to stiff, moist to wet	
7.5	S-2	6-5-8	0.8	-	2.5	-		Vadose zone to approximately 16'
9.0								
10.5	S-3	4-4-6	1.5	-	1.5	-	S-3: Same	
12.0								
13.5	S-4	3-3-5	1.5	-	0.7	-	S-4: Same	
15.0							S-5: Same, wet, trace F Sand	
16.5	S-5	2-2-3	1.0	-	<0.1	-	16.5'	El. 808.0'
18.0							Varved Gray and Light Olive Gray Clayey SILT (ml), soft to medium, moist	S-6: Clayey Silt (ml) Varved Gray and light Olive Gray
19.5	S-6	3-3-3	0.7	-	0.2	-		
21.0							S-7: Same	
22.5	S-7	3-2-2	0.8	-	<0.1	-		
24.0								El. 799.5'
25.5	S-8	2-3-6	1.0	-	<0.1 1.0	-	25.0'	S-8 trace of black material decomposed organics
							Gray Clayey SILT (ml), stiff, moist to wet, trace Organics	

Depth scale: -5, -10, -15, -20, -25

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 30, 1995

GU 11-03/4/91

B036 2/3

ENGINEER'S FIELD BORING LC

ROUTE/SECTION: GUE-070-14 COUNTY: Guernsey BORING NO.: B-36

SHEET 2 OF 3

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
27.0							S-9: Same, trace of fine gravel (angular shale fragments)	
28.5	S-9	5-5-6	1.5	-	1.5	-	S-10: Same, very soft 30.0' to 30.5'	S-10 Trace Organics
30.0							S-11: Varved Gray and Red Brown	
31.5	S-10	WOR-7-7	1.5	-	<0.1	-		
33.0								
34.5	S-11	4-4-5	1.5	-	0.4	-	34.5'	El. 790.0'
36.0							Gray and Brown Silty SAND with Gravel (sm), very dense, moist	Colluvium or local outwash 34.5 to 39.0'
37.5	S-12	11-30-27	1.5	-	-	-	Gravel is multicolored, angular to subrounded sandstone, shale fragments, trace coal particles	
39.0							39.0'	El. 785.5'
40.5	S-13	3-2-2	0.8	-	0.1	-	Gray Clayey SILT (ml), soft, moist trace fine Sand	Colluvium or local outwash 42.0' to 43.0'
42.0							42.0'	El. 782.5'
43.0	S-14	25-50/0.5	1.0	-	-	-	Gray, Olive and Brown Silty SAND with Gravel (sm), very dense, moist 43.0'	Gravel is multi-colored, sub rounded, sand stone, shale fragments and coal particles El. 781.5'
45.0	R-1	-	1.1/2.0	-	55%/0%	-	Gray Sandy SHALE, soft to hard, slightly weathered to fresh, (moderately weathered 43.0' to 45.8') RQD=46%	
	R-2	-	5.0/5.0	-	100%/26%	-		
50.0								
	R-3	-	5.0/5.0	-	100%/44%	-		
55.0								24 hour water level at El. 769.5'
	R-4	-	5.0/5.0	-	100%/68%	-		
60.0								

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 30, 1995

GU 11-03/4/91

B-036 3/3

ENGINEER'S FIELD BORING LOG

ROUTE/SECTION: GUE-070-14 COUNTY: Guernsey BORING NO.: B-36

SHEET 3 OF 3

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
							62.8'	Lost return water at 62.5' El. 761.7'
65.0	R-5	-	5.0/5.0	-	100%/44%	-	Black bituminous COAL	Upper Freeport Coal
							67.5'	El. 757.0'
70.0	R-6	-	3.2/5.0	-	64%/8%	-	Grey CLAYSTONE, very soft RQD=16% 70.0'	El. 754.5'
							Boring Terminated at 70.0'	

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY.

GU 11-0 3/4/91

B-036A

ENGINEER'S FIELD BORING LOG

PROJECT NAME: ODOT I-70 Mine Subsid.

BORING NO.: B-36A

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey

SHEET 1 OF 3

STATION: 477+84 OFFSET: 65' Lt. MUNICIPALITY: Center Twp.

DATE: START: 12/07/94

SURFACE ELEVATION: 824.5 RIG TYPE: ACKER AD21 CORE SIZE: -

FINISH: 12/09/94

SAMPLER: TYPE - O.D. - (in.) I.D. - (in.) Length - in.)

DRILLER/REPRESENTING: T. England/CTL SAMPLER HAMMER WT.: - (lbs.)

INSPECTOR/REPRESENTING: B. Roman/Gannett Fleming, Inc. SAMPLER HAMMER DROP: - (in.)

CHECKED BY: A. Welker/Gannett Fleming, Inc. DATE: 1/95

AUGER: TYPE Hollow Stem Continuous Flight O.D. 6¼ (in.) I.D. 3¼ (in.)

CASING SIZE: 4" PVC DEPTH: 44.0' CORE BARREL: TYPE NQ2

DIRECTION OF HOLE: ✓ VERTICAL - INCLINED - DEGREE(S) FROM VERTICAL

WATER LEVEL DEPTH: 13.6 FEET - TIME: 14:00 DATE: 12/9/94

12.0 FEET - TIME: 15:00 DATE: 12/12/94

DRILLING METHODS: Hollow Stem Auger, Wireline Rock Coring

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
							Augered without sampling to 44.0' See log of boring B-36 for description from 0.0' to 44.0'	
								24 hour water level at El. 812.5

-5

-10

-15

-20

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 12, 1995

GU 11-03/4/91

B-036A

ENGINEER'S FIELD BORING LOG

BORING NO.: B-36A
SHEET 2 OF 3

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
							44.0'	El. 780.5'
45.0	R-1	-	0.7	70%/0%	-	-	Gray Sandy SHALE, soft to medium hard, severely to moderately weathered, very closely jointed RQD=0% 46.0'	El. 778.5'
	R-2	-	5.0	100%/0%	-	-	Gray MF SANDSTONE, moderately hard, slightly weathered, very closely jointed RQD=0% 48.1'	El. 776.4'
50.0							Gray Sandy SHALE, medium hard, slightly weathered, very closely to closely jointed, trace Sandstone interbeds	Vertical fractures 48.6' to 48.7', 57.5' to 57.6'
	R-3	-	5.0	100%/40%	-	-	RQD=55%	
55.0								
	R-4	-	5.0	100%/64%	-	-		
60.0								

Depth scale: -30, -35, -40, -45, -55, -60

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 12, 1995

B-036A

ENGINEER'S FIELD BORING LOG

BORING NO.: B-36a
SHEET 3 OF 3

ROUTE/SECTION GUE-070-14.10 COUNTY: Guernsey

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
							62.2'	El. 762.3'
	R-5	-	5.0	100%/60%	-	-	Dark Gray SHALE, soft RQD=100% 63.0'	El. 761.5'
65.0							Black Bituminous Coal	
							RQD=0% 69.5'	El. 755.0'
70.0	R-6	-	5.0	100%/06%	-	-	Dark Gray CLAYSTONE, very soft, moderately severely weathered RQD=60% 70.0'	El. 754.5'
							Boring Terminated at 70.0'	

-65
-70
-75
-80
-85
-90
-95

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY.

GU 11-0 3/4/91

B-037 1/3

ENGINEER'S FIELD BORING LOG

PROJECT NAME: ODOT I-70 Mine Subsidence — BORING NO.: B-37
ROUTE/SECTION: GUE-070-14.10 — COUNTY: Guernsey — SHEET 1 OF 3
STATION: 486+25 — OFFSET: 65' Lt. — MUNICIPALITY: Center Twp. — DATE: START: 12/06/94
SURFACE ELEVATION: 828.5 — RIG TYPE: Acker AD2/S&H 20MH — CORE SIZE: NQ2 — FINISH: 12/08/94
SAMPLER: TYPE Split-Spoon — O.D. 2 (in.) I.D. 1⅜ (in.) Length 24 in.)
DRILLER/REPRESENTING: C. Workman/E. Hill/CTL — SAMPLER HAMMER WT.: 140 (lbs.)
INSPECTOR/REPRESENTING: B. Roman/Gannett Fleming, Inc. — SAMPLER HAMMER DROP: 30 (in.)
CHECKED BY: A. Welker/Gannett Fleming, Inc. — DATE: 1/95
AUGER: TYPE Hollow Stem Continuous Flight — O.D. 6½ (in.) I.D. 3¼ (in.)
CASING SIZE: 4" PVC — DEPTH: 25.5 — CORE BARREL: TYPE NQ2
DIRECTION OF HOLE: ✓ VERTICAL - INCLINED - DEGREE(S) FROM VERTICAL
WATER LEVEL DEPTH: 22.4 FEET - TIME: 15:00 DATE: 12/08/94
Blocked 23.0 FEET - TIME: DATE:
DRILLING METHODS: SPT, Hollow Stem Auger, Wireline Rock Coring

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
							Silty GRAVEL with Sand (gm), moist 2.0'	El. 826.5'
3.0							Mottled Brown and Gray Sandy Clayey SILT with Gravel (ml), very stiff, moist	Soil coarsens from 2.0' to 10.5'
4.5	S-1	8-8-12	0.4	-	-	-	Gravel consists of multicolored angular to subangular sandstone and shale fragments and black coal particles	Colluvium 2.0' to 12.0'
6.0								
7.5	S-2	4-7-10	0.7	-	-	-		
9.0								
10.5	S-3	5-6-9	0.9	-	-	-		
12.0							12.0'	El. 816.5'
13.5	S-4	3-3-4	1.2	-	0.75	-	Reddish Brown and Gray Varved Clayey SILT (ml)	Lacustrine deposit 12.0' to 21.3'
15.0							S-5: Same, more clay	
16.5	S-5	3-7-7	1.2	-	0.2	-		
18.0							S-6: Same, trace Fine Gravel (subangular gray sandstone)	
19.5	S-6	6-9-13	0.8	-	-	-		
21.0							21.3'	El. 807.2'
22.5	S-7	8-22-30	1.5	-	-	-	Black Bituminous COAL 23.0'	Mahoning Coal 0 hour water level at El. 806.1' El. 805.5'
24.0							Interbedded COAL, CLAY and SHALE, very soft, completely weathered	
25.5	S-8	34-38-32	1.5	-	-	-	25.5'	El. 803.0'

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 30, 1995

GU 11-03/4/91

B-037 2/3

ENGINEER'S FIELD BORIN LOG

BORING NO.: B-37

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey SHEET 2 OF 3

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
30.0	R-2	-	5.0	100%/93%	-	-	Gray M SANDSTONE, medium hard, slightly weathered, moderately closely jointed	R-1 shown in core box 23.5'-25.0' with 50% recovery and 42% RQD
35.0	R-3	-	5.0	100%/95%	-	-	33.6'	El. 794.9'
							Gray CLAYSTONE, trace M Sand, soft, moderately weathered, closely jointed 35.7'	El. 792.8'
40.0	R-4	-	5.0	100%/80%	-	-	Gray Clayey M SANDSTONE, soft to medium hard, moderately weathered, moderately closely jointed 39.8'	Soft Claystone 39.6' to 39.8' El. 788.7'
45.0	R-5	-	4.9	98%/63%	-	-	Gray Silty SHALE, medium hard, moderately closely to closely jointed, slightly weathered, trace Sandy interbeds	Vertical fracture 40.1' to 41.8'
50.0	R-6	-	5.0	100%/76%	-	-		Broken with angular fractures 47.2' to 47.6'
55.0	R-7	-	5.0	100%/66%	-	-		Severely weathered fracture 52.3'
60.0	R-8	-	4.8	96%/94%	-	-	59.7'	El. 768.8'

-30 -35 -40 -45 -50 -55 -60

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 30, 1995

GU 11-03/4/91

B-037 3/3

ENGINEER'S FIE') BORING LOG

BORING NO.: B-37

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey SHEET 3 OF 3

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
	R-9	-	4.9	98%/96%	-	-	Gray Sandy SHALE, moderately hard, fresh, moderately closely jointed 64.0'	El. 764.5'
65.0							Gray SHALE, slightly Sandy, medium hard, fresh RQD=100% 65.8'	El. 762.7'
	R-10	-	5.0	100%/16%	-	-	Black Bituminous COAL	
70.0							RQD= 0% 71.1'	El. 757.4
72.0	R-11	-	2.0	100%/0%	-	-	Dark Gray CLAYSTONE, soft, moderately severely weathered 72.0'	El. 756.5'
							Boring Terminated at 72.0'	

-65

-70

-75

-80

-85

-90

-95

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY.

GU 11-0 3/4/91

B-038 1/3

ENGINEER'S FIELD BORING LOG

PROJECT NAME: ODOT I-70 Mine Subside...

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey

STATION: 485+25 OFFSET: 65' Rt. MUNICIPALITY: Center Twp.

SURFACE ELEVATION: 827.5 RIG TYPE: Acker AD2 /S&H 20MH CORE SIZE: NQ2

SAMPLER: TYPE Split-Spoon O.D. 2½ (in.) I.D. 1⅜ (in.) Length 24 in.)

DRILLER/REPRESENTING: T. England E. Hill/CTL SAMPLER HAMMER WT.: 140 (lbs.)

INSPECTOR/REPRESENTING: B. Roman/Gannett Fleming, Inc. SAMPLER HAMMER DROP: 30 (in.)

CHECKED BY: A. Welker/Gannett Fleming, Inc. DATE: 1/95

AUGER: TYPE Hollow Stem Continuous Flight O.D. 6¼ (in.) I.D. 3¼ (in.)

CASING SIZE: 4" PVC DEPTH: 45.5 CORE BARREL: TYPE NQ2

DIRECTION OF HOLE: ✓ VERTICAL - INCLINED - DEGREE(S) FROM VERTICAL

WATER LEVEL DEPTH: 22.0 FEET - TIME: 15:30 DATE: 12/07/94

28.8 FEET - TIME: 10:00 DATE: 12/08/94

DRILLING METHODS: SPT, Hollow Stem Auger, Wireline Rock Coring

BORING NO.- B-38

SHEET 1 OF 3

DATE: START: 12/07/94

FINISH: 12/07/94

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
							Silty GRAVEL with Sand (gm), moist (Fill) 2.0'	El. 825.5'
3.0							Mottled Tan, Brown and Gray Clayey SILT (ml), very stiff, moist	Coal fragments in S-1
4.5	S-1	6-8-12	0.7	-	3.5	-	Trace (-) of Sand and fine Gravel	Colluvium 2.0' to 9.2'
6.0							S-2: Same, less gravel	
7.5	S-2	6-6-9	0.7	-	2.5	-	7.5'	El. 820.0'
9.0							Red-Brown and Gray Clayey SILT (ml), soft to stiff, moist to wet	
10.5	S-3	6-8-13	0.4	-	<0.1	-	10.0'	El. 817.5'
12.0							Mottled Orange-Brown Tan, Gray and Black Clayey SILT, stiff to very stiff, moist, trace (+) Sand	
13.5	S-4	3-6-8	1.1	-	0.5	-	13.5'	El. 814.0'
15.0							Brown Clayey SILT, very stiff, moist trace (+) Sand and Gravel	
16.5	S-5	3-8-14	1.5	-	0.75	-	S-5: Mottled Brown and Gray	Hole measured dry after augering to 18.0'
18.0							S-6: Same, mostly brown Trace Organics	
19.5	S-6	5-7-9	1.2	-	0.75	-	S-7: Same, Brown, trace multicolored coarse Sand (subangular to subrounded rock fragments and angular pieces of coal) Trace organics	
21.0								
22.5	S-7	5-8-10	1.2	-	0.75	-	24.0'	El. 803.5'
24.0							Orange Brown, Tan and Gray Silty SAND with Gravel (sm), medium dense, moist to wet, coarse Sand and Fine Gravel consists of multicolored angular to subangular Sandstone Shale, and coal fragments, maximum particle size=¾"	
25.5	S-8	6-6-9	0.8	-	-	-		

-5 -10 -15 -20

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 31, 1995

GU 11-03/4/91

B-038 2/3

ENGINEER'S FIELD BORING LOG

BORING NO.: B-38

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey SHEET 2 OF 3

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
27.0							27.5'	El. 800.0'
28.5	S-9	5-3-3	1.0	-	<0.1	-	Reddish-Brown and Gray Varved Clayey SILT (ml), medium to stiff, moist to wet	Lacustrine deposit 27.5' to 34.5'
30.0								24 hour water level at El. 798.7
31.5	S-10	4-5-6	1.2	-	<0.1	-		
33.0								
34.5	S-11	4-5-28	1.5	-	<0.1	-	34.5'	El. 793.0'
36.0							Silty GRAVEL with Sand (gm), very dense, moist to wet, angular to subangular Sandstone and Shale fragments	Glacial till 34.5' to 52.2'
36.4	S-12	50/0.4	0.4	-	-	-		Spoon refusal at 36.4' Augered without sampling 36.4' to 45.5'
45.5	-	-	-	-	-	-		
50.0	R-1	-	0.0/4.5	-	0%/0%	-		Assumed core loss occurred in till
55.0	R-2	-	4.0/5.0	-	80%/0%	-	53.2' Gray Silty SHALE, very soft to soft, moderately severely weathered, very closely jointed 56.5'	El. 774.3' Vertical fracture 54.8' to 55.0' severely weathered to soft clay 55.7' to 55.9', 56.0' to 56.2' 56.3' to 56.5'
60.0	R-3	-	5.0/5.0	-	100%/7%	-	Gray Sandy SHALE, soft to medium hard, slightly weathered, very closely jointed, trace sandstone interbeds	Severely weathered 58.6' to 58.9', 59.2' to 59.3' Severely weathered horizontal fracture 59.7'

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 31, 1995 GU 11-03/4/91

B-038 3/3

ENGINEER'S FIELD BORING LOG

BORING NO.: B-38

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey SHEET 3 OF 3

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
65.0	R-4	-	5.0	-	100%/56%	-	65.7'	Driller noted 2.5" to 3" rod drop and 30% to 40% water loss at 63.5' Severely weathered angular fractures 60.2' to 60.7' El. 761.8'
70.0	R-5	-	5.0	-	100%/84%	-	Gray Sandy SHALE, medium hard, closely to moderately closely jointed	
75.0	R-6	-	5.0	-	100%/80%	-	74.2'	El. 753.3'
							Dark Gray SHALE, soft 74.5'	El. 753.0'
80.0	R-7	-	5.0	-	100%/80%	-	Black Bituminous COAL 80.2'	El. 747.3'
82.0	R-8	-	1.8	-	90%/0%	-	Gray CLAYSTONE, soft, moderately severely weathered 82.0'	El. 745.5'
							Boring Terminated at 82.0'	

-65 -70 -75 -80 -85 -90 -95

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY.

GU 11-0 3/4/91

B-039 1/3

ENGINEER'S FIELD BORING LOG

PROJECT NAME: ODOT I-70 Mine Subsidence

BORING NO.: B-39

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey

SHEET 1 OF 3

STATION: 475+45 OFFSET: 60' Rt. MUNICIPALITY: Center Twp.

DATE: START: 12/08/94

SURFACE ELEVATION: 824.0 RIG TYPE: Acker AD2/S&H 20 MH CORE SIZE: NQ2

FINISH: 12/08/94

SAMPLER: TYPE - O.D. - (in.) I.D. - (in.) Length - in.)

DRILLER/REPRESENTING: T. England E. Hill/CTL SAMPLER HAMMER WT.: - (lbs.)

INSPECTOR/REPRESENTING: D. Clark/Gannett Fleming, Inc. SAMPLER HAMMER DROP: - (in.)

CHECKED BY: A. Welker/Gannett Fleming, Inc. DATE: 1/95

AUGER: TYPE Hollow Stem Continuous Flight O.D. 6½ (in.) I.D. 3½ (in.)

CASING SIZE: 4" DEPTH: 47.5' CORE BARREL: TYPE NQ2

DIRECTION OF HOLE: ✓ VERTICAL ___ INCLINED ___ DEGREE(S) FROM VERTICAL

WATER LEVEL DEPTH: 57.4 FEET - TIME: 16:30 DATE: 12/08/94

Caved at 49.3 FEET - TIME: 8:00 DATE: 12/09/94

DRILLING METHODS: CF HS Auger, Wireline Rock Coring

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
							Augered to 47.5' without sampling	

-5

-10

-15

-20

-25

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 31, 1995

GU 11-03/4/91

B-039 2/3

ENGINEER'S FIELD BORING LO'

BORING NO.: B-39
ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey SHEET 2 OF 3

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
47.5							47.5'	El. 776.5'
50.0	R-1	-	2.5	100%/48%	-	-	Gray Sandy SHALE, soft to medium hard, moderately weathered, very closely jointed, trace Sandstone interbeds	
55.0	R-2	-	5.0	100%/28%	-	-	54.7'	Very soft and severely weathered 53.1' to 54.0' El. 769.3'
60.0	R-3	-	5.0	100%/79%	-	-	Gray Shaley SANDSTONE, moderately hard, very closely to closely jointed, trace Sandy Shale interbeds	0 hour water level at El. 766

-30 -35 -40 -45 -50 -55 -60

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 31, 1995

GU 11-03/4/91

B-039 3/3

EN⌃ NEER'S FIELD BORING LOG

BORING NO.: B-39
SHEET 3 OF 3

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
							61.0'	El. 763.0'
65.0	R-4	-	5.0	100%/96%	-	-	Dark Gray SHALE, soft, closely jointed 64.8'	El. 759.2'
70.0	R-5	-	5.0	100%/8%	-	-	Black Bituminous COAL	Lost Water 69.0'
							71.5'	El. 752.5'
73.5	R-6	-	3.5	100%/42%	-	-	Dark Gray CLAYSTONE, very soft, moderately severely weathered, closely jointed 73.5'	El. 750.5'
							Boring Terminated at 73.5'	

-65 -70 -75 -80 -85 -90 -95

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY.

GU 11-0 3/4/91

B040 1/3

ENGINEER'S FIELD BORING LC

PROJECT NAME: ODOT I-70 Mine Subsic... ce

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey

STATION: 475+55 OFFSET: 65' Rt. MUNICIPALITY: Center Twp.

SURFACE ELEVATION: 824.0 RIG TYPE: Acker AD2/S&H 20MH CORE SIZE: NQ2

SAMPLER: TYPE - O.D. - (in.) I.D. - (in.) Length - in.)

DRILLER/REPRESENTING: T. England/ E. Hill/CTL SAMPLER HAMMER WT.: - (lbs.)

INSPECTOR/REPRESENTING: D. Clark/Gannett Fleming, Inc. SAMPLER HAMMER DROP: 30 (in.)

CHECKED BY: A. Welker/Gannett Fleming, Inc. DATE: 1/95

AUGER: TYPE Hollow Stem Continuous Flight O.D. 5½ (in.) I.D. 3¼ (in.)

CASING SIZE: 4" PVC DEPTH: 48.0' CORE BARREL: TYPE NQ2

DIRECTION OF HOLE: ✓ VERTICAL - INCLINED - DEGREE(S) FROM VERTICAL

WATER LEVEL DEPTH: 11.0 FEET - TIME: 14:00 DATE: 12/09/94

15.6 FEET - TIME: 14:00 DATE: 12/10/94

DRILLING METHODS: HSCF Augers, Wireline Coring

BORING NO.: B-40

SHEET 1 OF 3

DATE: START: 12/09/94

FINISH: 12/10/94

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
							Augered without sampling to 48.0'	
								24 hour water level at El. 808.4'

-5

-10

-20

-25

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 31, 1995

GU 11-03/4/91

B-040 2/3

ENGINEER'S FIELD BORING LOG

BORING NO.: B-40
SHEET 2 OF 3

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
48.0							48.0'	Began coring at 48.0' El. 776.0'
50.0	R-1	-	2.0	100%/0%	-	-	Gray Sandy SHALE, soft to medium hard, moderately weathered, very closely jointed, trace Sandstone interbeds	Very broken with angular fractures 49.0' to 52.0'
55.0	R-2	-	4.4	88%/0%	-	-	54.5'	El. 769.5'
60.0	R-3	-	5.0	100%/78%	-	-	Interbedded Gray Sandy SHALE and light Gray FM SANDSTONE, medium to moderately hard, closely to moderately closely jointed, fresh	

Depth scale: -30, -35, -40, -45, -50, -55, -60

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 31, 1995

GU 11-03/4/91

B-040 3/3

ENGINEER'S FIELD BORING LOG

BORING NO.: B-40

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey SHEET 3 OF 3

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
65.0	R-4	-	5.0	100%/56%	-	-	64.0'	El. 760.0'
							Dark Gray SHALE, soft 65.0'	El. 759.0'
70.0	R-5	-	5.0	100%/0%	-	-	Black Bituminous COAL	
73.0	R-6	-	3.0	100%/20%	-	-	71.7'	El. 752.3'
							Dark Gray CLAYSTONE, very soft to soft, moderately severely weathered 73.0'	El. 751.0'
							Boring terminated at 73.0'	

-65 -70 -75 -80 -90 -95

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY.

GU 11-0 3/4/91

B-041 1/1

ENGINEER'S FIELD BORING LOG

PROJECT NAME: ODOT I-70 Mine Subsidence | BORING NO.: B-41

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey | SHEET 1 OF 1

STATION: 475+38 OFFSET: 60' Rt. MUNICIPALITY: Center Township | DATE: START: 12/13/94

SURFACE ELEVATION: 824.0 RIG TYPE: ACKER AD - 2 CORE SIZE: - | FINISH: 12/13/94

SAMPLER: TYPE - O.D. - (in.) I.D. - (in.) Length - in.)

DRILLER/REPRESENTING: T. England/CTL SAMPLER HAMMER WT.: - (lbs.)

INSPECTOR/REPRESENTING: D. Clark/Gannett Fleming, Inc. SAMPLER HAMMER DROP: - (in.)

CHECKED BY: A. Welker/Gannett Fleming, Inc. DATE: 1/95

AUGER: TYPE Hollow Stem O.D. 5½ (in.) I.D. 3¼ (in.)

CASING SIZE: 4" PVC DEPTH: 49.0' CORE BARREL: TYPE -

DIRECTION OF HOLE: ✓ VERTICAL INCLINED DEGREE(S) FROM VERTICAL

WATER LEVEL DEPTH: 55.3 FEET - TIME: 12:30 DATE: 12/13/94

55.5 FEET - TIME: 11:00 DATE: 12/14/94

DRILLING METHODS: Continuous Flight Augers, Tri-cone Roller Wash Boring

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & ROD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
							Augered without sampling to 49.0' Set 4" PVC casing to 49.0' Roller bit 49.0 to 71.0' Void 65.0' to 71.0' Boring terminated at 71.0'	24 hour water level at El. 768.5'

-5 -10 -15 -20 -25

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 31, 1995 GU 11-0 3/4/91

B-042 1/1

ENGINEER'S FIELD BORING LO

PROJECT NAME: ODOT I-70 Mine Subside
ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey
STATION: 469+73 OFFSET: 60' Rt. MUNICIPALITY: Center Township
SURFACE ELEVATION: 822.0 RIG TYPE: ACKER AD - 2 CORE SIZE: -
SAMPLER: TYPE - O.D. - (in.) I.D. - (in.) Length - in.)
DRILLER/REPRESENTING: T. England/CTL SAMPLER HAMMER WT.: - (lbs.)
INSPECTOR/REPRESENTING: D. Clark/Gannett Fleming, Inc. SAMPLER HAMMER DROP: - (in.)
CHECKED BY: A. Welker/Gannett Fleming, Inc. DATE: 1/95
AUGER: TYPE Hollow Stem O.D. 5½ (in.) I.D. 3¼ (in.)
CASING SIZE: 4" PVC DEPTH: 44.0' CORE BARREL: TYPE -
DIRECTION OF HOLE: ✓ VERTICAL - INCLINED - DEGREE(S) FROM VERTICAL
WATER LEVEL DEPTH: 11.2 FEET - TIME: 9:30 DATE: 12/13/94
FEET - TIME: DATE:
DRILLING METHODS: Continuous Flight Augers, Tri-cone Roller Wash Boring

BORING NO.: B-42
SHEET 1 OF 1
DATE: START: 12/12/94
FINISH: 12/13/94

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
							Augered to 44' Roller bit 44' to 68' Coal 61.5' to 67.0' Boring terminated at 68.0'	
-5								
-10								0 hour water level at 810.0'
-15								
-20								

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 31, 1995

GU 11-0 3/4/91

B-43 1/2

ENGINEER'S FIELD BORING LOG

PROJECT NAME: ODOT I-70 Mine Subsid

BORING NO.: B-43

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey

SHEET 1 OF 2

STATION: 480+10 OFFSET: 65' Lt. MUNICIPALITY: Center Twp.

DATE: START: 12/13/94 FINISH: 12/13/94

SURFACE ELEVATION: 825.0 RIG TYPE: ACKER AD-2 CORE SIZE: -

SAMPLER: TYPE Split-Spoon O.D. 2½ (in.) I.D. 1⅜ (in.) Length 24 in.)

DRILLER/REPRESENTING: T. England /CTL SAMPLER HAMMER WT.: 140 (lbs.)

INSPECTOR/REPRESENTING: D. Clark/Gannett Fleming, Inc. SAMPLER HAMMER DROP: 30 (in.)

CHECKED BY: A. Welker/Gannett Fleming, Inc. DATE: 1/95

AUGER: TYPE Solid Stem O.D. 5½ (in.) I.D. 3¼ (in.)

CASING SIZE: - DEPTH: - CORE BARREL: TYPE -

DIRECTION OF HOLE: ✓ VERTICAL - INCLINED - DEGREE(S) FROM VERTICAL

WATER LEVEL DEPTH: 17.4 FEET - TIME: 16:30 DATE: 12/13/94

12.2 FEET - TIME: 12:30 DATE: 12/14/94

DRILLING METHODS: Continuous Flight Augers

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & ROD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
							Brown Silty SAND and GRAVEL, dry (fill)	
3.0								
4.5	S-1	17-5-6	0.3	-	-	-	5.0'	El. 820.0'
6.0							Brown and Gray Silty CLAY, moist	
7.5	S-2	5-5-8	1.0	-	-	-	Same: trace Sand and Gravel, wet	
9.0								
10.5	S-3	6-4-4	1.5	-	-	-	11.0'	El. 814.0'
12.0							Gray Silty CLAY, moist, varved	
13.5	S-4	3-3-3	1.5	-	-	-		
15.0								24 hour water level at El. 812.8'
16.5	S-5	4-3-6	1.2	-	-	-		
18.0								
19.0	S-6	3-3-3	1.2	-	-	-	Same: trace Gravel, wet	
21.0								
22.5	S-7	5-8-11	1.2	-	-	-	Same: trace Organics	
24.0								
	S-8	5-6-7	0.8	-	-	-	Same: some Sand and Gravel	

-5 -10 -15 -20 -25

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 13, 1995

GU 11-03/4/91

B-043 2/2

ENGINEER'S FIELD BORING LO[G]

BORING NO : 3 3

ROUTE/SECTION: GUE-070-14.10 COUNTY: Guernsey

SHEET 2 OF 2

DEPTH (FT.)	SAMPLE/ CORE #	BLOWS/ 0.5 FT.	RECOVERY (FT.)	RECOVERY% & RQD%	POCK PEN/ TORV (TSF)	USCS/ AASHTO	DESCRIPTION	REMARKS
25.5								
27.0								
28.5	S-9	4-4-4	0.8	-	-	-		
30.0								
31.5	S-10	5-7-6	1.5	-	-	-		
33.0								
34.5	S-11	4-4-5	0.0	-	-	-	Wet 35.0'	El. 790.0'
36.0							Gray Silty SAND and GRAVEL, slightly mottled, dense, subangular, damp	
37.5	S-12	35-22-27	0.0	-	-	-	38.0'	El. 787.0'
39.0							Gray Silty CLAY, some Sand and Gravel, wet	
40.5	S-13	17-30-27	-	-	-	-	40.5'	El. 784.5'
							Boring Terminated at 40.5'	

-30 -35 -40 -45 -50 -55 -60

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL OR ROCK TYPES AT THE BORING LOCATION ONLY. January 13, 1995

State of Ohio
Department of Transportation
Division of Highways
Testing Laboratory

LOG OF BORING

B101 ½

Date Started 9/19/94 Sampler: Type SS Dia. 1 3/8" Water Elev. 798.0' Project Identification: GUERNSEY
Date completed 9/20/94
Boring No. B-1 Station & Offset 468+82, 75' LT. Surface Elev. 820.5'

GUE-70-~~6.16~~ 14.10
~~SUBGRADE~~ INVESTIGATION
MINE

Elev.	Depth	Std. (N) Pen.	Rec. ft.	Loss ft.	Description	Sample No.	Physical Characteristics % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	SHTL Class
820.5	0														
819.7	2	AUGERED			BERM MATERIAL	-	-	-	-	-	-	-	-	-	VISUAL
818.0															
	4	3/3/8			BROWN SANDY CLAY	1	0	7	15	44	34	31	11	19	A-6A
815.5	6														
		2/3/4			GRAYISH BROWN SILT AND CLAY	2	0	0	4	61	35	34	12	28	A-6A
813.0	8														
		1/2/3			BROWN CLAYEY SILT	3	0	1	18	50	31	29	10	27	A-4B
810.5	10														
	12	2/6/8			BROWN SILTY CLAY	4	0	2	15	48	35	37	17	25	A-6B
808.0															
	14	6/6/8			BROWN CLAYEY GRAVELLY SAND	5	33	15	18	20	14	29	10	23	A-2-4
805.5															
	16	1/3/6			GRAY AND BROWN SILTY GRAVELLY SAND	6	17	26	25	21	11	25	7	17	A-2-4
803.0	18														
		8/10/11			BROWN SILTY GRAVELLY SAND	7	21	24	26	20	9	NP	NP	12	A-3A
0.5	20														
	22	7/9/16			BROWN SILTY GRAVELLY SAND	8	23	24	22	22	9	NP	NP	13	A-2-4
798.0															
	24	8/5/10			GRAY CLAYEY SILT	9	0	4	13	56	27	27	10	22	A-4B
795.5	26														
		3/7/12			BROWN AND GRAY SILT AND CLAY	10	0	2	10	49	39	33	14	20	A-6A
793.0	28														
		10/16/27			BROWN AND GRAY SILTY CLAY	11	0	1	6	47	46	38	19	21	A-6B
790.5	30														
	32	11/20/23			GRAY SILTY GRAVELLY SAND	12	27	23	22	21	7	NP	NP	15	A-2-4
788.0															
	34	8/14/12			GRAY SANDY CLAY	13	0	10	13	40	37	33	13	26	A-6A
785.5															
	36	4/15/22			GRAY SANDY SILT	14	0	16	22	45	17	NP	NP	28	A-4A

B-101 2/2

Boring No. B-1 Station & Offset 468+82, 75' LT. Surface Elev. 820.5' Project: GUS-70-~~6.16~~

Elev.	Depth	Std. Pen. (N)	Rec. ft.	Loss ft.	Description	Sample No.	% Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	SHTL Class
783.0	38														
		3/5/11			GRAY SILT AND CLAY	15	0	0	4	65	31	32	12	23	A-6A
780.5	40														
	42	3/5/10			GRAY CLAYEY SILT	16	0	0	6	69	25	30	9	26	A-4B
778.0															
	44	3/5/10			GRAY SANDY SILT	17	0	7	17	57	19	27	6	25	A-4B
775.5															
	46	21/60			GRAY SILTY SAND	18	0	30	31	31	8	NP	NP	12	A-4A
773.0	48	75(0.3)			GRAY SANDY SILT TOP OF ROCK	19	0	29	21	38	12	NP	NP	15	A-4A
770.5	50	50(0.1)			GRAY SHALE	20	-	-	-	-	-	-	-	1	VISUAL
770.4	52		4.9	0.0	SHALE, GRAY, BLACK, HARD, ARENACEOUS, MICACEOUS, CARBONACEOUS IN PART WITH THIN CLAY SEAMS, BROKEN AND JOINTED. NO CORE LOSS.										
	54														
764.8	56		5.0	0.0	COAL, BLACK, VITREOUS, BITUMINOUS, HIGHLY BROKEN AND JOINTED.										
	58														
	60														
759.4	62		5.0	0.0	SLIGHTLY WEATHERED CLAY SHALE INTERBEDDED WITH SLIGHTLY WEATHERED MUDSTONE BOTH BEING GREENISH GRAY WITH BLACK FIRM TO HARD, HIGHLY ARENACEOUS, AND HARD AT THE BOTTOM WITH SCATTERED CLAY SEAMS SLICKENSIDED, BROKEN AND JOINTED IN PART. NO CORE LOSS.										
	64														
	66														
753.8	68		5.0	0.0	SANDSTONE, GRAY, FIRM, MICACEOUS, FINE TO MEDIUM-GRAINED WITH SCATTERED THIN CLAY SEAMS, THIN TO MEDIUM-BEDDED, BROKEN AND JOINTED IN PART. NO CORE LOSS.										
750.5	70														
	72				BOTTOM OF BORING										
	74														
	76														
	78														
	80														

B-102 1/2

State of Ohio
Department of Transportation
Division of Highways
Testing Laboratory

LOG OF BORING

Date Started 9/22/94 Sampler: Type SS Dia. 1 3/8" Water Elev. 772.4' Project Identification: GUERNSEY
Date completed 9/22/94 GUE-70-~~6.16~~ 14.10
Boring No. B-2 Station & Offset 483+45, 88' RT. Surface Elev. 822.4' ~~SUBSURFACE~~ MINE INVESTIGATION

Elev.	Depth	Std. (N) Pen.	Rec. ft	Loss ft	Description	Sample No.	% Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	SHTL Class
822.4	0														
821.6	2	AUGERED			BERM MATERIAL (DRILLER'S DESCRIPTION)										VISUAL
819.9															
	4	3/4/5			BROWN SILT AND CLAY	21	0	6	6	48	40	34	13	22	A-6A
817.4	6														
		4/6/8			BROWN CLAY	22	0	1	5	50	44	45	22	21	A-7-6
814.9	8														
		4/5/6			GRAY SILT AND CLAY	23	0	0	2	52	46	34	15	21	A-6A
812.4	10														
	12	4/4/6			BROWN AND GRAY SILT AND CLAY	24	0	1	2	52	45	36	15	24	A-6A
809.9															
	14	5/5/9			BROWN AND GRAY SILT AND CLAY	25	0	1	4	56	39	34	14	24	A-6A
807.4	16														
		4/4/7			GRAY CLAYEY SILT	26	0	1	5	68	26	28	10	26	A-4B
804.9	18														
		7/7/11			BROWN SANDY SILT	27	0	19	28	32	21	31	9	20	A-4A
2.4	20														
	22	4/6/12			GRAY GRAVELLY CLAY	28	19	2	10	37	32	34	15	24	A-6A
799.9															
	24	6/6/12			GRAY SILT	29	0	6	12	56	26	NP	NP	21	A-4B
797.4	26														
		5/5/10			GRAY SILT	30	0	0	2	68	30	NP	NP	25	A-4B
794.9	28														
		4/5/7			GRAY SILT AND CLAY	31	0	0	1	55	44	34	11	30	A-6A
792.4	30														
	32	21/37/46			GRAY SILTY SANDY GRAVEL	32	36	16	17	25	6	NP	NP	11	A-2-4
789.9		60(0.5)			GRAY SILTY GRAVELLY SAND	33	38	22	18	19	3	NP	NP	8	A-1-B
	34														
787.4															
	36	28/36/40			GRAY SANDY SILT	34	0	11	15	59	15	NP	NP	25	A-4B

Boring No. B-2 Station & Offset 483+45, 88' RT. Surface Elev. 822.5' B-102 Project: GUE-70-~~6.16~~ 2/2

Elev.	Depth	Std. (N) Pen.	Rec. ft.	Loss ft.	Description	Sample No.	% Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	SHTL Class
784.9	38	54(0.5)			GRAY SANDY SILT	35	0	14	19	52	15	NP	NP	13	A-4B
782.4	40	60(0.1)			DARK GRAY ARENACEOUS, HARD SHALE TOP OF ROCK	36	-	-	-	-	-	-	-	2	VISUAI
782.3	42		4.9	0.0	SHALE, BLACK, GRAY, FIRM TO HARD CARBONACEOUS, ARENACEOUS WITH THIN CLAY SEAMS WITH SLICKENSIDES, JOINTED IN PART, INTERBEDDED WITH NUMEROUS THIN SEAMS, AND INTERVALS RANGING UP TO 0.5' THICK OF GRAY FIRM MICACEOUS, FINE GRAINED SANDSTONE. NO CORE LOSS.										
	44														
	46		5.0	0.0											
	48														
	50														
	52		5.0	0.0											
	54														
	56		4.5	0.0											
	58														
762.9	60				BOTTOM OF BORING										
	62														
	64														
	66														
	68														
	70														
	72														
	74														
	76														
	78														
	80														

NOTE: MINE SHAFT ENCOUNTERED AT APPROX. ELEV. 762.9'

B-104 ½

State of Ohio
Department of Transportation
Office of Materials Management

ENGLISH PROJECT

LOG OF BORING

Date Started 5/29/96 Sampler: Type SS Dia. 1⅜" Water Elev. - Project Identification: GUERNSEY
Date completed 5/29/96
Boring No. B-3[illegible] Station & Offset 478+37, 23' RT. Surface Elev. 825.6'

GUE-70-14.10
MINE SUBSIDENCE
SUBSURFACE INVESTIGATION

Elev.	Depth	Std. Pen. (N)	Rec. ft	Loss ft	Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
825.6	0														
	2														
	4														
	6														
	8														
	10														
	12														
	14														
	16														
	18														
	20				VOID										
	22														
	24														
	26														
	28														
	30														
	32														
	34														
	36														

Particle Sizes: Agg= >2.00mm, Coarse Sand= 2.00-0.42mm, Fine Sand= 0.42-0.074mm, Silt= 0.074-0.005mm, Clay= <0.005mm

Form TE-15 Revised 9/95

B-104 2/2

Boring No. B-3 Station & Offset 478+37, 23' RT. Surface Elev. 825.6' Project GUE-70-14.10

Elev.	Depth	Std. Pen. (N)	Rec. ft	Loss ft	Description	Sample No.	% Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
	38				VOID										
	40				TOP OF ROCK										
783.6	42														
781.6	44	45/60			GRAY CLAY-SHALE (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
780.6					GRAY & BROWN ARENACEOUS, JOINTED CLAY-SHALE	18	-	-	-	-	-	-	-	7	VISUAL
780.4	46				*										
779.2					**										
	48		5.0	0.0	SANDSTONE, GRAY, FIRM, WITH MICACEOUS LAMINAE, FINE-GRAINED, THIN-BEDDED, W/SCATTERED THIN CLAY SEAMS, JOINTED NEAR THE TOP; W/BLACK, FIRM, CARBONACEOUS, JOINTED IN PART SHALE LAMINAE AND INTERVALS RANGING UP TO 0.5' THICK THAT OCCURS MORE FREQUENTLY IN THE BOTTOM HALF. NO CORE LOSS.										
	50														
773.8	52		5.0	0.0											
	54				SHALE, BLACK, FIRM, CARBONACEOUS, ARENACEOUS, JOINTED IN PLACES; W/SCATTERED LAMINAE AND THIN TO THICK SEAMS OF GRAY, FIRM, MICACEOUS, FINE-GRAINED SANDSTONE THAT OCCURS MORE FREQUENTLY IN THE TOP HALF. NO CORE LOSS.										
	56														
	58		5.0	0.0											
	60														
	62														
761.8	64		5.0	0.0											
760.6					COAL, BLACK, BITUMINOUS, VITREOUS BROKEN AND JOINTED TO HIGHLY BROKEN & JOINTED. NO CORE LOSS.										

BOTTOM OF BORING

* GROUT, BLACK, BROKEN AND JOINTED, W/STONE FRAGMENTS. NO CORE LOSS.

** SHALE, DARK GRAY, FIRM, CARBONACEOUS, HIGHLY ARENACEOUS, W/NUMEROUS CLAY SEAMS, BROKEN AND JOINTED; W/THIN TO THICK SEAMS OF GRAY, FIRM, FINE-GRAINED SANDSTONE, AND WITH A FERRUGINOUS NODULE. NO CORE LOSS.

Particle Sizes: Agg= >2.00mm, Coarse Sand= 2.00-0.42mm, Fine Sand= 0.42-0.074mm, Silt= 0.074-0.005mm, Clay= <0.005mm

Form TE-15 Revised 9/95

State of Ohio
Department of Transportation
Office of Materials Management

ENGLISH PROJECT

B-105 1/2

LOG OF BORING

Date Started 6/3/96 Sampler: Type SS Dia. 1 3/8" Water Elev. -
Date completed 6/3/96
Boring No. B-4 Station & Offset 479+32, 60' RT. Surface Elev. 826.0'

Project Identification: GUERNSEY
GUE-70-14.10
MINE SUBSIDENCE
SUBSURFACE INVESTIGATION

Elev.	Depth	Std. Pen. (N)	Rec. ft	Loss ft	Description	Sample No.	% Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
826.0	0	AUGERED			ASPHALT	-	-	-	-	-	-	-	-	-	VISUAL
825.2	2	AUGERED			GRAVEL (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
	4	AUGERED			BROWN SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
821.0	6														
	8	AUGERED			GRAY SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
816.0	10														
	12	AUGERED			GRAY SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
	14														
811.0	16														
	18	AUGERED			GRAY SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
806.0	20														
	22	AUGERED			GRAY SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
	24														
801.0	26														
	28	AUGERED			GRAY SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
796.0	30														
	32	AUGERED			BROWN SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
	34														
791.0	36														

Particle Sizes: Agg= >2.00mm, Coarse Sand= 2.00-0.42mm Fine Sand= 0.42-0.074mm, Silt= 0.074-0.005mm, Clay= <0.005mm

Form TE-15L Revised 9/95

B-105 2/2

Boring No. B-4 Station & Offset 479+32, 60' RT. Surface Elev. 826.0' Project GUE-70-14.10

Elev.	Depth	Std. Pen. (N)	Rec. ft	Loss ft	Description	Sample No.	% Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
	38	AUGERED			BROWN SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
786.0	40				TOP OF ROCK										
	42														
	44	AUGERED			BROKEN AND JOINTED SHALE W/CLAY SEAMS (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
781.0 780.3	46				*										
777.7	48		5.0	0.0	SHALE, DARK GRAY, FIRM, CARBONACEOUS, HIGHLY ARENACEOUS, MICACEOUS, W/NUMREOUS CLAY SEAMS, WEATHERED IN THE MIDDLE, JOINTED; W/SCATTERED BROWNISH-GRAY FIRM, FINE-GRAINED SANDSTONE LAMINAE AND SEAMS. NO CORE LOSS.										
	50				SANDSTONE, GRAY, FIRM, MICACEOUS, FINE-GRAINED, W/HIGHLY MICACEOUS LAMINAE, W/CARBONACEOUS LAMINAE IN THE BOTTOM HALF, THIN-BEDDED W/SCATTERED THIN CLAY SEAMS, JOINTED IN PLACES. NO CORE LOSS.										
774.5	52		5.0	0.0											
	54														
	56														
	58		5.0	0.0	SHALE, BLACK, FIRM, CARBONACEOUS, ARENACEOUS TO HIGHLY ARENACEOUS AT THE TOP W/SCATTERED THIN CLAY SEAMS, BROKEN AND JOINTED NEAR THE TOP; W/NUMREOUS SCATTERED THIN TO THICK GRAY FIRM, MICACEOUS, FINE-GRAINED SANDSTONE SEAMS. NO CORE LOSS.										
	60														
	62		5.0	0.0											
761.5	64														
	66														
	68		5.0	0.0	COAL, BLACK, BITUMINOUS, VITREOUS, BROKEN AND JOINTED. NO CORE LOSS.										
756.0	70														

BOTTOM OF BORING

* SHALE, OLIVE, FIRM, ARENACEOUS, W/CLAY SEAMS, BROKEN AND JOINTED. NO CORE LOSS.

Particle Sizes: Agg= >2.00mm, Coarse Sand= 2.00-0.42mm, Fine Sand= 0.42-0.074mm, Silt= 0.074-0.005mm, Clay= <0.005mm

Form TE-15 Revised 9/95

State of Ohio
Department of Transportation
Office of Materials Management

ENGLISH PROJECT

B-106 ½

LOG OF BORING

Date Started 6/4/96 Sampler; Type SS Dia. 1⅜" Water Elev. -
Date completed 6/4/96
Boring No. B-5 Station & Offset 479+42, 60' RT. Surface Elev. 826.0'

Project Identification: GUERNSEY
GUE-70-14.10
MINE SUBSIDENCE
SUBSURFACE INVESTIGATION

Elev.	Depth	Std. Pen. (N)	Rec. ft	Loss ft	Description	Sample No.	% Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
826.0	0														
825.2		AUGERED			ASPHALT	-	-	-	-	-	-	-	-	-	VISUAL
824.0	2	AUGERED			GRAVEL (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
	4	AUGERED			BROWN SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
821.0	6														
	8	AUGERED			GRAY SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
816.0	10														
	12														
	14	AUGERED			GRAY SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
811.0	16														
	18	AUGERED			GRAY SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
806.0	20														
	22														
	24	AUGERED			GRAY SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
801.0	26														
	28	AUGERED			GRAY SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
796.0	30														
	32														
	34	AUGERED			BROWN SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
791.0	36														

Particle Sizes: Agg= >2.00mm, Coarse Sand= 2.00-0.42mm, Fine Sand= 0.42-0.074mm, Silt= 0.074-0.005mm, Clay= <0.005mm

Form TE-15L Revised 9/95

B-106 4/2

Boring No. B-5 Station & Offset 479+42, 60' RT. Surface Elev. 826.0' Project GUE-70-14.10

Elev.	Depth	Std. Pen. (N)	Rec. ft	Loss ft	Description	Sample No.	% Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
786.0	38, 40	AUGERED			BROWN SANDY CLAY (DRILLER'S DESCRIPTION) TOP OF ROCK	-	-	-	-	-	-	-	-	-	VISUAL
783.5	42	AUGERED			BROWN SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
781.0	44				BROKEN AND JOINTED SHALE W/CLAY SEAMS (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
780.8 780.5 777.8	46, 48		5.0	0.0	* SHALE, DARK GRAY, OLIVE, FIRM, CARBONACEOUS IN PART, ARENACEOUS, W/NUMEROUS CLAY SEAMS, BROKEN & JOINTED; W/LAMINAE AND THIN TO MEDIUM SEAMS IN THE BOTTOM HALF & A THICK SEAM IN THE MIDDLE OF GRAY, FIRM, MICACEOUS, FINE-GRAINED SANDSTONE & W/A CONCRETION NEAR THE BOTTOM. NO CORE LOSS.										
773.7	50, 52		5.0	0.0	SANDSTONE, GRAY, FIRM, MICACEOUS, FINE-GRAINED, THIN-BEDDED, W/NUMEROUS CARBONACEOUS LAMINAE IN THE BOTTOM HALF, W/SCATTERED THIN CLAY SEAMS; W/A THICK BLACK, FIRM, CARBONACEOUS SHALE SEAM IN THE MIDDLE. NO CORE LOSS.										
761.5	54, 56, 58, 60, 62, 64		5.0 5.0 5.0	0.0 0.0 0.0	SHALE, BLACK, FIRM, CARBONACEOUS, ARENACEOUS TO HIGHLY ARENACEOUS IN THE UPPER PORTION, WITH SCATTERED THICK BROKEN AND JOINTED SEAMS: WITH SCATTERED LAMINAE AND THIN TO THICK SEAMS OF GRAY, FIRM, MICACEOUS, FINE-GRAINED SANDSTONE. NO CORE LOSS.										
759.0	66				GROUT, BLACK, FIRM, WHOLE. NO CORE LOSS.										
755.6	68, 70		5.0	0.0	GROUT, BROWN, BLACK, DARK GRAY, FIRM, BROKEN AND JOINTED TO HIGHLY BROKEN AND JOINTED TO HIGHLY BROKEN AND JOINTED. NO CORE LOSS.										
754.0	72		2.0	0.0	SHALE, SLIGHTLY TO MEDIUM-WEATHERED, BLACK, FIRM, CARBONACEOUS, W/NUMEROUS THIN CLAY SEAMS, JOINTED IN PART. NO CORE LOSS. BOTTOM OF BORING										

* 45.0'-45.2' SILTSTONE, DARK GREEN, FIRM TO HARD, MICACEOUS, JOINTED. NO CORE LOSS.
45.2'-45.5' SANDSTONE, BROWNISH-GRAY, FIRM, MICACEOUS, FINE-GRAINED, JOINTED. NO CORE LOSS.

Particle Sizes: Agg= >2.00mm, Coarse Sand= 2.00-0.42mm Fine Sand= 0.42-0.074mm, Silt= 0.074-0.005mm, Clay= <0.005mm

B-107 1/2

B-107-4

State of Ohio
Department of Transportation
Office of Materials Management

... PROJECT

LOG OF BORING

Date Started 6/5/96 Sampler: Type SS Dia. 1 3/8" Water Elev. SEE NEXT PAGE Project Identification: GUERNSEY
Date completed 6/5/96 GUE-70-14.10
Boring No. B-7 Station & Offset 482+08, 47' RT. Surface Elev. 826.4' MINE SUBSIDENCE SUBSURFACE INVESTIGATION

Elev.	Depth	Std. Pen. (N)	Rec. ft	Loss ft	Description	Sample No.	% Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
826.4	0														
825.2		AUGERED			.4 ASPHALT & .8 CONTRETE	-	-	-	-	-	-	-	-	-	VISUAL
	2														
		AUGERED			BROKEN AND JOINTED GROUT (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
822.4	4														
821.4			1.0	0.0	GROUT, GRAY, FIRM, BROKEN AND JOINTED. NO CORE LOSS.										
	6														
	8		5.0	0.0	GROUT, DARK GRAY, BLACK, FIRM, WHOLE IN PART, JOINTED IN PART W/CLAY FILLING IN THE JOINTS. NO CORE LOSS.										
	10														
	12		4.4	0.6											
813.6					*										
813.3	14				GROUT, OLIVE-GRAY, MEDIUM-FIRM, JOINTED IN THE UPPER PORTION. NO CORE LOSS.										
812.3					BROWN CLAYEY SANDY SILT W/STONE FRAGMENTS. CORE LOSS 55% * *										
811.4	16														
	18		1.7	3.3	LIGHT BROWN SILT W/STONE FRAGMENTS AND COBBLES. CORE LOSS 66% * *										
806.4	20														
	22		1.5	3.5	BROWN CLAYEY SAND & STONE FRAGMENTS W/COBBLES. CORE LOSS 70% * *										
801.4	24														
	26														
	28		0.0	5.0											
	30														
	32		0.0	5.0	NO RECOVERY. CORE LOSS 100 % * *										
	34														
	36														

Particle Sizes: Agg= >2.00mm, Coarse Sand= 2.00-0.42mm Fine Sand= 0.42-0.074mm, Silt= 0.074-0.005mm, Clay= <0.005mm

Form TE-151 Revised 9/95

B-107 2/2

Boring No. B-7 Station & Offset 482+08, 47' RT. Surface Elev. 826.4' Project GUE-70-14.10

Elev.	Depth	Std. Pen. (N)	Rec. ft	Loss ft	Description	Sample No.	% Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
	38		0.0	5.0											
786.4	40														

BOTTOM OF BORING

* GROUT, OLIVE, SOFT, ARGILLACEOUS, CRUMBLY, BROKEN AND JOINTED. NO CORE LOSS.

* * NOTE: HIGH CORE LOSS DUE TO THE MATERIAL BEING SOIL

NOTE: WATER UNDERPRESSURE WAS OBSERVED FROM TEST BORING AT APPROX. ELEV. 801.4'

Particle Sizes: Agg= >2.00mm, Coarse Sand= 2.00-0.42mm, Fine Sand= 0.42-0.074mm, Silt= 0.074-0.005mm, Clay= <0.005mm

Form TE-151 Revised 9/95

3/3 1.01.41

B-108 1/3

PROJECT: I-70 Mine Subsidence	PROJECT LOCATION: Cambridge, Ohio	
DRILLER: T. England	CTL-WV PROJECT NO.: 94050033W	DATE OF HOLE
HOLE NO.: TB-1	TOP OF HOLE ELEV: N/A	START: 04/25/94 COMPLETE: 04/25/94
SOIL DEPTH: 43.0'	ROCK DEPTH: 4.0' TOTAL DEPTH: 47.0'	TOTAL NO. SOIL SAMPLES SPLIT SPOONS: 0 SHELBY TUBES: 0

REMARKS:

478400, 25'22 ? S.E. 825'±

SAMPLE/RUN NO.	BLOW COUNT 6 IN	BLOW COUNT 12 IN	DEPTH	% CORE RECOV.	% CORE RQD	0 10 20 30 40 50	825'± MATERIAL DESCRIPTION
			1				
			2				Brown, Silty SAND
			3				
			4				4.0'
			5				
			6				Brown, Clayey SILT with Trace Sand
			7				7.5'
			8				
			9				
			10				
			11				
			12				
			13				
			14				Brown to Gray, Sandy SILT with Trace Clay
			15				
			16				
			17				
			18				
			19				
			20				

CTL ENGINEERING

B-108 2/3

PROJECT: I-70 Mine Subsidence	PROJECT LOCATION: Cambridge, Ohio		
DRILLER: T. England	CTL-WV PROJECT NO.: 94060033W	DATE OF HOLE	
HOLE NO.: TB-1	TOP OF HOLE ELEV: N/A	START: 04/25/94	COMPLETE: 04/25/94
SOIL DEPTH: 43.0	ROCK DEPTH: 4.0'	TOTAL DEPTH: 47.0'	TOTAL NO. SOIL SAMPLES: SPLIT SPOONS: 0 / SHELBY TUBES: 0
REMARKS:			

SAMPLE/ RUN NO.	BLOW COUNT 6 IN	BLOW COUNT 12 IN	DEPTH	% CORE RECOV	RQD 0 10 20 30 40 50	MATERIAL DESCRIPTION
			21			
			22			
			23			
			24			
			25			
			26			
			27			
			28			
			29			Brown to Grey, Sandy SILT with Trace Clay
			30			
			31			
			32			
			33			
			34			
			35			
			36			
			37			37.5'
			38			
			39			Grey, Silty SAND
			40			

CTL ENGINEERING

B 108 3/3

PROJECT: I-70 Mine Subsidence	PROJECT LOCATION: Cambridge, OH		
DRILLER: T. England	CTL-WV PROJECT NO.: 94050033W	DATE OF HOLE	
HOLE NO.: TB-1	TOP OF HOLE ELEV: N/A	START: 04/25/94	COMPLETE: 04/25/94
SOIL DEPTH: 43.0'	ROCK DEPTH: 4.0'	TOTAL DEPTH: 47.0'	TOTAL NO. SOIL SAMPLES: SPLIT SPOONS: 0 / SHELBY TUBES: 0
REMARKS:			

SAMPLE/ RUN NO.	BLOW COUNT 6 IN	BLOW COUNT 12 IN	DEPTH	% CORE RECOV	RQD 0 10 20 30 40 50	MATERIAL DESCRIPTION
			41			
			42			Gray, Silty SAND
			43			43.0'
			44			
			45			Dry, Gray SHALE
			46			
			47			47.0'
			48			Bottom of Boring
			49			
			50			
			51			
			52			
			53			
			54			
			55			
			56			
			57			
			58			
			59			
			60			

CTL ENGINEERING

B-109 1/2

ENGLISH PROJECT

State of Ohio
Department of Transportation
Office of Materials Management

LOG OF BORING

Date Started 6/27/96 Sampler: Type SS Dia. 1 3/8" Water Elev. -
Date completed 6/27/96
Boring No. B-10 Station & Offset 484+62, 49' LT. Surface Elev. 827.7'

Project Identification: GUERNSEY
GUE-70-14.10
MINE SUBSIDENCE
SUBSURFACE INVESTIGATION

Elev.	Depth	Std. Pen. (N)	Rec. ft	Loss ft	Description	Sample No.	% Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
827.7	0														
826.7	2	AUGERED			.6' ASPHALT & .4' CONCRETE	-	-	-	-	-	-	-	-	-	VISUAL
822.7	4	AUGERED			BROWN SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
817.7	6, 8, 10	AUGERED			BROWN SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
812.7	12, 14, 16	AUGERED			BROWN SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
807.7	18, 20	AUGERED			BROWN SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
802.7	22, 24, 26	AUGERED			DARK BROWN SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
797.7	28, 30	AUGERED			DARK BROWN CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
792.7	32, 34	AUGERED			DARK BROWN CLAY (DRILLER'S DESCRIPTION) TOP OF ROCK	-	-	-	-	-	-	-	-	-	VISUAL

Particle Sizes: Agg= >2.00mm, Coarse Sand= 2.00-0.42mm, Fine Sand= 0.42-0.074mm, Silt= 0.074-0.005mm, Clay= <0.005mm

Form TE-15 Revised 9/95

B-109 2/2

Boring No. B-10 Station & Offset 484+62, 49' LT. Surface Elev. 827.7' Project GUE-70-14.10

Elev.	Depth	Std. Pen. (N)	Rec. ft	Loss ft	Description	Sample No.	% Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
792.7	36				CLAY-SHALE (DRILLER'S DESCRIPTION) TOP OF ROCK										
789.7	38, 40, 42				BROKEN AND JOINTED SHALE W/CLAY SEAMS (DRILLER'S DESCRIPTION)										
785.2	44				SHALE (DRILLER'S DESCRIPTION)										
782.7	46, 48, 50				ARENACEOUS SHALE W/CLAY SEAMS (DRILLER'S DESCRIPTION)										
777.7	52, 54				GRAY ARENACEOUS SHALE (DRILLER'S DESCRIPTION)										
772.7	56, 58, 60				GRAY SHALE (DRILLER'S DESCRIPTION)										
768.7	62, 64, 66		5.0	0.0	SHALE, BLACK, FIRM, CARBONACEOUS, ARENACEOUS, WITH THIN CLAY SEAMS, WITH SLICKENSIDEDS AT THE BOTTOM, BROKEN AND JOINTED IN THE MIDDLE. NO CORE LOSS.										
761.5	68, 70		5.0	0.0	COAL, BLACK, BITUMINOUS, VITREOUS, BROKEN AND JOINTED. NO CORE LOSS.										
757.7					BOTTOM OF BORING										

Particle Sizes: Agg= >2.00mm, Coarse Sand= 2.00-0.42mm Fine Sand= 0.42-0.074mm, Silt= 0.074-0.005mm, Clay= <0.005mm

Form TE-15 Revised 9/95

B-110

State of Ohio
Department of Transportation
Office of Materials Management

ENGLISH PROJECT

1/1

LOG OF BORING

Date Started 6/11/96 Sampler: Type SS Dia. 1 3/8" Water Elev. -
Date completed 6/11/96
Boring No. B-11 Station & Offset 485+57, 53' LT. Surface Elev. 828.1'

Project Identification: GUERNSEY
GUE-70-14.10
MINE SUBSIDENCE
SUBSURFACE INVESTIGATION

Elev.	Depth	Std. Pen. (N)	Rec. ft	Loss ft	Description	Sample No.	% Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
828.1	0	AUGERED			ASPHALT	-	-	-	-	-	-	-	-	-	VISUAL
827.8	2		4.7	0.0	GROUT, GRAY, WITH A THICK BLACK SEAMS, FRIABLE AT THE TOP, BROKEN AND JOINTED. NO CORE LOSS.										
825.2	4				GROUT, GRAY, WHOLE. NO CORE LOSS.										
823.1	6				GROUT, GRAY, LIGHT WEIGHT, HIGHLY BROKEN AND JOINTED. NO CORE LOSS.										
	8		5.0	0.0	GROUT, GRAY TO BLACK, JOINTED IN PLACES. NO CORE LOSS.										
	10														
816.6	12		1.5	3.5											
	14														
	16	* Rec. 2.0'			* Loss 16.0'										
	18		*	*											
	20				CLAY, BROWN, MIXED WITH GROUT, SILT, AND STONE FRAGMENTS, BROKEN AND JOINTED TO HIGHLY BROKEN AND JOINTED. CORE LOSS 91% HIGH CORE LOSS DUE TO THE NATURE OF THE MATERIAL.										
	22		*	*											
	24														
	26														
	28		*	*											
	30														
	32		*	*	TOP OF ROCK										
795.2					**										
795.1					BOTTOM OF BORING										

** MUDSTONE, LIGHT, OLIVE, MEDIUM FIRM, SLICKENSIDED. NO CORE LOSS.

Particle Sizes: Agg= >2.00mm, Coarse Sand= 2.00-0.42mm Fine Sand= 0.42-0.074mm, Silt= 0.074-0.005mm, Clay= <0.005mm

Form TE-151 Revised 9/95

FORM NO:
(12/89)

ENGINEERS FIELD BORING LOG B-111 1/4

BORING NO. CC-41
SHEET 1 OF 4
DATE: START 6-7-95
O.C. END 6-7-95
ELEV. ______

PROJECT NAME ODOT, I-70 COUNTY Guernsey
STATE RT. NO. ______ SECT. ______ SEGMENT ______ OFFSET ______
STATION 483 + 40 OFFSET FROM CENTERLINE 48 RT
INSPECTOR (SIGNED) M. L. Jones DRILLERS NAME/COMPANY Ed Hill / CTL
EQUIPMENT USED ______
DRILLING METHODS 2" Split Spoon, NX Wireline Core
CASING: SIZE: 4 in ; DEPTH: 37.3' ; WATER: DEPTH: ______ TIME: ______ DATE: ______
CHECKED BY: ______ ; DATE ______ DEPTH: ______ TIME: ______ DATE: ______
NOT ENCOUNTERED ☐

DEPTH (FT.)	SAMPLE NO. AND TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Inches or Ft.)	RECOVERY (%) / RQD (%)	POCKET PENT or TORVANE (TSF)	USCS / AASHTO	H_2O CONTENT	DESCRIPTION	REMARKS
1.5	S-1	3 2 3	1.5/1.5	100%	—	ml	DRY	Sandy SILT, (ml), orange-brown, mottled light gray, soft, dry, minor m to c - sandstone gravel FILL, traces of coal med. gravel size.	
3.0									
4.5	S-2	4 4 6	0.2/1.5	13%		ml	DRY	5.0'	• 3.0'-4.5' low recovery due to c-gravel blocking spoon sampler
6.0								Silty CLAY with gravel, (cl), orange-brown to light gray, stiff to soft, dry to moist. • med to coarse gravel consists of sandstone.	NOTE: Hole was redrilled out by Chris Martin (CTL) on 6-9-95 and grouted with ~200 gals of "Baroid Quik-Grout"
7.5	S-3	6 7 4	1.3/1.5	87%		cl	DRY		
9.0									
10.5	S-4	1 1 2	0.6/1.5	40%		cl	MOIST		
12.0								12.1'	
13.5	S-5	2 2 3	1.2/1.5	80%		ml	WET	Clayey SILT, (ml) med. gray, soft, wet.	
15.0								14.5	
16.5	S-6	2 3 5	0.8/1.5	53%		ml	MOIST	CLAY (cl), med. gray to brownish-gray, med. stiff to stiff, moist to wet.	
18.0									
19.5	S-7	2 2 3	0.2/1.5	13%		cl	WET		• 18.0'-19.5' low recovery due to c-gravel blocking spoon sampler

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES FOR THIS TEST PIT LOCATION AND SHOW ELEVATIONS

B-111 2/4

FORM NO: (12/89)

ENGINEERS FIELD BORING LOG

BORING NO. CC-41
SHEET 2 OF 4
DATE: START 6-7-95
O.G. END 6-7-95
ELEV.

PROJECT NAME ODOT, I-70 COUNTY Guernsey
STATE RT. NO. SECT. SEGMENT OFFSET
STATION 483+40 OFFSET FROM CENTERLINE 48 RT
INSPECTOR (SIGNED) M. L. Jones DRILLERS NAME/COMPANY Ed Hill / CTL
EQUIPMENT USED
DRILLING METHODS
CASING: SIZE: 4 in ; DEPTH: 37.3' ; WATER: DEPTH: TIME: DATE:
CHECKED BY: ; DATE DEPTH: TIME: DATE:
NOT ENCOUNTERED ☐

DEPTH (FT.)	SAMPLE NO. AND TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Inches or Ft.)	RECOVERY (%) / RQD (%)	POCKET PENT or TORVANE (TSF)	USCS / AASHTO	H_2O CONTENT	DESCRIPTION	REMARKS
20									
21.0–22.5	S-8	4 4 8	0.6/1.5	40%		cl	moist		
24.0–25.5	S-9	5 5 6	1.5/1.5	100%		sp	wet	24.0' Silty SAND with Gravel, (SP) orangish-brown, med. Dense, wet.	
26.0								26.0 Flyash-Cement GROUT, Dark Brown, med. Hard.	Began drilling through flyash grout (brown) at 26.0'
27.0–28.5	S-10	8 9 5	1.4/1.5	93%		–	wet		
30.0–31.5	S-11	2 2 3	1.5/1.5	100%		cl	moist	30.0' Silty CLAY (cl), dark brownish-gray, med. stiff, moist	Grout at top of sample S-11 30.0 FT
33.0–34.5	S-12	27 41 40	1.5/1.5	100%		sp	moist	33.2' Poorly sorted SAND (sp), gray-brown mottled orange-brown, Very Dense, moist.	
36.0–37.3	S-13	25 33 50/0.3	1.0/1.5	67%		sp	moist	TOP OF ROCK 37.3'	
37.3–39.0									Interval 37.3-39.0 not cored. Driller reamed casing to 40.0'.
39.0–40.0	R-1		0.5/1.0	50% / 0%					

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY

FORM NO1 (12/89)

ENGINEERS FIELD BORING LOG B 111 3/4

BORING NO. CC-41
SHEET 3 OF 4
DATE: START 6-7-95
O.G. ELEV. END 6-7-95

PROJECT NAME ODOT; I-70 COUNTY Guernsey
STATE RT. NO. SECT. SEGMENT OFFSET
STATION 483+40 OFFSET FROM CENTERLINE 48 RT
INSPECTOR (SIGNED) M. L. Jones DRILLERS NAME/COMPANY ED HILL / CTL
EQUIPMENT USED
DRILLING METHODS
CASING: SIZE: 4in. ; DEPTH: 37.3' ; WATER: DEPTH: TIME: DATE:
CHECKED BY: ; DATE DEPTH: TIME: DATE:
NOT ENCOUNTERED ☐

DEPTH (FT.)	SAMPLE NO. AND TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Inches or Ft.)	RECOVERY (%) / RQD (%)	POCKET PENT or TORVANE (TSF)	USCS / AASHTO	H_2O CONTENT	DESCRIPTION	REMARKS
40 – 45.0	R-2		0.9/5.0	18% / 0%				Flyash – Cement Grout as matrix material surrounding a highly weathered, very broken gray sandstone. RQD = 0% 45.0'	• Driller stated coring was steady though broken material was being washed away.
45.0 – 50.0	R-3		1.2/5.0	24% / 0%				Sandy SHALE, greenish-gray medium Hard, Very Broken RQD = 0% 48.5'	
								VOID 50.0'	
50.0 – 54.0	R-4		1.2/4.0	30% / 0%				SANDSTONE, light gray & dark gray laminated, moderately Hard to Hard, very slightly weathered. RQD = 31%	RQD 5.7'/18.5'
0.4/1.0 54.0 – 55.0	R-5		1.0/1.0	100% / 40%					
2.3/5.0 55.0 – 60.0	R-6		4.4/5.0	88% / 46%					

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES FOR THIS TEST PIT LOCATION AND SHOW ELEVATIONS

FORM NO: (12/89)

ENGINEERS FIELD BORING LOG B 11 4/4

BORING NO. CC-41
SHEET 4 OF 4
DATE: START 6-7-95
END 6-7-95
O.G. ELEV.

PROJECT NAME ODOT, I-70 COUNTY Guernsey
STATE RT. NO. ______ SECT. ______ SEGMENT ______ OFFSET ______
STATION 483+40 OFFSET FROM CENTERLINE 48 FT
INSPECTOR (SIGNED) M. L. Jones DRILLERS NAME/COMPANY ED HILL / CTL
EQUIPMENT USED ______
DRILLING METHODS ______
CASING: SIZE: 4 in ; DEPTH: 37.3' ; WATER: DEPTH: ______ TIME: ______ DATE: ______
CHECKED BY: ______ ; DATE ______ DEPTH: ______ TIME: ______ DATE: ______
NOT ENCOUNTERED ☐

DEPTH (FT.)	SAMPLE NO. AND TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Inches or Ft.)	RECOVERY (%) / RQD (%)	POCKET PENT or TORVANE (TSF)	USCS / AASHTO	H_2O CONTENT	DESCRIPTION	REMARKS
60									
	R-7		4.8/5.0	96%/48%					
65									
	R-8		2.6/5.0	52%/0%				68.5'	66.2-66.3 Grout Seam (Bag Cement Grout)
	VOID							VOID 70.0'	68.5' Lost water Return.
70								Sandy SHALE, Trace coal, Very Broken RQD = 0% 70.7'	70.0' Regained water Return
								UNDER CLAY, light gray, very stiff RQD = 0% 71.9'	
	R-9		4.7/5.0	94%/62%				SANDSTONE, light gray, fine grained, Hard, very slightly weathered. RQD = 100% 75.0'	
75								BOTTOM OF BORING = 75.0'	

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES FOR THIS TEST PIT LOCATION AND SHOW ELEVATIONS

State of Ohio
Department of Transportation
Office of Materials Management

B-112 ENGLISH PROJECT 1/1

LOG OF BORING

Date Started 6/11/96 Sampler: Type SS Dia. 1⅜" Water Elev. -
Date completed 6/11/96
Boring No. B-13 Station & Offset 485+82, 53' LT. Surface Elev. 828.2'

Project Identification: GUERNSEY
GUE-70-14.10
MINE SUBSIDENCE
SUBSURFACE INVESTIGATION

Elev.	Depth	Std. Pen. (N)	Rec. ft	Loss ft	Description	Sample No.	% Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
828.2	0														
828.0		AUGERED			ASPHALT	-	-	-	-	-	-	-	-	-	VISUAL
813.2	2	AUGERED			GROUT (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
825.7		AUGERED			GRAY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
824.2	4	7/12/21			DARK GRAY FRIABLE GROUT W/SANDY SILT & CLAY	32	-	-	-	-	-	-	-	35	VISUAL
822.7	6	18/25/25			DR. GRAY BROKEN & JOINTED GROUT W/SILT & CLAY	33	-	-	-	-	-	-	-	28	VISUAL
822.4					* GROUT (DRILLER'S DESCRIPTION)										
	8		2.5	2.0	** BROWN CLAY, CORE LOSS 48% (DRILLER'S DESCRIPTION)										
811.2	10														

BOTTOM OF BORING

Particle Sizes: Agg= >2.00mm, Coarse Sand= 2.00-0.42mm, Fine Sand= 0.42-0.074mm, Silt= 0.074-0.005mm, Clay= <0.005mm

Form TE-15 Revised 9/95

* NOTE: SAMPLE LOST IN TRANSIT TO LAB.

** NOTE: HIGH CORE LOSS DUE TO THE MATERIAL BEING SOIL.

FORM NO:
(12/89)

ENGINEERS FIELD BORING LOG B-113 1/4

BORING NO. D-38A-
SHEET 1 OF 4.
DATE: START 6-8-95 END 6-9-95
O.G. ELEV.

PROJECT NAME ODOT, I-70 COUNTY GUERNSEY
STATE RT. NO. SECT. SEGMENT OFFSET
STATION 483+80 OFFSET FROM CENTERLINE 36 RT
INSPECTOR (SIGNED) M. L. Jones DRILLERS NAME/COMPANY ED HILL / CTC
EQUIPMENT USED
DRILLING METHODS
CASING: SIZE: 4 in ; DEPTH: ; WATER: DEPTH: TIME: DATE:
CHECKED BY: ; DATE DEPTH: TIME: DATE:
NOT ENCOUNTERED ☐

B-113 1/4

DEPTH (FT.)	SAMPLE NO. AND TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Inches or Ft.)	RECOVERY (%) / RQD (%)	POCKET PENT or TORVANE (TSF)	USCS / AASHTO	H_2O CONTENT	DESCRIPTION	REMARKS
0–1.5	S-1	3 4 7	1.2/1.5	80%		SP	DRY	0.0-0.5 Sandy SILT (ml), orange-brown, med. Dense, Dry 0.5-1.5 Silty SAND (sp), Dark brown Med. Dense, Dry.	Top of Hole is ≈ 1 FT below road way pavement elevation.
3.0–4.5	S-2	3 5 6	1.5/1.5	100%		cl / SP	moist	silty CLAY, (cl) orange-brown slightly mottled light gray, med. Dense moist, wood fragment silty SAND with Gravel (sp) greenish-gray, med. Dense, moist	
7.0–8.5	S-3	4 4 7	1.5/1.5	100%		ml	moist	clayey SILT (ml) light, orange-brown to gray-brown med. stiff to stiff, soft 12.0-13.5',	NOTE:
9.0–10.5	S-4	2 3 4	1.5/1.5	100%		ml	moist		Tremmie Grouted on 6-9-95 with ~150 gals of 80/20 mix from Truck No. 3-48581 Filled Hole.
12.0–13.5	S-5	2 1 2	0.8/1.5	53%		ml	moist		
15.0–16.5	S-6	1 2 3	0.7/1.5	47%		ml	moist	• 16.0-16.3 Trace Limestone gravel, med. gravel, very angular.	
18.0–19.5	S-7	5 5 8	NO REC.	—		—	—		

Margin notes: 5, ST, m/s, 10, soft, 15, m st, st, 20

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES FOR THIS TEST PIT LOCATION AND SHOW ELEVATIONS

FORM NO: (12/89)

ENGINEERS FIELD BORING LOG

B113 2/4

BORING NO.	D-38A
SHEET	2 OF 4
DATE: START	6-8-95
END	6-9-95
O.G. ELEV.	

PROJECT NAME ODOT, I-70 COUNTY GUERNSEY
STATE RT. NO. ___ SECT. ___ SEGMENT ___ OFFSET ___
STATION 483+80 OFFSET FROM CENTERLINE 36 RT
INSPECTOR (SIGNED) M. L. Jones DRILLERS NAME/COMPANY ED HILL / CTL
EQUIPMENT USED ___
DRILLING METHODS ___
CASING: SIZE: ___ ; DEPTH: ___ ; WATER: DEPTH: ___ TIME: ___ DATE: ___
CHECKED BY: ___ ; DATE ___ DEPTH: ___ TIME: ___ DATE: ___
NOT ENCOUNTERED ☐

2/4 B-113

DEPTH (FT.)	SAMPLE NO. AND TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Inches or Ft.)	RECOVERY (%) / RQD (%)	POCKET PENT or TORVANE (TSF)	USCS / AASHTO	H2O CONTENT	DESCRIPTION	REMARKS
21.0									
22.5	S-8	6 4 7	NO REC	—		—	—		
24.0								~23.0 silty SAND with Gravel, (sp), orange-brown, med. Dense, wet.	
25.5	S-9	7 9 10	1.2/1.5	80%		sp	wet		
27.0								~26.0 CLAY, (cl), light greenish gray to brownish gray, slightly mottled orange brown, stiff, moist.	
28.5	S-10	5 5 5	0.4/1.5	27%		cl	moist		
30.0									
31.5	S-11	3 3 5	1.5/1.5	100%		cl	moist		
33.0									
34.5	S-12	6 22 24	1.2/1.5	80%		cl / sp	moist	33.9 Poorly sorted SAND with Gravel, (sp), Brownish-gray, slightly mottled Orange-brown, Dense	
36.0									
37.5	S-13	11 15 29	1.5/1.5	100%		sp	wet		
39.0									
	S-14	9 14 21	0.3/1.5	20%		SP	wet		

25 30 35 40

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES FOR THIS TEST PIT LOCATION AND SHOW ELEVATIONS

FORM NC1
(12/69)

ENGINEERS FIELD BORING LOG B-113 3/4

BORING NO. D-38 A
SHEET 3 OF 4
DATE: START 6-8-95
END 6-9-95
O.G. ELEV.

PROJECT NAME ODOT, I-70 COUNTY GUERNSEY
STATE RT. NO. SECT. SEGMENT OFFSET
STATION 483+80 OFFSET FROM CENTERLINE 36 RT
INSPECTOR (SIGNED) M. L. Jones DRILLERS NAME/COMPANY Ed Hill / CTL
EQUIPMENT USED
DRILLING METHODS
CASING: SIZE: ; DEPTH: ; WATER: DEPTH: TIME: DATE:
CHECKED BY: ; DATE DEPTH: TIME: DATE:
NOT ENCOUNTERED ☐

B-113 3/4

DEPTH (FT.)	SAMPLE NO. AND TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Inches or Ft.)	RECOVERY (%) / RQD (%)	POCKET PENT or TORVANE (TSF)	USCS / AASHTO	H2O CONTENT	DESCRIPTION	REMARKS
40 – 40.5									
~41.5								~41.5	
42.0 – 43.5	S-15	7 8 11	0.9/1.5	60%		SP	moist	Poorly Sorted SAND with Gravel, (SP) Light greenish-gray to blue-gray, very severely weathered shale & sandy shale bedrock.	
45.0 – 46.5	S-16	10 8 4	0.9/1.5	60%		gp	wet c.c	46.3 – 46.5 Flyash-Cement Grout	
48.0 – 49.5	S-17	14 27 30	0.8/1.5	53%		gp	wet		
50.0 – 51.5	S-18	30 46 35	1.1/1.5	73%		gp	wet	51.5'	Approx. Top of more competent bedrock.
51.5 – 53.0	R-1		1.2/1.5	80%/0%				SANDSTONE with interbedded Shale, greenish-gray, thin bedded, med. Hard. Evidence of Flyash-Cement Grout infilling numerous fractured and broken areas. RQD = 10%	
53.0 – 55.0	R-2		1.1/2.0	55%/0%					~54.6-55.0 Flyash-Cement Grout
55.0 – 60.0	R-3		3.5/5.0	70%/0%					

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES FOR THIS TEST PIT LOCATION AND SHOW ELEVATIONS

FORM NC4 (12/89)

ENGINEERS FIELD BORING LOG

B-13 4/4

BORING NO. D-38A
SHEET 4 OF 4
DATE: START 6-8-95
O.G. END 6-9-95
ELEV.

PROJECT NAME ODOT, I-70 COUNTY GUERNSEY
STATE RT. NO. ___ SECT. ___ SEGMENT ___ OFFSET ___
STATION 483+80 OFFSET FROM CENTERLINE 36 RT
INSPECTOR (SIGNED) M. L. Jones DRILLERS NAME/COMPANY ED HILL / CTL
EQUIPMENT USED
DRILLING METHODS
CASING: SIZE: ___ ; DEPTH: ___ ; WATER: DEPTH: ___ TIME: ___ DATE: ___
CHECKED BY: ___ ; DATE ___ DEPTH: ___ TIME: ___ DATE: ___
NOT ENCOUNTERED ☐

4/4

B-113

DEPTH (FT.)	SAMPLE NO. AND TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Inches or FT.)	RECOVERY (%) / RQD (%)	POCKET PENT or TORVANE (TSF)	USCS / AASHTO	H_2O CONTENT	DESCRIPTION	REMARKS
60									
	R-4		4.0'/5.0'	80% / 22%					Lost water circulation at 63.0'
65 65.0			4.3/5.0	86% / 16%				Broken 69.6'-70.2' 70.2	
70 70.0			4.5/5.0	90% / 38%				SILT with Sand (ML), Light gray, Very Soft, (UNDER CLAY). 73.0	
								SANDSTONE, Light gray, fine grained, Hard, slightly weathered. RQD = 100% 75.0	
75 75.0								BOTTOM OF BORING = 75.0 FT.	

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES FOR THIS TEST PIT LOCATION AND SHOW ELEVATIONS

FORM NCI
(12/89)

ENGINEERS FIELD BORING LOG

B-114 1/1

BORING NO. D-39 A
SHEET 1 OF 1
DATE: START 6-8-95 END 6-8-95
O.G. ELEV.

PROJECT NAME ODOT, I-70 COUNTY GUERNSEY
STATE RT. NO. ______ SECT. ______ SEGMENT ______ OFFSET ______
STATION 483+65 OFFSET FROM CENTERLINE 3.6 RT
INSPECTOR (SIGNED) M. L. Jones DRILLERS NAME/COMPANY ED HILL / CTL
EQUIPMENT USED Sprague & Henwood MH-20 Drill Rig
DRILLING METHODS 2" Split spoon, NQ2 Wireline Core
CASING: SIZE: 4 in ; DEPTH: ______ ; WATER: DEPTH: ______ TIME: ______ DATE: ______
CHECKED BY: ______ ; DATE ______ DEPTH: ______ TIME: ______ DATE: ______
NOT ENCOUNTERED ☐

B-114

DEPTH (FT.)	SAMPLE NO. AND TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Inches or Ft.)	RECOVERY (%) / RQD (%)	POCKET PENT or TORVANE (TSF)	USCS / AASHTO	H2O CONTENT	DESCRIPTION	REMARKS
1.5	S-1	6 27 14	1.1/1.5	73%		GP	Moist	Sand-Cement GROUT, light gray, Dense, moist. (FILL) 1.4'	
3.0								Flyash-Cement GROUT, dark brown Very Dense, wet. (FILL)	• Flyash-Cement grout at bottom of Sample S-1
4.5	S-2	16 26 32	NO REC	0%		—	—		
6.0								Fine to Coarse Limestone GRAVEL & Boulders. 7.0'	
7.5	S-3	28 50/0.5	0.9/1.0	90%		GP	wet	BOTTOM OF BORING = 7.0'	• Driller could not drill through Limestone boulders at 6.0' Hole was called off.
9.0									
10.5									

NOTE: Tremmie Grouted on 6-9-95 w ~30 gals of 80/20 mix from Truck No. 3-48581

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES FOR THIS TEST PIT LOCATION ...

FORM 1108
(12/89)

ENGINEERS FIELD BORING LOG B-115 1/4

BORING NO. D77A
SHEET 1 OF 4
DATE: START 6-13-95
D.G. END 6-14-95
ELEV.

PROJECT NAME ODOT I-70 COUNTY GUERNSEY
STATE RT. NO. ______ SECT. ______ SEGMENT ______ OFFSET ______
STATION 479 +10 OFFSET FROM CENTERLINE 36 R
INSPECTOR (SIGNED) BOB LOUGHNER DRILLERS NAME/COMPANY IRV CRABTREE / CTL
EQUIPMENT USED CME MODEL 75 DRILL RIG HOLLOW STEM AUGERS
DRILLING METHODS 2" SPLIT SPOON, NQ2 WIRELINE CORE
CASING: SIZE: 4" ; DEPTH: ______ ; WATER: DEPTH: ______ TIME: ______ DATE: ______
CHECKED BY: ______ ; DATE ______ DEPTH: ______ TIME: ______ DATE: ______
NOT ENCOUNTERED ☐

DEPTH (FT.)	SAMPLE NO. AND TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Inches or Ft.)	RECOVERY (%) / RQD (%)	POCKET PENT or TORVANE (TSF)	USCS / AASHTO	H_2O CONTENT	DESCRIPTION	REMARKS
0 – 3.0								3.0	
3.0 – 4.5	S1	3/9/18	1.0/1.5	67%		ML	DRY	Sandy Silt orange-brown and gray-brown dry with sandstone fragments	
6.0 – 7.5	S2	3/9/5	1.0/1.5	67%		ML	Moist	Sandy SILT Gray-Brown Soft. Moist with pieces of Sandstone fragments	
9.0 – 10.5	S3	3/5/6	1.5/1.5	100%		CL	Moist	Brown & Gray Silty CLAY Soft moist	
12.0 – 13.5	S4	3/4/4	1.5/1.5	100%		CL	Moist	Brown & Gray Silty CLAY Soft & Moist	
15.0 – 16.5	S5	3/4/4	1.5/1.5	100%		CL	Moist	Dark Gray Silty CLAY soft Moist	
18.0 – 19.5	S6	4/4/6	1.0/1.5	67%		CL	Moist	Light Gray silty CLAY, Soft Moist	

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES FOR THIS TEST PIT LOCATION AND SHOW ELEVATIONS

FORM NCI
(12/89)

ENGINEERS FIELD BORING LOG

b115 3/4

BORING NO. D77A
SHEET 2 OF 4
DATE: START 6-13-95
O.C. END 6-14-95
ELEV.

PROJECT NAME ODOT I-70 COUNTY GUERNSEY
STATE RT. NO. 479+10 SECT. SEGMENT OFFSET
STATION OFFSET FROM CENTERLINE 36 R
INSPECTOR (SIGNED) DRILLERS NAME/COMPANY IRV CRABTREE/CTL
EQUIPMENT USED
DRILLING METHODS
CASING: SIZE: ; DEPTH: ; WATER: DEPTH: TIME: DATE:
CHECKED BY: ; DATE DEPTH: TIME: DATE:
NOT ENCOUNTERED ☐

	DEPTH (FT.)	SAMPLE NO. AND TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Inches or Ft.)	RECOVERY (%) / RQD (%)	POCKET PENT or TORVANE (TSF)	USCS / AASHTO	H_2O CONTENT	DESCRIPTION	REMARKS
20										
	21.0								Gray Silty CLAY, Soft Moist	
	22.5	S7	2 3 3	1.5/1.5	100%		CL	Moist		
	24.0									
25	25.5	S8	7 9 13	1.5/1.5	100%		CL	Moist	Brown Sandy CLAY, stiff Moist	
	27.0								Hit water at 27'	
	28.5	S9	7 9 11	1.1/1.5	73%		CL	Moist	Brown Sandy CLAY, Stiff Sandstone fragments	
30	30.0									
	31.5	S10	3 4 4	1.1/1.5	73%		CL	Moist	Brown Silty CLAY, Soft Moist	
	33.0									
	34.5	S11	3 4 5	1.5/1.5	100%		CL	Moist		
35	36.0									
	37.5	S12	23 50/4	.8/1.0	80%				Gray Weathered Silty SHALE Soft	
	39.0									NEW DRILLER DOWN TIME 1 HOUR 10:00 AM to 11:00 AM
40		S13	9 10 7	1.5/1.5	100%				Gray weathered Sandy SHALE	

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES FOR THIS TEST PIT LOCATION AND SHOW ELEVATIONS

FORM NO
(12/89)

ENGINEERS FIELD BORING LOG B-115 3/4

BORING NO. B-115 3/4
SHEET 3 OF 4
DATE: START 6-13-95
END 6-14-95
O.G. ELEV.

PROJECT NAME ODOT I-70 COUNTY GUERNSEY
STATE RT. NO. ______ SECT. ______ SEGMENT ______ OFFSET ______
STATION 479+10 OFFSET FROM CENTERLINE 36 R
INSPECTOR (SIGNED) ______ DRILLERS NAME/COMPANY ED HILL / CTL
EQUIPMENT USED ______
DRILLING METHODS ______
CASING: SIZE: ______ ; DEPTH: ______ ; WATER: DEPTH: ______ TIME: ______ DATE: ______
CHECKED BY: ______ ; DATE ______ DEPTH: ______ TIME: ______ DATE: ______
NOT ENCOUNTERED ☐

DEPTH (FT.)	SAMPLE NO. AND TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Inches or Ft.)	RECOVERY (%) / RQD (%)	POCKET PENT or TORVANE (TSF)	USCS / AASHTO	H_2O CONTENT	DESCRIPTION	REMARKS
40								Gray Sandy SHALE AND CLAY HARD MOIST	
	S14	18 22 50/4	1.4 / 1.4	100%			MOIST	43.5	TOP OF ROCK
45	R1		0 / 1.5	0%					
	R2		2.8 / 3.0	93% / 0				Gray Clayey SHALE AND SANDSTONE FINE GRAINED SOFT TO MED HAR	
	R3		2.0 / 2.0	100% / 30%				GRAY MED-HARD SANDSTONE FINE GRAINED	
50	R4		5.0 / 5.0	100% / 28%					
55	R5		5.0 / 5.0	100% / 60%				GRAY MED-HARD SHALE AND SANDSTONE, INTERBEDDED	
60									

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES FOR THIS TEST PIT LOCATION AND SHOW ELEVATIONS

FORM NO: (12/89)

ENGINEERS FIELD BORING LOG

B115 4/4

BORING NO. D77A
SHEET 4 OF 4
DATE: START 6-13-95 END 6-14-95
O.G. ELEV.

PROJECT NAME ODOT I-70 COUNTY GUERNSEY
STATE RT. NO. SECT. SEGMENT OFFSET
STATION 479+10 OFFSET FROM CENTERLINE 36 R
INSPECTOR (SIGNED) DRILLERS NAME/COMPANY
EQUIPMENT USED
DRILLING METHODS
CASING: SIZE: ; DEPTH: ; WATER: DEPTH: TIME: DATE:
CHECKED BY: ; DATE DEPTH: TIME: DATE:
NOT ENCOUNTERED ☐

DEPTH (FT.)	SAMPLE NO. AND TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Inches or Ft.)	RECOVERY (%) / RQD (%)	POCKET PENT or TORVANE (TSF)	USCS / AASHTO	H_2O CONTENT	DESCRIPTION	REMARKS
60	R6		5.0 / 5.0	100% / 70%				Gray SHALE AND SANDSTONE MED HARD to Soft.	
								FLY ASH GROUT LAST 5"	
65	R7		5.0 / 5.0	100% / 80%				FLY ASH GROUT SOLID	
70	R8		4.5 / 5.0	90% / 58%				70.0 COAL BADLY BROKEN 70.5	
								GRAY UNDERCLAY	Bot. of Hole
75								75.0	

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES FOR THIS TEST PIT LOCATION AND SHOW ELEVATIONS

FIELD DATA - SOIL LOG

B-116 1/2

Project Code:

Project Identification: GUE-70-14.60 (Co., Rt., Br.No./Sec.No.)

Station: 483+41. Offset: 27R

Order Code: 01

Location No: TB-2 Over: RT 70 LANDSLIDE

Pier-Abut.

Started: 3-20-95 Equipment: SOIL MAX

Completed: 3-21-95 Water Level:

Depth Feet	Samples	Elevation	Description
0			BRN SANDY CLAY STONE FRAG
	1		0.0-1.5 B-2-2-3
			BRN SANDY CLAY STONE FRAG
	2		1.5-3.0 B-9-2-2
5			BRN TO GRAY CLAY STONE FRAG
	3		3.0-4.5 B-4-5-8
			BRN-GRAY CLAY
	4		4.5-6.0 B-5-16-15
			BRN GRAY CLAY
10	5		6.0-7.5 B-6-8-10
			BRN-GRAY CLAY
	6		7.5-9.0 B-5-7-7
			GRAY CLAY
	7		9.0-10.5 B-3-6-6
15			BRN CLAY
	8		10.5-12.0 B-0-2-4
			BRN TO GRAY CLAY
	9		12.0-13.5 B-2-3-3
			GRAY CLAY
20	10		13.5-15.0 B-3-4-6
			GRAY CLAY
	11		15.0-16.5 B-2-3-4
			GRAY CLAY (Slightly MOIST)
	12		16.5-18.0 B-2-2-5
25			

Form TE-6
DOT-Revised 1/92

Log 1 of 2

Depth Feet	Samples	Elevation	Description
25			GRAY CLAY SLIGHTLY MOIST
	13		18.0-19.5 B-2-3-5
			BRN SILTY CLAY
	14		19.5-21.0 B-3-7-10
30			BRN SILTY CLAY
	15		21.0-22.5 B-4-6-8
			BRN CLAY TO BRN SILTY CLAY STONE FRAG
	16		22.5-24.0 B-3-5-9
			SILTY CLAY STONE FRAG MOISTURE AT 25.5
35	17		24.0-25.5 B-4-7-10
			MOIST SILTY CLAY-STONE TO GRAY CLAY
	18		25.5-27.0 B-3-4-5
			GRAY SILTY CLAY
	19		27.0-28.5 B-3-4-7
40			GRAY SILTY CLAY
	20		28.5-30.0 B-3-5-6
			GRAY SILTY CLAY
	21		30.0-31.5 B-2-3-5
			GRAY SILTY CLAY
45	22		31.5-33.0 B-2-3-5
			CONG SAND STONE FRAG
	23		33.0-34.5 B-29-43-90
			CONG SAND STONE FRAG
	24		34.5-36.0 B-40-50-60
50			CONG SAND STONE FRAG
	25		36.0-37.0 B-37-100
			CONG SAND STONE FRAG
	26		37.0-38.0 B-80-80
55	27		40.0-40.8 B-53-60
			DENSE CLAY
	28		41.5-43.0 B-20-33-76
			DENSE CLAY SOME SHALE
	29		43.0-43.5 B-90.
60			TRIED SAMPLE AT 45' NO PENE.

Remarks:

Party: Lewis Valine

Chief of Party: Hopkins PAGE 1 OF 2

B-116

2/2

FIELD DATA - SOIL LOG

Project Code:

Project Identification: GUE-70 1410 (Co., Rt., Br.No./Sec.No.)

Station: 483+41. Offset: 27 R

Order Code: 01

Location No. 2 Over: RT 70 LANDSLIDE

Pier-Abut.

Started: 3-20-95 Equipment: Skid MAN

Completed: 3-21-95 Water Level:

Depth Feet	Samples	Elevation	Description
0			AUGARD DOWN TO 46'
			PUT BARREL IN 46'
			RAN 4' RECOVER 4'
			GRAY SHALE WITH CLAY SEAMS
5			
			PUT BARREL IN 50'
			RAN 5' RECOVER 4.3'
			GRAY SHALE CLAY SEAMS
10			PUT BARREL IN 55'
			RAN 5' RECOVER 4.8
			GRAY SHALE
			PUT BARREL IN 60'
15			HIT VOID AT 63'
			VOID APPROX 7' CORED
			FROM 70' TO 72'
			RECOVER- 4.1' GRAY SHALE
20			E.O.B. 72'
25			PAGE 2 OF 2

Form TE-6
DOT-Revised 1/92

Depth Feet			
25			
30			
35			
40			
45			
50			
55			
60			

Remarks:

Party: Lewis VAline

Chief of Party: Hopkins

B-112 (1/2)

FIELD DATA - SOIL LOG

Project Code | **Project Identification:** GUE 70-14.10 (Co., Rt., Br.No./Sec.No.)

Station 423+56. **Offset** 56 Rt **Order Code**

Location No. TB3 Over: MINE

Pier-Abut.

Started: 3-21-95 Equipment: B-53

Completed: Water Level:

Depth Feet	Samples	Elevation	Description
0			1.0' SAND + GRAVEL ROAD BASE
			BRN. CLAY W/STN. FRAGS.
	18		2.5-4.0 B 7-7-11
5			BRN + GREY SILTY CLAY
	19		5.0-6.5 B 3-4-14
			GREY + BRN SILTY CLAY
	20		7.5-9.0 B 5-4-7
10			BRN. SILTY CLAY
	21		10.0-11.5 B 3-4-7
			BRN + GREY SILTY CLAY
	22		12.5-14.0 B 2-2-4
15			GREY SILTY CLAY
	23		15.0-16.5 B 2-3-4
			BRN. SILTY CLAY
	24		17.5-19.0 B 2-4-6
20			BRN. SILTY CLAY
	25		20.0-21.5 B 4-6-9 WET AT 19.0'
			BRN. CLAY W/STN. FRAGS
	26		22.5-24.0 B 3-6-9
25			SANDY CLAY W/STN. FRAGS.
	27		25.0-26.5 B 6-4-3

Depth Feet	Samples	Elevation	Description
25			
			GREY SILTY CLAY
	28		27.5-29.0 B 3-4-4
30			GREY SILTY CLAY
	29		30.0-31.5 B 2-2-3
			SANDY CLAY W/COBBLES + STONE FRAGS
	30		32.5-34.0 B 7-7-24
35			SILTY SAND W/ STONE FRAGS
	31		35.0-36.5 B 48-33-57
			SILTY SAND W/ STONE FRAGS
	32		37.5-39.0 B 46-35-86
40			SILTY SAND W/ STONE FRAGS
	33		40.0-40.6 B 88
			WEAK SHALEY CLAY TO WEAK SHALE
	34		42.5-43.8 B 35-50
45			AUGERED DOWN TO 45.0'
50			GREY SHALE
			CORED FROM 45.0-50.0 REC 5.0'
55			GREY SHALE
			CORED FROM 50.0-55.0 REC 4.5'
60			SANDY GREY SHALE TO GREY SHALE
			CORED FROM 55.0-60.0 REC 5.0'

Remarks:

Party: PITTS, WILLIS

Chief of Party: McLEISH

Form TE-6 (L?) DOT-Revised 4/92

1 of 2

FIELD DATA - SOIL LOG

B-117 2/2

Project Code: | Project Identification: GUE. 70 - 14.10 (Co., Rt., Br.No./Sec.No.)

Station: 482 + 56. | Offset: 56 RT | Order Code:

Location No. T8 #3 | Over: MINE

Pier-Abut.

Started: 3-21-95 | Equipment: 1253

Completed: 3-22-95 | Water Level:

Depth Feet	Samples	Elevation	Description
0			
			CORED FROM 62.0 - 72.0'
			HIT VOID AT 64.0 TO 71.0'
			CORED AT BOTTOM OF MINE
5			FROM 71.0 - 72.0
10			CANDY SHALE TO FIRECLAY
			CORED FROM 60.0 - 72.0' REC 5.0'
			ACTUAL CORING 5.0'
			(7.0 OF VOID)
15			
			E.O.B 72.0
			OBTUSE WAYING SHALE AND FIRECLAY AT
20			BOTTOM OF SHAFT
25			

Depth Feet	Samples	Elevation	Description
25			
30			
35			
40			
45			
50			
55			
60			

Remarks:

Party:

Chief of Party:

Form YE-6
DOT-Revised 1/92

2 of 2

B-118 (1/4)

PROJECT: I-70 Mine Subside[illegible]	PROJECT LOCATION: Cambridge, O[illegible]
DRILLER: T. England	CTL-WV PROJECT NO.: 94050033W
HOLE NO.: TB-3	TOP OF HOLE ELEV: N/A
DATE OF HOLE	START: 04/26/94 · COMPLETED: 04/26/94
SOIL DEPTH: 46.0' · ROCK DEPTH: 24.0' · TOTAL DEPTH: 70.0'	TOTAL NO. SOIL SAMPLES — SPLIT SPOONS: 0 · SHELBY TUBES: 0

REMARKS:

473+90, 25'Lt? SE = 823'±

SAMPLE/ RUN NO.	BLOW COUNT 6 IN	BLOW COUNT 12 IN	DEPTH	% CORE RECOV	RQD 0 10 20 30 40 50	MATERIAL DESCRIPTION
			1			
			2			
			3			Brown, Silty SAND
			4			
			5			
			6			6.0'
			7			
			8			
			9			
			10			
			11			Light Brown, Clayey SILT With Trace Sand
			12			
			13			
			14			
			15			
			16			16.5'
			17			
			18			Brown, silty SAND
			19			
			20			

B-118 1/4

CTL ENGINEERING

B-118 (2/4)

PROJECT: I-70 Mine Subside	PROJECT LOCATION: Cambridge, Oh	
DRILLER: T. England	CTL-WV PROJECT NO.: 94050033W	DATE OF HOLE START: 04/26/94 COMPLETE: 04/26/94
HOLE NO.: TB-3	TOP OF HOLE ELEV: N/A	
SOIL DEPTH: 46.0'	ROCK DEPTH: 24.0'	TOTAL DEPTH: 70.0'
TOTAL NO. SOIL SAMPLES SPLIT SPOONS: 0	SHELBY TUBES: 0	
REMARKS:		

SAMPLE/ RUN NO.	BLOW COUNT 6 IN	BLOW COUNT 12 IN	DEPTH	% CORE RECOV	RQD: 0 10 20 30 40 50	MATERIAL DESCRIPTION
			21			
			22			
			23			
			24			Brown, Silty SAND
			25			
			26			
			27			27.0'
			28			
			29			
			30			
			31			
			32			
			33			
			34			Wet, Light Brown, Silty SAND
			35			
			36			
			37			
			38			
			39			
			40			

B-118

CTL ENGINEERING

B-118 (3/4)

PROJECT: I-70 Mine Subside	PROJECT LOCATION: Cambridge, O.	
DRILLER: T. England	CTL-WV PROJECT NO.: 94050033W	DATE OF HOLE START: 04/26/94 COMPLETE: 04/26/94
HOLE NO.: TB-3	TOP OF HOLE ELEV: N/A	
SOIL DEPTH: 46.0'	ROCK DEPTH: 24.0'	TOTAL DEPTH: 70.0'
TOTAL NO. SOIL SAMPLES SPLIT SPOONS: 0	SHELBY TUBES: 0	
REMARKS:		

SAMPLE/ RUN NO.	BLOW COUNT 6 IN	BLOW COUNT 12 IN	DEPTH	% CORE RECOV	% CORE RQD	0 10 20 30 40 50	MATERIAL DESCRIPTION
			41				
			42				
			43				Wet, Light Brown, Silty SAND
			44				
			45				
			46				46.0'
			47				
			48				
			49				
			50				
			51				
			52				
			53				Dry, Gray to Dark Gray SHALE
			54				
			55				
			56				
			57				
			58				
			59				
			60				

B-118 3/4

CTL ENGINEERING

B-118 (4/4)

PROJECT: I-70 Mine Subside	PROJECT LOCATION: Cambridge, Oh	
DRILLER: T. England	CTL-WV PROJECT NO.: 94050033W	DATE OF HOLE — START: 04/24/94 COMPLETE: 04/26/94
HOLE NO.: TB-3	TOP OF HOLE ELEV: N/A	
SOIL DEPTH: 46.0'	ROCK DEPTH: 24.0' TOTAL DEPTH: 70.0'	TOTAL NO. SOIL SAMPLES — SPLIT SPOONS: 0 SHELBY TUBES: 0
REMARKS:		

SAMPLE/ RUN NO.	BLOW COUNT 6 IN	BLOW COUNT 12 IN	DEPTH	% CORE RECOV	RQD 0 10 20 30 40 50	MATERIAL DESCRIPTION
			61			
			62			Dry, Gray to Dark Gray SHALE
			63			63.0'
			64			
			65			
			66			
			67			OPEN VOID
			68			
			69			
			70			70.0'
			71			Bottom of Boring
			72			
			73			
			74			
			75			
			76			
			77			
			78			
			79			
			80			

B-118 4/4

CTL ENGINEERING

FORM NC1
(12/89)

ENGINEERS FIELD BORING LOG

B119 1/4

BORING NO. B-41A
SHEET 1 OF 4
DATE: START 6-9-95
END 6-12-95
O.G. ELEV. ____

PROJECT NAME ODOT, I-70 COUNTY GUERNSEY
STATE RT. NO. ____ SECT. ____ SEGMENT ____ OFFSET ____
STATION 483+63 OFFSET FROM CENTERLINE 72 RT
INSPECTOR (SIGNED) M. L. Jones DRILLERS NAME/COMPANY CARL MARTIN / CTL
EQUIPMENT USED CME
DRILLING METHODS 2" Split Spoon, NQ2 Wireline Core, Hollow stem Augers
CASING: SIZE: ____ ; DEPTH: ____ ; WATER: DEPTH: ____ TIME: ____ DATE: ____
CHECKED BY: ____ ; DATE ____ DEPTH: ____ TIME: ____ DATE: ____
NOT ENCOUNTERED ☐

DEPTH (FT.)	SAMPLE NO. AND TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Inches or Ft.)	RECOVERY (%) / RQD (%)	POCKET PENT or TORVANE (TSF)	USCS / AASHTO	H_2O CONTENT	DESCRIPTION	REMARKS
0 – 1.5	S-1	6 4 2	0.7/1.5	47%		SP	Dry	Poorly Sorted SAND with Gravel, (SP) light gray, Loose, Dry (Fill)	
1.5 – 3.0								~2.0'	
3.0 – 4.5	S-2	3 6 4	1.3/1.5	87%		ml	moist	SILT to Sandy SILT, (ml), dark orange brown, medium brown, light brown, medium gray & greenish-gray, medium stiff to very stiff, moist.	
4.5 – 6.0									
6.0 – 7.5	S-3	4 3 3	0.3/1.5	20%		ml	moist		6.0'-7.5' Low recovery due to sandstone cobble in end of split spoon.
7.5 – 9.0									
9.0 – 10.5	S-4	2 3 2	1.3/1.5	87%		ml	moist		
10.5 – 12.0									NOTE: Tremmie Grouted on 6-12-95 with 200 gals of 80/20 mix
12.0 – 13.5	S-5	2 2 3	0.7/1.5	47%		ml	moist		
13.5 – 15.0									
15.0 – 16.5	S-6	3 4 5	1.2/1.5	80%		ml	moist		
16.5 – 18.0									
18.0 – 19.5	S-7	2 2 3	1.3/1.5	87%		ml	moist		
19.5 – 20									

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES FOR THIS TEST PIT LOCATION AND SHOW ELEVATIONS

(12/89)

ENGINEERS FIELD BORING LOG B-1192/4

BORING NO. B-41A
SHEET 2 OF 4
DATE: START 6-9-95
D.C. END 6-12-95
ELEV. ____

PROJECT NAME ODOT, I-70 COUNTY GUERNSEY
STATE RT. NO. ____ SECT. ____ SEGMENT ____ OFFSET ____
STATION 483+63 OFFSET FROM CENTERLINE 72 RT
INSPECTOR (SIGNED) M. L. Jones DRILLERS NAME/COMPANY Chris Martin / CTL
EQUIPMENT USED ____
DRILLING METHODS ____
CASING: SIZE: ____ ; DEPTH: ____ ; WATER: DEPTH: ____ TIME: ____ DATE: ____
CHECKED BY: ____ ; DATE ____ DEPTH: ____ TIME: ____ DATE: ____
NOT ENCOUNTERED ☐

DEPTH (FT.)	SAMPLE NO. AND TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Inches or Ft.)	RECOVERY (%) / RQD (%)	POCKET PENT or TORVANE (TSF)	USCS / AASHTO	H_2O CONTENT	DESCRIPTION	REMARKS
20									
21.0–22.5	S-8	5 7 10	1.3/1.5	87%		ml	moist		
24.0–25.5	S-9	6 6 5	1.5/1.5	100%		ml / SP	moist / wet	25.0' Poorly sorted SAND with Gravel, (sp), med. Dense, wet. ~30.0'	
27.0–28.5	S-10	2 2 3	1.5/1.5	100%		ml	moist	SILT, (ml), dark gray, medium stiff, moist.	
30.0–31.5	S-11	2 4 4	1.3/1.5	87%		ml	moist		
33.0–34.5	S-12	5 20 32	1.4/1.5	93%		ml / SP	moist	34.0' Poorly Sorted SAND with Gravel, (sp) brownish-gray mottled orange-brown	
36.0–37.5	S-13	27 37 45	0.6/1.5	40%		ml / sp	wet	36.9' SILT, (ml), dark gray, v. stiff, wet. 37.3' SAND, (sp), dark gray, v. dense, wet 38.5'	
39.0–40	S-14	17 37-	1.3/1.5	87%		ml	moist	SILT, (ml), dark gray, very stiff, wet 40.0'	

27 37 45

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES FOR THIS TEST PIT LOCATION AND SHOW ELEVATIONS

(12/89) ENGINEERS FIELD BORING LOG B-119 3/4

BORING NO. B-91A
SHEET 3 OF 4
DATE: START 6-9-95 END 6-12-95
O.G. ELEV.

PROJECT NAME ODOT, I-70 COUNTY GUERNSEY
STATE RT. NO. ____ SECT. ____ SEGMENT ____ OFFSET ____
STATION 483+63 OFFSET FROM CENTERLINE 72 Rt
INSPECTOR (SIGNED) M. L. Jones DRILLERS NAME/COMPANY Chris Martin / CTL
EQUIPMENT USED
DRILLING METHODS 2" Split Spoon, NQ2 Wireline Core, Hollow Stem Augers
CASING: SIZE: ____ ; DEPTH: ____ ; WATER: DEPTH: ____ TIME: ____ DATE: ____
CHECKED BY: ____ ; DATE ____ DEPTH: ____ TIME: ____ DATE: ____
NOT ENCOUNTERED ☐

DEPTH (FT.)	SAMPLE NO. AND TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Inches or Ft.)	RECOVERY (%) / RQD (%)	POCKET PENT or TORVANE (TSF)	USCS / AASHTO	H_2O CONTENT	DESCRIPTION	REMARKS
40 – 40.5		45				SP	moist	Poorly graded SAND with Gravel, (SP), dark orange-brown, very dense, moist.	
42.0 – 43.4	S-15	19 / 25 / 50/0.4	0.8/1.5	53%		ml	moist	42.2' Sandy SILT with Gravel, (ml), Greenish-Gray, Hard, moist. Completely weathered shale bedrock. 43.4'	• 43.5' Auger Refusal
43.4 – 45.3	R-1		0.6/1.8	33% / 0%				Interbedded SANDSTONE, SHALE, and 45.1 sandy SHALE, greenish-gray,	
45.3 – 47.3	R-2		1.7/2.0	0.85 / 0.2%			SS 45.35 / SH / 46.5 / SS	Sandstone is Hard, Shale & sandy Shale are medium Hard, moderately to Slightly weathered, Thin Bedded to Laminated, Horizontal bedding. RQD = 15%	
47.3 – 50.3	R-3		1.5/3.0	50% / 0%					
50.3 – 55.3	R-4		0.6/5.0	12% / 0%				50.3' • Approximate top of broken/caved zone. Bedding changes to 15° to 25°	
55.3 – 58.3	R-5		~1.8/3.0	60% / 0%				• 55.5 minor infilling of "Bag" cement Grout.	• 57.1' Lost water Return. • 58.3 Regained water return
58.3 – 60	R-6		1.5/2.0	75% / 0%					

RQD .35/2.0

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES FOR THIS TEST PIT LOCATION AND SHOW ELEVATIONS

(12/89) ENGINEERS FIELD BORING LOG B-119 4/4

BORING NO. [illegible]
SHEET 4 OF 4
DATE: START 6-9-95
END 6-12-95
O.G. ELEV. ______

PROJECT NAME ODOT, I-70 COUNTY GUERNSEY
STATE RT. NO. ______ SECT. ______ SEGMENT ______ OFFSET ______
STATION 483+63 OFFSET FROM CENTERLINE 72 Rt
INSPECTOR (SIGNED) M. L. Jones DRILLERS NAME/COMPANY Chris Martin / CTL
EQUIPMENT USED ______
DRILLING METHODS ______
CASING: SIZE: ______ ; DEPTH: ______ ; WATER: DEPTH: ______ TIME: ______ DATE: ______
CHECKED BY: ______ ; DATE ______ DEPTH: ______ TIME: ______ DATE: ______
NOT ENCOUNTERED ☐

RQD	DEPTH (FT.)	SAMPLE NO. AND TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Inches or Ft.)	RECOVERY (%) / RQD (%)	POCKET PENT or TORVANE (TSF)	USCS / AASHTO	H_2O CONTENT	DESCRIPTION	REMARKS
	60 / 60.3									• 60.3 Lost water Return
1.2/5.0		R-7		4.2/5.0	84% / 24%					
	65 / 65.3								• 65.9'–66.05' Flyash-Cement Grout.	
1.0/5.0		R-8		3.6/5.0	72% / 20%					
	70 / 70.3								70.0' CLAYSTONE (UNDER CLAY), Light gray, medium soft to soft. RQD = 0%. Recovery = 42%	• 70.3' small wood fragment.
2.2/5.0		R-9		3.5/5.0	70% / 44%				73.1' SANDSTONE, Greenish-Gray, Thick Bedded, Hard, Fresh. RQD = 100%. Recovery = 100%	
	75.3								75.3' BOTTOM OF BORING = 75.3'	

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES FOR THIS TEST PIT LOCATION AND SHOW ELEVATIONS

FORM NO: (12/89)

ENGINEERS FIELD BORING LOG

B120¼

BORING NO. CC-33A
SHEET 1 OF 4
DATE: START 6-9-95
END 6-10-95
O.G. ELEV.

PROJECT NAME ODOT, I-70 COUNTY GUERNSEY
STATE RT. NO. SECT. SEGMENT OFFSET
STATION 484 +40 OFFSET FROM CENTERLINE 48 FT
INSPECTOR (SIGNED) M. L. Jones DRILLERS NAME/COMPANY Ed Hill / CTL
EQUIPMENT USED Sprague & Henwood MH-20 Drill Rig, Hollow Stem Augers
DRILLING METHODS 2" Split-Spoon, NQ2 Wire line Core
CASING: SIZE: 4 in; DEPTH: ; WATER: DEPTH: TIME: DATE:
CHECKED BY: ; DATE DEPTH: TIME: DATE:
NOT ENCOUNTERED ☐

DEPTH (FT.)	SAMPLE NO. AND TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Inches or Ft.)	RECOVERY (%) / RQD (%)	POCKET PENT or TORVANE (TSF)	USCS / AASHTO	H_2O CONTENT	DESCRIPTION	REMARKS
0								Bituminous Pavement 0.5	
								Concrete 0.5	
								Subbase Aggregate 0.5	• Augered from 0.0' to 3.0'
3.0–4.5	S-1	3, 6, 10	0.6/1.5	40%		ml	moist	SILT, (ml), orange-brown to dark gray to dark brown, medium stiff to stiff, moist.	
5								or-br	
6.0–7.5	S-2	4, 5, 8	1.4/1.5	93%		ml	moist	gy-br	NOTE:
9.0–10.5	S-3	2, 3, 4	1.3/1.5	87%		ml	moist	or-br	Tremmie Grouted by CTL, NOT Full. • Hole was redrilled by Nicholson on 6-13-95 to be regrouted.
10								gy-br	
12.0–13.5	S-4	2, 3, 4	1.5/1.5	100%		ml	moist		
15.0–16.5	S-5	2, 2, 3	1.5/1.5	100%		ml	moist	dk or-b; dk gy	
18.0–19.5	S-6	2, 3, 5	0.3/1.5	20%		ml	moist	or-br; dk gy	
20									

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES FOR THIS TEST PIT LOCATION AND SHOW ELEVATIONS

FORM NO (12/89)

ENGINEERS FIELD BORING LOG B-120 2/4

BORING NO.	CC-33A
SHEET	2 OF 4
DATE: START	6-9-95
END	6-10-95
O.G. ELEV.	

PROJECT NAME ODOT, I-70 COUNTY GUERNSEY
STATE RT. NO. ______ SECT. ______ SEGMENT ______ OFFSET ______
STATION 484+40 OFFSET FROM CENTERLINE 40 RT
INSPECTOR (SIGNED) M. L. Jones DRILLERS NAME/COMPANY ED HILL / CTL
EQUIPMENT USED ______
DRILLING METHODS ______
CASING: SIZE: ______ DEPTH: ______ WATER: DEPTH: ______ TIME: ______ DATE: ______
CHECKED BY: ______ DATE ______ DEPTH: ______ TIME: ______ DATE: ______
NOT ENCOUNTERED ☐

DEPTH (FT.)	SAMPLE NO. AND TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Inches or Ft.)	RECOVERY (%) / RQD (%)	POCKET PENT or TORVANE (TSF)	USCS / AASHTO	H_2O CONTENT	DESCRIPTION	REMARKS
20									
21.0–22.5	S-7	4 5 8	1.5/1.5	100%		ml	moist		
24.5–25.5	S-8	3 2 3	1.3/1.5	87%		SP	moist	24.7 Silty SAND with Gravel, (SP) orange-brown, loose, wet.	
								~26.5 SILT, (ml), orange-brown, med. stiff, moist.	
27.0–28.5	S-9	8 5 4	1.5/1.5	100%		(ml) (SP) (ml)	moist	27.3 Poorly sorted SAND with Gravel, (SP), dark gray, loose, wet.	
								28.3 sandy SILT (ml), med. to dark gray, stiff, moist.	
30.0–31.5	S-10	4 5 5	1.5/1.5	100%		ml	moist		
33.0–34.5	S-11	3 2 4	1.5/1.5	100%		ml	wet		
36.0–37.5	S-12	16 35 36	1.5/1.5	100%		ml SP	moist	36.6 Poorly Sorted SAND with Gravel, (SP), Dark brown to dark orange-brown, blue-gray fine grained sandstone gravel, Very Dense, moist.	
39.0–40	S-13	13 12 28	1.3/1.5	87%		SP	moist		

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES FOR THIS TEST PIT LOCATION AND SHOW ELEVATIONS

FORM NO: (-12/89)

ENGINEERS FIELD BORING LOG B-120 3/4

BORING NO.	CC-33A
SHEET	3 OF 4
DATE: START	6-9-95
O.G. END	6.10.95
ELEV.	

PROJECT NAME ODOT, I-70 COUNTY GUERNSEY

STATE RT. NO. ____ SECT.: ____ SEGMENT ____ OFFSET ____

STATION 484+40 OFFSET FROM CENTERLINE 48 RT

INSPECTOR (SIGNED) M.L. Jones DRILLERS NAME/COMPANY ED HILL / CTL

EQUIPMENT USED ____

DRILLING METHODS ____

CASING: SIZE: ____ ; DEPTH: ____ ; WATER: DEPTH: ____ TIME: ____ DATE: ____

CHECKED BY: ____ ; DATE ____ DEPTH: ____ TIME: ____ DATE: ____

NOT ENCOUNTERED ☐

DEPTH (FT.)	SAMPLE NO. AND TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Inches or Ft.)	RECOVERY (%) / RQD (%)	POCKET PENT or TORVANE (TSF)	USCS / AASHTO	H_2O CONTENT	DESCRIPTION	REMARKS
40 – 40.5	S-13					ml		40.0 SILT, (ml), dark gray, stiff, moist. ~41.0	
42.0 – 43.0	S-14	48 / 50/0.5	0.9/1.5	60%		SP	moist	Poorly graded SAND with Gravel, (SP) dark gray, slightly mottled orange-brown, Trace blue-green sandstone gravel, very dense, moist. 43.0	TOP of Rock
43.0 – 45.5	R-1		1.4/2.5	56% / 16%				SHALE AND SANDSTONE, greenish-gray, interbedded, med. Hard thin bedded to fissle bedding.	
45 – 50.5	R-2		4.8/5.0	96% / 28%					
50 – 55.5	R-3		4.7/5.0	94% / 57%					
55 – 60	R-4		5.0/5.0	100% / 91%					

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES FOR THIS TEST PIT LOCATION AND SHOW ELEVATIONS

FORM NO1
(12/89)

ENGINEERS FIELD BORING LOG B-920 4/4

BORING NO.	CC-33A
SHEET	4 OF 4
DATE: START	6-9-95
O.G. END	6-10-95
ELEV.	

PROJECT NAME ODOT I-70 COUNTY GUERNSEY
STATE RT. NO. ____ SECT. ____ SEGMENT ____ OFFSET ____
STATION 484+40 OFFSET FROM CENTERLINE 45 FT
INSPECTOR (SIGNED) J. JAMES DRILLERS NAME/COMPANY ED HILL, CTL
EQUIPMENT USED ____
DRILLING METHODS ____
CASING: SIZE: ____ ; DEPTH: ____ ; WATER: DEPTH: ____ TIME: ____ DATE: ____
CHECKED BY: ____ ; DATE ____ DEPTH: ____ TIME: ____ DATE: ____
NOT ENCOUNTERED ☐

DEPTH (FT.)	SAMPLE NO. AND TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Inches or Ft.)	RECOVERY (%) / RQD (%)	POCKET PENT or TORVANE (TSF)	USCS / AASHTO	H_2O CONTENT	DESCRIPTION	REMARKS
60.5'	R-4		5.0/5.0	100%/91%				60.5'	
								SHALE AND SANDSTONE, GREENISH-GRAY, INTERBEDDED, MED. HARD, THIN BEDDED RQD = 90% 61.5'	
	R-5							FLY-ASH GROUT 65.2'	
65.5								VOID 65.5'	
	R-6		2.6/5.0	52%/0%				SHALE AND SANDSTONE, GREENISH-GRAY, VERY BROKEN, TRACE FLY-ASH GROUT AT TOP OF SAMPLE R-6. 4"-6" VOIDS THROUGHOUT. RQD = 0% 71.0'	
70.5								COAL, VERY BROKEN. RQD = 0% 71.1'	
	R-7		4.6/5.0	92%/21%				UNDERCLAY, LIGHT-DARK GRAY, VERY STIFF, RQD = 0% 73.9'	
								SANDSTONE, LIGHT GRAY, HARD, FINE-GRAINED. RQD = 97% 75.5'	
75.5'								BOTTOM OF BORING = 75.5'	

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES FOR THIS TEST PIT LOCATION AND SHOW ELEVATIONS

B-121

State of Ohio
Department of Transportation
Office of Materials Management

ENGLISH PROJECT

1/2

LOG OF BORING

Date Started 7/2/96 Sampler: Type SS Dia. 1 3/8" Water Elev. -
Date completed 7/2/96
Boring No. B-12 Station & Offset 485+70, 48' LT. Surface Elev. 828.1'

Project Identification: GUERNSEY
GUE-70-14.10
MINE SUBSIDENCE
SUBSURFACE INVESTIGATION

Elev.	Depth	Std. Pen. (N)	Rec. ft	Loss ft	Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
828.1	0														
826.9		AUGERED			.2' ASPHALT & 1.0' CONCRETE	-	-	-	-	-	-	-	-	-	VISUAL
	2														
	4	AUGERED			SANDY CLAY WITH GRAVEL (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
823.1															
	6														
	8	AUGERED			SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
818.1	10														
	12														
	14	AUGERED			SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
813.1															
	16														
	18	AUGERED			SANDY CLAY (DRILLER'S DESCRIPTION)	-		.	-	-	-	-	-	-	VISUAL
808.1	20														
	22														
	24	AUGERED			SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
803.1															
	26														
	28	AUGERED			SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
798.1	30														
	32														
	34	AUGERED			SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
793.1	36														

Particle Sizes: Agg= >2.00mm, Coarse Sand= 2.00-0.42mm, Fine Sand= 0.42-0.074mm, Silt= 0.074-0.005mm, Clay= <0.005mm

Form TE-151 Revised 5/95

(B-12) (2/2)

Boring No. B-12 Station & Offset 485+70, 48' LT. Surface Elev. 828.1' Project GUE-70-14.10

Elev.	Depth	Std. Pen. (N)	Rec. ft	Loss ft	Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
	38				TOP OF ROCK (DRILLER'S DESC.)										
788.1	40				SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
	42														
	44														
	46														
	48														
	50														
	52														
	54				NOTE: DRILLER'S WERE UNABLE TO GET CORING APPARATUS DOWN THE HOLE, HOWEVER THEY WERE ABLE TO ASCERTAIN THAT THEY NEITHER ENCOUNTERED COAL, NOR A VOID.										
	56														
	58														
	60														
	62														
	64														
	66														
	68														
753.1	70														

BOTTOM OF BORING

Particle Sizes: Agg= >2.00mm, Coarse Sand= 2.00-0.42mm Fine Sand= 0.42-0.074mm, Silt= 0.074-0.005mm, Clay= <0.005mm

Form TE-15(Revised 9/95

FORM NO.
(12/89)

ENGINEERS FIELD BORING LOG

B-122 1/4

BORING NO. D-22A
SHEET 1 OF 4
DATE: START 6-12-95 END 6-13-95
O.G. ELEV. ______

PROJECT NAME ODOT, I-70 COUNTY GUERNSEY
STATE RT. NO. ______ SECT. ______ SEGMENT ______ OFFSET ______
STATION 485+70 OFFSET FROM CENTERLINE 36 RT
INSPECTOR (SIGNED) M L. Jones DRILLERS NAME/COMPANY Chris Martin / CTL
EQUIPMENT USED CME-75
DRILLING METHODS 2" Split Spoon, NQ2 Wireline Core, Hollow Stem Augers
CASING: SIZE: ______ ; DEPTH: ______ ; WATER: DEPTH: ______ TIME: ______ DATE: ______
CHECKED BY: ______ ; DATE ______ DEPTH: ______ TIME: ______ DATE: ______
NOT ENCOUNTERED ☐

DEPTH (FT.)	SAMPLE NO. AND TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Inches or Ft.)	RECOVERY (%) / RQD (%)	POCKET PENT or TORVANE (TSF)	USCS / AASHTO	H_2O CONTENT	DESCRIPTION	REMARKS
0–3.0								3.0	0.0'-3.0' predrilled by D25k Track Rig (Don Taylor)
3.0–4.5	S-1	3 6 9	1.3/1.5	87%		ml	moist	SILT to Sandy SILT, (ml) orange-brown to dark orange-brown, medium stiff to stiff, moist	
6.0–7.5	S-2	2 2 5	1.4/1.5	93%		ml	moist		
9.0–10.5	S-3	7 8 9	0.7/1.5	47%		ml	moist		
12.0–13.5	S-4	4 5 9	1.5/1.5	100%		ml	moist		
15.0–16.5	S-5	5 9 11	1.5/1.5	100%		ml	moist		
18.0–19.5	S-6	3 5 8	1.5/1.5	100%		ml	moist		

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES FOR THIS TEST PIT LOCATION AND SHOW ELEVATIONS

FORM NO
(12/89)

ENGINEERS FIELD BORING LOG

B-122 2/4

BORING NO. B-122A
SHEET 2 OF 4
DATE: START 6-12-95
END 6-13-95
O.G. ELEV.

PROJECT NAME ODOT, I-70 COUNTY GUERNSEY
STATE RT. NO. ___ SECT. ___ SEGMENT ___ OFFSET ___
STATION 485+70 OFFSET FROM CENTERLINE 36 FT
INSPECTOR (SIGNED) M. L. Jones DRILLERS NAME/COMPANY CHRIS MARTIN / CTL
EQUIPMENT USED
DRILLING METHODS
CASING: SIZE: ___ ; DEPTH: ___ ; WATER: DEPTH: ___ TIME: ___ DATE: ___
CHECKED BY: ___ ; DATE ___ DEPTH: ___ TIME: ___ DATE: ___
NOT ENCOUNTERED ☐

DEPTH (FT.)	SAMPLE NO. AND TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Inches or Ft.)	RECOVERY (%) / RQD (%)	POCKET PENT or TORVANE (TSF)	USCS / AASHTO	H_2O CONTENT	DESCRIPTION	REMARKS
20									
21.0–22.5	S-7	2 3 3	1.5/1.5	100%		ml	moist		
24.0–25.5	S-8	4 9 10	1.5/1.5	100%		sm	moist	CLAY (cl), gray-brown, soft (24.0'–24.1'); silty SAND, (sm), dark greenish-brown to dark orange-brown, med. Dense, moist	24.0' 24.1'
								~26.0 SILT (ml), gray-brown, soft, moist	Hit water at ~26.5'
27.0–28.5	S-9	10 10 4	1.5/1.5	100%		ml sp ml	wet	27.3' poorly graded SAND with Gravel, gray-brown med. Dense, wet. 28.0' SILT, (ml), brown-gray, medium stiff, wet	
30.0–31.5	S-10	4 3 4	1.5/1.5	100%		ml	wet		
33.0–34.5	S-11	2 3 5	1.5/1.5	100%		ml	wet		
36.0–37.5	S-12	16 31 50/0.4	1.4/1.4	100%		ml sp	wet	36.5' Poorly Graded SAND with Gravel, (sp), dark grayish-brown, Very Dense, wet	• 37.5' air under pressure blowing from hole. Dirty water also blowing out. • Hole was stopped for 1 hr 25 min. Then continued to drill. Air did not stop venting until augered to 39.0'.
39.0–	S-13	22 43				sp	wet		
40									

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES FOR THIS TEST PIT LOCATION AND SHOW ELEVATIONS

FORM NO.
(12/89)

ENGINEERS FIELD BORING LOG B-122 3

BORING NO. B-122
SHEET 3 OF 4
DATE: START 6-12-95 END 6-13-95
O.G. ELEV.

PROJECT NAME ODOT, I-70 COUNTY GUERNSEY
STATE RT. NO. ___ SECT. ___ SEGMENT ___ OFFSET ___
STATION 485+70 OFFSET FROM CENTERLINE 36 RT
INSPECTOR (SIGNED) M. L. Jones DRILLERS NAME/COMPANY CHRIS MARTIN / CTL
EQUIPMENT USED
DRILLING METHODS
CASING: SIZE: ___ ; DEPTH: ___ ; WATER: DEPTH: ___ TIME: ___ DATE: ___
CHECKED BY: ___ ; DATE ___ DEPTH: ___ TIME: ___ DATE: ___
NOT ENCOUNTERED ☐

DEPTH (FT.)	SAMPLE NO. AND TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Inches or Ft.)	RECOVERY (%) / RQD (%)	POCKET PENT or TORVANE (TSF)	USCS / AASHTO	H_2O CONTENT	DESCRIPTION	REMARKS
40 40.5	S-13	50/0.4'							
41.5								41.5'	• 40.5'-41.5' Augered. • Had Auger Refusal at 41.5'
	R-1		0.9/2.0	45% / 0%				Interbedded SANDSTONE and SHALE Greenish-Gray, Hard to Medium Hard, Thin Bedded	
43.5	R-2		1.6/2.0	80% / 0%				• Approx. 41.8' to 43.5' Broken Zone, contains poorly graded sand with fine gravel as infilling between sandstone cobbles.	
45 45.5	R-3		4.2/4.6	91% / 26%					
50 50.1	R-4		5.0/5.0	100% / 90%					
55 55.1	R-5		5.0/5.0	100% / 100%					
60 60.1									

RQD
1.2/4.6
4.5/5.0

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES FOR THIS TEST PIT LOCATION AND SHOW ELEVATIONS

FORM NO (12/89)

ENGINEERS FIELD BORING LOG B-122 4/4

BORING NO. U-22?? SHEET 4 OF 4
DATE: START 6-12-95 END 6-13-95
O.G. ELEV. ____

PROJECT NAME ODOT, I-70 COUNTY GUERNSEY
STATE RT. NO. ____ SECT. ____ SEGMENT ____ OFFSET ____
STATION 485+70 OFFSET FROM CENTERLINE 36 RT
INSPECTOR (SIGNED) M.L. Jones DRILLERS NAME/COMPANY CHRIS MARTIN / CTL
EQUIPMENT USED ____
DRILLING METHODS ____
CASING: SIZE: ____ ; DEPTH: ____ ; WATER: DEPTH: ____ TIME: ____ DATE: ____
CHECKED BY: ____ ; DATE ____ DEPTH: ____ TIME: ____ DATE: ____
NOT ENCOUNTERED ☐

DEPTH (FT.)	SAMPLE NO. AND TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (inches or Ft.)	RECOVERY (%) / RQD (%)	POCKET PENT or TORVANE (TSF)	USCS / AASHTO	H_2O CONTENT	DESCRIPTION	REMARKS
60	R-6		4.7/5.0	94% / 84%				64.6'	
65 65.1	R-7		3.5/5.0	70% / 60%				FLYASH-CEMENT GROUT, Dark Brown contains medium to coarse Sand, Medium Hard. 67.0'	67.0'-67.9' & 68.4'-68.9' Did not loose water or air pressure
								Soft Sediment Filled CAVITY 67.9'	
								FLYASH-CEMENT GROUT 68.4'	
								SOFT SEDIMENT FILLED CAVITY 68.9'	
								FLYASH-CEMENT GROUT 70.1	
70 70.1	R-8		3.8/5.0	76% / 14%				CLAYSTONE, Light Gray, completely weathered, Soft, (UNDERCLAY). 72.5'	
								SANDSTONE, Greenish-Gray, Hard, slightly weathered. 73.4'	
								Poorly graded GRAVEL, (gp), medium gray, very broken, contains fine to coarse sand and gravel gray shale and carbonaceous shale. 75.1	
75 75.1	R-9		5.0/5.0	100% / 80%				SANDSTONE, Light greenish-gray, Hard, Fresh. RQD= 80%	Hole grouted with "BAROID" QUIK-GROUT" 50lb Bags
80 80.1								BOTTOM OF BORING = 80.1 FT	

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES FOR THIS TEST PIT LOCATION AND SHOW ELEVATIONS

B-123

ENGLISH PROJECT 1/2

State of Ohio
Department of Transportation
Office of Materials Management

LOG OF BORING

Date Started 6/6/96 Sampler: Type SS Dia. $1\frac{3}{8}$" Water Elev. - Project Identification: GUERNSEY
Date completed 6/7/96 GUE-70-14.10
Boring No. B-14 Station & Offset 486+00, 50' RT. Surface Elev. 828.2' MINE SUBSIDENCE
SUBSURFACE INVESTIGATION

Elev.	Depth	Std. Pen. (N)	Rec. ft	Loss ft	Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
828.2	0														
827.7		AUGERED			ASPHALT	-	-	-	-	-	-	-	-	-	VISUAL
	2 4	AUGERED			SANDY CLAY (DRILLER'S DESCRIPTION)	-	-	-	-	-	-	-	-	-	VISUAL
823.2	6 8	4/5/7			BROWN SANDY SILT AND CLAY	1	-	-	-	-	-	-	-	22	VISUAL
818.2	10 12 14	8/8/16			BROWN SILT AND CLAY	2	-	-	-	-	-	-	-	20	VISUAL
813.2	16 18	9/14/20			BROWN SILTY CLAY	3	-	-	-	-	-	-	-	22	VISUAL
808.2	20 22 24	3/4/8			BROWN SILTY CLAY	4	-	-	-	-	-	-	-	30	VISUAL
803.2	26 28	3/2/2			BROWN SILTY CLAY	5	-	-	-	-	-	-	-	26	VISUAL
798.2	30 32 34	3/3/3			GRAY SILTY CLAY W/SANDSTONE FRAGS.	6	-	-	-	-	-	-	-	26	VISUAL
793.2	36														

Particle Sizes: Agg= >2.00mm, Coarse Sand= 2.00-0.42mm Fine Sand= 0.42-0.074mm, Silt= 0.074-0.005mm, Clay= <0.005mm

B-123 (2/2)

Boring No. B-14 Station & Offset 486+00, 50' RT. Surface Elev. 828.2' Project GUE-70-14.10

Elev.	Depth	Std. Pen. (N)	Rec. ft	Loss ft	Description	Sample No.	% Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
	38	24/26/30			GRAY SILTY SAND & CLAY W/ST. FRAGS.	7	-	-	-	-	-	-	-	21	VISUAL
788.2	40				TOP OF ROCK (DRILLER'S DESC.)										
		55 (0.5)			GRAY STONE FRAGMENTS W/BROWN SILTY SAND	8	-	-	-	-	-	-	-	12	VISUAL
787.7	42														
	44														
	46														
	48														
	50														
	52				NO DESCRIPTION - DRILLERS USED ROLLER BIT.										
	54														
	56														
	58														
	60														
	62														
	64														
763.2	66		1.8	0.0	GROUT, DARK GRAY, HARD, JOINTED AT THE TOP, BROKEN AND JOINTED AT THE BOTTOM. NO CORE LOSS.										
761.6					*										
761.4					BOTTOM OF BORING										

* SHALE, BLACK, FIRM, CARBONACEOUS, W/THIN CLAY SEAMS, W/SLICKENSIDES, JOINTED. NO CORE LOSS.

Particle Sizes: Agg= >2.00mm, Coarse Sand= 2.00-0.42mm, Fine Sand= 0.42-0.074mm, Silt= 0.074-0.005mm, Clay= <0.005mm

Form TE-151 Revised 5/95

B-125 1/2

FIELD DATA - SOIL LOG

Project Code:

Project Identification: GUE. 70-14.10
Co., Rt., Br.No./Sec.No.

Station: 4 8 3 + 4 0 . 1 Offset: 5 6 R

Order Code: 0 1

Location No. TB 1 Over: MINE

Pier-Abut.

Started: 3-20-95 Equipment: B 53

Completed: 3-21-95 Water Level:

1 OF 2

Depth Feet	Samples	Elevation	Description
0			1.0' SAND + GRAVEL ROAD BASE
			BRN. SNDY CLAY
	(1)		2.5-4.0 B 7-6-11
5			GREY SILTY CLAY
	(2)		5.0-6.5 B 6-6-8
			BRN + GREY SILTY CLAY
	(3)		7.5-9.0 B 6-7-9
10			BRN + GREY SILTY CLAY
	(4)		10.0-11.5 B 5-5-6
			BRN + GREY SILTY CLAY
	(5)		12.5-14.0 B 3-5-5
15			GREY SILTY CLAY
	(6)		15.0-16.5 B 4-4-7
			GREY SILTY CLAY
	(7)		17.5-19.0 B 3-4-7
20			BRN SILTY CLAY WET AT 20.0'
	(8)		20.0-21.5 B 4-8-11
			BRN SILTY CLAY TO BRN CLAY W/STN. FRAGS
	(9)		22.5-24.0 B 5-6-9
25	(10)		(moist) GR. SANDY clay w/stone frags
			25.0-26.5 B 2-5-4
	(11)		GREY SILTY CLAY
			27.5-29.0 B 2-3-4
30			GREY SILTY CLAY
	(12)		30.0-31.5 B 3-3-5
			GR. SILT CLAY TO SILTY SAND W/STONE FRAGS
	(13)		32.5-34.0 B 6-14-37
35			SILTY SAND w/some clay + stone frags
	(14)		35.0-36.0 B 43-60
			SILTY SANDY CLAY w/STONE FRAGS
	(15)		37.5-39.0 B 17-21-16
40	1		40.0-46.0 W.O.H. VOID
			Tube dropped 40'-46' w/ weight of Hammer
45			GREY SHALEY CLAY w/weak shale frags
	(16)		46.0-46.5 B 50
			AIR DISCHARGE FROM HOLE
50			AUGERED TO 48
			ROLLER BIT TO 50 WATER Come + Go
			WEAK Broken shale w/clay seams
	(17)		50.0-51.5 B 8-28-28
55			GREY SHALE, WASHED AWAY CLAY
			CORED FROM 51.5'-55.0' REC. .8'
			PUT IN ROLLER BIT DRILLED DOWN TO 56.5'
60			SANDY GREY SHALE

Remarks: CORED FROM 56.5'-60.0 REC 1.0'

Party: PITTS, WILLIS

Chief of Party: Mitchell

Form TE-40 DOT-Revised 1/92

B-125 2/2

FIELD DATA - SOIL LOG

Project Code:

Project Identification: GUE 70-14.10 (Co., Rt., Br.No./Sec.No.)

Station: 483+40. Offset: 56 RT

Order Code: 01

Location No. TB1 Over: MINE

Pier-Abut.

