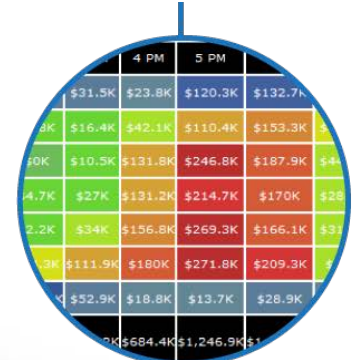
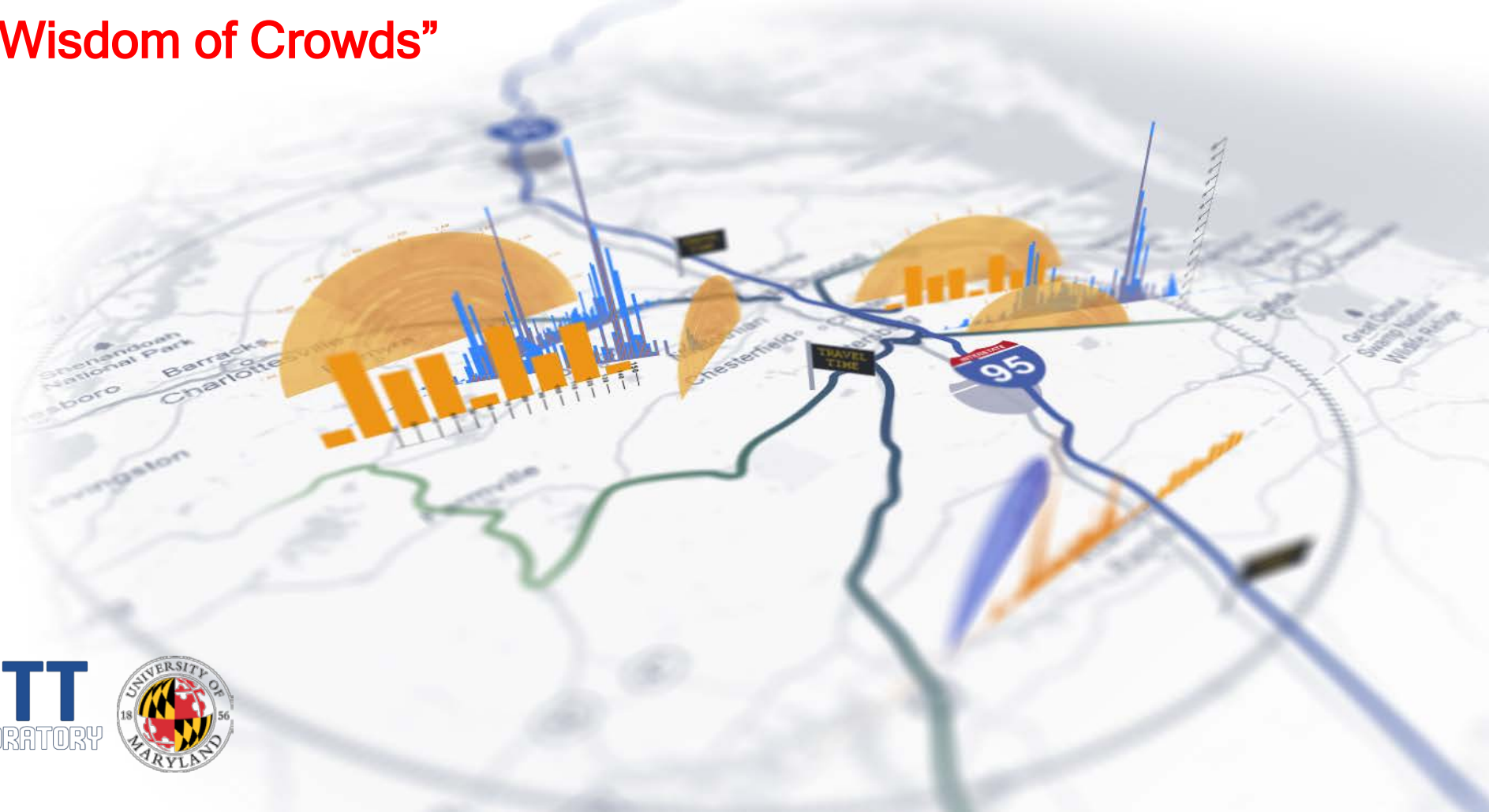
