Final Report

Roadway Data Representation and Application Development

Contract No: BD544-41

by

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16. Abstract

The Straight-line Diagrammer, a web-based application to produce Straight-line Diagrams (SLDs) automatically, was developed in this project to replace the old application (AutoSLD) which has out-dated structure and limited capabilities. The new application provides enhancements beyond replicating the functions of the old stand-alone application. The enhancements include:

- To create a direct connection to the Florida Department of Transportation (FDOT) Roadway Characteristics Inventory (RCI) database
- To modify SLDs according to the changes in the RCI database
- To provide a user friendly interface to reduce the work load and learning curve.
- To present customizable outputs of SLDs
- To offer savable generation schemes
- To re-generate SLDs easily
- To integrate online help information
- To incorporate additional RCI data

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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. Currently, the Florida Department of Transportation (FDOT) is utilizing a stand-alone application, named as AutoSLD, to generate SLDs. However, due to the out-dated structure, the current SLD application is working in a semi-automated manner and does not provide flexible configurations for generating SLD products. Considering recent developments in Geographic Information System (GIS) technology, aerial photography, digital roadway video logs, web application/database, and other production techniques, a research project was conducted to:

- Examine the usability of these new technologies in the SLD generation

- Modernize the SLD generation process to eliminate the disadvantages of the current SLD generation application

- Develop new SLD generation applications to produce SLD products in an automatic, flexible, efficient, and use-friendly manner

The main objective of this research is to develop an efficient, flexible, and user-friendly SLD generation application that utilizes advantages of Web-based database and other technologies to customize, produce, and output legible SLD products for all appropriate FDOT users.

The first and foremost result of the application is the replication of the existing SLD application, enabling current users the ability to continue to generate SLD products as required by the FDOT. In this project, the basic capabilities listed below have been achieved:

- A user-friendly user interface that requires a short learning curve
- A flexible method of selecting a roadway section for SLD generation
- Compliance with departmental requirements for applications and other web-based products (e.g. Section 508 compliance)
- Use of an appropriate programming language for an application with databases
- Execution in a web-based environment that is easily accessible to all appropriate department personnel

Beyond the replication of the existing SLD application functions, a number of enhancements were developed in this project as shown in following:

- A customization function to specify the output attributes (e.g. selection of Characteristics to be displayed, font size/color, paper size, scale per page, etc.)
- A comprehensive user guidance
- Generation of PDF and/or DXF formats
- Generation scheme that can store user-defined output attributes
- The SLD generation logic of the application should include routines that separate text in order to keep them legible
- Integration of new RCI Features

The new web-based SLD application can effectively reduce the SLD operator's workload and generate more flexible SLD products. All SLD users, such as transportation planners, technicians, and engineers, can gain benefits from the new application.

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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 the State Highway System. However, as an optional feature, SLDs for Active-Off the SHS roads may be produced at the discretion of the Districts. The SLD is annotated with text information and graphics that describe or illustrate information considered to be general interest roadway data (e.g. intersecting roads, roadway descriptions, bridges and other structures, functional classification, and curve data). The SLD is used by transportation planners, technicians, engineers, to verify RCI data, for field survey preparation, and for many other related applications. Currently, the Florida Department of Transportation (FDOT) is utilizing a stand-alone application, AutoSLD, for generating SLDs. A typical procedure to apply the application is: (1) to query RCI data on the FDOT mainframe; (2) to download RCI data to desktop; and (3) to generate SLDs in DXF files.

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. A recent study, *Roadway Data Representation and Application Development*, revealed that a majority of users were satisfied with the current SLD product, but were less satisfied with the current SLD generation application due to its outdated structure. Major disadvantages of the current SLD generation application include:

- The current SLD application is working in a semi-automated manner. Although SLD products can be produced automatically with the current application, RCI data must be downloaded manually from the department's mainframe based on roadway ID by SLD producers. The semi-automated working manner increases SLD producers' workloads.

- The current SLD application does not provide selectable and configurable parameters for generating SLD products. Users cannot select RCI data or specify SLD output parameters according to their needs, as well as cannot customize SLD products to make the outputs more legible.

- The current application does not provide a flexible method for users to select roadway sections. Users cannot select the objective roadway sections on maps, whereas they only

select sections by an unintuitive method: specifying roadway ID and Milepoints respectively.

- The current application does not provide the capability of integrating additional data beyond the basic RCI data. The additional data, such as aerial photography, traffic data, digital video logs, and other user-defined data, are most likely to improve the flexibility and efficiency in presenting RCI data.

- The current application only provides the DXF output format, which is sometimes too complex to end-users. For these users, a more popular and more convenient output format, such as the Adobe PDF, is more suitable.

- The current application is a Windows-based stand-alone software package. Users need to install a copy in each client computer. It is not advantageous to distribute updates of the application as well as to provide accessibility for appropriate FDOT personnel.

Considering recent developments in Geographic Information System (GIS) technology, aerial photography, digital roadway video logs, web application/database, and other production techniques, a study should be conducted to:

- Examine the usability of these new technologies in the SLD generation

- Modernize the SLD generation process to eliminate the disadvantages of the current SLD generation application

- Develop new SLD generation applications to produce SLD products in an automatic, flexible, efficient, and user-friendly manner

1.2 Research Objectives

The main objective of this research is to develop an efficient, flexible, and user-friendly SLD generation application that utilizes the advantages of new technologies to customize, produce, and output legible SLD products for all appropriate FDOT users. More importantly, the following objectives should be achieved:

- Design a user-friendly wizard to allow any user, following pre-defined steps, to complete the SLD generation task

- Re-design the layout of SLD products to resemble the current look of the SLD as well as integrating additional data

- Provide the ability to customize an SLD by specifying parameters including the RCI data category to display attributes (font size, etc) and page properties (page scale, etc)

- Develop a user management system to record users' personal configuration status so that users do not need to reconfigure the output parameters each time

- Output SLDs in both Adobe PDF format and/or DXF format

- Integrate functions to query RCI data in a fully automatic manner that can reduce the workload in the SLD generation process

- Provide the ability to incorporate additional data besides basic RCI data

- Adopt a Web-based solution which will be deployed in the FDOT Intranet and can be accessed by appropriate FDOT personnel

- Implement the Microsoft ASP.NET and AJAX technologies based on the FDOT computing environment and research team's past experience

- Be compliant with FDOT requirements for applications and other Web-based products (e.g. Section 508 compliance)

1.3 Report Organization

This report consists of four chapters. Chapter 1 provides a brief introduction to the research project. Chapter 2 describes the development of the new SLD generation application. The SLD design and data structure are given in Chapter 3. Finally, Chapter 4 gives the summary of the project and recommendations for future work. A user manual of the SLD application is shown in the Appendix.

2.   Development of SLD Application

An efficient, flexible, and user-friendly SLD generation application, named Straight-line Diagrammer, was developed in this project following the development route below. At first, the user needs were collected from the FDOT staff comments. By considering User needs, the system platform, system functions, the system architecture, and the database connection were designed. The application code was developed and deployed to a testing website, while an inner test was performed for debugging purposes. Finally, the FDOT staff executed a comprehensive product review before the final deployment in the FDOT computing environment.

2.1   System Platform

Considering the requirement that the application should be easily accessed by all appropriate FDOT personnel, a Web-based platform was selected because of its accessibility to users of the FDOT Intranet and the ability to update and maintain the application without redistributing and reinstalling software on potentially hundreds of client computers. Furthermore, a powerful computer environment for Web-based applications is available in the FDOT. The selection of platform is presented in Table 2.1.

