Phase 2 – GASB Statement 34 Compliance:
Development of a Fixed Asset (Infrastructure)

For the
Alabama Department of Transportation

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16. Abstract

The Alabama Department of Transportation (ALDOT) Bureau of Materials and Tests has been working with the University of Alabama's Management Information Systems Department to provide a tool for road maintenance and optimization associated funding. Specifically, ALDOT required an operational tool to:

- capture raw data collected by state road inspectors and RoadWare Inc. (a private firm)
- manage the verification and validation of the data, and
- accurately conduct analysis and reporting on this data.

In 2001 the Governmental Accounting Standards Board (GASB) issued a mandate that required each state to report its roadway conditions annually. Initially, the reporting was the main focus of this research project; however, The University of Alabama was able to create a more robust Pavement Management System that was more than a simple reporting methodology. Upon implementation, the system (named HYDRA+) will make ALDOT compliant with GASB reporting requirements. It will also provide operational reporting capabilities such as producing Preliminary Pavement Rating (PPR) reports, friction reports, and extensive ad hoc reports. The system can provide the data in a geographic format that can be mapped.

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Executive Summary

The Alabama Department of Transportation (ALDOT) Materials and Testing Bureau worked with the University of Alabama's Management Information Systems Department to provide a tool for road maintenance and optimization associated funding. Specifically, ALDOT desired an operational tool to:

- Capture raw data collected by state road inspectors and RoadWare Inc. (a private firm)
- Manage the verification and validation of the data, and
- Accurately conduct analysis and reporting on this data.

In 2001 the Governmental Accounting Standards Board (GASB) issued a mandate that required each state to report its roadway conditions annually. Initially, the reporting was the main focus of this research project; however, The University of Alabama (UA) was able to create a more robust Pavement Management System that was more than a simple reporting methodology. Upon implementation, the system (named HYDRA+) will make ALDOT compliant with GASB reporting requirements. It will also provide operational reporting capabilities such as Preliminary Pavement Rating (PPR) reports, friction reports, and extensive ad hoc reports. The system will provide geographic data that can be mapped.

Purpose

The UA team had four clear objectives for this project:

- Allow ALDOT to create the annual accounting report according to GASB standards
- Create and install a clean data warehouse containing all historical and current data collected on the state's roadways
- Provide state officials with graphical displays of state road conditions using GIS data linked to roadway data
- Begin preliminary analysis of Bridge Maintenance System software (separate from the HYDRA+ system)

Over the course of the project, the UA team elected to add features so that all future data loaded into the HYDRA+ database will go through a series of validation procedures to ensure data integrity throughout the system. The system has an administration interface in a wizard format for ease of use. Finally, knowledgeable users will be able to create both standard and on-demand reports using pre-generated report templates and Crystal Reports software, all through the same interface.

Conduct of the Project

In January 2002 the MIS team began initial analysis of current systems available at ALDOT and mapped the requirements of the HYDRA+ system. Through the summer of 2002 work

continued to refine the requirements and to clean historical data dating back to 1984. During the Fall of 2002 the project team began construction and implementation of the system.

The project followed a traditional waterfall systems development process. The process included six phases: survey, study, definition, design, construction, and integration. Upon completion of unit integration, the application was evaluated (through user acceptance testing by ALDOT staff).

The UA team included faculty members, graduate students, and undergraduates. Over the 16 months of this project, the team devoted an enormous level of effort (a total of 13,586 hours) to ensure project success.

Spring 2002:	3,150 hours
Summer 2002:	2,000 hours
Fall 2002:	4,916 hours
Spring 2003:	3,520 hours
	13,586 hours

Most of this time was not budgeted, and consisted of donated faculty time, and class exercises and laboratories devoted to the work steps of this project. The University considered the student time to be well spent from the educational standpoint, and from the service to ALDOT standpoint.

Section 1.0
Project Background

The Alabama Department of Transportation (ALDOT) faces critical challenges as it moves forward into the 21st century. ALDOT needs management tools and systems refinement to meet these challenges and to continue to effectively build and maintain the state's transportation system. Some of these challenges are reviewed in this section, along with some of ALDOT's current software tools that might be incorporated as part of an improved future management system.

