Final Report

BD548-27

IDENTIFICATION OF INTERSECTIONS' CRASH PROFILES/PATTERNS TO INCLUDE UNSIGNALIZED INTERSECTIONS AND EXPAND THE SAFETY/TRAFFIC DATABASE

Part II

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16. Abstract

The aim of the web site development aspect of this project was to add functionality to the signalized intersection crash profiles web site that was delivered as part of the previous project, 'Identification of Intersections' Crash Profiles/Patterns Phase II, Client/Server Computer Application Deployment' and integrate functionality to support the research on unsignalized intersections performed under this project. This required significant changes to both the web site and underlying database.

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CHAPTER 1. INTRODUCTION

1.1 Overview

After the submission of the final report 'Identification of Intersections' Crash Profiles/Patterns Phase II, Client/Server Computer Application Deployment' it was noted that more functionality was required for the web site that was developed in order to make it a more meaningful resource. The desired functionality was the inclusion of more signalized intersection inventory fields beyond what was included in the previous project. These fields encompass intersection geometry, roadside hazard, traffic control, signal timing, timing plans and traffic characteristics.

In addition, as part of this project, research was performed to categorize unsignalized intersections and create a web site that parallels the site created for the signalized intersections. This portion of the final report seeks to describe the changes to the existing web site as well as the sister web site created for the unsignalized intersections.

CHAPTER 2. MODIFICATIONS TO SIGNALIZED INTERSECTION WEB SITE

2.1 Site Navigation

The navigation of the site was enhanced using cascading style sheets (*css*) which controlled the appearance and behavior of an unordered list. To the user the site navigation appears as a drop down menu underneath the site title (see Figure 1 in the Appendix). Hovering the mouse cursor over the content areas causes submenus to appear. To maintain accessibility, the navigation system is part of an HTML unordered list which is demonstrated by disabling the styles in the browser (see Figure 2 in the Appendix). The navigation system is held within a .NET user control that is embedded near the top of every web page within the site. Appearing before the navigation links is a link that allows a user using a assistive device such as a screen reader to bypass the navigation of each page. This skip navigation link is hidden from the visual user.

The web pages of the two sister sites are stored within the same web application. Switching between the two sites is performed easily by hovering the mouse cursor over the 'home link' and clicking on the link that appears below it (see Figure 3 in the Appendix).

2.2 Enhanced Intersection Inventory

The original web site was designed to store only data that was used to classify signalized intersections. These data included:

- County

- Node number
- Number of legs
- State Road number/name
- State Road milepoint(s)
- Number of lanes
- Annual average daily traffic
- Speed limit
- Directionality (one way, two way, ramp)

The web site and database were expanded to include a multitude of fields of data and are divided into similar areas on different web pages. A signalized intersection does not have to be categorized in order for the extra data to be submitted. The data are:

- Geometry data (see Figure 5 in the Appendix)
    - Degree of horizontal curve
    - Select percent of grade
    - Surface width
    - Surface type
    - Median width (ft.)
    - Median type
    - Shoulder type (by approach)
    - Offset of left turn lanes (by roadway)
    - Skew angle
    - Channelization
    - Refuge island

    - Distance to nearest upstream signalized intersection (by approach)
    - Rural/urban designation
- Roadside hazard (see Figure 6)
    - Clear zone (by approach)
    - Sideslope (by approach)
    - Off-road features (by approach)
    - Guardrail (by approach)
    - Recoverable (by approach)
- Traffic Control (see Figure 7, Figure 8 and Figure 9 in the Appendix)
    - Type of control
    - Signal installation type
    - Traffic detection type
    - Signal control system
    - Back plates (by approach)
    - Late night flashing operation
        - Flashing start time (24 hr clock)
        - Flashing end time (24 hr clock)
    - Right turn restriction (by approach)
    - Crosswalk (by approach)
    - Pedestrian signal (by approach)
    - Auditory alerts(by approach)
    - Enforcement lights
        - Northbound left turn

        - Northbound through
        - Southbound left turn
        - Southbound Through
        - Eastbound left turn
        - Eastbound Through
        - Westbound left turn
        - Westbound Through
    - Automated red light running cameras (by approach)
    - Dilemma zone detection control system
    - Transverse rumble strips (by approach)
    - Rumble strips - distance from intersection (ft.) (by approach)
    - Lane line, arrow, and other pavement marking(by approach)
    - Cross street sign (by approach)
    - Advance directional signing, street name signing (by approach)
    - Roadway lighting (by approach)
    - High mast lighting (by quadrant)
    - Bus stop location (by approach, by side)
- Signal timing (see Figure 10 in the Appendix)
    - Cycle length, in seconds
    - Signal coordination
    - Protected/permitted left turn operation (by approach)
    - Flashing yellow arrow for permissive left turn (by approach)
    - Leading/lagging left turn operation (by approach)

    - Leading pedestrian phase, in seconds (by approach)

- Timing plan (see Figure 11 in the Appendix) – this page was modeled after the spreadsheet used by the Orange County Traffic Operations Department. On this page, the user can also download the timing plan in Microsoft Excel format.
    - Basic timing
        - Min green (sec)
        - Vehicle gap (sec)
        - Max green 1 (sec)
        - Max green 2 (sec)
        - Yellow (sec)
        - All-red (sec)
        - Walk (sec)
        - Flashing don't walk (sec)
        - Recall/memory
        - Detector delay (sec)
        - Dual entry
        - Overlap
        - Flash
        - Speed limit (mph)
        - Crossing distance (ft)
        - Pedestrian clearance (sec)
    - Coordination plans
        - Cycle

        - Split 1
        - Split 2
        - Split 3
        - Split 4
        - Split 5
        - Split 6
        - Split 7
        - Split 8
        - Offset
        - Lagging phases
        - Coordination implemented
    - Daily plan
    - Pattern
- Traffic characteristics (see Figure 12 in the Appendix)
    - Average daily traffic
        - North-South roadway
        - East-West roadway
    - Pedestrian volume count
        - North-South roadway
        - East-West roadway
    - Truck percentage
        - North-South roadway
        - East-West roadway

- Peak hour
    - Start time (military time)
    - End Time (military time)
- Peak hour turning movement
    - Northbound approach
        - Left turn
        - Through
        - Right
    - Southbound approach
        - Left turn
        - Through
        - Right
    - Eastbound approach
        - Left turn
        - Through
        - Right turn
    - Westbound approach
        - Left turn
        - Through
        - Right

When the signalized intersection web site was created, a master list of nodes was provided by the Florida Department of Transportation (FDOT) to populate the database table of intersections. This master list included county, node number, roadway id, mile point, route name

and cross street. Unfortunately, it did not indicate which intersections were signalized. Therefore, the entire inventory was included within the signalized intersection web site. With the development of the unsignalized portion of the web site, it became apparent that a method to convert an unsignalized intersection that was stored in the database as a signalized intersection was necessary. To access this new feature, the user starts at the 'intersection inventory' page (see Figure 13 in the Appendix) which now includes a new column titled 'convert'. For each intersection that has not been categorized as a signalized intersection, a link is provided in the 'convert' column to access another page that will confirm and perform the conversion (see Figure 14 in the Appendix).

CHAPTER 3. DEVELOPMENT OF THE UNSIGNALIZED INTERSECTION WEB SITE

3.1 Overview

The unsignalized section of the web site was developed to categorize unsignalized intersections and provide statistical analyses using crash data. This section parallels the signalized section and utilizes a similar design with the major exception of the color scheme. The signalized section uses a light blue background with black text while the unsignalized section uses a light green background with black text (see Figure 15 in the Appendix). Both sections are presented as two different sites but are part of the same web application. They are combined as one because the pages that perform inserting or modifications of data in the database require logging in. By including the two sections in one application, once a user has logged into one site, he or she can navigate from one site to the other without having to log in again.

3.2 Shared Functionality

The unsignalized and signalized sections are tightly integrated in that they share some functionality. From either section, a user can download the summarized crash data, upload crash data from the Crash Analysis/Reporting (CAR) application housed on the FDOT mainframe, modify which counties are in which districts and manage users.

3.3 Similar Functionality

The unsignalized section, like the signalized section, allows users to upload a file of intersection data rather than modify individual records, review the inventory of unsignalized intersections by county (see Figure 16 in the Appendix), view the category descriptions (see Figure 17 in the Appendix), produce statistical tables based on the most current crash data (see Figure 18 in the Appendix), insert new unsignalized intersections (see Figure 19 in the Appendix) and modify existing unsignalized intersections (see Figure 20 in the Appendix).

The statistic output pages are the same as the signalized intersection pages in that analysis is divided into overall, collision type, severity, light condition, surface condition, month, day of week and time of day. For each of these, the following data are provided:

- The total number of crashes that occurred at this intersection in the most recent year that data is available.
- The average number of crashes per year and standard deviation for the same category of intersection from the same county from the past 3 years. The number of intersections is provided at the top of the column.
- The average number of crashes per year and standard deviation for the same category of intersection from the same district from the past 3 years. The number of intersections is provided at the top of the column.
- The average number of crashes per year and standard deviation for the same category of intersection from the state from the past 3 years. The number of intersections is provided at the top of the column.
- The percentile for the state is provided in the last column. The choice of 80^{th}, 85^{th}, 90^{th} and 95^{th} percentile is available when selecting the intersection.

CHAPTER 4. SITE DEFINITION

4.1 Location

The site was developed using the Microsoft .NET 2.0 framework on a Windows server 2003 computer. In development, it is running in a subdirectory of the root domain.

4.2 Security

The site, as mentioned in section 3.1, requires the user to be logged in to perform data inserts and modifications. The site uses the .NET Forms Authentication protocol and restricts access based on roles. There are two authenticated roles: manager and district. The manager role is able to perform higher level tasks such as maintaining users and modifying district boundaries. The manager role is able to modify all intersection data through the web site. Users of the district role are able to modify data for their district.