Table 2.1 Selected Application Platforms

ITEM	RECOMMENDATION
System Platform	Web-based
Operating System	MS Windows Enterprise 2003
Web Server	MS Internet Information Server 6
Framework	MS .NET 2.0 + AJAX
Development Tools	MS Visual Studio 2005
Programming Language	Visual Basic.NET + SQL
RDBMS	ORACLE 10.2 + DB2
GIS Connector	.NET connector
PDF Generation Engine	Wout Ware Cadlib 2.0
DXF generation Engine	Wout Ware Cadlib 2.0

The Microsoft ASP.NET plus AJAX technologies were adopted because of the following advantages:

- ASP.NET is a powerful framework to develop dynamic web applications with various programming languages;

- AJAX components are integrated to create next-generation user-friendly interfaces;

- Many rapid programming and debugging tools are provided to reduce the execution time;

- An integrated solution is provided including operating system, web server, database management system, and program developer;

- Finally, the research team at University of South Florida has excellent experience in the development of transportation web-based applications with the Microsoft ASP.NET solution. This experience will reduce the risk and period of the application development.

2.2 System Function and Architecture

According to FDOT users' requirements, the SLD application should: (1) provide interface to select roadway segment and RCI features; (2) provide interface to create, update, and delete generation schemes; (3) connect to the FDOT RCI database for retrieving live RCI data and retrieving/updating generation scheme; (4) output SLDs at DXF/PDF format. Based on the user needs, the system function was designed as shown in Figure 2.1. And the system architecture was designed to achieve the system functions as shown in Figure 2.2.
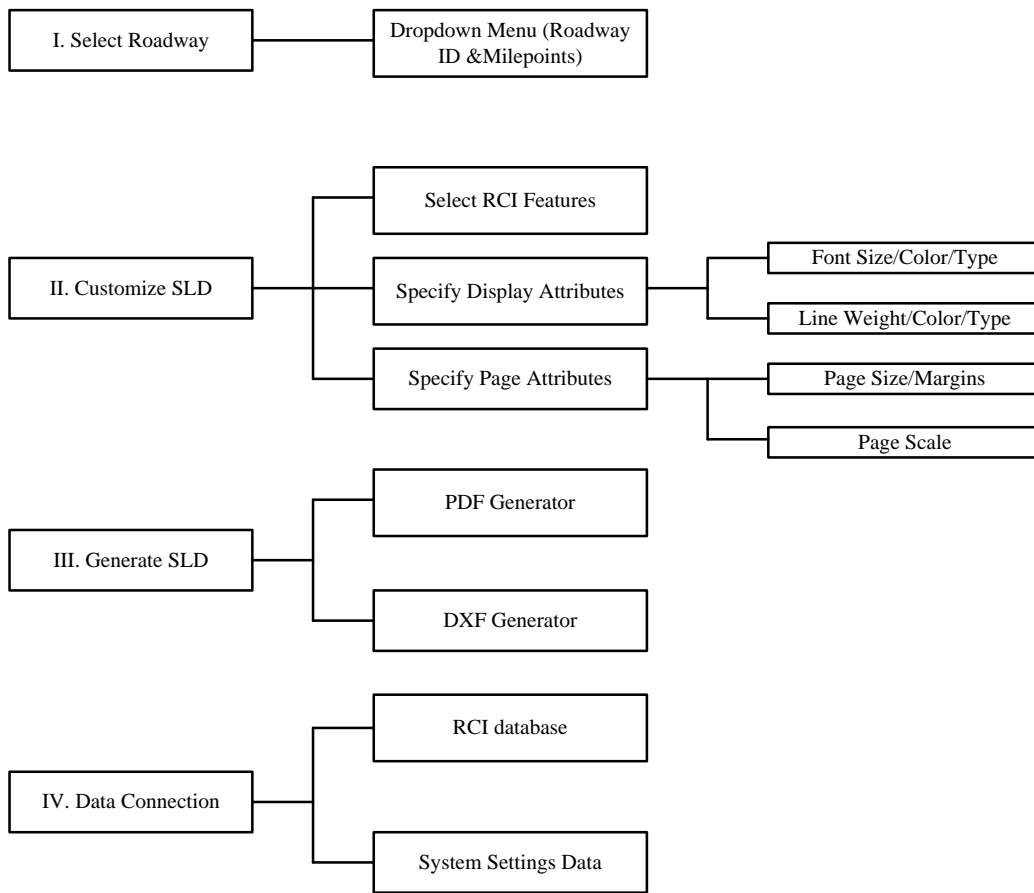
Figure 2.1 System Function
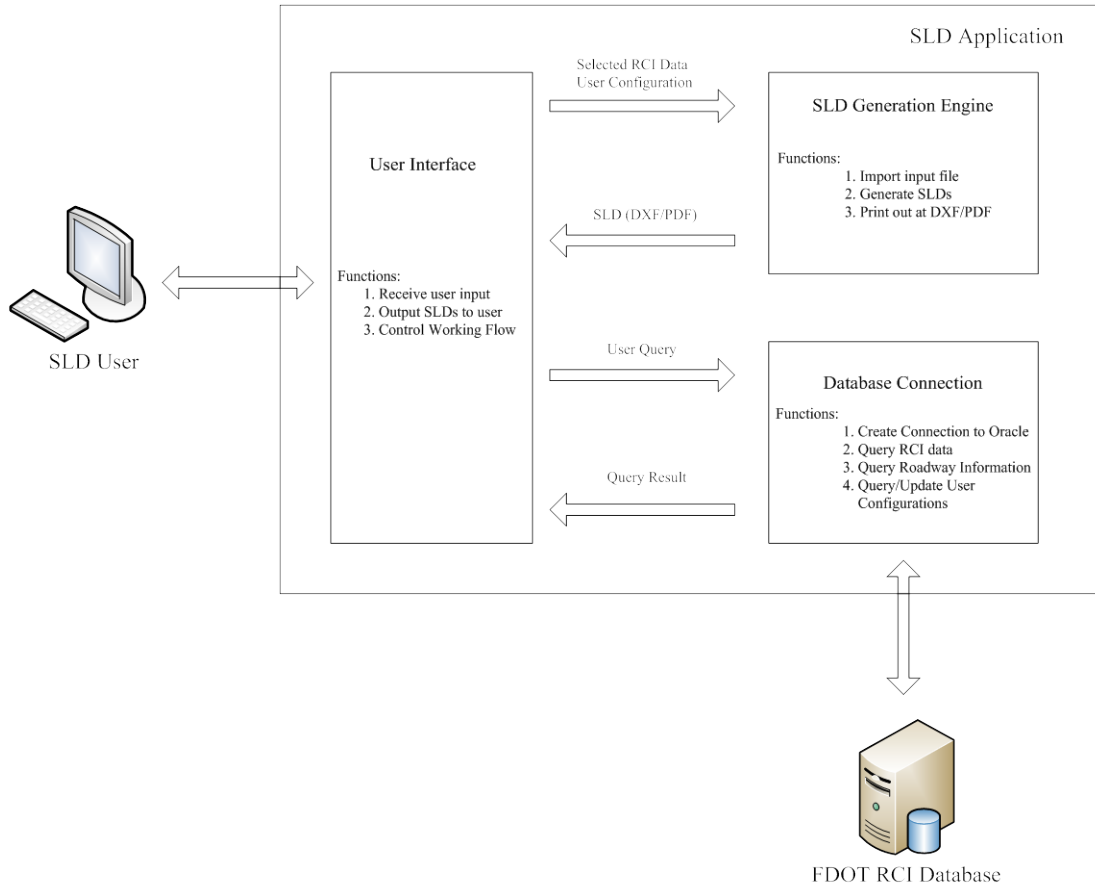
Figure 2.2 System Architecture of SLD Application

