

Wisconsin Predictive Analytics for Roadway Safety and Enforcement

Andi Bill



Traffic Operations and Safety (TOPS) Lab

- Formed in 2003
- Part of UW-Madison CEE Department
- Three Program Areas
 - Information Technology
 - ITS / Operations (TSM&O)
 - Traffic Safety Engineering
- WisDOT Partnerships
 - Bureau of Traffic Operations
 - Bureau of Transportation Safety
 - Bureau of State Highway Programs
- Research / Government



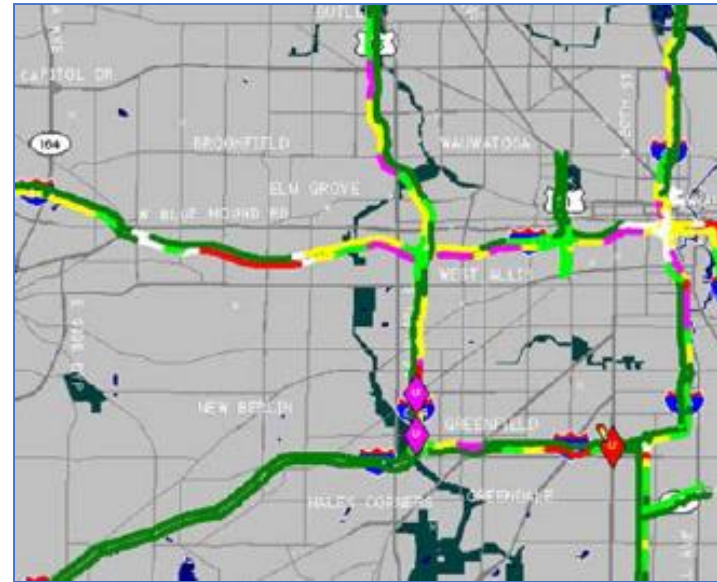
WisTransPortal Overview

- Objectives
 - Archived Data Management
 - Real-Time Data Exchange
 - Centralize Access to Data
 - Data & Systems Integration
 - IT Test Bed Environment
 - Research / Government Shared Objectives



WisTransPortal Overview

- Data Sources
 - Traffic Data
 - Crash Data
 - Traffic Incidents
 - Lane Closures
 - Traffic Video
 - ITS Inventory
 - Road Weather Data
 - GIS Roadway Inventory



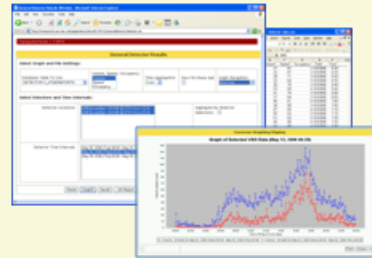
WisTransPortal Software Systems

Crash Data Retrieval Facility



Query retrieve statewide MV4000 crash data (1994-present) and police crash reports (2000-present). Data is updated on a monthly basis through coordination with WisDOTDMV. Adding highway and local road GIS crash map in 2012.

V-SPOC Traffic Detector Data



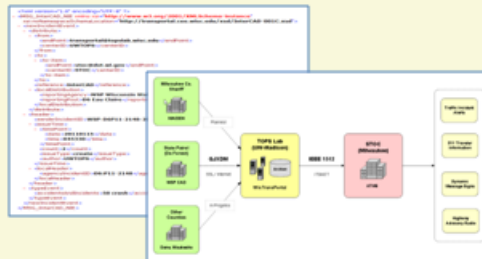
Query and retrieve freeway traffic detector data from the WisDOT Statewide Traffic Operations Center (STOC). Contains a complete archive of detector data from the STOC since 1996. Database is updated on a 24-hour basis.

Wisconsin Lane Closure System



Online acceptance and reporting system for lane closures and restrictions statewide. Tracks closure details for all construction, maintenance, permit, special event, and emergency closures on major state highways. Sends closure data in real-time to 511.

InterCAD Traffic Incident Data



Wisconsin State Patrol dispatch to Statewide Traffic Operations Center control room traffic incident data exchange. Provides real-time data transfer, GJXDM to IEEE 1512 XML translation, and incident data archiving. Adding Dane and Waukesha Counties in 2012.

LINK Freeway Traffic Video



Agency video-sharing and real-time traffic conditions. Provides web-based access to WisDOT traffic video for public safety, emergency services, towing, media, and others. Connects directly to WisDOT CCTV network through the ITS fiber backbone (ITSNET).

TIA Traffic Incident Alerts



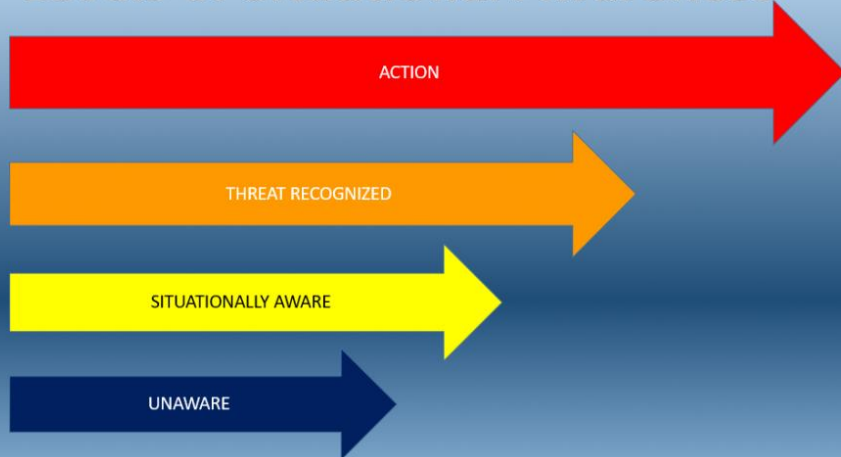
Statewide traffic incident notification system. Sends email, fax, and Twitter alerts to the media and others. Also handles traffic related media releases and EOC activation alerts. Jointly administered by the Statewide Traffic Operations Center and Wisconsin State Patrol.

- “Predictive analytics (PA) – Technology that learns from experience (data) to predict the future behavior of individuals in order to drive better decisions.”
- Eric Siegel, founder of *Predictive Analytics World* and Executive Editor of *Predictive Analytics Times*

State Patrol Predictive Analytics Program Objectives

- Optimize staffing allocation
- Increase law enforcement visibility in the right locations at the right times to maximize impact on traffic safety
- Enhance incident management capability by reducing response time
- Create safer roads in Wisconsin

Levels of Situational Awareness



Predictive Analytics Delivery System

- Community Maps - assists with planning and resource allocation
- Mobile Architecture for Communication Handling (MACH) – provides in-car information about optimal location to deploy



Law Enforcement
(In Field)