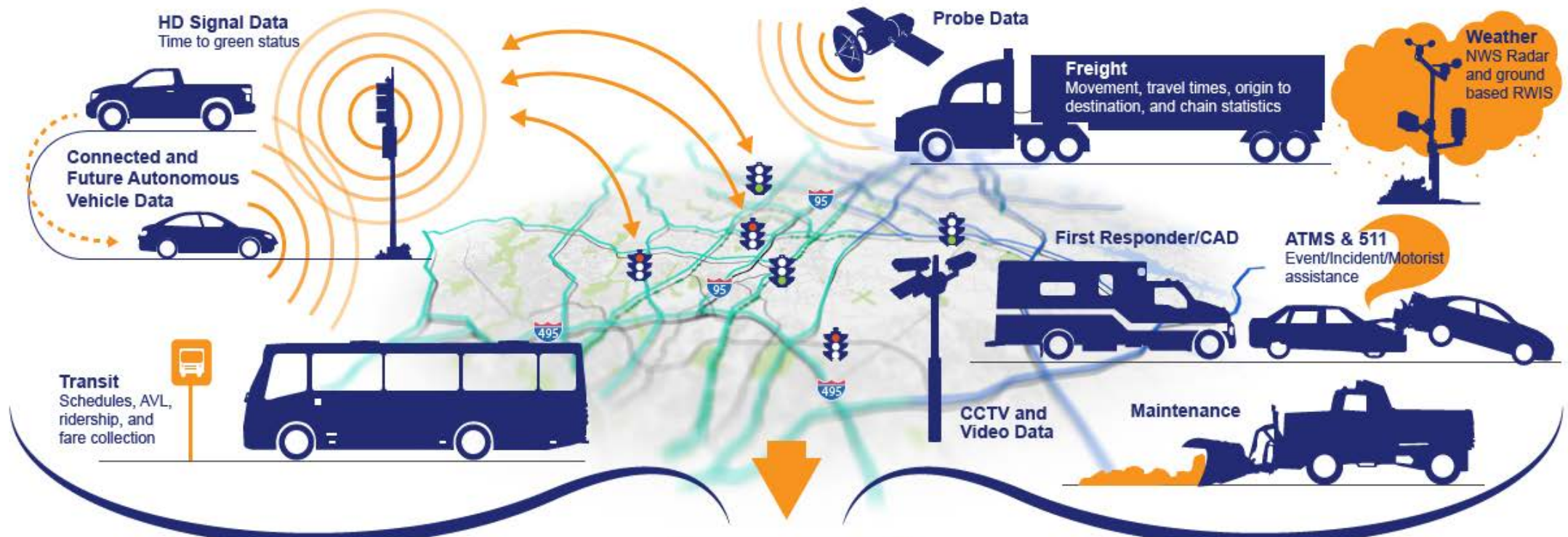