In Figure 2.2, the SLD application could be divided into three modules: user interface, SLD generation engine, and database connection. User interface module provides a series of web pages to interact with users. Users can complete the following tasks through the module:

- Select roadway segment by indicating Roadway ID, which is an 8-digit unique number for identifying a roadway segment, and beginning/ending milepoints, which are the distances to the start and end points of roadway segment in miles
- Select RCI features/characteristics
- Specify the display attributes of SLDs, such as font, line, color, page, partition number, etc
- Save the specified display attributes as a generation scheme, and load the scheme
- Download SLDs in DXF and/or PDF format

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Except for the interaction with users, the user interface module also serves as the hub of the application to control work flow. All database and generation operations are controlled by the module.
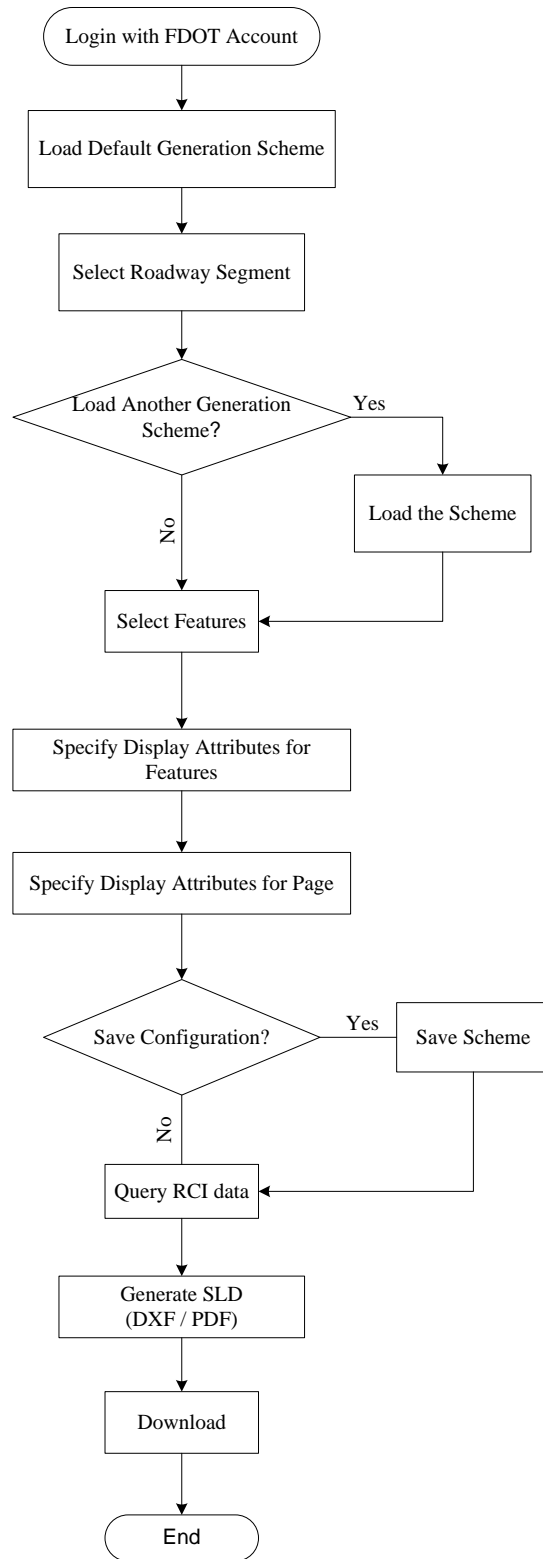
SLD generation engine is the core module of the SLD application. Its major function is to generate SLD products based on the selected RCI data and selected generation scheme which are received from the user interface module. The SLDs can be printed out as DXFs, PDFs, or both of them. The generated SLDs are transferred to users through the user interface.

Database connection module is used to create a connection to the live FDOT RCI database. All data queries, including RCI data, roadway information, and generation schemes, are operated through the database connection module. And query results are returned to the user interface module.

2.3   Working Flow

The working flow inside the SLD application is given in Figure 2.3. To start a task of SLD generation, users should login the FDOT Intranet with an appropriate account. When a user logs to the application, a default generation scheme, which specifies the default values of selection of RCI features and display attributes, is loaded. Users can load another predefined generation scheme, or create a new one after logging to the application. Users also can save the change of generation scheme with the user interface.

The first step of SLD generation is to select the roadway segment and specify the beginning/ending milepoints. According to the selected roadway segment, RCI data associated with the selected RCI features are retrieved from the live FDOT RCI database. The retrieved RCI data and specified display attributes are used for the SLD generation. Two output formats of SLDs can be indicated by users: DXF and/or PDF. Finally, the output files are sent to users for downloading.

```
┌─────────────────────────────┐
│   Login with FDOT Account   │
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────────┐
│  Load Default Generation Scheme │
└─────────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐
│    Select Roadway Segment   │
└─────────────────────────────┘
              │
              ▼
        ◇ Load Another Generation    Yes
          Scheme?  ─────────────────────┐
              │                         │
             No                         ▼
              │              ┌──────────────────┐
              │              │  Load the Scheme │
              │              └──────────────────┘
              ▼                         │
┌─────────────────┐◄───────────────────┘
│  Select Features│
└─────────────────┘
              │
              ▼
┌─────────────────────────────┐
│  Specify Display Attributes │
│        for Features         │
└─────────────────────────────┘
              │
              ▼
┌──────────────────────────────────┐
│ Specify Display Attributes for Page│
└──────────────────────────────────┘
              │
              ▼
        ◇ Save Configuration?  Yes ┌──────────────┐
              │                     │ Save Scheme  │
             No                     └──────────────┘
              │                            │
              ▼                            │
┌─────────────────┐◄──────────────────────┘
│  Query RCI data │
└─────────────────┘
              │
              ▼
┌─────────────────┐
│  Generate SLD   │
│  (DXF / PDF)    │
└─────────────────┘
              │
              ▼
┌─────────────────┐
│    Download     │
└─────────────────┘
              │
              ▼
┌─────────────────┐
│      End        │
└─────────────────┘
```

Figure 2.3 System Working Flow

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3.   SLD DESIGN AND DATA STRUCTURE

3.1   SLD Layout Design

The design of new SLD products keeps the similarity with the current version. A standard SLD consists of the following elements: page, partition, section, block, symbol, and annotation. Two typical SLD samples are given in Figures 3.2 and 3.3.

3.1.1   Page

A SLD product can be composed of a series of pages, which are the top containers of SLD elements. There are two important components of SLD pages: page header and partitions. The administrative and inventory related information are on display in the page header, including:

- *SLD Inventory Block*

  This section contains information that records the last 5-year inventory date (section labeled "5 YR INV") and the dates of subsequent interim revisions (section labeled "INTERIM REVISIONS") noting the Beginning Milepoint (BMP) and the Ending Milepoint (EMP) of the affected change.

- *County and District ID*

  This section gives the name of the County and the identification of the District.

- *Interstate or U.S. Route No. & State Road No. ID.*

  This section lists the Interstate, U.S. Route, or State Road Number designation of the roadway segment.

A SLD page may contain one or two partitions. The number of partitions can be appointed by users.

3.1.2   Partition

A SLD partition is the second level container that comprises several different categories of representations of RCI data for a roadway segment. These RCI representations are divided into 8 sections:

- *Roadway Features*

  In the beginning and throughout the SLD, Features are identified by the milepoint number located primarily in the Roadway Features Section.