MACH



Crash Database



Community
Maps



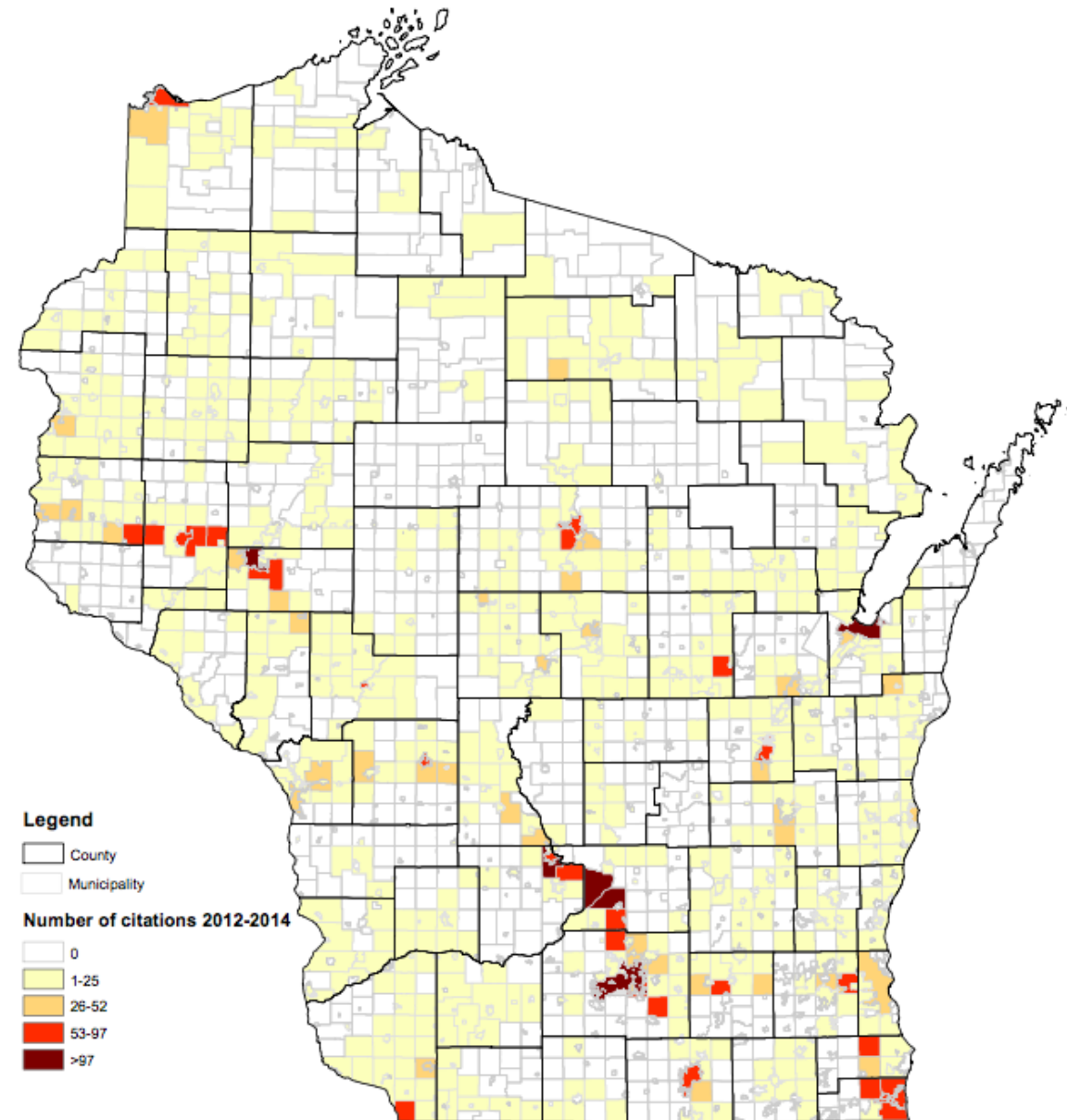


TraCS

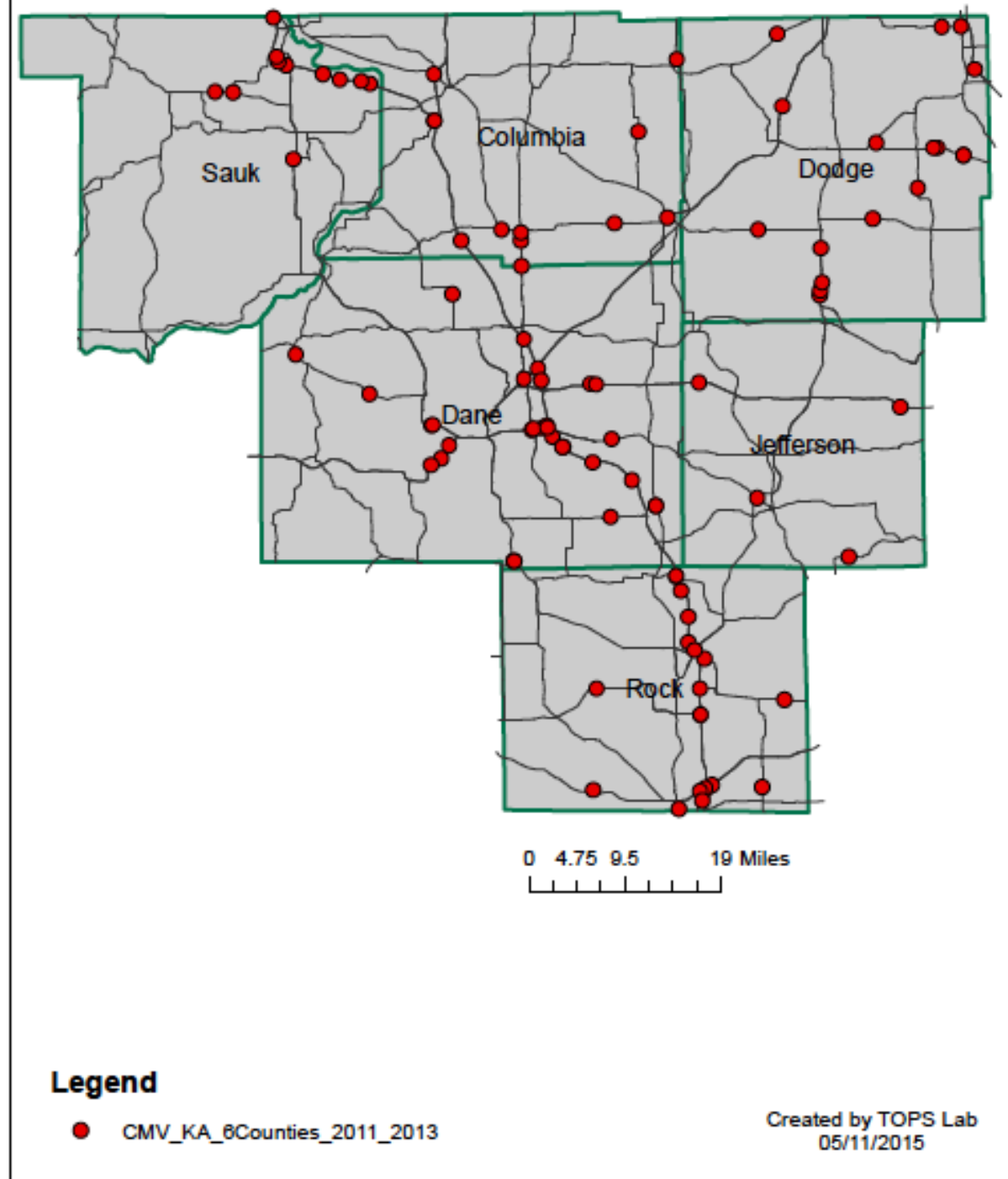
Traffic and Criminal Software

- Great way for individual Agencies to do analysis
- Collecting more data
 - Citizen Contact
 - Warnings
 - Citations

Total Number of Alcohol Related Citations in WI Municipalities from 2012-2014



Previous Mapping



Forecasting Models

- CRASH – Predict likelihood of serious injury and fatal crashes
- OWI – Predict likelihood of alcohol-involved incidents
- Incident Management – Predict likelihood of intermediate or major incidents
- CMV – Predict likelihood of commercial vehicle crashes

Predictive Model Overview

- Identifies areas of concern by time of day, day of week and geographic location
- 4-hour blocks of time
- Data is presented as a heat map and table
- Staffing is allocated accordingly

WisTransPortal

Wisconsin Traffic Operations and Safety Laboratory
The WisTransPortal Project

The WisTransPortal crash database contains information on all reported crashes in Wisconsin from 1994 through the current year. The [Crash Data User Guide](#) provides definitions for most data elements available through the online system. Complete information on the WisTransPortal crash database is available from the [Crash Database Documentation](#) page. User feedback is welcome. Please send comments to crash-data@topslab.wisc.edu.

Home > Web Applications > Crash Data Tools > Crash Data

Welcome, sparker | [Manage Account](#) | [Logout](#) | [Preferences](#) | [Contact](#) | [Help](#)

Crash Data Retrieval Facility, Version 1.1.16, July 13, 2011

```
SELECT * FROM CRASHPRD.V_COMBINED WHERE ACCDDATE BETWEEN TO_DATE('2010-JAN','YYYY-MM') AND LAST_DAY(TO_DATE('2010-DEC','YYYY-MM')) AND ACCDLOC IN ('I','N') AND (ALCLFLAG = 'Y') AND ACCDSVR IN ('FAT','INJ') ORDER BY ACCDDATE, NTFYHOUR, COUNTY, MUNICIPALITY, MUNITYTYPE, ONHWYRYP, ONHWYDIR, RPNMNR, RPDIS, ONHWY, ONSTR, ATHWY, ATSTR, INTDIR, INTDIS
```

The Total Number of Records for this Query is 2753.

Refine Location | Summarize Data | Show RP Map | New Query | Exit

View additional crash detail | View the crash report | Crash report is not available | Crash report is restricted

[Crash Data User Guide \(PDF\)](#)

First | Previous | Next | Last | Rows Per Page: 50 | Order By: ACCDDATE | Column List: CUSTOM LIST | Customize | Download Result Set (Text/CSV)