# Crowdsourced Data for Ops and Performance Measures

“The Wisdom of Crowds”



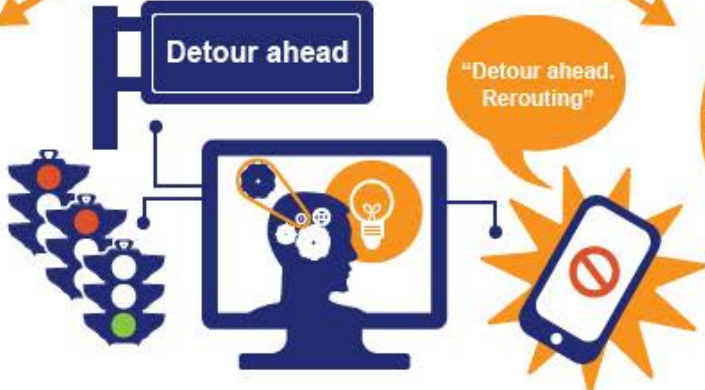
An overview of Speed, Incident, Connected Vehicles, and O-D data available from 3<sup>rd</sup> Parties.



**RITIS**  
Fusion & DSS



**Measure Operational Performance**

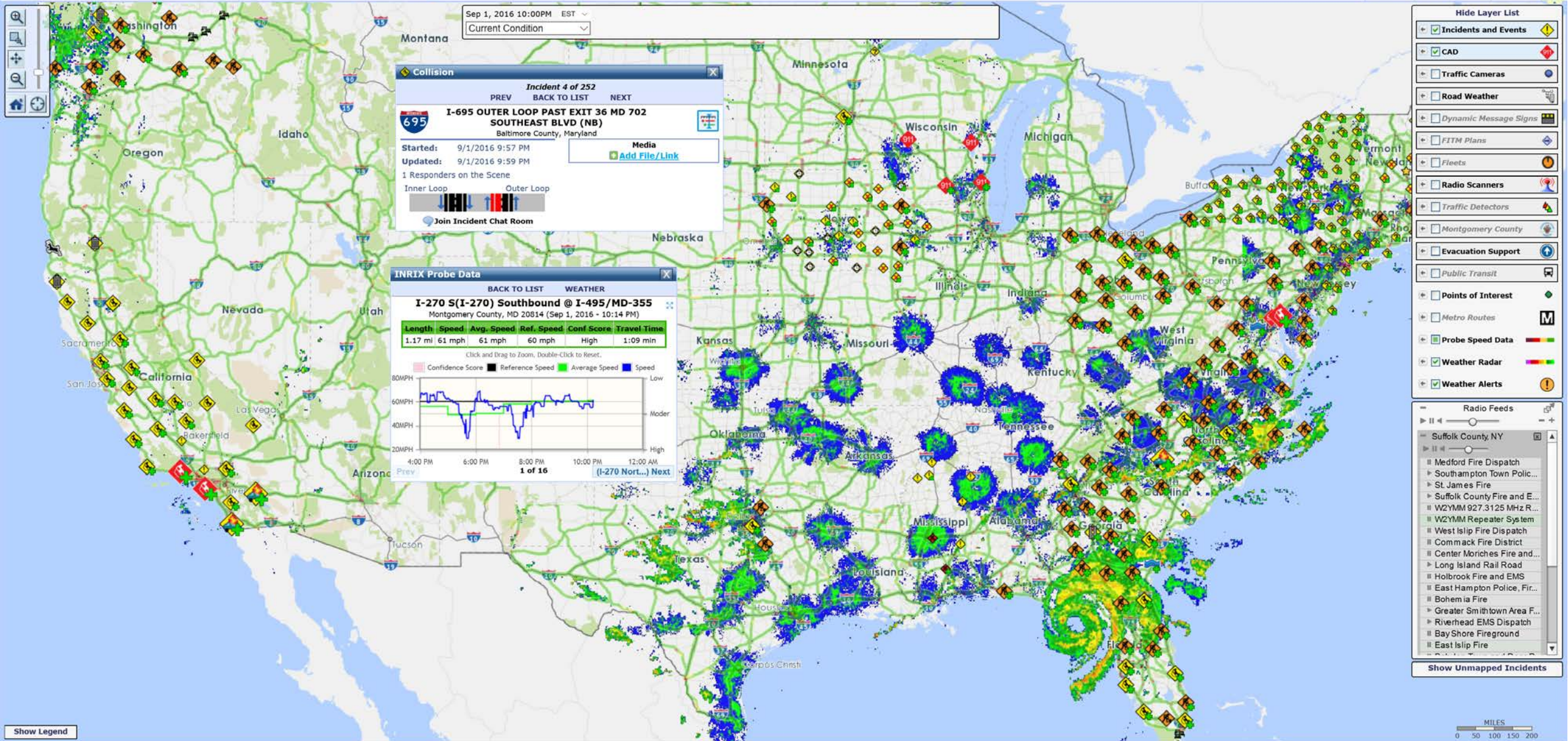


**Evaluate Safety/Mobility Improvements**

**Prioritize Investment Decisions**

Year	2016	2017	2018	2019	2020
Year 1 (17)	\$4.00	\$5.10	\$4.40	\$4.90	\$5.00
Year 2 (18)	\$4.00	\$28.90	\$18.40	\$18.40	\$5.00
CHISON BR	\$4.00	\$5.10	\$4.40	\$4.90	\$5.00
	\$4.00	\$11.70	\$4.30	\$4.90	\$5.00
	\$4.00	\$4.00	\$4.40	\$4.90	\$5.00
	\$4.00	\$4.30	\$4.90	\$4.90	\$5.00
	\$4.00	\$4.90	\$4.40	\$4.90	\$5.00
	\$4.00	\$4.90	\$4.40	\$4.90	\$5.00