Started: 3-20-95 Equipment: B53

Completed: 3-21-95 Water Level:

2 OF 2

Depth Feet	Samples	Elevation	Description
0			
65			RAN AUGERS DOWN TO 65.0 THRU BROKEN ROCK
70			BROKEN SANDY SHALE + WOOD CORED FROM 65.0-70.0 REC 1.0'
75			HARD FIRECLAY + SANDY SHALE CORED FROM 70.0-75.0 REC 3.5'
			E.O.B 75.0'
20			
25			
30			
35			
40			
45			
50			
55			
60			

Remarks:

Party:

Chief of Party:

Form TE-8
DOT-Revised 1/92

FORM NO: (12/89)

ENGINEERS FIELD BORING LOG

B-126-1/4

BORING NO. 380A
SHEET 1 OF 4
DATE: START ____
O.G. ELEV. ____ END ____

PROJECT NAME ODOT I-70 COUNTY GUERNSEY
STATE RT. NO. ____ SECT. ____ SEGMENT ____ OFFSET ____
STATION 478+70 OFFSET FROM CENTERLINE 36 L
INSPECTOR (SIGNED) BOB LOUGHNER DRILLERS NAME/COMPANY ED HILL / CTL
EQUIPMENT USED CME RIG
DRILLING METHODS ____
CASING: SIZE: ____ ; DEPTH: ____ ; WATER: DEPTH: ____ TIME: ____ DATE: ____
CHECKED BY: ____ ; DATE ____ DEPTH: ____ TIME: ____ DATE: ____
NOT ENCOUNTERED ☐

DEPTH (FT.)	SAMPLE NO. AND TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Inches or Ft.)	RECOVERY (%) / RQD (%)	POCKET PENT or TORVANE (TSF)	USCS / AASHTO	H_2O CONTENT	DESCRIPTION	REMARKS
0 – 3.0									
3.0 – 4.5	S1	7 9 9	.1/1.5	7%			WET	SMALL PIECES OF SHALE, SOME CLAY, WET BOULDER AT 3.5'	
4.5 – 6.0									
6.0 – 7.5	S2	6 4 6	.8/1.5	53%		CL	MOIST	Br & GRAY SOFT CLAY MOIST SOME SAND & SILT	
7.5 – 9.0									
9.0 – 10.5	S3	3 3 2	1.0/1.5	67%		CL	MOIST		
10.5 – 12.0									
12.0 – 13.5	S4	2 2 2	1.2/1.5	75%		CL	MOIST	Gray Soft. Silty CLAY MOIST	
13.5 – 15.0									
15.0 – 16.5	S5	1 1 2	1.5/1.5	100%			WET		
16.5 – 18.0									
18.0 – 19.5	S6	2 2 3	0.0/1.5	0%			WET		

Margin depth marks: 0, 5.0, 10, 15, 20

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES FOR THIS TEST PIT LOCATION AND SHOW ELEVATIONS

FORM NO: (12/89)

ENGINEERS FIELD BORING LOG B-126 2/4

BORING NO. J80A
SHEET 2 OF 4
DATE: START
O.G. ELEV. END

PROJECT NAME O DOT I-70 COUNTY GUERNSEY
STATE RT. NO. SECT. SEGMENT OFFSET
STATION 478+70 OFFSET FROM CENTERLINE 36 L
INSPECTOR (SIGNED) DRILLERS NAME/COMPANY
EQUIPMENT USED
DRILLING METHODS
CASING: SIZE: ; DEPTH: ; WATER: DEPTH: TIME: DATE:
CHECKED BY: ; DATE DEPTH: TIME: DATE:
NOT ENCOUNTERED ☐

DEPTH (FT.)	SAMPLE NO. AND TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Inches or Ft.)	RECOVERY (%) / RQD (%)	POCKET PENT or TORVANE (TSF)	USCS / AASHTO	H_2O CONTENT	DESCRIPTION	REMARKS
21									
	S7	2 2 2	1.2/1.5	75%		CL	Moist	Gray moist to wet soft silty CLAY	
22.5									
24.0									
25	S8	4 6 9	1.5/1.5	100%		GC	Moist	Silty sand & gravel with some clay, soft	
25.5									
27.0									
	S9	3 3 4	1.5/1.5	100%		CL	Moist	Brown silty clay soft moist	
28.5									
30									
	S10	2 2 3	1.5/1.5	100%		CL	Moist		
31.5									
33.0									
	S11	4 4 4	1.5/1.5	100%		CL	Moist		
34.5									
35									
36.0									
	S12	4 7 11	1.2/1.5	75%		GC	Moist	Silty sand & gravel with some clay, soft	
37.5									
39									
	S13	3 3 4	1.5/1.5	100%		CL	Moist	Gray soft silty CLAY,	
40									

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES FOR THIS TEST PIT LOCATION AND SHOW ELEVATIONS

FORM NO: (12/89)

ENGINEERS FIELD BORING LOG

B-126 3/4

BORING NO. 180A
SHEET 3 OF 4
DATE: START ____
O.G. END ____
ELEV. ____

PROJECT NAME O-DOT I-70 COUNTY GUERNSEY
STATE RT. NO. ____ SECT. ____ SEGMENT ____ OFFSET ____
STATION 478+70 OFFSET FROM CENTERLINE 36 L
INSPECTOR (SIGNED) ____ DRILLERS NAME/COMPANY ____
EQUIPMENT USED ____
DRILLING METHODS ____
CASING: SIZE: ____ ; DEPTH: ____ ; WATER: DEPTH: ____ TIME: ____ DATE: ____
CHECKED BY: ____ ; DATE ____ DEPTH: ____ TIME: ____ DATE: ____
NOT ENCOUNTERED ☐

DEPTH (FT.)	SAMPLE NO. AND TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Inches or Ft.)	RECOVERY (%) / RQD (%)	POCKET PENT or TORVANE (TSF)	USCS / AASHTO	H_2O CONTENT	DESCRIPTION	REMARKS
40									
42.0–43.5	S14	13, 17, 37	1.5/1.5	100%				SAND & GRAVEL WITH PIECES OF SANDSTONE, HARD	
45	S15	30, 50/.5						46.0	TOP OF ROCK
	R1		4.0/4.0	100%/35%				Gray Med-Hard SANDSTONE Some Silty Shale WEATHERED CLAYSEAM @ 47.	
50	R2		5.0/5.0	100%/8%				GRAY SHALE AND SANDSTONE MED-HARD CLAY SEAM AT 49'	
55	R3		3.5/5.0	70%/10%				VOID FROM 58' to 59.5' GROUT 59.5 to 60.0	
60									

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES FOR THIS TEST PIT LOCATION AND SHOW ELEVATIONS

FORM NO: (12/89)

ENGINEERS FIELD BORING LOG

B-126 4/4

BORING NO. J80A
SHEET 4 OF 4
DATE: START ___
END ___
O.G. ELEV. ___

PROJECT NAME I-70 O-DOT COUNTY GUERNSEY
STATE RT. NO. ___ SECT. ___ SEGMENT ___ OFFSET ___
STATION 478+70 OFFSET FROM CENTERLINE 36L
INSPECTOR (SIGNED) ___ DRILLERS NAME/COMPANY ___
EQUIPMENT USED ___
DRILLING METHODS ___
CASING: SIZE: ___ ; DEPTH: ___ ; WATER: DEPTH: ___ TIME: ___ DATE: ___
CHECKED BY: ___ ; DATE ___ DEPTH: ___ TIME: ___ DATE: ___
NOT ENCOUNTERED ☐

DEPTH (FT.)	SAMPLE NO. AND TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Inches or Ft.)	RECOVERY (%) / RQD (%)	POCKET PENT or TORVANE (TSF)	USCS / AASHTO	H_2O CONTENT	DESCRIPTION	REMARKS
60	R4		3.8/5.0	76%/0%				Gray Med-Hard SHALE AND SANDSTONE 4" Void AT 62.5 3" Void AT 64'	
								LOST APPROX 50% water AT 64'	
65	R5		3.5/5.0	70%/0%				Gray Med-Hard Silty SHALE Badly Broken	
								Gray Under CLAY, soft	
70	R6		5.0/5.0	100%/50%					
75								75.0	Bot. of Hole
									200 GALLONS OF GROUT DID NOT FILL HOLE CONTRACTOR TOPPED HOLE OFF WITH 80/20

NOTE: DRAW STRATIFICATION LINES AT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES FOR THIS TEST PIT LOCATION AND SHOW ELEVATIONS

Water Well Log and Drilling Report
Ohio Department of Natural Resources
Division of Water
Phone: 614-265-6740
email: cleve.brown@dnr.state.oh.us
Water Home: http://www.dnr.state.oh.us/water

WELL LOG AND DRILLING REPORT

Well Log Number: 602847 [redacted]

ORIGINAL OWNER AND LOCATION

Original Owner Name: *TERRY CHAPMAN* **Lot Number:**
County: *GUERNSEY* **Township:** *CENTER* **Section Number:**
Address: *14720 ZANE ROAD*
City: **State:** *OH* **Zip Code:**
Location Number: *43* **Location Map Year:** *1988* **Location Area:**

CONSTRUCTION DETAILS

Borehole Diameter: **Total Depth:** *40 ft.* **Depth to Bedrock:**
Casing Diameter: *6 in.* **Casing Thickness:** **Casing Length:** *42 ft.*
Well Use: **Screen Length:** **Date of Completion:** *12/14/84*
Aquifer Type: *SHALE* **Driller's Name:** *WAGGONER WELL DRILLING*

WELL TEST DETAILS

Static Water Level: *5 ft.* **Test Rate:** *3 gpm*
Drawdown: *0 ft.* **Test Duration:** *2.5 hrs*

Associated Reports
NONE

COMMENTS:

WELL LOG

Formations	From	To
CLAY	0	- 5
SHELLS LIME SAND	5	- 10
GRY SANDSTONE	10	- 32
GRY SHALE	32	- 35
GRY SHALE	35	- 40

43

WE' LOG AND DRILLING RE'ORT

ORIGINAL

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Geological Survey
Fountain Square
Columbus, Ohio 43224 Phone (614) 466-5344

NO CARBON PAPER NECESSARY– SELF-TRANSCRIBING

492112

COUNTY Guernsey TOWNSHIP Center SECTION OF TOWNSHIP OR LOT NUMBER

OWNER Rodney King ADDRESS Cambridge R.D. 4

LOCATION OF PROPERTY 5 mile East of Cambridge on old Rt 40 on twp Rd 365

CONSTRUCTION DETAILS

Casing diameter 8" Length of casing 20

Type of screen Length of screen

Type of pump

Capacity of pump

Depth of pump setting

Date of completion 11/3/75

BAILING OR PUMPING TEST

(specify one by circling)

Test rate 4 gpm Duration of test 3 hrs

Drawdown Complete ft Date 11/3/75

Static level (depth to water) 47' ft

Quality (clear, cloudy, taste, odor)

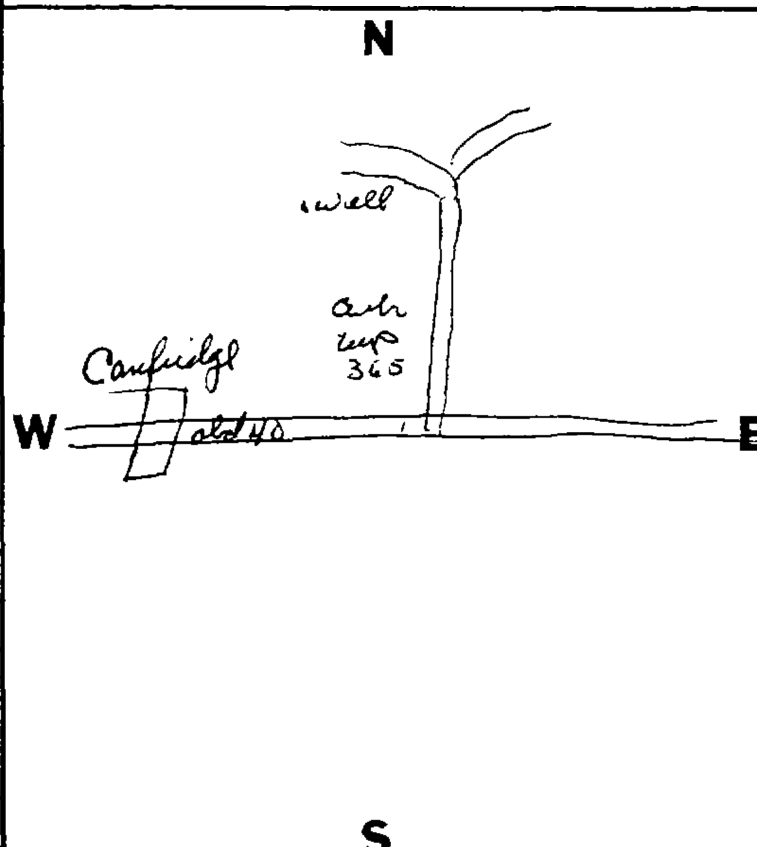
Pump installed by

WELL LOG*

Formations: sandstone, shale, limestone, gravel, clay	From	To
Clay	0 ft	4 ft
Brown shale	4	36
Gray shale	36	52
dark shale	52	68
Gray shale	68	75
Red shale	75	83
Sand stone	83	86
Gray shale	86	92
Red shale	92	100
Well lined with 85' of liner		
100 gal storage		

SKETCH SHOWING LOCATION

Locate in reference to numbered state highways, street intersections, county roads, etc.



DRILLING FIRM Dan Wells & Son DATE 11/3/75

ADDRESS R.D 1 Cambridge Ohio SIGNED James R Wells

*If additional space is needed to complete well log, use next consecutive numbered form.

Water Well Log and Drilling Report
Ohio Department of Natural Resources
Division of Water
Phone: 614-265-6740
email: cleve.brown@dnr.state.oh.us
Water Home: http://www.dnr.state.oh.us/water

WELL LOG AND DRILLING REPORT

Well Log Number: 492111 [redacted]

ORIGINAL OWNER AND LOCATION

Original Owner Name: *ROLAND GADD* **Lot Number:**
County: *GUERNSEY* **Township:** *CENTER* **Section Number:**
Address: *SUNDEW*
City: **State:** *OH* **Zip Code:**
Location Number: *57* **Location Map Year:** *1988* **Location Area:**

CONSTRUCTION DETAILS

Borehole Diameter: **Total Depth:** *85 ft.* **Depth to Bedrock:**
Casing Diameter: *8 in.* **Casing Thickness:** **Casing Length:** *21 ft.*
Well Use: **Screen Length:** **Date of Completion:** *11/1/75*
Aquifer Type: *SHALE* **Driller's Name:** *WELLS & SON, J.R.*

WELL TEST DETAILS

Static Water Level: *43 ft.* **Test Rate:** *20 gpm*
Drawdown: **Test Duration:** *3 hrs.*

Associated Reports
NONE

COMMENTS:

WELL LOG

Formations	From	To
CLAY	0	- 4
BRN SHALE	4	- 35
GRY SHALE	35	- 42
DRK SHALE	42	- 55
COAL	55	- 56
BRN SHALE	56	- 64
GRY SHALE	64	- 85

57

ORIGINAL

WELL LOG AND DRILLING REPORT

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1562 W. First Avenue
Columbus 12, Ohio

PLEASE USE PENCIL OR TYPEWRITER DO NOT USE INK.

Nº 295914

County Guernsey Township Center Section of Township 13

Owner Richard Poole Address RT. 4 Cambridge O.

Location of property On Twp Rd - 365 - Off. US 40 - 5 mi. E. Cambridge O.

CONSTRUCTION DETAILS

Casing diameter 8 5/8" Length of casing 18'

Type of screen — Length of screen —

Type of pump —

Capacity of pump To be set by Owner

Depth of pump setting

Date of completion Incomplete

BAILING OR PUMPING TEST

Pumping Rate Bail Test 5 gpm G.P.M. Duration of test hrs.

Drawdown ft. Date 7/18/63

Static level-depth to water 15' ft.

Quality (clear, cloudy, taste, odor) Clear, good Taste

Pump installed by Owner

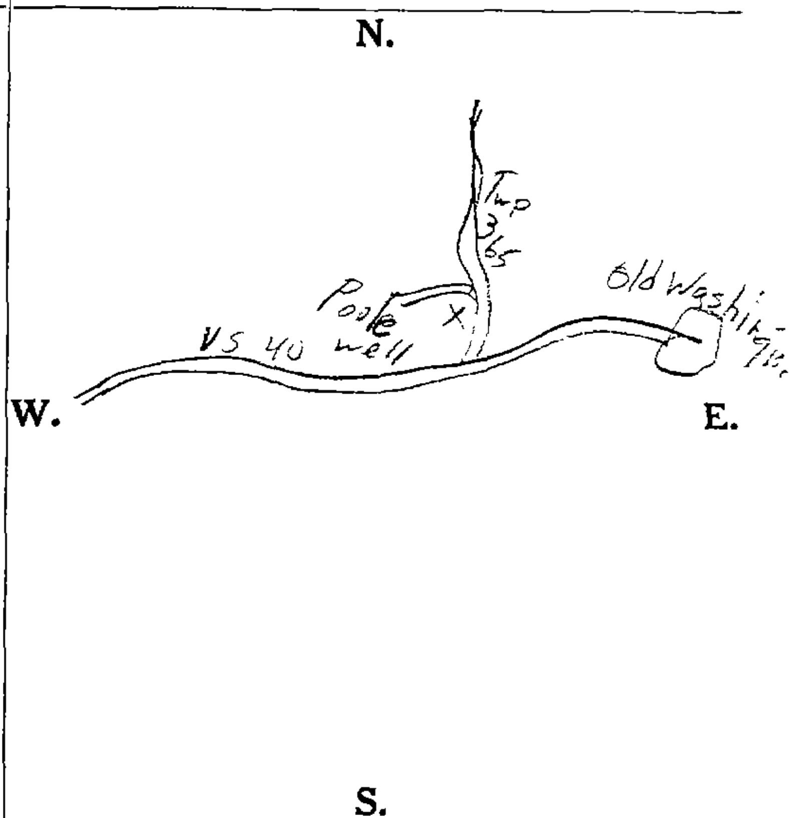
WELL LOG

Formations Sandstone, shale, limestone, gravel and clay	From	To
Soil + clay	0 Feet	3 Ft.
Limestone	3	5
Br. Sandr.	5	15
Blue Core	15	25
Slate	25	30
Sandrock	30	45
Bl. Core Lime	45	60
Sandr.	60	100
Shale	100	120

water at 50' + 114'
5 gpm.

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



See reverse side for instructions

Drilling Firm Marlatt Drilling Date

Address RT. 3 Cambridge O. Signed [illegible signature]

WELL LOG AND DRILLING REPORT

ORIGINAL

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1562 W. First Avenue
Columbus, Ohio

PLEASE USE PENCIL OR TYPEWRITER. DO NOT USE INK.

No. 268494

County Guernsey Township Center Section of Township 8

Owner Robt Cunningham Address Lore City #RD1

Location of property Sec 8 Center Twp

CONSTRUCTION DETAILS	
Casing diameter 8 3/4	Length of casing 19'
Type of screen —	Length of screen —
Type of pump Jet Deep Well	
Capacity of pump To be installed	
Depth of pump setting at Later Date	
Date of completion Incomplete	

BAILING OR PUMPING TEST	
Pumping rate 5 G.P.M.	Duration of test ____ hrs.
Drawdown — ft.	Date 1/28/62
Developed capacity Bail Test 5 gpm	
Static level—depth to water 12' ft.	
Pump installed by Owner	

WELL LOG

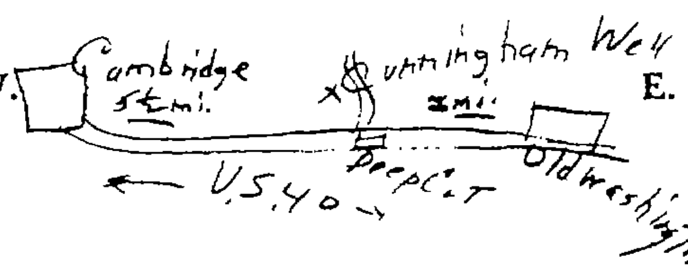
Formations Sandstone, shale, limestone, gravel and clay	From	To
Surf + Soil	0 Feet	4 Ft.
Clay —	4	8
Br. Shale	8	12
Sandy Shale	12	18
Sandrock	18	40
Blue Core	40	45
Limestone	45	48
Blue Shale	48	65
Sand stone	65	85
Fireclay	85	88
Blue Core + Lime	88	102
water at ~~65~~ 88'		
5 to 6 gpm		

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.

N.

See 8 Center Twp.

W.  E.

S.

See reverse side for instructions

Drilling Firm Marlatt Drilling Date 1/28/62

Address RT 3 Cambridge O. Signed Don B. Marlatt

59

WELL LOG AND DRILLING REPORT

ORIGINAL

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1562 W. First Avenue
Columbus, Ohio

PLEASE USE PENCIL OR TYPEWRITER. DO NOT USE INK.

No. 268493

County Guernsey Township Center Section of Township 8

Owner Deb Fisher Address RD #3 Cambridge, Ohio

Location of property Sec 8 Center Twp. - Just off U.S. 40 - AT Deep Cut - 2 mi W. Old Washington

CONSTRUCTION DETAILS

Casing diameter 8 5/8 Length of casing 19'

Type of screen — Length of screen

Type of pump Deep Well Jet

Capacity of pump To be installed

Depth of pump setting To be installed

Date of completion by Owner

BAILING OR PUMPING TEST

Pumping rate 10 G.P.M. Duration of test ____ hrs.

Drawdown — ft. Date 9/25/62

Developed capacity Bail Test - 10 gPM

Static level—depth to water 15' St. Level ft.

Pump installed by Owner

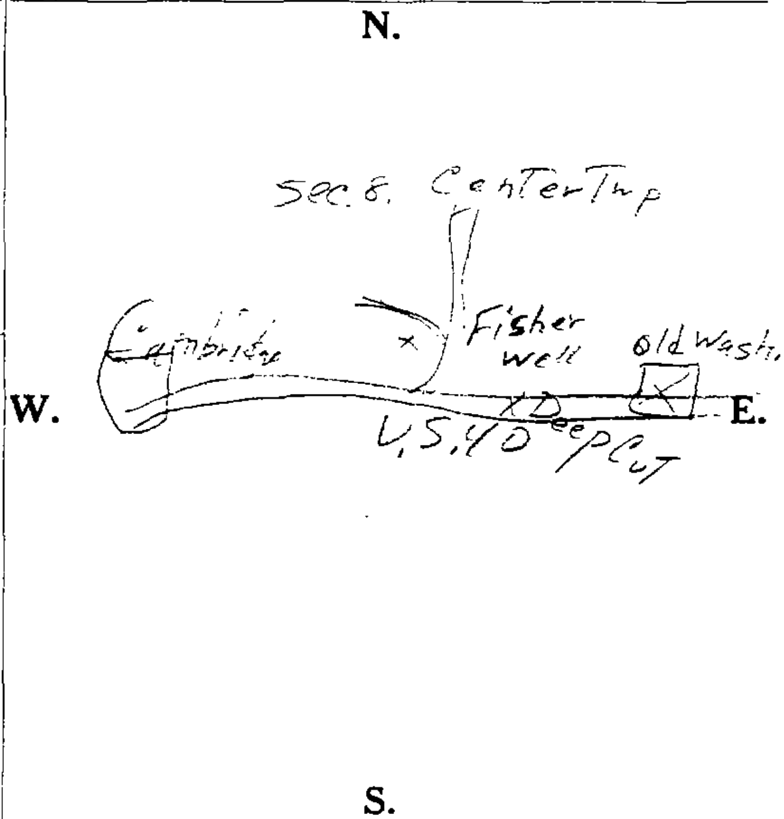
WELL LOG

Formations Sandstone, shale, limestone, gravel and clay	From	To
Clay + Silt	0 Feet	6 Ft.
Shale Br.	6	12
Sandy Sh.	12	18
Br. Sand	18	36
Blue Lime	36	62
Sandstone	62	90
Fire clay	90	95
Limestone	95	102
Fireclay	102	104

Water at 68 } 10 g.p.m.
" at 89 }

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



See reverse side for instructions

Drilling Firm Marlatt Drilling Date 9/25/62

Address RT 3 Cambridge O. Signed [illegible]

Water Well Log and Drilling Report
Ohio Department of Natural Resources
Division of Water
Phone: 614-265-6740
email: cleve.brown@dnr.state.oh.us
Water Home: http://www.dnr.state.oh.us/water

WELL LOG AND DRILLING REPORT

Well Log Number: 48509 [redacted]

ORIGINAL OWNER AND LOCATION

Original Owner Name: *LESLIE LARRICK* **Lot Number:**
County: *GUERNSEY* **Township:** *CENTER* **Section Number:**
Address: *US ROUTE 40*
City: **State:** *OH* **Zip Code:**
Location Number: *61* **Location Map Year:** *1945* **Location Area:**

CONSTRUCTION DETAILS

Borehole Diameter: **Total Depth:** *100 ft.* **Depth to Bedrock:**
Casing Diameter: *6 25 in.* **Casing Thickness:** **Casing Length:** *10 ft.*
Well Use: **Screen Length:** **Date of Completion:** *12/10/48*
Aquifer Type: *SHALE* **Driller's Name:** *LARRICK FRANCIS*

WELL TEST DETAILS

Static Water Level: *54 ft.* **Test Rate:** *2 gpm*
Drawdown: **Test Duration:** *24 hrs.*

Associated Reports
NONE

COMMENTS:

WELL LOG

Formations	From	To
CLAY	0	10
SANDSTONE	10	48
RED SHALE	48	53
SHALE	53	65
COAL	65	68
FIRE CLAY	68	70
SHELLS LIME SAND	70	75
BRN SHALE	75	95
SHALE	95	100
WATER AT	73	73

61

Water Well Log and Drilling Report
Ohio Department of Natural Resources
Division of Water
Phone: 614-265-6740
email: cleve.brown@dnr.state.oh.us
Water Home: http://www.dnr.state.oh.us/water

WELL LOG AND DRILLING REPORT

Well Log Number: 365085 [redacted]

ORIGINAL OWNER AND LOCATION

Original Owner Name: *HENRY LEONHARDT* **Lot Number:**
County: *GUERNSEY* **Township:** *CENTER* **Section Number:** *12*
Address: *ST RT 40*
City: **State:** *OH* **Zip Code:**
Location Number: *62* **Location Map Year:** *1988* **Location Area:**

CONSTRUCTION DETAILS

Borehole Diameter: **Total Depth:** *90 ft.* **Depth to Bedrock:**
Casing Diameter: *8.63 in.* **Casing Thickness:** **Casing Length:** *25 ft.*
Well Use: **Screen Length:** **Date of Completion:** *5/1/68*
Aquifer Type: *SHALE* **Driller's Name:** *MARLATT WELL DRILLING*

WELL TEST DETAILS

Static Water Level: *25 ft* **Test Rate:** *4 gpm*
Drawdown: **Test Duration:**

Associated Reports
NONE

COMMENTS:

WELL LOG

Formations	From	To
CLAY	0	- 4
SURFACE	4	- 4
SHALE	4	- 20
SANDSTONE	20	- 35
BLU CORED	35	- 50
FIRE CLAY	50	- 55
SOFT SHALE	55	- 68
BLU CORED	68	- 75
SHALE	75	- 90
WATER AT	50	- 50
WATER AT	80	- 80

62

ORIGINAL

W̄LL LOG AND DRILLING REP̄RT

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1500 Dublin Road
Columbus, Ohio

No. 196904

County Guernsey Township Center Section of Township 13

Owner Neal Gillespie Address Upland Road, Cambridge, O.

Location of property ½ mi North of U.S. 40 on Twp. Road 706

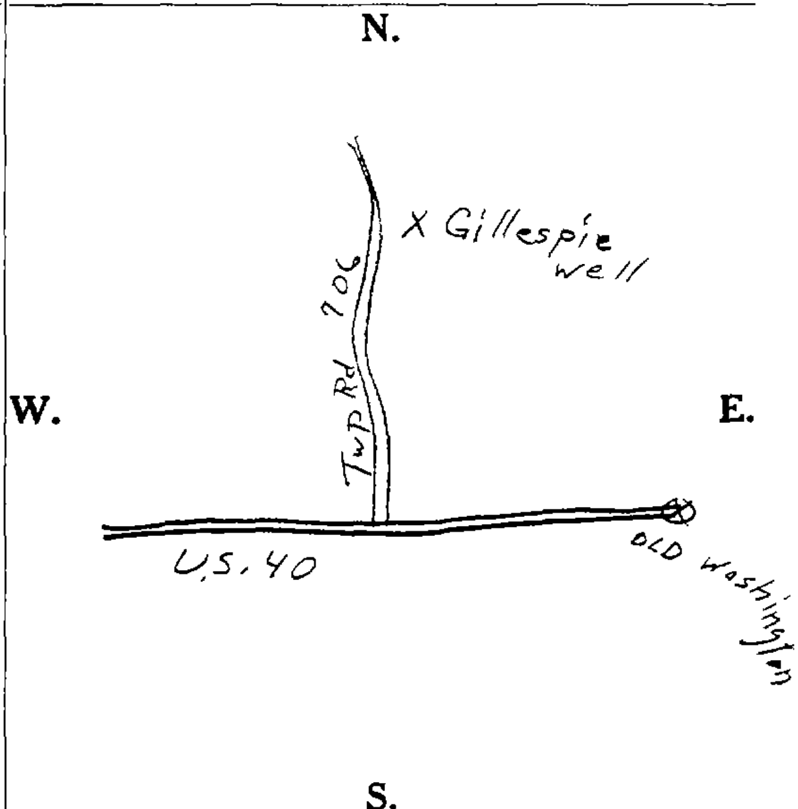
CONSTRUCTION DETAILS	BAILING OR PUMPING TEST
Casing diameter 8" Length of casing 15'	Pumping rate ...... G.P.M. Duration of test ...... hrs.
Type of screen ...... Length of screen	Drawdown ...... ft. Date 5/26/57
Type of pump	Developed capacity 50 g.p.h.
Capacity of pump Not yet installed	Static level—depth to water 160' ft.
Depth of pump setting	Pump installed by Owner
Date of completion	

WELL LOG

Formations Sandstone, shale, limestone, gravel and clay	From	To
0—15 Yell. Clay	0 Feet	15 Ft.
Grey Shale	15	22
Fireclay	22	35
Blue Sandrock-H.	35	55
Limestone	55	60
Slate	60	65
Lime Rock	65	80
Blue Sand + Lime	80	105
Hard Sandrock	105	120
BL. Slate	120	135
Coal	135	137
Fireclay	137	150
Limerock	150	175
White Sandrock	175	195
water at 175'	50 g.p.h.	

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



See reverse side for instructions

Drilling Firm Danice Marlatt Contr. Date 6/26/57

Address RD4 Cambridge, Ohio Signed Danice Marlatt

(1078)

WELL LOG AND DRILLING REPORT

ORIGINAL

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1500 Dublin Road
Columbus, Ohio

No. 196903

County Guernsey Township Center Section of Township 13

Owner D.G. Fisher Address 73 Gomber, Cambridge

Location of property ½ mi. North of U.S. 40 - on Twp rd. 706

CONSTRUCTION DETAILS	BAILING OR PUMPING TEST
Casing diameter 8" Length of casing 18'	Pumping rate ...... G.P.M. Duration of test ...... hrs.
Type of screen ...... Length of screen	Drawdown ...... ft. Date 5/20/57
Type of pump	Developed capacity 3 g.p.m. Bail Test
Capacity of pump Not yet installed	Static level—depth to water 15' ft.
Depth of pump setting	Pump installed by Owner
Date of completion	

WELL LOG

Formations Sandstone, shale, limestone, gravel and clay	From	To
Yellow Clay	0 Feet	15 Ft.
Grey Shale	15	22
Fireclay	22	35
Sandrock Blue	35	54
Limestone	54	55
Slate	57	57
Fireclay	57	65
Blue Sandrock	65	80
Limestone	80	81
Blue Sandrock	81	95
Limestone	95	105

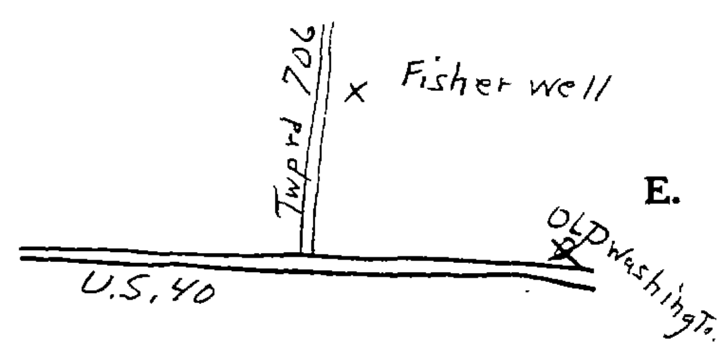
water at 68' - ½ gal. p.m.
water at 95 - 1½ g.p.m.

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.

N.

W. E.



S.

See reverse side for instructions

Drilling Firm Donice Marlatt Date Donice Marlatt

Address RD 4 Cambridge, Ohio Signed 5/20/57

(104)

Water Well Log and Drilling Report
Ohio Department of Natural Resources
Division of Water
Phone: 614-265-6740
email: cleve.brown@dnr.state.oh.us
Water Home: http://www.dnr.state.oh.us/water

WELL LOG AND DRILLING REPORT

Well Log Number: 20586 [redacted]

ORIGINAL OWNER AND LOCATION

Original Owner Name: *MCCOUL* **Lot Number:**
County: *GUERNSEY* **Township:** *CENTER* **Section Number:**
Address: *US ROUTE 40*
City: **State:** *OH* **Zip Code:**
Location Number: *65* **Location Map Year:** *1945* **Location Area:**

CONSTRUCTION DETAILS

Borehole Diameter: **Total Depth:** *125 ft.* **Depth to Bedrock:**
Casing Diameter: *8 in.* **Casing Thickness:** **Casing Length:** *20 ft*
Well Use: **Screen Length:** **Date of Completion:** *9/25/48*
Aquifer Type: *SAND* **Driller's Name:**

WELL TEST DETAILS

Static Water Level: *20 ft.* **Test Rate:** *3 gpm*
Drawdown: *60 ft* **Test Duration:** *16 hrs.*

Associated Reports
NONE

COMMENTS:

WELL LOG

Formations	**From**	**To**
FILL MATERIAL	0	8
BLU SHALE	8	18
SAND	18	50
SHALE	50	70
SAND	70	110
SHALE	110	115
SAND	115	125
WATER AT	40	40
WATER AT	90	90

WELL LOG AND DRILLING REPORT

ORIGINAL

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1500 Dublin Road
Columbus, Ohio

No. 196905

County Guernsey Township Center Section of Township 13

Owner P.L. PachuTa Address N. 8Th ST. Cambridge, O.

Location of property On Co. Rd. 60 1 mi. North of U.S. 40

CONSTRUCTION DETAILS

Casing diameter 8" Length of casing 15'

Type of screen ______ Length of screen ______

Type of pump ______

Capacity of pump To be by Owner

Depth of pump setting ______

Date of completion ______

BAILING OR PUMPING TEST

Pumping rate ______ G.P.M. Duration of test ______ hrs.

Drawdown ______ ft. Date 5/28/57

Developed capacity 60 g.p.hr.

Static level—depth to water ______ ft.

Pump installed by To be by owner

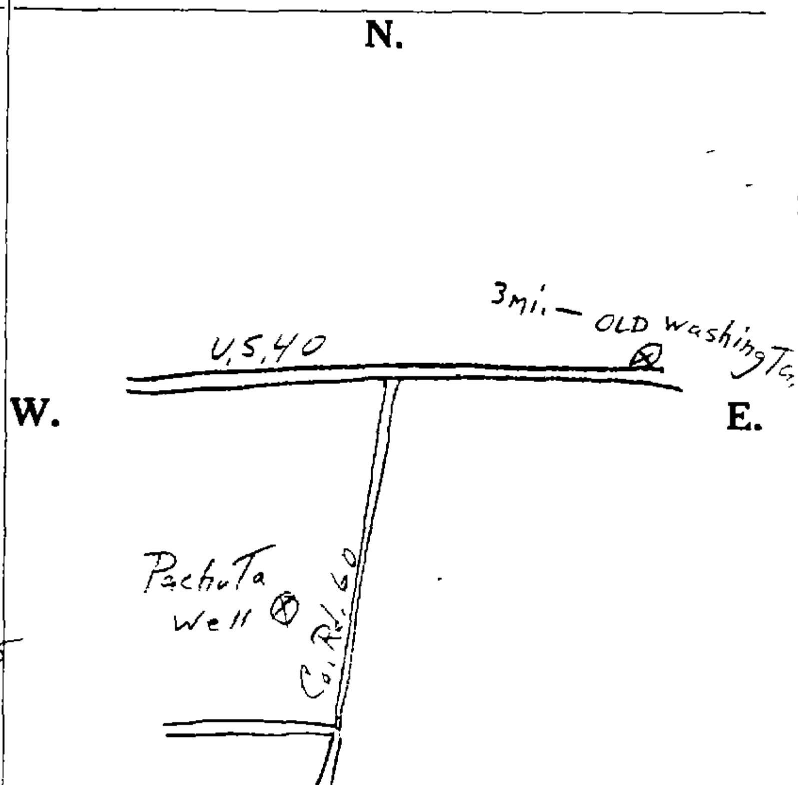
WELL LOG

Formations Sandstone, shale, limestone, gravel and clay	From	To
Clay	0 Feet	7 Ft.
Grey Shale	7	17
Hard Sandrock	17	19
Fireclay	19	30
Limestone	30	32
H. Blue Sandrock	32	60
White Sandrock	60	75
Bl. Sand + Limerock	75	95
grey shale	95	100
Grey Slate	100	103
Fireclay	103	108
Grey Shale	108	138
138–155 Hard Bl. Sandrock	138	155

Water at 75'
Water at 140'

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



See reverse side for instructions

Drilling Firm Donice Marlatt Date 6/24/57

Address R.D. 4 Cambridge, Ohio Signed Donice Marlatt

ORIGINAL

WELL LOG AND DRILLING REPORT

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1562 W. First Avenue
Columbus 12, Ohio

PLEASE USE PENCIL OR TYPEWRITER DO NOT USE INK.

№ 295912

County Guernsey Township Center Section of Township 8

Owner Carl Benson Address Cambridge RD 4

Location of property 1/2 mi East of Old Washington, Ohio off Rt 40

CONSTRUCTION DETAILS	
Casing diameter	7"
Length of casing	19'
Type of screen	—
Length of screen	—
Type of pump	To be set by
Capacity of pump	
Depth of pump setting	owner
Date of completion	Incomplete

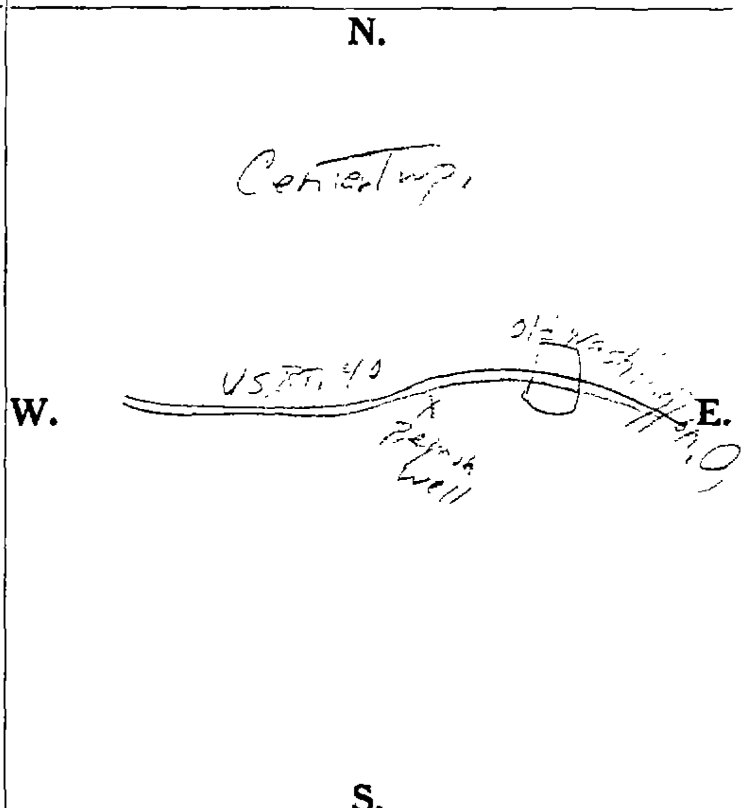
BAILING OR PUMPING TEST	
Pumping Rate	2 G.P.M.
Duration of test	Bail Time hrs.
Drawdown	— ft.
Date	7/12/63
Static level-depth to water	60 ft.
Quality (clear, cloudy, taste, odor)	Good + clear
Pump installed by	To be by Owner

WELL LOG

Formations Sandstone, shale, limestone, gravel and clay	From	To
Clay + shale	0 Feet	6 Ft.
Limestone	6'	10'
Blue core	10'	22'
grey Shale	22'	40
Sandrock	40	75
Blue Shale	75	90
Blue Core	90	110
Sandrock	110	130
Dry ... 95' - 115'		

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



See reverse side for instructions

Drilling Firm Merlatt + Sons Date 7/12/63

Address RT 3 Cambridge O. Signed [illegible]

WELL LOG AND DRILLING REPORT

ORIGINAL

PLEASE USE PENCIL OR TYPEWRITER DO NOT USE INK.

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1562 W. First Avenue
Columbus 12, Ohio

№ 295907

County Guernsey Township Center Section of Township 12

Owner Carl Beynon Address RT. 4 Cambridge, O.

Location of property On U.S. 40 - 1 mi. West of Old Washington, O.

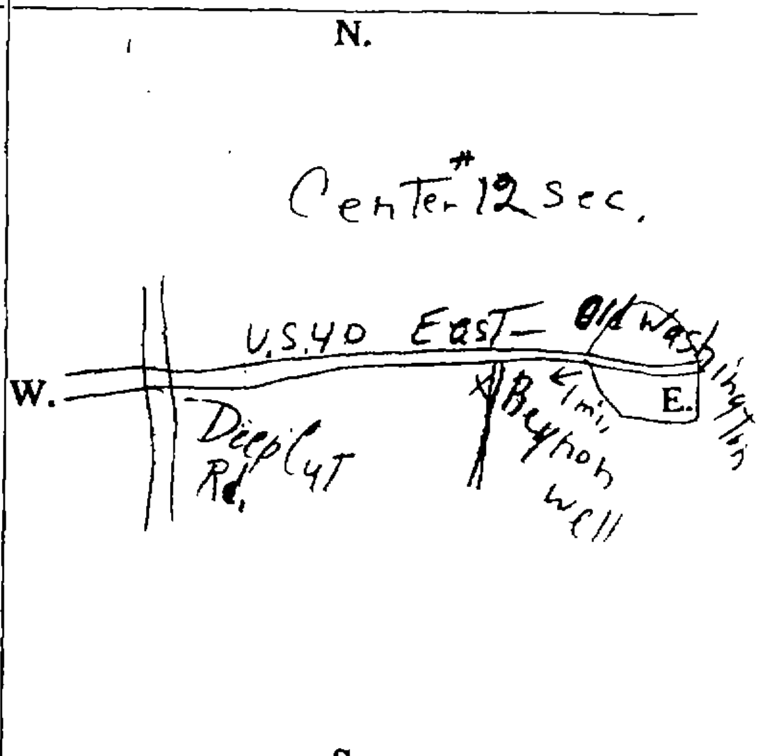
CONSTRUCTION DETAILS	BAILING OR PUMPING TEST
Casing diameter 8 5/8" Length of casing 20'	Pumping Rate 6 G.P.M. Duration of test Bail Test hrs.
Type of screen Length of screen	Drawdown ft. Date 5/15/63
Type of pump Jet - Deep Well	Static level-depth to water 20' ft.
Capacity of pump	Quality (clear, cloudy, taste, odor)
Depth of pump setting Set by Owner	Clear - good Taste
Date of completion	Pump installed by Owner

WELL LOG

Formations Sandstone, shale, limestone, gravel and clay	From	To
Clay + Surf. Soil	0 Feet	4 Ft.
Shale Br.	4	18
Sandrock Br.	18	35
Blue Core	35	48
Shale gray	48	60
gray slate	60	65
grey Shale	65	72
Sandrock	72	85
Fireclay	85	92
Sandstone	92	100
water at 32' + 92'		
6 g.p.m.		

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



See reverse side for instructions

Drilling Firm Marlatt Drilling Date 5/15/63

Address RT. 3 Cambridge, O. Signed Donald B. Marlatt

68

W[illegible]LL LOG AND DRILLING REP[illegible]RT

ORIGINAL

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1500 Dublin Road
Columbus, Ohio

No. 196929

County Guernsey Township Center Section of Township 13

Owner Carl Beynon Address Park Ave, Cambridge O.

Location of property On U.S. 40 - 6 mi. East of Cambridge, O.

CONSTRUCTION DETAILS	BAILING OR PUMPING TEST
Casing diameter 8 5/8" OD Length of casing 20'	Pumping rate .... G.P.M. Duration of test .... hrs.
Type of screen .... Length of screen	Drawdown .... ft. Date Sept 21-57
Type of pump	Developed capacity 3 gpm - Bail Test
Capacity of pump	Static level—depth to water .... ft.
Depth of pump setting By owner	Pump installed by Owner
Date of completion	

WELL LOG

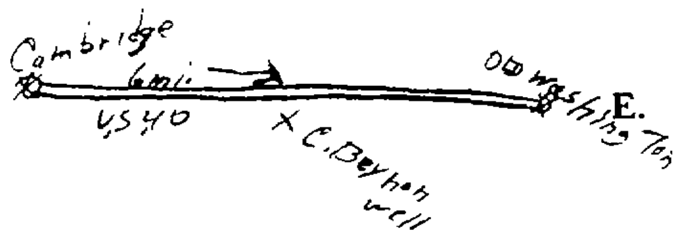
Formations Sandstone, shale, limestone, gravel and clay	From	To
Clay	0 Feet	15 Ft.
Sandy gr. shale	15	25
Br. shale	25	35
Fireclay	35	45
Shale	45	52
Limestone	52	54
Fireclay	54	60
Shale	60	62
Limestone	62	65
Blue Sandrock	70	85
H. Bl. Sandst.	85	87
H Bl. St.	87	94
water at 80'		

03V13374

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.

N.



S.

See reverse side for instructions

Drilling Firm Marlatt, Contr. Date Oct. 16-57

Address RD 1 Cambridge, O. Signed Donald Marlatt

(69)

WELL LOG AND DRILLING REPORT

ORIGINAL

NO CARBON PAPER
NECESSARY—
SELF-TRANSCRIBING

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
65 S. Front St., Rm. 815 Phone (614) 469-2646
Columbus, Ohio 43215

457902

County Guernsey Township Center Section of Township

Owner Carl Beynon Address Cambridge O.

Location of property approximate 1 mile of Rt 40 on twp 707

CONSTRUCTION DETAILS	
Casing diameter 6"	Length of casing 66'
Type of screen perforate	Length of screen 34'
Type of pump	
Capacity of pump	
Depth of pump setting	
Date of completion	

BAILING OR PUMPING TEST
(Specify one by circling)

Test Rate 2 G.P.M. Duration of test hrs.
Drawdown ft. Date
Static level-depth to water 32' ft.
Quality (clear, cloudy, taste, odor) clear

Pump installed by

WELL LOG*

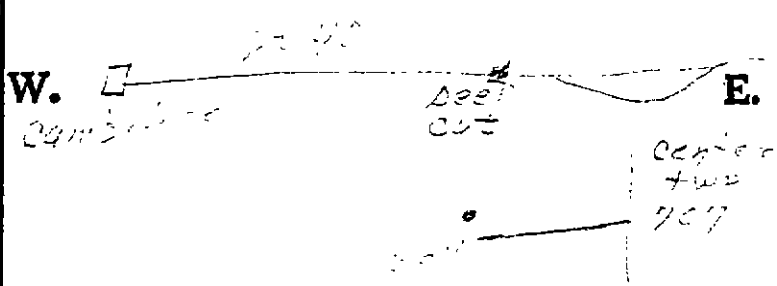
Formations Sandstone, shale, limestone, gravel and clay	From	To
Clay	0 Feet	15 Ft.
Slate	15	25
Sand	25	30
Lime Stone	30	32
Iron Slate	32	54
Sand Stone	54	64
Slate	64	65
water at 32'		
10 gal per min		

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.

N.

W.



E.

S.

Drilling Firm [illegible]

Date 5-29-73

Address R1 Kimbolton O

Signed [illegible]

*If additional space is needed to complete well log, use next consecutive numbered form.

461

WE LOG AND DRILLING REF RT

ORIGINAL

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1562 W. First Avenue
Columbus 12, Ohio

PLEASE USE PENCIL OR TYPEWRITER DO NOT USE INK.

№ 286233

County Guernsey Township Center Section of Township 12

Owner Ray McConnell Address Old Washington, Ohio

Location of property Near Deep Cut on US40 - ½ mi. W. Old Wash., Ohio

CONSTRUCTION DETAILS	BAILING OR PUMPING TEST
Casing diameter 8 5/8 Length of casing 17'	Pumping Rate 1 G.P.M. Duration of test 24 hrs.
Type of screen Length of screen	Drawdown — ft. Date 12/7/62
Type of pump Jet To be installed	Static level-depth to water 10' ft.
Capacity of pump by Owner	Quality (clear, cloudy, taste, odor) Clear No odor
Depth of pump setting —	
Date of completion —	Pump installed by To be by owner

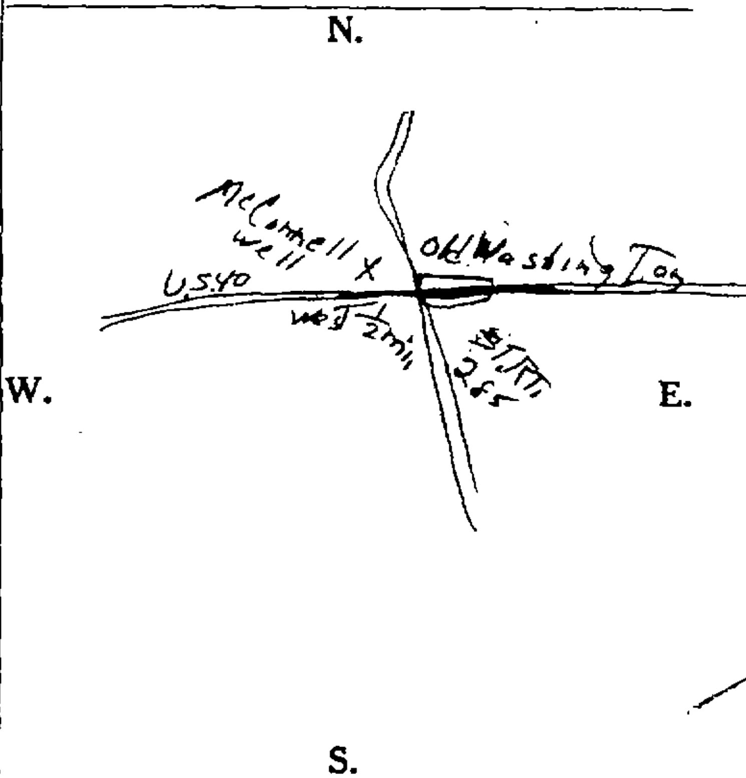
WELL LOG

Formations Sandstone, shale, limestone, gravel and clay	From	To
Clay + Soil	0 Feet	4 Ft.
Yell Clay	4	8
Br. Shale	8	14
Sandy Shale	14	17
Sandrock	17	40
Blue Core	40	68
Blue Shale	68	83
Sandstone	83	90

water at 40' } 1 gpm.
" at 83

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



See reverse side for instructions

Drilling Firm Donie Marlatt Date 12/7/62

Address RT 3 Cambridge, O. Signed Don B. Marlatt

(M1)

WELL LOG AND DRILLING REPORT

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1562 W. First Avenue
Columbus, Ohio

PLEASE USE PENCIL OR TYPEWRITER. DO NOT USE INK.

No. 234605

County Guernsey Township Center Section of Township 12

Owner Clyde Patrick Address Old Washington, Ohio

Location of property 1½ mi. West of Old Washington Ohio on US. 40

CONSTRUCTION DETAILS	BAILING OR PUMPING TEST
Casing diameter 8" Length of casing 16'	Pumping rate 3 G.P.M. Duration of test ___ hrs.
Type of screen ___ Length of screen ___	Drawdown ___ ft. Date 7/8/57
Type of pump To be set by owner	Developed capacity 3 g.p.m.
Capacity of pump Not yet installed	Static level—depth to water 18' ft.
Depth of pump setting ___	Pump installed by Owner
Date of completion ___	

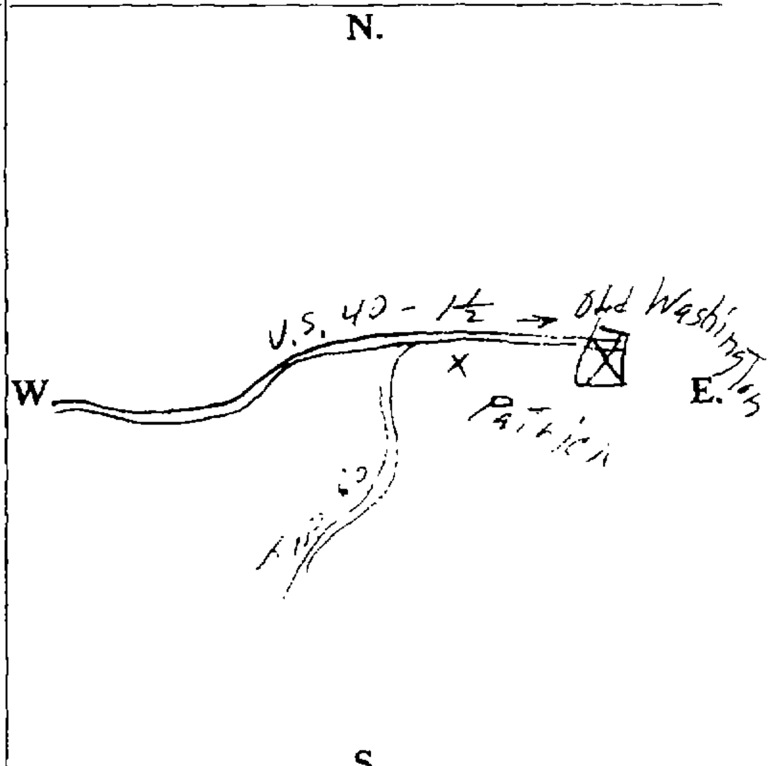
WELL LOG

Formations Sandstone, shale, limestone, gravel and clay	From	To
Clay + Sh.	0 Feet	12 Ft.
Grey Shale	12	15
Sandrock	15	26
Fireclay	26	40
Blue core	40	65
Limestone	65	70
Blue core	70	85
Sandstone	85	98

water 65' - 1 gpm
" " 90' - 2 gpm

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



See reverse side for instructions

Drilling Firm Denice Marlett Contr. Date 7/8/57

Address RD 3 Signed Denice Marlett

(M2)

WELL LOG AND DRILLING REPORT

ORIGINAL

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1562 W. First Avenue
Columbus, Ohio 43212

PLEASE USE PENCIL OR TYPEWRITER
DO NOT USE INK.

Nº 351172

County GUERNSEY Township CENTER Section of Township 21

Owner MARGIE BROWN Address Rt. 4 CAMBRIDGE, OHIO

Location of property 4 MIL EAST OF CAMBRIDGE ON OLD Rt 40

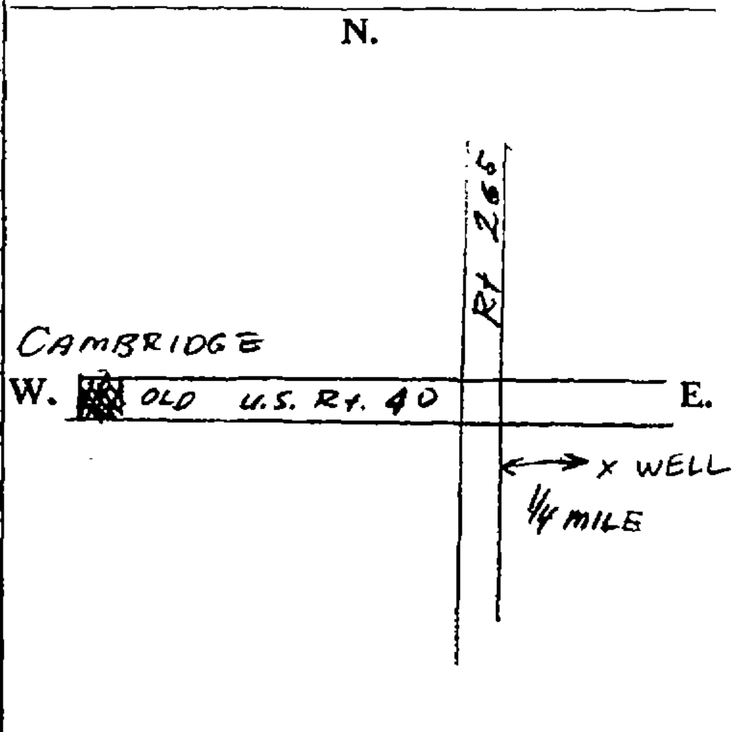
CONSTRUCTION DETAILS	BAILING OR PUMPING TEST
Casing diameter 6 1/4 I.D. Length of casing 45'	Pumping Rate 1 1/2 G.P.M. Duration of test 1 hrs.
Type of screen ✓ Length of screen ✓	Drawdown ✓ ft. Date 8/12/67
Type of pump ✓	Static level-depth to water 42 ft.
Capacity of pump ✓	Quality (clear, cloudy, taste, odor) GOOD
Depth of pump setting ✓	
Date of completion ✓	Pump installed by ✓

WELL LOG*

Formations Sandstone, shale, limestone, gravel and clay	From	To
BROWN CLAY	0 Feet	14 Ft.
SOFT GRAY SHALE	14	36
RED SHALE	36	38
GRAY SHALE	38	45
SAND ROCK	45	55
DARK SHALE	55	58
COAL	58	63 1/2
GRAY SHALE	63 1/2	65
SAND ROCK	65	95
(W) 72		

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



See reverse side for instructions

Drilling Firm McFARLAND DRILLING Date 9/9/67

Address Rt. 3 - CAMBRIDGE O. Signed John McFarland

*If additional space is needed to complete well log, use next consecutive numbered form.

86

WELL LOG AND DRILLING REPORT

ORIGINAL

NO CARBON PAPER NECESSARY— SELF-TRANSCRIBING

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
65 S. Front St., Rm. 815 Phone (614) 469-2646
Columbus, Ohio 43215

No. 384064

County Guernsey Township Center Section of Township 24

Owner Forest Paver Address RT 4 Cambridge, Ohio

Location of property On ST. RT 265 ¼ mi. N of RT. 40

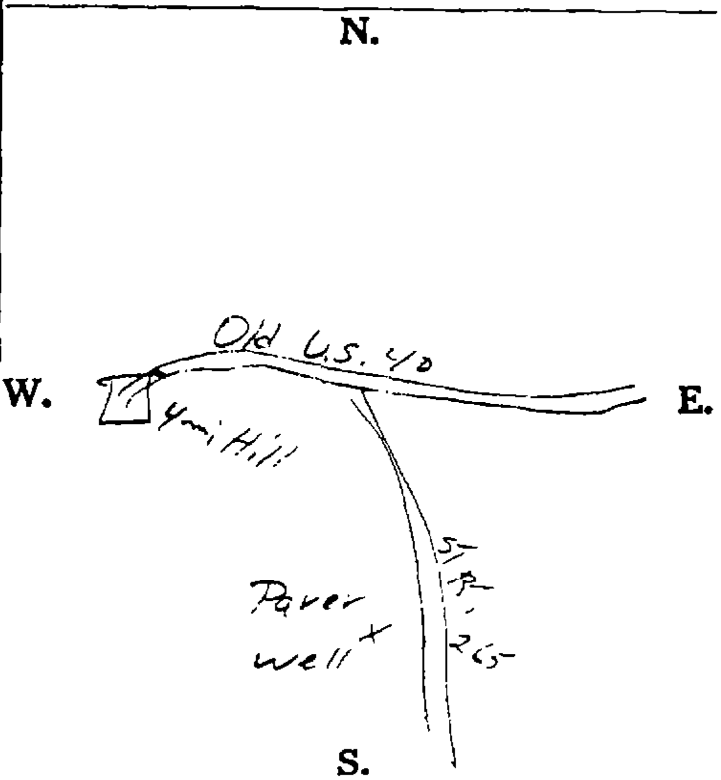
CONSTRUCTION DETAILS	BAILING OR PUMPING TEST (Specify one by circling)
Casing diameter 8" Length of casing 20	Test Rate 5 G.P.M. Duration of test 12 hrs.
Type of screen Liner Length of screen Grav. pack	Drawdown 35 ft. Date 4-15-69
Type of pump	Static level-depth to water 15 ft.
Capacity of pump Incomplete	Quality (clear, cloudy, taste, odor) Clear good Taste
Depth of pump setting	
Date of completion To be set by owner	Pump installed by Owner

WELL LOG*

Formations Sandstone, shale, limestone, gravel and clay	From	To
Clay + Surface	0 Feet	6 Ft.
Shaley	6	12
Br. Shale	12	20
Bl. Core	20	35
Sandrock	35	50
Fireclay	50	60
Sandrock	60	64
Water at	35' +	60'
5 gpm		

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



Drilling Firm Marlatt Drilling Date 4-15-69

Address RT 3 Cambridge Ohio Signed Doris Marlatt

*If additional space is needed to complete well log, use next consecutive numbered form.

87

Water Well Log and Drilling Report
Ohio Department of Natural Resources
Division of Water
Phone: 614-265-6740
email: cleve.brown@dnr.state oh.us
Water Home: http://www.dnr.state.oh.us/water

WELL LOG AND DRILLING REPORT

Well Log Number: 35010 [redacted]

ORIGINAL OWNER AND LOCATION

Original Owner Name: *R KLOTT* **Lot Number:**
County: *GUERNSEY* **Township:** *CENTER* **Section Number:** *17*
Address: *US ROUTE 40*
City: **State:** *OH* **Zip Code:**
Location Number: *89* **Location Map Year:** *1945* **Location Area:**

CONSTRUCTION DETAILS

Borehole Diameter: **Total Depth:** *72 ft.* **Depth to Bedrock:**
Casing Diameter: *13 in.* **Casing Thickness:** **Casing Length:** *19 ft.*
Well Use: **Screen Length:** **Date of Completion:** *10/3/49*
Aquifer Type: *SANDSTONE* **Driller's Name:** *MCFARLAND DRILLING CO*

WELL TEST DETAILS

Static Water Level: *42 ft* **Test Rate:** *1 gpm*
Drawdown: **Test Duration:** *24 hrs.*

Associated Reports
NONE

COMMENTS:

WELL LOG

Formations	From	To
CLAY	0	- 4
SANDY SHALE	4	- 15
SANDSTONE	15	- 53
BLU SHALE	53	- 69
SANDSTONE	69	- 72
WATER AT	53	- 53

ORIGINAL

WELL LOG AND DRILLING REPORT

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1562 W. First Avenue
Columbus, Ohio

PLEASE USE PENCIL OR TYPEWRITER. DO NOT USE INK.

No. 268476

County: Guernsey Township: Center Section of Township: 20

Owner: Wm Hague Address: Route 4 Cambridge, O.

Location of property: 1 mi. East of ST.RT.265 on Twp Rd 362

CONSTRUCTION DETAILS

Casing diameter: 8 5/8 Length of casing: 20'

Type of screen: — Length of screen: —

Type of pump: Jet Deep well

Capacity of pump:

Depth of pump setting: By Owner

Date of completion:

BAILING OR PUMPING TEST

Pumping rate: 1 1/2 G.P.M. Duration of test: 48 hrs.

Drawdown: — ft. Date: 2/24/62

Developed capacity: 1 1/2 gpm Bail Test

Static level—depth to water: 50' ft.

Pump installed by: Owner

WELL LOG

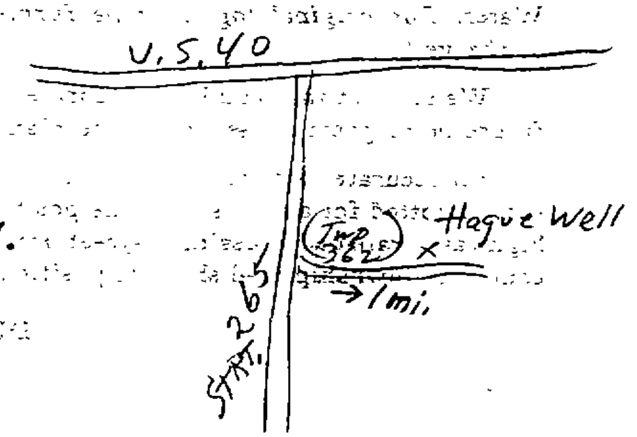
Formations Sandstone, shale, limestone, gravel and clay	From	To
Soil & Surface	0 Feet	4 Ft.
grey Shale	4	15
Br. Sandrock	15	40
Wh. Sandrock	40	65
Shale - Blue	65	75
Limestone	75	80
Grey Shale	80	90
Blue Core	90	107

water at 65 & 80
1 1/2 g.p.m.

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.

N.



W. E.

S.

See reverse side for instructions

Drilling Firm: Donice B Marlett Date: 2/24/62

Address: Rt. 3 Cambridge, O. Signed: Donice B. Marlatt

WELL LOG AND DRILLING REPORT

ORIGINAL

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1562 W. First Avenue
Columbus, Ohio 43212

PLEASE USE PENCIL OR TYPEWRITER
DO NOT USE INK.

Nº 332196

County Guernsey Township Center Section of Township

Owner Hixon Collart Address Lore City Rt. 2.

Location of property 2 Miles North of Kings Mines

CONSTRUCTION DETAILS

Casing diameter 8 Length of casing 17

Type of screen ✓ Length of screen ✓

Type of pump ✓

Capacity of pump ✓

Depth of pump setting ✓

Date of completion Aug 21-1966

BAILING OR PUMPING TEST

Pumping Rate 8 G.P.M. Duration of test 2 hrs.

Drawdown 6 ft. Date Aug. 21-196

Static level-depth to water 28 ft.

Quality (clear, cloudy, taste, odor) Clear.

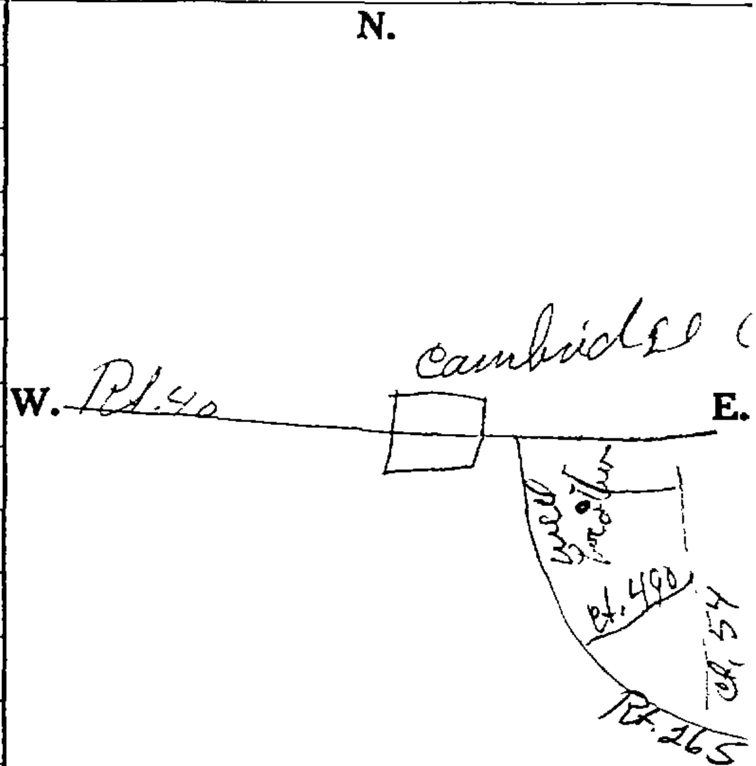
Pump installed by ✓

WELL LOG*

Formations Sandstone, shale, limestone, gravel and clay	From	To
Clay	0 Feet	2 Ft.
Sandy Shale	2	13
Sand Stone	13	19
Gray Shale	19	30
Red Rock	30	42
Gray Shale	42	48
Sandy Shale	48	55
Water 17		
" 48		

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



See reverse side for instructions

Drilling Firm Day Wells & Son Date Aug. 22-1966

Address Rt. 1 Cambridge O. Signed James Wells

90

*If additional space is needed to complete well log, use next consecutive numbered form.

WELL LOG AND DRILLING REPORT

ORIGINAL

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1562 W. First Avenue
Columbus 12, Ohio

PLEASE USE PENCIL
OR TYPEWRITER
DO NOT USE INK.

Nº 323103

County GUERNSEY Township CENTER Section of Township 19

Owner ANDY ROCKER Address RD 2 LORE CITY, O.

Location of property 3 mile S. of Old Washington on twp. 54

CONSTRUCTION DETAILS

Casing diameter 6 5/8 OD Length of casing 20'6"

" " 4 1/2 OD " " 130' (printed: ~~Type of screen~~ ~~Length of screen~~)

Type of pump ✓ 4 1/2 Casing slotted

Capacity of pump ✓

Depth of pump setting ✓

Date of completion ✓

BAILING OR PUMPING TEST

Pumping Rate 4 G.P.M. Duration of test 2 hrs.

Drawdown ✓ ft. Date OCT. 20, 64

Static level-depth to water 64 ft.

Quality (clear, cloudy, taste, odor)

Pump installed by

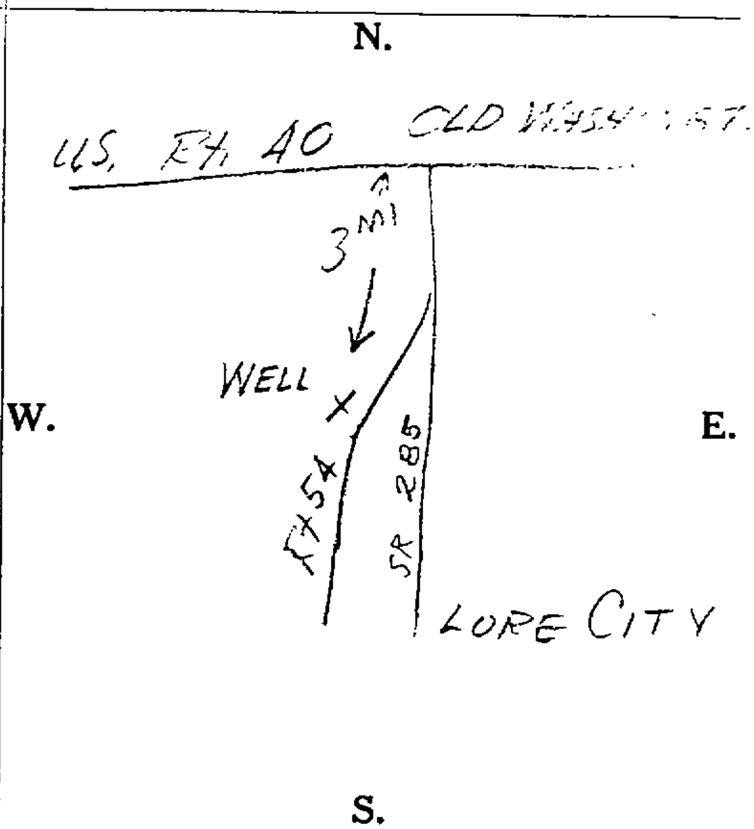
WELL LOG

Formations Sandstone, shale, limestone, gravel and clay	From	To
BROWN CLAY	0 Feet	4 Ft.
SHALE	4	7
SANDY SHALE	7	8
SAND ROCK	8	9
SHALE	9	14
SOFT GRAY SHALE	14	18
SAND ROCK	18	62
DK. SHALE	62	64
SAND ROCK	64	70
GRAY SHALE-SOFT	70	76
RED SHALE-SOFT	76	86
SAND SHALE GRAY	86	88
GRAY SHALE-SOFT	88	102
RED SHALE SOFT	102	118
SANDY SHALE	118	121
SAND ROCK	121	135
DARK SANDY SHALE	135	140

W - 64
120

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



See reverse side for instructions

Drilling Firm McFarland Drilling Co. Date 11.19.64

Address R. 3 - Cambridge, O. Signed John R. McFarland

(91)

470

Water Well Log and Drilling Report
Ohio Department of Natural Resources
Division of Water
Phone: 614-265-6740
email: cleve.brown@dnr.state.oh.us
Water Home: http://www.dnr.state.oh.us/water

WELL LOG AND DRILLING REPORT

Well Log Number: 656022

Conduct Another Search

ORIGINAL OWNER AND LOCATION

Original Owner Name: *FRANK HEDELSON* **Lot Number:**
County: *GUERNSEY* **Township:** *CENTER* **Section Number:**
Address: *63613 INSTITUTE ROAD*
City: **State:** *OH* **Zip Code:**
Location Number: *92* **Location Map Year:** *1988* **Location Area:**

CONSTRUCTION DETAILS

Borehole Diameter: **Total Depth:** *156 ft.* **Depth to Bedrock:**
Casing Diameter: *8 in.* **Casing Thickness:** **Casing Length:** *25 ft.*
Well Use: **Screen Length:** **Date of Completion:** *9/13/86*
Aquifer Type: *SHALE* **Driller's Name:** *WELLS & SON, J.R.*

WELL TEST DETAILS

Static Water Level: *40 ft.* **Test Rate:** *1 gpm*
Drawdown: *Total* **Test Duration:** *2 hrs.*

Associated Reports
NONE

COMMENTS:

WELL LOG

Formations	From	To
CLAY	0	- 3
BRN SHALE	3	- 16
SANDSTONE	16	- 24
WHI SANDSTONE	24	- 42
DRK SHALE	42	- 46
BRN SHALE	46	- 52
GRY SHALE	52	- 58
DRK SHALE	58	- 92
COAL	92	- 93
RED SHALE	93	- 98
GRY SHALE	98	- 115
SANDY SHALE	115	- 141
DRK SHALE	141	- 156

92

[illegible]
739 500 S

WELL LOG AND DRILLING REPORT

ORIGINAL

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
Columbus, Ohio

№ 90917

County GUERNSEY Township CENTER Section of Township or Lot Number 19

Owner WILLIAM POLASKY Address LORE CITY, ROUTE 1.

Location of property 2 MI. S. OF OLD WASHINGTON ON S.R. 285

CONSTRUCTION DETAILS

Casing diameter 8 Length of casing 10

Type of screen .... Length of screen ....

Type of pump ....

Capacity of pump ....

Depth of pump setting ....

PUMPING TEST

Pumping rate 2 G.P.M. Duration of test .... hrs.

Drawdown .... ft. Date ....

Developed capacity 120 PH.

Static level—depth to water 30 ft.

Pump installed by OWNER

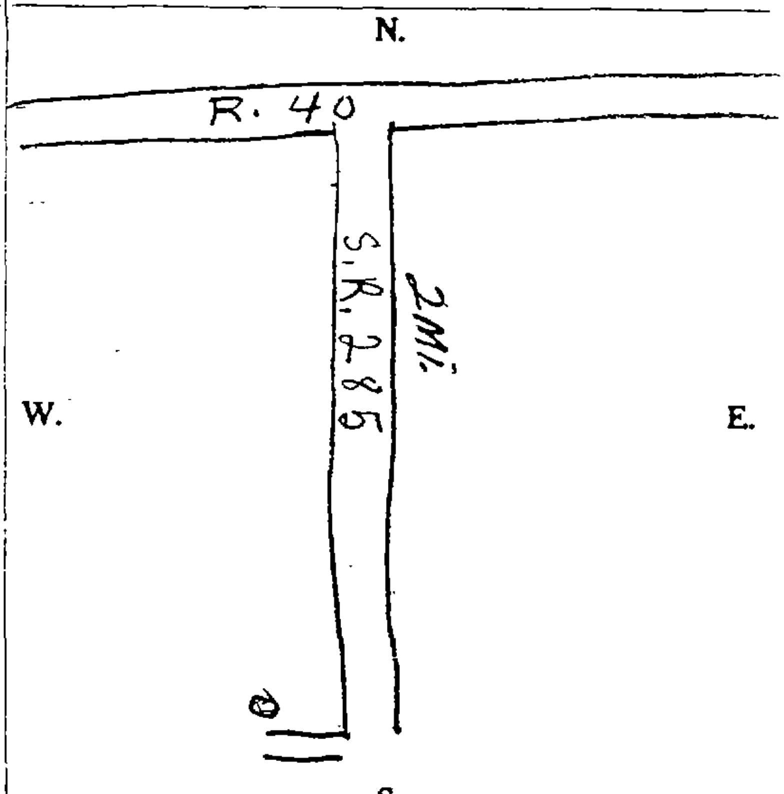
WELL LOG

Formations Sandstone, shale, limestone, gravel and clay	From	To
CLAY	0 Feet	8 Ft.
S. ROCK	8	40
G. SHALE	40	50
R. SHALE	50	56
S. ROCK	56	60

WATER AT 41 FT.

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



See reverse side for instructions

Drilling Firm ELLIS B. LARRICK Date 3-25-54.

Address CAMBRIDGE, O. ROUTE 4 Signed Wm. Polasky (93)

WELL LOG AND DRILLING REPORT

ORIGINAL

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Geological Survey
Fountain Square
Columbus, Ohio 43224 Phone (614) 466-5344

NO CARBON PAPER NECESSARY– SELF-TRANSCRIBING

476541

COUNTY Guernsey TOWNSHIP Center SECTION OF TOWNSHIP OR LOT NUMBER ______

OWNER Paul E Cass ADDRESS 1330 N. High St Columbus

LOCATION OF PROPERTY 3 miles North of old Washington

CONSTRUCTION DETAILS

Casing diameter 8" Length of casing 17½'

Type of screen ______ Length of screen ______

Type of pump ______

Capacity of pump ______

Depth of pump setting ______

Date of completion 7/3/75

BAILING OR PUMPING TEST
(specify one by circling)

Test rate 8 gpm Duration of test 2 hrs

Drawdown Complete ft Date 7/3/75

Static level (depth to water) 41' ft

Quality (clear, cloudy, taste, odor) ______

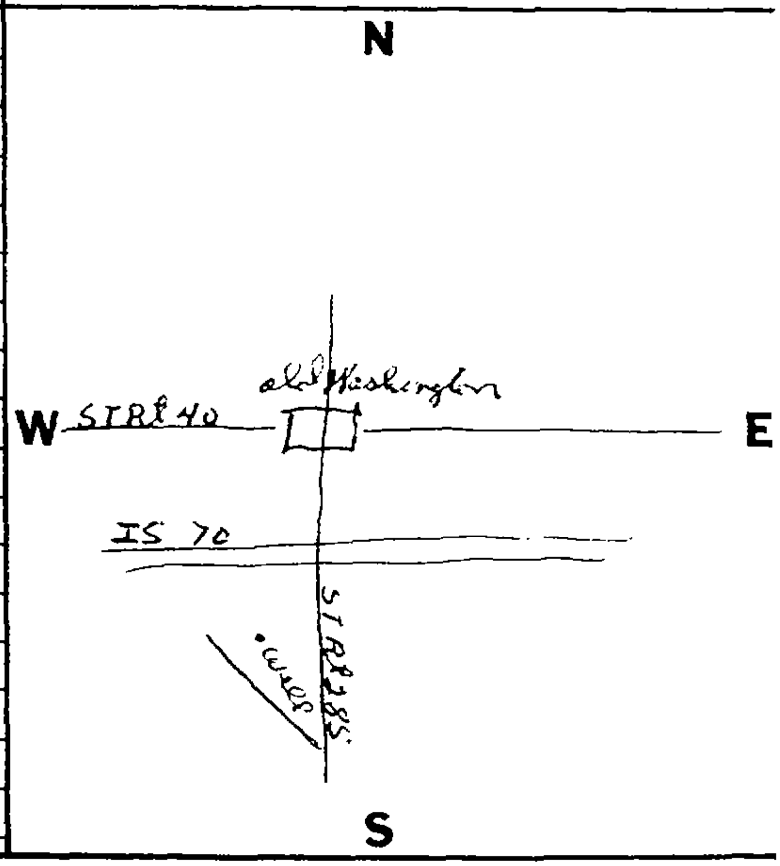
Pump installed by ______

WELL LOG*

Formations: sandstone, shale, limestone, gravel, clay	From	To
Clay	0 ft	4 ft
Brown sand stone	4	16
Grey shale	16	28
Sandy shale	28	56
Sand stone	56	81
dark shale	81	86
Water at 56'		
Well lined with		
70' of liner		

SKETCH SHOWING LOCATION

Locate in reference to numbered state highways, street intersections, county roads, etc.



DRILLING FIRM Dan Wells & Son DATE 7/6/75

ADDRESS R.D. 1 Cambridge Ohio SIGNED James R Wells

94

*If additional space is needed to complete well log, use next consecutive numbered form

WELL LOG AND DRILLING REPORT

ORIGINAL

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
Columbus, Ohio

№ 161169

County GUERNSEY Township CENTER Section of Township or Lot Number 28

Owner CARL ADAMS Address CAMBRIDGE, OHIO, ROUTE 4

Location of property ON ROUTE 40 4MI EAST OF CAMBRIDGE OHIO AT ROUTE 265

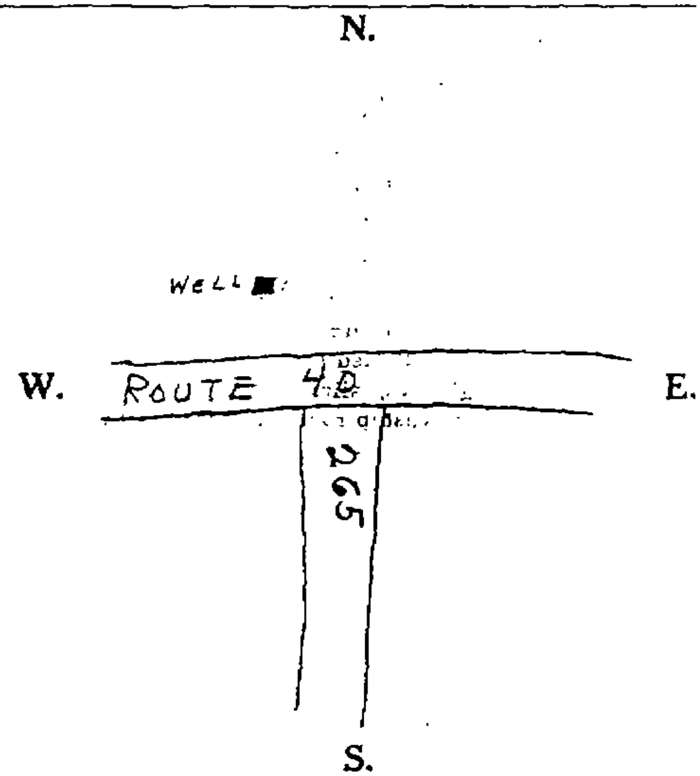
CONSTRUCTION DETAILS	PUMPING TEST
Casing diameter 6 5/8 Length of casing 41 FT	Pumping rate 12 G.P.M. Duration of test ____ hrs.
Type of screen ____ Length of screen ____	Drawdown ____ ft. Date ____
Type of pump ____	Developed capacity ____
Capacity of pump ____	Static level—depth to water 30 ft.
Depth of pump setting ____	Pump installed by ____

WELL LOG

Formations Sandstone, shale, limestone, gravel and clay	From	To
~~C~~ CLAY	0 Feet	40 Ft.
ROCK	40	51
WATER AT 45 FT		

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



See reverse side for instructions

Drilling Firm ELLIS B. LARRICK Date 12-19-59

Address CAMBRIDGE OHIO, ROUTE 4 Signed Carl Adams

98

2 275 300

130 600 N

WELL LOG AND DRILLING REPORT

ORIGINAL

State of Ohio
OHIO WATER RESOURCES BOARD
Department of Public Works
553 E. Broad St., Columbus 15, Ohio

Nº 48542

County GUERNSEY Township CENTER Section of Township or Lot Number 28

Owner CARL ADAMS Address CAMBRIDGE OHIO. RR#4

Location of property ON ROUTE 40. 4 MI EAST O CAMBRIDGE O. AT ROUTE 265

CONSTRUCTION DETAILS

Casing diameter 6 Length of casing 12 Ft

Type of screen ______ Length of screen ______

Type of pump ______

Capacity of pump ______

Depth of pump setting ______

PUMPING TEST

Pumping rate 10 G.P.M. Duration of test ______ hrs.

Drawdown ______ ft. Date ______

Developed capacity 6 on RH

Static level of completed well 58 ft.

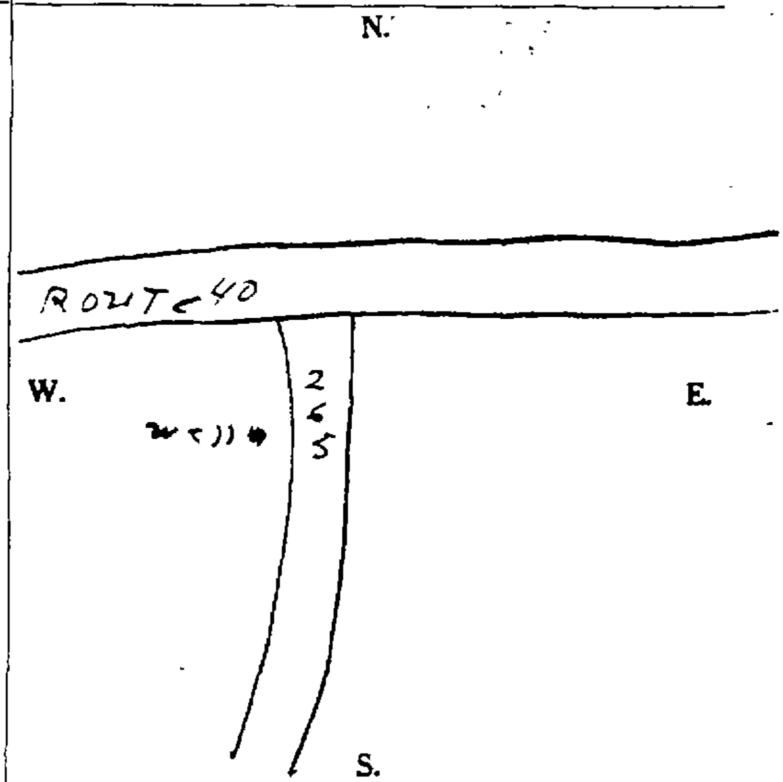
Pump installed by ______

WELL LOG

Formations Sandstone, shale, limestone, gravel and clay	From	To
CLAY	0 Feet	10 Ft.
SHALE	10	15
SLATE	15	25
CLAY	25	31
FIRE CLAY	31	36
SHALE	36	60
ROCK	60	70
SLATE	70	71½
CLAY	71½	73
ROCK	73	80
WATER AT 68		

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



See reverse side for instructions

Drilling Firm E.B. LARRICK

Address CAMBRIDGE OHIO RR#4

Date 9-12-51

Signed CARL ADAMS

99

WELL LOG AND DRILLING REPORT

ORIGINAL

NO CARBON PAPER NECESSARY— SELF-TRANSCRIBING

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
65 S. Front St., Rm. 815 Phone (614) 469-2646
Columbus, Ohio 43215

463768

County GUERNSEY Township CENTER Section of Township 30

Owner RANDY WHITE Address SO. 10th ST. Cambridge

Location of property C. RD 265 1/2 mi SO. of S.R. 40.

CONSTRUCTION DETAILS

Casing diameter 8" Length of casing 27'

Type of screen ______ Length of screen ______

Type of pump ______

Capacity of pump ______

Depth of pump setting ______

Date of completion ______

BAILING OR PUMPING TEST

(Specify one by circling)

Test Rate 12 G.P.M. Duration of test ______ hrs.

Drawdown ______ ft. Date ______

Static level-depth to water 19 ft.

Quality (clear, cloudy, taste, odor) CLEAR

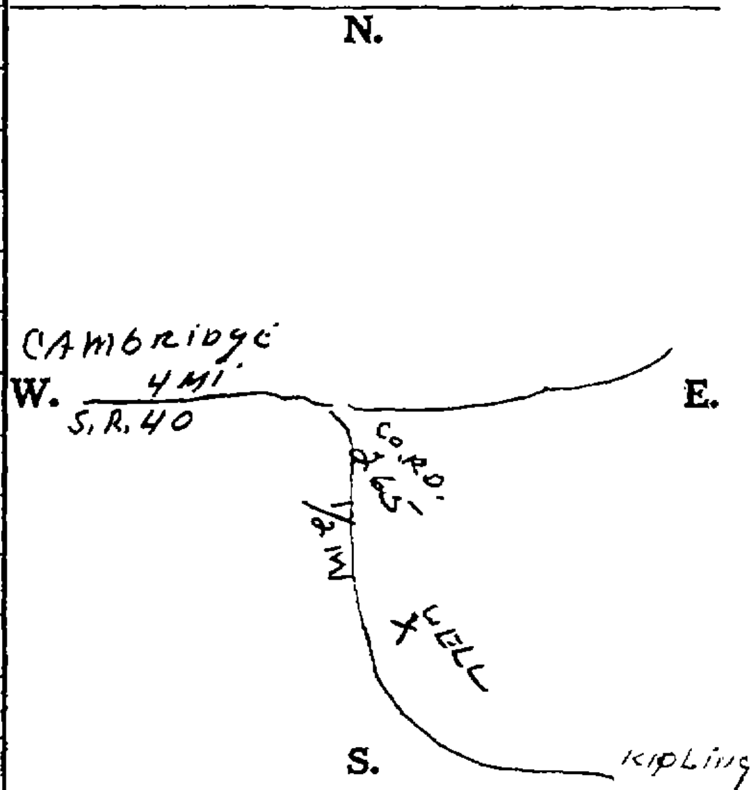
Pump installed by ______

WELL LOG*

Formations Sandstone, shale, limestone, gravel and clay	From	To
CLAY	0 Feet	20 Ft.
GRAY SHALE	20	23
LIME	23	25 ~~30~~
GRAY SHALE	25	32
DARK SHALE	32	46
BLK SHALE	46	48
COAL	48	51
DARK SHALE	51	55

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



Drilling Firm G&J Drilling

Address R.D.#5 Cambridge O

Date June 7, 1974

Signed William R. Gilcher
JAG

*If additional space is needed to complete well log, use next consecutive numbered form.

(100)

.G #20

WE~~ LOG AND DRILLING RE~~ORT

ORIGINAL

NO CARBON PAPER
NECESSARY—
SELF-TRANSCRIBING

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
65 S. Front St., Rm. 815 Phone (614) 469-2646
Columbus, Ohio 43215

445113

County GUERNSEY Township CENTER Section of Township

Owner HARRY NIEKRO Address RT 4 CAMBRIDGE OHIO

Location of property TWP RD 362 1000' EAST OF ST RT 265

CONSTRUCTION DETAILS

Casing diameter 7" Length of casing 24'

Type of screen Length of screen

Type of pump

Capacity of pump

Depth of pump setting

Date of completion 10-27-72

BAILING OR PUMPING TEST
(Specify one by circling)

Test Rate No B D G.P.M. Duration of test 3 hrs

Drawdown 15 ft. Date 10-27-72

Static level-depth to water 15 ft.

Quality (clear, cloudy, taste, odor) CLEAR

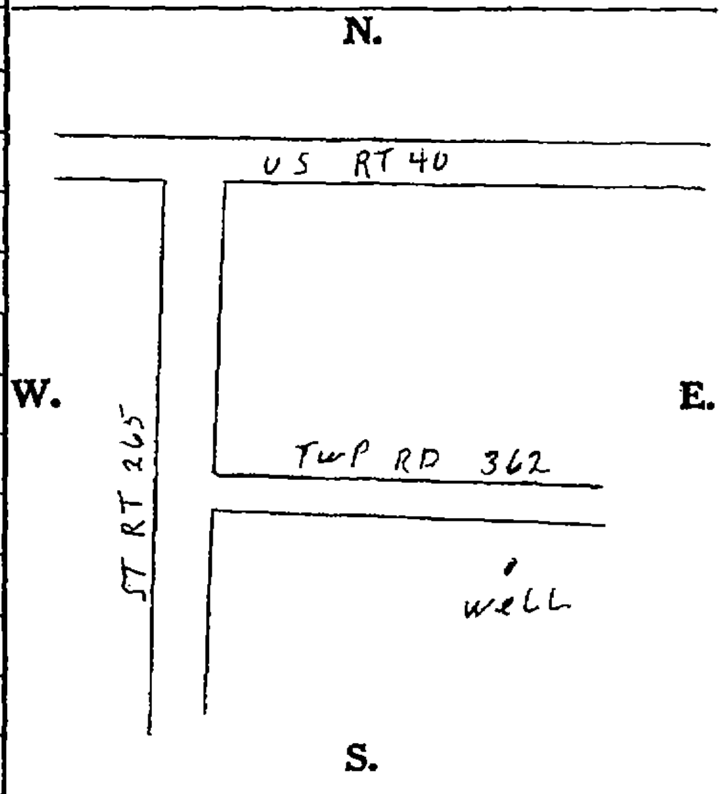
Pump installed by

WELL LOG*

Formations Sandstone, shale, limestone, gravel and clay	From	To
OWN CLAY	0 Feet	4 Ft.
BROWN SHALE	4	8
BROWN SANDSTONE	8	13
GRAY SANDSTONE	13	18
BROWN SANDSTONE	18	24
GRAY SANDSTONE	24	35
GRAY SHALE	35	38
COAL	38	TD
WATER AT 22'		

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



Drilling Firm SUBURBAN DRILLING CO Date 10-28-72

Address 1950 EAST PIKE ZANESVILLE OHIO Signed Bill H White Jr

*If additional space is needed to complete well log, use next consecutive numbered form.

101

2 274 800

137 900 N

WELL LOG AND DRILLING REPORT

ORIGINAL

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
Columbus, Ohio

№ 90925

County GUERNSEY Township CENTER Section of Township or Lot Number 30

Owner VIRGIL HOUSEHOLDER Address CAMBRIDGE, OHIO, RT. 4

Location of property 4 MI. E. OF CAMBRIDGE O. ON STATE RT. 265 AND TWP. RD. 362.

CONSTRUCTION DETAILS	PUMPING TEST
Casing diameter 5 5/8 Length of casing 55	Pumping rate 3 G.P.M. Duration of test ___ hrs.
Type of screen ___ Length of screen ___	Drawdown ___ ft. Date ___
Type of pump ___	Developed capacity 150 P.H.
Capacity of pump ___	Static level—depth to water 45 ft.
Depth of pump setting ___	Pump installed by OWNER

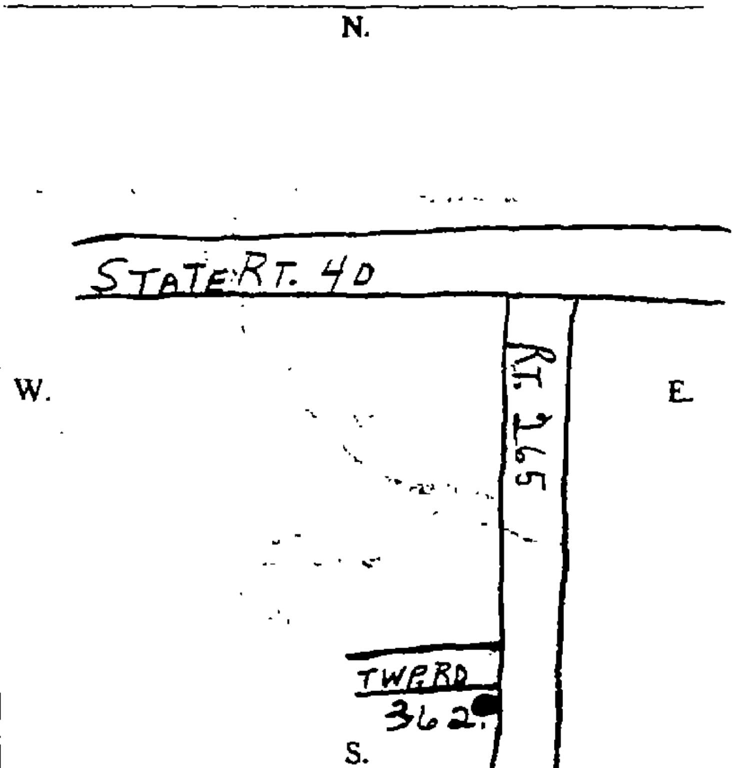
WELL LOG

Formations Sandstone, shale, limestone, gravel and clay	From	To
CLAY	0 Feet	10 Ft.
SHALE	11	20
ROCK	20	37
SLATE	37	42
COAL	42	48½
FIRECLAY	48½	52
SHALE	52	60
SLATE	60	75
COAL	75	77
F. CLAY	77	80
SHALE	80	85
	85	

WATER AT 75 FT.

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



See reverse side for instructions

Drilling Firm ELLIS B. LARRICK Date 7-18-54

Address CAMBRIDGE, OHIO, RT. 4 Signed Virgil Householder

P

102

478

WELL LOG AND DRILLING REPORT

ORIGINAL

NO CARBON PAPER NECESSARY— SELF-TRANSCRIBING

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
65 S. Front St., Rm. 815 Phone (614) 469-2646
Columbus, Ohio 43215

No. 401985

County Guernsey Township Center Section of Township

Owner Henry R. Pickutanski Address 2463 Woodbury ave Dayton Ohio

Location of property 2 miles East of Rt 265 on Rd. 342 on Right side

CONSTRUCTION DETAILS	
Casing diameter ~~24-10~~ 9"	Length of casing 24-10
Type of screen –	Length of screen –
Type of pump –	
Capacity of pump –	
Depth of pump setting –	
Date of completion Feb. 27-1971	

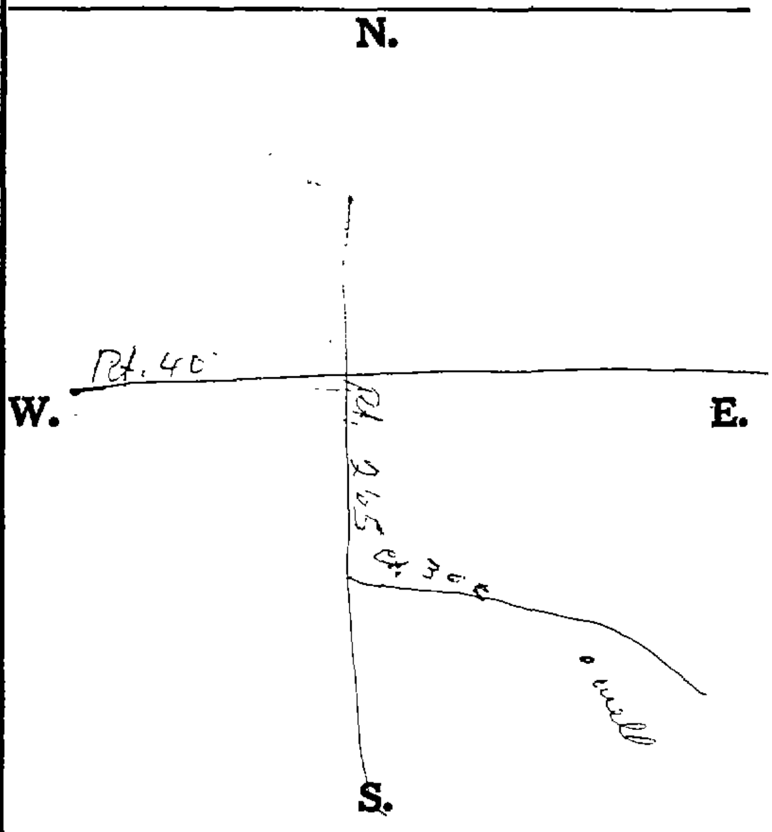
BAILING OR PUMPING TEST (Specify one by circling)	
Test Rate 10 G.P.M.	Duration of test 3 hrs.
Drawdown 10 ft.	Date Feb 27-1971
Static level-depth to water 56 ft.	
Quality (clear, cloudy, taste, odor)	
Pump installed by –	

WELL LOG*

Formations Sandstone, shale, limestone, gravel and clay	From	To
Clay	0 Feet	3 Ft.
Shale	3	6
Sandy Shale	6	33
Sand Stone	33	56
Gray Sand Stone	56	68
Brown Sand Stone	68	72
Dark Shale	72	76
Gray Shale	76	85
Water at 68		

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



Drilling Firm Dan Wells & Son Date Mar. 8 - 1971

Address Rt. Cambridge O Signed James Wells

105

*If additional space is needed to complete well log, use next consecutive numbered form.

County Permit No. ____

NO CARBON PAPER NECESSARY— SELF-TRANSCRIBING

WELL LOG AND DRILLING REPORT

ORIGINAL

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
Fountain Square
Columbus, Ohio 43224

532419

COUNTY GUErNSEY TOWNSHIP CENTEr SECTION OF TOWNSHIP ____

OWNER Craig WArNE ADDRESS Kipling, Ohio

LOCATION OF PROPERTY LEFT OFF 265 TO T65 1/2 mi LEFT ON T 4553

CONSTRUCTION DETAILS

Casing diameter 7" Length of casing 62

Type of screen ____ Length of screen ____

Type of pump ____

Capacity of pump ____

Depth of pump setting ____

Date of completion ____

BAILING OR PUMPING TEST (specify one by circling)

Test rate 20 gpm Duration of test 1 hrs

Drawdown 70 ft Date 3-10-79

Static level (depth to water) 21 ft

Quality (clear, cloudy, taste, odor) odor

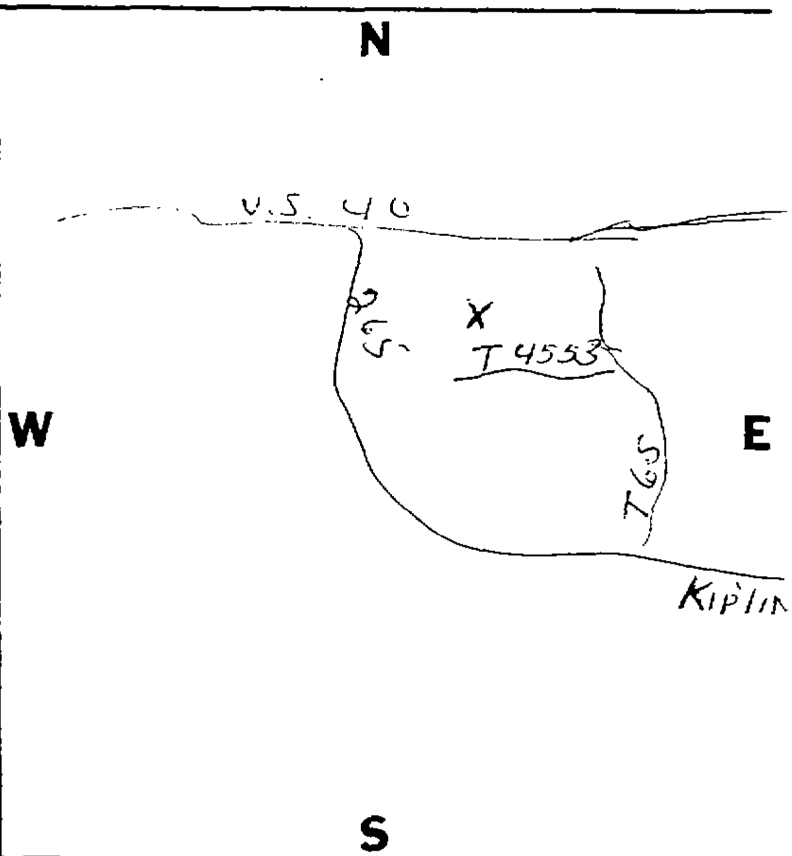
Pump installed by ____

WELL LOG*

Formations: sandstone, shale, limestone, gravel, clay	From	To
Brown CLAY	0 ft	10 ft
RED CLAY	10	14
Brown CLAy	14	22
ShALE	22	37
gray ShALE	37	43
	43	53
COAL	53	58
CLAy	58	63
ShALE	63	85
WATEr 76'		

SKETCH SHOWING LOCATION

Locate in reference to numbered state highways, street intersections, county roads, etc.



DRILLING FIRM C & J Drilling DATE 3-10-79

ADDRESS RT Cambridge, O SIGNED William R Gilchrist

480

(106)

*If additional space is needed to complete well log, use next consecutive ...

WELL LOG AND DRILLING REPORT

ORIGINAL

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1562 W. First Avenue
Columbus 12, Ohio

PLEASE USE PENCIL
OR TYPEWRITER
DO NOT USE INK.

No 295913

County: Guernsey Township: Center Section of Township: 2

Owner: James Ross Address: Lore City RD 1 Ohio

Location of property: On Co. Road 60 – 1 mi N. Kipling, Ohio

CONSTRUCTION DETAILS

Casing diameter: 5 1/2" Length of casing: 76 Ft

Type of screen: — Length of screen: —

Type of pump:

Capacity of pump: Jet Deepwell

Depth of pump setting: By owner

Date of completion: 7/16/63

BAILING OR PUMPING TEST

Pumping Rate: 5 G.P.M. Duration of test: 1 hr Bail Or hrs.

Drawdown: Bail Test ft. Date: 7/14/63

Static level-depth to water: 18' ft.

Quality (clear, cloudy, taste, odor): good Taste
Not settled yet

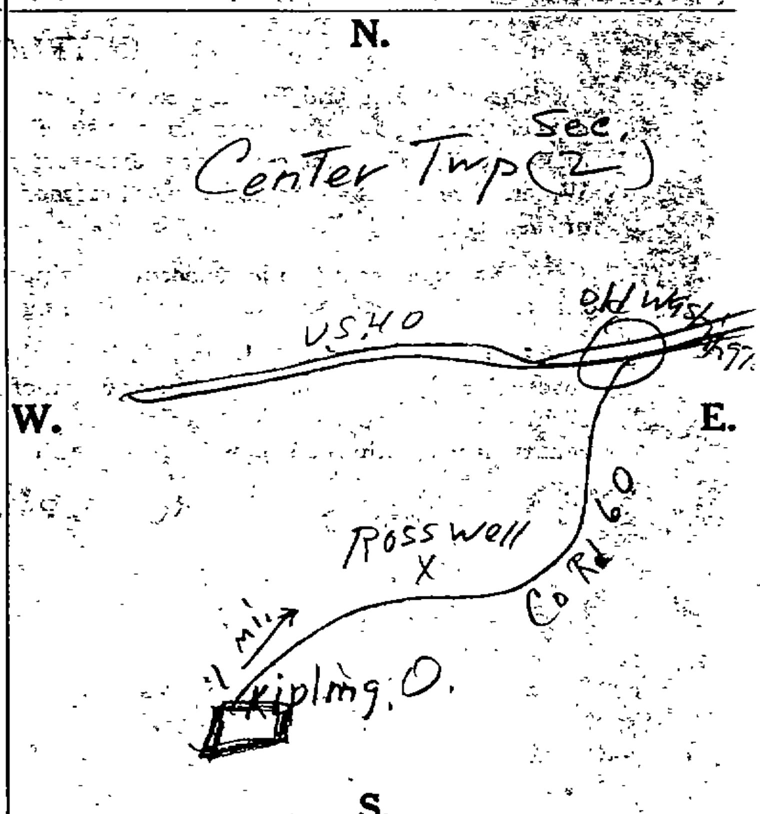
Pump installed by: Owner

WELL LOG

Formations Sandstone, shale, limestone, gravel and clay	From	To
Clay + Soil	0 Feet	3 Ft.
Br. Sandrock	3	10
Blue Core	10	18'
Red Rock	18	55
Limestone	55	60
Red Shale	60	78'
Water at 40' + 65'		

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



See reverse side for instructions

Drilling Firm: Marlatt + Sons Date: 7/14/63

Address: RT 3 Cambridge Ohio Signed: Dennis Marlatt

107

ORIGINAL

WELL LOG AND DRILLING REPORT

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1500 Dublin Road
Columbus, Ohio

No. 209212

County GUERNSEY Township CENTER Section of Township 23

Owner EARL BRIDGEMAN Address LORE CITY - RT 1

Location of property 1-MILE NORTH OF KINGS MINE - RT. 54

CONSTRUCTION DETAILS

Casing diameter 6 Length of casing 18'

Type of screen ✓ Length of screen ✓

Type of pump ✓

Capacity of pump ✓

Depth of pump setting ✓

Date of completion ✓

BAILING OR PUMPING TEST

Pumping rate 1 G.P.M. Duration of test 3 hrs.

Drawdown ✓ ft. Date 7-26-58

Developed capacity 2 GPM

Static level—depth to water 38 ft.

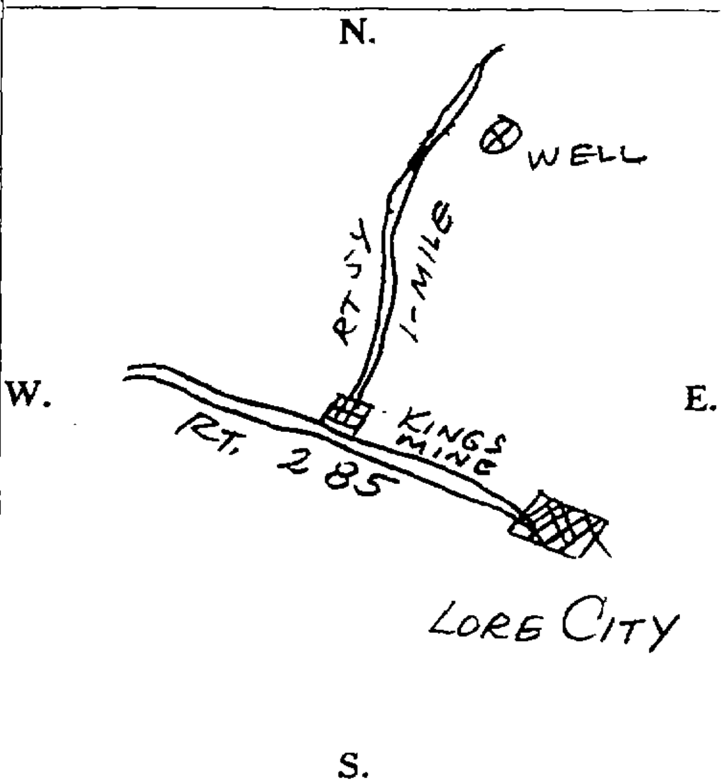
Pump installed by ✓

WELL LOG

Formations Sandstone, shale, limestone, gravel and clay	From	To
CLAY	0 Feet	5 Ft.
SAND ROCK	5	11
SHALE	11	18
SAND ROCK	18	21
SHALE	21	24
SAND R.	24	32
LIME	32	41
SAND R.	41	70
W 54 65		

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



See reverse side for instructions

Drilling Firm Mc FARLAND

Address RT. 3 - CAMBRIDGE

Date 8-23-58

Signed John McFarland

108

WELL LOG AND DRILLING REPORT

ORIGINAL

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
Fountain Square
Columbus, Ohio 43224

NO CARBON PAPER
NECESSARY–
SELF-TRANSCRIBING

509258

COUNTY Guernsey TOWNSHIP Center SECTION OF TOWNSHIP 3

OWNER Hugh Ramage ADDRESS Kipling, Ohio

LOCATION OF PROPERTY Co Rd 43 - 1/2 mile off 265

CONSTRUCTION DETAILS

Casing diameter 8" Length of casing 32 1/2'

Type of screen ______ Length of screen ______

Type of pump ______

Capacity of pump ______

Depth of pump setting ______

Date of completion 6/10/77

BAILING OR PUMPING TEST
(specify one by circling)

Test rate 10 gpm Duration of test 1 hrs

Drawdown ______ ft Date 6/10/77

Static level (depth to water) 18 ft

Quality (clear, ~~cloudy, taste, odor~~) ______

Pump installed by ______

WELL LOG*

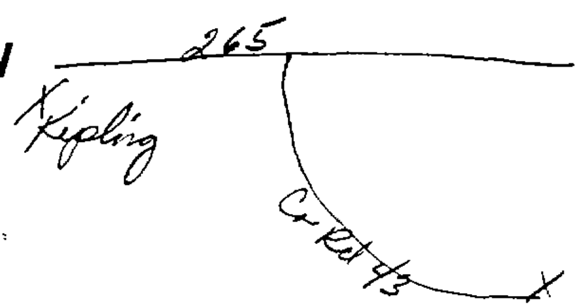
Formations: sandstone, shale, limestone, gravel, clay	From	To
Br. Clay	0 ft	18 ft
Gr. Clay	18	27
Sand	27	29
Gy. Shale	29	33
Br. sandrock	33	50
water at 40'		

SKETCH SHOWING LOCATION

Locate in reference to numbered state highways, street intersections, county roads, etc.

N

W E



S

DRILLING FIRM G + G Drilling DATE 6/14/77

ADDRESS Rt 5 Camb. O 43725 SIGNED William K Gleke

*If additional space is needed to complete well log, use next consecutive numbered form.

Water Well Log and Drilling Report
Ohio Department of Natural Resources
Division of Water
Phone: 614-265-6740
email: cleve.brown@dnr.state.oh.us
Water Home: http://www.dnr.state.oh.us/water

WELL LOG AND DRILLING REPORT

Well Log Number: 463788 [redacted]

ORIGINAL OWNER AND LOCATION

Original Owner Name: *WILLIAM SWANKJ* **Lot Number:**
County: *GUERNSEY* **Township:** *CENTER* **Section Number:** *4*
Address: *TWP RD 4535*
City: **State:** *OH* **Zip Code:**
Location Number: *110* **Location Map Year:** *1988* **Location Area:**

CONSTRUCTION DETAILS

Borehole Diameter: **Total Depth:** *42 ft.* **Depth to Bedrock:**
Casing Diameter: *8 in.* **Casing Thickness:** **Casing Length:** *18 ft.*
Well Use: **Screen Length:** **Date of Completion:** *5/14/76*
Aquifer Type: *COAL* **Driller's Name:**

WELL TEST DETAILS

Static Water Level: *10 ft.* **Test Rate:** *6 gpm*
Drawdown: **Test Duration:**

Associated Reports
NONE

COMMENTS:

WELL LOG

Formations	From	To
CLAY	0	- 12
SANDY SHALE	12	- 19
SANDSTONE	19	- 26
GRY SAND	26	- 38
GRY SHALE	38	- 40
DRK SHALE	40	- 42
COAL	42	- 43
WATER AT	38	- 38

110

WELL LOG AND DRILLING REPORT

ORIGINAL

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1562 W. First Avenue
Columbus, Ohio 43212

PLEASE USE PENCIL OR TYPEWRITER
DO NOT USE INK.

Nº 337601

County Guernsey Township Center Twp Section of Township Sec. 4

Owner Hugh Rammage Address Lore City, Ohio R1

Location of property On Twp Rd 102 – ½ mi E. of ST. RT 265

CONSTRUCTION DETAILS	BAILING OR PUMPING TEST
Casing diameter 7" O.D. Length of casing 30'	Pumping Rate 10 G.P.M. Duration of test Bail Test only hrs.
Type of screen – Length of screen –	Drawdown ft. Date 9/20/65
Type of pump Jet pump	Static level-depth to water 25' ft.
Capacity of pump Deepwell	Quality (clear, cloudy, taste, odor) Clear good Taste
Depth of pump setting 55'	
Date of completion 9/20/65	Pump installed by Owner

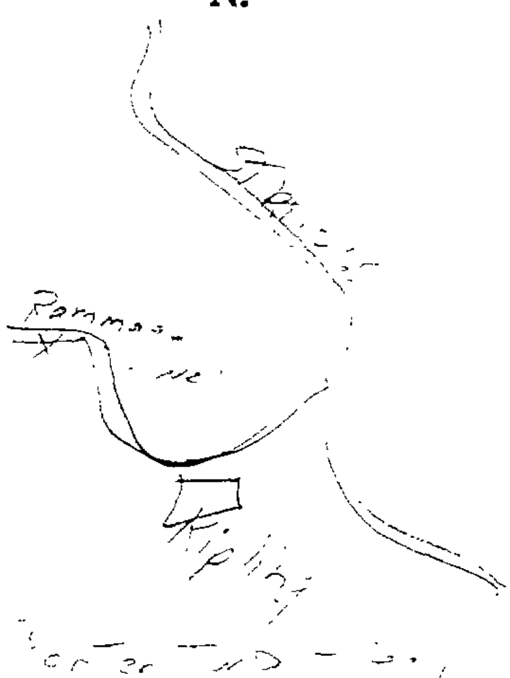
WELL LOG*

Formations Sandstone, shale, limestone, gravel and clay	From	To
Yell. Clay	0 Feet	25 Ft.
+ Broken Sn.	25	30
Sandrock	30	45
Shale-Hard	45	50
Lime-Blue Core	50	60
Sandrock	60	62
Water 45 + 58		

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.

N.

W.  E.

S.

See reverse side for instructions

Drilling Firm [illegible] Date 9/20/65

Address [illegible] Signed Donice B. Marlott (111)

*If additional space is needed to complete well log, use next consecutive numbered form.

Water Well Log and Drilling Report
Ohio Department of Natural Resources
Division of Water
Phone: 614-265-6740
email: cleve.brown@dnr.state.oh.us
Water Home: http://www.dnr.state.oh.us/water

WELL LOG AND DRILLING REPORT

Well Log Number: 509284 [redacted]

ORIGINAL OWNER AND LOCATION

Original Owner Name: *DIANE TOMAH* **Lot Number:**
County: *GUERNSEY* **Township:** *CENTER* **Section Number:** *4*
Address: *TWP RD 5430*
City: **State:** *OH* **Zip Code:**
Location Number: *112* **Location Map Year:** *1988* **Location Area:**

CONSTRUCTION DETAILS

Borehole Diameter: **Total Depth:** *57 ft.* **Depth to Bedrock:**
Casing Diameter: *7 in.* **Casing Thickness:** **Casing Length:** *44 ft.*
Well Use: **Screen Length:** **Date of Completion:** *6/19/78*
Aquifer Type: *SANDSTONE* **Driller's Name:**

WELL TEST DETAILS

Static Water Level: *37 ft.* **Test Rate:** *25 gpm*
Drawdown: **Test Duration:**

Associated Reports
NONE

COMMENTS:

WELL LOG

Formations	From	To
CLAY	0	- 32
SANDSTONE	32	- 39
CLAY	39	- 41
GRY SANDSTONE	41	- 43
GRY SHALE	43	- 44
GRY SANDSTONE	44	- 57
WATER AT	43	- 43

112

WELL LOG AND DRILLING REPORT

ORIGINAL

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1562 W. First Avenue
Columbus 12, Ohio

PLEASE USE PENCIL OR TYPEWRITER
DO NOT USE INK.

№ 297195

County GUERNSEY Township CENTER Section of Township ✓

Owner Mrs Raymond Clark Address KIPLING, OHIO - BOX 23 & BROOKS / GREEN

Location of property 1/4 mile west of Kipling, O.

CONSTRUCTION DETAILS	BAILING OR PUMPING TEST
Casing diameter 6 5/8 O.D. Length of casing 66'	Pumping Rate 10 G.P.M. Duration of test 2 hrs.
Type of screen ✓ Length of screen ✓	Drawdown ✓ ft. Date 5.19.65
Type of pump ✓	Static level-depth to water 23 ft.
Capacity of pump ✓	Quality (clear, cloudy, taste, odor)
Depth of pump setting ✓	
Date of completion ✓	Pump installed by ✓

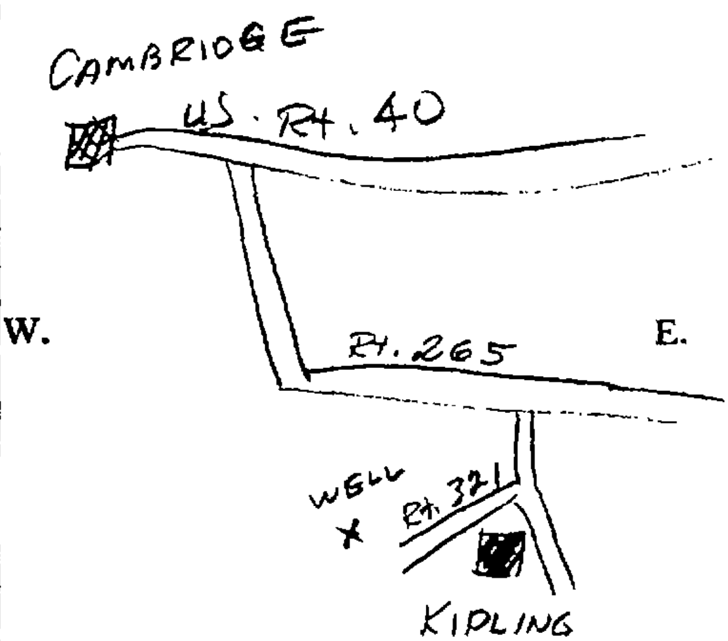
WELL LOG

Formations Sandstone, shale, limestone, gravel and clay	From	To
Brown Clay	0 Feet	15 Ft.
Shale	15	25
Sand	25	64
Soft Sand	64	66
Sand Rock	66	76
W - 68'		

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.

N.



W. E.

S.

See reverse side for instructions

Drilling Firm McFarland Drilling Co Date 6.18.65

Address Rt. 3 Cambridge O. Signed John R. McFarland

113D

WELL LOG AND DRILLING REPORT

ORIGINAL

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1500 Dublin Road
Columbus, Ohio

No. 193558

County Guernsey Township Center 1 Section of Township 4 — Range 2

Owner Eldon Waller Address Rt. 3, Cambridge, O.

Location of property Co. Rd. 318, approx 1½ mi. off St. Rd. 265

CONSTRUCTION DETAILS	
Casing diameter 6¼	Length of casing 16'
Type of screen	Length of screen
Type of pump	
Capacity of pump	
Depth of pump setting	
Date of completion	

BAILING OR PUMPING TEST	
Pumping rate 1 G.P.M.	Duration of test 1 hrs.
Drawdown — ft.	Date 8-20-57
Developed capacity	
Static level—depth to water 36' ft.	
Pump installed by	

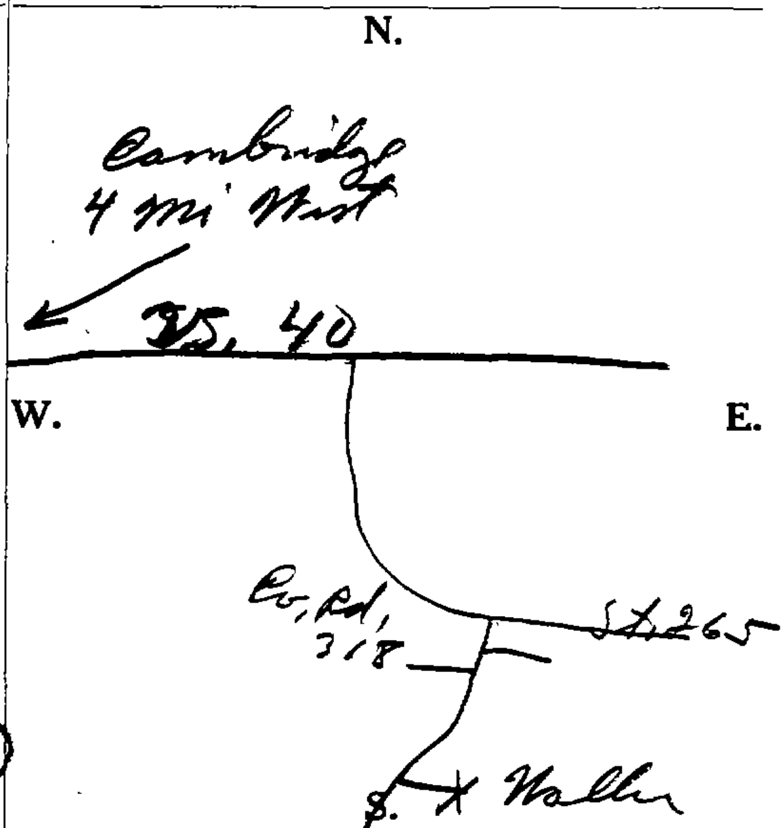
WELL LOG

Formations Sandstone, shale, limestone, gravel and clay	From	To
soil	0 Feet	10 Ft.
sandstone	10	28
shale ~~gr~~	28	30
sandstone	30	48
gray shale	48	52
sandstone	52	60

Water approx 39'

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



See reverse side for instructions

Drilling Firm C. L. McFarland Date 9-14-57

Address Rt. 1, Cambridge, O. Signed C. L. McFarland

114

2275000
727500S

WELL LOG AND DRILLING REPORT

ORIGINAL

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
Columbus, Ohio

№ 90920

County GUERNSEY Township CENTER Section of Township or Lot Number 4.

Owner CHARLES RAMAGE Address CAMBRIDGE, OHIO, RT. 4

Location of property 1½ SW. 265 2 Mi. FROM - BYESVILLE, O. NORTH

CONSTRUCTION DETAILS	PUMPING TEST
Casing diameter 6 Length of casing 15	Pumping rate ...... G.P.M. Duration of test ...... hrs.
Type of screen ...... Length of screen	Drawdown ...... ft. Date ......
Type of pump	Developed capacity 10 P.H.
Capacity of pump	Static level—depth to water 20 ft.
Depth of pump setting	Pump installed by ......

WELL LOG

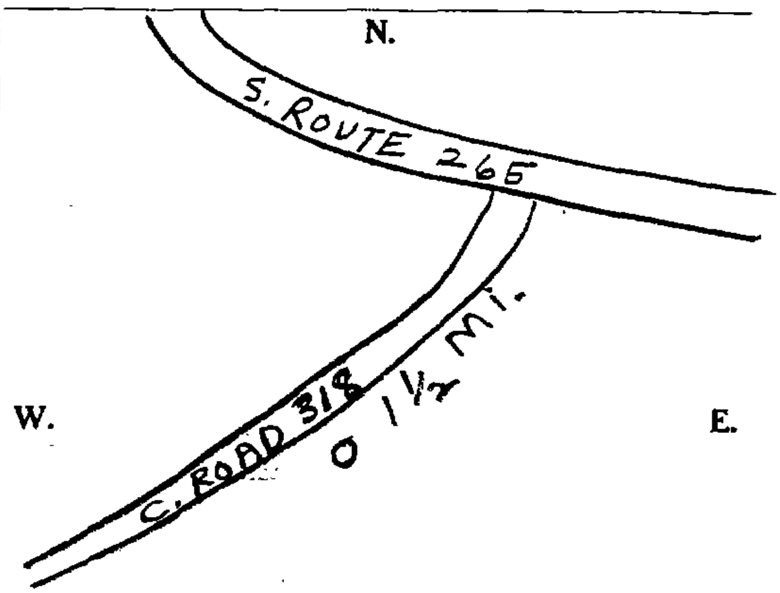
Formations Sandstone, shale, limestone, gravel and clay	From	To
CLAY	0 Feet	4 Ft.
SHALE	4	15
S. ROCK	15	35
SHALE	35	45
R. SHALE	45	50
SLATE	50	60

WATER-AT-35 FT.

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.

N.



W. E.

S.

See reverse side for instructions

Drilling Firm ELLIS B. LARRICK Date 4 - 19 - 54

Address CAMBRIDGE, OHIO. RT 4 Signed Charles Ramage

WELL LOG AND DRILLING REPORT

ORIGINAL

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1562 W. First Avenue
Columbus 12, Ohio

PLEASE USE PENCIL OR TYPEWRITER DO NOT USE INK.

Nº 323134

County Guernsey Township Center Section of Township 1

Owner Joe Seecrest Address 120 E. 8th St. Cambridge, O.

Location of property 1 mile N.E. of Kipling off S.R. 265 - County Road 490

CONSTRUCTION DETAILS	BAILING OR PUMPING TEST
Casing diameter 6" I.D. Length of casing 78 ft	Pumping Rate 1 G.P.M. Duration of test 2 hrs.
Type of screen Length of screen	Drawdown ✓ ft. Date 12.17.65
Type of pump	Static level-depth to water 40 ft.
Capacity of pump	Quality (clear, cloudy, taste, odor) GOOD
Depth of pump setting	
Date of completion	Pump installed by

WELL LOG

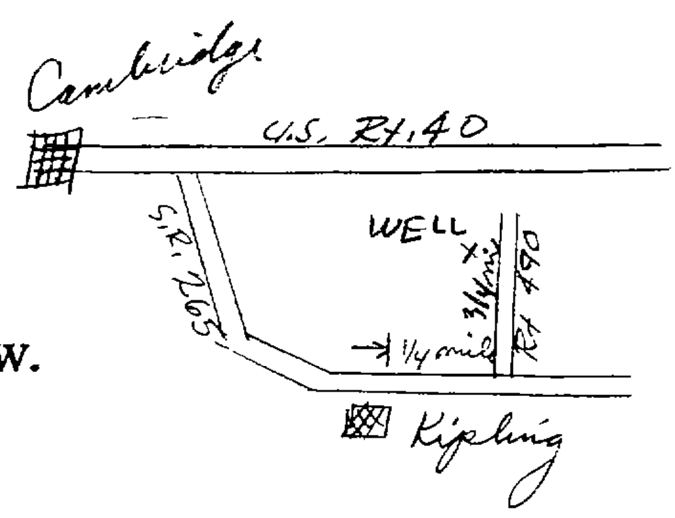
Formations Sandstone, shale, limestone, gravel and clay	From	To
Brown Clay	0 Feet	5 Ft.
Shale	5	11
Sandy Shale	11	22
Sand Rock	22	40
Coal	40	41
Gray Shale	41	55
Sand Rock	55	57
Gray Shale	57	74
Sandy Gray Shale	74	80
Sand Rock	80	95
Gray Shale	95	98
Dark Shale	98	115
W 40		

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.

N.

W.



E.

S.

See reverse side for instructions

Drilling Firm McFarland Drilling

Address Rt. 3 Cambridge, O.

Date 1.2.66

Signed John R. McFarland

116

WE'" LOG AND DRILLING RE")RT

ORIGINAL

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
Fountain Square
Columbus, Ohio 43224

NO CARBON PAPER NECESSARY— SELF-TRANSCRIBING

509270

COUNTY Guernsey TOWNSHIP Center SECTION OF TOWNSHIP 3

OWNER Jack Belick ADDRESS Box 86 Kipling

LOCATION OF PROPERTY ½ mile E. Kipling on 265

CONSTRUCTION DETAILS	
Casing diameter 8"	Length of casing 30'
Type of screen	Length of screen
Type of pump	
Capacity of pump	
Depth of pump setting	
Date of completion	

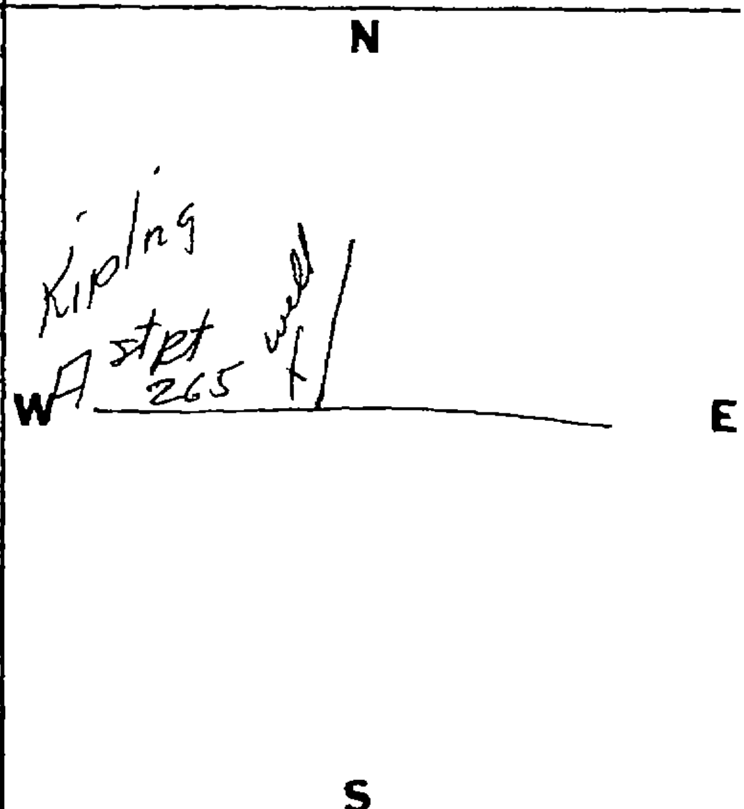
BAILING OR PUMPING TEST (specify one by circling)	
Test rate 5 gpm	Duration of test hrs
Drawdown ft	Date 9/26/77
Static level (depth to water) 15' ft	
Quality (clear, cloudy, taste, odor)	
Pump installed by	

WELL LOG*

Formations: sandstone, shale, limestone, gravel, clay	From	To
Br. Clay	0 ft	29 ft
Shale	29	33
Br. Sand.	33	45
Gr. Sand.	45	55
Gr. Sand	55	74
Gr. Shale	74	80
water at 55'		

SKETCH SHOWING LOCATION

Locate in reference to numbered state highways, street intersections, county roads, etc.



DRILLING FIRM G & J Drilling
ADDRESS Rt 5 Camb. O.

DATE 9/26/77
SIGNED W. K. Gillespie by MS

*If additional space is needed to complete well log, use next consecutive numbered form.

117

WELL LOG AND DRILLING REPORT

ORIGINAL

NO CARBON PAPER NECESSARY— SELF-TRANSCRIBING

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
65 S. Front St., Rm. 815 Phone (614) 469-2646
Columbus, Ohio 43215

No. 398428

County Guernsey Township Center Section of Township 3

Owner Jack Helik Address RD 1 Kipling Ohio

Location of property 1/2 mile North east of Kipling Ohio On C RD 436

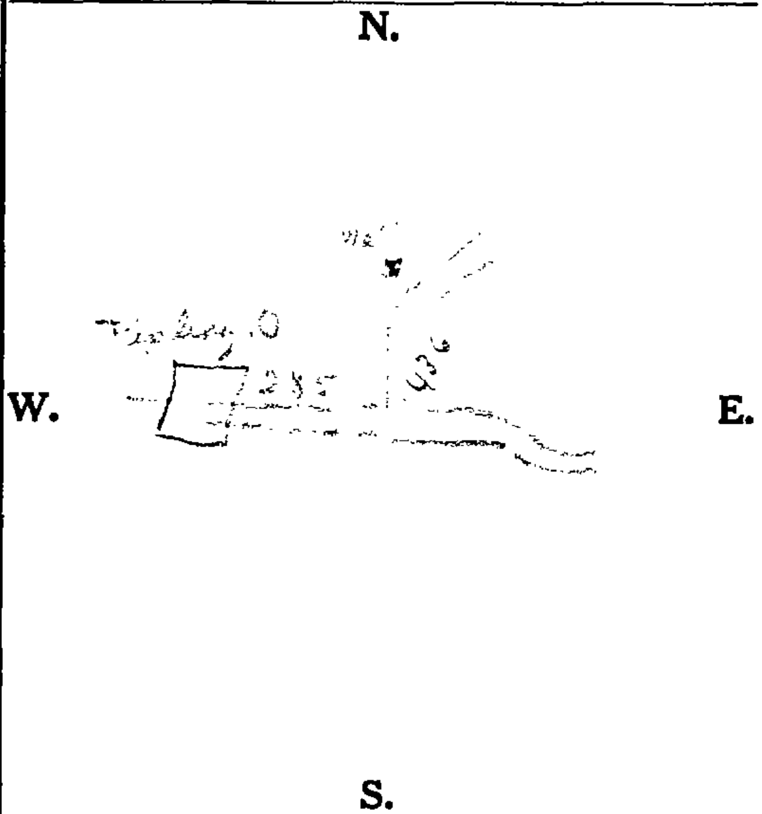
CONSTRUCTION DETAILS	BAILING OR PUMPING TEST (Specify one by circling)
Casing diameter 6 Length of casing 50	Test Rate 10 G.P.M. Duration of test 1 hrs.
Type of screen Length of screen	Drawdown ft. Date
Type of pump	Static level-depth to water 50' ft.
Capacity of pump	Quality (clear, cloudy, taste, odor) Clear
Depth of pump setting	
Date of completion 5/1/71	Pump installed by

WELL LOG*

Formations Sandstone, shale, limestone, gravel and clay	From	To
Clay	0 Feet	10 Ft.
Clay Fill	10	50
Shale	50	58
Sandrock	58	65
Shale	65	80
Water at 62 Ft		

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



Drilling Firm Babosky Drilling

Address Box 304 Buffalo, O

Date 5/1/71

Signed John F Babosky

118

*If additional space is needed to complete well log, use next consecutive numbered form.

WELL LOG AND DRILLING REPORT

ORIGINAL

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1562 W. First Avenue
Columbus, Ohio

PLEASE USE PENCIL OR TYPEWRITER. DO NOT USE INK.

No. 251914

County Guernsey Township Center Section of Township 3

Owner Jack Trubee Address Cambridge, RD 6, Ohio

Location of property On Twp Rd 490 - 1 mi N. of ST RT. 265 near Kipling, O.

CONSTRUCTION DETAILS

Casing diameter $8\frac{5}{8}$" Length of casing 18'

Type of screen - Length of screen -

Type of pump Deep Well JeT

Capacity of pump 3 gpm

Depth of pump setting 116'

Date of completion SeT by Owner

BAILING OR PUMPING TEST

Pumping rate 10 G.P.H. Duration of test 48 hrs.

Drawdown - ft. Date

Developed capacity 100 gal. over night (12 hrs

Static level—depth to water 90' ft.

Pump installed by Owner

WELL LOG

Formations Sandstone, shale, limestone, gravel and clay	From	To
Soil & Clay	0 Feet	4 Ft.
Br. Shale	4	12
Br. Sandrock	12	30
Wh. Sandrock	30	50
Blue Core Lime	50	75
Bl. Shale + Lime	75	90
W. Sandrock	90	121

water at 75'

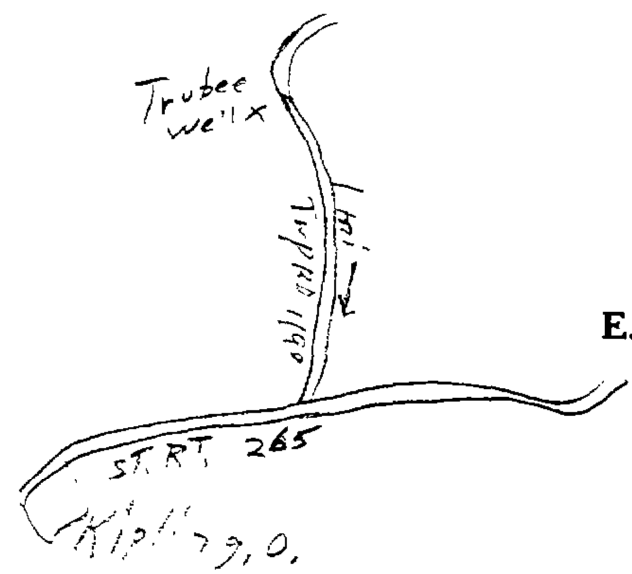
Developed 100 gal. - 12 hrs.

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.

N.

W.



E.

S.

See reverse side for instructions

Drilling Firm Denice Marlatt - Dr. Cont. Date 9/11/60

Address RD 3 Cambridge, O. Signed Denice Marlatt

119

ORIGINAL

WELL LOG AND DRILLING REPORT

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1562 W. First Avenue
Columbus, Ohio 43212

PLEASE USE PENCIL OR TYPEWRITER
DO NOT USE INK.

Nº 365099

County Guernsey Township Center Section of Township 23

Owner Geo. Tomak Address Lore City, Ohio - RT 2

Location of property Twp R54 - 1¼ mi N. of ST. RT. 265 - Kings Mine, O.

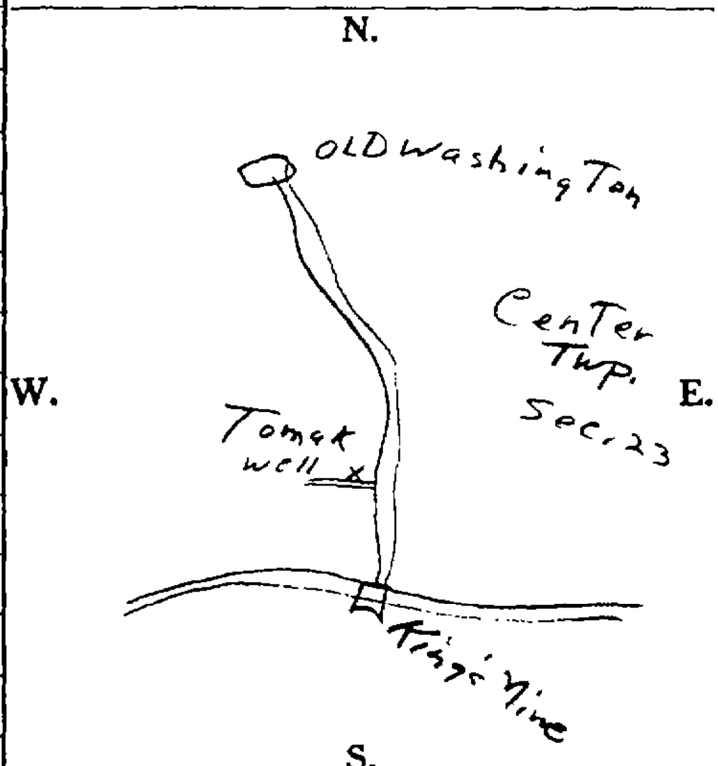
CONSTRUCTION DETAILS	BAILING OR PUMPING TEST
Casing diameter 8⅝ Length of casing 20	Pumping Rate 5 G.P.M. Duration of test 24 hrs.
Type of screen Liner Length of screen 78'	Drawdown ft. Date 9-3-68
Type of pump	Static level-depth to water 30' ft.
Capacity of pump Submersible	Quality (clear, cloudy, taste, odor) Clear
Depth of pump setting Set by owner	Good Taste
Date of completion 9-8-68	Pump installed by - Owner

WELL LOG*

Formations Sandstone, shale, limestone, gravel and clay	From	To
Red Clay	0 Feet	4 Ft.
Shale redrgr.	4	15
Sh. + Blue Core	15	30
Sandstone	30	55
Fireclay	55	68
Shale + Bl. C.	68	80
water at 50'		
+ 70' - 5 gpm		

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



See reverse side for instructions

Drilling Firm Marlatt Drilling
Address RT 3 Cambridge, O.

Date 9-3-68
Signed Donn Marlatt

*If additional space is needed to complete well log, use next consecutive numbered form.

120

WE[illegible] LOG AND DRILLING RE[illegible]RT

ORIGINAL

NO CARBON PAPER
NECESSARY–
SELF-TRANSCRIBING

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
Fountain Square
Columbus, Ohio 43224

504435

COUNTY Guernsey TOWNSHIP Center SECTION OF TOWNSHIP

OWNER Phil Wagler ADDRESS Senecaville Rt 1

LOCATION OF PROPERTY 1 mile East of state Rt 265 on Rd 43

CONSTRUCTION DETAILS

Casing diameter 8" Length of casing 16

Type of screen Length of screen

Type of pump

Capacity of pump

Depth of pump setting

Date of completion 2/9/78

BAILING OR PUMPING TEST (specify one by circling)

Test rate 2 gpm Duration of test 3 hrs

Drawdown Complete ft Date 2/9/78

Static level (depth to water) 3 ft

Quality (clear, cloudy, taste, odor) clear

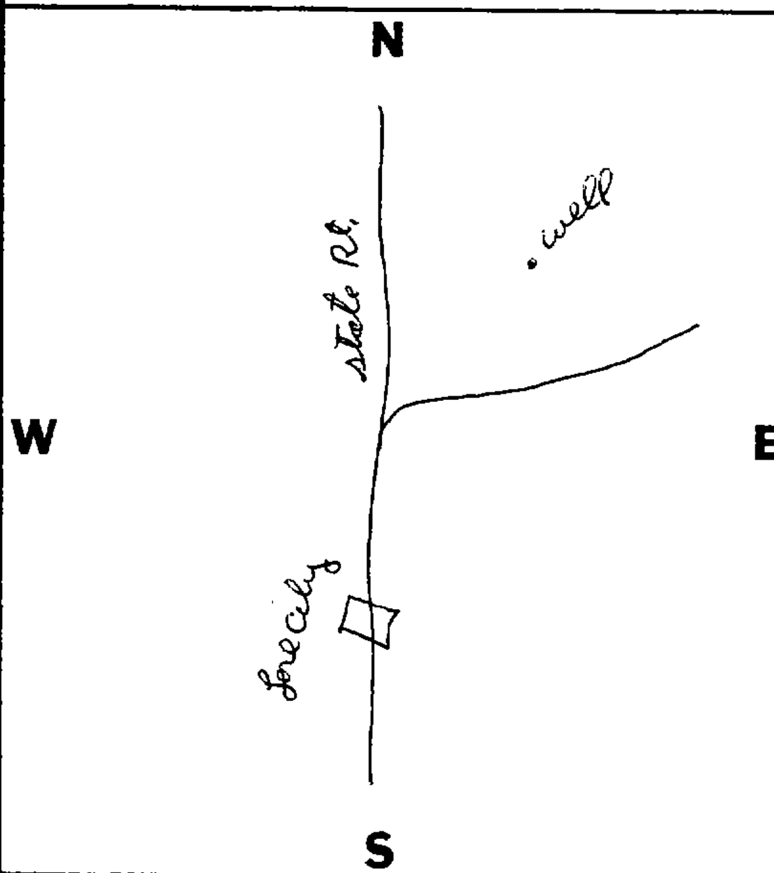
Pump installed by

WELL LOG*

Formations: sandstone, shale, limestone, gravel, clay	From	To
clay	0 ft	4 ft
Brown shale	4	16
Brown Sand stone	16	24
Gray shale	24	32
dark shale	32	62
Sand stone	62	68
dark shale	68	74
Gray shale	74	104
dark shale	104	115
Well lined with 105'		
of plastic well liner		

SKETCH SHOWING LOCATION

Locate in reference to numbered state highways, street intersections, county roads, etc.



DRILLING FIRM Don Wells & Son DATE 2/15/78

ADDRESS R. D. 7 Cambridge SIGNED James R Wells

*If additional space is needed to complete well log, use next consecutive numbered form.

121

WELL LOG AND DRILLING REPORT

ORIGINAL

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1562 W. First Avenue
Columbus 12, Ohio

PLEASE USE PENCIL
OR TYPEWRITER
DO NOT USE INK.

No. 286214

County Guernsey Township Center Section of Township 3

Owner Wm Trehorne Address Kings Mine - Ohio

Location of property On The Kings-Oldwash Rd - Co Rd 54 - In Kings Mine, O. Near Kipling

CONSTRUCTION DETAILS	BAILING OR PUMPING TEST
Casing diameter 2" Length of casing 17	Pumping Rate 22 overhile G.P.M. Duration of test ...... hrs.
Type of screen — Length of screen —	Drawdown ...... ft. Date 9/7/62
Type of pump	Static level-depth to water ...... ft.
Capacity of pump Set by Owner	Quality (clear, cloudy, taste, odor) good water Clear
Depth of pump setting	
Date of completion	Pump installed by Owner

WELL LOG

Formations Sandstone, shale, limestone, gravel and clay	From	To
Clay	0 Feet	3 Ft.
Shale Brown	3	9
Sandy Shale	9	16
Sandrock	16	40
Gray Shale	40	65
Fire Clay	65	72
Blue Sandst.	72	90
Wh Sandst.	90	100
Water at [illegible]	33 34 [illegible]	

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.

N.

W.

E.

S.

See reverse side for instructions

Drilling Firm [illegible] Date [illegible]

Address [illegible] Signed

(122F.)

WELL LOG AND DRILLING REPORT

ORIGINAL

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1500 Dublin Road
Columbus, Ohio

No. 193556

County Guernsey Township Center Section of Township 3

Owner Mr. Lester Green Address Love City O. Rt. 2

Location of property Co. Rd. 54 approx. 1/10 mi off St. Rd. 265 ([illegible])

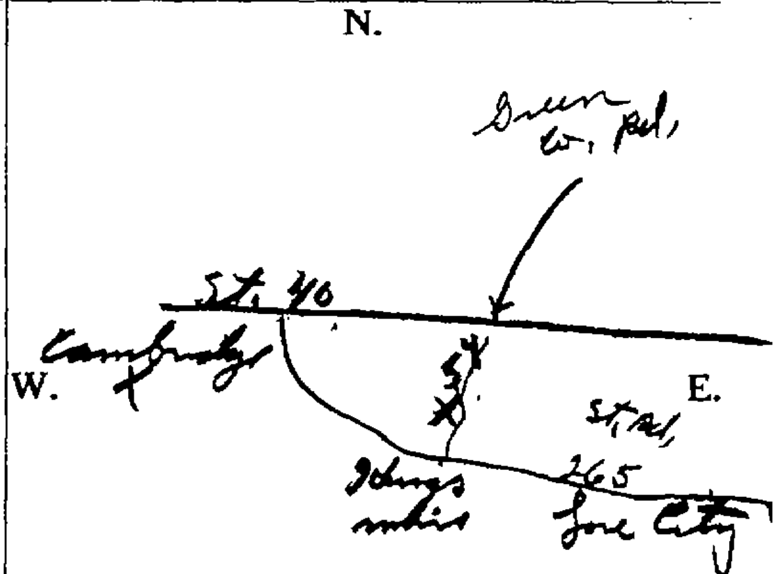
CONSTRUCTION DETAILS	BAILING OR PUMPING TEST
Casing diameter 6 1/4 Length of casing 26'	Pumping rate 30 G.P.M. Duration of test 1 hrs.
~~Type of~~ screen 5" casing ~~Length of screen~~ 16'	Drawdown none ft. Date 8-8-57
Type of pump	Developed capacity 30 G.P.M.
Capacity of pump	Static level—depth to water 50' ft.
Depth of pump setting	Pump installed by
Date of completion	

WELL LOG

Formations Sandstone, shale, limestone, gravel and clay	From	To
Soil	0 Feet	3 Ft.
shale	3	16
red mud	16	24
sand stone	24	49
fire clay	49	55
red mud	55	65
sand stone	65	72
gray shale	72	85
(water at 71')		
reduced hole to 5" at 65'; 5" casing from 49' to 65'		

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



See reverse side for instructions

Drilling Firm C. L. McFarland Date Aug. 26, 57

Address Rt. 1, Cambridge, O. Signed C. L. McFarland

123E

WELL LOG AND DRILLING REPORT

ORIGINAL

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1562 W. First Avenue
Columbus, Ohio 43212

PLEASE USE PENCIL OR TYPEWRITER

DO NOT USE INK.

