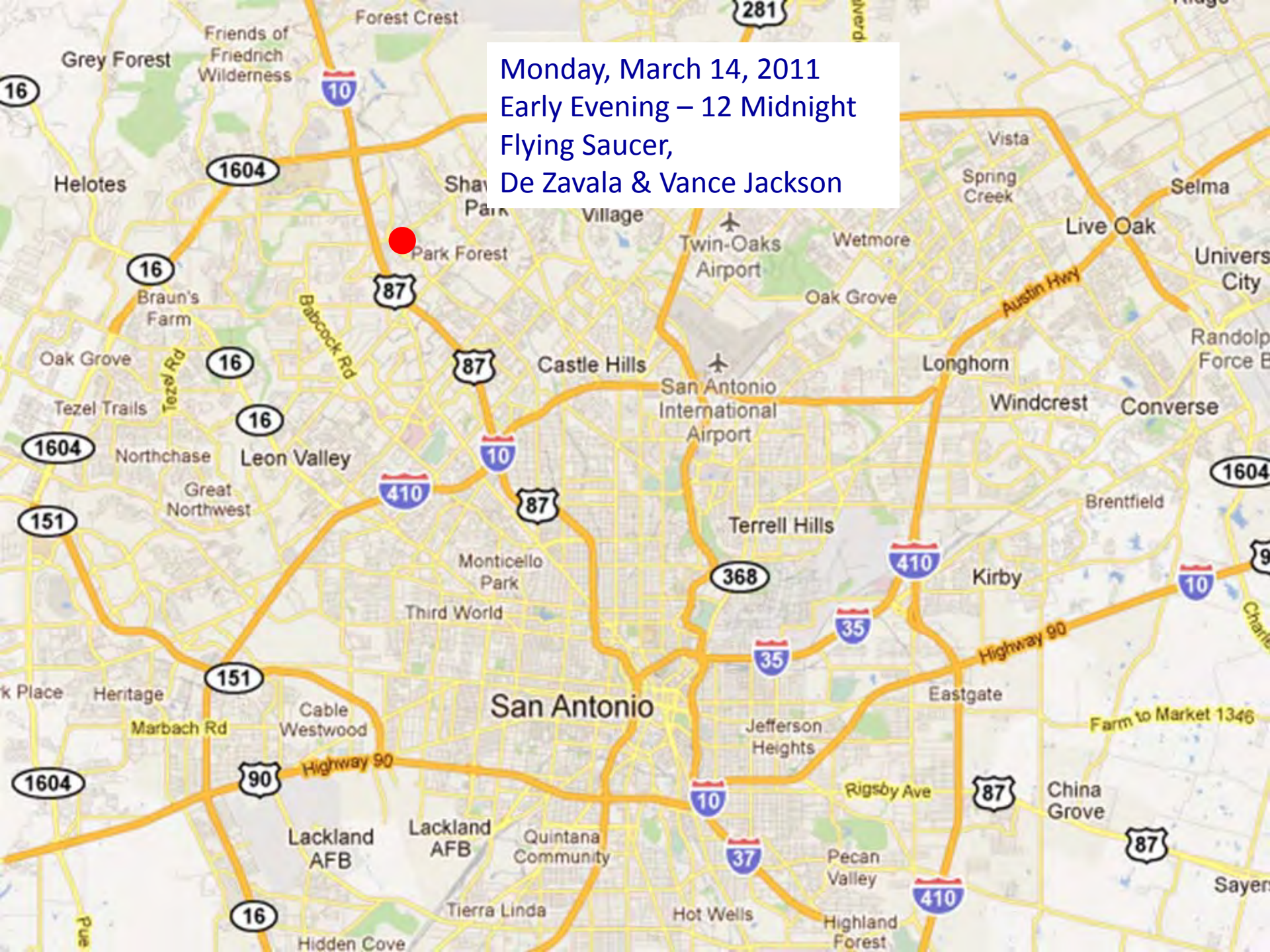


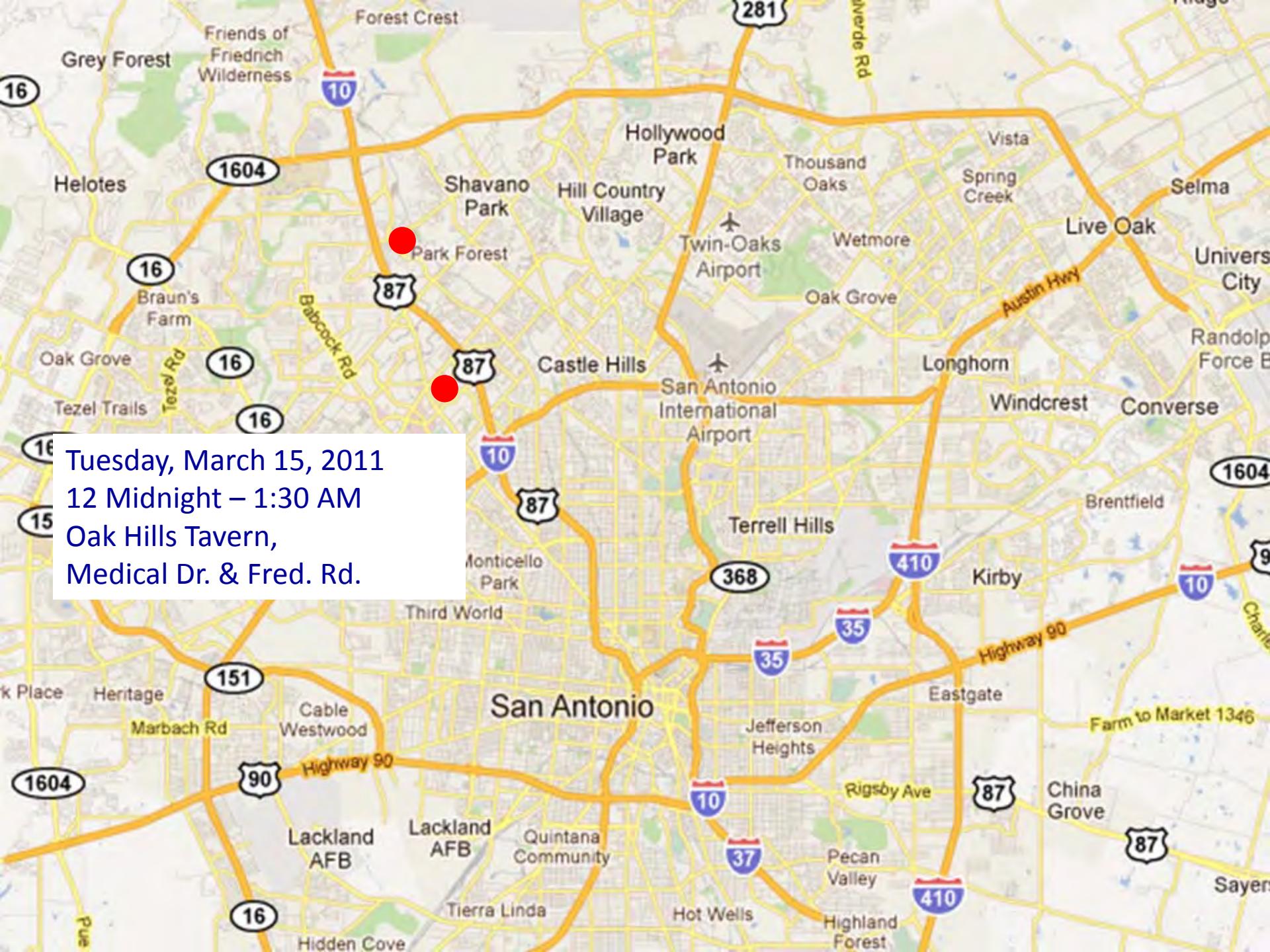
San Antonio Wrong Way Driving Initiative



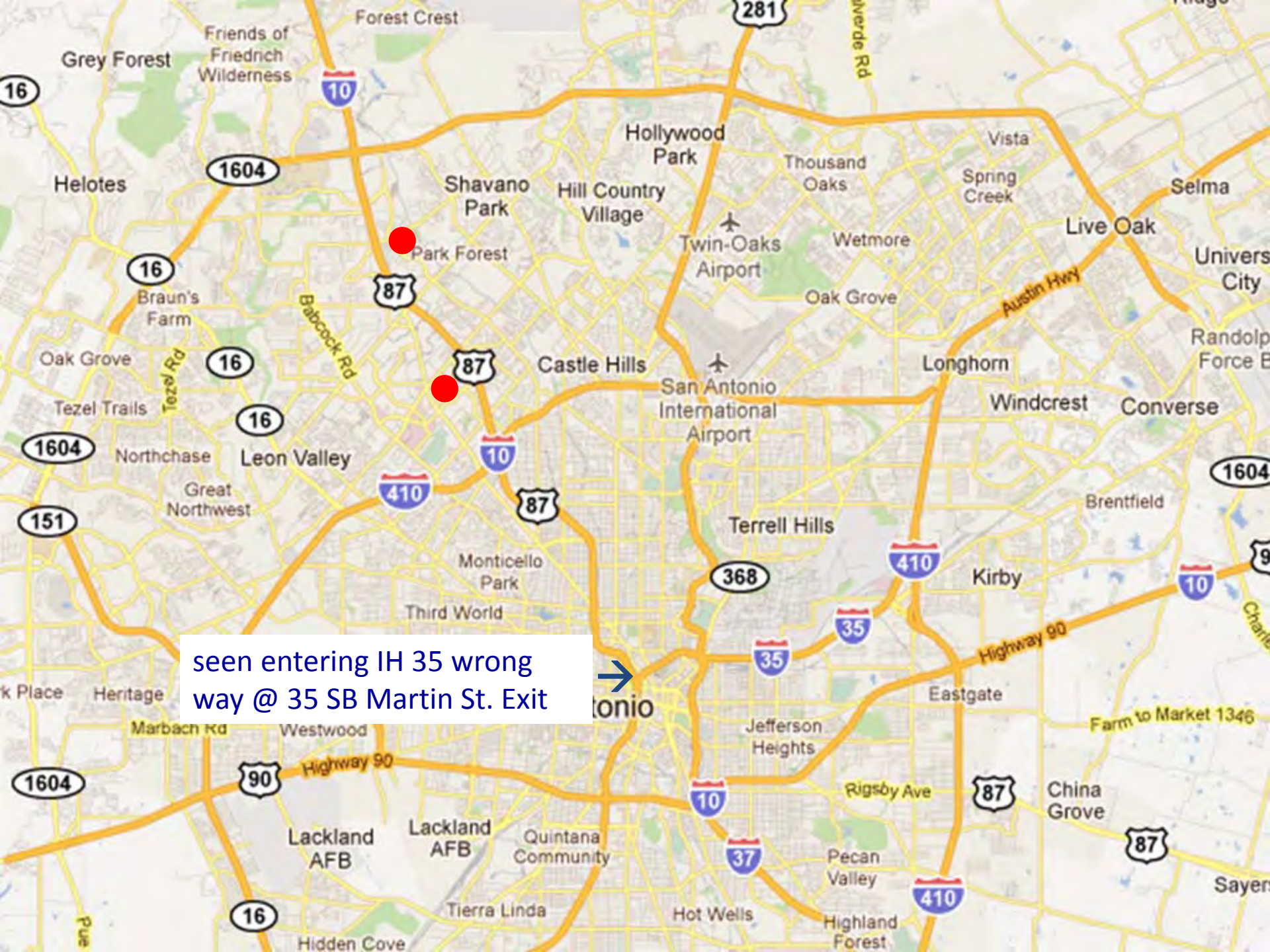
Brian G. Fariello, P.E.
Traffic Management Engineer- TransGuide
San Antonio District- TxDOT
brian.fariello@txdot.gov

Monday, March 14, 2011
Early Evening – 12 Midnight
Flying Saucer,
De Zavala & Vance Jackson





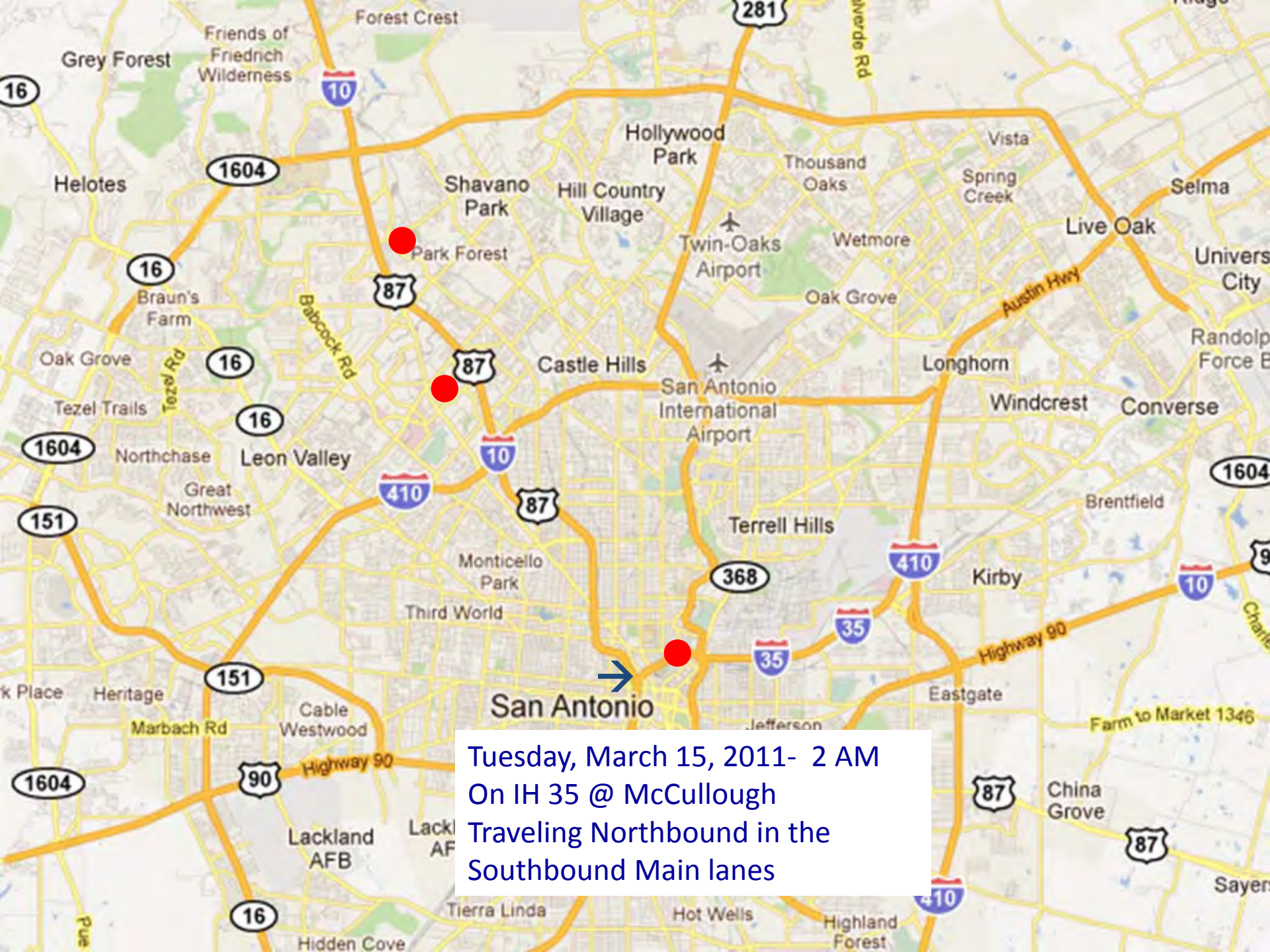
Tuesday, March 15, 2011
12 Midnight – 1:30 AM
Oak Hills Tavern,
Medical Dr. & Fred. Rd.



seen entering IH 35 wrong
way @ 35 SB Martin St. Exit



San Antonio



Tuesday, March 15, 2011- 2 AM
On IH 35 @ McCullough
Traveling Northbound in the
Southbound Main lanes

**IH 35 @ McCullough, 2 AM, March 15, 2011-
2 fatalities, WWD & SAPD Officer Stephanie Brown**



- No reports of WWD prior to accident
- Less than one minute of drive time from ramp to accident location (3500 ft.)