- *Roadway Composition*

  This section describes the roadway surface characteristics and surface type (e.g. asphalt, concrete, multiple surfaces, and Characteristics information). Generally, the friction course information is shown when available.

- *Horizontal Alignment*

  This is where the information about the curvature, direction changes, and bearing of the roadway is reported. The horizontal alignment data is divided into left and right roadway sides by the line which bisects this area, so that data for curves to the left is entered above the line, data for curves to the right below the line.

- *Structure Description*

  General structural information about bridges, drainage pipes, overpasses, and culverts is reported here. Two symbols are used to represent structures on the SLD. Structures less than 20 feet long are shown by a vertical graphic (a line with inverted arrowheads at each end) with annotated text. This format is similar for drainage pipes. If the structure is over 20 feet long, the bridge graphic is shown (a text annotated rectangle). Text data for bridges, at a minimum, includes the beginning and ending milepoints, structure number, structure type code, and approximate width in feet.

- *District Use*

  This area is available for use by Districts to show non-standard information that may be desired and is not currently required to be reported. Examples include access management, traffic counts, signalized intersections, special information, etc. This information must be kept current and reflect accurate data.

- *SIS*

  This section indicates the Strategic Intermodal System (SIS) designation for the roadway. There are ten SIS designations that can be coded for Highway Facilities, Connectors, Active Exclusives, and Planned facilities.

- *Functional Classification*

  This area denotes the Federal Functional Classification designation for the roadway. There are a total of 12 designations ranging from an Urban Principal Arterial (the highest level) to a Rural Local Road (the lowest level).
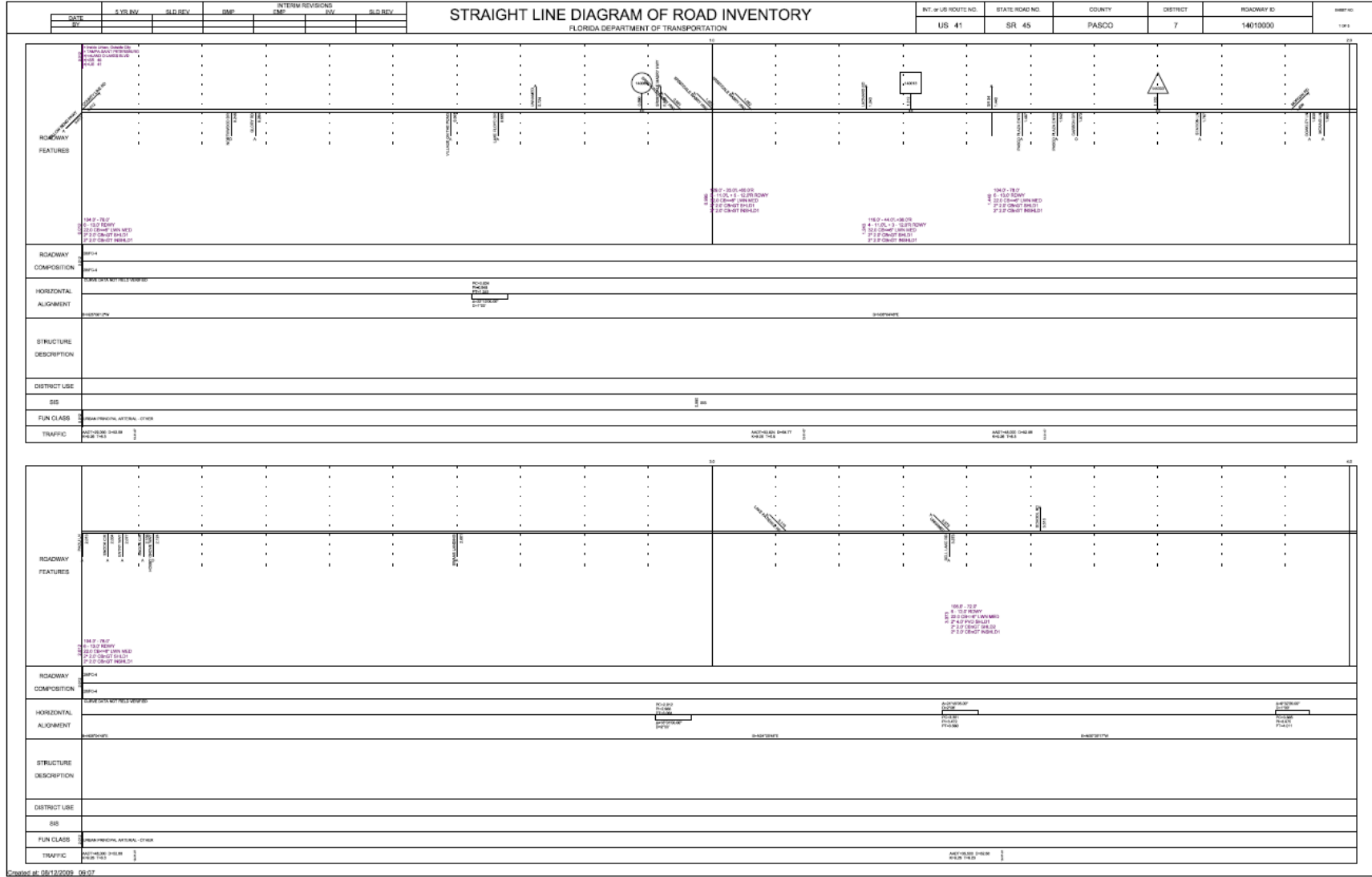
- *Traffic*

The last section represents traffic-related data for the roadway segment, including AADT, collection date, direction factor, etc.

3.1.3   Block, Symbol and Annotation

A SLD block contains a series of graphical symbols and/or text annotations to represent a group of RCI data. Within a section, one or more SLD blocks are printed and arranged according to their beginning location. Figure 3.1 is an example of SLD blocks which denotes the inventory data for through lanes, median, inside shoulder, and outside shoulder. A more detailed description of SLD block, symbol, and annotation are given in Figure 3.4.
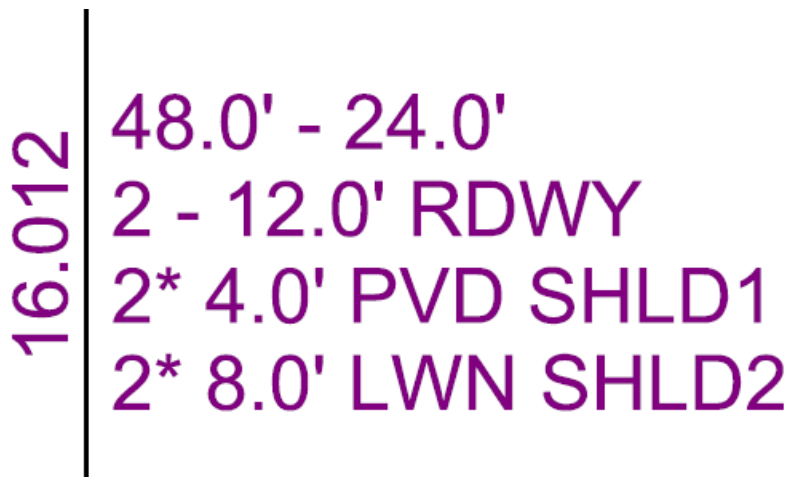
Figure 3.1 Example of SLD Block