Aging Transportation Systems

For most of the 20th Century the United States focused its transportation system efforts on construction of new highways and interstates. The early 1900's saw the initiation of a national highway system. In the 1950's the United States began the development of the Interstate Highway System that was completed in the early 1990's. As a result, there is a shift from new construction to an emphasis on maintenance, management, and reconstruction of existing infrastructure. The shift is one of the drivers causing many transportation organizations to seek improvement in their planning processes and ALDOT is no exception.

Aging Workforce and Personnel Constraints

Some states have lost significant numbers of staff in recent years as a result of government reinvention and accompanying downsizing and outsourcing. The trend is likely to continue. Furthermore, ALDOT is particularly vulnerable in that many of their most experienced employees are nearing retirement age and the organization has been unable to adequately prepare personnel to replace that outgoing experience and expertise.

Constrained Funding

Budget pressures are arising from constraints on the availability of funds. This pressure is compounded by the fact that the demands on the transportation system are increasing. As a result ALDOT is being asked to do more with less. Therefore, ALDOT would like to utilize tools that will articulate the trade-offs between alternative investment strategies.

GASB 34

The establishment of Governmental Accounting Standards Board Policy 34 (GASB 34) requires ALDOT to set infrastructure preservation levels associated with alternative condition targets, and estimate the spending levels necessary to achieve those targets. This information will provide a basis from which to establish attainable condition goals.

Comprehensive Project Management System

With the implementation of ALDOT's Comprehensive Project Management System (CPMS), extensive project and financial information become available. It can be leveraged for use by other tools designed to assist ALDOT in the planning process and to improve communication with stakeholders.

GIS

Geographic Information System (GIS) software is no longer a leading edge technology. It is being utilized by a variety of industries, and has become readily available in the market place. GIS has a number of potential uses and would be helpful both as a planning tool and a communication tool.

Continuing Effort

This is the second in a series of projects that The University of Alabama (UA) is conducting for ALDOT, to create and initialize an asset management system. UTCA project 01459 – "GASB Statement 34 Compliance: Development of a Fixed Asset (Infrastructure) MIS – Phase 1" began that effort, and it is anticipated that a total of six to ten projects will be needed to complete the effort. The envisioned end product will be a comprehensive management tool that assembles, stores, transforms, reports, and visualizes data to assist decision makers in planning optimal strategies for Alabama's road and bridge infrastructure. The system will be fully compliant with GSP 34 requirements.

Section 2.0
Project Value

Project Goals

The goal of this system is to enable ALDOT to meet federal reporting standards by generating an annual GASB 34 report. Ultimately, the vision for the HYDRA+ system is to provide the department the capability to use the system for future resource allocation and funding purposes. The following list briefly describes the specific goals of HYDRA +:

- Meet GASB 34 reporting requirements
- Save time and money by reducing time spent on data entry and other clerical tasks
- Improve Materials and Testing Bureau management efficiency by ensuring that valid data are entered and saved in the application database on an annual basis

    - Generating additional standard summary reports
    - Generating ad hoc reports
    - Use GIS to generating graphic thematics of most summary report information

Scope

To meet these goals, The HYDRA + system was developed to capture incoming data from each ALDOT Division, and to output relevant and necessary reports based upon this data on multiple levels of abstraction, for example by:

- route
- county
- Division
- political district, and
- statewide.

Section 3.0
Development Process

The Goals and Objectives for the system were defined in previous research, UTCA project 01459, introduced in Section 1.0 of this report. The current project commenced in the spring of 2002 by refining the user requirements developed during Phase 1 into a set of detailed system requirements. Next these requirements were transformed into system specifications during the summer of 2002. Through the use of mockups and prototypes, client feedback was obtained and design revisions were made during the early fall of 2002. Concurrently the team researched the integration requirements necessary to implement the new system, as well as the associated applications tiered architecture.

Continuing the efforts from the summer of 2002, historical ALDOT data was cleaned and loaded into the database. Once the HYDRA+ software components were in production, the client approved an Administrator Interface. At this point a test environment was created which mirrored ALDOT's work environment as closely as possible.

The next step was unit testing and integration testing. Each unit team submitted commented code and associated documentation, including necessary inputs and appropriate outputs. As code was submitted, the software quality assurance team created test cases, ran various tests, and submitted feedback to the development team.

The final phase of the project began in mid-December when the database was installed, loaded and tested on-site. The visualization component of the system was delivered immediately following this step, and the UA team provided training to ALDOT personnel.

In the spring of 2003, development of system utilities began, including incorporating a security and user role module into the system. At this point, the UA team conducted user training on the Crystal Reports functionality of the reporting module.