Lessons Learned from Accident Investigations:

- Drivers were impaired, with extremely high BAC
- Drivers were initially driving in correct direction on freeway
- Drivers either missed exit, or were driving away from their intended destination to begin with
- Driver eventually exited freeway; wrong way event resulted when impaired driver attempted to re-enter freeway
- Conclusion:
 - The solution is not as simple as identifying the locations of drinking establishments and the nearest exit ramps

The San Antonio Wrong Way Driver Task Force

- **The San Antonio Wrong Way Driver Task Force was organized in the spring of 2011 specifically to examine the factors contributing to the wrong way driving problem in San Antonio, and to identify possible methods of addressing the wrong way driver problem**
- **Agencies Participating:**
 - **Texas Department of Transportation**
 - **Headquarters**
 - **Traffic Engineering, Traffic Management, Traffic Safety**
 - **San Antonio District**
 - **Traffic Engineering, Traffic Management, PIO**
 - **The San Antonio Police Department**
 - **City of San Antonio Department of Public Works**
 - **The Bexar County Sheriff's Department**
 - **The Federal Highway Administration**
 - **The Texas Transportation Institute**

Task Force Goals And Challenges:

- **Goals**
 - Identify high risk locations
 - Investigate prior WWD related research
 - Investigate WWD Counter Measures implemented elsewhere
 - Identify potential WWD Counter Measures for San Antonio
 - Identify funding resources for implementation of WWD Counter Measures
- **Challenges**
 - Determining points of entry for WWDs
 - How to get the attention of drivers that are severely impaired
 - Number of ramps-
 - More than 400 exit ramps in San Antonio metro area
 - Manual of Uniform Traffic Control Devices Compliance
 - Spike Strips are not MUTCD compliant

Institutional Actions

- **San Antonio Police Department**
 - **Aug 2010- Implemented E-Tone WWD notification for its radio network**
 - **Nov 2010- Initiated use of portable spike strips**
 - **Jan 2011- Implemented code in CAD system identifying WWD events**
 - **Jul 2011- Traffic Investigations Section instructed to focus on determining entry point/exit ramps used by WWDs**
- **TxDOT/TransGuide**
 - **Mar 2010- TransGuide Operations began documenting all WWD events**
 - **Previously documented WWD accidents**
 - **May 2011- TransGuide system operators authorized to display WWD warning message on DMS when SAPD issued E-Tone for WWD alert**
 - **Previously operators verified the WWD, and then placed the messages**

TransGuide DMS Wrong Way Driver Warning Message



- No lane instruction directions given
- Displayed until WWD stopped, accident located, or until SAPD cancels Alert
- Message displayed first, then operator searches for vehicle using cameras

Role of the TransGuide Operations Center in the Apprehension of Wrong Way Drivers

- **TxDOT and SAPD have been co-located at TransGuide since 1996**
- **In 2011 there were 14 documented WWD events where:**
 - **A 911 caller alerted SAPD Dispatcher at TransGuide of a wrong way driver**
 - **The wrong way driver was located by a TxDOT/TransGuide operator with a CCTV camera prior to a crash**
 - **The SAPD dispatcher working at TransGuide was able to alert SAPD officers on the highways of the location and direction of the wrong way driver**
 - **The officers on the highway apprehended the wrong way driver prior to an accident**
- **12 camera assisted apprehensions in 2012, 2 thus far in 2013**

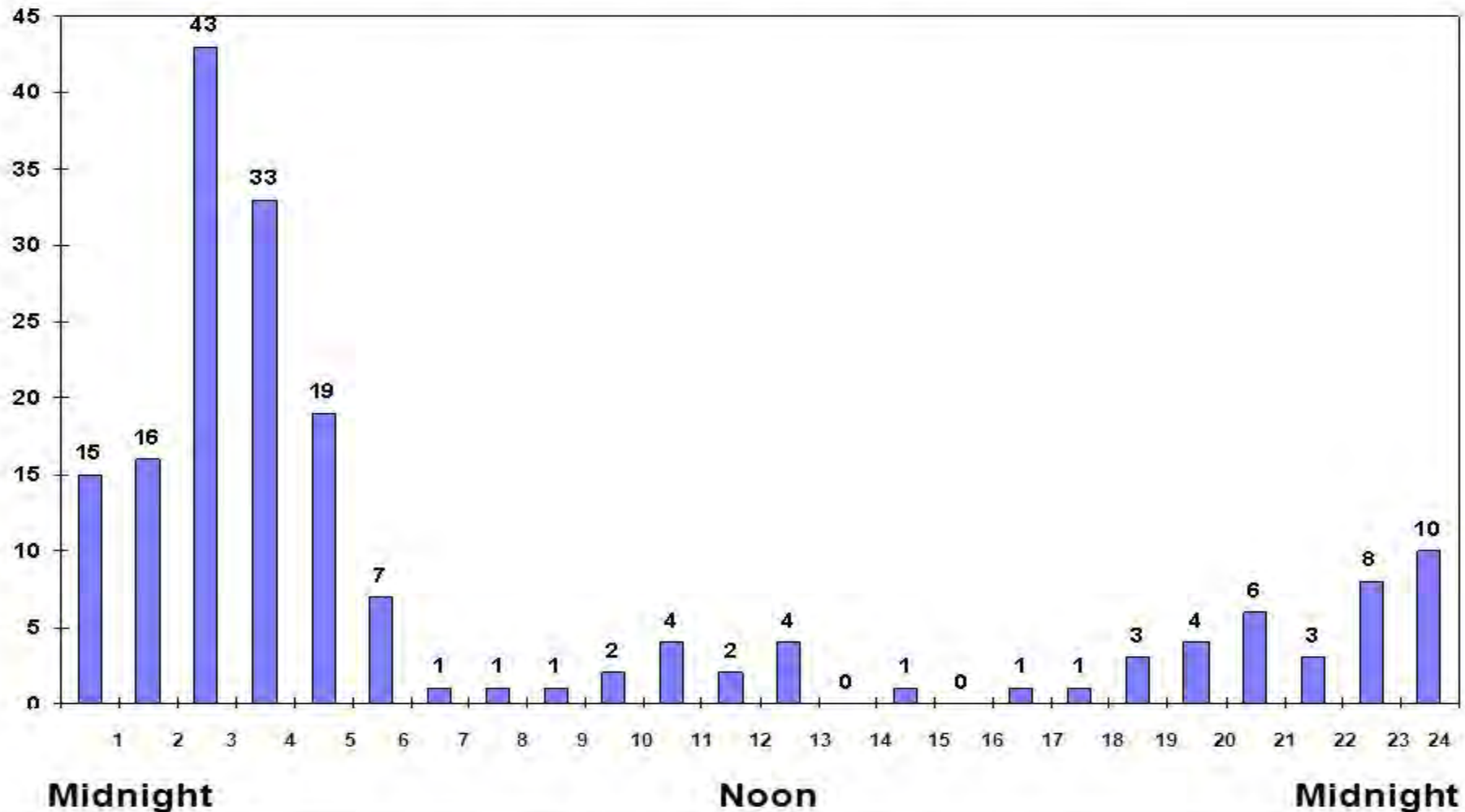
2011 WWD Statistics (TransGuide Operator Logs)

- 185- Total WWD Events logged by TransGuide Operators (Mar – Dec)
- 150- WWD not apprehended, no accident
- 21- Total accidents documented
 - 4- Vehicle matching description of WWD found wrecked, abandoned
 - 4- Accidents involving fatality, Driver DWI (7 fatalities in 4 accidents)
 - 3- Accident with serious injuries, Driver DWI
 - 10- Accident with no serious injuries, Driver DWI
- 10- No Accident, WWD apprehended, Driver DWI
- 4- No Accident, WWD Disoriented due to medical condition

Wrong Way Driver Reports analyzed by hour of day show:

- 80% happen at night
- 45% occurring between 2 AM and 4 AM

Wrong Way Driver Reports by Hour of Day

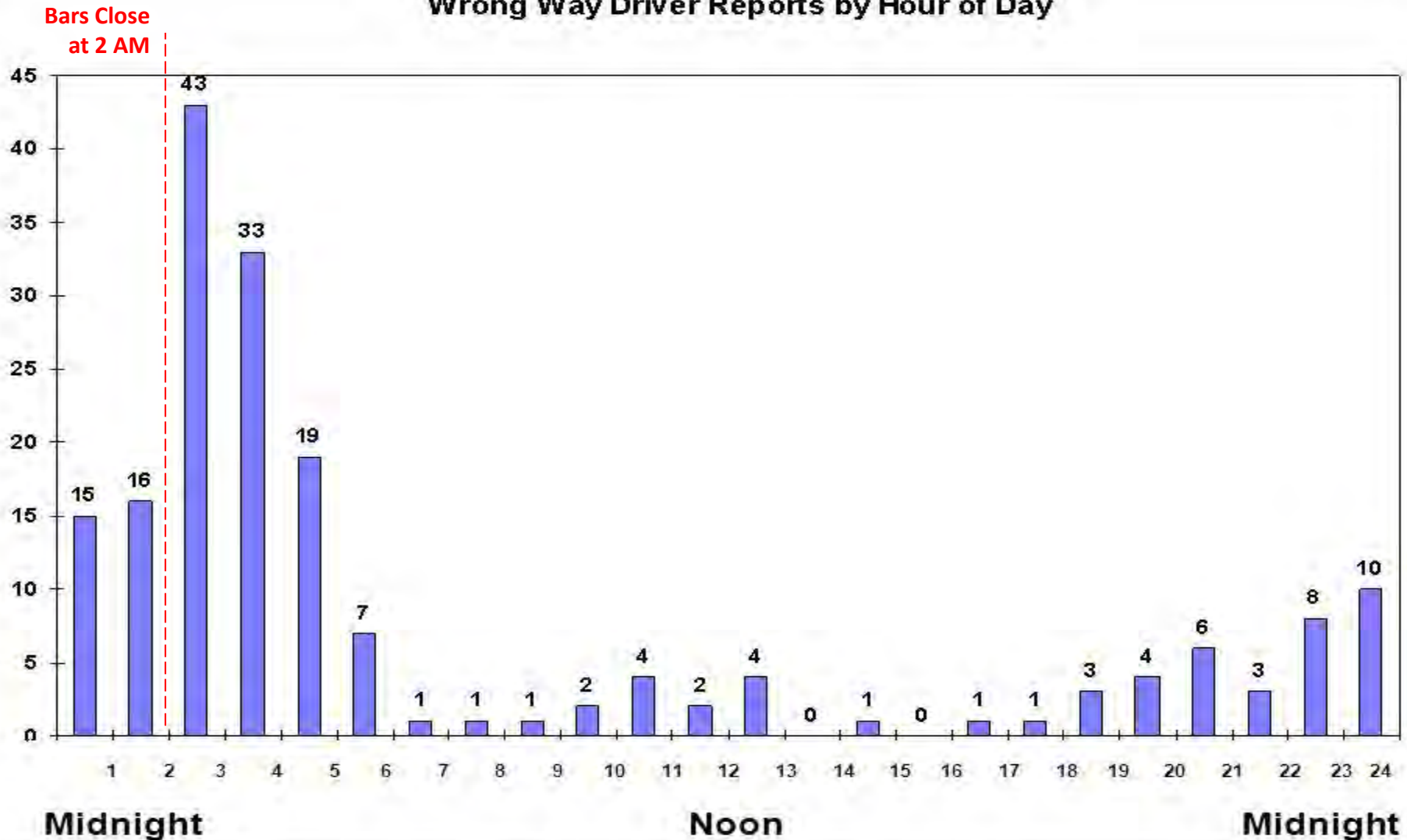


March 15, 2011 through December 31, 2011

Wrong Way Driver Reports analyzed by hour of day show:

- 80% happen at night
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Wrong Way Driver Reports by Hour of Day