No. 357901

County Guernsey Township Center Section of Township

Owner Raymond Hamel Address Rt 2 Lore City

Location of property 1 Mile Northwest of Lore City

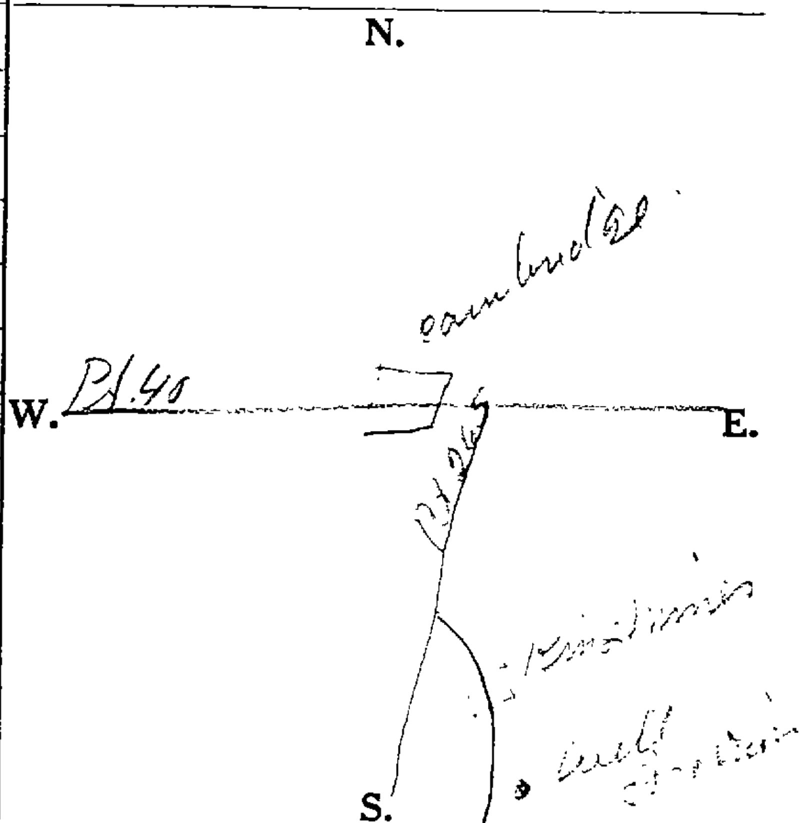
CONSTRUCTION DETAILS	BAILING OR PUMPING TEST
Casing diameter 8 Length of casing 11	Pumping Rate 2½ G.P.M. Duration of test 4 hrs.
Type of screen Length of screen	Drawdown complete ft. Date Nov. 1 - 66
Type of pump	Static level-depth to water 85 ft.
Capacity of pump	Quality (clear, cloudy, taste, odor) Clear
Depth of pump setting	
Date of completion Nov. 2 - 66	Pump installed by

WELL LOG*

Formations Sandstone, shale, limestone, gravel and clay	From	To
Deepen well	0 Feet	Ft.
From 51		
Gray Shale	51	104
Dark Shale	104	132
Coal	132	134
Gray Shale	134	165
Sandy Shale	165	187
White Sand	187	200
Water at 187		

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



See reverse side for instructions

Drilling Firm Dan Wells & Son Date Nov 2 1966

Address Rt. Cambridge O Signed James Wells

124

*If additional space is needed to complete well log, use next consecutive numbered form.

WELL LOG AND DRILLING REPORT

TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

Ohio Department of Natural Resources, Divison of Water
1939 Fountain Square Drive, Columbus, Ohio 43224 Phone (614) 265-6739

716869

Permit Number

COUNTY Guernsey TOWNSHIP Center SECTION/LOT No. (CIRCLE ONE)

ER/BUILDER (CIRCLE ONE OR BOTH) Ken Shaver PROPERTY ADDRESS 12100 Happydale Rd (ADDRESS OF WELL LOCATION) Cambridge Oh 43725

LOCATION OF PROPERTY SAME

CONSTRUCTION DETAILS

CASING

Borehole Diameter 8 in.

1 Diameter 8 in. Length 44' ft. Wall Thickness .332 in.

2 Diameter in. Length ft. Wall Thickness in.

Type: 1/2 Steel 1/2 Galv. ☑ PVC 1/2 Other

Joints: 1/2 Threaded 1/2 Welded 1/2 Solvent 1/2 Other

Liner: Length Type Wall Thickness in.

SCREEN

Type (wire wrapped, louvered, etc.) Material

Length ft. Diameter in.

Set between ft. and ft. Slot

GROUT

Material Beneseal Volume used 200 lb

Method of installation Slurry

Depth: placed from 44 ft. to Surface ft.

GRAVEL PACK (Filter Pack)

Material Volume used

Method of installation

Depth: placed from ft. to ft.

Pitless Device ☑ Adapter ☐ Preassembled unit

Use of Well private dwelling

☑ Rotary ☐ Cable ☐ Augered ☐ Driven ☐ Dug ☐ Other

Date of Completion 6/9/91

WELL LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc.

	From	To
Br. Clay	0	10
Gr. shale	10	34
Mine	34	39
Shale	39	40
Sandrock	40	50

Mine hit at 34'
packer set at
30' - cased thru
mine shaft

WELL TEST

☑ Bailing ☐ Pumping* ☐ Other

Test rate 25+ gpm Duration of test 1 hrs.

Drawdown none ft.

Measured from: ☐ top of casing ☑ ground level ☐ Other

Static Level (depth to water) 30 ft. Date: 6/9/91

Quality (clear, ~~cloudy, taste, odor~~)

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

PUMP

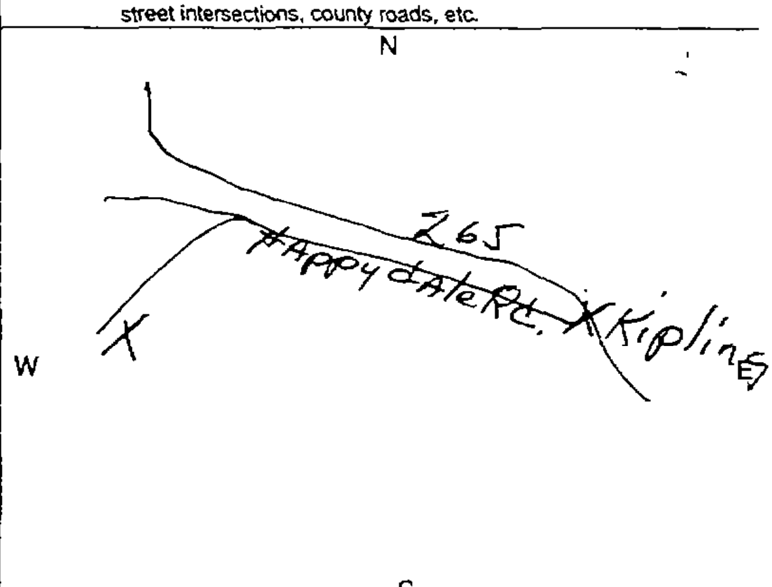
Type of pump Sub Capacity 10 gpm

Pump set at 42' ft.

Pump installed by driller

SKETCH SHOWING WELL LOCATION

Show distances well lies from numbered state highways, street intersections, county roads, etc.



*If additional space is needed to complete well log, use next consecutively numbered form.

Drilling Firm G & J Drilling
Address 6535 Pigeon Gap
City, State, Zip Camb. O 43725

Signed William K. Gilchrist Jr. NC
Date 7/10/91
ODH Registration Number 831

DNR 7802.90

U-5

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224

DNR 7802.94
TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Divison of Water, 1939 Fountain Square Drive
Columbus, Ohio 43224 Phone (614) 265-6739

832734

Permit Number 32

COUNTY Guernsey TOWNSHIP Center SECTION/LOT No. (Circle One)

OWNER/BUILDER (Circle One or Both) Terry (First) Geiger (Last) PROPERTY ADDRESS (Address of well location) 63004 (Number) Arrowhead Rd (Street) Cambridge (City) 43725 (Zip Code + 4)

LOCATION OF PROPERTY Same

CONSTRUCTION DETAILS

CASING *(Length below grade) Borehole Diameter 8 in.
1 Diameter 6 in. Length* 28 ft. Wall Thickness SDR 21 in.
2 Diameter ___ in. Length* ___ ft. Wall Thickness ___ in.
Type. 1/2 Steel 1/2 Galv. 1/2 PVC 1/2 Other
Joints 1/2 Threaded 1/2 Welded 1/2 Solvent 1/2 Other
Liner: Length 57' Type 5" PVC Wall Thickness SDR 26 in.

SCREEN
Type (wire wrapped, louvered, etc.) N/A Material
Length ___ ft. Diameter ___ in.
Set between ___ ft. and ___ ft. Slot

GROUT
Material Sakrete Volume used 400 lb.
Method of installation poured
Depth: placed from 28 ft. to 4 ft.

GRAVEL PACK (Filter Pack)
Material pea gravel Volume used 1 ton
Method of installation poured
Depth: placed from 85 ft. to 28 ft.

Pitless Device None ☐ Adapter ☐ Preassembled unit
Use of Well domestic
☐ Rotary ☒ Cable ☐ Augered ☐ Driven ☐ Dug ☐ Other
Date of Completion 9-30-96

WELL LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc.	From	To
Topsoil	0	1
yellow shale	1	15
red rock	15	20
blue rock	20	25
shale	25	28
red rock	28	31
grey shale	31	*60
Coal	60	62
blue rock	62	65
grey shale	65	85
* water 58'		

*(If additional space is needed to complete well log, use next consecutively numbered form.)

WELL TEST

☒ Bailing ☐ Pumping* ☐ Other
Test rate 1 gpm Duration of test 4 hrs.
Drawdown 80 ft.
Measured from. ☒ top of casing ☐ ground level ☐ Other
Static Level (depth to water) 40 ft. Date: 9-30-96
Quality (clear, cloudy, taste, odor) cloudy no taste or odor
*(Attach a copy of the pumping test record, per section 1521.05, ORC)

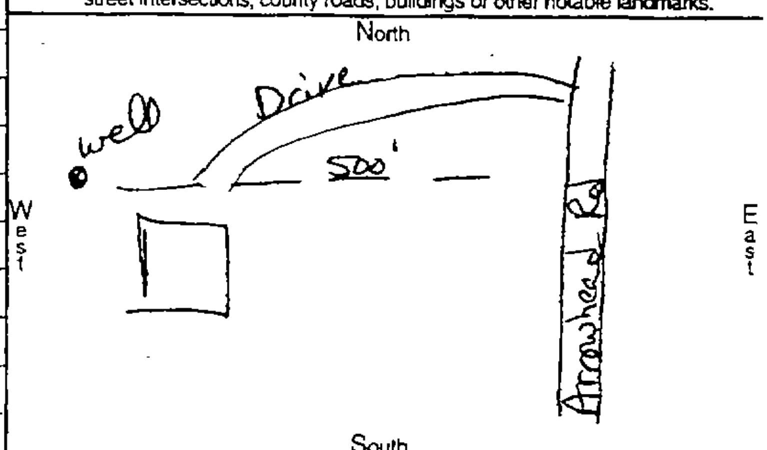
PUMP

Type of pump N/A Capacity ___ gpm
Pump set at N/A ft.
Pump installed by

WELL LOCATION

Location of well in State Plane coordinates, if available:
Zone ___ x ___ y ___
Elevation of well ___ ft./m. Datum plain: ☐ NAD27 ☐ NAD83
Source of coordinates: ☐ GPS ☐ Survey ☐ Other

Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks.



I hereby certify the information given is accurate and correct to the best of my knowledge

Drilling Firm D+M Water Well Signed Monroe Dickey
Address 58021 Buffalo Mine Rd Date 10-20-96
City, State, Zip Senecaville OH 45780 ODH Registration Number 2015

U-6

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224

DNR 7802.96

TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Divison of Water, 1939 Fountain Square Drive
Columbus, Ohio 43224-9971 Voice (614) 265-6739 Fax (614) 447-9503

853326

WELL LOCATION

County Guernsey Township Center

Owner/Builder (Circle One or Both) Gary & Kelly Stein (First / Last)

Address of Well Location 61210 (Number) arrowhead Rd (Street Name)

City Cambridge ohio Zip Code +4 3725

Permit No. 121 Section/Lot No. (Circle One or Both)

Location of Well in State Plane coordinates, if available: Use of Well home

N ☐ X ______ . ______ +/- ______ ft. or m

S ☐ Y ______ . ______ +/- ______ ft. or m

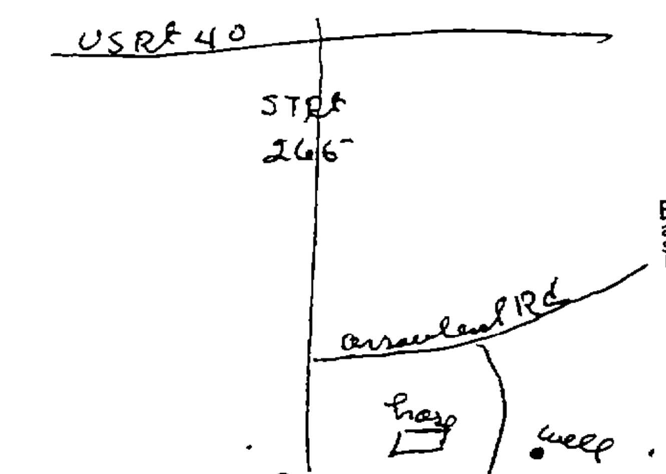
Elevation of Well ______ . ______ +/- ______ ft. or m

Datum Plain: ☐ NAD27 ☐ NAD83 Elevation Source ______

Source of Coordinates: ☐ GPS ☐ Survey ☐ Other ______

Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks. If latitude and longitude are available please include here: Lat: ______ Long: ______

North



W East South

WELL TEST*

Pre-Pumping Static Level 32 ft. Date 10/30/97

Measured from: ☐ Top of Casing ☒ Ground Level ☐ Other ______

☒ Air ☐ Bailing ☐ Pumping* ☐ Other ______

Test Rate 10 gpm Duration of Test 2 hrs.

Feet of Drawdown Complete ft. Sustainable Yield 10 gpm

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

Is Copy Attached? ☐ Yes ☒ No Flowing Well? ☐ Yes ☒ No

Quality clear with odor

PUMP/PITLESS

Type of pump ______ Capacity ______ gpm

Pump set at ______ ft. Pitless Type ______

Pump Installed by ______

I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm J R Wells

Address 3381 Bloomfield Rd

City, State, Zip Cambridge ohio 43725

Signed J R Wells Date 10/30/97

ODH Registration Number 303

CONSTRUCTION DETAILS

☒ Rotary ☐ Cable ☐ Augered ☐ Driven ☐ Other ______

BOREHOLE/CASING (measured from ground surface)

1 ☐ Borehole Diameter 13 inches Depth 26 ft.
Casing Diameter 8 in. Length 27 ft. Thickness SDR21 in.

2 ☐ Borehole Diameter 8 inches Depth 92 ft.
Casing Diameter 6 in. Length 80 ft. Thickness SDR16 in.

Casing Height Above Ground 18" ft.

Type: 1 ☐ 2 ☐ Steel; 1 ☐ 2 ☐ Galv.; 1 ☒ 2 ☒ PVC; 1 ☐ 2 ☐ Other ______

Joints: 1 ☐ 2 ☐ Threaded; 1 ☐ 2 ☐ Welded; 1 ☒ 2 ☒ Solvent; 1 ☐ 2 ☐ Other ______

SCREEN

Diameter ______ Slot Size ______ Screen Length ______ ft.

Type ______ Material ______

Set Between ______ ft. and ______ ft.

GRAVEL PACK (Filter Pack)

Material/Size ______ Volume/Weight Used ______

Method of Installation ______

Depth: Placed FROM ______ ft. TO ______ ft.

GROUT

Material Benseal Volume/Weight Used 375 lbs

Method of Installation pour

Depth: Placed FROM 0 ft. TO 26 ft.

DRILLING LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED. Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc.	From	To
brown shale	0	31
red shale	31	40
gray shale	40	58
dark shale	58	67
Coal	67	68
gray shale	68	76
white Sandstone	76	92

077

*(If more space is needed to complete drilling log, use next consecutively numbered form.)

Date of Well Completion 10-30-97 Total Depth of Well 92 ft.

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224-9971

Blue - Customer's copy Pink - Driller's copy Green - Local Health Dept. copy

WELL LOG AND DRILLING REPORT

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1939 Fountain Square Drive
Columbus, Ohio 43224

693516

TYPE OR USE PEN
SELF-TRANSCRIBING
PRESS HARD!

Permit Number ______

COUNTY Guernsey TOWNSHIP Center SECTION OF TOWNSHIP ______
OWNER Von palsons PROPERTY ADDRESS NONE assigned
LOCATION OF PROPERTY Spies St, Kipling (past VFW. first Rd to left)

CONSTRUCTION DETAILS

CASING
Casing Diameter 8" in. Length of Casing 26 ft.
Type: ☐ Steel ☐ Galv. ☑ PVC ☐ Other ______
Joints: ☐ Threaded ☐ Welded ☑ Solvent ☐ Other ______

SCREEN
Type (wire wrapped, louvered, etc.) ______ Material ______
Length ______ ft. Diameter ______ in.
Set between ______ ft. and ______ ft. Slot ______

GROUT
Material Beronite Volume used 300 lbs
Method of installation pour
Depth: placed from 0 ft. to 26 ft.
☑ Rotary ☐ Cable ☐ Augered ☐ Driven ☐ Dug ☐ Other ______

BAILING OR PUMPING TEST
(specify one by circling)

WELL TEST
Test rate 2 gpm Duration of test 2 hrs.
Drawdown (water level during pumping) Complete ft.
Measured from: ☐ top of casing ☑ ground level ☐ Other 11-17-89
Static Level (depth to water) 52 ft. Date: ______
Quality (clear, cloudy, taste, odor) Clear

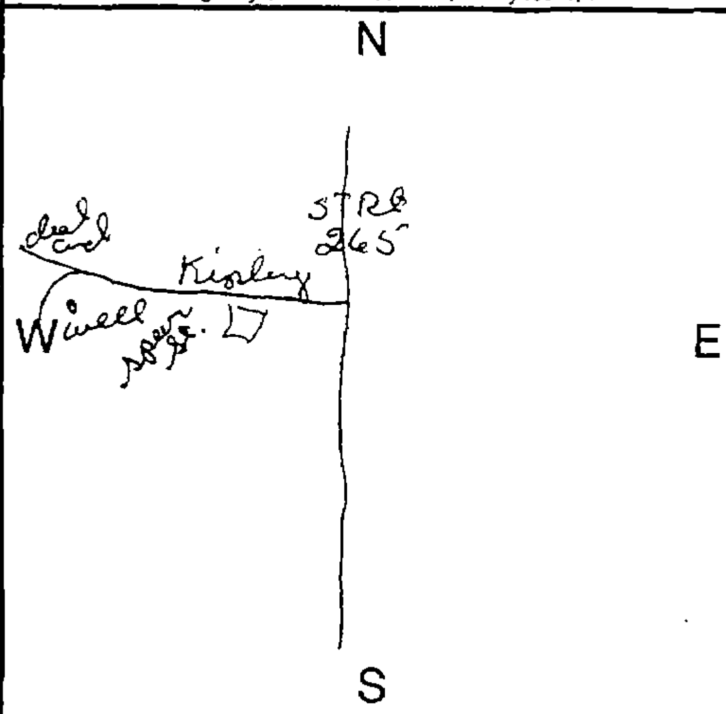
PUMP
Type of pump ______ Capacity ______ gpm
Pump set at ______ ft.
Pump installed by ______
Pitless Device ☐ Adapter ☐ Preassembled unit
Use of Well ______

WELL LOG*

Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand	From	To
clay	0 ft	4 ft
brown shale	4	36
gray shale	36	48
red shale	48	51
gray shale	51	63
red shale	63	67
gray shale	67	71
dark shale	71	92
Coal	92	93
gray shale	93	108
red shale	108	112
gray shale	112	120
well has 108' of		
6" liner		

SKETCH SHOWING LOCATION

Show distances well lies from numbered state highways, street intersections, county roads, etc.



* If additional space is needed to complete well log, use next consecutively numbered form.

DNR 7802.88

DRILLING FIRM J. R. Wells
ADDRESS 3382 Bloomfield Rd
CITY, STATE, ZIP Cambridge Ohio 43725
SIGNED J. R. Wells
DATE 11-19-89
ODH REGISTRATION NUMBER 303

U-8

Completion of this form is required by 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.

SECTION 10.2 - HYDROGEOLOGIC DATA

GRNDSAMP.DWG

GROUNDWATER SAMPLING

JOB # 7000.03
LOCATION Gve-70-14.0
WEATHER CONDITIONS Snow, very cold

DATE 12-27-99 / 01-04-00
SAMPLERS TLH
WITNESS —

WELL #	CASING LENGTH	STATIC WATER LEVEL	3X VOLUME OF WATER *	VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	DISSOLVED OXYGEN	SAMPLING TECHNIQUE	IMMICIBLE LAYERS	CONDITION OF THE WELL	SAMPLING PROBLEMS / OBSERVATIONS
221A	60.9	17.3	22.3	23.0	9.0	7.93	548 mS	258	Bail	none	good 48min no drawdown	Clear
221B	41.8	17.4	12.8	14.0	10.7	7.73	851 mS	427	Bail	none	good 31min no drawdown	very silty
221C	27.1	11.7	8.0	8.5	11.2	7.52	961 mS	480	Bail	none	good 28" 13min	very Silty
222A	68.0	11.0	29.5	30.0	11.6	7.88	721 mS	362	Bail	none	good 24.4 1,06 min 10:00	Bailer came off the rope nearly clear
222B	34.3	11.5	11.96	12.5	8.7	7.83	486 mS	234	Bail	none	good 25min	Slightly Silty *
222C	12.9	3.1	5.10	5.5	8.8	7.41	422 mS	213	Bail	none	good 9min	very silty *
223A	73.7	19.3	28.3	28.5	10.9	8.31	875 mS	837	Bail	none	good 43.4 1,16min 10:45	Clear Sulphur Odor
223B	26.8	11.2	8.1	8.5	10.3	7.61	771 mS	394	Bail	none	good 12.7 16min 8:45	slightly Silty

* 3 X VOL. = L.F. WATER X (0.52 (2" WELLS) / 1.98 (4" WELLS))

* need specific capacity

GROUNDWATER SAMPLING

JOB # 7000.03
LOCATION Gue-70-14.10
WEATHER CONDITIONS Snow, very cold

DATE 12-28-99 / 01-03-00 / 01-05-00
SAMPLERS TLH
WITNESS -

WELL #	CASING LENGTH	STATIC WATER LEVEL	3X VOLUME OF WATER *	VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	DISSOLVED OYXGEN	SAMPLING TECHNIQUE	IMMICIBLE LAYERS	CONDITION OF THE WELL	SAMPLING PROBLEMS / OBSERVATIONS
224A	67.5	12.0	28.8	29.0	8.6	7.55	546 uS	276	Bail	none	good 12.3 .53min 11:15	Slightly Silty
224B	28.7	8.9	9.7	11.0	7.3	7.58	619 uS	306	Bail	none	good 12.1 16min 12:00	very Silty
225A	84.5	32.0	27.2	27.5	13.6	7.02	324 uS	262	Bail	none	good 32.4 1,13min 1:15	Clear
225B	19.5	2.9	8.7	9.0	14.1	7.22	511 uS	256	Bail	none	good 5.6 17min 2:10	very silty
226A	74.5	20.1	27.5	28.0	8.4	8.01	1376 uS	684	Bail	none	good 67.7 1,14min 4:45	very silty
227A	76.8	23.5	27.6	28.0	6.4	8.08	1298 uS	643	Bail	none	good 51.4 1,21min 2:15	Sulphur odor Slightly Silty
227B	32.4	11.1	11.0	11.5	7.3	7.91	664 uS	340	Bail	none	good 30.1 26 min 3:20	Bail Dry very Silty

* 3 X VOL. = L.F. WATER X (0.52 (2" WELLS) / 1.96 (4" WELLS))

2

GROUNDWATER SAMPLING

JOB # 7000.03
LOCATION Gve-70-14.10
WEATHER CONDITIONS Snow/very cold

DATE 12-29-99 /12-30-99 /01-04-00
SAMPLERS TLH
WITNESS -

WELL #	CASING LENGTH	STATIC WATER LEVEL	3X VOLUME OF WATER *	VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	DISSOLVED OYXGEN	SAMPLING TECHNIQUE	IMMICIBLE LAYERS	CONDITION OF THE WELL	SAMPLING PROBLEMS / OBSERVATIONS
228A	76.5	14.9	28.4	29.0	10.5	11.94	650 mS	326	Bail	none	good 1hr 22.2' 2:00	nearly Clear note pH
228B	47.7	20.6	14.0	14.0	10.2	7.98	743 mS	374	Bail	none	good 18min Dry 3:30	very silty
228C	29.7	13.5	8.4	8.5	10.4	7.21	770 mS	394	Bail	none	good 19min 14.2' 12:15	very silty
DW-1	68.5	12.9	≈250gal	500gal	8.7	7.49	516 mS	256	Bail	none	good 1,05 12.9 3:00	Slightly silty
1A	71.5	16.8	28.4	29.0	11.3	8.02	623 mS	311	Bail	none	good 1,05 17.8 9:30	Clear
1B	36.0	16.9	9.9	10.0	13.7	8.25	881 mS	443	Bail	none	good 34min 17.1 4:45	very silty
2A	70.4	17.3	27.6	28.0	12.6	12.34	1443 mS	46	Bail	none	good 1,16min 18.8 3:15	Slightly silty
2B	38.0	17.3	10.8	11.0	12.3	7.34	690 mS	345	Bail	none	good 25min 17.5 11:30	very silty

* 3 X VOL. = L.F. WATER X (0.52 (2" WELLS) / 1.98 (4" WELLS))

GROUNDWATER SAMPLING

JOB # 7000.03
LOCATION Guernsey County
WEATHER CONDITIONS Very Very Cold

DATE 01-24-00 / 01-25-00
SAMPLERS TLH
WITNESS —

WELL #	CASING LENGTH	STATIC WATER LEVEL	3X VOLUME OF WATER *	VOLUME PURGED	TEMPERATURE °C	pH	CONDUCTIVITY	~~DISSOLVED OXYGEN~~ TDS	SAMPLING TECHNIQUE	IMMICIBLE LAYERS	CONDITION OF THE WELL	SAMPLING PROBLEMS / OBSERVATIONS
P-1A	71.7	16.75	28.5	30.0	11.9	6.52	558	280	Bail	none	good 1hr 4min 17.4 11:57	Sulphur Odor Clear
221A	61.1	17.77	22.5	25.0	9.9	6.15	508	251	"	"	good 45min 17.8 1:59	Very Clear
221B	40.9	17.45	12.2	15.0	9.0	5.81	815	405	"	"	good 27min 17.6 2:42	Silty
221C	26.5	11.85	8.4	10.0	9.6	6.04	824	414	"	"	good 15min 12.4 3:26	very silty
228B	47.7	19.25	15.5	6.0	8.0	6.04	768	388	"	"	good 17min dry 4:30	very silty
228C	29.7	13.67	8.5	10.0	8.8	5.79	702	350	"	"	good 16min 15.0 5:07	very silty
225A	84.5	31.75	27.7	30.0	7.7	5.75	494	248	"	"	good 1hr 1min no drawdown 9:17	Very Clear
226A	74.7	20.23	28.5	30.0	8.1	6.24	1250	627	"	"	good 1hr 24min 70.2 12:04	Sulphur Odor very silty

* 3 X VOL. = L.F. WATER X (0.52 (2" WELLS) / 1.98 (4" WELLS))

GRNDSAMP.DWG

GROUNDWATER SAMPLING

JOB # 7000.03
LOCATION Guernsey County
WEATHER CONDITIONS Very Very Cold

DATE 01-25-00
SAMPLERS TLH
WITNESS —

WELL #	CASING LENGTH	STATIC WATER LEVEL	3X VOLUME OF WATER *	VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	DISSOLVED OYXGEN	SAMPLING TECHNIQUE	IMMICIBLE LAYERS	CONDITION OF THE WELL	SAMPLING PROBLEMS / OBSERVATIONS
222A	68.0	11.19	29.6	30.0	9.1	6.56	697	347	Bail	none	good 26.9 56min 2:54	Sulphur Odor Clear
224A	67.5	12.51	27.4	30.0	8.6	6.26	591	298	Bail	none	good 12.9 47min 9:27	Sulphur Odor Slightly Silty
228A	76.5	19.86	29.5	30.0	10.7	9.68	630	314	Bail	none	good 23.4 53min 2:43	Clear
227A	76.8	23.99	27.5	30.0	8.1	6.95	1215	603	Bail	none	good 1hr 24min 5:43	Sulphur Odor Silty
OW-1		13.72		600	10.9	6.75	471	238	Bail	none	good ? 1hr 1:16	Slightly Silty

* 3 X VOL. = L.F. WATER X (0.52 (2" WELLS) / 1.98 (4" WELLS))

GRNDSAMP.DWG

GROUNDWATER SAMPLING

JOB # 0107000.063

LOCATION Guernsey County

WEATHER CONDITIONS Cold /Cool

DATE 02-17-00

SAMPLERS Takeshi Hirano

WITNESS -

WELL #	CASING LENGTH	STATIC WATER LEVEL	3X VOLUME OF WATER *	VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	DISSOLVED OYXGEN	SAMPLING TECHNIQUE	IMMICIBLE LAYERS	CONDITION OF THE WELL	SAMPLING PROBLEMS / OBSERVATIONS
221A	61.15	17.14	23gal	30gal	11.7	6.34	519	262	Bail	none	good 55min drawdown to 17.4	Clear
221B	40.92	16.64	13gal	15gal	11.9	6.51	811	405	Bail	none	good 27min drawdown to 16.8	very silty
221C	26.47	11.44	8gal	10gal	11.44	6.40	909	455	Bail	none	good 18min drawdown none	very silty
222A	68.02	10.81	29gal	30gal	10.7	7.14	692	345	Bail	none	good 1,02min drawdown to 25.3	nearly clear
224A	67.50	11.80	28gal	30gal	12.0	6.61	599	299	Bail	none	good 58min drawdown none	Clear
225A	84.50	29.85	28gal	30gal	11.1	6.30	478	236	Bail	none	good 57min drawdown 30.1	nearly Clear
226A	74.75	19.07	28gal	30gal	15.8	6.72	1317	653	Bail	none	good 1,22min drawdown to 52.8	nearly Clear
227A	76.81	22.59	27gal	30gal	15.7	6.70	1195	598	Bail	none	good 1,27min drawdown to 63.9	Sulphur Odor Slightly Silty

* 3 X VOL. = L.F. WATER X (0.52 (2" WELLS) / 1.98 (4" WELLS))

GRNDSAMP.DWG

GROUNDWATER SAMPLING

JOB # 0110 7000.003

LOCATION Guernsey County

WEATHER CONDITIONS Cold / Cool

DATE 02-16-00

SAMPLERS Takeshi Hirano

WITNESS –

WELL #	CASING LENGTH	STATIC WATER LEVEL	3X VOLUME OF WATER *	VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	DISSOLVED OYXGEN	SAMPLING TECHNIQUE	IMMICIBLE LAYERS	CONDITION OF THE WELL	SAMPLING PROBLEMS / OBSERVATIONS
228A	76.50	18.87	29gal	30gal	12.8	9.77	626	313	Bail	none	good 1,03 min drawdown to 23.1	nearly clear
228B	47.74	18.29	15gal	7gal	12.2	6.52	816	405	Bail	none	good 15 min drawdown - dry	very silty
228C	29.72	13.00	8gal	10gal	11.3	6.29	714	356	Bail	none	good 21min drawdown to 14.4	Very silty
P-1A		15.98		30gal	12.8	6.72	655	328	Bail	none	good 1,02 min drawdown to 25.3	nearly clear
PW-1		12.50		500± gal	12.5	6.33	515	248	Bail	none	good 1,00min drawdown to 12.52	clear

* 3 X VOL. = L.F. WATER X (0.52 (2" WELLS) / 1.98 (4" WELLS))

GRNDSAMP.DWG

GROUNDWATER SAMPLING

JOB # 7000.03
LOCATION Gue · 70 · 14.10
WEATHER CONDITIONS mild

DATE 3-6-00 / 3-7-00
SAMPLERS Takeshi Hirano
WITNESS N/A

WELL #	CASING LENGTH	STATIC WATER LEVEL	3X VOLUME OF WATER *	VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	~~DISSOLVED OYXGEN~~ TDS	SAMPLING TECHNIQUE	IMMICIBLE LAYERS	CONDITION OF THE WELL	SAMPLING PROBLEMS / OBSERVATIONS
226A	74.75	19.11	28.9 gal	30gal	17.2	6.93	1347	677	Bail	none	good 1,31 drawdown to 1:15	Sulphur odor Slightly Silty
227A	76.81	22.63	28.1gal	30gal	161	7.14	1179	585	Bail	none	good 1,19 drawdown to 3:00	Sulphur odor Slightly Silty
225A	84.50	30.62	28.0gal	30gal	16.9	6.58	477	243	Bail	none	good 1,02 drawdown to 5:00	very clear
224A	67.5	12.18	28.7gal	30gal	10.1	6.76	599	294	Bail	none	good 1,09 nodrawdown 9:35	nearly clear
222A	68.02	11.15	29.5gal	30gal	12.9	7.22	677	340	Bail	none	good 1,03 drawdown to 10:15	nearly clear Sulphur Odor
228A	76.50	19.14	29.8gal	30gal	16.8	10.22	663	333	Bail	none	good 57 drawdown to 3:10	Nearly Clear
221A	61.15	17.34	22.7gal	30gal	17.6	7.14	545	272	Bail	none	good 52 drawdown to 1:45	very clear
P/A		16.32		30gal	15.9	7.16	672	336	Bail	none	good 54 drawdown to 12:25	clear

* 3 X VOL. = L.F. WATER X (0.52 (2" WELLS) / 1.98 (4" WELLS))

GRNDSAMP.DWG

GROUNDWATER SAMPLING

JOB # 7000.03
LOCATION Gue-'B-14,10
WEATHER CONDITIONS mild

DATE 3-7-00 / 3-8-00
SAMPLERS Takeshi Hirano
WITNESS N/A

WELL #	CASING LENGTH	STATIC WATER LEVEL	3X VOLUME OF WATER *	VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	~~DISSOLVED OXYGEN~~ TDS	SAMPLING TECHNIQUE	IMMICIBLE LAYERS	CONDITION OF THE WELL	SAMPLING PROBLEMS / OBSERVATIONS
228C	29.72	12.70	8.8gal	10gal	17.2	6.86	743	372	Bail	none	good 16min drawdown to 14.3 4:30	Very Silty
228B	47.74	18.64	15.1gal	7gal	17.1	7.00	867	435	Bail	none	good 13min Dry 5:15	Slightly Silty
221B	40.92	16.99	12.4gal	13gal	17.1	6.73	832	416	Bail	none	good 23min no drawdown 12:35	Silty
221C	26.47	11.00	8.0gal	9gal	17.8	6.72	924	463	Bail	none	good 13min drawdown to 11.7 12:00	very Silty
PW-1		12.97		500 gal	12.3	6.78	537	268	Bail	none	good 1:00 drawdown to 12.99 8:20	Sulphur odor Nearly Clear

* 3 X VOL. = L.F. WATER X (0.52 (2" WELLS) / 1.96 (4" WELLS))

GRNDSMP4 DWG

May Sampling Event

GROUNDWATER SAMPLING

JOB # 01107000.096

LOCATION Guernsey County Gue-70-14.10

WEATHER CONDITIONS Rain/Cloudy

DATE 05-21-01 / 05-22-01 / 05-23-01

SAMPLERS TLH

WITNESS –

WELL #	CASING LENGTH	STATIC WATER LEVEL	VOLUME OF WATER IN WELL	VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	TDS ~~DISSOLVED OYXGEN~~	SAMPLING TECHNIQUE	IMMICIBLE LAYERS TOP	IMMICIBLE LAYERS BOT	CONDITION OF THE WELL	SAMPLING PROBLEMS / OBSERVATIONS
PN-1	68.50	12.89 12.89	approx 250gal	approx 350gal	15.1°C 15.2°C 15.2°C	4.98 5.15 5.20	492 606 603	301 300 302	pump	n/a	n/a	good	water-clear
B-302A	61.23	7.25 7.26	9.17 gal	30gal	14.6°C 14.0°C 13.4°C	5.49 5.67 5.71	701 705 706	352 351 350	Bail	n/a		good	water-very clear
B-304A	67.55	8.54 8.54	10.03 gal	30gal	14.2°C 14.1°C 13.7°C	5.46 5.45 5.45	549 552 552	275 275 274	Bail	n/a		good	water very clear
B-306A	65.17	9.56 9.46	9.45 gal	30gal	15.5°C 15.1°C 14.8°C	5.82 5.81 5.79	545 543 543	271 271 271	Bail	n/a		good	water very clear
B-222A	68.02	11.01 10.96	9.70 gal	30gal	14.1°C 14.1°C 14.1°C	6.37 6.43 6.45	713 717 716	357 356 357	Bail	n/a		good	slightly silty
B-227A	77.0	22.72 22.64	9.24 gal	30gal	15.9°C 15.8°C 15.8°C	6.26 6.27 6.29	1199 1200 1190	604 606 605	Bail	n/a		good	Slightly Silty
B-226A	75.6	19.01 19.06	9.61 gal	30gal	15.7°C 15.5°C 15.4°C	6.31 6.29 6.27	1318 1319 1315	655 655 661	Bail	n/a		good	Slightly Silty
B-305A	66.25	14.63 14.51	8.80 gal	30gal	15.6°C 15.8°C 15.9°C	6.53 6.44 6.37	751 753 752	375 374 374	Bail	n/a		good	Cloudy but not Silty

VOLUME OF WATER IN WELL = L.F. OF WATER X (0.17 (2" WELLS) / 0.66 (4" WELLS))

Note 1st Static waterlevel is from 05-21-01 ("one day static") the 2nd is before purging

10

GRNDSMP4 DWG

GROUNDWATER SAMPLING

JOB # 01107600.090

LOCATION Guernsey County Gue-70-14.16

WEATHER CONDITIONS Rain / Cloudy

DATE 05-23-01 / 05-24-01

SAMPLERS TLH

WITNESS —

WELL #	CASING LENGTH	STATIC WATER LEVEL	VOLUME OF WATER IN WELL	VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	TDS ~~DISSOLVED OXYGEN~~	SAMPLING TECHNIQUE	IMMICIBLE LAYERS TOP	IMMICIBLE LAYERS BOT	CONDITION OF THE WELL	SAMPLING PROBLEMS / OBSERVATIONS
B-303	69.33	14.87	9.28 gal	30 gal	15.9°C	7.09	718	368	Bail	N/a	N/A	good	Slightly Silty
		14.72			14.8°C	7.22	724	367					
					14.7°C	7.22	737	366					
B-304	57.26	7.73	8.42 gal	30 gal	13.8	5.98	637	323	Bail	n/a		good	Slightly Silty
		7.50			13.9	6.19	643	328					
					13.9	6.19	646	329					
B-30[illegible]	[illegible]6.15	14.27	8.82 gal	28 gal	13.1	6.03	981	486	Bail	n/a		needs grout	Very Silty Bailed Dry @ 28 gal
		14.02			13.5	6.00	976	487					
					13.6	6.03	973	486					

VOLUME OF WATER IN WELL = L.F. OF WATER X (0.17 (2" WELLS) / 0.66 (4" WELLS))

GROUNDWATER SAMPLING

JOB # 0110 7000.090
LOCATION 6oe-70-14.10
WEATHER CONDITIONS Showers early, Sunny 90°

DATE ~~06-26-01~~ 06-27-01
SAMPLERS TLH / EMP
WITNESS —

WELL #	CASING LENGTH	STATIC WATER LEVEL	VOLUME OF WATER IN WELL	VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	TDS ~~DISSOLVED OXYGEN~~	SAMPLING TECHNIQUE	IMMICIBLE LAYERS TOP	IMMICIBLE LAYERS BOT	CONDITION OF THE WELL	SAMPLING PROBLEMS / OBSERVATIONS
P-222A	68.02	11.74	≈9gal	30gal	16.7 16.6 16.4	6.56 6.56 6.57	677 681 680	340 340 340	Bail	none	n/A	good	nearly clear Sulphur odor
P-230A	71.22	16.96	≈9gal	30gal	21.0 21.0 21.0	6.19 6.20 6.20	1020 1020 1020	510 511 511	Bail	none		good	Moderately Silty Sulphur Odor
P-W-1	n/a	12.89	≈250gal	≈500gal	17.1 17.2 17.3	5.67 5.67 5.67	616 ~~616~~ 615 613	306 306 306	pump Bail	none		good	Clear Sulphur odor
P-305A	66.24	15.13	≈9gal	30gal	18.8 18.6 18.5	5.89 5.87 5.85	627 625 628	~~636~~ 315 ~~635~~ 316 ~~635~~ 316	Bail	none		good	translucent but not transparent, Sulphur O.
P-226A	74.5	19.63	≈9gal	30gal	17.0 16.8 16.6	6.32 6.31 6.31	1276 1276 1276	636 635 635	Bail	none		good	Slightly silty Sulphur Odor
P-222A	76.81	23.15	≈9gal	30gal	16.9 17.0 17.1	6.26 6.26 6.27	1160 1160 1160	580 580 579	Bail	none		good	nearly Clear Sulphur Odor

VOLUME OF WATER IN WELL = L.F. OF WATER X (0.17 (2" WELLS) / 0.66 (4" WELLS))

GRNDSMP4.DWG

GROUNDWATER SAMPLING

JOB # 01107000.090

LOCATION Gue-70-14.10

WEATHER CONDITIONS Sunny 85°

DATE 06-26-01

SAMPLERS TLH/EMD

WITNESS —

WELL #	CASING LENGTH	STATIC WATER LEVEL	VOLUME OF WATER IN WELL	VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	TDS ~~DISSOLVED OXYGEN~~	SAMPLING TECHNIQUE	IMMICIBLE LAYERS TOP	IMMICIBLE LAYERS BOT	CONDITION OF THE WELL	SAMPLING PROBLEMS / OBSERVATIONS
P-303A	69.33	15.34	≈9gal	30gal	18.5 18.3 18.2	7.31 7.33 7.35	749 751 751	374 375 374	Bail	none	N/A	good	Slightly Silty Sulphur Odor
P-303B	33.92	10.30	≈4gal	15gal	16.6 16.4 16.2	6.02 5.94 5.96	677 681 685	343 341 341	Bail	none		good	very Silty
P-304A	66.15	14.70	≈9gal	19gal	15.85 14.1 17.3 17.0	6.26 6.20 6.21	1327 1325 1324	660 660 660	Bail	none		good	Bailed Dry, Sulphur Odor Moderately Silty
P-304B	21.24	10.96	≈3gal	3gal	15.8 15.8 15.4	5.44 5.43 5.42	829 828 825	412 412 411	Bail	none		good	Bailed Dry Very Silty
P-307A	59.98	13.55	≈8gal	25gal	16.4 16.3 16.4	8.00 8.04 8.01	741 740 739	368 367 367	Bail	none		good	nearly Clear Sulphur odor
P-307B	38.49	12.36	≈4gal	15gal	16.3 16.2 16.2	5.77 5.79 5.79	725 728 724	363 363 363	Bail	none		good	very silty
P-301A	57.20	8.17	≈9gal	30gal	20.6 17.9 17.5	6.44 6.42 6.41	659 661 662	331 332 332	Bail	none		good	nearly clear
P-301B	16.12	3.28	≈2gal	10gal	15.9 15.8 15.8	5.37 5.32 5.29	409 410 409	203 203 203	Bail	none		good	very silty

VOLUME OF WATER IN WELL = L.F. OF WATER X (0.17 (2" WELLS) / 0.66 (4" WELLS))

GRNDSMP4 DWG

GROUNDWATER SAMPLING

JOB # 01107000.090
LOCATION Gue-70-14.10
WEATHER CONDITIONS Sunny 85°

DATE 06-25-01 / 06-26-01
SAMPLERS TLH/EMP
WITNESS —

WELL #	CASING LENGTH	STATIC WATER LEVEL	VOLUME OF WATER IN WELL	VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	TDS ~~DISSOLVED OXYGEN~~	SAMPLING TECHNIQUE	IMMICIBLE LAYERS TOP	IMMICIBLE LAYERS BOT	CONDITION OF THE WELL	SAMPLING PROBLEMS / OBSERVATIONS
P-302A	61.23	7.62	≈9gal	30gal	16.8 16.5 16.4	5.72 5.73 5.74	701 703 703	350 348 348	Bail	none	N/A	good	Very Clear Sulphur Odor
P-302B	14.20	2.27	≈2gal	10gal	16.7 16.7 16.7	4.25 4.27 4.26	651 655 656	327 324 323	Bail	none		may need more concrete	very silty
P-304A	67.55	9.13	≈9gal	30gal	16.1 15.9 15.7	5.66 5.66 5.68	551 551 547	274 274 273	Bail	none		good	very clear Sulphur Odor
P-304B	19.16	3.11	≈3gal	10gal	14.7 14.7 14.7	6.61 6.60 6.56	783 785 782	390 387 383	Bail	none		good	very silty
P-308A	70.46	14.15	≈9gal	30gal	18.4 18.3 18.1	6.25 6.25 6.26	545 549 548	273 274 274	Bail	none		good	moderately silty Sulphur odor
P-308B	19.81	7.95	≈2gal	10gal	17.0 16.8 16.5	5.92 5.87 5.79	948 948 947	459 458 458	Bail	none		good	very silty
P-306A	65.14	10.23	≈9gal	30gal	14.0 13.8 13.8	6.31 6.33 6.28	569 570 570	285 285 284	Bail	none		good	very clear Sulphur Odor
P-306B	9.74	2.00	≈2gal	10gal	13.4 13.3 13.3	5.94 5.88 5.82	542 545 546	273 272 272	Bail	none		good	moderately silty

VOLUME OF WATER IN WELL = L.F. OF WATER X (0.17 (2" WELLS) 0.66 (4" WELLS))

GROUNDWATER SAMPLING

JOB # 0110700.096
LOCATION Guernsey County
WEATHER CONDITIONS Very Hot & Humid w/ Showers

DATE 07-23-01/07-24-01/07-25-01
SAMPLERS TLH
WITNESS —

WELL #	CASING LENGTH	STATIC WATER LEVEL	VOLUME OF WATER IN WELL	VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	TDS ~~DISSOLVED OXYGEN~~	SAMPLING TECHNIQUE	IMMICIBLE LAYERS TOP	IMMICIBLE LAYERS BOT	CONDITION OF THE WELL	SAMPLING PROBLEMS / OBSERVATIONS
P-226A	74.5	19.87	9.20 gal	30gal	17.8	7.09	1456	729	Bail	none	N/A	good	Slightly Silty Sulphur Odor
P-227A	76.8	23.25	9.00 gal	30gal	19.9	6.85	1266	638	"	"		"	Slightly Silty Sulphur Odor partially translucent
P-302A	61.23	7.71	9.17 gal	30gal	20.2	6.79	736	368	"	"		"	Clear Sulphur Odor
P-304A	67.95	9.43	10.09 gal	30gal	18.3	~~6.53~~ 6.60	606	302	"	"		"	Clear Sulphur Odor
P-306A	65.17	10.43	9.45 gal	30gal	21.5	6.72	584	290	"	"		"	Clear Sulphur Odor
P-222A	68.02	11.85	9.70 gal	30gal	20.1	7.26	766	386	"	"		"	Slightly Silty Sulphur Odor
PW1	68.50	13.70	≈250gal	≈500gal	19.0	6.99	595	306	Pump	"		"	Clear
P-305A	66.25	15.21	8.8gal	30gal	19.3	6.86	671	532	Bail	"		"	Cloudy but not Silty ~~Slight~~ Sulphur Odor

VOLUME OF WATER IN WELL = L.F. OF WATER x (0.17 (2" WELLS) / 0.66 (4" WELLS))

GRNDSMP4.DWG

GROUNDWATER SAMPLING

JOB # 01107000.090

LOCATION Guernsey County

WEATHER CONDITIONS Very Hot & Humid w/Showers

DATE 07-23-01/07-24-01/07-25-01

SAMPLERS TJH

WITNESS —

WELL #	CASING LENGTH	STATIC WATER LEVEL	VOLUME OF WATER IN WELL	VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	TDS ~~DISSOLVED OXYGEN~~	SAMPLING TECHNIQUE	IMMICIBLE LAYERS TOP	IMMICIBLE LAYERS BOT	CONDITION OF THE WELL	SAMPLING PROBLEMS / OBSERVATIONS
P301A	57.26	8.43	8.42 gal	30gal	17.4	7.11	718	359	Bail	None	N/A	good	Nearly Clear Sulphur Odor
P303A	69.33	15.43	9.28 gal	30gal	20.4	8.02	723	365	"	"		"	Cloudy but not Silty

VOLUME OF WATER IN WELL = L.F. OF WATER x (0.17 (2" WELLS) / 0.66 (4" WELLS))

0107000.090 GROUNDWATER SAMPLING

JOB # Gue-70-1410

LOCATION Guernsey County

WEATHER CONDITIONS Fair

DATE 08-20-01/08-21-01

SAMPLERS TLH / MTL

WITNESS

WELL #	CASING LENGTH	STATIC WATER LEVEL	VOLUME OF WATER IN WELL	VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	T.D.S. ~~DISSOLVED OXYGEN~~	SAMPLING TECHNIQUE	IMMICIBLE LAYERS TOP	IMMICIBLE LAYERS BOT	CONDITION OF THE WELL	SAMPLING PROBLEMS / OBSERVATIONS
P-227A	76.81	23.24	9.24 gal	30gal	16.0 18.5 18.5	6.09 6.25 6.30	1190 1195 1191	593 595 595	Bail	none	N/A	good	Slightly Silty (opaque) Sulphur Odor
P-226A	74.75	19.73	9.61 gal	30gal	17.2 16.7 16.4	6.38 6.42 6.46	1325 1333 1330	664 662 662	Bail	none		good	Slightly Silty (opaque) Sulphur Odor
P-305A	66.24	15.21	8.8 gal	30gal	16.8 16.7 16.8	6.22 6.21 6.24	667 671 672	335 334 334	Bail	none		good	Cloudy but not silty Slight Sulphur Odor
P-303A	69.33	16.43	9.28 gal	30gal	19.7 16.1 16.0	7.75 7.83 7.86	722 769 768	383 385 387	Bail	none		good	Moderately Silty Slight Sulphur Odor
P-302A	61.73	7.54	9.17 gal	30gal	13.0 12.9 12.9	6.69 6.69 6.68	647 648 647	325 324 324	Bail	none		good	Clear Strong Sulpur Odor
P-304A	67.55	9.07	10.0 gal	30gal	14.4 14.3 14.4	6.47 6.45 6.44	570 575 576	287 287 286	Bail	none		good	Clear Slight Sulphur Odor
P-222A	68.02	11.53	9.79 gal	30gal	17.2 16.2 16.1	6.90 6.99 7.01	679 694 681	339 339 339	Bail	none		good	Slightly cloudy + silty Slight Sulphur odor
P-306A	65.14	10.08	9.45 gal	30gal	16.9 16.8 16.6	6.66 6.60 6.50 6.47	520 524 524	262 261 261	Bail	none		good	Nearly clear Slight Sulphur Odor

VOLUME OF WATER IN WELL = L.F. OF WATER x (0.17 (2" WELLS) / 0.66 (4" WELLS))

GROUNDWATER SAMPLING

JOB # 0110 7000.090 Goe-70-14.16

LOCATION Guernsey County

WEATHER CONDITIONS Fair

DATE 0820-01/08-21-01

SAMPLERS TLM / MTC

WITNESS —

WELL #	CASING LENGTH	STATIC WATER LEVEL	VOLUME OF WATER IN WELL	VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	~~T.D.S.~~ ~~DISSOLVED OXYGEN~~	SAMPLING TECHNIQUE	IMMICIBLE LAYERS TOP	IMMICIBLE LAYERS BOT	CONDITION OF THE WELL	SAMPLING PROBLEMS / OBSERVATIONS
PW-1	n/a	13.41	.250 gal	30 gal	18.1 16.9 17.8	7.05 7.07 7.08	[illegible] 698 699	348 348 347	Bail	none	N/A	good	Slightly Silty & Cloudy Slight Sulphur Odor
P-301A	57.26	8.27	8.42 gal	30 gal	22.3 22.2 25.8	6.56 6.56 6.55	553 557 560	278 278 278	Pump	none		good	Slightly Silty Slight Sulphur Odor

VOLUME OF WATER IN WELL = L.F. OF WATER X (0.17 (2" WELLS) / 0.66 (4" WELLS))

GROUNDWATER SAMPLING

JOB # 01107000.090
LOCATION Guernsey County
WEATHER CONDITIONS Cool, Cloudy, windy

DATE 09-25-01/09-26-01/09-27-01
SAMPLERS TCH
WITNESS ——

WELL #	CASING LENGTH	STATIC WATER LEVEL	VOLUME OF WATER IN WELL	VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	T.D.S. ~~DISSOLVED OXYGEN~~	SAMPLING TECHNIQUE	IMMICIBLE LAYERS TOP	IMMICIBLE LAYERS BOT	CONDITION OF THE WELL	SAMPLING PROBLEMS / OBSERVATIONS
P-220A	75.6	20.28	9.61 gal	30gal	11.8	7.04	1430	100	Bail	N/A	N/A	good	Moderately Silty Strong sulphur odor
P-227A	77.0	23.81	9.24 gal	30gal	11.5	7.07	1220	800	Bail			good	"
PW-1	68.50	14.07	≈250gal	500gal	12.6	7.10	510	330	Pump			good	"
P-222A	68.02	12.15	9.70 gal	30gal	13.6	7.59	642	446	Bail			good	"
P-305A	66.25	15.79	8.80 gal	30gal	13.0	7.19	733	~~[illegible]~~ 470	Bail			good	"
P-303A	69.33	15.98	9.28 gal	30gal	12.5	8.75	892	570	Bail			good	"
P-301A	57.26	8.75	8.42 gal	30gal	13.5	7.79	723	460	Bail			good	"
P-302A	61.23	8.17	9.17 gal	30gal	16.5	7.35	714	460	Bail			good	"

VOLUME OF WATER IN WELL = L.F. OF WATER x (0.17 (2" WELLS) / 0.66 (4" WELLS))

GRIIOSMP4 DWG

GROUNDWATER SAMPLING

JOB # 01107000.096
LOCATION Guernsey Co.
WEATHER CONDITIONS Cool, Cloudy, Windy

DATE 09-25-01/09-26-01/09-27-01
SAMPLERS TLH
WITNESS —

WELL #	CASING LENGTH	STATIC WATER LEVEL	VOLUME OF WATER IN WELL	VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	~~DISSOLVED OXYGEN~~ TDS	SAMPLING TECHNIQUE	IMMICIBLE LAYERS TOP	IMMICIBLE LAYERS BOT	CONDITION OF THE WELL	SAMPLING PROBLEMS / OBSERVATIONS
P-304A	67.55	9.74	10.0 gal	30 gal	15.1	7.23	569	370	Bail	N/a	N/A	good	Slightly silty/nearly clear sulphur odor
P-306A	65.17	10.73	9.45 gal	30 gal	14.7	7.19	510	330	Bail	Yes		good	Dead field Mouse decaying in well, strong decomposing odor

VOLUME OF WATER IN WELL = L.F. OF WATER x (0.17 (2" WELLS) / 0.66 (4" WELLS))

R-1

GROUNDWATER SAMPLING

JOB # 011-07000.090

LOCATION Guernsey County

WEATHER CONDITIONS Clear

DATE 10-22-01 / 10-23-01 / 10-24-01

SAMPLERS TCH

WITNESS —

WELL #	CASING LENGTH	STATIC WATER LEVEL	VOLUME OF WATER IN WELL	VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	T.D.S. ~~DISSOLVED OXYGEN~~	SAMPLING TECHNIQUE	IMMICIBLE LAYERS TOP	IMMICIBLE LAYERS BOT	CONDITION OF THE WELL	SAMPLING PROBLEMS / OBSERVATIONS
P-222A	77.00	23.94	9.24 gal	30 gal	15.9	6.91	1115	557	Bail	none	N/A	good	Opaque but not Silty
P-226A	75.60	20.45	9.61 gal	"	14.7	7.02	1276	637	"	"		good	"
PW-1	68.50	14.35	22.50 gal	500 gal	19.5	6.55	542	272	Pump	"		good	Clear
P-222A	68.02	11.89	9.70 gal	30 gal	14.9	7.14	670	336	Bail	"		good	Nearly Clear
P-305A	66.25	15.88	8.80 gal	"	16.6	6.77	654	667	"	"		good	Clear
P-301A	57.76	8.85	8.42 gal	"	16.4	7.29	711	355	"	"		good	Nearly Clear
P-303A	69.73	16.04	9.28 gal	"	16.4	8.26	795	397	"	"		good	Nearly Clear
P-302A	61.23	8.12	9.17 gal	"	16.5	6.97	682	377	"	"		good	Sulphur Odor Clear

VOLUME OF WATER IN WELL = L.F. OF WATER x (0.17 (2" WELLS) / 0.66 (4" WELLS))

GROUNDWATER SAMPLING

JOB # ~~[illegible]~~ 011-07000.090

LOCATION Guernsey County

WEATHER CONDITIONS Rainy / Cloudy

DATE 10-22-01 / 10-23-01 / 10-24-01

SAMPLERS TJH

WITNESS

WELL #	CASING LENGTH	STATIC WATER LEVEL	VOLUME OF WATER IN WELL	VOLUME PURGED	TEMPERATURE	pH	CONDUCTIVITY	~~DISSOLVED OXYGEN~~ T.D.S.	SAMPLING TECHNIQUE	IMMICIBLE LAYERS TOP	IMMICIBLE LAYERS BOT	CONDITION OF THE WELL	SAMPLING PROBLEMS / OBSERVATIONS
P304A	67.55	9.67	10.0 gal	30 gal	15.9	6.87	537	268	Bail	none	N/A	good	Clear
P302A	65.17	10.66	9.45 gal	30 gal	17.0	6.79	574	288	Bail	"		good	Clear

VOLUME OF WATER IN WELL = L.F. OF WATER x (0.17 (2" WELLS) / 0.66 (4" WELLS))

CHAIN OF CUSTODY RECORD

BBC&M ENGINEERING INC

BBC&M Engineering, Inc.
6190 Enterprise Court
Dublin, Ohio 43017
Phone: (614) 793-2226
Fax: (614) 793-2410

PROJECT NUMBER: 7000.03

PROJECT NAME AND LOCATION: Gue-70-14.10 Guernsey County

SAMPLERS NAME AND SIGNATURE: Takeshi Hirano

SAMPLE NO.	DATE	TIME	SAMPLE TYPE: MATRIX	SAMPLE TYPE: COMPOSITE	SAMPLE TYPE: GRAB	NO. OF CONTS.	PRESERVATIVE: NONE	PRESERVATIVE: H_2SO_4	PRESERVATIVE: HNO_3	PRESERVATIVE:	PRESERVATIVE:	ANALYSES ASSIGNED: CALCIUM, TOTAL	ANALYSES ASSIGNED: SULFATES, TTL	ANALYSES ASSIGNED: IRON, TTL	ANALYSES ASSIGNED: HARDNESS	ANALYSES ASSIGNED: ALKALINITY/ACIDITY	REMARKS
222 B	12-27	11:15	WATER		X	3	1	1	1			X	X	X	X	X	
222 C	↓	1:10															
221 A	12-28	11:20															
221 B		9:30															
221 C		8:10															
226 A		4:45															
227 A		2:15															
227 B	↓	3:20															
223 A	12-29	10:45															
223 B		8:45															
228 A		2:00															
228 B		3:30															
228 C	↓	12:15	↓			↓	↓	↓	↓			↓	↓	↓	↓	↓	

Relinquished by(Signature):	Date/Time:	Received by(Signature):	Relinquished by(Signature):	Date/Time:	Received by(Signature):
Takeshi Hirano	01/03/00	[illegible]			
[illegible]	01-04-00	Takeshi Hirano			
Takeshi Hirano	1/6/00 10:00 AM	[illegible]	Remarks:		

PLATE 24

BBC&M Engineering Inc

CHAIN OF CUSTODY RECORD

PROJECT NUMBER:	PROJECT NAME AND LOCATION:
7000.03	Gue-70-14.10 Guernsey County

SAMPLERS NAME AND SIGNATURE: Takeshi Hirano [signature]

BBC&M Engineering, Inc.
6190 Enterprise Court
Dublin, Ohio 43017
Phone: (614) 793-2226
Fax: (614) 793-2410

SAMPLE NO.	DATE	TIME	SAMPLE TYPE: MATRIX	SAMPLE TYPE: COMPOSITE	SAMPLE TYPE: GRAB	NO. OF CONTS.	PRESERVATIVE: none	PRESERVATIVE: H_2SO_4	PRESERVATIVE: HNO_3	PRESERVATIVE:	PRESERVATIVE:	ANALYSES ASSIGNED: Calcium, Total	ANALYSES ASSIGNED: Sulfates, total	ANALYSES ASSIGNED: Iron, Total	ANALYSES ASSIGNED: Hardness	ANALYSES ASSIGNED: Alkalinity/Acidity	REMARKS
1B	12-29	4:45	water		X	3	1	1	1			X	X	X	X	X	
1A	12-30	9:30															
2A	↓	3:15															
2B		11:30															
225B	01-03	2:10															
225A	↓	1:15															
222A	01-04	10:00															
PW-1	↓	3:00															
224A	01-05	11:15															
224B	↓	12:00															

Relinquished by(Signature):	Date/Time:	Received by(Signature):	Relinquished by(Signature):	Date/Time:	Received by(Signature):
[signature]	01/03/00	[signature]			
Relinquished by(Signature): [signature]	Date/Time: 01-06-00	Received by(Signature): [signature]	Relinquished by(Signature):	Date/Time:	Received by(Signature):
Relinquished by(Signature): [signature]	Date/Time: 1/6/00 10 00 AM	Received by(Signature): [signature]	Remarks:		

$45.00 per Sample
per Eve

BBC&M CHAIN OF CUSTODY RECORD

PROJECT NUMBER: 7000.03

PROJECT NAME AND LOCATION: Gue-70-14.10 Guernsey County

SAMPLERS NAME AND SIGNATURE: Takeshi Hirano

BBC&M Engineering, Inc.
6190 Enterprise Court
Dublin, Ohio 43017
Phone: (614) 793-2226
Fax: (614) 793-2410

SAMPLE NO.	DATE	TIME	SAMPLE TYPE: MATRIX	SAMPLE TYPE: COMPOSITE	SAMPLE TYPE: GRAB	NO. OF CONTS.	PRESERVATIVE:	HNO3	None			ANALYSES ASSIGNED: Calcium, Total	Iron, Total	Hardness	Sulfates	Alkalinity/Acidity	REMARKS
221 A	01-24-00	1:54				2											
221 B	01-24-00	2:42															
221 C	01-24-00	3:26															
222 A	01-25-00	2:34															
224 A	01-26-00	4:27															
225 A	01-25-00	4:17															
226A	01-25-00	12:07															
227A	01-26-00	5:43															
228A	01-26-00	2:43															
228 B	01-24-00	4:30															
228C	01-24-00	5:07															
P-1 A	01-24-00	11:57															
P-W1	01-27-00	1:16															

Relinquished by (Signature):	Date/Time:	Received by (Signature):	Relinquished by (Signature):	Date/Time:	Received by (Signature):
Takeshi Hirano	01-27-00 3:30pm	Maria DePalma			
Relinquished by (Signature):	Date/Time:	Received by (Signature):	Relinquished by (Signature):	Date/Time:	Received by (Signature):
Relinquished by (Signature):	Date/Time:	Received by (Signature):	Remarks:		

CHAIN OF CUSTODY RECORD

BBC&M ENGINEERING, INC.

BBC&M Engineering, Inc.
6190 Enterprise Court
Dublin, Ohio 43017
Phone: (614) 793-2226
Fax: (614) 793-2410

PROJECT NUMBER: 7000.03

PROJECT NAME AND LOCATION: Gue 70-14.10, Guernsey County

SAMPLERS NAME AND SIGNATURE: Takeshi Hirano

SAMPLE NO.	DATE	TIME	SAMPLE TYPE: MATRIX	SAMPLE TYPE: COMPOSITE	SAMPLE TYPE: GRAB	NO. OF CONTS.	PRESERVATIVE: HNO_3	PRESERVATIVE: None	PRESERVATIVE: H_2SO_4	PRESERVATIVE:	PRESERVATIVE:	ANALYSES ASSIGNED: Total Calcium	ANALYSES ASSIGNED: Total Iron	ANALYSES ASSIGNED: Sulfates	ANALYSES ASSIGNED: Hardness	ANALYSES ASSIGNED: Acidity/Alkalinity	REMARKS
221A	02-15-00	8:50			1	1											
221B	02-16-00	10:40															
221C	02-16-00	9:55															
222A	02-15-00	12:00															
224A	02-15-00	4:00															
225A	02-15-00	5:20															
226A	02-14-00	5:30															
227A	02-14-00	3:40															
228A	02-15-00	10:10															
228B	02-16-00	11:25															
228C	02-16-00	12:00															
P-1A	02-15-00	2:40															
PW-1	02-16-00	9:15															

Relinquished by (Signature):	Date/Time:	Received by (Signature):	Relinquished by (Signature):	Date/Time:	Received by (Signature):
Takeshi Hirano	02-17-00	Joshua Miller			
Relinquished by (Signature):	Date/Time:	Received by (Signature):	Relinquished by (Signature):	Date/Time:	Received by (Signature):
Relinquished by (Signature):	Date/Time:	Received by (Signature):	Remarks:		

ADVANCED ANALYTICS LABORATORIES
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922   FAX (614) 299-4002

P.O. No. ______

PROJ. NO.	CUSTOMER NAME / ADDRESS
7000.03	BBC+M Engineering 6190 Enterprise Ct Dublin
DATE: 3-6-00	RESULTS TO: Chris Hall

ASSAY FOR: Preservative Type *: HNO_3, None (2); Total Iron; Total Calcium; Sulfates; Hardness; Alkalinity / Acidity

SAMPLE NUMBER	SAMPLE DESCRIPTION		No. / Type Containers	HNO_3	None (2)	Total Iron	Total Calcium	Sulfates	Hardness	Alkalinity / Acidity	REMARKS
221A	3-7-00	1:45	2								
221B	3-8-00	12:35	2								
221C	3-8-00	12:00	2								
222A	3-7-00	10:15	2								
224A	3-7-00	8:35	2								
225A	3-6-00	5:00	2								
226A	3-6-00	1:15	2								
227A	3-6-00	3:00	2								
228A	3-7-00	3:10	2								
P-1A	~~3-8-00~~ 3-7-00	12:25	2								

* 1. $NA_2S_2O_3$ 2. HNO_3 3. H_2SO_4 4. HCL 5. NaOH

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
[signature]	3-8-00 13:15	Maria DePalma			
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Date / Time	Remarks	

ADVANCED ANALYTICS LABORATORIES
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002

P.O. No. ______

PROJ. NO.	CUSTOMER NAME / ADDRESS
7000.03	BBC+M Engineering
DATE: 3-6-00	RESULTS TO: Chris Hall

ASSAY FOR:

SAMPLE NUMBER	SAMPLE DESCRIPTION		No. / Type Containers	Preservative Type *	HNO_3 (2)	None		Total Iron	Total Calcium	Sulfates	Hardness	Alkalinity / Acidity		REMARKS
228B	3-7-00	5:15	2		↓	↓		↓	↓	↓	↓	↓		
228C	3-7-00	4:30	2											
P-W1	3-8-00	820	2											

* 1. $NA_2S_2O_3$ 2. HNO_3 3. H_2SO_4 4. HCL 5. NaOH

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Takashi Ho	3-8-00 3:15	Maria DePalma			
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Date / Time	Remarks	

BBC&M — CHAIN OF CUSTODY RECORD

BBC&M Engineering, Inc.
6190 Enterprise Court
Dublin, Ohio 43017
Phone: (614) 793-2226
Fax: (614) 793-2410

PROJECT NUMBER: 01107000.090

PROJECT NAME AND LOCATION: Gue-70-14.10 Guernsey County

SAMPLERS NAME AND SIGNATURE: Takeshi Hirano

SAMPLE NO.	DATE	TIME	SAMPLE TYPE: MATRIX	COMPOSITE	GRAB	NO. OF CONTS.	PRESERVATIVE:				ANALYSES ASSIGNED: TDS	IRON	CALCIUM	SULFATES	ALKALINITY	HARDNESS	REMARKS
PW-1	[illegible]	7:30 am															PLEASE SEND
B-302	[illegible]	9:25 am															RESULTS TO
B-301	[illegible]	11:45 am															ATTN: CHRIS
B-306	05-22-01	[illegible] pm															HALL
B-[illegible]	05-22-01	[illegible] pm															
F-[illegible]	[illegible]	[illegible] am															- SAMPLES TO
[illegible]	[illegible]	[illegible] pm															BE ANALYZED
[illegible]	[illegible]	[illegible] pm															FOR IRON +
[illegible]	[illegible]	[illegible] pm															CALCIUM WERE
B-301	05-24-01	9:45 am				2											FIELD FILTERED
B-309	05-24-01	12:35 pm				2											USING 0.45 MICRON
																	DISPOSABLE FILTER
[illegible]																	

Relinquished by (Signature):	Date/Time:	Received by (Signature):	Relinquished by (Signature):	Date/Time:	Received by (Signature):
[signature]	5-24-01 3:17	Maria DePalma			
Relinquished by (Signature):	Date/Time:	Received by (Signature):	Relinquished by (Signature):	Date/Time:	Received by (Signature):
Relinquished by (Signature):	Date/Time:	Received by (Signature):	Remarks:		

BBC&M Engineering, Inc.

CHAIN OF CUSTODY RECORD

BBC&M Engineering, Inc.
6190 Enterprise Court
Dublin, Ohio 43017
Phone: (614) 793-2226
Fax: (614) 793-2410

PROJECT NUMBER: 01107000.090

PROJECT NAME AND LOCATION: Gue-70-14.10 Guernsey Co.

SAMPLERS NAME AND SIGNATURE: Takeshi Hirano

SAMPLE NO.	DATE	TIME	SAMPLE TYPE: MATRIX	SAMPLE TYPE: COMPOSITE	SAMPLE TYPE: GRAB	NO. OF CONTS.	PRESERVATIVE: HNO_3	PRESERVATIVE: None	PRESERVATIVE:	PRESERVATIVE:	PRESERVATIVE:	ANALYSES ASSIGNED: TDS	ANALYSES ASSIGNED: Alkalinity	ANALYSES ASSIGNED: Sulfates	ANALYSES ASSIGNED: Iron	ANALYSES ASSIGNED: Calcium	ANALYSES ASSIGNED: Hardness	REMARKS
P-307A	06-26-01	4:00				2												
P-307B	06-26-01	4:40																
P-301A	06-26-01	4:50																
P-301B	06-26-01	3:30																
P-222A	06-27-01	8:30																
P-310A	06-27-01	9:30																
P-305A	06-27-01	10:25																
PW-1	06-27-01	9:45																
P-226A	06-27-01	1:00																
P-227A	06-27-01	1:15																
R-1						2	X	X				X	X	X	X	X	X	

Relinquished by (Signature):	Date/Time:	Received by (Signature):	Relinquished by (Signature):	Date/Time:	Received by (Signature):
[signature]	06-28-01 9:00am	[signature]			
Relinquished by (Signature):	Date/Time:	Received by (Signature):	Relinquished by (Signature):	Date/Time:	Received by (Signature):
Relinquished by (Signature):	Date/Time:	Received by (Signature):	Remarks:		

BBC&M ENGINEERING INC

CHAIN OF CUSTODY RECORD

PROJECT NUMBER: 01107000.080

PROJECT NAME AND LOCATION: Gue-70-14.10 Guernsey Co.

SAMPLERS NAME AND SIGNATURE: Takeshi Hirano

BBC&M Engineering, Inc.
6190 Enterprise Court
Dublin, Ohio 43017
Phone: (614) 793-2226
Fax: (614) 793-2410

SAMPLE NO.	DATE	TIME	SAMPLE TYPE: MATRIX	COMPOSITE	GRAB	NO. OF CONTS.	PRESERVATIVE: HNO_3	None			ANALYSES ASSIGNED: TDS	Alkalinity	Sulfates	Iron	Calcium	Hardness	REMARKS
P-302A	06-25-01	12:45				2											
P-302B	06-25-01	12:15															
P-304A	06-25-01	2:20															
P-304B	06-25-01	2:00															
P-308A	06-25-01	4:40															
P-308B	06-25-01	5:20															
P-306A	~~06~~ 06-26-01	7:50															
P-306B	06-26-01	8:20															
P-303A	06-26-01	10:45															
P-303B	06-26-01	10:15															
P-309A	06-26-01	1:30															
P-309B	06-26-01	2:00															

Relinquished by (Signature):	Date/Time:	Received by (Signature):	Relinquished by (Signature):	Date/Time:	Received by (Signature):
Takeshi H.	06-28-01 9:00am	Maria DePalma			
Relinquished by (Signature):	Date/Time:	Received by (Signature):	Relinquished by (Signature):	Date/Time:	Received by (Signature):
Relinquished by (Signature):	Date/Time:	Received by (Signature):	Remarks:		

BBC&M ENGINEERING INC

CHAIN OF CUSTODY RECORD

BBC&M Engineering, Inc.
6190 Enterprise Court
Dublin, Ohio 43017
Phone: (614) 793-2226
Fax: (614) 793-2410

PROJECT NUMBER: 0110200.090

PROJECT NAME AND LOCATION: Gue-70-14.10 Guernsey, County

SAMPLERS NAME AND SIGNATURE: Takeshi Hirano Takeshi Ho

SAMPLE NO.	DATE	TIME	SAMPLE TYPE: MATRIX	COMPOSITE	GRAB	NO. OF CONTS.	PRESERVATIVE: HNO_3	none				ANALYSES ASSIGNED: Calcium	Sulfates	Alkalinity	Hardness	Metals (Iron)	Dissolved Solids	REMARKS
P-227A	07-23-01	2:00pm				2												(Same tests
PW-1	07-23-01	4:45pm				2												as before)
P-302A	07-24-01	9:30am				2												
P-304A	07-24-01	12:05pm				2												
P-306A	07-24-01	2:30pm				2												
P-222A	07-24-01	5:30pm				2												
P-305A	07-24-01	8:30pm				2												
P-301A	07-25-01	8:30am				2												
P-226A	07-25-01	11:15am				2												
P-303A	07-25-01	1:20pm				2												
R-1						2	X	X				X	X	X	X	X	X	

Relinquished by(Signature):	Date/Time:	Received by(Signature):	Relinquished by(Signature):	Date/Time:	Received by(Signature):
[signature]	07-25-01 3:45pm	Maria DePalma			
Relinquished by(Signature):	Date/Time:	Received by(Signature):	Relinquished by(Signature):	Date/Time:	Received by(Signature):
Relinquished by(Signature):	Date/Time:	Received by(Signature):	Remarks:		

BBC&M ENGINEERING INC

CHAIN OF CUSTODY RECORD

BBC&M Engineering, Inc.
6190 Enterprise Court
Dublin, Ohio 43017
Phone: (614) 793-2226
Fax: (614) 793-2410

PROJECT NUMBER: 01107009.090

PROJECT NAME AND LOCATION: Gue-70-14.10 Guernsey County

SAMPLERS NAME AND SIGNATURE: Takeshi Hirano

SAMPLE NO.	DATE	TIME	SAMPLE TYPE: MATRIX	SAMPLE TYPE: COMPOSITE	SAMPLE TYPE: GRAB	NO. OF CONTS.	PRESERVATIVE: HNO_3	PRESERVATIVE: None	PRESERVATIVE:	PRESERVATIVE:	PRESERVATIVE:	ANALYSES ASSIGNED: Iron	ANALYSES ASSIGNED: Calcium	ANALYSES ASSIGNED: Hardness	ANALYSES ASSIGNED: Alkalinity	ANALYSES ASSIGNED: TDS	ANALYSES ASSIGNED: Sulfates	REMARKS
P-226A	08-20-01	12:30pm				2												
P-227A	08-20-01	2:30pm				2												
P-305A	08-20-01	4:00pm				2												
P-303A	08-20-01	6:00pm				2												
P-302A	08-21-01	8:30am				2												
P-304A	08-21-01	9:00am				2												
P-306A	08-21-01	10:30am				2												
P-222A	08-21-01	11:00am				2												
PW-1	08-21-01	12:30pm				2												
P-301A	08-21-01	1:45pm				2												
R-1						2	X	X				X	X	X	X	X	X	

Relinquished by(Signature): Takeshi Hirano	Date/Time: 8/21/01 4:10	Received by(Signature): Maria DePalma	Relinquished by(Signature):	Date/Time:	Received by(Signature):
Relinquished by(Signature):	Date/Time:	Received by(Signature):	Relinquished by(Signature):	Date/Time:	Received by(Signature):
Relinquished by(Signature):	Date/Time:	Received by(Signature):	Remarks:		

BBC&M CHAIN OF CUSTODY RECORD

BBC&M Engineering, Inc.
6190 Enterprise Court
Dublin, Ohio 43017
Phone: (614) 793-2226
Fax: (614) 793-2410

PROJECT NUMBER: 01167000.090

PROJECT NAME AND LOCATION: Gue-70-14.10 Guernsey County

SAMPLERS NAME AND SIGNATURE: Takeshi Hirano Takeshi H

SAMPLE NO.	DATE	TIME	SAMPLE TYPE: MATRIX	COMPOSITE	GRAB	NO. OF CONTS.	PRESERVATIVE: None	HNO3				ANALYSES ASSIGNED: Iron	Calcium	Sulphates	Alkalinity	Hardness	TDS	REMARKS
P-226A	09-25-01	2:30pm				2												Same analysis as
P-227A	09-25-01	5:30pm																previous testings
DW-1	09-26-01	9:30am																from May-Aug
P-222A	09-26-01	11:15am																2001.
P-305A	09-26-01	1:15pm																
P-303A	09-26-01	3:30pm																
P-301A	09-26-01	5:45pm																
P-302A	09-27-01	9:15am																
P-304A	09-27-01	11:45am																
P-306A	09-27-01	2:00pm																
R-1						2	X	X				X	X	X	X	X	X	

Relinquished by (Signature): Takeshi H	Date/Time: 09-27-01 3:45pm	Received by (Signature): Maria DePalma	Relinquished by (Signature):	Date/Time:	Received by (Signature):
Relinquished by (Signature):	Date/Time:	Received by (Signature):	Relinquished by (Signature):	Date/Time:	Received by (Signature):
Relinquished by (Signature):	Date/Time:	Received by (Signature):	Remarks:		

ZANDE ENVIRONMENTAL SERVICE, INC.
1233 Dublin Road
Columbus, OH 43215
(614) 486-4383
Ohio EPA Approval # 1030
West Virginia Certification # 190

Sample Name: 1A
Sample Number: ZD0001017-2
Sample Type: Aqueous
Sampled By: TH

Client Id: BBCM4
ORDER Id: ZD0001017
Date Sampled: 12/30/99
Date Received: 01/06/00
Project: GUE-70-14.10 GUER

TEST	METHOD	RESULT	REPORTING LIMIT	UNITS	COMPLETE DATE	ANALYST
Total Calcium	3120B	52.0	0.1	mg/L	01/11/00	CCM
Sulfate	375.4	43.0	2.0	mg/L	01/10/00	JRW
Total Iron	3120B	652	40	ug/L	01/10/00	CCM
Hardness	130.2	182	1.0	mg/L	01/10/00	BAZ
Alkalinity, Tot.(CaC	310.1	220	1.0	mg/L	01/10/00	DAS
Acidity in Water	305.1	173	2	mg/L	01/10/00	DAS

ND: Not detected at or above reporting limit
--: Information not available or not applicable

ZANDE ENVIRONMENTAL SERVICE, INC.
1233 Dublin Road
Columbus, OH 43215
(614) 486-4383
Ohio EPA Approval # 1030
West Virginia Certification # 190

Sample Name:	1B	Client Id:	BBCM4
Sample Number:	ZD0001017-1	ORDER Id:	ZD0001017
Sample Type:	Aqueous	Date Sampled:	12/29/99
Sampled By:	TH	Date Received:	01/06/00
		Project:	GUE-70-14.10 GUER

TEST	METHOD	RESULT	REPORTING LIMIT	UNITS	COMPLETE DATE	ANALYST
Total Calcium	3120B	93.7	1.0	mg/L	01/11/00	CCM
Sulfate	375.4	62.4	2.0	mg/L	01/10/00	JRW
Total Iron	3120B	37100	4000	ug/L	01/10/00	CCM
Hardness	130.2	269	1.0	mg/L	01/10/00	BAZ
Alkalinity, Tot.(CaC	310.1	200	1.0	mg/L	01/10/00	DAS
Acidity in Water	305.1	194	2	mg/L	01/10/00	DAS

ND: Not detected at or above reporting limit
--: Information not available or not applicable

ZANDE ENVIRONMENTAL SERVICE, INC.
1233 Dublin Road
Columbus, OH 43215
(614) 486-4383
Ohio EPA Approval # 1030
West Virginia Certification # 190

Sample Name: 2A
Sample Number: ZD0001017-3
Sample Type: Aqueous
Sampled By: TH

Client Id: BBCM4
ORDER Id: ZD0001017
Date Sampled: 12/30/99
Date Received: 01/06/00
Project: GUE-70-14.10 GUER

TEST	METHOD	RESULT	REPORTING LIMIT	UNITS	COMPLETE DATE	ANALYST
Total Calcium	3120B	38.1	0.1	mg/L	01/11/00	CCM
Sulfate	375.4	287	2.0	mg/L	01/10/00	JRW
Total Iron	3120B	2500	400	ug/L	01/10/00	CCM
Hardness	130.2	88	1.0	mg/L	01/10/00	BAZ
Alkalinity, Tot.(CaC	310.1	180	1.0	mg/L	01/10/00	DAS
Acidity in Water	305.1	56	2	mg/L	01/10/00	DAS

ND: Not detected at or above reporting limit
--: Information not available or not applicable

ZANDE ENVIRONMENTAL SERVICE, INC.
1233 Dublin Road
Columbus, OH 43215
(614) 486-4383
Ohio EPA Approval # 1030
West Virginia Certification # 190

Sample Name:	2B	Client Id:	BBCM4
Sample Number:	ZD0001017-4	ORDER Id:	ZD0001017
Sample Type:	Aqueous	Date Sampled:	12/30/99
Sampled By:	TH	Date Received:	01/06/00
		Project:	GUE-70-14.10 GUER

TEST	METHOD	RESULT	REPORTING LIMIT	UNITS	COMPLETE DATE	ANALYST
Total Calcium	3120B	86.7	0.1	mg/L	01/11/00	CCM
Sulfate	375.4	83.3	2.0	mg/L	01/10/00	JRW
Total Iron	3120B	46200	4000	ug/L	01/10/00	CCM
Hardness	130.2	322	1.0	mg/L	01/10/00	BAZ
Alkalinity, Tot.(CaC	310.1	250	1.0	mg/L	01/10/00	DAS
Acidity in Water	305.1	217	2	mg/L	01/10/00	DAS

ND: Not detected at or above reporting limit
--: Information not available or not applicable

ZANDE ENVIRONMENTAL SERVICE, INC.
1233 Dublin Road
Columbus, OH 43215
(614) 486-4383
Ohio EPA Approval # 1030
West Virginia Certification # 190

Sample Name:	221A	Client Id:	BBCM4
Sample Number:	ZD0001018-3	ORDER Id:	ZD0001018
Sample Type:	Aqueous	Date Sampled:	12/28/99
Sampled By:	TH	Date Received:	01/06/00
		Project:	7000.03

TEST	METHOD	RESULT	REPORTING LIMIT	UNITS	COMPLETE DATE	ANALYST
Total Calcium	3120B	68.3	0.1	mg/L	01/11/00	CCM
Sulfate	375.4	50.1	2.0	mg/L	01/10/00	JRW
Total Iron	3120B	958	40	ug/L	01/10/00	CCM
Hardness	130.2	228	1.0	mg/L	01/10/00	BAZ
Alkalinity, Tot.(CaC	310.1	200	1.0	mg/L	01/10/00	DAS
Acidity in Water	305.1	191	2	mg/L	01/10/00	DAS

ND: Not detected at or above reporting limit
--: Information not available or not applicable

ZANDE ENVIRONMENTAL SERVICE, INC.
1233 Dublin Road
Columbus, OH 43215
(614) 486-4383
Ohio EPA Approval # 1030
West Virginia Certification # 190

Sample Name: 221B
Sample Number: ZD0001018-4
Sample Type: Aqueous
Sampled By: TH

Client Id: BBCM4
ORDER Id: ZD0001018
Date Sampled: 12/28/99
Date Received: 01/06/00
Project: 7000.03

TEST	METHOD	RESULT	REPORTING LIMIT	UNITS	COMPLETE DATE	ANALYST
Total Calcium	3120B	113	1.0	mg/L	01/11/00	CCM
Sulfate	375.4	78.6	2.0	mg/L	01/10/00	JRW
Total Iron	3120B	139000	4000	ug/L	01/10/00	CCM
Hardness	130.2	352	1.0	mg/L	01/10/00	BAZ
Alkalinity, Tot.(CaC	310.1	170	1.0	mg/L	01/10/00	DAS
Acidity in Water	305.1	146	2	mg/L	01/10/00	DAS

ND: Not detected at or above reporting limit
--: Information not available or not applicable

ZANDE ENVIRONMENTAL SERVICE, INC.
1233 Dublin Road
Columbus, OH 43215
(614) 486-4383
Ohio EPA Approval # 1030
West Virginia Certification # 190

Sample Name: 221C
Sample Number: ZD0001018-5
Sample Type: Aqueous
Sampled By: TH

Client Id: BBCM4
ORDER Id: ZD0001018
Date Sampled: 12/28/99
Date Received: 01/06/00
Project: 7000.03

TEST	METHOD	RESULT	REPORTING LIMIT	UNITS	COMPLETE DATE	ANALYST
Total Calcium	3120B	81.6	0.1	mg/L	01/11/00	CCM
Sulfate	375.4	92.0	2.0	mg/L	01/10/00	JRW
Total Iron	3120B	139000	4000	ug/L	01/10/00	CCM
Hardness	130.2	308	1.0	mg/L	01/10/00	BAZ
Alkalinity, Tot.(CaC	310.1	200	1.0	mg/L	01/10/00	DAS
Acidity in Water	305.1	210	2	mg/L	01/10/00	DAS

ND: Not detected at or above reporting limit
--: Information not available or not applicable

ZANDE ENVIRONMENTAL SERVICE, INC.
1233 Dublin Road
Columbus, OH 43215
(614) 486-4383
Ohio EPA Approval # 1030
West Virginia Certification # 190

Sample Name: 222A
Sample Number: ZD0001017-7
Sample Type: Aqueous
Sampled By: TH

Client Id: BBCM4
ORDER Id: ZD0001017
Date Sampled: 01/04/00
Date Received: 01/06/00
Project: GUE-70-14.10 GUER

TEST	METHOD	RESULT	REPORTING LIMIT	UNITS	COMPLETE DATE	ANALYST
Total Calcium	3120B	23.4	0.1	mg/L	01/11/00	CCM
Sulfate	375.4	13.5	2.0	mg/L	01/10/00	JRW
Total Iron	3120B	831	40	ug/L	01/10/00	CCM
Hardness	130.2	90	1.0	mg/L	01/10/00	BAZ
Alkalinity, Tot.(CaC	310.1	350	1.0	mg/L	01/10/00	DAS
Acidity in Water	305.1	275	2	mg/L	01/10/00	DAS

ND: Not detected at or above reporting limit
--: Information not available or not applicable

ZANDE ENVIRONMENTAL SERVICE, INC.
1233 Dublin Road
Columbus, OH 43215
(614) 486-4383
Ohio EPA Approval # 1030
West Virginia Certification # 190

Sample Name:	222B	Client Id:	BBCM4
Sample Number:	ZD0001018-1	ORDER Id:	ZD0001018
Sample Type:	Aqueous	Date Sampled:	12/27/99
Sampled By:	TH	Date Received:	01/06/00
		Project:	7000.03

TEST	METHOD	RESULT	REPORTING LIMIT	UNITS	COMPLETE DATE	ANALYST
Total Calcium	3120B	64.1	0.1	mg/L	01/11/00	CCM
Sulfate	375.4	53.1	2.0	mg/L	01/10/00	JRW
Total Iron	3120B	7460	400	ug/L	01/10/00	CCM
Hardness	130.2	266	1.0	mg/L	01/10/00	BAZ
Alkalinity, Tot.(CaC	310.1	200	1.0	mg/L	01/10/00	DAS
Acidity in Water	305.1	172	2	mg/L	01/10/00	DAS

ND: Not detected at or above reporting limit
--: Information not available or not applicable

ZANDE ENVIRONMENTAL SERVICE, INC.
1233 Dublin Road
Columbus, OH 43215
(614) 486-4383
Ohio EPA Approval # 1030
West Virginia Certification # 190

Sample Name: 222C
Sample Number: ZD0001018-2
Sample Type: Aqueous
Sampled By: TH

Client Id: BBCM4
ORDER Id: ZD0001018
Date Sampled: 12/27/99
Date Received: 01/06/00
Project: 7000.03

TEST	METHOD	RESULT	REPORTING LIMIT	UNITS	COMPLETE DATE	ANALYST
Total Calcium	3120B	70.1	0.1	mg/L	01/11/00	CCM
Sulfate	375.4	43.9	2.0	mg/L	01/10/00	JRW
Total Iron	3120B	132000	4000	ug/L	01/10/00	CCM
Hardness	130.2	206	1.0	mg/L	01/10/00	BAZ
Alkalinity, Tot.(CaC	310.1	190	1.0	mg/L	01/10/00	DAS
Acidity in Water	305.1	199	2	mg/L	01/10/00	DAS

ND: Not detected at or above reporting limit
--: Information not available or not applicable

ZANDE ENVIRONMENTAL SERVICE, INC.
1233 Dublin Road
Columbus, OH 43215
(614) 486-4383
Ohio EPA Approval # 1030
West Virginia Certification # 190

Sample Name:	223A	Client Id:	BBCM4
Sample Number:	ZD0001018-9	ORDER Id:	ZD0001018
Sample Type:	Aqueous	Date Sampled:	12/29/99
Sampled By:	TH	Date Received:	01/06/00
		Project:	7000.03

TEST	METHOD	RESULT	REPORTING LIMIT	UNITS	COMPLETE DATE	ANALYST
Total Calcium	3120B	28.5	0.1	mg/L	01/11/00	CCM
Sulfate	375.4	143	2.0	mg/L	01/10/00	JRW
Total Iron	3120B	249	40	ug/L	01/10/00	CCM
Hardness	130.2	99	1.0	mg/L	01/10/00	BAZ
Alkalinity, Tot.(CaC	310.1	310	1.0	mg/L	01/10/00	DAS
Acidity in Water	305.1	286	2	mg/L	01/10/00	DAS

ND: Not detected at or above reporting limit
--: Information not available or not applicable

ZANDE ENVIRONMENTAL SERVICE, INC.
1233 Dublin Road
Columbus, OH 43215
(614) 486-4383
Ohio EPA Approval # 1030
West Virginia Certification # 190

Sample Name: 223B
Sample Number: ZD0001018-10
Sample Type: Aqueous
Sampled By: TH

Client Id: BBCM4
ORDER Id: ZD0001018
Date Sampled: 12/29/99
Date Received: 01/06/00
Project: 7000.03

TEST	METHOD	RESULT	REPORTING LIMIT	UNITS	COMPLETE DATE	ANALYST
Total Calcium	3120B	87.0	0.1	mg/L	01/11/00	CCM
Sulfate	375.4	77.9	2.0	mg/L	01/10/00	JRW
Total Iron	3120B	10200	400	ug/L	01/10/00	CCM
Hardness	130.2	392	2.0	mg/L	01/10/00	BAZ
Alkalinity, Tot.(CaC	310.1	350	1.0	mg/L	01/10/00	DAS
Acidity in Water	305.1	321	2	mg/L	01/10/00	DAS

ND: Not detected at or above reporting limit
--: Information not available or not applicable

ZANDE ENVIRONMENTAL SERVICE, INC.
1233 Dublin Road
Columbus, OH 43215
(614) 486-4383
Ohio EPA Approval # 1030
West Virginia Certification # 190

Sample Name:	224A	Client Id:	BBCM4
Sample Number:	ZD0001017-9	ORDER Id:	ZD0001017
Sample Type:	Aqueous	Date Sampled:	01/05/00
Sampled By:	TH	Date Received:	01/06/00
		Project:	GUE-70-14.10 GUER

TEST	METHOD	RESULT	REPORTING LIMIT	UNITS	COMPLETE DATE	ANALYST
Total Calcium	3120B	62.1	0.1	mg/L	01/11/00	CCM
Sulfate	375.4	54.3	2.0	mg/L	01/10/00	JRW
Total Iron	3120B	8110	400	ug/L	01/10/00	CCM
Hardness	130.2	226	1.0	mg/L	01/10/00	BAZ
Alkalinity, Tot.(CaC	310.1	220	1.0	mg/L	01/10/00	DAS
Acidity in Water	305.1	111	2	mg/L	01/10/00	DAS

ND: Not detected at or above reporting limit
--: Information not available or not applicable

ZANDE ENVIRONMENTAL SERVICE, INC.
1233 Dublin Road
Columbus, OH 43215
(614) 486-4383
Ohio EPA Approval # 1030
West Virginia Certification # 190

Sample Name: 224B
Sample Number: ZD0001017-10
Sample Type: Aqueous
Sampled By: TH

Client Id: BBCM4
ORDER Id: ZD0001017
Date Sampled: 01/05/00
Date Received: 01/06/00
Project: GUE-70-14.10 GUER

TEST	METHOD	RESULT	REPORTING LIMIT	UNITS	COMPLETE DATE	ANALYST
Total Calcium	3120B	82.8	0.1	mg/L	01/11/00	CCM
Sulfate	375.4	64.0	2.0	mg/L	01/10/00	JRW
Total Iron	3120B	85400	4000	ug/L	01/10/00	CCM
Hardness	130.2	276	1.0	mg/L	01/10/00	BAZ
Alkalinity, Tot.(CaC	310.1	230	1.0	mg/L	01/10/00	DAS
Acidity in Water	305.1	207	2	mg/L	01/10/00	DAS

ND: Not detected at or above reporting limit
--: Information not available or not applicable

ZANDE ENVIRONMENTAL SERVICE, INC.
1233 Dublin Road
Columbus, OH 43215
(614) 486-4383
Ohio EPA Approval # 1030
West Virginia Certification # 190

Sample Name: 225A
Sample Number: ZD0001017-6
Sample Type: Aqueous
Sampled By: TH

Client Id: - BBCM4
ORDER Id: ZD0001017
Date Sampled: 01/03/00
Date Received: 01/06/00
Project: GUE-70-14.10 GUER

TEST	METHOD	RESULT	REPORTING LIMIT	UNITS	COMPLETE DATE	ANALYST
Total Calcium	3120B	49.5	0.1	mg/L	01/11/00	CCM
Sulfate	375.4	52.3	2.0	mg/L	01/10/00	JRW
Total Iron	3120B	3530	400	ug/L	01/10/00	CCM
Hardness	130.2	175	1.0	mg/L	01/10/00	BAZ
Alkalinity, Tot.(CaC	310.1	240	1.0	mg/L	01/10/00	DAS
Acidity in Water	305.1	255	2	mg/L	01/10/00	DAS

ND: Not detected at or above reporting limit
---: Information not available or not applicable

ZANDE ENVIRONMENTAL SERVICE, INC.
1233 Dublin Road
Columbus, OH 43215
(614) 486-4383
Ohio EPA Approval # 1030
West Virginia Certification # 190

Sample Name:	225B	Client Id:	BBCM4
Sample Number:	ZD0001017-5	ORDER Id:	ZD0001017
Sample Type:	Aqueous	Date Sampled:	01/03/00
Sampled By:	TH	Date Received:	01/06/00
		Project:	GUE-70-14.10 GUER

TEST	METHOD	RESULT	REPORTING LIMIT	UNITS	COMPLETE DATE	ANALYST
Total Calcium	3120B	84.8	0.1	mg/L	01/11/00	CCM
Sulfate	375.4	41.2	2.0	mg/L	01/10/00	JRW
Total Iron	3120B	101000	4000	ug/L	01/10/00	CCM
Hardness	130.2	286	1.0	mg/L	01/10/00	BAZ
Alkalinity, Tot.(CaC	310.1	240	1.0	mg/L	01/10/00	DAS
Acidity in Water	305.1	219	2	mg/L	01/10/00	DAS

ND: Not detected at or above reporting limit
--: Information not available or not applicable

ZANDE ENVIRONMENTAL SERVICE, INC.
1233 Dublin Road
Columbus, OH 43215
(614) 486-4383
Ohio EPA Approval # 1030
West Virginia Certification # 190

Sample Name: 226A
Sample Number: ZD0001018-6
Sample Type: Aqueous
Sampled By: TH

Client Id: BBCM4
ORDER Id: ZD0001018
Date Sampled: 12/28/99
Date Received: 01/06/00
Project: 7000.03

TEST	METHOD	RESULT	REPORTING LIMIT	UNITS	COMPLETE DATE	ANALYST
Total Calcium	3120B	39.4	0.1	mg/L	01/11/00	CCM
Sulfate	375.4	264	2.0	mg/L	01/10/00	JRW
Total Iron	3120B	28600	4000	ug/L	01/10/00	CCM
Hardness	130.2	126	1.0	mg/L	01/10/00	BAZ
Alkalinity, Tot.(CaC	310.1	430	1.0	mg/L	01/10/00	DAS
Acidity in Water	305.1	412	2	mg/L	01/10/00	DAS

ND: Not detected at or above reporting limit
--: Information not available or not applicable

ZANDE ENVIRONMENTAL SERVICE, INC.
1233 Dublin Road
Columbus, OH 43215
(614) 486-4383
Ohio EPA Approval # 1030
West Virginia Certification # 190

Sample Name:	227A	Client Id:	BBCM4
Sample Number:	ZD0001018-7	ORDER Id:	ZD0001018
Sample Type:	Aqueous	Date Sampled:	12/28/99
Sampled By:	TH	Date Received:	01/06/00
		Project:	7000.03

TEST	METHOD	RESULT	REPORTING LIMIT	UNITS	COMPLETE DATE	ANALYST
Total Calcium	3120B	50.0	0.1	mg/L	01/11/00	CCM
Sulfate	375.4	267	2.0	mg/L	01/10/00	JRW
Total Iron	3120B	2310	400	ug/L	01/10/00	CCM
Hardness	130.2	142	1.0	mg/L	01/10/00	BAZ
Alkalinity, Tot.(CaC	310.1	410	1.0	mg/L	01/10/00	DAS
Acidity in Water	305.1	405	2	mg/L	01/10/00	DAS

ND: Not detected at or above reporting limit
--: Information not available or not applicable

ZANDE ENVIRONMENTAL SERVICE, INC.
1233 Dublin Road
Columbus, OH 43215
(614) 486-4383
Ohio EPA Approval # 1030
West Virginia Certification # 190

Sample Name: 227B
Sample Number: ZD0001018-8
Sample Type: Aqueous
Sampled By: TH

Client Id: BBCM4
ORDER Id: ZD0001018
Date Sampled: 12/28/99
Date Received: 01/06/00
Project: 7000.03

TEST	METHOD	RESULT	REPORTING LIMIT	UNITS	COMPLETE DATE	ANALYST
Total Calcium	3120B	111	1.0	mg/L	01/11/00	CCM
Sulfate	375.4	77.9	2.0	mg/L	01/10/00	JRW
Total Iron	3120B	40800	4000	ug/L	01/10/00	CCM
Hardness	130.2	308	1.0	mg/L	01/10/00	BAZ
Alkalinity, Tot.(CaC	310.1	310	1.0	mg/L	01/10/00	DAS
Acidity in Water	305.1	300	2	mg/L	01/10/00	DAS

ND: Not detected at or above reporting limit
--: Information not available or not applicable

ZANDE ENVIRONMENTAL SERVICE, INC.
1233 Dublin Road
Columbus, OH 43215
(614) 486-4383
Ohio EPA Approval # 1030
West Virginia Certification # 190

Sample Name: 228A
Sample Number: ZD0001018-11
Sample Type: Aqueous
Sampled By: TH

Client Id: BBCM4
ORDER Id: ZD0001018
Date Sampled: 12/29/99
Date Received: 01/06/00
Project: 7000.03

TEST	METHOD	RESULT	REPORTING LIMIT	UNITS	COMPLETE DATE	ANALYST
Total Calcium	3120B	10.5	0.1	mg/L	01/11/00	CCM
Sulfate	375.4	131	2.0	mg/L	01/10/00	JRW
Total Iron	3120B	965	40	ug/L	01/10/00	CCM
Hardness	130.2	26	1.0	mg/L	01/10/00	BAZ
Alkalinity, Tot.(CaC	310.1	100	1.0	mg/L	01/10/00	DAS
Acidity in Water	305.1	35	2	mg/L	01/10/00	DAS

ND: Not detected at or above reporting limit
--: Information not available or not applicable

ZANDE ENVIRONMENTAL SERVICE, INC.
1233 Dublin Road
Columbus, OH 43215
(614) 486-4383
Ohio EPA Approval # 1030
West Virginia Certification # 190

Sample Name: 228B
Sample Number: ZD0001018-12
Sample Type: Aqueous
Sampled By: TH

Client Id: BBCM4
ORDER Id: ZD0001018
Date Sampled: 12/29/99
Date Received: 01/06/00
Project: 7000.03

TEST	METHOD	RESULT	REPORTING LIMIT	UNITS	COMPLETE DATE	ANALYST
Total Calcium	3120B	79.3	0.1	mg/L	01/11/00	CCM
Sulfate	375.4	83.3	2.0	mg/L	01/10/00	JRW
Total Iron	3120B	4710	400	ug/L	01/10/00	CCM
Hardness	130.2	298	1.0	mg/L	01/10/00	BAZ
Alkalinity, Tot.(CaC	310.1	310	1.0	mg/L	01/10/00	DAS
Acidity in Water	305.1	332	2	mg/L	01/10/00	DAS

ND: Not detected at or above reporting limit
--: Information not available or not applicable

ZANDE ENVIRONMENTAL SERVICE, INC.
1233 Dublin Road
Columbus, OH 43215
(614) 486-4383
Ohio EPA Approval # 1030
West Virginia Certification # 190

Sample Name:	228C	Client Id:	BBCM4
Sample Number:	ZD0001018-13	ORDER Id:	ZD0001018
Sample Type:	Aqueous	Date Sampled:	12/29/99
Sampled By:	TH	Date Received:	01/06/00
		Project:	7000.03

TEST	METHOD	RESULT	REPORTING LIMIT	UNITS	COMPLETE DATE	ANALYST
Total Calcium	3120B	117	1.0	mg/L	01/11/00	CCM
Sulfate	375.4	81.9	2.0	mg/L	01/10/00	JRW
Total Iron	3120B	182000	4000	ug/L	01/10/00	CCM
Hardness	130.2	338	1.0	mg/L	01/10/00	BAZ
Alkalinity, Tot.(CaC	310.1	220	1.0	mg/L	01/10/00	DAS
Acidity in Water	305.1	165	2	mg/L	01/10/00	DAS

ND: Not detected at or above reporting limit
--: Information not available or not applicable

ZANDE ENVIRONMENTAL SERVICE, INC.
1233 Dublin Road
Columbus, OH 43215
(614) 486-4383
Ohio EPA Approval # 1030
West Virginia Certification # 190

Sample Name: PW-1
Sample Number: ZD0001017-8
Sample Type: Aqueous
Sampled By: TH

Client Id: BBCM4
ORDER Id: ZD0001017
Date Sampled: 01/04/00
Date Received: 01/06/00
Project: GUE-70-14.10 GUER

TEST	METHOD	RESULT	REPORTING LIMIT	UNITS	COMPLETE DATE	ANALYST
Total Calcium	3120B	70.1	0.1	mg/L	01/11/00	CCM
Sulfate	375.4	42.4	2.0	mg/L	01/10/00	JRW
Total Iron	3120B	11600	400	ug/L	01/10/00	CCM
Hardness	130.2	232	1.0	mg/L	01/10/00	BAZ
Alkalinity, Tot.(CaC	310.1	280	1.0	mg/L	01/10/00	DAS
Acidity in Water	305.1	307	2	mg/L	01/10/00	DAS

ND: Not detected at or above reporting limit
--: Information not available or not applicable

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

February 3, 2000

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

DATE COLLECTED: 01/24/00
DATE RECEIVED: 01/27/00
DATE REPORTED: 02/03/00

AALI ORDER ID: 8231
APPROVAL #: EPA Certification 4043
CLIENT PROJECT: 7000 03
CLIENT PO NO.:

TEST RESULTS

Test: Sulfate

Method: 375.4

AALI Sample Number	Client Sample Identification	Sulfate Result	Detection Limit	Date Collected	Date Analyzed
36261	221A	42.7 mg/L	5	01/24/00	02/01/00
36262	221B	50.4 mg/L	10	01/24/00	02/01/00
36263	221C	35.3 mg/L	10	01/24/00	02/01/00
36264	222A	5.72 mg/L	1	01/25/00	02/01/00
36265	224A	59 5 mg/L	5	01/26/00	02/01/00
36266	225A	45 6 mg/L	5	01/25/00	02/01/00
36267	226A	249 mg/L	10	01/25/00	02/01/00
36268	227A	244 mg/L	10	01/26/00	02/01/00
36269	228A	118 mg/L	10	01/26/00	02/01/00
36270	228B	65.0 mg/L	10	01/24/00	02/01/00
36271	228C	49.0 mg/L	10	01/24/00	02/01/00
36272	P-1A	28.7 mg/L	5	01/24/00	02/01/00
36273	PW-1	25.1 mg/L	5	01/27/00	02/03/00

Respectfully submitted,

Janet Ricks

Janet Ricks, Laboratory Manager

Page 1 of 1

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

January 31, 2000

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

DATE COLLECTED: 01/24/00
DATE RECEIVED: 01/27/00
DATE REPORTED: 01/31/00

AALI ORDER ID: 8231
APPROVAL # : EPA Certification 4043
CLIENT PROJECT: 7000.03
CLIENT PO NO.:

TEST RESULTS

Test: Hardness as CaCO3
Method: 130.2

AALI Sample Number	Client Sample Identification	Hardness as CaCO3 Result	Detection Limit	Date Collected	Date Analyzed
36261	221A	188 mg/L	0.1	01/24/00	01/31/00
36262	221B	388 mg/L	0.1	01/24/00	01/31/00
36263	221C	344 mg/L	0.1	01/24/00	01/31/00
36264	222A	88 mg/L	0.1	01/25/00	01/31/00
36265	224A	222 mg/L	0.1	01/26/00	01/31/00
36266	225A	172 mg/L	0.1	01/25/00	01/31/00
36267	226A	186 mg/L	0.1	01/25/00	01/31/00
36268	227A	162 mg/L	0.1	01/26/00	01/31/00
36269	228A	34 mg/L	0.1	01/26/00	01/31/00
36270	228B	356 mg/L	0 1	01/24/00	01/31/00
36271	228C	340 mg/L	0.1	01/24/00	01/31/00
36272	P-1A	196 mg/L	0.1	01/24/00	01/31/00
36273	PW-1.	172 mg/L	0.1	01/27/00	01/31/00

Respectfully submitted,

Janet Ricks

Janet Ricks, Laboratory Manager

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

February 2, 2000

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

AALI ORDER ID: 8231
APPROVAL #: EPA Certification 4043
CLIENT PROJECT: 7000.03
CLIENT PO NO.:

DATE COLLECTED: 01/24/00
DATE RECEIVED: 01/27/00
DATE REPORTED: 02/02/00

TEST RESULTS

Test: Iron
Method: 3010A/7380/236.1

AALI Sample Number	Client Sample Identification	Iron Result	Detection Limit	Date Collected	Date Analyzed
36261	221A	1.24 mg/L	0.02	01/24/00	02/02/00
36262	221B	14.2 mg/L	0.02	01/24/00	02/02/00
36263	221C	19.6 mg/L	0.02	01/24/00	02/02/00
36264	222A	0.56 mg/L	0 02	01/25/00	02/02/00
36265	224A	3.70 mg/L	0.02	01/26/00	02/02/00
36266	225A	4 16 mg/L	0.02	01/25/00	02/02/00
36267	226A	31 0 mg/L	0.02	01/25/00	02/02/00
36268	227A	2.14 mg/L	0.02	01/26/00	02/02/00
36269	228A	0.72 mg/L	0 02	01/26/00	02/02/00
36270	228B	10.2 mg/L	0 02	01/24/00	02/02/00
36271	228C	78 5 mg/L	0.02	01/24/00	02/02/00
36272	P-1A	0.54 mg/L	0.02	01/24/00	02/02/00
36273	PW-1.	10.6 mg/L	0.02	01/27/00	02/02/00

Respectfully submitted,

Janet Ricks

Janet Ricks, Laboratory Manager

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

February 1, 2000

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

DATE COLLECTED: 01/24/00
DATE RECEIVED: 01/27/00
DATE REPORTED: 02/01/00

AALI ORDER ID: 8231
APPROVAL # : EPA Certification 4043
CLIENT PROJECT: 7000 03
CLIENT PO NO.:

TEST RESULTS

Test: Calcium
Method: 215.1

AALI Sample Number	Client Sample Identification	Calcium Result	Detection Limit	Date Collected	Date Analyzed
36261	221A	75.7 mg/L	0.1	01/24/00	02/01/00
36262	221B	100 mg/L	0.1	01/24/00	02/01/00
36263	221C	89.0 mg/L	0.1	01/24/00	02/01/00
36264	222A	40.7 mg/L	0.1	01/25/00	02/01/00
36265	224A	75.8 mg/L	0.1	01/26/00	02/01/00
36266	225A	52.5 mg/L	0.1	01/25/00	02/01/00
36267	226A	77.7 mg/L	0 1	01/25/00	02/01/00
36268	227A	84.0 mg/L	0.1	01/26/00	02/01/00
36269	228A	36.2 mg/L	0 1	01/26/00	02/01/00
36270	228B	92.0 mg/L	0 1	01/24/00	02/01/00
36271	228C	142 mg/L	0.1	01/24/00	02/01/00
36272	P-1A	83.8 mg/L	0.1	01/24/00	02/01/00
36273	PW-1.	92.2 mg/L	0.1	01/27/00	02/01/00

Respectfully submitted,

Janet Ricks

Janet Ricks, Laboratory Manager

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

January 31, 2000

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

DATE COLLECTED: 01/24/00
DATE RECEIVED: 01/27/00
DATE REPORTED: 01/31/00

AALI ORDER ID: 8231
APPROVAL #: EPA Certification 4043
CLIENT PROJECT: 7000.03
CLIENT PO NO.:

TEST RESULTS

Test: Alkalinity, Total as $CaCO_3$

Method: 2320 B

AALI Sample Number	Client Sample Identification	Alkalinity, Total as CaCO3 Result	Detection Limit	Date Collected	Date Analyzed
36261	221A	240 mg/L	1	01/24/00	01/31/00
36262	221B	200 mg/L	1	01/24/00	01/31/00
36263	221C	210 mg/L	1	01/24/00	01/31/00
36264	222A	365 mg/L	1	01/25/00	01/31/00
36265	224A	230 mg/L	1	01/26/00	01/31/00
36266	225A	200 mg/L	1	01/25/00	01/31/00
36267	226A	430 mg/L	1	01/25/00	01/31/00
36268	227A	415 mg/L	1	01/26/00	01/31/00
36269	228A	110 mg/L	1	01/26/00	01/31/00
36270	228B	180 mg/L	1	01/24/00	01/31/00
36271	228C	250 mg/L	1	01/24/00	01/31/00
36272	P-1A	235 mg/L	1	01/24/00	01/31/00
36273	PW-1.	205 mg/L	1	01/27/00	01/31/00

Respectfully submitted,

Janet Ricks

Janet Ricks, Laboratory Manager

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

February 22, 2000

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

AALI ORDER ID: 8304
APPROVAL #: EPA Certification 4043
CLIENT PROJECT: 7000.03
CLIENT PO NO.:

DATE COLLECTED: 02/15/00
DATE RECEIVED: 02/17/00
DATE REPORTED: 02/22/00

TEST RESULTS

Test: Sulfate
Method: 375.4

AALI Sample Number	Client Sample Identification	Sulfate Result	Detection Limit	Date Collected	Date Analyzed
36509	221A	41.3 mg/L	1	02/15/00	02/22/00
36510	221B	48.3 mg/L	1	02/16/00	02/22/00
36511	221C	105 mg/L	1	02/16/00	02/22/00
36512	222A	4.89 mg/L	1	02/15/00	02/22/00
36513	224A	65.5 mg/L	1	02/15/00	02/22/00
36514	225A	40.2 mg/L	1	02/15/00	02/22/00
36515	226A	277 mg/L	1	02/14/00	02/22/00
36516	227A	248 mg/L	1	02/14/00	02/22/00
36517	228A	111 mg/L	1	02/15/00	02/22/00
36518	228B	85.3 mg/L	1	02/16/00	02/22/00
36519	228C	79.9 mg/L	1	02/16/00	02/22/00
36520	P-1A	26.8 mg/L	1	02/15/00	02/22/00
36521	PW-1	39.1 mg/L	1	02/16/00	02/22/00

Respectfully submitted,

Janet Ricks

Janet Ricks, Laboratory Manager

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

February 24, 2000

BBC&M Engineering
6190 Enterprise Court
Dublin. OH 43016-7297
ATTN: Takeshi Hirano

DATE COLLECTED: 02/15/00
DATE RECEIVED: 02/17/00
DATE REPORTED: 02/24/00

AALI ORDER ID: 8304
APPROVAL # : EPA Certification 4043
CLIENT PROJECT: 7000 03
CLIENT PO NO.:

TEST RESULTS

Test: Hardness as CaCO3

Method: 130.2

AALI Sample Number	Client Sample Identification	Hardness as CaCO3 Result	Detection Limit	Date Collected	Date Analyzed
36509	221A	240 mg/L	0.1	02/15/00	02/24/00
36510	221B	440 mg/L	0.1	02/16/00	02/24/00
36511	221C	408 mg/L	0.1	02/16/00	02/24/00
36512	222A	96 mg/L	0.1	02/15/00	02/24/00
36513	224A	240 mg/L	0.1	02/15/00	02/24/00
36514	225A	184 mg/L	0.1	02/15/00	02/24/00
36515	226A	144 mg/L	0.1	02/14/00	02/24/00
36516	227A	180 mg/L	0.1	02/14/00	02/24/00
36517	228A	44 mg/L	0.1	02/15/00	02/24/00
36518	228B	344 mg/L	0.1	02/16/00	02/24/00
36519	228C	520 mg/L	0.1	02/16/00	02/24/00
36520	P-1A	200 mg/L	0.1	02/15/00	02/24/00
36521	PW-1	260 mg/L	0.1	02/16/00	02/24/00

Respectfully submitted,

Janet Ricks

Janet Ricks. Laboratory Manager

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

March 1, 2000

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

DATE COLLECTED: 02/15/00
DATE RECEIVED: 02/17/00
DATE REPORTED: 03/01/00

AALI ORDER ID: 8304
APPROVAL # : EPA Certification 4043
CLIENT PROJECT: 7000 03
CLIENT PO NO.:

TEST RESULTS

Test: Iron
Method: 3010A/7380/236.1

AALI Sample Number	Client Sample Identification	Iron Result	Detection Limit	Date Collected	Date Analyzed
36509	221A	0.68 mg/L	0.02	02/15/00	02/24/00
36510	221B	71.1 mg/L	0.02	02/16/00	02/24/00
36511	221C	247 mg/L	0.02	02/16/00	02/24/00
36512	222A	0.64 mg/L	0.02	02/15/00	02/24/00
36513	224A	2.2 mg/L	0.02	02/15/00	02/24/00
36514	225A	2.1 mg/L	0.02	02/15/00	02/24/00
36515	226A	2.4 mg/L	0.02	02/14/00	02/24/00
36516	227A	3.4 mg/L	0.02	02/14/00	02/24/00
36517	228A	1.3 mg/L	0.02	02/15/00	02/24/00
36518	228B	7.4 mg/L	0.02	02/16/00	02/24/00
36519	228C	389 mg/L	0.02	02/16/00	02/24/00
36520	P-1A	0.38 mg/L	0.02	02/15/00	02/24/00
36521	PW-1	0.63 mg/L	0.02	02/16/00	02/24/00

Respectfully submitted,

Janet Ricks

Janet Ricks, Laboratory Manager

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

February 25, 2000

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN. Takeshi Hirano

DATE COLLECTED: 02/15/00
DATE RECEIVED: 02/17/00
DATE REPORTED: 02/25/00

AALI ORDER ID: 8304
APPROVAL # : EPA Certification 4043
CLIENT PROJECT: 7000.03
CLIENT PO NO.:

TEST RESULTS

Test: Calcium

Method: 215.1

AALI Sample Number	Client Sample Identification	Calcium Result	Detection Limit	Date Collected	Date Analyzed
36509	221A	99.4 mg/L	0.1	02/15/00	02/25/00
36510	221B	164 mg/L	0 1	02/16/00	02/25/00
36511	221C	101 mg/L	0.1	02/16/00	02/25/00
36512	222A	13 2 mg/L	0.1	02/15/00	02/25/00
36513	224A	55 0 mg/L	0.1	02/15/00	02/25/00
36514	225A	83.2 mg/L	0.1	02/15/00	02/25/00
36515	226A	78.0 mg/L	0.1	02/14/00	02/25/00
36516	227A	91.3 mg/L	0 1	02/14/00	02/25/00
36517	228A	16.7 mg/L	0.1	02/15/00	02/25/00
36518	228B	137 mg/L	0.1	02/16/00	02/25/00
36519	228C	219 mg/L	0.1	02/16/00	02/25/00
36520	P-1A	78 5 mg/L	0.1	02/15/00	02/25/00
36521	PW-1	94.0 mg/L	0.1	02/16/00	02/25/00

Respectfully submitted,

Janet Ricks

Janet Ricks, Laboratory Manager

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002

Analysis & Testing - Quality Control Programs - Research & Development

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

February 22, 2000

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

DATE COLLECTED: 02/15/00
DATE RECEIVED: 02/17/00
DATE REPORTED: 02/22/00

AALI ORDER ID: 8304
APPROVAL # : EPA Certification 4043
CLIENT PROJECT: 7000.03
CLIENT PO NO.:

TEST RESULTS

Test: Alkalinity, Total as CaCO3

Method: 2320 B

AALI Sample Number	Client Sample Identification	Alkalinity, Total as CaCO3 Result	Detection Limit	Date Collected	Date Analyzed
36509	221A	210 mg/L	1	02/15/00	02/22/00
36510	221B	200 mg/L	1	02/16/00	02/22/00
36511	221C	210 mg/L	1	02/16/00	02/22/00
36512	222A	300 mg/L	1	02/15/00	02/22/00
36513	224A	230 mg/L	1	02/15/00	02/22/00
36514	225A	200 mg/L	1	02/15/00	02/22/00
36515	226A	430 mg/L	1	02/14/00	02/22/00
36516	227A	410 mg/L	1	02/14/00	02/22/00
36517	228A	110 mg/L	1	02/15/00	02/22/00
36518	228B	210 mg/L	1	02/16/00	02/22/00
36519	228C	250 mg/L	1	02/16/00	02/22/00
36520	P-1A	230 mg/L	1	02/15/00	02/22/00
36521	PW-1	230 mg/L	1	02/16/00	02/22/00

Respectfully submitted,

Janet Ricks

Janet Ricks, Laboratory Manager

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

March 9, 2000

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN Chris Hall

DATE COLLECTED: 03/07/00
DATE RECEIVED: 03/08/00
DATE REPORTED: 03/09/00

AALI ORDER ID: 8354
APPROVAL #: EPA Certification 4043
CLIENT PROJECT: 7000.03
CLIENT PO NO.:

TEST RESULTS

Test: Calcium

Method: 3010A/7140/215.1

AALI Sample Number	Client Sample Identification	Calcium Result	Detection Limit	Date Collected	Date Analyzed
36690	221-A	61.4 mg/L	0.1	03/07/00	03/09/00
36691	221-B	72.1 mg/L	0.1	03/08/00	03/09/00
36692	221-C	64.0 mg/L	0.1	03/08/00	03/09/00
36693	222-A	13 7 mg/L	0.1	03/07/00	03/09/00
36694	224-A	38 4 mg/L	0.1	03/07/00	03/09/00
36695	225-A	31.9 mg/L	0 1	03/06/00	03/09/00
36696	226-A	20.7 mg/L	0.1	03/06/00	03/09/00
36697	227-A	32.2 mg/L	0 1	03/06/00	03/09/00
36698	228-A	11.6 mg/L	0.1	03/07/00	03/09/00
36699	P-1A	24.2 mg/L	0.1	03/07/00	03/09/00
36700	228-B	71.4 mg/L	0.1	03/07/00	03/09/00
36701	228-C	111 mg/L	0.1	03/07/00	03/09/00
36702	P-W1	55.2 mg/L	0.1	03/08/00	03/09/00

Respectfully submitted,

Janet Ricks

Janet Ricks, Laboratory Manager

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

March 9, 2000

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Chris Hall

DATE COLLECTED: 03/07/00
DATE RECEIVED: 03/08/00
DATE REPORTED: 03/09/00

AALI ORDER ID: 8354
APPROVAL # : EPA Certification 4043
CLIENT PROJECT: 7000.03
CLIENT PO NO.:

TEST RESULTS

Test: Iron

Method: 3010A/7380/236.1

AALI Sample Number	Client Sample Identification	Iron Result	Detection Limit	Date Collected	Date Analyzed
36690	221-A	0.91 mg/L	0 02	03/07/00	03/09/00
36691	221-B	45 mg/L	0.02	03/08/00	03/09/00
36692	221-C	116 mg/L	0.02	03/08/00	03/09/00
36693	222-A	0.57 mg/L	0.02	03/07/00	03/09/00
36694	224-A	1.8 mg/L	0.02	03/07/00	03/09/00
36695	225-A	2.2 mg/L	0.02	03/06/00	03/09/00
36696	226-A	1.2 mg/L	0.02	03/06/00	03/09/00
36697	227-A	1.6 mg/L	0.02	03/06/00	03/09/00
36698	228-A	1.6 mg/L	0.02	03/07/00	03/09/00
36699	P-1A	0.58 mg/L	0.02	03/07/00	03/09/00
36700	228-B	34 mg/L	0.02	03/07/00	03/09/00
36701	228-C	320 mg/L	0.02	03/07/00	03/09/00
36702	P-W1	1.0 mg/L	0.02	03/08/00	03/09/00

Respectfully submitted,
Janet Ricks
Janet Ricks, Laboratory Manager

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

March 13, 2000

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Chris Hall

DATE COLLECTED: 03/07/00
DATE RECEIVED: 03/08/00
DATE REPORTED: 03/13/00

AALI ORDER ID: 8354
APPROVAL # : EPA Certification 4043
CLIENT PROJECT: 7000 03
CLIENT PO NO.:

TEST RESULTS

Test: Sulfate

Method: 375 4

AALI Sample Number	Client Sample Identification	Sulfate Result	Detection Limit	Date Collected	Date Analyzed
36690	221-A	43.6 mg/L	5	03/07/00	03/13/00
36691	221-B	43 4 mg/L	10	03/08/00	03/13/00
36692	221-C	55.1 mg/L	10	03/08/00	03/13/00
36693	222-A	3 90 mg/L	1	03/07/00	03/13/00
36694	224-A	23.3 mg/L	10	03/07/00	03/13/00
36695	225-A	38.8 mg/L	5	03/06/00	03/13/00
36696	226-A	227 mg/L	10	03/06/00	03/13/00
36697	227-A	209 mg/L	10	03/06/00	03/13/00
36698	228-A	110 mg/L	10	03/07/00	03/13/00
36699	P-1A	28.8 mg/L	5	03/07/00	03/13/00
36700	228-B	72.1 mg/L	10	03/07/00	03/13/00
36701	228-C	42.1 mg/L	10	03/07/00	03/13/00
36702	P-W1	43.2 mg/L	5	03/08/00	03/13/00

Respectfully submitted,

L. Eve Karnitis

L. Eve Karnitis, President

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

March 10, 2000

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Chris Hall

AALI ORDER ID: 8354
APPROVAL #: EPA Certification 4043
CLIENT PROJECT: 7000.03
CLIENT PO NO.:

DATE COLLECTED: 03/07/00
DATE RECEIVED: 03/08/00
DATE REPORTED: 03/10/00

TEST RESULTS

Test: Hardness as CaCO3

Method: 130.2

AALI Sample Number	Client Sample Identification	Hardness as CaCO3 Result	Detection Limit	Date Collected	Date Analyzed
36690	221-A	224 mg/L	0.1	03/07/00	03/10/00
36691	221-B	392 mg/L	0.1	03/08/00	03/10/00
36692	221-C	360 mg/L	0.1	03/08/00	03/10/00
36693	222-A	84 mg/L	0.1	03/07/00	03/10/00
36694	224-A	208 mg/L	0.1	03/07/00	03/10/00
36695	225-A	168 mg/L	0.1	03/06/00	03/10/00
36696	226-A	132 mg/L	0.1	03/06/00	03/10/00
36697	227-A	160 mg/L	0.1	03/06/00	03/10/00
36698	228-A	24 mg/L	0.1	03/07/00	03/10/00
36699	P-1A	176 mg/L	0.1	03/07/00	03/10/00
36700	228-B	396 mg/L	0.1	03/07/00	03/10/00
36701	228-C	860 mg/L	0.5	03/07/00	03/10/00
36702	P-W1	236 mg/L	0.1	03/08/00	03/10/00

Respectfully submitted,

Janet Ricks

Janet Ricks, Laboratory Manager

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002

Analysis & Testing - Quality Control Programs - Research & Development

March 14, 2000

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Chris Hall

DATE COLLECTED: 03/07/00
DATE RECEIVED: 03/08/00
DATE REPORTED: 03/14/00

AALI ORDER ID: 8354
APPROVAL # : EPA Certification 4043
CLIENT PROJECT: 7000.03
CLIENT PO NO.:

TEST RESULTS

Test: Alkalinity, Total as CaCO3

Method: 2320 B

AALI Sample Number	Client Sample Identification	Alkalinity, Total as CaCO3 Result	Detection Limit	Date Collected	Date Analyzed
36690	221-A	230 mg/L as C	1	03/07/00	03/14/00
36691	221-B	200 mg/L as C	1	03/08/00	03/14/00
36692	221-C	210 mg/L as C	1	03/08/00	03/14/00
36693	222-A	350 mg/L as C	1	03/07/00	03/14/00
36694	224-A	210 mg/L as C	1	03/07/00	03/14/00
36695	225-A	210 mg/L as C	1	03/06/00	03/14/00
36696	226-A	450 mg/L as C	1	03/06/00	03/14/00
36697	227-A	430 mg/L as C	1	03/06/00	03/14/00
36698	228-A	110 mg/L as C	1	03/07/00	03/14/00
36699	P-1A	240 mg/L as C	1	03/07/00	03/14/00
36700	228-B	190 mg/L as C	1	03/07/00	03/14/00
36701	228-C	240 mg/L as C	1	03/07/00	03/14/00
36702	P-W1	220 mg/L as C	1	03/08/00	03/14/00

Respectfully submitted,

L. Eve Karnitis

L. Eve Karnitis, President

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

May Sampling Event

June 12, 2001

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN. Chris Hall

DATE COLLECTED: 05/21/01
DATE RECEIVED: 05/24/01
DATE REPORTED: 06/12/01

AALI ORDER ID: 9641
APPROVAL #: EPA Certification 4043
CLIENT PROJECT: 011-07000-090 Gue-70-14 10 Guernsey County
CLIENT PO NO.:

3 sets

TEST RESULTS

Test: Dissolved Solids
Method: 160.1

AALI Sample Number	Client Sample Identification	Dissolved Solids Result	Detection Limit	Date Collected	Date Analyzed
40824	DW-1	413 mg/L	10	05/21/01	06/12/01
40825	B-302	453 mg/L	10	05/22/01	06/12/01
40826	B-304	290 mg/L	10	05/22/01	06/12/01
40827	B-306	194 mg/L	10	05/22/01	06/12/01
40828	B-222A	384 mg/L	10	05/22/01	06/12/01
40829	B-227A	800 mg/L	10	05/23/01	06/12/01
40830	B-226A	820 mg/L	10	05/23/01	06/12/01
40831	B-305	462 mg/L	10	05/23/01	06/12/01
40832	B-303	507 mg/L	10	05/23/01	06/12/01
40833	B-301	212 mg/L	10	05/24/01	06/12/01
40834	B-309	673 mg/L	10	05/24/01	06/12/01
40835	R-1	330 mg/L	10	05/24/01	06/12/01

Respectfully submitted,

L. Eve Karnitis

L. Eve Karnitis, President

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ADVANCED ANALYTICS LABORATORIES, INC.

1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002

Analysis & Testing - Quality Control Programs - Research & Development

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

June 4, 2001

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Chris Hall

DATE COLLECTED: 05/21/01
DATE RECEIVED: 05/24/01
DATE REPORTED. 06/04/01

AALI ORDER ID: 9641
APPROVAL # : EPA Certification 4043
CLIENT PROJECT: 011-07000-090 Gue-70-14.10 Guernsey County
CLIENT PO NO.:

TEST RESULTS

Test: Calcium

Method: 3010A/7140/215 1

AALI Sample Number	Client Sample Identification	Calcium Result	Detection Limit	Date Collected	Date Analyzed
40824	DW-1	110 mg/L	0.03	05/21/01	06/03/01
40825	B-302	50 5 mg/L	0 03	05/22/01	06/03/01
40826	B-304	102 mg/L	0.03	05/22/01	06/03/01
40827	B-306	102 mg/L	0.03	05/22/01	06/03/01
40828	B-222A	31.9 mg/L	0.03	05/22/01	06/03/01
40829	B-227A	66.6 mg/L	0.03	05/23/01	06/03/01
40830	B-226A	49 6 mg/L	0.03	05/23/01	06/03/01
40831	B-305	73.0 mg/L	0.03	05/23/01	06/03/01
40832	B-303	18 8 mg/L	0.03	05/23/01	06/03/01
40833	B-301	38 9 mg/L	0.03	05/24/01	06/03/01
40834	B-309	114 mg/L	0.03	05/24/01	06/03/01
40835	R-1	104 mg/L	0 03	05/24/01	06/03/01

Respectfully submitted,

L. Eve Karnitis, President

ADVANCED ANALYTICS LABORATORIES, INC.

1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

May 31, 2001

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Chris Hall

AALI ORDER ID: 9641
APPROVAL # : EPA Certification 4043
CLIENT PROJECT: 011-07000-090 Gue-70-14.10 Guernsey County
CLIENT PO NO.:

DATE COLLECTED: 05/21/01
DATE RECEIVED: 05/24/01
DATE REPORTED: 05/31/01

TEST RESULTS

Test: Sulfate

Method: 375.4

AALI Sample Number	Client Sample Identification	Sulfate Result	Detection Limit	Date Collected	Date Analyzed
40824	DW-1	69.9 mg/L	5	05/21/01	05/31/01
40825	B-302	52.3 mg/L	1	05/22/01	05/31/01
40826	B-304	55 9 mg/L	5	05/22/01	05/31/01
40827	B-306	54 2 mg/L	1	05/22/01	05/31/01
40828	B-222A	7 3 mg/L	1	05/22/01	05/31/01
40829	B-227A	207 mg/L	5	05/23/01	05/31/01
40830	B-226A	246 mg/L	5	05/23/01	05/31/01
40831	B-305	134 mg/L	5	05/23/01	05/31/01
40832	B-303	33.5 mg/L	1	05/23/01	05/31/01
40833	B-301	<1.0 mg/L	1	05/24/01	05/31/01
40834	B-309	181 mg/L	5	05/24/01	05/31/01
40835	R-1	53.1 mg/L	1	05/24/01	05/31/01

Respectfully submitted.

L. Eve Karnitis

L. Eve Karnitis, President

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ADVANCED ANALYTICS LABORATORIES, INC.

1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

May 30, 2001

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Chris Hall

DATE COLLECTED: 05/21/01
DATE RECEIVED: 05/24/01
DATE REPORTED: 05/30/01

AALI ORDER ID: 9641
APPROVAL # : EPA Certification 4043
CLIENT PROJECT: 011-07000-090 Gue-70-14.10 Guernsey Coun
CLIENT PO NO.:

TEST RESULTS

Test: Iron

Method: 3010A/7380/236 1

AALI Sample Number	Client Sample Identification	Iron Result	Detection Limit	Date Collected	Date Analyzed
40824	DW-1	0 915 mg/L	0.05	05/21/01	05/30/01
40825	B-302	0.058 mg/L	0.05	05/22/01	05/30/01
40826	B-304	0 346 mg/L	0.05	05/22/01	05/30/01
40827	B-306	0 697 mg/L	0.05	05/22/01	05/30/01
40828	B-222A	0 159 mg/L	0 05	05/22/01	05/30/01
40829	B-227A	0 784 mg/L	0 05	05/23/01	05/30/01
40830	B-226A	0 300 mg/L	0 05	05/23/01	05/30/01
40831	B-305	0.258 mg/L	0 05	05/23/01	05/30/01
40832	B-303	0.060 mg/L	0 05	05/23/01	05/30/01
40833	B-301	0.610 mg/L	0 05	05/24/01	05/30/01
40834	B-309	0.897 mg/L	0.05	05/24/01	05/30/01
40835	R-1	1.176 mg/L	0 05	05/24/01	05/30/01

Respectfully submitted.

L. Eve Karnitis

L Eve Karnitis, President

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

June 13. 2001

BBC&M Engineering
6190 Enterprise Court
Dublin. OH 43016-7297
ATTN: Chris Hall

DATE COLLECTED: 05/21/01
DATE RECEIVED: 05/24/01
DATE REPORTED: 06/13/01

AALI ORDER ID: 9641
APPROVAL #: EPA Certification 4043
CLIENT PROJECT: 011-07000-090 Gue-70-14.10 Guernsey County
CLIENT PO NO.:

TEST RESULTS

Test: Hardness as CaCO3

Method: 130.2

AALI Sample Number	Client Sample Identification	Hardness as CaCO3 Result	Detection Limit	Date Collected	Date Analyzed
40824	DW-1	228 mg/L	2	05/21/01	06/13/01
40825	B-302	116 mg/L	2	05/22/01	06/13/01
40826	B-304	222 mg/L	2	05/22/01	06/13/01
40827	B-306	224 mg/L	2	05/22/01	06/13/01
40828	B-222A	80.0 mg/L	2	05/22/01	06/13/01
40829	B-227A	146 mg/L	2	05/23/01	06/13/01
40830	B-226A	108 mg/L	2	05/23/01	06/13/01
40831	B-305	178 mg/L	2	05/23/01	06/13/01
40832	B-303	56 mg/L	2	05/23/01	06/13/01
40833	B-301	192 mg/L	2	05/24/01	06/13/01
40834	B-309	238 mg/L	2	05/24/01	06/13/01
40835	R-1	236 mg/L	2	05/24/01	06/13/01

Respectfully submitted.

L. Eve Karnitis

L. Eve Karnitis. President

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

June 18, 2001

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Chris Hall

DATE COLLECTED: 5/21/01
DATE RECEIVED: 5/24/01
DATE REPORTED: 6/18/01

AALI ORDER ID: 9641
APPROVAL #: EPA Certification 4043
CLIENT PROJECT: 011-07000-090 Gue-70-14.10 Guernsey Coun
CLIENT PO NO.:

May Sampling event

TEST RESULTS

Test: Alkalinity
Method: 310.2

AALI Sample Number	Client Sample Identification	Alkalinity Result	Detection Limit	Date Collected	Date Analyzed
40824	DW-1	225 mg/L	5	5/21/01	6/15/01
40825	B-302	300 mg/L	5	5/22/01	6/15/01
40826	B-304	240 mg/L	5	5/22/01	6/15/01
40827	B-306	220 mg/L	5	5/22/01	6/15/01
40828	B-222A	390 mg/L	5	5/22/01	6/15/01
40829	B-227A	465 mg/L	5	5/23/01	6/15/01
40830	B-226A	535 mg/L	5	5/23/01	6/15/01
40831	B-305	225 mg/L	5	5/23/01	6/15/01
40832	B-303	360 mg/L	5	5/23/01	6/15/01
40833	B-301	350 mg/L	5	5/24/01	6/15/01
40834	B-309	430 mg/L	5	5/24/01	6/15/01
40835	R-1	190 mg/L	5	5/24/01	6/15/01

Respectfully submitted,

L. Eve Karnitis

L. Eve Karnitis, President

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

July 10, 2001

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

June Sampling Event

DATE COLLECTED: 06/25/01
DATE RECEIVED: 06/28/01
DATE REPORTED: 07/10/01

AALI ORDER ID: 9758
APPROVAL # : EPA Certification 4043
CLIENT PROJECT: 011-07000-090 Gue-70-14 10 Guernsey County
CLIENT PO NO.:

TEST RESULTS

Test: Dissolved Solids
Method: 160.1

AALI Sample Number	Client Sample Identification	Dissolved Solids Result	Detection Limit	Date Collected	Date Analyzed
41131	P-302A	426 mg/L	10	06/25/01	07/05/01
41132	P-302B	500 mg/L	10	06/25/01	07/05/01
41133	P-304A	297 mg/L	10	06/25/01	07/05/01
41134	P-304B	3650 mg/L	500	06/25/01	07/09/01
41135	P-308A	417 mg/L	10	06/25/01	07/05/01
41136	P-308B	570 mg/L	10	06/25/01	07/05/01
41137	P-306A	303 mg/L	10	06/26/01	07/05/01
41138	P-306B	200 mg/L	10	06/26/01	07/05/01
41139	P-303A	471 mg/L	10	06/26/01	07/05/01
41140	P-303B	387 mg/L	10	06/26/01	07/05/01
41141	P-309A	767 mg/L	10	06/26/01	07/05/01
41142	P-309B	500 mg/L	10	06/26/01	07/05/01
41143	P-307A	488 mg/L	10	06/26/01	07/05/01
41144	P-307B	438 mg/L	10	06/26/01	07/05/01
41145	P-301A	490 mg/L	10	06/26/01	07/09/01
41146	P-301B	581 mg/L	10	06/26/01	07/09/01
41147	P-222A	506 mg/L	10	06/27/01	07/09/01
41148	P-310A	748 mg/L	10	06/27/01	07/09/01
41149	P-305A	438 mg/L	10	06/27/01	07/09/01
41150	PW-1	372 mg/L	10	06/27/01	07/09/01

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

TEST RESULTS

Test: Dissolved Solids

Method: 160.1

AALI Sample Number	Client Sample Identification	Dissolved Solids Result	Detection Limit	Date Collected	Date Analyzed
41151	P-226A	806 mg/L	10	06/27/01	07/09/01
41152	P-227A	819 mg/L	10	06/27/01	07/09/01
41162	R-1	324 mg/L	10	06/25/01	07/09/01

Respectfully submitted,

L. Eve Karnitis

L Eve Karnitis. President

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

July 5, 2001

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

AALI ORDER ID: 9758
APPROVAL #: EPA Certification 4043
CLIENT PROJECT: 011-07000-090 Gue-70-14.10 Guernsey Coun
CLIENT PO NO.:

DATE COLLECTED: 6/25/01
DATE RECEIVED: 6/28/01
DATE REPORTED: 7/5/01

TEST RESULTS

Test: Calcium

Method: 3010A/7140/215.1

AALI Sample Number	Client Sample Identification	Calcium Result	Detection Limit	Date Collected	Date Analyzed
41131	P-302A	39 8 mg/L	0.03	6/25/01	7/5/01
41132	P-302B	80.8 mg/L	0.03	6/25/01	7/5/01
41133	P-304A	70.3 mg/L	0.03	6/25/01	7/5/01
41134	P-304B	41.3 mg/L	0.03	6/25/01	7/5/01
41135	P-308A	60.2 mg/L	0 03	6/25/01	7/5/01
41136	P-308B	81.7 mg/L	0.03	6/25/01	7/5/01
41137	P-306A	69.2 mg/L	0.03	6/26/01	7/5/01
41138	P-306B	70 1 mg/L	0 03	6/26/01	7/5/01
41139	P-303A	16.7 mg/L	0 03	6/26/01	7/5/01
41140	P-303B	65 3 mg/L	0 03	6/26/01	7/5/01
41141	P-309A	72.4 mg/L	0.03	6/26/01	7/5/01
41142	P-309B	70.3 mg/L	0.03	6/26/01	7/5/01
41143	P-307A	21.9 mg/L	0 03	6/26/01	7/5/01
41144	P-307B	80.8 mg/L	0.03	6/26/01	7/5/01
41145	P-301A	32 1 mg/L	0.03	6/26/01	7/5/01
41146	P-301B	47 1 mg/L	0 03	6/26/01	7/5/01
41147	P-222A	29 6 mg/L	0.03	6/27/01	7/5/01
41148	P-310A	57.4 mg/L	0 03	6/27/01	7/5/01
41149	P-305A	64 7 mg/L	0.03	6/27/01	7/5/01
41150	PW-1	75.3 mg/L	0 03	6/27/01	7/5/01

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

TEST RESULTS

Test: Calcium

Method: 3010A/7140/215 1

AALI Sample Number	Client Sample Identification	Calcium Result	Detection Limit	Date Collected	Date Analyzed
41151	P-226A	38.1 mg/L	0 03	6/27/01	7/5/01
41152	P-227A	46 9 mg/L	0.03	6/27/01	7/5/01
41162	R-1	70.0 mg/L	0.03	6/25/01	7/5/01

Respectfully submitted,

L. Eve Karnitis

L Eve Karnitis, President

ADVANCED ANALYTICS LABORATORIES, INC.

1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002

Analysis & Testing - Quality Control Programs - Research & Development

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

July 12, 2001

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

DATE COLLECTED: 06/25/01
DATE RECEIVED: 06/28/01
DATE REPORTED: 07/12/01

AALI ORDER ID: 9758
APPROVAL # : EPA Certification 4043
CLIENT PROJECT: 011-07000-090 Gue-70-14 10 Guernsey County
CLIENT PO NO.:

TEST RESULTS

Test: Sulfate
Method: 375.4

AALI Sample Number	Client Sample Identification	Sulfate Result	Detection Limit	Date Collected	Date Analyzed
41131	P-302A	33.7 mg/L	1	06/25/01	06/29/01
41132	P-302B	48.0 mg/L	1	06/25/01	06/29/01
41133	P-304A	39.8 mg/L	1	06/25/01	06/29/01
41134	P-304B	96.4 mg/L	5	06/25/01	07/11/01
41135	P-308A	36.8 mg/L	1	06/25/01	06/29/01
41136	P-308B	93.4 mg/L	5	06/25/01	06/29/01
41137	P-306A	38.7 mg/L	1	06/26/01	06/29/01
41138	P-306B	50.4 mg/L	1	06/26/01	06/29/01
41139	P-303A	26.1 mg/L	1	06/26/01	06/29/01
41140	P-303B	31 0 mg/L	1	06/26/01	06/29/01
41141	P-309A	177 mg/L	5	06/26/01	06/29/01
41142	P-309B	115 mg/L	5	06/26/01	06/29/01
41143	P-307A	40.2 mg/L	1	06/26/01	06/29/01
41144	P-307B	52 2 mg/L	1	06/26/01	06/29/01
41145	P-301A	1 67 mg/L	1	06/26/01	06/29/01
41146	P-301B	51 9 mg/L	1	06/26/01	06/29/01
41147	P-222A	7.95 mg/L	1	06/27/01	06/29/01
41148	P-310A	132 mg/L	5	06/27/01	06/29/01
41149	P-305A	53.8 mg/L	1	06/27/01	06/29/01
41150	PW-1	45.7 mg/L	1	06/27/01	06/29/01

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

TEST RESULTS

Test: Sulfate

Method: 375.4

AALI Sample Number	Client Sample Identification	Sulfate Result	Detection Limit	Date Collected	Date Analyzed
41151	P-226A	137 mg/L	5	06/27/01	06/29/01
41152	P-227A	161 mg/L	5	06/27/01	06/29/01
41162	R-1	42.4 mg/L	1	06/25/01	06/29/01

Respectfully submitted,

L. Eve Karnitis

L. Eve Karnitis, President

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

July 10, 2001

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

DATE COLLECTED: 06/25/01
DATE RECEIVED: 06/28/01
DATE REPORTED: 07/10/01

AALI ORDER ID: 9758
APPROVAL # : EPA Certification 4043
CLIENT PROJECT: 011-07000-090 Gue-70-14.10 Guernsey County
CLIENT PO NO.:

TEST RESULTS

Test: Iron

Method: 3010A/7380/236.1

AALI Sample Number	Client Sample Identification	Iron Result	Detection Limit	Date Collected	Date Analyzed
41131	P-302A	0.098 mg/L	0.05	06/25/01	07/05/01
41132	P-302B	4.948 mg/L	0.05	06/25/01	07/05/01
41133	P-304A	0.747 mg/L	0 05	06/25/01	07/05/01
41134	P-304B	253 mg/L	0.05	06/25/01	07/05/01
41135	P-308A	0 874 mg/L	0.05	06/25/01	07/05/01
41136	P-308B	7.15 mg/L	0.05	06/25/01	07/05/01
41137	P-306A	0 861 mg/L	0.05	06/26/01	07/05/01
41138	P-306B	0.833 mg/L	0.05	06/26/01	07/05/01
41139	P-303A	0.322 mg/L	0.05	06/26/01	07/05/01
41140	P-303B	1 79 mg/L	0.05	06/26/01	07/05/01
41141	P-309A	0.826 mg/L	0.05	06/26/01	07/05/01
41142	P-309B	0.431 mg/L	0.05	06/26/01	07/05/01
41143	P-307A	0 191 mg/L	0.05	06/26/01	07/05/01
41144	P-307B	18.5 mg/L	0.05	06/26/01	07/05/01
41145	P-301A	0.718 mg/L	0.05	06/26/01	07/05/01
41146	P-301B	3 85 mg/L	0.05	06/26/01	07/05/01
41147	P-222A	0.524 mg/L	0.05	06/27/01	07/05/01
41148	P-310A	3.69 mg/L	0.05	06/27/01	07/05/01
41149	P-305A	1.93 mg/L	0.05	06/27/01	07/05/01
41150	PW-1	1 41 mg/L	0.05	06/27/01	07/05/01

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

TEST RESULTS

Test: Iron

Method: 3010A/7380/236 1

AALI Sample Number	Client Sample Identification	Iron Result	Detection Limit	Date Collected	Date Analyzed
41151	P-226A	1.09 mg/L	0.05	06/27/01	07/05/01
41152	P-227A	1.04 mg/L	0.05	06/27/01	07/05/01
41162	R-1	1.30 mg/L	0.05	06/25/01	07/05/01

Respectfully submitted,

L. Eve Karnitis

L. Eve Karnitis, President

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

July 12, 2001

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN. Takeshi Hirano

DATE COLLECTED: 06/25/01
DATE RECEIVED: 06/28/01
DATE REPORTED: 07/12/01

AALI ORDER ID: 9758
APPROVAL # : EPA Certification 4043
CLIENT PROJECT: 011-07000-090 Gue-70-14.10 Guernsey County
CLIENT PO NO.:

TEST RESULTS

Test: Hardness as $CaCO_3$

Method: 130.2

AALI Sample Number	Client Sample Identification	Hardness as CaCO3 Result	Detection Limit	Date Collected	Date Analyzed
41131	P-302A	100 mg/L	2	06/25/01	06/29/01
41132	P-302B	276 mg/L	2	06/25/01	06/29/01
41133	P-304A	220 mg/L	2	06/25/01	06/29/01
41134	P-304B	N.A. * mg/L	2	06/25/01	07/12/01
41135	P-308A	176 mg/L	2	06/25/01	06/29/01
41136	P-308B	352 mg/L	2	06/25/01	06/29/01
41137	P-306A	244 mg/L	2	06/26/01	06/29/01
41138	P-306B	188 mg/L	2	06/26/01	06/29/01
41139	P-303A	60 mg/L	2	06/26/01	06/29/01
41140	P-303B	212 mg/L	2	06/26/01	06/29/01
41141	P-309A	220 mg/L	2	06/26/01	06/29/01
41142	P-309B	220 mg/L	2	06/26/01	06/29/01
41143	P-307A	44 mg/L	2	06/26/01	06/29/01
41144	P-307B	280 mg/L	2	06/26/01	06/29/01
41145	P-301A	84 mg/L	2	06/26/01	06/29/01
41146	P-301B	156 mg/L	2	06/26/01	06/29/01
41147	P-222A	72 mg/L	2	06/27/01	06/29/01
41148	P-310A	142 mg/L	2	06/27/01	06/30/01
41149	P-305A	174 mg/L	2	06/27/01	06/30/01
41150	PW-1	216 mg/L	2	06/27/01	06/30/01

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

TEST RESULTS

Test: Hardness as CaCO3

Method: 130 2

AALI Sample Number	Client Sample Identification	Hardness as CaCO3 Result	Detection Limit	Date Collected	Date Analyzed
41151	P-226A	108 mg/L	2	06/27/01	06/30/01
41152	P-227A	128 mg/L	2	06/27/01	06/30/01
41162	R-1	212 mg/L	2	06/25/01	06/30/01

N.A. * Analysis result inconclusive due to sample matrix interference

Respectfully submitted,

L. Eve Karnitis

L. Eve Karnitis, President

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

July 10, 2001

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN. Takeshi Hirano

DATE COLLECTED: 06/25/01
DATE RECEIVED: 06/28/01
DATE REPORTED: 07/10/01

AALI ORDER ID: 9758
APPROVAL #: EPA Certification 4043
CLIENT PROJECT: 011-07000-090 Gue-70-14 10 Guernsey County
CLIENT PO NO.:

TEST RESULTS

Test: Alkalinity, Total as CaCO3

Method: 2320 B

AALI Sample Number	Client Sample Identification	Alkalinity, Total as CaCO3 Result	Detection Limit	Date Collected	Date Analyzed
41131	P-302A	320 mg/L	1	06/25/01	07/06/01
41132	P-302B	2700 mg/L	1	06/25/01	07/06/01
41133	P-304A	200 mg/L	1	06/25/01	07/09/01
41134	P-304B	1300 mg/L	1	06/25/01	07/09/01
41135	P-308A	250 mg/L	1	06/25/01	07/09/01
41136	P-308B	1140 mg/L	1	06/25/01	07/09/01
41137	P-306A	230 mg/L	1	06/26/01	07/09/01
41138	P-306B	210 mg/L	1	06/26/01	07/09/01
41139	P-303A	390 mg/L	1	06/26/01	07/09/01
41140	P-303B	600 mg/L	1	06/26/01	07/10/01
41141	P-309A	380 mg/L	1	06/26/01	07/09/01
41142	P-309B	310 mg/L	1	06/26/01	07/10/01
41143	P-307A	330 mg/L	1	06/26/01	07/09/01
41144	P-307B	340 mg/L	1	06/26/01	07/10/01
41145	P-301A	360 mg/L	1	06/26/01	07/09/01
41146	P-301B	<1.0 mg/L	1	06/26/01	07/09/01
41147	P-222A	360 mg/L	1	06/27/01	07/09/01
41148	P-310A	330 mg/L	1	06/27/01	07/10/01
41149	P-305A	250 mg/L	1	06/27/01	07/10/01
41150	PW-1	230 mg/L	1	06/27/01	07/10/01

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

TEST RESULTS

Test: Alkalinity, Total as CaCO3

Method: 2320 B

AALI Sample Number	Client Sample Identification	Alkalinity, Total as CaCO3 Result	Detection Limit	Date Collected	Date Analyzed
41151	P-226A	210 mg/L	1	06/27/01	07/10/01
41152	P-227A	470 mg/L	1	06/27/01	07/10/01
41162	R-1	220 mg/L	1	06/25/01	07/10/01

High levels of particulate matter (e.g., sediment) may cause elevated alkalinity levels.