Figure 3.2 SLD Sample with Two Partitions
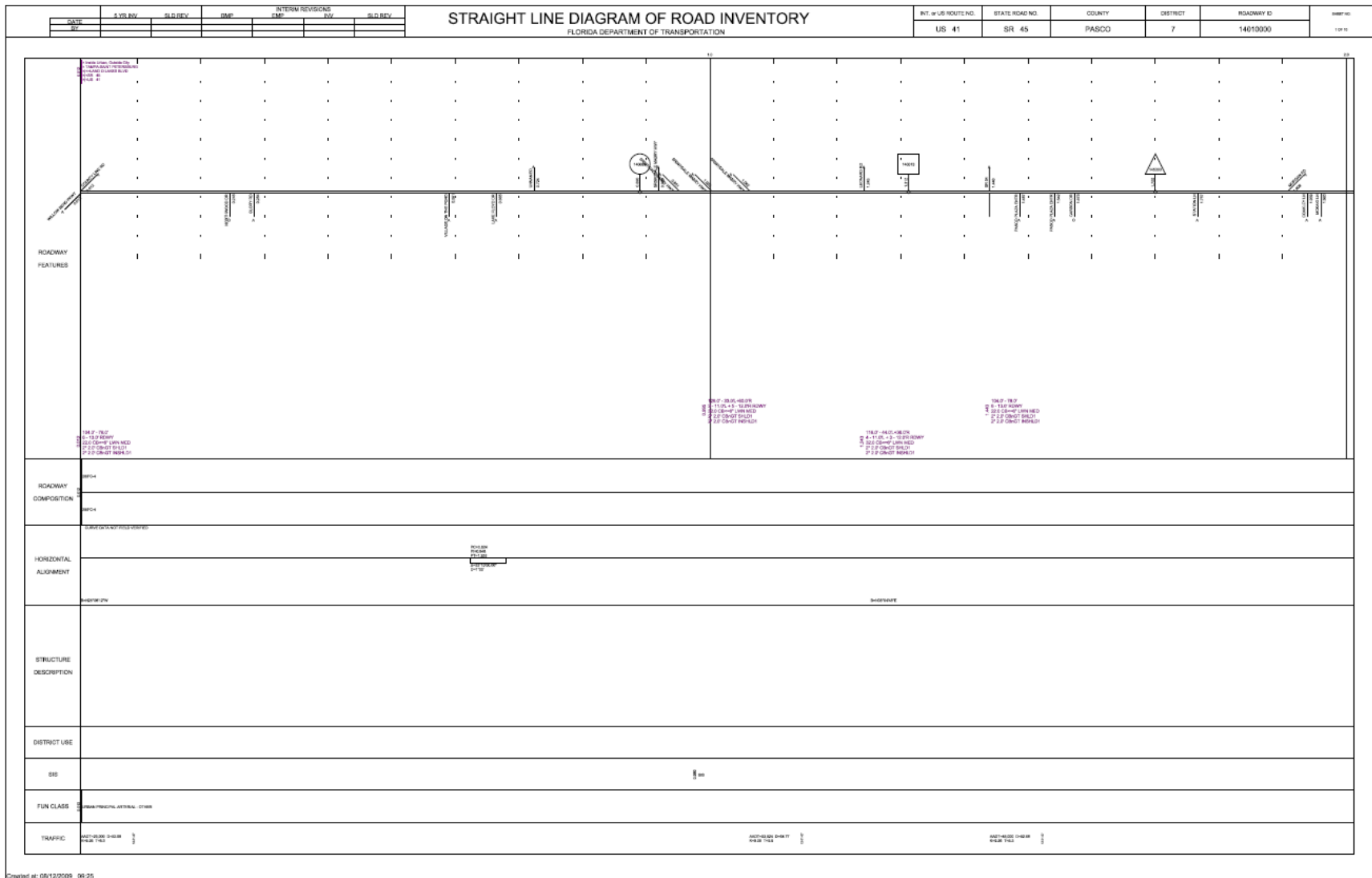
Figure 3.3 SLD Sample with One Partition

Route Name and Number

Feature 111

Optional Symbology

State Road Numbers: 44, 618, FLORIDA County Road Number: 2196, 5A

Feature 113

Optional Symbology

Interstate Number: 75   U.S. Route Number: 301, US 41, ALT 98

This feature identifies the federal route number.

Feature 114

Local Name: "<=West Main Street"

Urban Classification

Feature 124

Location Codes:
Outside City & Urban
Inside Urban, Outside City
Inside City, Not Urban
Inside City & Urban

Report Format:
X URBAN & MUNICIPAL STATUS
X URBAN AREA AND/OR CITY NAME

Examples: Possible combos (change begins/ends on side of X's)

X INSIDE CITY & URBAN
X WINTER GARDEN, ORLANDO
X
X
Ex: 1

X INSIDE URBAN, OUTSIDE CITY
X ORLANDO
X
X
Ex: 2

Intersections

Feature 251

Identifies the intersecting road names, 9 directions, and 4 surface types.

FLOYD BLVD 0.726   1.499   RAMP # 023...C 15.989

Intersection Surface Types:
A - Asphaltic Concrete
B – Brick
C - Portland Cement Concrete
O - Other

W COMMERCIAL BLVD   S MIAMI AVE 0.136   WINN DIXIE ENTR 12.552   ENTR 12.572   EB OFF TO SR 50 16.000

Optional Symbology

WINN DIXIE

ROADWAY FEATURES

Type Road

Feature 120

Describes the types of roadways on a straight-line as divided, not divided, or one-way.

Not Divided Roadway or One-way

Left Side
Right Side

Divided Roadway

Most roadways are inventoried in the direction of South to North or West to East.

Left Side
Right Side

INVENTORY DIRECTION

Surface and Lane Width

Features 212, 214, 215, and 219

Identifies the total width for Through Lanes, Medians, Outside Shoulders, and Inside Shoulders.

72.0' = total Through Lane surface width

291.0' = total road width

291.0'- 72.0'
6 - 12.0' RDWY
195.0' LWN MED
2*10.0' PVD SHLD1
2*2.0' LWN SHLD2
2*10.0' PVD INSHLD1

291.0'= 72.0' of RDWY + 195' LWN MED + 20' PVD SHLD1 + 4' LWN SHLD2

Traffic Monitoring Feature 326

Identifies Traffic Monitoring Sites.

For further information contact the Traffic Counts Section.

Through Lanes

Feature 212

Identifies the total width for Through Lanes.
e.g. 72.0' = 6 Through Lanes each averaging 12.0' wide.

291.0' - 72.0'
6 - 12.0' RDWY
195.0' LWN MED
2*10.0' PVD SHLD1
2*2.0' LWN SHLD2
2*10.0' PVD INSHLD1

The leading "6" identifies that there are six 12-foot average Through Lanes.

Types of Traffic Count Stations:

TTMS - Telemetered Traffic Monitoring Site
PTMS - Portable Traffic Monitoring Site
Road Tubes - Tube Count Site

ROADWAY COMPOSITION

Pavement Surface Type Feature 230

Identifies the Pavement Surface Type.

Types of Pavement Surfaces:
08 - Portland Cement Concrete
25 - Brick
28 - Asphaltic Concrete
99 - Other

Format:

MP   Surface Type Friction Course

Examples:

Not Divided Road:
28/FC-2

Divided Road:
28/FC-2
28/FC-2

Surface Layers Feature 232

HORIZONTAL ALIGNMENT

Non-Curve Intersection Feature 220

Identifies the Non-Curve Point of Intersection.