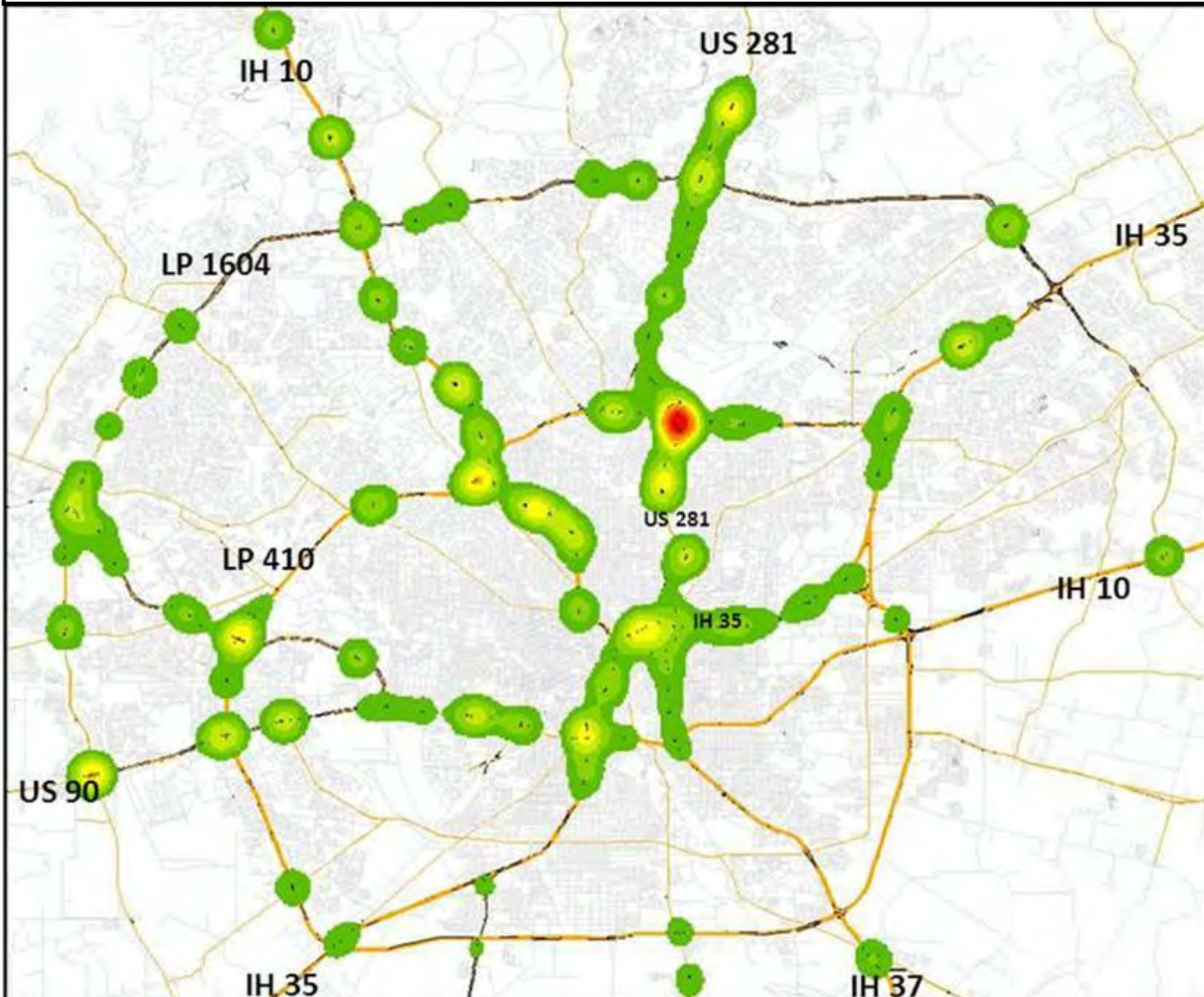


March 15, 2011 through December 31, 2011

Development of GIS Map of Wrong Way Driver Events

- **WWD Event Data Sources Available:**
 - **TxDOT Crash Record Information System (CRIS) reports**
 - **CRIS records filtered for “wrong way” events**
 - **TxDOT TransGuide Operator reports**
 - **San Antonio Police Department CAD data**
- **All reports of WWDs, not just accidents & apprehensions**
- **Developed by TTI**
 - **WWD reports typically referenced nearest cross street or major interchange**
 - **To provide a comprehensive analysis of WWD activity across corridors throughout the urbanized area, spatial analysis features in the GIS software were applied to create a density, or “heat,” map of WWD activity**

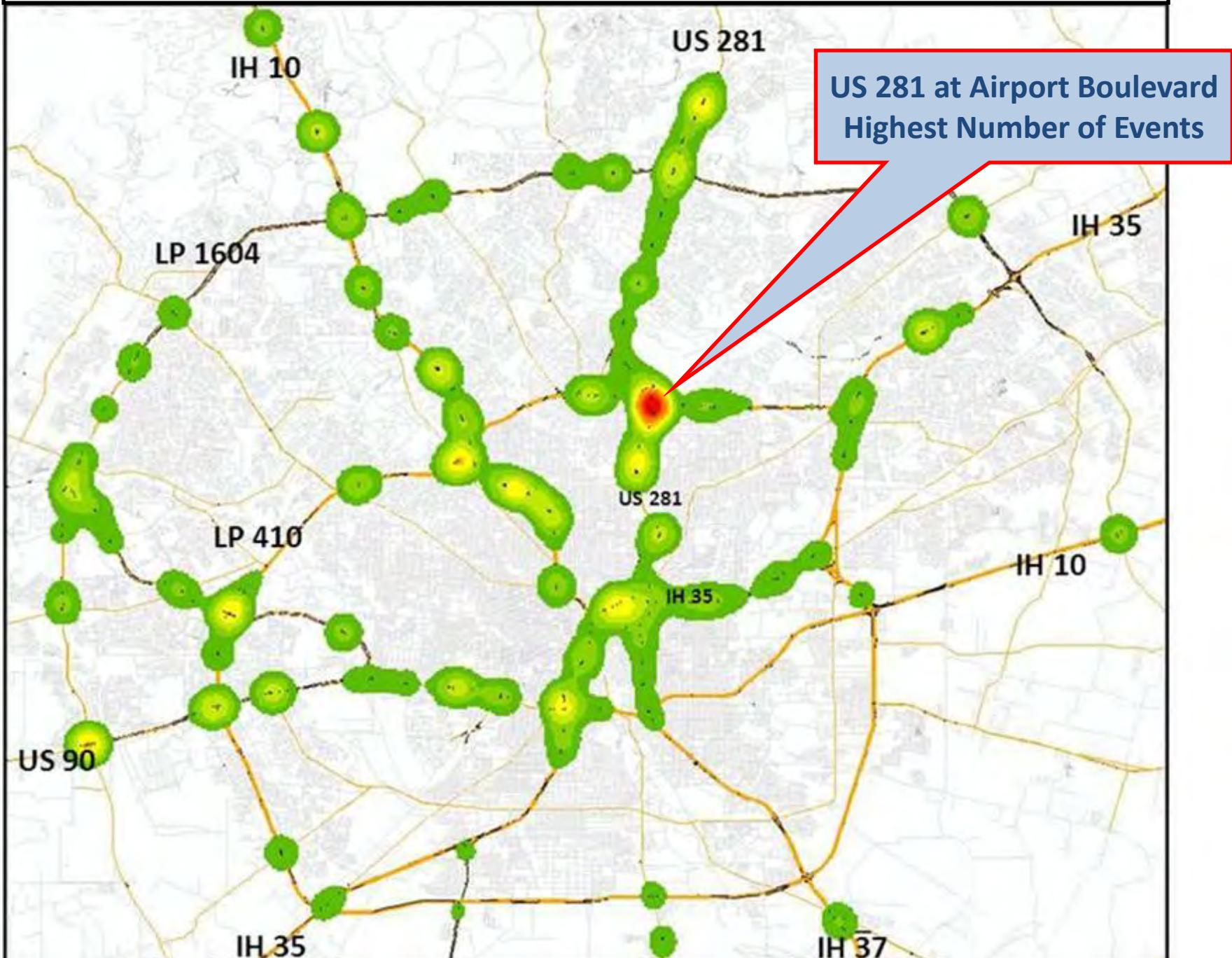
San Antonio Area GIS Map/Density Map- Wrong Way Driver Location Reports 2011



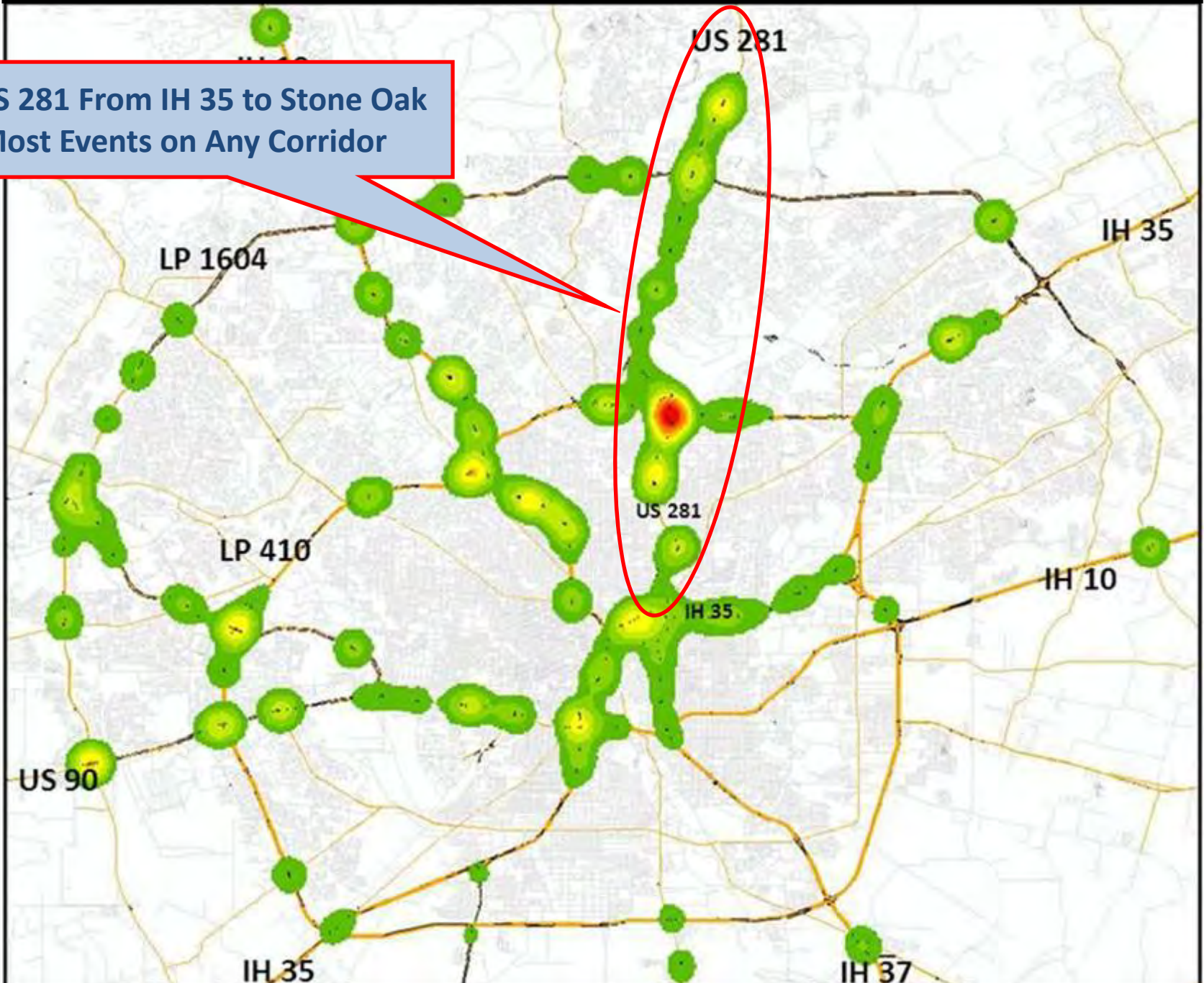
Identification of High Risk Locations Using GIS Map

- Considered an approach that identified individual high risk ramp locations:
 - identify nearby drinking establishments
 - target the exit ramp locations nearest those establishments
- Of 358 WWD reports to 911, only 5 identified the exit used by the WWD
- The available data provides a good indication of the high risk corridors, but does not indicate individual high risk ramps
- Conclusion- The installation of WWD countermeasures on an entire corridor section is needed so that the number of WWD reports before and after deployment can be compared to determine the effectiveness of the implemented countermeasures

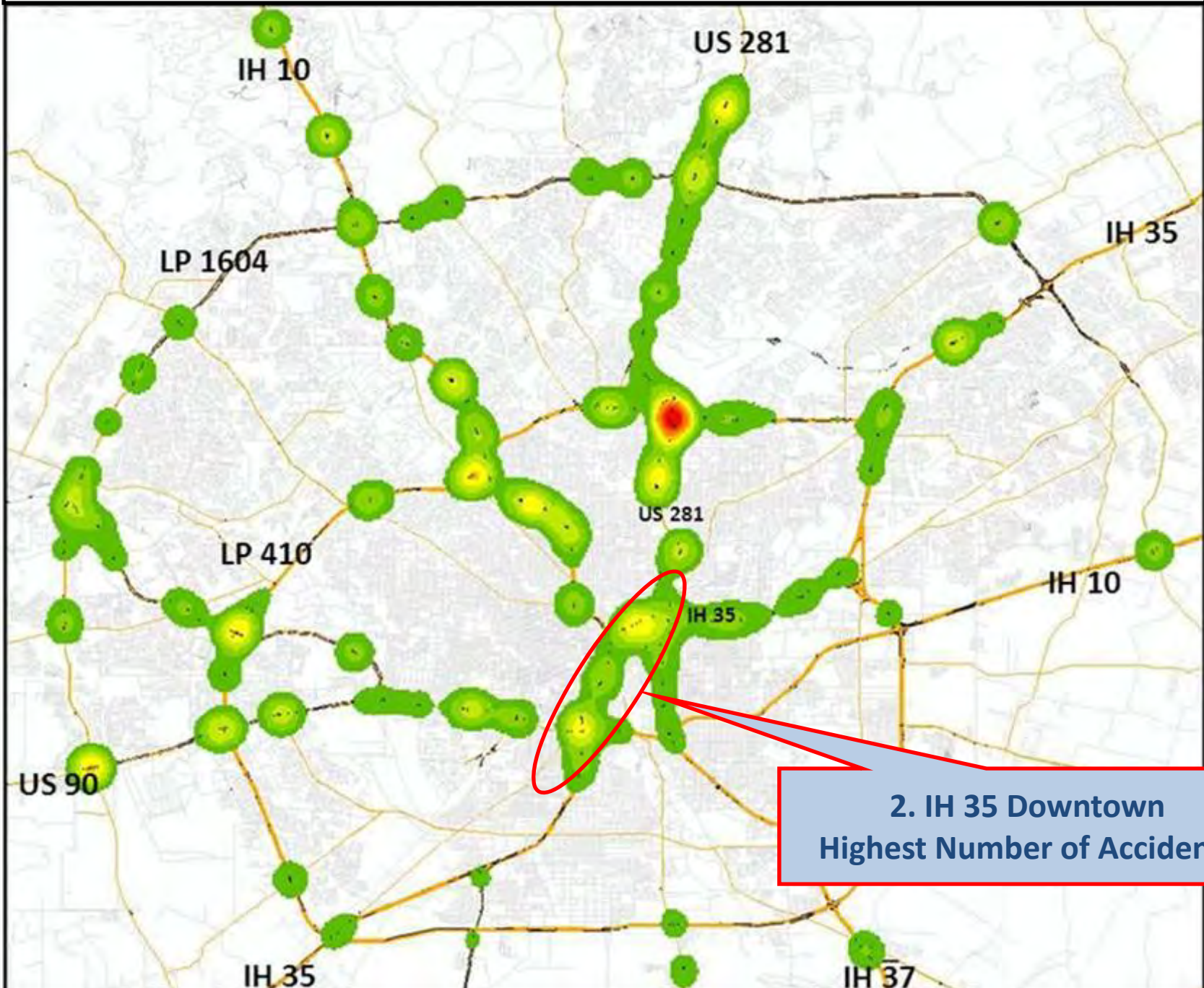
San Antonio Area GIS Map/Density Map- Wrong Way Driver Location Reports 2011