Respectfully submitted,

L. Eve Karnitis

L. Eve Karnitis, President

ADVANCED ANALYTICS LABORATORIES, INC.

1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002

Analysis & Testing - Quality Control Programs - Research & Development

July 26, 2001

July Sampling Event

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

AALI ORDER ID: 9836
APPROVAL # : EPA Certification 4043
CLIENT PROJECT: 01107000.090
CLIENT PO NO.:

DATE COLLECTED: 07/25/01
DATE RECEIVED: 07/25/01
DATE REPORTED: 07/26/01

TEST RESULTS

Test: Sulfate

Method: 375.4

AALI Sample Number	Client Sample Identification	Sulfate Result	Detection Limit	Date Collected	Date Analyzed
41405	P227A	242.00 mg/L	1	07/25/01	07/26/01
41406	PW1	70.25 mg/L	1	07/25/01	07/26/01
41407	P302A	50.48 mg/L	1	07/25/01	07/26/01
41408	P304A	57.10 mg/L	1	07/25/01	07/26/01
41409	P306A	53.16 mg/L	1	07/25/01	07/26/01
41410	P222A	1.80 mg/L	1	07/25/01	07/26/01
41411	P305A	88.30 mg/L	1	07/25/01	07/26/01
41412	P301A	1.97 mg/L	1	07/25/01	07/26/01
41413	P226A	220.70 mg/L	1	07/25/01	07/26/01
41414	P303A	25.09 mg/L	1	07/25/01	07/26/01
41415	R-1	53.16 mg/L	1	07/25/01	07/26/01

Respectfully submitted,

L. Eve Karnitis

L Eve Karnitis, President

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ADVANCED ANALYTICS LABORATORIES, INC.

1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

July 27, 2001

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

DATE COLLECTED: 07/25/01
DATE RECEIVED: 07/25/01
DATE REPORTED: 07/27/01

AALI ORDER ID: 9836
APPROVAL #: EPA Certification 4043
CLIENT PROJECT: 01107000.090
CLIENT PO NO.:

TEST RESULTS

Test: Dissolved Solids

Method: 160.1

AALI Sample Number	Client Sample Identification	Dissolved Solids Result	Detection Limit	Date Collected	Date Analyzed
41405	P227A	781 mg/L	10	07/25/01	07/27/01
41406	PW1	263 mg/L	10	07/25/01	07/27/01
41407	P302A	313 mg/L	10	07/25/01	07/27/01
41408	P304A	275 mg/L	10	07/25/01	07/27/01
41409	P306A	263 mg/L	10	07/25/01	07/27/01
41410	P222A	325 mg/L	10	07/25/01	07/27/01
41411	P305A	281 mg/L	10	07/25/01	07/27/01
41412	P301A	238 mg/L	10	07/25/01	07/27/01
41413	P226A	784 mg/L	10	07/25/01	07/27/01
41414	P303A	416 mg/L	10	07/25/01	07/27/01
41415	R-1	294 mg/L	10	07/25/01	07/27/01

Respectfully submitted,

L. Eve Karnitis

L. Eve Karnitis, President

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ADVANCED ANALYTICS LABORATORIES, INC.

1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002

Analysis & Testing - Quality Control Programs - Research & Development

August 7, 2001

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

DATE COLLECTED: 7/25/01
DATE RECEIVED: 7/25/01
DATE REPORTED: 8/7/01

AALI ORDER ID: 9836
APPROVAL # : EPA Certification 4043
CLIENT PROJECT: 01107000.090
CLIENT PO NO.:

TEST RESULTS

Test: Calcium

Method: 3010A/7140/215.1

AALI Sample Number	Client Sample Identification	Calcium Result	Detection Limit	Date Collected	Date Analyzed
41405	P227A	58.0 mg/L	0.03	7/25/01	8/7/01
41406	PW1	119.2 mg/L	0.03	7/25/01	8/7/01
41407	P302A	42 4 mg/L	0.03	7/25/01	8/7/01
41408	P304A	102 7 mg/L	0.03	7/25/01	8/7/01
41409	P306A	93 mg/L	0 03	7/25/01	8/7/01
41410	P222A	27.7 mg/L	0.03	7/25/01	8/7/01
41411	P305A	90.3 mg/L	0.03	7/25/01	8/7/01
41412	P301A	31.1 mg/L	0.03	7/25/01	8/7/01
41413	P226A	38.8 mg/L	0.03	7/25/01	8/7/01
41414	P303A	10 2 mg/L	0.03	7/25/01	8/7/01
41415	R-1	99.0 mg/L	0 03	7/25/01	8/7/01

Respectfully submitted,

L. Eve Karnitis

L. Eve Karnitis, President

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ADVANCED ANALYTICS LABORATORIES, INC.

1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002

Analysis & Testing - Quality Control Programs - Research & Development

August 7, 2001

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

DATE COLLECTED: 7/25/01
DATE RECEIVED: 7/25/01
DATE REPORTED: 8/7/01

AALI ORDER ID: 9836
APPROVAL #: EPA Certification 4043
CLIENT PROJECT: 01107000.090
CLIENT PO NO.:

TEST RESULTS

Test: Iron

Method: 3010A/7380/236.1

AALI Sample Number	Client Sample Identification	Iron Result	Detection Limit	Date Collected	Date Analyzed
41405	P227A	0.806 mg/L	0.05	7/25/01	7/30/01
41406	PW1	0.827 mg/L	0.05	7/25/01	7/30/01
41407	P302A	0.098 mg/L	0.05	7/25/01	7/30/01
41408	P304A	0.532 mg/L	0.05	7/25/01	7/30/01
41409	P306A	0.581 mg/L	0.05	7/25/01	7/30/01
41410	P222A	<0 05 mg/L	0.05	7/25/01	7/30/01
41411	P305A	0 370 mg/L	0.05	7/25/01	7/30/01
41412	P301A	0.218 mg/L	0.05	7/25/01	7/30/01
41413	P226A	0.463 mg/L	0.05	7/25/01	7/30/01
41414	P303A	<0.05 mg/L	0.05	7/25/01	7/30/01
41415	R-1	0.535 mg/L	0 05	7/25/01	7/30/01

Respectfully submitted,

L. Eve Karnitis

L. Eve Karnitis, President

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002

Analysis & Testing - Quality Control Programs - Research & Development

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

July 27, 2001

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

DATE COLLECTED: 07/25/01
DATE RECEIVED: 07/25/01
DATE REPORTED: 07/27/01

AALI ORDER ID: 9836
APPROVAL # : EPA Certification 4043
CLIENT PROJECT: 01107000.090
CLIENT PO NO.:

TEST RESULTS

Test: Hardness as CaCO3
Method: 130.2

AALI Sample Number	Client Sample Identification	Hardness as CaCO3 Result	Detection Limit	Date Collected	Date Analyzed
41405	P227A	>1000 mg/L	2	07/25/01	07/27/01
41406	PW1	228 mg/L	2	07/25/01	07/27/01
41407	P302A	112 mg/L	2	07/25/01	07/27/01
41408	P304A	216 mg/L	2	07/25/01	07/27/01
41409	P306A	204 mg/L	2	07/25/01	07/27/01
41410	P222A	104 mg/L	2	07/25/01	07/27/01
41411	P305A	188 mg/L	2	07/25/01	07/27/01
41412	P301A	132 mg/L	2	07/25/01	07/27/01
41413	P226A	68 mg/L	2	07/25/01	07/27/01
41414	P303A	40 mg/L	2	07/25/01	07/27/01
41415	R-1	236 mg/L	2	07/25/01	07/27/01

Respectfully submitted,

L. Eve Karnitis

L. Eve Karnitis, President

ADVANCED ANALYTICS LABORATORIES, INC.

1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002

Analysis & Testing - Quality Control Programs - Research & Development

July 27, 2001

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

DATE COLLECTED: 07/25/01
DATE RECEIVED: 07/25/01
DATE REPORTED: 07/27/01

AALI ORDER ID: 9836
APPROVAL #: EPA Certification 4043
CLIENT PROJECT: 01107000.090
CLIENT PO NO.:

TEST RESULTS

Test: Alkalinity, Total as CaCO3

Method: 2320 B

AALI Sample Number	Client Sample Identification	Alkalinity, Total as CaCO3 Result	Detection Limit	Date Collected	Date Analyzed
41405	P227A	405 mg/L	1	07/25/01	07/27/01
41406	PW1	195 mg/L	1	07/25/01	07/27/01
41407	P302A	260 mg/L	1	07/25/01	07/27/01
41408	P304A	220 mg/L	1	07/25/01	07/27/01
41409	P306A	200 mg/L	1	07/25/01	07/27/01
41410	P222A	310 mg/L	1	07/25/01	07/27/01
41411	P305A	210 mg/L	1	07/25/01	07/27/01
41412	P301A	310 mg/L	1	07/25/01	07/27/01
41413	P226A	430 mg/L	1	07/25/01	07/27/01
41414	P303A	350 mg/L	1	07/25/01	07/27/01
41415	R-1	200 mg/L	1	07/25/01	07/27/01

Respectfully submitted,

L. Eve Karnitis

L. Eve Karnitis, President

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

August 30, 2001

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

Data Entered for August monitoring Event

AALI ORDER ID: 9912
APPROVAL # : EPA Certification 4043
CLIENT PROJECT: 01107000.090
CLIENT PO NO.:

DATE COLLECTED: 8/20/01
DATE RECEIVED: 8/21/01
DATE REPORTED: 8/30/01

TEST RESULTS

Test: Sulfate
Method: 375.4

AALI Sample Number	Client Sample Identification	Sulfate Result	Detection Limit	Date Collected	Date Analyzed
41615	P-226A	256 mg/L	1	8/20/01	8/22/01
41616	P-227A	245 mg/L	1	8/20/01	8/22/01
41617	P-305A	88.8 mg/L	1	8/20/01	8/22/01
41618	P-303A	41.4 mg/L	1	8/20/01	8/22/01
41619	P-302A	54.3 mg/L	1	8/21/01	8/22/01
41620	P-304A	36.5 mg/L	1	8/21/01	8/22/01
41621	P-306A	47.0 mg/L	1	8/21/01	8/22/01
41622	P-222A	4.73 mg/L	1	8/21/01	8/22/01
41623	PW-1	53.1 mg/L	1	8/21/01	8/29/01
41624	P-301A	16.1 mg/L	1	8/21/01	8/22/01
41625	R-1	51.0 mg/L	1	8/21/01	8/22/01

Respectfully submitted,
L. Eve Karnitis

L. Eve Karnitis, President

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

August 30, 2001

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

DATE COLLECTED: 8/20/01
DATE RECEIVED: 8/21/01
DATE REPORTED: 8/30/01

AALI ORDER ID: 9912
APPROVAL #: EPA Certification 4043
CLIENT PROJECT: 01107000.090
CLIENT PO NO.:

TEST RESULTS

Test: Dissolved Solids

Method: 160.1

AALI Sample Number	Client Sample Identification	Dissolved Solids Result	Detection Limit	Date Collected	Date Analyzed
41615	P-226A	897 mg/L	10	8/20/01	8/29/01
41616	P-227A	877 mg/L	10	8/20/01	8/29/01
41617	P-305A	483 mg/L	10	8/20/01	8/29/01
41618	P-303A	610 mg/L	10	8/20/01	8/29/01
41619	P-302A	560 mg/L	10	8/21/01	8/29/01
41620	P-304A	407 mg/L	10	8/21/01	8/29/01
41621	P-306A	480 mg/L	10	8/21/01	8/29/01
41622	P-222A	533 mg/L	10	8/21/01	8/29/01
41623	PW-1	407 mg/L	10	8/21/01	8/29/01
41624	P-301A	420 mg/L	10	8/21/01	8/29/01
41625	R-1	274 mg/L	10	8/21/01	8/29/01

Respectfully submitted,

L. Eve Karnitis

L. Eve Karnitis, President

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ADVANCED ANALYTICS LABORATORIES, INC.

1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002

Analysis & Testing - Quality Control Programs - Research & Development

August 30, 2001

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

DATE COLLECTED: 8/20/01
DATE RECEIVED: 8/21/01
DATE REPORTED: 8/30/01

AALI ORDER ID: 9912
APPROVAL #: EPA Certification 4043
CLIENT PROJECT: 01107000.090
CLIENT PO NO.:

TEST RESULTS

Test: Hardness as $CaCO_3$

Method: 130.2

AALI Sample Number	Client Sample Identification	Hardness as CaCO3 Result	Detection Limit	Date Collected	Date Analyzed
41615	P-226A	124. mg/L	2	8/20/01	8/28/01
41616	P-227A	136. mg/L	2	8/20/01	8/28/01
41617	P-305A	244. mg/L	2	8/20/01	8/28/01
41618	P-303A	56. mg/L	2	8/20/01	8/28/01
41619	P-302A	116. mg/L	2	8/21/01	8/28/01
41620	P-304A	224. mg/L	2	8/21/01	8/28/01
41621	P-306A	220. mg/L	2	8/21/01	8/28/01
41622	P-222A	88. mg/L	2	8/21/01	8/28/01
41623	PW-1	260. mg/L	2	8/21/01	8/28/01
41624	P-301A	120. mg/L	2	8/21/01	8/28/01
41625	R-1	224. mg/L	2	8/21/01	8/28/01

Respectfully submitted,

L. Eve Karnitis

L. Eve Karnitis, President

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ADVANCED ANALYTICS LABORATORIES, INC.

1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

September 18, 2001

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

DATE COLLECTED: 8/20/01
DATE RECEIVED: 8/21/01
DATE REPORTED: 9/18/01

AALI ORDER ID: 9912
APPROVAL #: EPA Certification 4043
CLIENT PROJECT: 01107000.090
CLIENT PO NO.:

TEST RESULTS

Test: Iron

Method: 3010A/7380/236 1

AALI Sample Number	Client Sample Identification	Iron Result	Detection Limit	Date Collected	Date Analyzed
41615	P-226A	0.426 mg/L	0.05	8/20/01	8/30/01
41616	P-227A	0.151 mg/L	0.05	8/20/01	8/30/01
41617	P-305A	1.33 mg/L	0.05	8/20/01	8/30/01
41618	P-303A	<0.05 mg/L	0.05	8/20/01	8/30/01
41619	P-302A	<0.05 mg/L	0.05	8/21/01	8/30/01
41620	P-304A	0.356 mg/L	0.05	8/21/01	8/30/01
41621	P-306A	0 541 mg/L	0.05	8/21/01	8/30/01
41622	P-222A	0.226 mg/L	0.05	8/21/01	8/30/01
41623	PW-1	0.667 mg/L	0.05	8/21/01	8/30/01
41624	P-301A	0.241 mg/L	0.05	8/21/01	8/30/01
41625	R-1	0.528 mg/L	0.05	8/21/01	8/30/01

Respectfully submitted.

L. Eve Kamitis

L. Eve Kamitis, President

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

September 17, 2001

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

DATE COLLECTED: 8/20/01
DATE RECEIVED: 8/21/01
DATE REPORTED: 9/17/01

AALI ORDER ID: 9912
APPROVAL # : EPA Certification 4043
CLIENT PROJECT: 01107000.090
CLIENT PO NO.:

TEST RESULTS

Test: Calcium

Method: 3010A/7140/215.1

AALI Sample Number	Client Sample Identification	Calcium Result	Detection Limit	Date Collected	Date Analyzed
41615	P-226A	50.2 mg/L	0.03	8/20/01	9/14/01
41616	P-227A	71.0 mg/L	0.03	8/20/01	9/14/01
41617	P-305A	105 1 mg/L	0.03	8/20/01	9/14/01
41618	P-303A	14.6 mg/L	0.03	8/20/01	9/14/01
41619	P-302A	54 1 mg/L	0.03	8/21/01	9/14/01
41620	P-304A	111.1 mg/L	0.03	8/21/01	9/14/01
41621	P-306A	124.5 mg/L	0.03	8/21/01	9/14/01
41622	P-222A	39.2 mg/L	0 03	8/21/01	9/14/01
41623	PW-1	120.6 mg/L	0.03	8/21/01	9/14/01
41624	P-301A	40 1 mg/L	0.03	8/21/01	9/14/01
41625	R-1	119.3 mg/L	0.03	8/21/01	9/14/01

Respectfully submitted,

L. Eve Karnitis

L. Eve Karnitis, President

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

August 31, 2001

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

DATE COLLECTED: 8/20/01
DATE RECEIVED: 8/21/01
DATE REPORTED: 8/31/01

AALI ORDER ID: 9912
APPROVAL # : EPA Certification 4043
CLIENT PROJECT: 01107000.090
CLIENT PO NO.:

TEST RESULTS

Test: Alkalinity, Total as CaCO3

Method: 2320 B

AALI Sample Number	Client Sample Identification	Alkalinity, Total as CaCO3 Result	Detection Limit	Date Collected	Date Analyzed
41615	P-226A	480 mg/L	1	8/20/01	8/29/01
41616	P-227A	450 mg/L	1	8/20/01	8/29/01
41617	P-305A	270 mg/L	1	8/20/01	8/29/01
41618	P-303A	380 mg/L	1	8/20/01	8/29/01
41619	P-302A	300 mg/L	1	8/21/01	8/29/01
41620	P-304A	260 mg/L	1	8/21/01	8/29/01
41621	P-306A	240 mg/L	1	8/21/01	8/29/01
41622	P-222A	360 mg/L	1	8/21/01	8/29/01
41623	PW-1	220 mg/L	1	8/21/01	8/29/01
41624	P-301A	350 mg/L	1	8/21/01	8/29/01
41625	R-1	200 mg/L	1	8/21/01	8/29/01

Respectfully submitted,

L. Eve Karnitis

L. Eve Karnitis, President

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

October 2, 2001

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

Sept. Sampling Event

AALI ORDER ID: 10029
APPROVAL #: EPA Certification 4043
CLIENT PROJECT: 01107000.090
CLIENT PO NO.:

DATE COLLECTED: 9/25/01
DATE RECEIVED: 9/27/01
DATE REPORTED: 10/2/01

TEST RESULTS

Test: Sulfate
Method: 375.4

AALI Sample Number	Client Sample Identification	Sulfate Result	Detection Limit	Date Collected	Date Analyzed
41974	P-226A	227 mg/L	5	9/25/01	10/1/01
41975	P-227A	205 mg/L	5	9/25/01	10/1/01
41976	P-W-1	54 0 mg/L	1	9/26/01	10/1/01
41977	P-222A	3.74 mg/L	1	9/26/01	10/1/01
41978	P-305A	104 mg/L	5	9/26/01	10/1/01
41979	P-303A	34.5 mg/L	1	9/26/01	10/1/01
41980	P-301A	5.60 mg/L	1	9/26/01	10/1/01
41981	P-302A	39.2 mg/L	1	9/27/01	10/1/01
41982	P-304A	49.5 mg/L	1	9/27/01	10/1/01
41983	P-306A	46.2 mg/L	1	9/27/01	10/1/01
41984	R-1	48.3 mg/L	1	9/27/01	10/1/01

Respectfully submitted,

L. Eve Karnitis

L Eve Karnitis, President

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

October 2, 2001

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

AALI ORDER ID: 10029
APPROVAL # : EPA Certification 4043
CLIENT PROJECT: 01107000.090
CLIENT PO NO.:

DATE COLLECTED: 9/25/01
DATE RECEIVED: 9/27/01
DATE REPORTED: 10/2/01

TEST RESULTS

Test: Dissolved Solids

Method: 160.1

AALI Sample Number	Client Sample Identification	Dissolved Solids Result	Detection Limit	Date Collected	Date Analyzed
41974	P-226A	837 mg/L	10	9/25/01	10/2/01
41975	P-227A	927 mg/L	10	9/25/01	10/2/01
41976	P-W-1	380 mg/L	10	9/26/01	10/2/01
41977	P-222A	447 mg/L	10	9/26/01	10/2/01
41978	P-305A	497 mg/L	10	9/26/01	10/2/01
41979	P-303A	747 mg/L	10	9/26/01	10/2/01
41980	P-301A	527 mg/L	10	9/26/01	10/2/01
41981	P-302A	427 mg/L	10	9/27/01	10/2/01
41982	P-304A	350 mg/L	10	9/27/01	10/2/01
41983	P-306A	373 mg/L	10	9/27/01	10/2/01
41984	R-1	507 mg/L	10	9/27/01	10/2/01

Respectfully submitted,

L. Eve Karnitis

L. Eve Karnitis, President

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

October 2, 2001

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

DATE COLLECTED: 9/25/01
DATE RECEIVED: 9/27/01
DATE REPORTED: 10/2/01

AALI ORDER ID: 10029
APPROVAL # : EPA Certification 4043
CLIENT PROJECT: 01107000.090
CLIENT PO NO.:

TEST RESULTS

Test: Hardness as $CaCO_3$

Method: 130.2

AALI Sample Number	Client Sample Identification	Hardness as $CaCO_3$ Result	Detection Limit	Date Collected	Date Analyzed
41974	P-226A	114 mg/L	2	9/25/01	10/1/01
41975	P-227A	138 mg/L	2	9/25/01	10/1/01
41976	P-W-1	234 mg/L	2	9/26/01	10/1/01
41977	P-222A	106 mg/L	2	9/26/01	10/1/01
41978	P-305A	238 mg/L	2	9/26/01	10/1/01
41979	P-303A	46 mg/L	2	9/26/01	10/1/01
41980	P-301A	520 mg/L	2	9/26/01	10/1/01
41981	P-302A	128 mg/L	2	9/27/01	10/1/01
41982	P-304A	234 mg/L	2	9/27/01	10/1/01
41983	P-306A	230 mg/L	2	9/27/01	10/1/01
41984	R-1	230 mg/L	2	9/27/01	10/1/01

Respectfully submitted,

L. Eve Karnitis

L. Eve Karnitis, President

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

October 2, 2001

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

DATE COLLECTED: 9/25/01
DATE RECEIVED: 9/27/01
DATE REPORTED: 10/2/01

AALI ORDER ID: 10029
APPROVAL # : EPA Certification 4043
CLIENT PROJECT: 01107000.090
CLIENT PO NO.:

TEST RESULTS

Test: Alkalinity, Total as CaCO3

Method: 2320 B

AALI Sample Number	Client Sample Identification	Alkalinity, Total as CaCO3 Result	Detection Limit	Date Collected	Date Analyzed
41974	P-226A	540 mg/L	1	9/25/01	10/1/01
41975	P-227A	485 mg/L	1	9/25/01	10/1/01
41976	P-W-1	245 mg/L	1	9/26/01	10/1/01
41977	P-222A	380 mg/L	1	9/26/01	10/1/01
41978	P-305A	285 mg/L	1	9/26/01	10/1/01
41979	P-303A	910 mg/L	1	9/26/01	10/1/01
41980	P-301A	390 mg/L	1	9/26/01	10/1/01
41981	P-302A	330 mg/L	1	9/27/01	10/1/01
41982	P-304A	250 mg/L	1	9/27/01	10/1/01
41983	P-306A	250 mg/L	1	9/27/01	10/1/01
41984	R-1	250 mg/L	1	9/27/01	10/1/01

Respectfully submitted,

L. Eve Karnitis

L. Eve Karnitis, President

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

October 9, 2001

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

DATE COLLECTED: 9/25/01
DATE RECEIVED: 9/27/01
DATE REPORTED: 10/9/01

AALI ORDER ID: 10029
APPROVAL # : EPA Certification 4043
CLIENT PROJECT: 01107000.090
CLIENT PO NO.:

TEST RESULTS

Test: Calcium

Method: 3010A/7140/215.1

AALI Sample Number	Client Sample Identification	Calcium Result	Detection Limit	Date Collected	Date Analyzed
41974	P-226A	37.6 mg/L	0.03	9/25/01	10/8/01
41975	P-227A	44.9 mg/L	0.03	9/25/01	10/8/01
41976	P-W-1	85.7 mg/L	0.03	9/26/01	10/8/01
41977	P-222A	27.3 mg/L	0.03	9/26/01	10/8/01
41978	P-305A	79.4 mg/L	0.03	9/26/01	10/8/01
41979	P-303A	19.7 mg/L	0.03	9/26/01	10/8/01
41980	P-301A	29.2 mg/L	0.03	9/26/01	10/8/01
41981	P-302A	37.4 mg/L	0 03	9/27/01	10/8/01
41982	P-304A	74.4 mg/L	0.03	9/27/01	10/8/01
41983	P-306A	74.4 mg/L	0.03	9/27/01	10/8/01
41984	R-1	75.6 mg/L	0.03	9/27/01	10/8/01

Respectfully submitted,

L. Eve Karnitis

L. Eve Karnitis, President

ADVANCED ANALYTICS LABORATORIES, INC.

1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

October 9, 2001

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

DATE COLLECTED: 9/25/01
DATE RECEIVED: 9/27/01
DATE REPORTED: 10/9/01

AALI ORDER ID: 10029
APPROVAL # : EPA Certification 4043
CLIENT PROJECT: 01107000.090
CLIENT PO NO.:

TEST RESULTS

Test: Iron
Method: 3010A/7380/236.1

AALI Sample Number	Client Sample Identification	Iron Result	Detection Limit	Date Collected	Date Analyzed
41974	P-226A	0.214 mg/L	0.05	9/25/01	10/3/01
41975	P-227A	0.058 mg/L	0.05	9/25/01	10/3/01
41976	P-W-1	0.532 mg/L	0.05	9/26/01	10/3/01
41977	P-222A	<0.05 mg/L	0.05	9/26/01	10/3/01
41978	P-305A	1.481 mg/L	0.05	9/26/01	10/3/01
41979	P-303A	<0.05 mg/L	0.05	9/26/01	10/3/01
41980	P-301A	0.353 mg/L	0.05	9/26/01	10/3/01
41981	P-302A	<0.05 mg/L	0.05	9/27/01	10/3/01
41982	P-304A	0.121 mg/L	0.05	9/27/01	10/3/01
41983	P-306A	0.674 mg/L	0.05	9/27/01	10/3/01
41984	R-1	0.208 mg/L	0.05	9/27/01	10/3/01

Respectfully submitted,

L. Eve Karnitis

L. Eve Karnitis, President

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

October 30, 2001

Oct Sampling Event

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

DATE COLLECTED: 10/22/01
DATE RECEIVED: 10/24/01
DATE REPORTED: 10/30/01

AALI ORDER ID: 10120
APPROVAL # : EPA Certification 4043
CLIENT PROJECT: 011-07000-090 Gue-70-14.10 Guernsey Count
CLIENT PO NO.:

TEST RESULTS

Test: Dissolved Solids

Method: 160.1

AALI Sample Number	Client Sample Identification	Dissolved Solids Result	Detection Limit	Date Collected	Date Analyzed
42271	P-227A	640 mg/L	10	10/22/01	10/30/01
42272	P-226A	743 mg/L	10	10/22/01	10/30/01
42273	PW-1	60 mg/L	10	10/22/01	10/30/01
42274	P-222A	423 mg/L	10	10/23/01	10/30/01
42275	P-305A	403 mg/L	10	10/23/01	10/30/01
42276	P-303A	< 10 mg/L	10	10/23/01	10/30/01
42277	P-301A	< 10 mg/L	10	10/23/01	10/30/01
42278	P-302A	383 mg/L	10	10/24/01	10/30/01
42279	P-304A	127 mg/L	10	10/24/01	10/30/01
42280	P-306A	< 10 mg/L	10	10/24/01	10/30/01
42281	R-1	307 mg/L	10	10/24/01	10/30/01

Respectfully submitted,

L. Eve Karnitis

L. Eve Karnitis, President

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002

Analysis & Testing - Quality Control Programs - Research & Development

October 30, 2001

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

DATE COLLECTED: 10/22/01
DATE RECEIVED: 10/24/01
DATE REPORTED: 10/30/01

AALI ORDER ID: 10120
APPROVAL # : EPA Certification 4043
CLIENT PROJECT: 011-07000-090 Gue-70-14.10 Guernsey Count
CLIENT PO NO.:

TEST RESULTS

Test: Calcium
Method: 3010A/7140/215.1

AALI Sample Number	Client Sample Identification	Calcium Result	Detection Limit	Date Collected	Date Analyzed
42271	P-227A	47.0 mg/L	0.03	10/22/01	10/29/01
42272	P-226A	36.2 mg/L	0.03	10/22/01	10/29/01
42273	PW-1	78 0 mg/L	0.03	10/22/01	10/29/01
42274	P-222A	30.0 mg/L	0.03	10/23/01	10/29/01
42275	P-305A	72.2 mg/L	0.03	10/23/01	10/29/01
42276	P-303A	10.7 mg/L	0.03	10/23/01	10/29/01
42277	P-301A	30.5 mg/L	0.03	10/23/01	10/29/01
42278	P-302A	36.6 mg/L	0.03	10/24/01	10/29/01
42279	P-304A	75.9 mg/L	0.03	10/24/01	10/29/01
42280	P-306A	72.9 mg/L	0.03	10/24/01	10/29/01
42281	R-1	29.8 mg/L	0.03	10/24/01	10/29/01

Respectfully submitted,

L. Eve Karnitis

L. Eve Karnitis, President

Page 1 of 1

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

November 5, 2001

Oct Sampling Event

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

DATE COLLECTED: 10/22/01
DATE RECEIVED: 10/24/01
DATE REPORTED: 11/5/01

AALI ORDER ID: 10120
APPROVAL # : EPA Certification 4043
CLIENT PROJECT: 011-07000-090 Gue-70-14.10 Guernsey Count
CLIENT PO NO.:

TEST RESULTS

Test: Sulfate
Method: 375.4

AALI Sample Number	Client Sample Identification	Sulfate Result	Detection Limit	Date Collected	Date Analyzed
42271	P-227A	222 mg/L	5	10/22/01	10/24/01
42272	P-226A	272 mg/L	5	10/22/01	10/26/01
42273	PW-1	52 mg/L	1	10/22/01	10/26/01
42274	P-222A	2.68 mg/L	1	10/23/01	10/24/01
42275	P-305A	110 mg/L	5	10/23/01	10/26/01
42276	P-303A	30.0 mg/L	1	10/23/01	10/26/01
42277	P-301A	6.18 mg/L	1	10/23/01	10/24/01
42278	P-302A	48.0 mg/L	1	10/24/01	10/24/01
42279	P-304A	54.2 mg/L	1	10/24/01	10/26/01
42280	P-306A	52.6 mg/L	1	10/24/01	10/26/01
42281	R-1	6.12 mg/L	1	10/24/01	10/24/01

Respectfully submitted,

L. Eve Karnitis

L. Eve Karnitis, President

Page 1 of 1

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002

Analysis & Testing - Quality Control Programs - Research & Development

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

October 30, 2001

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

DATE COLLECTED: 10/22/01
DATE RECEIVED: 10/24/01
DATE REPORTED: 10/30/01

AALI ORDER ID: 10120
APPROVAL # : EPA Certification 4043
CLIENT PROJECT: 011-07000-090 Gue-70-14.10 Guernsey Count
CLIENT PO NO.:

TEST RESULTS

Test: Iron

Method: 3010A/7380/236.1

AALI Sample Number	Client Sample Identification	Iron Result	Detection Limit	Date Collected	Date Analyzed
42271	P-227A	0.109 mg/L	0.05	10/22/01	10/30/01
42272	P-226A	<0.05 mg/L	0.05	10/22/01	10/30/01
42273	PW-1	0.259 mg/L	0.05	10/22/01	10/30/01
42274	P-222A	<0.05 mg/L	0.05	10/23/01	10/30/01
42275	P-305A	1.337 mg/L	0.05	10/23/01	10/30/01
42276	P-303A	<0.05 mg/L	0.05	10/23/01	10/30/01
42277	P-301A	0.189 mg/L	0.05	10/23/01	10/30/01
42278	P-302A	<0.05 mg/L	0.05	10/24/01	10/30/01
42279	P-304A	<0.05 mg/L	0.05	10/24/01	10/30/01
42280	P-306A	0.630 mg/L	0.05	10/24/01	10/30/01
42281	R-1	<0.05 mg/L	0.05	10/24/01	10/30/01

Respectfully submitted,

L. Eve Kamitis

L. Eve Kamitis, President

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

October 30, 2001

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

AALI ORDER ID: 10120
APPROVAL # : EPA Certification 4043
CLIENT PROJECT: 011-07000-090 Gue-70-14.10 Guernsey Count
CLIENT PO NO.:

DATE COLLECTED: 10/22/01
DATE RECEIVED: 10/24/01
DATE REPORTED: 10/30/01

TEST RESULTS

Test: Hardness as CaCO3
Method: 130.2

AALI Sample Number	Client Sample Identification	Hardness as CaCO3 Result	Detection Limit	Date Collected	Date Analyzed
42271	P-227A	152 mg/L	2	10/22/01	10/25/01
42272	P-226A	104 mg/L	2	10/22/01	10/25/01
42273	PW-1	232 mg/L	2	10/22/01	10/25/01
42274	P-222A	116 mg/L	2	10/23/01	10/25/01
42275	P-305A	224 mg/L	2	10/23/01	10/25/01
42276	P-303A	48 mg/L	2	10/23/01	10/25/01
42277	P-301A	96 mg/L	2	10/23/01	10/25/01
42278	P-302A	116 mg/L	2	10/24/01	10/25/01
42279	P-304A	216 mg/L	2	10/24/01	10/25/01
42280	P-306A	220 mg/L	2	10/24/01	10/25/01
42281	R-1	104 mg/L	2	10/24/01	10/25/01

Respectfully submitted,

L. Eve Karnitis

L. Eve Karnitis, President

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002

Analysis & Testing - Quality Control Programs - Research & Development

October 30, 2001

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

DATE COLLECTED: 10/22/01
DATE RECEIVED: 10/24/01
DATE REPORTED: 10/30/01

AALI ORDER ID: 10120
APPROVAL # : EPA Certification 4043
CLIENT PROJECT: 011-07000-090 Gue-70-14 10 Guernsey Count
CLIENT PO NO.:

TEST RESULTS

Test: Alkalinity, Total as CaCO3

Method: 2320 B

AALI Sample Number	Client Sample Identification	Alkalinity, Total as CaCO3 Result	Detection Limit	Date Collected	Date Analyzed
42271	P-227A	470 mg/L	1	10/22/01	10/24/01
42272	P-226A	540 mg/L	1	10/22/01	10/24/01
42273	PW-1	250 mg/L	1	10/22/01	10/24/01
42274	P-222A	375 mg/L	1	10/23/01	10/24/01
42275	P-305A	270 mg/L	1	10/23/01	10/24/01
42276	P-303A	425 mg/L	1	10/23/01	10/24/01
42277	P-301A	385 mg/L	1	10/23/01	10/24/01
42278	P-302A	325 mg/L	1	10/24/01	10/24/01
42279	P-304A	250 mg/L	1	10/24/01	10/24/01
42280	P-306A	250 mg/L	1	10/24/01	10/24/01
42281	R-1	380 mg/L	1	10/24/01	10/24/01

Respectfully submitted,

L. Eve Karnitis

L. Eve Karnitis, President

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ADVANCED ANALYTICS LABORATORIES, INC.

1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

June 5, 2002

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

AALI ORDER ID: 10768
APPROVAL # : EPA Certification 4043
CLIENT PROJECT: 01107000.090
CLIENT PO NO.:

DATE COLLECTED: 5/30/02
DATE RECEIVED: 5/31/02
DATE REPORTED: 6/5/02

TEST RESULTS

AALI Sample No.: 44041 **Client Sample ID:** P-311B

Compound	Result	Test Method:	Detection Limit	Analysis Date
Alkalinity, Total as CaCO3	250 mg/L	2320 B	1	6/3/02
Hardness as CaCO3	100 mg/L	130.2	2	6/3/02
Dissolved Solids	307 mg/L	160.1	10	6/4/02
Sulfate	49.19 mg/L	375 4	10	6/4/02

Respectfully submitted,

L Eve Karnitis

L Eve Karnitis, President

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

June 18, 2002

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

AALI ORDER ID: 10768
APPROVAL # : EPA Certification 4043
CLIENT PROJECT: 01107000.090
CLIENT PO NO.:

DATE COLLECTED: 5/30/02
DATE RECEIVED: 5/31/02
DATE REPORTED: 6/18/02

TEST RESULTS

AALI Sample No.: 44041 Client Sample ID: P-311B

Compound	Result	Test Method:	Detection Limit	Analysis Date
Calcium	35.2 mg/L	3010A/7140/215.1	0.21	6/18/02
Iron	1 26 mg/L	3010A/7380/236.1	0.025	6/10/02

Respectfully submitted,

L Eve Karnitis

L Eve Karnitis. President

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

June 5, 2002

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

AALI ORDER ID: 10768
APPROVAL # : EPA Certification 4043
CLIENT PROJECT: 01107000 090
CLIENT PO NO.:

DATE COLLECTED: 5/30/02
DATE RECEIVED: 5/31/02
DATE REPORTED: 6/5/02

TEST RESULTS

AALI Sample No.: 44042 **Client Sample ID:** P-311C

Compound	Result	Test Method:	Detection Limit	Analysis Date
Alkalinity, Total as CaCO3	290 mg/L	2320 B	1	6/3/02
Hardness as CaCO3	496 mg/L	130 2	2	6/3/02
Dissolved Solids	703 mg/L	160.1	10	6/4/02
Sulfate	42.63 mg/L	375.4	10	6/4/02

Respectfully submitted,

L. Eve Karnitis

L. Eve Karnitis, President

Page 1 of 1

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

June 18, 2002

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Takeshi Hirano

AALI ORDER ID: 10768
APPROVAL # : EPA Certification 4043
CLIENT PROJECT: 01107000.090
CLIENT PO NO.:

DATE COLLECTED: 5/30/02
DATE RECEIVED: 5/31/02
DATE REPORTED: 6/18/02

TEST RESULTS

AALI Sample No.: 44042 **Client Sample ID:** P-311C

Compound	Result	Test Method:	Detection Limit	Analysis Date
Calcium	64.1 mg/L	3010A/7140/215.1	0.21	6/18/02
Iron	15.5 mg/L	3010A/7380/236.1	0.25	6/10/02

Respectfully submitted,

L. Eve Karnitis

L. Eve Karnitis, President

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ADVANCED ANALYTICS LABORATORIES, INC.

1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

September 21, 2000

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Chris Hall

AALI ORDER ID: 8843
APPROVAL # : EPA Certification 4043
CLIENT PROJECT: 70000.030 Guernsev Co. I70
CLIENT PO NO.:

DATE COLLECTED: 8/25/2000
DATE RECEIVED: 8/25/2000
DATE REPORTED: 9/21/2000

TEST RESULTS

AALI Sample No.: 38374 **Client Sample ID:** P-224 A Grout Dissolution Control

Compound	Result		Test Method:	Detection Limit	Analysis Date
Alkalinity, Total as CaC	205	mg/L	2320 B	1	8/31/20
Calcium	70.0	mg/L	3010A/7140/215.1	0.5	8/29/20
Conductivity	606	uohms/	120.1	20	8/28/20
Iron	0.57	mg/L	3010A/7380/236.1	0.02	8/29/20
Hardness as CaCO3	236	mg/L	130.2	0.1	9/1/200
pH	7.33	S.U.	150.1	0.1	8/28/20
Dissolved Solids	392	mg/L	160.1	10	8/31/20
Sulfate	59 9	mg/L	375.4	2	8/31/20

8-31-01

Comment: Initial 5 gallon water sample.

Respectfully submitted.

L. Eve Karnutis

L. Eve Karnutis, President

ADVANCED ANALYTICS LABORATORIES, INC.

1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

September 14, 2000

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Chris Hall

AALI ORDER ID: 8872
APPROVAL # : EPA Certification 4043
CLIENT PROJECT: 7000.03
CLIENT PO NO.:

DATE COLLECTED: 09/06/00
DATE RECEIVED: 09/06/00
DATE REPORTED: 09/14/00

TEST RESULTS

AALI Sample No.: 38460 **Client Sample ID:** P-224A Grout Dissolution Control

Compound	Result		Test Method:	Detection Limit	Analysis Date
Alkalinity, Total as CaC	205	mg/L	2320 B	1	09/13/00
Conductivity	614	uohms/	120.1	2	09/13/00
Hardness as CaCO3	222	mg/L	130.2	0.1	09/13/00
pH	7.76	S.U.	150.1	0 1	09/13/00
Dissolved Solids	432	mg/L	160 1	10	09/13/00
Sulfate	73.2	mg/L	375.4	1	09/13/00

Respectfully submitted,

L. Eve Karnitis

L. Eve Karnitis, President

ADVANCED ANALYTICS LABORATORIES, INC.

1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

September 21, 2000

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Chris Hall

AALI ORDER ID:	8872	**DATE COLLECTED:**	9/6/00
APPROVAL #:	EPA Certification 4043	**DATE RECEIVED:**	9/6/00
CLIENT PROJECT:	7000.03	**DATE ANALYZED:**	9/20/00
CLIENT PO NO.:		**DATE REPORTED:**	9/21/00

TEST RESULTS

AALI Sample No.: 38460 - Composite Water **Client Sample ID:** P-224A [illegible]

Compound	Result	Test Mehtod	Detection Limit
Alkalinity, Total as CaCO3	215 mg/L	2320B	1
Conductivity	645 uohms/	120.1	2
Hardness as CaCO3	228 mg/L	130.2	0.1
pH	7.80 S.U.	150.1	0.1
Dissolved Solids	423 mg/L	160.1	10
Sulfate	30.60 mg/L	375.4	1

Comment: This is the second analysis of the composite water. No Calcium or Iron analysis.

Respectfully submitted,

L. Eve Karnitis

L. Eve Karnitis, President

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002

Analysis & Testing - Quality Control Programs - Research & Development

October 20, 2000

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Chris Hall

AALI ORDER ID: 8872		**DATE COLLECTED:**	9/6/00
APPROVAL #: EPA Certification 4043		**DATE RECEIVED:**	9/6/00
CLIENT PROJECT: 7000.03		**DATE ANALYZED:**	10/20/00
CLIENT PO NO.:		**DATE REPORTED:**	10/20/00

TEST RESULTS

[illegible]

AALI Sample No.: 38460 **Client Sample ID:** P-224A

Compound	**Result**	**Test Mehtod**	**Detection Limit**
Alkalinity, Total as CaCO3	170 mg/L	2320B	1
Conductivity	554 uohms/	120.1	2
Hardness as CaCO3	194 mg/L	130.2	0.1
pH	7.80 S.U.	150.1	0.1
Dissolved Solids	460 mg/L	160.1	10
Sulfate	57.8 mg/L	375.4	1
Calcium	71.0 mg/L	3010A/7140/215.1	0.1
Iron	1.69 mg/L	3010A/7380/236.1	0.02

10-20-00

Comment: This is the analysis of the composite water after 1 month.

Respectfully submitted.

L. Eve Karnitis

L. Eve Karnitis, President

ADVANCED ANALYTICS LABORATORIES, INC.

1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

January 14, 2001

RECEIVED
JAN 16 2002
BBC & M

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Chris Hall

AALI ORDER ID: 8872
APPROVAL #: EPA Certification 4043
CLIENT PROJECT : 7000.03
CLIENT PO NO.:

DATE COLLECTED: 09/06/00
DATE RECEIVED: 09/06/00
DATE REPORTED: 07/09/01

TEST RESULTS

[illegible]

AALI Sample No.: 38460-Composite Water
Client Sample ID: P-224-A

Compound	Result	Test Method	Detection Limit	Analysis Date
Alkalinity, Total as $CaCO_3$	130 mg/L	2320B	1	06/15/01
Conductivity	295 umhos/cm	120.1	2	05/02/01
Hardness as $CaCO_3$	122 mg/L	130.2	0.1	06/03/01
pH	8.22 S.U.	150.1	0.1	05/02/01
Dissolved Solids	188 mg /L	160.1	10	05/09/01
Sulfate	70.1 mg/L	375.4	1	05/02/01
Calcium	mg/L	3010A/7140/215.1	0.03	
Iron	mg/L	3010A/7380/236.1	0.02	

Comment: Results are from water fraction after 8-10 months (water blank).

Respectfully submitted,

L. Eve Karnitis

L. Eve Karnitis, President

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

February 13, 2002

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Chris Hall

AALI ORDER ID: 8872
APPROVAL #: EPA Certification 4043
CLIENT PROJECT : 7000 03
CLIENT PO NO.:

DATE COLLECTED: 09/06/00
DATE RECEIVED: 09/06/00
DATE REPORTED: 02/13/02

TEST RESULTS

Gravel Dissolution Control

AALI Sample No.: 38460-Composite Water **Client Sample ID:** P-224-A

Compound	**Result**	**Method**	**Detection Limit**	**Analysis Date**
Alkalinity, Total as CaCO3	130 mg/L	2320B	1	01/25/02
Conductivity	194.2 umhos/cm	120.1	2	01/23/02
Hardness as CaCO3	128 mg/L	130.2	0.1	01/23/02
pH	8 18 S.U	150.1	0.1	01/22/02
Dissolved Solids	209 mg /L	160.1	10	02/11/02
Sulfate	82.5 mg/L	375.4	1	01/23/02
Calcium	38.8 mg/L	3010A/7140/215.1	0.03	01/31/02
Iron	0.884 mg/L	3010A/7380/236.1	0.02	01/23/02

Comment: Results are from water fraction only after 16 months.

Respectfully submitted,

L. Eve Karnitis/clc

L. Eve Karnitis, President

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

September 21, 2000

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Chris Hall

AALI ORDER ID:	8872	**DATE COLLECTED:**	9/6/00
APPROVAL #:	EPA Certification 4043	**DATE RECEIVED:**	9/6/00
CLIENT PROJECT:	7000.03	**DATE ANALYZED:**	9/20/00
CLIENT PO NO.:		**DATE REPORTED:**	9/21/00

TEST RESULTS

[illegible]

AALI Sample No.: 38372 **Client Sample ID:** P-224A

Compound	Result	Test Mehtod	Detection Limit
Alkalinity, Total as CaCO3	185 mg/L	2320B	1
Conductivity	608 uohms/	120 1	2
Hardness as CaCO3	240 mg/L	130.2	0.1
pH	7 81 S.U.	150.1	0.1
Dissolved Solids	433 mg/L	160.1	10
Sulfate	47 10 mg/L	375 4	1

Comment: Results are from water fraction upon submerging solid sample for 1 week. No Calcium or Iron analysis.

Respectfully submitted,

L. Eve Karnitis

L. Eve Karnitis, President

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ADVANCED ANALYTICS LABORATORIES, INC.

1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

October 20, 2000

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Chris Hall

AALI ORDER ID: 8872		**DATE COLLECTED:**	9/6/00
APPROVAL #: EPA Certification 4043		**DATE RECEIVED:**	9/6/00
CLIENT PROJECT: 7000.03		**DATE ANALYZED:**	10/20/00
CLIENT PO NO.:		**DATE REPORTED:**	10/20/00

TEST RESULTS

Grout Dissolution - Production

AALI Sample No.: 38372 **Client Sample ID:** P-224A

Compound	**Result**	**Test Mehtod**	**Detection Limit**
Alkalinity, Total as $CaCO_3$	130 mg/L	2320B	1
Conductivity	557 uohms/	120.1	2
Hardness as $CaCO_3$	176 mg/L	130.2	0.1
pH	7.89 S.U.	150.1	0.1
Dissolved Solids	437 mg/L	160.1	10
Sulfate	58.3 mg/L	375.4	1
Calcium	63.3 mg/L	3010A/7140/215.1	0.1
Iron	1.82 mg/L	3010A/7380/236.1	0.02

10-20-00

Comment: Results are from water fraction containing submerged solid sample after 1 month.

Respectfully submitted,

L. Eve Karnitis

L. Eve Karnitıs, President

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ADVANCED ANALYTICS LABORATORIES, INC.

1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002

Analysis & Testing - Quality Control Programs - Research & Development

July 9, 2001

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
Attn: Chris Hall

AALI ORDER ID:	8872	**DATE COLLECTED:**	9/06/00
APPROVAL #:	EPA Certification 4043	**DATE RECEIVED:**	9/06/00
CLIENT PROJECT:	7000 03	**DATE REPORTED:**	7/09/01
CLIENT PO NO.:			

TEST RESULTS

AALI Sample No.: 38372 Client Sample ID. P-224A Grout Dissolution - Production

Sample No.	Result	Test Method	Detection Limit	Analysis Date
Alkalinity, Total as CaCO3	120 mg/L	2320B	1	6/15/01
Conductivity	284 uohms/	120.1	2	5/02/01
Hardness as CaCO3	104 mg/L	130 2	0.1	6/03/01
pH	8.32 S.U.	150.1	0 1	5/02/01
Dissolved Solids	234 mg/L	160.1	10	5/09/01
Sulfate	84.6 mg/L	375.4	1	5/02/01
Calcium	28.5 mg/L	3010a/7140/215.1	0 03	7/05/01
Iron	2.10 mg/L	3010A/7380/236.1	0.02	6/26/01

6-05-01

Comment: Results are from water fraction upon submerging solid sample for 8-10 months.

Respectfully submitted,

L. Eve Karnitis

L. Eve Karnitis, President

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

December 27, 2001

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Chris Hall

AALI ORDER ID: 8872	**DATE COLLECTED:** 09/06/00
APPROVAL #: EPA Certification 4043	**DATE RECEIVED:** 09/06/00
CLIENT PROJECT : 7000.03	**DATE REPORTED:** 12/27/01
CLIENT PO NO.:	

TEST RESULTS

Grout Dissolution - Production

AALI Sample No.: 38372 **Client Sample ID:** P-224-A

Compound	Result	Method	Detection Limit	Analysis Date
Alkalinity, Total as CaCO3	120 mg/L	2320B	1	10/26/01
Conductivity	194.6 umhos/cm	120.1	2	11/10/01
Hardness as CaCO3	92 mg/L	130.2	0.1	10/25/01
pH	8.39 S.U.	150.1	0.1	10/26/01
Dissolved Solids	220 mg /L	160.1	10	10/26/01
Sulfate	110 mg/L	375.4	1	11/02/01
Calcium	42.9 mg/L	3010a/7140/215.1	0.03	11/28/01
Iron	1.179 mg/L	3010A/7380/236.1	0.02	11/29/01

Comment: Results are from water fraction upon submerging solid sample for 14 months

Respectfully submitted.

L. Eve Karnitis/dc

L. Eve Karnitis. President

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

September 21, 2000

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN: Chris Hall

AALI ORDER ID:	8872	**DATE COLLECTED:**	9/6/00
APPROVAL #:	EPA Certification 4043	**DATE RECEIVED:**	9/6/00
CLIENT PROJECT:	7000.03	**DATE ANALYZED:**	9/20/00
CLIENT PO NO.:		**DATE REPORTED:**	9/21/00

TEST RESULTS

Grout Dissolution - Barrier

AALI Sample No.: 38371 **Client Sample ID:** P-224A

Compound	**Result**	**Test Mehtod**	**Detection Limit**
Alkalinity, Total as CaCO3	195 mg/L	2320B	1
Conductivity	589 uohms/	120.1	2
Hardness as CaCO3	244 mg/L	130.2	0.1
pH	7.870 S U.	150.1	0.1
Dissolved Solids	453 mg/L	160.1	10
Sulfate	61.20 mg/L	375.4	1

9-22-00

Comment: Results are from water fraction upon submerging solid sample for 1 week. No Calcium or Iron analysis.

Respectfully submitted.

L. Eve Karnitis

L. Eve Karnitis. President

ADVANCED ANALYTICS LABORATORIES, INC.

1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002

Analysis & Testing - Quality Control Programs - Research & Development

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

September 21, 2000

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
Attn: Chris Hall

AALI ORDER ID: 8872
APPROVAL #: EPA Certification 4043
CLIENT PROJECT: 7000.03
CLIENT PO NO.:

DATE COLLECTED: 9/06/00
DATE RECEIVED: 9/06/00
DATE ANALYZED: 10/20/00
DATE REPORTED: 9/21/00

TEST RESULTS

GROUT DISSOLUTION - BARRIER

AALI Sample No.: 38371 Client Sample ID: P-224A

Sample No.	**Result**	**Test Method**	**Detection Limit**
Alkalinity, Total as CaCO3	160 mg/L	2320B	1
Conductivity	540 uohms/	120.1	2
Hardness as CaCO3	192 mg/L	130.2	0.1
pH	7.89 S.U.	150.1	0.1
Dissolved Solids	553 mg/L	160.1	10
Sulfate	74.9 mg/L	375.4	1
Calcium	71.9 mg.L	3010A/7140/215.1	0.1
Iron	1.69 mg/L	3010A/7380/236.1	0.02

10-20-00

Comment: Analysis of water containing submerged solid sample after 1 month.

Respectfully submitted,

L. Eve Karnitis

L. Eve Karnitis, President

ADVANCED ANALYTICS LABORATORIES, INC.
1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002
Analysis & Testing - Quality Control Programs - Research & Development

July 9, 2001

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
Attn: Chris Hall

AALI ORDER ID: 8872
APPROVAL #: EPA Certification 4043
CLIENT PROJECT: 7000.03
CLIENT PO NO.:

DATE COLLECTED: 9/06/00
DATE RECEIVED: 9/06/00
DATE REPORTED: 7/09/01

TEST RESULTS

Grout Dissolution - Barrier

AALI Sample No.: 38371 Client Sample ID: P-224A

Sample No.	Result	Test Method	Detection Limit	Analysis Date
Alkalinity, Total as CaCO3	125 mg/L	2320B	1	6/15/01
Conductivity	296 uohms/	120.1	2	5/02/01
Hardness as CaCO3	114 mg/L	130.2	0.1	6/03/01
pH	8 270 S.U.	150.1	0.1	5/02/01
Dissolved Solids	262 mg/L	160.1	10	5/09/01
Sulfate	93.0 mg/L	375.4	1	5/02/01
Calcium	24.4 mg/L	3010a/7140/215.1	0.03	7/05/01
Iron	2 14 mg/L	3010A/7380/236.1	0.02	6/26/01

6-3-01

Comment: Results are from water fraction upon submerging solid sample for 8-10 months.

Respectfully submitted,

L. Eve Kamitis

L. Eve Kamitis, President

Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

ADVANCED ANALYTICS LABORATORIES, INC.

1025 CONCORD AVENUE
COLUMBUS, OHIO 43212
(614) 299-9922 FAX (614) 299-4002

Analysis & Testing - Quality Control Programs - Research & Development

December 27, 2001

BBC&M Engineering
6190 Enterprise Court
Dublin, OH 43016-7297
ATTN. Chris Hall

AALI ORDER ID: 8872
APPROVAL #: EPA Certification 4043
CLIENT PROJECT : 7000 03
CLIENT PO NO.:

DATE COLLECTED: 09/06/00
DATE RECEIVED: 09/06/00
DATE REPORTED: 12/27/01

TEST RESULTS

Grout Dissolution Barrier

AALI Sample No.: 38371 **Client Sample ID:** P-224-A

Compound	Result	Method	Detection Limit	Analysis Date
Alkalinity, Total as CaCO3	125 mg/L	2320B	1	10/26/01
Conductivity	183.5 umhos/cm	120.1	2	11/10/01
Hardness as CaCO3	100 mg/L	130.2	0.1	10/25/01
pH	8.44 S.U.	150.1	0.1	10/26/01
Dissolved Solids	20 mg /L	160.1	10	10/26/01
Sulfate	83.5 mg/L	375.4	1	11/02/01
Calcium	34.0 mg/L	3010a/7140/215.1	0.03	11/28/01
Iron	3 361 mg/L	3010A/7380/236.1	0.02	11/29/01

Comment: Results are from water fraction upon submerging solid sample for 14 months.

Respectfully submitted,

L. Eve Karnitis / dc

L. Eve Karnitis, President

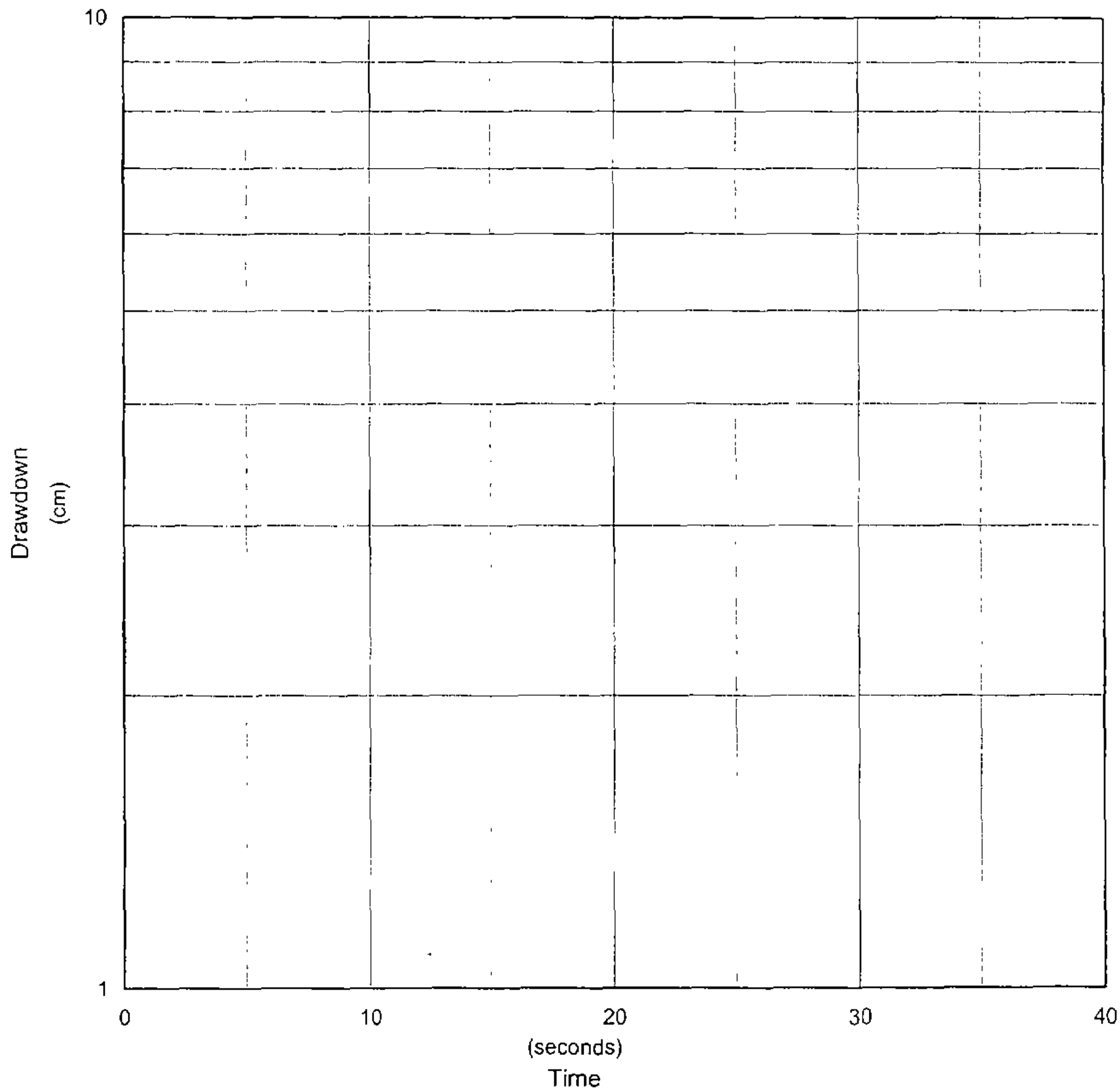
Gas Chromatography - Infra-red Spectroscopy - Ultraviolet-visible Spectrophotometry - Atomic Absorption Spectrophotometry

Modified Slug Test Data
Monitoring Well 221A
Guernsey County, Ohio

Testing Date: 12/22/99
Static Level: 18.00

Time		Water Level	Plot Data		
			Time	Drawdown	Match Pts
Minutes	Seconds	(feet)	(seconds)	(cm)	(cm)
			0		
0	36	18.00	36	0.0	

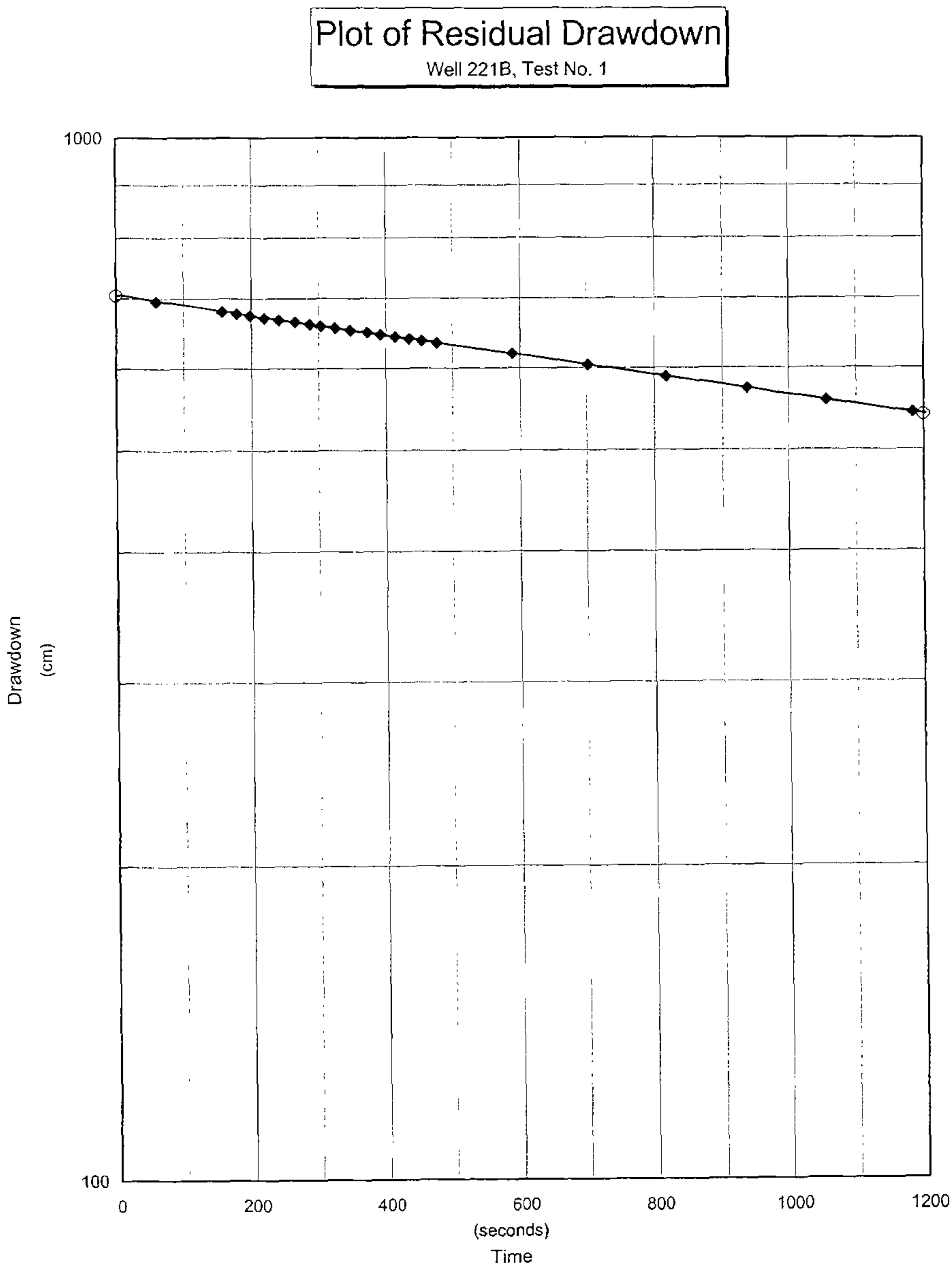
Plot of Residual Drawdown



Modified Slug Test Data
Monitoring Well 221B
Guernsey County, Ohio

Testing Date: 12/22/99
Static Level: 17.20

Time		Water Level	Plot Data		
Minutes	Seconds	(feet)	Time (seconds)	Drawdown (cm)	Match Pts (cm)
			0		705
1	0	40.00	60	694.9	
2	37	39.50	157	679.7	
2	59	39.40	179	676.7	
3	19	39.30	199	673.6	
3	40	39.20	220	670.6	
4	1	39.10	241	667.5	
4	25	39.00	265	664.5	
4	47	38.90	287	661.4	
5	3	38.80	303	658.4	
5	25	38.70	325	655.3	
5	48	38.60	348	652.3	
6	13	38.50	373	649.2	
6	32	38.40	392	646.2	
6	54	38.30	414	643.1	
7	15	38.20	435	640.1	
7	34	38.10	454	637.0	
7	57	38.00	477	634.0	
9	49	37.50	589	618.7	
11	42	37.00	702	603.5	
13	38	36.50	818	588.3	
15	37	36.00	937	573.0	
17	36	35.50	1056	557.8	
19	45	35.00	1185	542.5	
			1200		540

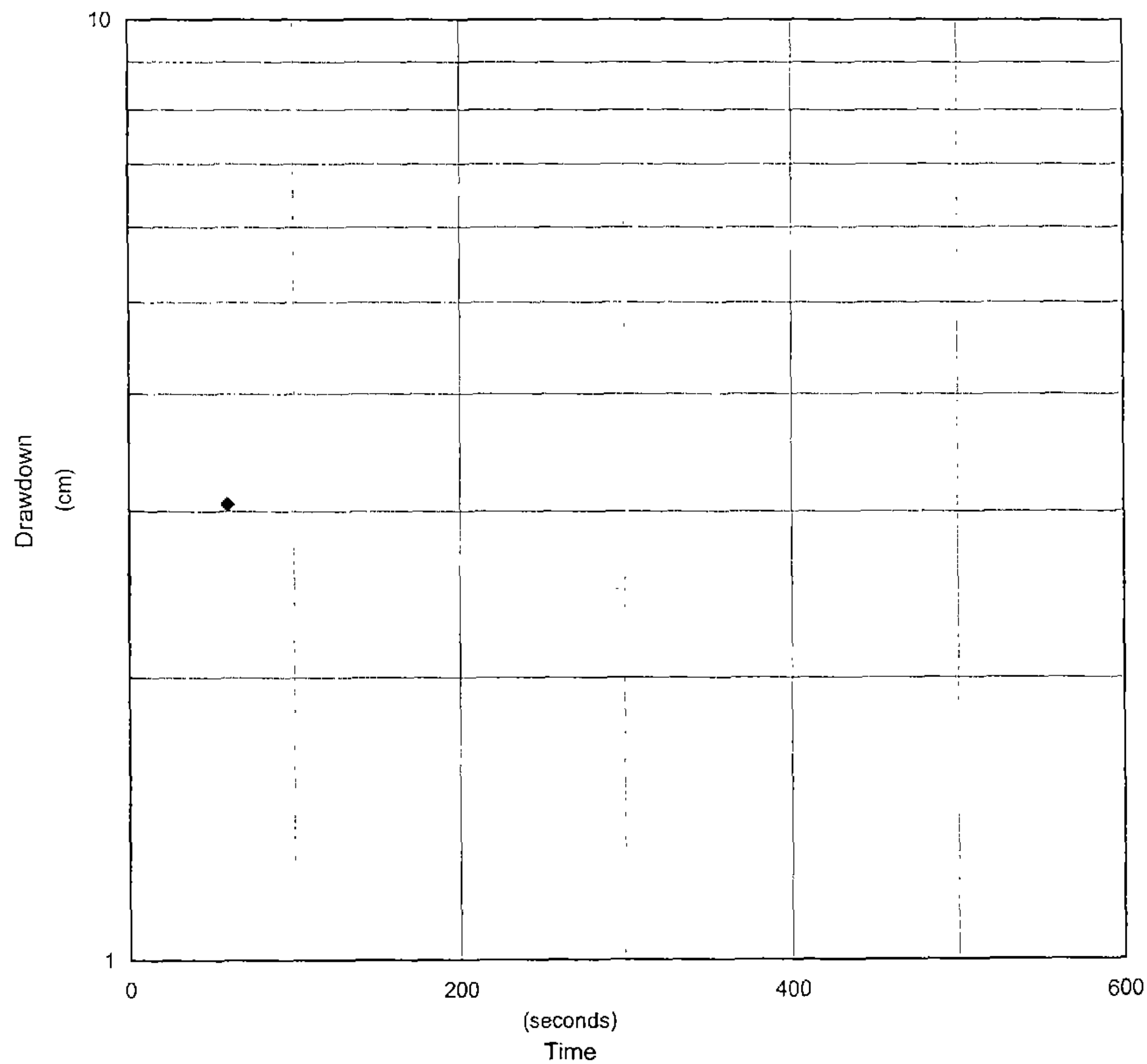

Plot of Residual Drawdown
Well 221B, Test No. 1
1000
100
Drawdown
(cm)
0
200
400
600
800
1000
1200
(seconds)
Time

Modified Slug Test Data
Monitoring Well 221C
Guernsey County, Ohio

Testing Date: 12/22/99
Static Level: 12.10

Time		Water Level	Plot Data		
Minutes	Seconds	(feet)	Time (seconds)	Drawdown (cm)	Match Pts (cm)
			0		
1	0	12.2	60	3.0	
8	44	12.1	524	0.0	

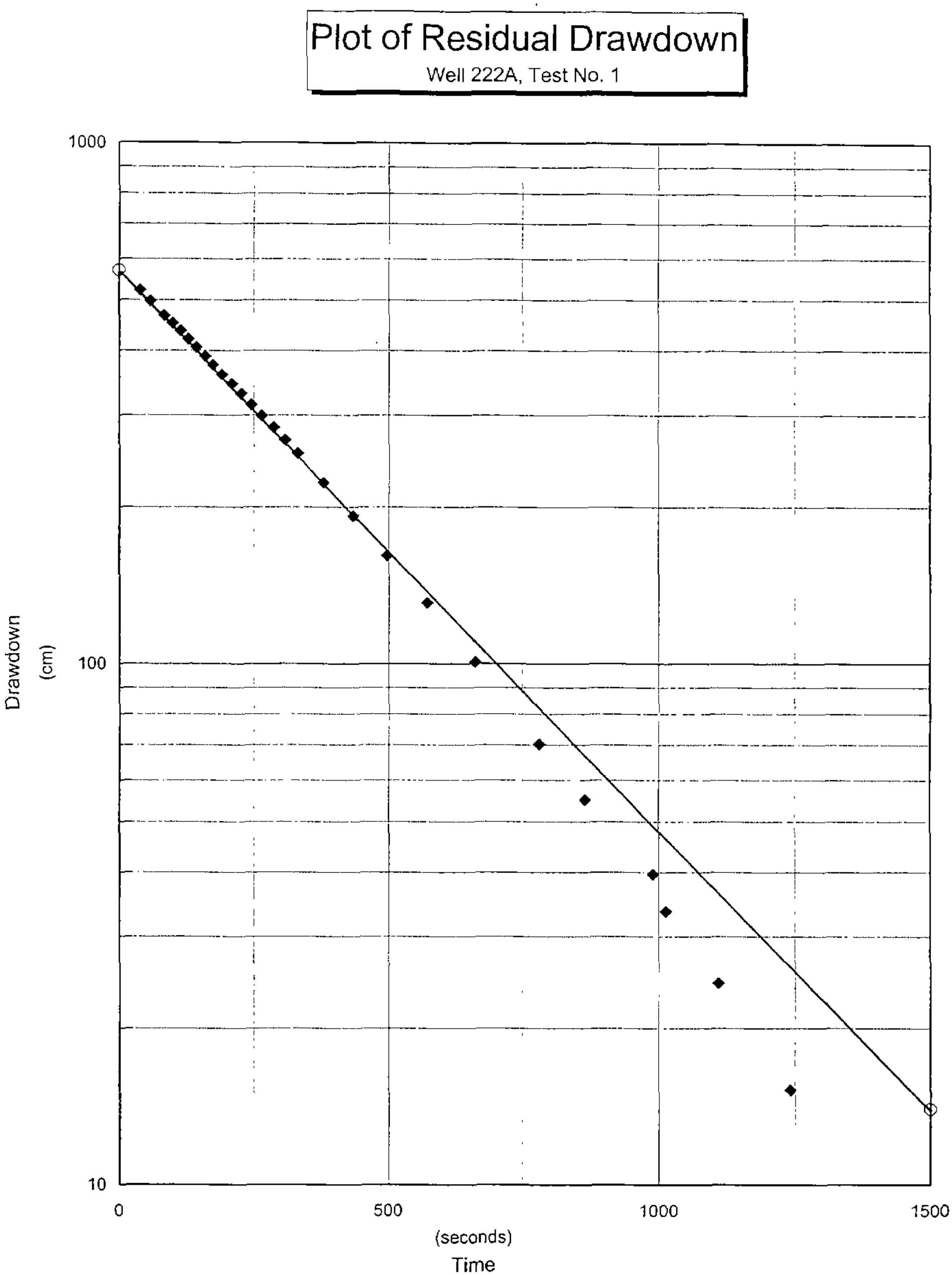
Plot of Residual Drawdown



Modified Slug Test Data
Monitoring Well 222A
Guernsey County, Ohio

Testing Date: 12/22/99
Static Level: 11.70

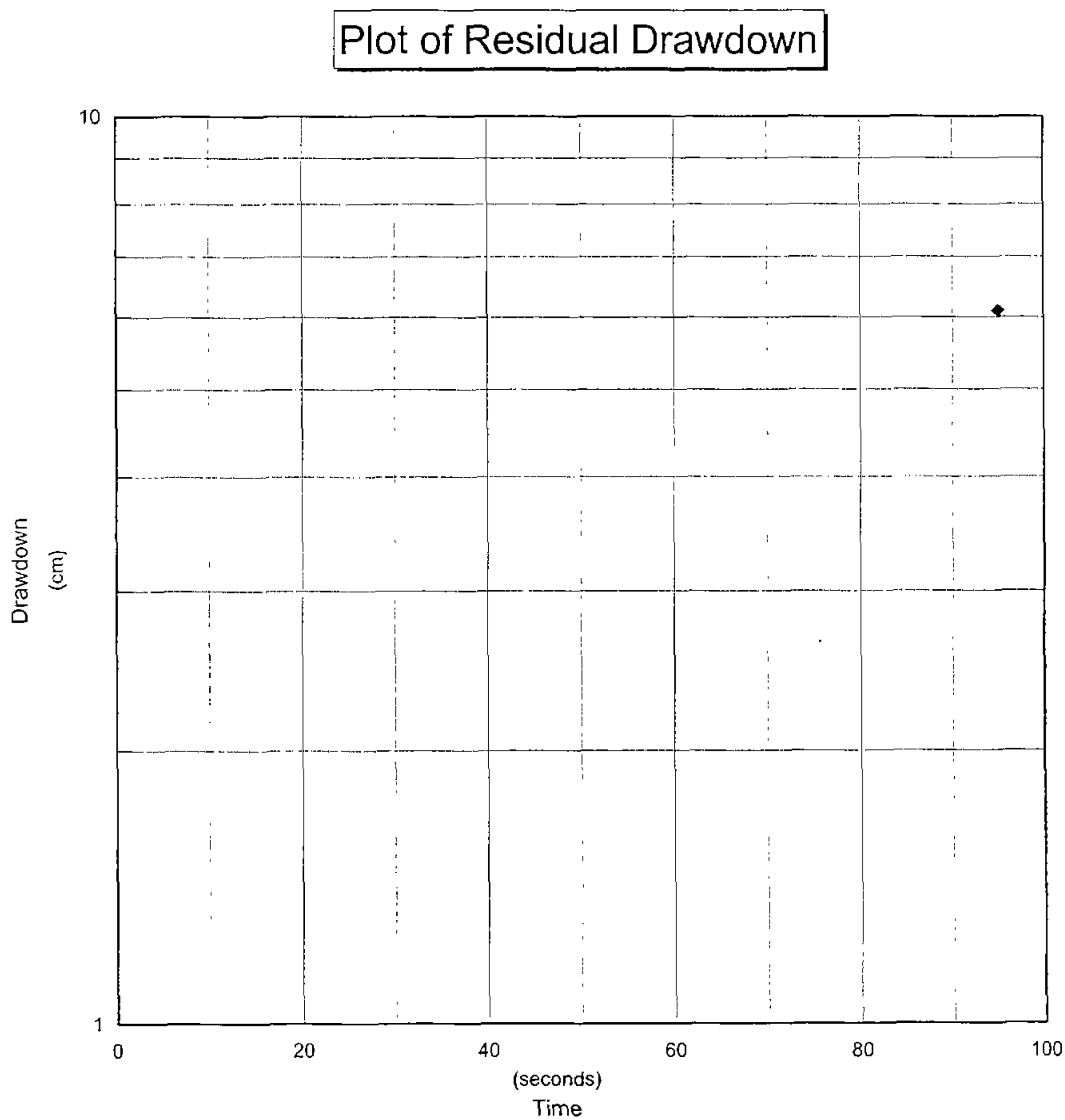
Time		Water Level	Plot Data		
			Time	Drawdown	Match Pts
Minutes	Seconds	(feet)	(seconds)	(cm)	(cm)
	0		0		570
0	40	28.80	40	521.2	
0	59	28.00	59	496.8	
1	24	27.00	84	466.3	
1	39	26.50	99	451.1	
1	53	26.00	113	435.9	
2	7	25.50	127	420.6	
2	22	25.00	142	405.4	
2	39	24.50	159	390.1	
2	54	24.00	174	374.9	
3	11	23.50	191	359.7	
3	30	23.00	210	344.4	
3	47	22.50	227	329.2	
4	6	22.00	246	313.9	
4	25	21.50	265	298.7	
4	47	21.00	287	283.5	
5	8	20.50	308	268.2	
5	30	20.00	330	253.0	
6	19	19.00	379	222.5	
7	14	18.00	434	192.0	
8	17	17.00	497	161.5	
9	32	16.00	572	131.1	
11	2	15.00	662	100.6	
13	1	14.00	781	70.1	
14	26	13.50	866	54.9	
16	30	13.00	990	39.6	
16	54	12.80	1014	33.5	
18	29	12.50	1109	24.4	
20	42	12.20	1242	15.2	
22	50	12.00	1370	9.1	
			1500		14


Plot of Residual Drawdown
Well 222A, Test No. 1
1000
100
10
Drawdown
(cm)
0
500
1000
1500
(seconds)
Time

Modified Slug Test Data
Monitoring Well 222B
Guernsey County, Ohio

Testing Date: 12/22/99
Static Level: 11.60

Time		Water Level	Plot Data		
			Time	Drawdown	Match Pts
Minutes	Seconds	(feet)	(seconds)	(cm)	(cm)
			0		
1	35	11.80	95	6.1	

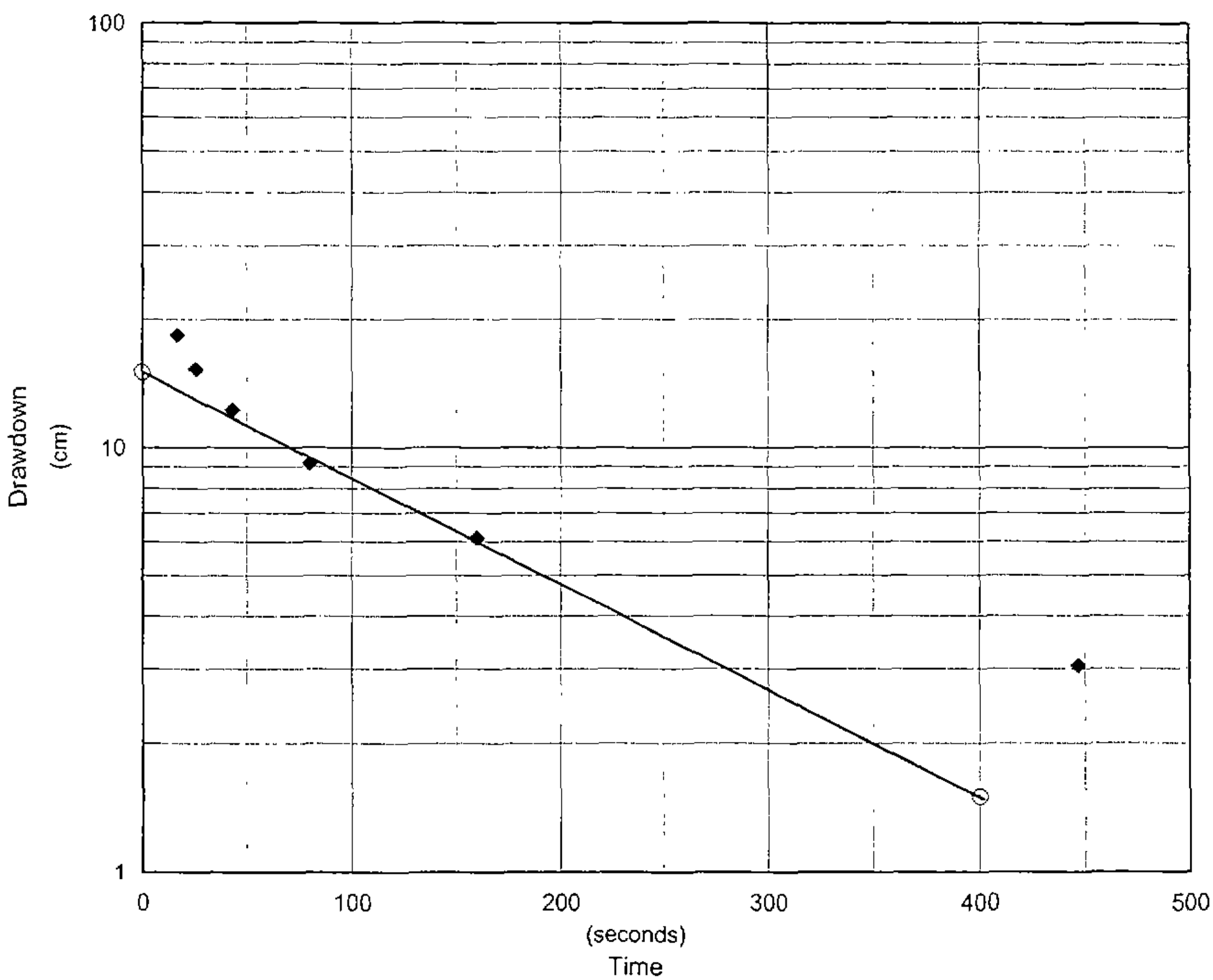


Modified Slug Test Data
Monitoring Well 222C
Guernsey County, Ohio

Testing Date: 12/22/99
Static Level: 3.1

Time		Water Level	Plot Data		
			Time	Drawdown	Match Pts
Minutes	Seconds	(feet)	(seconds)	(cm)	(cm)
			0		15
0	17	3.7	17	18.3	
0	26	3.6	26	15.2	
0	43	3.5	43	12.2	
1	20	3.4	80	9.1	
2	40	3.3	160	6.1	
7	27	3.2	447	3.0	
			400		1.5

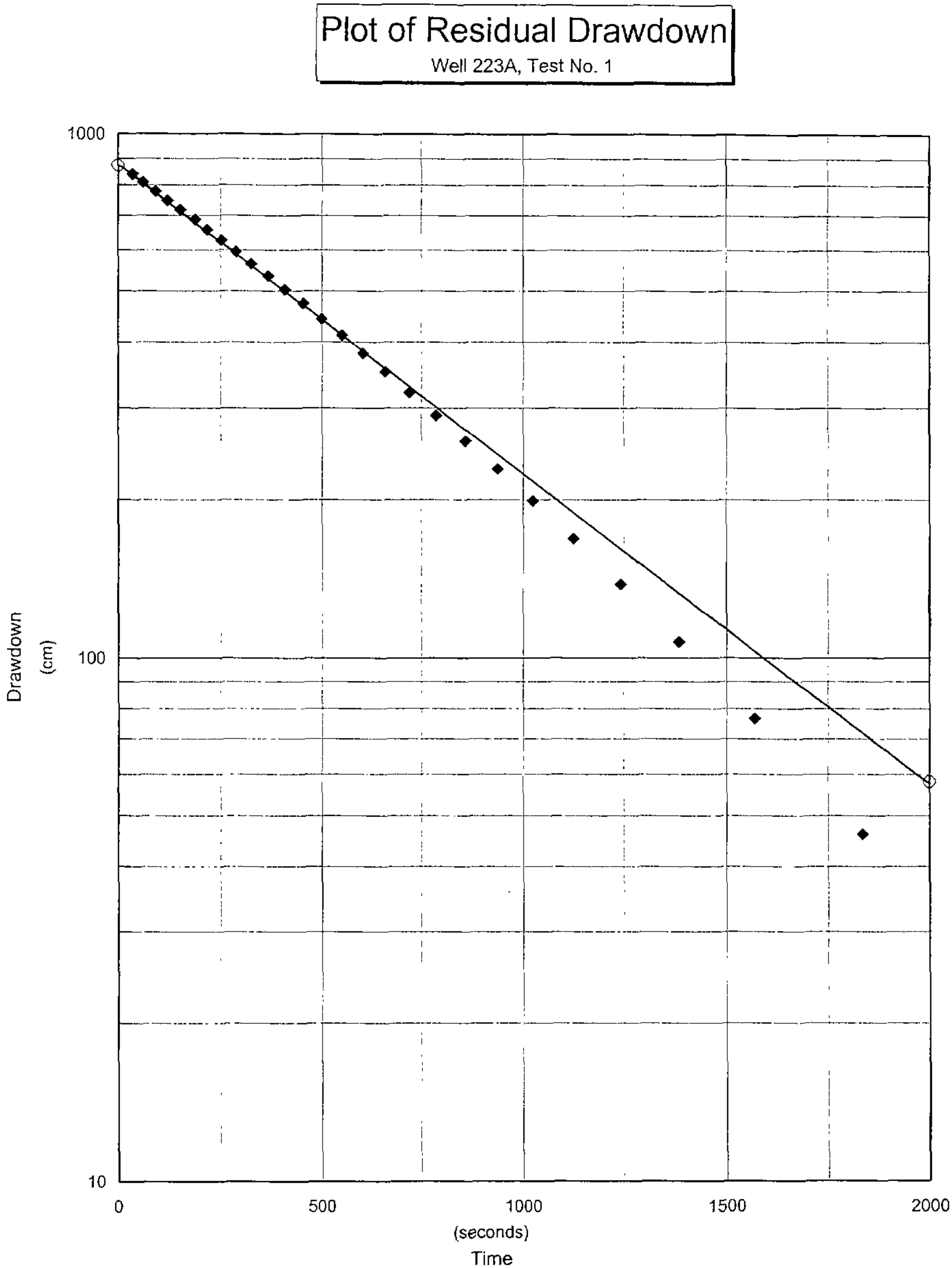
Plot of Residual Drawdown



Modified Slug Test Data
Monitoring Well 223A
Guernsey County, Ohio

Testing Date: 01/26/00
Static Level: 19.49

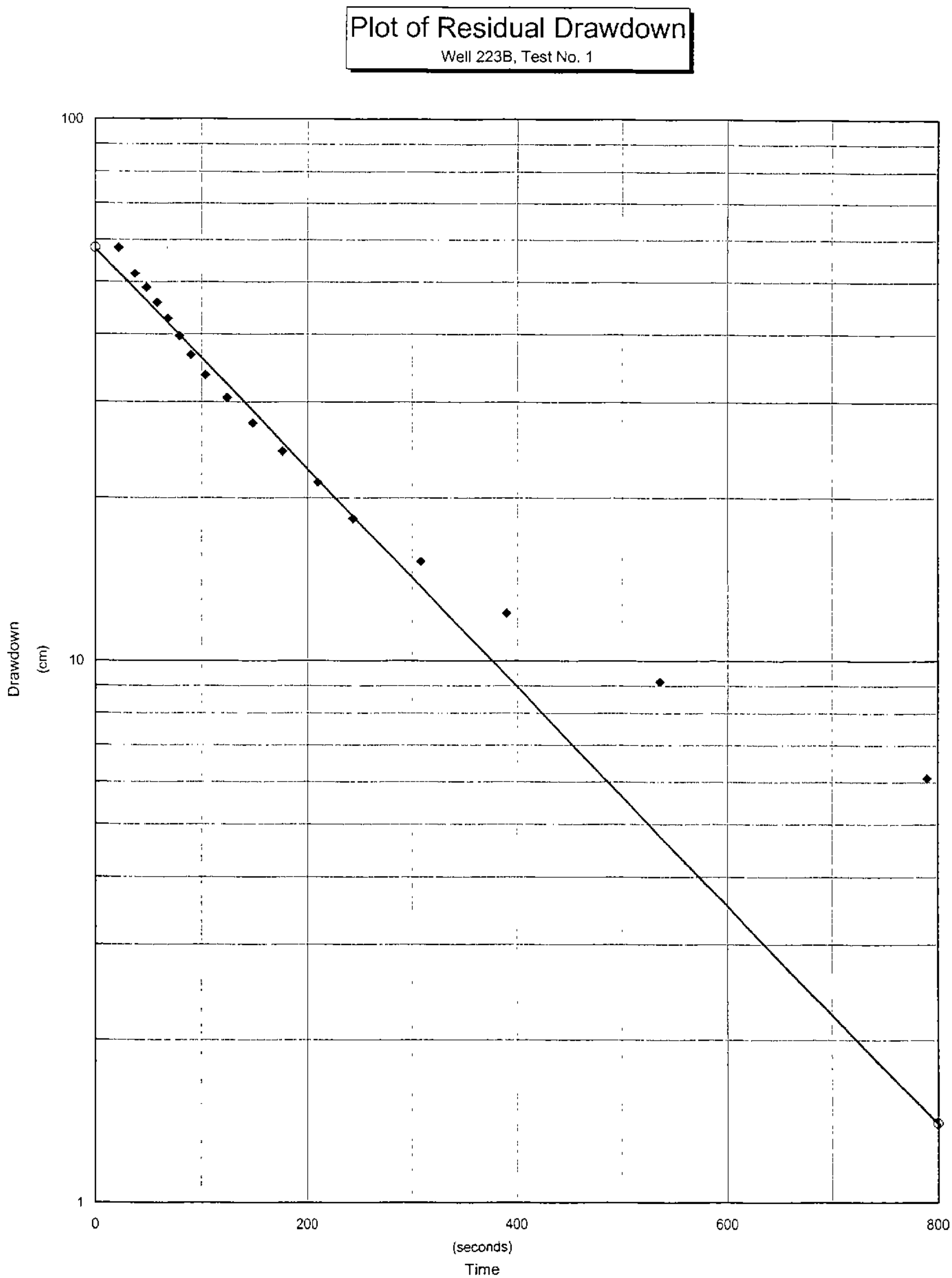
Time		Water Level	Plot Data		
Minutes	Seconds	(feet)	Time (seconds)	Drawdown (cm)	Match Pts (cm)
			0		870
0	35	47.00	35	838.5	
1	1	46.00	61	808.0	
1	32	45.00	92	777.5	
2	1	44.00	121	747.1	
2	32	43.00	152	716.6	
3	9	42.00	189	686.1	
3	38	41.00	218	655.6	
4	13	40.00	253	625.1	
4	49	39.00	289	594.7	
5	26	38.00	326	564.2	
6	8	37.00	368	533.7	
6	49	36.00	409	503.2	
7	34	35.00	454	472.7	
8	20	34.00	500	442.3	
9	11	33.00	551	411.8	
10	3	32.00	603	381.3	
10	59	31.00	659	350.8	
12	0	30.00	720	320.3	
13	6	29.00	786	289.9	
14	17	28.00	857	259.4	
15	37	27.00	937	228.9	
17	5	26.00	1025	198.4	
18	45	25.00	1125	167.9	
20	43	24.00	1243	137.5	
23	5	23.00	1385	107.0	
26	10	22.00	1570	76.5	
30	34	21.00	1834	46.0	
			2000		58


Plot of Residual Drawdown
Well 223A, Test No. 1
1000
100
10
Drawdown
(cm)
0
500
1000
1500
2000
(seconds)
Time

Modified Slug Test Data
Monitoring Well 223B
Guernsey County, Ohio

Testing Date: 12/22/99
Static Level: 11.40

Time		Water Level	Plot Data		
Minutes	Seconds	(feet)	Time (seconds)	Drawdown (cm)	Match Pts (cm)
			0		58
0	22	13.30	22	57.9	
0	37	13.10	37	51.8	
0	48	13.00	48	48.8	
0	58	12.90	58	45.7	
1	8	12.80	68	42.7	
1	19	12.70	79	39.6	
1	30	12.60	90	36.6	
1	44	12.50	104	33.5	
2	4	12.40	124	30.5	
2	28	12.30	148	27.4	
2	56	12.20	176	24.4	
3	30	12.10	210	21.3	
4	3	12.00	243	18.3	
5	8	11.90	308	15.2	
6	30	11.80	390	12.2	
8	56	11.70	536	9.1	
13	10	11.60	790	6.1	
			800		1.4

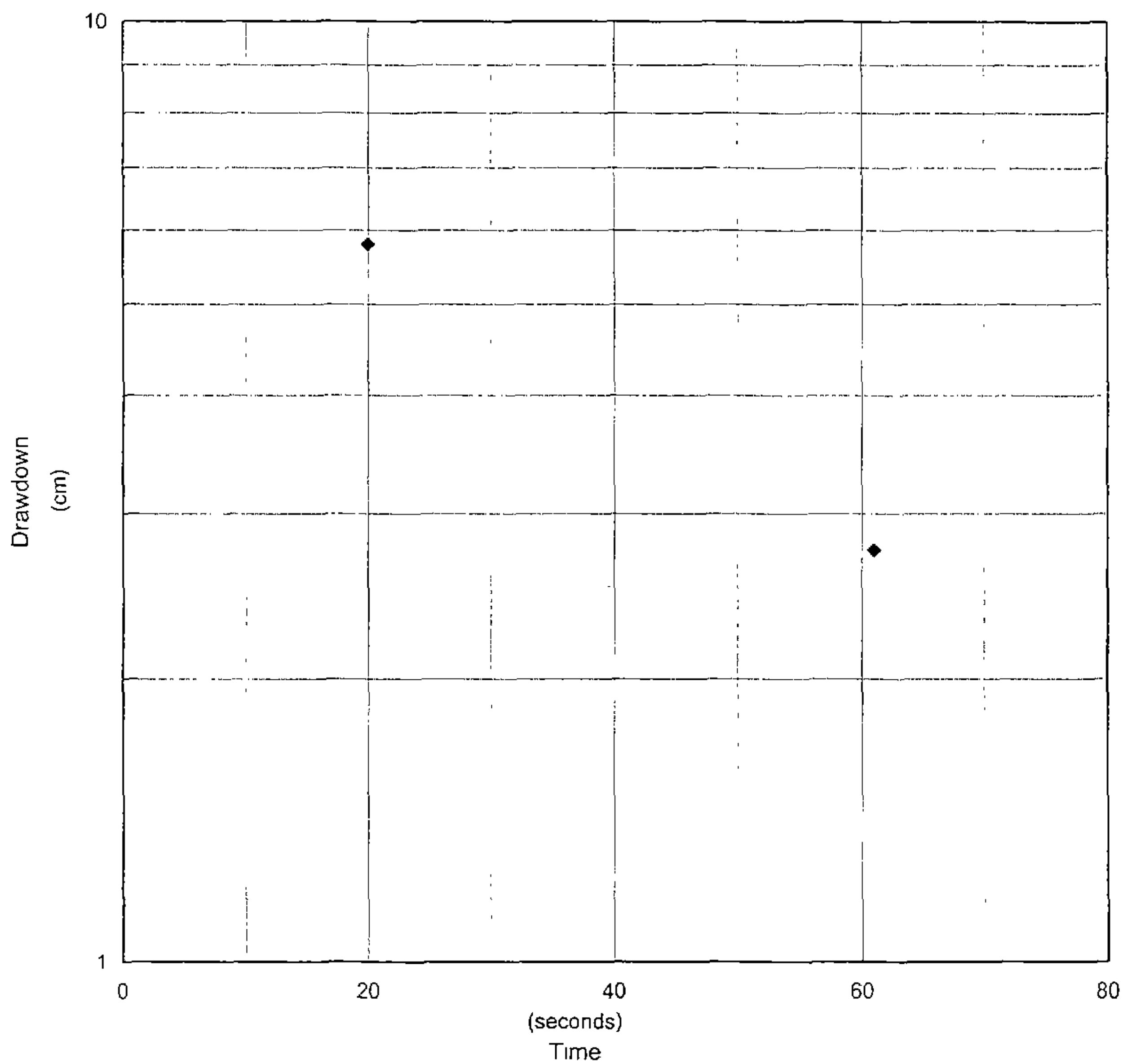

Plot of Residual Drawdown
Well 223B, Test No. 1
100
10
1
Drawdown
(cm)
0
200
400
600
800
(seconds)
Time

Modified Slug Test Data
Monitoring Well 224A
Guernsey County, Ohio

Testing Date: 01/26/00
Static Level: 12.51

Time		Water Level	Plot Data		
Minutes	Seconds	(feet)	Time (seconds)	Drawdown (cm)	Match Pts (cm)
			0		
0	20	12.70	20	5.8	
1	1	12.60	61	2.7	

Plot of Residual Drawdown

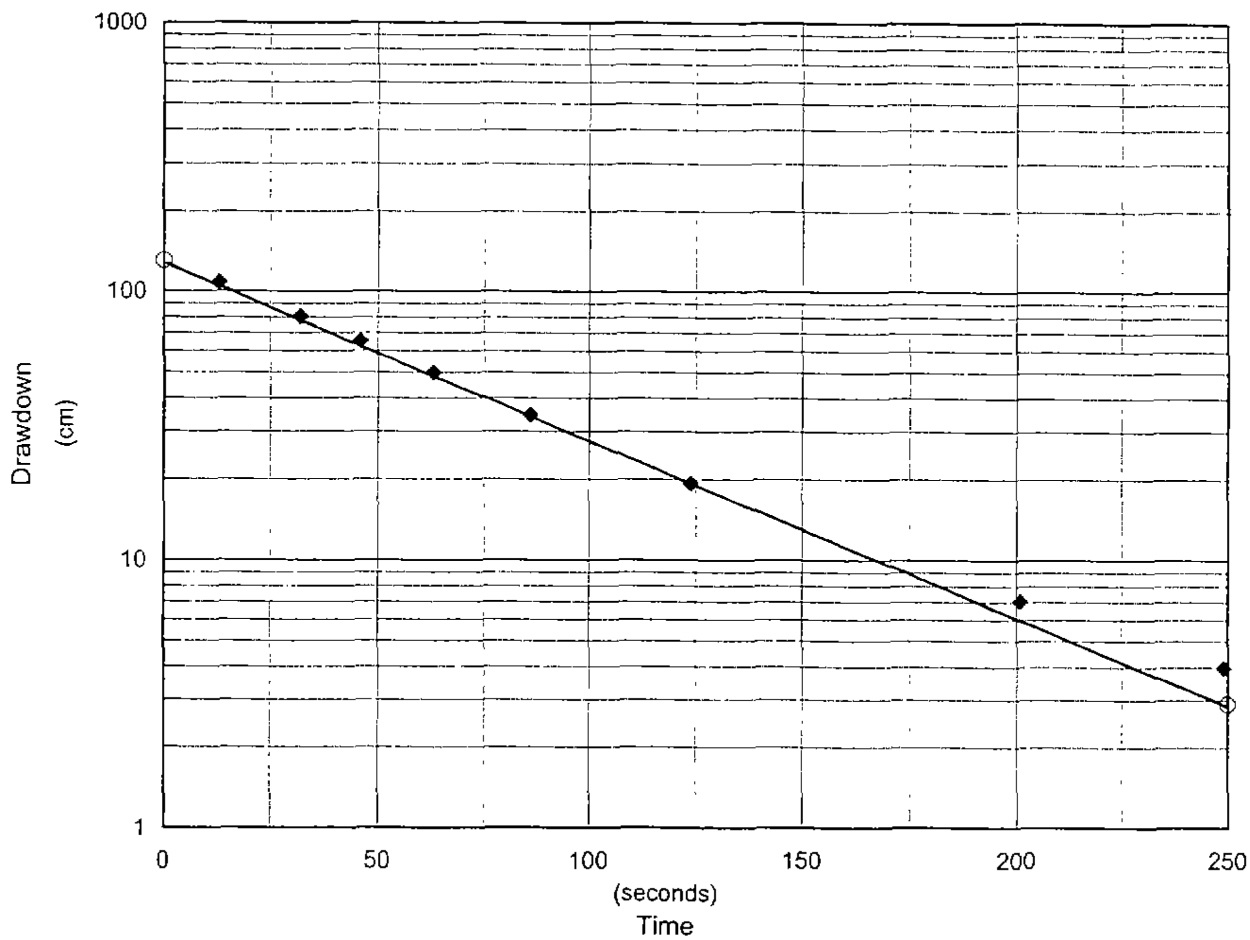


Modified Slug Test Data
Monitoring Well 224B
Guernsey County, Ohio

Testing Date: 01/26/00
Static Level: 9.87

Time		Water Level	Plot Data		
Minutes	Seconds	(feet)	Time (seconds)	Drawdown (cm)	Match Pts (cm)
			0		130
0	13	13.40	13	107.6	
0	32	12.50	32	80.2	
0	46	12.00	46	64.9	
1	3	11.50	63	49.7	
1	26	11.00	86	34.4	
2	4	10.50	124	19.2	
3	21	10.10	201	7.0	
4	9	10.00	249	4.0	
			250		2.9

Plot of Residual Drawdown

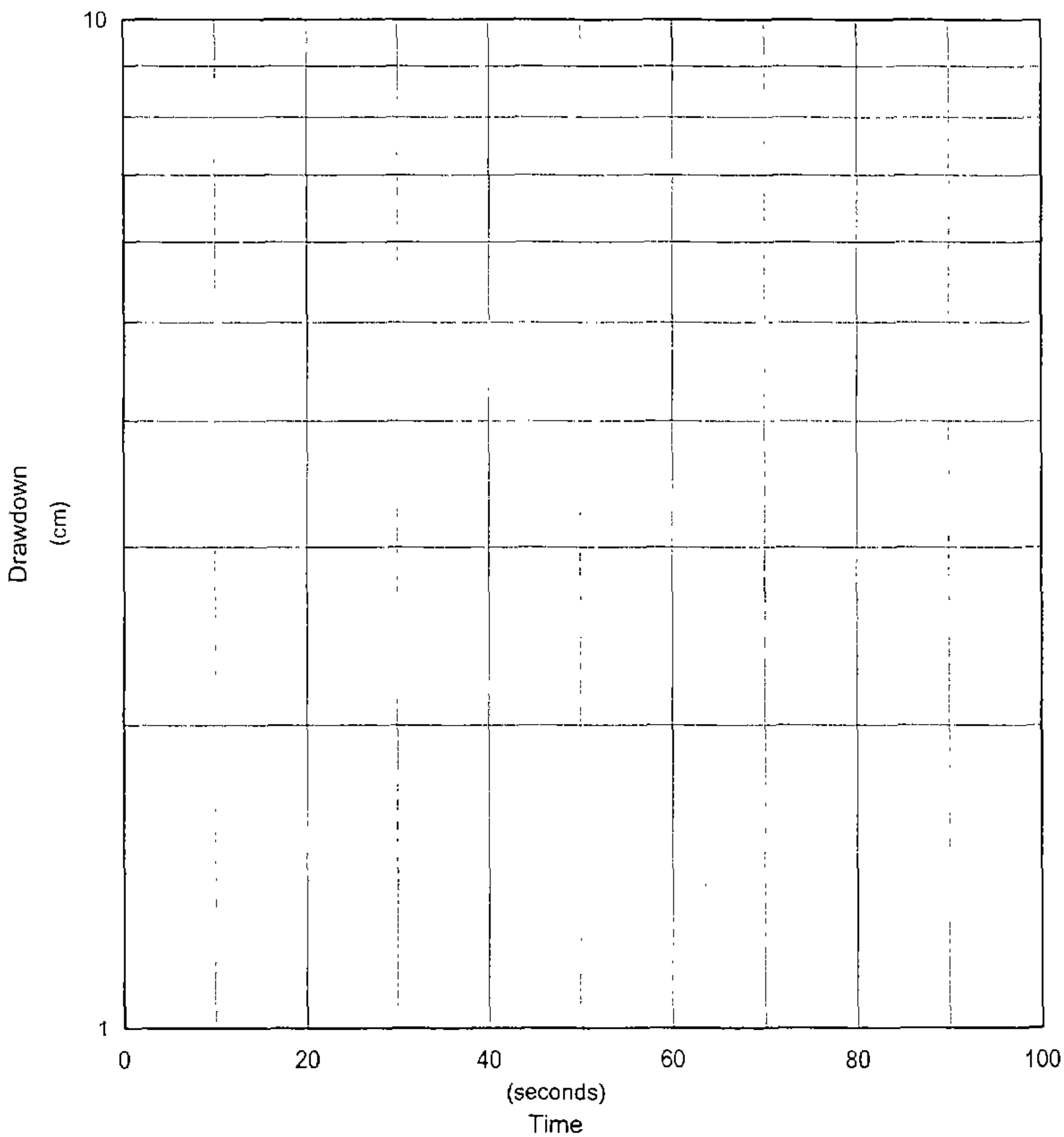


Modified Slug Test Data
Monitoring Well 225A
Guernsey County, Ohio

Testing Dat 01/25/00
Static Level 31.75

Time		Water Level	Plot Data		
			Time	Drawdown	Match Pts
Minutes	Seconds	(feet)	(seconds)	(cm)	(cm)
			0		
1	22	31.75	82	0.0	

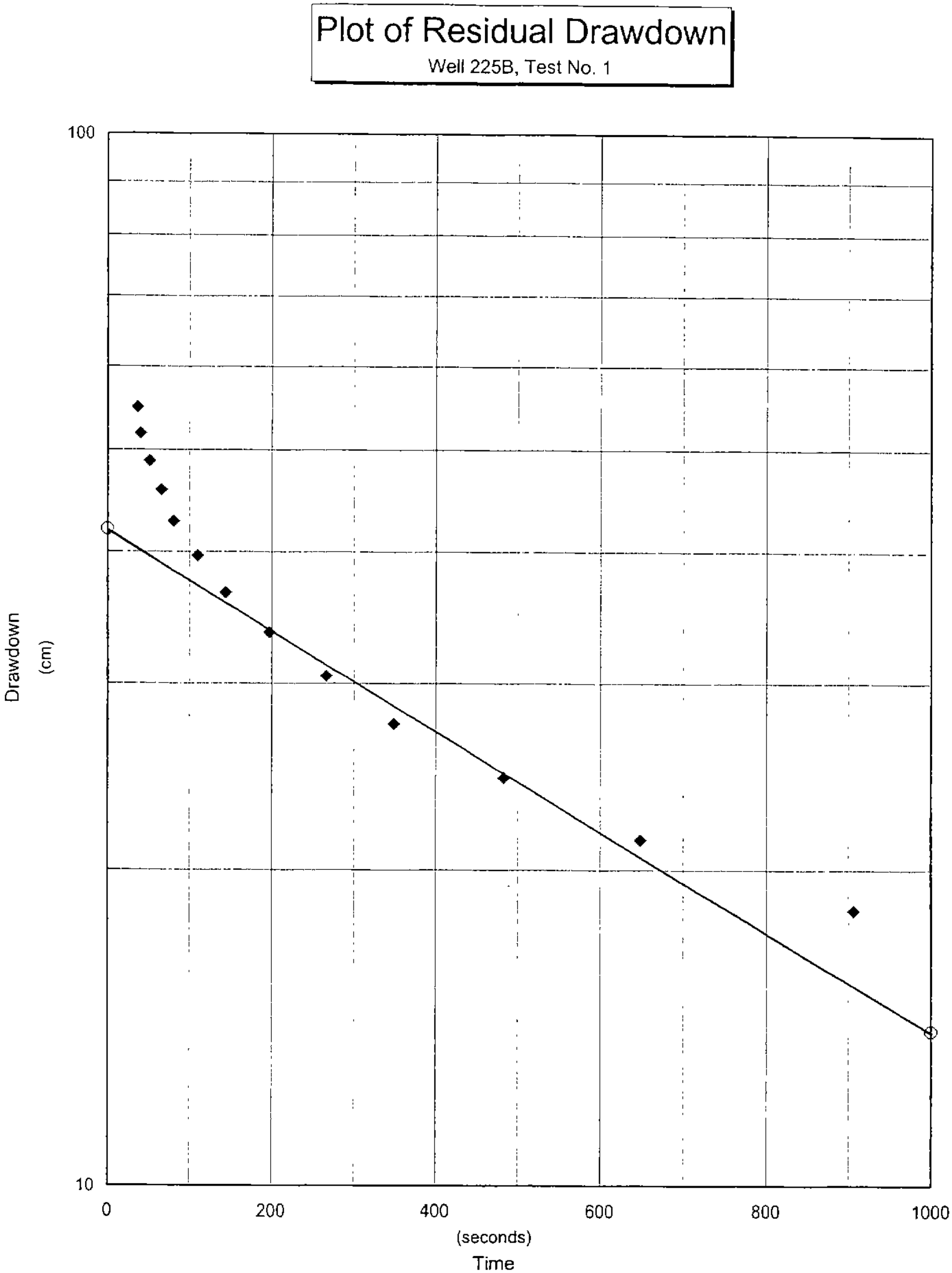
Plot of Residual Drawdown



Modified Slug Test Data
Monitoring Well 225B
Guernsey County, Ohio

Testing Date: 01/25/00
Static Level: 3.60

Time		Water Level	Plot Data		
Minutes	Seconds	(feet)	Time (seconds)	Drawdown (cm)	Match Pts (cm)
			0		42
0	37	5.40	37	54.9	
0	41	5.30	41	51.8	
0	52	5.20	52	48.8	
1	6	5.10	66	45.7	
1	21	5.00	81	42.7	
1	50	4.90	110	39.6	
2	24	4.80	144	36.6	
3	17	4.70	197	33.5	
4	26	4.60	266	30.5	
5	49	4.50	349	27.4	
8	3	4.40	483	24.4	
10	49	4.30	649	21.3	
15	6	4.20	906	18.3	
			1000		14



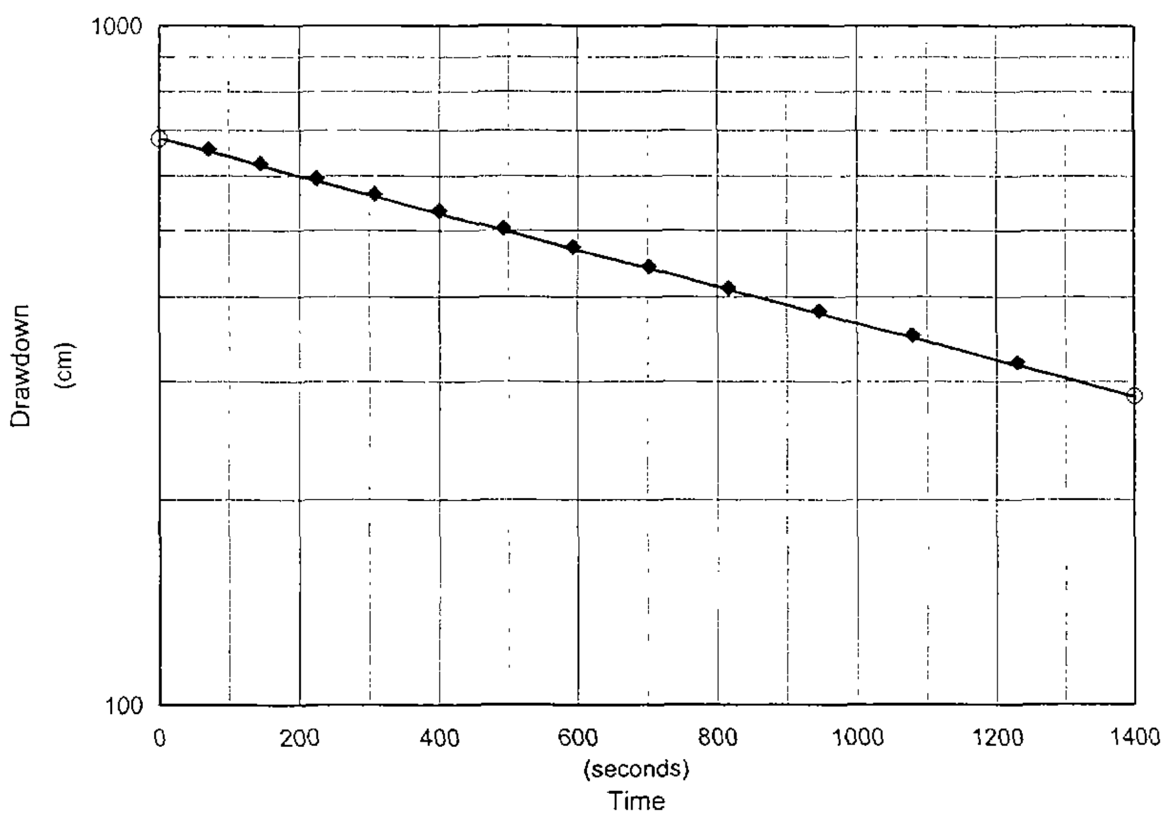
Plot of Residual Drawdown
Well 225B, Test No. 1
100
10
Drawdown
(cm)
0
200
400
600
800
1000
(seconds)
Time

Modified Slug Test Data
Monitoring Well 226A
Guernsey County, Ohio

Testing Dat‹ 12/23/99
Static Level 19.50

Time		Water Level	Plot Data		
			Time	Drawdown	Match Pts
Minutes	Seconds	(feet)	(seconds)	(cm)	(cm)
			0		680
1	11	41.00	71	655.3	
2	24	40.00	144	624.8	
3	44	39.00	224	594.4	
5	8	38.00	308	563.9	
6	40	37.00	400	533.4	
8	13	36.00	493	502.9	
9	54	35.00	594	472.4	
11	43	34.00	703	442.0	
13	37	33.00	817	411.5	
15	47	32.00	947	381.0	
17	59	31.00	1079	350.5	
20	30	30.00	1230	320.0	
			1400		285

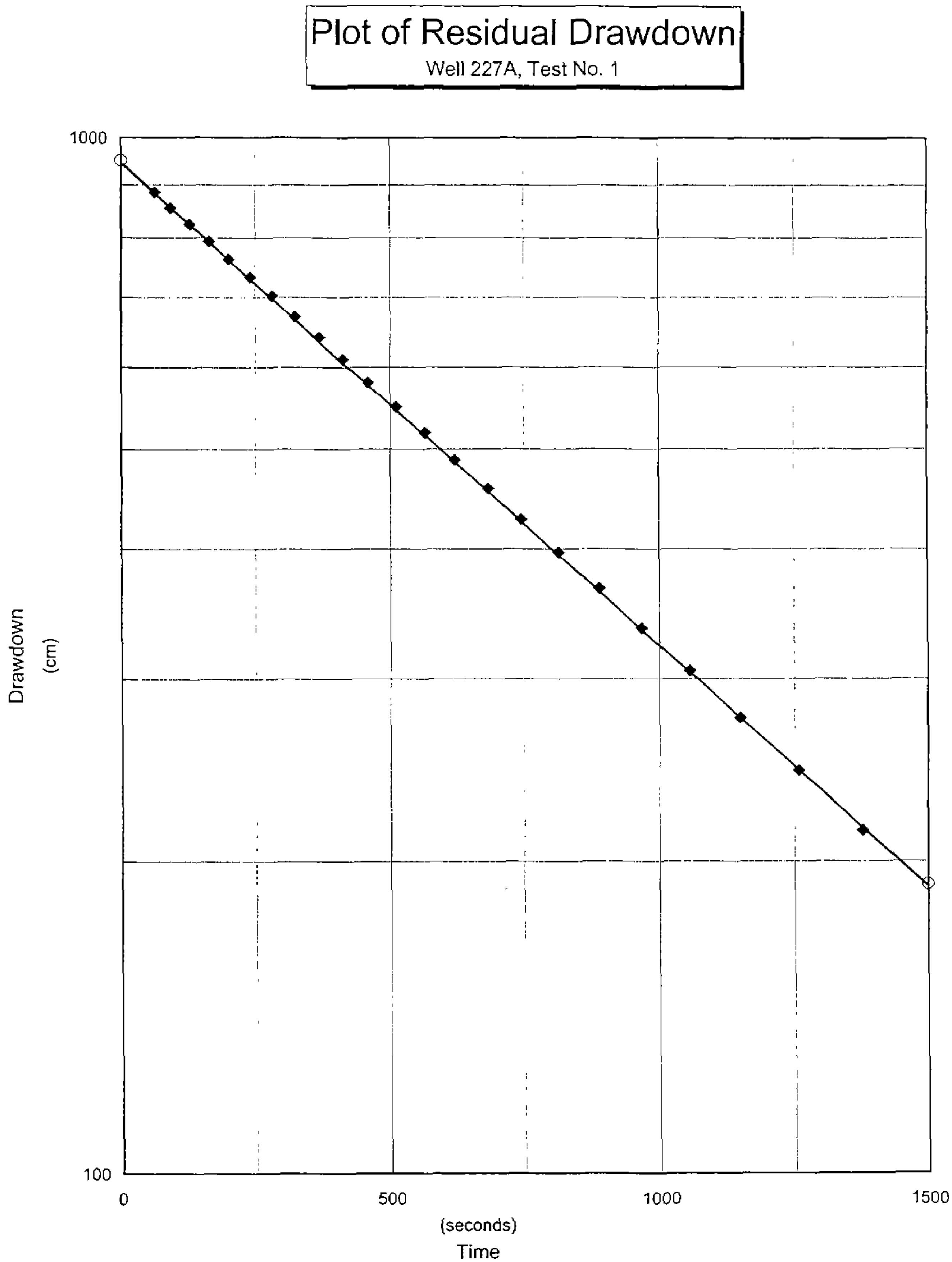
Plot of Residual Drawdown



Modified Slug Test Data
Monitoring Well 227A
Guernsey County, Ohio

Testing Date: 01/26/00
Static Level: 23.99

Time		Water Level	Plot Data		
Minutes	Seconds	(feet)	Time (seconds)	Drawdown (cm)	Match Pts (cm)
			0		950
1	4	53.00	64	884.2	
1	34	52.00	94	853.7	
2	9	51.00	129	823.3	
2	44	50.00	164	792.8	
3	21	49.00	201	762.3	
4	1	48.00	241	731.8	
4	42	47.00	282	701.3	
5	23	46.00	323	670.9	
6	8	45.00	368	640.4	
6	52	44.00	412	609.9	
7	40	43.00	460	579.4	
8	31	42.00	511	548.9	
9	25	41.00	565	518.5	
10	21	40.00	621	488.0	
11	23	39.00	683	457.5	
12	25	38.00	745	427.0	
13	35	37.00	815	396.5	
14	49	36.00	889	366.1	
16	8	35.00	968	335.6	
17	36	34.00	1056	305.1	
19	10	33.00	1150	274.6	
20	58	32.00	1258	244.1	
22	58	31.00	1378	213.7	
			1500		190

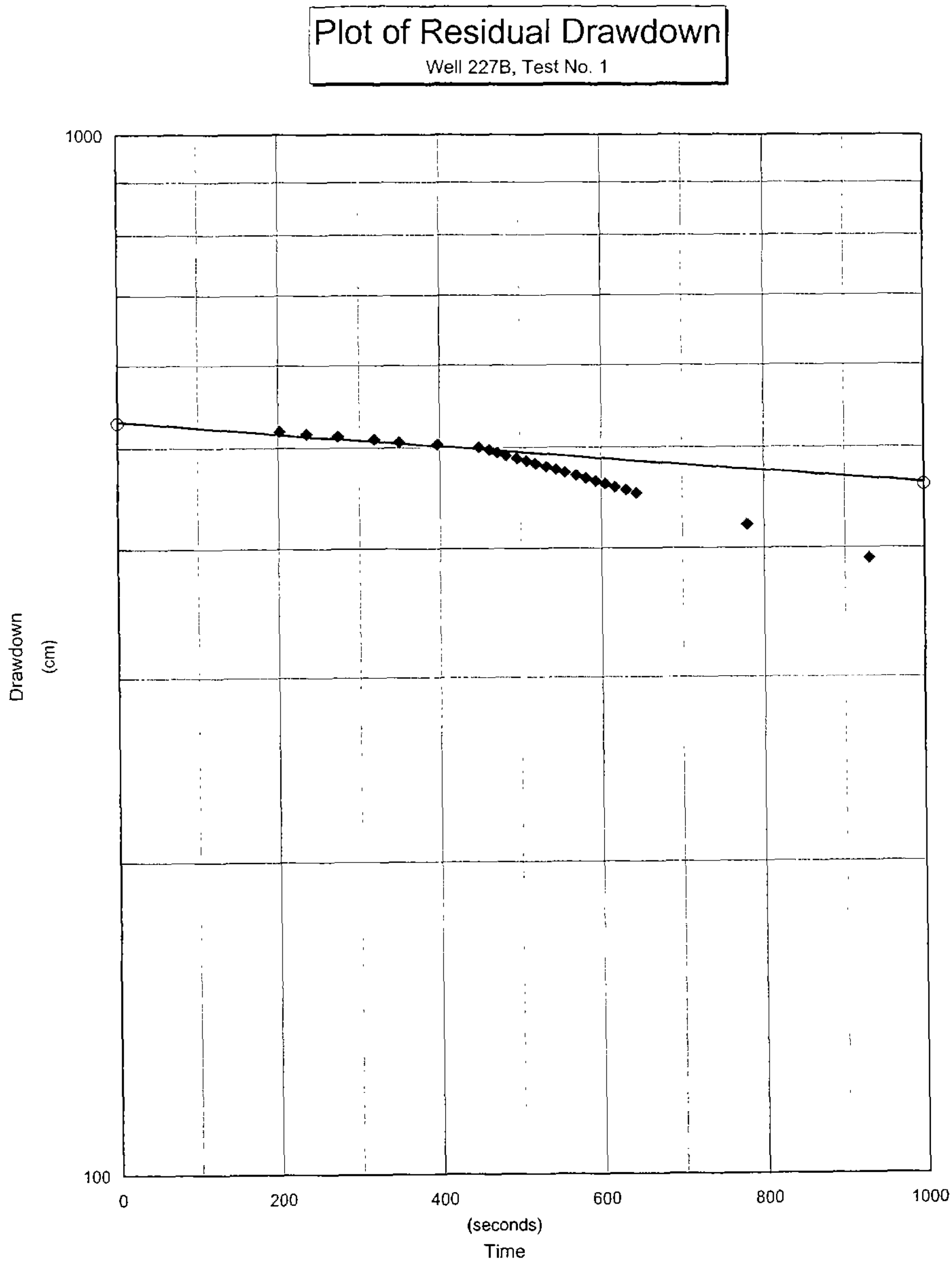


Plot of Residual Drawdown
Well 227A, Test No. 1
1000
100
Drawdown
(cm)
0
500
1000
1500
(seconds)
Time

Modified Slug Test Data
Monitoring Well 227B
Guernsey County, Ohio

Testing Date: 12/23/99
Static Level: 11.20

Time		Water Level	Plot Data		
			Time	Drawdown	Match Pts
Minutes	Seconds	(feet)	(seconds)	(cm)	(cm)
			0		528
3	22	28.20	202	518.2	
3	56	28.10	236	515.1	
4	34	28.00	274	512.1	
5	19	27.90	319	509.0	
5	50	27.80	350	506.0	
6	38	27.70	398	502.9	
7	29	27.60	449	499.9	
7	42	27.50	462	496.8	
7	52	27.40	472	493.8	
8	3	27.30	483	490.7	
8	16	27.20	496	487.7	
8	28	27.10	508	484.6	
8	39	27.00	519	481.6	
8	52	26.90	532	478.5	
9	4	26.80	544	475.5	
9	15	26.70	555	472.4	
9	29	26.60	569	469.4	
9	41	26.50	581	466.3	
9	53	26.40	593	463.3	
10	5	26.30	605	460.2	
10	17	26.20	617	457.2	
10	31	26.10	631	454.2	
10	44	26.00	644	451.1	
12	59	25.00	779	420.6	
15	31	24.00	931	390.1	
			1000		460

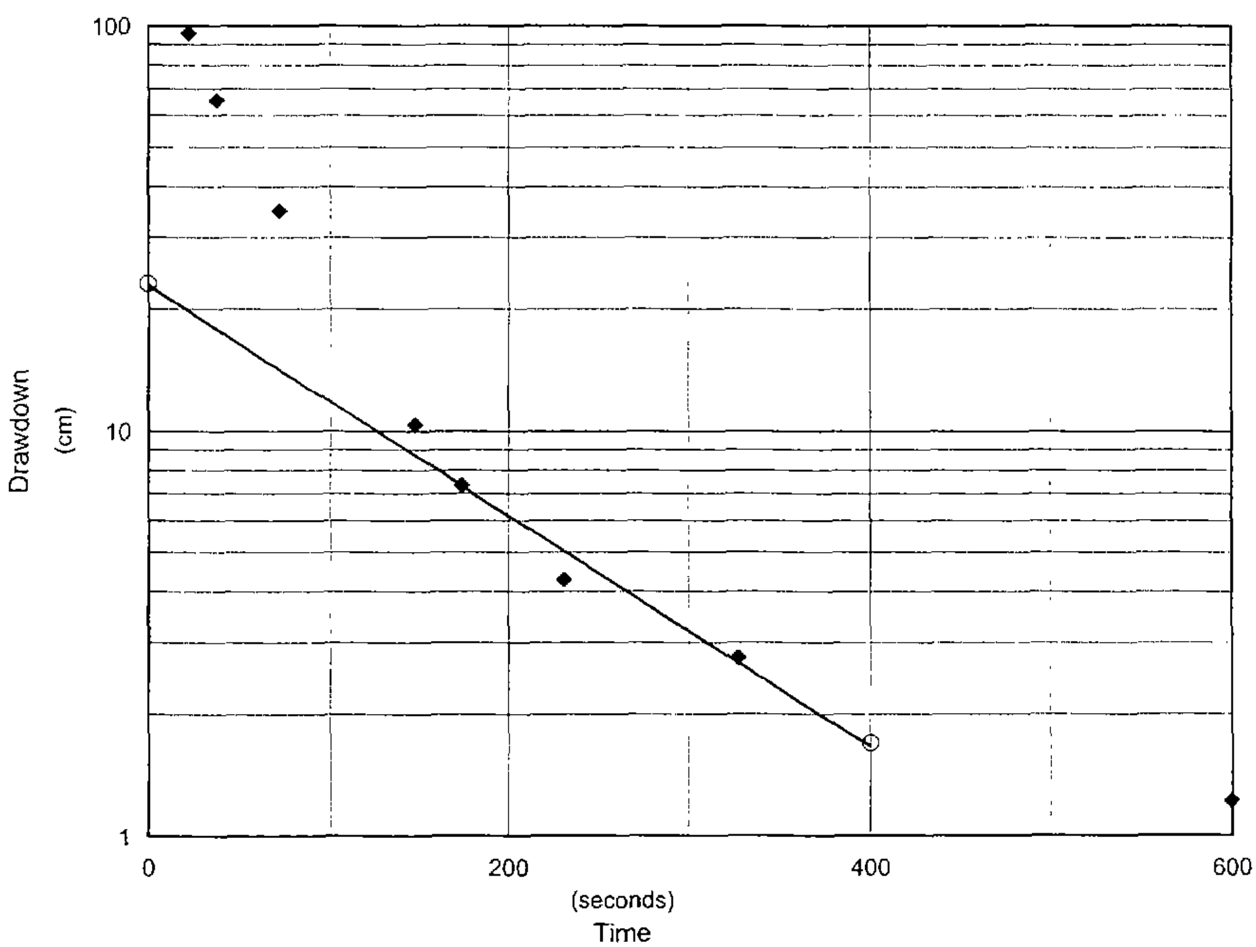

Plot of Residual Drawdown
Well 227B, Test No. 1
1000
100
Drawdown
(cm)
0
200
400
600
800
1000
(seconds)
Time

Modified Slug Test Data
Monitoring Well 228A
Guernsey County, Ohio

Testing Date: 01/26/00
Static Level: 19.86

Time		Water Level	Plot Data		
Minutes	Seconds	(feet)	Time (seconds)	Drawdown (cm)	Match Pts (cm)
			0		23
0	22	23.00	22	95.7	
0	37	22.00	37	65.2	
1	12	21.00	72	34.7	
2	27	20.20	147	10.4	
2	54	20.10	174	7.3	
3	51	20.00	231	4.3	
5	27	19.95	327	2.7	
10	0	19.90	600	1.2	
			400		1.7

Plot of Residual Drawdown

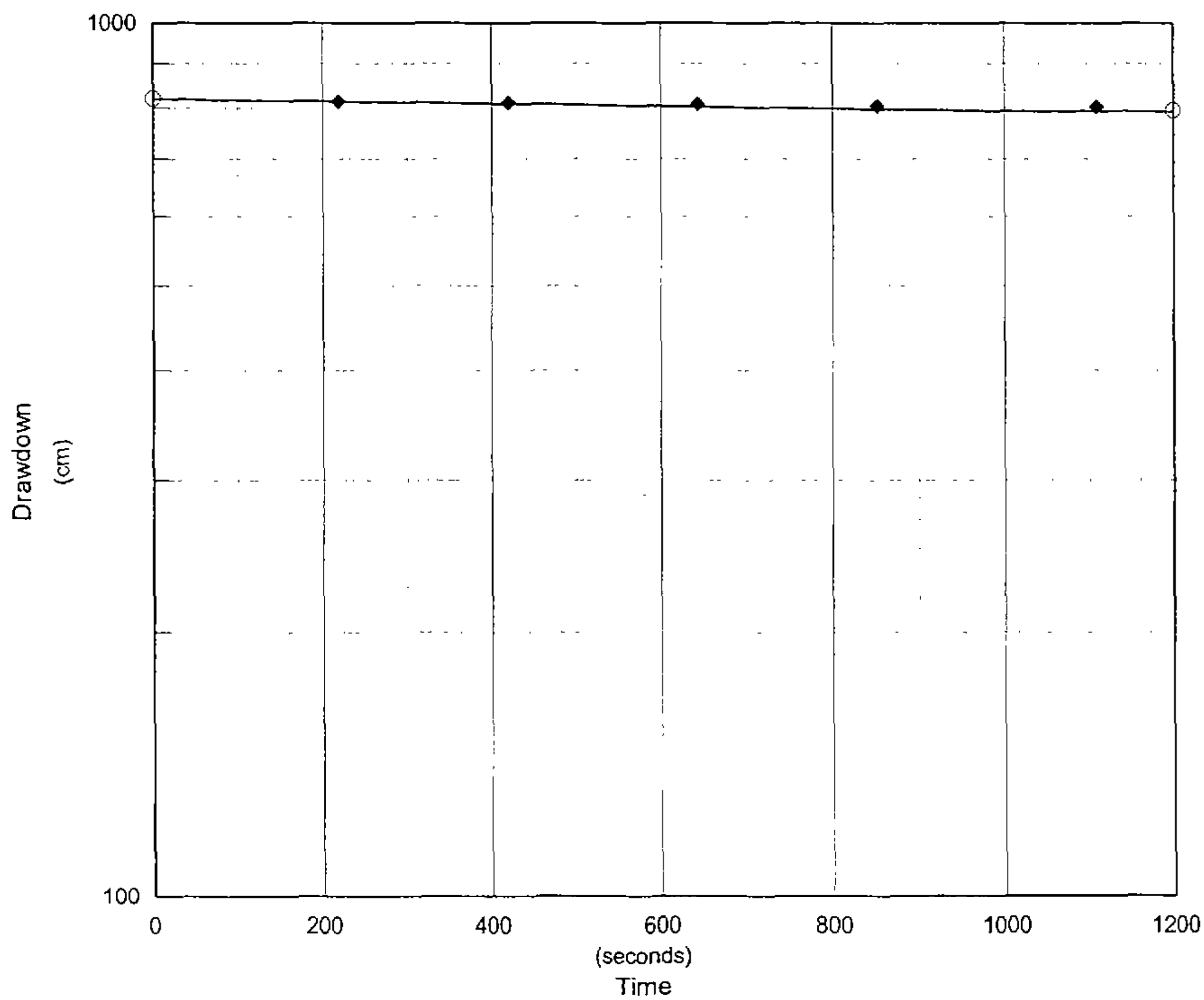


Modified Slug Test Data
Monitoring Well 228B Test No. 1
Guernsey County, Ohio

Testing Date: 12/22/99
Static Level: 20.60

			Plot Data		
Time		Water Level	Time	Drawdown	Match Pts
Minutes	Seconds	(feet)	(seconds)	(cm)	(cm)
			0		820
3	39	47.30	219	813.8	
7	0	47.20	420	810.8	
10	43	47.10	643	807.7	
14	12	47.00	852	804.7	
18	29	46.90	1109	801.6	
			1200		795

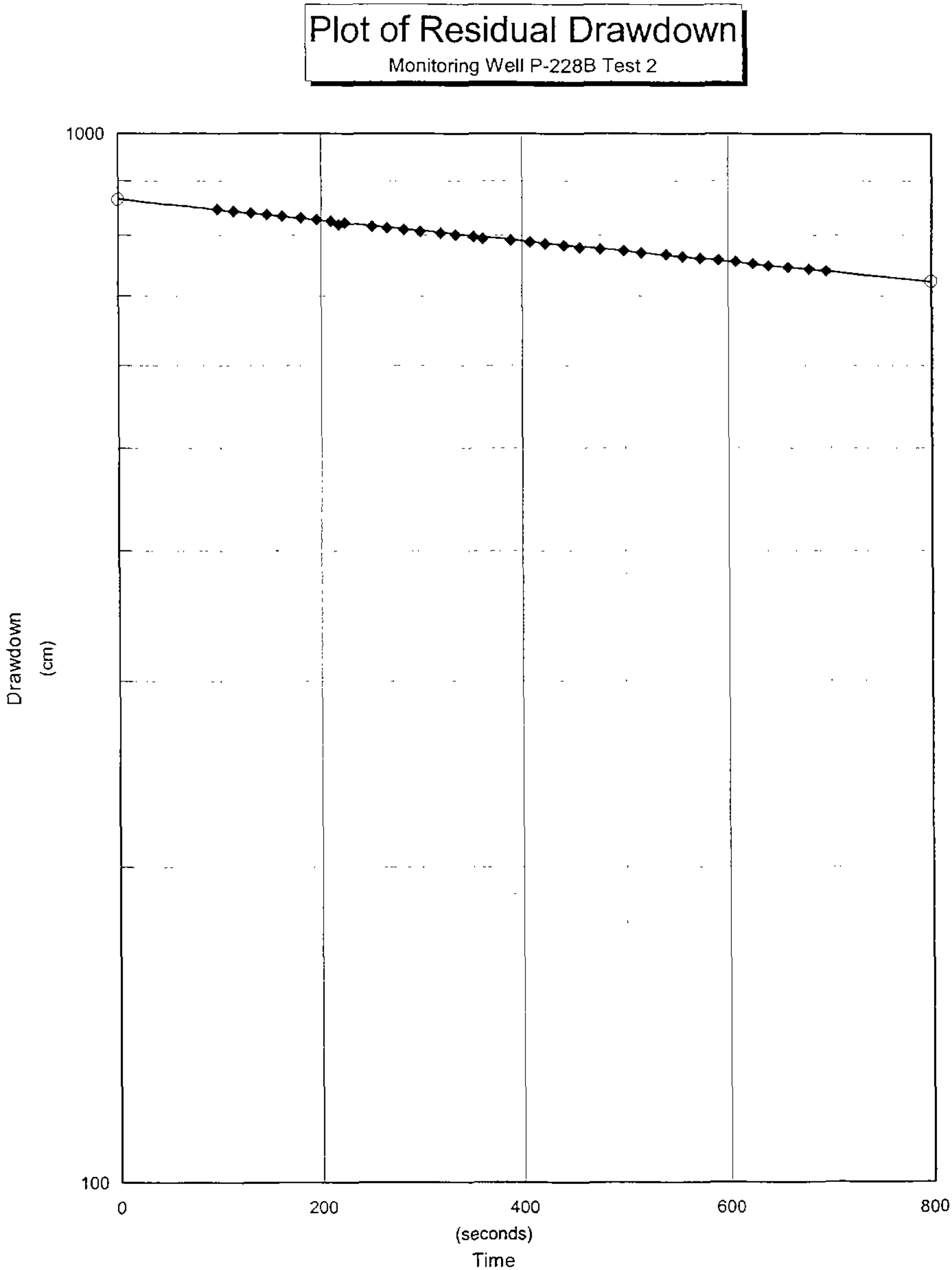
Plot of Residual Drawdown



Modified Slug Test Data
Monitoring Well 228B Test No. 2
Guernsey County, Ohio

Testing Date: 03/08/00
Static Level: 18.74

Time		Water Level	Plot Data		
			Time	Drawdown	Match Pts
Minutes	Seconds	(feet)	(seconds)	(cm)	(cm)
			0		865
1	38	46.50	98	846.1	
1	54	46.40	114	843.1	
2	11	46.30	131	840.0	
2	27	46.20	147	837.0	
2	42	46.10	162	833.9	
3	0	46.00	180	830.9	
3	16	45.90	196	827.8	
3	30	45.80	210	824.8	
3	44	45.70	224	821.7	
3	38	45.60	218	818.7	
4	11	45.50	251	815.6	
4	26	45.40	266	812.6	
4	43	45.30	283	809.5	
4	59	45.20	299	806.5	
5	19	45.10	319	803.5	
5	34	45.00	334	800.4	
5	52	44.90	352	797.4	
6	1	44.80	361	794.3	
6	29	44.70	389	791.3	
6	48	44.60	408	788.2	
7	3	44.50	423	785.2	
7	21	44.40	441	782.1	
7	36	44.30	456	779.1	
7	56	44.20	476	776.0	
8	19	44.10	499	773.0	
8	36	44.00	516	769.9	
9	0	43.90	540	766.9	
9	16	43.80	556	763.8	
9	33	43.70	573	760.8	
9	51	43.60	591	757.7	
10	8	43.50	608	754.7	
10	25	43.40	625	751.6	
10	40	43.30	640	748.6	
10	59	43.20	659	745.5	
11	19	43.10	679	742.5	
11	36	43.00	696	739.4	
			800		723



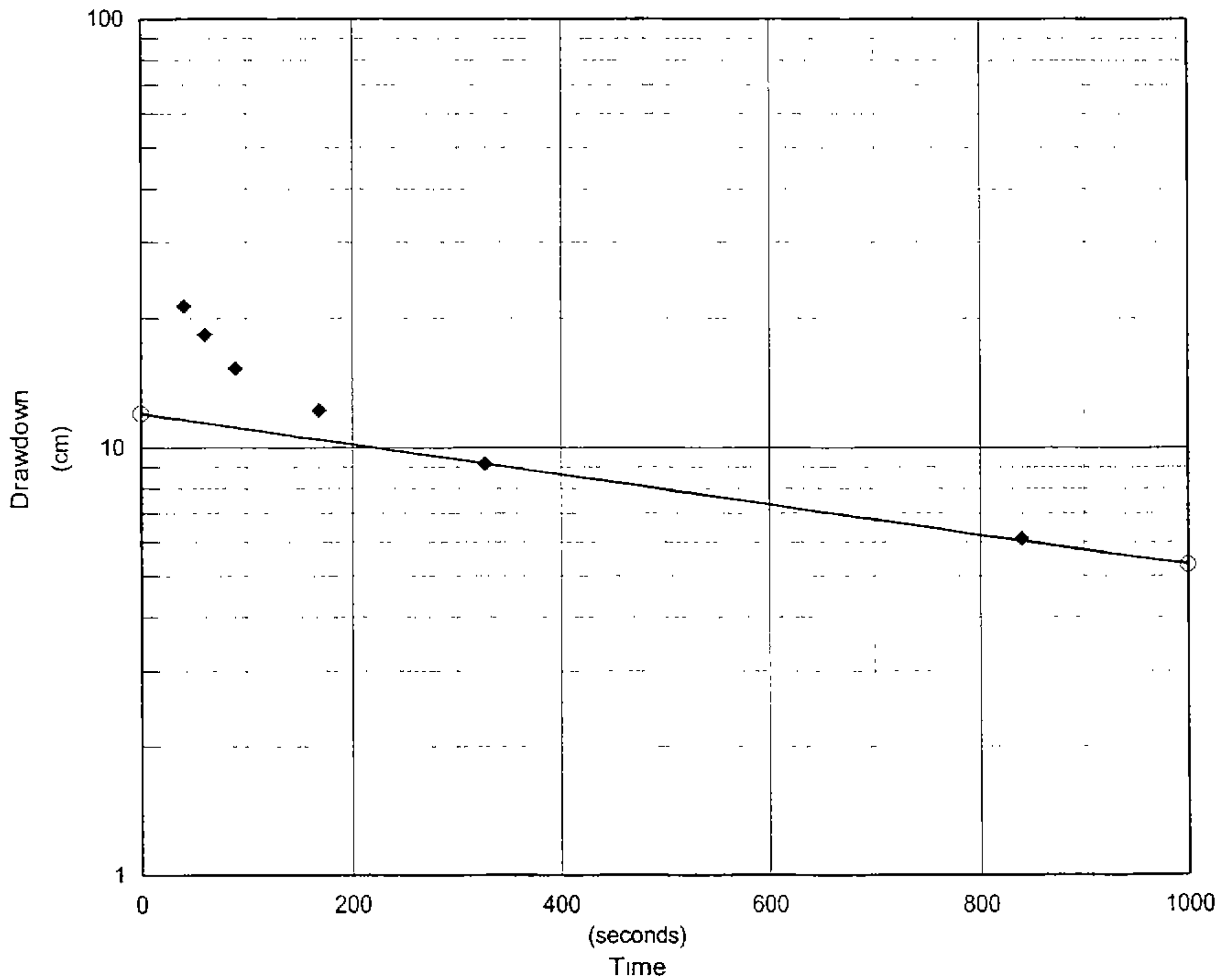
Plot of Residual Drawdown
Monitoring Well P-228B Test 2
1000
100
Drawdown
(cm)
0
200
400
600
800
(seconds)
Time

Modified Slug Test Data
Monitoring Well 228C Test No. 1
Guernsey County, Ohio

Testing Date: 12/22/99
Static Level: 13.50

Time		Water Level	Plot Data		
			Time	Drawdown	Match Pts
Minutes	Seconds	(feet)	(seconds)	(cm)	(cm)
			0		12
0	41	14.20	41	21.3	
1	1	14.10	61	18.3	
1	30	14.00	90	15.2	
2	49	13.90	169	12.2	
5	27	13.80	327	9.1	
14	0	13.70	840	6.1	
			1000		5.3