4.3 Database

For development purposes, Oracle Database Express Edition 10g Release 2 (10.2) was used to create the table, views, procedures and packages. The Oracle Express Edition allowed for the development of a compatible relational database without having to acquire fee based licenses. At deployment, scripts can be generated to recreate the database schema and data within FDOT's Oracle environment.

In order for the web site to be able to communicate with the Oracle database, the Oracle Data Access Components 10.2.0.2.21 were installed.

4.4 Accessibility

To test the site's accessibility, the Web Accessibility Evaluation Tool toolbar was downloaded from the web site http://wave.webaim.org and installed as a toolbar in Mozilla Firefox (see Figure 21 in the Appendix). Each page was processed using the toolbar to evaluate each page's accessibility. The toolbar found that all but two pages have no known errors. The two pages that failed are the pages for inserting and modifying the timing plan data for the signalized intersections. These pages have so many data fields that it was more convenient to organize them in a grid similar to a spreadsheet. These pages fail because there is no corresponding label for each input field.

APPENDIX

Screen Shots from the Signalized and Unsignalized Web Sites

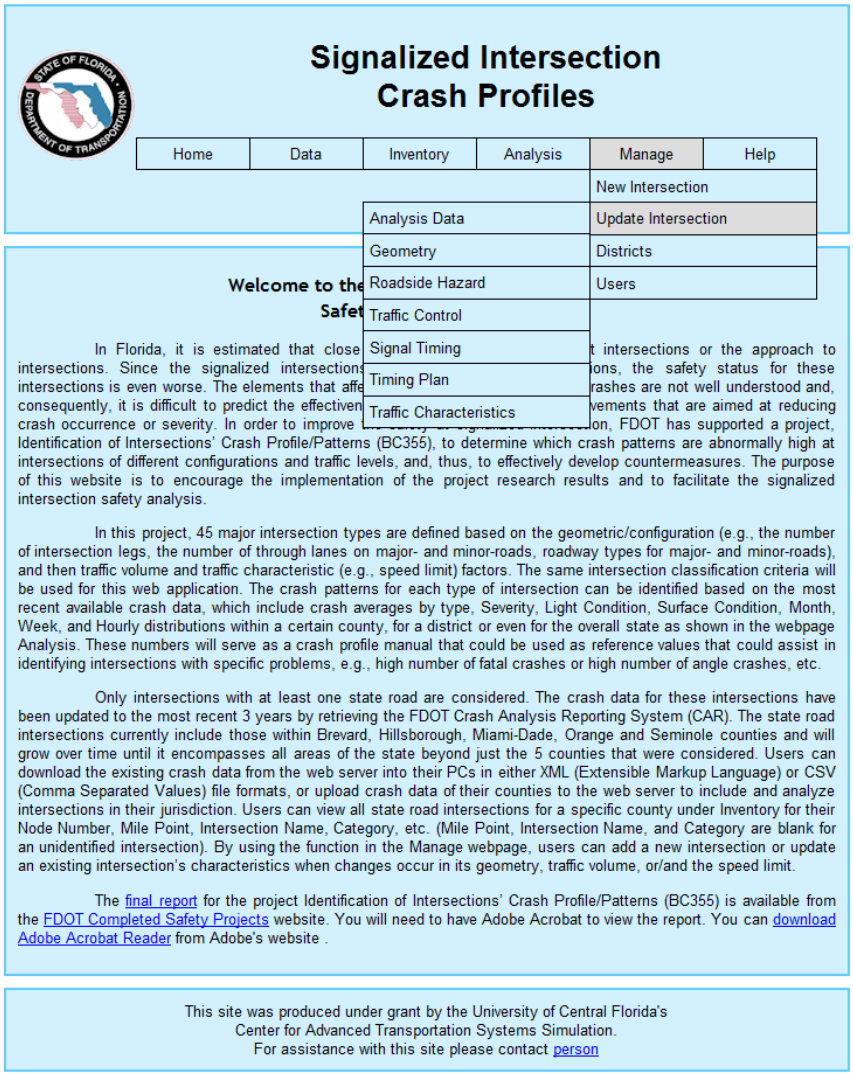


Figure 1. Enhanced visual navigation

Skip Navigation

Signalized Intersection Crash Profiles

- Home
  - Unsignalized Intersections
- Data
  - Download Summarized Crash Data
  - Upload Crashes
  - Upload Intersections
- Inventory
  - View Intersections
  - View Categories
- Analysis
  - Intersection
  - Milepoint
  - Node
- Manage
  - New Intersection
    - Analysis Data
    - Geometry
    - Roadside Hazard
    - Traffic Control
    - Signal Timing
    - Timing Plan
    - Traffic Characteristics
  - Update Intersection
    - Analysis Data
    - Geometry
    - Roadside Hazard
    - Traffic Control
    - Signal Timing
    - Timing Plan
    - Traffic Characteristics
  - Districts
  - Users
- Help