#	DOCTNMBR	ACCDDATE	COUNTY	MUNICIPALITY	MUNITYTYPE	ONHWYRYP	ONHWYDIR	ONHWY	ONSTR	ATHWY	ATSTR	INTDIR	INTDIS	INJSVR	ACC
1	F0DR0F7	01/01/2010	ONEIDA	PELICAN	T			008			HAYMEADOW RD	W	4	K	FAT
2	A385890	01/01/2010	ROCK	BELOIT	C				MOORE ST		ST LAWRENCE AVE	N	3	B	INJ
3	9H0R0WT	01/01/2010	MILWAUKEE	MILWAUKEE	C				GREEN BAY AVE N		VILLARD AVE W	N	9	C	INJ
4	F2WFQPX	01/01/2010	MONROE	PORTLAND	T	033	E	033		PC		W	10	B	INJ
5	G1PH73T	01/01/2010	SHAWANO	BELLE PLAINE	T	022	N	022			ROSE BROOK RD	N	50	C	INJ
6	A139127	01/01/2010	VILAS	FLAMBEAU	T	047	N	047			E BOUNDARY TRL	N	19	B	INJ
7	C7VG3SQ	01/01/2010	JEFFERSON	AZTALAN	T	094	W	094	WB	N		W	30	C	INJ
8	CVNFCJG	01/01/2010	MARATHON	ROTHSCHILD	V				BROWN BLVD		1ST ST	E	2	C	INJ
9	9GBFCKB	01/01/2010	MILWAUKEE	MILWAUKEE	C				27TH ST N		LOCUST ST W		0	K	FAT
10	A289314	01/01/2010	WAUKESHA	EAGLE	T			059				E	0	A	INJ
11	A243796	01/01/2010	DODGE	WATERTOWN	C				CTH R FOURTH ST N		SCHUMAN DR	E	3	B	INJ
12	CVNFCJ	01/01/2010	MARATHON	ROTHSCHILD	V				PARK ST		KORT ST	S	15	B	INJ
13	BMNRQR8	01/01/2010	MILWAUKEE	MILWAUKEE	C			043	NB		SILVER SPRING DR W S		25	B	INJ
14	A246258	01/01/2010	MILWAUKEE	GREENFIELD	C				S 116TH ST		W HOWARD AVE	N	30	B	INJ
15	BMN9NWW	01/01/2010	MILWAUKEE	MILWAUKEE	C			043	SB	43	HOLT AVE E	S	1	C	INJ
16	A136991	01/01/2010	RACINE	RACINE	C				21ST ST		HAYES AVE	W	3	B	INJ

16	BMN9NWW	1/1/2010	MILWAUKEE	MILWAUKEE	C				43	SB	43	HOLT AVE E	S	1	C	INJ		
17	A136991	1/1/2010	RACINE	RACINE	C				21ST ST		HAYES AVE	W	3	B	INJ			
18	A096013	1/1/2010	ROCK	BRADFORD	T			140	N	140		CREEK RD	S	10	C	INJ		
19	A003936	1/1/2010	BROWN	GREEN BAY	C						13TH AVE		LIBERTY ST	S	4	K	FAT	
20	C7TS3VS	1/1/2010	DANE	PLEASANT SPRINGS	T			39	S	39		MN		N	4	B	INJ	
21	9LRSV2R	1/1/2010	MARINETTE	PEMBINE	T			8	E	141		OO		S	4	B	INJ	
22	A326455	1/1/2010	RICHLAND	SYLVAN	T			14	E	14				E	6	A	INJ	
23	A287477	1/1/2010	PORTAGE	STEVENS POINT	C						DIVISION ST		FOURTH AVE		0	C	INJ	
24	A375929	1/1/2010	MANITOWOC	TWO RIVERS	C						CTH O SANDY BAY RD		SANDY RIDGE DR	N	10	C	INJ	
25	A245977	1/1/2010	WASHBURN	SPOONER	C			63	N		HAZEL ST		63	RIVER ST		0	C	INJ
26	A321474	1/1/2010	JEFFERSON	CONCORD	T					F				N	10	K	FAT	
27	A315683	1/1/2010	ROCK	RFOIT	C						CRANSTON RD		F RIDGE RD		1	C	INI	

crash-data-download-1.csv [Read-Only] - Microsoft Excel

Formulas | Data | Review | View | Acrobat

Ruler | Formula Bar | Gridlines | Headings | Message Bar | Zoom 100% | Zoom to Selection | New Window | Arrange All | Freeze Panes | Hide | Unhide | View Side by Side | Synchronous Scrolling | Reset Window Position | Save Workspace | Switch Windows | Macros

PROF7

D	E	F	G	H	I	J	K	L	M	N	O				
MUNICIPALITY	MUNITYTYPE	ONHWYRYP	ONHWYDIR	ONHWY	ONSTR	ATHWY	ATSTR	INTDIR	INTDIS	INJSVR	ACC				
PELICAN	T				8		HAYMEADOW RD	W	4	K	FAT				
BELOIT	C				MOORE ST		ST LAWRENCE AVE	N	3	B	INJ				
MILWAUKEE	C				GREEN BAY AVE N		VILLARD AVE W	N	9	C	INJ				
PORTLAND	T		33	E		33		PC		W	10	B	INJ		
BELLE PLAINE	T		22	N		22				ROSE BROOK RD	N	50	C	INJ	
FLAMBEAU	T		47	N		47				E BOUNDARY TRL	N	19	B	INJ	
AZTALAN	T		94	W		94	WB		N		W	30	C	INJ	
ROTHSCHILD	V						BROWN BLVD			1ST ST	E	2	C	INJ	
MILWAUKEE	C						27TH ST N			LOCUST ST W		0	K	FAT	
EAGLE	T					59				E	0	A	INJ		
WATERTOWN	C						CTH R FOURTH ST N			SCHUMAN DR	E	3	B	INJ	
ROTHSCHILD	V						PARK ST			KORT ST	S	15	B	INJ	
MILWAUKEE	C					43	NB			SILVER SPRING DR W	S	25	B	INJ	
GREENFIELD	C						S 116TH ST			W HOWARD AVE	N	30	B	INJ	
MILWAUKEE	C					43	SB		43	HOLT AVE E	S	1	C	INJ	
A096013	T		140	N		140				CREEK RD	S	10	C	INJ	
A003936	C						13TH AVE			LIBERTY ST	S	4	K	FAT	
C7TS3VS	T		39	S		39			MN		N	4	B	INJ	
9LRSV2R	T		8	E		141			OO		S	4	B	INJ	
A326455	T		14	E		14				JIM TOWN DR	E	6	A	INJ	
A287477	C						DIVISION ST			FOURTH AVE		0	C	INJ	
A375929	C						CTH O SANDY BAY RD			SANDY RIDGE DR	N	10	C	INJ	
A245977	C		63	N			HAZEL ST			63	RIVER ST		0	C	INJ
A321474	T					F				WILLOW GLEN RD	N	10	K	FAT	
A315683	C						CRANSTON RD			F RIDGE RD		1	C	INI	

Ready | 100%

Wisconsin MV4000 Crash Data

7533739
Wisconsin Motor Vehicle Accident Report

REPORTING OFFICER: [Name]
DATE: 01/17/12
TIME: 08:00
LOCATION: [Address]

VEHICLE INFORMATION:

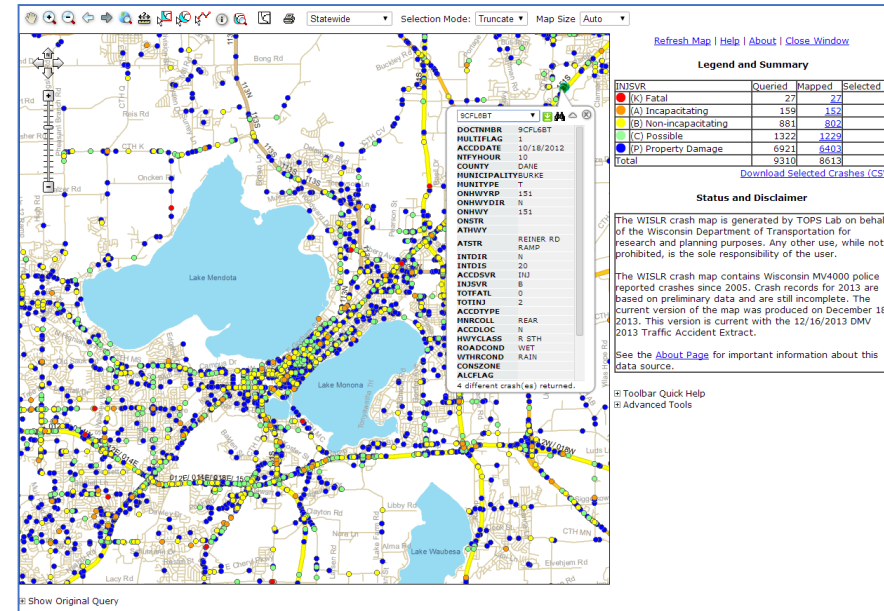
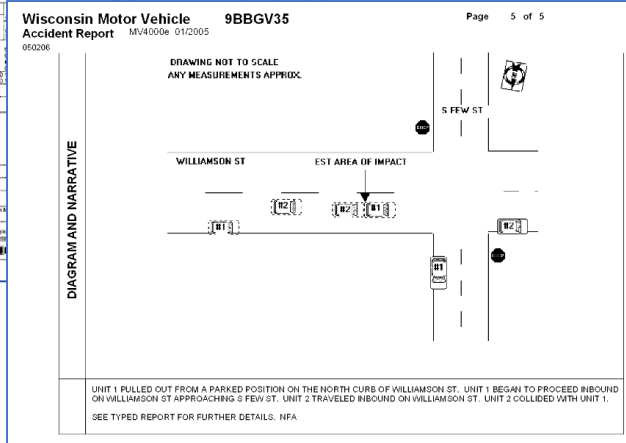
PLATE	TYPE	YEAR	MAKE	MODEL	VEHICLE IDENTIFICATION NUMBER
WJ 1234	Passenger	2011	Ford	Fusion	1FADP3C98A1123456