Non-Curve Point of Intersection Codes:
Δ - Horizontal Curve Central Angle (degrees)
PI - Point of Intersection (MP)
B - Bearing = Δ & PI (non-gradual curves or directional change only, major turns shown using Bearings)

Examples with and without Bearing:

Shift to the right:
PI = 12.456
Δ = 9°15'00"

Shift to the left:
Δ = 9°15'00"
PI = 2.091   B = N15°07'00"W

Horizontal Curve Feature 221

STRUCTURE DESCRIPTION

Structures & Crossdrains

Types of Structures:

Feature 241
CBC - Concrete Box Culvert
CC - Concrete Pipe
CIP - Cast Iron Pipe
CMP - Corrugated Metal Pipe

Feature 258
BR - Bridge (roadway travels on structure)
UP - Underpass (roadway travels under structure)
CB - Box Culvert ≥ 20'

Structure Attributes:
MP - Milepoint
TS - Type of Structure
SN - Structure Number
DIA - Diameter
L - Length
W - Width
H - Height

Structures Feature 258

Identifies the structure number, milepoint, and structure length or width.

For further information contact the District Bridge Office.

BMP   EMP
SN
L'
TS

Crossdrains Feature 241

DISTRICT USE

For District Use

SIS

SIS Feature 147

Identifies the Strategic Intermodal System, and designated and/or emerging SIS routes and connectors.

Highway Facilities
SIS
Emerging SIS

Connectors
SIS Connector
Emerging SIS Connector

Planned
Planned SIS
Planned Emerging SIS

Planned SIS Con
Planned Emergin

FUN CLASS

Functional Classification Feature 121

Functional Classification is the assignment of roads into systems according to the character of service they provide in relation to the total road network.

Rural Functional Classification Types:

Rural Principal Arterial - Interstate
Rural Principal Arterial - Other
Rural Minor Arterial

Rural Major Collector
Rural Minor Collector
Rural Local

Urban Principal Ar
Urban Principal Ar
Urban Principal Ar

Figure 3.4 SLD Legend (source: FDOT RCI Handbook)

15

Interchanges
Feature 252

Exit Number:
EXIT # 38
Type of Interchange:
DIAMOND

WB FROM SR 44
MAIN ST
44

Types of Interchanges:
Diamond
Partial Cloverleaf
Trumpet
Y Intersection
Partial Cloverleaf
4 Quad Cloverleaf
Cloverleaf
4 Quad Cloverleaf with
Collector
Direct Connection Design
Other

Identifies the Interchanges along the roadway with the Exit Number and the Type of Interchange.

Railroads
Feature 253

Identifies the at-grade railroad crossings that intersect the roadway.

627451-B — RR Crossing Number
Check Digit

M P 5.931

At-Grade Railroad

Structures
Feature 258

Bridges/Box Culverts: (roadway travels on structure)
Facility Crossing

Underpasses: (roadway travels under structure)
1ST AVE

Structure   Structure

Identifies the Structures intersecting the roadway and the names of the Facility Crossings.

Outside Shoulders
Feature 214

Identifies the Outside Shoulder Width and Type.
e.g. 4' Paved Shoulder1 Left, 8' Lawn Shoulder2 Left, and 12' Lawn Shoulder1 Right.

291.0' - 72.0'
6 - 12.0' RDWY
195.0' LWN MED
4.0' PVD SHLD1 - LT
8.0' LWN SHLD2 - LT
12.0' LWN SHLD1 - RT
2*10.0' PVD INSHLD1

Different shoulder widths from side to side are noted with "LT" - Left and "RT" - Right.

Medians
Feature 215

Identifies the Median Width and Median Type.
e.g. 195.0' Lawn Median

291.0' - 72.0'
6 - 12.0' RDWY
195.0' LWN MED
4.0' PVD SHLD1 - LT
8.0' LWN SHLD2 - LT
12.0' LWN SHLD1 - RT
2*10.0' PVD INSHLD1

Inside Shoulders
Feature 219

Identifies the Inside Shoulder Width and Type. This measurement is included in the Median Width.
e.g. 2*10' Paved Inside Shoulders

The leading "2" identifies that there are two-10 foot paved inside shoulders.

291.0' - 72.0'
6 - 12.0' RDWY
195.0' LWN MED
2*10.0' PVD SHLD1
2*2.0' LWN SHLD2
2*10.0' PVD INSHLD1

The Inside Shoulder Width is excluded from the total measurement of 291.0' because it is included in the Median Width.

TTMS Example:
This station number and location are continuous traffic counts for a specific permanent site. The data is transmitted through telephone lines to Central Office.

Station Number → 5057
MP — 1.000

PTMS Example:
This station number and location are seasonal noncontinuous traffic counts for a specific permanent site.

Station Number → 3056
MP — 1.000

Road Tube Example:
This station number and location of a portable traffic monitoring site that uses rubber hoses for senses.

Station Number
0043
MP — 1.000
Optional Symbology

Surface Layers — Feature 232

Identifies the Type of Friction Layer Course.

Types of Friction Layer Courses:
0 - None   5 - Type 5
1 - Type 1   6 - Type 6
2 - Type 2   7 - Type 9.5
3 - Type 3   8 - Type 12.5
4 - Type 4   9 - Other

Format:
MP — Surface Type Friction Course

Examples:
Not Divided Road:
28 FC-2   1.000

Divided Road:
28 FC-2
28 FC-2   1.000

Horizontal Curve — Feature 221

Identifies the Horizontal Curve data such as Bearings, Central Angles, Degrees of Curves and Points of Intersection.

Horizontal Curve Codes:
Δ - Horizontal Curve Central Angle (degrees)
D - Degree of Curvature (degrees or radians)
PC - Point of Curvature (MP)
PI - Point of Intersection (MP)
PT - Point of Tangency (MP)
B - Bearing = Compass Bearing on Tangent, i.e. compass direction N or S in degrees & curve

Examples with and without Bearing:

Curve to the right:
PC = 3.519
PI = 3.577
PT = 3.632
D = 0°05'00"
Δ = 0°25'30"   B = S89°32'25"E

Curve to the left:
Δ = 0°48'00"
D = 0°05'00"
PC = 3.965
PI = 4.056
PT = 4.147

Crossdrains — Feature 241

Identifies the type of crossdrain, the number of pipes, and the crossdrain diameter.

For further information contact the Maintenance Office.

Crossdrains:
MP
NC - Dia (" or mm) X L'TS

Culverts:
MP
NC - Dia (" or mm) X L'TS

Examples:
1-14" 1-18" X 180' CC
1-28" 1-24" X 150' CC
1.393 1-15" X 80' CC
1.670 1-4" X 4' X 145' CBC

Bridges and Box Culverts
20 feet and over in opening have a structure number and are coded under Feature 258.

Box Culverts and Crossdrains
less than 20 feet in opening do not have a structure number and are coded under Feature 241.

Planned SIS Connector
Planned Emerging SIS Connector

For further information contact the Systems Planning Office.

Urban Functional Classification Types:

Urban Principal Arterial - Interstate
Urban Principal Arterial - Other Freeways and Expressways
Urban Principal Arterial - Other

Urban Minor Arterial
Urban Collector
Urban Local

Functional Classification Example:

0.000 Rural Principal Arterial 1.149 Rural Minor Arterial

Figure 3.4 SLD Legend (continued)

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3.2 SLD Data Structure

The SLD's content is produced based on the RCI data retrieved from the FDOT database. RCI data are organized as Feature, which is a general grouping of physical attributes of a roadway that is identified by a unique three-digit number and a unique name, and Characteristic, which is a more specific element of the roadway and is identified by a unique name up to eight characters long. All RCI Features and Characteristics that are used for SLDs are listed in Table 3.1. The description of the Features and Characteristics can be found in the FDOT RCI Field Handbook.