Plot of Residual Drawdown

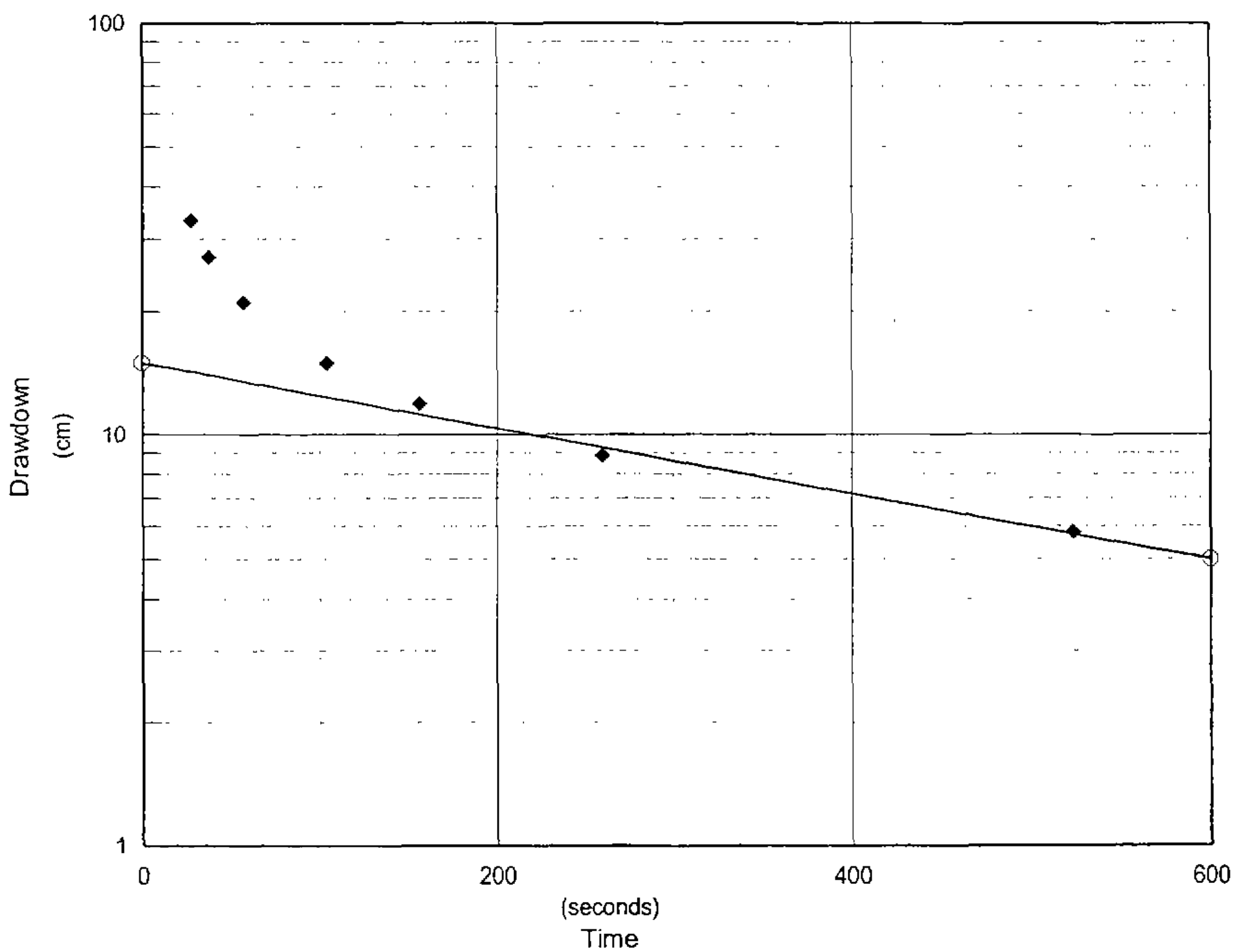


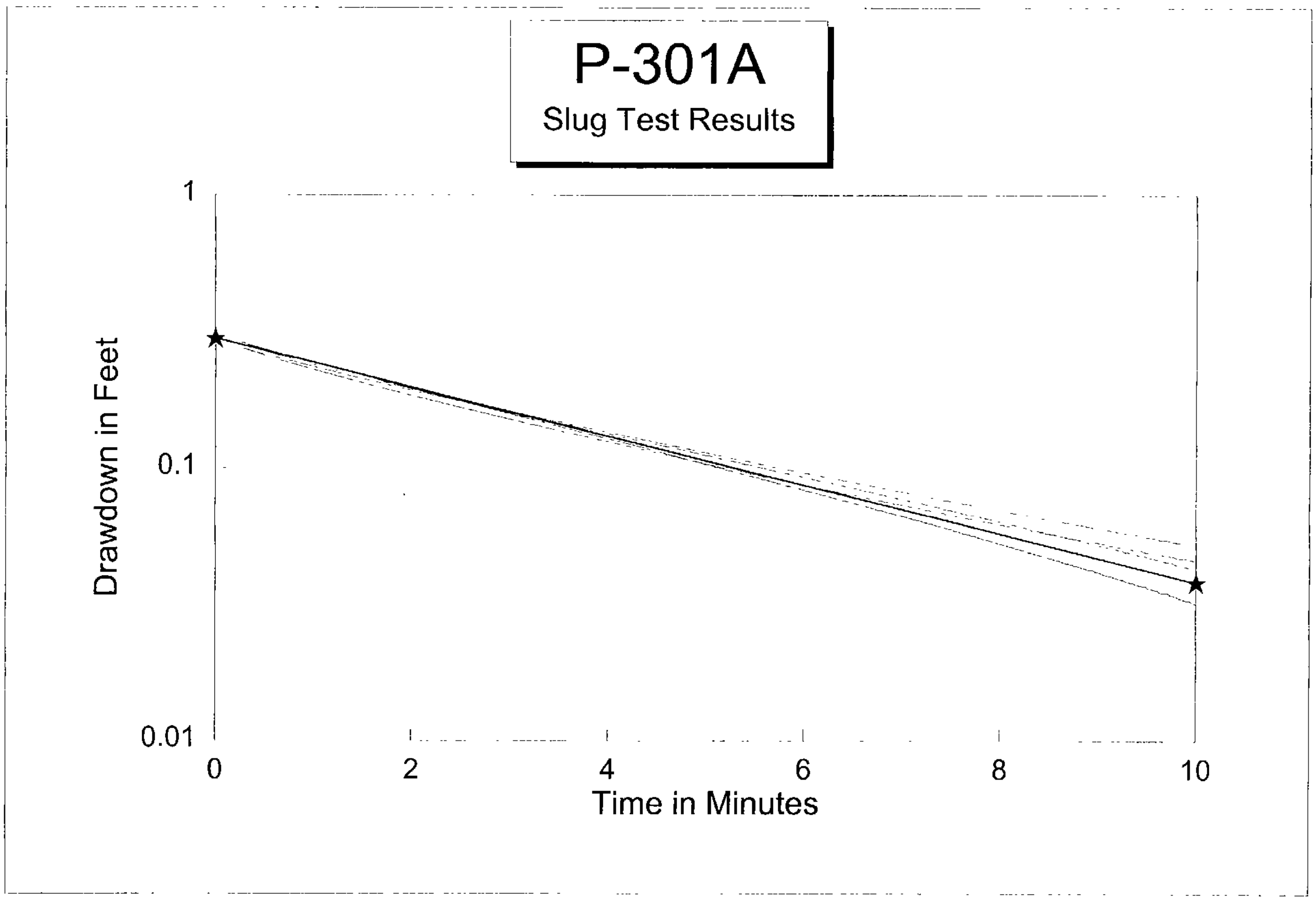
Modified Slug Test Data
Monitoring Well 228C Test No. 2
Guernsey County, Ohio

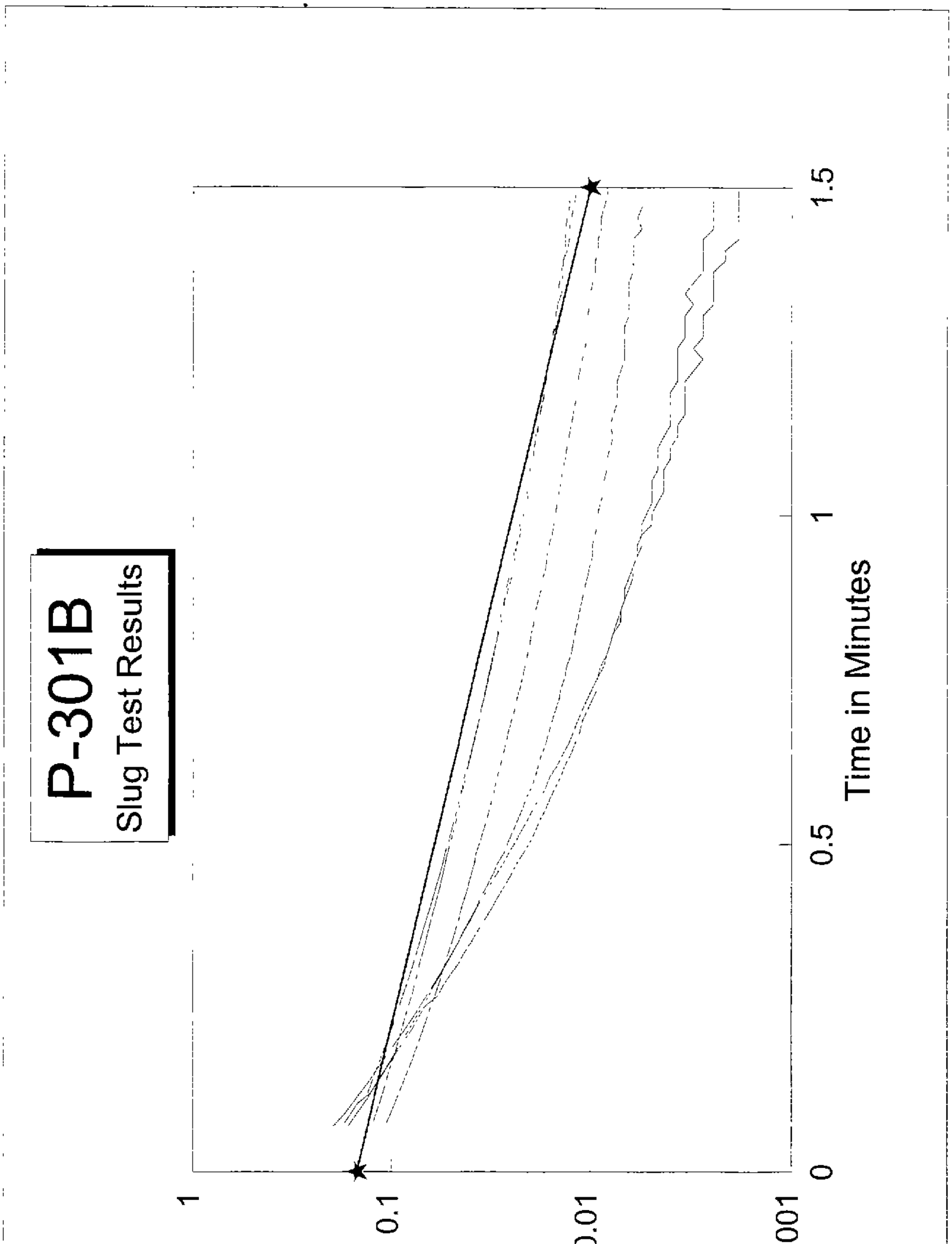
Testing Date: 03/08/00
Static Level: 12.81

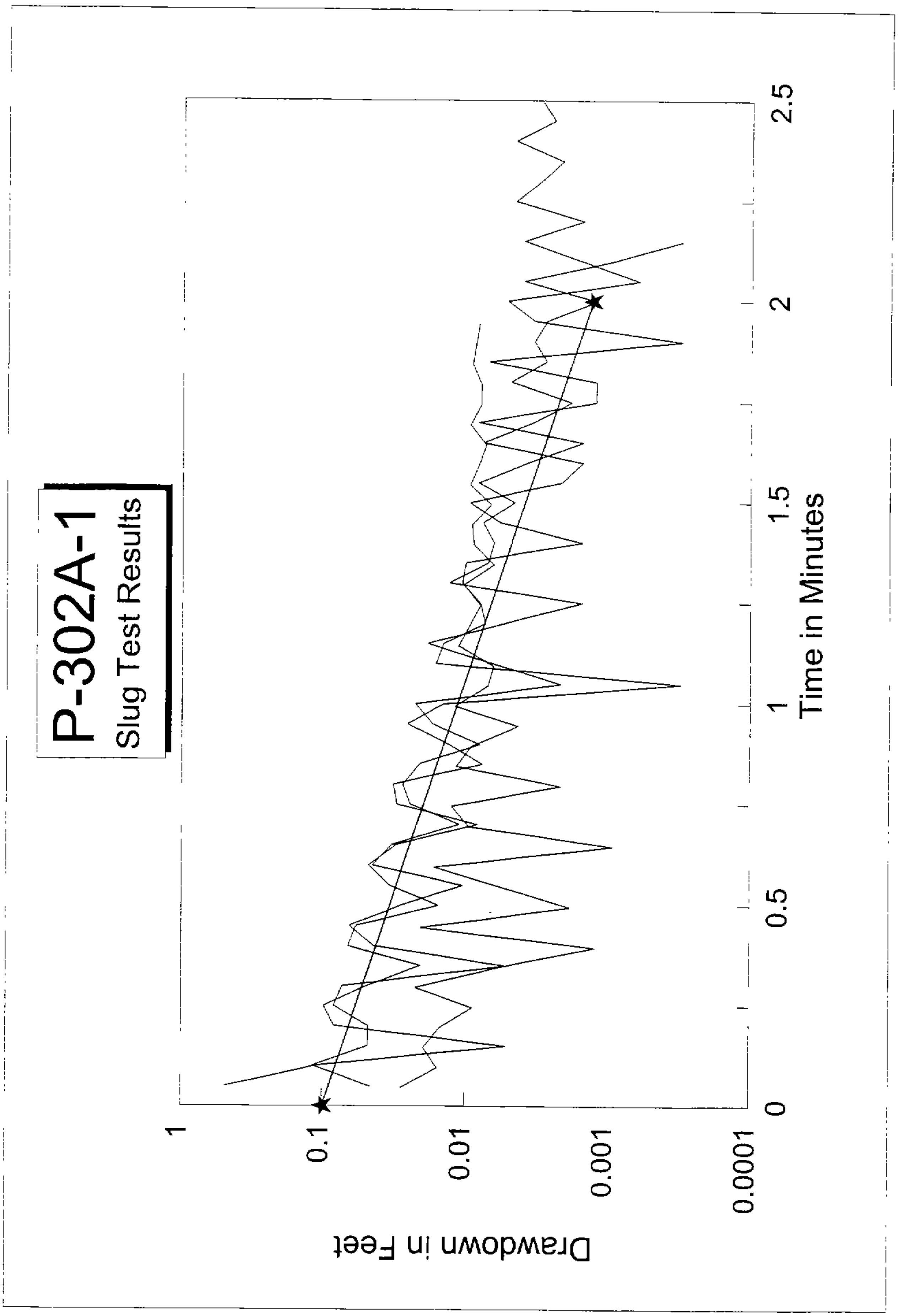
Time		Water Level	Plot Data		
Minutes	Seconds	(feet)	Time (seconds)	Drawdown (cm)	Match Pts (cm)
			0		15
0	27	13.90	27	33.2	
0	37	13.70	37	27.1	
0	57	13.50	57	21.0	
1	44	13.30	104	14.9	
2	36	13.20	156	11.9	
4	20	13.10	260	8.8	
8	43	13.00	523	5.8	
			600		5

Plot of Residual Drawdown

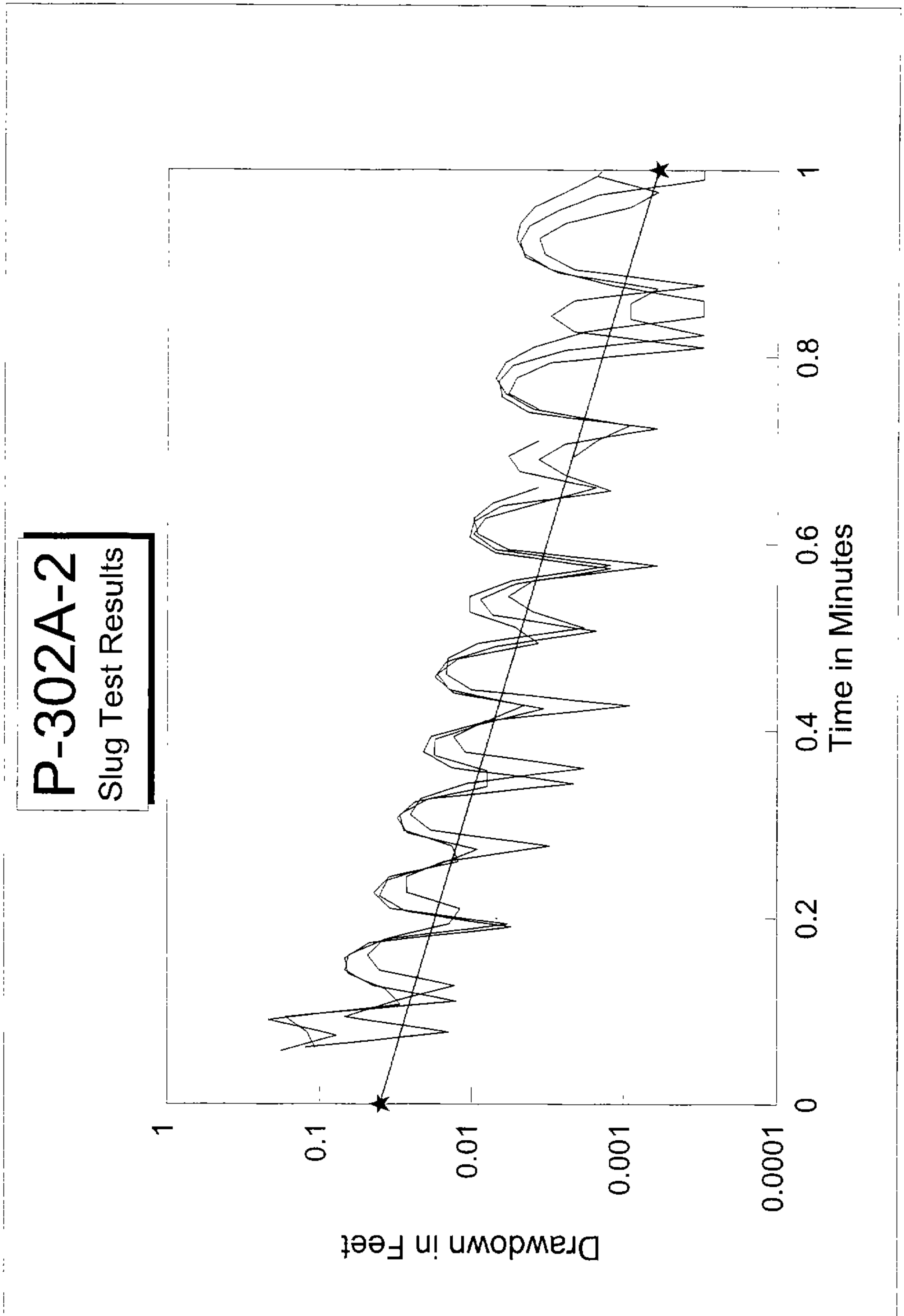


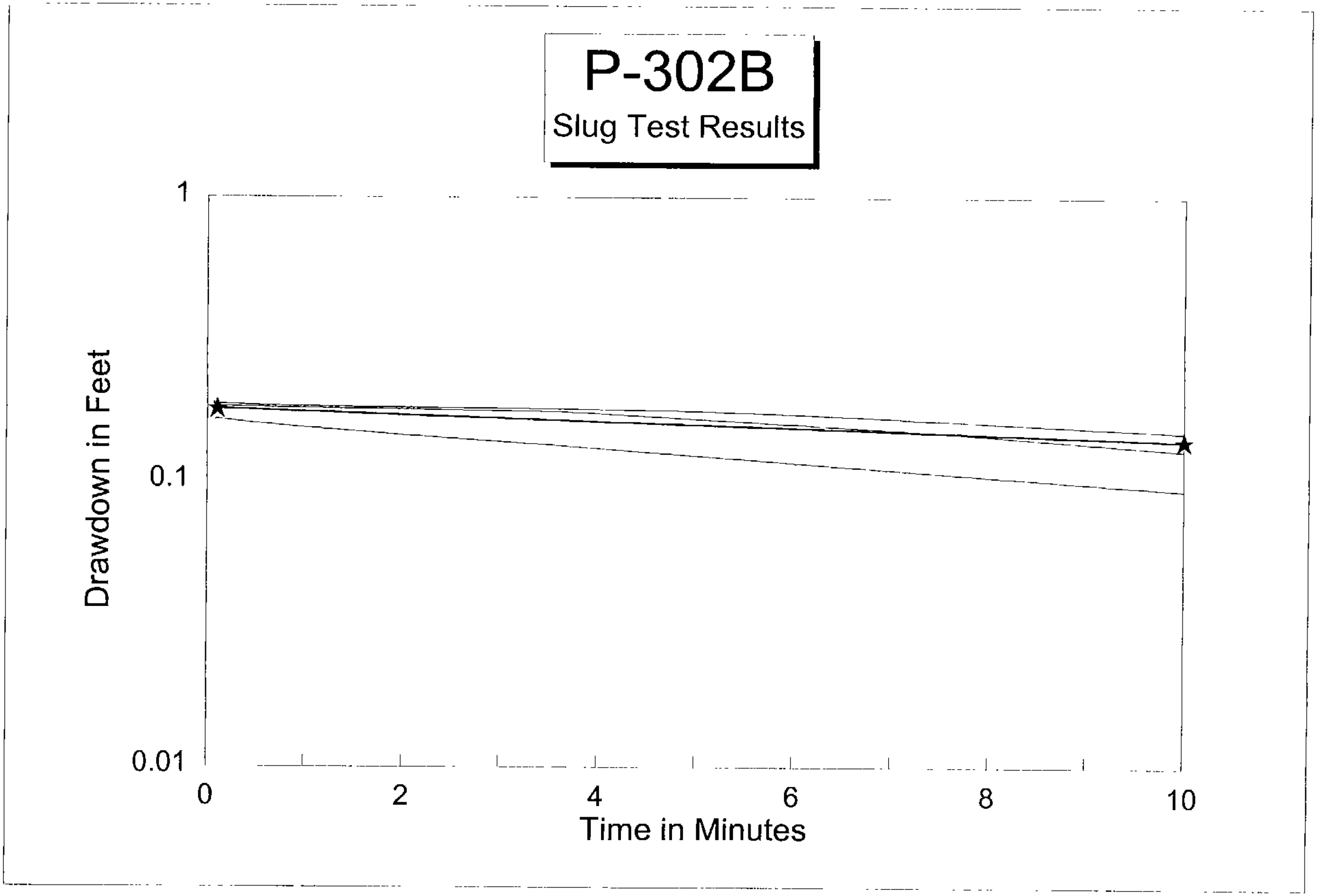

P-301A
Slug Test Results
Drawdown in Feet
1
0.1
0.01
0
2
4
6
8
10
Time in Minutes

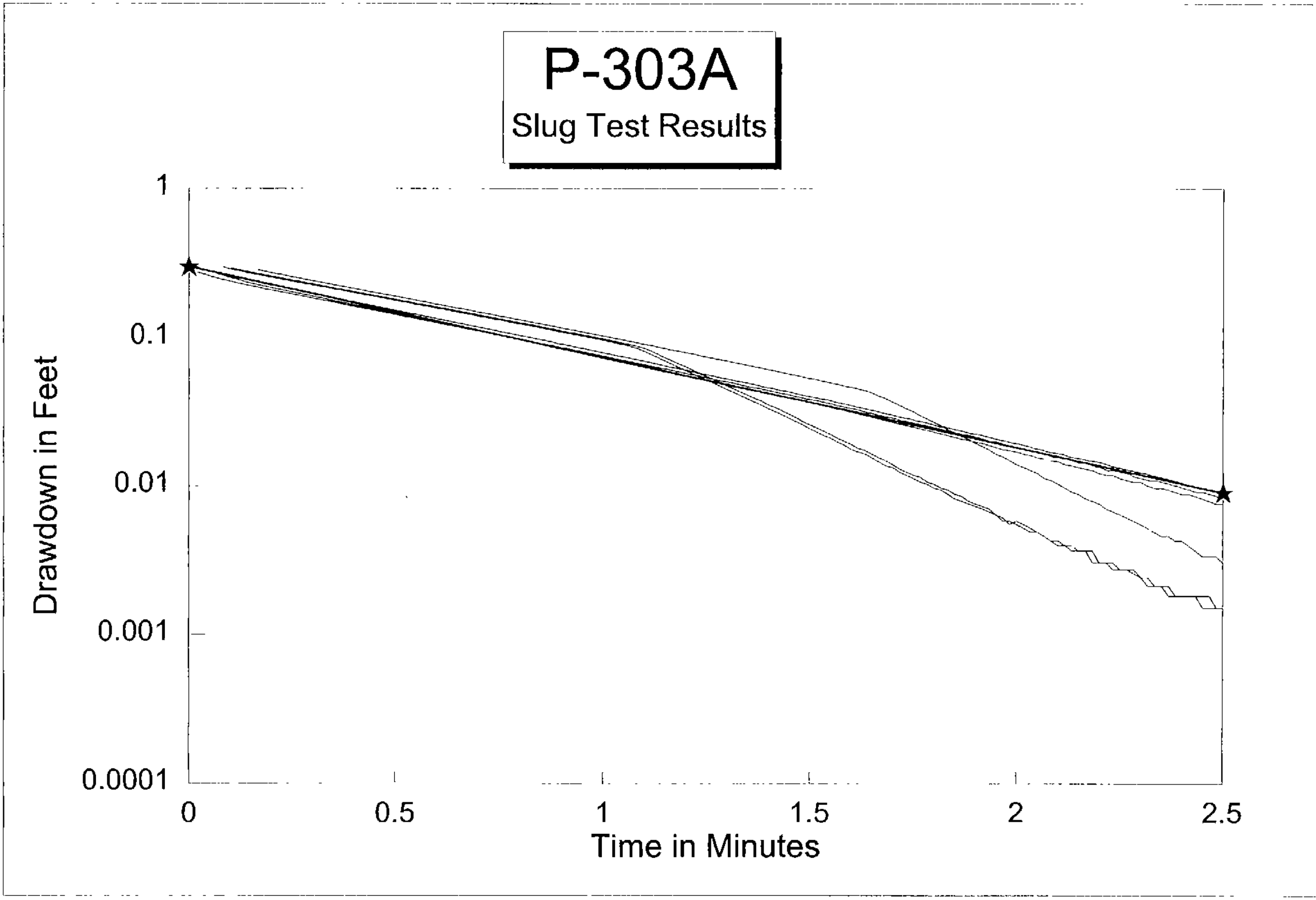

P-301B
Slug Test Results
Drawdown in Feet
1
0.1
0.01
0.001
Time in Minutes
0
0.5
1
1.5

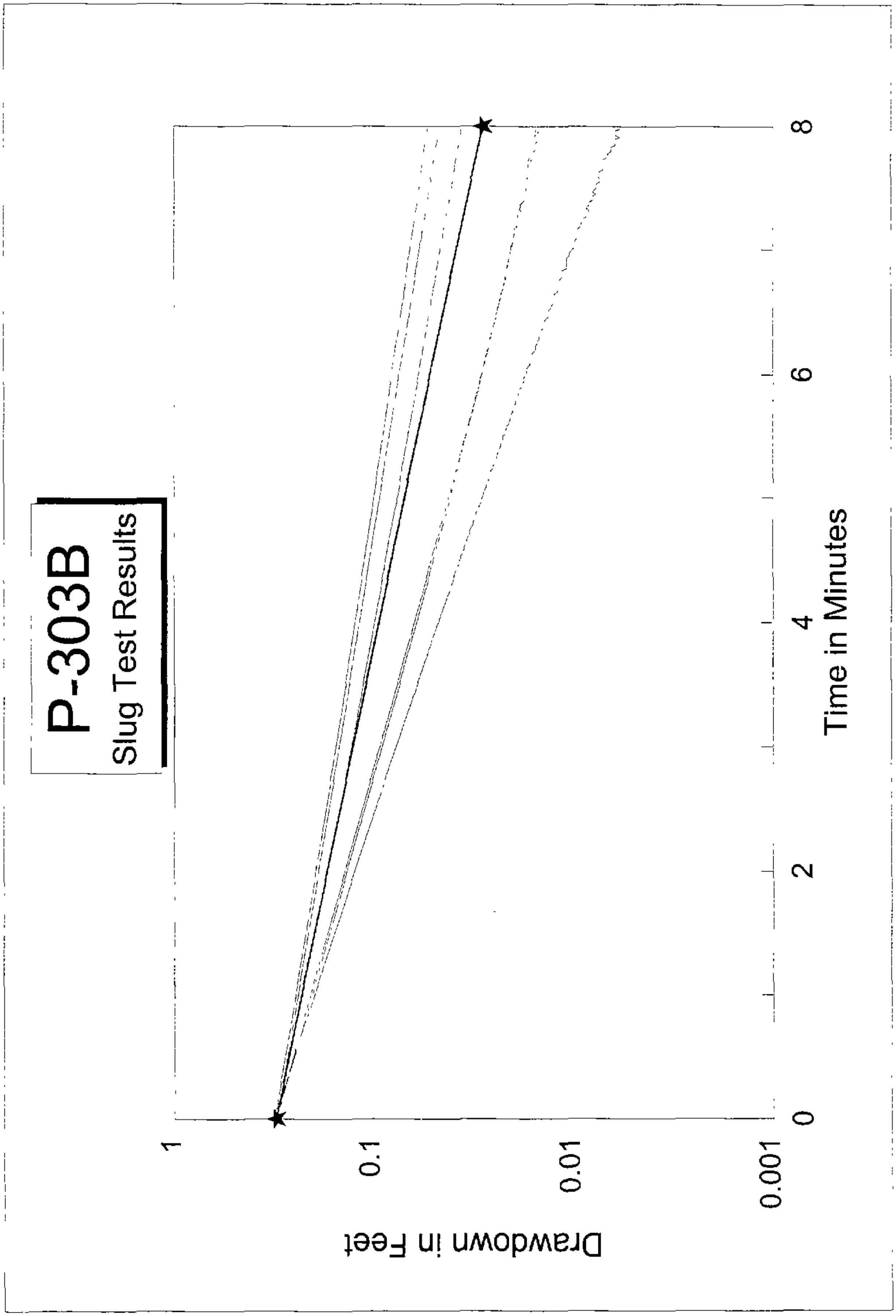


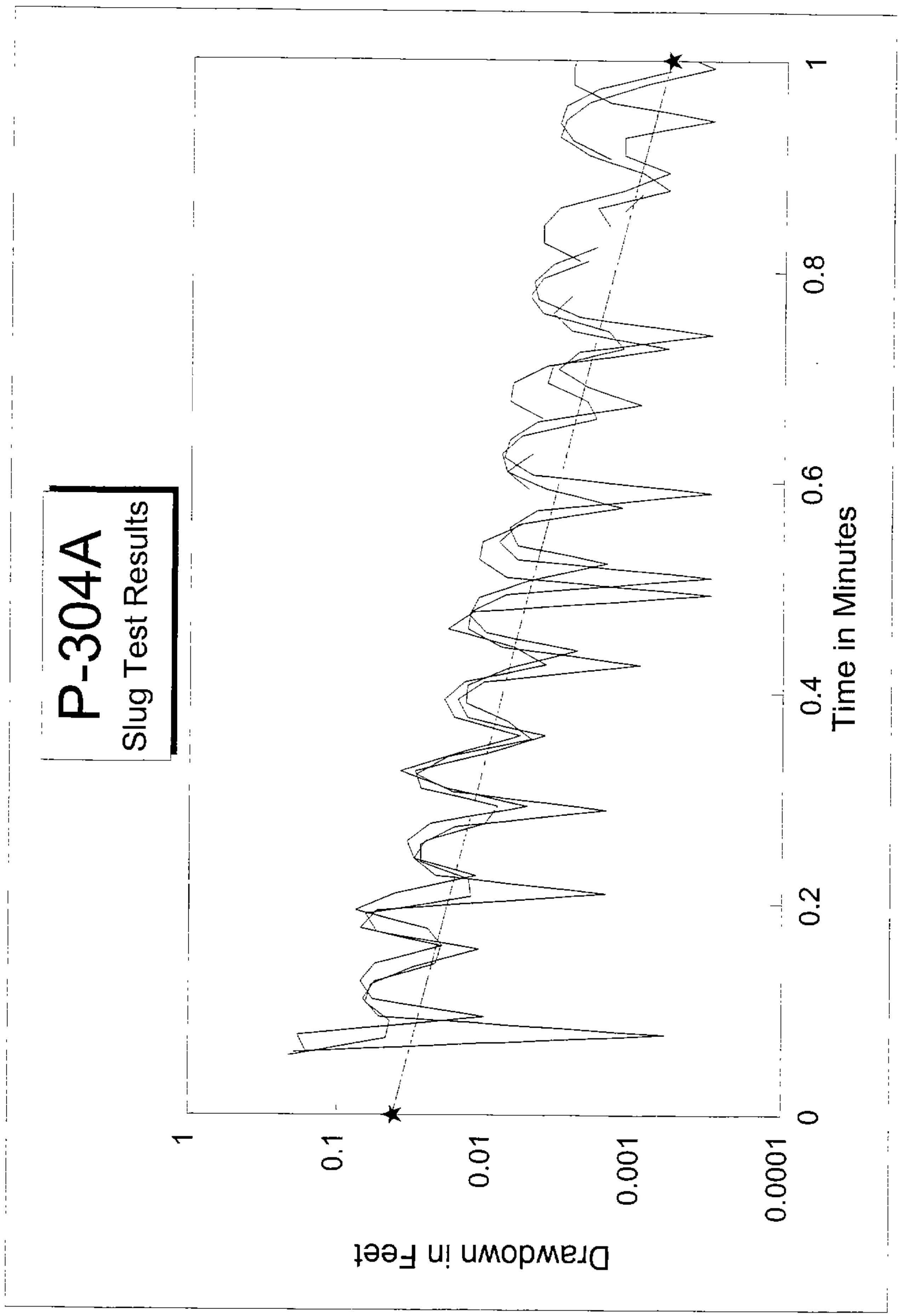
P-302A-1
Slug Test Results
Drawdown in Feet
1
0.1
0.01
0.001
0.0001
0
0.5
1
1.5
2
2.5
Time in Minutes

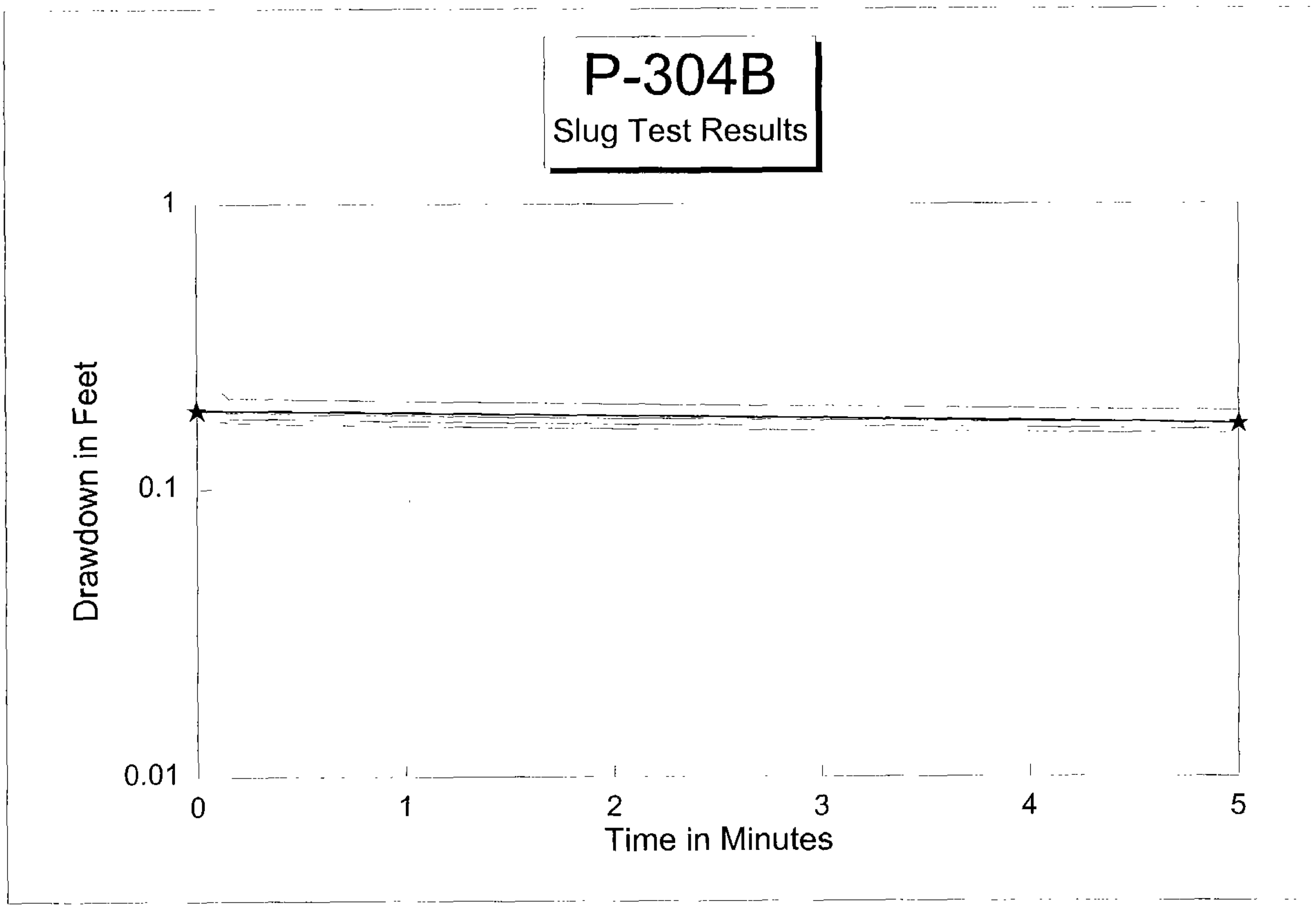

P-302A-2
Slug Test Results
Drawdown in Feet
1
0.1
0.01
0.001
0.0001
Time in Minutes
0
0.2
0.4
0.6
0.8
1

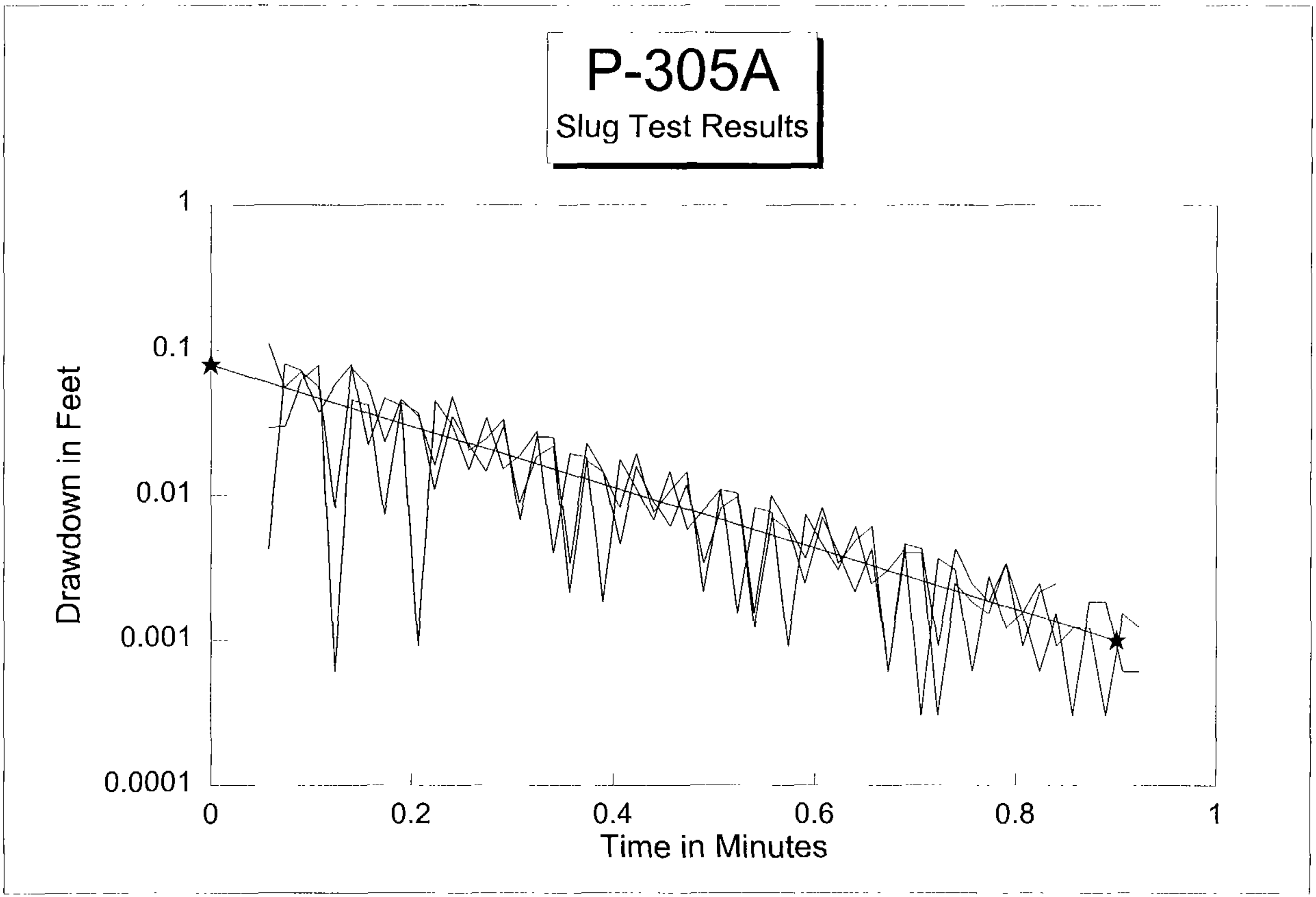

P-302B
Slug Test Results
Drawdown in Feet
1
0.1
0.01
0
2
4
6
8
10
Time in Minutes

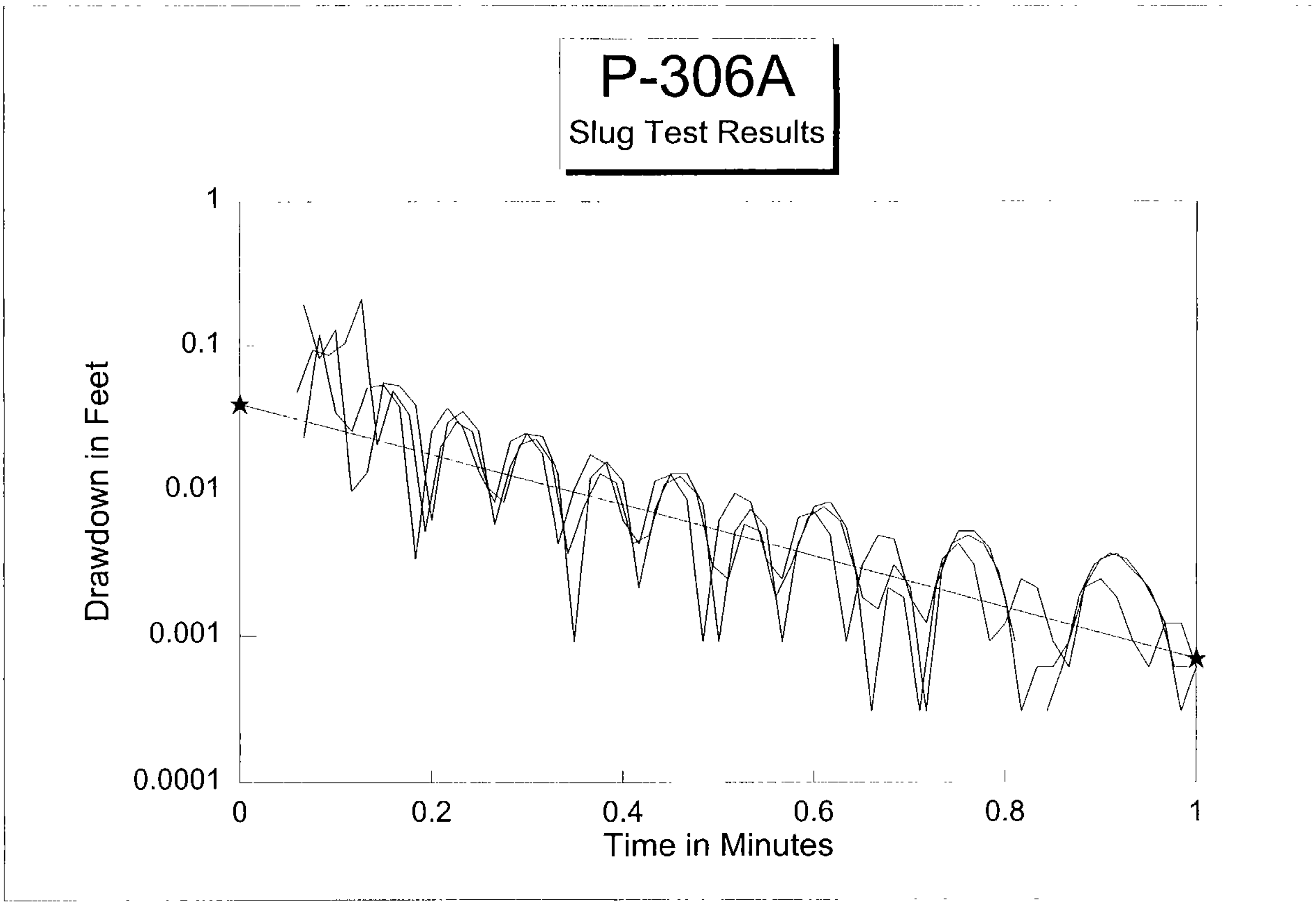

P-303A
Slug Test Results
Drawdown in Feet
1
0.1
0.01
0.001
0.0001
0
0.5
1
1.5
2
2.5
Time in Minutes

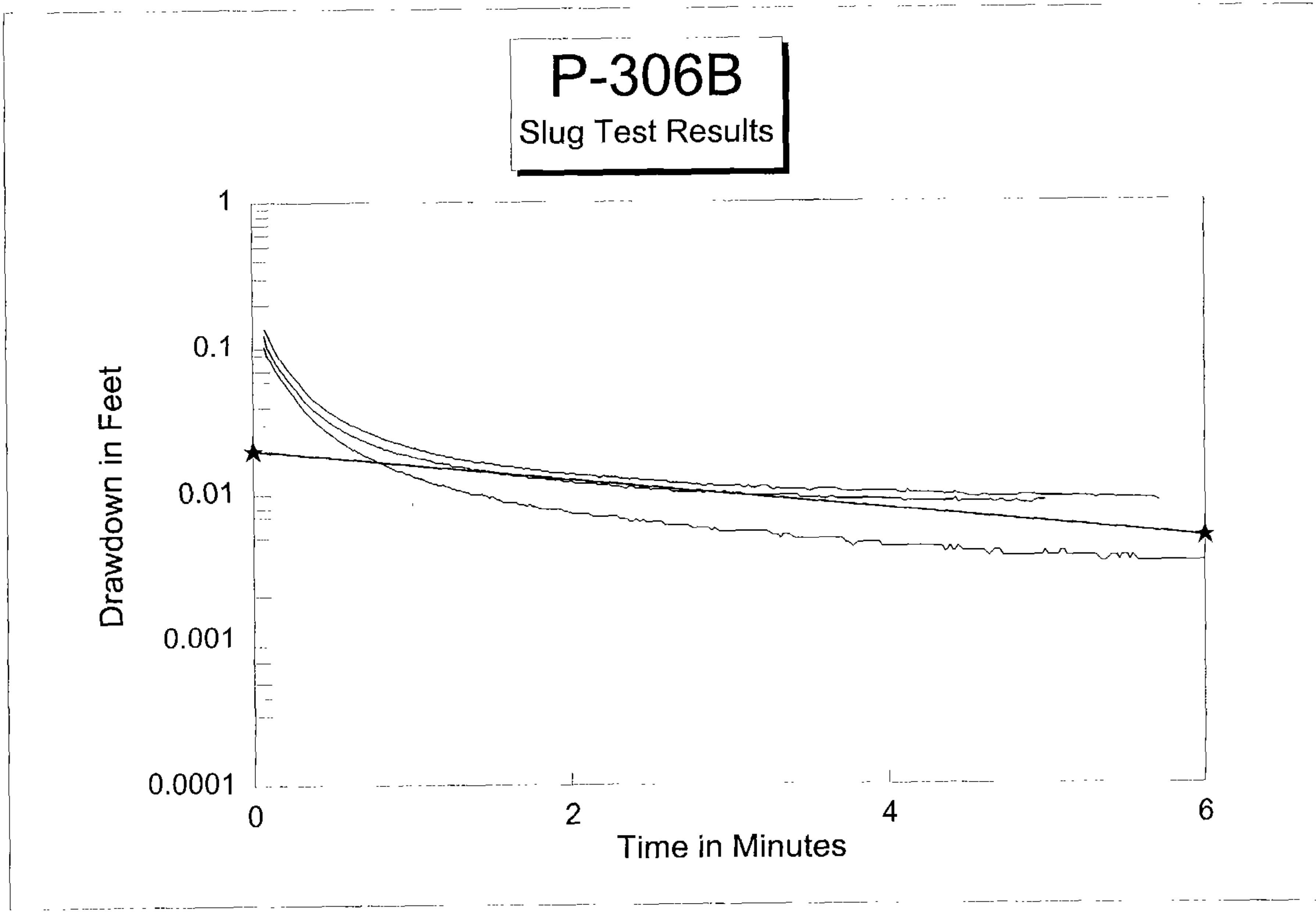

P-303B
Slug Test Results
Drawdown in Feet
1
0.1
0.01
0.001
0
2
4
6
8
Time in Minutes

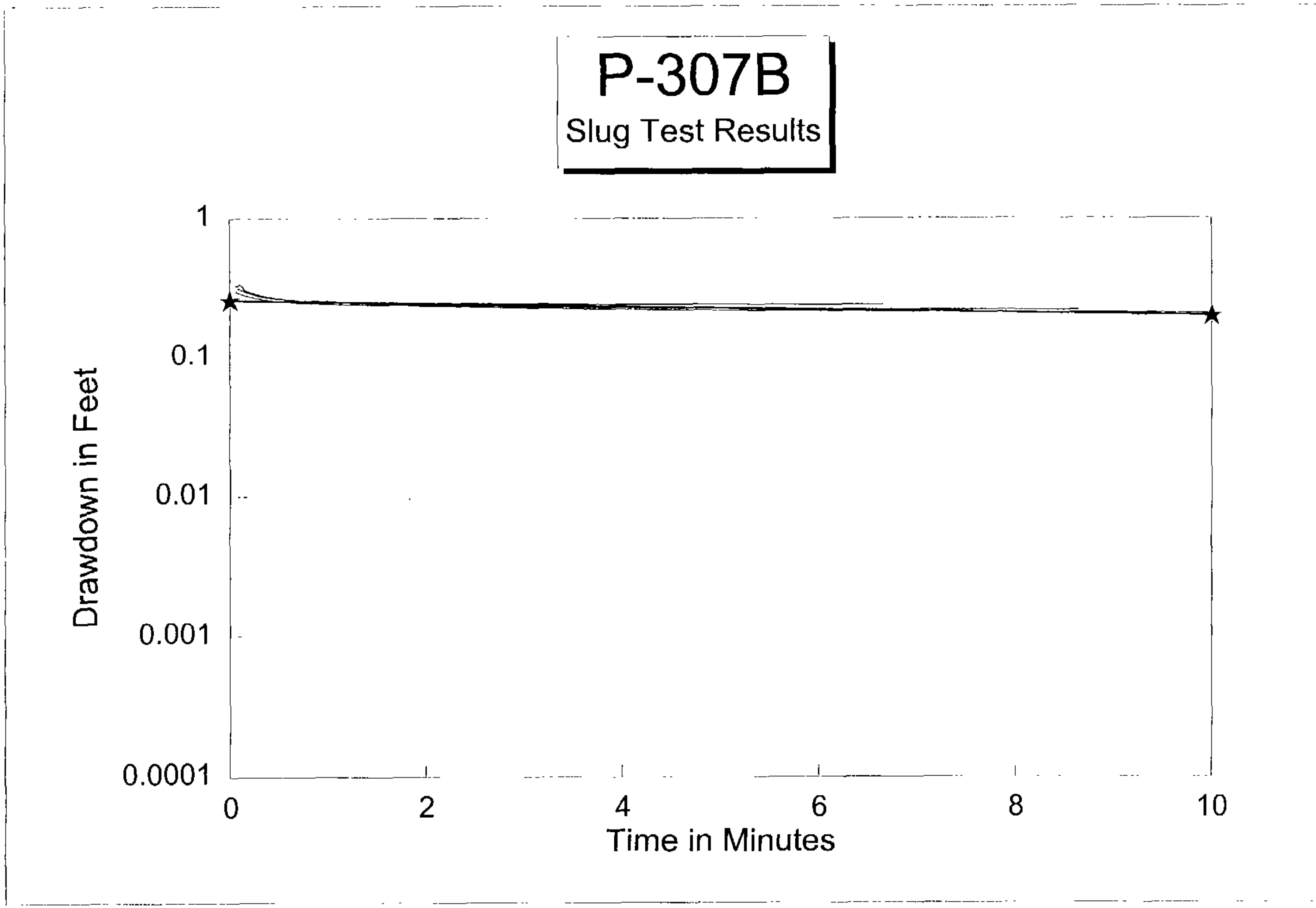

P-304A
Slug Test Results
Drawdown in Feet
1
0.1
0.01
0.001
0.0001
Time in Minutes
0
0.2
0.4
0.6
0.8
1

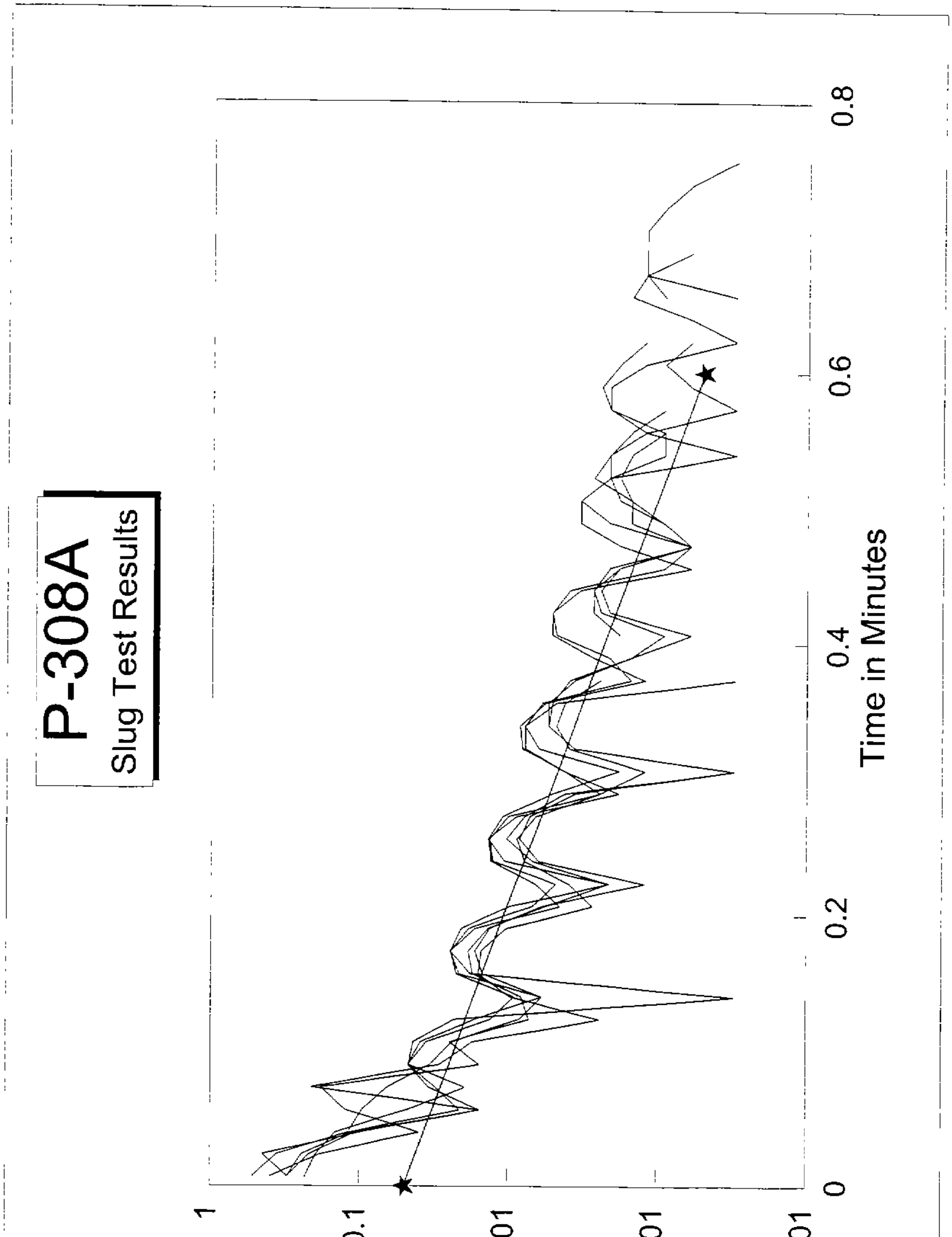

P-304B
Slug Test Results
Drawdown in Feet
1
0.1
0.01
0
1
2
3
4
5
Time in Minutes

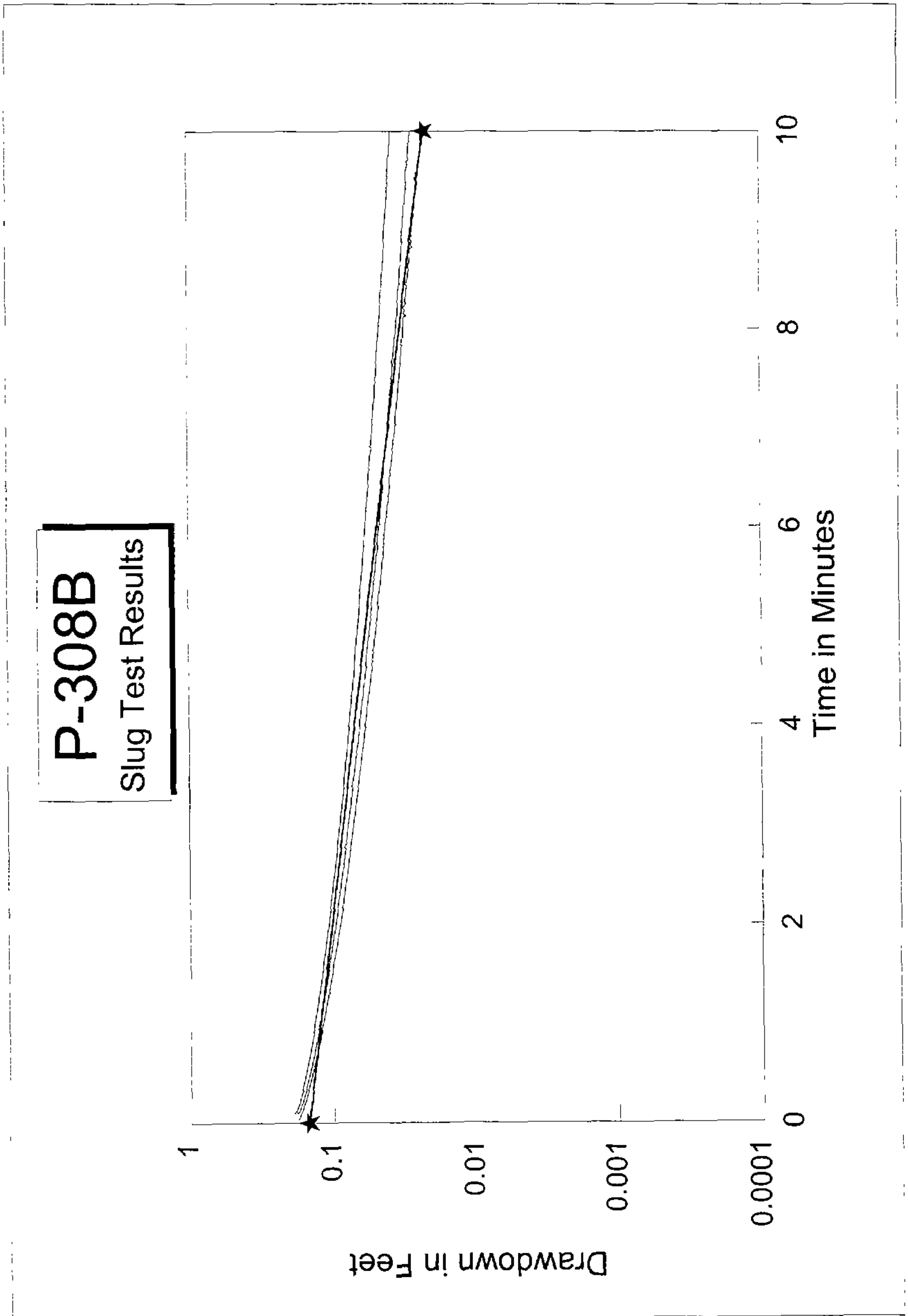

P-305A
Slug Test Results
Drawdown in Feet
1
0.1
0.01
0.001
0.0001
0
0.2
0.4
0.6
0.8
1
Time in Minutes

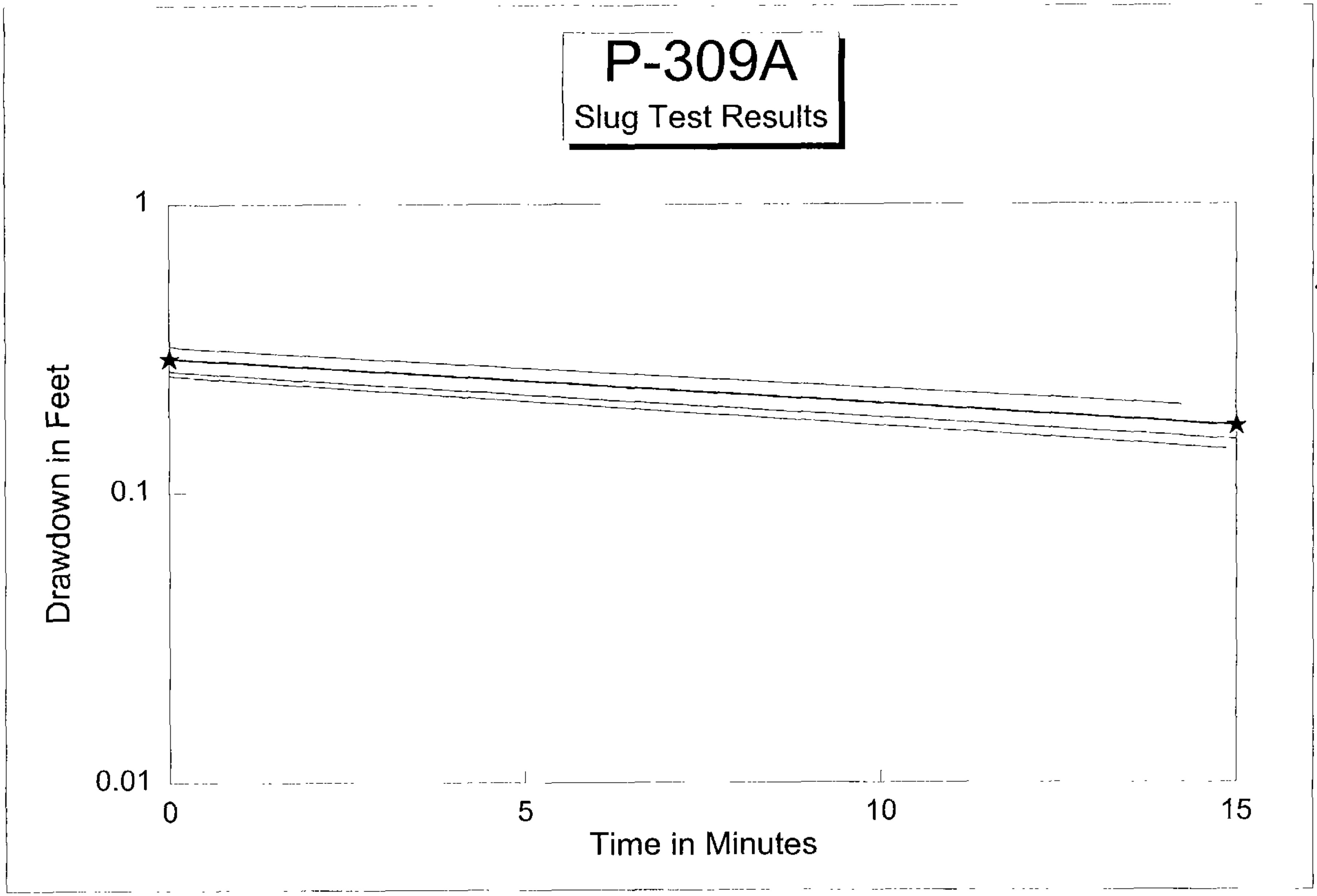

P-306A
Slug Test Results
1
0.1
0.01
0.001
0.0001
Drawdown in Feet
0
0.2
0.4
0.6
0.8
1
Time in Minutes


P-306B
Slug Test Results
Drawdown in Feet
1
0.1
0.01
0.001
0.0001
0
2
4
6
Time in Minutes

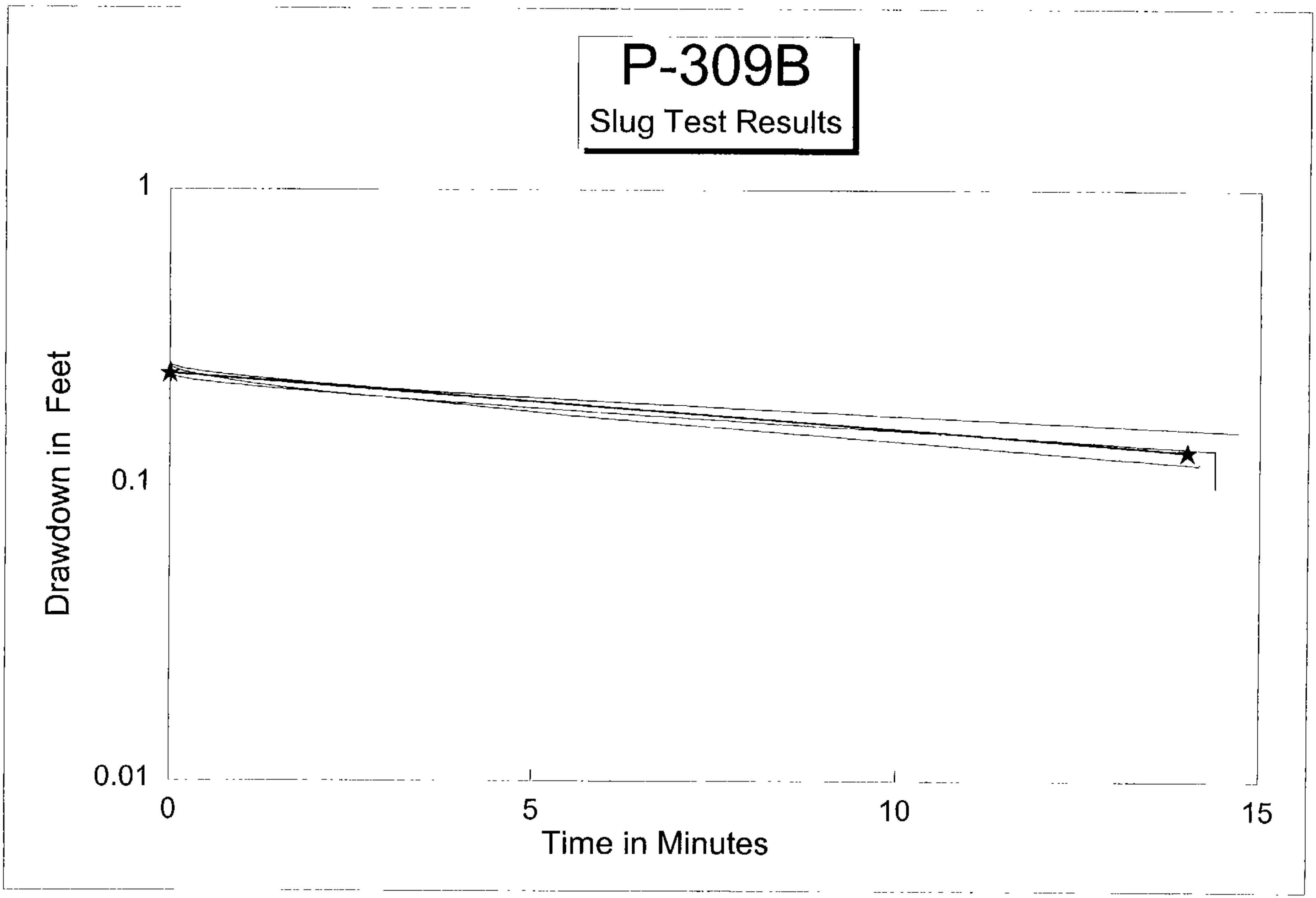

P-307B
Slug Test Results
1
0.1
0.01
0.001
0.0001
Drawdown in Feet
0
2
4
6
8
10
Time in Minutes

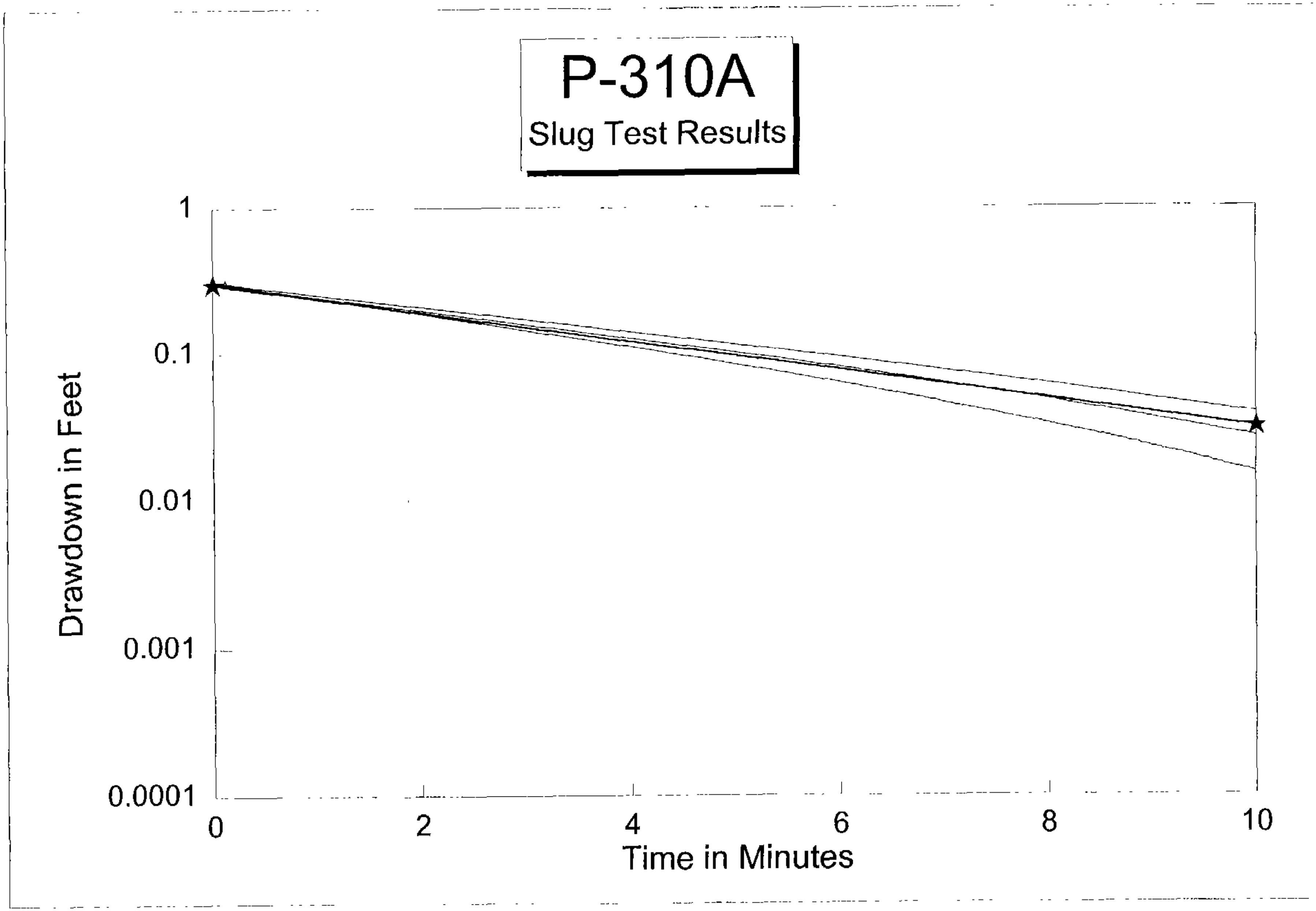

P-308A
Slug Test Results
Drawdown in Feet
1
0.1
0.01
0.001
0.0001
0
0.2
0.4
0.6
0.8
Time in Minutes


P-308B
Slug Test Results
Drawdown in Feet
1
0.1
0.01
0.001
0.0001
Time in Minutes
0
2
4
6
8
10

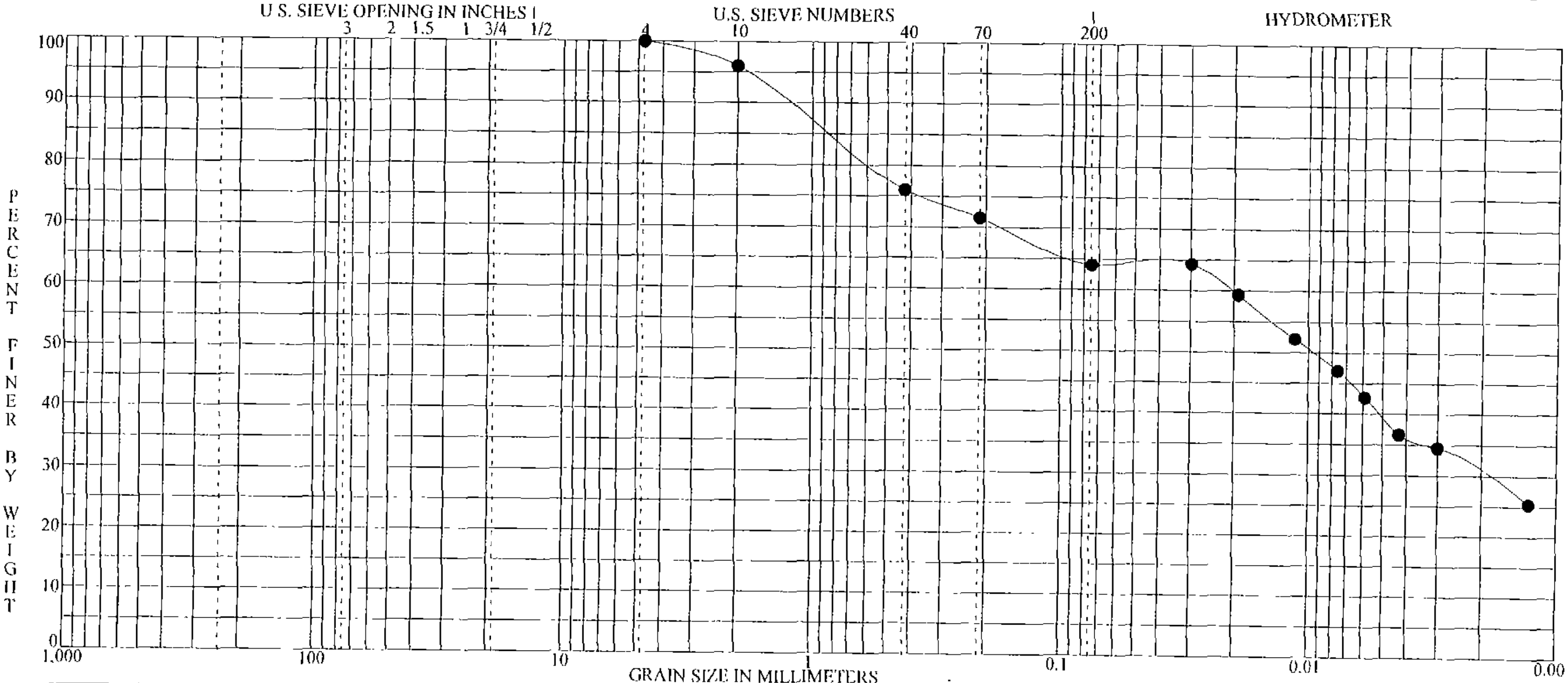

P-309A
Slug Test Results
Drawdown in Feet
1
0.1
0.01
0
5
10
15
Time in Minutes

177


P-309B
Slug Test Results
Drawdown in Feet
1
0.1
0.01
0
5
10
15
Time in Minutes


P-310A
Slug Test Results
1
0.1
0.01
0.001
0.0001
Drawdown in Feet
0
2
4
6
8
10
Time in Minutes

SECTION 10.3 - GEOTECHNICAL DATA (Soils Laboratory Testing)



BOULDERS	COBBLES	AGGREGATE		SAND		SILT OR CLAY
		coarse	fine	coarse	fine	

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	D15	D85
●	**B-407G S-2 3.5' to 4.5'**	**FILL: Brown, gray, and red-brown silty clay, "and" fine to coarse sand.**	**15**	**36**	**23**	**13**		**0.8533**
		ODOT CLASSIFICATION : A-6a(7)						
		AASHTO CLASSIFICATION : A-6(7)						

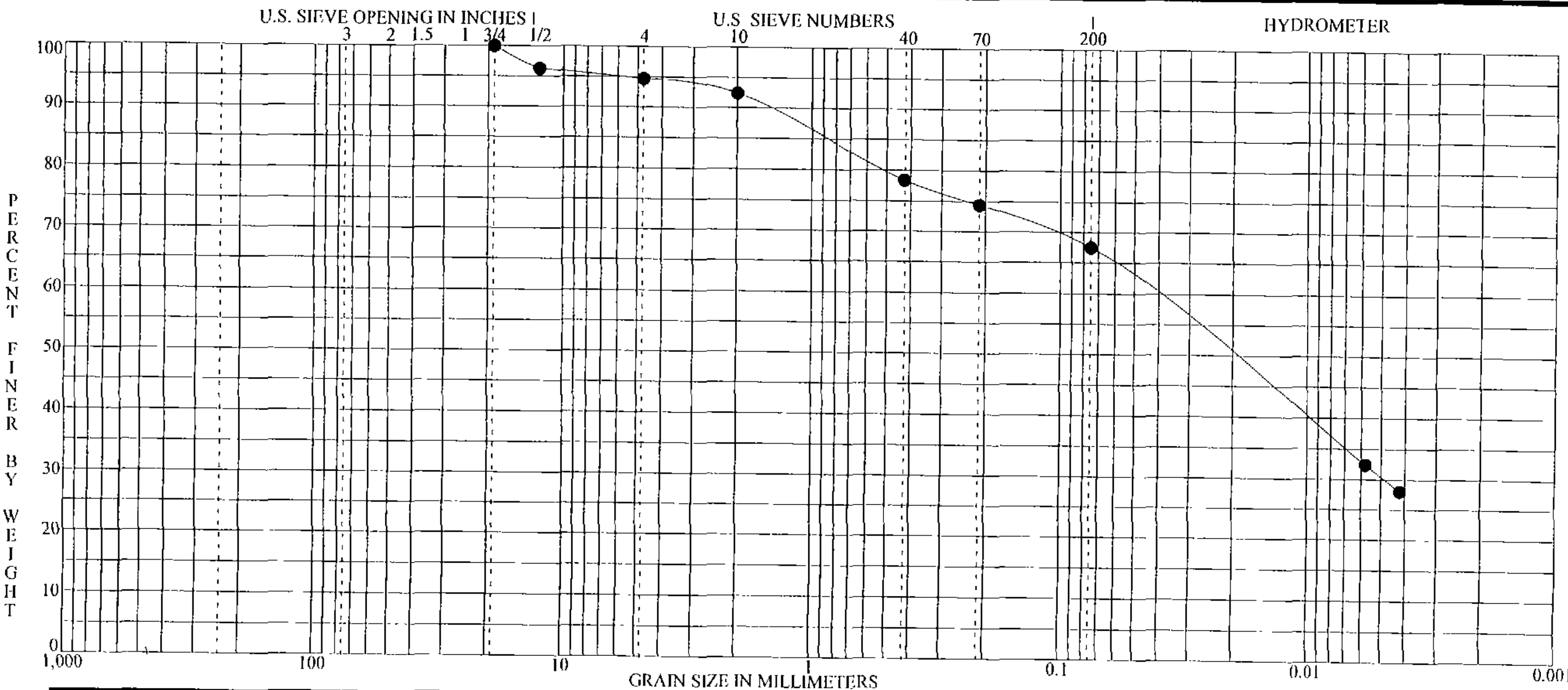
	Specimen Identification - Depth	D90	D50	D30	D10	%Aggregate	%Sand	%Silt	%Clay
●	**B-407G S-2 3.5' to 4.5'**	**1.2567**	**0.0096**	**0.0020**		**4**	**32**	**24**	**40**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **1/16/03**

GRN-ODOT



BOULDERS	COBBLES	GRAVEL coarse	GRAVEL fine	SAND coarse	SAND medium	SAND fine	SILT OR CLAY

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	B-407H S-1B 1.8' to 2.5'	**Brown mottled with gray silty clay, some fine to coarse sand, trace fine gravel.**	16	38	18	20		

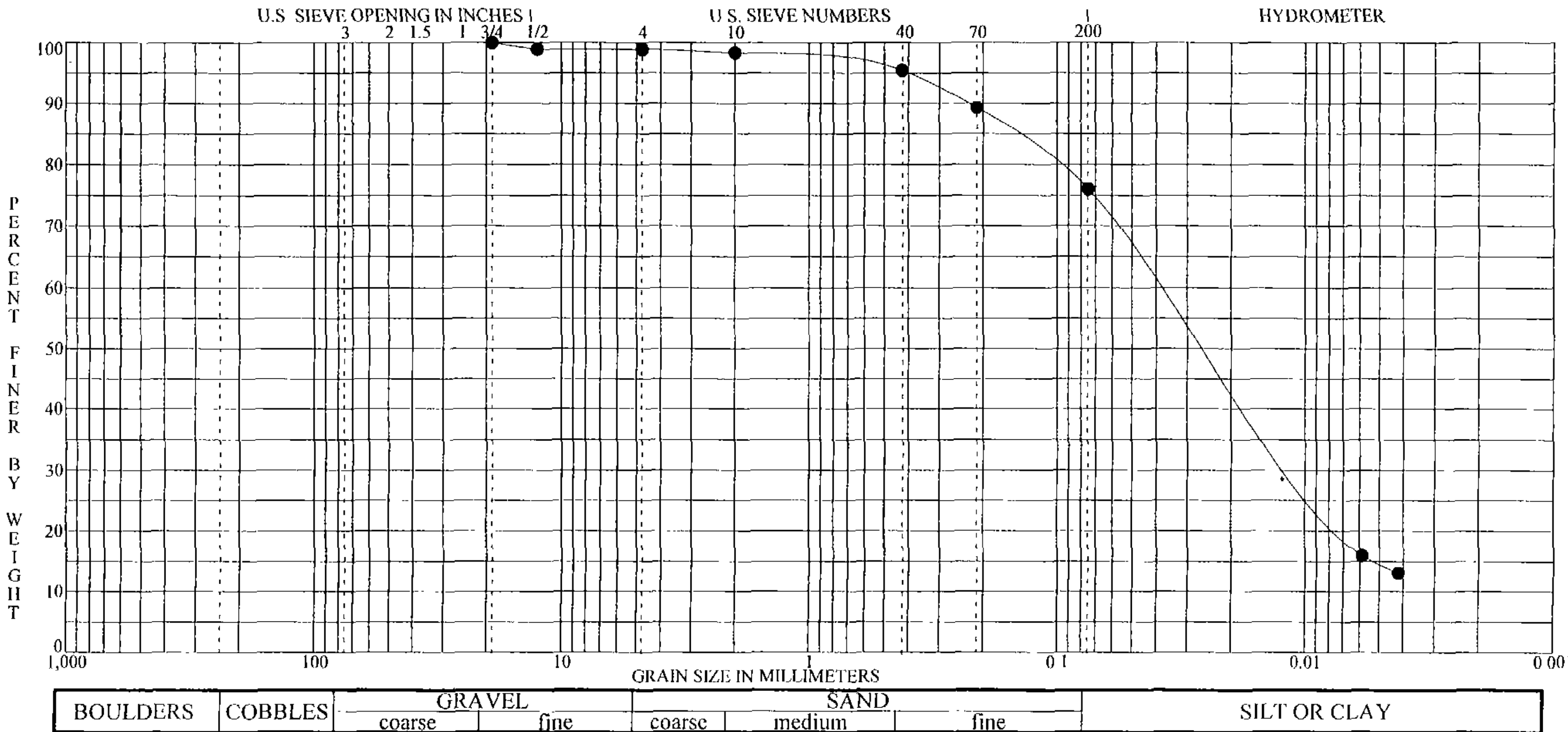
	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-407H S-1B 1.8' to 2.5'	19.0000	0.0434	0.0049		5.3	27.2	37.1	30.4

BBCM

GRADATION CURVE

PROJECT GUE-70-14.10
LOCATION GUERNSEY COUNTY, OHIO
JOB NO. 01107000.090 DATE 11/15/02

GRN-REG



Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● B-407H S-5 9.0' to 10.6'	**Gray organic silty clay, little fine to medium sand, trace coarse sand, trace fine gravel.**	**27**	**35**	**20**	**15**		

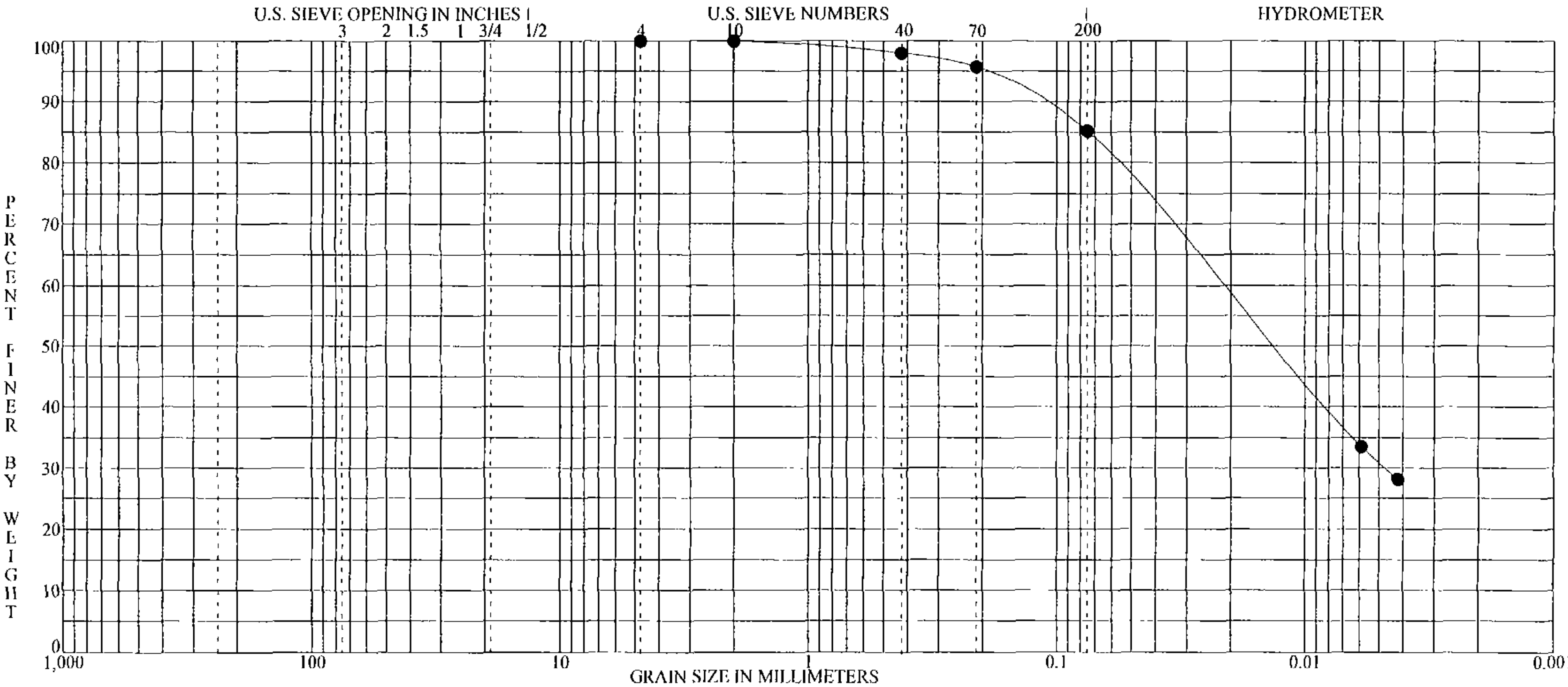
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-407H S-5 9.0' to 10.6'**	**19.0000**	**0.0380**	**0.0107**		**1.1**	**22.8**	**61.5**	**14.6**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● B-407H S-7 13.0' to 14.2'	**Gray mottled with brown silty clay, little fine to medium sand, trace coarse sand.**	23	37	20	17		

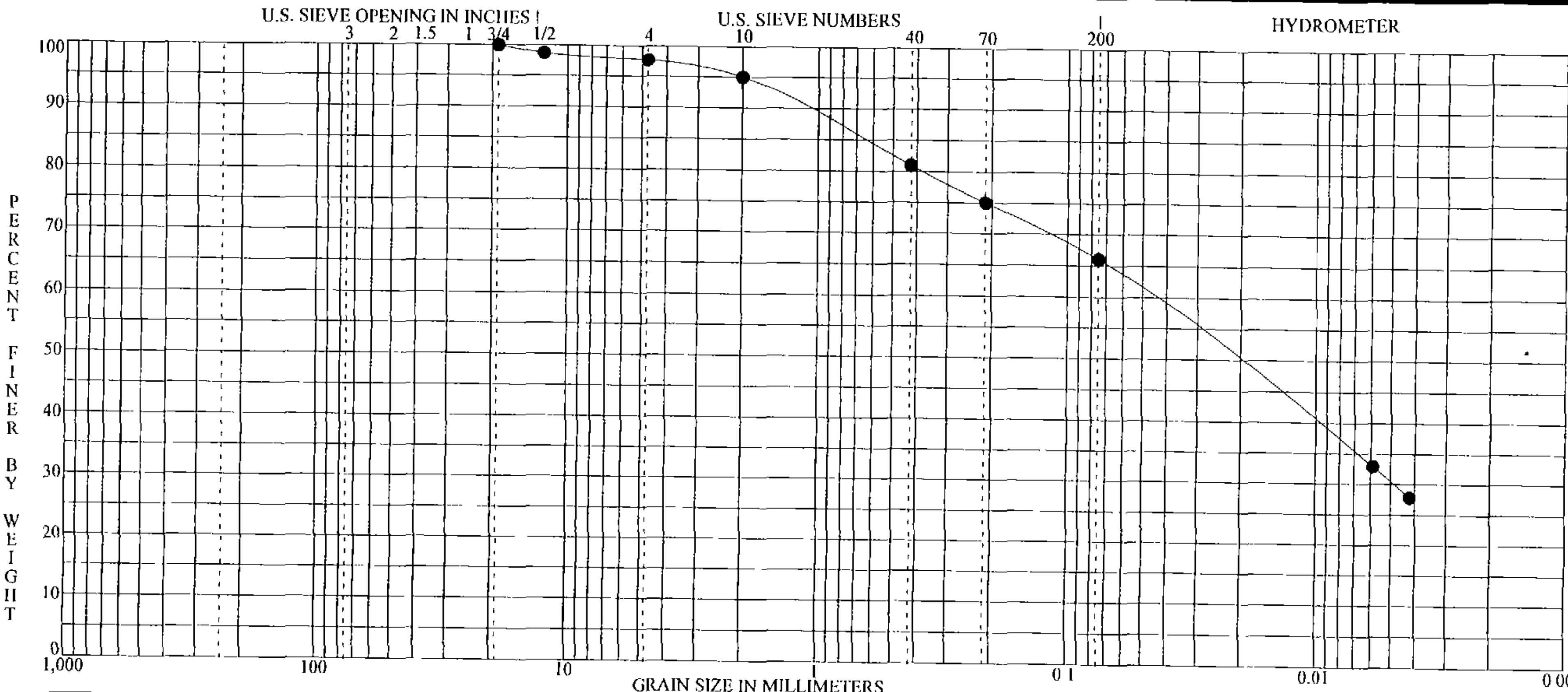
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● B-407H S-7 13.0' to 14.2'	4.7500	0.0217	0.0047		0.0	14.8	54.3	30.9

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	B-4071 S1B 2.0' to 2.6'	**Brown silty clay, some fine to coarse sand, trace fine gravel.**	15	35	20	15		

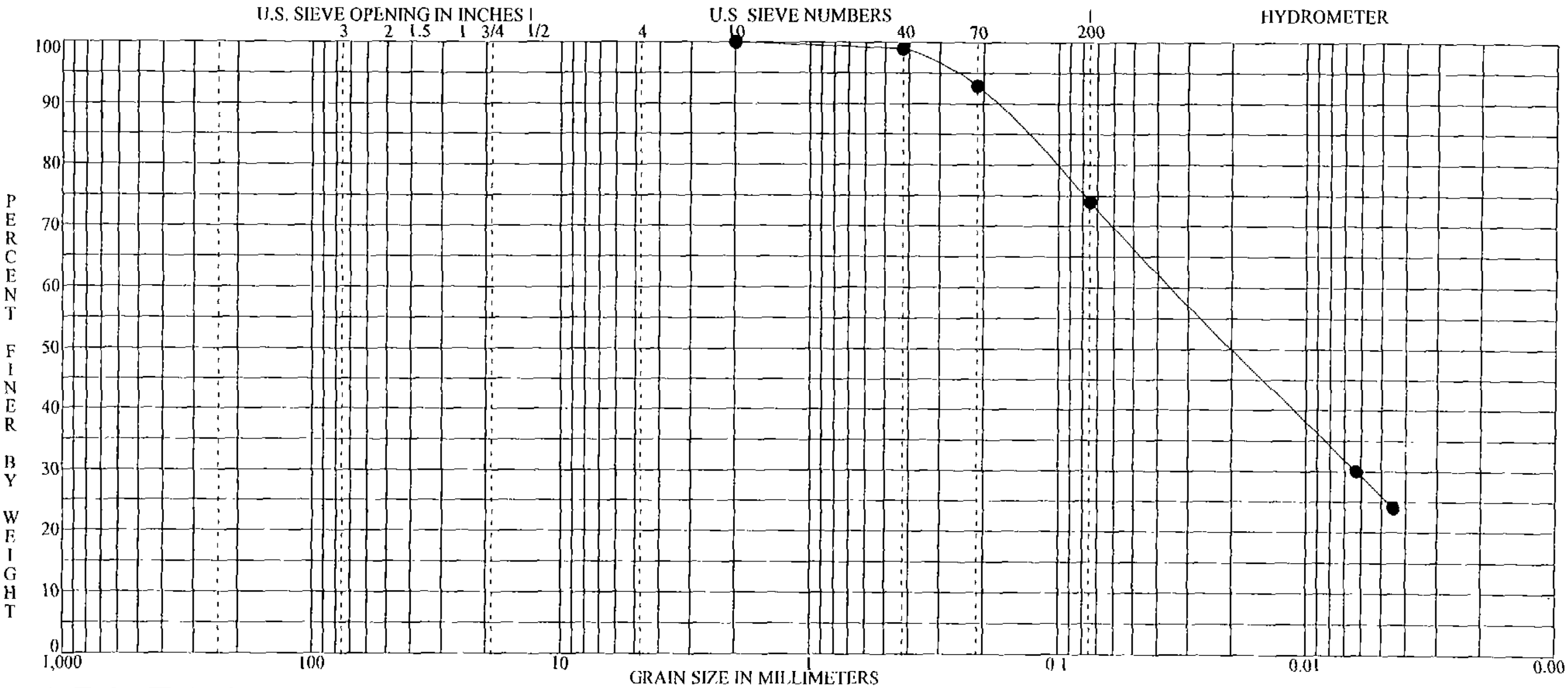
	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-4071 S1B 2.0' to 2.6'	19.0000	0.0473	0.0049		2.3	31.7	35.6	30.4

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



BOULDERS	COBBLES	GRAVEL coarse	GRAVEL fine	SAND coarse	SAND medium	SAND fine	SILT OR CLAY

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● B-407I S-5 III 9.5' to 11.7'	**Soft gray mottled with brown and dark-gray silty clay, some fine to medium sand, partly organic, few seams of organic clayey silt.**	32	36	21	15		

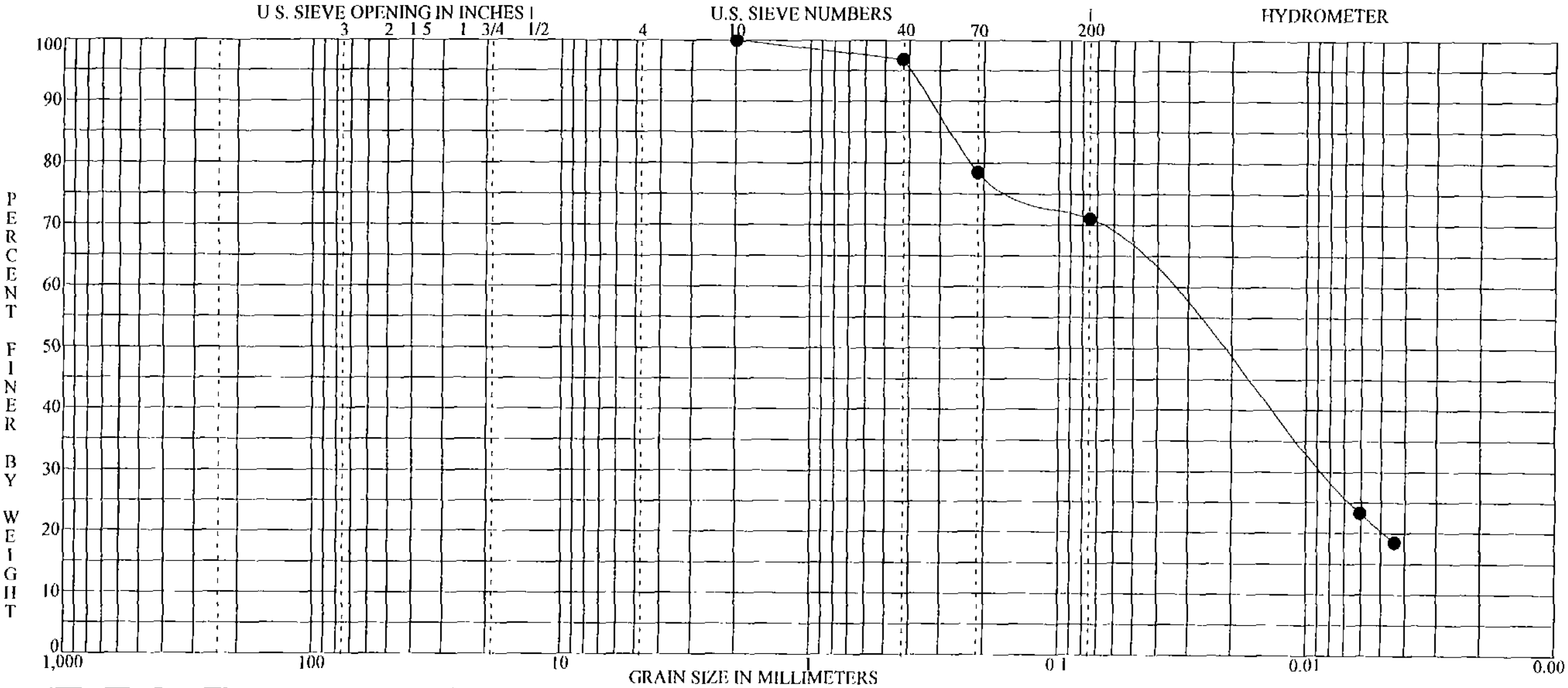
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● B-407I S-5 III 9.5' to 11.7'	2.0000	0.0341	0.0063		0.0	26.0	48.1	25.9

BBCM

GRADATION CURVE

PROJECT GUE-70-14.10
LOCATION GUERNSEY COUNTY, OHIO
JOB NO. 01107000.090 DATE 11/15/02

GRN-REG



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	**B-4071 S-6A 11.5' to 12.7'**	**Gray organic clayey silt, some fine to medium sand.**	**25**	**28**	**21**	**7**		

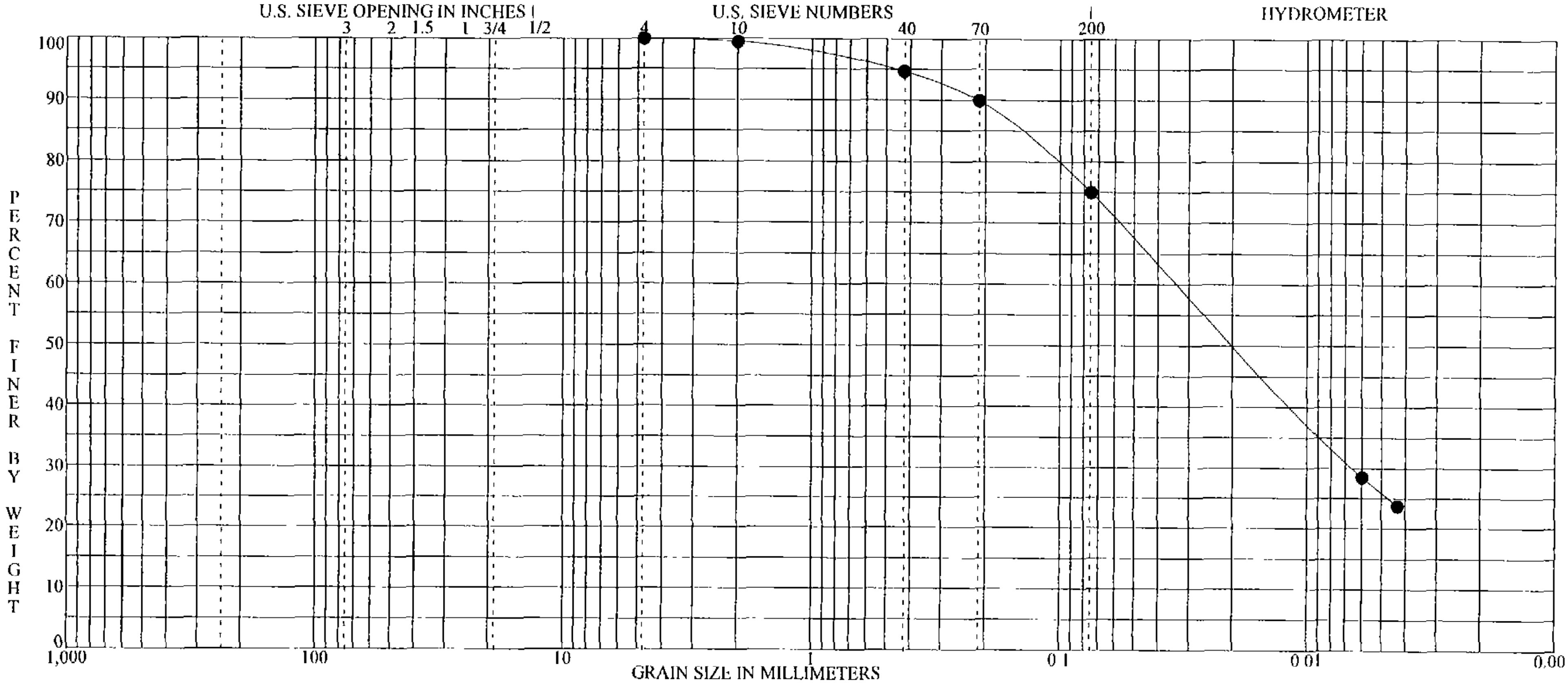
	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-4071 S-6A 11.5' to 12.7'**	**2.0000**	**0.0419**	**0.0087**		**0.0**	**28.9**	**50.7**	**20.4**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



BOULDERS	COBBLES	GRAVEL coarse	GRAVEL fine	SAND coarse	SAND medium	SAND fine	SILT OR CLAY

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● B-4071 S-7A 13.5' to 14.2'	**Gray mottled with brown silty clay, little fine sand, trace medium to coarse sand.**	**22**	**32**	**18**	**14**		

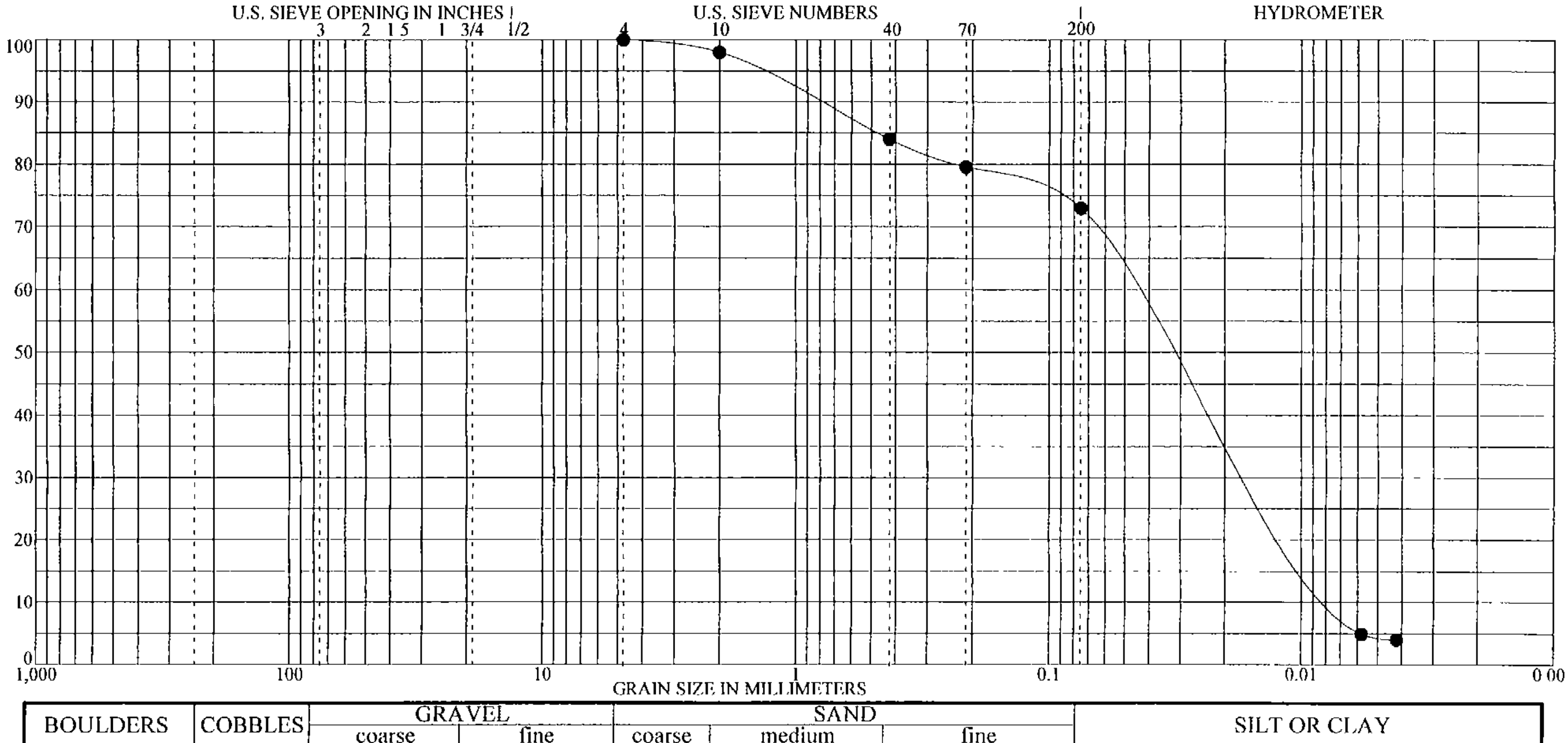
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● B-4071 S-7A 13.5' to 14.2'	**4.7500**	**0.0332**	**0.0065**		**0.0**	**25.0**	**49.1**	**25.9**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	**B-408C S-2 3.5' to 4.5'**	**Brown mottled with gray silty clay, some fine to coarse sand.**	**17**	**38**	**19**	**19**		

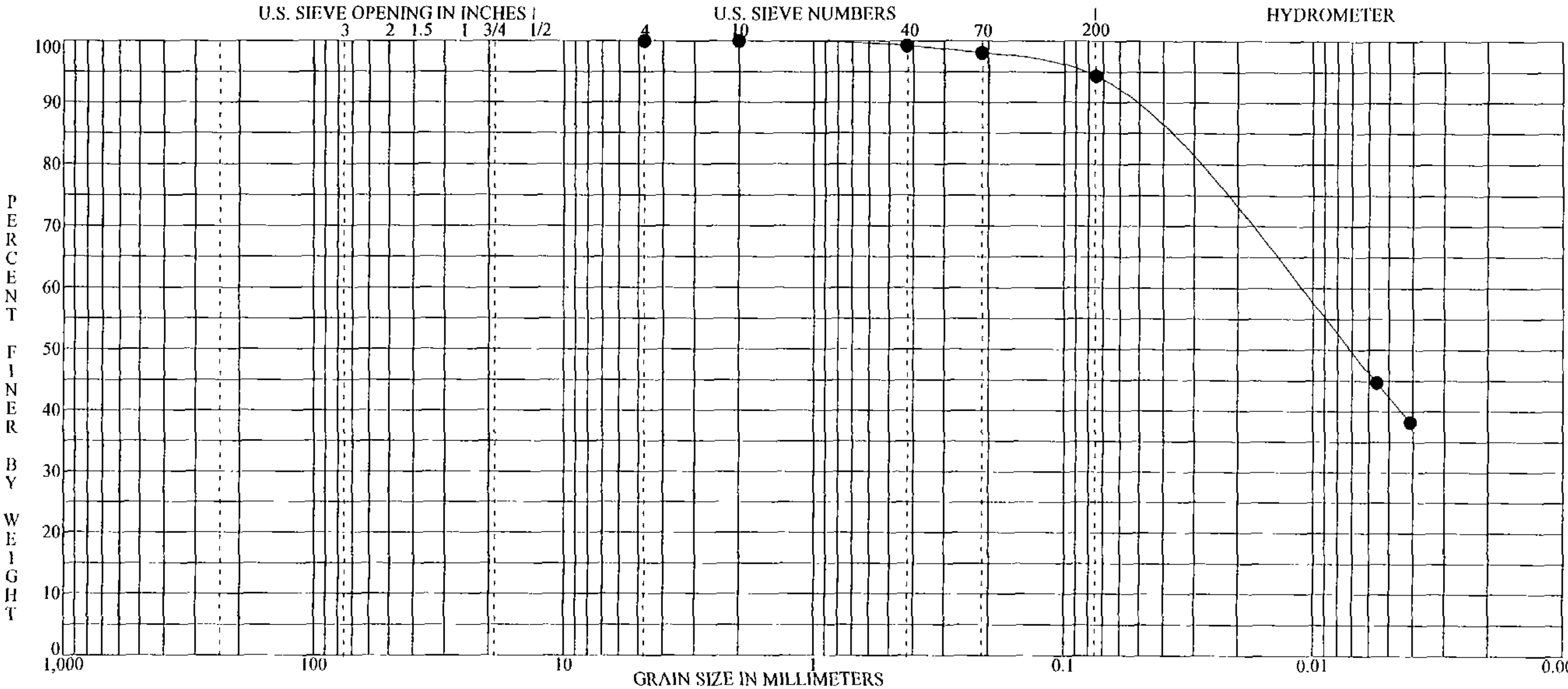
	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-408C S-2 3.5' to 4.5'**	**4.7500**	**0.0460**	**0.0149**	**0.0070**	**0.0**	**27.0**	**68.5**	**4.5**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



BOULDERS	COBBLES	GRAVEL coarse	GRAVEL fine	SAND coarse	SAND medium	SAND fine	SILT OR CLAY

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● B-408C S-4A 7.5' to 8.1'	**Brown mottled with gray silty clay, trace fine to coarse sand.**	27	45	23	22		

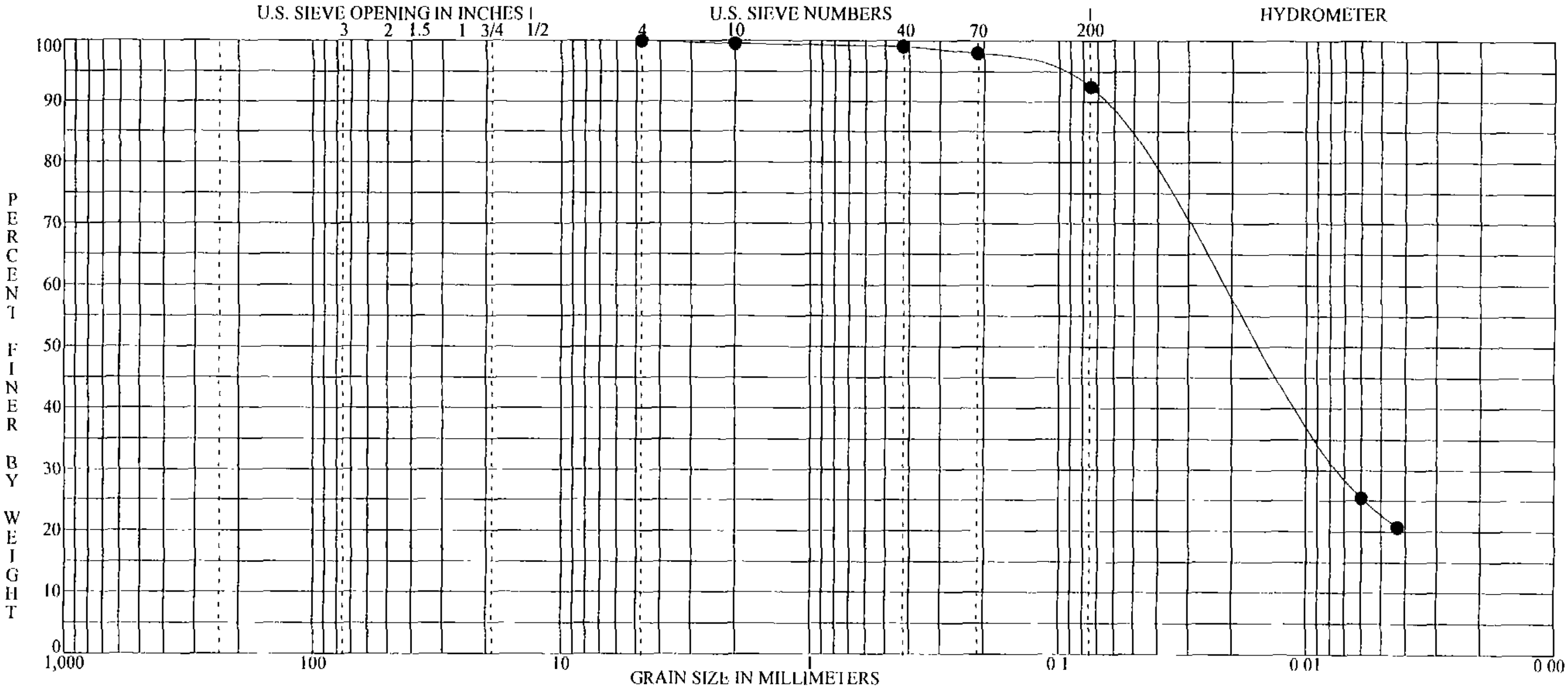
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● B-408C S-4A 7.5' to 8.1'	4.7500	0.0125			0.0	5.7	52.0	42.3

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



BOULDERS	COBBLES	GRAVEL coarse	GRAVEL fine	SAND coarse	SAND medium	SAND fine	SILT OR CLAY

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	**B-408C S-7B 14.7' to 15.1'**	**Gray clayey silt, trace fine to coarse sand.**	**22**	**28**	**20**	**8**		

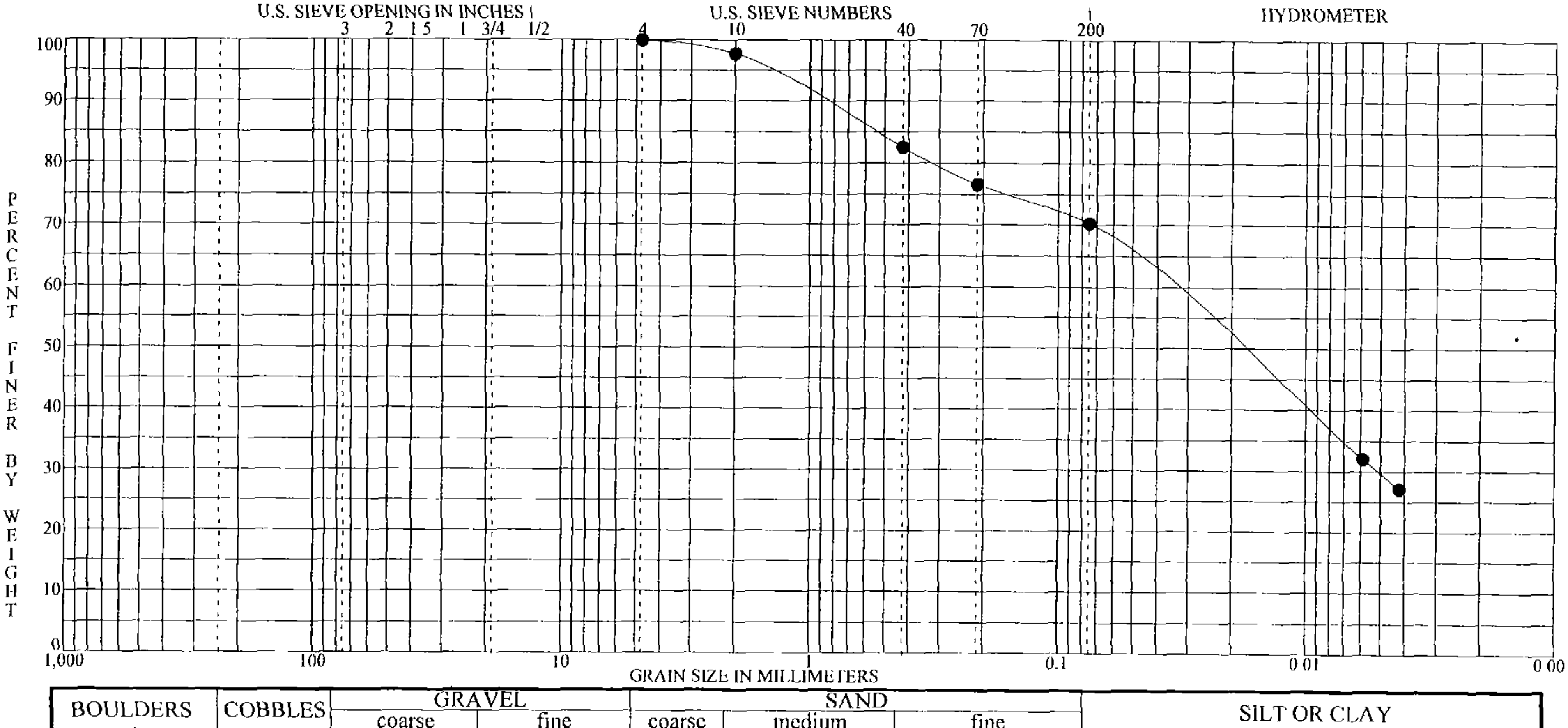
	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-408C S-7B 14.7' to 15.1'**	**4.7500**	**0.0221**	**0.0071**		**0.0**	**7.5**	**69.7**	**22.8**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	**B-412E S-1B 1.4' to 2.5'**	**Brown mottled with gray silty clay, intermixed with organic silty clay, some fine to coarse sand.**	**17**	**34**	**18**	**16**		

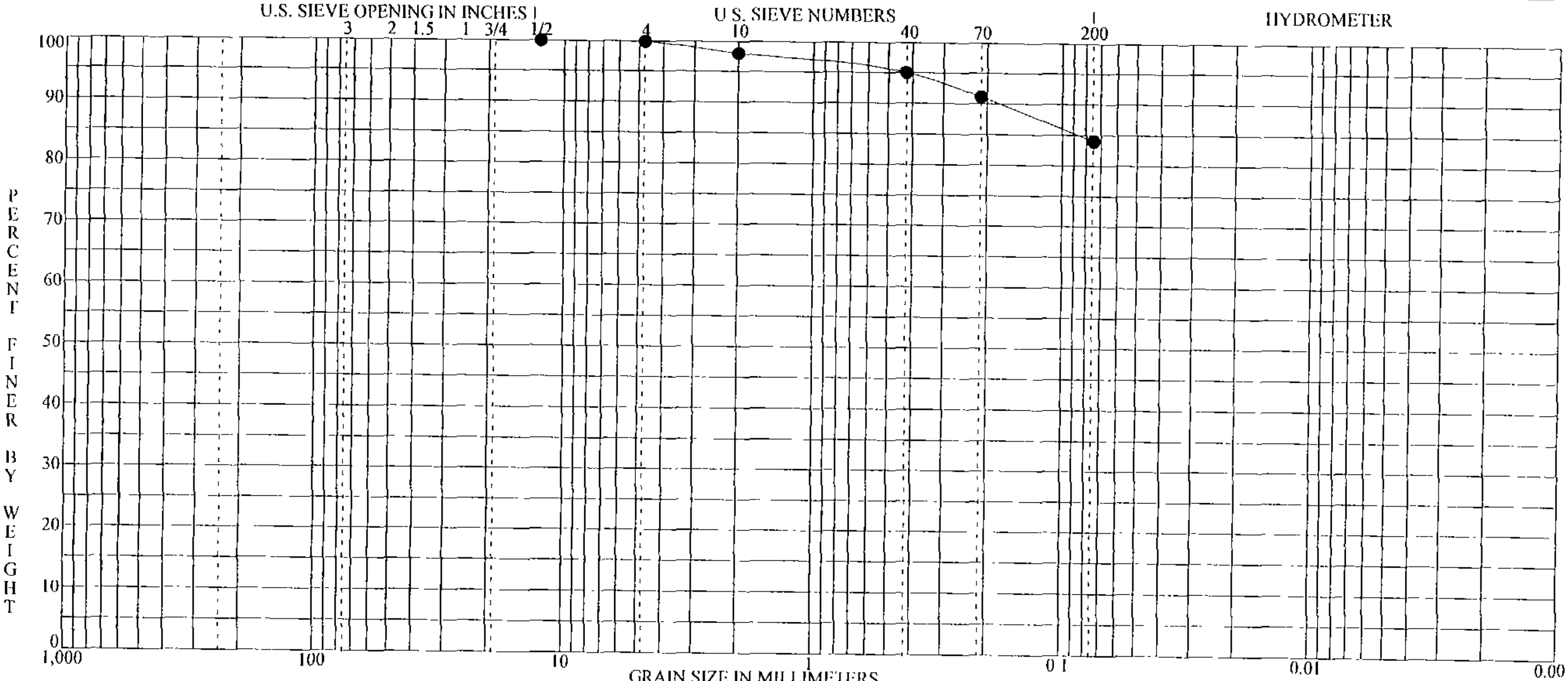
	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-412E S-1B 1.4' to 2.5'**	**4.7500**	**0.0379**	**0.0051**		**0.0**	**29.7**	**40.6**	**29.7**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



BOULDERS	COBBLES	AGGREGATE coarse	AGGREGATE fine	SAND coarse	SAND fine	SILT OR CLAY

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	D15	D85
●	**B-412E S-2 3.0' to 4.2'**	**FILL: Brown mottled with gray silty clay, trace to little fine to coarse sand (% varies), trace fine gravel.**	**19**	**42**	**21**	**21**		**0.0868**
		ODOT CLASSIFICATION : A-7-6(13)						
		AASHTO CLASSIFICATION : A-7-6(13)						

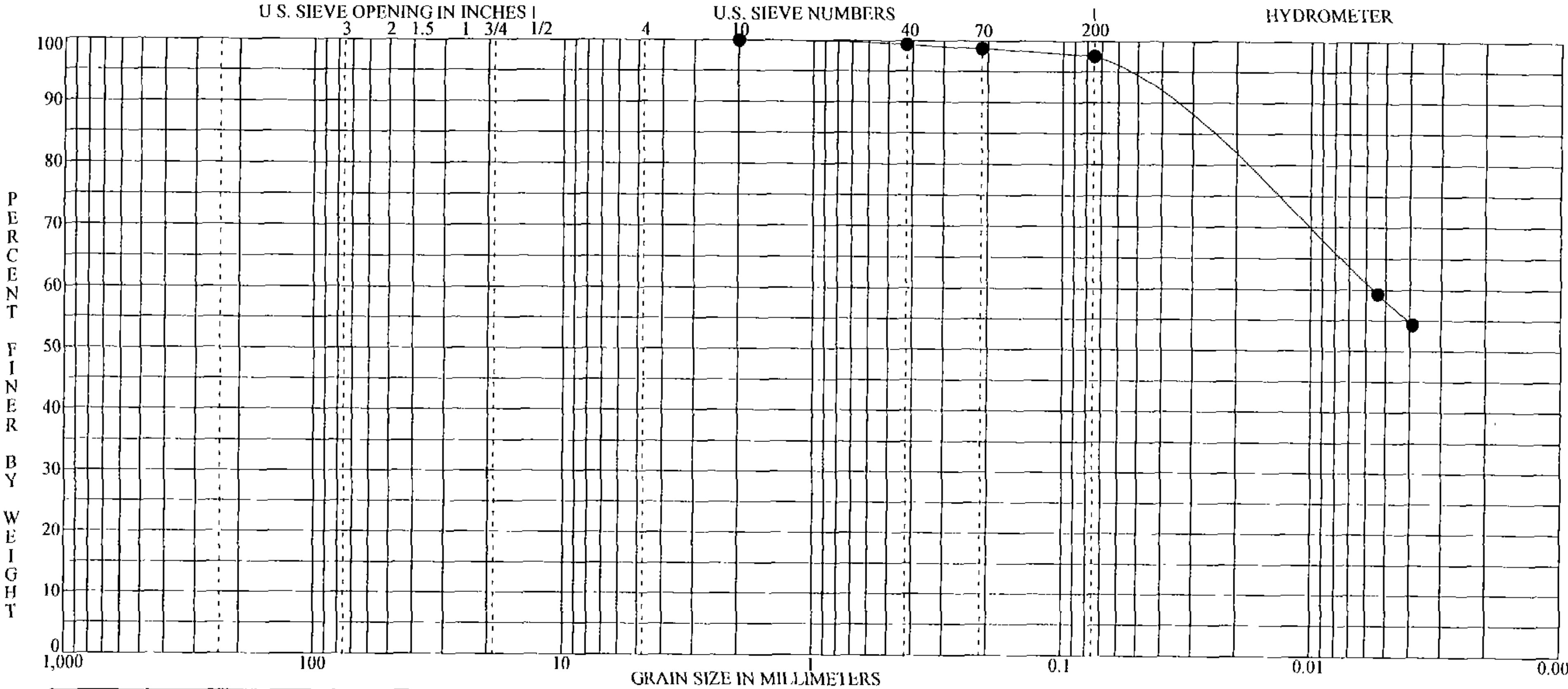
	Specimen Identification - Depth	D90	D50	D30	D10	%Aggregate	%Sand	%Silt	%Clay
●	**B-412E S-2 3.0' to 4.2'**	**0.1800**				**2**	**14**	**84**	

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **1/16/03**

GRN-ODOT



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	B-412E S-4B 7.5' to 8.3'	**Gray mottled with brown organic silty clay, trace fine to medium sand.**	29	70	23	47		

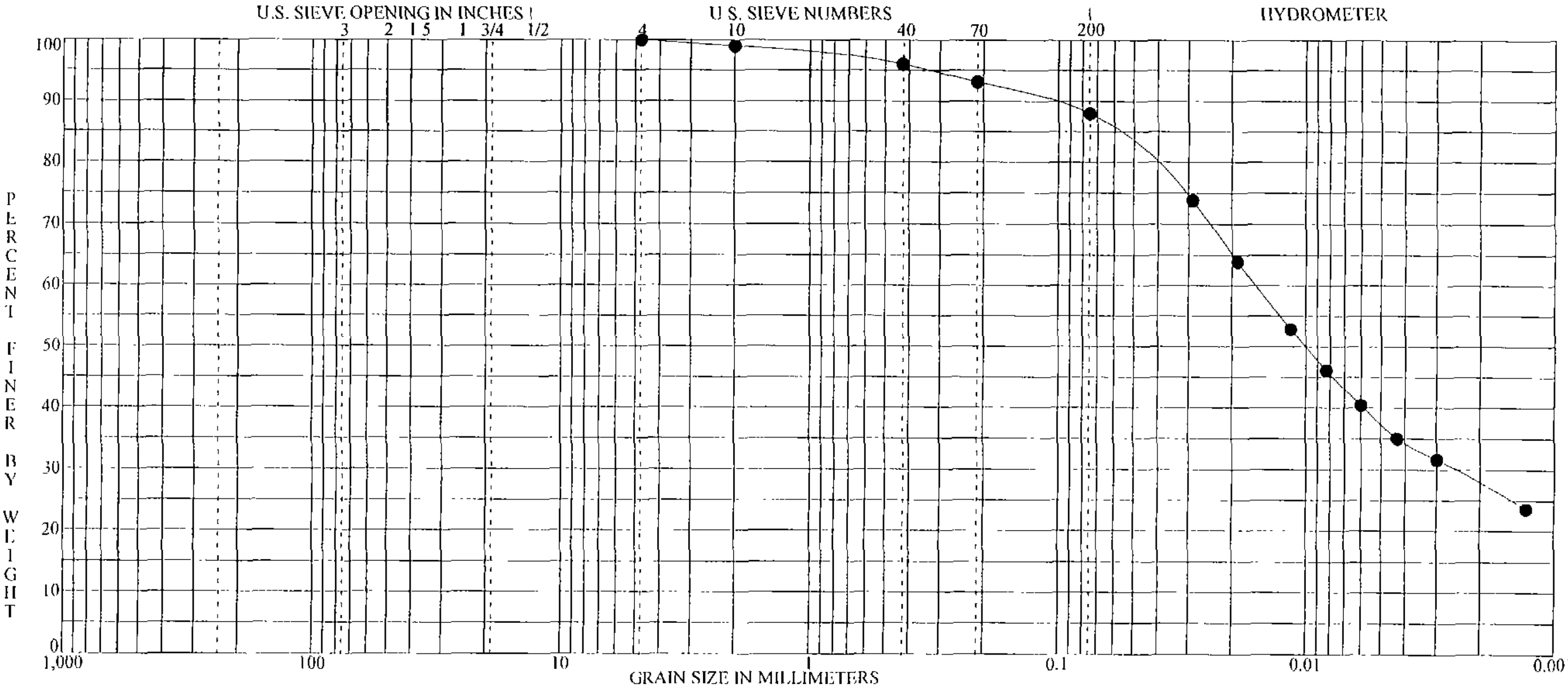
	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-412E S-4B 7.5' to 8.3'	2.0000	0.0057			0.0	2.4	39.4	58.1

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



BOULDERS	COBBLES	AGGREGATE coarse	AGGREGATE fine	SAND coarse	SAND fine	SILT OR CLAY

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	D15	D85
●	B-413H S-2 3.0' to 4.8'	**FILL: Brown mottled with gray silty clay intermixed with dark-gray organic silt, little fine to coarse sand.**	**18**	**38**	**20**	**18**		**0.0613**
		ODOT CLASSIFICATION : A-6b(11)						
		AASHTO CLASSIFICATION : A-6(11)						

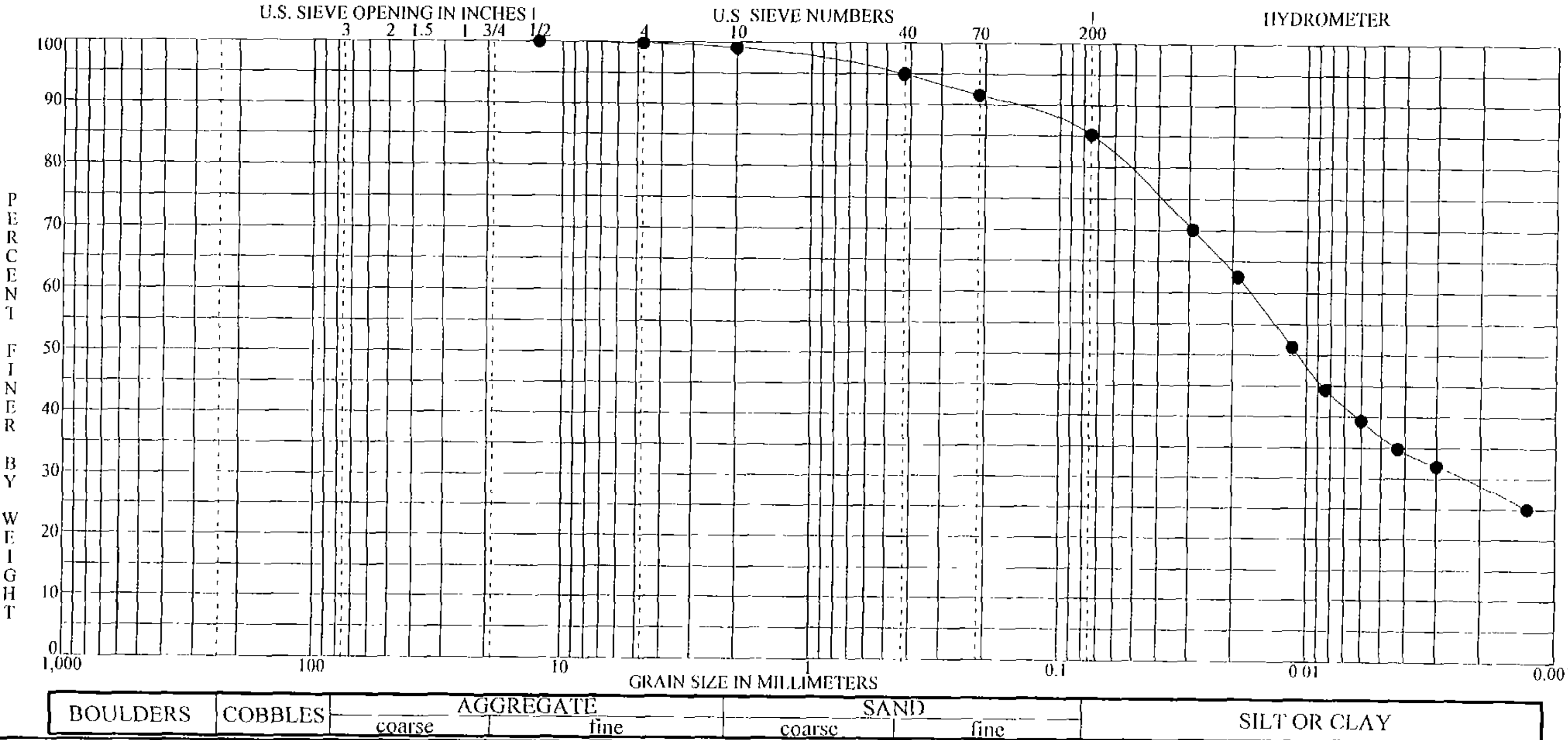
	Specimen Identification - Depth	D90	D50	D30	D10	%Aggregate	%Sand	%Silt	%Clay
●	**B-413H S-2 3.0' to 4.8'**	**0.1125**	**0.0100**	**0.0025**		**1**	**11**	**51**	**37**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **1/16/03**

GRN-ODOT



Specimen Identification - Depth	Classification	MC%	LL	PL	PI	D15	D85
● GC-302 S-2 2.0' to 3.0'	**FILL: Brown, gray, dark-gray, and red-brown silty clay, little fine to coarse sand, trace fine gravel, few seams of organic silt.**	**16**	**37**	**21**	**16**		**0.0740**
	ODOT CLASSIFICATION : A-6b(10)						
	AASHTO CLASSIFICATION : A-6(10)						

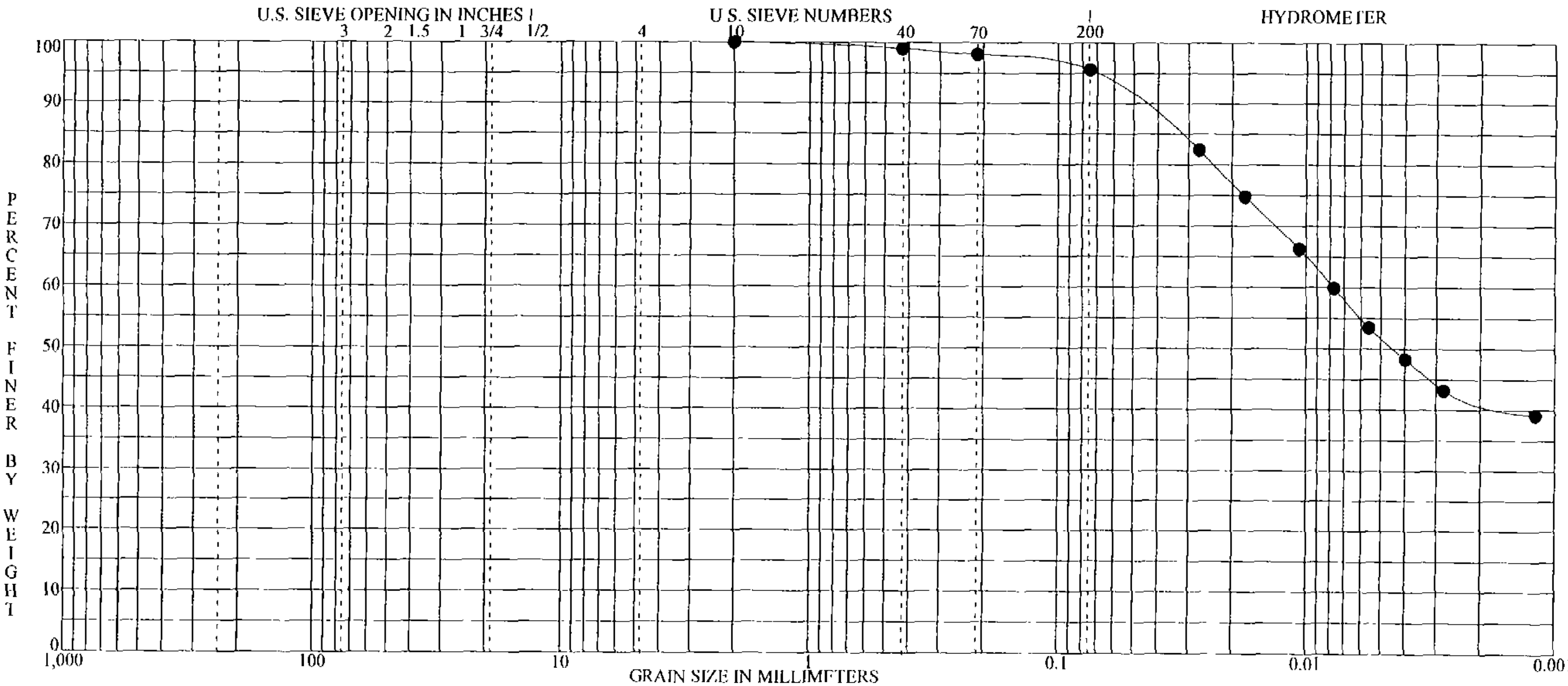
Specimen Identification - Depth	D90	D50	D30	D10	%Aggregate	%Sand	%Silt	%Clay
● GC-302 S-2 2.0' to 3.0'	**0.1631**	**0.0108**	**0.0024**		**1**	**14**	**48**	**37**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **1/16/03**

GRN-ODOT



BOULDERS	COBBLES	GRAVEL coarse	GRAVEL fine	SAND coarse	SAND medium	SAND fine	SILT OR CLAY

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	**GC-203 S-2 5.5' to 7.0'**	**Brown and gray silty clay, trace fine to medium sand.**	**26**	**62**	**21**	**41**		

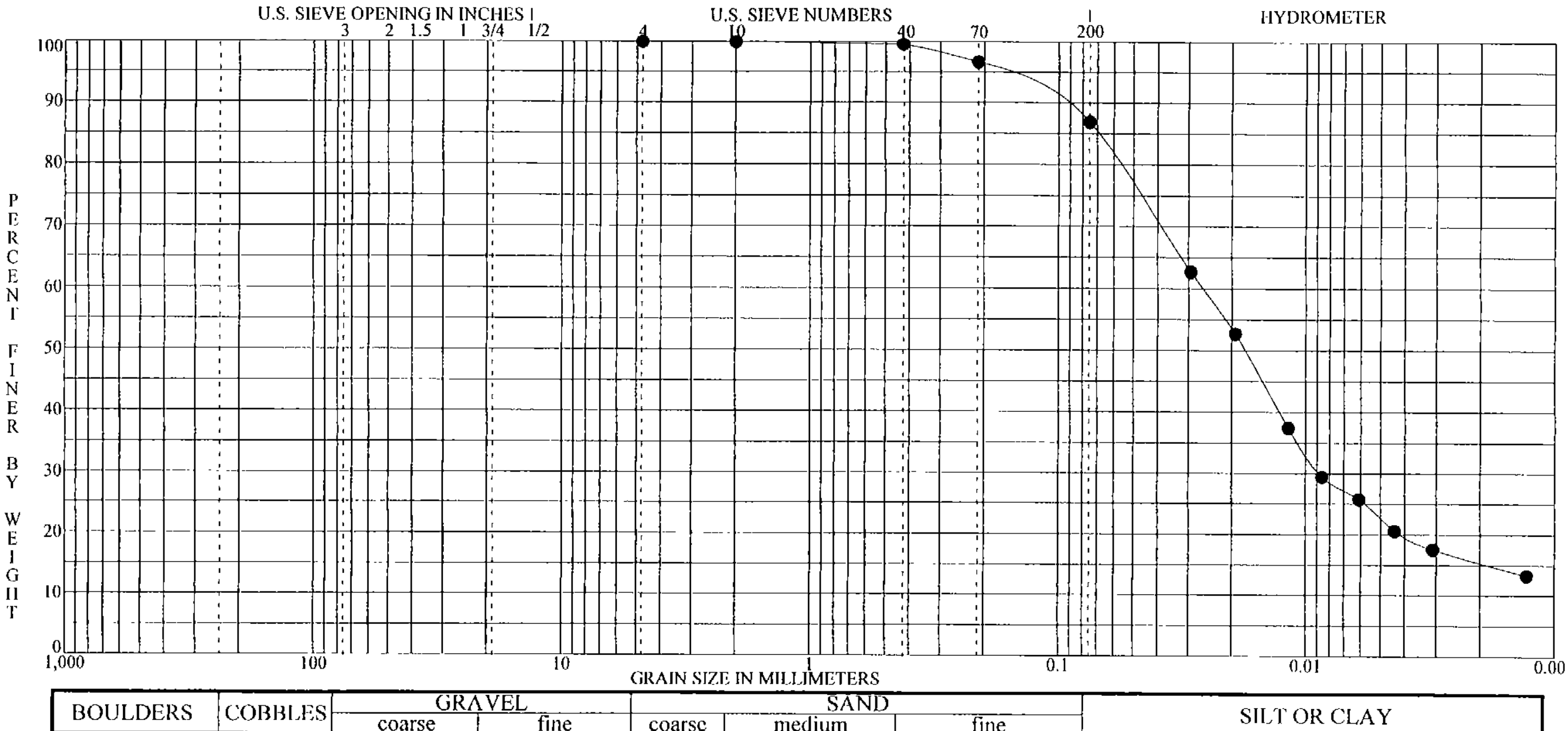
	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**GC-203 S-2 5.5' to 7.0'**	**2.0000**	**0.0077**			**0.0**	**4.4**	**43.9**	**51.7**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● GC-203 S-4 13.5' to 15.0'	**Gray clayey silt, little fine to medium sand.**	**24**	**27**	**18**	**9**		

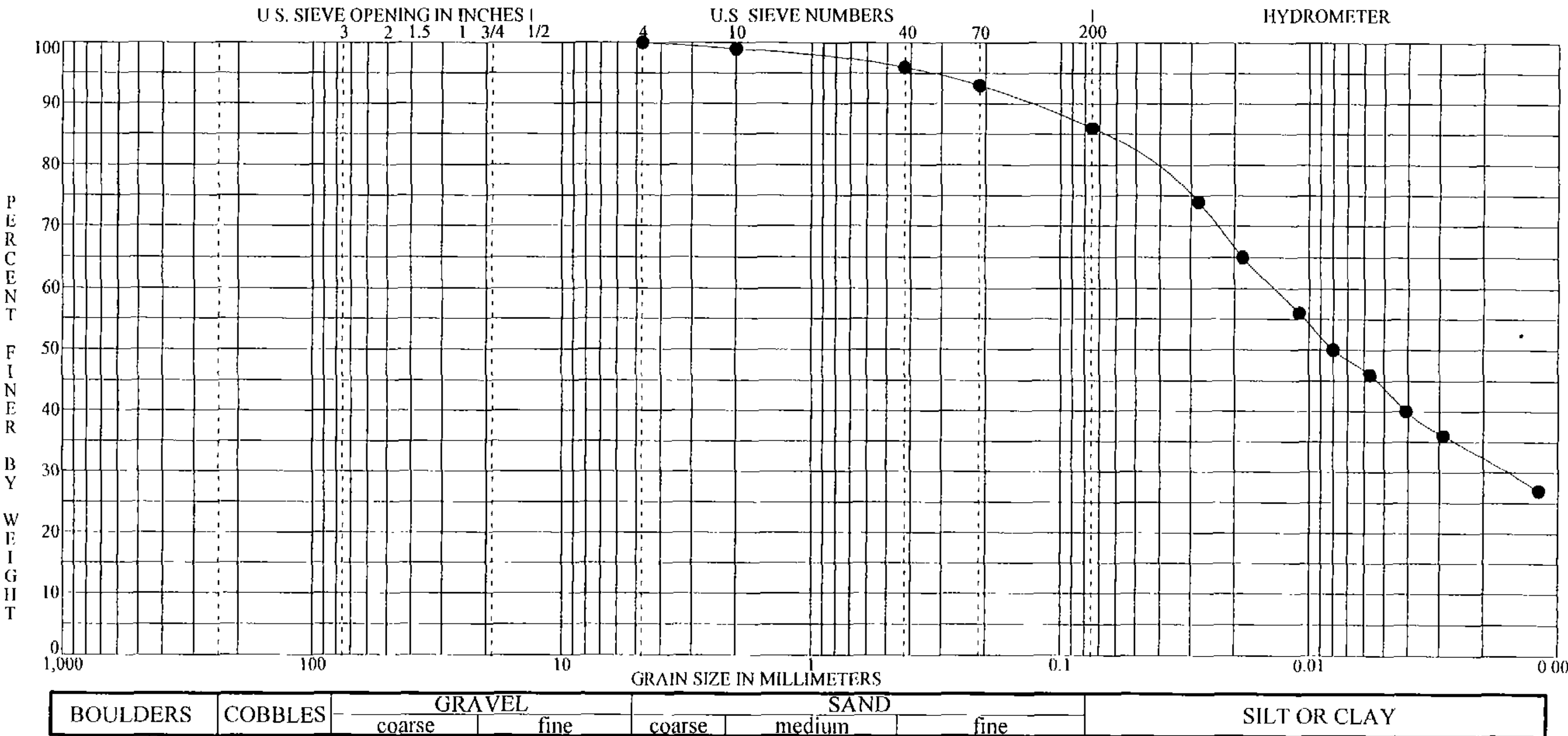
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● GC-203 S-4 13.5' to 15.0'	**4.7500**	**0.0263**	**0.0088**		**0.0**	**13.1**	**64.3**	**22.6**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	GC-206 S-1 3.0' to 3.6'	**Brown mottled with dark brown silty clay, little fine to coarse sand, trace fine gravel.**	**21**	**44**	**22**	**22**		