DRIVER INFORMATION:

PLATE	TYPE	YEAR	MAKE	MODEL	VEHICLE IDENTIFICATION NUMBER
WJ 1234	Passenger	2011	Ford	Fusion	1FADP3C98A1123456

ADDITIONAL INFORMATION:

CRASH TYPE: [Code]
WEATHER: [Code]
ROAD SURFACE: [Code]
ROAD CONDITION: [Code]

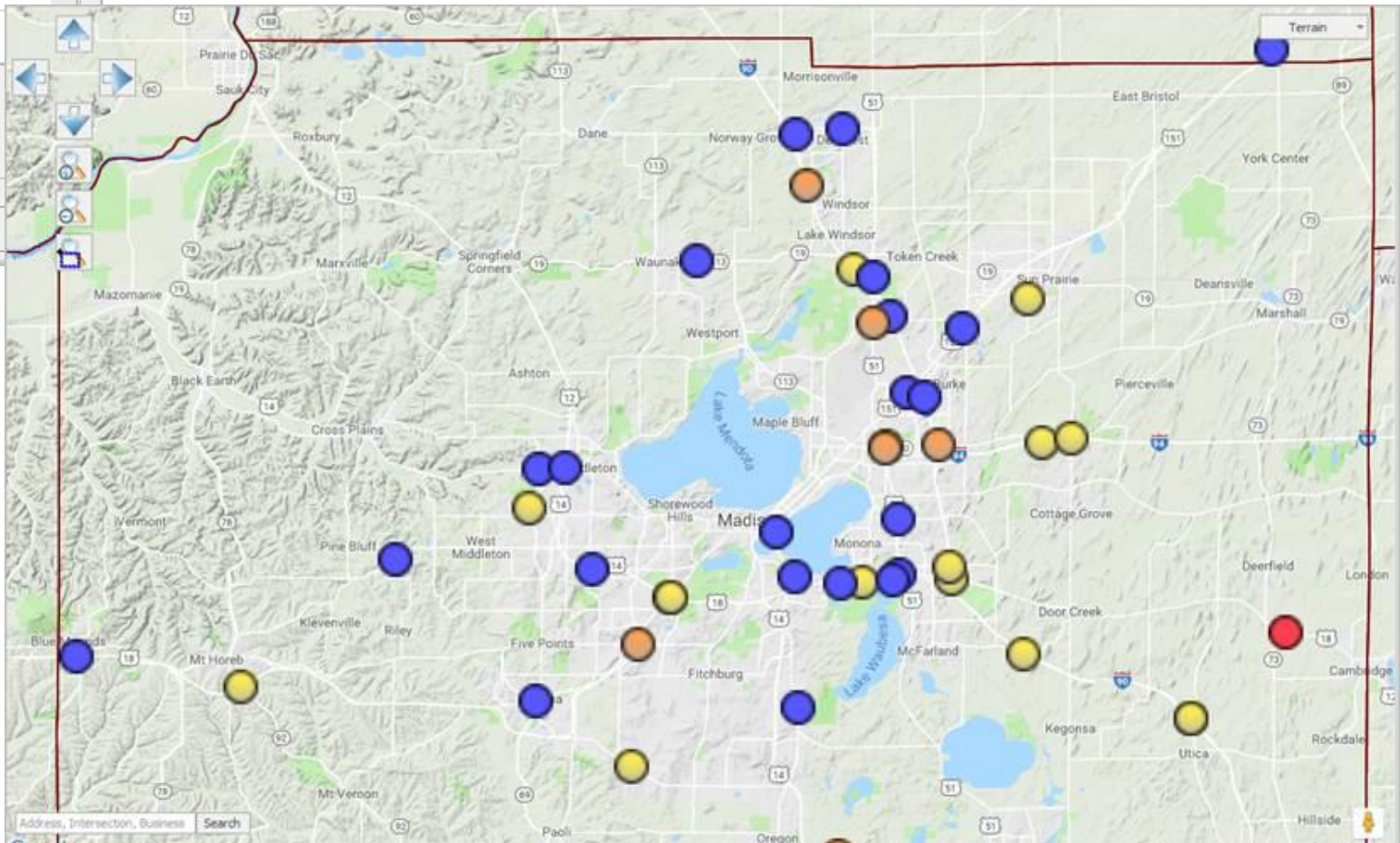


Crash Reports (2008) and Statewide GIS Crash Map (2012)

Map Layers

Available Layers

Name	Mark...	Shapes
<input type="checkbox"/> 10-Predictive Analytics-Day Shift	9263	0
<input checked="" type="checkbox"/> 15-CMV Predictive Analytics-Day Shift	614	0
<input type="checkbox"/> 20-Predictive Analytics-Afternoon Shift	9036	0
<input checked="" type="checkbox"/> 25-CMV Predictive Analytics-Afternoon Shift	300	0
<input type="checkbox"/> 30-Predictive Analytics-Night Shift	2614	0
<input checked="" type="checkbox"/> 35-CMV Predictive Analytics-Night Shift	164	0
<input type="checkbox"/> 55-Alcohol Related Crashes (2015 through 06-2017)	12199	0
<input checked="" type="checkbox"/> 72-Overdose Incident Location	5	0



This is a TEST crash map generated from preliminary police crash report data - it does not represent an official source of Wisconsin motor vehicle crashes. [\[More\]](#)

Search Input

Select the form below to filter the crash map based on high level crash attributes. Click Apply to apply your filters or Reset to go back to the default settings.

- Fatality
- Injury (A)
- Injury (B)
- Injury (C)
- Property Damage

There are **300** of **320** total crashes displayed.

Counties ?

Date Range ?

Begin Year/Month:

End Year/Month:

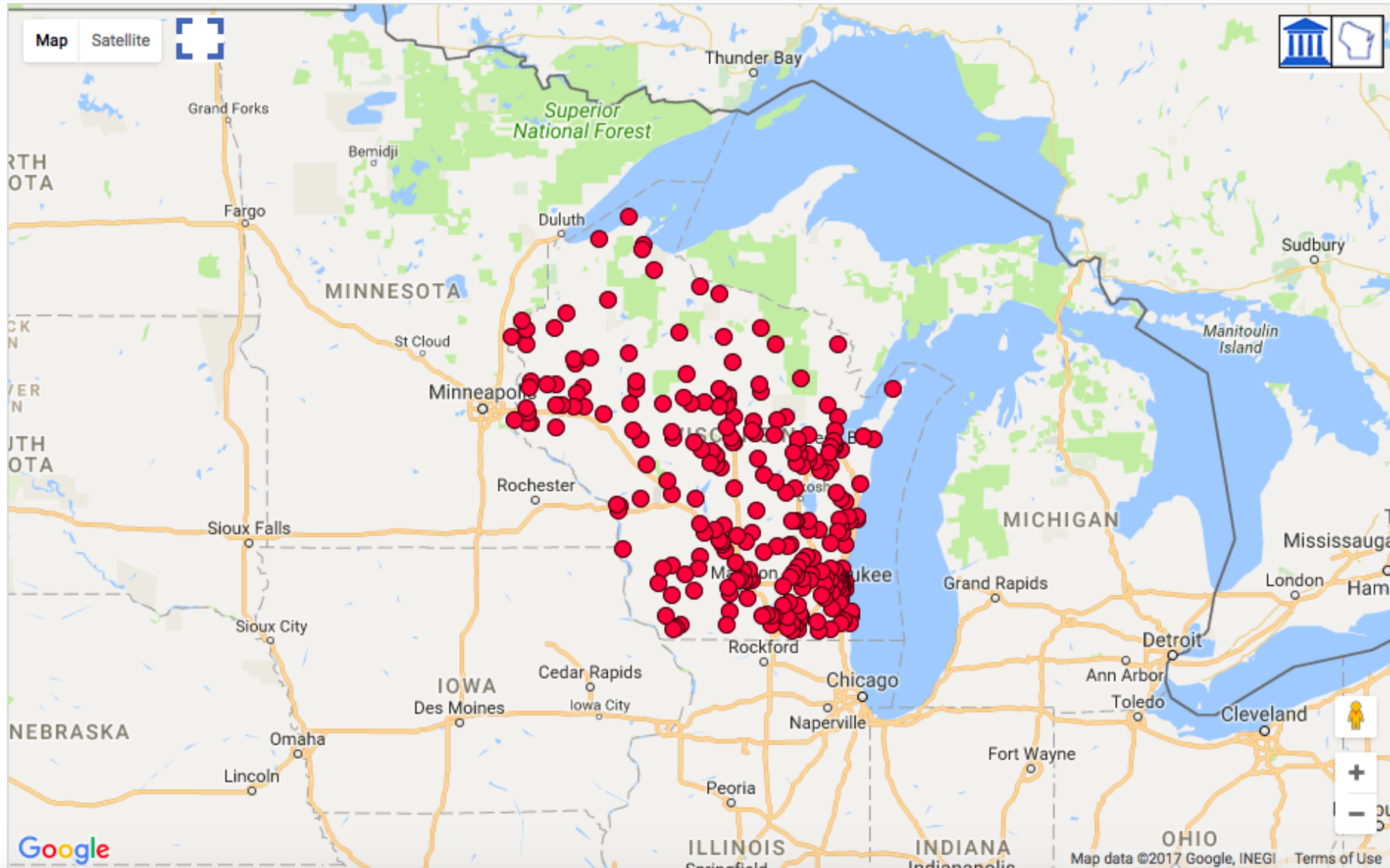
Crash Severity ?

