Final Report

Roadway Data Representation and Application Development

Phase III

Contract No.: BDK84 977-18

by

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16. Abstract

The Florida Department of Transportation's Transportation Statistics (TranStat) Office would like to finalize the existing Web-based Straight-Line Diagram (SLD) application, which was developed in the first phase of the research application development project in 2008 and 2009 and was improved in the second phase in 2010. The overall objective of the third phase of the application's development is to address production environment issues, improve operational characteristics and stabilize user schemes essential to realizing full use of capabilities listed below:

1. Application maintenance
2. Adjust application framework
3. Improvement of automatic scaling
4. Application code and 508 compliance reviews

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EXECUTIVE SUMMARY

The Straight-Line Diagram (SLD), a graphical linear representation of select Roadway Characteristics Inventory (RCI) data reported for individual roadways on the State Highway System in Florida, is widely used by transportation planners, technicians, and engineers. The Web-based SLD application was developed through a FDOT research project, *Roadway Data Representation and Application Development (Phase I)*, to replace the original SLD Diagrammer application developed in the late 1980's. In 2010, a successive research project, *Roadway Data Representation and Application Development (Phase II)*, was conducted to improve the Web-based SLD application and fix existing problems.

In this project, on the basis of the existing Web-based SLD application, the following activities were completed for producing a more effective SLD application:

1. Application maintenance, correcting errors found in previous testing
2. Adjustments to the application's framework to improve response time
3. Improvement of automatic scaling
4. Clean-up of application code and insuring continuing 508 compliance
5. Correction of application errors discovered during FDOT testing

As the final result, the Web-based SLD application was successfully re-deployed in the FDOT production environment.

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1. INTRODUCTION

1.1 Problem Statement

The Straight-Line Diagram (SLD) is a graphical linear representation of select Roadway Characteristics Inventory (RCI) data reported for individual roadways on and off the State Highway System. The SLD is annotated with text information and graphics that describe or illustrate information considered to be general interest roadway data. The SLD is used by transportation planners, technicians, and engineers to verify RCI data, for field survey preparation, and for many other related applications. The SLD has been the document of choice in the FDOT for more than 25 years, and the primary methodology and application used to produce SLDs was developed in the late 1980's. Two recent projects, *Roadway Data Representation and Application Development – Phases I and II*, developed the Web-based Straight-Line Diagram application and provided several advantages, including:

- A user-friendly wizard allows any user, following pre-defined steps, to complete the SLD generation task;
- The re-designed layout of SLDs resembles the current look of the SLD as well as integrating additional data;
- The ability to customize appearance of SLDs by specifying a series of display parameters makes SLDs more legible;
- A user management capability records users' configurations so that users do not need to re-enter display parameters each time;
- SLDs can be generated in both PDF format and DXF format;
- RCI database connection retrieves RCI data in real time and reduces users' workloads;
- Through database connectivity, additional data besides basic RCI data is included;
- A Web-based solution that can be accessed by appropriate FDOT staff and does not require any installation on client computers.

However, the Web-based SLD application still needed to be improved before finalizing the development and re-deploying it in the FDOT production environment.

1.2 Research Objectives

The overall objective of this project was the correction of production issues and implementation of enhancements to the SLD application in areas that became apparent in the production environment. These enhancements included improving the SLD application, making adjustments to detrimental operational characteristics for improved overall performance, and incorporate minor modifications to provide a better final product. The following tasks were completed in the order listed:

1. Application Maintenance
2. Adjust Application Framework
3. Improvement of Automatic Scaling
4. Application Code and 508 Compliance Review

1.3 Report Organization

This report consists of three chapters. Chapter 1 provides a brief introduction to the research project. Chapter 2 summarizes the sub-tasks, including functionality, implementation method, and problems and associated resolutions. Finally, Chapter 3 gives summaries of the project and recommendations for future work.

2. DEVELOPMENT OF TASKS

In this chapter, the 4 tasks are summarized respectively in terms of functionality, technical approach, and completion status.