Analysis by Milepoint

Figure 2. Site navigation with styles disabled

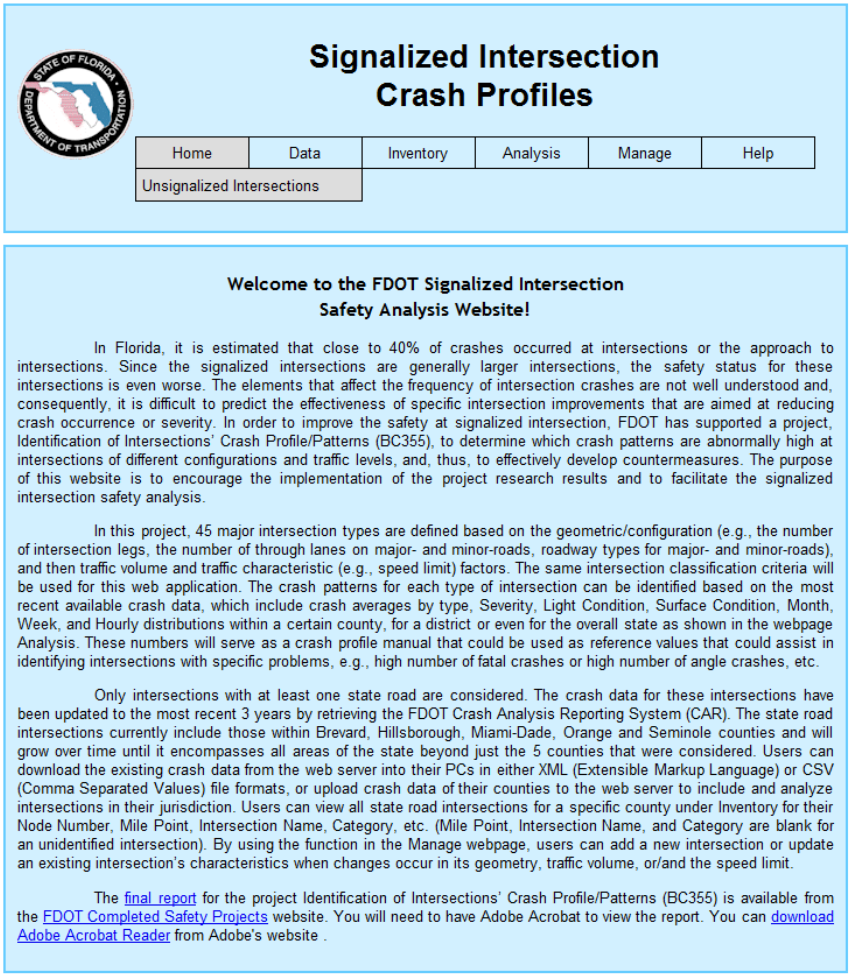


Figure 3. Switching between sites

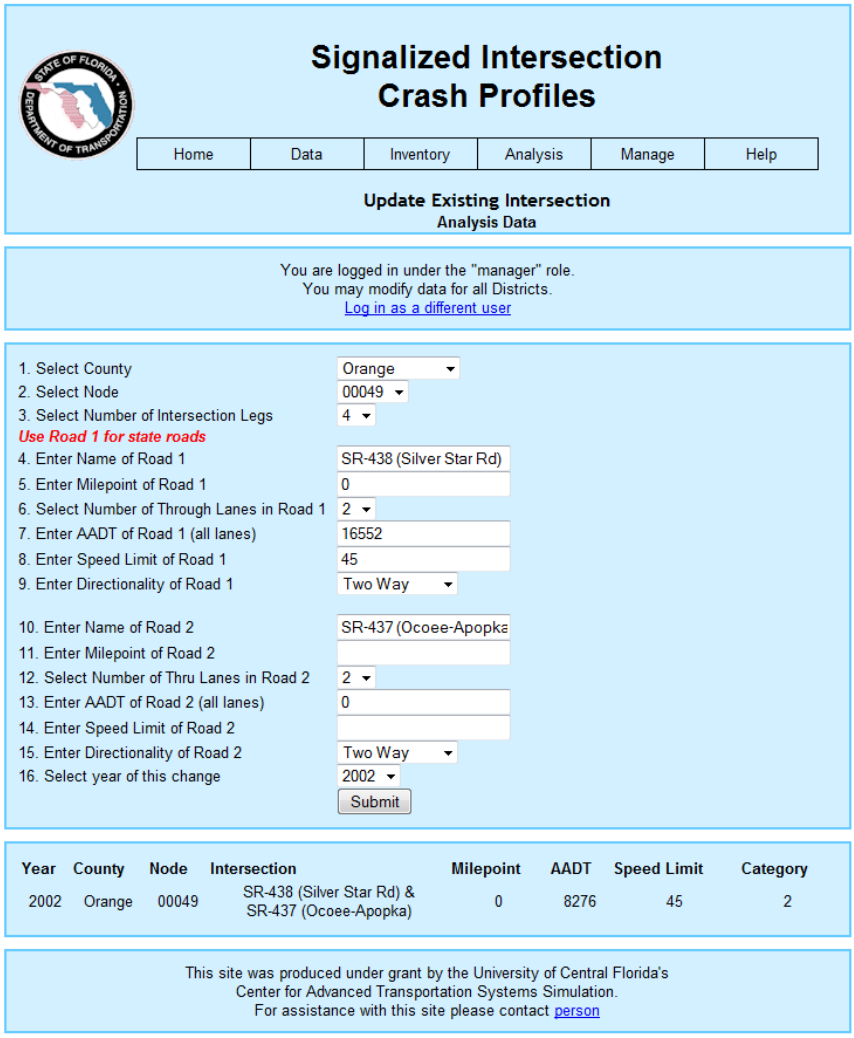


Figure 4. Analysis data

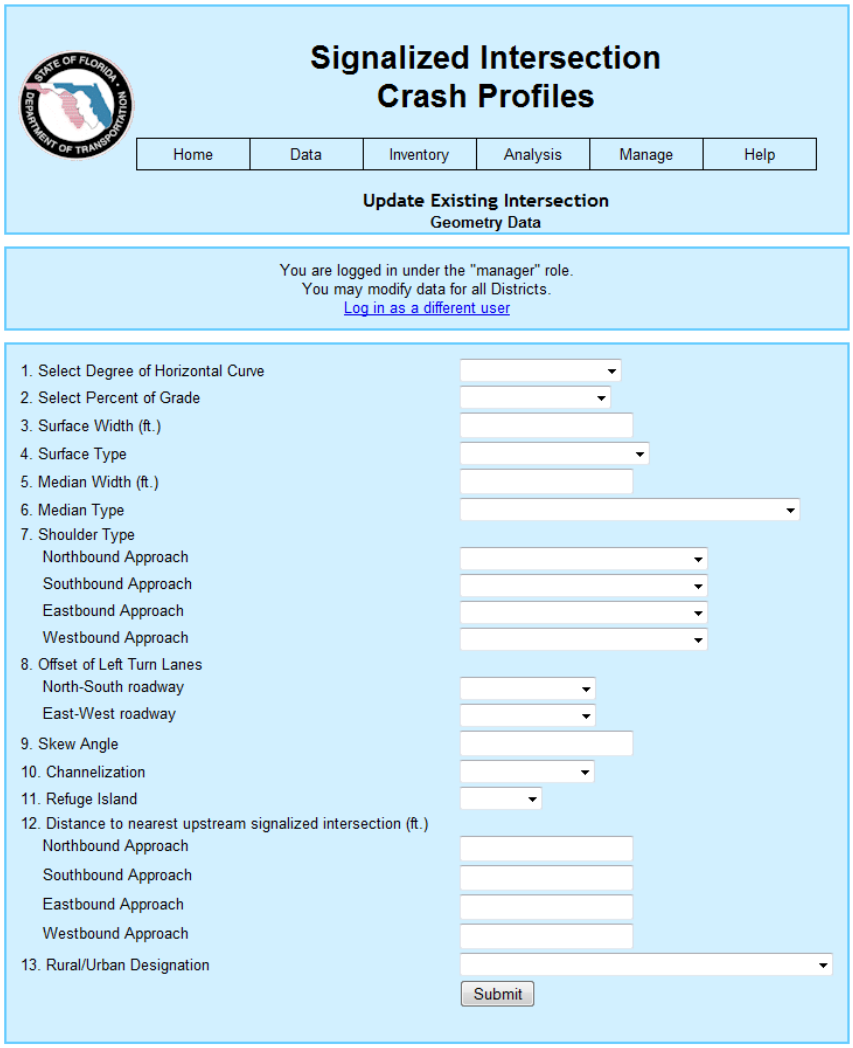


Figure 5. Geometry data