Sep 1, 2016 10:00PM EST Current Condition

**Collision** Incident 4 of 252  
 PREV BACK TO LIST NEXT  
**I-695 OUTER LOOP PAST EXIT 36 MD 702 SOUTHEAST BLVD (NB)**  
 Baltimore County, Maryland  
 Started: 9/1/2016 9:57 PM  
 Updated: 9/1/2016 9:59 PM  
 1 Responders on the Scene  
 Inner Loop Outer Loop  
 Join Incident Chat Room

**INRIX Probe Data** BACK TO LIST WEATHER  
**I-270 S(I-270) Southbound @ I-495/MD-355**  
 Montgomery County, MD 20814 (Sep 1, 2016 - 10:14 PM)  

Length	Speed	Avg. Speed	Ref. Speed	Conf. Score	Travel Time
1.17 mi	61 mph	61 mph	60 mph	High	1:09 min

Click and Drag to Zoom, Double-Click to Reset.  
 Legend: Confidence Score (Pink), Reference Speed (Black), Average Speed (Green), Speed (Blue)  
 Graph showing speed fluctuations from 4:00 PM to 12:00 AM.  
 1 of 16 (I-270 Nort...) Next

**Hide Layer List**

- Incidents and Events
- CAD
- Traffic Cameras
- Road Weather
- Dynamic Message Signs
- FITM Plans
- Fleets
- Radio Scanners
- Traffic Detectors
- Montgomery County
- Evacuation Support
- Public Transit
- Points of Interest
- Metro Routes
- Probe Speed Data
- Weather Radar
- Weather Alerts

**Radio Feeds**

- Suffolk County, NY
  - Medford Fire Dispatch
  - Southampton Town Polic...
  - St James Fire
  - Suffolk County Fire and E...
  - W2YMM 927.3125 MHz R...
  - W2YMM Repeater System
  - West Islip Fire Dispatch
  - Commack Fire District
  - Center Moriches Fire and...
  - Long Island Rail Road
  - Holbrook Fire and EMS
  - East Hampton Police, Fir...
  - Bohemia Fire
  - Greater Smithtown Area F...
  - Riverhead EMS Dispatch
  - Bay Shore Fireground
  - East Islip Fire



## What is crowdsourcing?

- “Outsourcing to the crowd”
- “Voluntary undertaking of a task” by a group of diverse individuals
- Mutual benefit

## How is it different from what we did so far?

- Reliance on “unknown” to provide valuable information
- Develop trust in “wisdom of crowds”
- Access to a much wider view

A NEW YORK TIMES BUSINESS BESTSELLER  
“As entertaining and thought-provoking as *The Tipping Point* by Malcolm Gladwell. . . . *The Wisdom of Crowds* ranges far and wide.”  
—*The Boston Globe*