As the project progressed, integration testing identified several key issues, including knowledge transfer of the commit process, data cleansing, and algorithm accuracy. Client interaction was significantly increased to resolve these process, data, and algorithm issues. True end-to-end system testing began. Following successful testing, the system HYDRA+ Version 1 was delivered on May 5, 2003.

An effort of this size obviously required a substantial commitment on the part of the UA team, and a clear administrative organization. This is reflected in the detailed listing of sub-team staff assignments presented in the Appendix.

Section 4.0
Application Modules

The process flow diagram (Figure 4-1) on the following page displays how the modules interact within the system. The modules are numbered for the convenience of the reader of this report.

- When a change has been made to the form of certain database tables, the Update Table Process (module 1.0) allows the user to make the changes and save it to the database.

- When traffic and condition data have been collected from the divisions, the Auto Load Process (module 2.0) will automatically load the files into the database.

- When overlay and friction data has been collected from ALDOT Divisions, the Manual Load Process (module 3.0) provides an interface for manually loading the data. HYDRA Admin interface, error, and transaction logs will be produced.

- Next, the inputted data goes through a series of validation procedures in the Validate Records Process (module 4.0).

- Once validation has been completed and records have been entered for the Divisions, all data will be committed to the database in the Commit Table process (5.0).

- At this point, standardized reports such as GASB 34 will be automatically produced in the Generate Reports Process (module 6.0).

- Finally, through the user interface the user will have the option to retrieve and create ad hoc reports and maps in the Retrieve Report Process (module 7.0).

- The Visualization component is captured within Process 7.0, Retrieve Report.