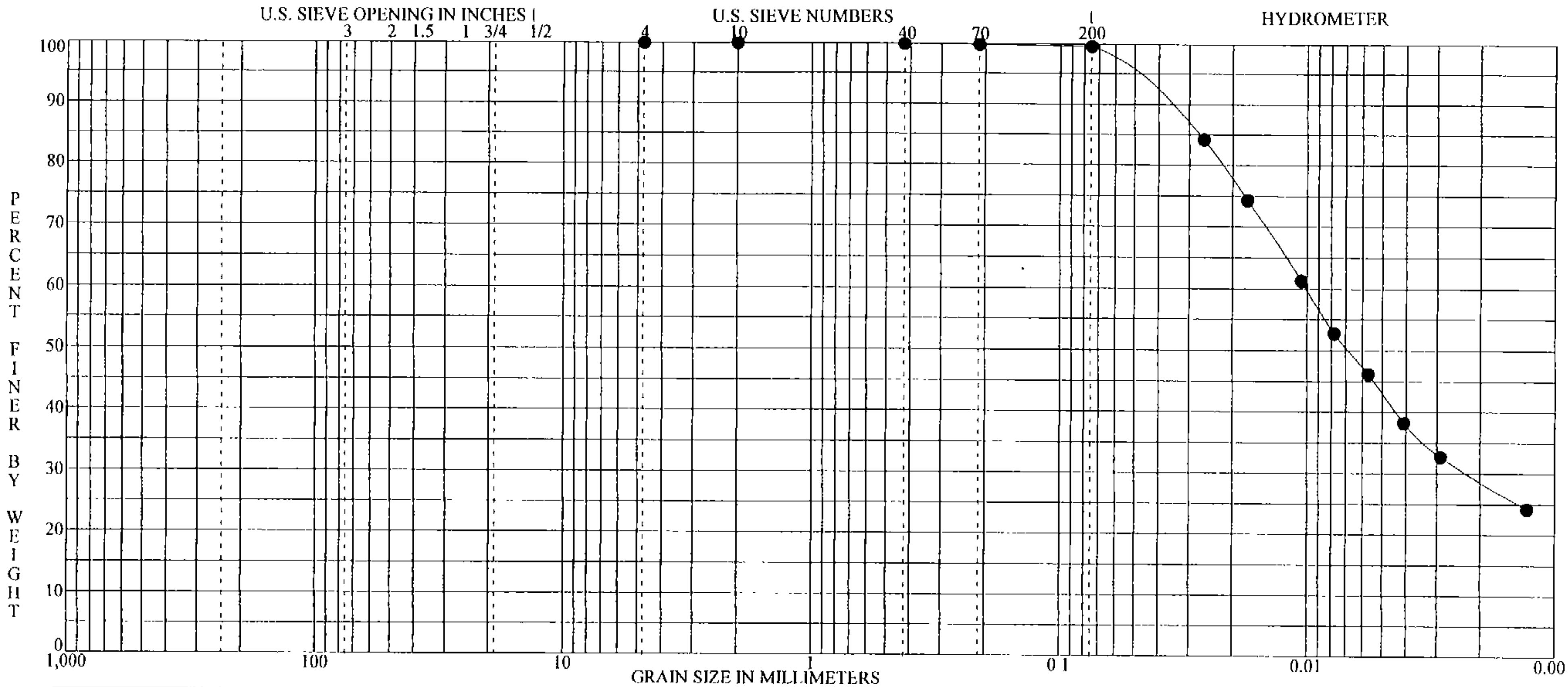
	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	GC-206 S-1 3.0' to 3.6'	**4.7500**	**0.0139**	**0.0016**		**0.0**	**14.0**	**42.4**	**43.6**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



BOULDERS	COBBLES	GRAVEL coarse	GRAVEL fine	SAND coarse	SAND medium	SAND fine	SILT OR CLAY

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● GC-206 S-4 13.5' to 14.5'	**Gray silty clay, trace fine to medium sand.**	25	37	18	19		

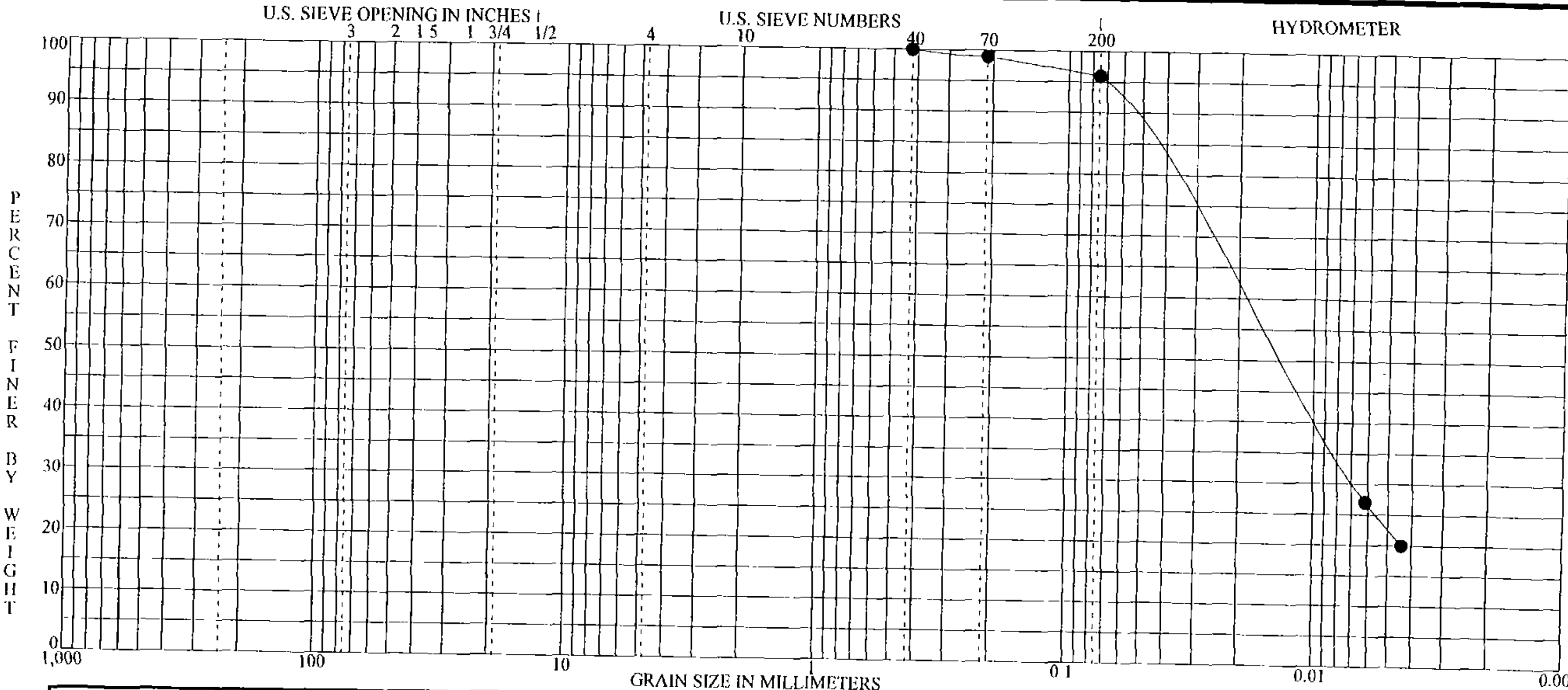
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● GC-206 S-4 13.5' to 14.5'	4.7500	0.0101	0.0022		0.0	0.4	56.6	43.0

BBCM

GRADATION CURVE

PROJECT GUE-70-14.10
LOCATION GUERNSEY COUNTY, OHIO
JOB NO. 01107000.090 DATE 11/15/02

GRN-REG



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● GC-208 S-4B 13.8' to 14.3'	**Brown clayey silt, trace fine to medium sand.**	27	28	19	9		

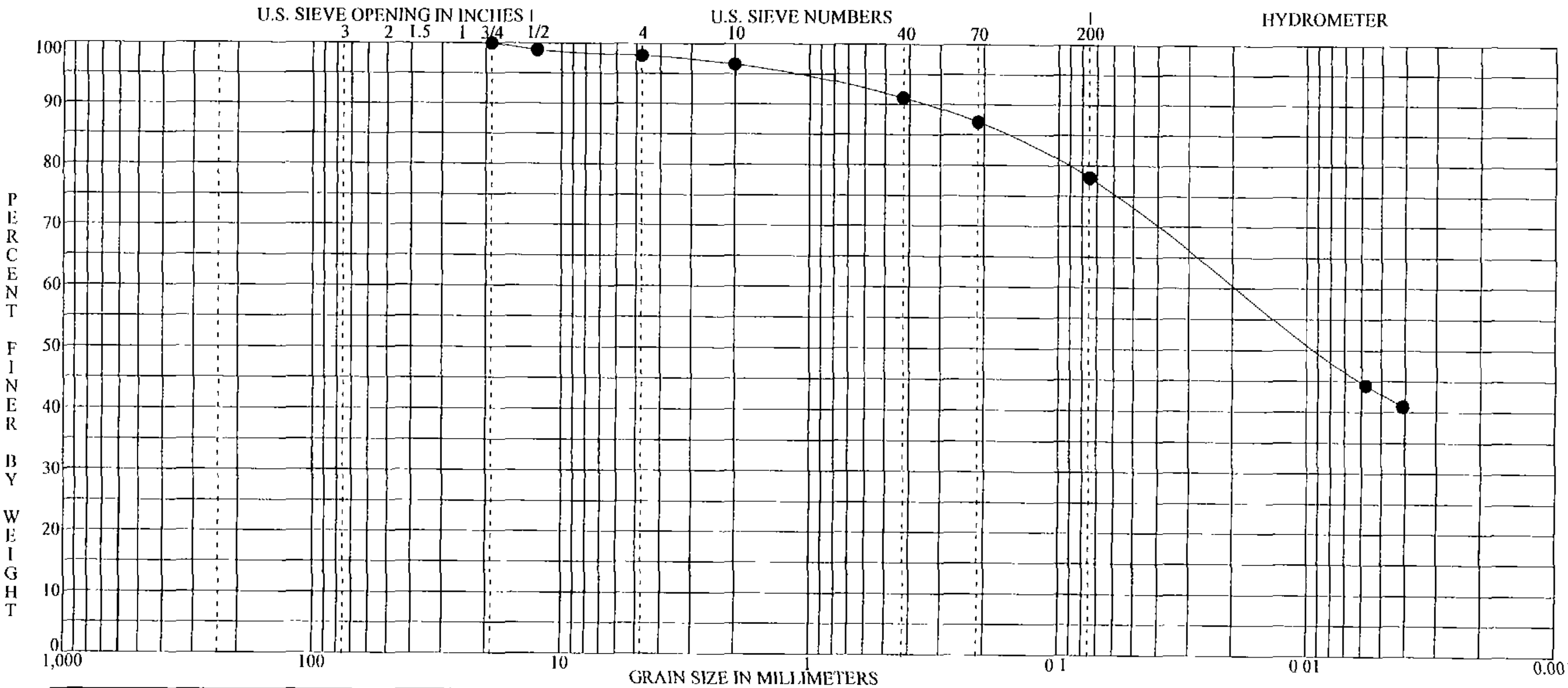
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● GC-208 S-4B 13.8' to 14.3'	0.4250	0.0204	0.0069		0.0	4.0	73.4	22.6

BBCM

GRADATION CURVE

PROJECT GUE-70-14.10
LOCATION GUERNSEY COUNTY, OHIO
JOB NO. 01107000.090 DATE 11/15/02

GRN-REG



BOULDERS	COBBLES	GRAVEL coarse	GRAVEL fine	SAND coarse	SAND medium	SAND fine	SILT OR CLAY

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● GC-209 S-4 135.' to 14.6'	**Brown silty clay, little fine to coarse sand, trace fine gravel.**	**18**	**39**	**20**	**19**		

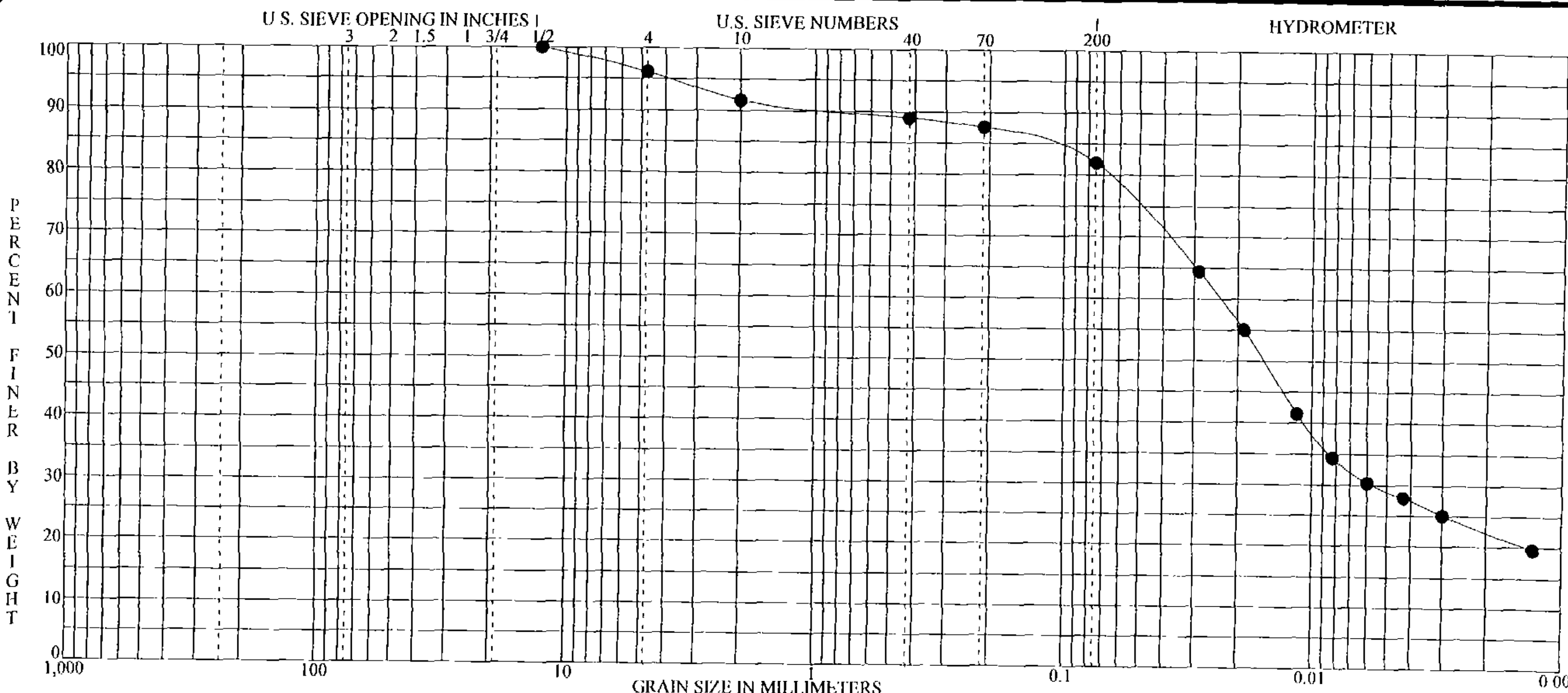
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● GC-209 S-4 135.' to 14.6'	**19.0000**	**0.0191**			**2.0**	**20.0**	**35.2**	**42.8**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



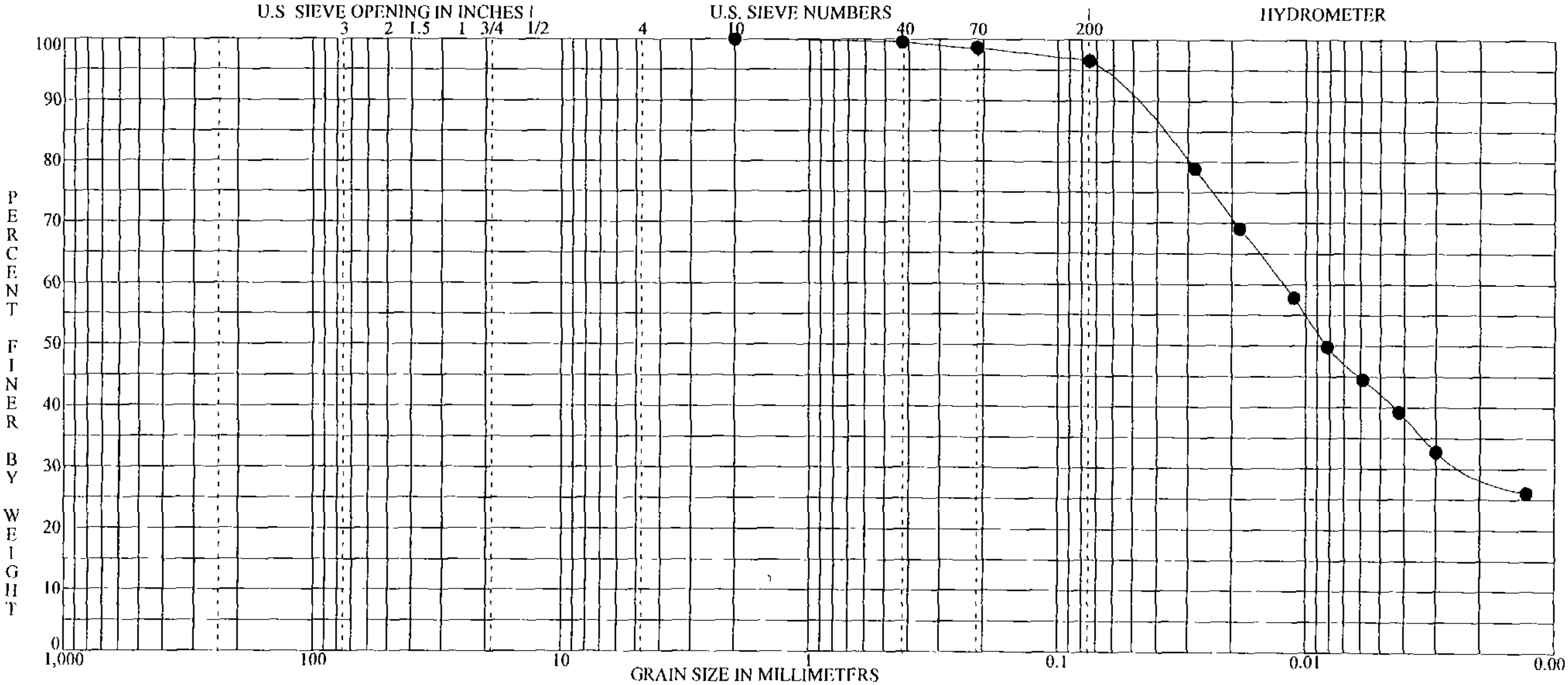
BOULDERS	COBBLES	GRAVEL coarse	GRAVEL fine	SAND coarse	SAND medium	SAND fine	SILT OR CLAY

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	**GC-215 S-3 8.5' to 9.7'**	**Brown mottled with gray and dark brown silty clay, little fine to coarse sand, trace fine gravel.**	**22**	**39**	**19**	**20**		

	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**GC-215 S-3 8.5' to 9.7'**	**12.5000**	**0.0236**	**0.0058**		**3.9**	**14.1**	**53.0**	**29.0**

BBCM	GRADATION CURVE	PROJECT	**GUE-70-14.10**
		LOCATION	**GUERNSEY COUNTY, OHIO**
		JOB NO.	**01107000.090** DATE **11/15/02**

GRN-REG



BOULDERS	COBBLES	GRAVEL coarse	GRAVEL fine	SAND coarse	SAND medium	SAND fine	SILT OR CLAY

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● GC-215 S-5A II 15.0'-16.9'	**Stiff gray silty clay, trace fine to medium sand.**	22	36	18	18		

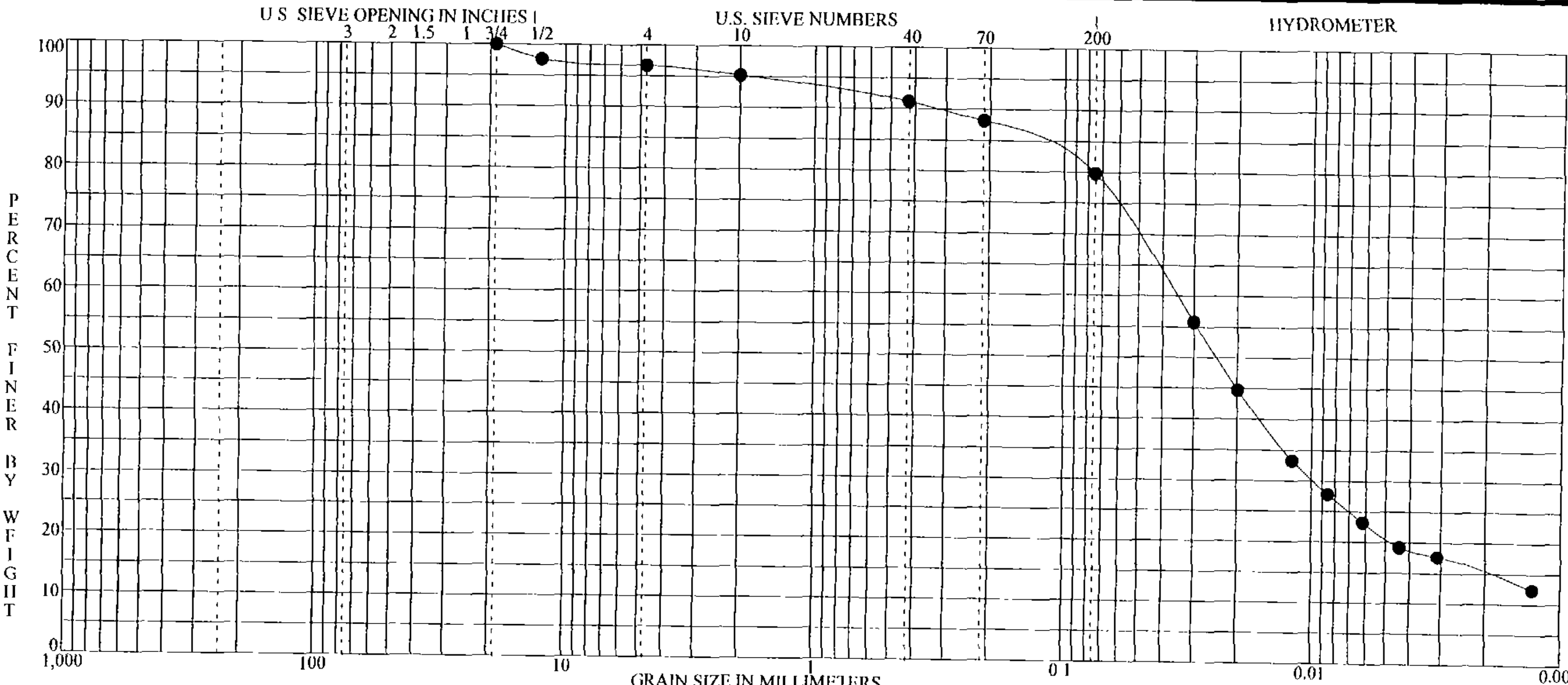
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● GC-215 S-5A II 15.0'-16.9'	2.0000	0.0124	0.0021		0.0	3.4	54.7	41.9

BBCM

GRADATION CURVE

PROJECT	GUE-70-14.10
LOCATION	GUERNSEY COUNTY, OHIO
JOB NO.	01107000.090
DATE	11/15/02

GRN-REG



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	GC-216 S-3 III 10.0' - 12.0'	**Very stiff brown mottled with gray silty clay, little fine to coarse sand, trace fine gravel, few seams of sand.**	20	29	19	10		

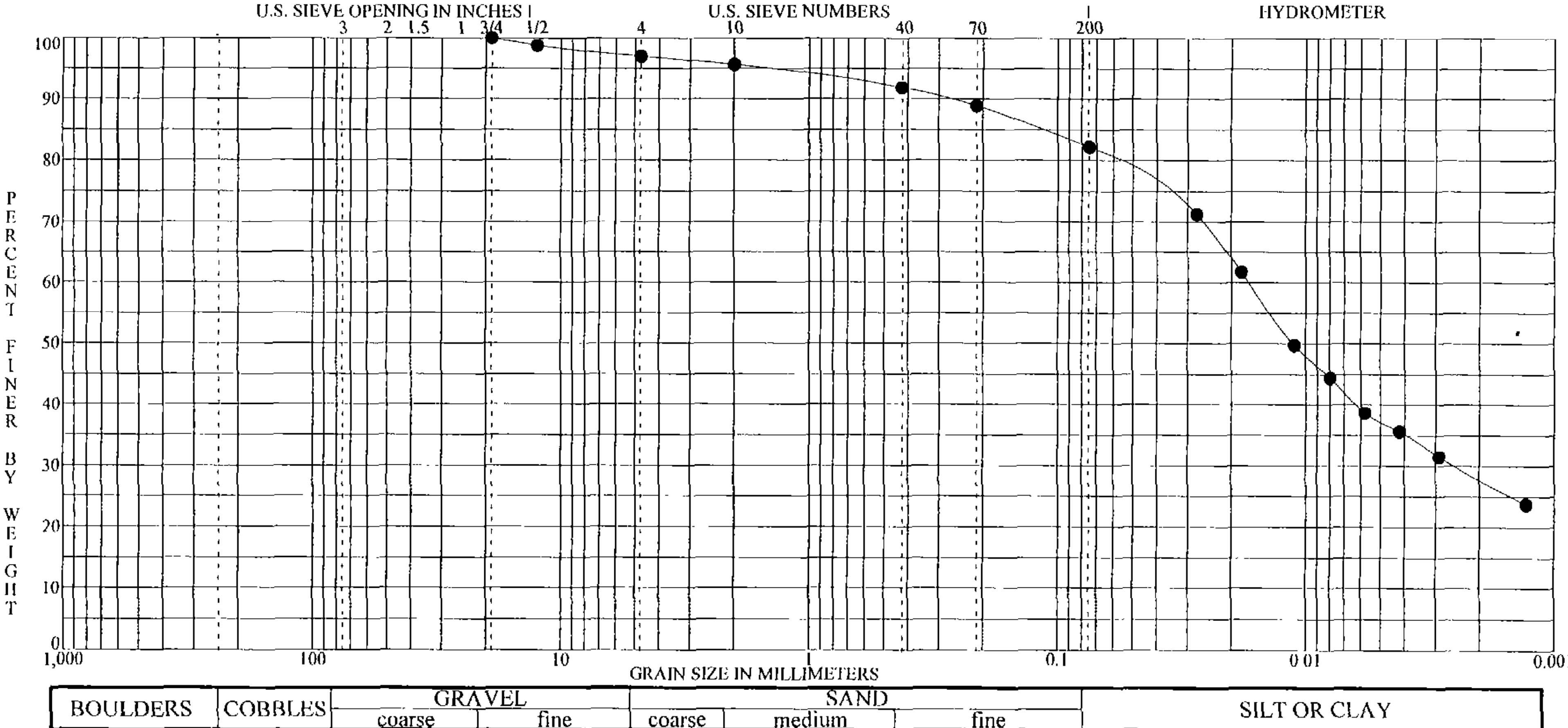
	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	GC-216 S-3 III 10.0' - 12.0'	19.0000	0.0353	0.0098		3.3	16.9	59.1	20.7

BBCM

GRADATION CURVE

PROJECT GUE-70-14.10
LOCATION GUERNSEY COUNTY, OHIO
JOB NO. 01107000.090 DATE 11/15/02

GRN-REG



	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	GC-217 S-1 3.0' to 4.0'	**Red brown mottled with gray silty clay, little fine to coarse sand, trace fine gravel.**	**20**	**44**	**20**	**24**		

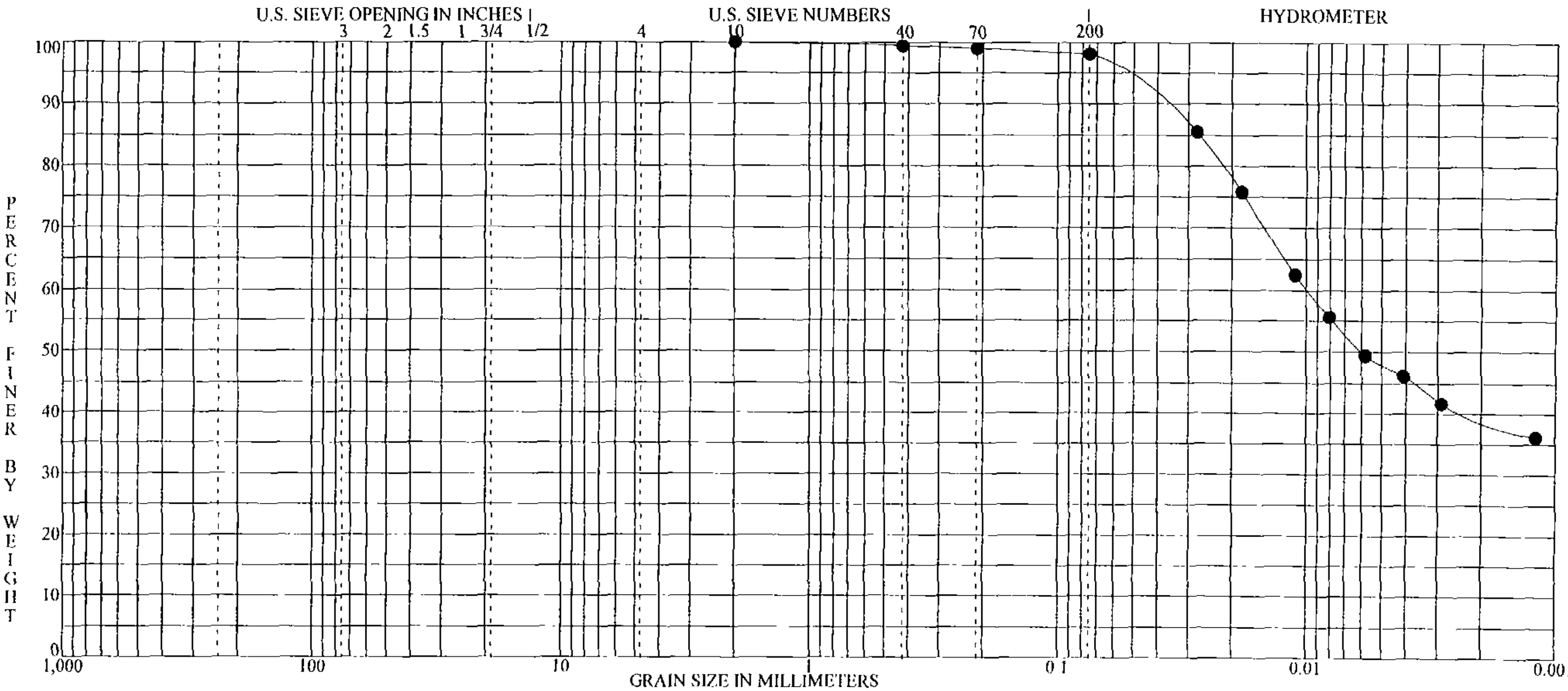
	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	GC-217 S-1 3.0' to 4.0'	**19.0000**	**0.0170**	**0.0025**		**3.0**	**14.8**	**45.0**	**37.2**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



BOULDERS	COBBLES	GRAVEL coarse	GRAVEL fine	SAND coarse	SAND medium	SAND fine	SILT OR CLAY

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	GC-218 S-4 I 8.5'-9.0'	**Very stiff brown mottled with gray silty clay, trace fine to medium sand**	23	56	21	35		

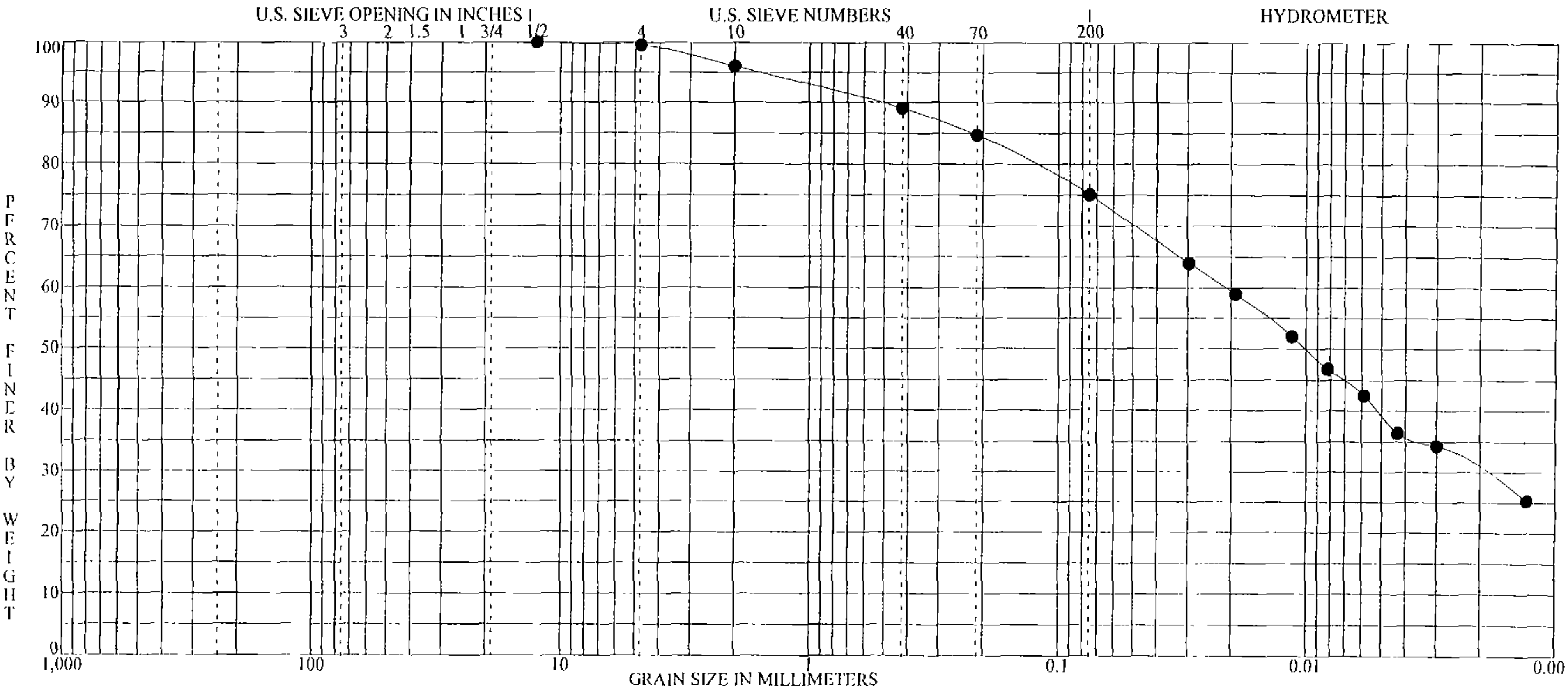
	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	GC-218 S-4 I 8.5'-9.0'	2.0000	0.0099			0.0	1.9	50.1	48.0

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



BOULDERS	COBBLES	AGGREGATE coarse	AGGREGATE fine	SAND coarse	SAND fine	SILT OR CLAY

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	D15	D85
●	GC-301 S-2 2.0' to 3.2'	**FILL: Brown mottled with gray and dark-gray silty clay, some fine to coarse sand, trace fine gravel.**	17	42	22	20		0.2218
		ODOT CLASSIFICATION : A-7-6(12)						
		AASHTO CLASSIFICATION : A-7-6(12)						

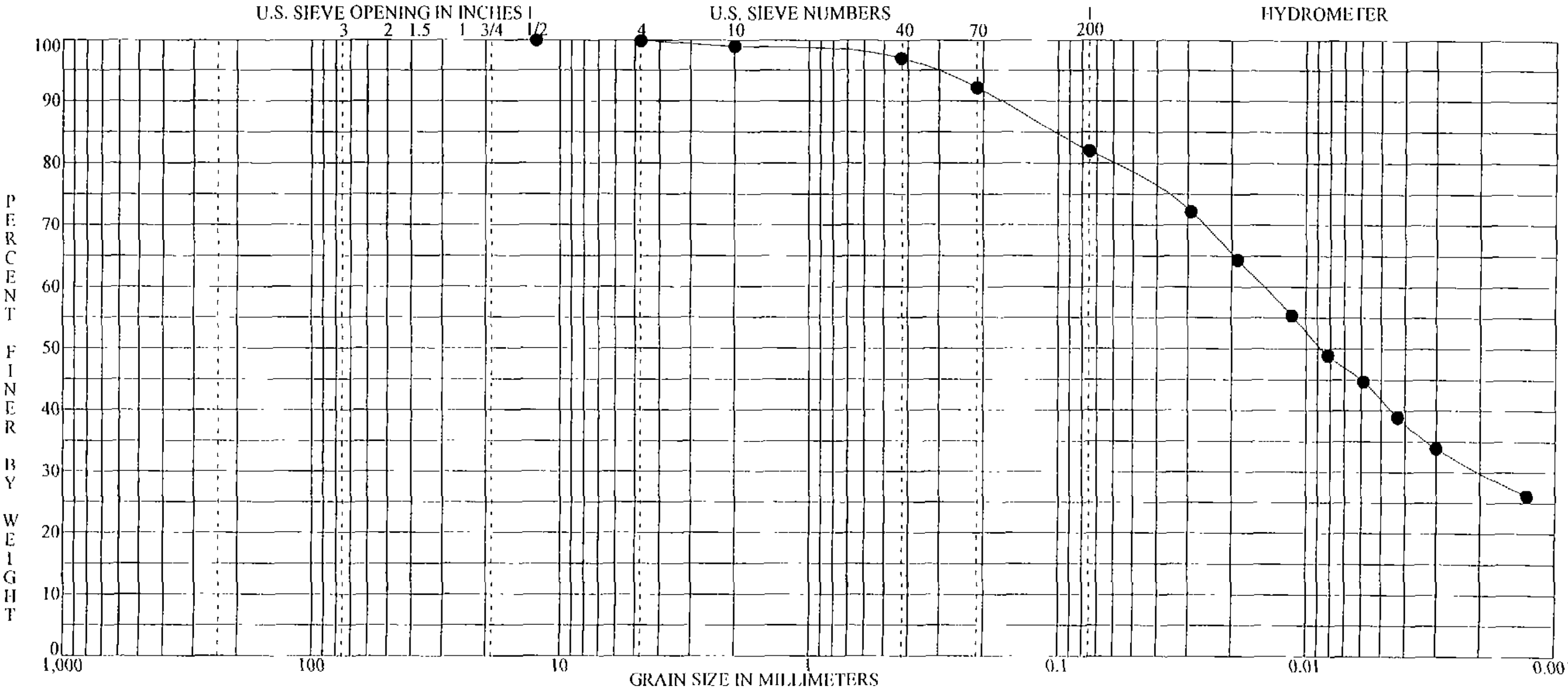
	Specimen Identification - Depth	D90	D50	D30	D10	%Aggregate	%Sand	%Silt	%Clay
●	GC-301 S-2 2.0' to 3.2'	0.5200	0.0100	0.0020		4	21	36	39

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **1/16/03**

GRN-ODOT



BOULDERS	COBBLES	AGGREGATE coarse	AGGREGATE fine	SAND coarse	SAND fine	SILT OR CLAY

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	D15	D85
●	GC-304 S-2 2.0' to 3.4'	**FILL: Brown mottled with gray and dark-gray silty clay, trace to little fine to coarse sand (% varies), trace fine gravel, partly organic, few roots. ODOT CLASSIFICATION : A-7-6(12) AASHTO CLASSIFICATION : A-7-6(12)**	**18**	**41**	**22**	**19**		**0.1019**

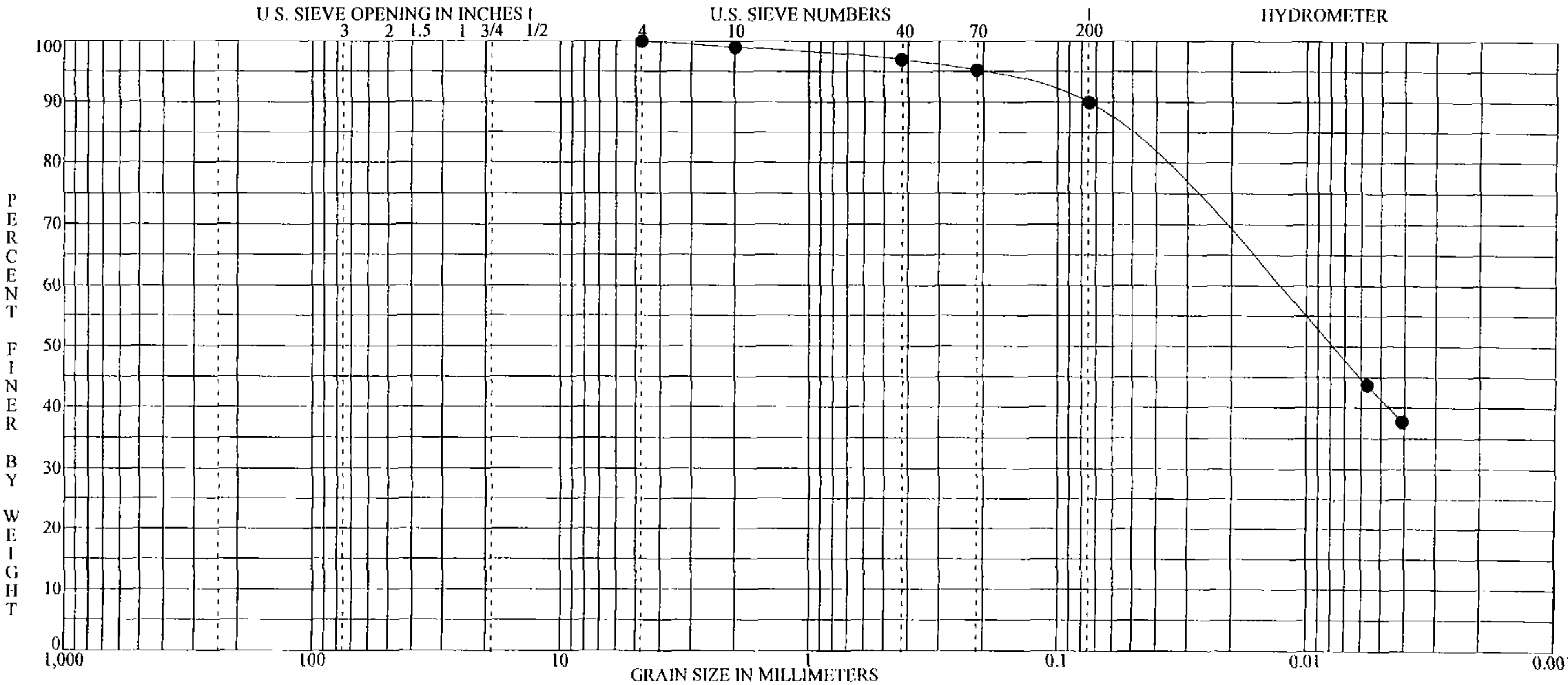
	Specimen Identification - Depth	D90	D50	D30	D10	%Aggregate	%Sand	%Silt	%Clay
●	**GC-304 S-2 2.0' to 3.4'**	**0.1700**	**0.0087**	**0.0020**		**1**	**17**	**40**	**42**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **1/16/03**

GRN-ODOT



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	**GC-305 S-2B 2.4' to 2.9'**		**24**	**45**	**23**	**22**		

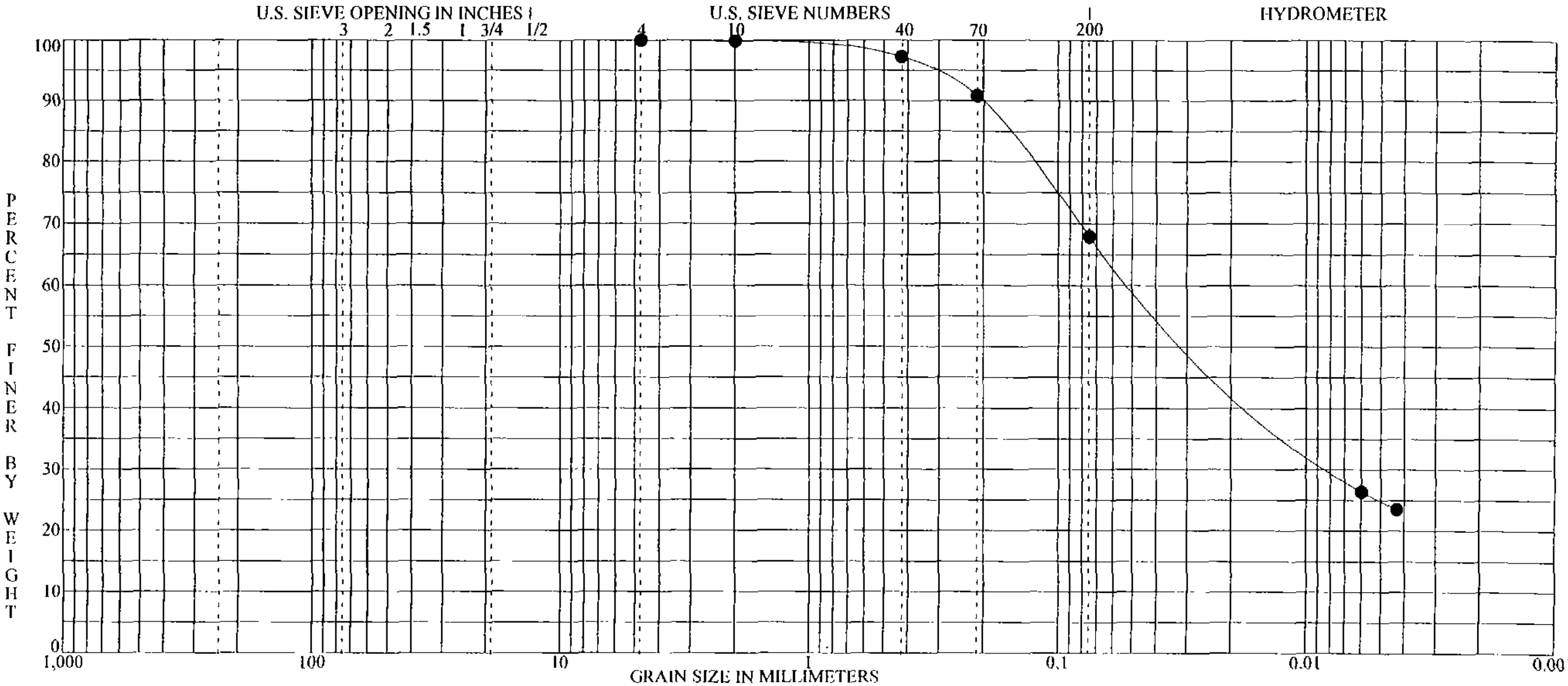
	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**GC-305 S-2B 2.4' to 2.9'**	**4.7500**	**0.0141**			**0.0**	**10.0**	**48.7**	**41.3**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	**GC-305 S-7 12.0' to 12.5'**		**21**	**30**	**18**	**12**		

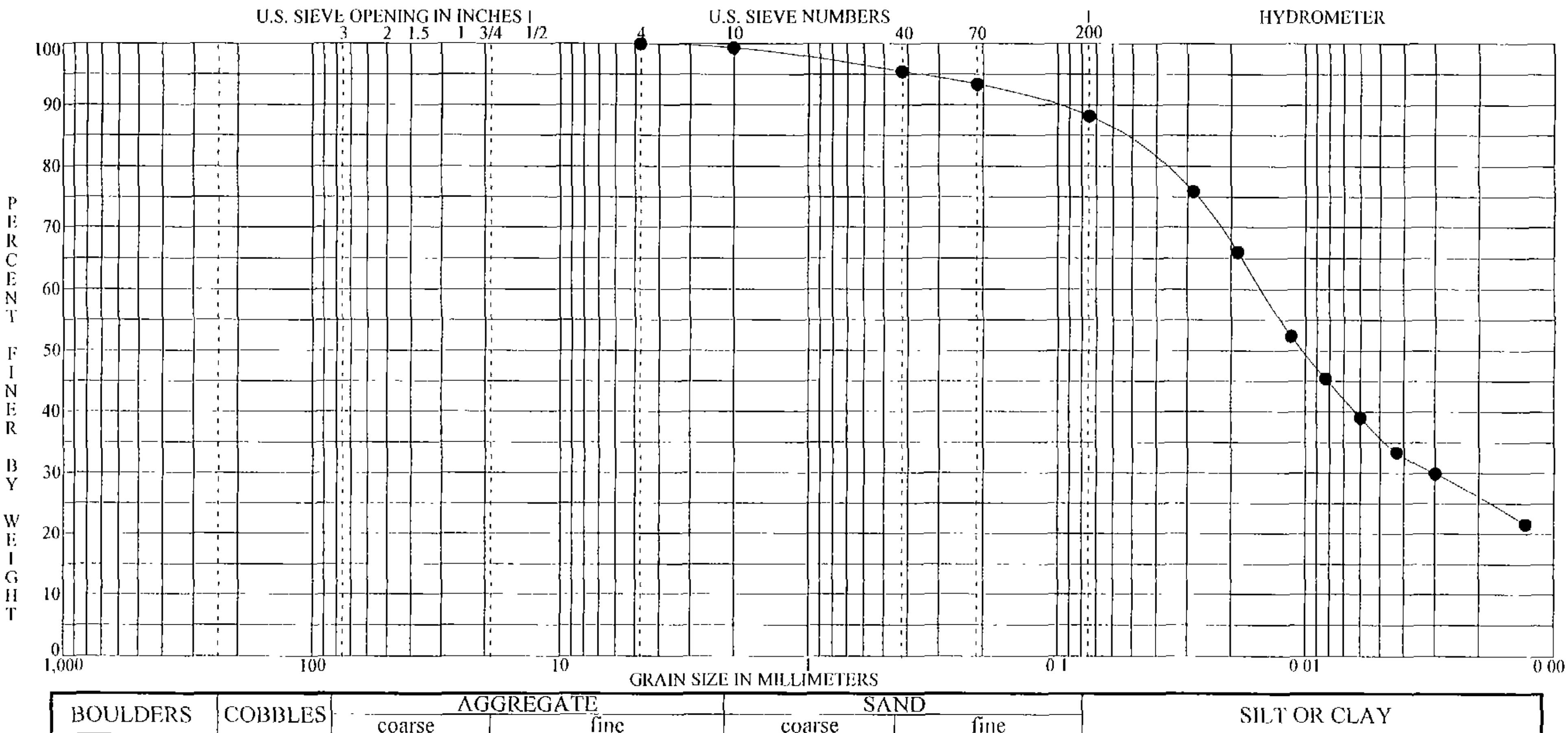
	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**GC-305 S-7 12.0' to 12.5'**	**4.7500**	**0.0464**	**0.0075**		**0.0**	**32.1**	**43.1**	**24.8**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



Specimen Identification - Depth	Classification	MC%	LL	PL	PI	D15	D85
● GC-306 S-2B 2.4' to 3.0'	**FILL: Gray silty clay intermixed with gray mottled with brown organic silt, little fine to coarse sand.**	19	33	21	12		0.0583
	ODOT CLASSIFICATION : A-6a(9)						
	AASHTO CLASSIFICATION : A-6(9)						

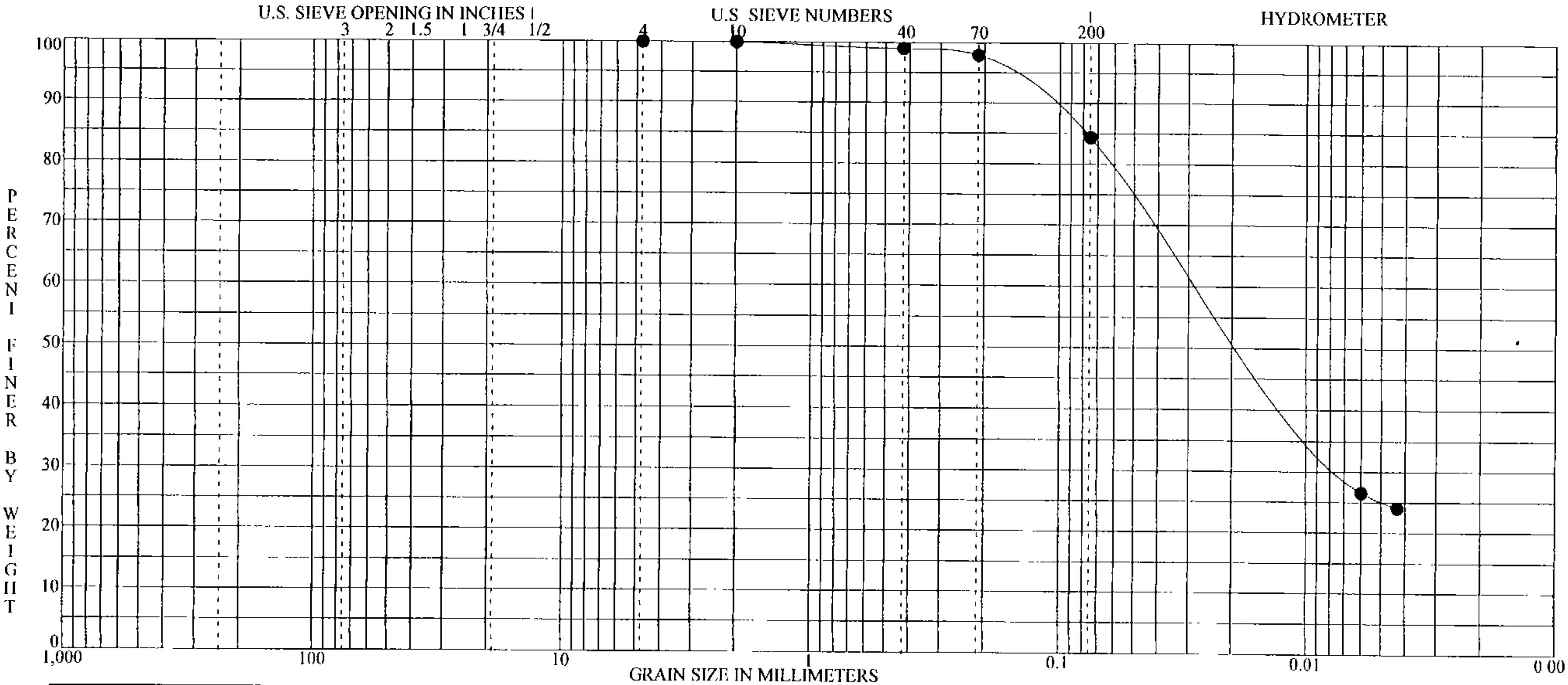
Specimen Identification - Depth	D90	D50	D30	D10	%Aggregate	%Sand	%Silt	%Clay
● GC-306 S-2B 2.4' to 3.0'	0.1075	0.0103	0.0030		1	11	52	36

BBCM

GRADATION CURVE

PROJECT GUE-70-14.10
LOCATION GUERNSEY COUNTY, OHIO
JOB NO. 01107000.090 DATE 1/16/03

GRN-ODOT



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● GC-306 S-5 8.0' to 10.0'		26	31	20	11		

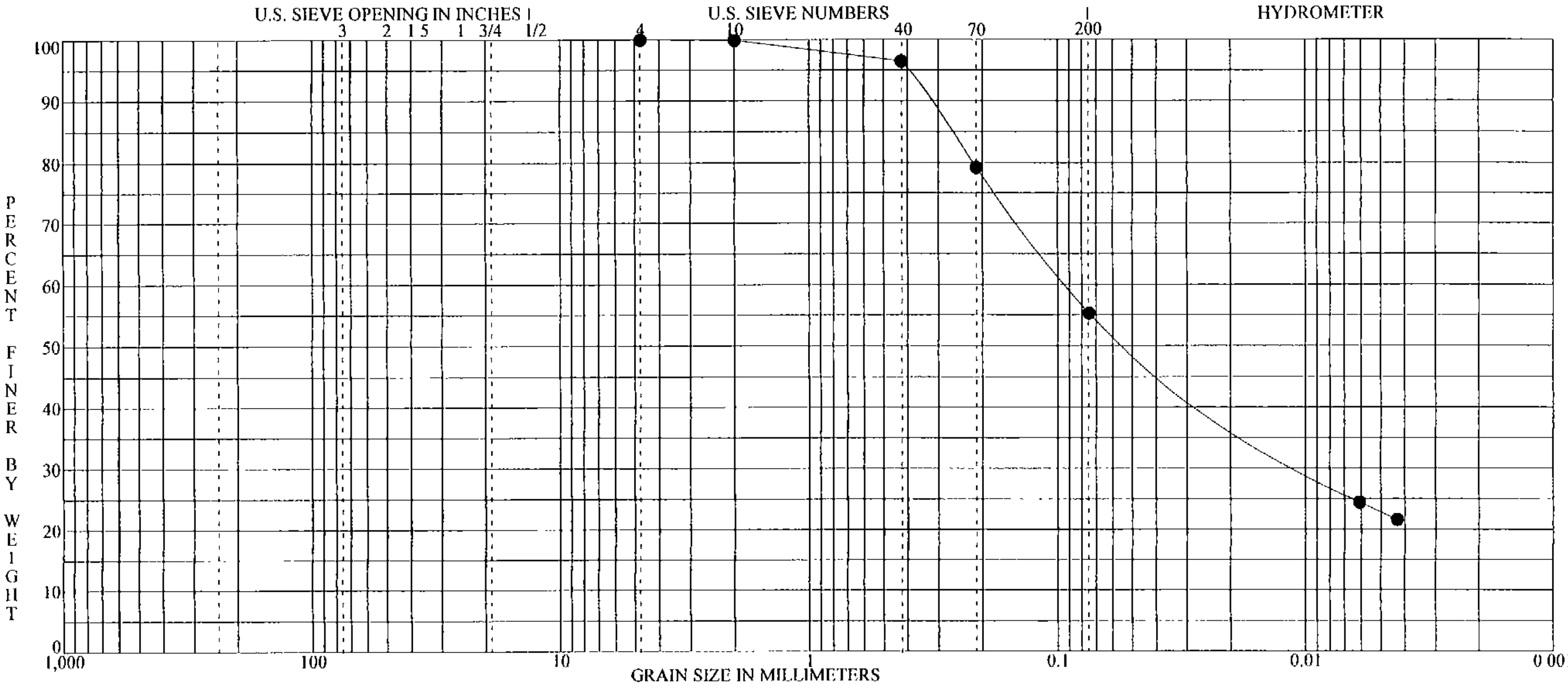
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● GC-306 S-5 8.0' to 10.0'	4.7500	0.0259	0.0070		0.0	15.6	59.2	25.1

BBCM

GRADATION CURVE

PROJECT GUE-70-14.10
LOCATION GUERNSEY COUNTY, OHIO
JOB NO. 01107000.090 DATE 11/15/02

GRN-REG



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	GC-306 S-6 10.0' to 11.4'		27	31	19	12		

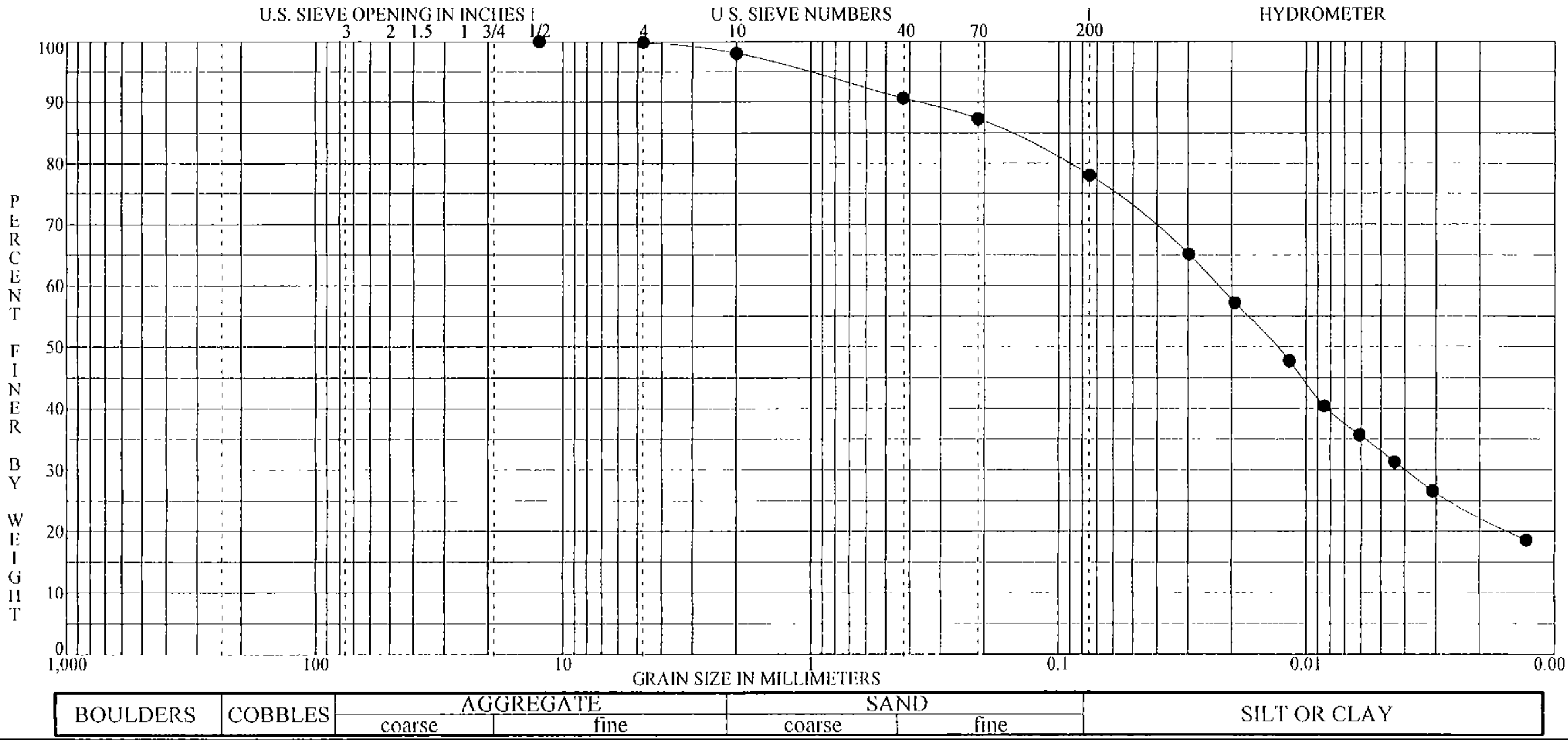
	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	GC-306 S-6 10.0' to 11.4'	4.7500	0.0920	0.0096		0.0	44.7	32.5	22.8

BBCM

GRADATION CURVE

PROJECT GUE-70-14.10
LOCATION GUERNSEY COUNTY, OHIO
JOB NO. 01107000.090 DATE 11/15/02

GRN-REG



	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	D15	D85
●	GC-307 S-3 4.0' to 4.9'	**FILL: Brown intermixed with gray silty clay, some fine to coarse sand, trace fine gravel (shale fragments), few coal fragments.** **ODOT CLASSIFICATION : A-6b(11)** **AASHTO CLASSIFICATION : A-6(11)**	**18**	**40**	**23**	**17**		**0.1642**

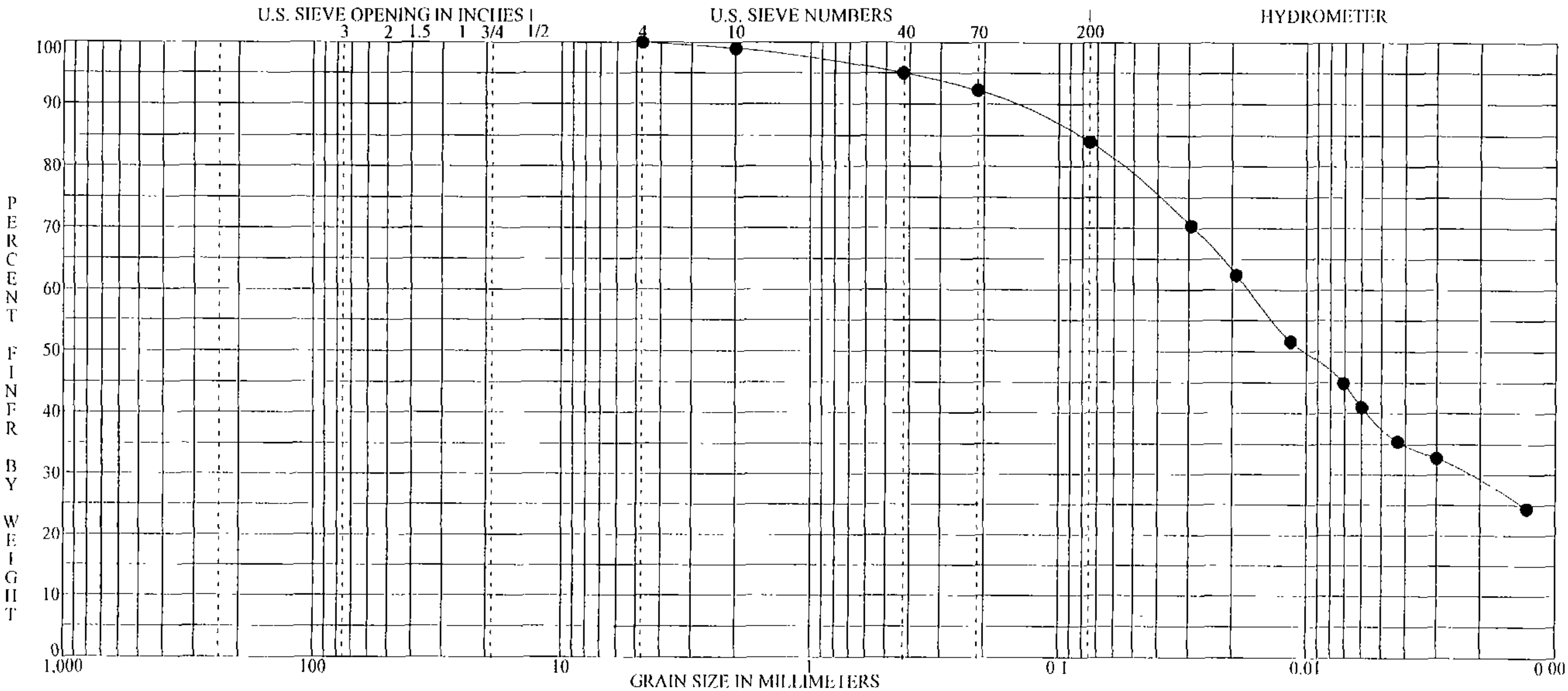
	Specimen Identification - Depth	D90	D50	D30	D10	%Aggregate	%Sand	%Silt	%Clay
●	**GC-307 S-3 4.0' to 4.9'**	**0.3748**	**0.0132**	**0.0040**		**2**	**20**	**45**	**33**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **1/16/03**

GRN-ODOT



BOULDERS	COBBLES	AGGREGATE coarse	AGGREGATE fine	SAND coarse	SAND fine	SILT OR CLAY

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	D15	D85
● GC-308 S-2 2.0' to 3.0'	**FILL: Brown intermixed with red-brown mottled with gray silty clay, little fine to coarse sand, few seams of silt.**	**12**	**38**	**19**	**19**		**0.0851**
	ODOT CLASSIFICATION : A-6b(12)						
	AASHTO CLASSIFICATION : A-6(12)						

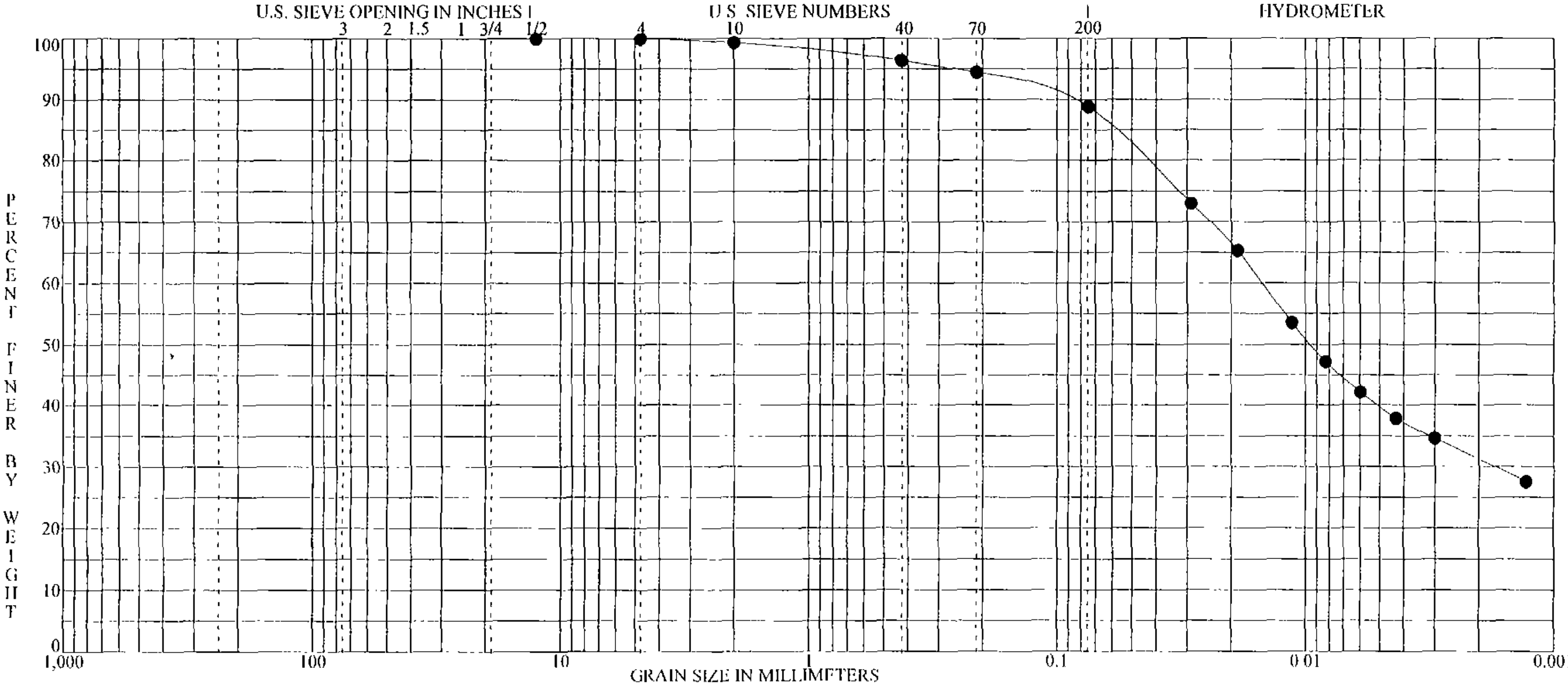
Specimen Identification - Depth	D90	D50	D30	D10	%Aggregate	%Sand	%Silt	%Clay
● **GC-308 S-2 2.0' to 3.0'**	**0.1605**	**0.0103**	**0.0023**		**1**	**15**	**46**	**38**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **1/16/03**

GRN-ODOT



BOULDERS	COBBLES	AGGREGATE		SAND		SILT OR CLAY
		coarse	fine	coarse	fine	

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	D15	D85
●	GC-309 S-2 2.0' to 3.0'	FILL: Brown mottled with gray silty clay intermixed with dark-brown silty clay, little fine to coarse sand, trace fine gravel, few coal fragments. **ODOT CLASSIFICATION : A-7-6(13)** **AASHTO CLASSIFICATION : A-7-6(13)**	18	41	19	22		0.0594

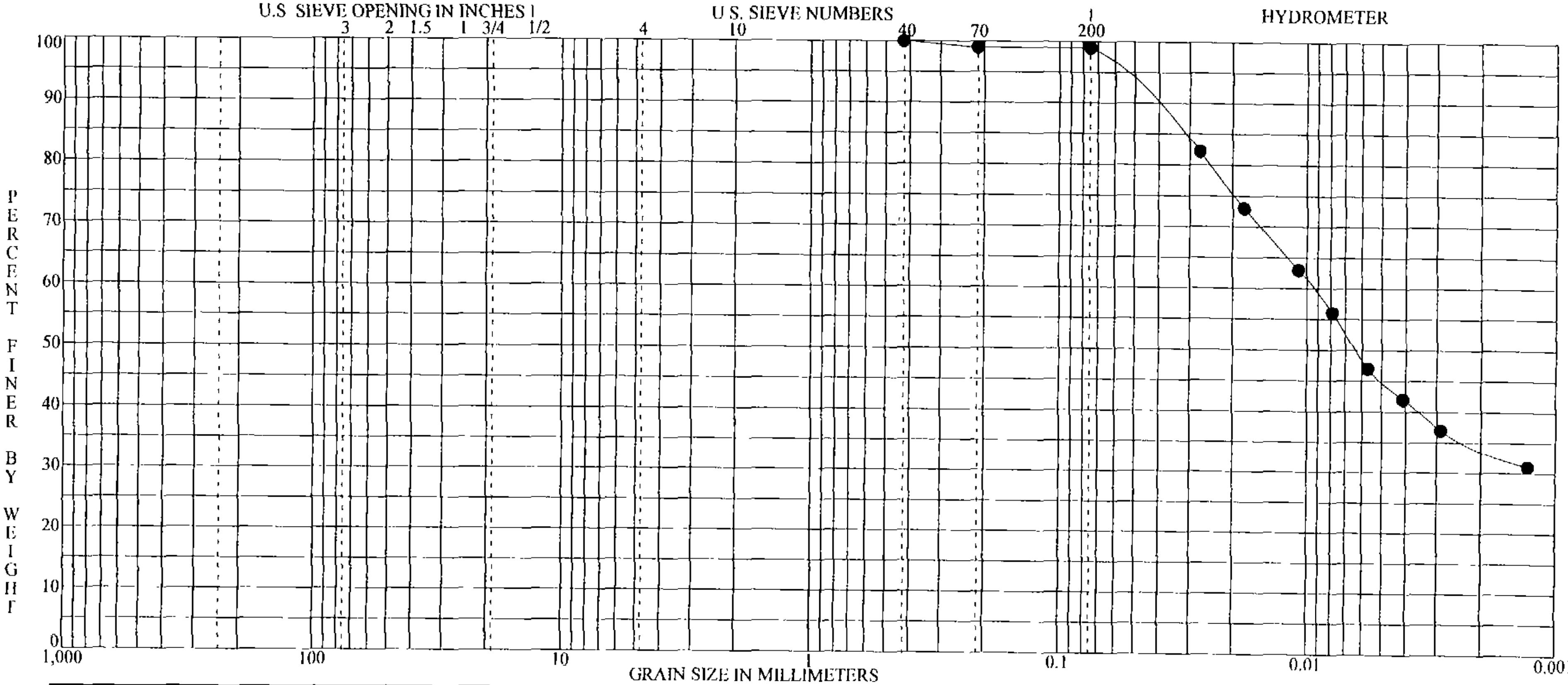
	Specimen Identification - Depth	D90	D50	D30	D10	%Aggregate	%Sand	%Silt	%Clay
●	GC-309 S-2 2.0' to 3.0'	0.0924	0.0096	0.0017		1	10	49	40

BBCM

GRADATION CURVE

PROJECT: GUE-70-14.10
LOCATION: GUERNSEY COUNTY, OHIO
JOB NO.: 01107000.090 DATE: 1/16/03

GRN-ODOT



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● **P-228A S-3 8.5' to 9.7'**	**Brown mottled with gray silty clay, little fine to coarse sand, trace fine gravel.**	**25**	**54**	**20**	**34**		

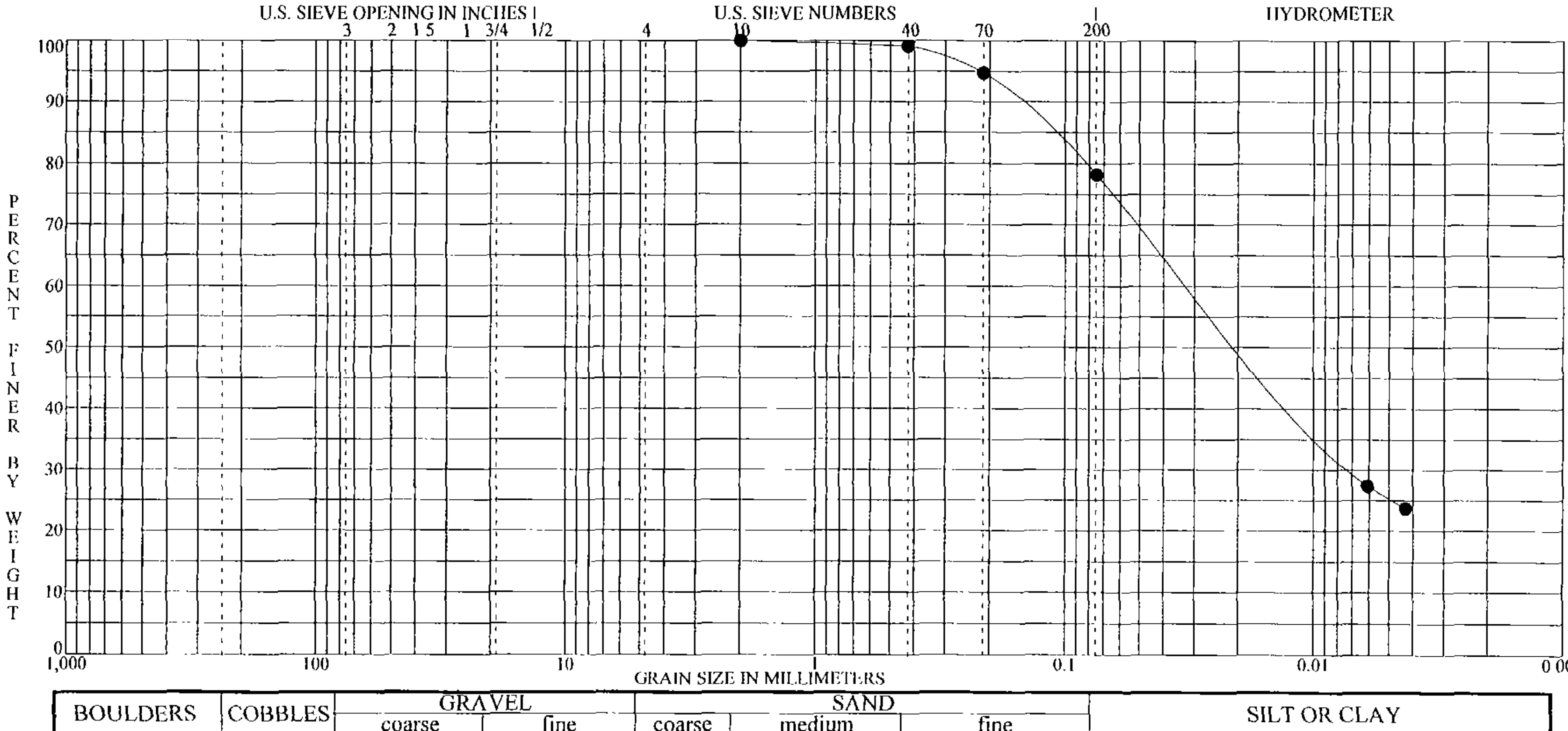
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **P-228A S-3 8.5' to 9.7'**	**0.4250**	**0.0094**			**0.0**	**1.0**	**54.0**	**45.0**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	**P-304A S-1 3.0' to 3.8'**	**Brown silty clay, some fine sand, trace medium sand, few seams of fine sand.**	**27**	**35**	**22**	**13**		

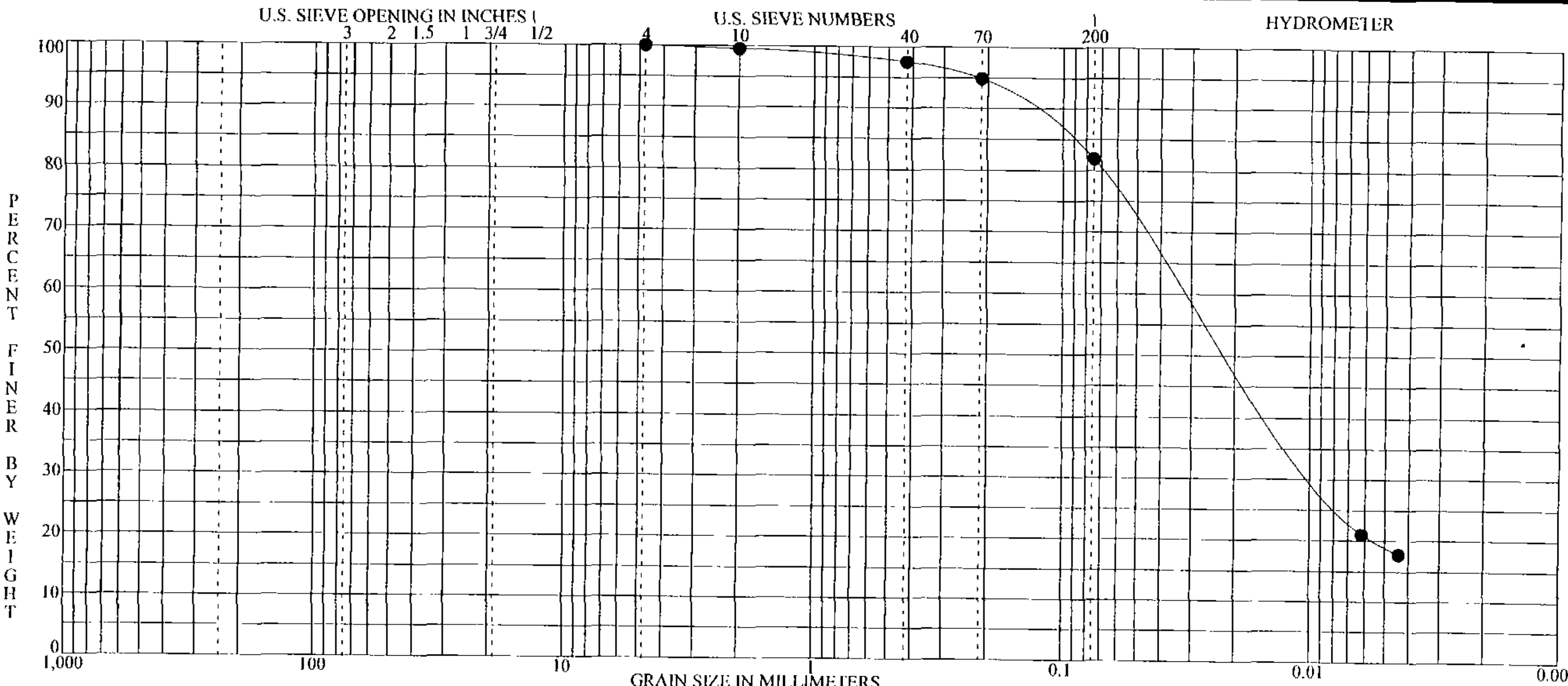
	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**P-304A S-1 3.0' to 3.8'**	**2.0000**	**0.0305**	**0.0069**		**0.0**	**21.8**	**53.0**	**25.3**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



BOULDERS	COBBLES	GRAVEL coarse	GRAVEL fine	SAND coarse	SAND medium	SAND fine	SILT OR CLAY

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	P-304A S-3 8.5' to 9.4'	**Gray clayey silt, little fine to coarse sand, few seams of silt.**	**21**	**25**	**20**	**5**		

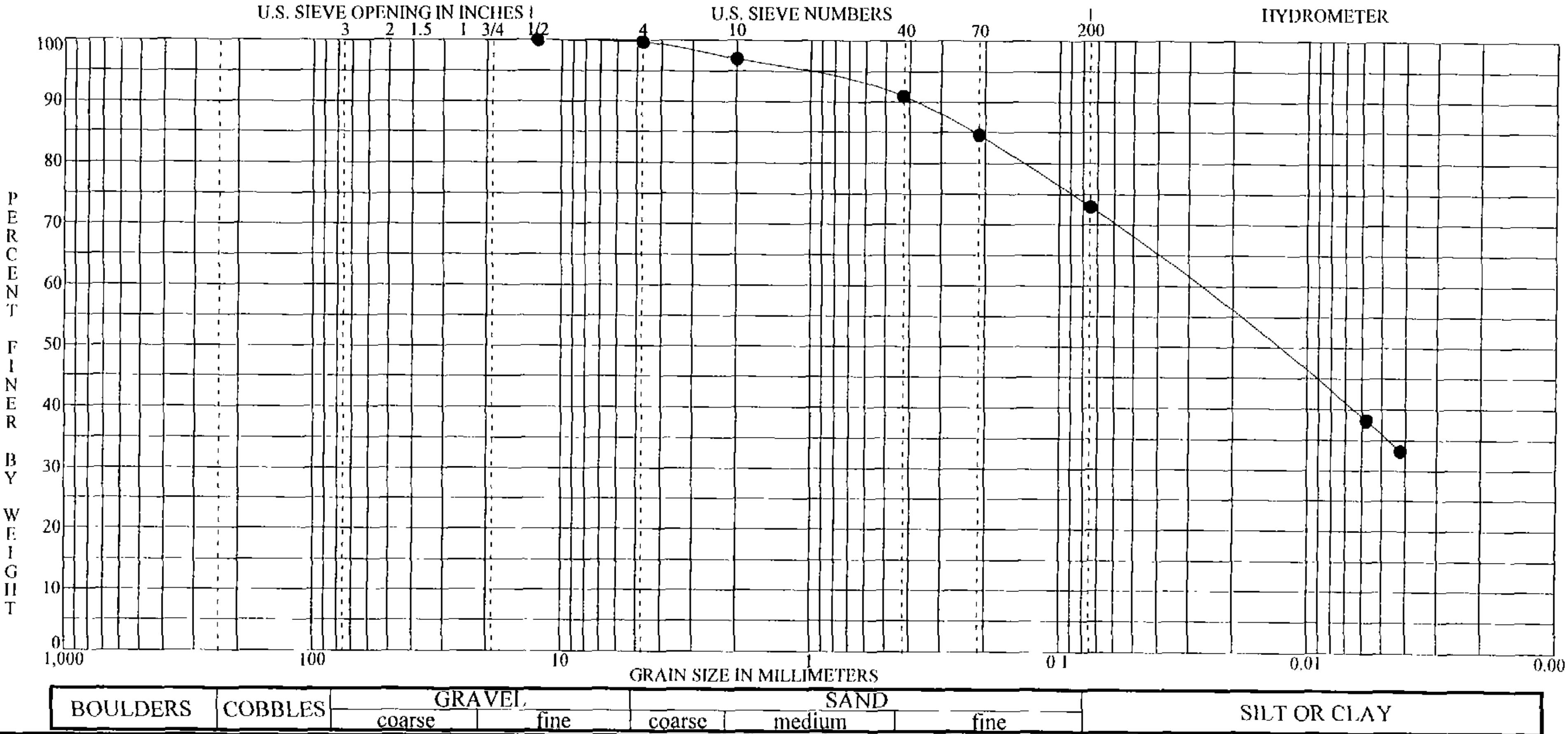
	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	P-304A S-3 8.5' to 9.4'	4.7500	0.0306	0.0090		0.0	18.1	62.9	19.0

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● **P-305A S-3 8.5' to 9.2'**	**Brown mottled with gray silty clay, some fine to coarse sand, trace fine gravel.**	**21**	**35**	**19**	**16**		

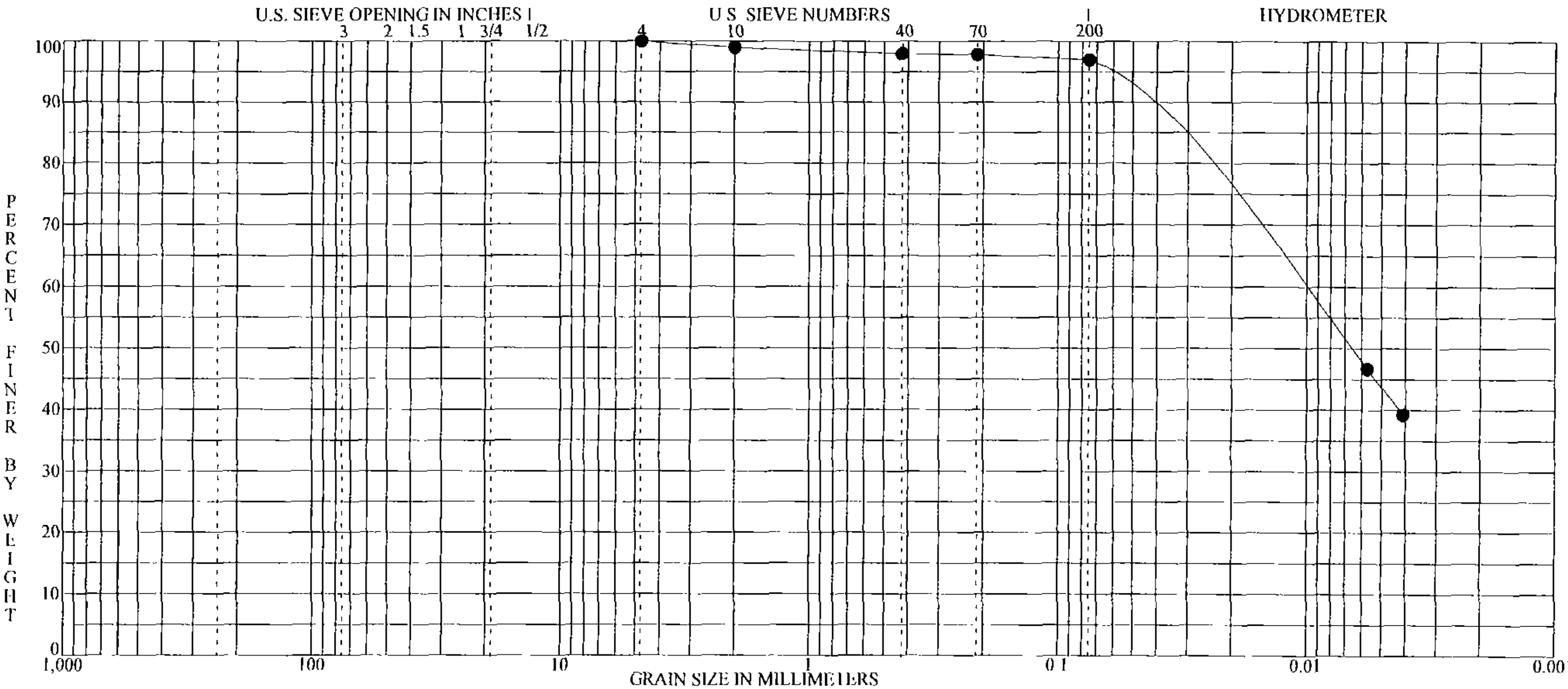
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **P-305A S-3 8.5' to 9.2'**	**12.5000**	**0.0288**			**0.3**	**26.7**	**37.1**	**35.9**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



BOULDERS	COBBLES	GRAVEL coarse	GRAVEL fine	SAND coarse	SAND medium	SAND fine	SILT OR CLAY

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	**P-309A S-3 8.5' to 9.5'**	**Brown mottled with gray silty clay, trace fine to coarse sand.**	**28**	**44**	**22**	**22**		

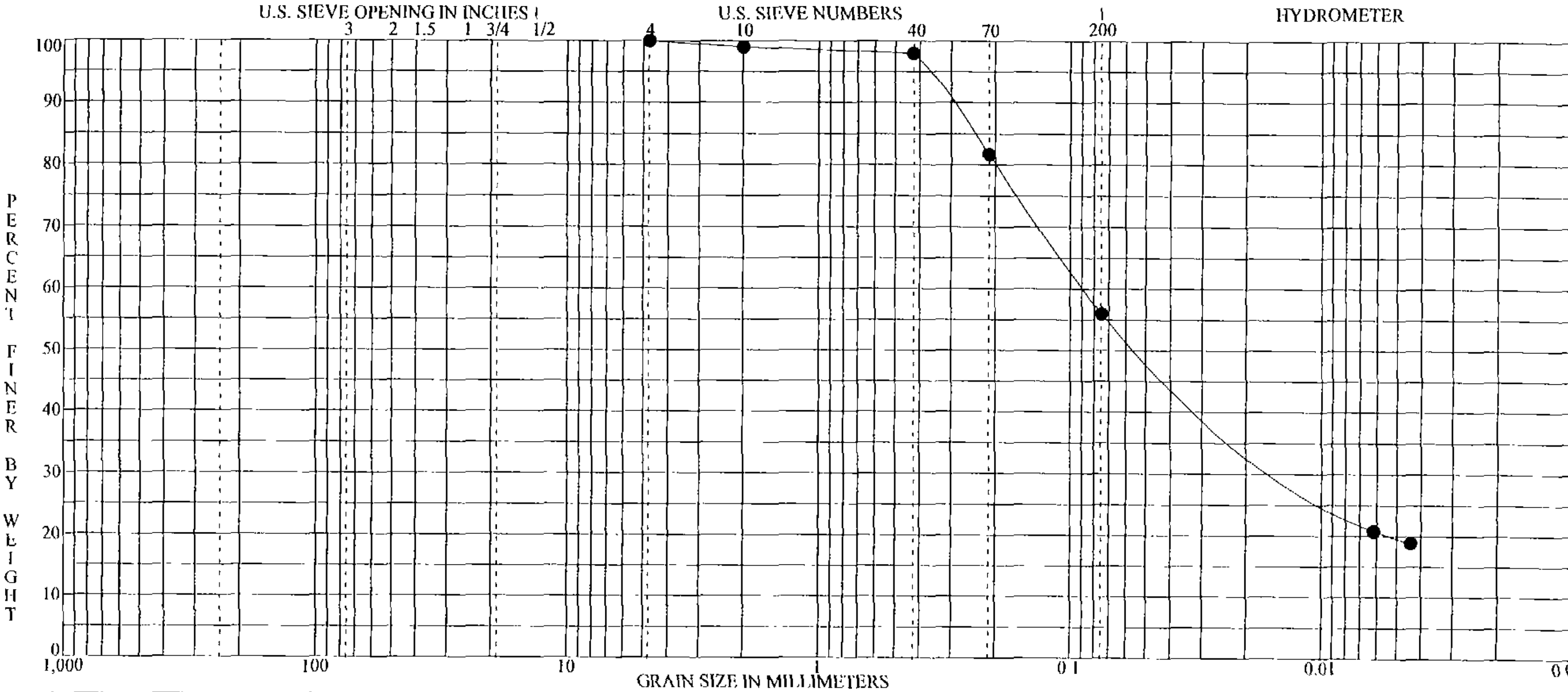
	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**P-309A S-3 8.5' to 9.5'**	**4.7500**	**0.0113**			**0.0**	**3.0**	**53.3**	**43.7**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	**P-309A S-4 13.5' to 14.5'**	**Gray organic silty clay, "and" fine sand, trace medium to coarse sand.**	**23**	**26**	**19**	**7**		

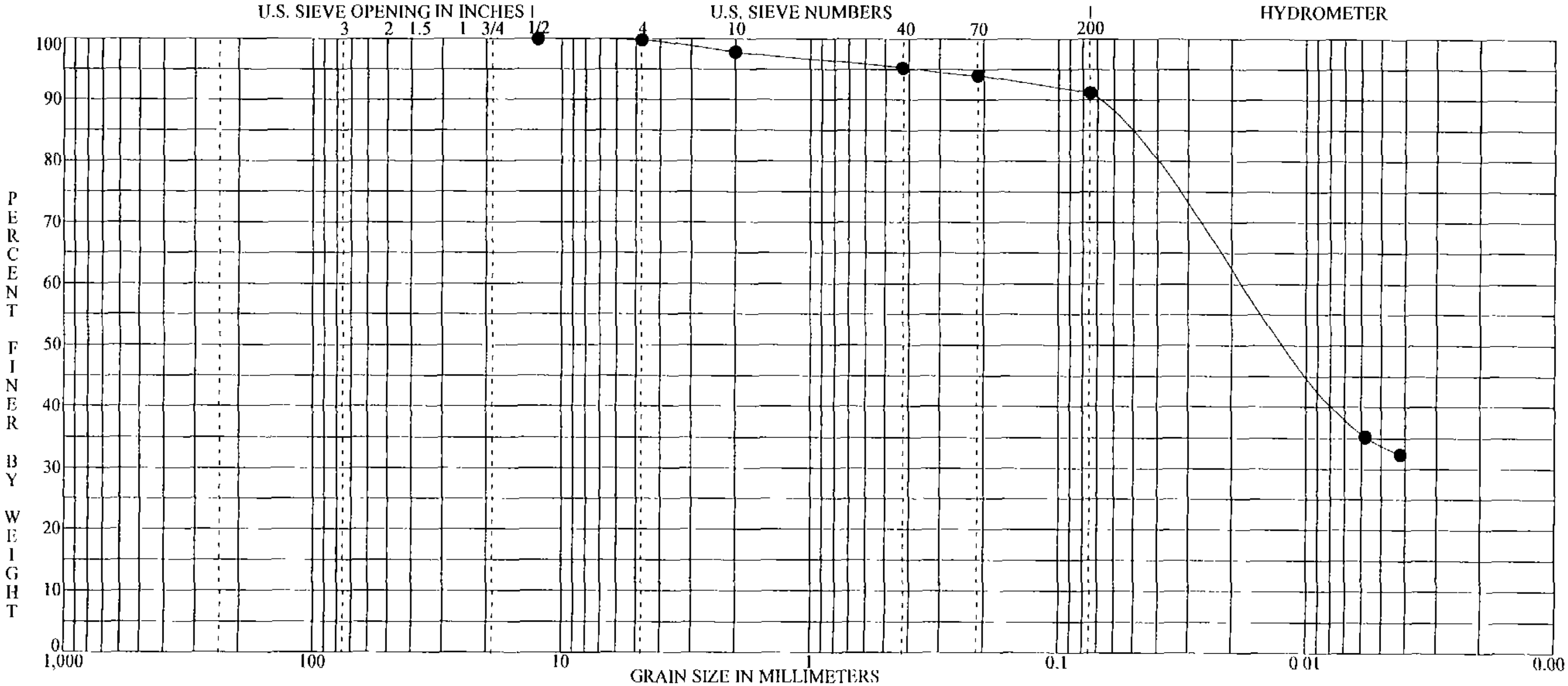
	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**P-309A S-4 13.5' to 14.5'**	**4.7500**	**0.0882**	**0.0119**		**0.0**	**44.0**	**36.4**	**19.6**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



BOULDERS	COBBLES	GRAVEL coarse	GRAVEL fine	SAND coarse	SAND medium	SAND fine	SILT OR CLAY

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	**P-311B S-1B 1.7' to 2.1'**	**Brown mottled with gray and dark brown silty clay, trace fine to coarse sand, trace fine gravel.**	**21**	**41**	**19**	**22**		

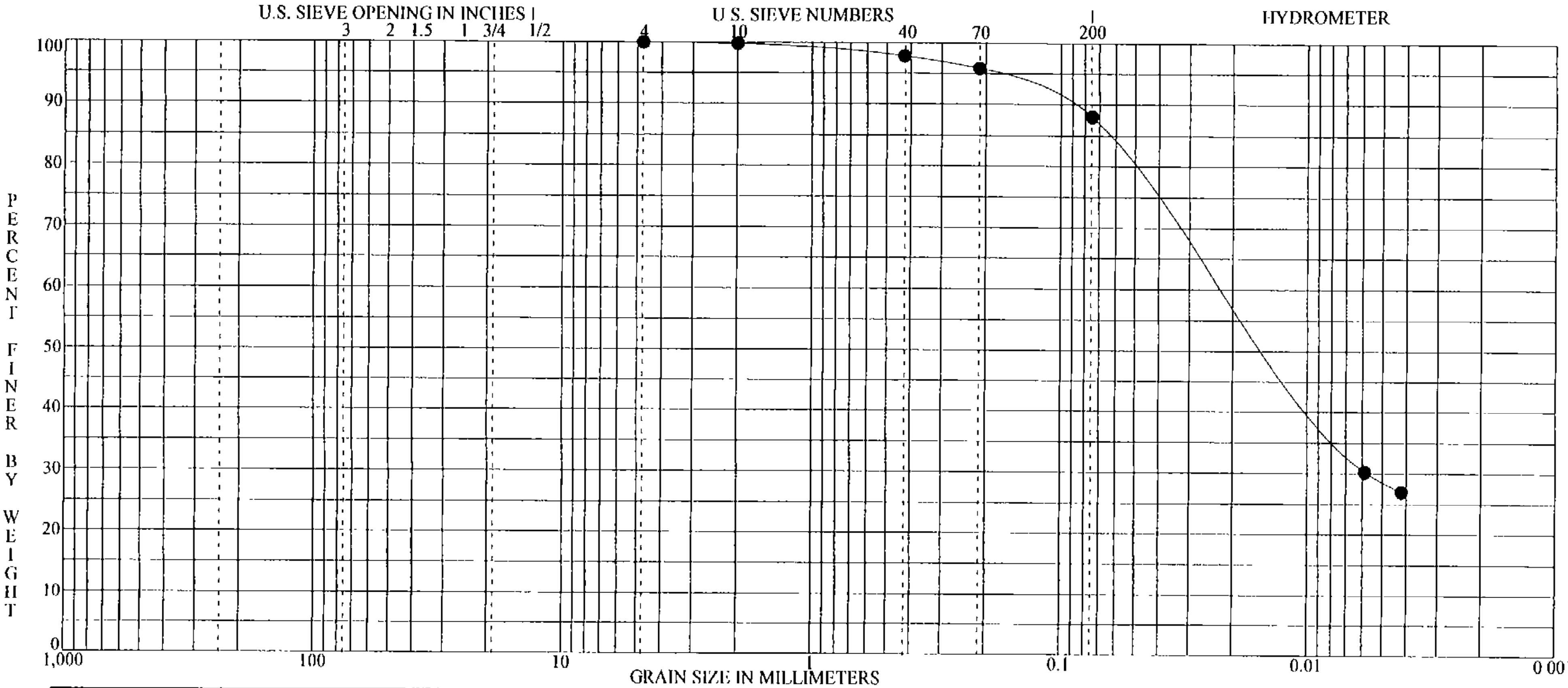
	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**P-311B S-1B 1.7' to 2.1'**	**12.5000**	**0.0180**			**0.2**	**8.6**	**57.3**	**33.9**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



BOULDERS	COBBLES	GRAVEL coarse	GRAVEL fine	SAND coarse	SAND medium	SAND fine	SILT OR CLAY

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	P-311B S-2 3.0' to 4.9'	Brown mottled with gray silty clay, little fine to coarse sand, many lenses of silt.	20	34	17	17		

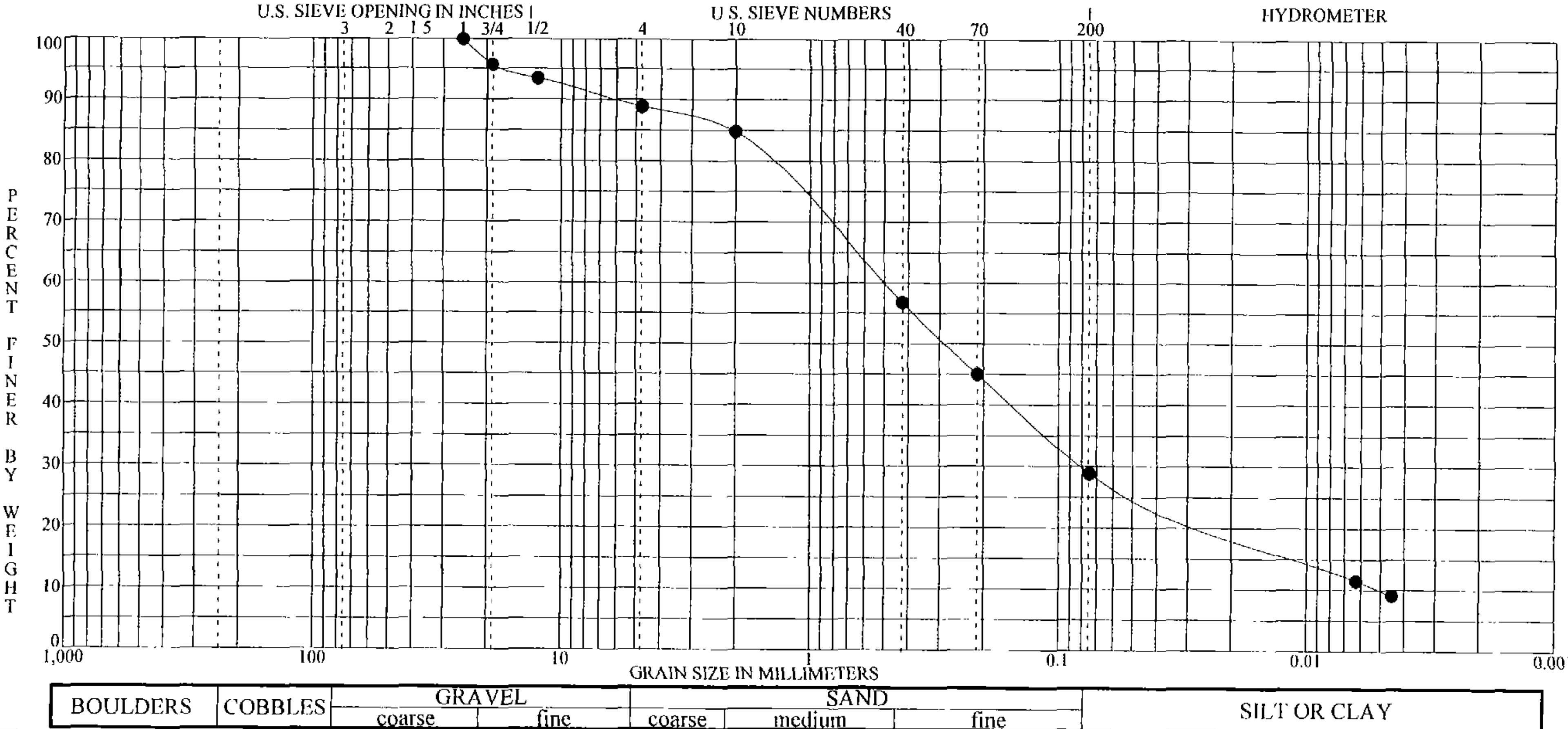
	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	P-311B S-2 3.0' to 4.9'	4.7500	0.0219	0.0058		0.0	12.0	59.4	28.6

BBCM

GRADATION CURVE

PROJECT GUE-70-14.10
LOCATION GUERNSEY COUNTY, OHIO
JOB NO. 01107000.090 DATE 11/15/02

GRN-REG



	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	B-4071 S-8 17.5' to 18.2'	Brown fine to coarse sand, little fine to coarse gravel, some clayey silt.	13					

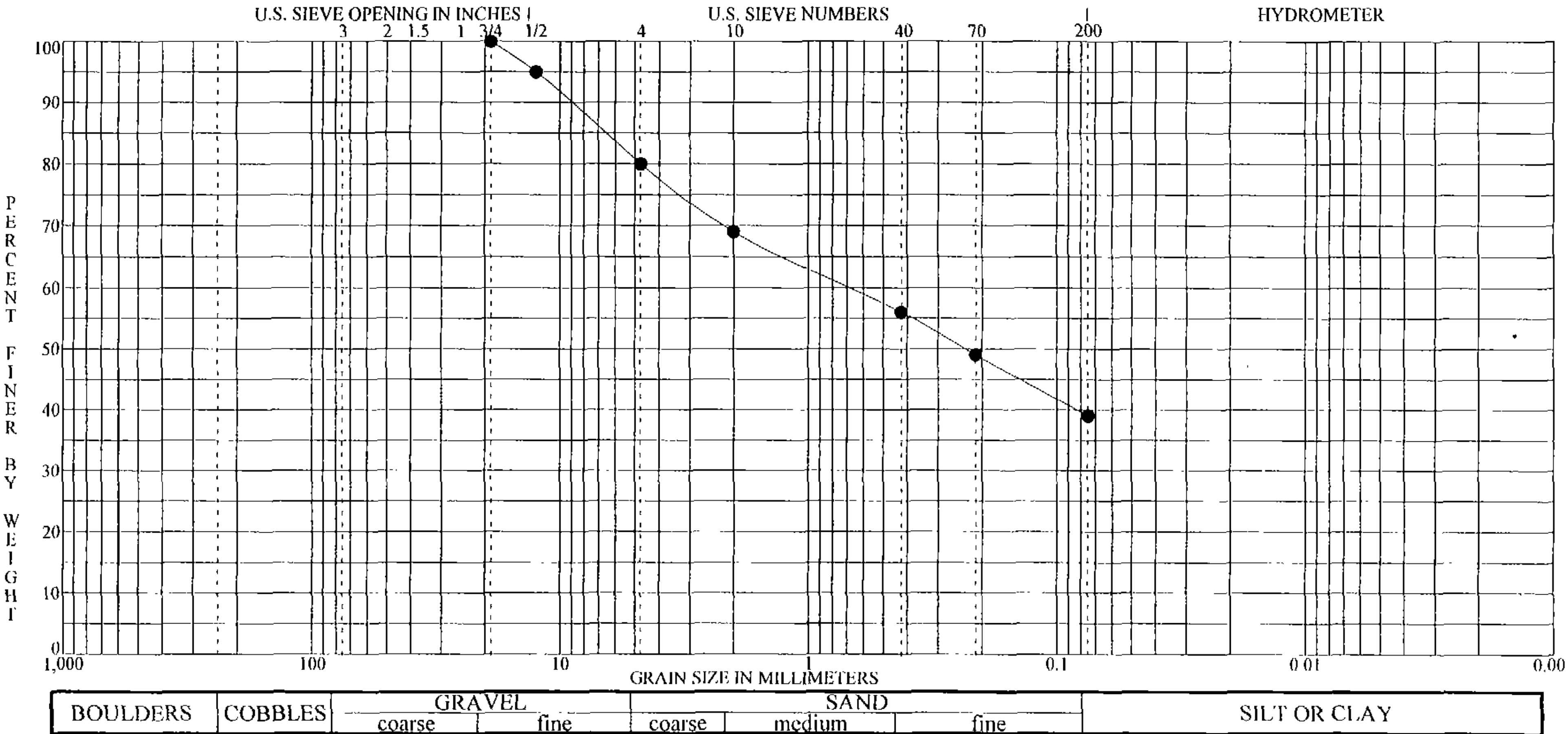
	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-4071 S-8 17.5' to 18.2'	25.0000	0.5084	0.0809	0.0051	11.2	60.0	19.0	9.9

BBCM

GRADATION CURVE

PROJECT GUE-70-14.10
LOCATION GUERNSEY COUNTY, OHIO
JOB NO. 01107000.090 DATE 11/15/02

GRN-REG



Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● GC-201 S-6 23.5' to 24.7'	**Brown mottled with gray and orange fine to coarse sand, little fine gravel, "and" clayey silt.**						

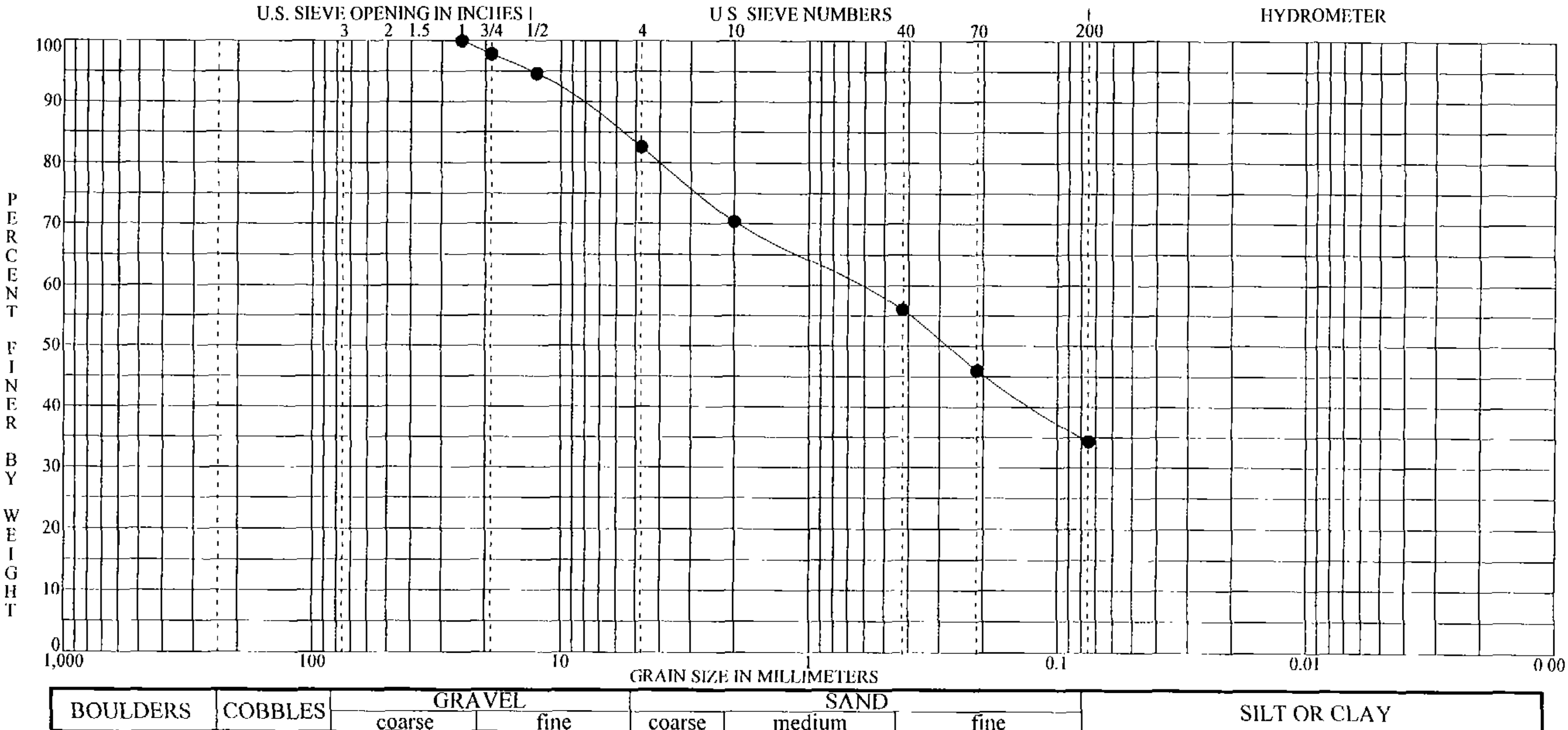
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **GC-201 S-6 23.5' to 24.7'**	**19.0000**	**0.6845**			**20.0**	**41.0**	**39.0**	

BBCM

GRADATION CURVE

PROJECT	**GUE-70-14.10**
LOCATION	**GUERNSEY COUNTY, OHIO**
JOB NO.	**01107000.090**
DATE	**11/15/02**

GRN-REG



Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● GC-209 S-6B 23.8' to 24.7'	**Brown and gray fine to coarse sand, little fine to coarse gravel, some silty clay.**						

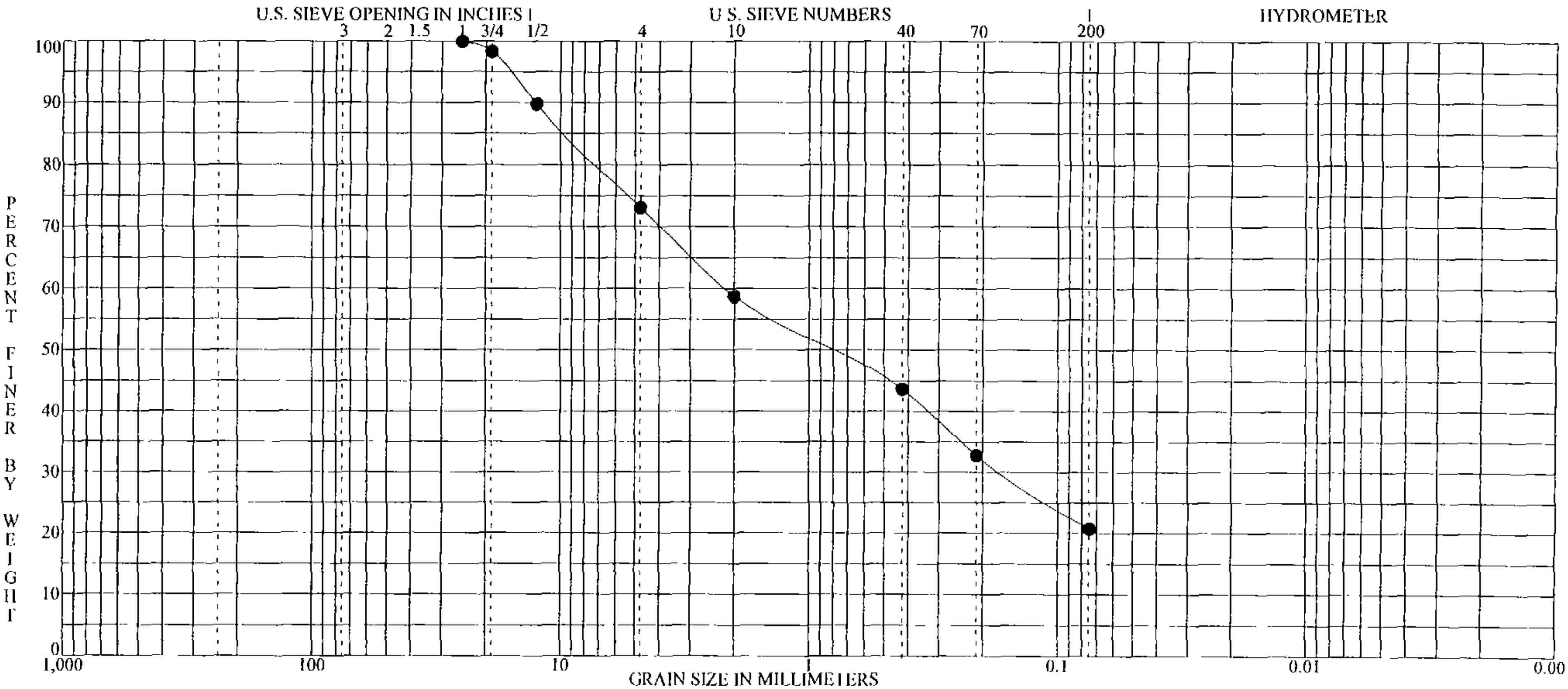
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● GC-209 S-6B 23.8' to 24.7'	25.0000	0.6514			17.4	48.3	34.3	

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	GC-218 S-6 23.5' to 24.6'	**Brown and gray fine to coarse sand, some fine to coarse gravel, some clayey silt.**						

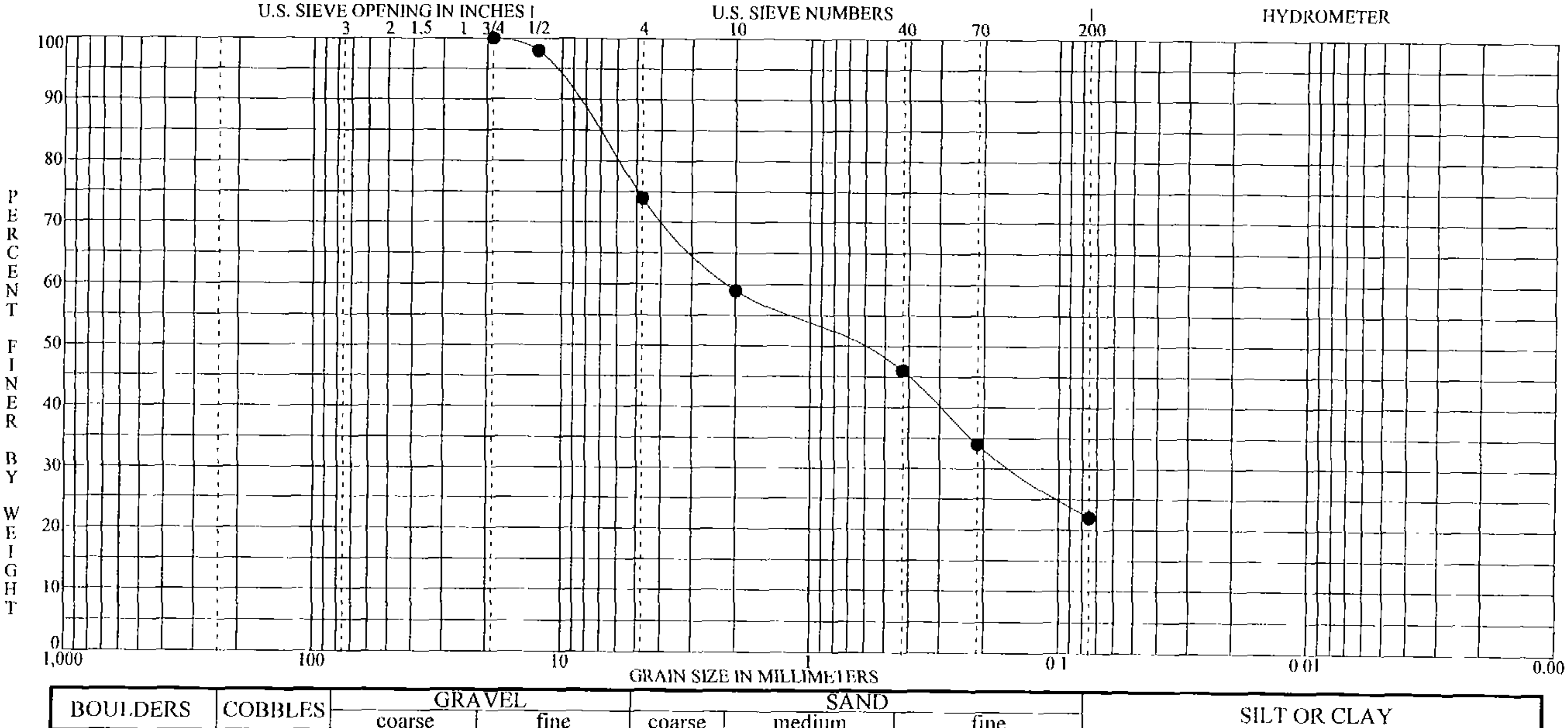
	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	GC-218 S-6 23.5' to 24.6'	25.0000	2.1662	0.1674		26.9	52.3	20.7	

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● P-221A S-6 23.5' to 24.4'	Brown and gray fine to coarse sand, trace fine gravel, some silty clay.						

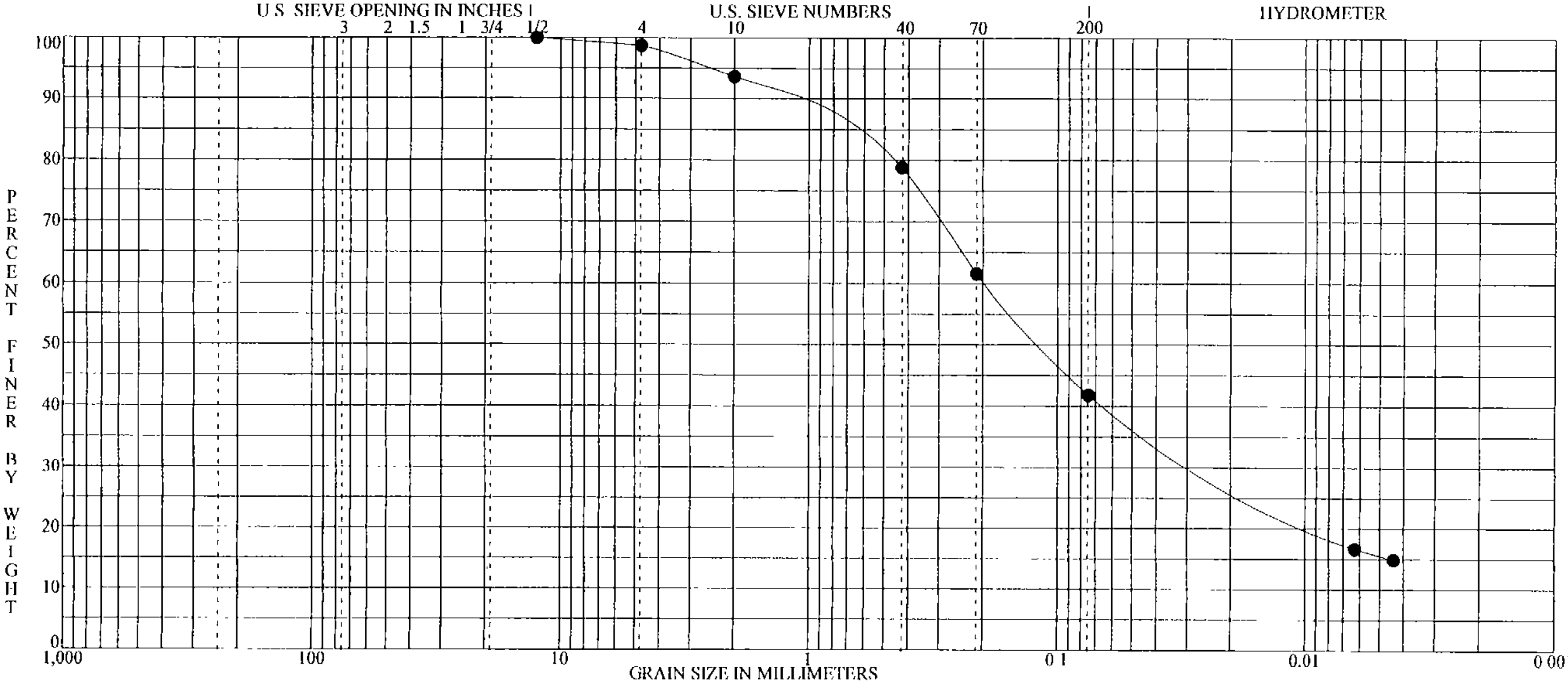
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● P-221A S-6 23.5' to 24.4'	19.0000	2.1187	0.1499		26.0	52.0		22.0

BBCM

GRADATION CURVE

PROJECT GUE-70-14.10
LOCATION GUERNSEY COUNTY, OHIO
JOB NO. 01107000.090 DATE 11/15/02

GRN-REG



BOULDERS	COBBLES	GRAVEL coarse	GRAVEL fine	SAND coarse	SAND medium	SAND fine	SILT OR CLAY

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● P-302A S-2 8.5' to 9.3'	**Brown and gray fine to medium sand, trace coarse sand, trace fine gravel, "and" clayey silt.**	**18**	**29**	**19**	**10**		

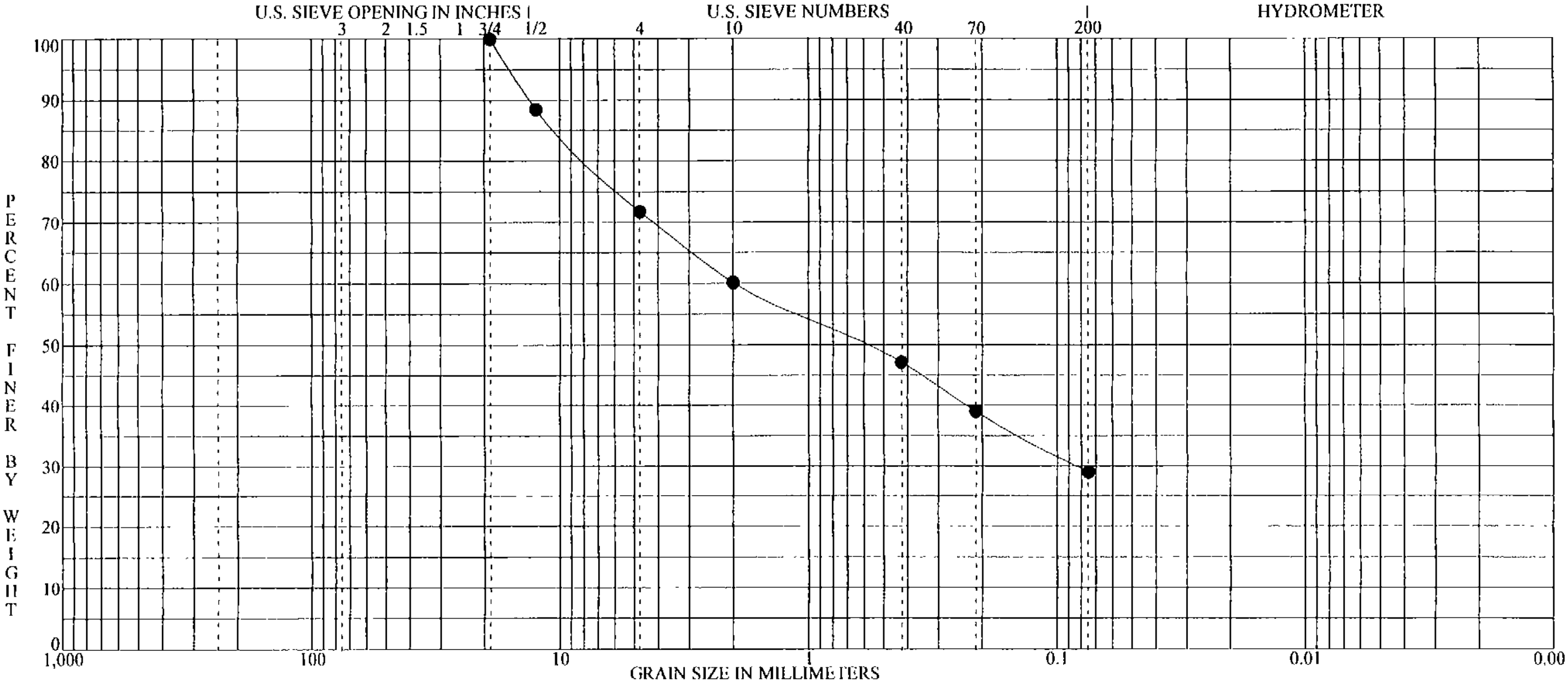
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● P-302A S-2 8.5' to 9.3'	**12.5000**	**0.1952**	**0.0234**		**1.3**	**56.9**	**26.3**	**15.5**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● P-302A S-3 8.5' to 9.3'	Dark-brown and gray fine to coarse sand, some fine gravel, some silty clay.						

