



## Technical Memorandum

## SunGuide® Software System



## Wrong-Way Driving Concept of Operations

Version 1.0

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### Prepared for:

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## List of Acronyms and Abbreviations

511/FL-ATIS.....	Florida Advanced Travel Information System
C2C.....	Center-To-Center
CAD.....	Computer Aided Dispatch
CCTV.....	Closed-Circuit Television
CPU.....	Central Processing Unit
DMS.....	Dynamic Message Sign
DTN.....	Data Transmission Network
DSRC.....	Dedicated Short Range Communication
EM.....	Event Management
FDOT.....	Florida Department of Transportation
FHP.....	Florida Highway Patrol
FTE.....	Florida’s Turnpike Enterprise
GUI.....	Graphical User Interface
HAR.....	Highway Advisory Radio
IDS.....	Incident Detection System
IP.....	Internet Protocol
ITS.....	Intelligent Transportation Systems
MCP.....	Manual Control Panel
NTCIP.....	National Transportation Communications for ITS Protocol
PLC.....	Programmable Logic Controller
PTZ.....	Pan-Tilt-Zoom
RPG.....	Response Plan Generator
RRMA.....	Road Ranger Mobile Application
RWIS.....	Road Weather Information Subsystem
SMS.....	Short Message Service
SPARR.....	Smart Phone Application for Road Rangers
TAPCO.....	Traffic & Parking Control Co.
TMC.....	Transportation Management Center
TSS.....	Transportation Sensor Subsystem

VOD ..... Video On Desktop  
WWD ..... Wrong-Way Driving  
XML..... Extensible Markup Language

# 1 Introduction

## 1.1 Document Identification

This document describes the concept of how the wrong-way driving (WWD) detection operations should behave and be operated through SunGuide® software.

## 1.2 Contacts

The following is a list of contacts for the SunGuide software project:

- Elizabeth Birriel, ITS Section, Traffic Engineering and Operations Office, [elizabeth.birriel@dot.state.fl.us](mailto:elizabeth.birriel@dot.state.fl.us), 850-410-5606
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Additional information on the SunGuide software can be found online at <http://sunguidesoftware.com/about-hub>.

# 2 Concepts for the Proposed System

## 2.1 Objectives and Scope

The objectives of the WWD development are:

1. Receive WWD detection incident data from devices capable of detecting WWD.
2. Add a WWD event type in SunGuide software:
  - a. This event type can be created manually by operators if the event was not automatically detected and created by IDS, for which there will be a shortcut accessible from the operator map.
  - b. This event type would be used in the automatic WWD event creation and response plan activation by IDS as described below.
3. Allow FDOT Districts to configure the response behavior to meet the needs of their operations:

- a. Configure devices into the system for communications;
  - b. Configure up to five cameras and their presets that should be used for each WWD detection device. When a WWD incident is detected by the WWD detection device, the associated cameras will have their presets automatically invoked and will have their video automatically displayed with the alert-handling dialog;
  - c. Configure whether the alert handling window should pop up automatically;
  - d. Configure which operators will receive the WWD detection alert; and
  - e. Configure dynamic message signs (DMS) and email recipients to be enabled for inclusion in an automatically activated response plan.
    - i. Configure the default distance upstream of the WWD detection to include when the system chooses DMSs for a WWD device. Upstream is in reference to the correct direction of travel on which a WWD detection event has occurred. Messages should not be posted to motorists in the other direction of the roadway since there is substantial separation between the two directions of the roadway. The operator can always change the distance and request a new response plan suggestion after handling the alert created by the WWD event.
    - ii. Configure which email groups to include in the email sent by the WWD response plan. The operator can add additional email recipients after taking ownership of the event.
4. Automatically perform the following actions when a WWD detection is received if configured to do so:
- a. Provide immediate notification to responders via email;
  - b. Create an event with a type of WWD in SunGuide software;
  - c. Post DMS warning messages to motorists;
  - d. Send “move to preset” commands to closed-circuit television (CCTV) cameras configured as nearest cameras to the WWD detection device that are likely to capture the incident in progress. The “move to preset” commands will invoke the camera to PTZ to a pre-configured view with the highest likelihood of capturing the incident. The system will keep the cameras locked for a configurable amount of time with 30 minutes being the default so that a scheduled action cannot move the camera out of the field of view;