2.1 Task 1 – Application Maintenance

As with any new application, once it is placed in the production environment and put to practical use some application issues become apparent and opportunities for improvement can be identified that were not obvious in other environments with a smaller set of users. The DOT Project Manager provided the following list of issues at the start of the project:

- Saved User Schemes do not contain all configurable options
- Adjusting the configurable options of the scheme adversely affects the active scheme
- Every Web page change experienced a loading operation. This loading was investigated and the logic modified to speed-up page generation.

Improve User Schemes

In the previous version of the SLD application, not all configurable options can be recorded in a user scheme. In this phase to correct the problem, the following configurable options were added in a user scheme record:

- RCI Features involved in Autoscaling
  - 251 - Intersections
  - 252 - Interchanges
  - 253 - Railroads
  - 320 - Milemarker Signs
  - 326 - Traffic Monitoring Sites
  - 212 - Surface Layers
  - 241 – Crossdrains

- The following text sections (located in the bottom partition of the SLD) included an opportunity to be removed from the final product (Hidden Sections)
  - F – Roadway Composition
  - G – Horizontal Alignment
  - H - Structure
  - I – Structure Description
  - J - District Use
  - K - SIS
  - L – Fun Class

  - M - Traffic
  - N – Speed Limit
  - O – Bike Lanes

- Historical date – date of last usage

- RCI data output capabilities
  - Original Data
  - Partitional Data

Adjust Configurable Options

Some characteristic check boxes became unchecked by the system when users saved a scheme. This problem was caused by logic bugs in the user scheme module. In this project phase, the user scheme model was updated to eliminate this problem.

Improve User Interface

In the previous version, changing tabs (going from page to page) resulted in a delay with the hour-glass cursor appearing indicating page refreshing. The architecture of the user interface was updated to accelerate the operation loading process, thus reducing the delay.

2.2 Task 2 - Adjust Application Framework

The SLD application was investigated to assure it will work properly with multiple simultaneous users. Because of slight differences in the test and production environments for Web applications, the SLD application was modified to take advantage of and correct some existing environment related situations. In addition:

- An administrator function was included for modifying the Default Scheme and User Scheme, including record deletion.
- All code descriptions were converted to Database Tables, not hard coded in the application.
- All tables were indexed for faster record access.

Administrator Function

An administrator page was added to provide management functions for system managers. These functions are shown below and include deletion of user records.

- Administrators can delete existing users and their user schemes from the system database using this screen:

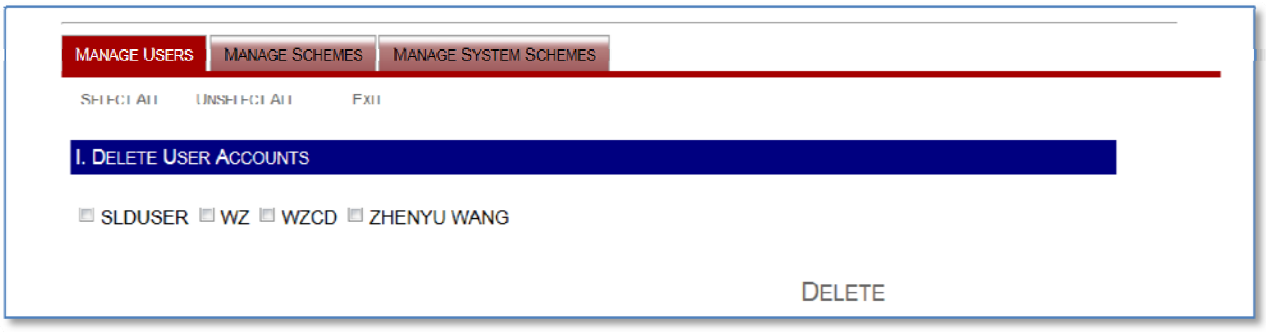

Figure 2.1 Deleting Users

- Modification of User Privileges
  Administrators can assign administrator or user privileges to an existing user. A user account only allows users to produce SLDs. .