1. US 281 From IH 35 to Stone Oak
Most Events on Any Corridor



San Antonio Area GIS Map/Density Map- Wrong Way Driver Location Reports 2011



Countermeasures Identified

- **Enhanced Static Signing & Pavement Markings**
- **On-Site Driveway Channelization**
- **Detection Technologies (Radar Sensors)**
- **Active/Illuminated Signing**

Enhanced Static Signing

- Prior research has shown that increased visibility of “WRONG WAY” and “DO NOT ENTER” signs can reduce the instances of wrong way driving
- San Antonio implemented countermeasures recommended in a prior study: “Countermeasures for Wrong-Way Movement on Freeways: Overview of Project Activities and Findings”, TTI 2003/2004
 - Field Inspection of all ramps using 2004 TTI Study Checklist
 - Ensure all required signs, pavement markings and RPM’s are in place and visible
 - Recommend additional (supplemental) measures:
 - Add reflective tape on sign posts
 - Increased size of ONE WAY signs
 - Additional WRONG WAY & DO NOT ENTER signs at critical locations
 - Lowered sign heights*

* Note: San Antonio is not implementing lowered sign heights at this time

On-Site Driveway Channelization



- Force traffic into correct direction using on-site driveway channelization (curb or striping with RPMs)
- Voluntary action on part of property owners

Detection Technologies (Radar Sensors)

- Selected radar detectors from two manufacturers for evaluation as WWD detection devices for San Antonio, one type of radar detector will be used for exit ramps, and the other will be used for mainlane WWD system locations
 - Radar unit selected for exit ramps is the standard unit used by TAPCO in conjunction with its illuminated signing (\$1,000/unit)
 - Radar unit selected for the mainlane systems is the Wavetronix HD sensor (\$7,000/unit)
- TxDOT & Southwest Research Institute worked with suppliers to integrate the wrong way data with Lonestar software
 - The date, time and location of the event is logged, an alarm is generated at the TransGuide Operations Manager's workstation, and email notifications are provided

Active/Illuminated Signing

- Over 80% of the wrong way driver events occur at night



**LED Illuminated
Wrong Way Signs**



LED Blank Out Signs

LED Illuminated Wrong Way Signs



LED ILLUMINATED
WRONG WAY SIGN
AS SEEN FROM A DISTANCE



LED ILLUMINATED
WRONG WAY SIGN
AS VEHICLE APPROACHES

The flashing LED lights will be visible to the wrong driver from a distance

As the WWD gets closer to the sign, the vehicle headlights will illuminate the retroreflective WRONG WAY message (greater visibility than LEDs)

Fully MUTCD Compliant (size, shape, retroreflectivity)

LED Blank Out Signs



Blank Out Sign is an LED DMS panel capable of displaying a single message when activated, otherwise message panel is “blank”

WWD Active Countermeasures (Ramps)

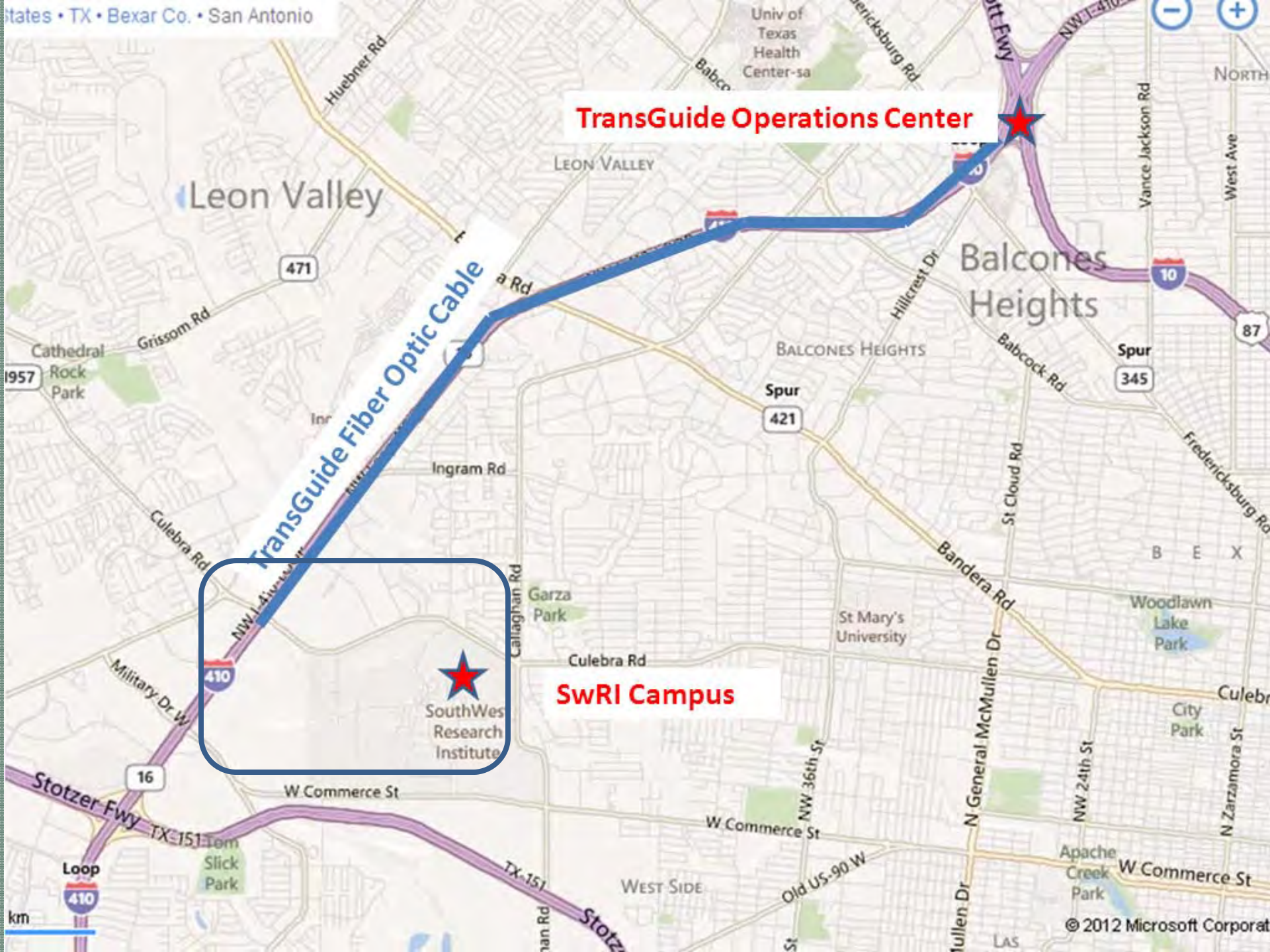
- **Exit Ramp Installations**
 - **Installing 2 TAPCO LED Illuminated Wrong Way Signs**
 - Photocell activated for night and low visibility operation
 - **Installing 1 TAPCO Radar Detector**
 - Radar unit will provide notification of wrong way detection using TxDOT communication network connection to TMC
- **Illuminated wrong way signs are installed as supplemental signs where possible, in some locations the existing wrong ways were replaced with the LED Illuminated Wrong Way Signs due to site conditions**

WWD Countermeasures (Mainlanes)

- **Mainlanes Systems**
 - Installing 1 TAPCO LED Illuminated Wrong Way Sign & 1 SES Blank-Out Sign on each shoulder
 - Installing 1 Wavetronix HD Radar Detector in advance of sign location
 - MAINLANE SYSTEMS WILL BE RADAR DETECTOR ACTIVATED due to visibility of illuminated signs to drivers on the other side of the median
 - Radar unit will provide notification of wrong way detection using TxDOT communication network connection to TMC
- Set up test environment at test track on Southwest Research Institute Campus for mainlane system configuration, demonstration and testing

Overview of Testing at SwRI Test Track

- Set up interconnected system with Wavetronix radar unit activating both the TAPCO Illuminated Wrong Way sign and the SES Blank Out Sign
- Establish correct configuration settings for radar unit and signs
 - Radars must be installed at least 600 ft. in advance of the signs
 - Wireless connection used to activate the signs
- The test track is connected to TransGuide using a WER connection from the SwRI campus to TxDOT's fiber network on LP 410
- Allows active testing of equipment from TxDOT operator workstations in TransGuide Operations Center
- Ensure that mainlane WWD systems work before installation