- e. Log WWD detection information in the database for future reporting and analysis;
  - f. Create an alert in the alert box;
  - g. Immediately display an alert handling and video viewing window. The VOD window will appear on all operator workstations without the operator having to click on the alert. This window will include the alert-handling dialog within a viewer in the top viewer of the VOD window. The alert handling dialog will contain an alert with the alert type of WWD detection, a location description of the alert, and a “Find on Map” button to recenter the operator map to the location. Below the alert handling dialog viewer are the viewers of the configured cameras configured to be nearest the WWD device or location reported. The first operator to handle the alert will be assigned ownership to the event, and the alert handling viewer will disappear leaving the remaining VOD window with video stream viewers open until the operator chooses to close it.
5. Provide report templates to list WWD detections and WWD events from the SunGuide software archive for future analysis.
- a. WWD Detection Report would include the date, time, WWD detection device or notification source, location, associated alert, and associated event, and
  - b. The event reports are already filterable by event type and can be used to provide reporting on WWD detection events.

## **2.2 Operational Policies and Constraints**

- WWD incidents are time-critical events. Operators will not have sufficient time to verify an incident and post a warning message to motorists.
- Workstation performance and Internet Explorer limitations may need to be overcome to support five additional streaming video feeds.
- Automatic actions taken by the system will need to be able to be enabled or disabled through configuration in order for changes to operations to be able to be made independent of the software upgrade or deployment.
- Oftentimes, communications from motorists may have the incorrect direction of travel or may be further down the road so messaging should error on the side of caution, having a large search radius and using both sides of the road for selecting DMS signs for manually entered (non-detected) events.

- SunGuide software shall always post WWD warning messages with a priority of 1. Thus, operators should never create or store or schedule messages with a priority of 1. Also, the response plan generator functionality of EM should never generate a message with a priority of 1 unless it is a WWD warning message which should only have a priority of 1.

## **2.3 Description of the Proposed System**

### **2.3.1 Software Changes**

There will be several anticipated changes to the software to accomplish the objectives; however, this will be confirmed in the design and implementation phase.

1. New WWD Detection Driver added to the Incident Detection Subsystem (IDS)
2. Changes to IDS to support the processing of WWD detections
3. Changes to EM to support the new event type and response plan parameters, and an added flag for each agency contact to automatically receive WWD email notifications.
4. Changes to the GUI to support all user interaction changes needed to support the objectives.
  - a. When creating a manual event, confirm with the operator the event location, the GUI should confirm with the operator that the location of the event is correct and the directionality for which to include DMS messages is chosen. The operator can choose to include DMS signs along the roadway direction of the event, or choose to include DMS signs on both sides of the roadway.
  - b. Added context menu option on operator map to create new WWD event with activated response plan if the system is configured for automatic WWD response plan activation. This should create the event, prompt the operator to confirm the location and directionality for DMS inclusion, automatically generate the response plan, activate the response plan, and also launch a VOD window with up to the five closest CCTVs to the location selected by the operator in either direction. If the system is not configured for automatic WWD detection response plan activation, the event will be created, the alert handling window will appear, but the operator will have to generate a response plan and activate it without the system taking this action automatically.
  - c. The GUI should recognize when the workstation has reached a maximum threshold of CPU utilization so that it warns the operator who could then close other videos that may contribute to overwhelming the workstation.

5. Additional configurability to enable or disable automated system functions to accommodate operational constraints and workstation capabilities.

The architectural diagram in Figure 3.1 shows the added and modified components needed to SunGuide software Release 6.0.