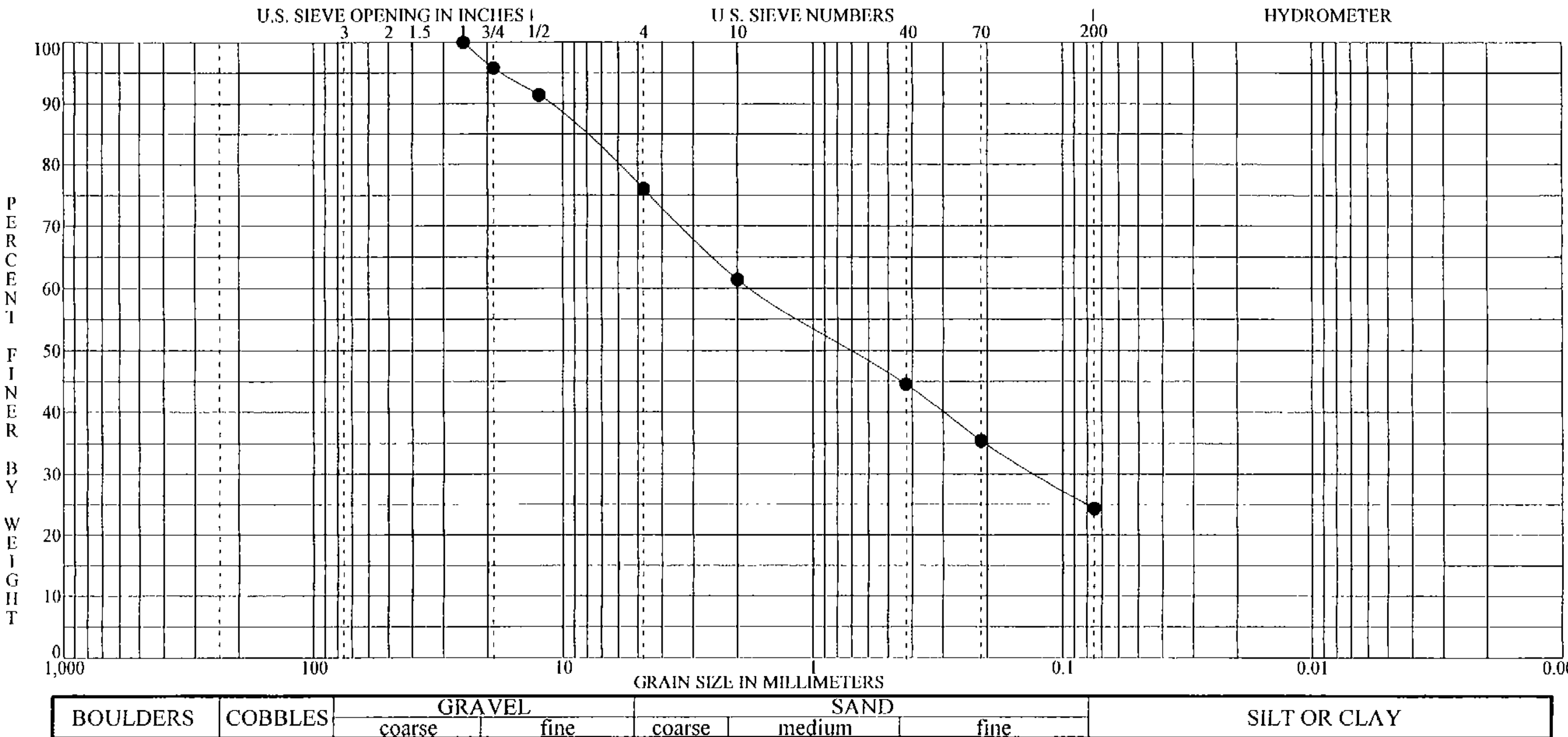
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● P-302A S-3 8.5' to 9.3'	19.0000	1.9676	0.0836		28.2	42.9	28.9	

BBCM

GRADATION CURVE

PROJECT GUE-70-14.10
LOCATION GUERNSEY COUNTY, OHIO
JOB NO. 01107000.090 DATE 11/15/02

GRN-REG



	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	**P-302A S-6 23.5' to 24.6'**	**Dark-brown and gray fine to coarse sand, some fine to coarse gravel, some silty clay.**						

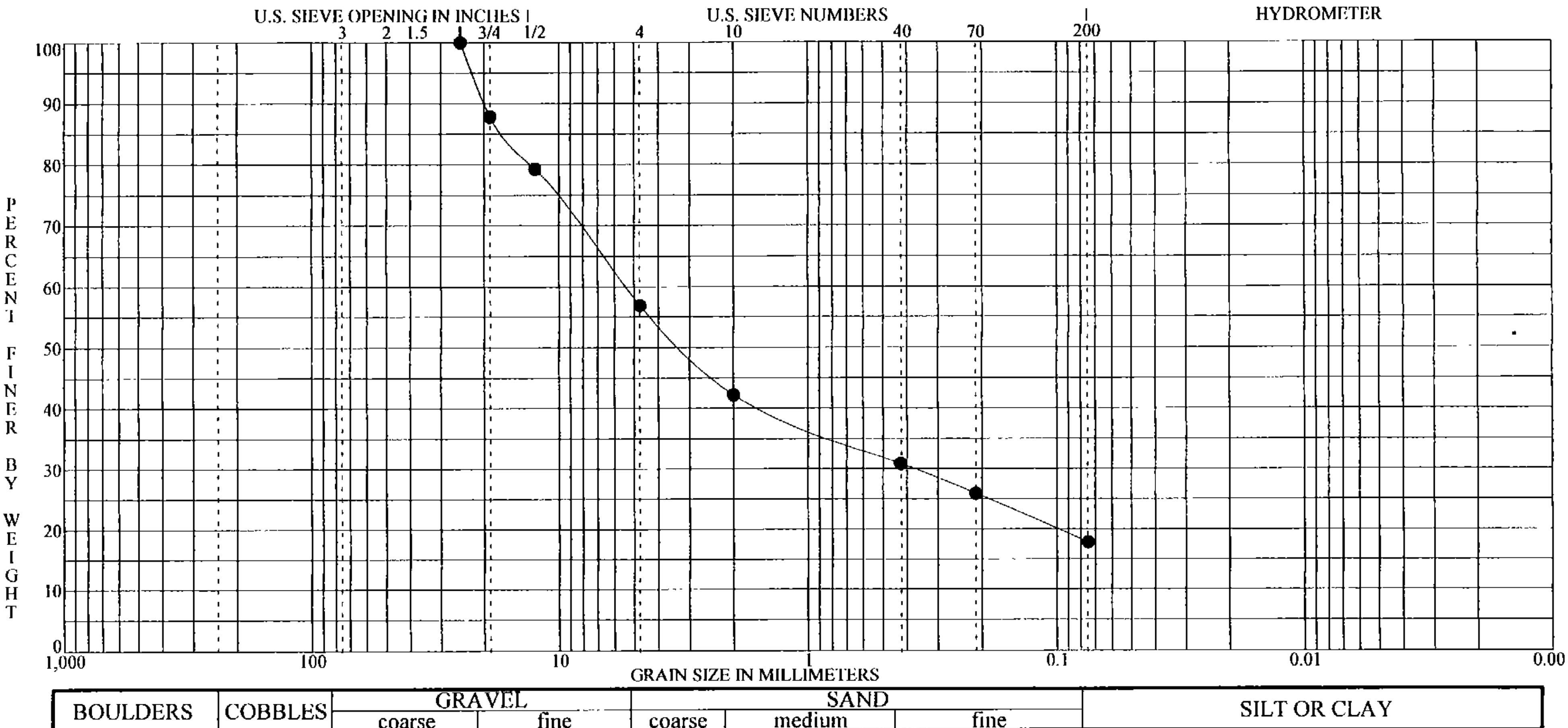
	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**P-302A S-6 23.5' to 24.6'**	**25.0000**	**1.7606**	**0.1276**		**24.0**	**51.7**	**24.3**	

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● P-304A S-6 23.5' to 24.0'	**Brown fine to coarse gravel, "and" fine to coarse sand, little silty clay.**						

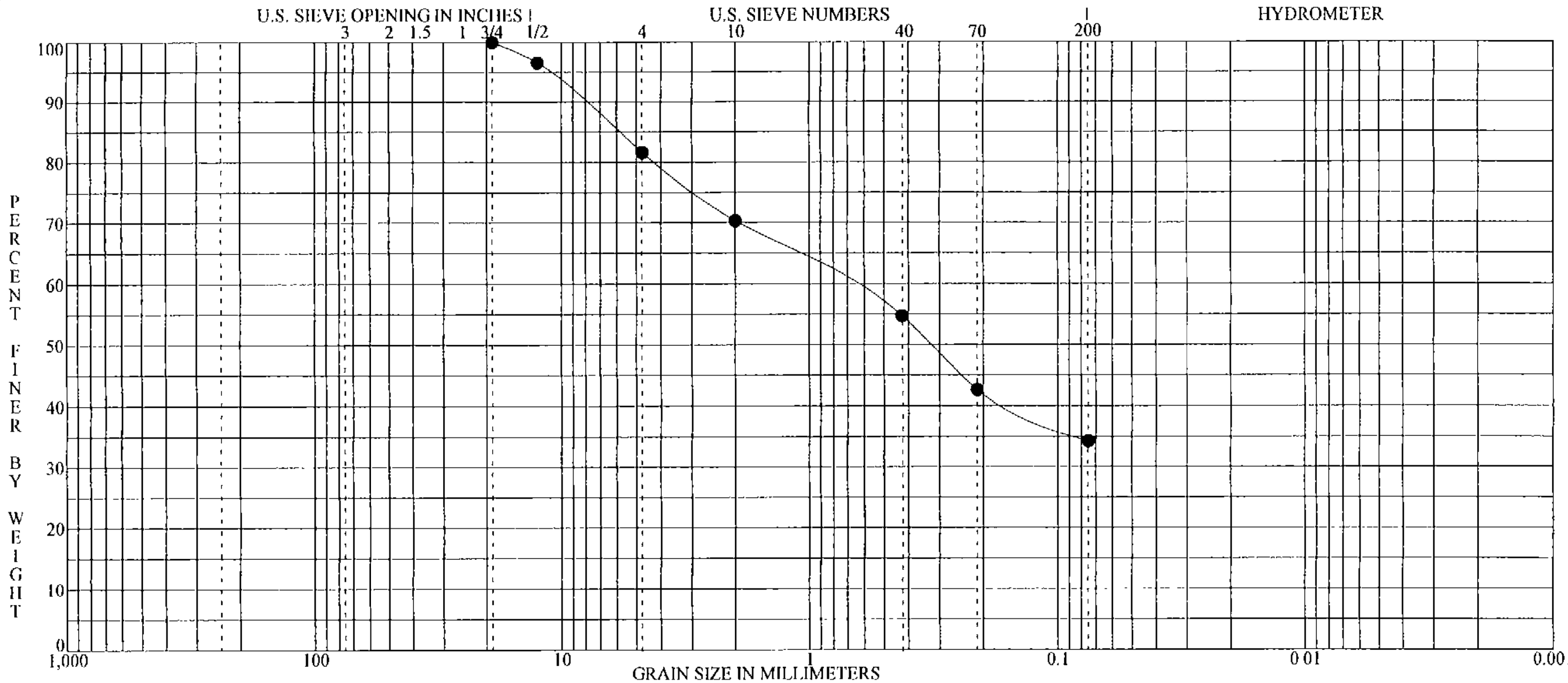
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● P-304A S-6 23.5' to 24.0'	25.0000	5.4362	0.3789		43.1	39.0	17.9	

BBCM

GRADATION CURVE

PROJECT	GUE-70-14.10
LOCATION	GUERNSEY COUNTY, OHIO
JOB NO.	01107000.090
DATE	11/15/02

GRN-REG



BOULDERS	COBBLES	GRAVEL coarse	GRAVEL fine	SAND coarse	SAND medium	SAND fine	SILT OR CLAY

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● P-305A S-6 23.5' to 24.3'	**Brown and gray**						

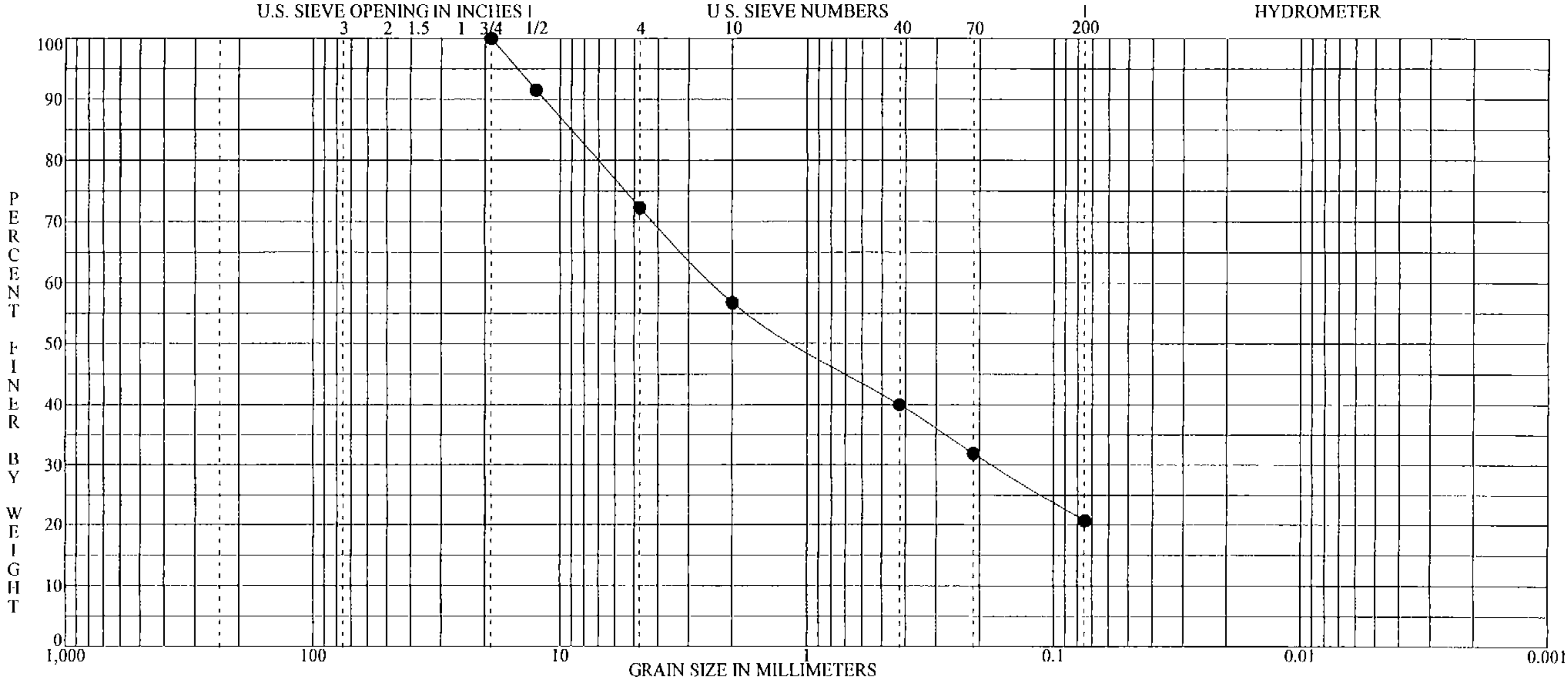
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● P-305A S-6 23.5' to 24.3'	**19.0000**	**0.7182**			**18.4**	**47.4**	**34.2**	

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



BOULDERS	COBBLES	GRAVEL coarse	GRAVEL fine	SAND coarse	SAND medium	SAND fine	SILT OR CLAY

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● P-306A S-3 8.5' to 9.4'	**Brown fine to coarse sand, some fine gravel, some clayey silt.**						

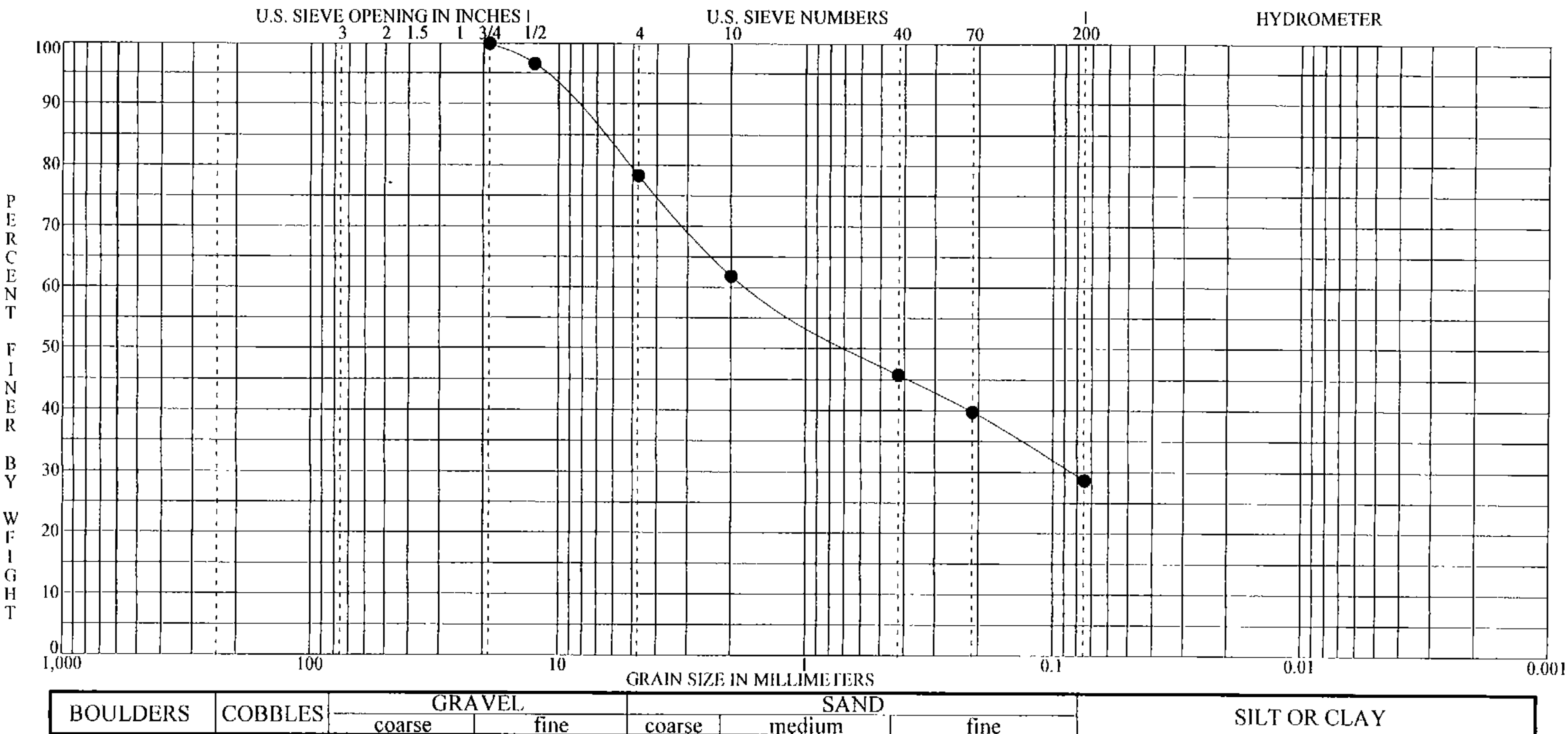
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● P-306A S-3 8.5' to 9.4'	19.0000	2.4002	0.1784		27.7	51.6	20.7	

BBCM

GRADATION CURVE

PROJECT: **GUE-70-14.10**
LOCATION: **GUERNSEY COUNTY, OHIO**
JOB NO.: **01107000.090** DATE: **11/15/02**

GRN-REG



Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● P-306A S-4 13.5' to 14.4'	**Brown and gray fine to coarse sand, some fine gravel, some clayey silt.**						

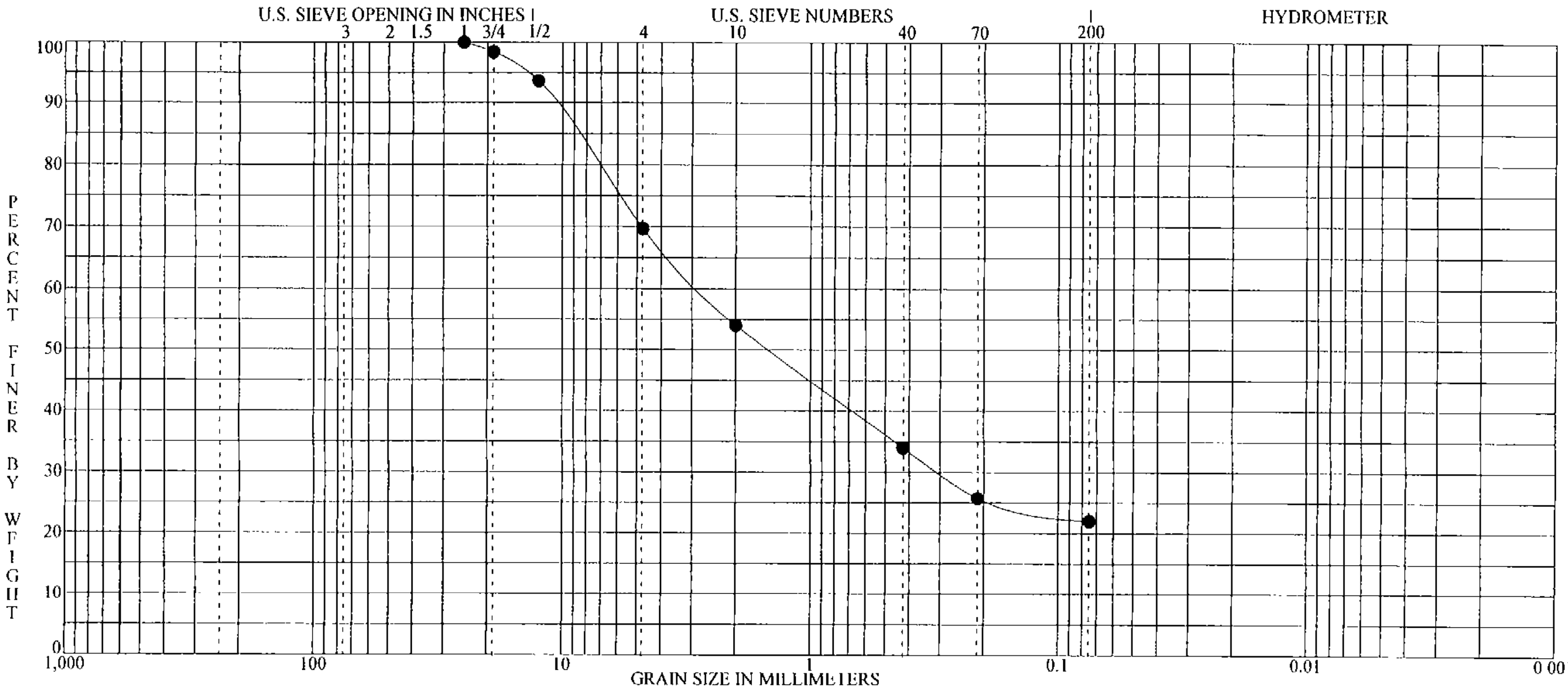
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● P-306A S-4 13.5' to 14.4'	**19.0000**	**1.6754**	**0.0850**		**21.7**	**49.6**	**28.7**	

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



BOULDERS	COBBLES	GRAVEL coarse	GRAVEL fine	SAND coarse	SAND medium	SAND fine	SILT OR CLAY

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	P-309A S-5 18.5' to 19.3'	**Brown fine to coarse sand, some fine to coarse gravel, some silty clay.**						

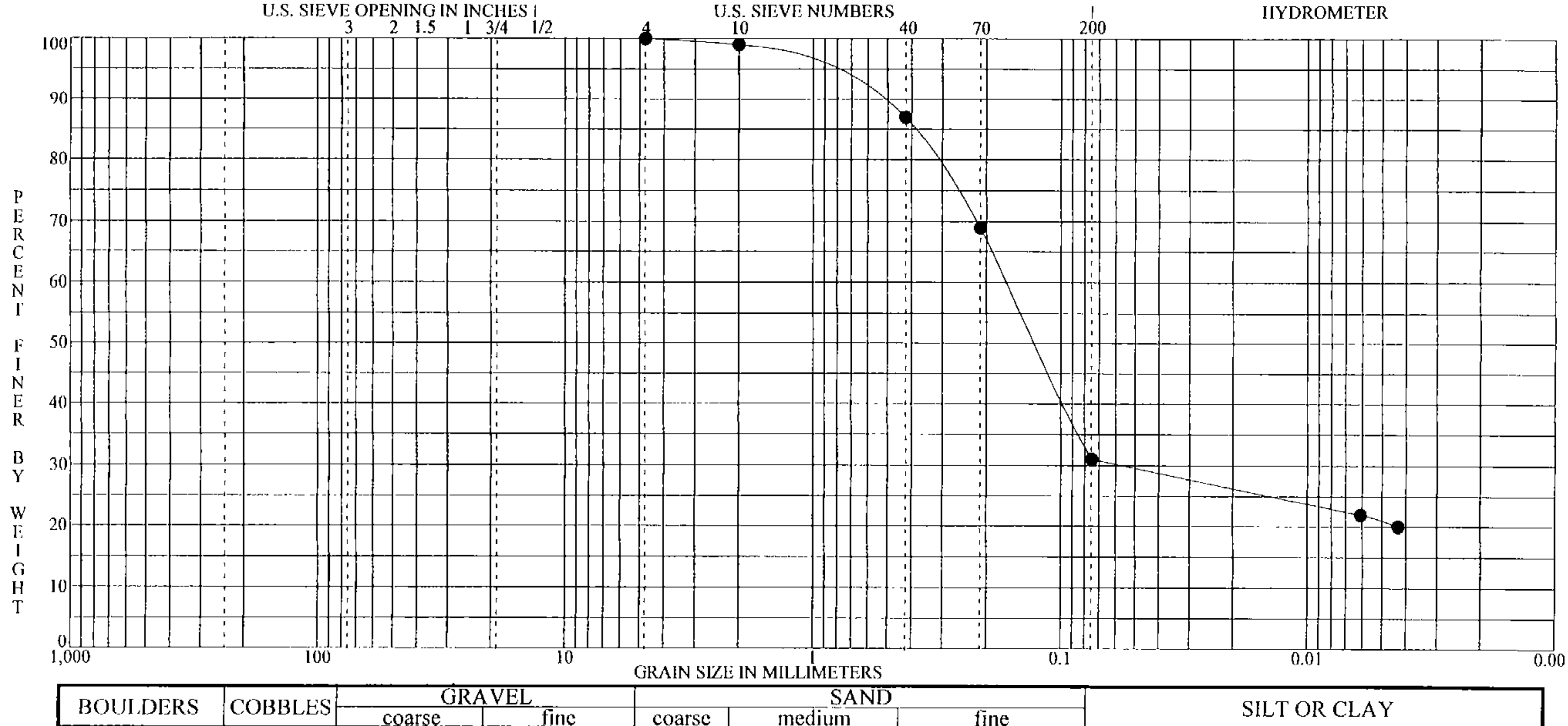
	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	P-309A S-5 18.5' to 19.3'	25.0000	2.7828	0.3042		30.3	47.7	22.0	

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● **P-311B S-10C 24.3' to 24.7'**	**Gray and dark brown fine to medium sand, trace coarse sand, some clayey silt.**	**19**	**27**	**17**	**10**		

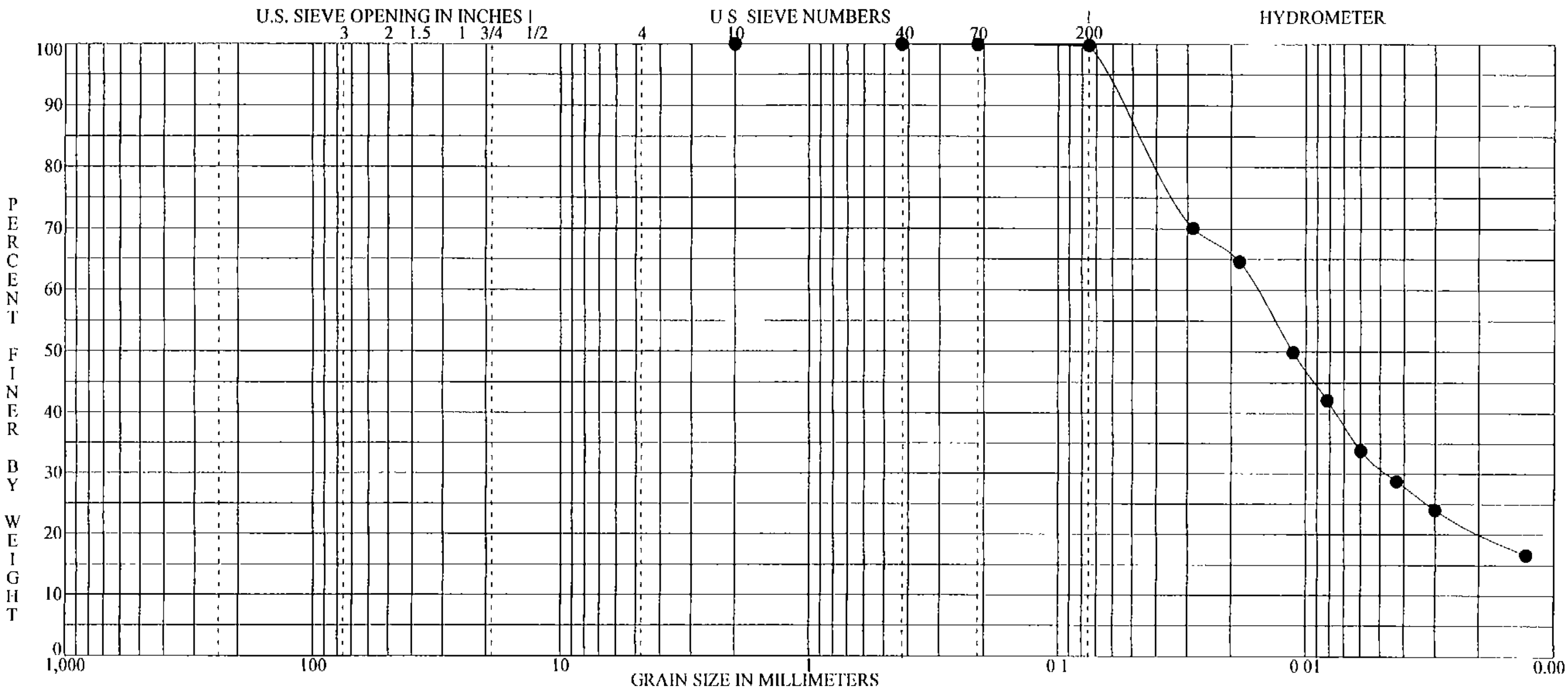
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **P-311B S-10C 24.3' to 24.7'**	**4.7500**	**0.1661**	**0.0569**		**0.0**	**69.0**	**10.2**	**20.8**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	**GC-207 S-7 28.5' to 30.0'**	**Gray silty clay, trace fine sand.**		**37**	**22**	**15**		

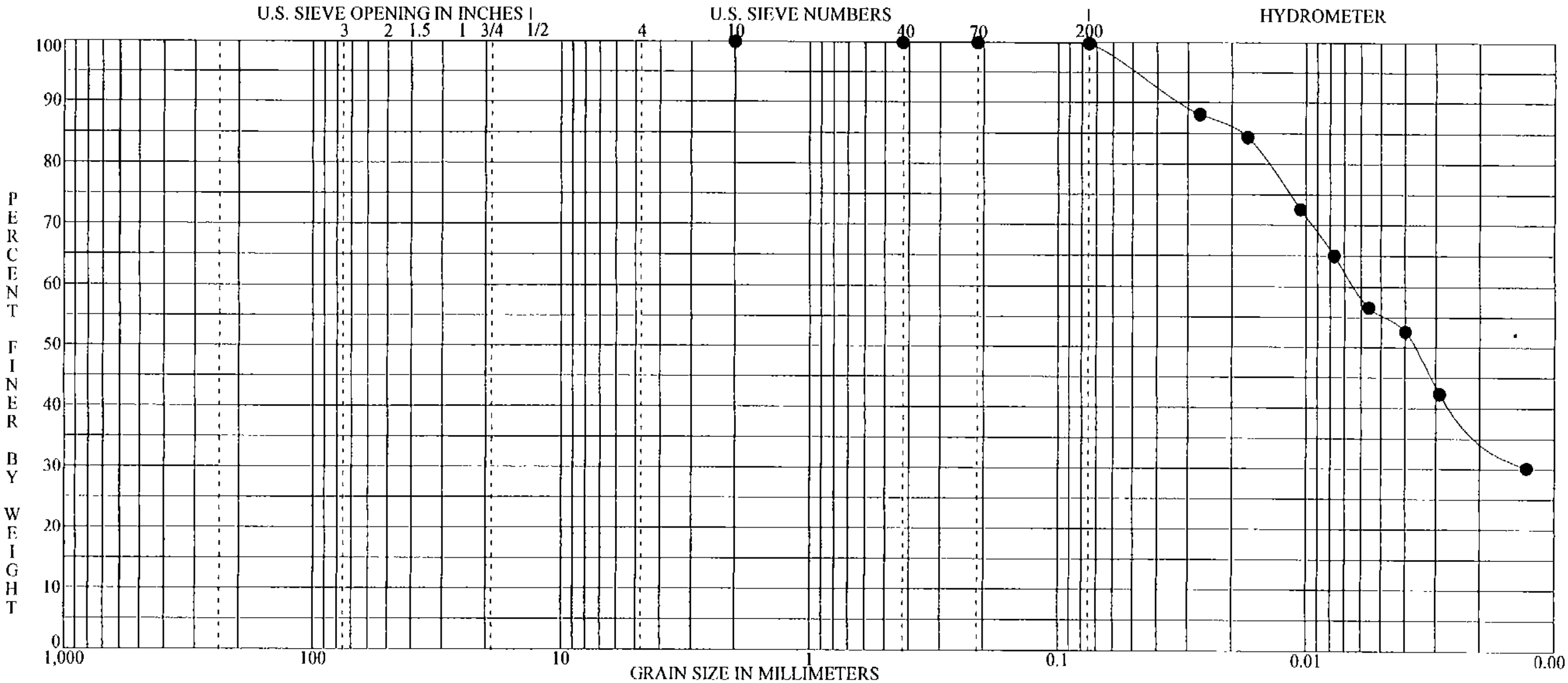
	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**GC-207 S-7 28.5' to 30.0'**	**2.0000**	**0.0159**	**0.0047**		**0.0**	**0.2**	**68.8**	**31.0**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	GC-207 S-8 I 33.5' - 34.0	**Soft to stiff gray clayey silt, trace fine to medium sand**	**31**	**27**	**18**	**9**		

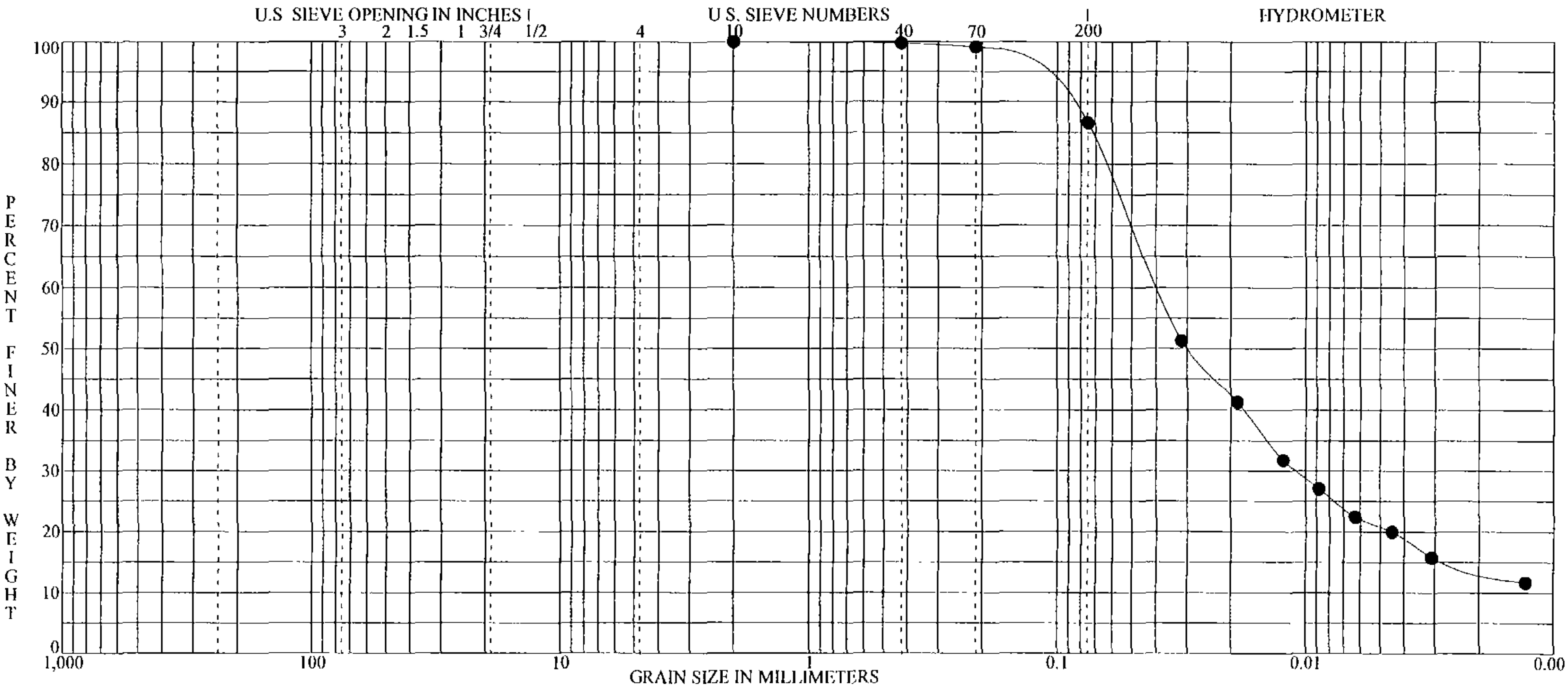
	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	GC-207 S-8 I 33.5' - 34.0	**2.0000**	**0.0064**			**0.0**	**0.2**	**44.6**	**55.3**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



BOULDERS	COBBLES	GRAVEL coarse	GRAVEL fine	SAND coarse	SAND medium	SAND fine	SILT OR CLAY

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	GC-207 S-8 II 34.0' - 34.4	Stiff gray silty clay, little fine to coarse sand, trace fine gravel, contains silt seams	23	32	19	13		

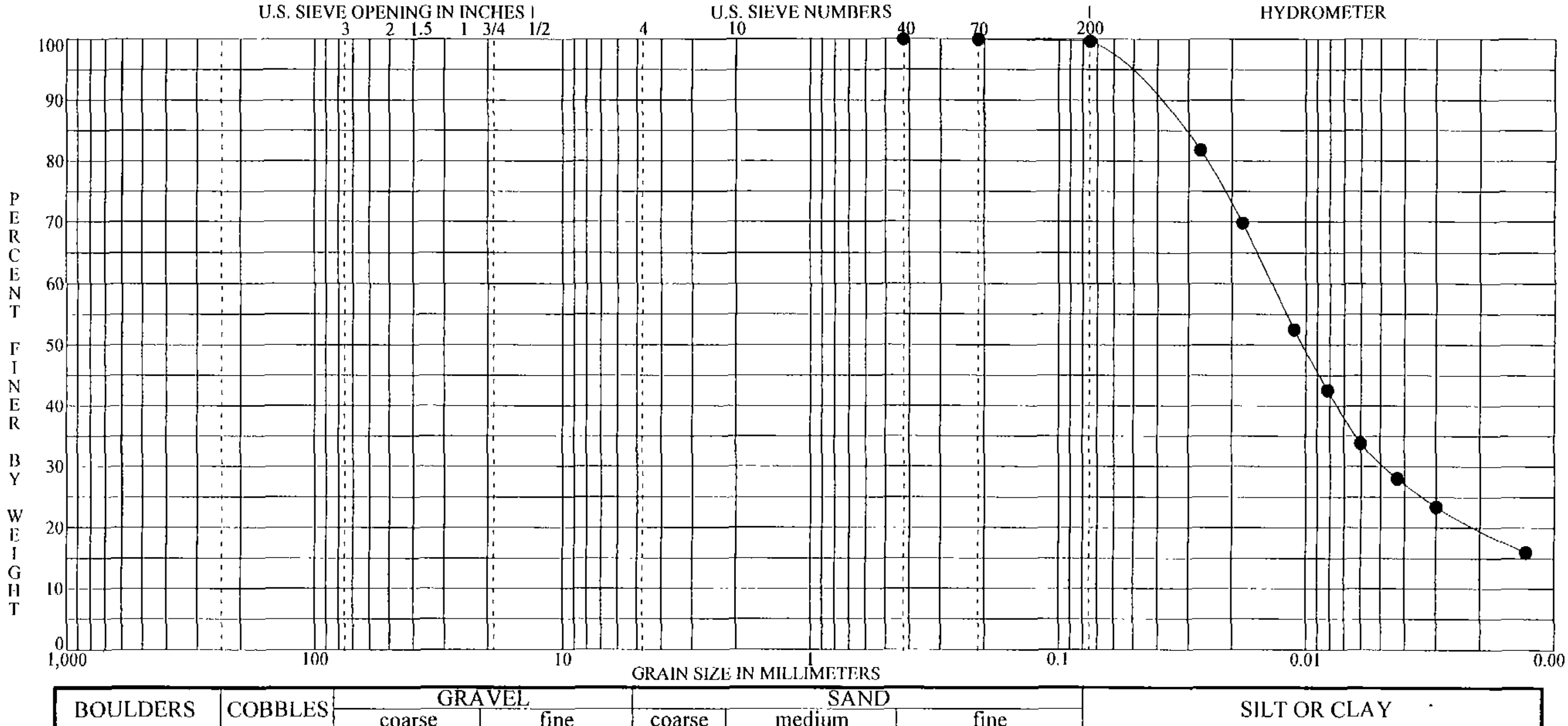
	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	GC-207 S-8 II 34.0' - 34.4	2.0000	0.0391	0.0108		0.0	13.4	65.9	20.8

BBCM

GRADATION CURVE

PROJECT GUE-70-14.10
LOCATION GUERNSEY COUNTY, OHIO
JOB NO. 01107000.090 DATE 11/15/02

GRN-REG



Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● GC-209 S-7 28.5' to 29.8'	**Gray silty clay, trace fine sand.**	29	34	22	12		

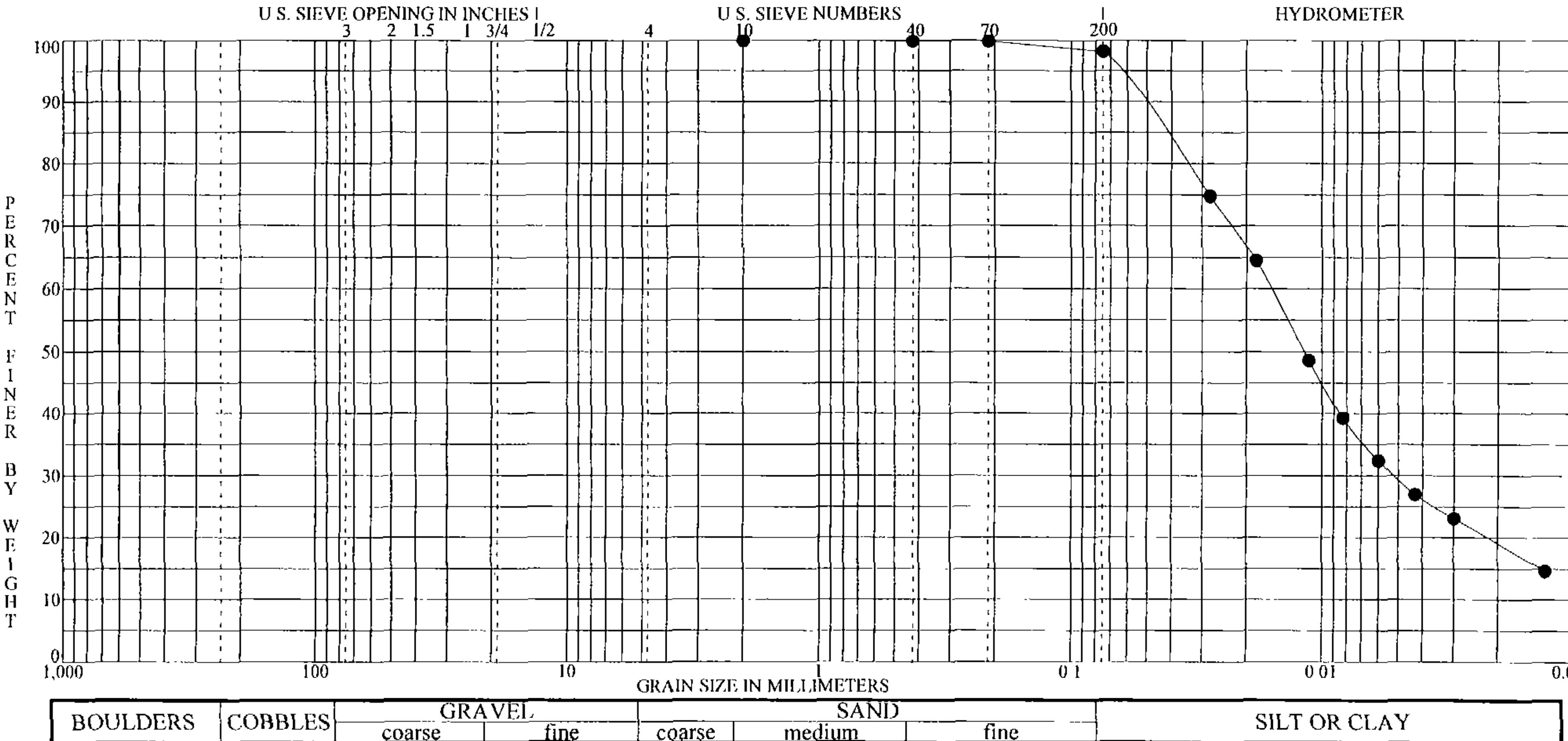
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● GC-209 S-7 28.5' to 29.8'	0.4250	0.0138	0.0048		0.0	0.3	69.0	30.6

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	GC-213 S-7 28.5' to 30.0'	**Gray mottled with brown silty clay, trace fine to medium sand.**	**27**	**33**	**22**	**11**		

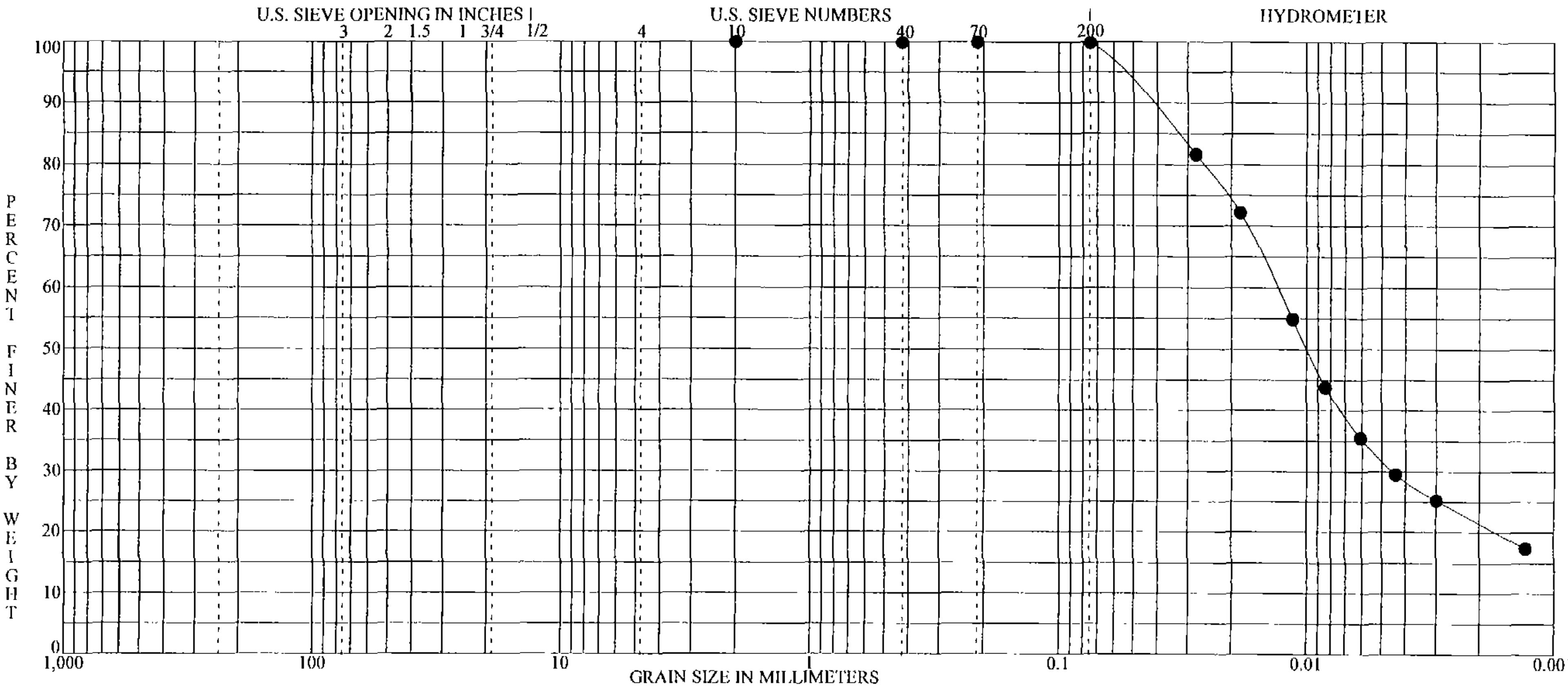
	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	GC-213 S-7 28.5' to 30.0'	**2.0000**	**0.0160**	**0.0052**		**0.0**	**1.8**	**68.8**	**29.4**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●GC-216 S-7A III 30.0' - 32.0'	**Stiff gray silty clay, trace fine to medium sand, contains seams of silt.**	**29**	**37**	**23**	**14**		

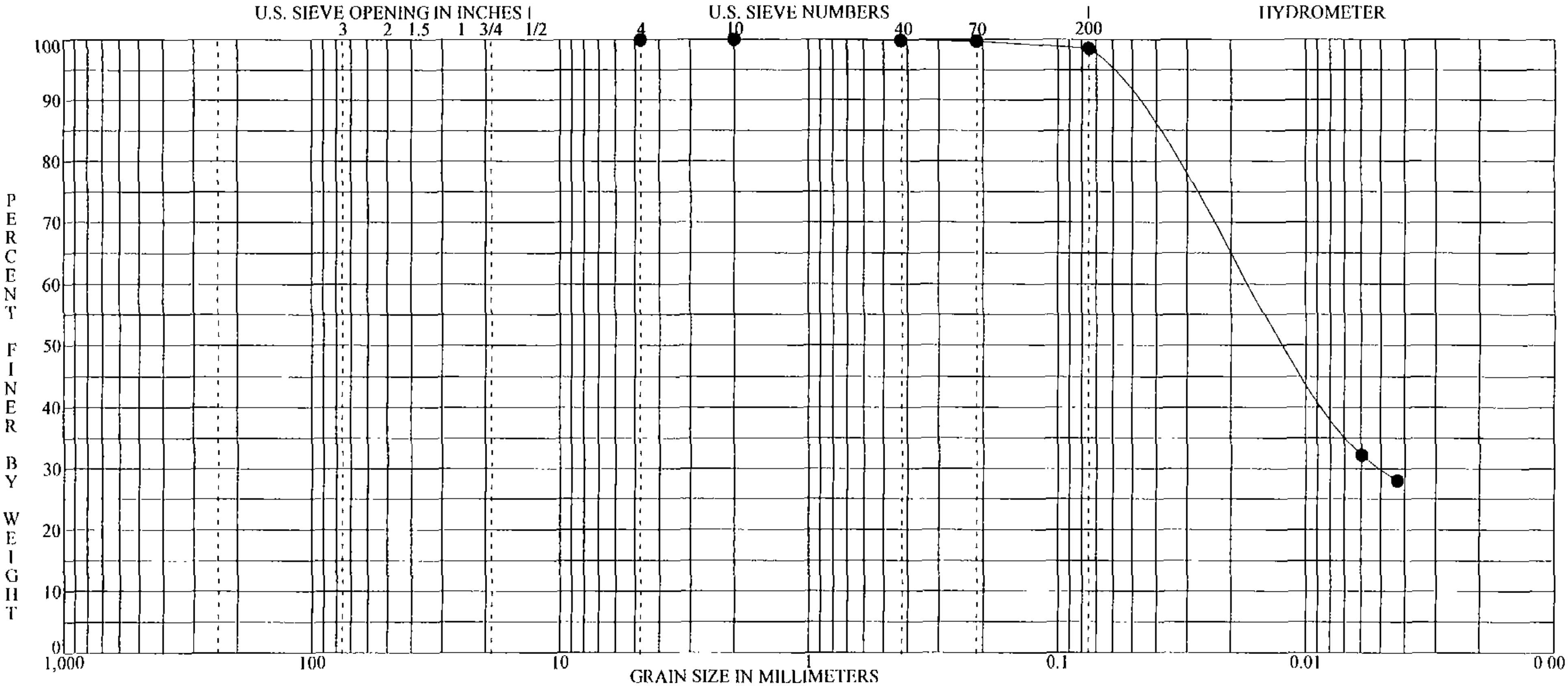
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●GC-216 S-7A III 30.0' - 32.0'	**2.0000**	**0.0131**	**0.0045**		**0.0**	**0.1**	**68.0**	**31.8**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



BOULDERS	COBBLES	GRAVEL coarse	GRAVEL fine	SAND coarse	SAND medium	SAND fine	SILT OR CLAY

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● **P-221A S-7 28.5' to 30.0'**	**Gray mottled with brown silty clay, trace fine to medium sand.**	**28**	**34**	**20**	**14**		

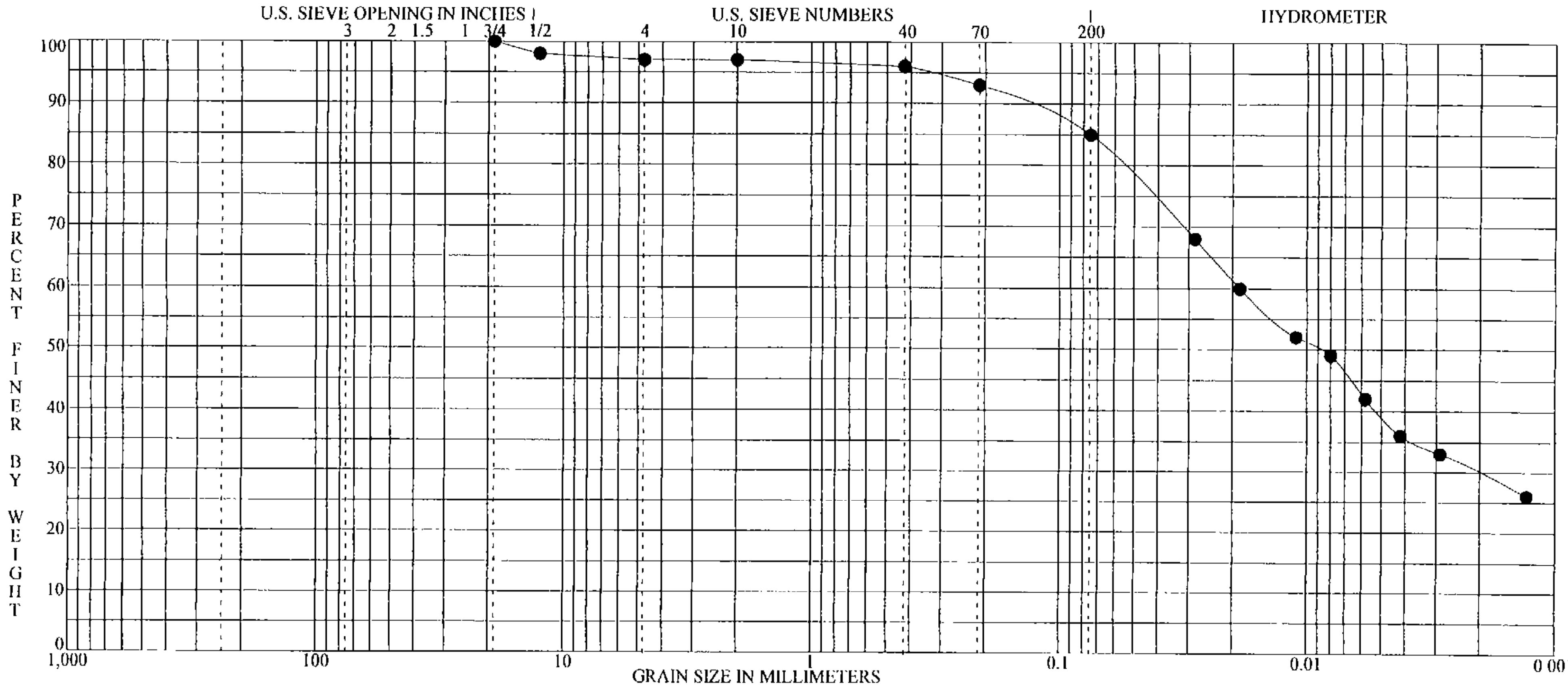
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **P-221A S-7 28.5' to 30.0'**	**4.7500**	**0.0173**	**0.0050**		**0.0**	**1.4**	**68.7**	**29.9**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● P-228A S-6 23.5' to 23.9'	**Gray mottled with brown silty clay, little fine to coarse sand, trace fine gravel.**	**21**	**37**	**19**	**18**		

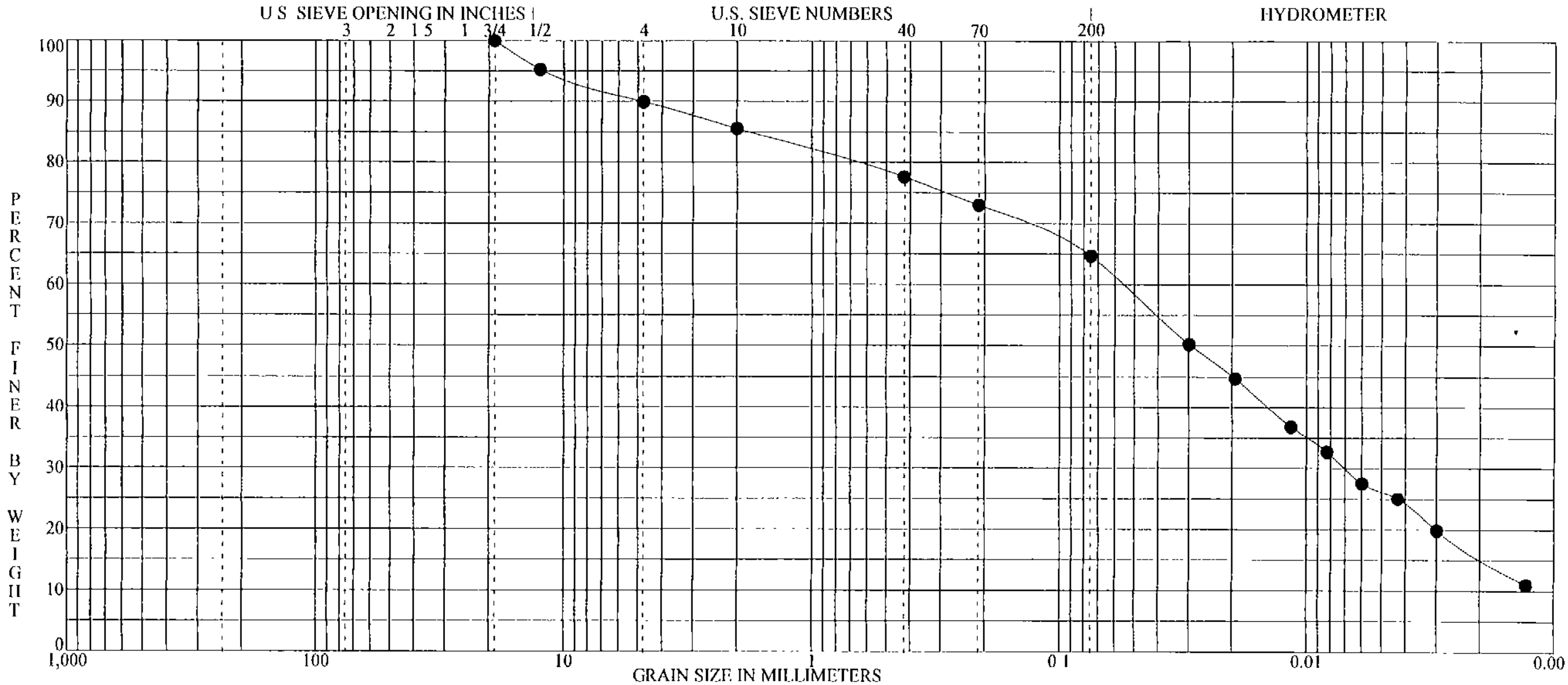
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● P-228A S-6 23.5' to 23.9'	**19.0000**	**0.0187**	**0.0021**		**3.0**	**12.0**	**45.8**	**39.2**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	**P-228A S-9 38.5' to 40.0'**	**Brown mottled with gray silty clay, some fine to coarse sand, trace fine gravel.**	**27**	**34**	**19**	**15**		

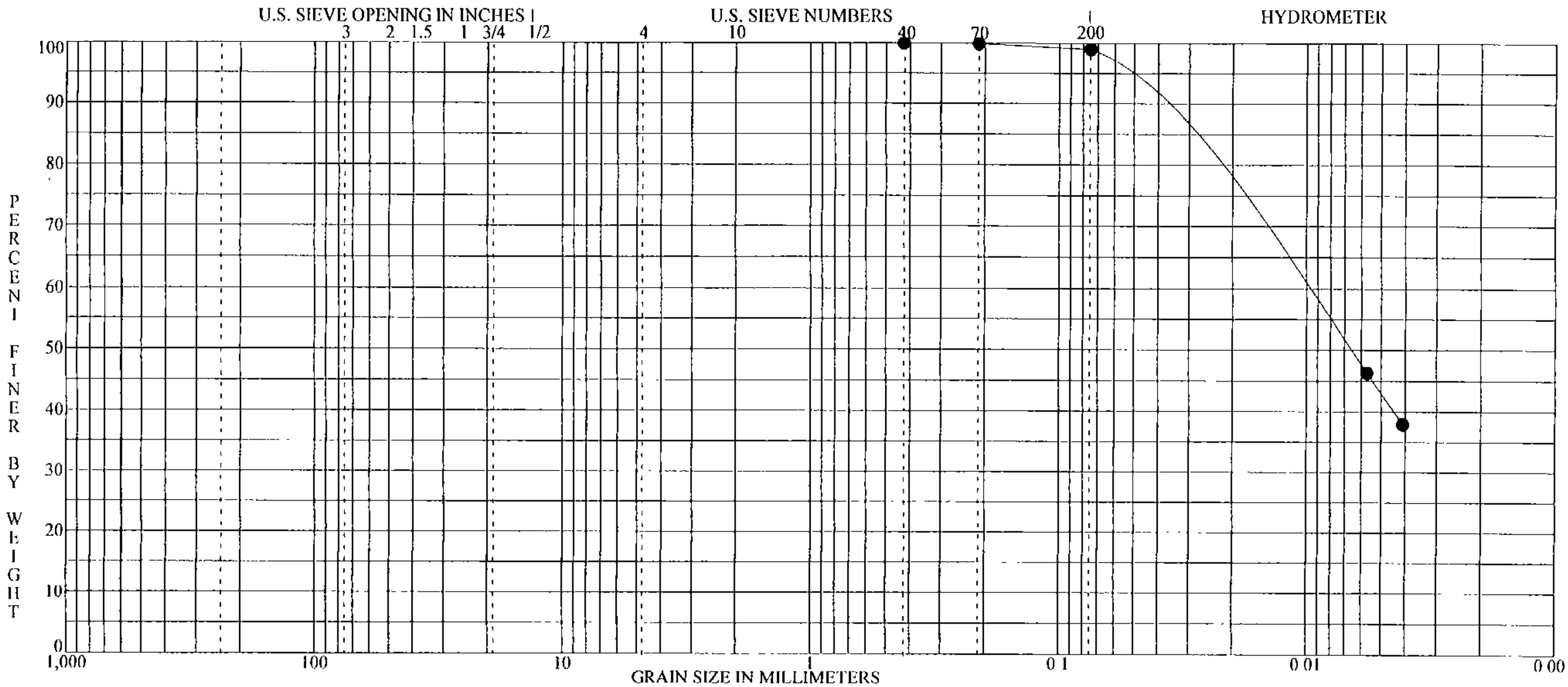
	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**P-228A S-9 38.5' to 40.0'**	**19.0000**	**0.0559**	**0.0070**		**10.1**	**25.3**	**38.5**	**26.1**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/20/02**

GRN-REG



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	**P-303A S-8 33.5' to 35.0'**	**Gray silty clay, trace fine to medium sand.**	**31**	**39**	**20**	**19**		

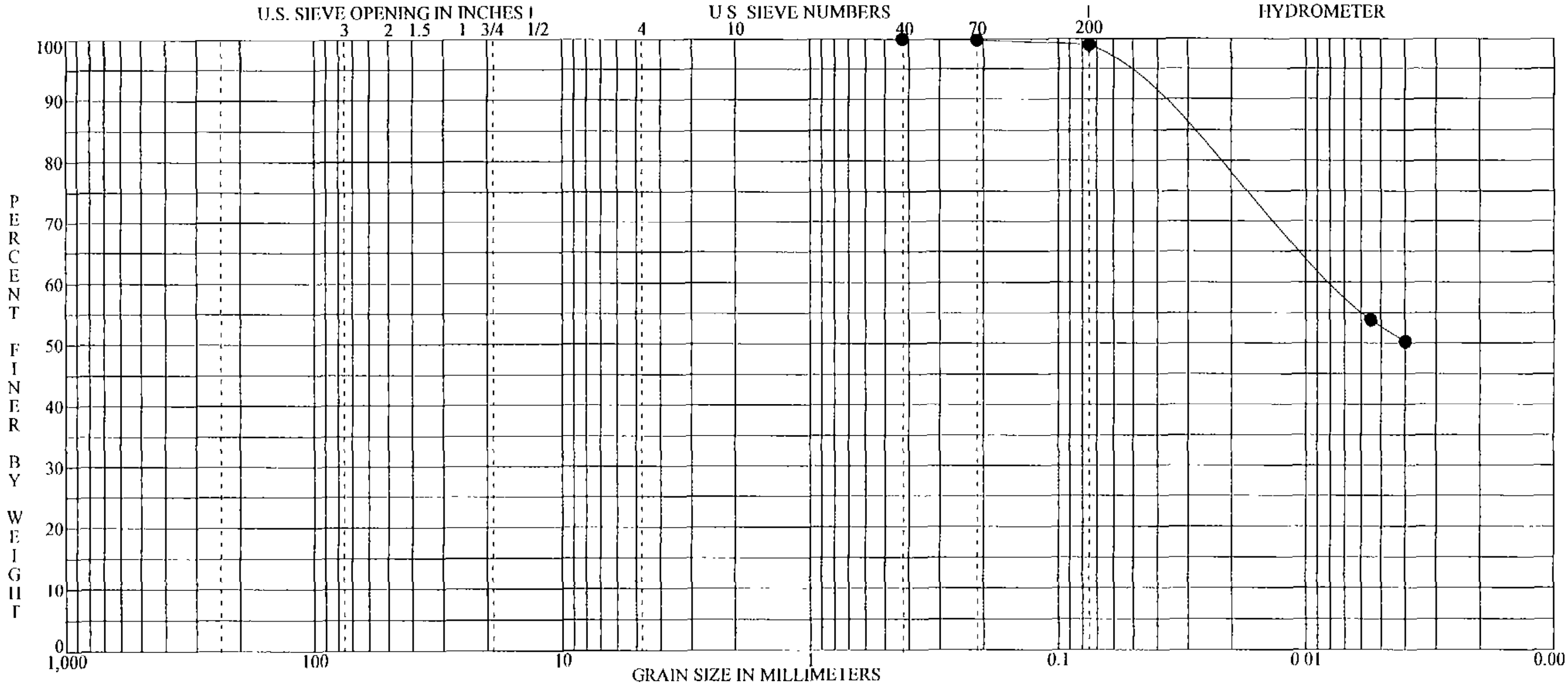
	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**P-303A S-8 33.5' to 35.0'**	**0.4250**	**0.0111**			**0.0**	**1.0**	**56.0**	**43.0**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



BOULDERS	COBBLES	GRAVEL coarse	GRAVEL fine	SAND coarse	SAND medium	SAND fine	SILT OR CLAY

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● P-305A S-8 33.5' to 35.0'	**Gray mottled with brown silty clay interbedded with clayey silt, trace fine to coarse sand.**	**31**	**44**	**22**	**22**		

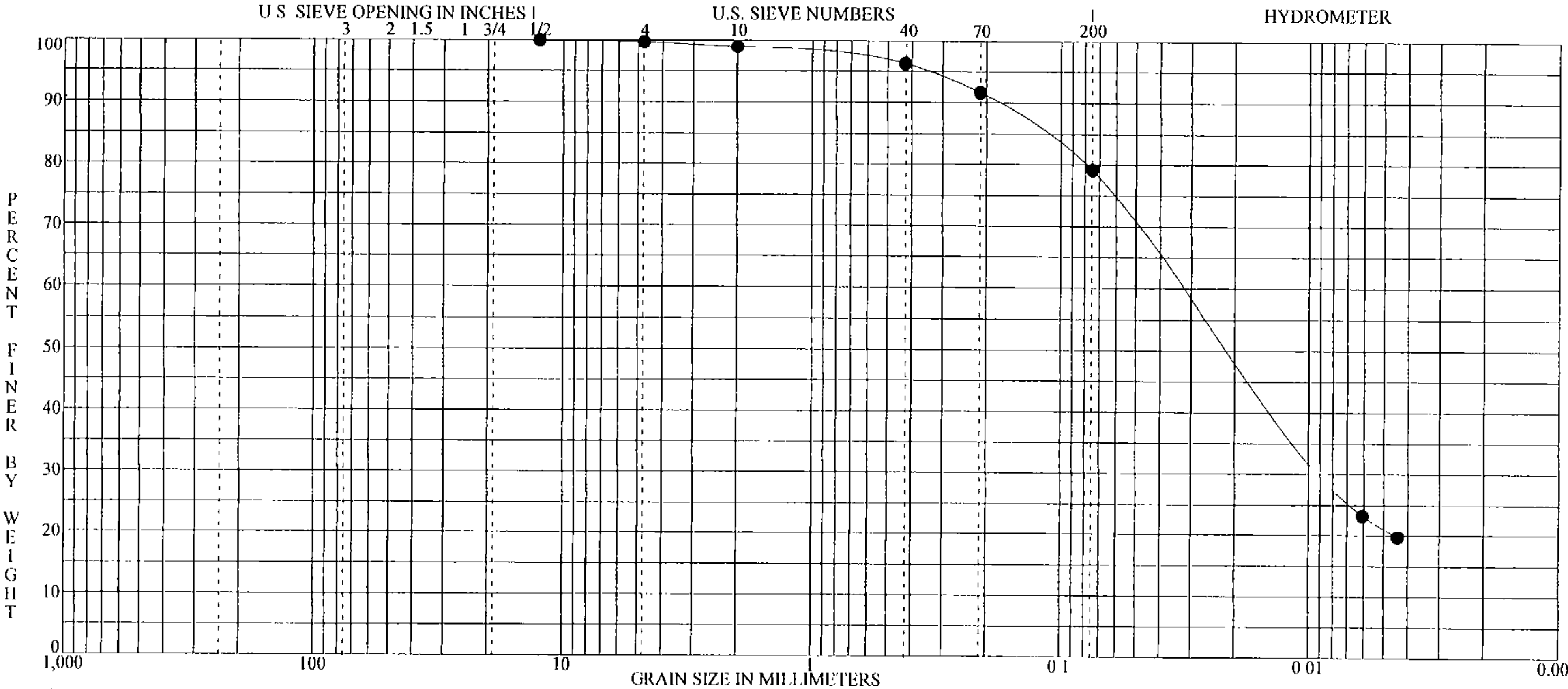
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● P-305A S-8 33.5' to 35.0'	**0.4250**	**0.0079**			**0.0**	**1.0**	**46.3**	**52.7**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	P-306A S-5 18.5' to 19.3'	**Gray mottled with brown silty clay, some fine to coarse sand, trace fine gravel.**	22	31	19	12		

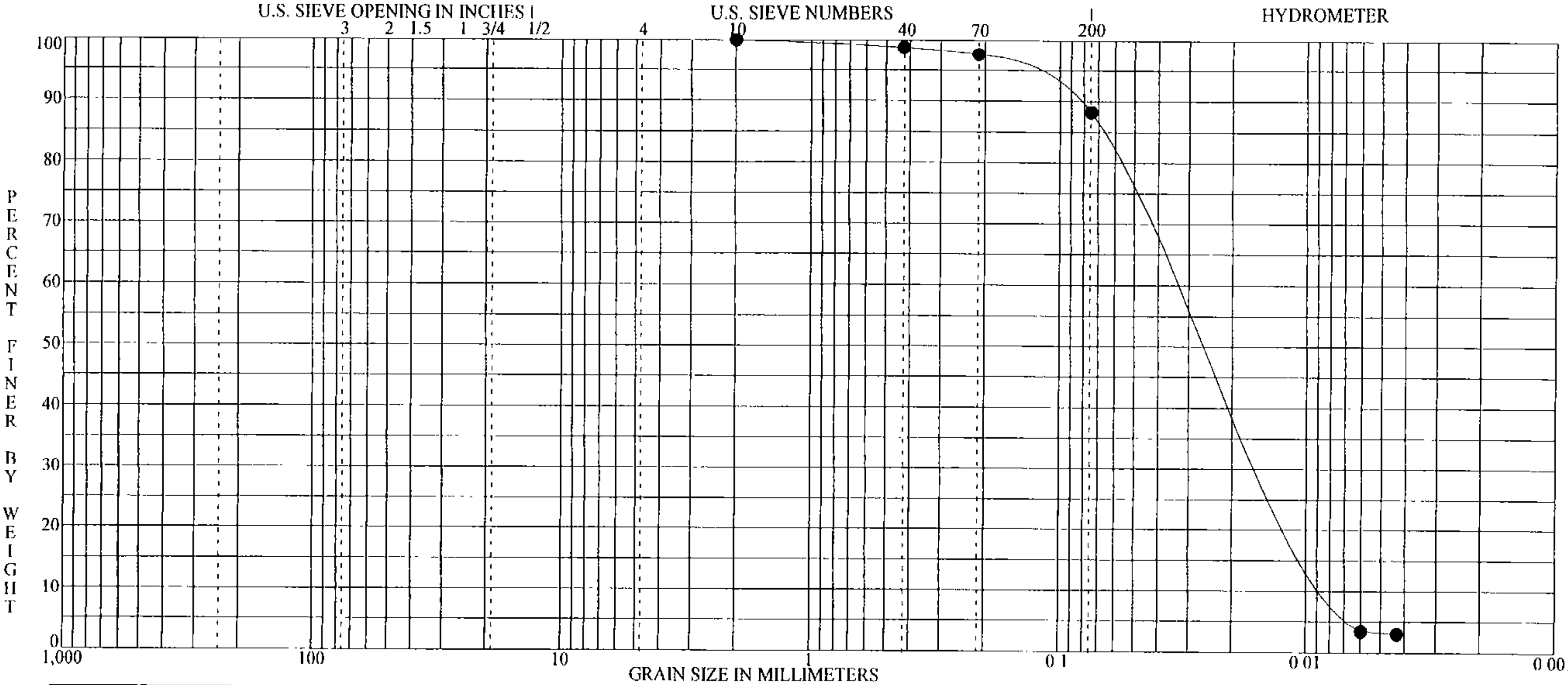
	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	P-306A S-5 18.5' to 19.3'	12.5000	0.0318	0.0083		0.3	20.6	58.1	21.1

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	**P-308A S-6 23.5' to 24.3'**	**Gray mottled with brown silty clay, little fine to medium sand, contains many silt seams.**	**24**	**32**	**20**	**12**		

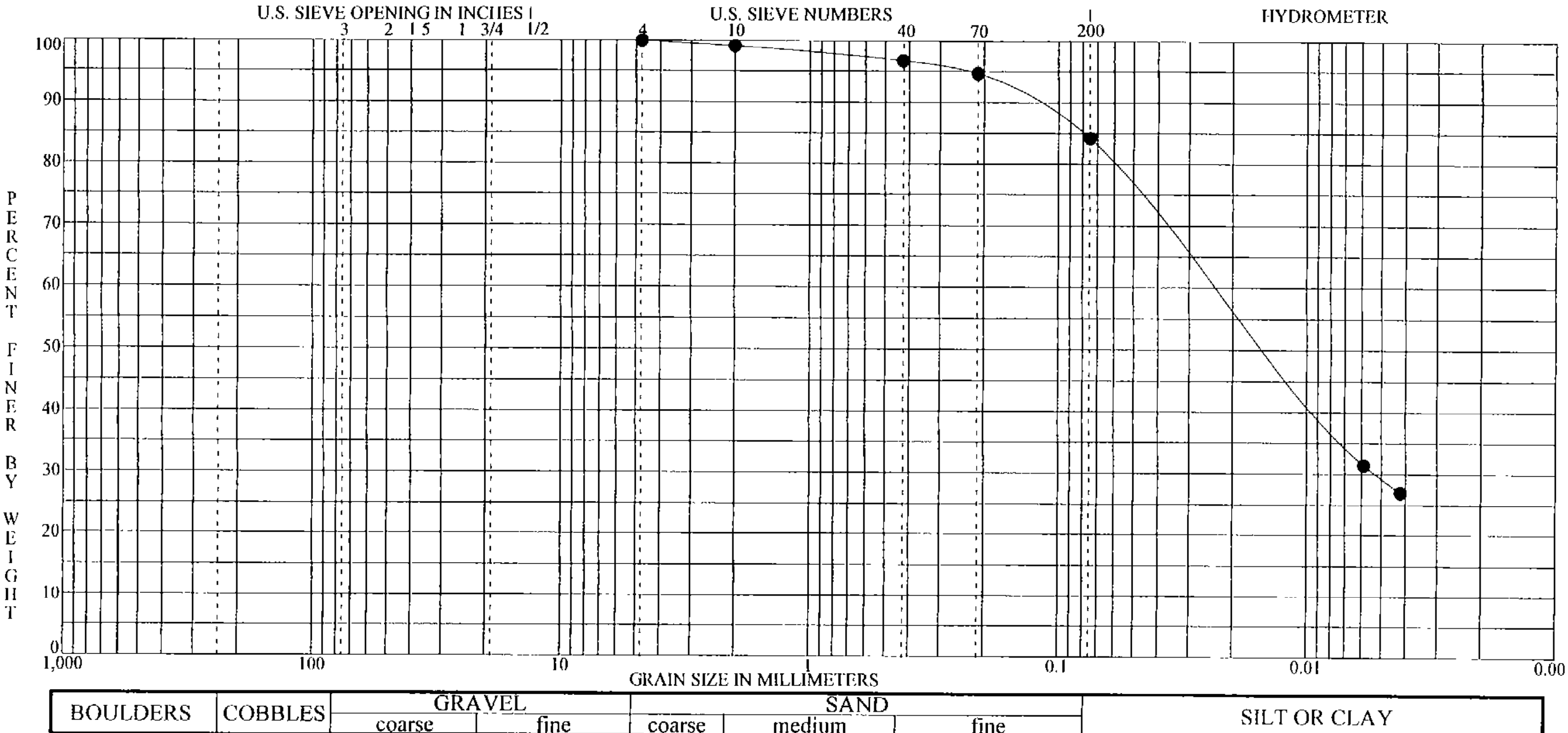
	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**P-308A S-6 23.5' to 24.3'**	**2.0000**	**0.0324**	**0.0132**	**0.0073**	**0.0**	**11.8**	**85.0**	**3.2**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● **P-311B S-8B 17.0' to 17.9'**	**Gray silty clay, little fine to coarse sand, few lenses and seams of silt.**	**21**	**31**	**18**	**13**		

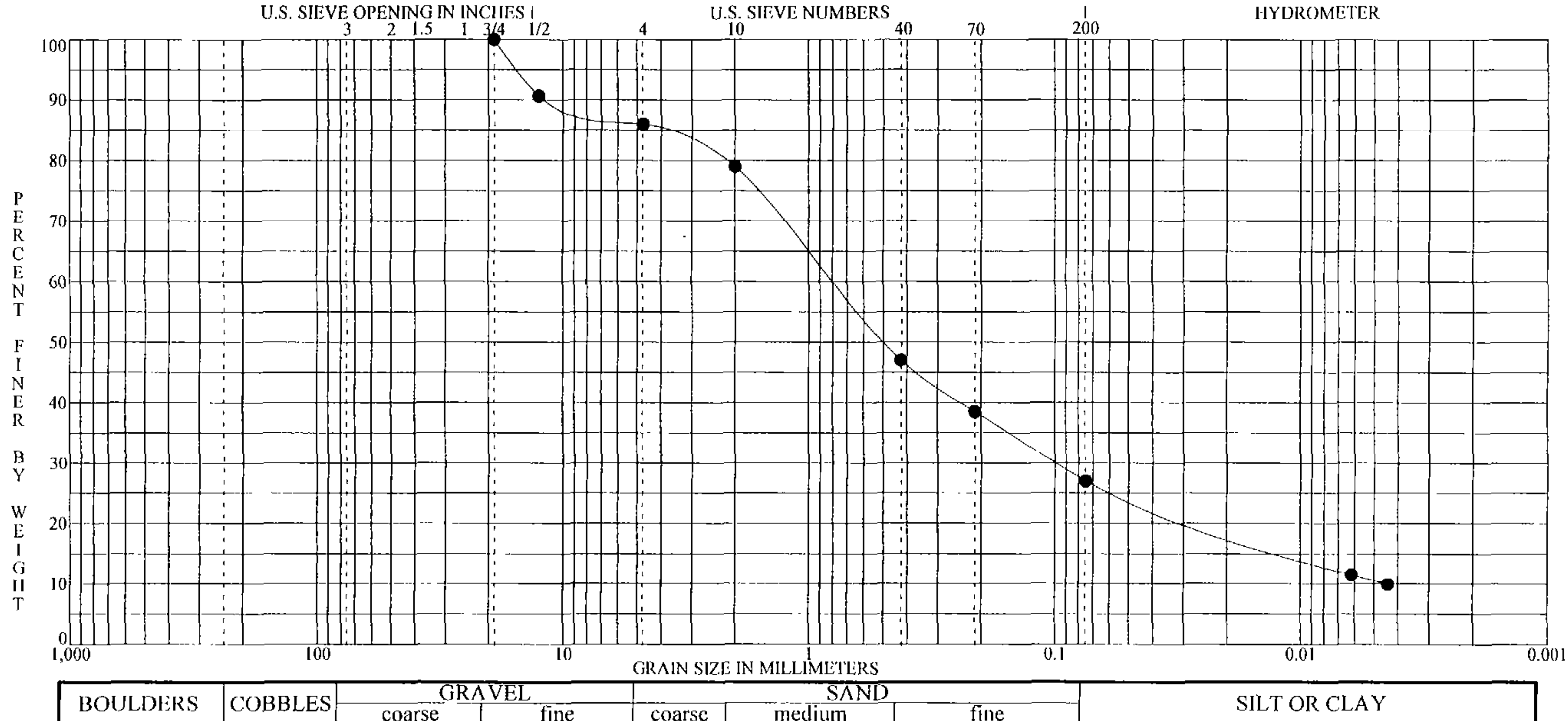
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **P-311B S-8B 17.0' to 17.9'**	**4.7500**	**0.0234**	**0.0053**		**0.0**	**15.8**	**54.9**	**29.3**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	B-407H S-9 18.5' to 19.5'	**Brown fine to coarse sand, little fine gravel, some silty clay.**	**12**					

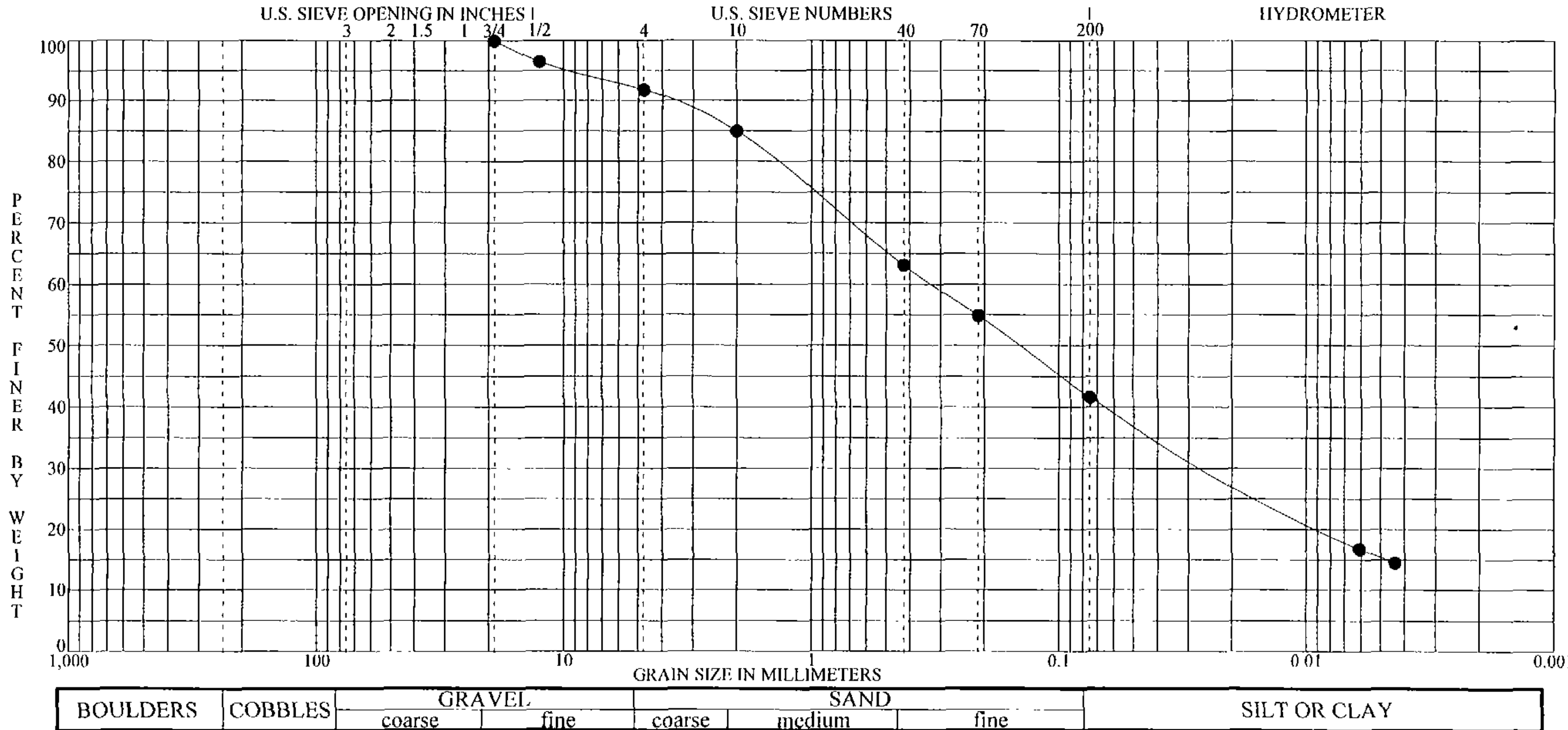
	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-407H S-9 18.5' to 19.5'	**19.0000**	**0.7974**	**0.0984**	**0.0045**	**14.0**	**59.0**	**16.5**	**10.5**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● B-407H S-12 33.5' to 34.0'	**Gray fine to coarse sand, trace fine gravel, "and" silty clay.**	22					

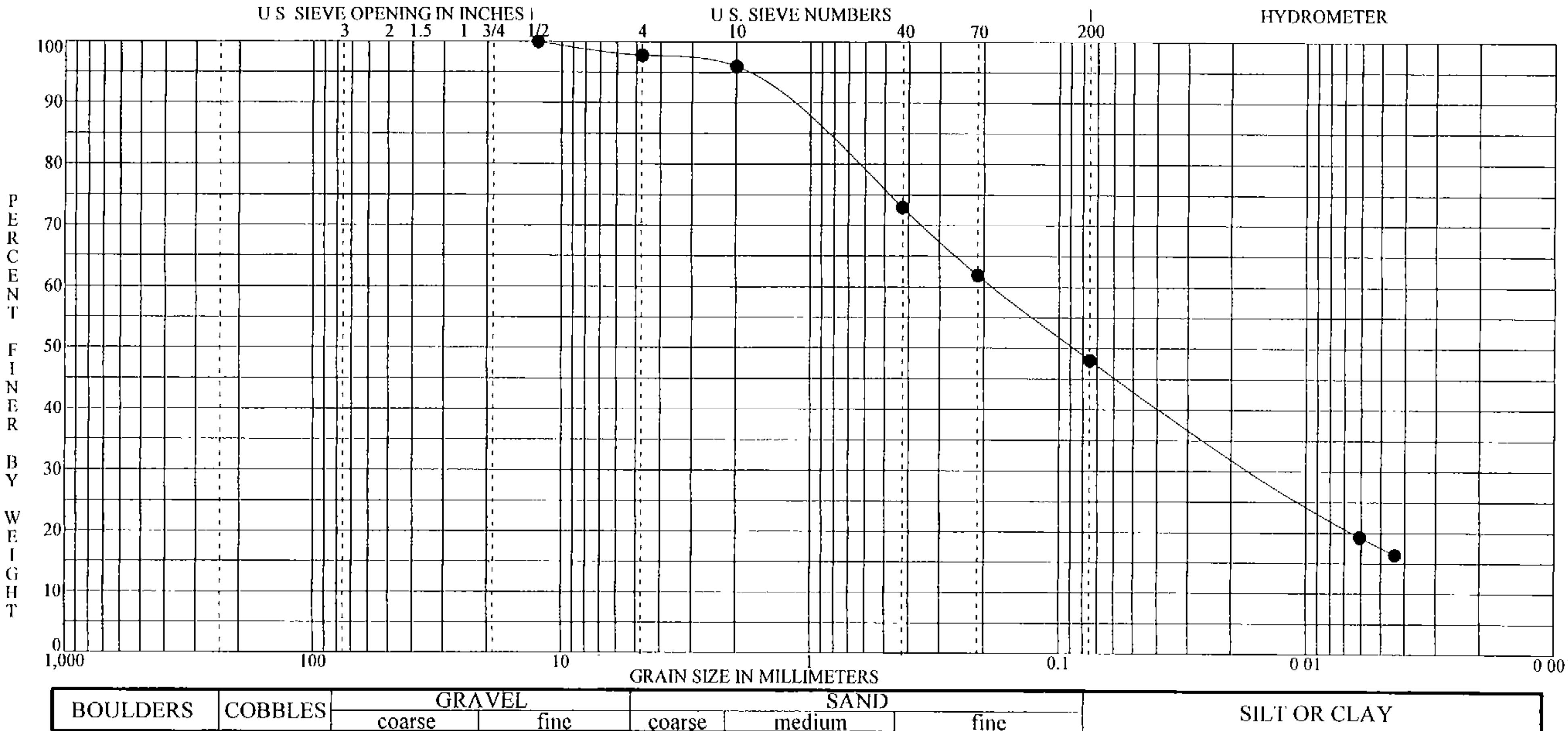
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● B-407H S-12 33.5' to 34.0'	19.0000	0.3273	0.0232		8.2	50.2	26.2	15.4

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● **B-412E S-11 28.5' to 29.0'**	**Gray fine to coarse sand, trace fine gravel, "and" clayey silt.**	**19**	**30**	**22**	**8**		

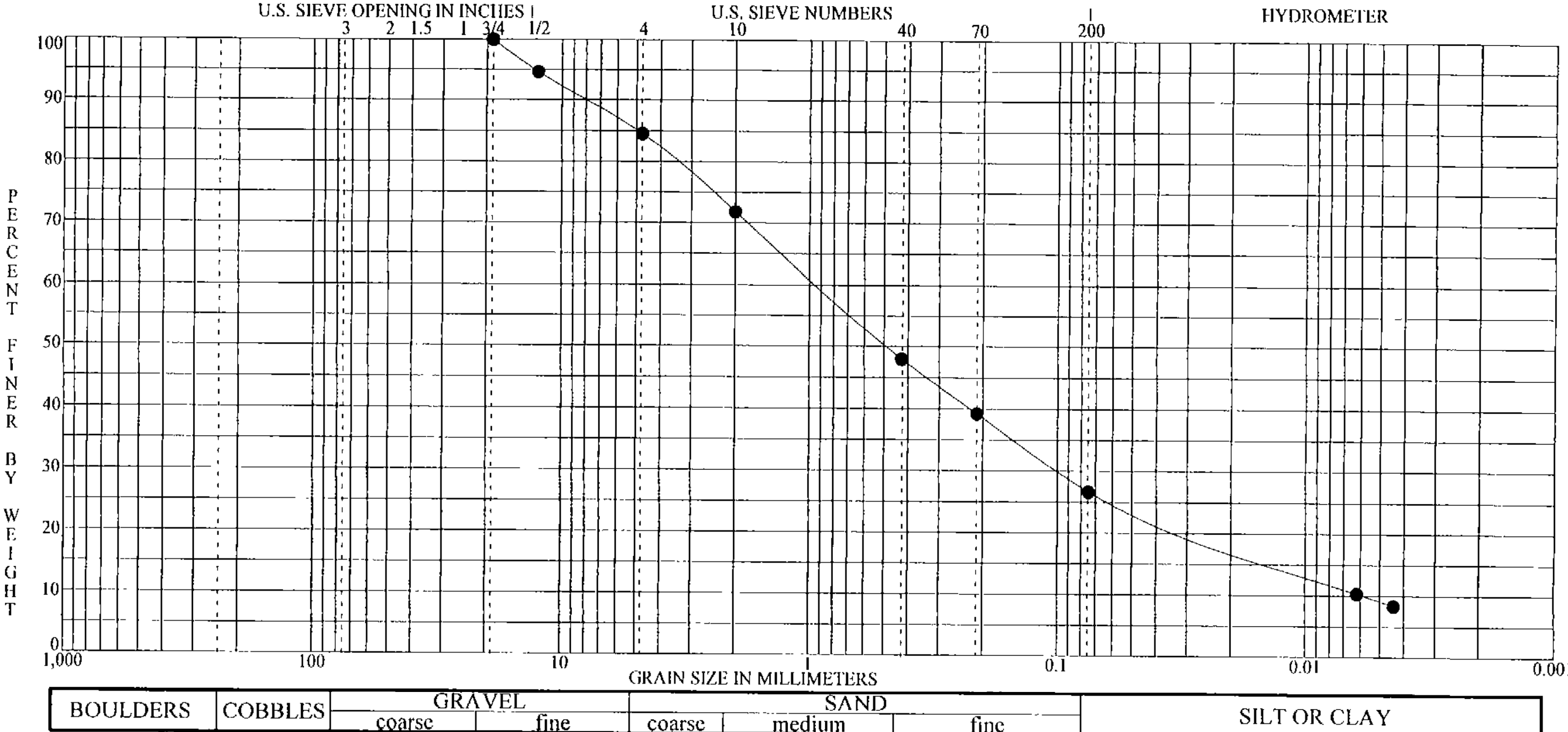
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-412E S-11 28.5' to 29.0'**	**12.5000**	**0.1839**	**0.0155**		**2.2**	**49.8**	**30.5**	**17.5**

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● B-412E S-14 43.5' to 44.2'	Brown fine to coarse sand, little fine gravel, some silty clay.	16					

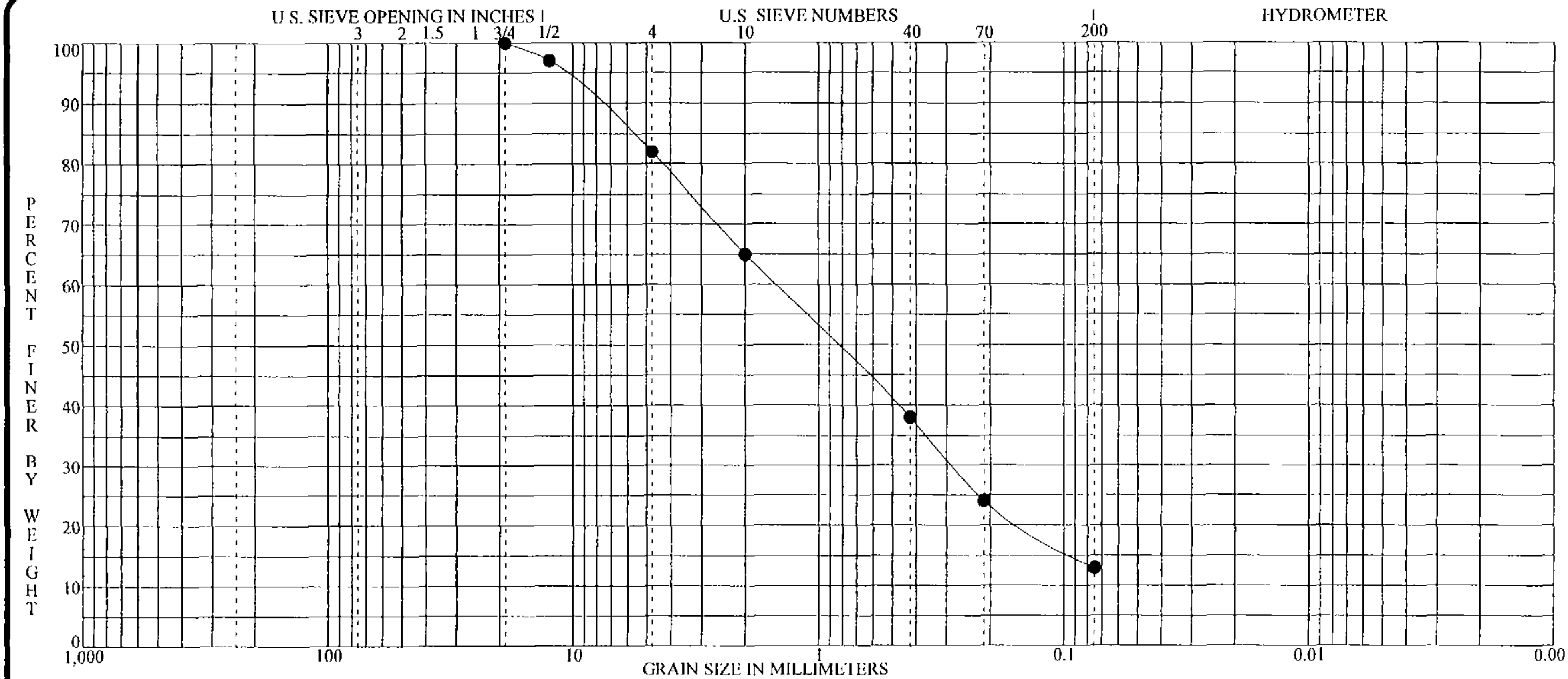
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● B-412E S-14 43.5' to 44.2'	19.0000	0.9284	0.0992	0.0059	15.4	57.9	17.6	9.0

BBCM

GRADATION CURVE

PROJECT GUE-70-14.10
LOCATION GUERNSEY COUNTY, OHIO
JOB NO. 01107000.090 DATE 11/15/02

GRN-REG



BOULDERS	COBBLES	GRAVEL coarse	GRAVEL fine	SAND coarse	SAND medium	SAND fine	SILT OR CLAY

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	**GC-203 S-9 37.0' to 38.4'**	**Brown and gray fine to coarse sand, little fine gravel, little clayey silt.**						

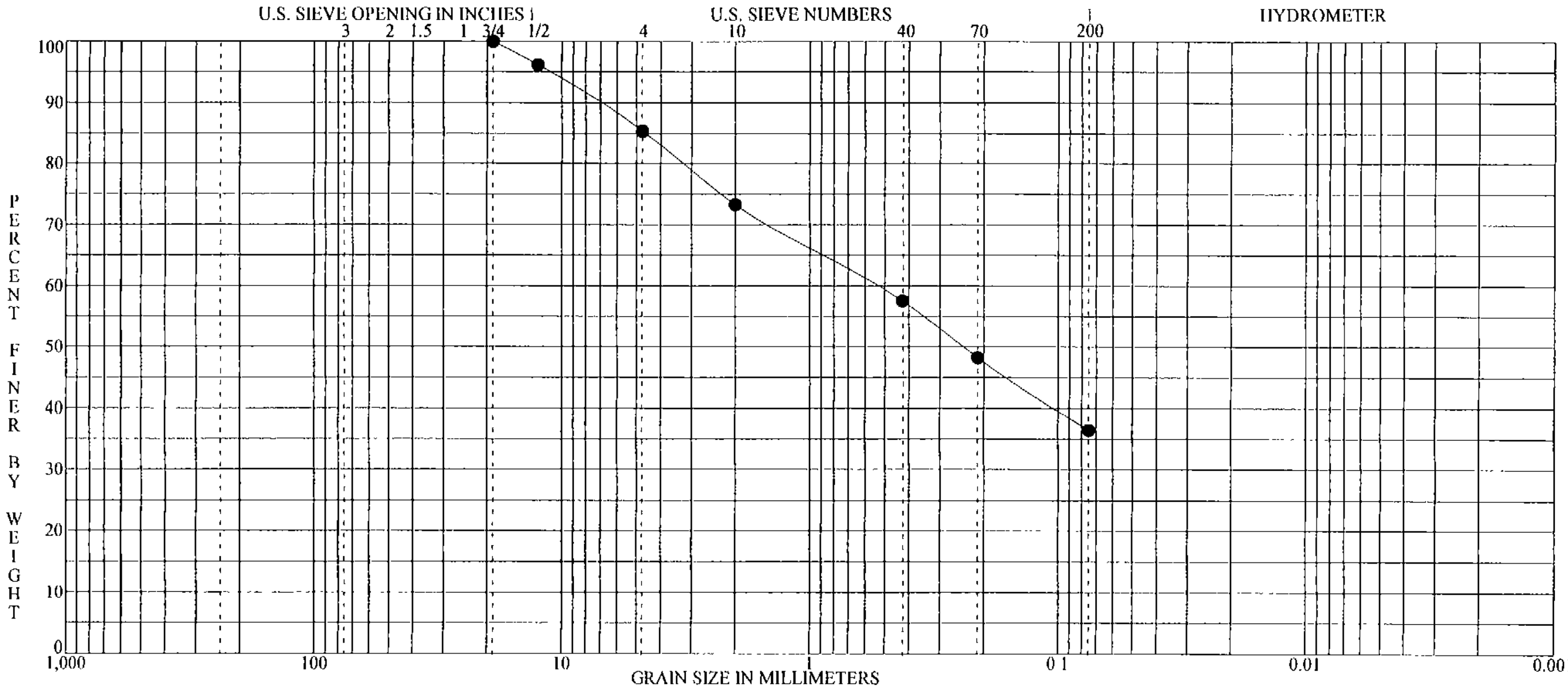
	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**GC-203 S-9 37.0' to 38.4'**	**19.0000**	**1.5013**	**0.2856**		**18.0**	**69.0**	**13.0**	

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	GC-205 S-6 23.5' to 24.3'	**Brown mottled with gray fine to coarse sand, little fine gravel, "and" clayey silt, trace coal.**						

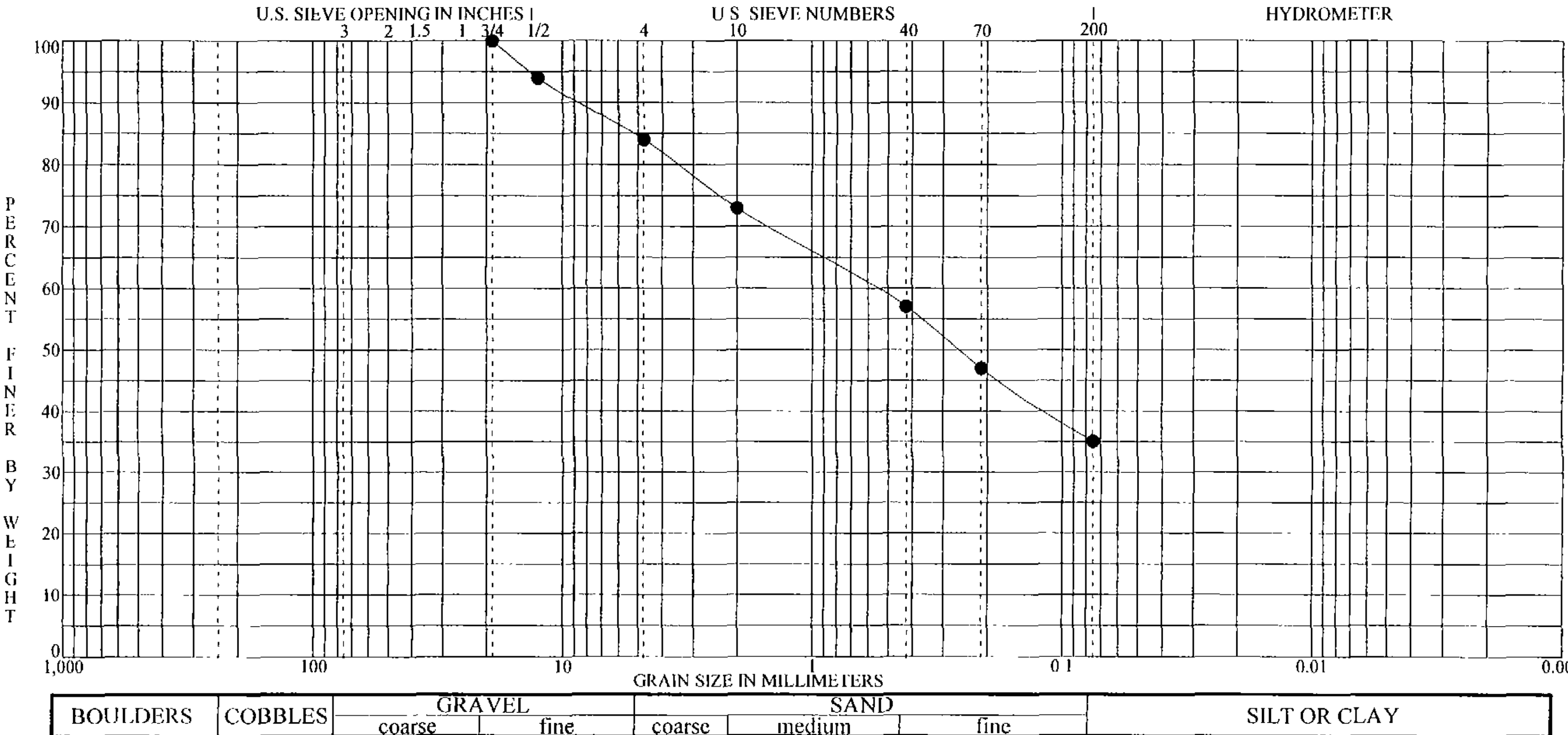
	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	GC-205 S-6 23.5' to 24.3'	**19.0000**	**0.5421**			**14.6**	**49.0**	**36.4**	

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● GC-206 S-6B 24.4' to 24.7'	**Brown mottled with gray fine to coarse sand, little fine gravel, "and" clayey silt.**						

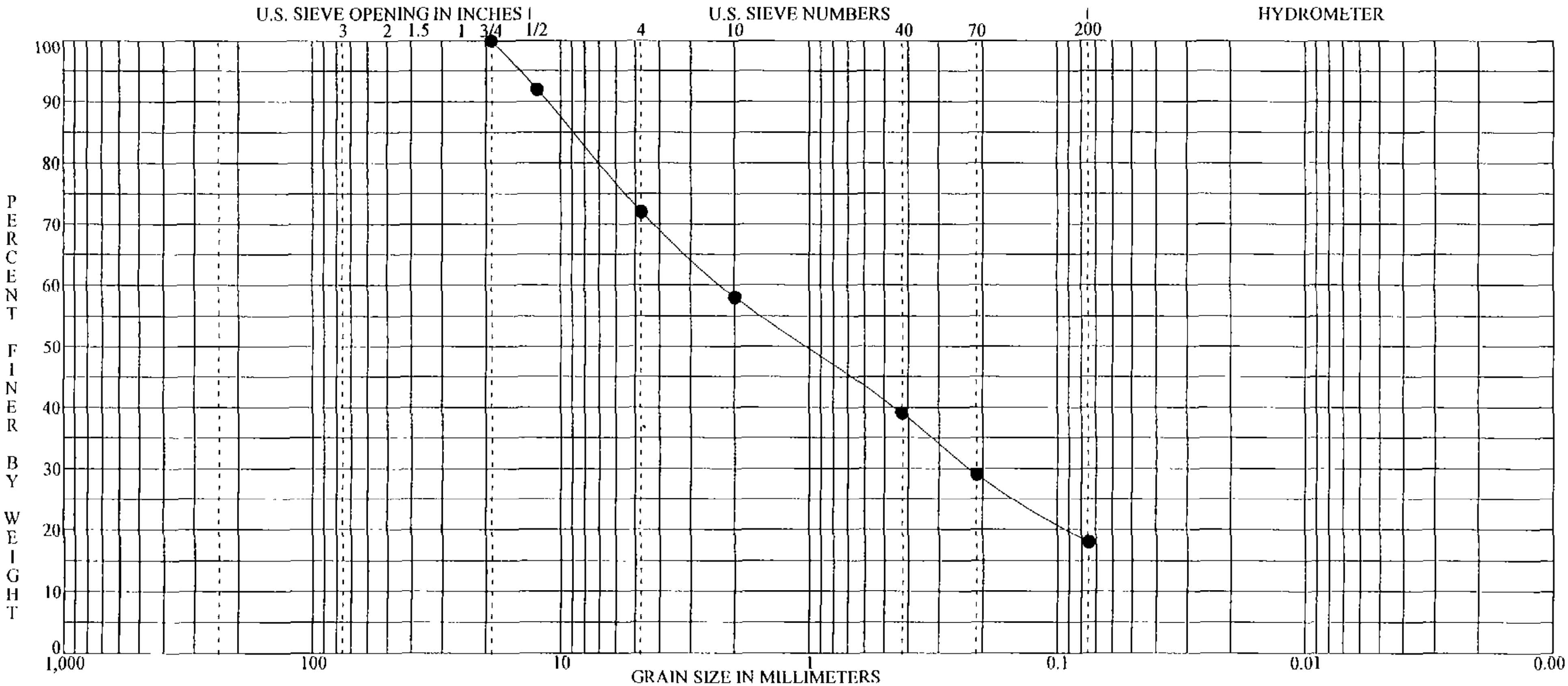
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● GC-206 S-6B 24.4' to 24.7'	19.0000	0.5682			16.0	49.0	35.0	

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	GC-211 S-8 33.5' to 34.6'	**Brown and gray fine to coarse sand, some fine gravel, little clayey silt.**						

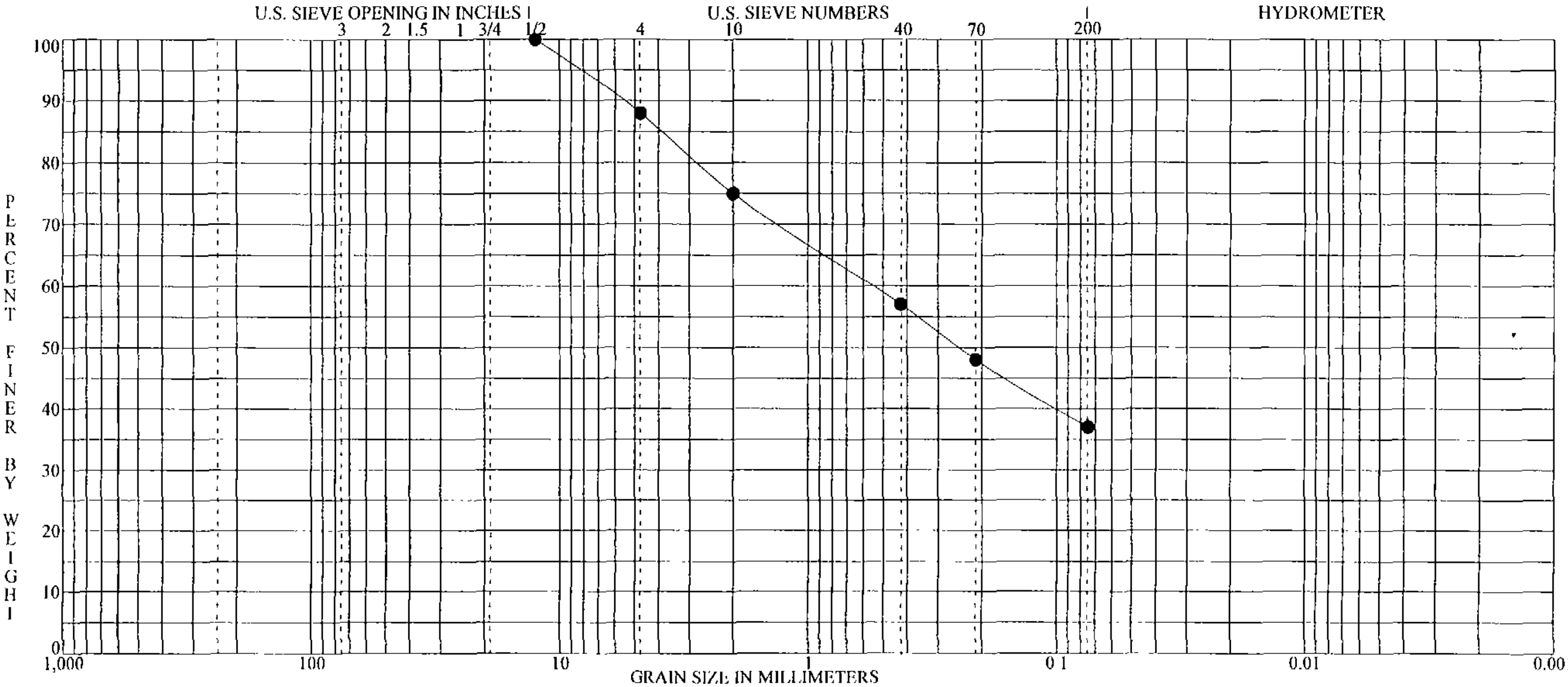
	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	GC-211 S-8 33.5' to 34.6'	19.0000	2.2631	0.2273		28.0	54.0	18.0	

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



BOULDERS	COBBLES	GRAVEL coarse	GRAVEL fine	SAND coarse	SAND medium	SAND fine	SILT OR CLAY

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● GC-215 S-7B 24.0' to 25.0'	**Red brown fine to coarse sand, little fine gravel, "and" silty clay.**						

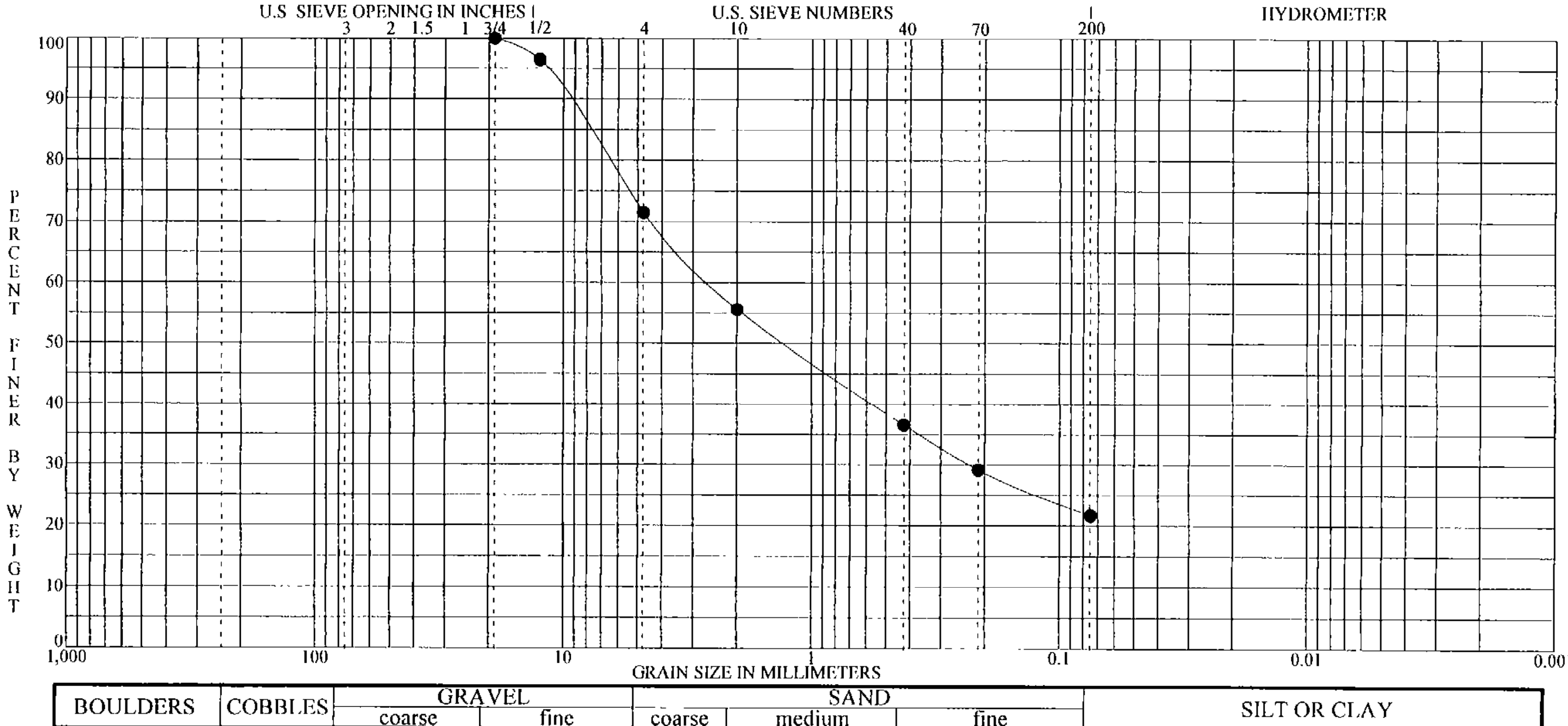
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● GC-215 S-7B 24.0' to 25.0'	12.5000	0.5502			12.0	51.0	37.0	

BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG



Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● P-221A S-8 33.5' to 34.5'	**Brown fine to coarse sand, some fine gravel, some silt.**						

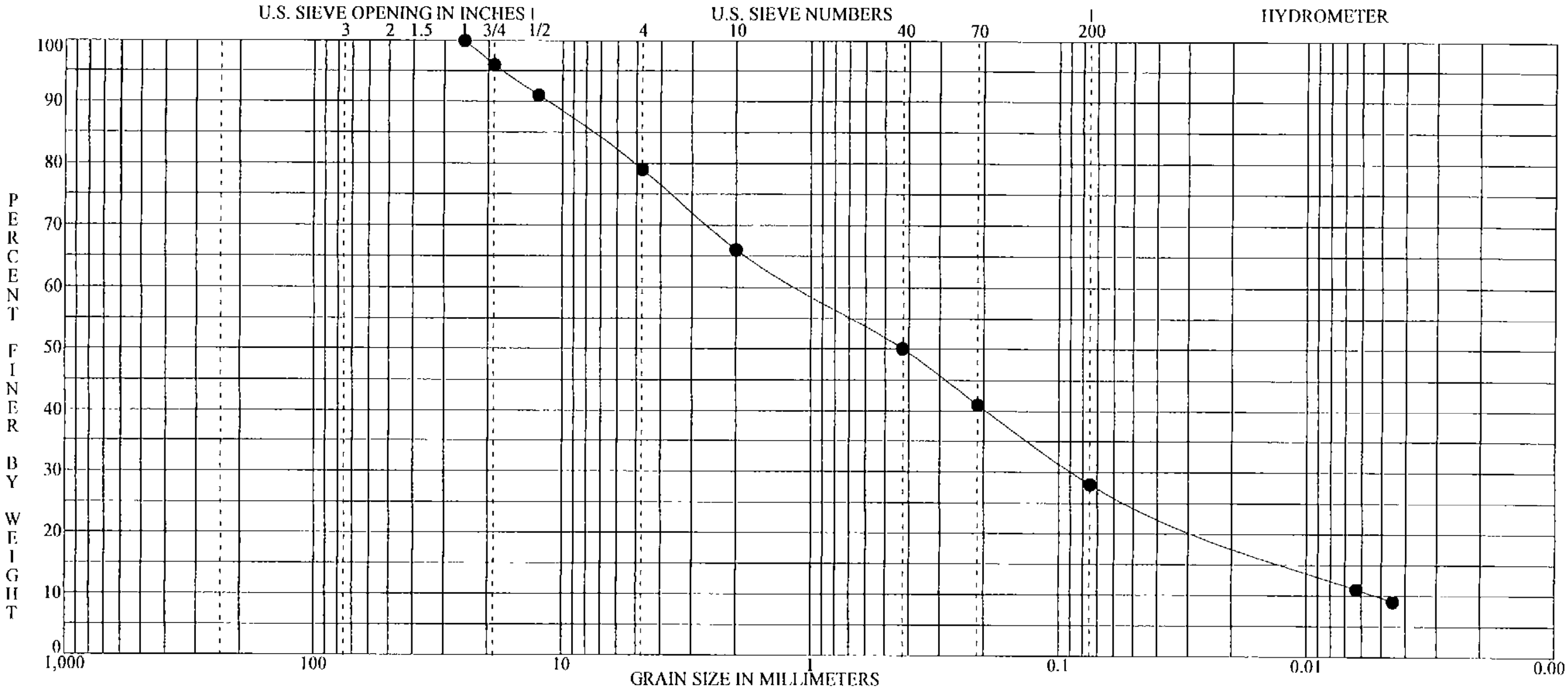
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● P-221A S-8 33.5' to 34.5'	19.0000	2.5414	0.2306		28.5	49.9	21.6	

BBCM

GRADATION CURVE

PROJECT	GUE-70-14.10
LOCATION	GUERNSEY COUNTY, OHIO
JOB NO.	01107000.090
DATE	11/15/02

GRN-REG



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● **P-222A S-3 8.5' to 9.8'**	**Brown and gray fine to coarse sand, some fine to coarse gravel, some silty clay.**						

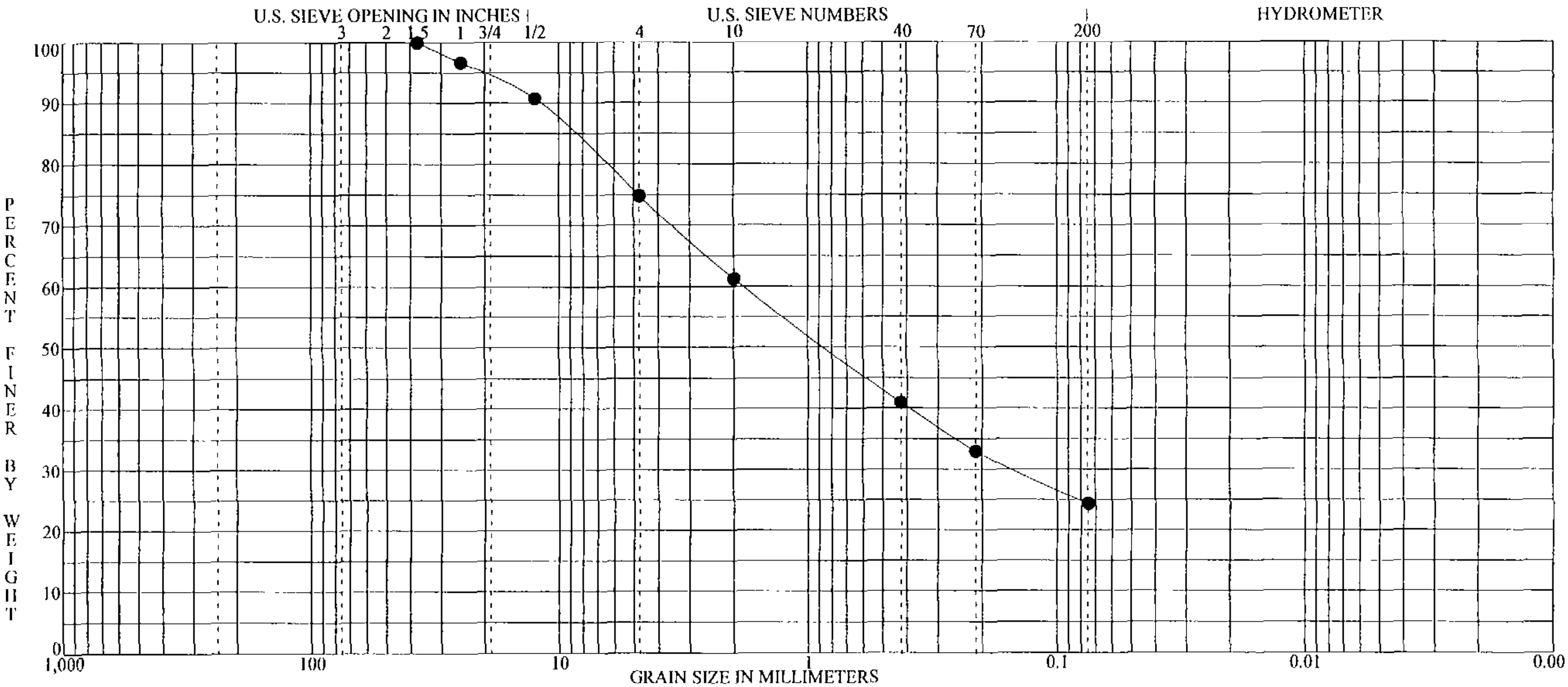
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **P-222A S-3 8.5' to 9.8'**	**25.0000**	**1.1189**	**0.0880**	**0.0053**	**21.0**	**51.0**	**18.4**	**9.6**

BBCM

GRADATION CURVE

PROJECT	**GUE-70-14.10**
LOCATION	**GUERNSEY COUNTY, OHIO**
JOB NO.	**01107000.090**
DATE	**11/15/02**

GRN-REG



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

	Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
●	P-301A S-8 33.5' to 34.5'	**Dark-brown and gray fine to coarse sand, some fine to coarse gravel, some clayey silt.**						

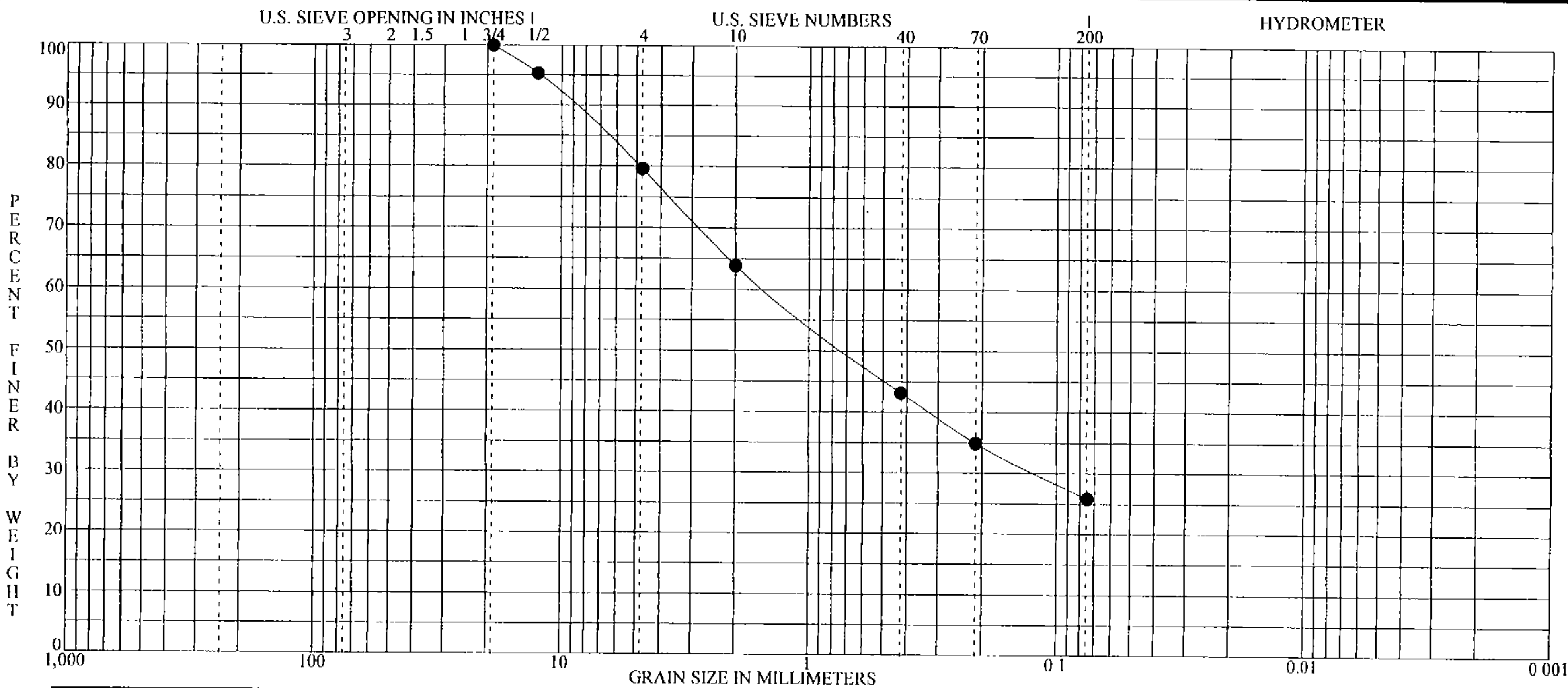
	Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	P-301A S-8 33.5' to 34.5'	37.5000	1.8235	0.1482		25.2	50.5	24.4	

BBCM

GRADATION CURVE

PROJECT	**GUE-70-14.10**
LOCATION	**GUERNSEY COUNTY, OHIO**
JOB NO.	**01107000.090** DATE **11/15/02**

GRN-REG



BOULDERS	COBBLES	GRAVEL coarse	GRAVEL fine	SAND coarse	SAND medium	SAND fine	SILT OR CLAY

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● P-303A S-10 43.5' to 44.5'	Dark-brown and gray fine to coarse sand, little fine gravel, some clayey silt.						

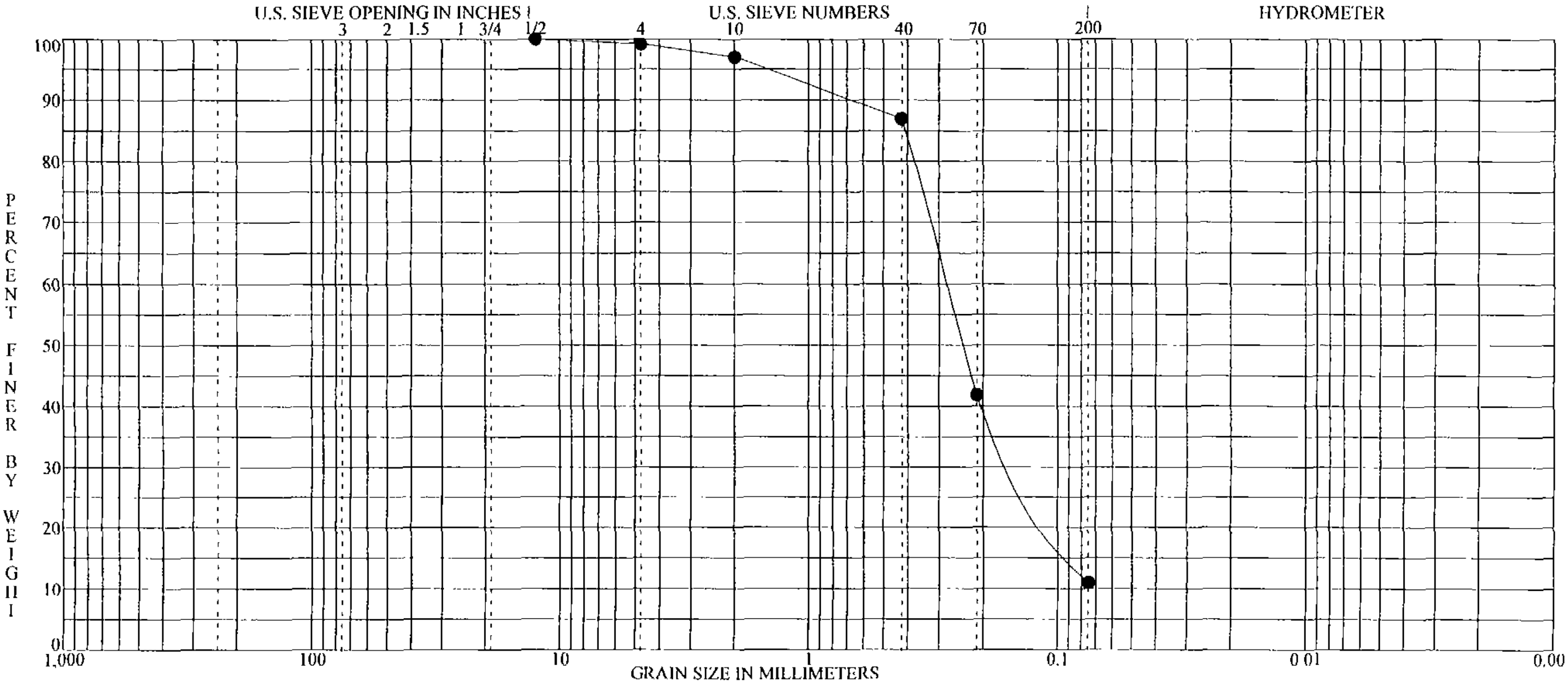
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● P-303A S-10 43.5' to 44.5'	19.0000	1.4993	0.1210		20.4	53.8	25.8	

BBCM

GRADATION CURVE

PROJECT GUE-70-14.10
LOCATION GUERNSEY COUNTY, OHIO
JOB NO. 01107000.090 DATE 11/15/02

GRN-REG



BOULDERS	COBBLES	GRAVEL coarse	GRAVEL fine	SAND coarse	SAND medium	SAND fine	SILT OR CLAY

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● P-307A S-9A 38.5' to 38.9'	**Brown and gray fine to medium sand, trace fine sand, trace fine gravel, little silt.**						

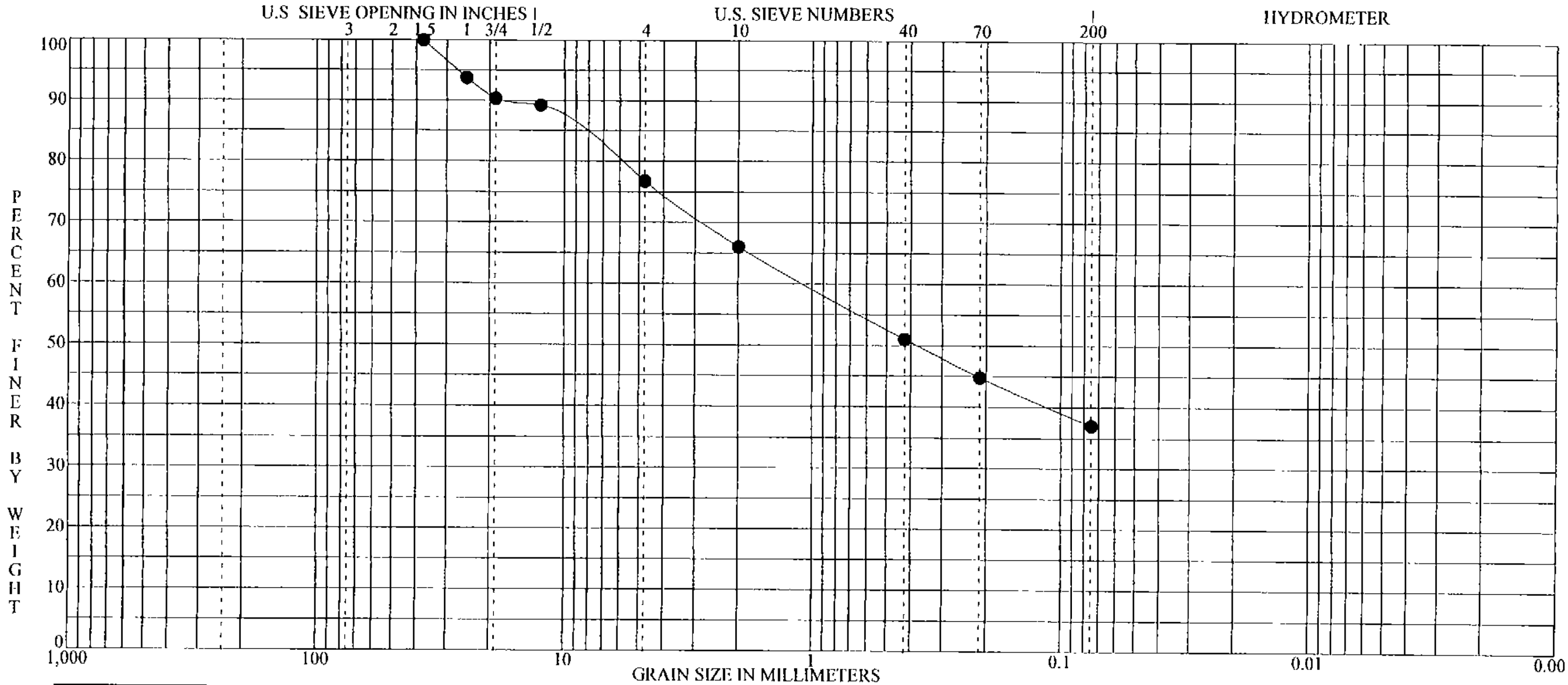
Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● P-307A S-9A 38.5' to 38.9'	12.5000	0.2803	0.1421		0.8	88.2	11.0	

BBCM

GRADATION CURVE

PROJECT GUE-70-14.10
LOCATION GUERNSEY COUNTY, OHIO
JOB NO. 01107000.090 DATE 11/15/02

GRN-REG



BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

Specimen Identification - Depth	Classification	MC%	LL	PL	PI	opt mc %	max pcf
● P-309A S-9 38.5' to 39.4'	**Brown and gray fine to coarse sand, some fine to coarse gravel, "and" silty clay.**						

Specimen Identification - Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● P-309A S-9 38.5' to 39.4'	**37.5000**	**1.0764**			**23.2**	**39.8**	**37.0**	

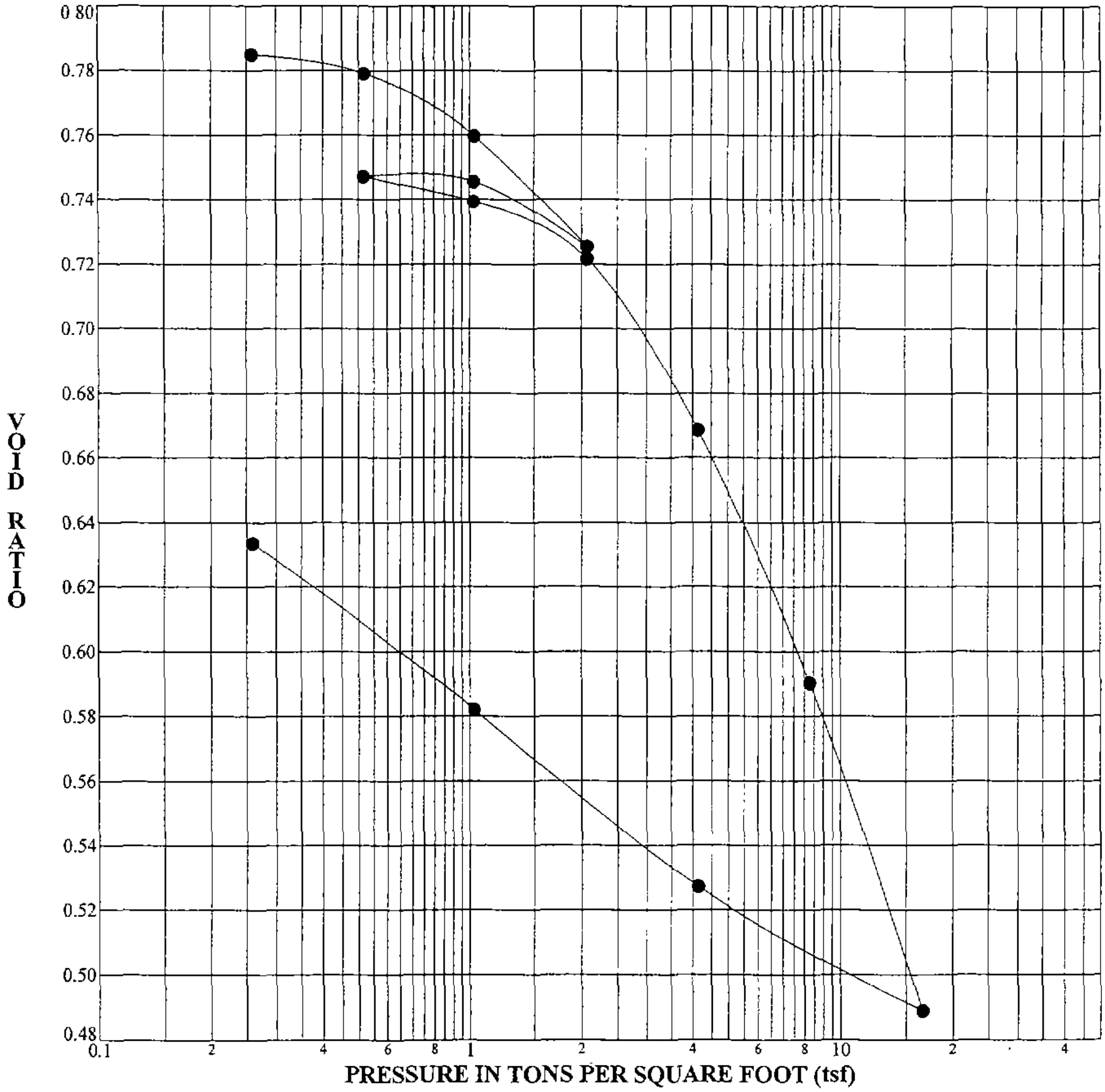
BBCM

GRADATION CURVE

PROJECT **GUE-70-14.10**
LOCATION **GUERNSEY COUNTY, OHIO**
JOB NO. **01107000.090** DATE **11/15/02**

GRN-REG

PRESSURE - VOID RATIO CURVE



Specimen Identification	Classification
●*B-207 S-8 Sec.I 33.5' - 34.0*	*Soft to stiff gray clayey silt, trace fine to medium sand*

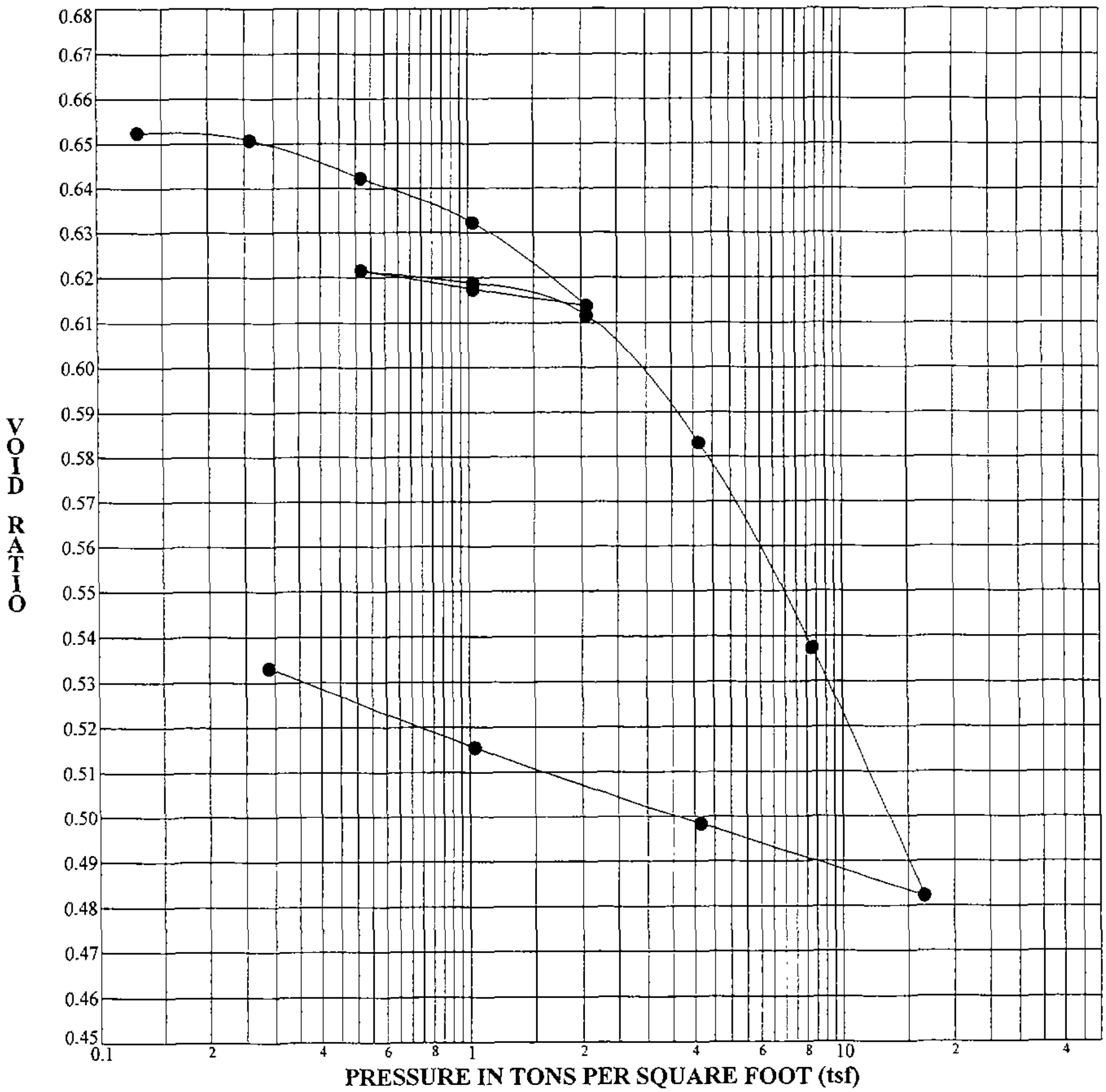
MC	LL	PL	PI	DD	SG	Eo	Ef	% Sat.
31	*27*	*18*	*9*	*93*	*2.68*	*0.7950*	*0.7134*	*104.9*

BBC&M ENGINEERING, INC.

PROJECT	GUE-70-14.10
LOCATION	Guernsey County, Ohio
JOB NO.	7000.040
DATE	12/20/99

CON/VOID

PRESSURE - VOID RATIO CURVE



Specimen Identification	Classification
● B-207 S-8 Sec. II 34.0' - 34.4	*Stiff gray silty clay, little fine to coarse sand, trace fine gravel, contains silt seams*

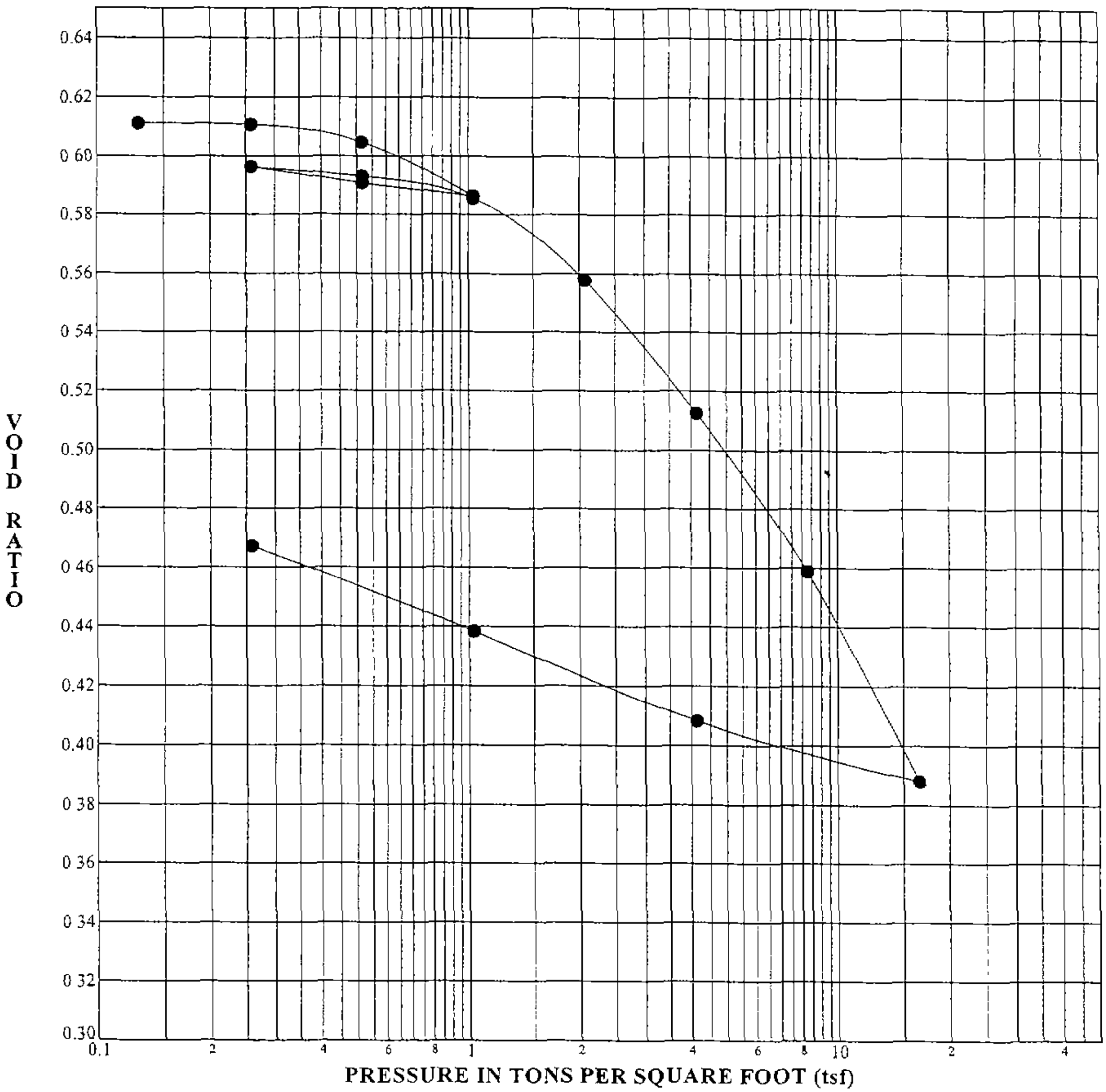
MC	LL	PL	PI	DD	SG	Eo	Ef	% Sat.
23	32	19	13	102	2.72	0.6570	0.5616	97.2

BBC&M ENGINEERING, INC.

PROJECT GUE-70-14.10
LOCATION Guernsey County, Ohio
JOB NO. 7000.040 DATE 12/16/99

CON/VOID

PRESSURE - VOID RATIO CURVE



Specimen Identification	Classification
● B-215 S-5A Sec. II 15.0'-16 9'	*Stiff gray silty clay, trace fine to medium sand.*

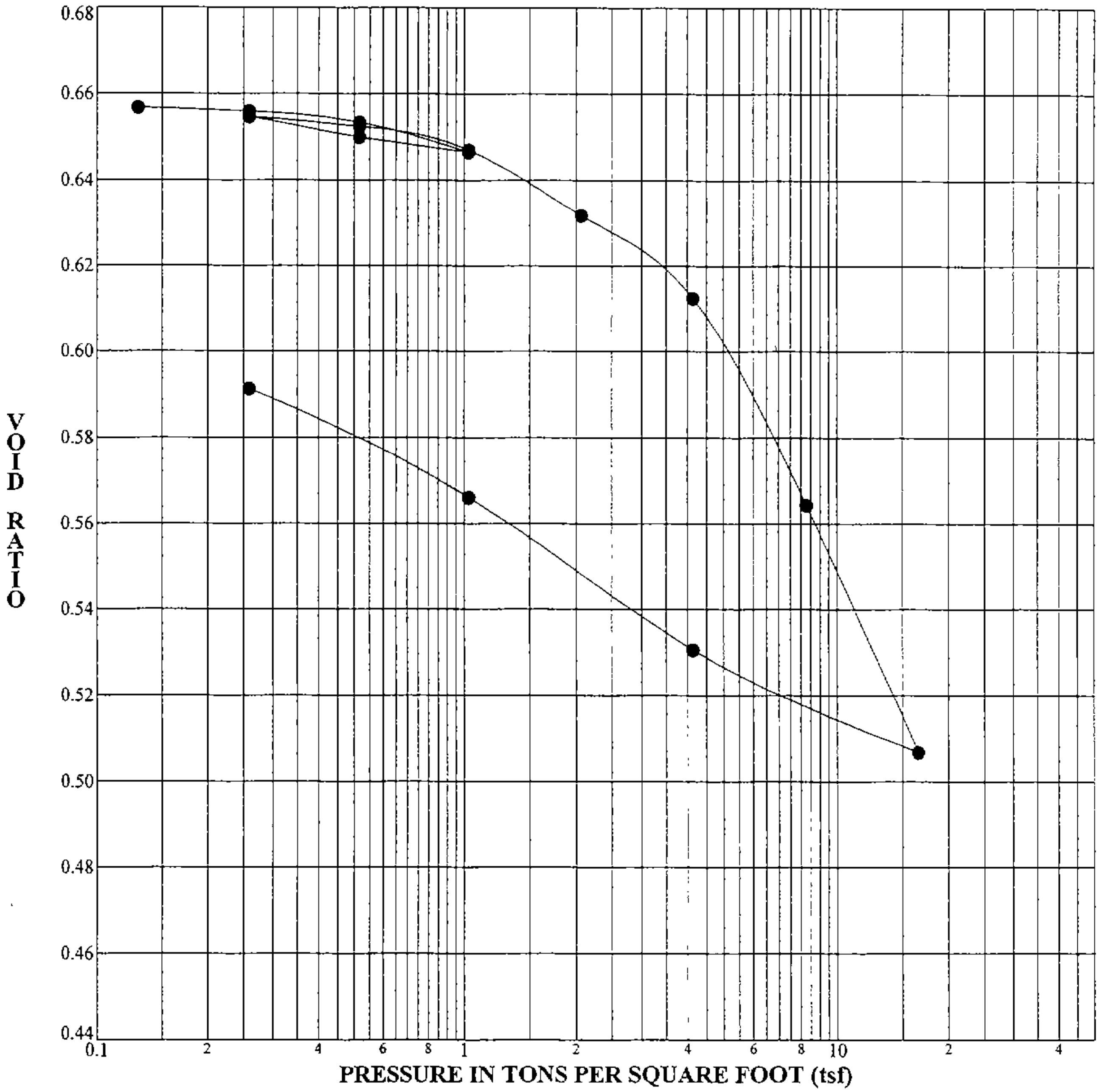
MC	LL	PL	PI	DD	SG	Eo	Ef	% Sat.
22	36	18	18	105	2.70	0.6111	0 5101	95.2

BBC&M ENGINEERING, INC.

PROJECT	GUE-70-14.10		
LOCATION	Guernsey County, Ohio		
JOB NO.	7000.040	DATE	12/15/99

CON/VOID

PRESSURE - VOID RATIO CURVE



Specimen Identification	Classification
● *B-218 S-4 Sec. I 8.5'-9.0'*	*Very stiff brown mottled with gray silty clay, trace fine to medium sand*

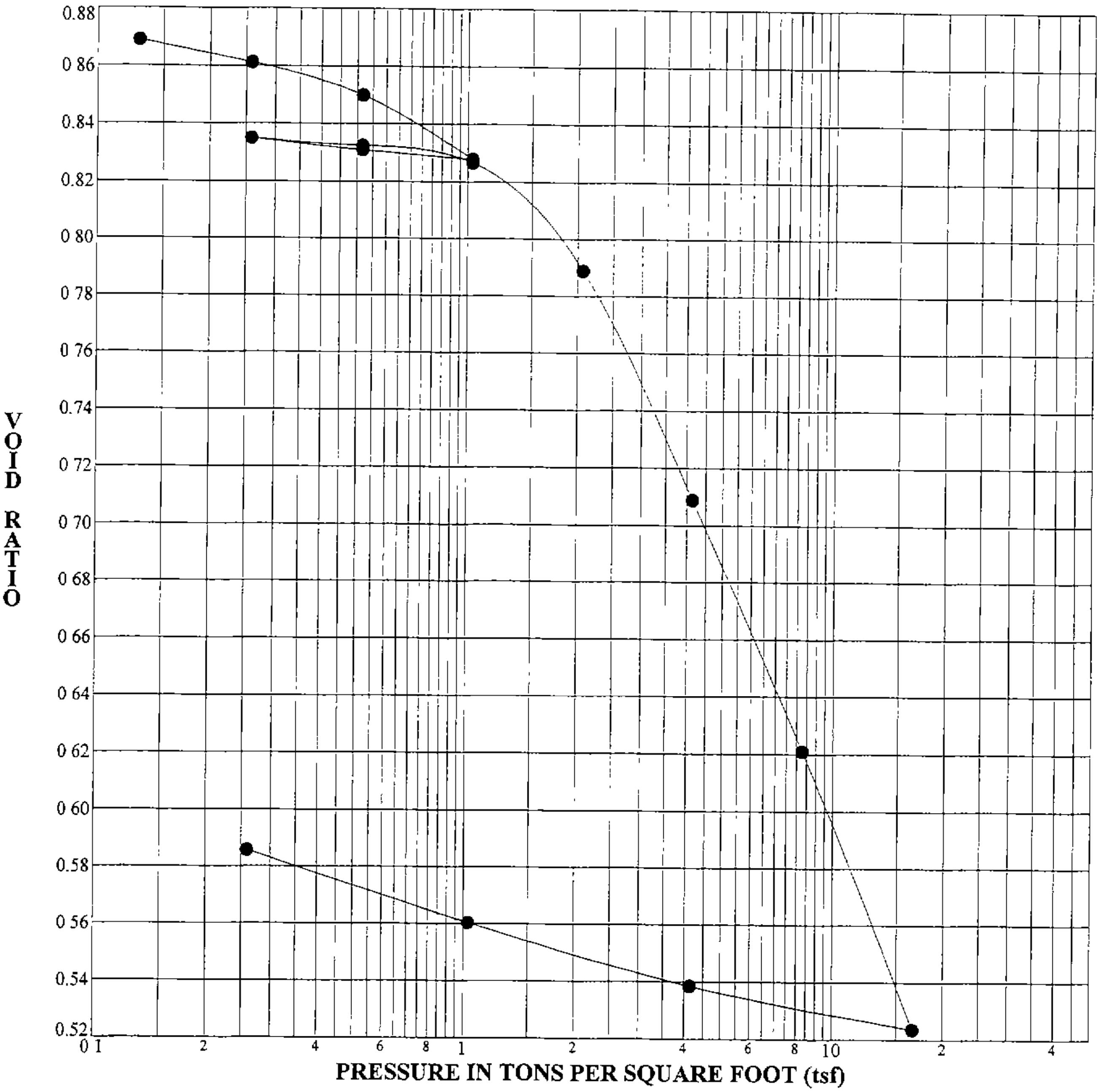
MC	LL	PL	PI	DD	SG	Eo	Ef	% Sat.
23	*56*	*21*	*35*	*103*	*2.74*	*0.6581*	*0.6330*	*96.1*

BBC&M ENGINEERING, INC.

PROJECT GUE-70-14.10
LOCATION Guernsey County, Ohio
JOB NO. 7000.040 DATE 12/16/99

CON/VOID

PRESSURE - VOID RATIO CURVE



Specimen Identification	Classification
● *B-407I S-5 III 9.5' to 11.7'*	*Soft gray mottled with brown and dark-gray silty clay, some fine to medium sand, partly organic, few seams of organic clayey silt.*

MC	LL	PL	PI	DD	SG	Eo	Ef	% Sat.
32	*36*	*21*	*15*	*87*	*2.62*	*0.8746*	*0.6230*	*96.5*

BBCM

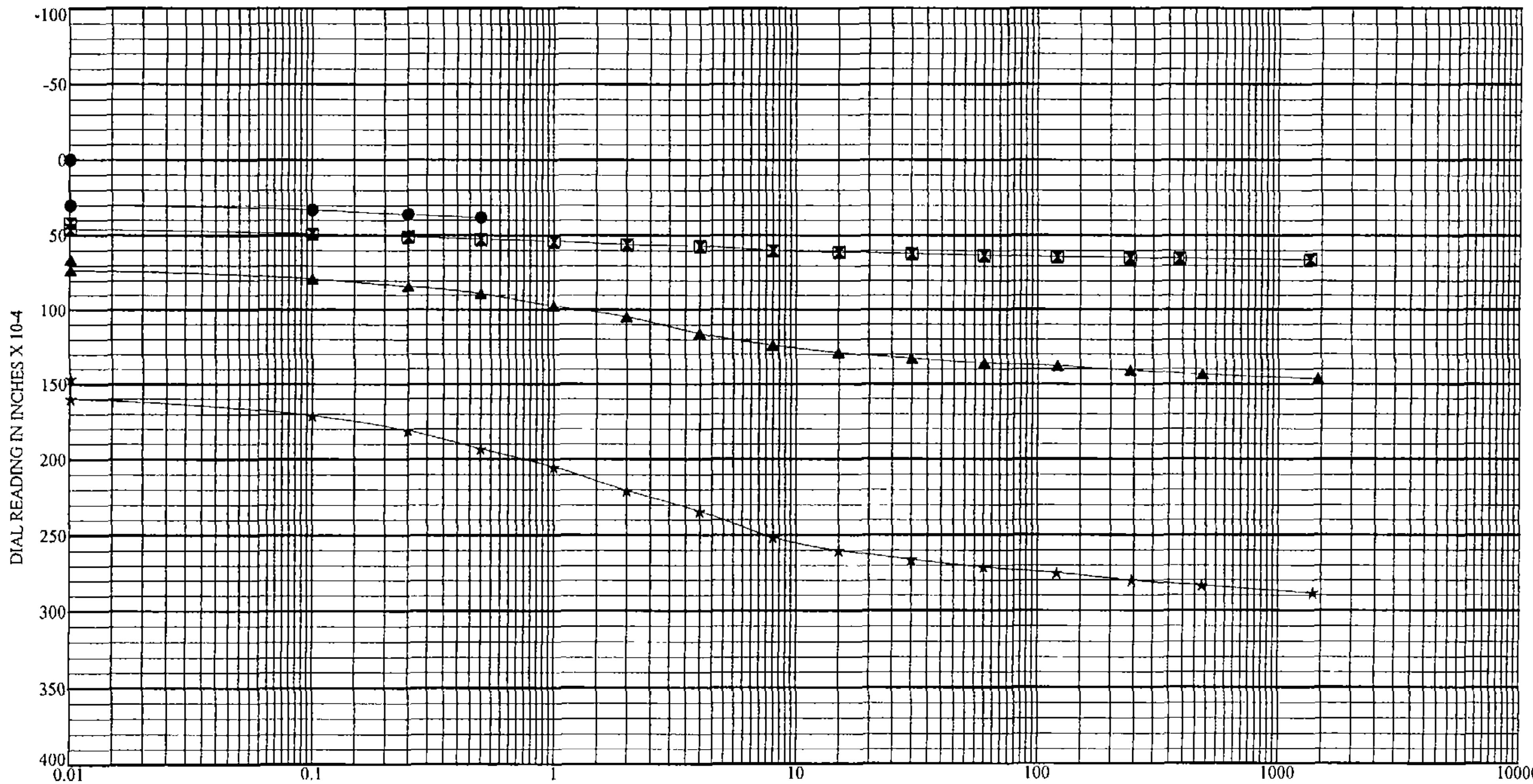
PROJECT	GUE-70-14.10
LOCATION	GUERNSEY COUNTY, OHIO
JOB NO.	01107000.090
DATE	9/26/02

CON/VOID

CONSOLIDATION - TIME CURVES

NOTE: THICKNESS OF SAMPLE =0.7440"

Note: Water Added @ 4 minute @ 0.129 tsf



B-207 S-8 Sec.I 33.5' - 34.0 Soft to stiff gray clayey silt, trace fine to medium sand

BBC&M ENGINEERING, INC.