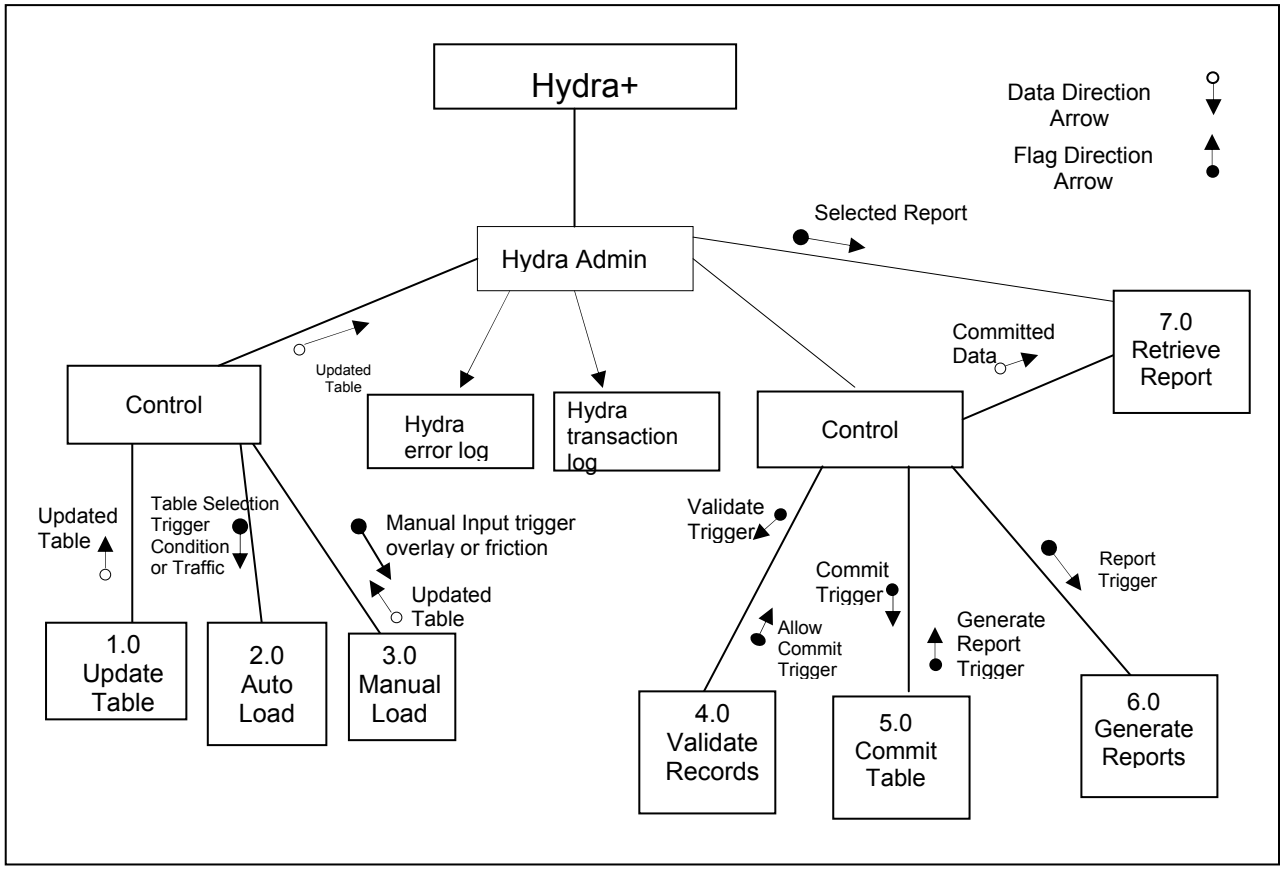

Figure 4-1 "Hydra +" process flow diagram

Section 5.0
HYDRA + Deliverables

This section of the report listed the deliverables developed during the research project. The narrative is in outline style, and more details may be acquired by contacting the report authors.

1) The installed HYDRA+ Version 1 can be used to for the following functions:

    - Update tables that change over time
    - Input a wide range of data:
        1. Condition Data
        2. Friction Data
        3. Overlay Data
        4. Traffic Data
    - Ensure that inputted data is valid and within range for the system
    - Store all data in an Oracle data warehouse for historical archiving, and for developing the following reports:
        1. GASB
        2. Preliminary Priority Report
        3. Friction
        4. Ad Hoc
    - Allow current reporting for Friction data as it is input into the system, prior to permanent storage
    - Create map thematics, graphs, and charts to visually display road conditions for the following categories:
        1. County
        2. Road
        3. District
        4. State
        5. Type of Road (State, National Highway, Non-national Highway)

2) Installation of Oracle HYDRA+ Database

3) Installation and training on GeoMedia for visualization mapping functionality; this included providing training materials

4) User's Manual

5) Developer's Manual

Section 6.0
HYDRA + Admin Interface

This portion of the report introduces administrative interfaces for data input and reporting. Typical data input screens are shown as Figures 6-1 through 6-5. Typical reporting screens are shown as Figures 6-6 thorough 6-10.