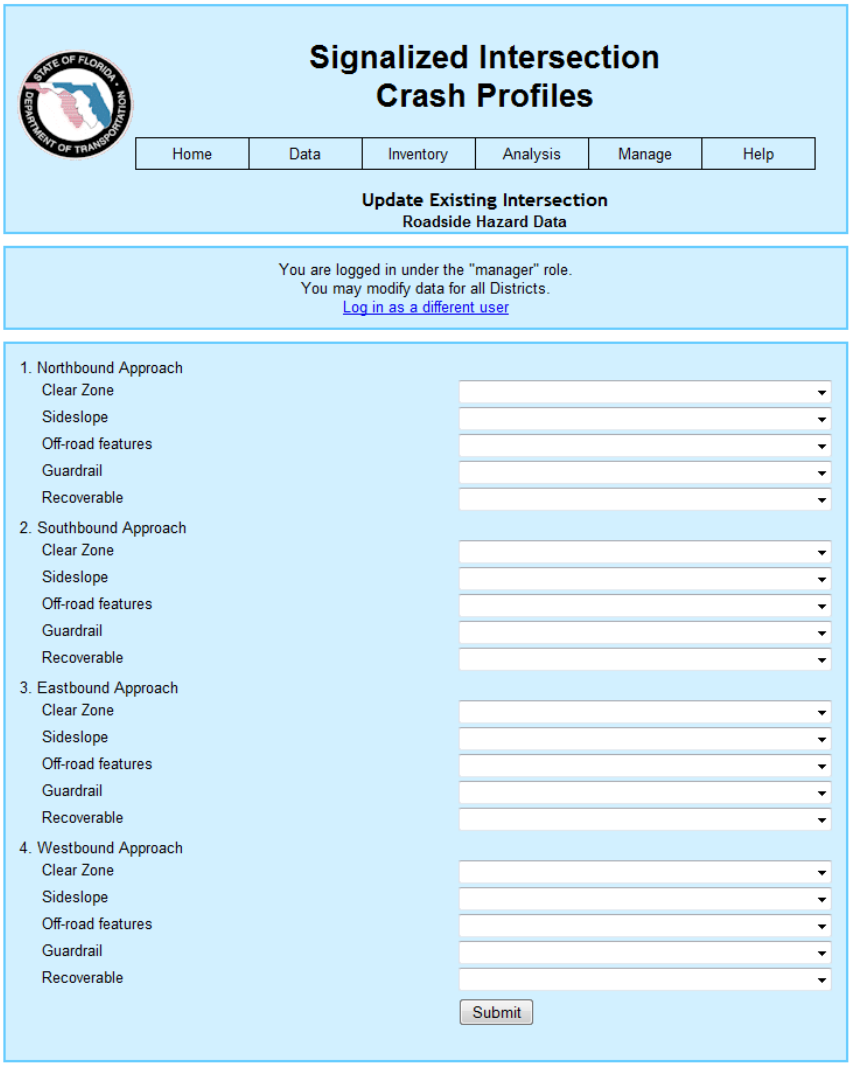


Figure 6. Roadside hazard

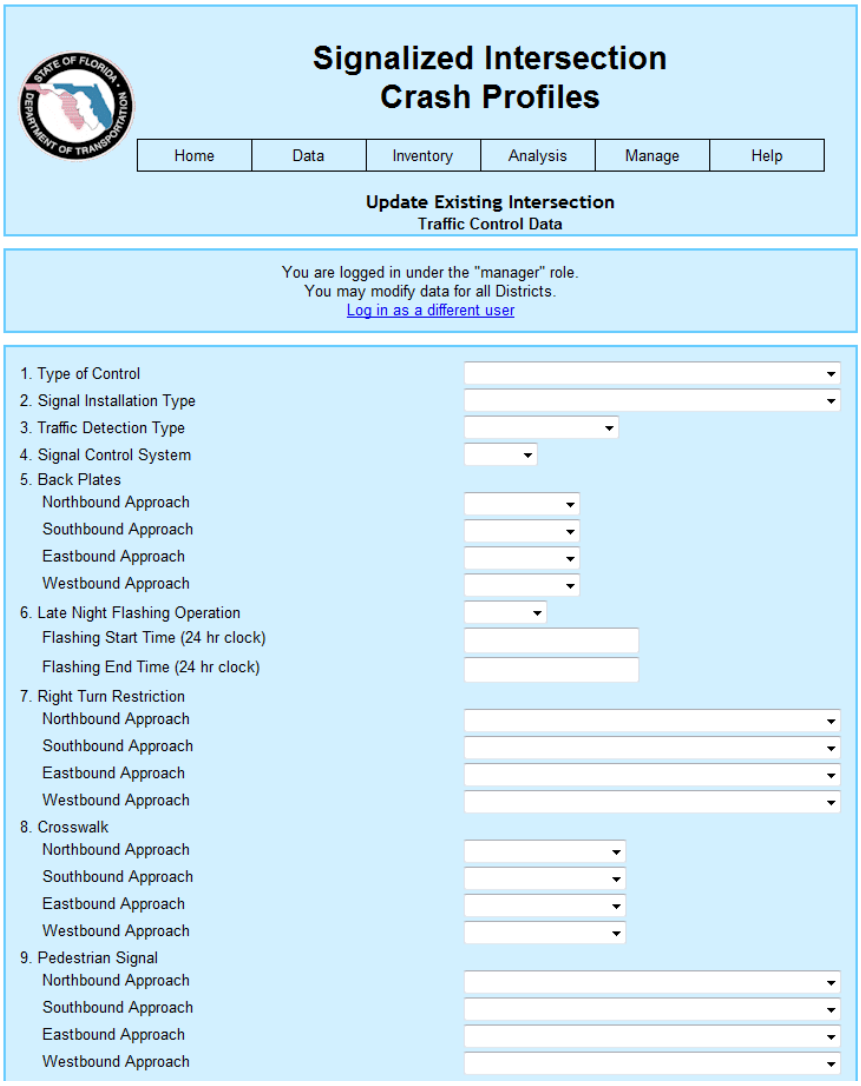


Figure 7. Traffic control

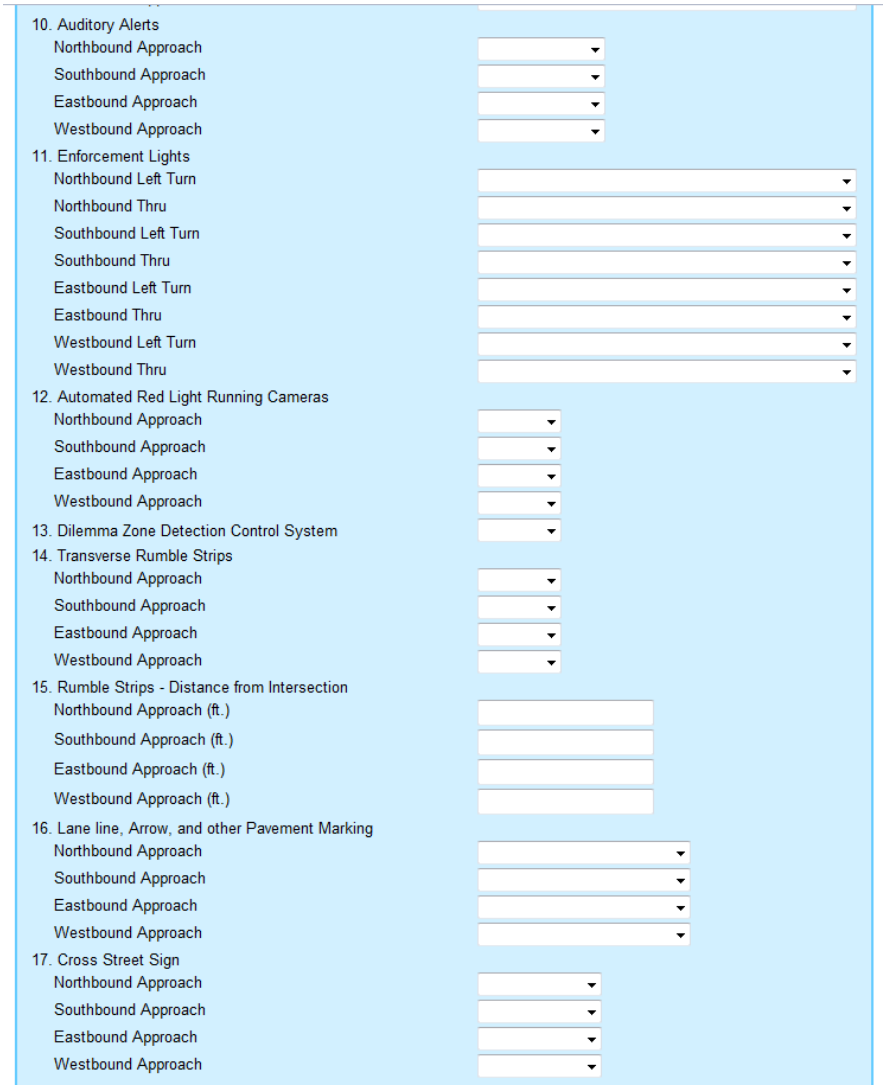


Figure 8. Traffic control (continued)

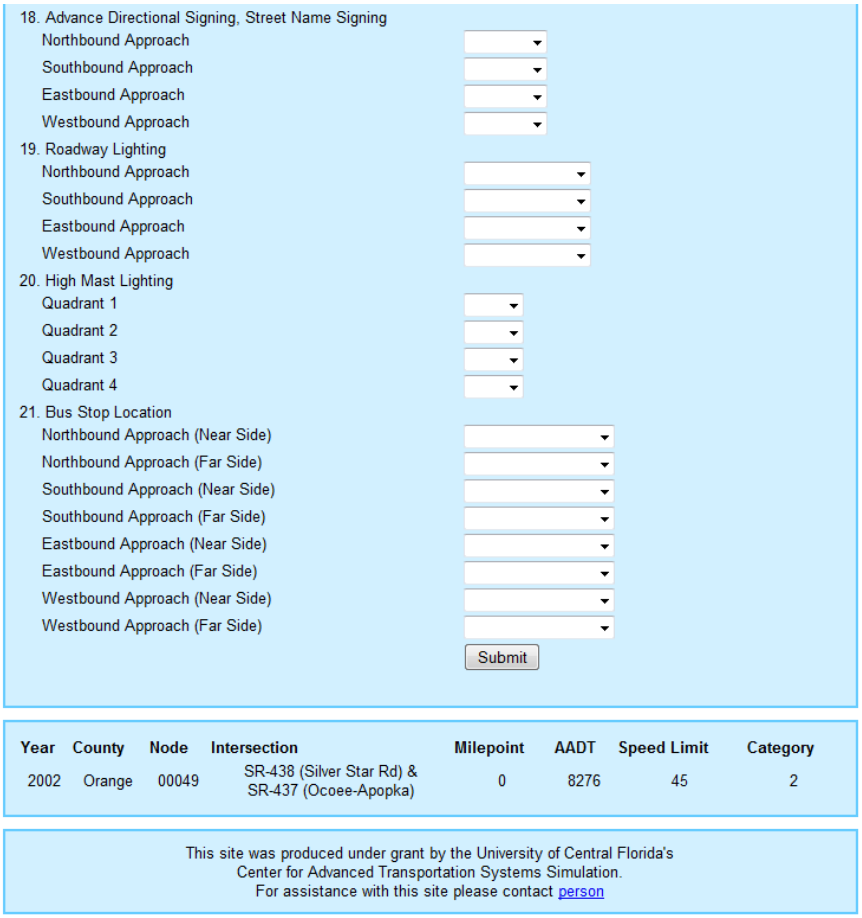


Figure 9. Traffic control (continued)