[Clear Selected](#)

- (K) Fatality
- (A) Suspected Major Injury
- (B) Suspected Minor Injury
- (C) Possible Injury
- (O) No Apparent Injury

Crash Flags ?

- Alcohol Flaq
- Bike Flaq



This crash map is updated from preliminary police crash report data and does not represent a final and complete source of Wisconsin motor vehicle crashes. [\[More\]](#)

[About](#) [Search](#) [Advanced](#) [Analyze](#) [Admin](#) [TSC Resources](#) [Contact](#) [Help](#)

[Home](#) > [Community Maps](#) > [Crash](#) > [Advanced](#)

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Search Results

Collection : **Wisconsin DT4000 Crashes**

[New Search](#) [Edit Search](#) [Spot Map](#) [Download CSV](#)

● Fatality ● Injury (A) ● Injury (B) ● Injury (C) ● Property Damage

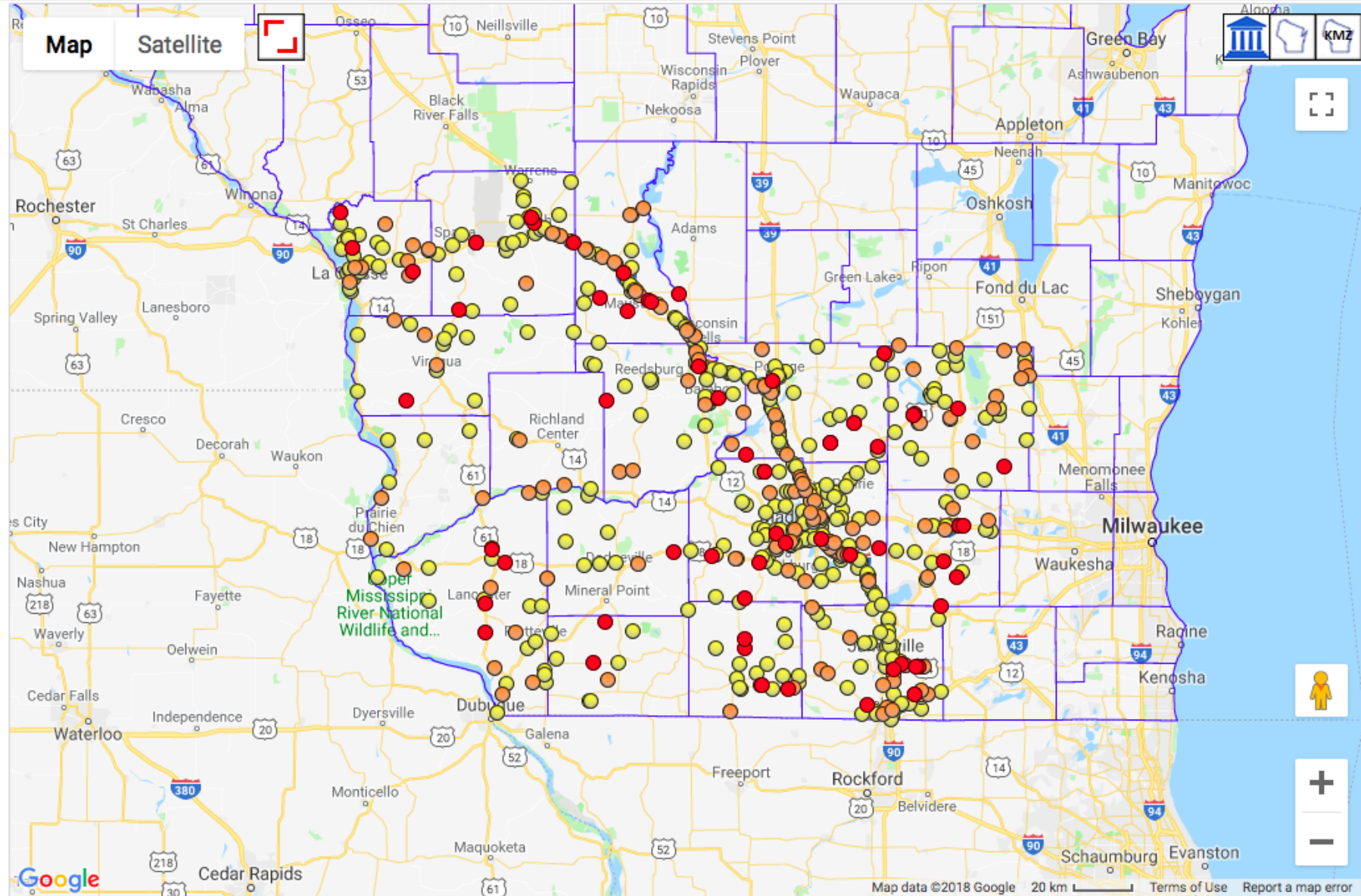
There are **671** of **707** total crashes displayed. [\[More\]](#)

[Show Search Constraints](#)


[Check ALL](#) | [UnCheck ALL](#) | [Zoom To Selected](#)

Sort By: Display:

- KV1GH0M**
061 AT CIRCLE RD
 LIBERTY (T), GRANT County
 (A) Suspected Serious Injury
 01/01/2016
 Flags: CMV **1**
- 9CJNRTG**
138 AT HILL RD
 RUTLAND (T), DANE County
 (A) Suspected Serious Injury
 01/04/2016
 Flags: CMV **2**
- GVPJ18**
014 AT ROHERTY RD
 CENTER (T), ROCK County
 (A) Suspected Serious Injury
 01/05/2016
 Flags: Seat Belt, CMV, Distracted **3**
- RX2M9BW**
090 WB AT SCHEPP RD
 CALEDONIA (T), COLUMBIA County
 (B) Suspected Minor Injury
 01/05/2016



Analyze Interface: Heat Map of CMV and Speed Related Crashes



Community Maps - Wisconsin County TSC Crash Mapping

This crash map is updated from preliminary police crash report data and does not represent a final and complete source of Wisconsin motor vehicle crashes. [More](#)

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[Home](#) > [Community Maps](#) > [Crash](#) > [Analyze](#) [Welcome, sparker](#) | [Manage Account](#) | [Logout](#) | [Contact](#) | [Help](#) | [Release Notes](#)

Predictive Analysis Filters

This map is based on "K", "A", and "B" injury crashes from the last two years. Deer crashes have been excluded. [More](#)

There are **2975** of **3124** total crashes analyzed.

[Apply](#) [Reset](#) [Advanced](#)

Display Crash Heatmap
 Display Crash Locations
 Display Heatmap and Locations

Location ?

Region:

County:

Municipality:

[Center](#)

Date & Time ?

Select by Date Range

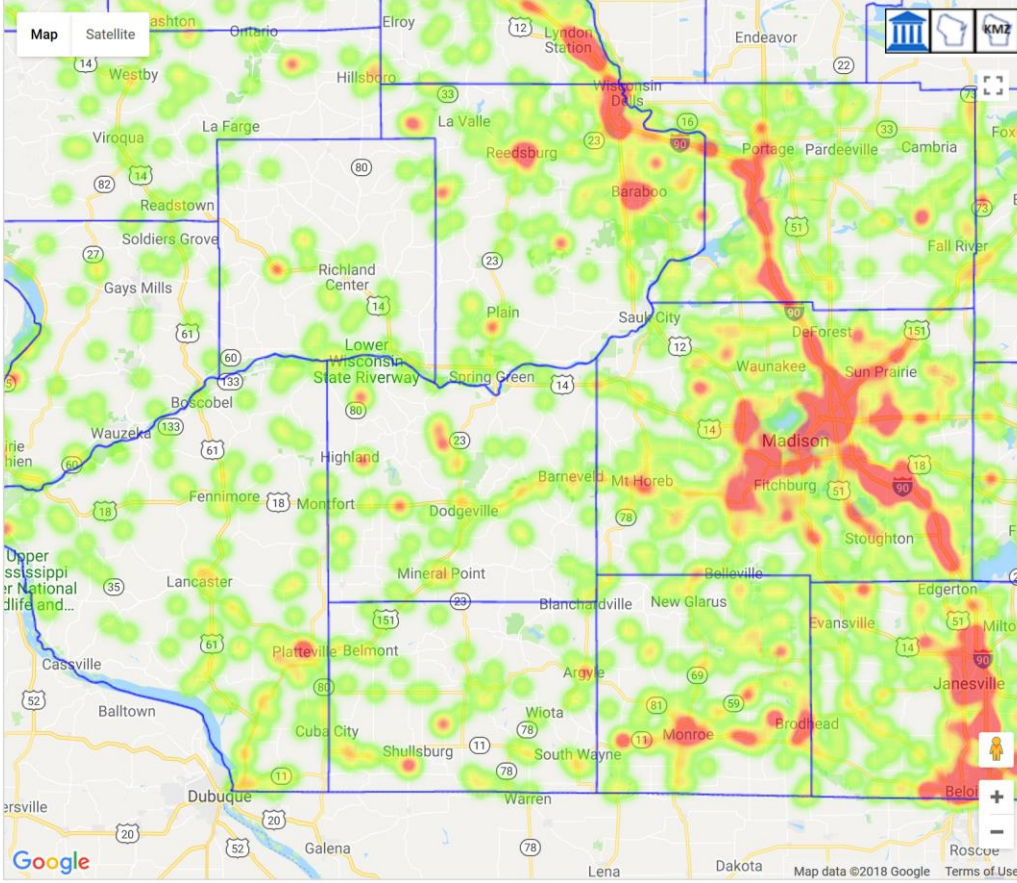
Select by Day of Week

Select by Time of Day

Crash Flags ?