Table 3.1 List of RCI Features and Characteristics for SLD

Section	Feature	Characteristic
Roadway Features	111- State Road System	STROADNO STRDNUM2
	113- AASHTO	USROUTE USROUTE2
	114- Local Name	LOCALNAM
	124- Urban Classification	HWYLOCAL PLACECD URBAREA
	120- Type of Road	TYPEROAD
	212- Through Lanes	NOLANES SURWIDTH
	214- Outside Shoulders	SHLDTYPE SHLDTYPx SLDWIDTH SHLDWTHx
	215- Highway Median Type	MEDWIDTH RDMEDIAN
	219- Inside Shoulders	ISLDTYPE, ISLDTYPx ISLDWDTH, ISLDWTHx

Table 3.1 (continued)

Section	Feature	Characteristic
Roadway Features	251- Intersections	INTSDIRx
		INTSRTPx
	252- Interchanges	EXITNO
		INTERCHG
	253- Railroads	CHKDIGIT
		RRCROSNO
	258- Structures	BOXCULNO
		BRIDGENO
		FACCROSS
		UNDPASNO
	326- Traffic Monitoring Sites	TRFSTANO
		TRSTATYP
Roadway Composition	230- Surface Description	SURFNUM
	232- Surface layers	FRICTCSE
	221 - Horizontal Curve	BEARING
		HRZCANGL
		HRZDGCRV
		HRZPTINT
Structure Description	241 - Cross Drains (and Box Culverts)	BOXCULHT
		BOXCULLT
		BXCULGTH
		CRSDRLGH
		NOBXCULV
		NOCRDRAN
		PIPEDIAM
		PIPEHIGH
		PIPETYPE
		PIPEWDTH

Table 3.1 (continued)

Section	Feature	Characteristic
Horizontal Alignment	220 - Non-Curve Intersection	NCPTINT
SIS	147 - Strategic Intermodal System	SISFACTP
Function Classification	121 - Functional Classification	FUNCLASS
Traffic Data	331 - Traffic Flow Breaks	AADTDATE AVGDFACT AVGKFACT AVGTFACT SECTADT

4.   Summary, Conclusions, and Suggestions

In general, the overall goal of this project is the development of a new application that generates SLDs and reduces user's workload. This was accomplished with a new Web-based application that: (1) replicates the current SLD application in its entirety; (2) provides improvements (selection and configuration) in the method of generation and overall appearance; and (3) includes a portion of the following desired enhancements: reduction of over-printing and ability to include additional RCI data.

The first and foremost goal of the project is the replication of the functions of existing SLD application, enabling current users the ability to continue to generate SLD products as required by the FDOT. In this project, the basic capabilities listed below have been achieved:

- User-friendly Web-based user interface that requires a short learning curve
- A flexible method for selecting a roadway
- Compliance with departmental requirements for applications and other Web-based products (e.g. Section 508 compliance)
- Use of an appropriate programming language for an application with databases
- Execution in a web-based environment that is easily accessible to all appropriate department personnel

Beyond the replication of the existing SLD application functions, a number of enhancements were developed in this project as shown in following:

- A customization function to specify the output attributes (e.g. selection of Characteristics to be displayed, font size/color, paper size, scale per page, etc.)
- A comprehensive user guide
- Generation of PDF and/or DXF formats
- Generation scheme that can store user-defined output attributes
- The SLD generation logic of the application should include routines that separate text in order to keep them legible
- Inclusion of additional RCI Features

However, some issues still exist in the new SLD application. One expectation of the research is the application of GIS technology in the SLD production. But the requirement was removed from this project due to the following reasons:

- FDOT staff and USF research team had no mature scheme on how to utilize the GIS technology in the SLD application. Several ideas had been proposed and discussed, but no agreements were achieved;

- In this project, the most important task is to develop a Web-based application to realize the functions of querying RCI data, integrating new RCI features, and printing SLD products. The application of GIS technology can enhance the functionality of the new SLD application, but are not the indispensable component of the SLD application. Additionally, to develop a GIS application is a time-consuming task; for ensuring the core task of this research project could be completed on time, the GIS application is proposed to be achieved in the next phase.

Another unachieved expectation is the integration of Aerial photos, Videologs, and GIS Basemaps. By a preliminary review performed by FDOT staff and USF team, it was found that the additional data are stored in different databases, in different data format, and with different programming APIs. It is too complex to retrieve the additional data from the heterogeneous data sources and match to the original SLDs. Due to the difficulty which might influence the progress of the application development and deployment, this function was also proposed to be implemented in the next phase.

A successive research project is suggested to research the implementation of enhancements to the SLD in areas that will improve the appearance and add flexibility to the data included in the final product. The desire is to take advantage of available technologies for improved data display, as well as functionality. Final product considerations include:

- Presentation of a GIS map showing all state roads with identifiers for road selection

- Connection to a second FDOT database (RITA) for the reporting of items related to RCI data maintenance

- From an investigation of the feasibility of incorporating FDOT Videologs, Aerials, and/or GIS Basemap as data sources, implement the feasible data sources into the SLD output

- Generation of a listing of RCI data that changed since the last generation of an SLD for the identified road. This can be accomplished using the update dates associated with each RCI Characteristic to be displayed in the SLD

- The incorporation of additional User selectable and configurable parameters for generating customized SLDs that could affect the look of the SLD

- Generation of a SVG product besides DXF/PDF

- Ability to generate a historic SLD by selecting RCI data by date

- Improve existing logic and add new logic to separate text in order to keep it legible

- Compliance with departmental requirements for applications and other web-based products (e.g. Section 508 compliance)

- Addition of user desired items, such as: Overall Status in SLD header and FDOT logo in Title area

- Improve Automatic Scaling capabilities by adding better scale determining logic

- Extension of the context sensitive help system

APPENDIX

Straight-line Diagrammer User Guide

Introduction

Straight-line Diagrammer is a Web-based application to produce Straight-line Diagrams (SLDs), which are graphical representations of Roadway Characteristics Inventory (RCI) data reported for roadways in Florida, in an automatic manner. Users can follow a wizard to complete the following tasks:

1) Select roadway segments
2) Select RCI Features and display settings
3) Customize Page and Section configurations
4) Save configuration scheme, input inventory data, indicate output format, and submit

Finally, users can download the generation results in a zip file which compresses all PDF files and DXF files.

For utilizing the Straight-line Diagrammer, users need:

- Permission for accessing the FDOT Intranet, and
- Personal computer with a Web Browser

Tips: The application is fully compatible with MS Internet Explorer, Firefox, Apple Safari, and Google Chrome.

Login

- Login to a work station computer with an appropriate FDOT computing account

- Enter the URL of the Straight-line Diagrammer in web browser, and the Welcome Page displays on screen

- Click **Enter** to access the generation wizard

Skip to Main Content

Florida Department of Transportation

Straight-line Diagrammer 0.6.7

Welcome, ZHENYU WANG

Straight-Line Diagrammer is a web-based application to produce SLDs automatically. Users could follow the wizard to complete the following tasks:
1. Specify roadway segments
2. Select roadway inventory data
3. Customize display properties
4. State output formats, and
5. Download SLDs

A full description of Straight-Line Diagram Generator is given in the User Guidance.

Enter

Email questions and comments to:
Eric Hanson
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Step 1: Roadway Selection

Users should select a roadway segment in which they are interested before performing SLD generation. For this purpose, Roadway ID and Milepoints should be specified in Step 1.

Input Roadway ID

Two methods for specifying Roadway ID are available:

- Enter Roadway ID (8-digits number combing county, section, and sub-section)

  in

- Click to display the beginning and ending milepoints for the whole segment

Or

▪ Select District, County, and Roadway ID respectively from

Specify Milepoints

▪ Change the beginning and ending milepoints to determine the generation range.

Step 2: Feature Selection

After selecting the roadway segment, users can select RCI Features/Characteristics and change display setting of Feature Blocks.