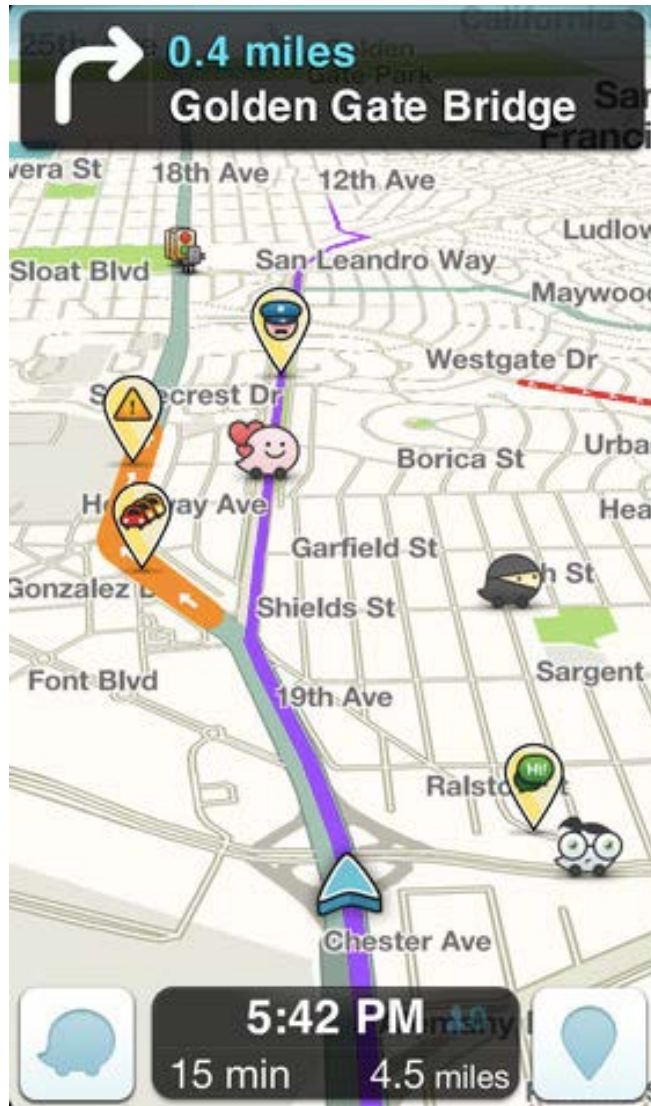
THE WISDOM  
OF CROWDS

JAMES  
SUROWIECKI

WITH A NEW AFTERWORD BY THE AUTHOR



# Waze Connected Citizens Program (CCP)



Source: TechCrunch

The infographic features a blue background with a white circuit-like graphic at the top left. The text "CONNECTED CITIZENS" is written in large white letters, with "by waze" in a smaller white box below it. To the right, a paragraph of text describes the program. Below the text are two light blue boxes containing descriptions of Waze and Partners. At the bottom, a white road with dashed lines is shown with several icons: a white smiley face, a red car icon, a white car icon, a red and white striped barrier icon, a white car icon, and a pink smiley face.

**CONNECTED CITIZENS**  
by waze

The Waze Connected Citizens Program (CCP) is a free, two-way data exchange empowering municipal decisions to achieve concrete community impact. Launched in October 2014 with 10 city partners, the program has expanded to more than 63 partners including city, state and country government agencies, nonprofits and first responders.

**WAZE** provides real-time, anonymous, proprietary incident and slow-down information directly from the source: drivers themselves

**PARTNERS** provide real-time and advance information on government-reported construction, crash and road closure data

Source: Waze

# Waze Incidents in RITIS Incident List

Transportation System Status

Welcome Nikola Ivanov!

---

[Incident List](#)
[Traffic Map](#)
[Incident Overview](#)
[Traffic Cameras](#)
[RSS Feed](#)
[VWS](#)
[WZPMA](#)
[RITIS Meeting](#)

[Set Region of Interest](#)
[Set Filters](#)
[Use Night Colors](#)
[Fullscreen](#)

Applied Filters: Data Source is equal to WAZE.