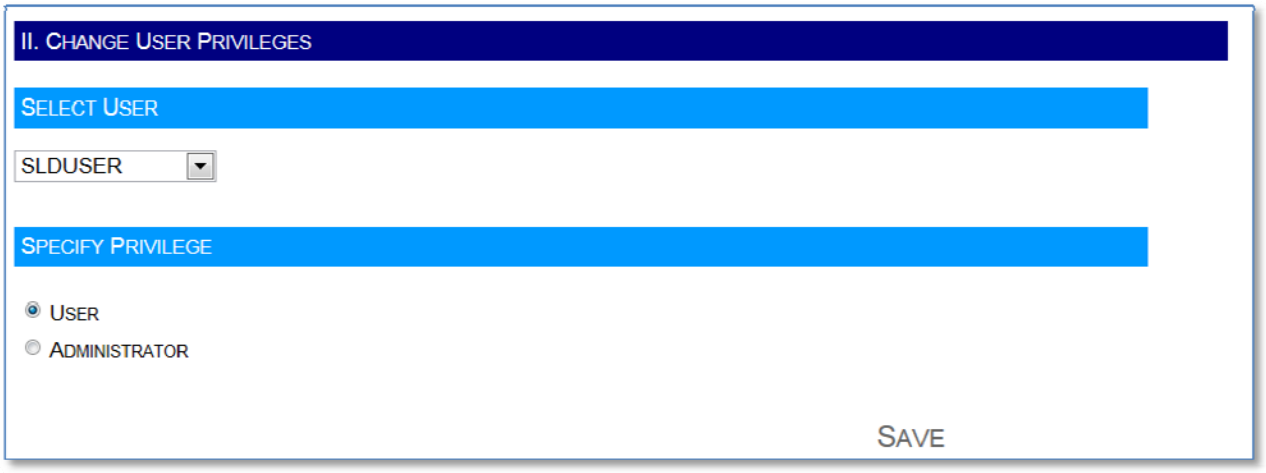

Figure 2.2 Changing Users' Privilege

- Deletion of User Schemes
  Administrators can delete any scheme created by users.

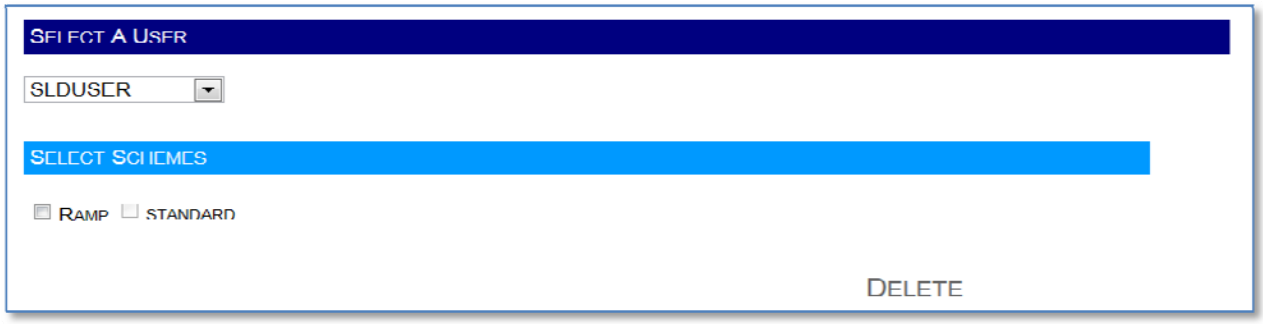

Figure 2.3 Deleting User Scheme

- Editing System Schemes
  System schemes are the standard schemes created by administrators. Users can create their schemes based on the system default scheme. This administrator page allows administrators to create, edit, distribute, and delete user schemes.