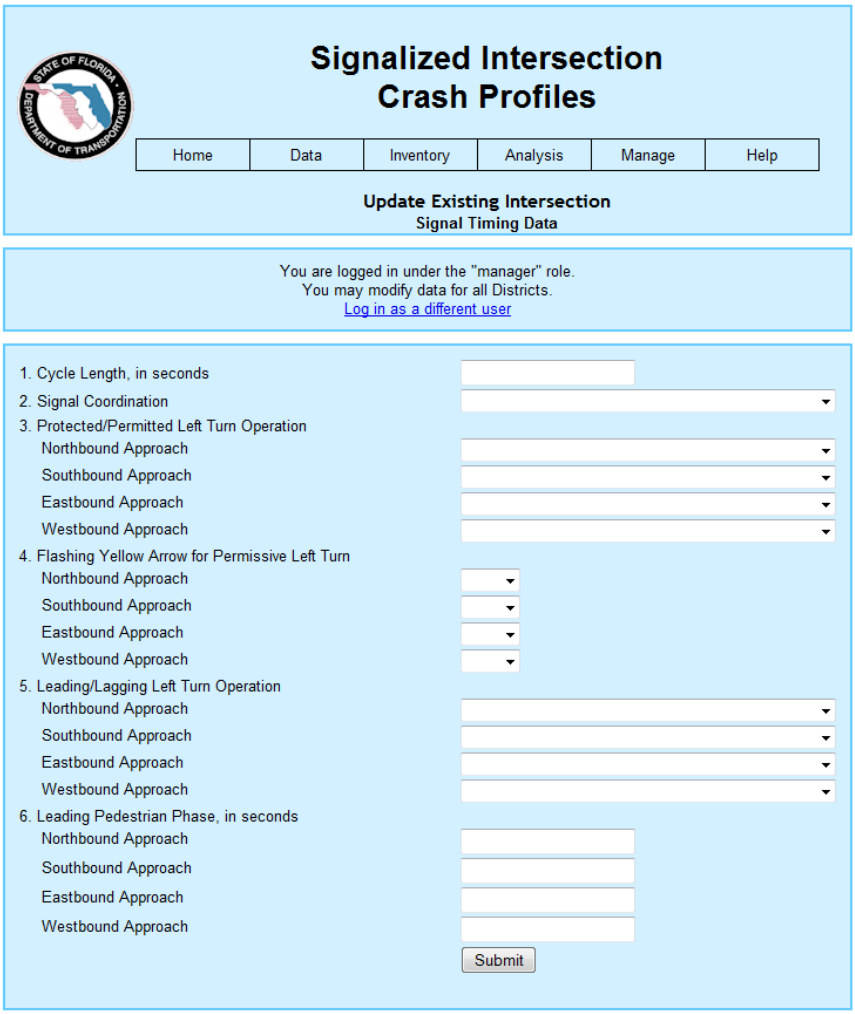


Figure 10. Signal timing

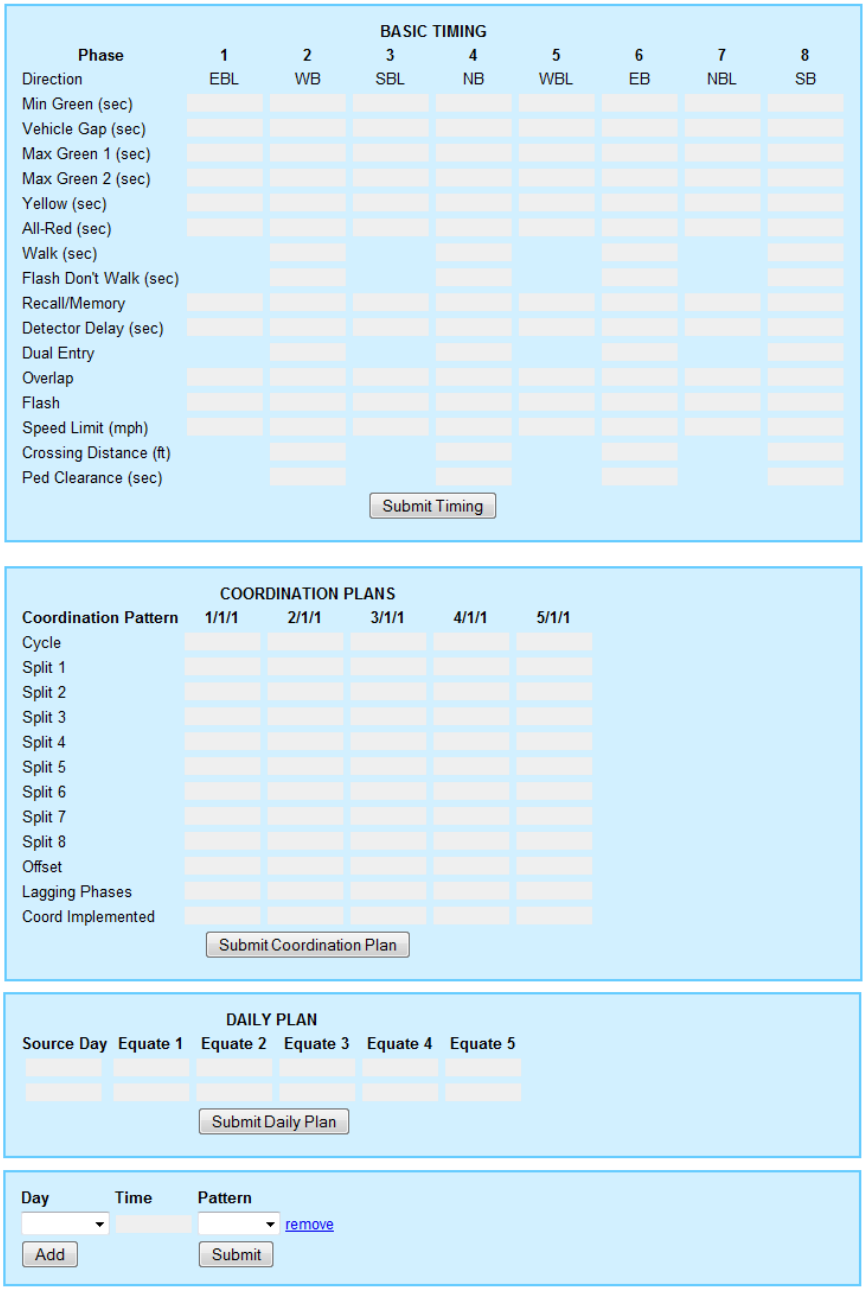


Figure 11. Timing plan

Figure 12. Traffic characteristics

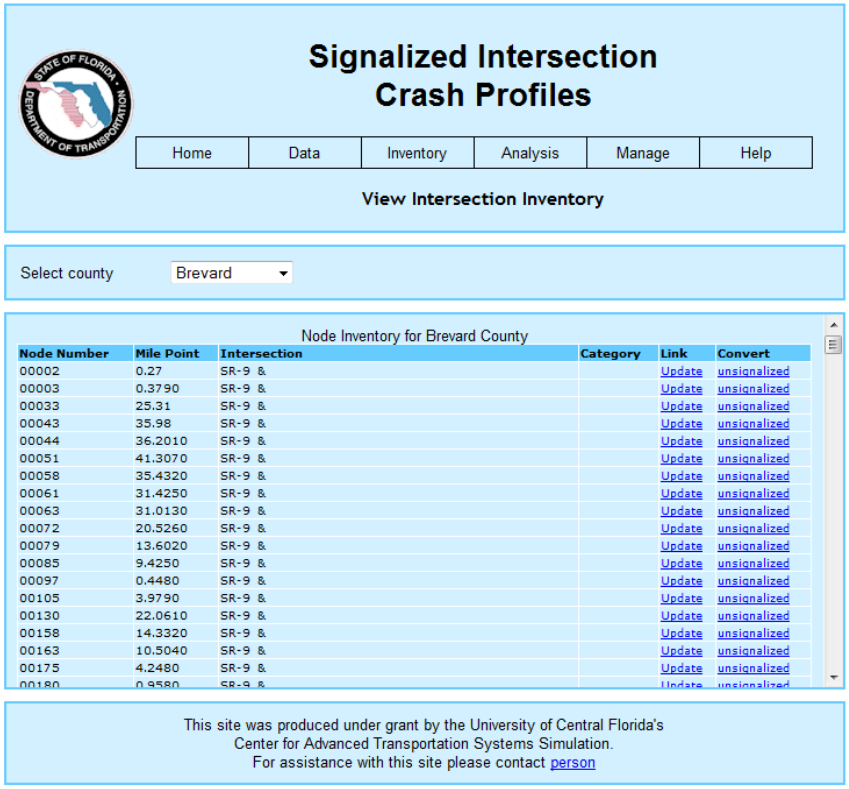


Figure 13. Statewide node inventory by county

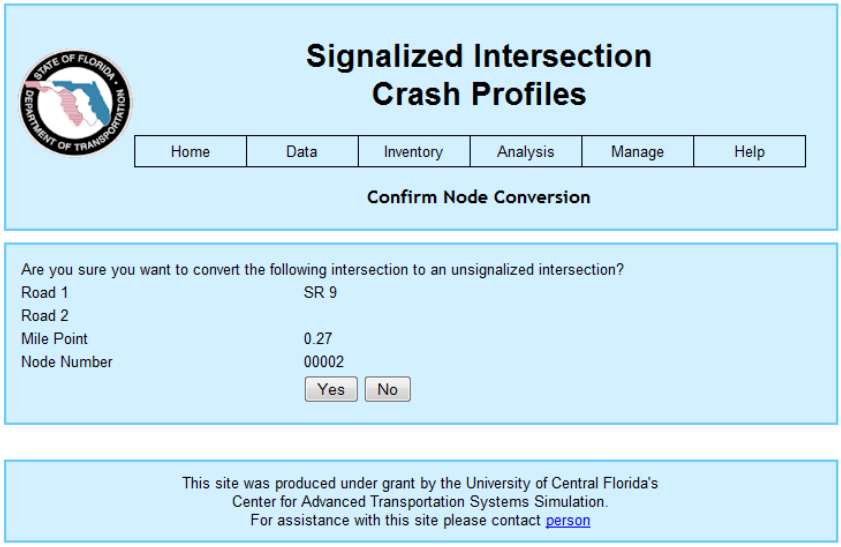


Figure 14. Converting to unsignalized intersections