SunGuide® Software System  
 Wrong-Way Driving Concept of Operations

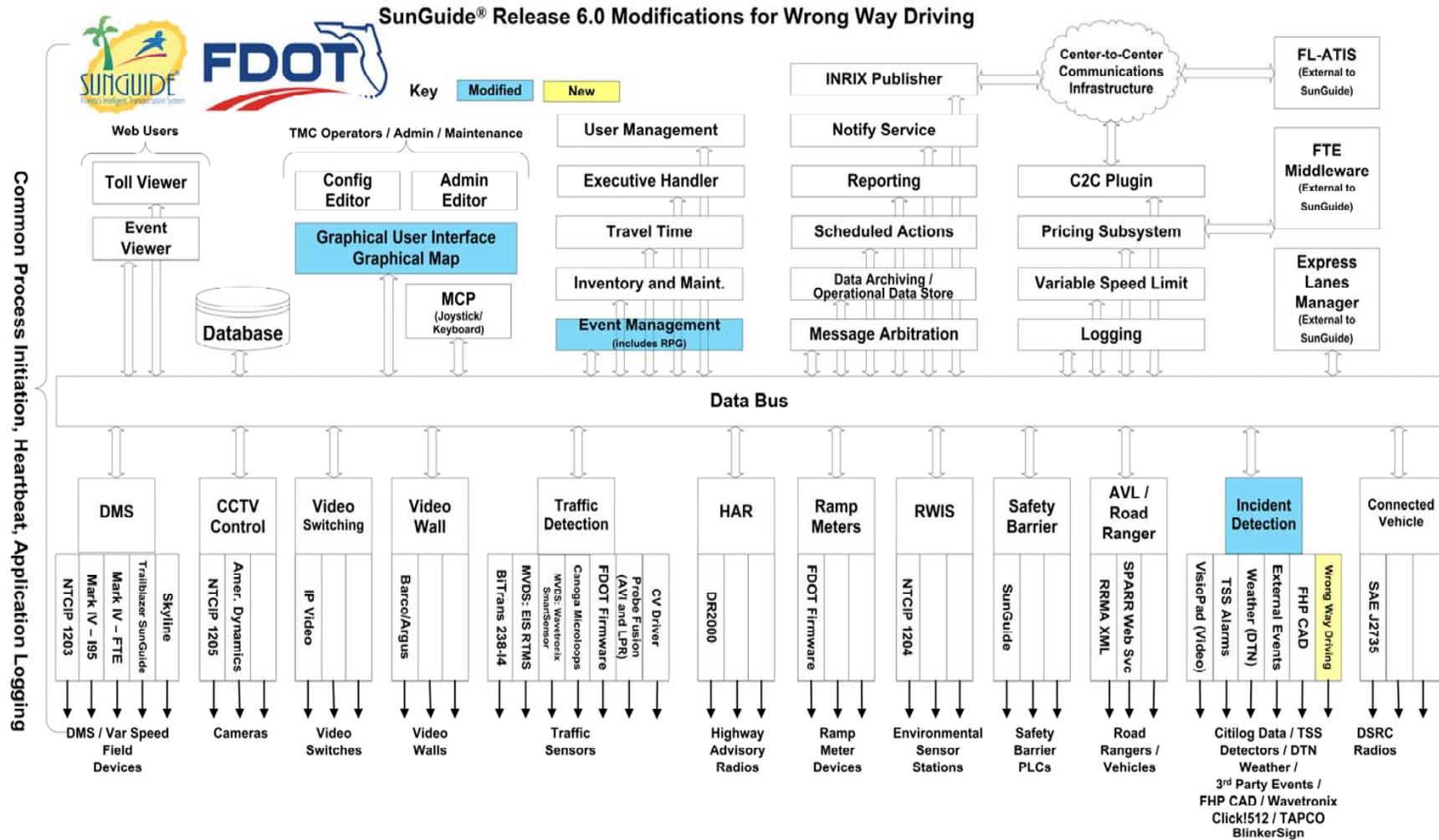


Figure 3.1 – Modifications to SunGuide Software Release 6.0 Needed for WWD

### ***2.3.2 Device Configuration***

Once the radar devices are deployed, SunGuide software will allow a system administrator to configure each of the devices into the SunGuide software system as a WWD incident detection device. SunGuide software will also allow the operator to associate CCTV cameras and one of their presets to the WWD detection device.

The radar device may provide both the TSS subsystem with traffic conditions data and the IDS subsystem with WWD detection events. In this case, there will be two different network interfaces and protocols that the SunGuide software will use for these two independent operations. This will allow the SunGuide software administrator to disable either the TSS or the IDS device without impacting the operation of the other.

### ***2.3.3 WWD Detection Response***

Once the device detects a WWD occurrence, it will send a signal to the SunGuide software. The SunGuide software can be configured to automatically take the following actions:

1. Generate an alert using the existing Incident Detection Subsystem.
2. Create an event using the WWD event type indicating the location at which the WWD detection device is located.
3. Generate a response plan for the event. Each device will be configurable as to which response plan items are generated for the event. The following items are able to be configured and included in the automated response:
  - a. Send an email to a preconfigured list of responders. The email will contain the timestamp, location, roadway affected, direction of roadway affected, and direction of wrong way driver.
    - i. This capability also provides the capability to send to mobile devices via Short Message Service (SMS), also known as text messages. Each SMS provider has a specific email address format that includes the phone number associated to the device, so that the device can be emailed a message to be received as an SMS message. This link shows a list of several providers and their email address format:  
<http://www.emailtextmessages.com/>
  - b. Post warning messages to motorists on DMSs with a message priority of 1. DMSs will be selected by the response plan generation function using a configurable radius search from the WWD event location. This will happen differently for an automatically, device-detected WWD event versus an operator, manually-entered

WWD event. Note, this can include remote District DMSs available via C2C control.