TransGuide Operations Center

Leon Valley

Balcones Heights

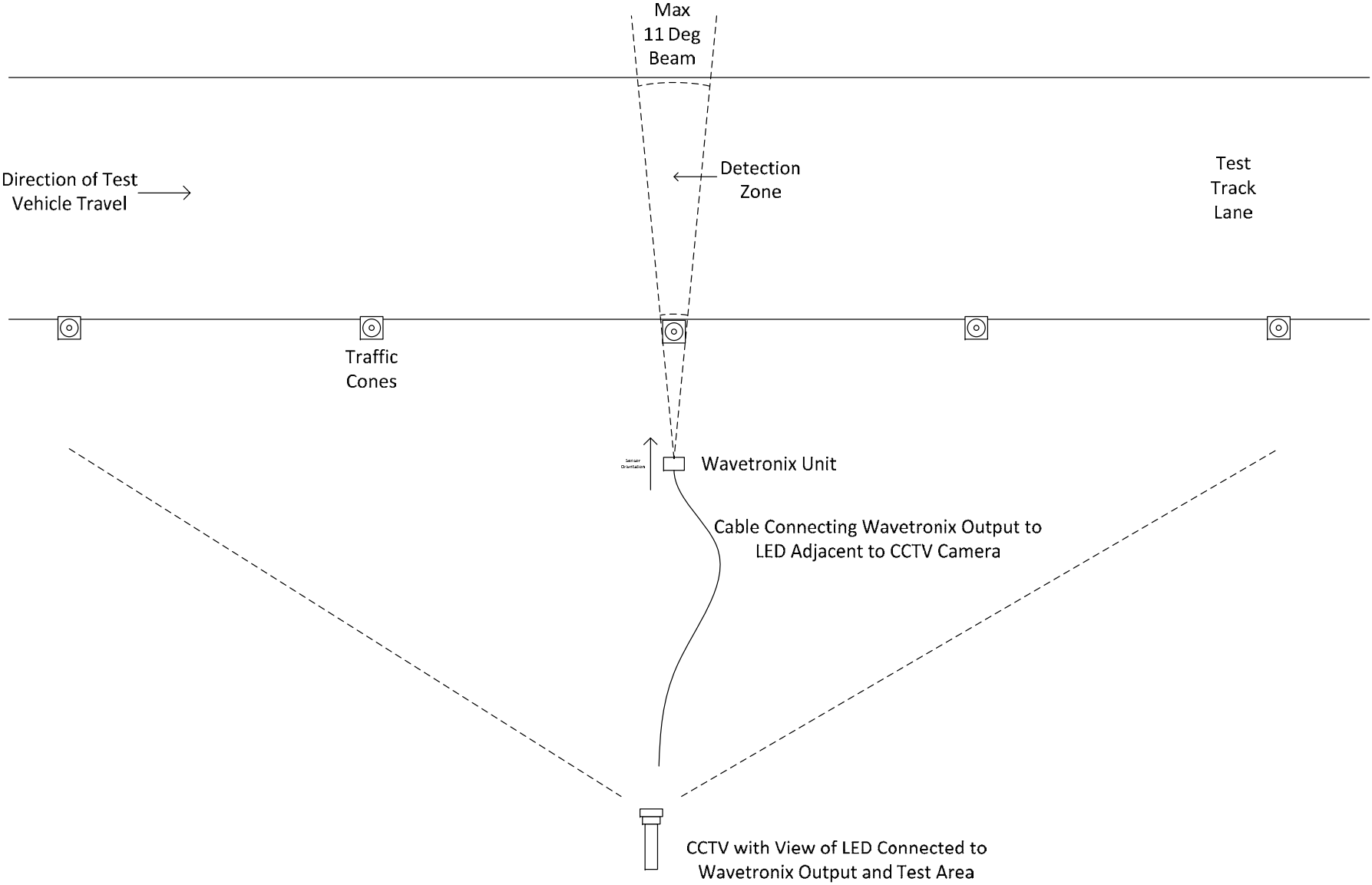
SwRI Campus

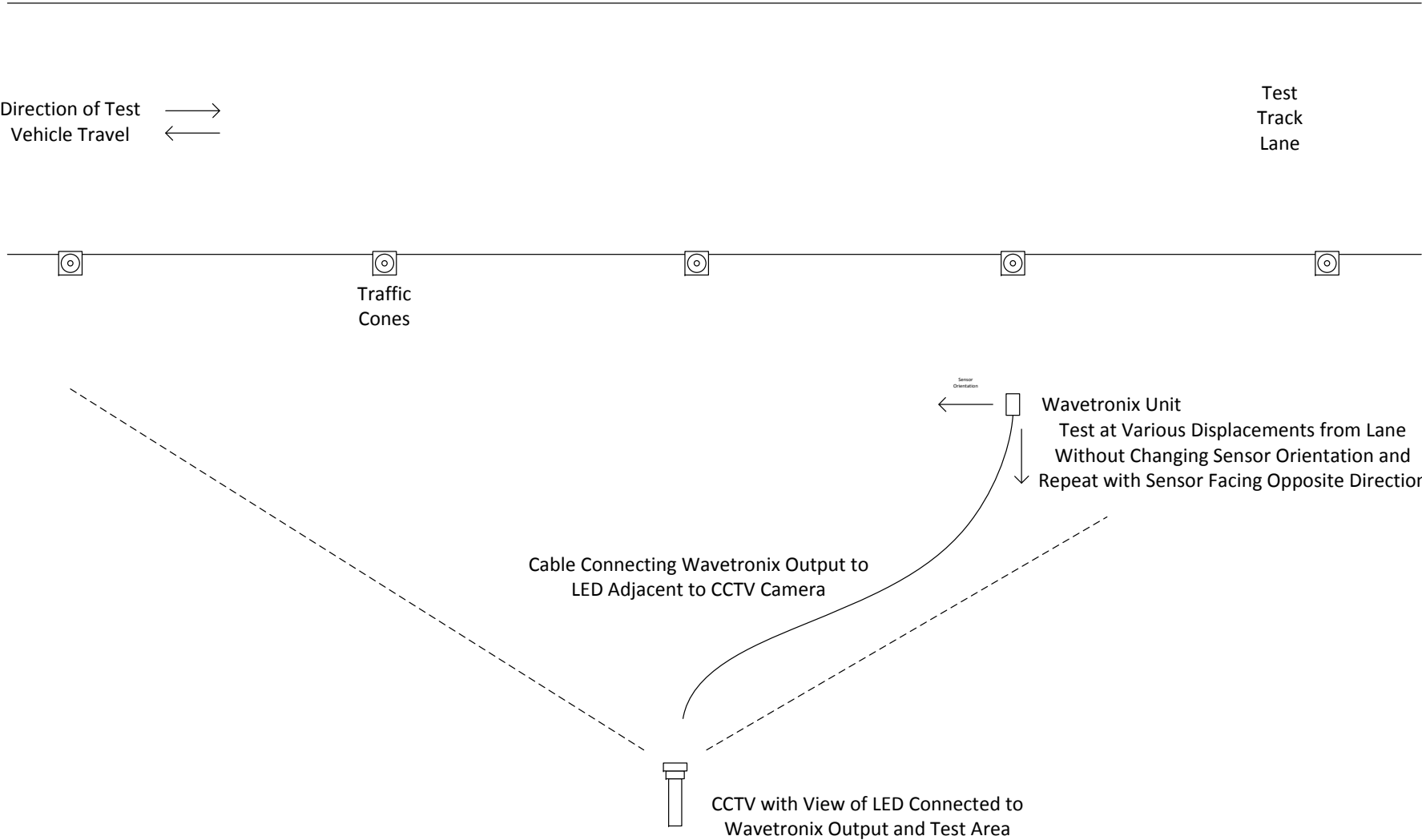
SouthWest
Research
Institute

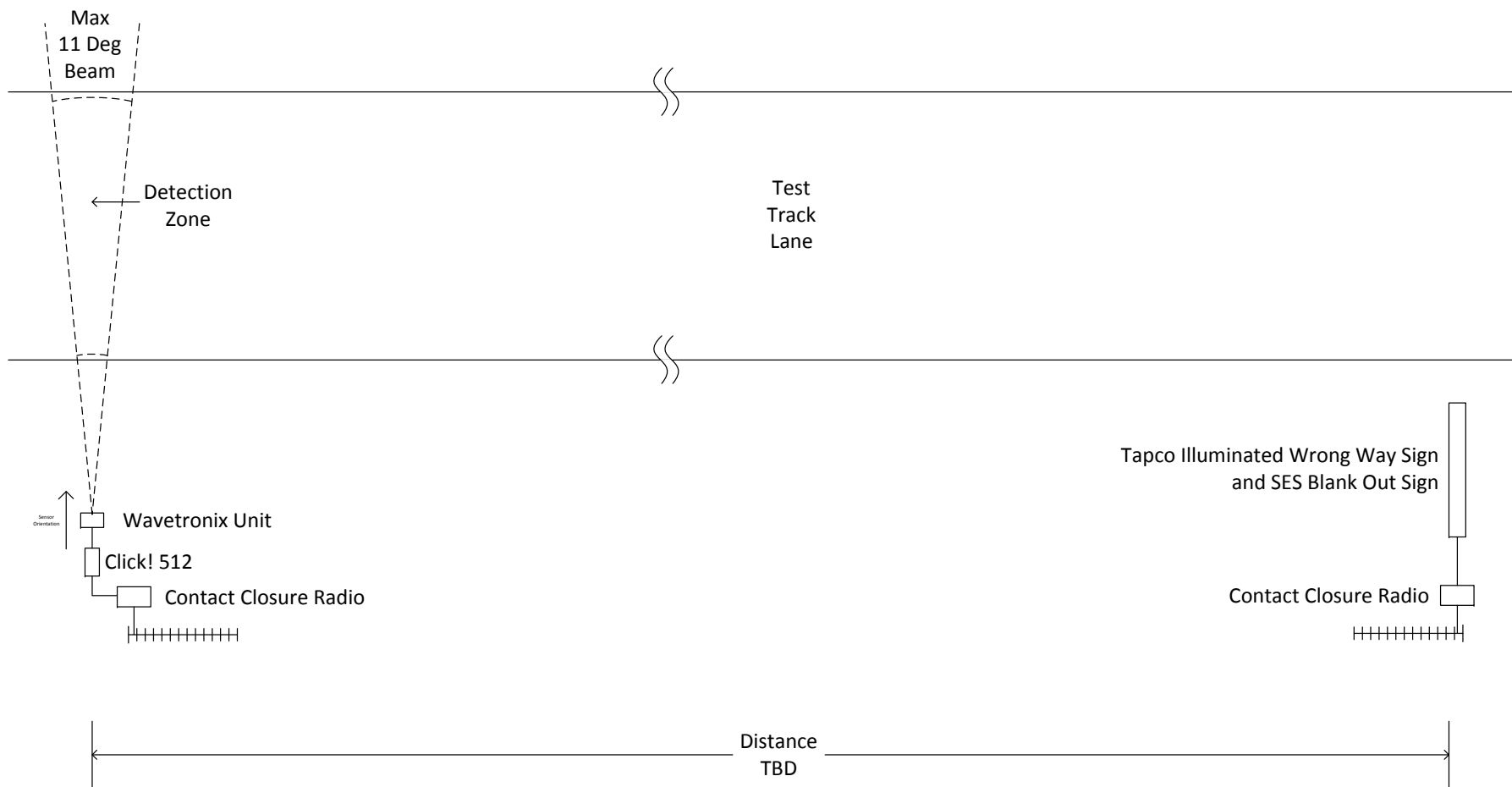


TxDOT Fiber

Wireless Link







US 281 Pilot Project

Limits: From IH 35 (downtown)
To Stone Oak Parkway

15 Miles

29 Exit Ramps

- 2 LED Illuminated Wrong Way Signs
- 1 Radar Detection Unit

1 Mainlane Location

- LED Illuminated Wrong Way & LED Blank Out Sign installed on both shoulders
- 1 Radar Detection Unit

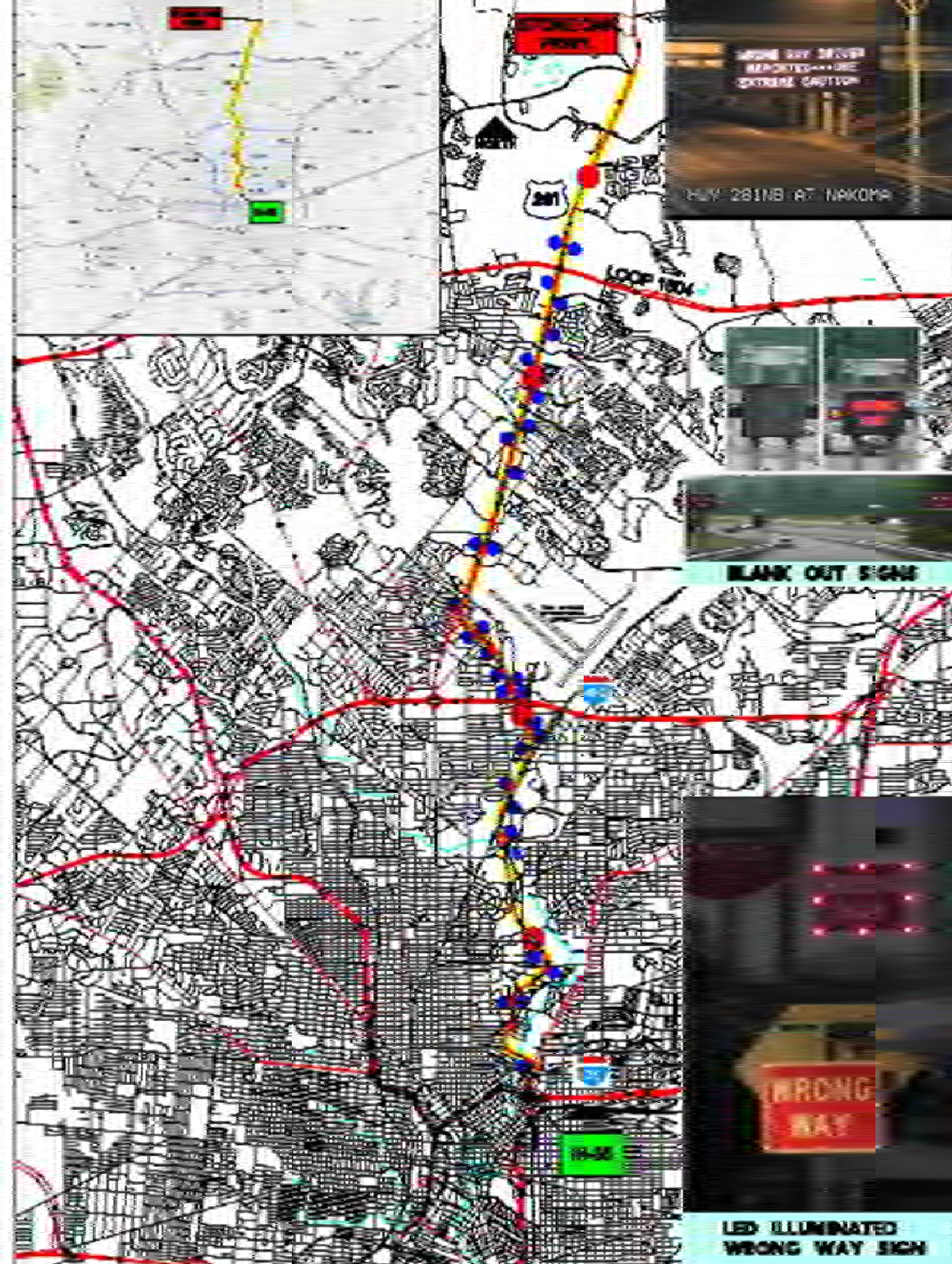
-Installation began Jan 2012

-LED Illuminated Wrong Way Sign
Installation Completed June 2012

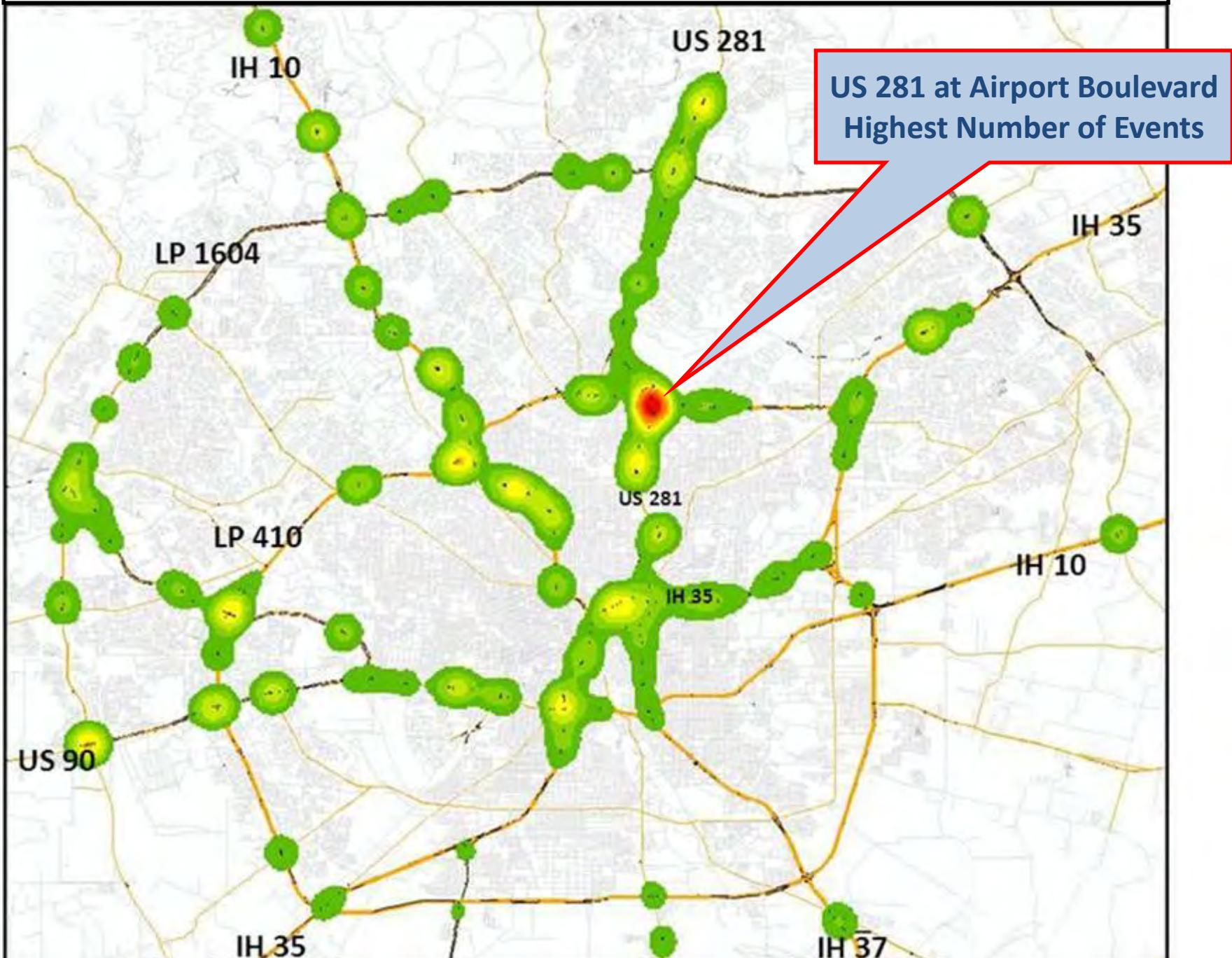
-Radar Unit Installation is Ongoing

-Mainlane System Installation
pending

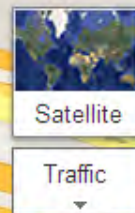
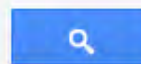
-Budget \$500,000