Select Feature and Characteristics

- Expand Collapsible Panels to show the list of Characteristics which are organized by Features

  - Click **Expand All** to expand all panels, or click ⊗ to expand an individual panel

  - Click **Collapse All** to collapse all panels, or click ⊗ to collapse an individual panel

- Select Characteristics for printing
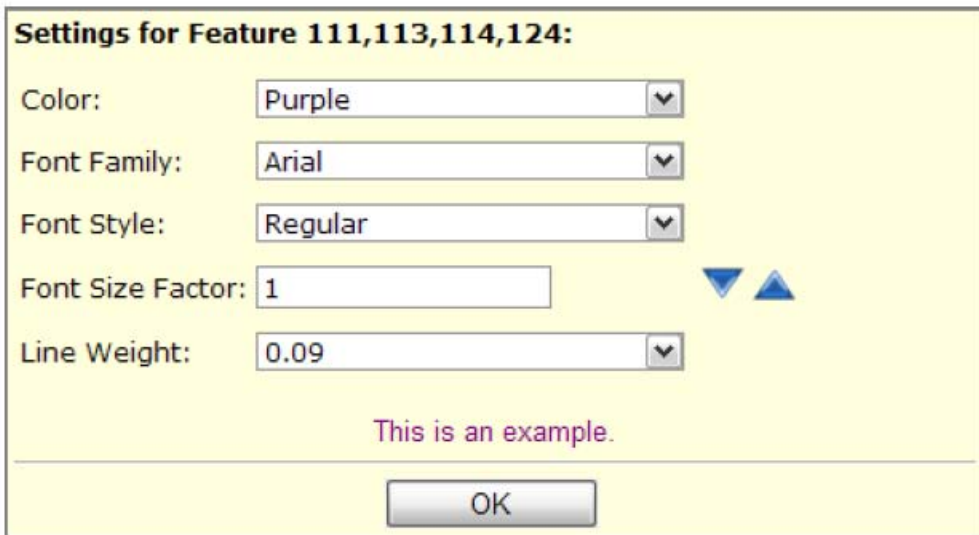
  - o Click **Select All** to select all characteristics, or click to select an individual characteristic

  Tips: If the item "Off System Road Data Only" is the only one checked, then the Active Off the SHS road data would be plotted; if not, only the Active on the SHS road data would be printed. The "select all" function does not work on this item.

  - o Click **Unselect All** to unselect all characteristics, or click to unselect an individual characteristic

Change Display Settings

- Click **Display Settings ( )...** to display the Display Setting Dialog

  Settings for Feature 111,113,114,124:

Color:	Purple
Font Family:	Arial
Font Style:	Regular
Font Size Factor:	1
Line Weight:	0.09

  This is an example.

  OK
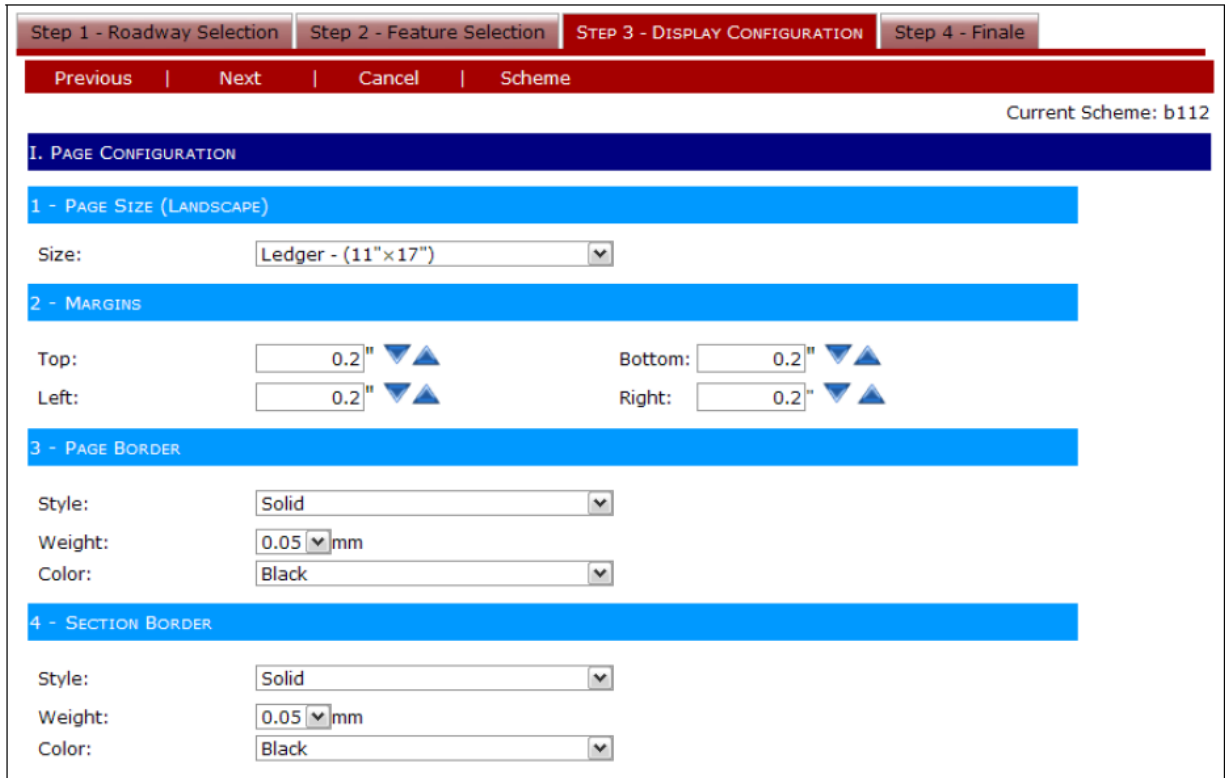
- Change display settings of Feature Blocks

  *Tips: Font Size Factor is not an absolute value to control font size but a relative factor. **font size = predefined font size × font size factor**.*

- Click **OK** to save settings

Step 3: Display Configuration

Users can configure Page, Section, and Partition properties in Step-3.

- Configure Page properties, including Page Size, Page Margins, Page Border, and Section Border

- Configure Font properties for Page Title, Section Title, and Section A-D Title, including Font Color, Font Family, and Font Size Factor

Tips: Font Size Factor is not an absolute value to control font size but a relative factor. **font size = predefined font size × font size factor**.

- Set the number of partitions per page (1/page or 2/page)
- Determine the length of the selected road segment per partition by three methods.
  - Automatic: the application decides the display length automatically
  - Constant: users define uniform value of display length for all partitions
  - Manual: users give the value of display length for each partition individually

Step 4: Finale

Users can save their settings scheme, input revision data, and select output format.

Save Scheme

- Scheme is a collection of user settings which can be saved so that users do not need to reconfigure display settings in next generation of SLDs.

  - Click **Save Scheme** to save the current scheme
  - Click **Select Another Name ...** to load another scheme
  - Click **Input New Name ...** to create a new scheme

Revision Block Data

  o Input Revision Block Data which display in the Section A of SLDs

Submission

  ▪ Select output format: DXF, PDF, or both of them

  ▪ Click   Submit   to generate SLDs

Download Results

When SLDs are produced, the results display on the Result Page.

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Straight-line Diagrammer 0.6.5

Exit

Querying Completed. Generating Completed.

Download SLD Products ...

You may need a PDF reviewer to open the SLD products.
Please download the installation file from here.

Back to Wizard

Email questions and comments to:
Eric Hanson
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- Click Download SLD Products ... to download a zip file which contains SLDs

- Click Back to Wizard to return to Wizard

- Click Logout to exit the application