- For automatically detected WWD alarms, include DMS signs only upstream of the WWD detection
  - For manually operator-entered WWD events, provide operators the option to select the roadway direction of the WWD event location or to include DMS signs from all directions of the WWD event location.
- c. Post warning messages to motorists on highway advisory radios. HARs will be selected by the response plan generation function using a configurable radius search from the WWD event location. The message will be autogenerated from the following template:  
“A Wrong Way Driver was reported at <the WWD location>. Use Extreme Caution.”
- d. Post the WWD event to Florida’s 511 system.
4. Provide immediate alert to operators.
- a. Highlight the device icon with a visual indication such as a flashing red circle.
  - b. Provide an audible tone until the alert is handled by the operator.
  - c. Pop-up an immediate alert window with identification of the WWD detection device and location.
  - d. Pop-up the VOD view of the nearest and upstream CCTV cameras at the configured preset if configured to for the WWD detection device. Note: CCTV cameras will be locked by IDS, but users with permission can override the lock and PTZ the cameras. This is to prevent a lower priority scheduled action from moving the camera, but to allow operators to move the camera as needed.

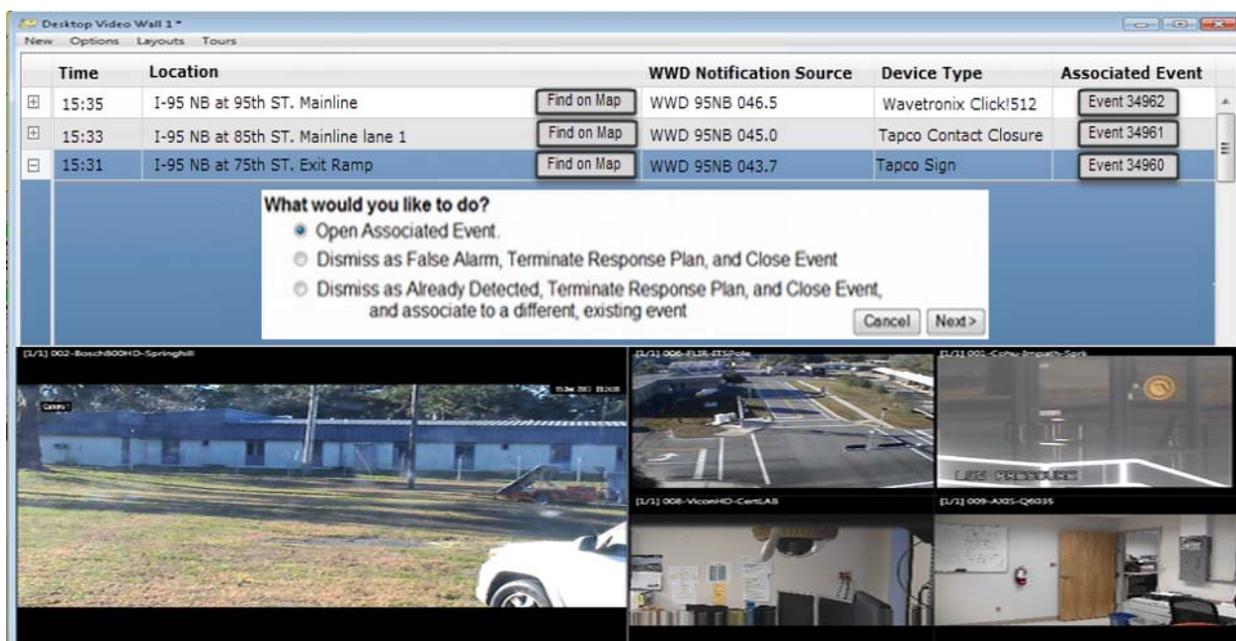


Figure 2.1 – Operator Alert Handling with Video

5. Log WWD information in the database and produce a SunGuide software report for future analysis. The WWD detection information stored in the database and included in the report will include the following:
  - i. WWD detection device or notification source,
  - ii. time of notification,
  - iii. detailed location information,
  - iv. the identification number of the alert produced to operators, and
  - v. the identification number to the event created.

The existing Event related reports will be able to be filtered to show only WWD event types using the existing filtering. This will include all actions taken by operators or by the system in regards to the WWD event.

## 2.4 User Involvement and Interaction

The primary users to interact with the system are the operators. They will interact with the system in response to a WWD detection with the following:

- Create or take ownership of the event.
- If the system is configured to automatically post a response plan, take ownership of the event and validate that the response plan was activated.