<input type="checkbox"/> Alcohol Flag	<input type="checkbox"/> Motorcycle Flag
<input type="checkbox"/> Bike Flag	<input type="checkbox"/> Pedestrian Flag
<input checked="" type="checkbox"/> CMV Flag	<input type="checkbox"/> Seat Belt Flag
<input type="checkbox"/> Distracted Flag	<input checked="" type="checkbox"/> Speed Flag
<input type="checkbox"/> Drug Flag	<input type="checkbox"/> Work Zone Flag

[Apply](#) [Reset](#)



Predictive Analysis Filters

This map is based on "K", "A", and "B" injury crashes from the last three years. Deer crashes have been excluded. [\[More\]](#)

There are **1316** of **1455** total crashes analyzed.

- Display Crash Heat Map
- Display Crash Locations
- Display Analysis Areas

- Analysis Area #1
- Analysis Area #2
- Analysis Area #3
- Analysis Area #4
- Analysis Area #5

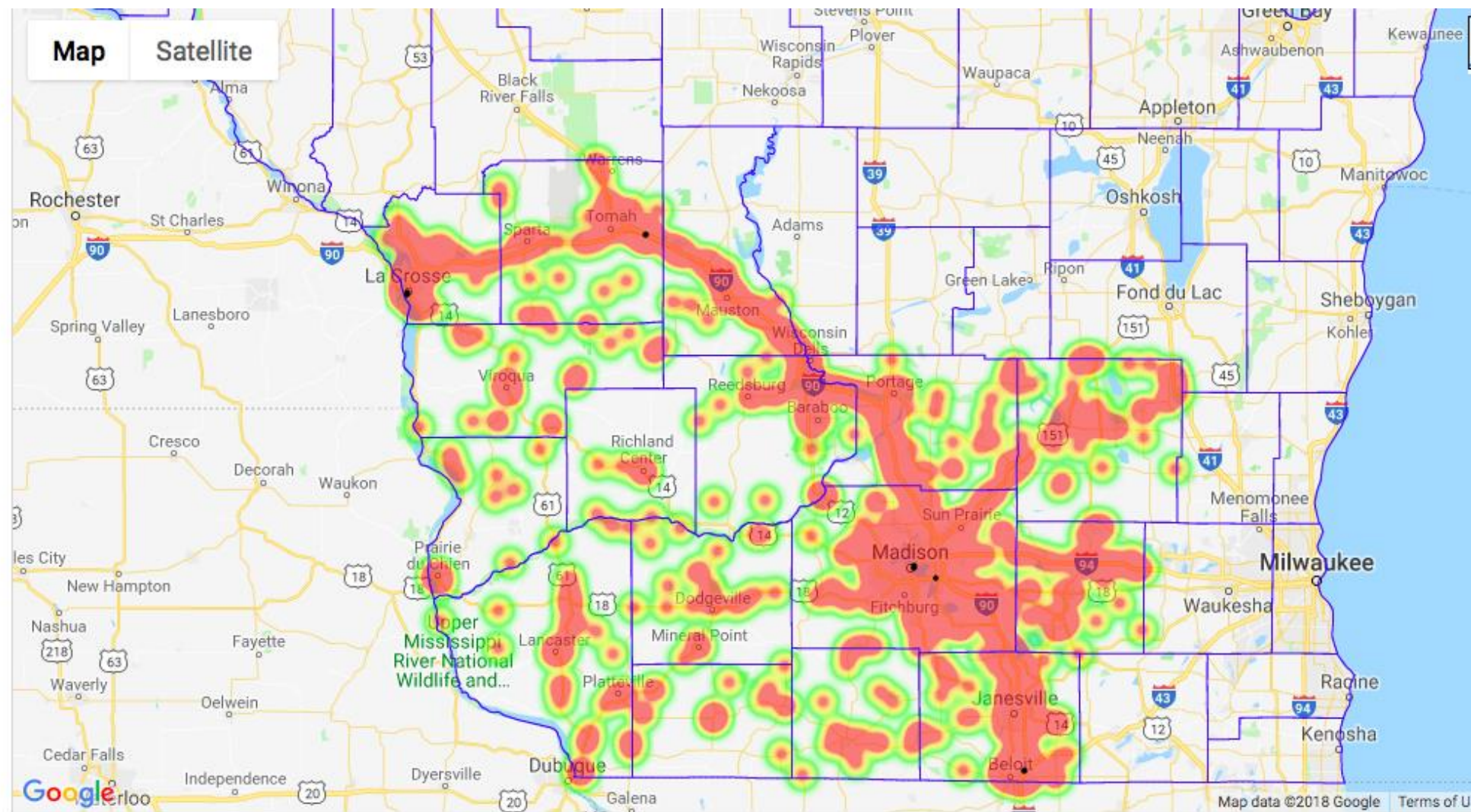
Location ?

Region:

County:

Municipality:

Date & Time ?



This crash map is updated from preliminary police crash report data and does not represent a final and complete source of Wisconsin motor vehicle crashes. [\[More\]](#)

Predictive Analysis Filters

This map is based on "K", "A", and "B" injury crashes from the last three years. Deer crashes have been excluded. [\[More\]](#)

There are **1290** of **1483** total crashes analyzed.

[Apply](#) [Reset](#) [Hide Options](#)

- Display Crash Heat Map
- Display Crash Locations
- Display Analysis Areas

- Analysis Area #1
- Analysis Area #2
- Analysis Area #3
- Analysis Area #4
- Analysis Area #5

Location ?

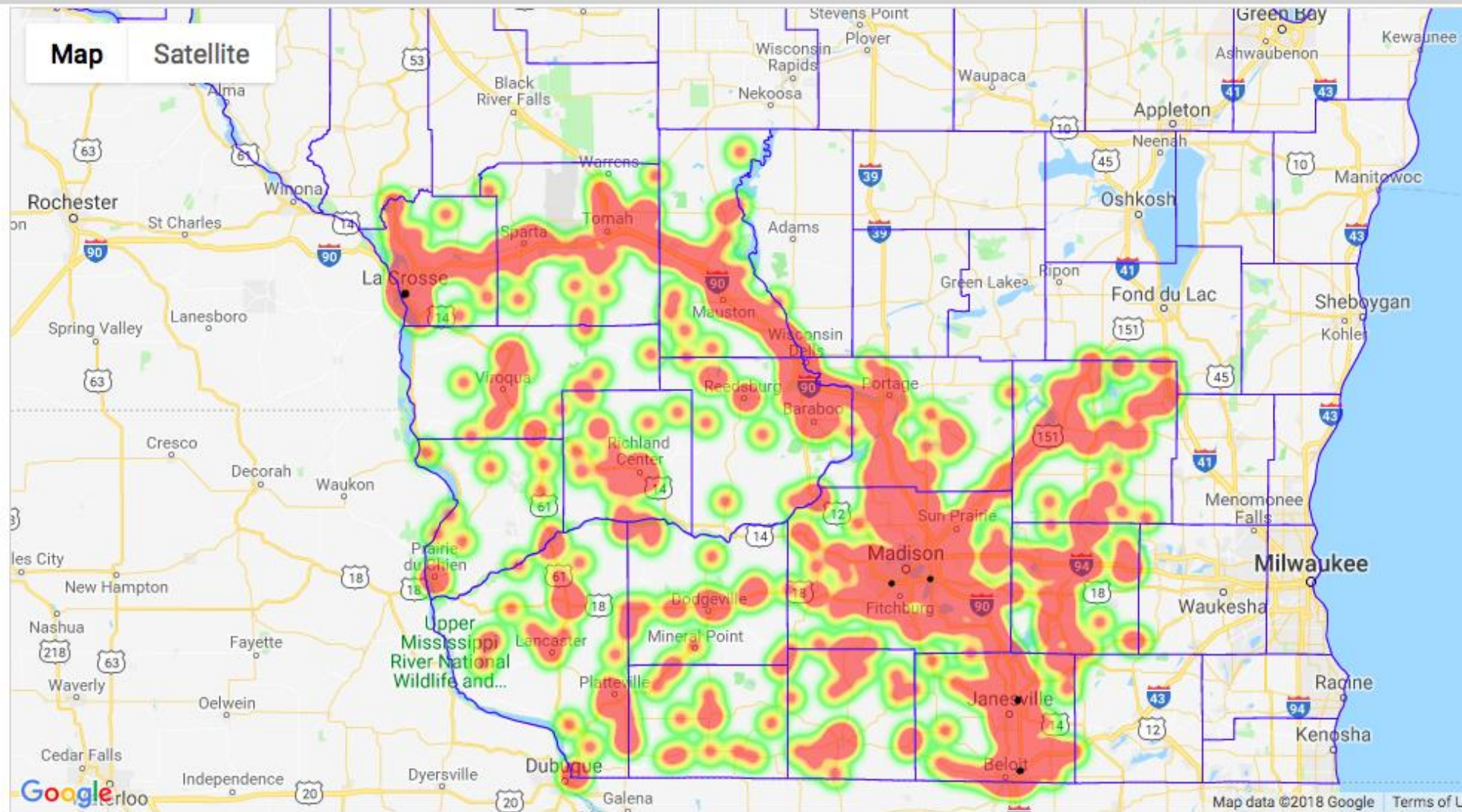
Region:

