

# OHIO DEPARTMENT OF TRANSPORTATION OFFICE OF GEOTECHNICAL ENGINEERING RESEARCH IMPLEMENTATION PLAN

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**Title:** Use of Electrical Resistivity to Detect Underground Mine Voids in Ohio

**State Job Number:** 14709

**PID Number:**

**Research Agency:** USGS

**Researcher(s):** Rodney Sheets

**Technical Liaison(s):** Rick Ruegsegger

**Research Manager:** Karen Pannell

**Sponsor(s):** Tim McDonald, Gene Geiger

**Study Start Date:** 8/1/1998

**Study Completion Date:** 4/30/2002

**Study Duration:** 45 Months

**Study Cost:** \$57,500.00

**Study Funding Type:** 80 Federal / 20 State, ODOT SPR (2)

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## **STATEMENT OF NEED:**

This project was a natural extension of the 1996-1997 void detection work completed by the USGS for ODOT. This earlier project was entitled "Detection of Underground Mine Voids in Ohio by Use of Geophysical Methods" and was published as U. S. Geological Survey (USGS) Water-Resources Investigations Report # 97-4221. This report discussed several possible geophysical techniques that might be successful at detecting mine voids. The only geophysical technique tested during this earlier research project was ground penetrating radar. The report indicated that the likelihood of detecting variations in electrical resistivity due to the presence of abandoned underground mine voids was sufficient to warrant further investigation.

The approach for the current research project reflects the proposed completion of the investigation of electrical resistivity measurements for this purpose. This proposed research approach would benefit the Office of Geotechnical Engineering as a continuation of research related to finding effective methods for identifying and evaluating roadway locations where abandoned underground mines exist.

## **RESEARCH OBJECTIVES:**

- determine the applicability of electrical resistivity to detect underground mine voids or related structures beneath state roadways in the coal-bearing strata of eastern Ohio.
- determine the capabilities of electrical resistivity to differentiate between air-filled and water-filled mine voids will also be examined.

## **RESEARCH TASKS:**

Tasks for this research include:

- literature reviews to determine a suite of electrical resistivity arrays to be used in a field setting.
- selection of two state roadway sites to test the chosen electrical resistivity arrays.
- determine array(s) that are effective at detecting mine-related subsurface voids.
- determine of limits of applicability of this form of testing in roadway testing settings.
- Determine electrical resistivity's capability to detect the presence of water in mine-related subsurface voids.

### **RESEARCH DELIVERABLES:**

The final report describing methods used and results obtained was published as USGS Water-Resources Investigations Report 02-4041, March 2002.

### **RESEARCH RECOMMENDATIONS:**

Resistivity should be strongly considered when determining the possible use of geophysical methods to determine the existence and extent of abandoned underground mine voids beneath state roadways.

### **PROJECT PANEL COMMENTS:**

- The research effort achieved the primary goal of demonstrating the applicability of electrical resistivity for detecting abandoned underground mine voids beneath state roadways.
- The 1998 resistivity testing performed by this project at JAC-35-18.65 provided very valuable subsurface imaging of unmapped underground mine voids. This information was utilized to direct drilling operations to mine void locations. The resulting JAC-32-18.65 Emergency Mine Remediation Project was immediately constructed in 1998-1999.
- The USGS provided \$30,000 in co-funding for this research, which reduced the project funding required from ODOT from \$87,500 down to \$57,500.

### **IMPLEMENTATION STEPS & TIME FRAME:**

- an ongoing effort to encourage District Geotechnical Engineers, District AUMIRA Coordinators, staff of the Office of Geotechnical Engineering and geotechnical consultants to consider using resistivity testing as a means to locate mine voids beneath state roadways.

### **EXPECTED BENEFITS:**

- increased public safety through the detection of unmapped, or previously unlocated mine voids.
- decreased subsurface drilling costs by using resistivity imagery to detect mine workings

### **EXPECTED RISKS, OBSTACLES, & STRATEGIES TO OVERCOME THEM:**

The primary obstacle will be to convince ODOT staff to invest time and money in Resistivity testing when they have had little, or no, previous experience with this form of subsurface testing.

### **OTHER ODOT OFFICES AFFECTED BY THE CHANGE:**

Other possible ODOT applications for this successful research would be for locating buried drainage structures and/or determining the location and extent of buried structural foundations

### **PROGRESS REPORTING & TIME FRAME:**

Since the completion of this research, several ODOT roadway projects have utilized resistivity testing to determine subsurface conditions related to underground mines. These projects have included:

- 1) WAY-241-2.92 (2001)
- 2) STA-77-3.69 (2002)
- 3) TUS-250-23.25 (2005)

### **TECHNOLOGY TRANSFER METHODS TO BE USED:**

Distribute copies of Final Report to District Geotechnical Engineers, District AUMIRA Coordinators, staff of the Office of Geotechnical Engineering and geotechnical consultants

**IMPLEMENTATION COST & SOURCE OF FUNDING:**

No implementation cost required.

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**Approved By:** (attached additional sheets if necessary)

Office Administrator(s):

Signature: Gene Geiger Office: OGE Date: 9/21/2005

Division Deputy Director(s):

Signature: Tim McDonald Division: PM Date: 9/22/2005