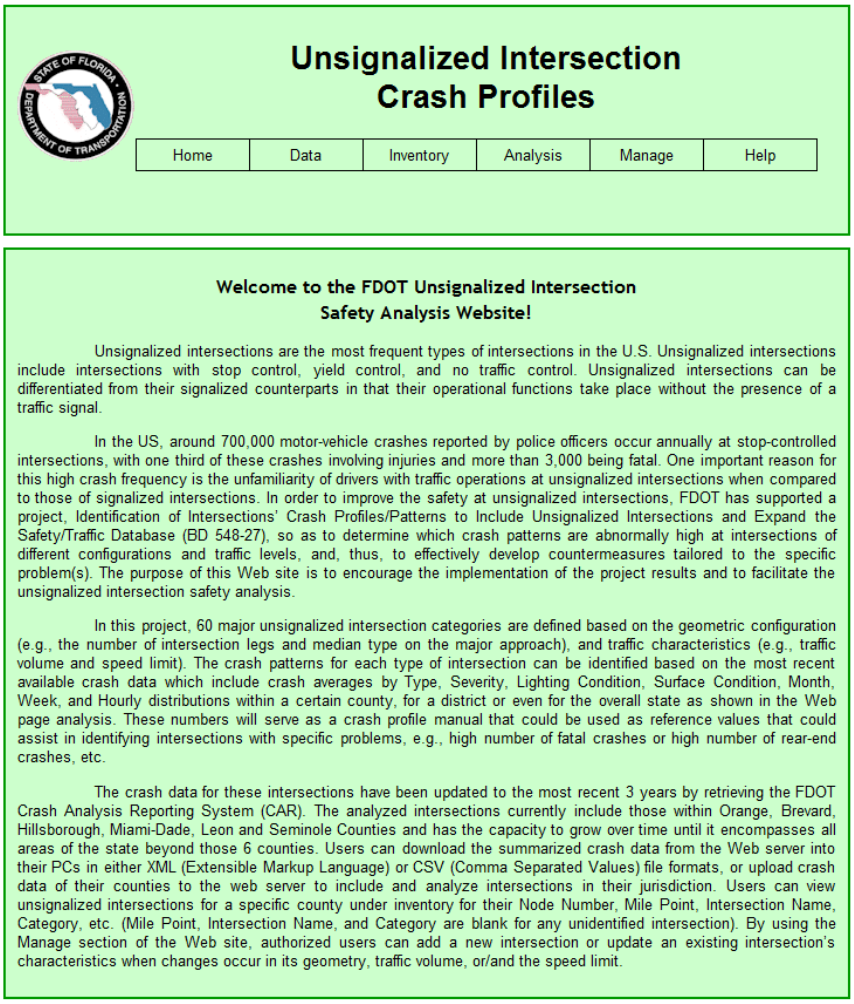


Figure 15. Unsignalized section home page

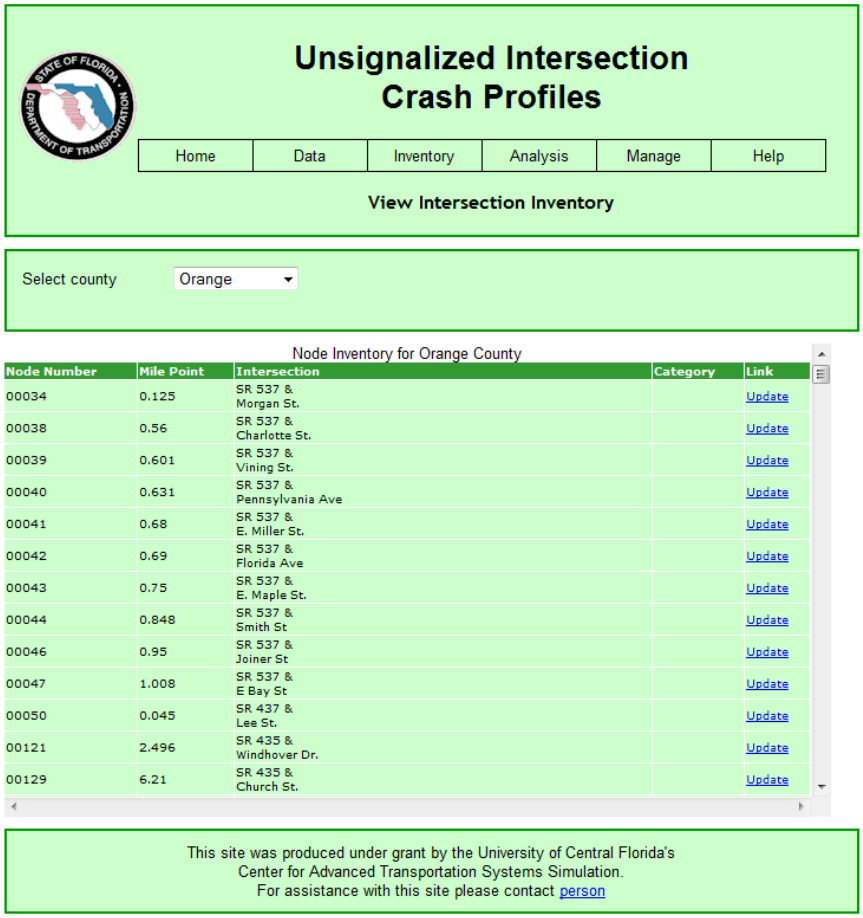
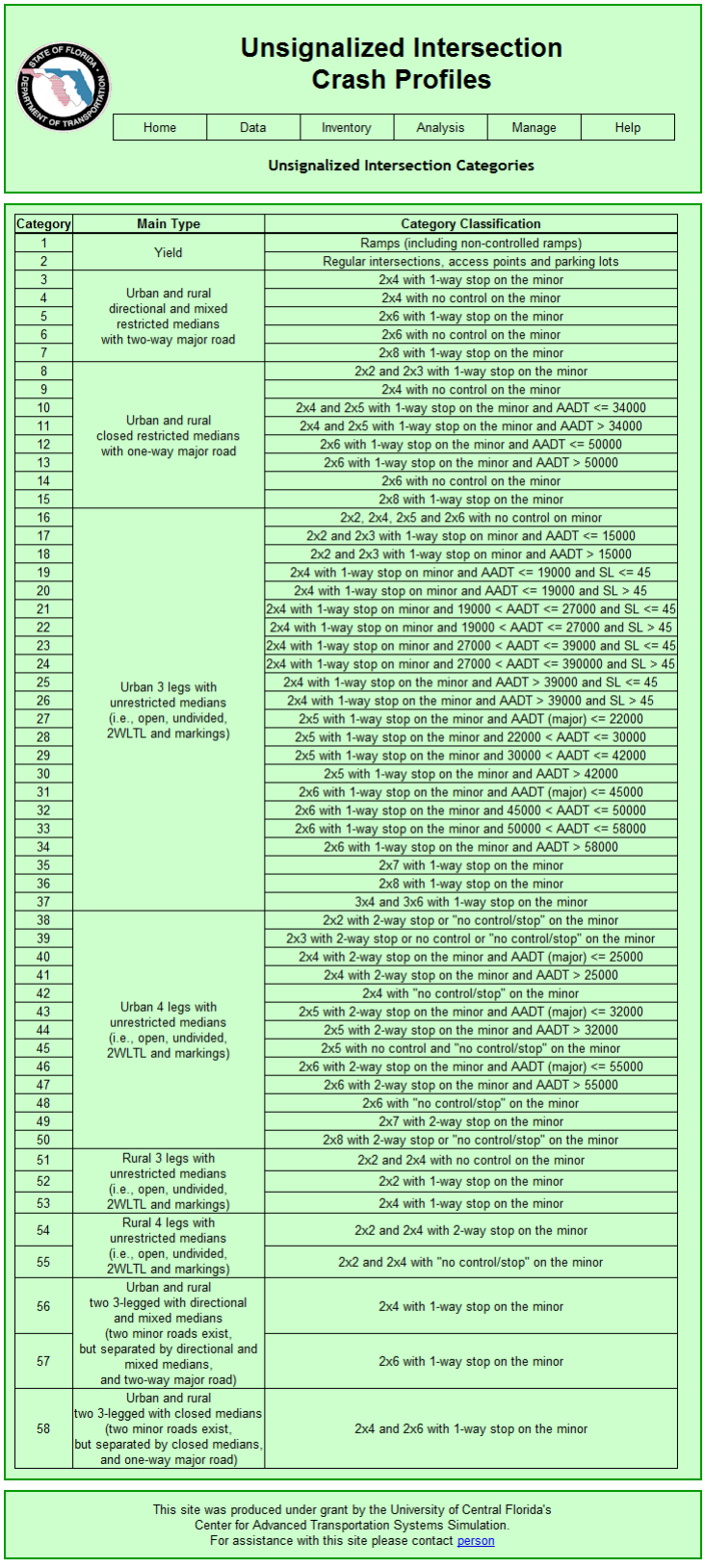


Figure 16. Unsignalized intersection inventory



Unsignalized Intersection Crash Profiles

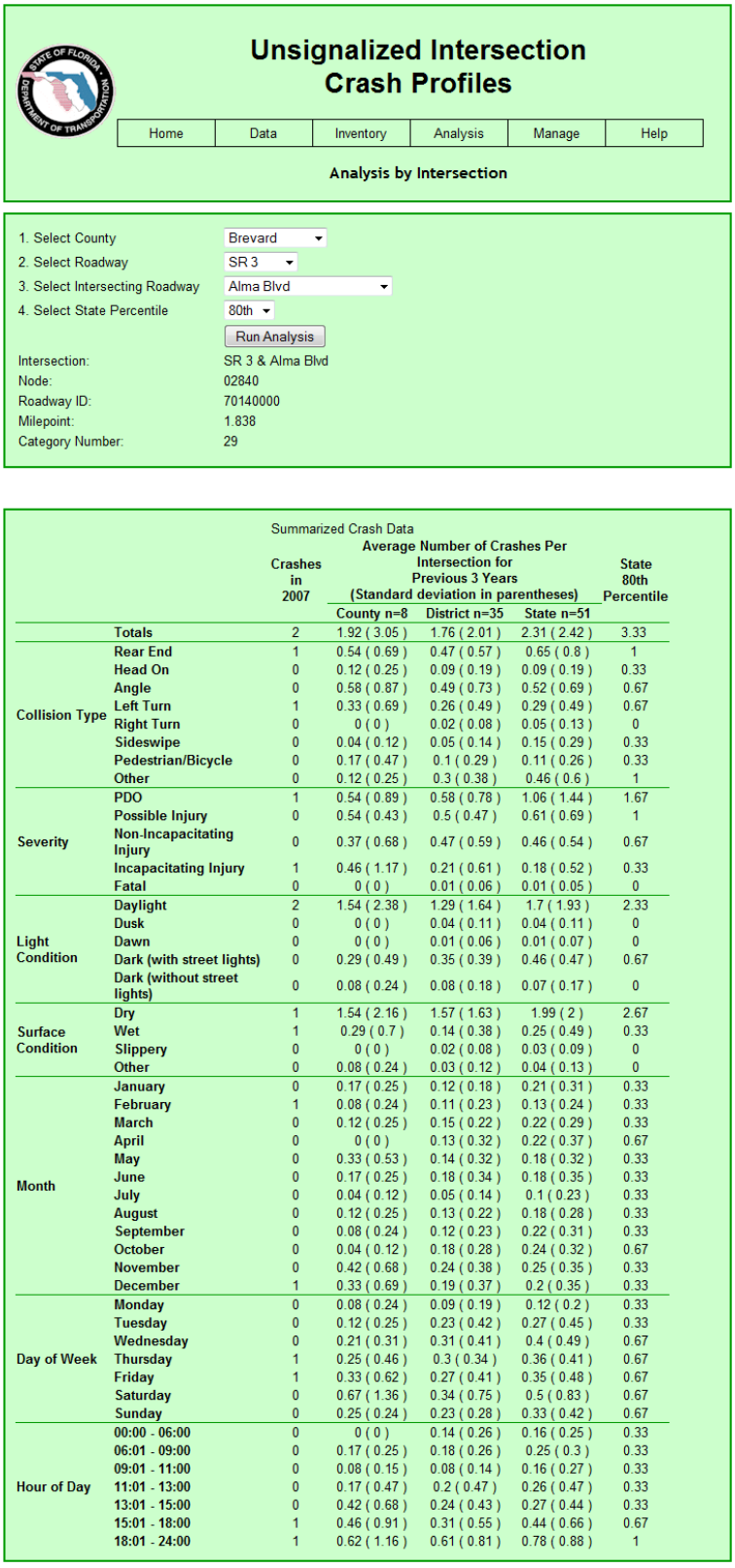
Home | Data | Inventory | Analysis | Manage | Help