County:

Municipality:

[Center](#)

Date & Time ?



DSP Predictive Analytics Pilots

- SW Region – Four troopers assigned to focus on primarily two main hot spots in Sauk County, with some focus on other emphasis areas
- NE Region – Four troopers rotating shifts between six counties (Winnebago, Brown, Outagamie, Fond du Lac, Manitowoc, and Calumet) with a strategic focus on hot spot zones, including a CMV focus
- NW Region – Six troopers assigned to work their eight hour shifts in hot spots with a county wide focus in Chippewa County

- PA -Traffic Safety Meeting or Commission Outreach
 - PA - Media Outreach (TV, radio, online etc.)
 - PA - Civic Group Outreach
 - PA - Community Event Outreach
 - PA - School Outreach
 - PA - Partner Law Enforcement Outreach
 - PA - Community Business Outreach

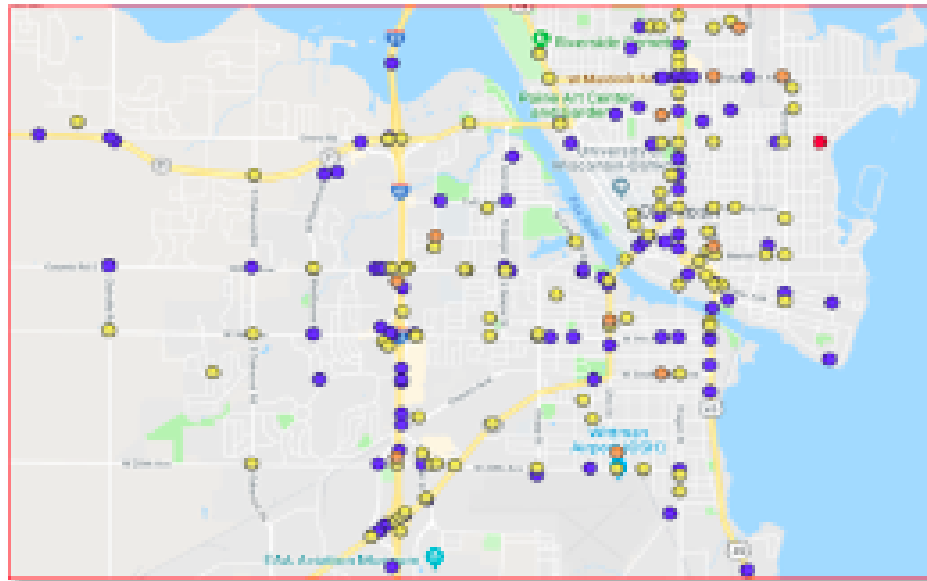
Citizen of Wisconsin:

You have had a recent contact by law enforcement officials while you were operating a vehicle in a current hotspot enforcement area identified using crash data in your county. September, October, and November of the last three years produced 311 injury crashes and 418 actual injuries in this part of our community. The following unsafe driving behaviors lead to these injury crashes:

Distracted Driving 26%

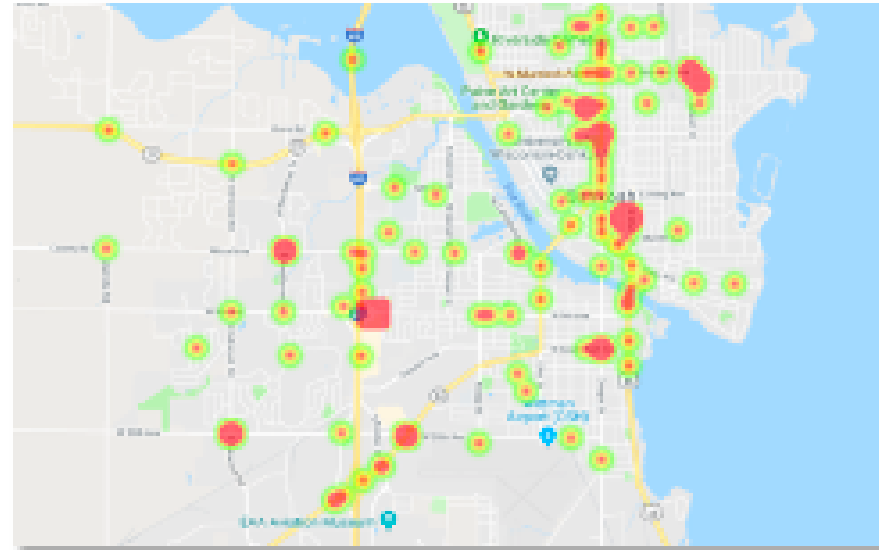
Unbelted 10%

Impaired Driving (Alcohol or Drugs) 7%



Mission: Behavior Change

The Wisconsin State Patrol is working with the local community to change the driving behavior in and around these hotspots.



Law Enforcement agencies in this area are serious about the safety of the community and we take pride in providing the highest level of service to our citizens. This operation is an extension of that philosophy and its intent is provide a safer and healthier community for all residents.

Sep, Oct, Nov 2015-2017 County and Muni Data Facts:

	ALCFLAG	BIKEFLAG	CMVFLAG	CONSZONE	DISTFLAG	DRUGFLAG	MCYCLFLAG	PEDFLAG	BELT	SPEEDFLAG
Winnebago	52	35	48	85	230	16	47	38	94	108
Oshkosh	14	13	9	3	80	8	16	21	32	10
% of County	26.92%	37.14%	18.75%	3.49%	34.78%	50.00%	33.33%	55.26%	33.68%	9.26%



Predictive Analytics – SW Pilot

Sauk County

KABC Crashes, SEP – NOV, 2015 – 2017

Hot Spot #1 (Delton / Lake Delton)