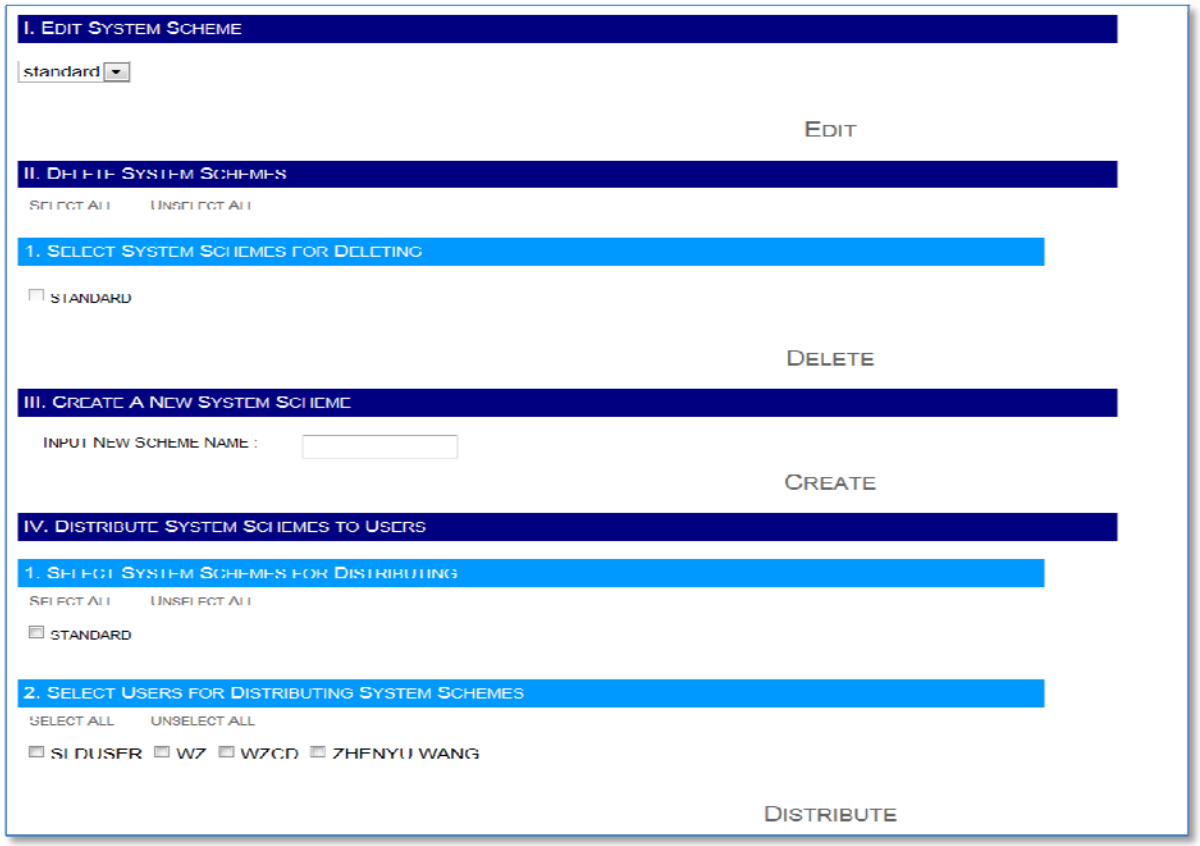

Figure 2.4 Manage System Schemes

Improve Code Descriptions

In the previous version, some roadway characteristic codes were embedded in the application codes. To generalize, the code descriptions, these code description values are now retrieved from the FDOT database. The updated code tables include:

- Current Place Code
- Urban Area Number
- Current Highway Location Code
- Functional Classification
- Roadway Section Status
- SIS Facility Type
- Type of Interchange
- Bicycle Slot
- Type of Median
- Highway Shoulder Type
- Inside Shoulder Type

Index Data Tables in User Scheme Database

All data tables in the user scheme database were indexed in terms of Record IDs to accelerate the query process.