San Antonio Area GIS Map/Density Map- Wrong Way Driver Location Reports 2011



Google maps

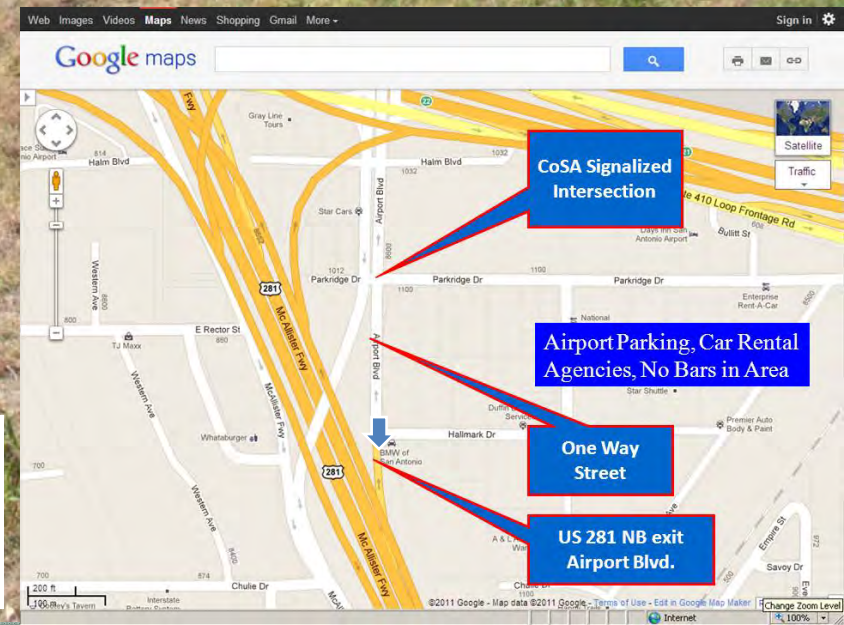


CoSA Signalized Intersection

Airport Parking, Car Rental Agencies, No Bars in Area

One Way Street

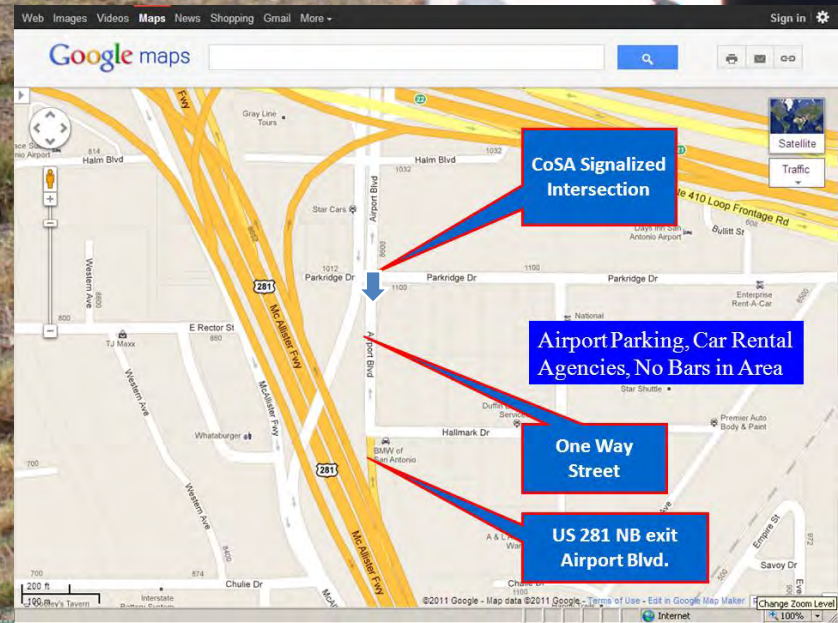
US 281 NB exit Airport Blvd.



- Reflective RPM arrows were present
- Wrong Way and Do Not Enter Signs present, **BUT:**
- Red/White Signs mounted on Red/White Columns



- Wrong Way and Do Not Enter Signs not visible
- No Wrong Way/Do Not Enter Signs between signal and ramp

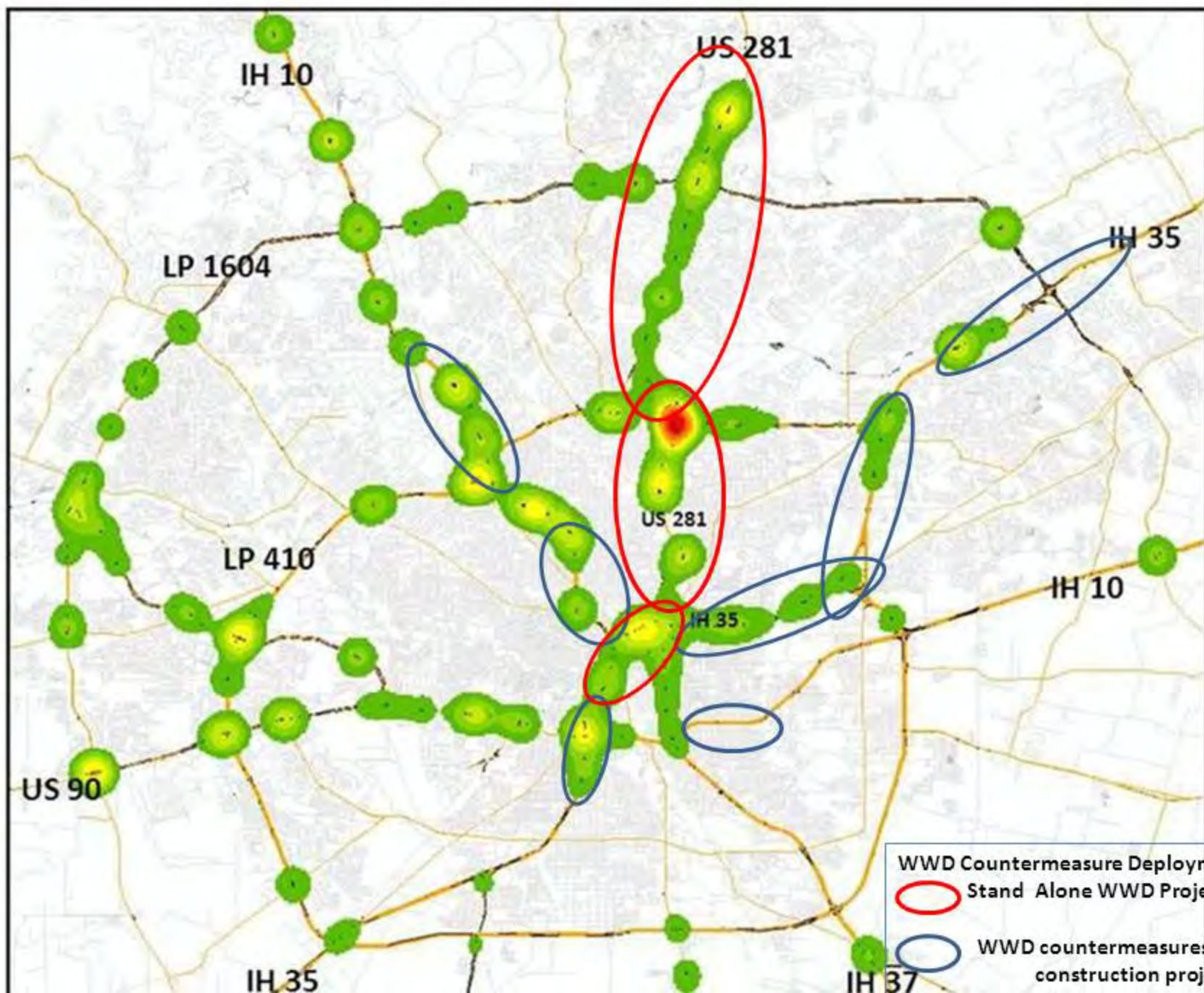




- Relocated Wrong Way & Do Not Enter Signs
- Added reflective tape to sign mounts
- Wrong Way Signs are LED Illuminated
- Installed radar detector

- Supplemental Wrong Way & Do Not Enter Signs added between signalized intersection and ramp
- Wrong Way Signs are LED Illuminated



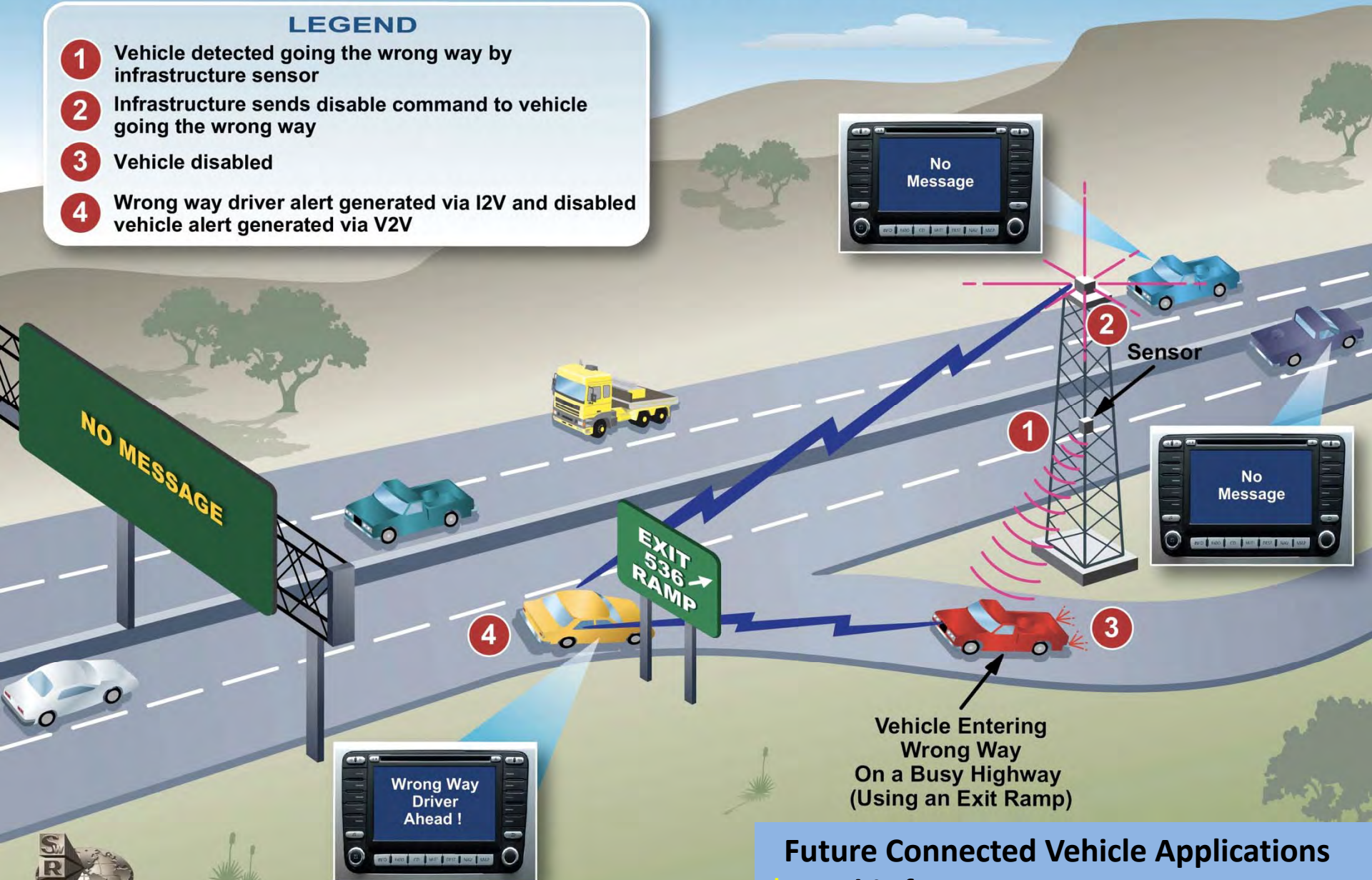


Advance Wrong Way Driver Alert

Local Wrong Way Driver – Vehicle Disable

LEGEND

- 1 Vehicle detected going the wrong way by infrastructure sensor
- 2 Infrastructure sends disable command to vehicle going the wrong way
- 3 Vehicle disabled
- 4 Wrong way driver alert generated via I2V and disabled vehicle alert generated via V2V



Future Connected Vehicle Applications

*Graphic from Ryan Lamm, SwRI



TxDOT Research Project 0-6769

Wrong Way Driving Countermeasures

- **Research project will evaluate the effectiveness of WWD countermeasures implemented on US 281 and IH 35 Corridors, elsewhere in Texas and around the country**
- **Will evaluate detection methods used to detect wrong way drivers in San Antonio, Dallas (NTTA), Houston (HCTRA) and elsewhere**
- **Will review MUTCD guidelines for Illuminated Signing applications for WWD countermeasures and make best practice recommendations**
- **The research project will commence in the fall of 2012, and is expected to be completed in two years**