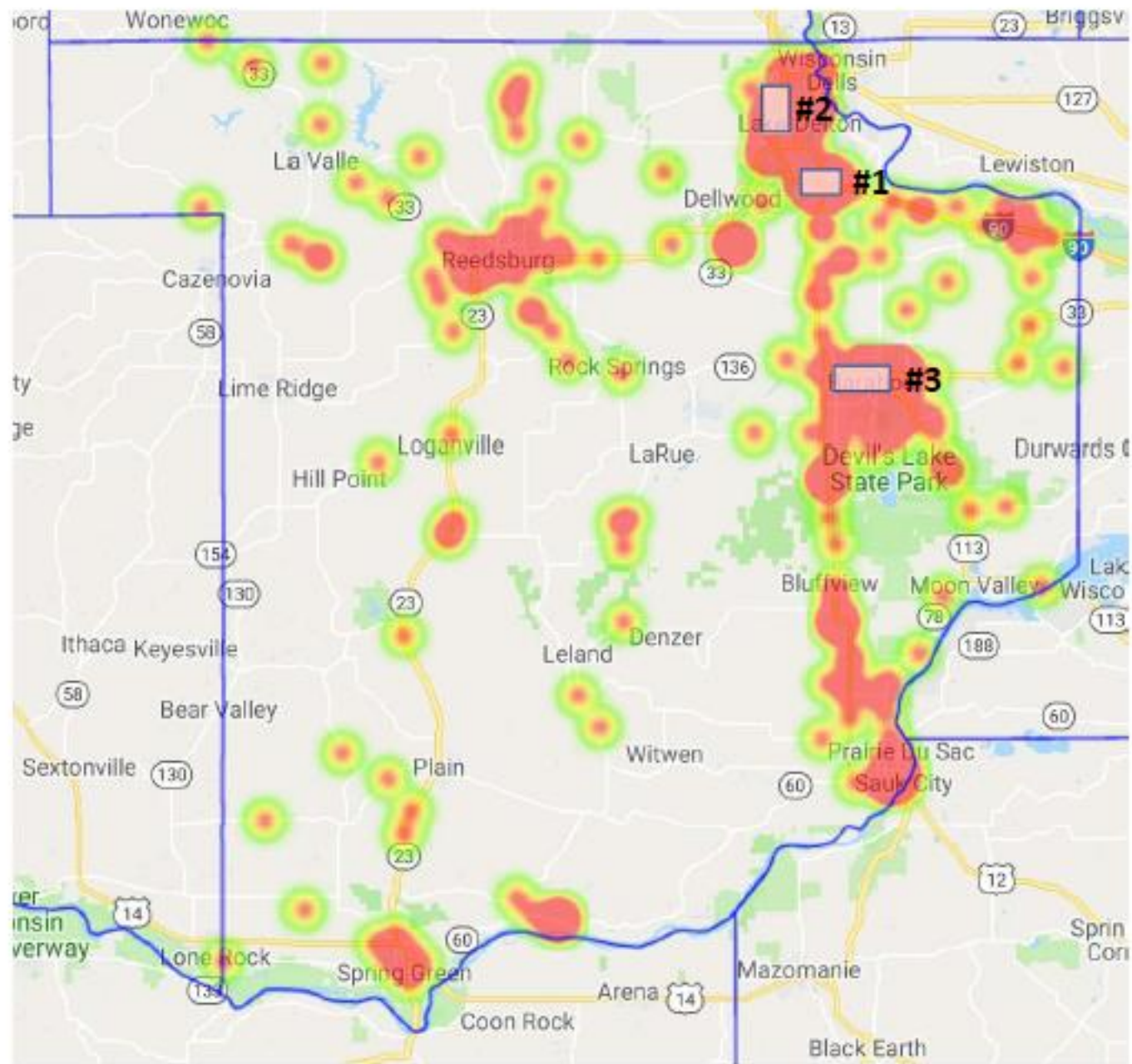
- *Distracted, Speed, Motorcycle*

Hot Spot #2 (Delton / Lake Delton)

- *Distracted, Speed*

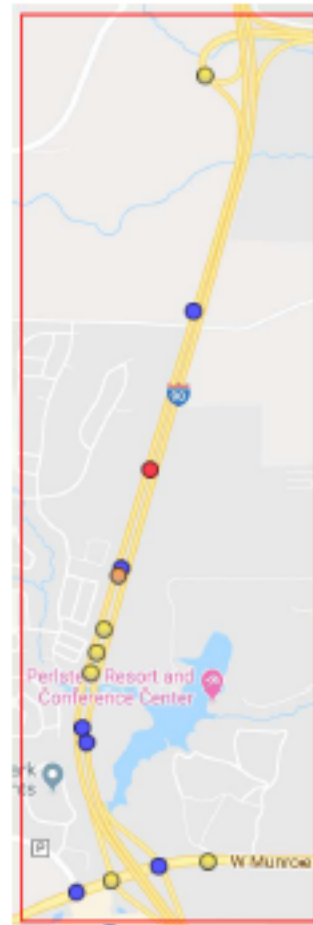
Hot Spot #3 (Baraboo / West Baraboo)

- *Distracted*

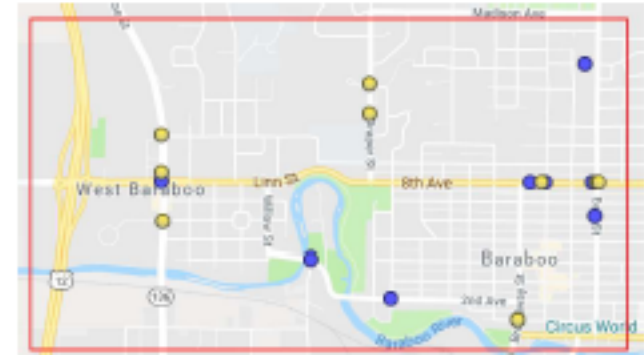




Hot Spot #1 (Delton / Lake Delton)

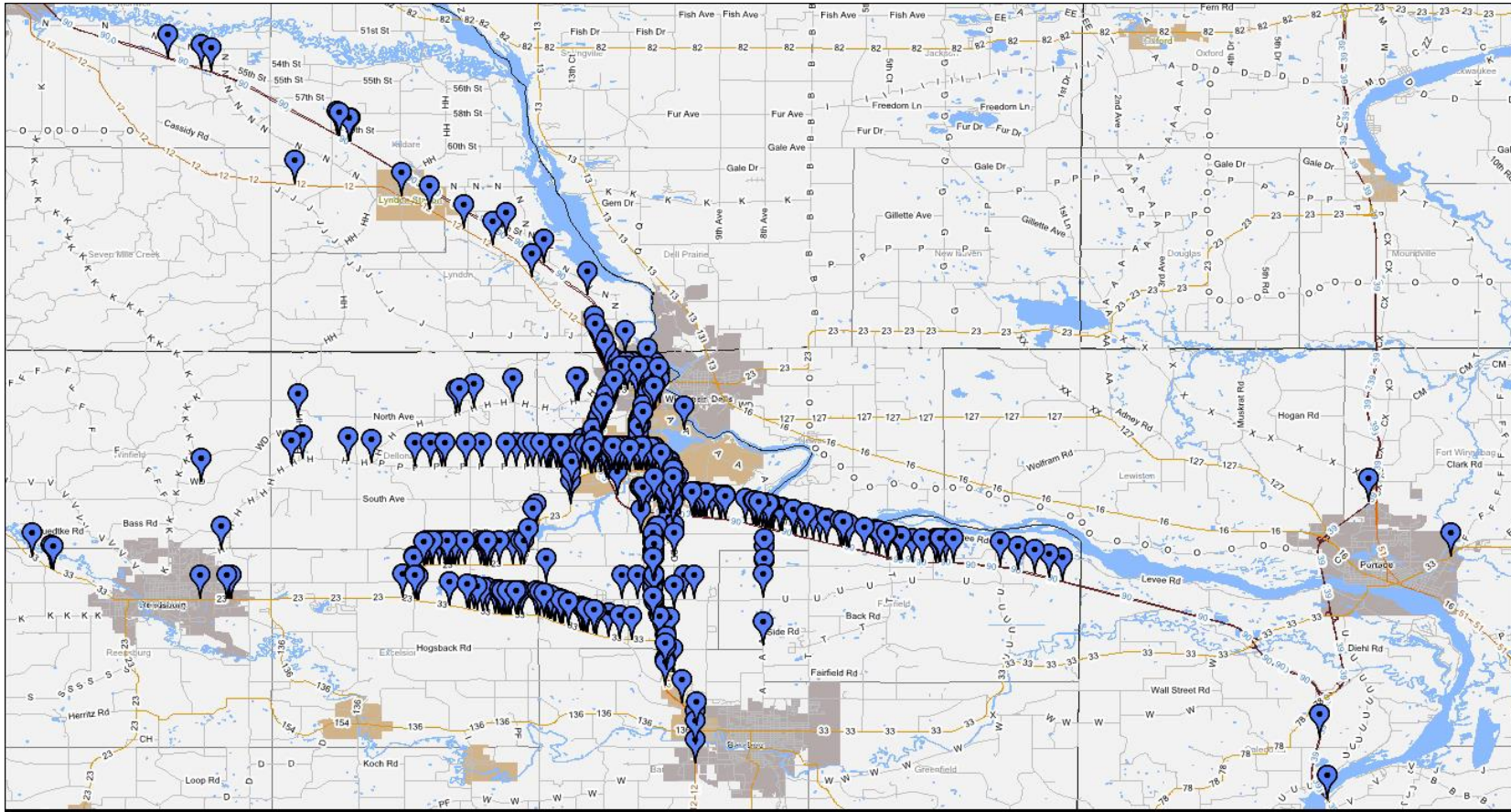


Hot Spot #2 (Delton / Lake Delton)



Hot Spot #3 (Baraboo / West Baraboo)

SW Region Traffic Stop Locations



Results

- Local agencies starting to take notice
- Increased visibility in these areas
- Citizen complaints / support to neutral from chiefs
- Took a few conversations to get through the change
- CM issues helped get the buy-in
- Lots of contacts
- Added Benefits
 - Bail Jumper
 - Marshall Service

Overview for future refinements:

- Process development
- Tools development
- Validation/calibration

State Patrol Predictive Analytics Next Steps

- Provide lists of contacts for community organizations to the posts for community outreach purposes (BOTS)
- Develop a template community outreach Power Point (BOTS)
- Develop template for a community relations flyer that posts can customize with their own local heat maps (BOTS)
- Update MACH visualizations (BSS)

State Patrol Predictive Analytics Next Steps (continued)

- Refine algorithm and provide updated opportunity for posts to develop refined heat maps (TOPS Lab)
- Work on an evaluation/validation component (TOPS Lab/BOTS/BSS)
- Gather input on social media outreach for the predictive analytics tool (OPA)

Any questions?