2.3 Task 3 – Improvement of Automatic Scaling

The current scaling logic was fine tuned for improved SLD generation. To improve the scaling effectiveness, the automatic scaling algorithm was updated in this project. The major improvements include, with logic flow following the improvements:

- Providing an option of maximum and minimum scales for users
- Considering Features 111, 113, 114, and 124 in the autoscaling algorithm
- Considering Feature 258 in the autoscaling algorithm in Section H
- Considering Feature 140, 141, and 143 in the autoscaling algorithm
- Optimizing the autoscaling algorithm to avoid some features (251, 252, 253, 320, 326, 212, 214, 215, 219) printing past the end of the partition.

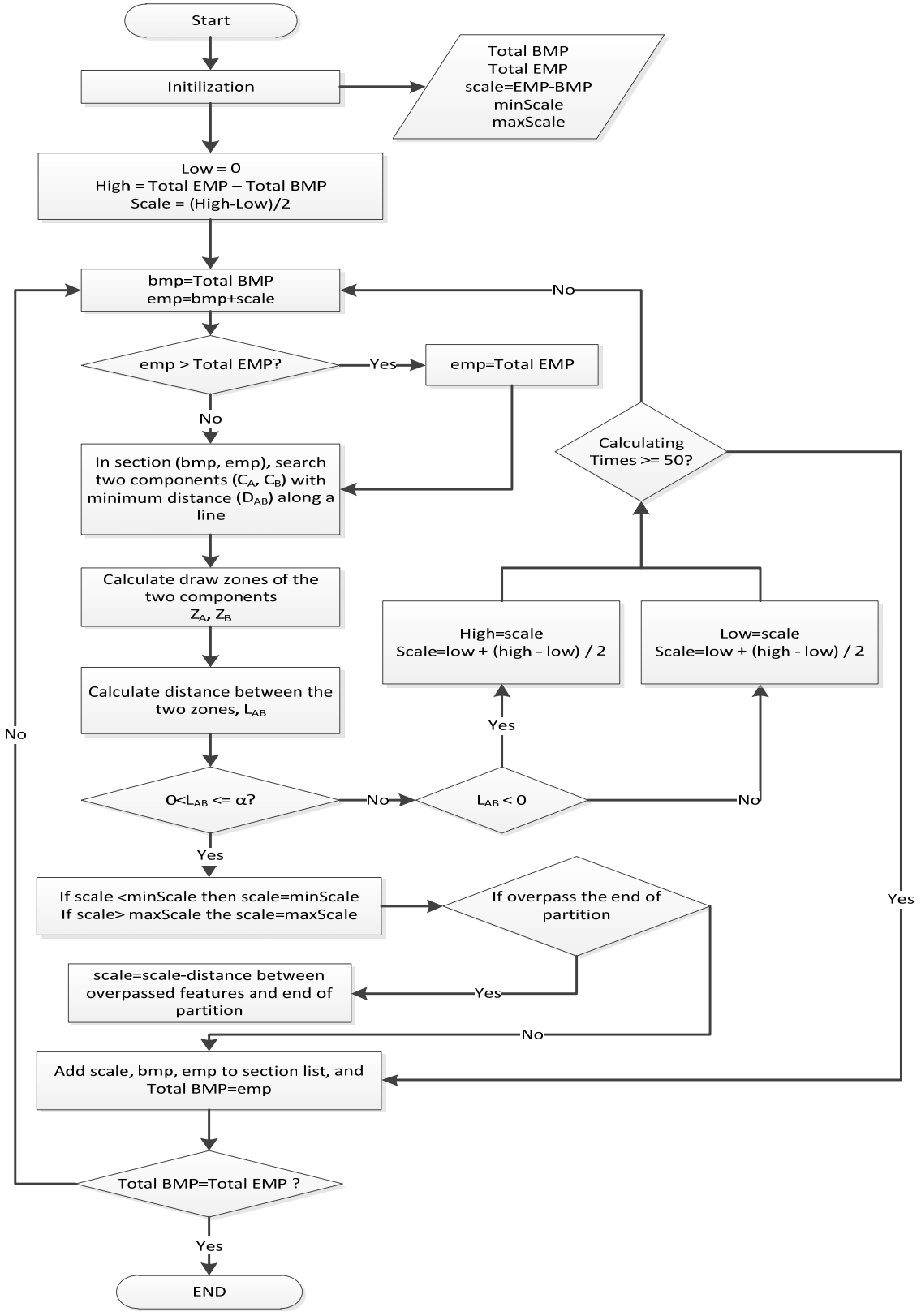

Figure 2.5 Updated Autoscaling Algorithm

2.4 Task 4 – Application Code and 508 Compliance Reviews

Compliance with Departmental requirements for applications and other Web-based products (Section 508 Compliance) is required before the application's final acceptance occurs. This application was reviewed and passed in-house quality checks.

2.5 Other Modifications

Besides the 4 tasks, many modifications were made to improve the functionality of the SLD application or correct errors according to FDOT staff comments. These modifications included:

- Correcting display errors of Intersection Surface Type for INTSDIR7, INTSDIR8 and INTSDIR9
- Correcting display errors of Composite Characteristics with Offset Direction
- Correcting display errors of Shoulders and Inside Shoulders
- Replacing the Feature 147 Characteristic SISFACTP with SISFCTP1
- Correcting display errors of the total width of Through Lane surface
- Changing the display effects of the application title
- Correcting display errors of Friction Course
- Correcting display errors of Type Road for One-Way segments reporting the wrong EMP or BMP when spanning partitions
- Correcting display errors of Facility Crossing missed at some interchanges and reported incorrectly when spanning partitions
- Adding a new additional Traffic Signal characteristic (SIGNALNC)

3. SUMMARY AND RECOMMENDATIONS

In general, the overall goal of this project was the improvement of the current Web-based Straight-Line Diagram application, to enhance its functionality and effectiveness and to re-deploy it in the FDOT production environment. This was accomplished with a new Web-based application through the following tasks: (1) Application maintenance; (2) Adjust application framework; (3) Improvement of automatic scaling; and, (4) Application code and 508 compliance reviews.