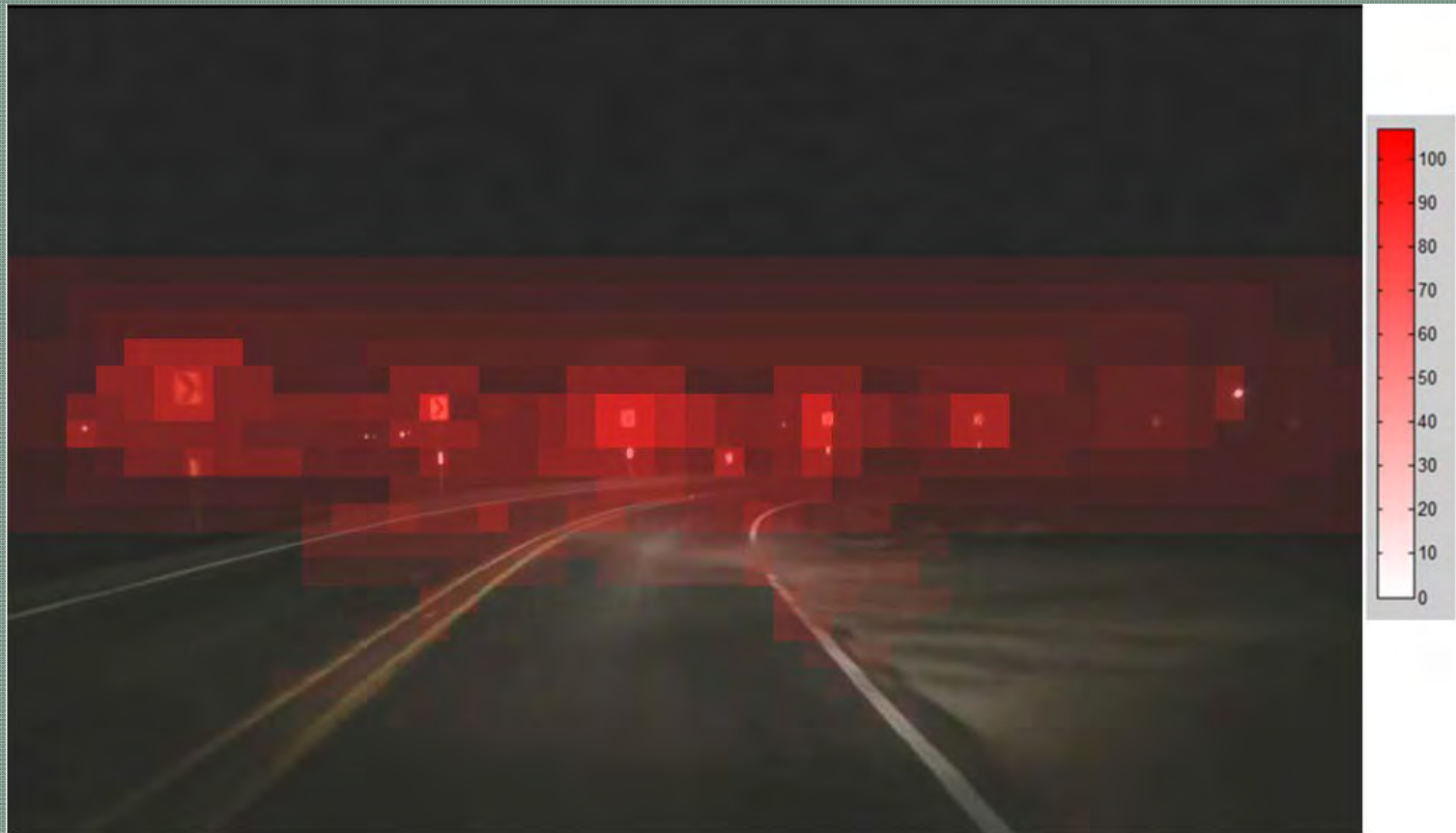
TxDOT Research Project 0-6769

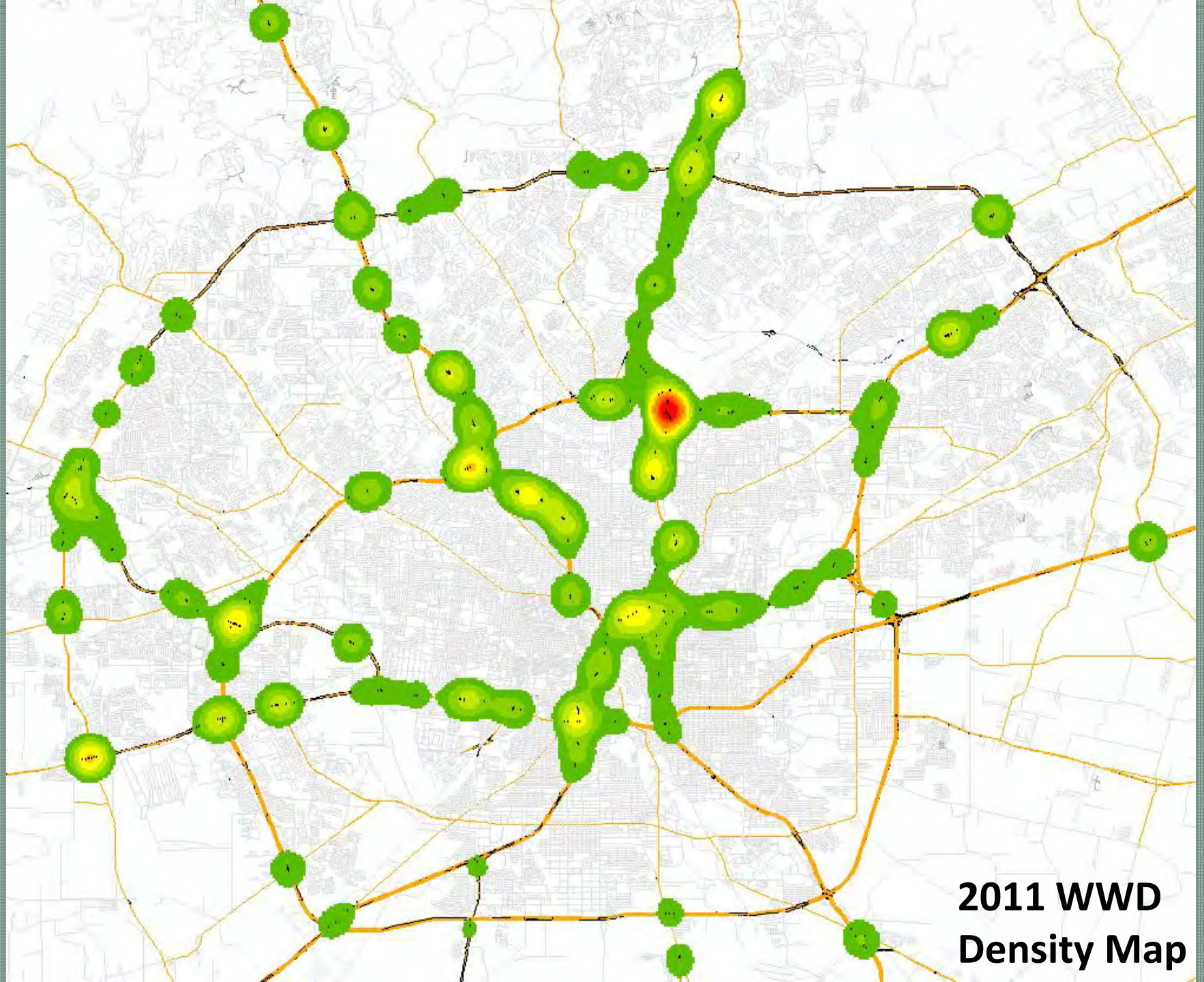
Wrong Way Driving Countermeasures

- **Research Plan**
 - **Task 1: Assess State-of-Knowledge in the US and Texas**
 - **Task 2: Evaluate Countermeasures in a Closed-Course Environment**
 - **Monitored, intoxicated test subjects on a closed course at night in an instrumented vehicle**
 - **Task 3: Evaluate countermeasures and detection systems in an operational environment**
 - **Utilize data from San Antonio, Dallas and Houston WWD countermeasure deployments to assess their impacts**
 - **Task 4: Develop and assess wrong-way driver warning messages**
 - **Determine what message(s) to deliver to right-way drivers**
 - **Task 5: Develop recommendations and report**

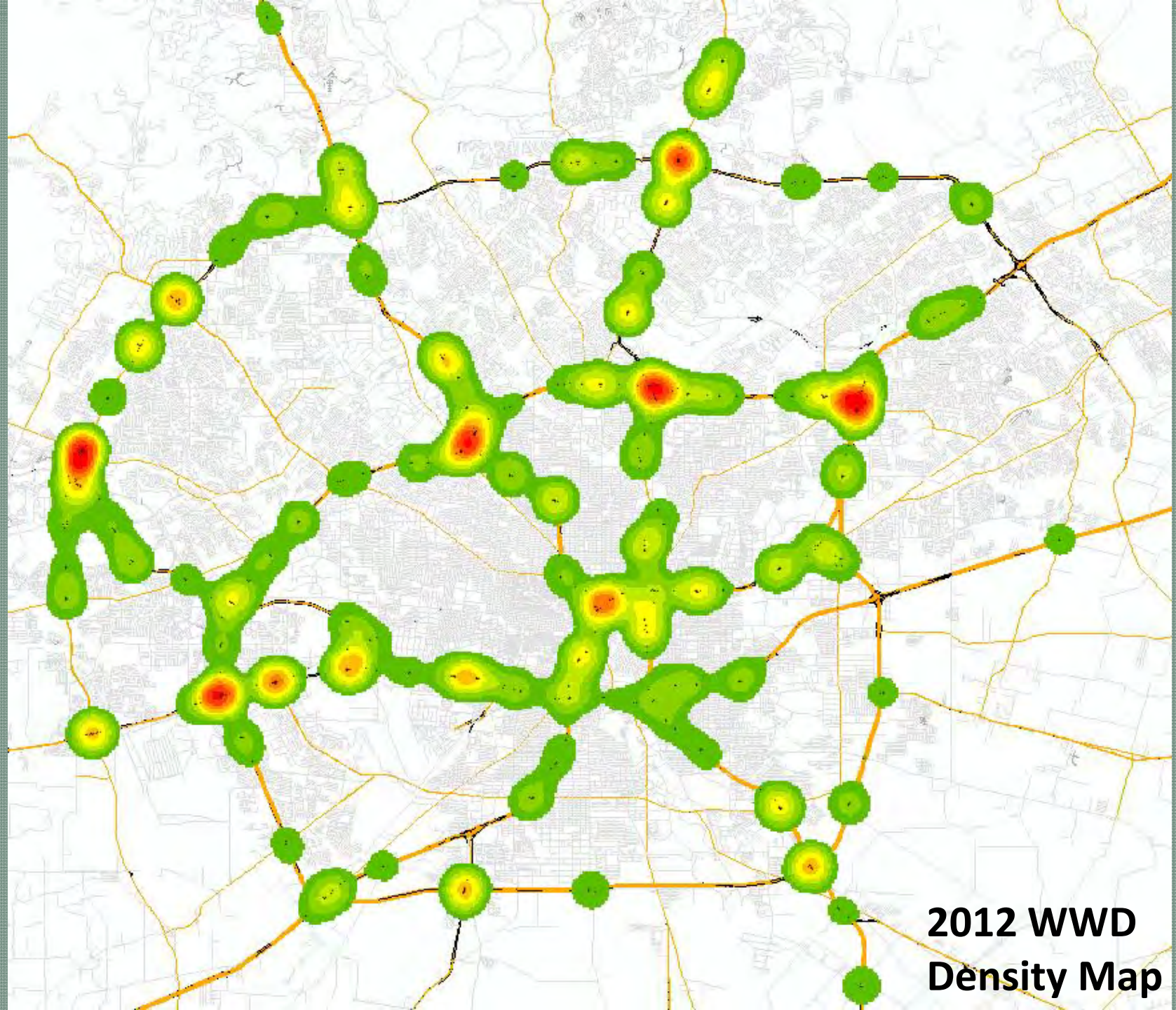
WWD Research Testing

- Example of eye-tracking heat map to document driver looking behavior (signs, pavement lines, etc.)





**2011 WWD
Density Map**



**2012 WWD
Density Map**

Comparison of the new 2012 WWD density/heat map and the 2011 map (as a reference). Comparing the two maps shows that addressing WWDs on US 281 has brought that corridor down from the highest WWD event density (as show in the 2011 map) to make US 281's WWD density comparable to other high-volume corridors in San Antonio (as shown in the 2012 map). Locations that seem to have increased in their intensity include:

- 1. IH 35 N at Loop 410 (Fratt Interchange)**
- 2. Loop 1604 between Bandera and SH 151,**
- 3. US 90 between Loop 410 and Gen. McMullen**
- 4. Loop 1604/US 281 interchange**
- 5. Loop 410 S at Spur 422/Palo Alto Road**
- 6. I-37 between SW Military and Loop 410 S**

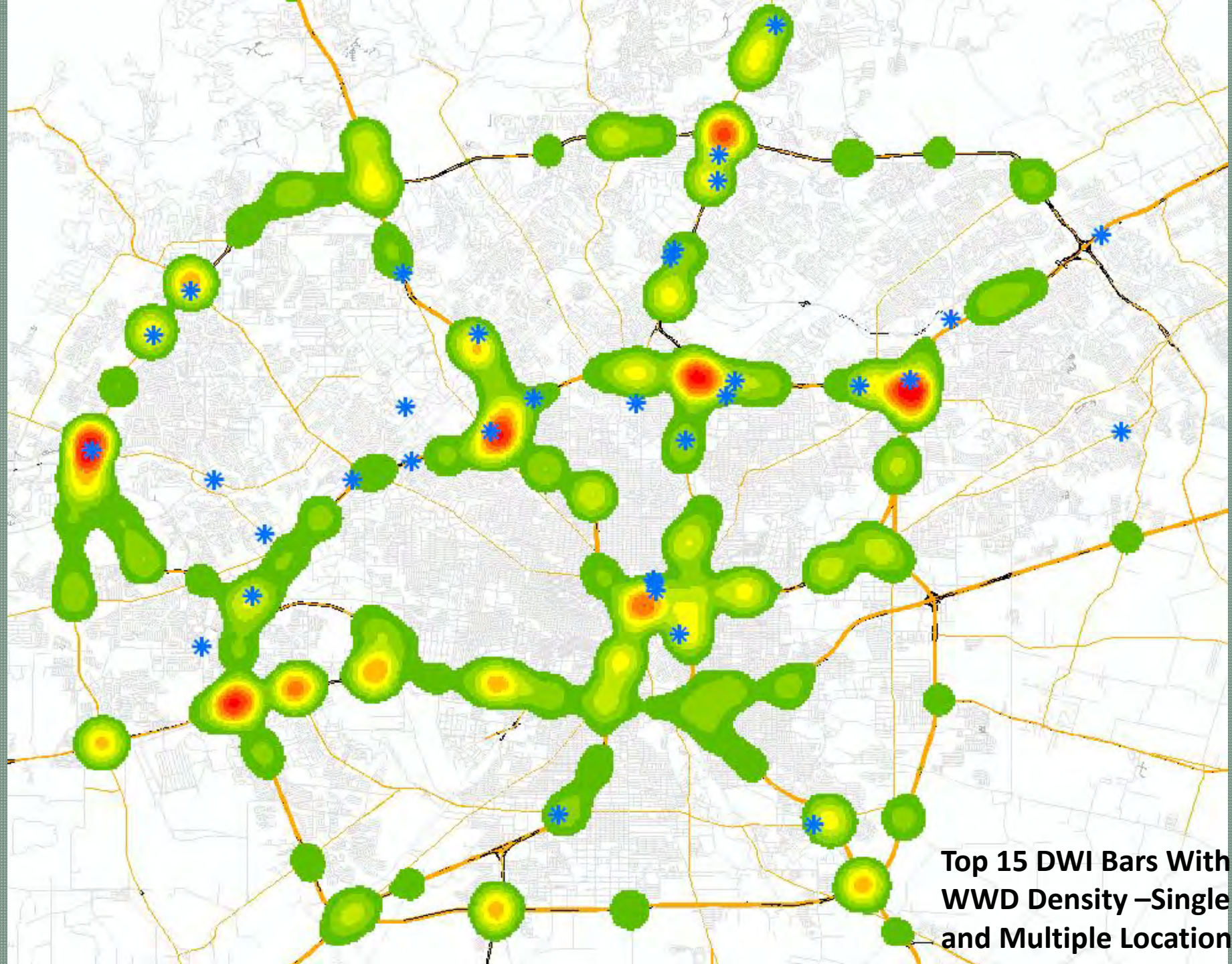
San Antonio TransGuide Operator Logs, Wrong Way Driver Reports