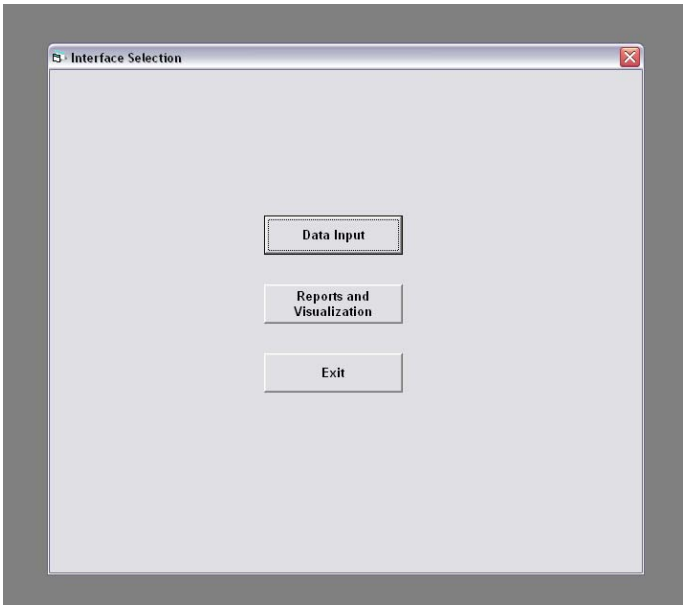

Figure 6-1 Interface screen for data input

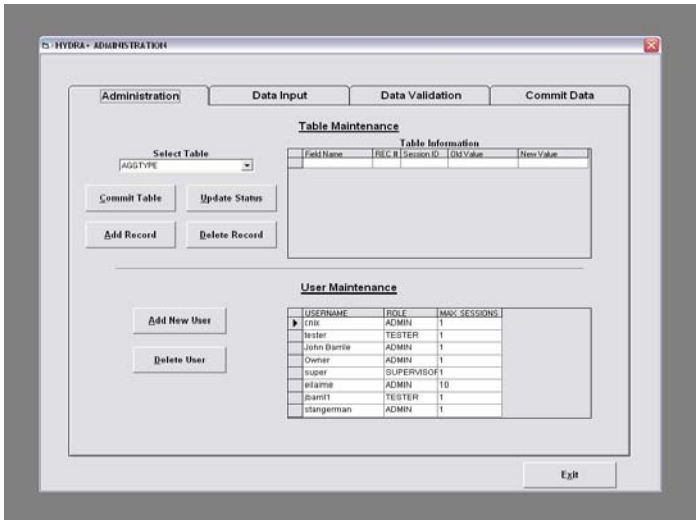

Figure 6-2 Data input "administration" screen

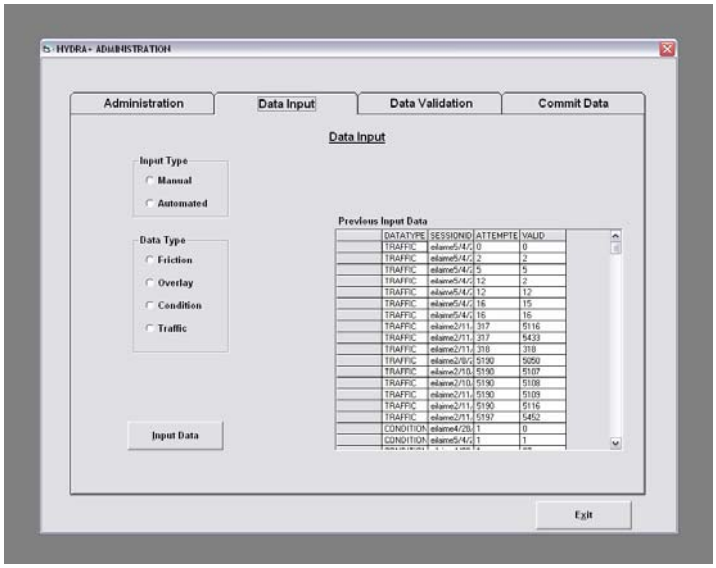

Figure 6-3 Data input "previous data" screen

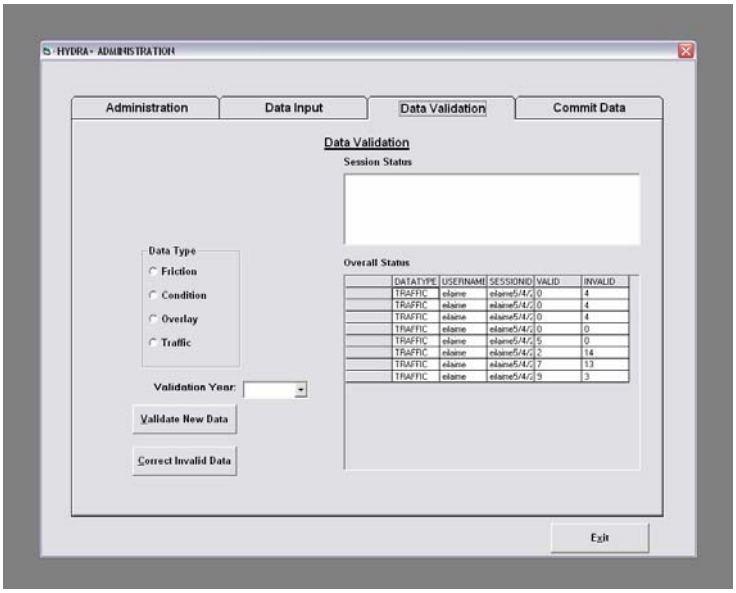

Figure 6-4 Data input "validation" screen

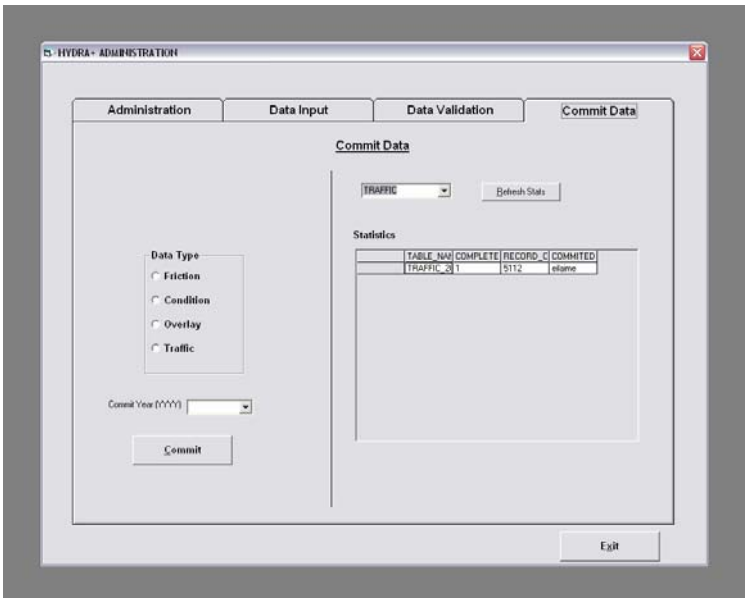

Figure 6-5 Data input "commit data" screen

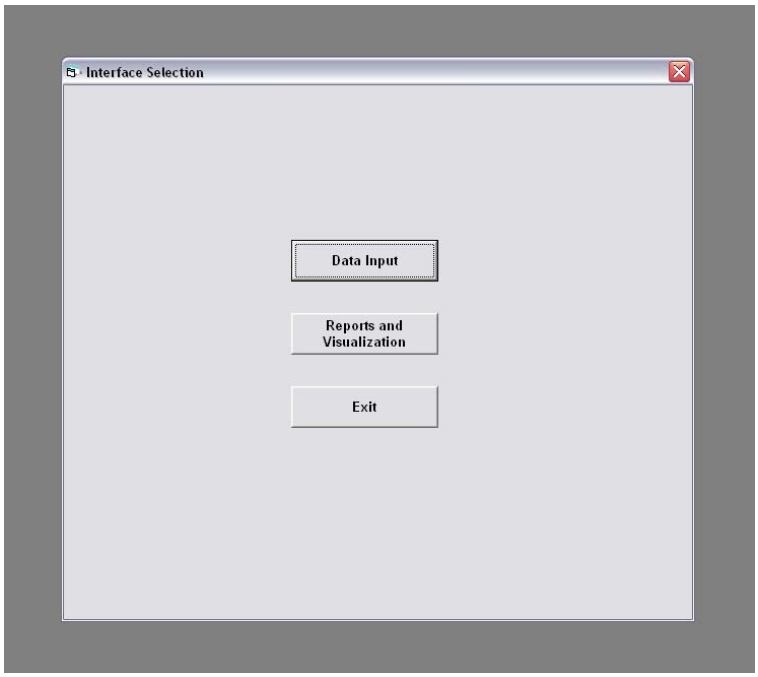

Figure 6-6 Interface screen for report generation

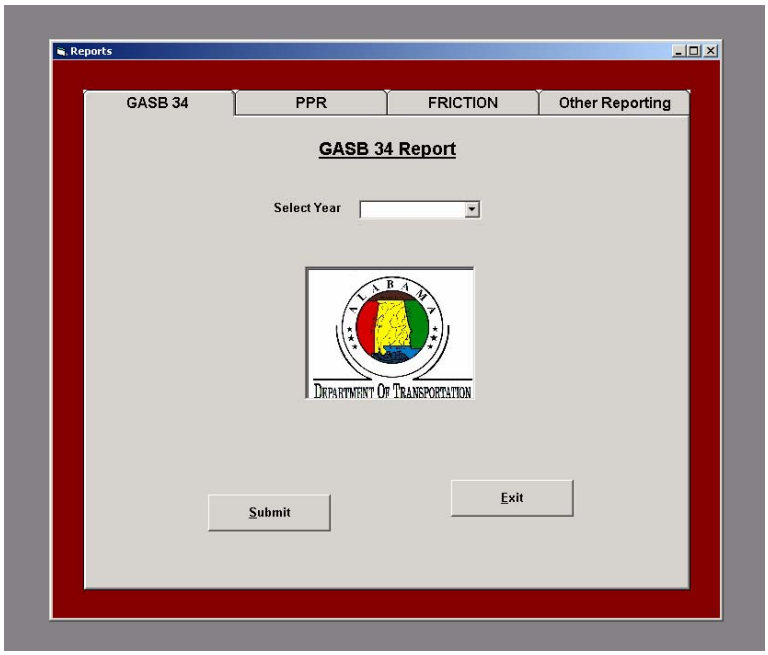

Figure 6-7 GASB 34 report generation screen

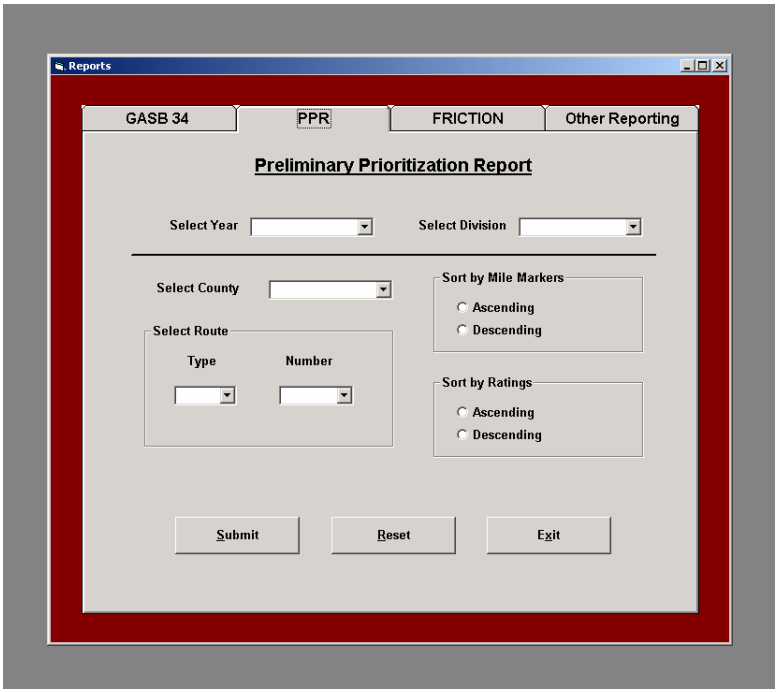

Figure 6-8 Preliminary Prioritization Report generation screen

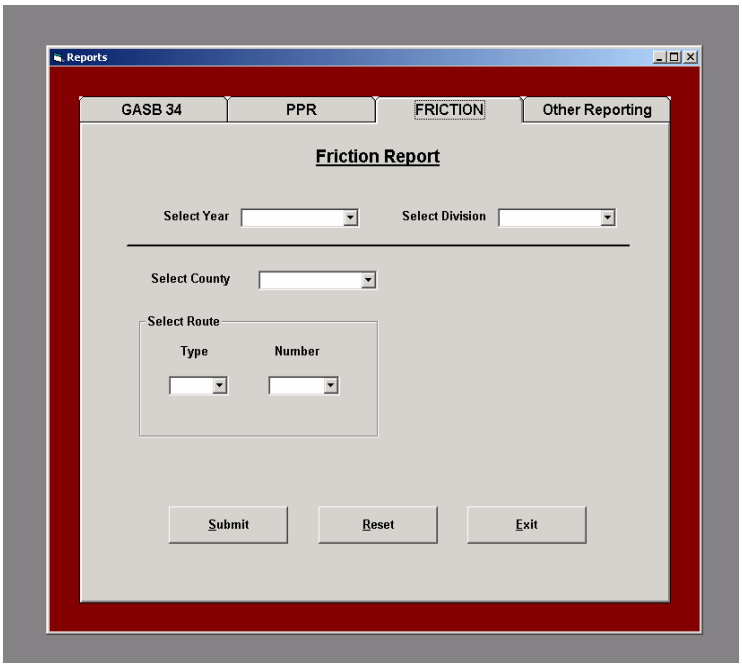

Figure 6-9 Friction Report generation screen

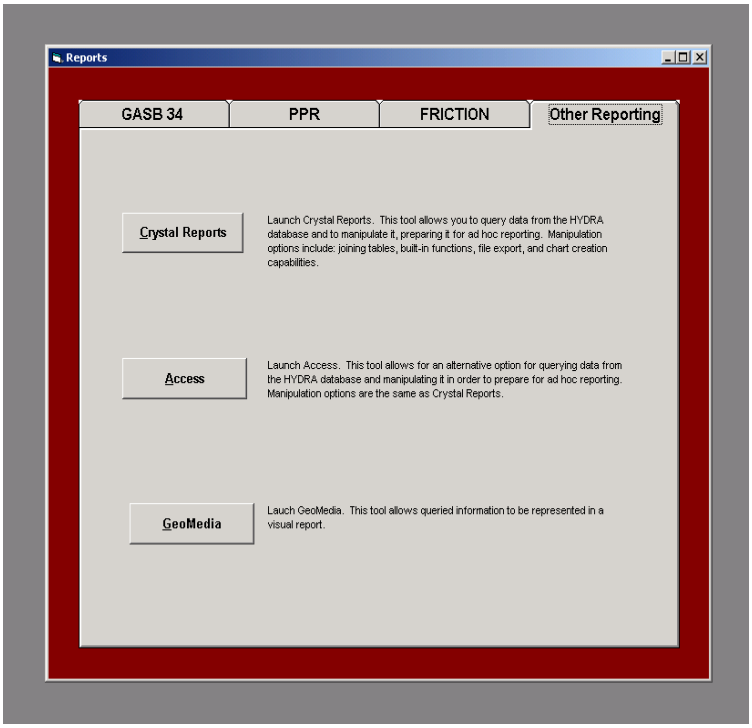

Figure 6-10 "Other" report generation screen

Section 7.0
Recommended Future Enhancements