- If the system is configured not to automatically post a response plan, post a response plan to warn upstream motorists of the potential WWD incident ahead.
- Notify law enforcement of the potential incident.
- Verify the WWD incident with CCTV cameras if possible. Coordinate with response agencies.
- Open the response plan and make adjustments if necessary.
- Terminate the response plan and close the WWD event when WWD incident is over or cannot be verified after some time.
- If a crash ensues, the operator will create a new, secondary event at the new location. The secondary relationship will help identify the crash event as a result of WWD detection event.

An ITS Analyst will also be interacting with the system. Initially, they could configure the system to not automatically activate response plans with DMS messages warning motorists upstream of the WWD incident. After several events are logged by the system, they can analyze whether the system has too many false positive detections or if the system is accurate enough at detections to enable the automatic activation.

## ***2.5 Changes Considered for future phase***

### ***2.5.1 Connected Vehicle***

On board units could display or present traveler advisory messages to motorists, warning them of the wrong way driver and to use extreme caution. A traveler advisory message can also be displayed to the wrong way driver, informing them they are traveling in the wrong direction.

### ***2.5.2 Ramp Meter Shutoff***

In order to minimize exposure to additional motorists, ramp meters upstream of the wrong way driver could be automatically changed to a solid red/stop state during the WWD event in order to not allow additional traffic to enter the roadway.

#### ***2.5.2.1 Add DMS or Blankout Sign By Ramp Meter***

This is to accompany the ramp meter shutoff during a wrong way event so that motorists are informed of why they are being asked not to enter the freeway. Without this information, motorists may disregard the stop light and enter the freeway because they may believe the extended stop is in error and not be aware of the dangerous situation ahead.

### ***2.5.3 NTCIP Standard for WWD Detection Devices***

It will be considered to develop a standard, possibly within the NTCIP family, for WWD detection devices to follow to allow more vendors to provide solutions that are immediately compatible with SunGuide software.

### ***2.5.4 Auto-Dismiss Redundant Upstream Alerts***

The software will be modified as part of a different enhancement to suppress redundant TSS alerts upstream of an initial alert with an active event assigned to the first alert. This concept could be extended to include WWD alerts with additional discussion and analysis.

### ***2.5.5 Format Email Messages Destined for SMS***

The software could add a flag to email addresses if the destination was actually an SMS device. The software would then format emails to that address to fit into the character limit, and possibly use two separate emails if additional details were needed to be included and would not fit into the first email. This would apply to all event types, not just WWD detection events, and would need additional discussion.

## **3 Summary of Impacts**

1. Existing system does not post DMS messages without operator intervention. This is a change to that precedent.

## **4 Operational Scenarios**

The first operational scenario involves having the WWD event detected by the detection devices and the second scenario involves having the TMC notified of the WWD event by a motorist and entered into the system manually.

### ***4.1 Automatic Detection of WWD***

Olivia, an operator in Tampa, sees the wrong way alert handling window pop up on her workstation. She chooses the option to open the associated event in order to manage the incident. She also sees the nearest five CCTV cameras appear in a VOD window move to a zoomed out preset so that she can view the covered area quickly. She looks at the cameras to try to find the WWD vehicle. Once she finds the vehicle, she sets the incident to confirmed, generates another response plan suggestion, reviews and fine tunes the response plan by making sure all signs have the WWD warning message, that an email and 511 response plan item are present, and activates the response plan. She puts the video showing the WWD vehicle on the shared video wall and informs the other co-located agencies so they can view the vehicle and its location.

## **4.2 Manual Creation of WWD Event**

Omar, an operator in Orlando, receives a phone call notifying him of a WWD reported by a motorist. Omar immediately goes to the map, and at the approximate location described in the phone call, right-clicks the map, and selects the shortcut in the context menu to create a WWD event. The system immediately creates an event with an automatically activated response plan, opens the event details window for Omar to manage, and opens the VOD window for Omar to look for the reported WWD vehicle in the nearest CCTV cameras. The cameras are automatically zoomed out to a present to be able to view a large coverage area to help in the search for the WWD vehicle. Omar then notifies the co-located FHP staff of the WWD unconfirmed event. Omar looks at the cameras and finds the WWD vehicle in one of the cameras, puts that camera on the shared video wall, and notifies the co-located FHP staff of the video of the WWD event that they can see. Omar then sets the incident to confirmed, generates another response plan suggestion, reviews and fine tunes the response plan by making sure all signs have the WWD warning message, that an email and 511 response plan item are present, and activates the response plan.