	2011 (Mar - Dec)	2012 (Jan - Dec)
Number of Reports	185	274
No Accident/Not Apprehended	150	235
Accident (Fatal)	4	5
-Number of Fatalities	7	7
Accident (Non-Fatal)	17	17
Medical Conditon/Elderly Driver	4	2
No Accident/WWD Apprehended	10	15
WWD Observed with Camera	14	12
WWD reports 10 PM to 6 AM	80%	72%
WWD Repoprts 2 AM to 4 AM	45%	32%

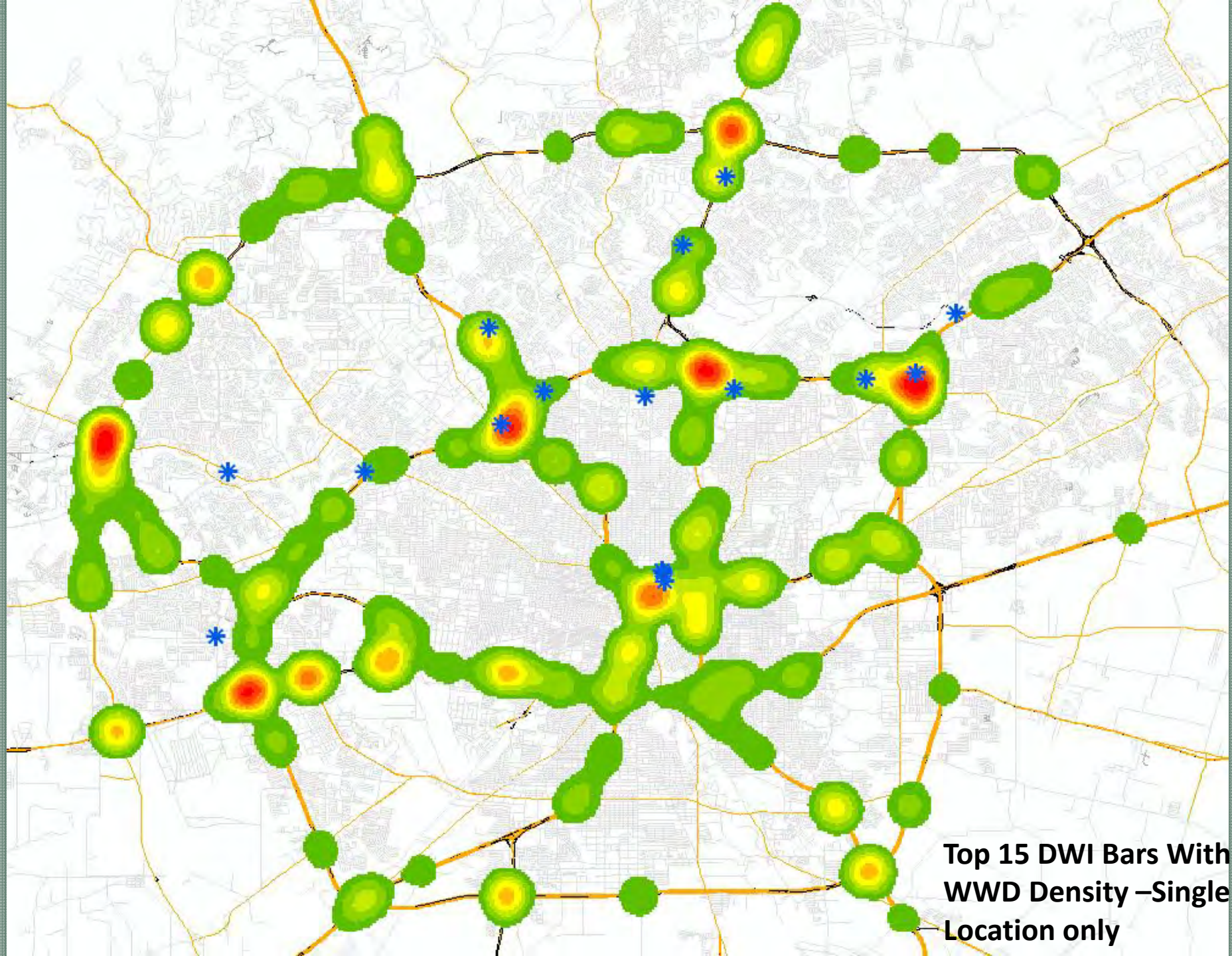
US 281 Corridor Wrong Way Driver Countermeasure Operational Test Project- Preliminary Findings

	Jul 2012 - Dec 2012 (6 Months)	Jul 2012 - Jan 2013 (7 Months)	Jul 2012 - Feb 2013 (8 Months)	Jul 2012 - Mar 2013 (9 Months)	Jul 2012 - Apr 2013 (10 Months)
Reduction in Average Rate of WWD Events/Month TransGuide Operator Logs US 281- IH 35 to LP 1604	-30.32%	-28.11%	-27.42%	-31.18%	-29.62%
Reduction in Average Rate WWD Events/Month TransGuide Operator Logs IH 35 to Stone Oak Parkway		-36.33%	-35.71%	-39.05%	-37.66%
Reduction in Average Rate WWD Events/Month SAPD 911 Call Logs US 281- IH 35 to LP 1604	-20.87%	-30.43%	-31.52%	-32.37%	-30.00%
Reduction in Average Rate WWD Events/Month SAPD 911 Call Logs US 281- IH 35 to Stone Oak Parkway		-20.00%	-21.64%	-20.81%	-18.55%
Calculated Annual Cost Savings (Average of SAPD and TransGuide Data)	\$218,015.69	\$249,276.39	\$251,022.56	\$270,656.33	\$253,919.00
Benefit - Cost Ratio	11.5 to 1	13.2 to 1	13.3 to 1	14.3 to 1	13.4 to 1
Cost Recovery Time (Years)	1.7	1.5	1.5	1.4	1.5

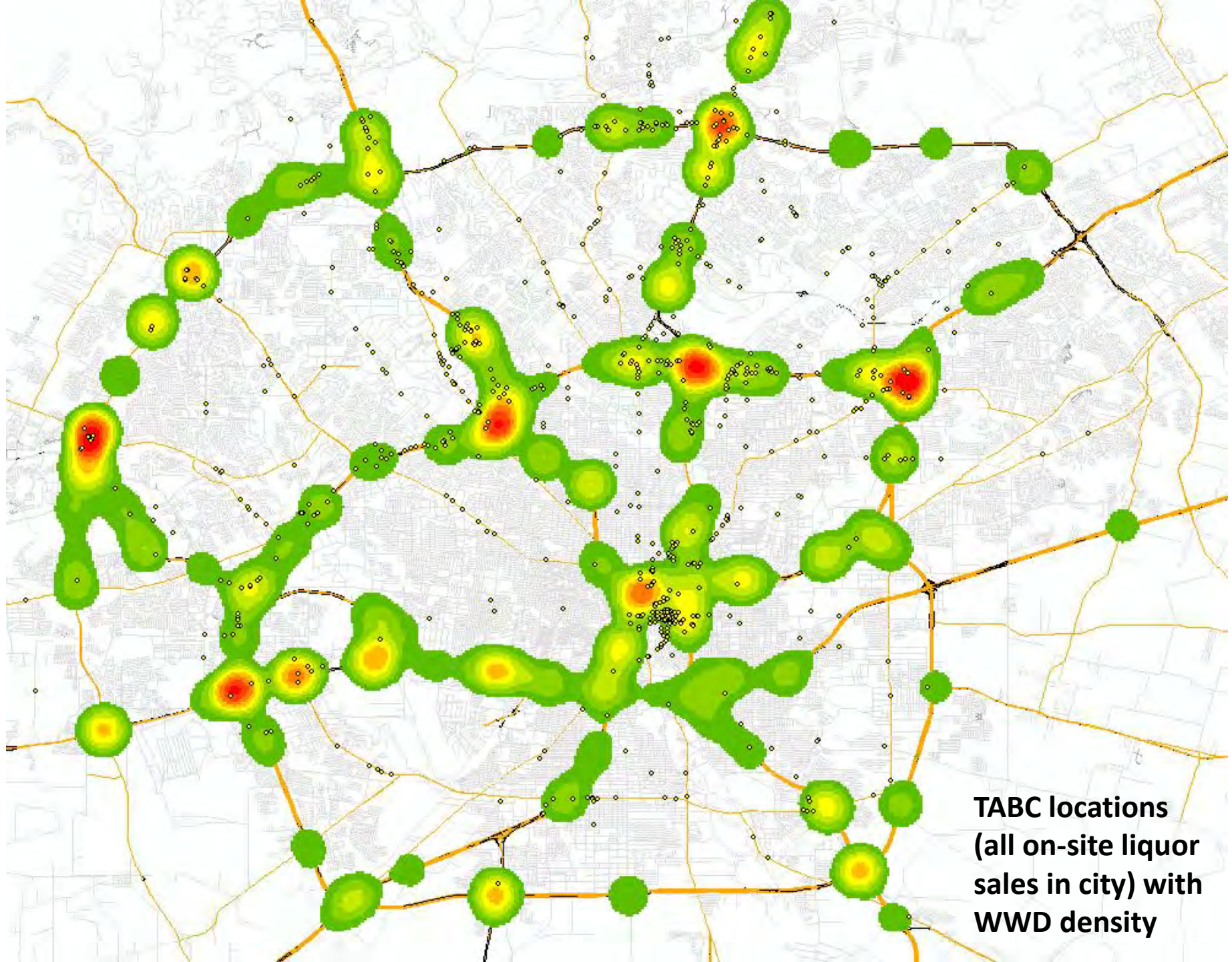
- **Project Cost-** **\$377,605**
- **Benefit – Cost Ratio-** **14.3 to 1**
- **Annual Cost Savings-** **\$270,656**
- **Cost Recovery Time-** **1.4 Years**



**Top 15 DWI Bars With
WWD Density –Single
and Multiple Locations**



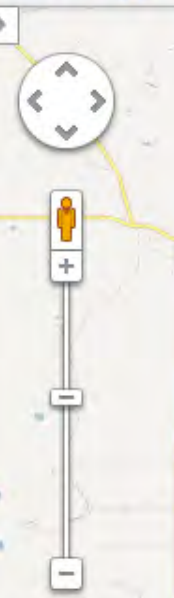
**Top 15 DWI Bars With
WWD Density –Single
Location only**



**TABC locations
(all on-site liquor
sales in city) with
WWD density**

Wrong Way Crash US 90 @ LP 1604 April 14, 2013

- **0001- SAPD dispatcher at TransGuide receives 911 call reporting WWD on US 90 WB in EB lanes**
- **0001- TransGuide Operators place WWD warning message on DMS on US 90 in both EB and WB directions**
- **0003- SAPD receives 911 calls reporting crash on US 90 @ LP 1604**
- **WWD was actually traveling EB in WB lanes**
- **WWD was 18 wheeler, cab & trailer, carrying a load of bottled water**
- **WWD struck Ford Expedition carrying family of 5**
- **4 family members were killed, 1 survivor (injured)**
- **Secondary accident, single vehicle, resulted in minor injuries**
- **18 wheeler driver uninjured**
- **18 wheeler driver charged with 4 counts of intoxication manslaughter, \$1 million bond**
- **Last westbound DMS is 4 miles from crash location, it is unlikely that the WWD warning message was on the DMS when the Expedition passed it (accident report lists time of accident as 23:56 on 4/13/13)**



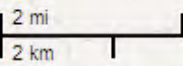
US 90- Rural Divided Highway West of SH 211

5 Miles

First Reported WWD Location

Accident Location

- First report of WWD reported location as SH 211
- WWD traveled at least 5 miles EB in WB lanes





GMSA
NOW
60°
KSAT
abc 12
#KSATnews

FORECAST: Pleasanton 88°/68° Mostly Sunny 6:02 60°



GMSA
NOW
KSAT
abc 12
#KSATnews
6:02 60°

FORECAST:









Anderson Loop

EXIT $\frac{1}{2}$ MILE





Summary- SA WWD Task Force Lessons Learned

- **Adopted lessons learned from prior research and countermeasure deployment projects**
 - TTI Study 2003/2004
 - NTTA Project- Task Force Summary Report
 - HCTRA Detection Project
- **Law enforcement (SAPD) took steps that aided in identifying problem areas:**
 - E-Tone Radio Network Alerts
 - Created specific code in CAD systems for wrong way driver reports
 - Critical data for developing GIS map
- **Many opportunities for sharing lessons learned**
 - Dallas, Houston and San Antonio all have active WWD efforts
 - WWD sessions have been included in many technical conferences (ITS Texas November 2011, ITS America May 2012, Texas ITE August 2012)
 - TxDOT Research Project
 - NTSB special investigation of wrong way accidents (report to be released fall 2012)

QUESTIONS?