The deliverables for each of the 4 tasks were submitted to the FDOT Project Manager and installed in the FDOT test environment as applicable. During the execution of each task, all issues raised by FDOT were addressed and their solution incorporated into the submitted application version. The last application version was successfully tested with full functionality realized and moved to the FDOT production environment.

Some future improvements for this application could be considered for a more robust application and include:

- Inclusion of additional RCI Features

  The SLD application can be used by all FDOT personnel and the inclusion of other RCI Features could be a benefit to other FDOT offices.

- Improve autoscaling algorithm

  The autoscaling logic developed in this project considers horizontal scale only (one dimension). The absence of other dimensions, such as vertical scale and size of display blocks, often results in a “not bad” scale solution, but not the “best” one. Thus, improved autoscaling logic incorporating multiple dimensions, including: (1) horizontal scale, (2) vertical scale, (3) vertical location of display blocks, and, (4) size of display blocks, could result in an optimum solution.

- Optimize autoscaling processing

  Due to the complexity of the autoscaling algorithm, the current scaling processing time sharply increases when multiple RCI Features are selected. Long processing times degrade the user experience and may result in system failures. Thus, optimization of the autoscaling process is suggested to reduce processing time,

improve the user's experience, and, more importantly, could allow more RCI Features and spatially related factors to be considered.

There are two approaches to optimize the autoscaling algorithm:

1. Adopt multi-threading technology to process multiple scaling calculations simultaneously utilizing the capacity of modern processors with multi-cores. This technology can improve scaling process speed significantly.

2. Remove the redundant features that are not considered in iterations of autoscaling calculations.

- Add GIS functionality

  A GIS interface can provide users with an alternate means of selecting a roadway by providing a graphical hot-linked display of the roadway network allowing a user to select a roadway directly from the GIS basemap. This would enhance the functionality of the SLD application. Two major functions should be considered: (1) users can review the roadway section and select RCI Features on a GIS interface; and (2) insertion of a GIS map in the SLD products.