Unsignalized Intersection Categories

Category	Main Type	Category Classification
1	Yield	Ramps (including non-controlled ramps)
2		Regular intersections, access points and parking lots
3	Urban and rural directional and mixed restricted medians with two-way major road	2x4 with 1-way stop on the minor
4		2x4 with no control on the minor
5		2x6 with 1-way stop on the minor
6		2x6 with no control on the minor
7		2x8 with 1-way stop on the minor
8	Urban and rural closed restricted medians with one-way major road	2x2 and 2x3 with 1-way stop on the minor
9		2x4 with no control on the minor
10		2x4 and 2x5 with 1-way stop on the minor and AADT <= 34000
11		2x4 and 2x5 with 1-way stop on the minor and AADT > 34000
12		2x6 with 1-way stop on the minor and AADT <= 50000
13		2x6 with 1-way stop on the minor and AADT > 50000
14		2x6 with no control on the minor
15		2x8 with 1-way stop on the minor
16	Urban 3 legs with unrestricted medians (i.e., open, undivided, 2WLTL and markings)	2x2, 2x4, 2x5 and 2x6 with no control on minor
17		2x2 and 2x3 with 1-way stop on minor and AADT <= 15000
18		2x2 and 2x3 with 1-way stop on minor and AADT > 15000
19		2x4 with 1-way stop on minor and AADT <= 19000 and SL <= 45
20		2x4 with 1-way stop on minor and AADT <= 19000 and SL > 45
21		2x4 with 1-way stop on minor and 19000 < AADT <= 27000 and SL <= 45
22		2x4 with 1-way stop on minor and 19000 < AADT <= 27000 and SL > 45
23		2x4 with 1-way stop on minor and 27000 < AADT <= 39000 and SL <= 45
24		2x4 with 1-way stop on minor and 27000 < AADT <= 390000 and SL > 45
25		2x4 with 1-way stop on the minor and AADT > 39000 and SL <= 45
26		2x4 with 1-way stop on the minor and AADT > 39000 and SL > 45
27		2x5 with 1-way stop on the minor and AADT (major) <= 22000
28		2x5 with 1-way stop on the minor and 22000 < AADT <= 30000
29		2x5 with 1-way stop on the minor and 30000 < AADT <= 42000
30		2x5 with 1-way stop on the minor and AADT > 42000
31		2x6 with 1-way stop on the minor and AADT (major) <= 45000
32		2x6 with 1-way stop on the minor and 45000 < AADT <= 50000
33		2x6 with 1-way stop on the minor and 50000 < AADT <= 58000
34		2x6 with 1-way stop on the minor and AADT > 58000
35		2x7 with 1-way stop on the minor
36		2x8 with 1-way stop on the minor
37		3x4 and 3x6 with 1-way stop on the minor
38	Urban 4 legs with unrestricted medians (i.e., open, undivided, 2WLTL and markings)	2x2 with 2-way stop or "no control/stop" on the minor
39		2x3 with 2-way stop or no control or "no control/stop" on the minor
40		2x4 with 2-way stop on the minor and AADT (major) <= 25000
41		2x4 with 2-way stop on the minor and AADT > 25000
42		2x4 with "no control/stop" on the minor
43		2x5 with 2-way stop on the minor and AADT (major) <= 32000
44		2x5 with 2-way stop on the minor and AADT > 32000
45		2x5 with no control and "no control/stop" on the minor
46		2x6 with 2-way stop on the minor and AADT (major) <= 55000
47		2x6 with 2-way stop on the minor and AADT > 55000
48		2x6 with "no control/stop" on the minor
49		2x7 with 2-way stop on the minor
50		2x8 with 2-way stop or "no control/stop" on the minor
51	Rural 3 legs with unrestricted medians (i.e., open, undivided, 2WLTL and markings)	2x2 and 2x4 with no control on the minor
52		2x2 with 1-way stop on the minor
53		2x4 with 1-way stop on the minor
54	Rural 4 legs with unrestricted medians (i.e., open, undivided, 2WLTL and markings)	2x2 and 2x4 with 2-way stop on the minor
55		2x2 and 2x4 with "no control/stop" on the minor
56	Urban and rural two 3-legged with directional and mixed medians (two minor roads exist, but separated by directional and mixed medians, and two-way major road)	2x4 with 1-way stop on the minor
57		2x6 with 1-way stop on the minor
58	Urban and rural two 3-legged with closed medians (two minor roads exist, but separated by closed medians, and one-way major road)	2x4 and 2x6 with 1-way stop on the minor

This site was produced under grant by the University of Central Florida's Center for Advanced Transportation Systems Simulation.
For assistance with this site please contact person

Figure 17. Unsignalized intersection categories



Unsignalized Intersection Crash Profiles

Home | Data | Inventory | Analysis | Manage | Help

Analysis by Intersection

1. Select County: Brevard
2. Select Roadway: SR 3
3. Select Intersecting Roadway: Alma Blvd
4. Select State Percentile: 80th

Run Analysis

Intersection: SR 3 & Alma Blvd
Node: 02840
Roadway ID: 70140000
Milepoint: 1.838
Category Number: 29

Summarized Crash Data

		Crashes in 2007	Average Number of Crashes Per Intersection for Previous 3 Years (Standard deviation in parentheses)			State 80th Percentile
			County n=8	District n=35	State n=51	
	Totals	2	1.92 (3.05)	1.76 (2.01)	2.31 (2.42)	3.33
Collision Type	**Rear End**	1	0.54 (0.69)	0.47 (0.57)	0.65 (0.8)	1
	Head On	0	0.12 (0.25)	0.09 (0.19)	0.09 (0.19)	0.33
	Angle	0	0.58 (0.87)	0.49 (0.73)	0.52 (0.69)	0.67
	Left Turn	1	0.33 (0.69)	0.26 (0.49)	0.29 (0.49)	0.67
	Right Turn	0	0 (0)	0.02 (0.08)	0.05 (0.13)	0
	Sideswipe	0	0.04 (0.12)	0.05 (0.14)	0.15 (0.29)	0.33
	Pedestrian/Bicycle	0	0.17 (0.47)	0.1 (0.29)	0.11 (0.26)	0.33
	Other	0	0.12 (0.25)	0.3 (0.38)	0.46 (0.6)	1
Severity	**PDO**	1	0.54 (0.89)	0.58 (0.78)	1.06 (1.44)	1.67
	Possible Injury	0	0.54 (0.43)	0.5 (0.47)	0.61 (0.69)	1
	Non-Incapacitating Injury	0	0.37 (0.68)	0.47 (0.59)	0.46 (0.54)	0.67
	Incapacitating Injury	1	0.46 (1.17)	0.21 (0.61)	0.18 (0.52)	0.33
	Fatal	0	0 (0)	0.01 (0.06)	0.01 (0.05)	0
Light Condition	**Daylight**	2	1.54 (2.38)	1.29 (1.64)	1.7 (1.93)	2.33
	Dusk	0	0 (0)	0.04 (0.11)	0.04 (0.11)	0
	Dawn	0	0 (0)	0.01 (0.06)	0.01 (0.07)	0
	Dark (with street lights)	0	0.29 (0.49)	0.35 (0.39)	0.46 (0.47)	0.67
	Dark (without street lights)	0	0.08 (0.24)	0.08 (0.18)	0.07 (0.17)	0
Surface Condition	**Dry**	1	1.54 (2.16)	1.57 (1.63)	1.99 (2)	2.67
	Wet	1	0.29 (0.7)	0.14 (0.38)	0.25 (0.49)	0.33
	Slippery	0	0 (0)	0.02 (0.08)	0.03 (0.09)	0
	Other	0	0.08 (0.24)	0.03 (0.12)	0.04 (0.13)	0
Month	**January**	0	0.17 (0.25)	0.12 (0.18)	0.21 (0.31)	0.33
	February	1	0.08 (0.24)	0.11 (0.23)	0.13 (0.24)	0.33
	March	0	0.12 (0.25)	0.15 (0.22)	0.22 (0.29)	0.33
	April	0	0 (0)	0.13 (0.32)	0.22 (0.37)	0.67
	May	0	0.33 (0.53)	0.14 (0.32)	0.18 (0.32)	0.33
	June	0	0.17 (0.25)	0.18 (0.34)	0.18 (0.35)	0.33
	July	0	0.04 (0.12)	0.05 (0.14)	0.1 (0.23)	0.33
	August	0	0.12 (0.25)	0.13 (0.22)	0.18 (0.28)	0.33
	September	0	0.08 (0.24)	0.12 (0.23)	0.22 (0.31)	0.33
	October	0	0.04 (0.12)	0.18 (0.28)	0.24 (0.32)	0.67
	November	0	0.42 (0.68)	0.24 (0.38)	0.25 (0.35)	0.33
	December	1	0.33 (0.69)	0.19 (0.37)	0.2 (0.35)	0.33
Day of Week	**Monday**	0	0.08 (0.24)	0.09 (0.19)	0.12 (0.2)	0.33
	Tuesday	0	0.12 (0.25)	0.23 (0.42)	0.27 (0.45)	0.33
	Wednesday	0	0.21 (0.31)	0.31 (0.41)	0.4 (0.49)	0.67
	Thursday	1	0.25 (0.46)	0.3 (0.34)	0.36 (0.41)	0.67
	Friday	1	0.33 (0.62)	0.27 (0.41)	0.35 (0.48)	0.67
	Saturday	0	0.67 (1.36)	0.34 (0.75)	0.5 (0.83)	0.67
	Sunday	0	0.25 (0.24)	0.23 (0.28)	0.33 (0.42)	0.67
Hour of Day	**00:00 - 06:00**	0	0 (0)	0.14 (0.26)	0.16 (0.25)	0.33
	06:01 - 09:00	0	0.17 (0.25)	0.18 (0.26)	0.25 (0.3)	0.33
	09:01 - 11:00	0	0.08 (0.15)	0.08 (0.14)	0.16 (0.27)	0.33
	11:01 - 13:00	0	0.17 (0.47)	0.2 (0.47)	0.26 (0.47)	0.33
	13:01 - 15:00	0	0.42 (0.68)	0.24 (0.43)	0.27 (0.44)	0.33
	15:01 - 18:00	1	0.46 (0.91)	0.31 (0.55)	0.44 (0.66)	0.67
	18:01 - 24:00	1	0.62 (1.16)	0.61 (0.81)	0.78 (0.88)	1