While conducting this project, the UA team worked closely with ALDOT managers in developing the design for Hydra+, and in outlining improvements to it as part of ALDOT's planned asset management system. The Hydra+ recommendations for future enhancements are outlined in Table 7-1.

Table 7-1 Recommendations for future enhancements

Category	Future Project Requirements	Comments
Input Design	Give users the ability to search for records that have already been added to input tables to allow for additional modification of data before it is committed to the Hydra+ database	This enhancement could be an add-on to the existing input forms. It would be a "query builder" enhancement where the user may be able to enter data in one or more fields on the form and then press a search button to find all records that match the criteria entered by the user
Ad Hoc Queries	Monitor queries that are most commonly used and turn them into standard reports as system output	
System Updates	Give users the ability to remotely update the local version of HYDRA+ as enhancements are made per client feedback	In order to reduce excessive travel time that may be necessary as client begins working with HYDRA+ and requests upgrades
Research Capability	Compare historical conditions to projections for a specific area and time period	This would allow research to identify discrepancies and facilitate finding the cause and possibly improve the projections
Reporting	Historical Reporting	Using routes tables
Validation Quality Improvement	Evaluate the quality and adequacy of data and algorithms	
PPR/Friction Reports	Include ESAL's	Waiting for data to be provided from ALDOT

Appendix
Sub-Team Staff Assignments

Spring 2002

Process 00: Workflow and Data Requirements Definition

Brandon Haynie
Brian Anderson
David McMillan
David Templenton
Douglas Marsh
Jacob Stough
Jay Mayfield
Jim Hand
John Barrile
Lance Randolph
Mohammed Alquanti
Norman Antonio
Scott Otts
Stephen Tangerman

Visualization

Brandon Price
Clark Grissom
Kelly Brennan
Lindsey Brooks

Summer 2002

Detailed Specification

Brandon Haynie
David McMillan
Douglas Marsh
John Barrile
John Batte
Norman Antonio
Kelly Brennan

Fall 2002

Process 01: Update Tables

Daniel Pritchett
David Templenton

Process 02: Automated Load

Jim Hand
John Barrile
Jonathan Funk

Process 03: Manual Load

Kyle Jernigan
Lance Randolph

Process 04: Validation

Jeremy White
Norman Antonio

Process 05: Commit

David McMillan
Jay Mayfield

Process 06: GASB

Brian Anderson
Mohammed Alquanti
Roderick Anderson

Process 07: Reporting

Jacob Stough
Kerr Cooper
Steve Shelton

Fall 2002 (continued)

Visualization
Jason Harrelson
Sam Smith

Bridges/SQA
Dana Eason
Douglas Marsh
Stephen Tangerman

Coordination/Management
Cassie Cravens
Cristiano Paiva
Kelly Brennan
Brandon Haynie

Spring 2003

Finish Development
John Barrile
Jeremy White
Keir Cooper

New Development
Brandon Harper
Chris Patrick
Norman Antonio
William Wells

Testing /SQA
Christopher Nix
Stephen Tangerman

Visualization
Jason Harrelson
Samuel Smith

Coordination/Management
Cassie Cravens
Cristiano Paiva
Kelly Brenna

Principle Investigators throughout Project:
Shane Sharpe, Ph.D.
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Joanne Hale, Ph.D.

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