LOADS : ● 0.259 tsf
⊠ 0.517 tsf
▲ 1.030 tsf
★ 2.070 tsf

DOUBLE DRAINAGE

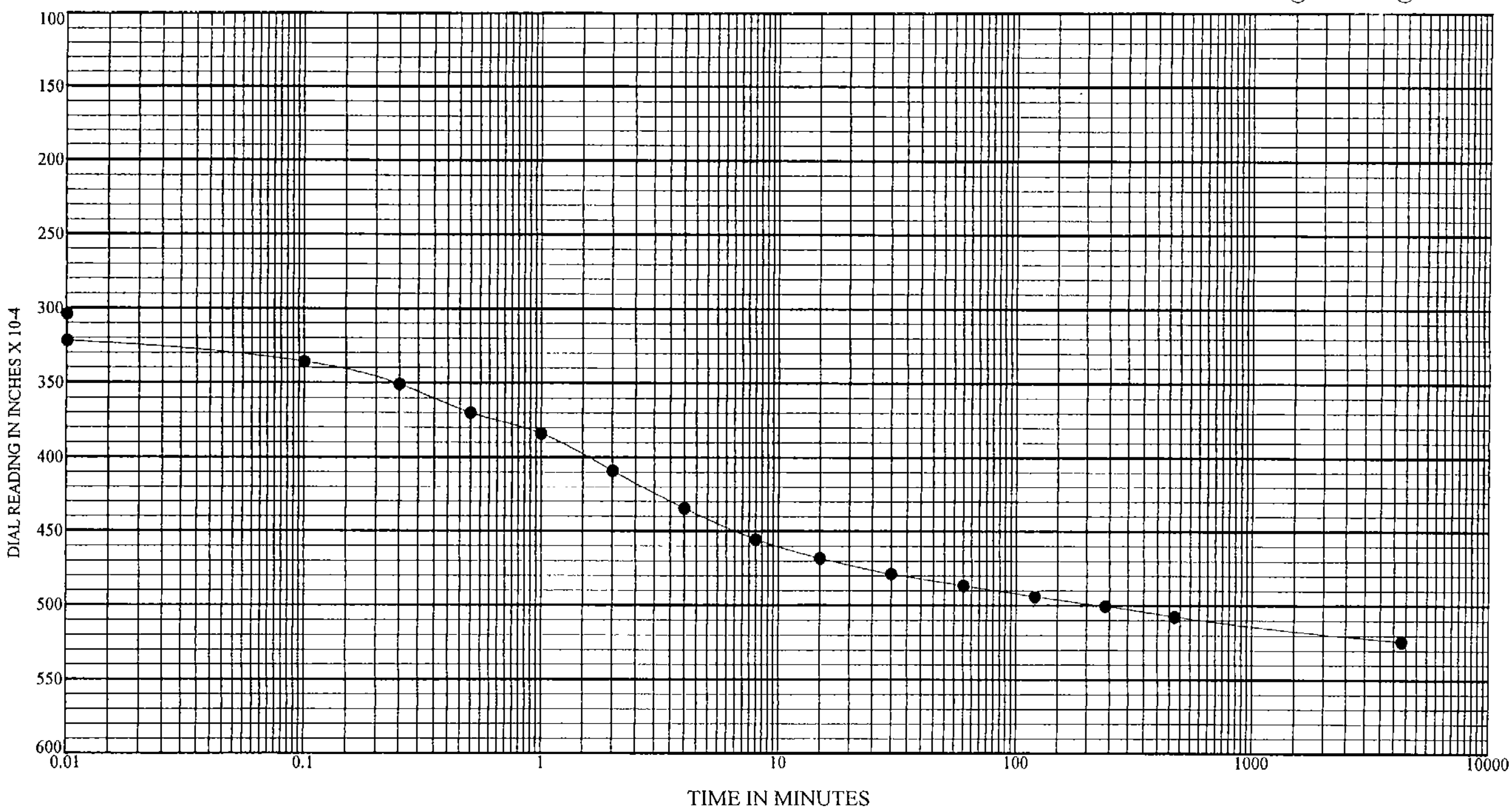
PROJECT GUE-70-14.10
LOCATION Guernsey County, Ohio
JOB NO. 7000.040 DATE 12/20/99

CON-TIME

CONSOLIDATION - TIME CURVES

NOTE: THICKNESS OF SAMPLE =0.7136"

Note: Water Added @ 4 minute @ 0.129 tsf



B-207 S-8 Sec.I 33.5' - 34.0 Soft to stiff gray clayey silt, trace fine to medium sand

BBC&M ENGINEERING, INC.

LOADS : ● **4.140 tsf**

DOUBLE DRAINAGE

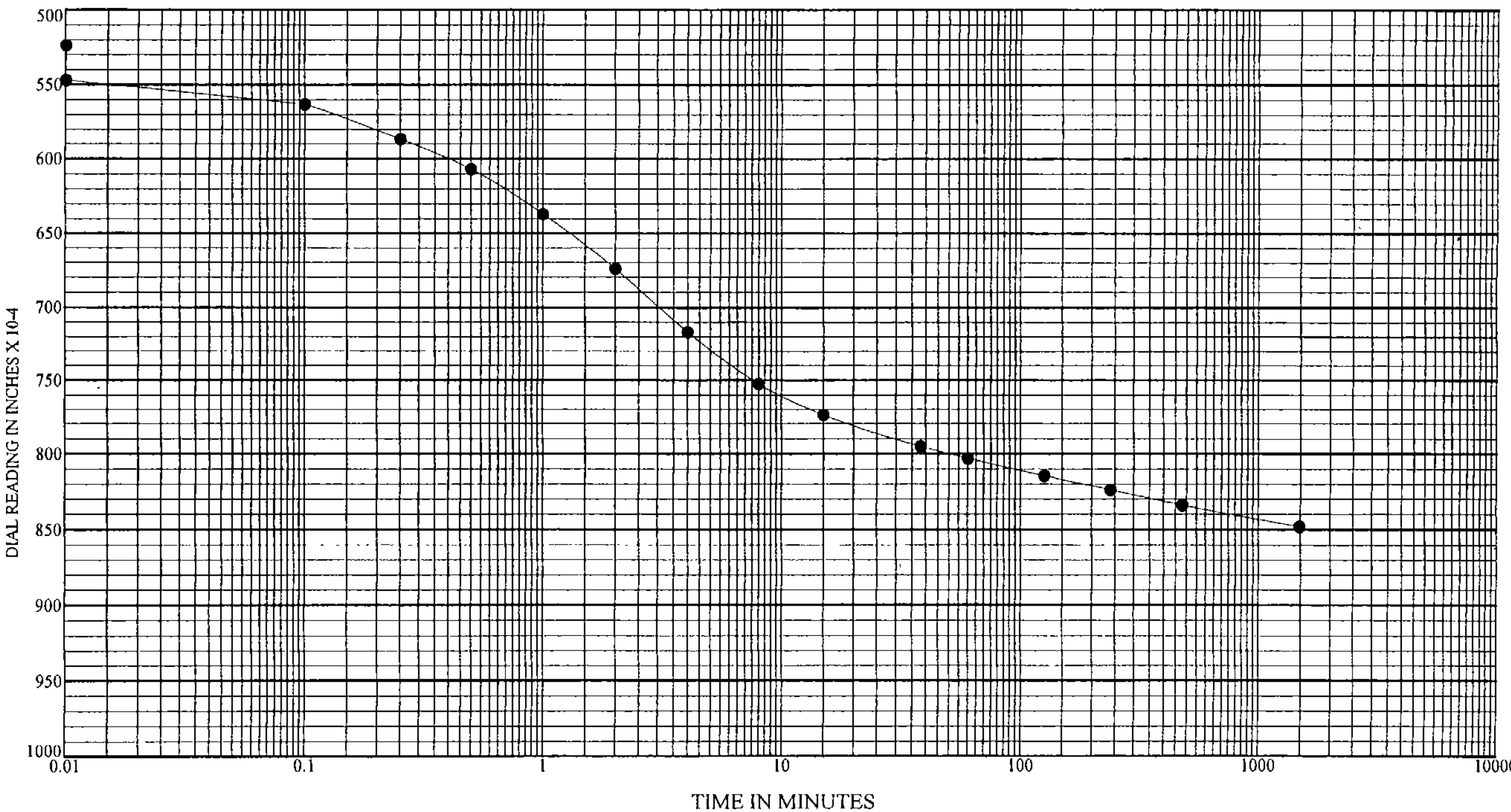
PROJECT	GUE-70-14.10
LOCATION	Guernsey County, Ohio
JOB NO.	7000.040
DATE	12/20/99

CON-TIME

CONSOLIDATION - TIME CURVES

NOTE: THICKNESS OF SAMPLE =0.6916"

Note: Water Added @ 4 minute @ 0.129 tsf



B-207 S-8 Sec.I 33.5' - 34.0 Soft to stiff gray clayey silt, trace fine to medium sand

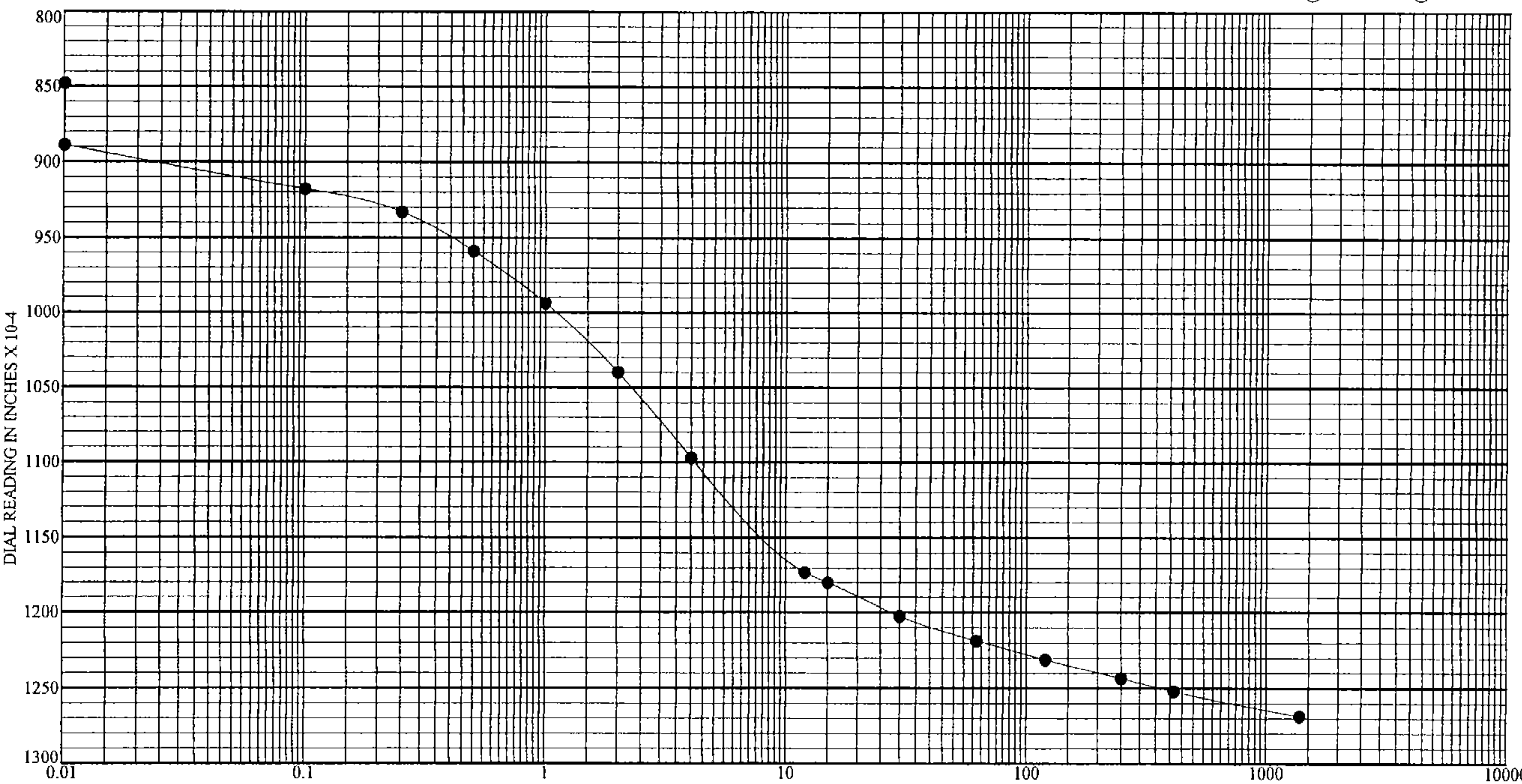
BBC&M ENGINEERING, INC.	LOADS : ● **8.280 tsf**	DOUBLE DRAINAGE	PROJECT GUE-70-14.10 LOCATION Guernsey County, Ohio JOB NO. 7000.040 DATE 12/20/99

CON-TIME

CONSOLIDATION - TIME CURVES

NOTE: THICKNESS OF SAMPLE =0.6592"

Note: Water Added @ 4 minute @ 0.129 tsf



B-207 S-8 Sec.I 33.5' - 34.0 **Soft to stiff gray clayey silt, trace fine to medium sand**

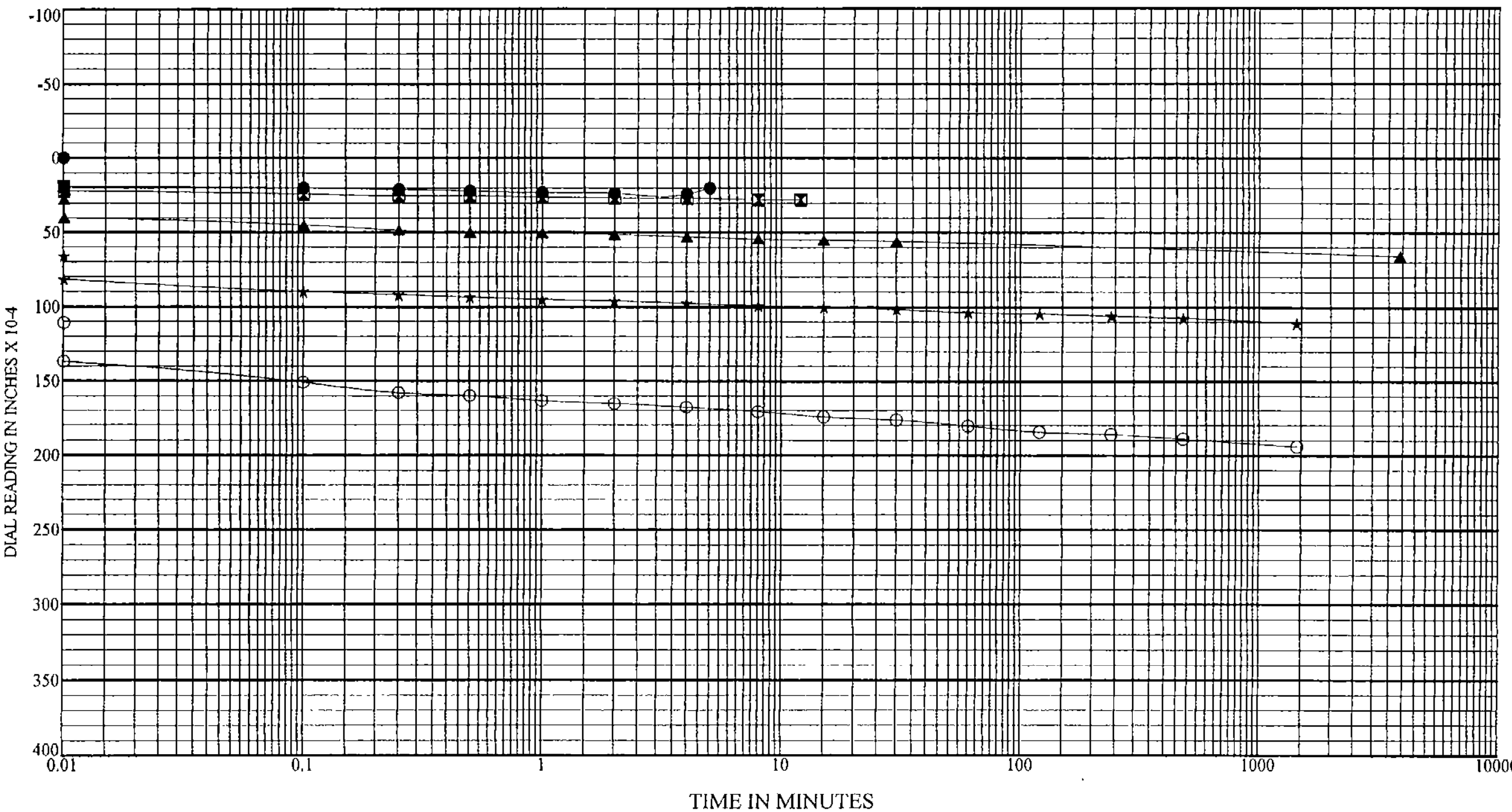
BBC&M ENGINEERING, INC	LOADS : ● **16.60 tsf**	DOUBLE DRAINAGE	PROJECT GUE-70-14.10 LOCATION Guernsey County, Ohio JOB NO. 7000.040 DATE 12/20/99

CON-TIME

CONSOLIDATION - TIME CURVES

NOTE: THICKNESS OF SAMPLE =0.7430"

Note: Water Added @ 4 minute @ 0.129 tsf



B-207 S-8 Sec. II 34.0' - 34.4 Stiff gray silty clay, little fine to coarse sand, trace fine gravel, contains silt seams

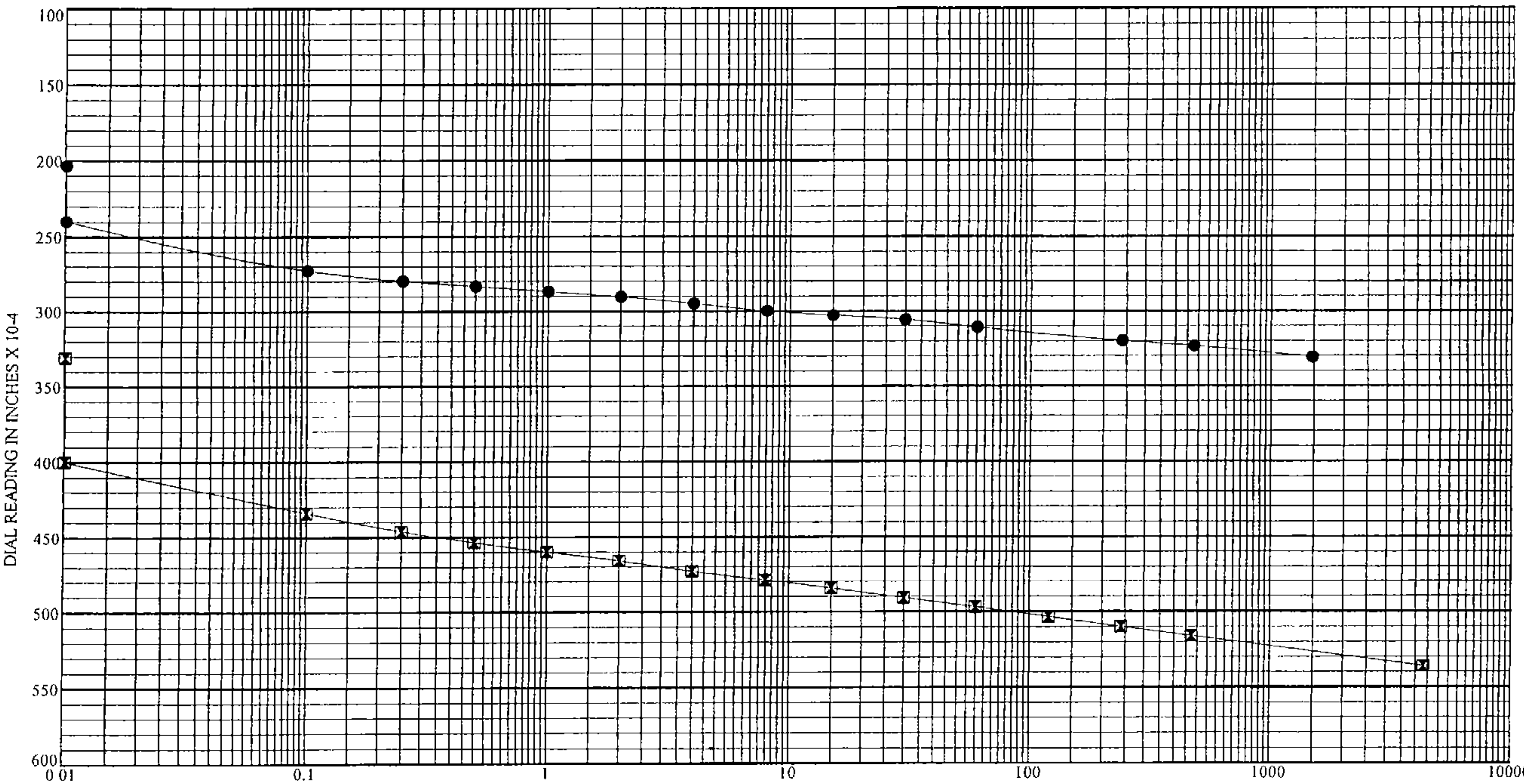
BBC&M ENGINEERING, INC.	LOADS : ● 0.129 tsf ⊠ 0.259 tsf ▲ 0.517 tsf ★ 1.030 tsf ⊙ 2.070 tsf	DOUBLE DRAINAGE	PROJECT GUE-70-14.10 LOCATION Guernsey County, Ohio JOB NO. 7000.040 DATE 12/16/99

CON-TIME

CONSOLIDATION - TIME CURVES

NOTE: THICKNESS OF SAMPLE = 0.7227"

Note: Water Added @ 4 minute @ 0.129 tsf



B-207 S-8 Sec. II 34.0' - 34.4 Stiff gray silty clay, little fine to coarse sand, trace fine gravel, contains silt seams

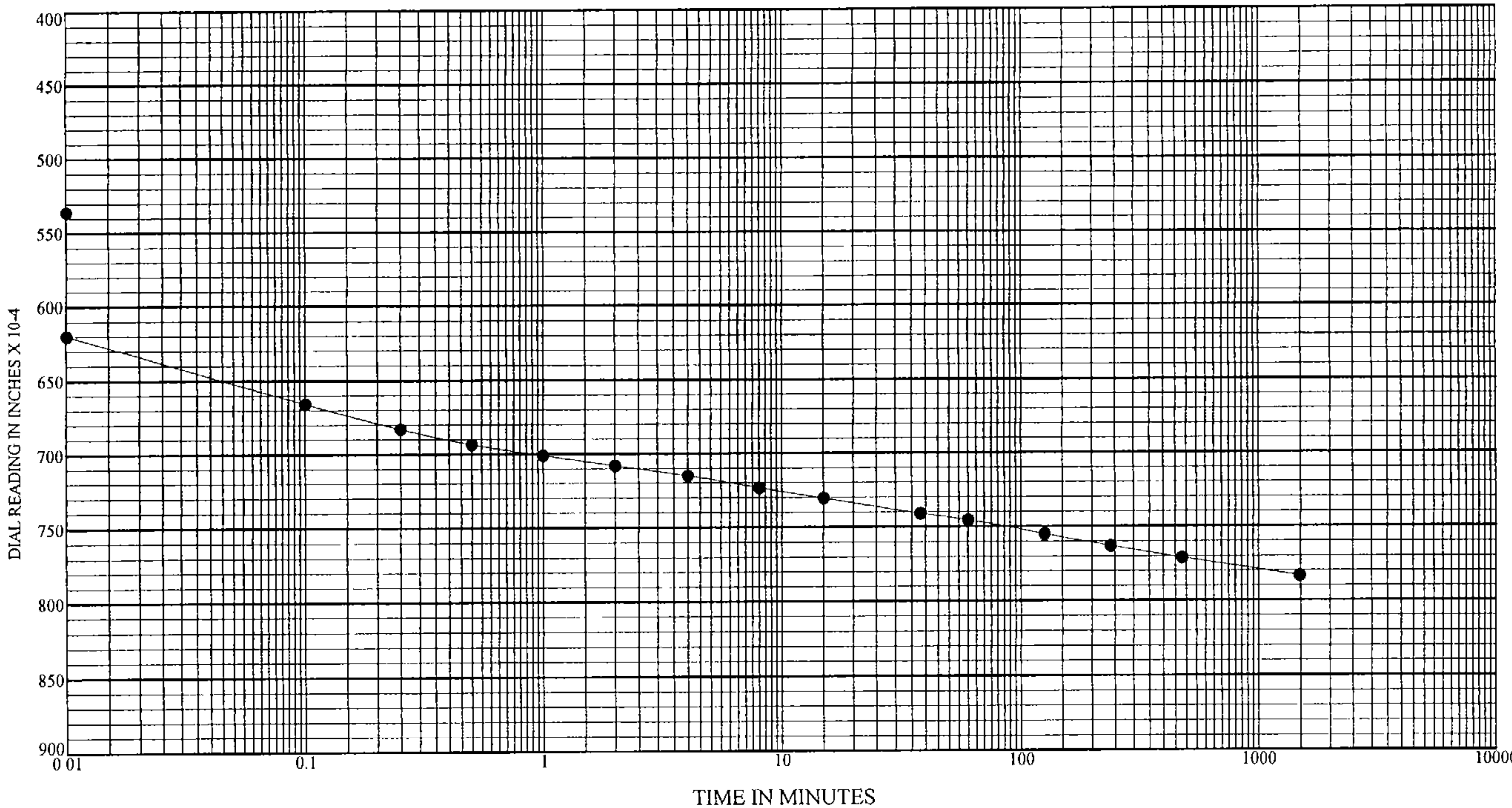
BBC&M ENGINEERING, INC.	LOADS : ● 4.140 tsf ⊠ 8.280 tsf	DOUBLE DRAINAGE	PROJECT GUE-70-14.10 LOCATION Guernsey County, Ohio JOB NO. 7000.040 DATE 12/16/99

CON-TIME

CONSOLIDATION - TIME CURVES

NOTE: THICKNESS OF SAMPLE =0.6894"

Note: Water Added @ 4 minute @ 0.129 tsf



B-207 S-8 Sec. II 34.0' - 34.4 Stiff gray silty clay, little fine to coarse sand, trace fine gravel, contains silt seams

BBC&M ENGINEERING, INC.

LOADS : ● **16.60 tsf**

DOUBLE DRAINAGE

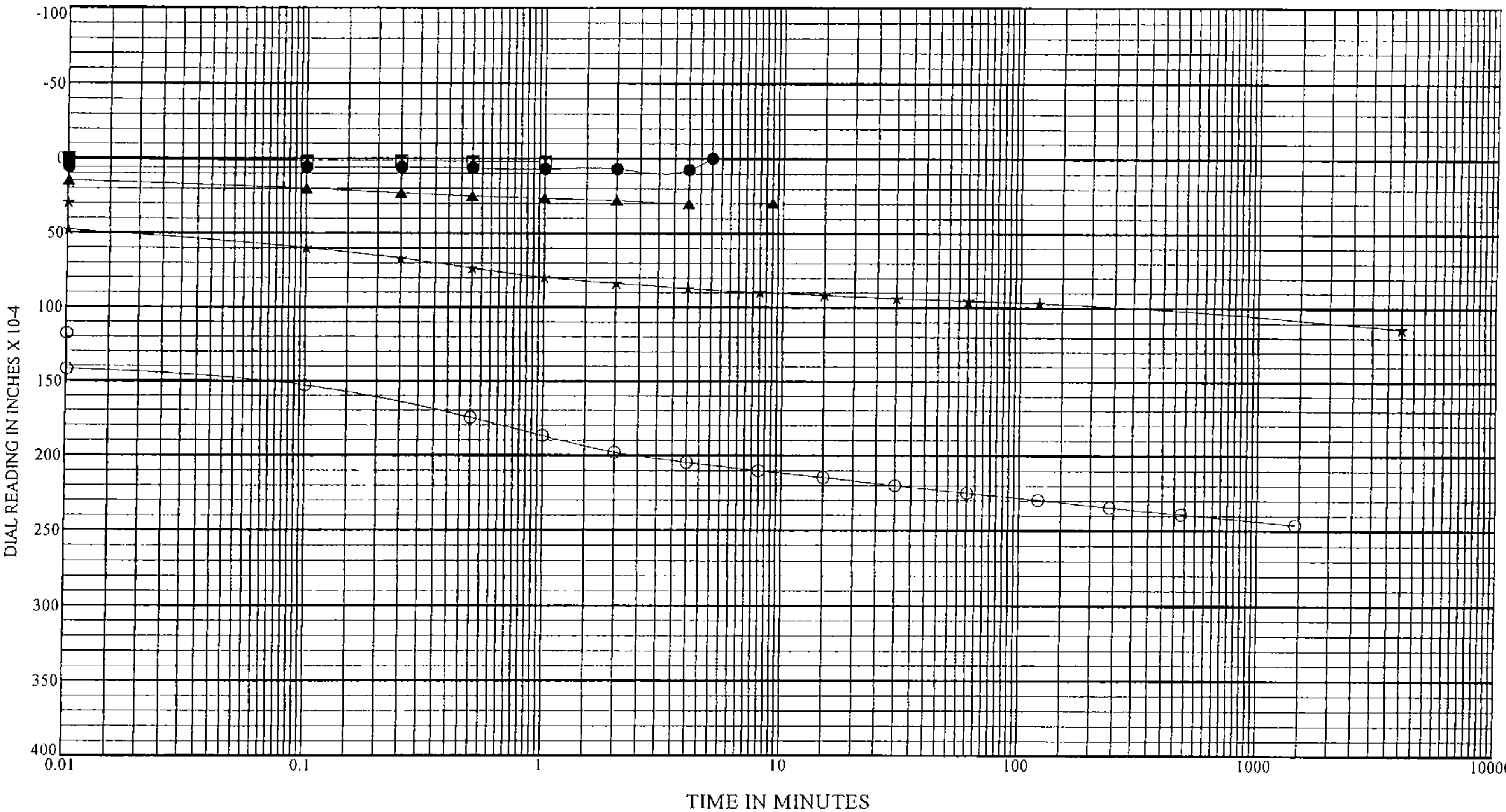
PROJECT GUE-70-14.10
LOCATION Guernsey County, Ohio
JOB NO. 7000.040 **DATE** 12/16/99

CON-TIME

CONSOLIDATION - TIME CURVES

NOTE: THICKNESS OF SAMPLE =0.7440"

Note: Water Added @ 4 minute @ 0.129 tsf



B-215 S-5A Sec. II 15.0'-16.9' Stiff gray silty clay, trace fine to medium sand.

BBC&M ENGINEERING, INC.

LOADS : ● 0.129 tsf
⊠ 0.259 tsf
▲ 0.517 tsf
★ 1.030 tsf
○ 2.070 tsf

DOUBLE DRAINAGE

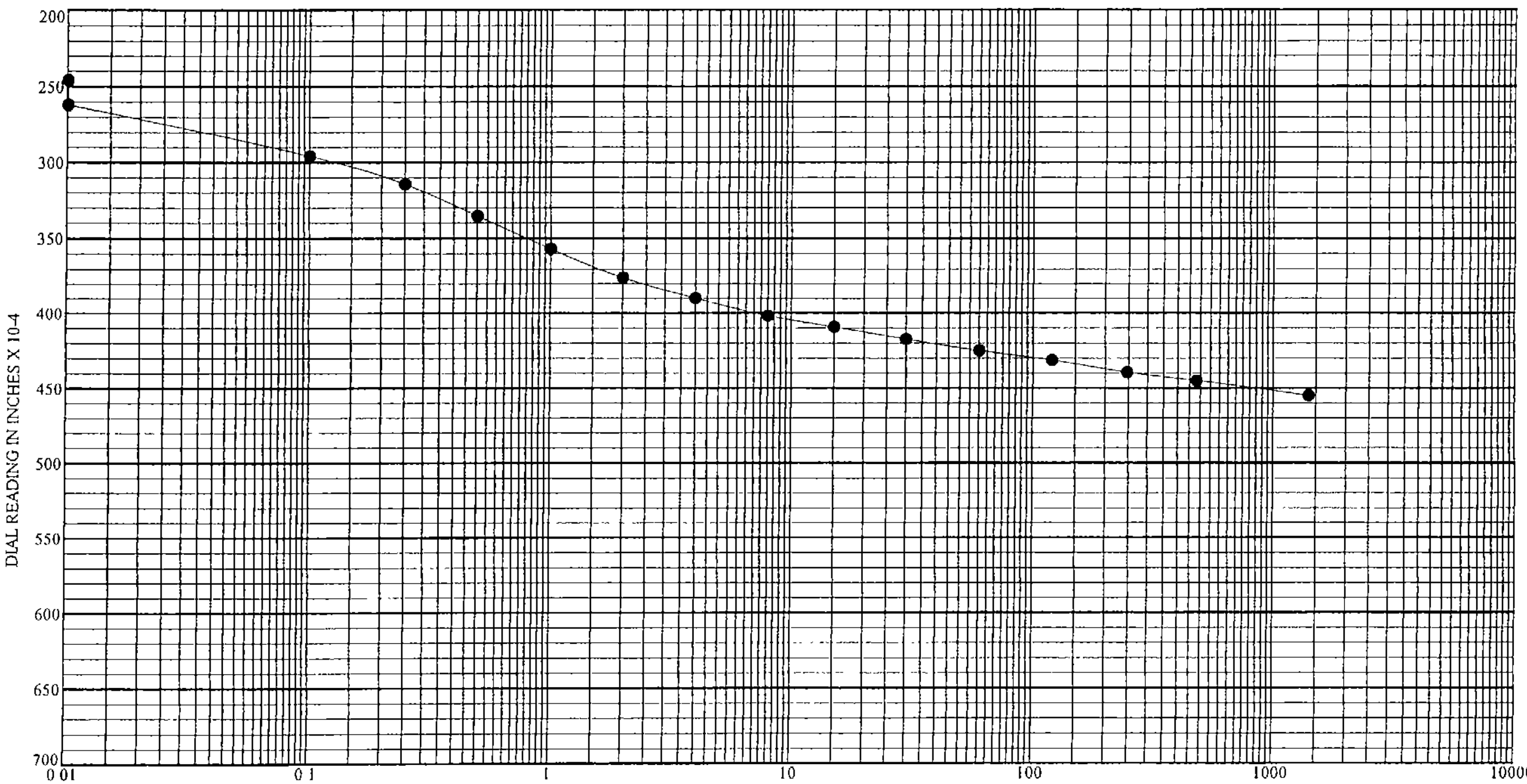
PROJECT GUE-70-14.10
LOCATION Guernsey County, Ohio
JOB NO. 7000.040 DATE 12/15/99

CON-TIME

CONSOLIDATION - TIME CURVES

NOTE: THICKNESS OF SAMPLE =0.7194"

Note: Water Added @ 4 minute @ 0.129 tsf



B-215 S-5A Sec. II 15.0'-16.9' Stiff gray silty clay, trace fine to medium sand.

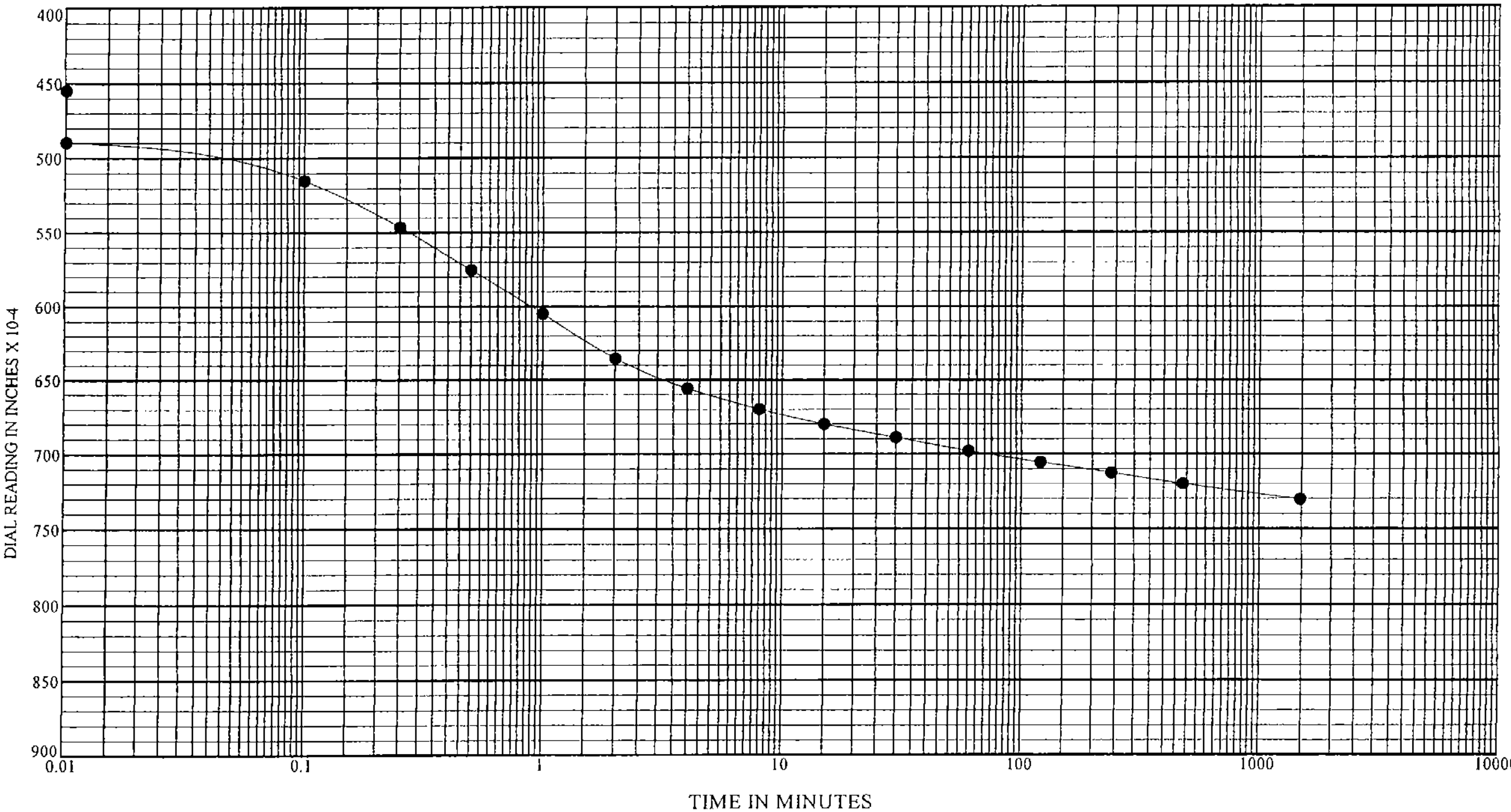
BBC&M ENGINEERING, INC.	LOADS : ● **4.140 tsf**	DOUBLE DRAINAGE	PROJECT GUE-70-14.10 LOCATION Guernsey County, Ohio JOB NO. 7000.040 DATE 12/15/99

CON-TIME

CONSOLIDATION - TIME CURVES

NOTE: THICKNESS OF SAMPLE = 0.6989"

Note: Water Added @ 4 minute @ 0.129 tsf



B-215 S-5A Sec. II 15.0'-16.9' Stiff gray silty clay, trace fine to medium sand.

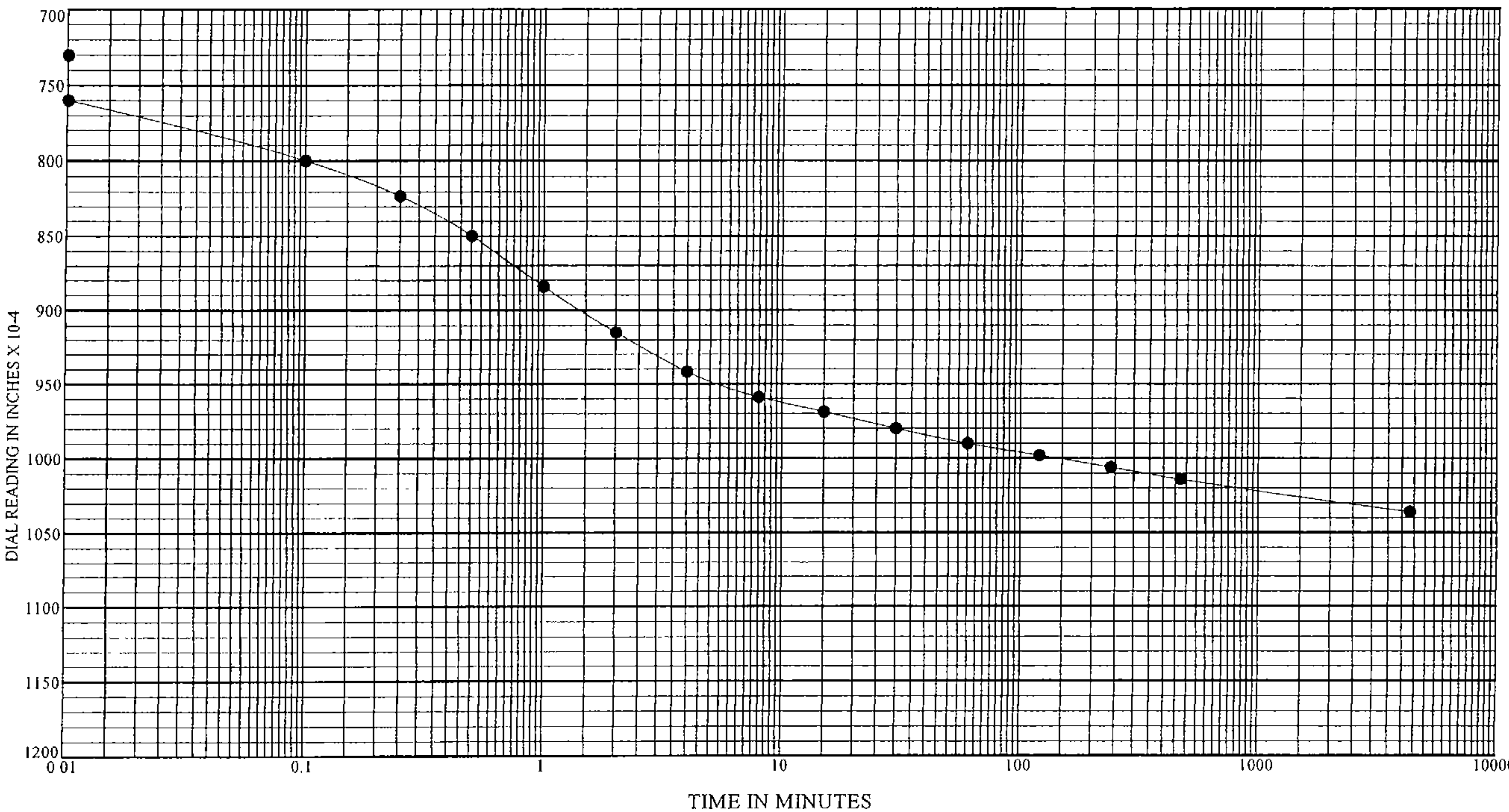
BBC&M ENGINEERING, INC.	LOADS : ● 8.280 tsf	DOUBLE DRAINAGE	PROJECT GUE-70-14.10 LOCATION Guernsey County, Ohio JOB NO. 7000.040 DATE 12/15/99

CON-TIME

CONSOLIDATION - TIME CURVES

NOTE: THICKNESS OF SAMPLE = 0.6710"

Note: Water Added @ 4 minute @ 0.129 tsf



B-215 S-5A Sec. II 15.0'-16.9' Stiff gray silty clay, trace fine to medium sand.

LOADS : ● 16.60 tsf

DOUBLE DRAINAGE

PROJECT GUE-70-14.10

LOCATION Guernsey County, Ohio

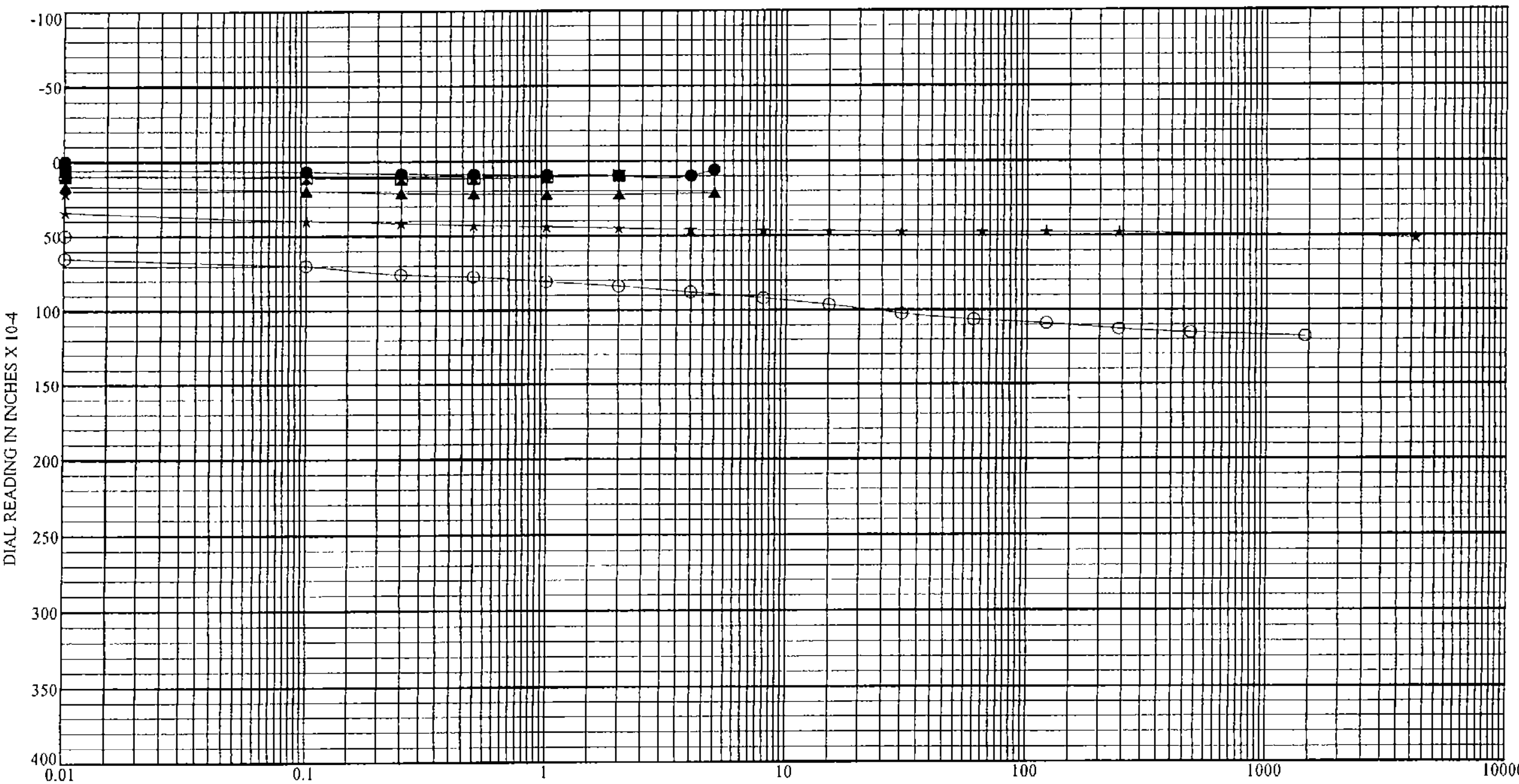
JOB NO. 7000.040 DATE 12/15/99

CON-TIME

CONSOLIDATION - TIME CURVES

NOTE: THICKNESS OF SAMPLE =0.7430"

Note: Water Added @ 4 minute @ 0.129 tsf



B-218 S-4 Sec. I 8.5'-9.0' Very stiff brown mottled with gray silty clay, trace fine to medium sand

BBC&M ENGINEERING, INC.

LOADS : ● 0.129 tsf
⊠ 0.259 tsf
▲ 0.517 tsf
★ 1.030 tsf
○ 2.070 tsf

DOUBLE DRAINAGE

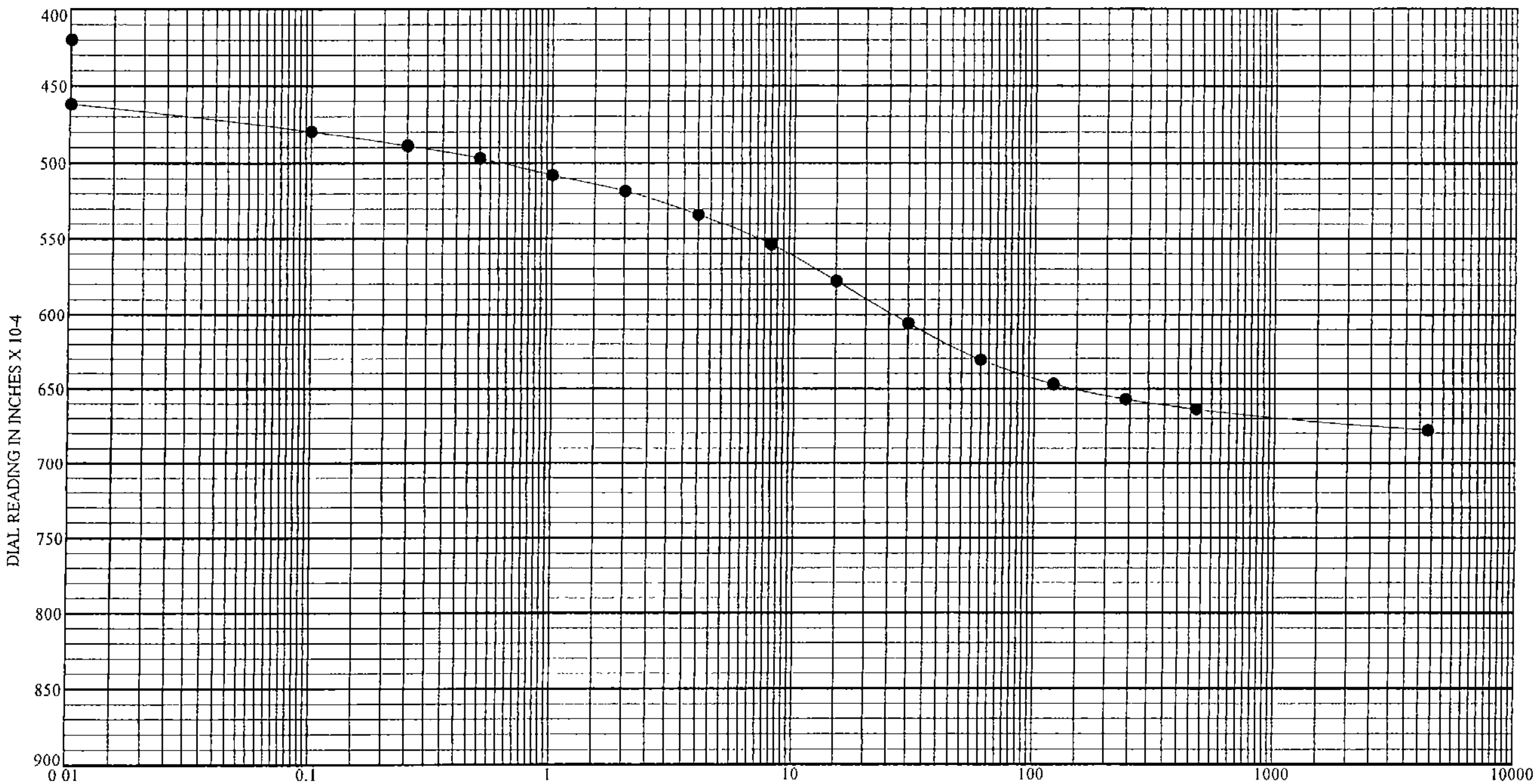
PROJECT GUE-70-14.10
LOCATION Guernsey County, Ohio
JOB NO. 7000.040 DATE 12/15/99

CON-TIME

CONSOLIDATION - TIME CURVES

NOTE: THICKNESS OF SAMPLE = 0.7010"

Note: Water Added @ 4 minute @ 0.129 tsf



B-218 S-4 Sec. I 8.5'-9.0' Very stiff brown mottled with gray silty clay, trace fine to medium sand

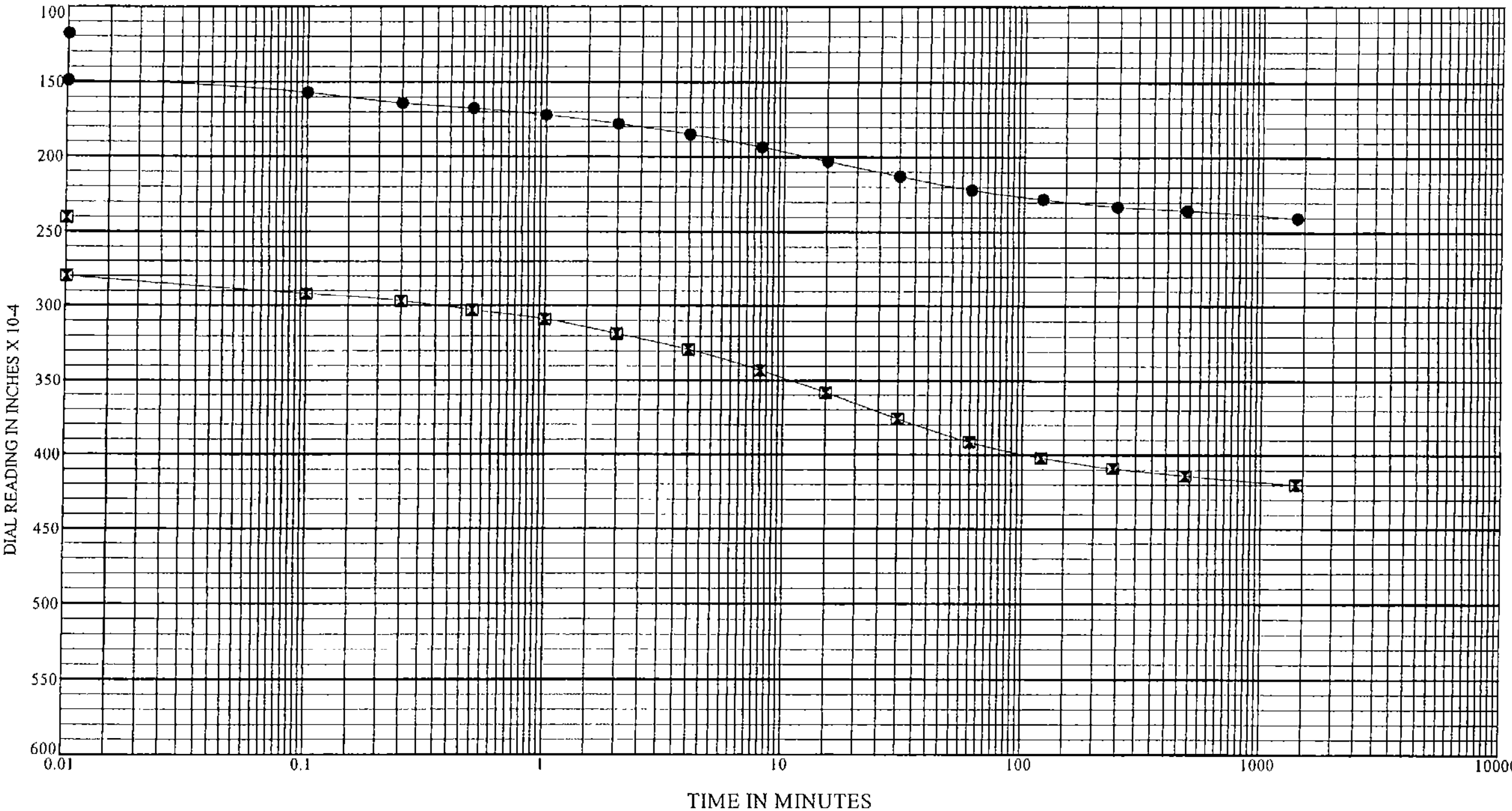
BBC&M ENGINEERING, INC.	LOADS : ● 16.60 tsf	DOUBLE DRAINAGE	PROJECT GUE-70-14.10 LOCATION Guernsey County, Ohio JOB NO. 7000.040 DATE 12/15/99

CON-TIME

CONSOLIDATION - TIME CURVES

NOTE: THICKNESS OF SAMPLE =0.7312"

Note: Water Added @ 4 minute @ 0.129 tsf



B-218 S-4 Sec. I 8.5'-9.0' **Very Stiff brown mottled with gray silty clay, trace fine to medium sand**

LOADS : ● **4.140 tsf**

⊠ **8.280 tsf**

DOUBLE DRAINAGE

PROJECT GUE-70-14.10

LOCATION Guernsey County, Ohio

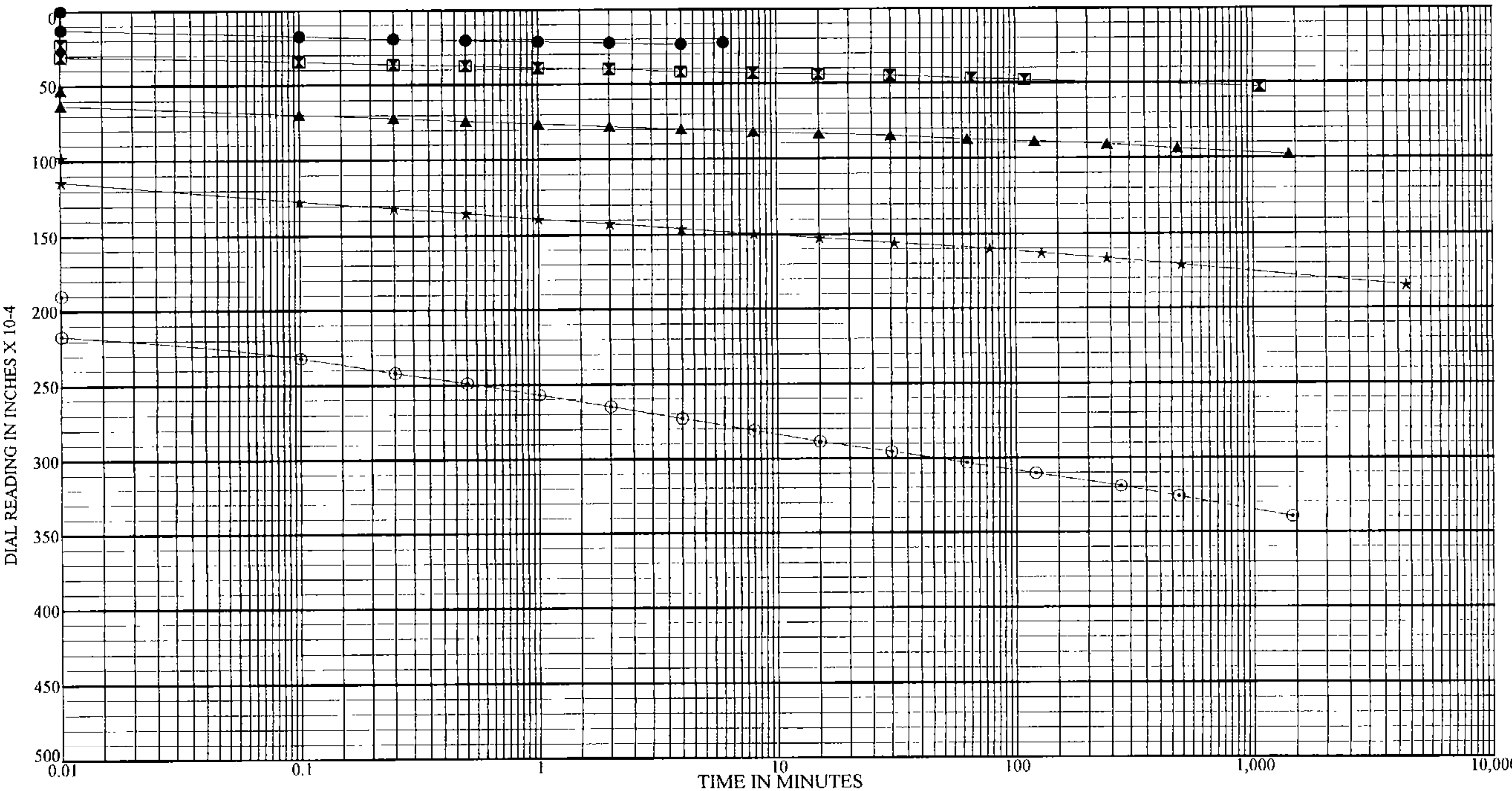
JOB NO. 7000.040 DATE 12/15/99

CON-TIME

CONSOLIDATION - TIME CURVES

NOTE: THICKNESS OF SAMPLE =0.7430"

Note: Water Added @ 4 minute @ 0.129 tsf



B-407I S-5 III 9.5' to 11.7' **Soft gray mottled with brown and dark-gray silty clay, some fine to medium sand, partly organic, few seams of organic clayey silt.**

BBCM

LOADS : ● **0.129 tsf**
⊠ **0.259 tsf**
▲ **0.517 tsf**
★ **1.030 tsf**
⊙ **2.070 tsf**

DOUBLE DRAINAGE

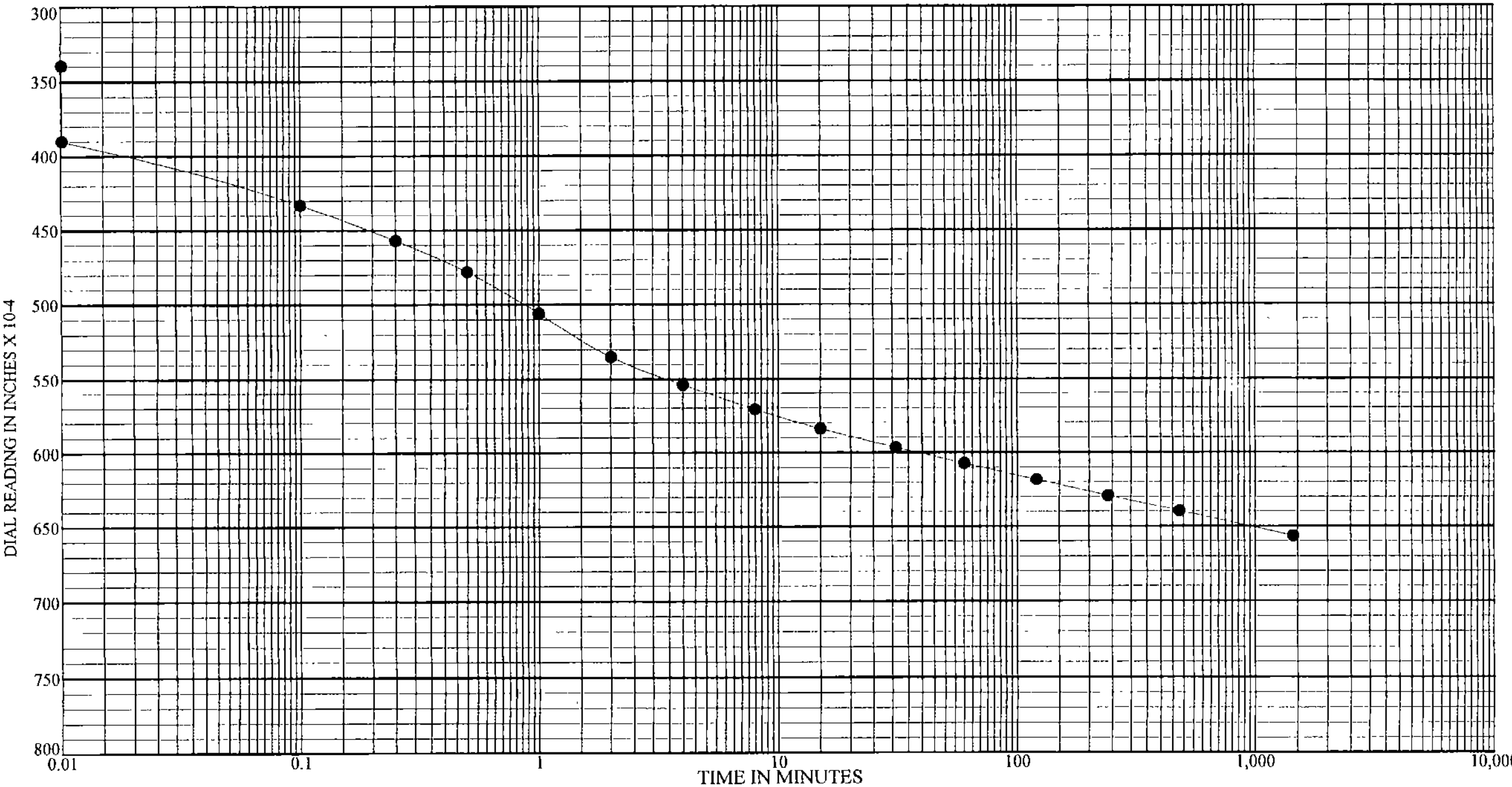
PROJECT GUE-70-14.10
LOCATION GUERNSEY COUNTY, OHIO
JOB NO. 01107000.090 DATE 9/26/02

CON-TIME

CONSOLIDATION - TIME CURVES

NOTE: THICKNESS OF SAMPLE =0.7091"

Note: Water Added @ 4 minute @ 0.129 tsf



B-407I S-5 III 9.5' to 11.7' **Soft gray mottled with brown and dark-gray silty clay, some fine to medium sand, partly organic, few seams of organic clayey silt.**

LOADS : ● **4.140 tsf**

DOUBLE DRAINAGE

BBCM

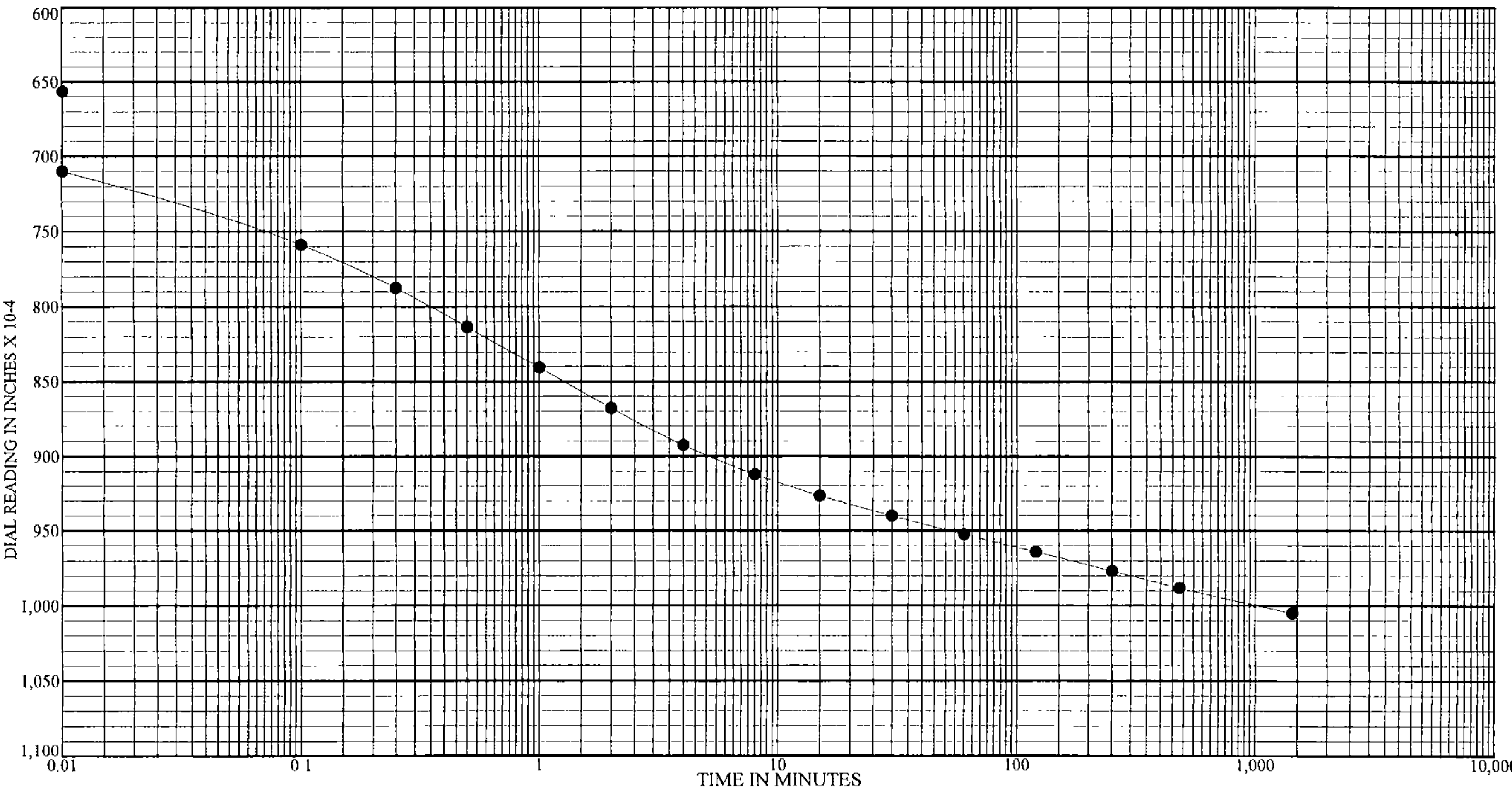
PROJECT	GUE-70-14.10
LOCATION	GUERNSEY COUNTY, OHIO
JOB NO.	01107000.090
DATE	9/26/02

CON-TIME

CONSOLIDATION - TIME CURVES

NOTE: THICKNESS OF SAMPLE =0.6774"

Note: Water Added @ 4 minute @ 0.129 tsf



B-407I S-5 III 9.5' to 11.7' **Soft gray mottled with brown and dark-gray silty clay, some fine to medium sand, partly organic, few seams of organic clayey silt.**

BBCM

LOADS : ● **8.280 tsf**

DOUBLE DRAINAGE

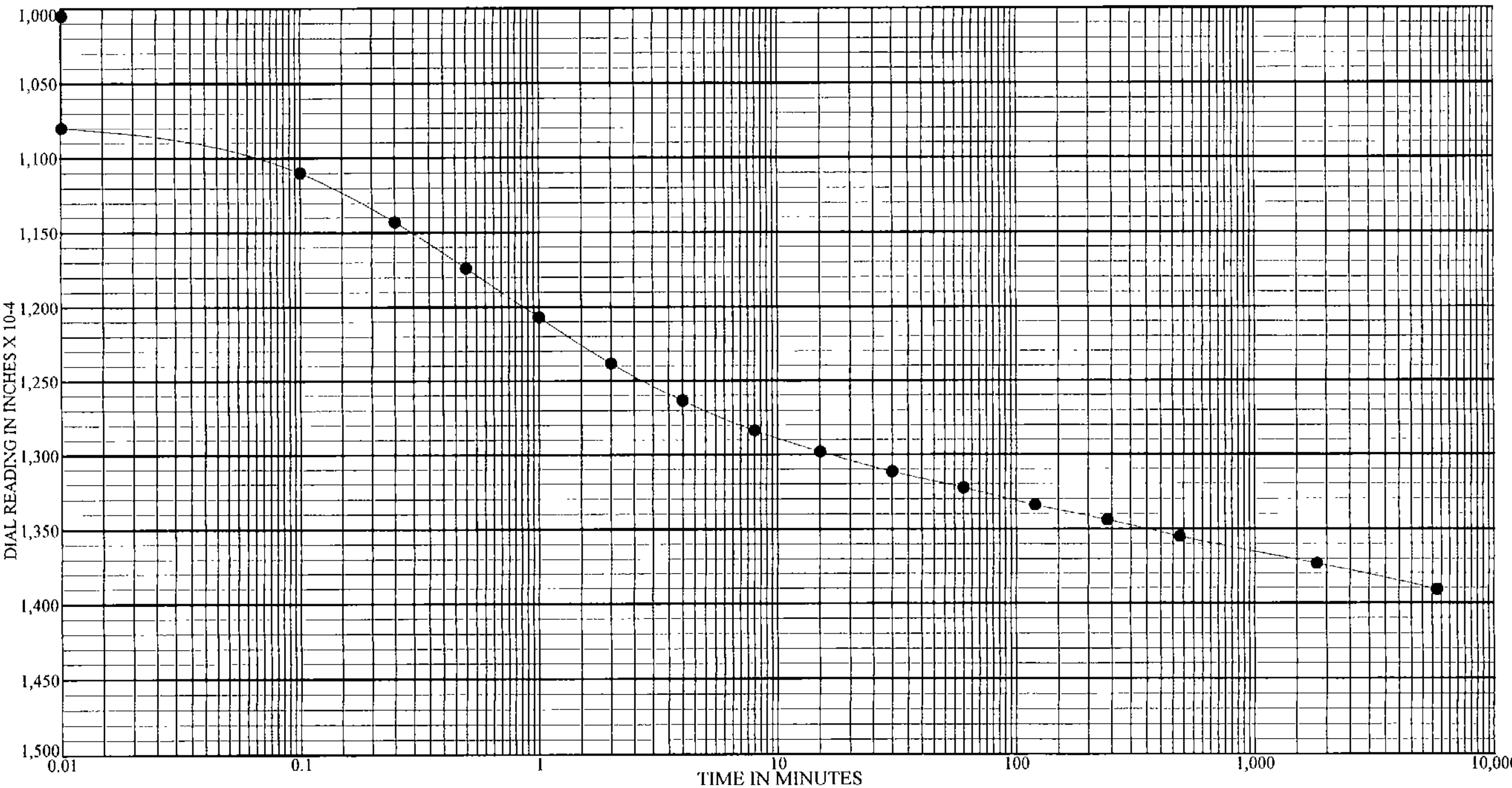
PROJECT GUE-70-14.10
LOCATION GUERNSEY COUNTY, OHIO
JOB NO. 01107000.090 **DATE** 9/26/02

CON-TIME

CONSOLIDATION - TIME CURVES

NOTE: THICKNESS OF SAMPLE =0.6425"

Note: Water Added @ 4 minute @ 0.129 tsf



B-4071 S-5 III 9.5' to 11.7' **Soft gray mottled with brown and dark-gray silty clay, some fine to medium sand, partly organic, few seams of organic clayey silt.**

BBCM

LOADS : ● **16.60 tsf**

DOUBLE DRAINAGE

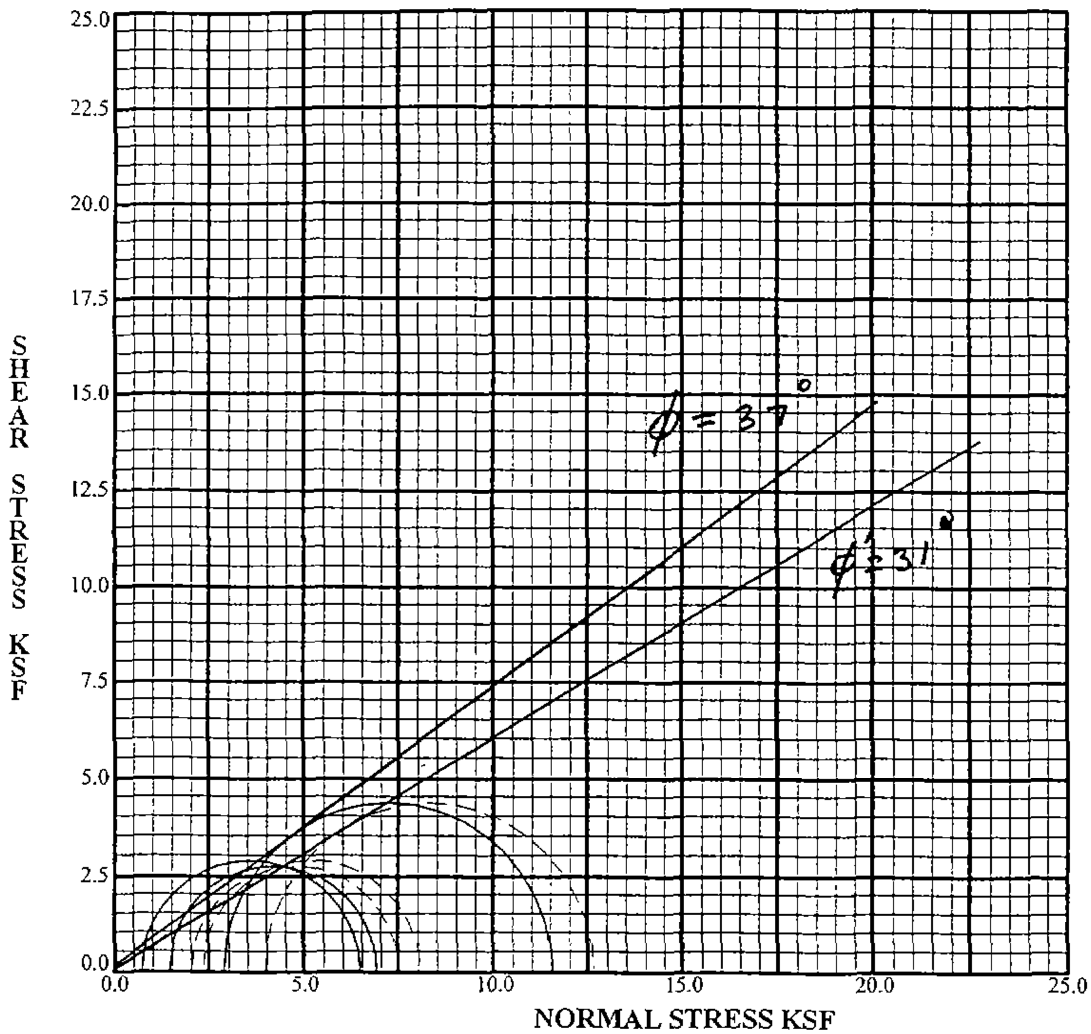
PROJECT GUE-70-14.10
LOCATION GUERNSEY COUNTY, OHIO
JOB NO. 01107000.090 **DATE** 9/26/02

CON-TIME

SUMMARY OF TRIAXIAL COMPRESSION TESTS

SATURATED, CONSOLIDATED, UNDRAINED

SHEAR STRESS VS NORMAL STRESS



TOTAL STRESS ——— EFFECTIVE STRESS - - - -

Specimen Identification	Classification	DD	MC%
B-216 S-3 II 10.0' - 12.0'	*Very stiff brown mottled with gray silty clay, little fine to coarse sand, trace fine gravel, few seams of sand.*	108	20
B-216 S-3 III 10.0' - 12.0'	*Very stiff brown mottled with gray silty clay, little fine to coarse sand, trace fine gravel, few seams of sand.*	110	20
B-216 S-3 IV 10.0' - 12.0'	*Very stiff brown mottled with gray silty clay, little fine to coarse sand, trace fine gravel, few seams of sand.*	106	23

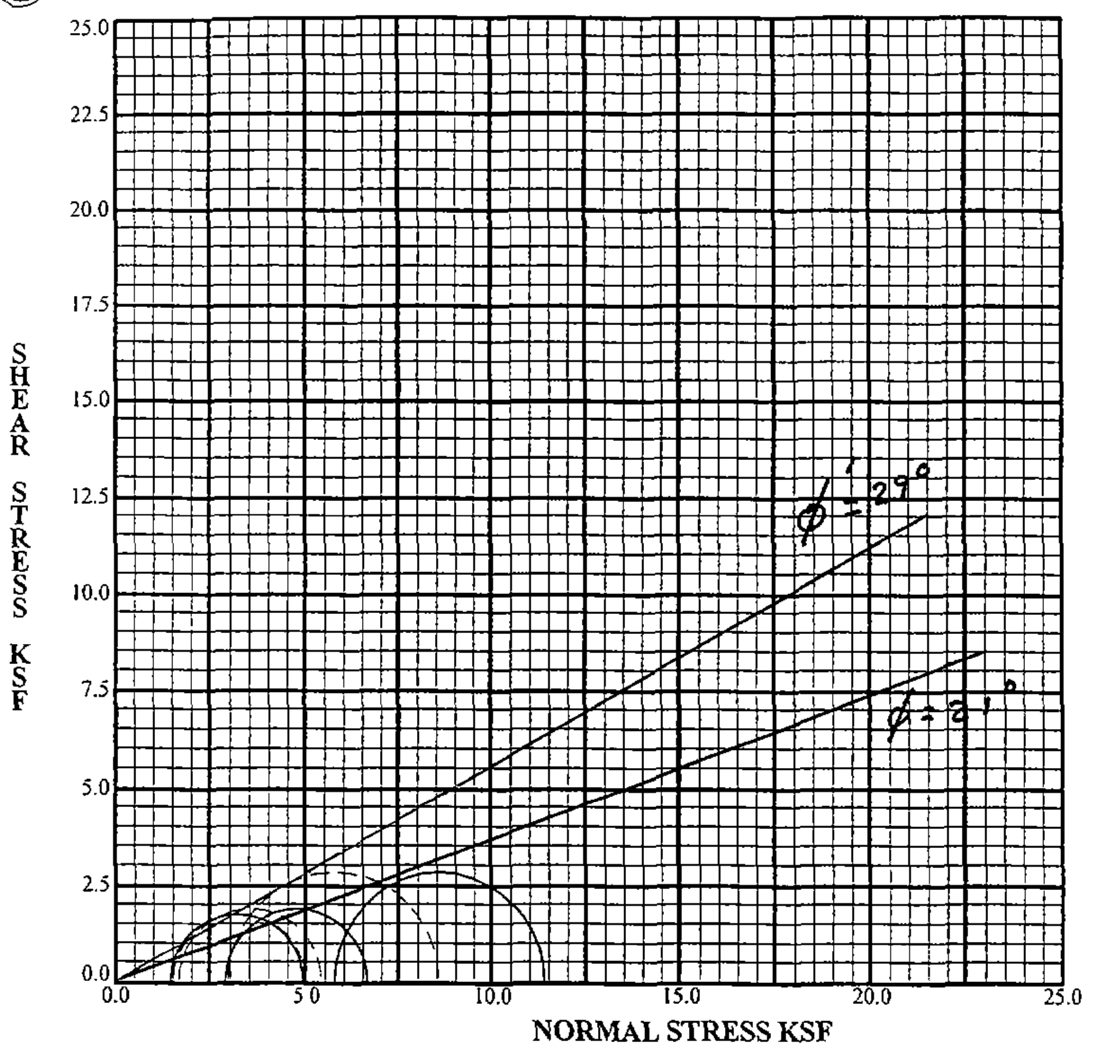
BBC&M ENGINEERING INC.

PROJECT GUE-70-14.10
LOCATION Guernsey County, Ohio
JOB NO. 7000.040 DATE 12/18/99

SUMMARY OF TRIAXIAL COMPRESSION TESTS

SATURATED, CONSOLIDATED, UNDRAINED

SHEAR STRESS VS NORMAL STRESS



TOTAL STRESS ——— EFFECTIVE STRESS - - - -

Specimen Identification	Classification	DD	MC%
B-216 S-7A II 30.0' - 32.0'	*Stiff gray silty clay, trace fine to medium sand, contains seams of silt.*	98	26
B-216 S-7A III 30.0' - 32.0'	*Stiff gray silty clay, trace fine to medium sand, contains seams of silt.*	95	29
B-216 S-7A IV 30.0' - 32.0'	*Stiff gray silty clay, trace fine to medium sand, contains seams of silt.*	96	29

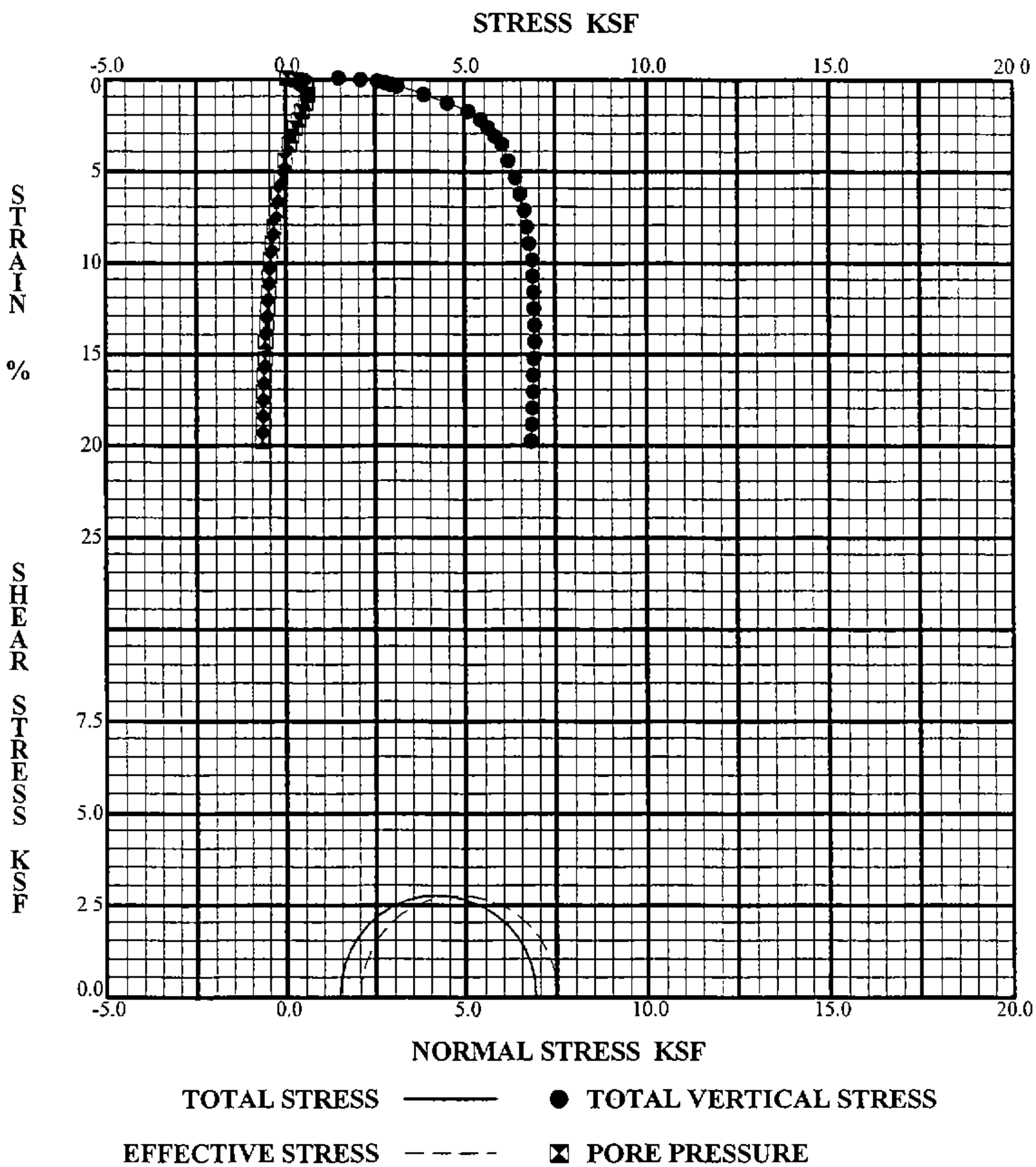
BBC&M ENGINEERING, INC.

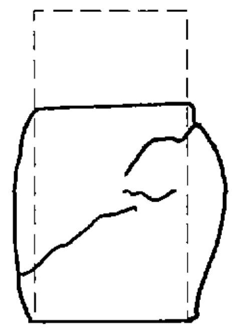
PROJECT GUE-70-14.10
LOCATION Guernsey County, Ohio
JOB NO. 7000.040 DATE 12/17/99

TRIAX04

TRIAXIAL COMPRESSION TESTS

SATURATED, CONSOLIDATED, UNDRAINED
WITH PORE PRESSURE MEASUREMENTS





Specimen Identification		Classification	DD	MC%
●	*B-216 S-3 II 10.0' - 12.0'*	*Very stiff brown mottled with gray silty clay, little fine to coarse sand, trace fine gravel, few seams of sand.*	108	20
⧗			Int. % Sat.	
			96.1	

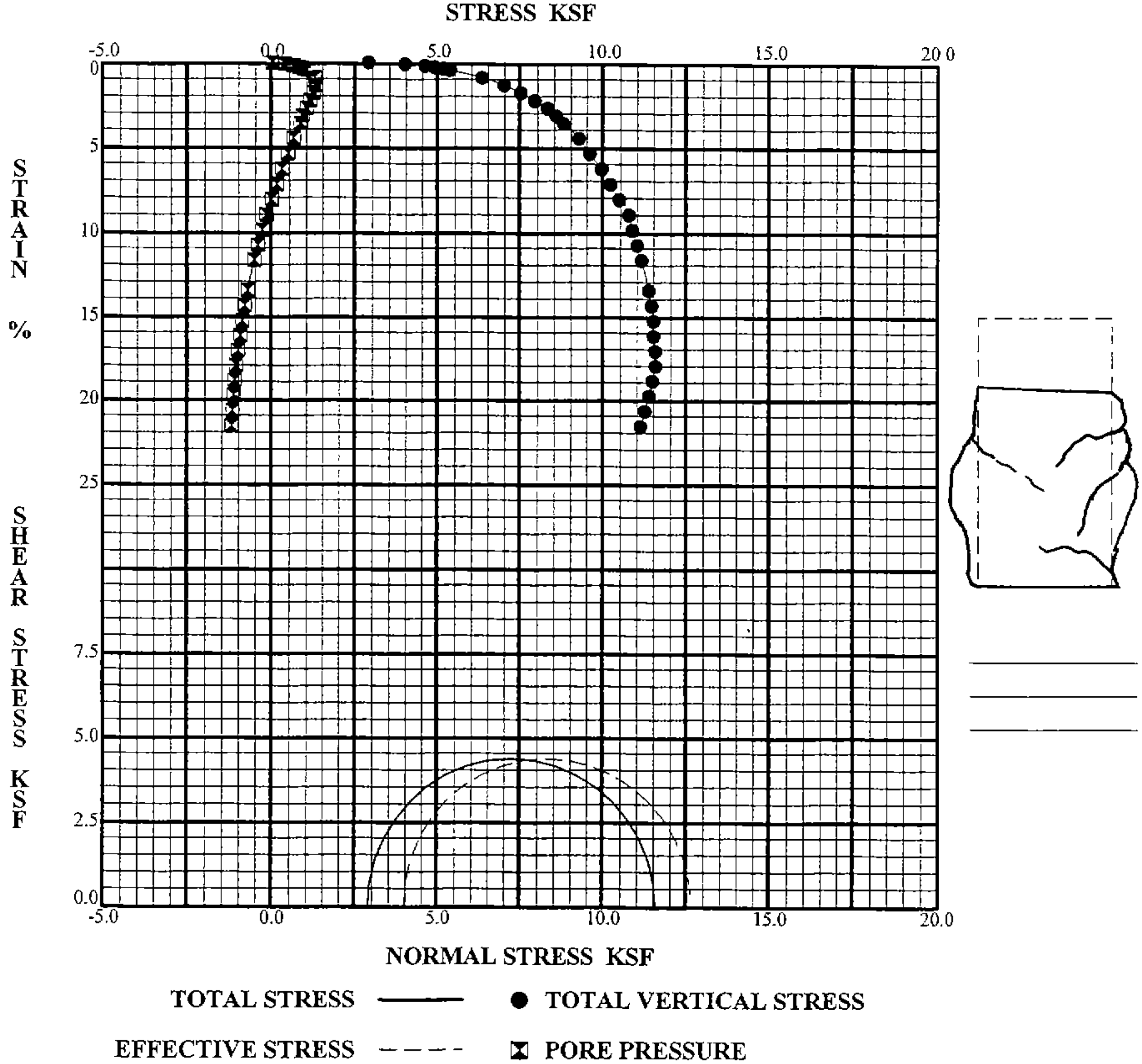
BBC&M ENGINEERING, INC.

PROJECT	GUE-70-14.10
LOCATION	Guernsey County, Ohio
JOB NO.	7000.040
DATE	12/18/99

RIAX01

TRIAXIAL COMPRESSION TESTS

SATURATED, CONSOLIDATED, UNDRAINED
WITH PORE PRESSURE MEASUREMENTS



	Specimen Identification	Classification	DD	MC%
● ⧗	*B-216 S-3 III 10.0' - 12.0'*	*Very stiff brown mottled with gray silty clay, little fine to coarse sand, trace fine gravel, few seams of sand.*	110	20
			Int. % Sat.	
			101.9	

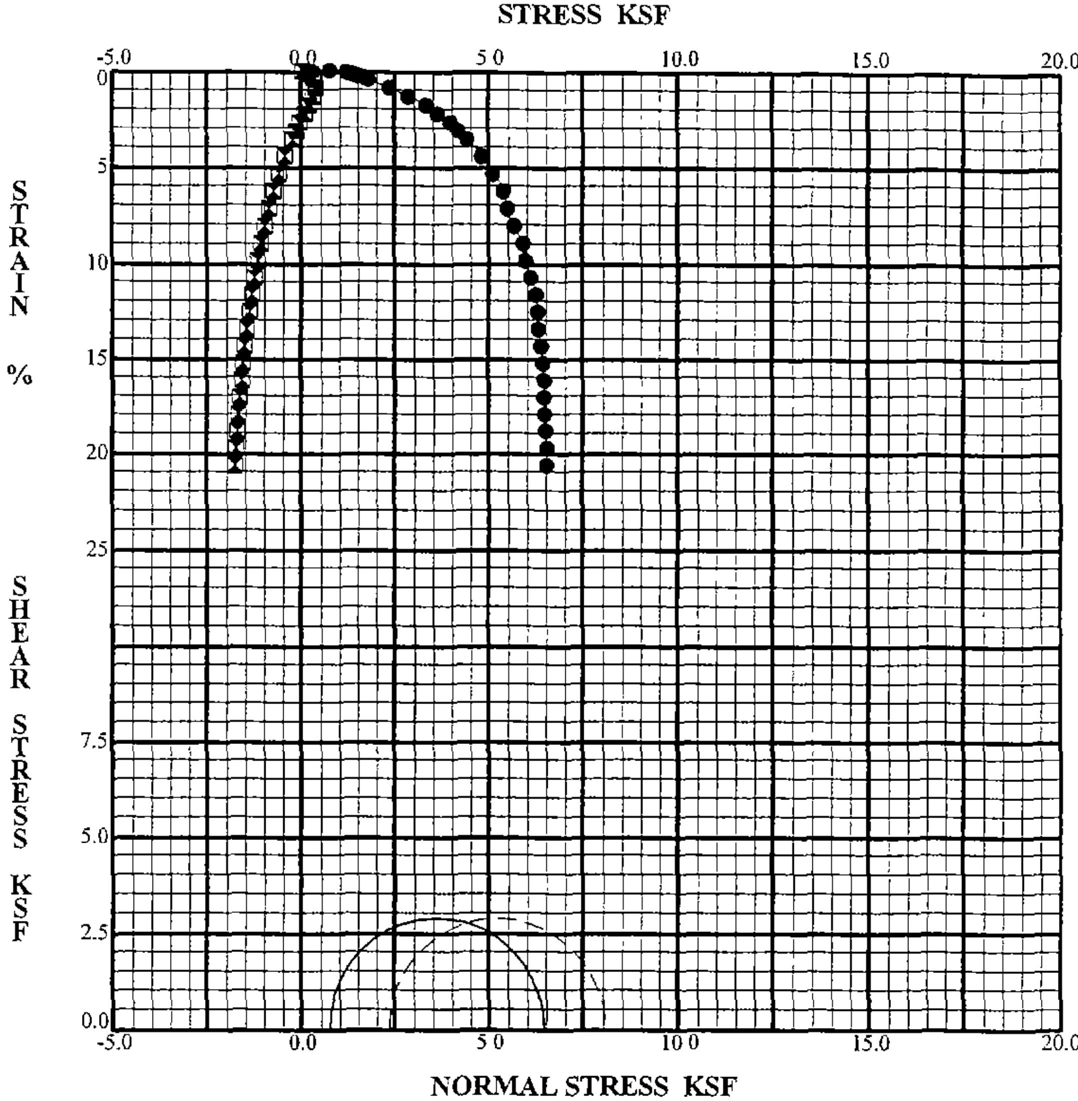
BBC&M ENGINEERING, INC.

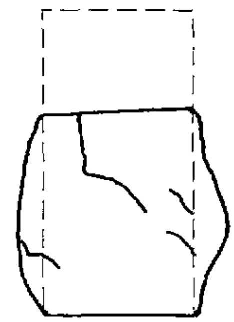
PROJECT GUE-70-14.10
LOCATION Guernsey County, Ohio
JOB NO. 7000.040 DATE 12/18/99

TRIAX01

TRIAXIAL COMPRESSION TESTS

SATURATED, CONSOLIDATED, UNDRAINED
WITH PORE PRESSURE MEASUREMENTS





TOTAL STRESS ——— ● TOTAL VERTICAL STRESS

EFFECTIVE STRESS - - - - ⊠ PORE PRESSURE

	Specimen Identification	Classification	DD	MC%
● ⊠	*B-216 S-3 IV 10.0' - 12.0'*	*Very stiff brown mottled with gray silty clay, little fine to coarse sand, trace fine gravel, few seams of sand.*	106	23
			Int. % Sat.	
			103.6	

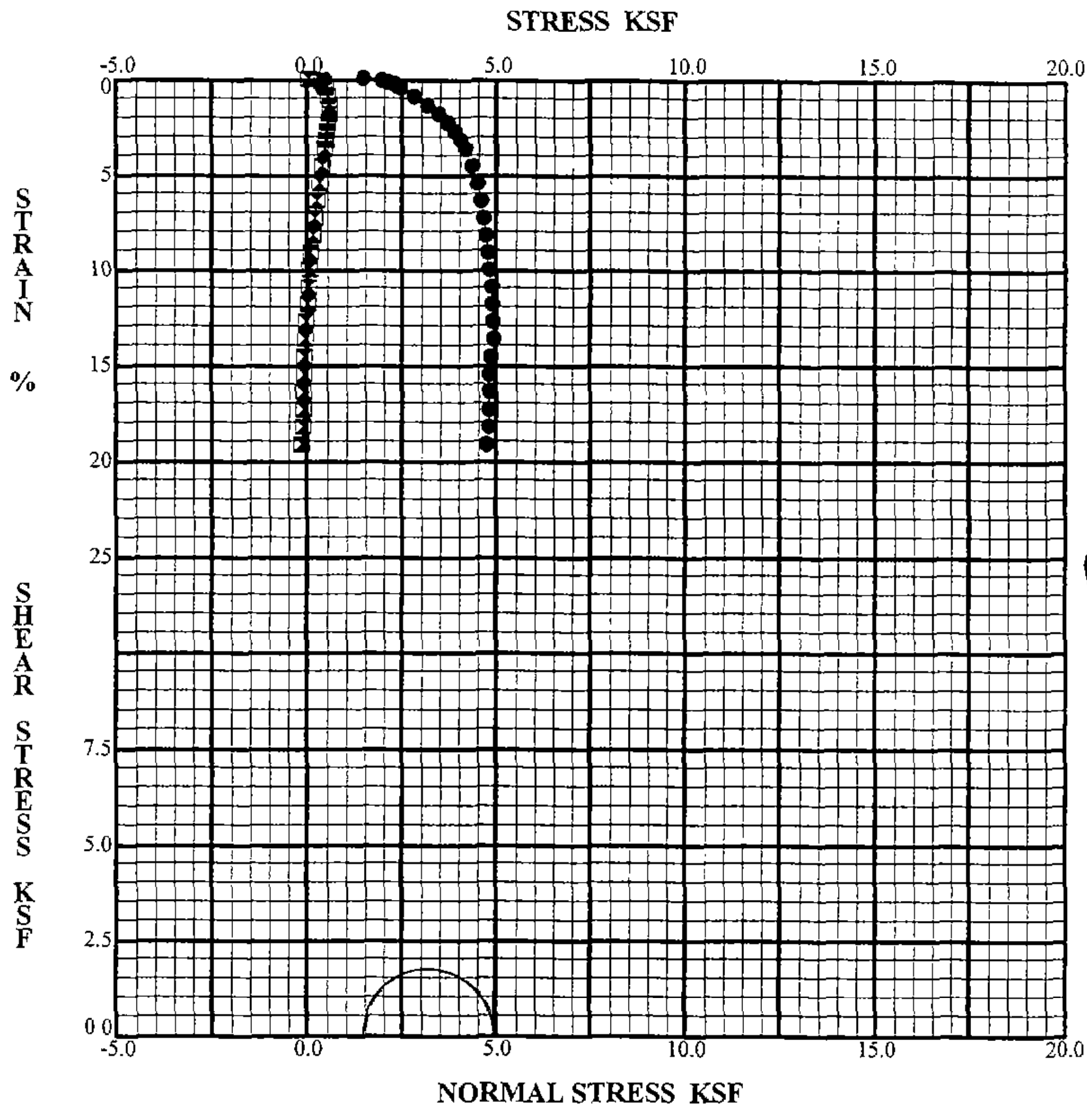
BBC&M ENGINEERING, INC.

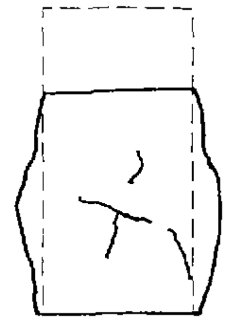
PROJECT GUE-70-14.10
LOCATION Guernsey County, Ohio
JOB NO. 7000.040 DATE 12/18/99

TRIAX01

TRIAXIAL COMPRESSION TESTS

SATURATED, CONSOLIDATED, UNDRAINED
WITH PORE PRESSURE MEASUREMENTS





TOTAL STRESS ——— ● TOTAL VERTICAL STRESS

EFFECTIVE STRESS - - - - ⧗ PORE PRESSURE

	Specimen Identification	Classification	DD	MC%
● ⧗	*B-216 S-7A // 30.0' - 32.0'*	*Stiff gray silty clay, trace fine to medium sand, contains seams of silt.*	98	26
			Int. % Sat.	
			98.4	

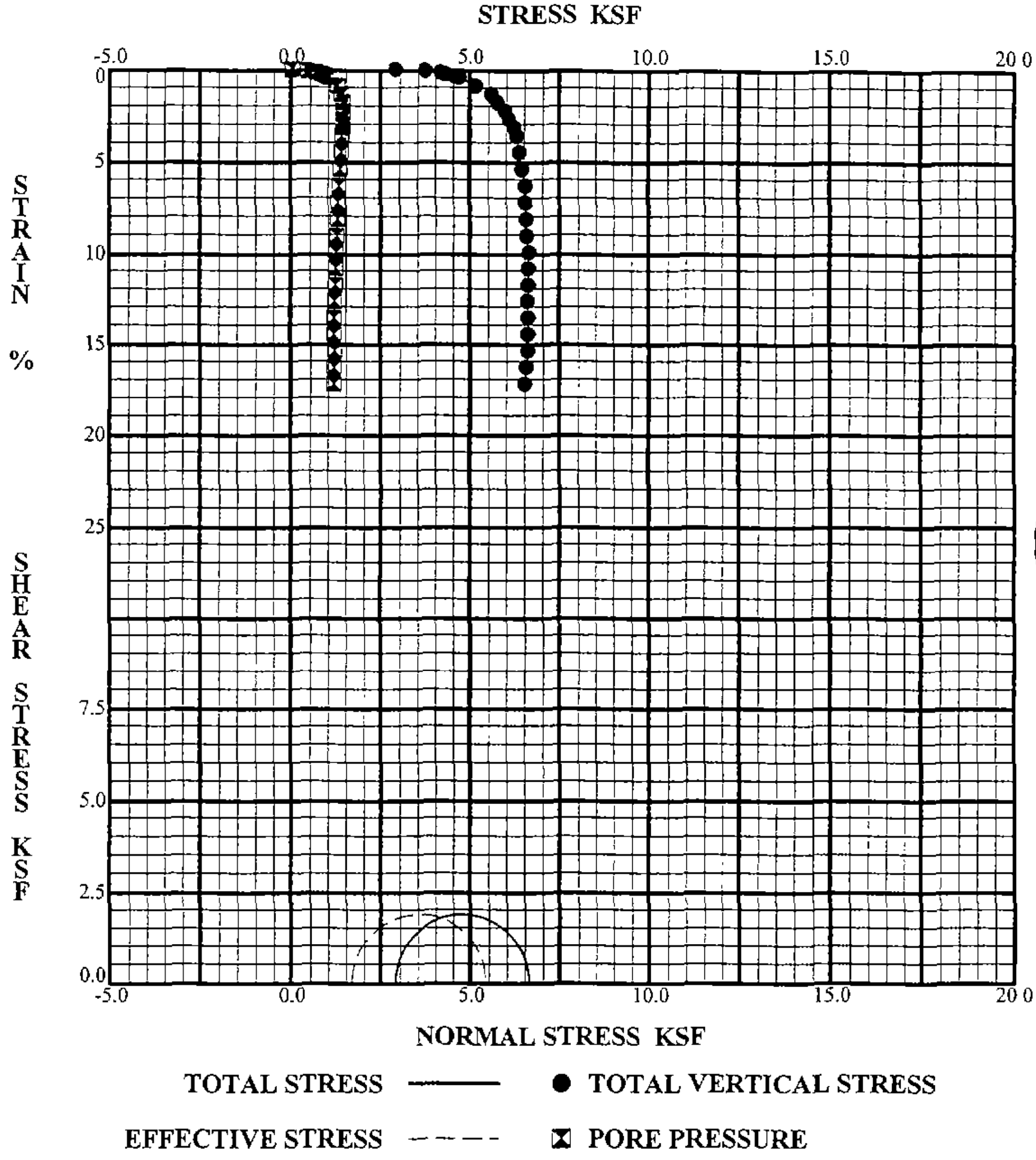
BBC&M ENGINEERING, INC.

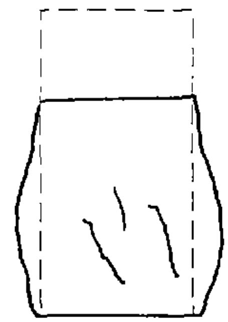
PROJECT	GUE-70-14.10
LOCATION	Guernsey County, Ohio
JOB NO.	7000.040
DATE	12/17/99

TRIAX01

TRIAXIAL COMPRESSION TESTS

SATURATED, CONSOLIDATED, UNDRAINED
WITH PORE PRESSURE MEASUREMENTS





	Specimen Identification	Classification	DD	MC%
● ⌧	*B-216 S-7A III 30.0' - 32.0'*	*Stiff gray silty clay, trace fine to medium sand, contains seams of silt.*	95	29
			Int. % Sat.	
			99.4	

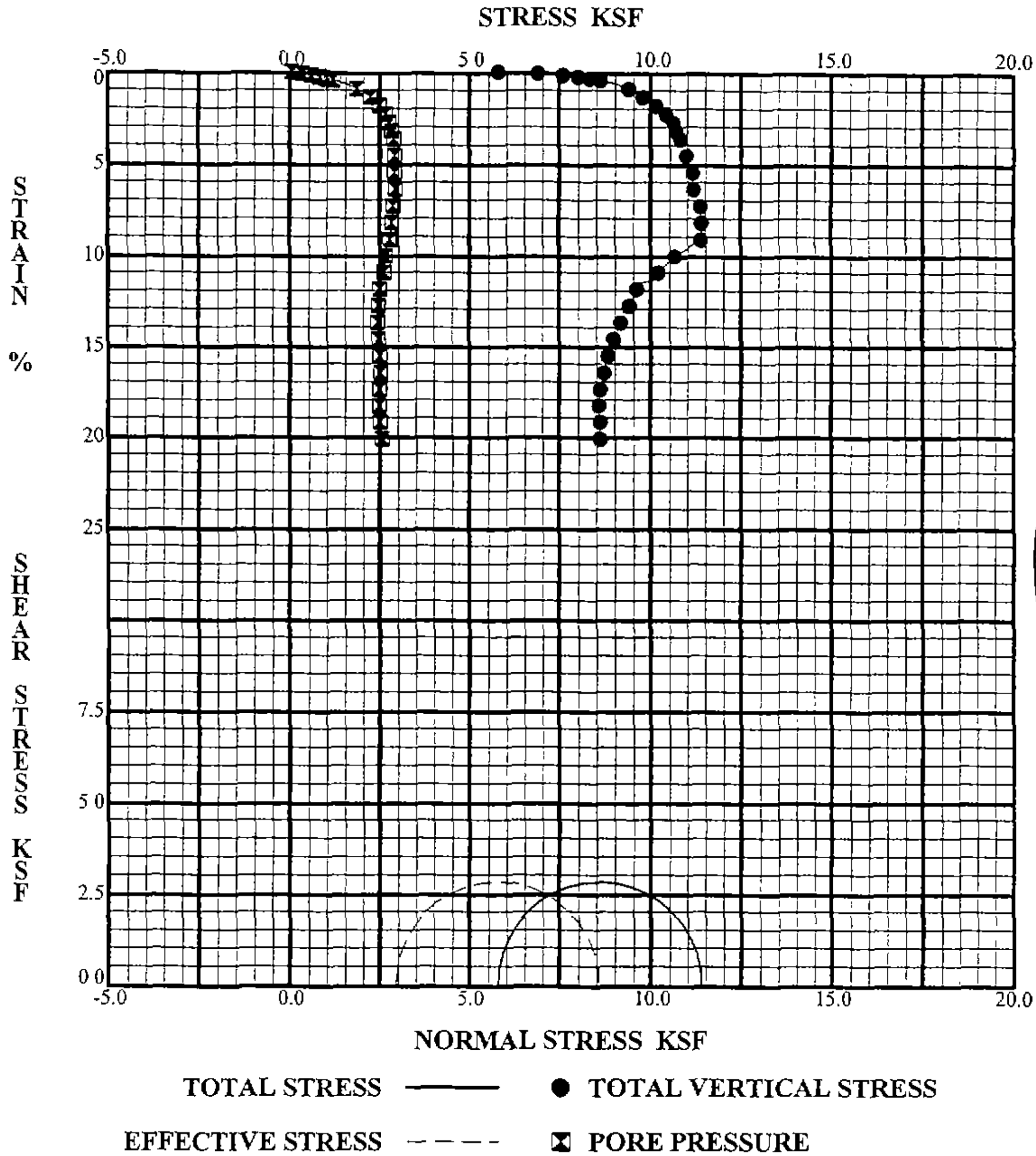
BBC&M ENGINEERING, INC.

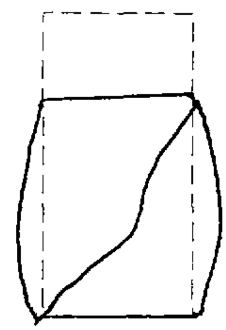
PROJECT	GUE-70-14.10
LOCATION	Guernsey County, Ohio
JOB NO.	7000.040
DATE	12/17/99

TRIAX01

TRIAXIAL COMPRESSION TESTS

SATURATED, CONSOLIDATED, UNDRAINED
WITH PORE PRESSURE MEASUREMENTS





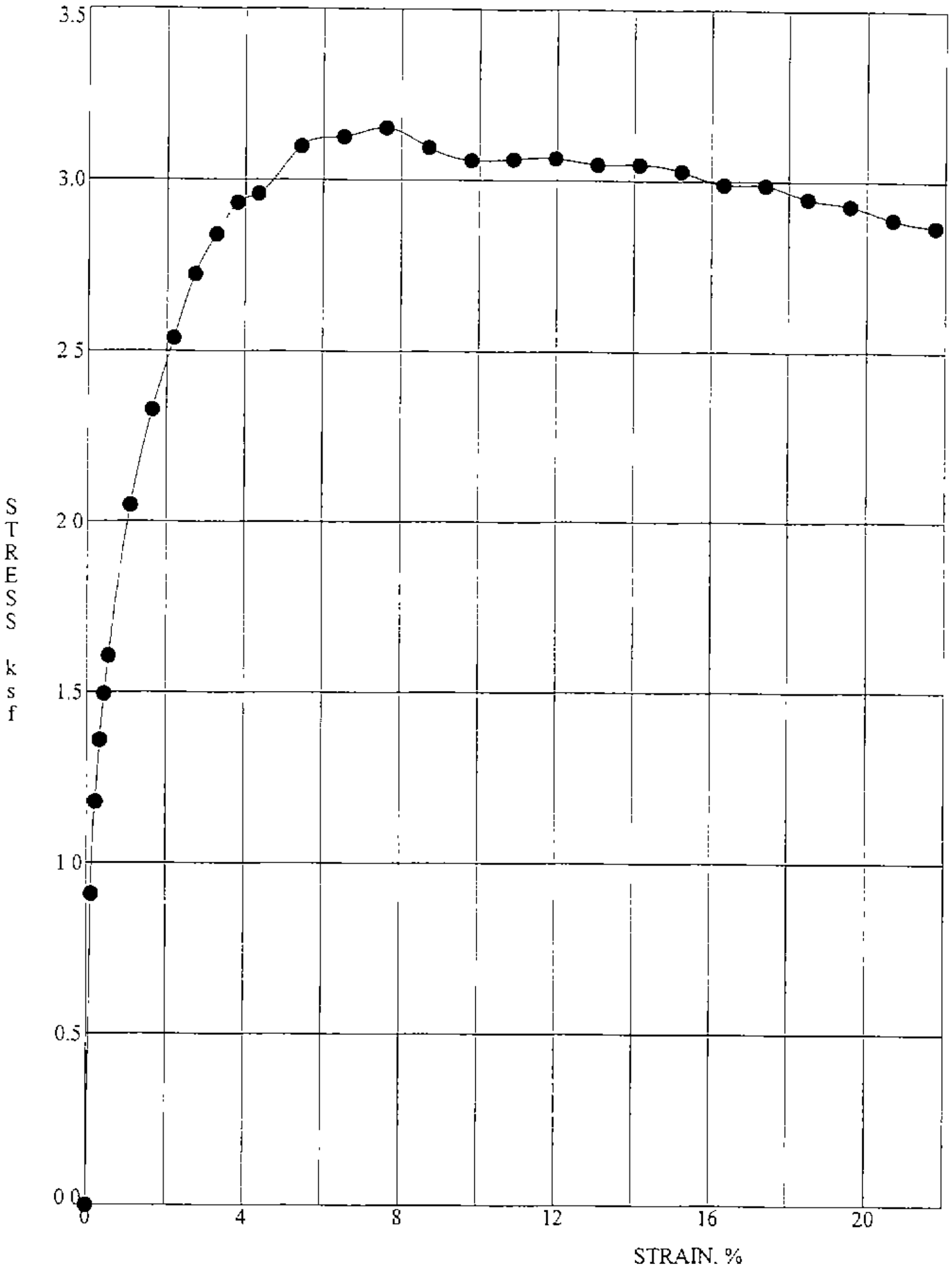
	Specimen Identification	Classification	DD	MC%
● ⧗	*B-216 S-7A IV 30.0' - 32.0'*	*Stiff gray silty clay, trace fine to medium sand, contains seams of silt.*	96	29
			Int. % Sat.	
			102.5	

BBC&M ENGINEERING, INC.

PROJECT GUE-70-14.10
LOCATION Guernsey County, Ohio
JOB NO. 7000.040 DATE 12/17/99

TRIAX01

UNCONFINED COMPRESSION TEST



Maximum Stress

● 3.15 ksf @ 7.61 % Strain

● Sheared along desiccation planes.

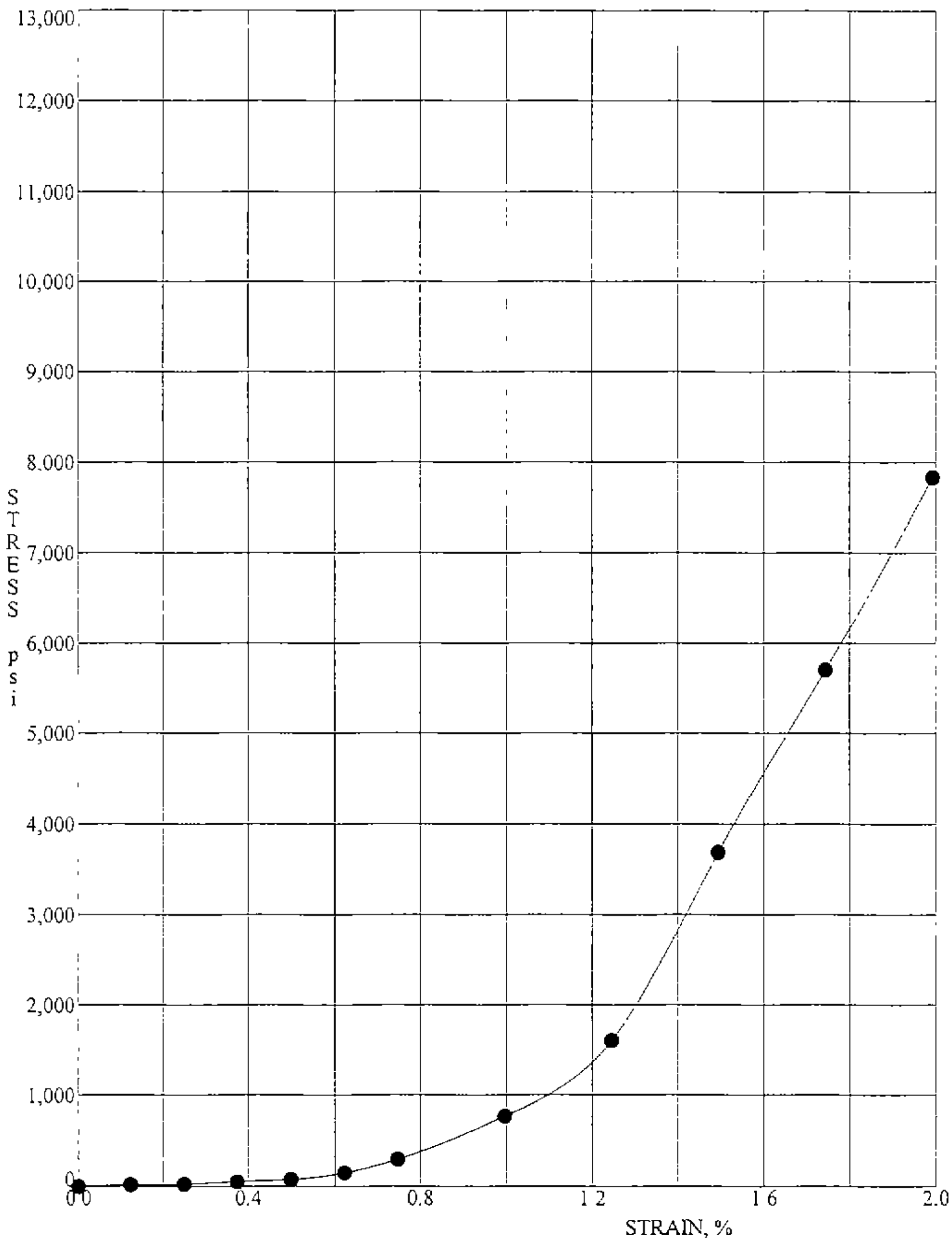
Specimen Identification	Classification	DD	MC%
● B-407I S-5 I 9.5' to 11.7'	Medium-stiff gray mottled with brown and dark-gray organic clayey silt, some fine to medium sand.	92.7	27.6

BBCM

PROJECT GUE-70-14.10
LOCATION GUERNSEY COUNTY, OHIO
JOB NO. 01107000.090 DATE 1/10/03

QUTEST (UNITS = KSF)

UNCONFINED COMPRESSION TEST



Maximum Stress

● 7835.23 psi @ 1.99 % Strain

Specimen Identification	Classification	DD	MC%
● GC-301 S-16 45.5' to 63.5'	Gray shale laminated with fine-grained sandstone.	164.4	0.0

BBCM

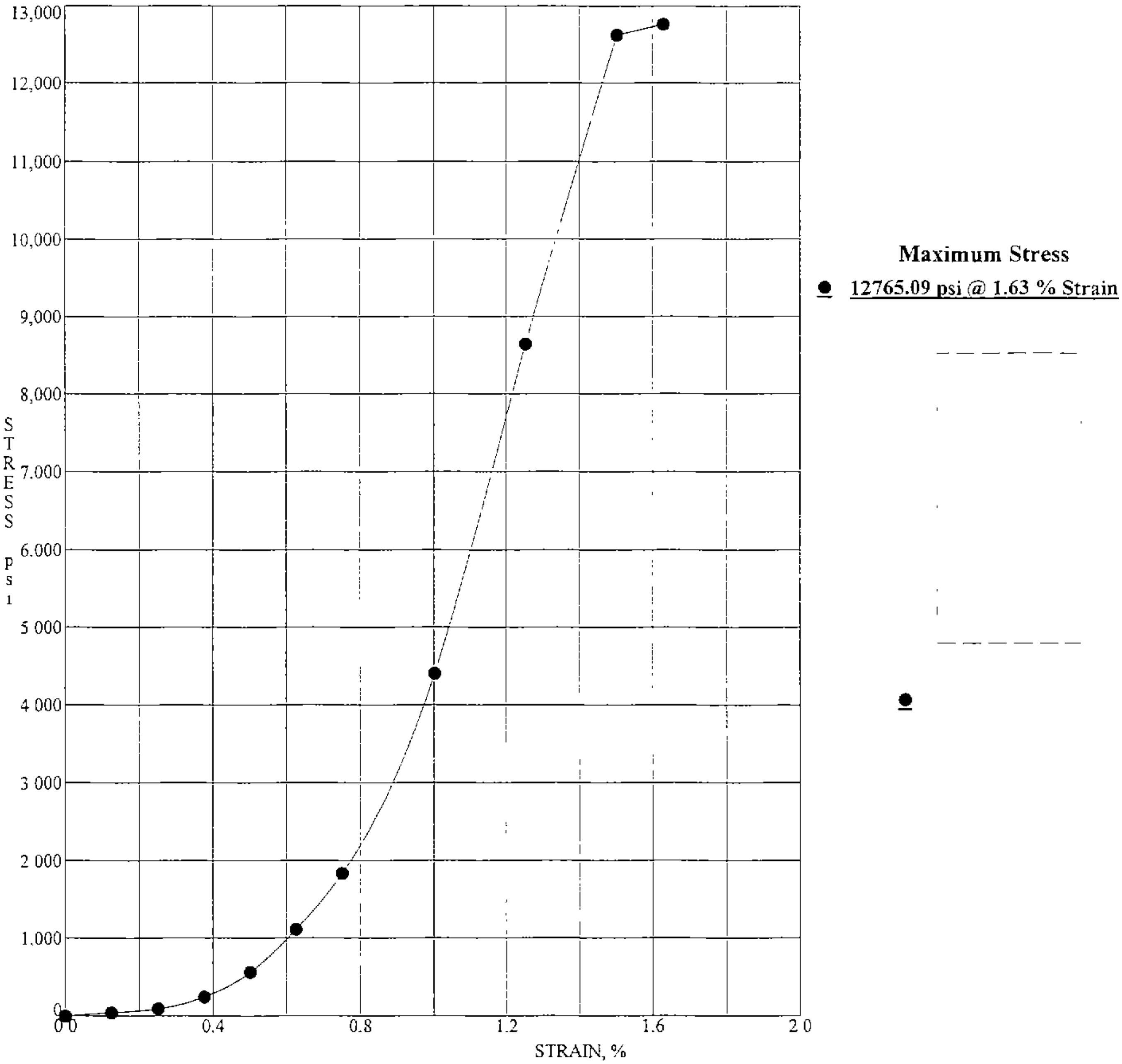
PROJECT GUE-70-14.10

LOCATION GUERNSEY COUNTY, OHIO

JOB NO. 01107000.090 DATE 1/10/03

QU/LIME - ROCK CORE (UNITS = PSI)

UNCONFINED COMPRESSION TEST



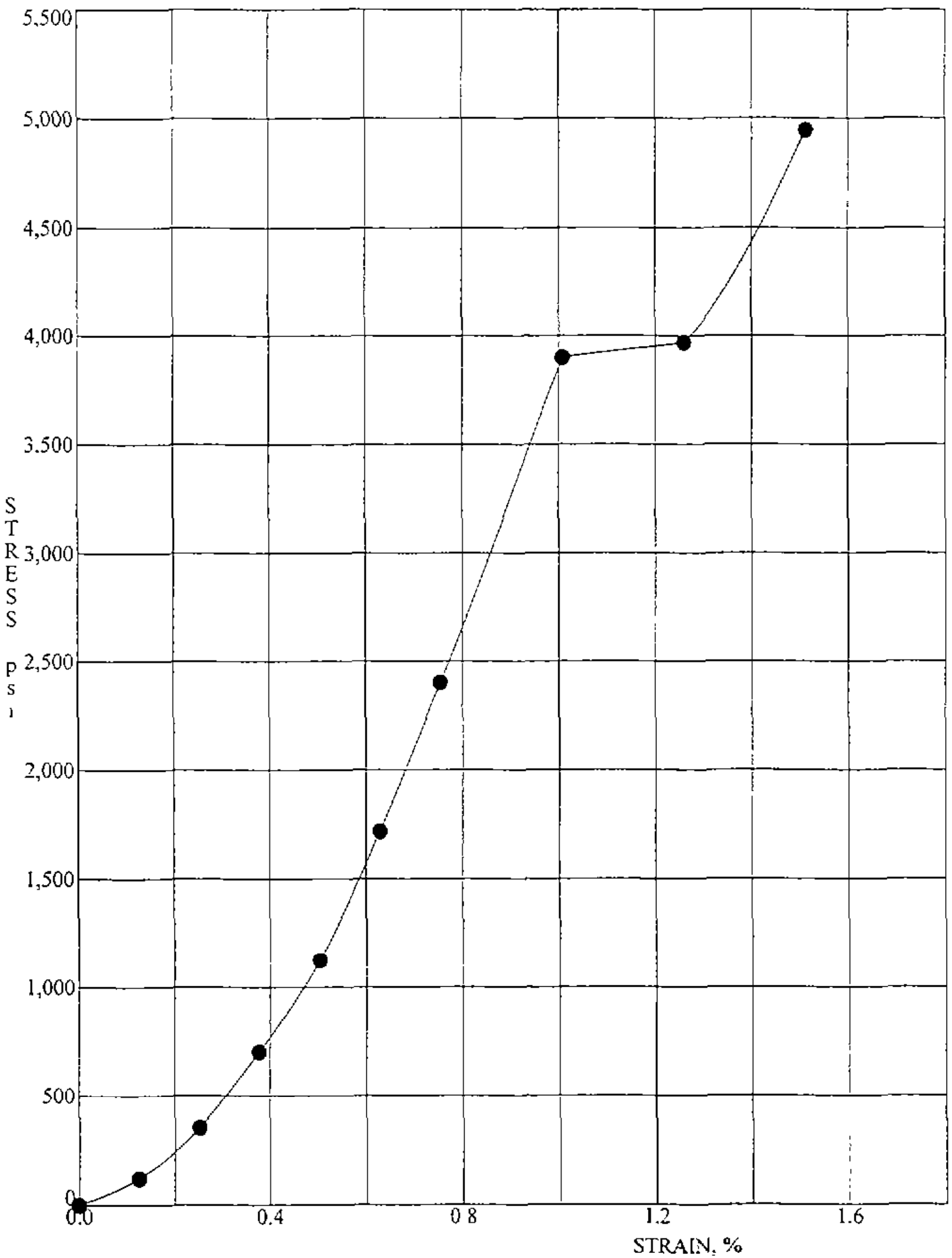
Specimen Identification	Classification	DD	MC%
● GC-301 S-19B 74.0' to 81.0'	Gray sandstone laminated with shale.	167.0	0.0

BBCM

PROJECT: GUE-70-14.10
LOCATION: GUERNSEY COUNTY, OHIO
JOB NO.: 01107000.090 DATE: 1/10/03

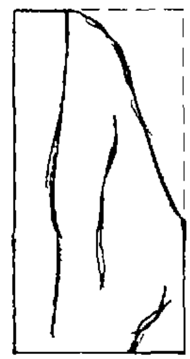
QU/LIME - ROCK CORE (UNITS = PSI)

UNCONFINED COMPRESSION TEST



Maximum Stress

● 4946.28 psi @ 1.51 % Strain



	Specimen Identification	Classification	DD	MC%
●	GC-308 S-20A 73.2' to 73.6'	Gray silt stone.	166.1	0.0

BBCM

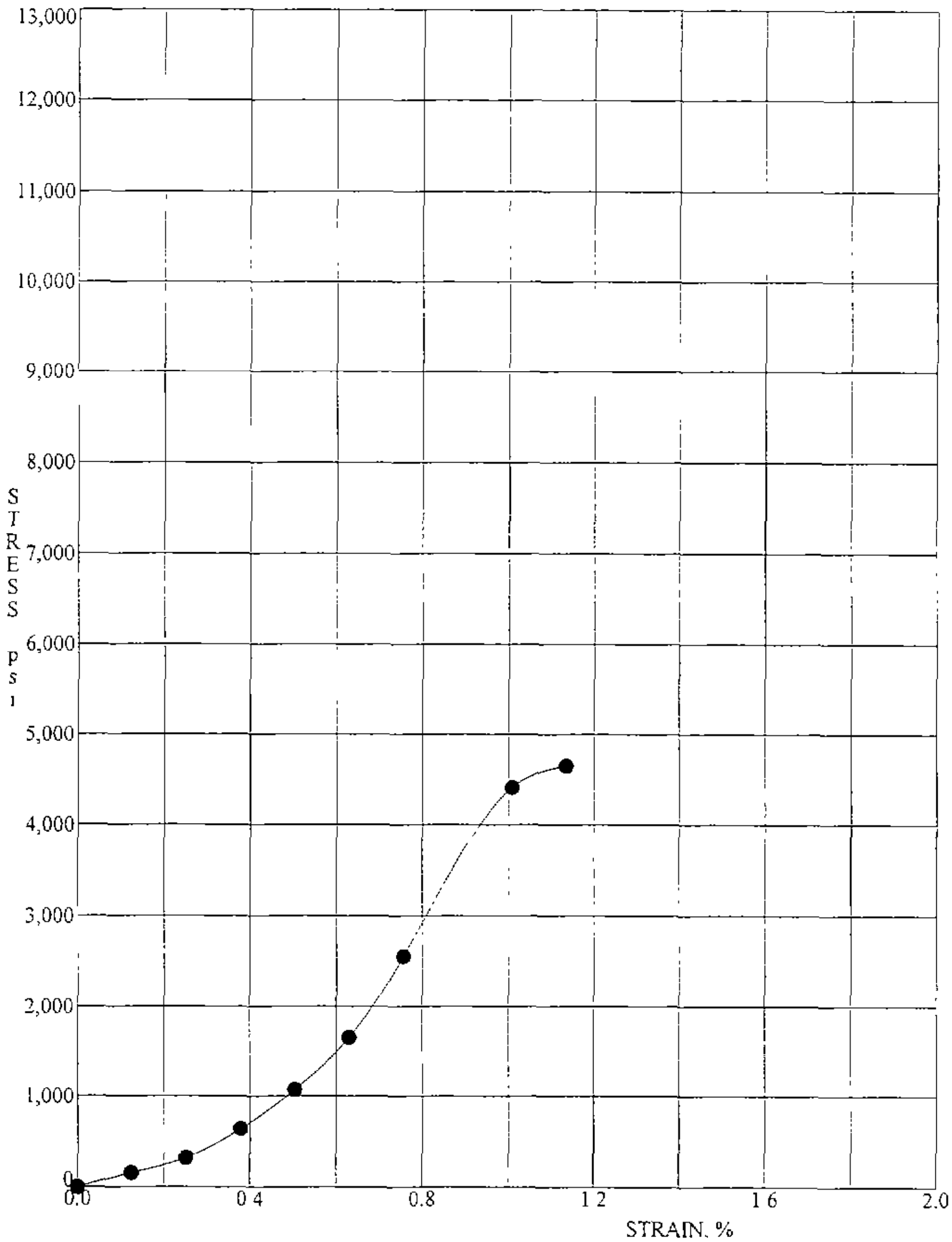
PROJECT GUE-70-14.10

LOCATION GUERNSEY COUNTY, OHIO

JOB NO. 01107000.090 DATE 1/15/03

QU/LIME - ROCK CORE (UNITS = PSI)

UNCONFINED COMPRESSION TEST



Maximum Stress

● 4651.33 psi @ 1.13 % Strain

	Specimen Identification	Classification	DD	MC%
●	GC-306 S-18 59.5' to 66.0'	GROUT - PRODUCTION	124.0	0.0

BBCM

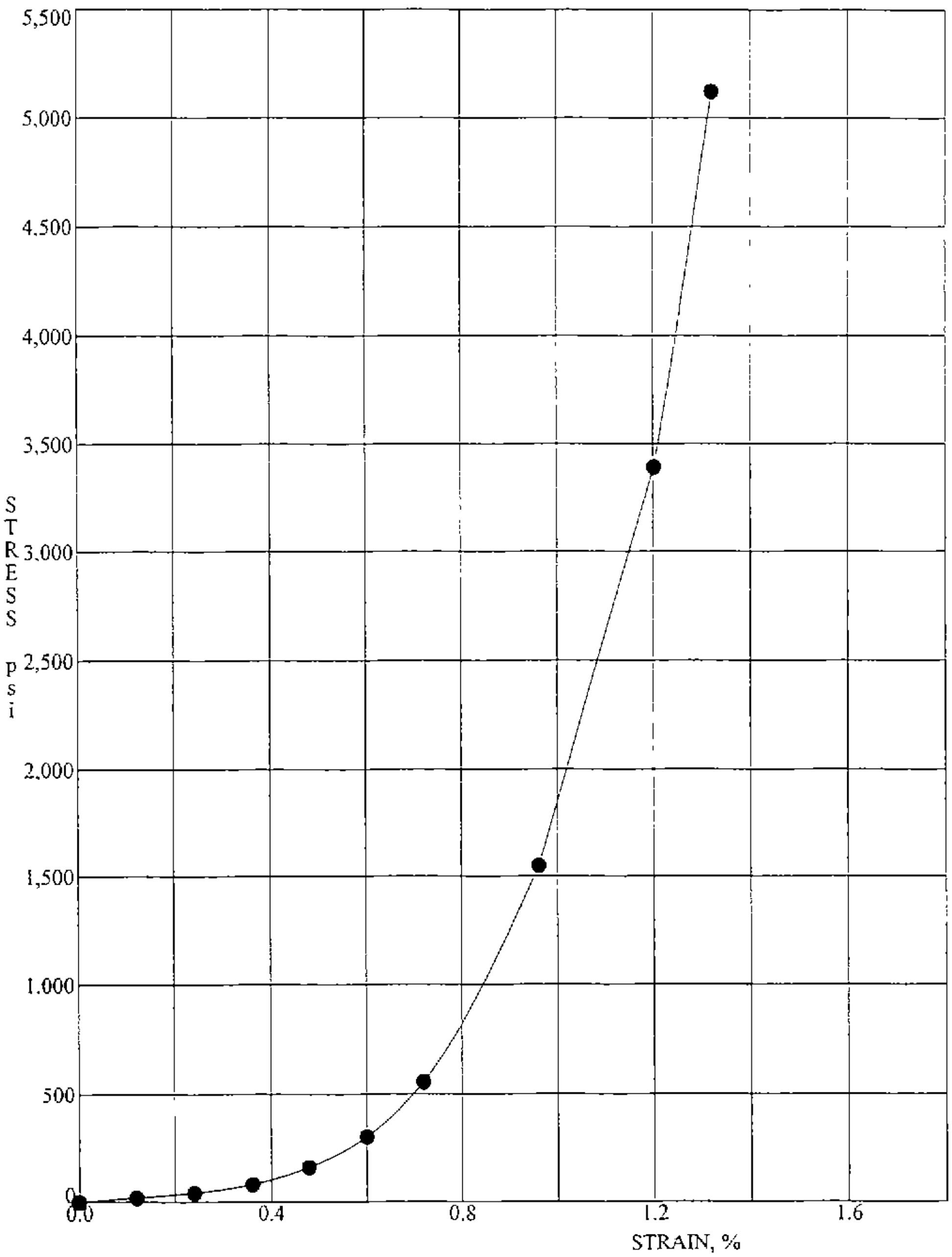
PROJECT GUE-70-14.10

LOCATION GUERNSEY COUNTY, OHIO

JOB NO. 01107000.090 DATE 1/10/03

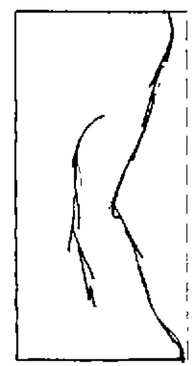
QU.LIME - ROCK CORE (UNITS = PSI)

UNCONFINED COMPRESSION TEST



Maximum Stress

● 5124.02 psi @ 1.32 % Strain



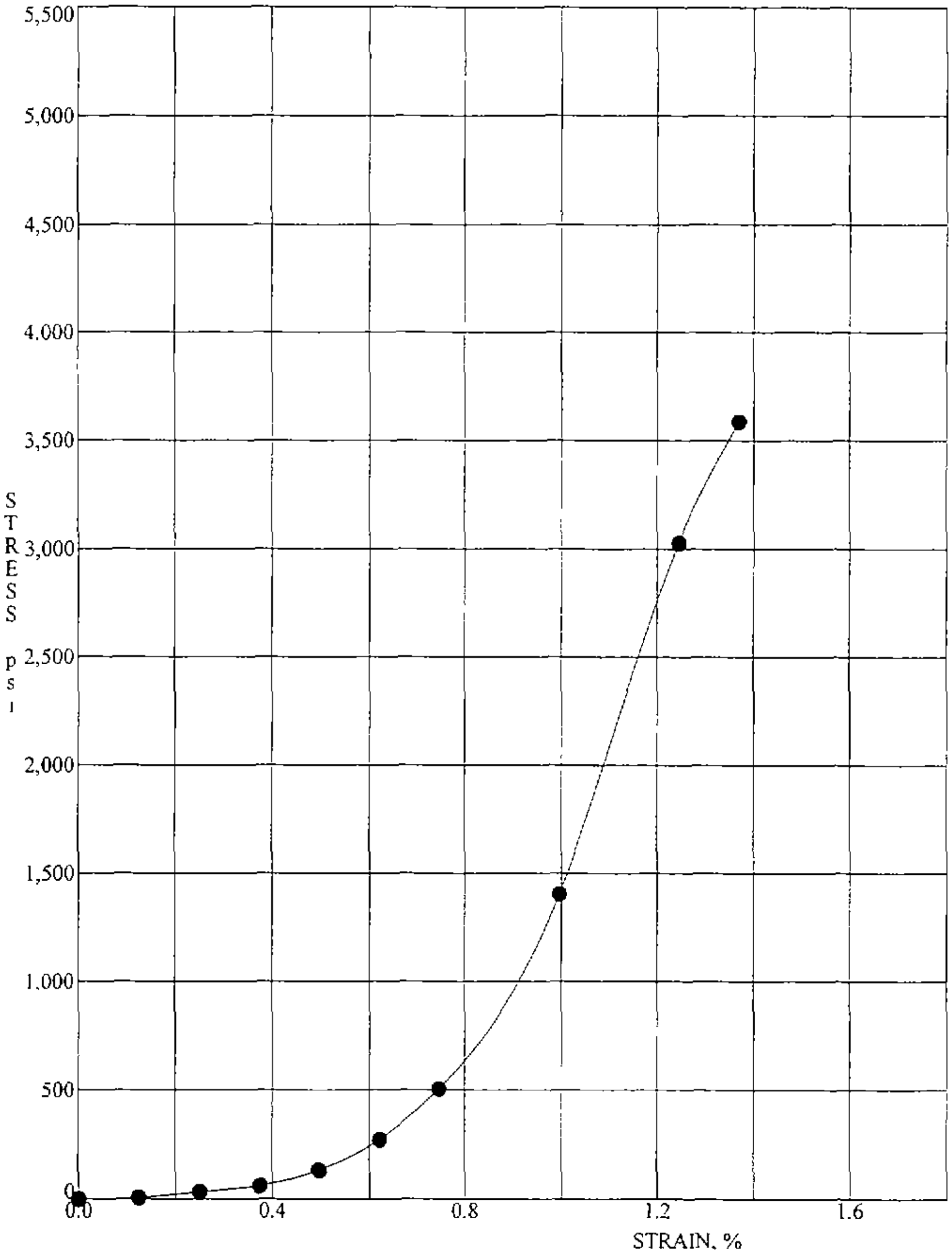
	Specimen Identification	Classification	DD	MC%
●	B-407G S-17 61.7' to 62.1'	Production Grout	125.1	0.0

BBCM

PROJECT GUE-70-14.10
LOCATION GUERNSEY COUNTY, OHIO
JOB NO. 01107000.090 DATE 1/15/03

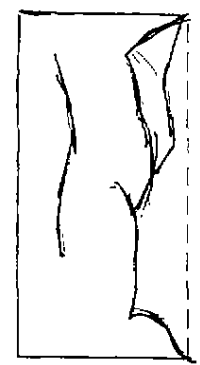
QU/LIME - ROCK CORE (UNITS = PSI)

UNCONFINED COMPRESSION TEST



Maximum Stress

● 3586.61 psi @ 1.37 % Strain



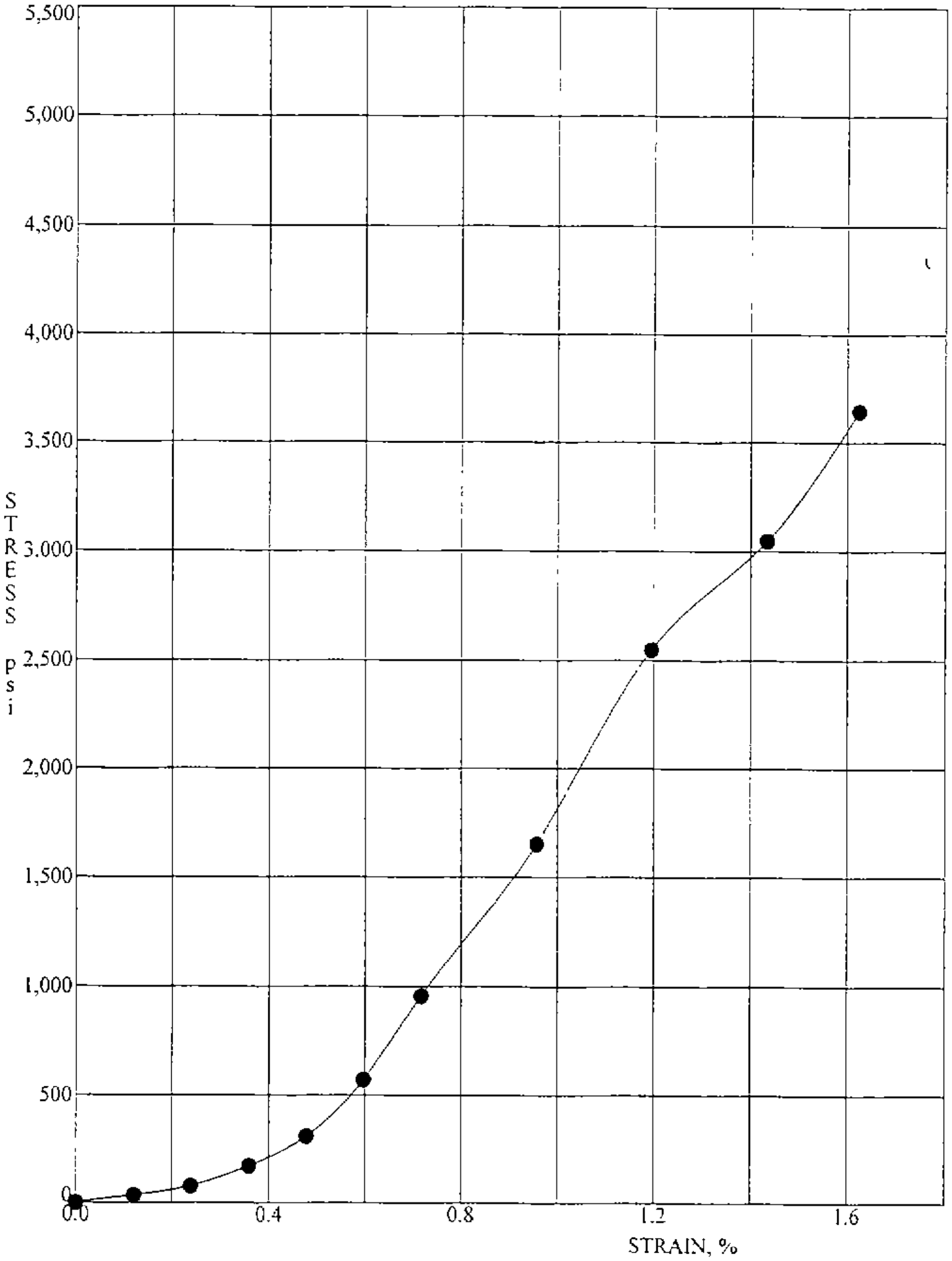
	Specimen Identification	Classification	DD	MC%
●	B-413H S-17 63.6' to 64.4	Barrier Grout	126.7	0.0

BBCM

PROJECT GUE-70-14.10
LOCATION GUERNSEY COUNTY, OHIO
JOB NO. 01107000.090 DATE 1/15/03

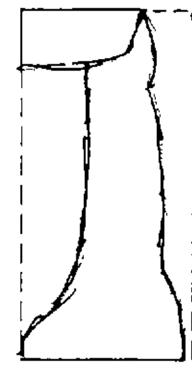
QU/LIME - ROCK CORE (UNITS = PSI)

UNCONFINED COMPRESSION TEST



Maximum Stress

● 3644.27 psi @ 1.63 % Strain



Specimen Identification	Classification	DD	MC%
● B-407G S-17 63.7' to 64.3'	Barrier Grout	132.9	0.0

BBCM

PROJECT GUE-70-14.10

LOCATION GUERNSEY COUNTY, OHIO

JOB NO. 01107000.090 DATE 1/15/03

QU/LIME - ROCK CORE (UNITS = PSI)