Figure 18. Unsignalized intersection statistical output page

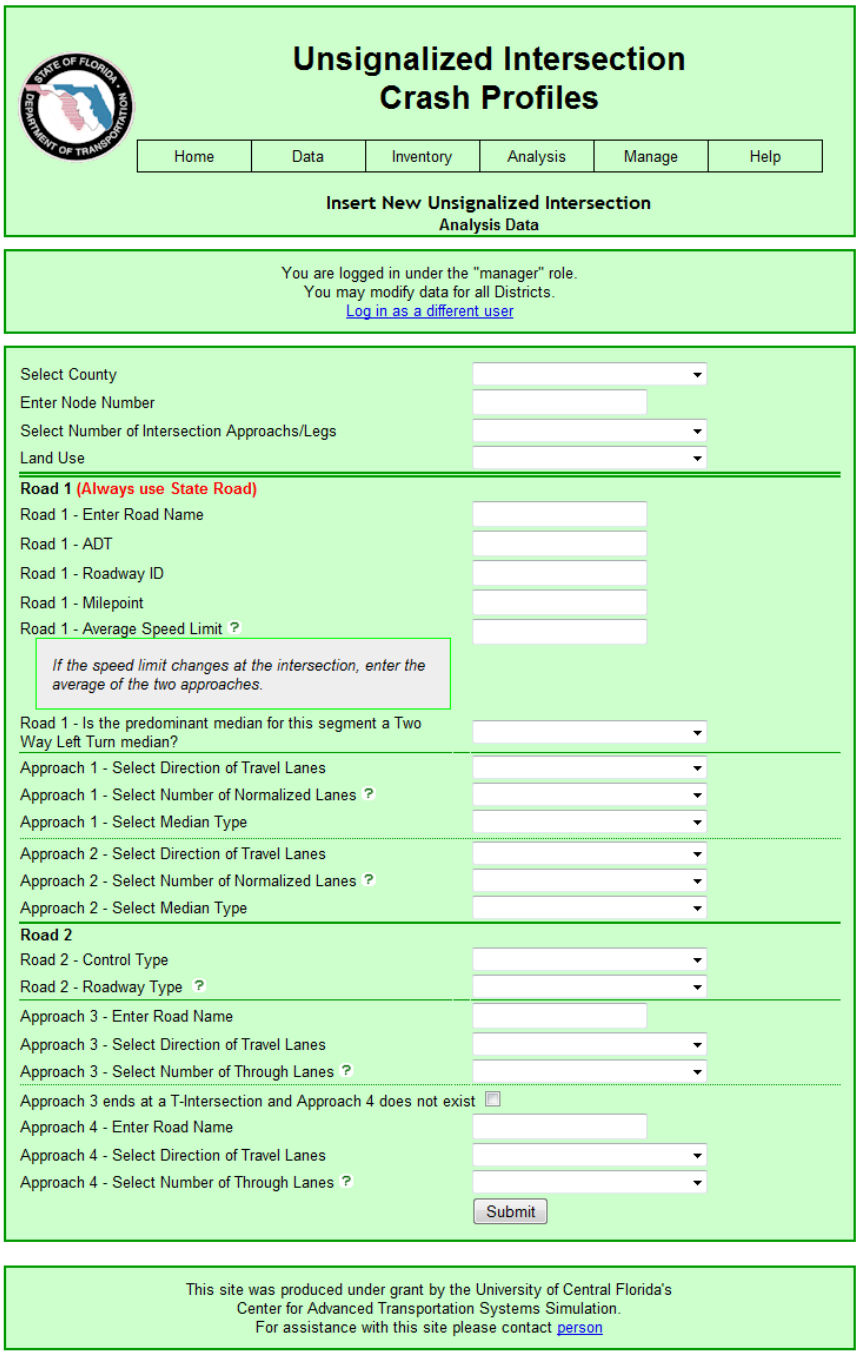


Figure 19. Insert new unsignalized intersection

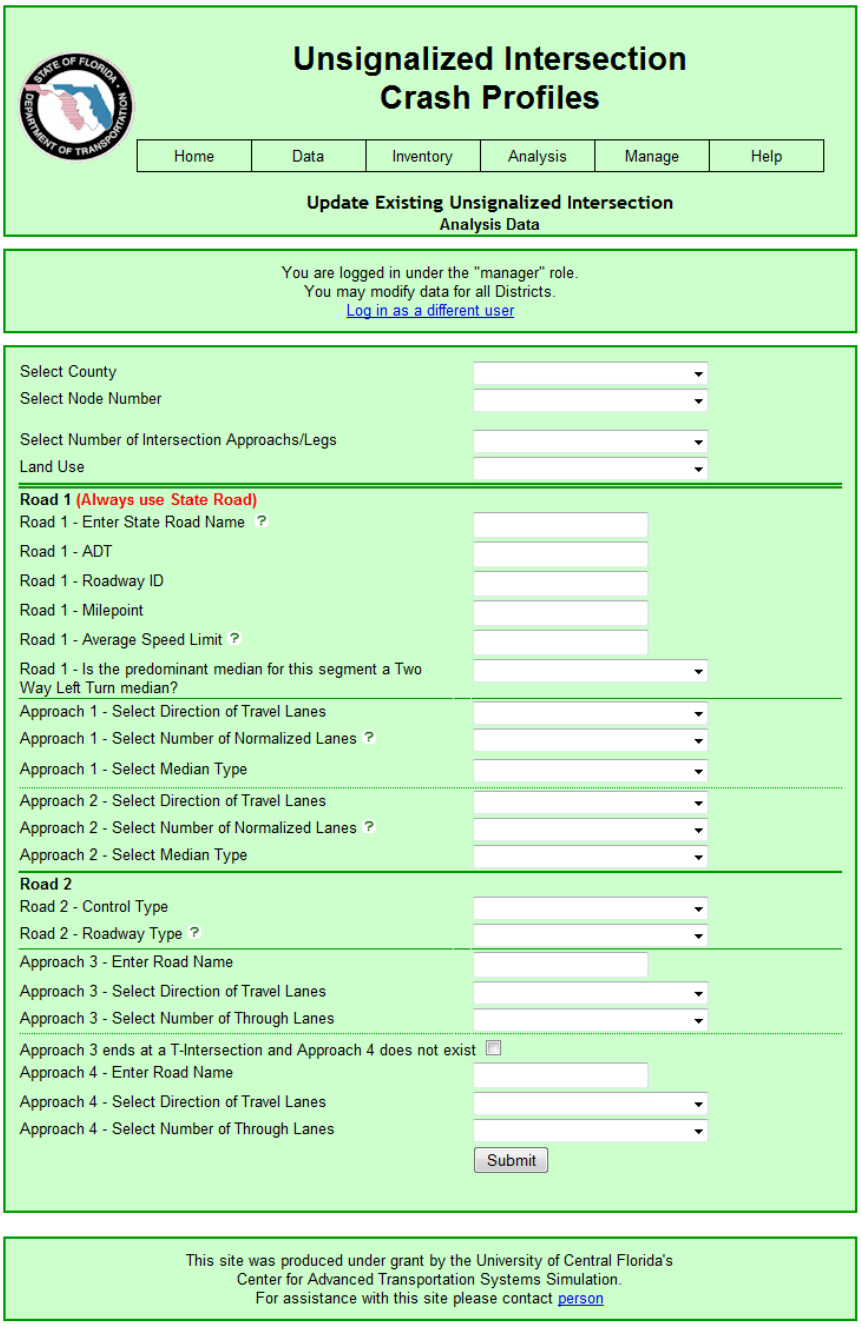


Figure 20. Update existing unsignalized intersection

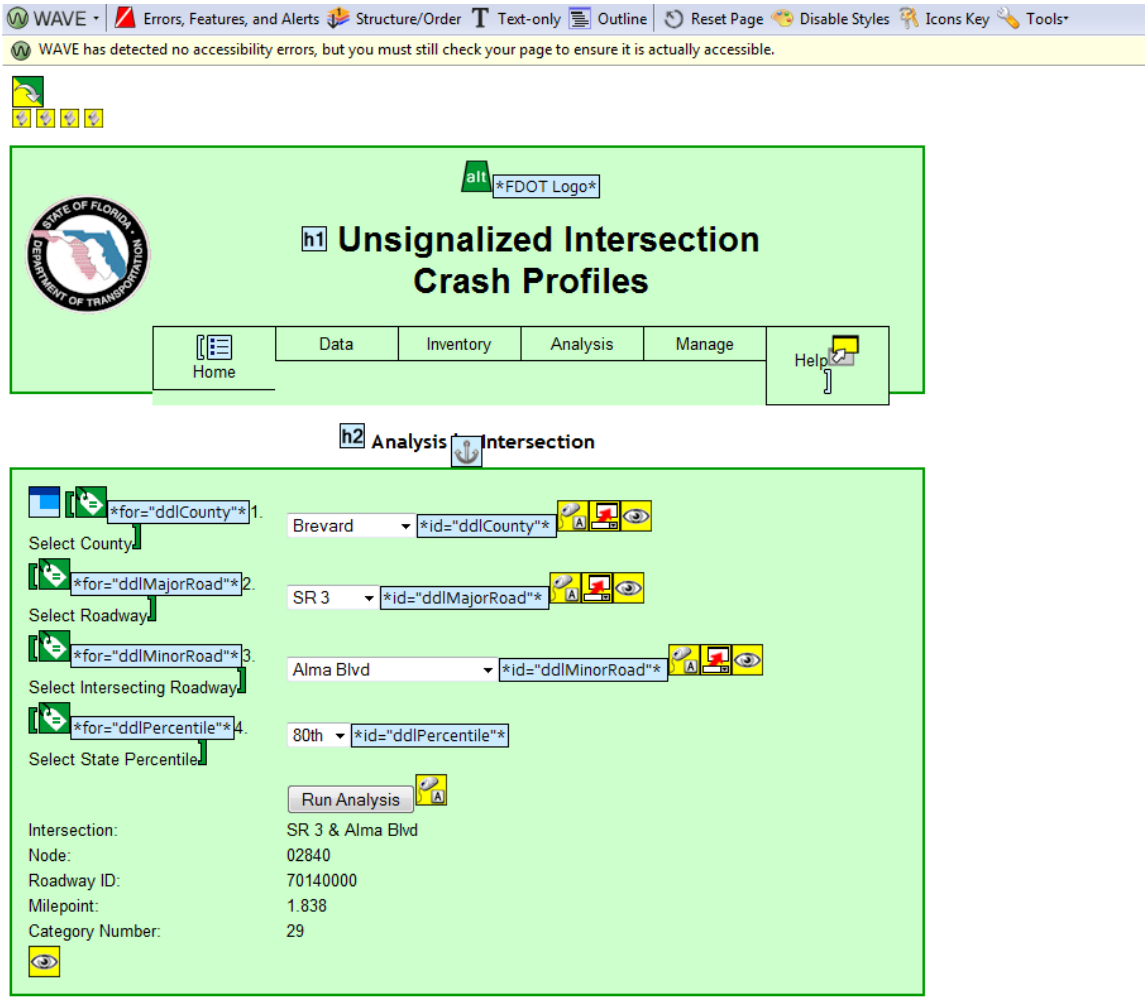


Figure 21. The WAVE toolbar in Mozilla Firefox