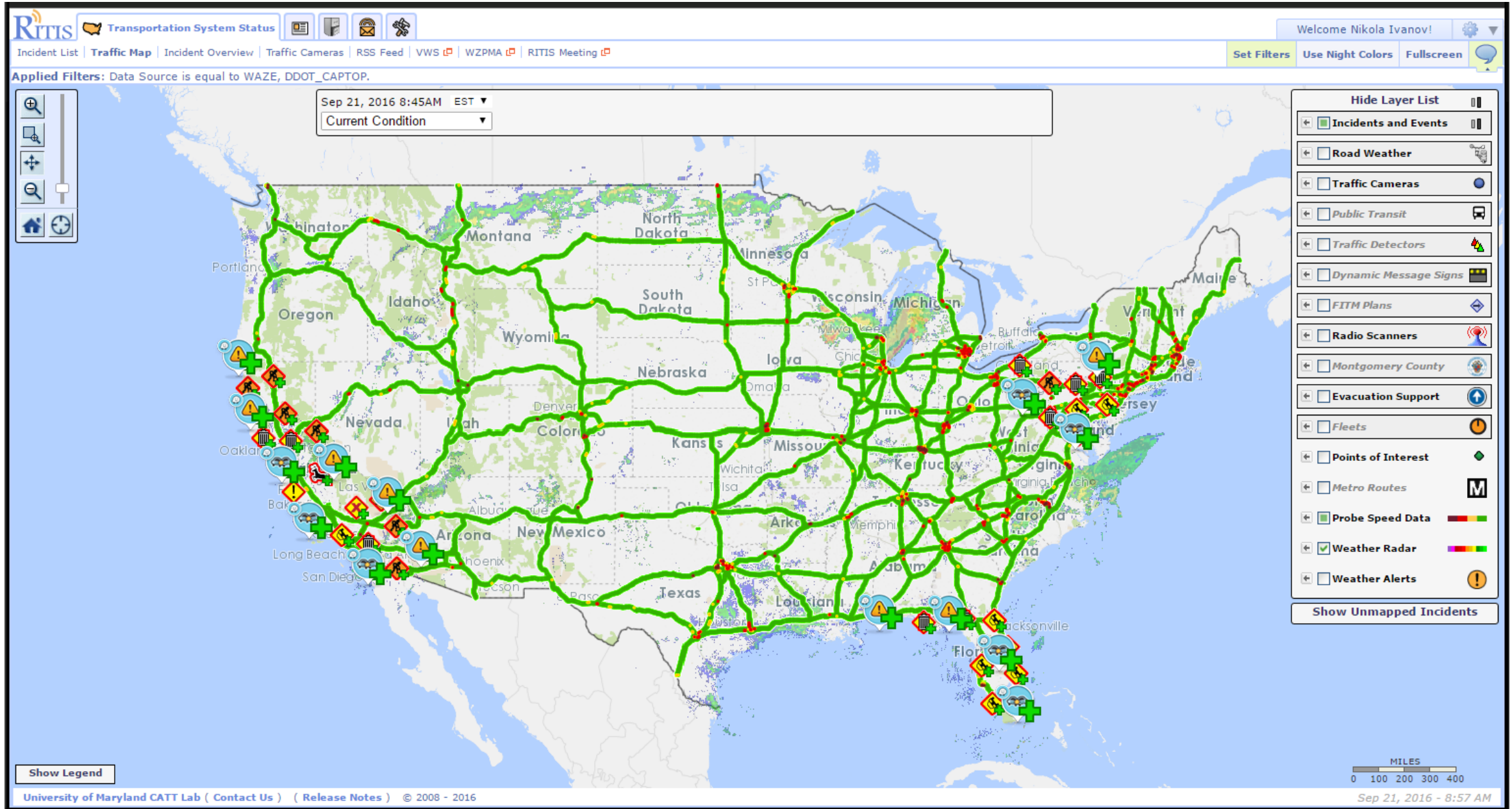
Showing: 1 - 100 (of 6844 incidents) 1 2 3 4 5 ... 69 Next »

Source	Location	Type	Updated ↑	Start Time	Lane Status	Description	
WAZE	JAM at I95 north in Delaware County	Traffic Congestion	6 mins ago	29 mins ago	—		
WAZE	FLOWER ST	Congestion Due to Closure	6 mins ago	18 hrs 55 mins ago	—	I-5 Bridge Girder Installation	
WAZE	STATE RD	Traffic Congestion	6 mins ago	11 mins ago	—		
WAZE	MCDUFF AVE	Congestion Due to Closure	6 mins ago	08/25/16 1:56PM	—	Closed due to construction on Beaver St.	
WAZE	EASTON RD	Traffic Congestion	6 mins ago	28 mins ago	—		
WAZE	US-422	Obstructions	6 mins ago	9 mins ago	—		
WAZE	WEATHERHAZARD at Calgrove Blvd in Los Angeles County	Incident	6 mins ago	5 hrs 33 mins ago	—	Sign Installation	
WAZE	PERIMETER RD	Traffic Congestion	6 mins ago	9 mins ago	—		
WAZE	MAGNOLIA DR	Congestion Due to Closure	6 mins ago	08/10/16 8:31AM	—		
WAZE	US-95	Construction Work	6 mins ago	02/01/16 2:00PM	—	Road maintenance operations: Construction on US-95 NB at Avenue 11E. Allow extra time.	
WAZE	9TH ST	Traffic Congestion	6 mins ago	11 mins ago	—		
WAZE	FRANKLIN ST	Congestion Due to Closure	6 mins ago	06/18/16 8:29PM	—	662 Reconstruction	
WAZE	ACCIDENT at I15 south in Riverside County	Incident	6 mins ago	21 mins ago	—	Accident involving pedestrian: Incident on I-15 SB at Rancho California. Expect delays.	
WAZE	LOUCKS RD	Traffic Congestion	6 mins ago	13 mins ago	—		

[University of Maryland CATT Lab](#) ( [Contact Us](#) ) ( [Release Notes](#) ) © 2008 - 2016

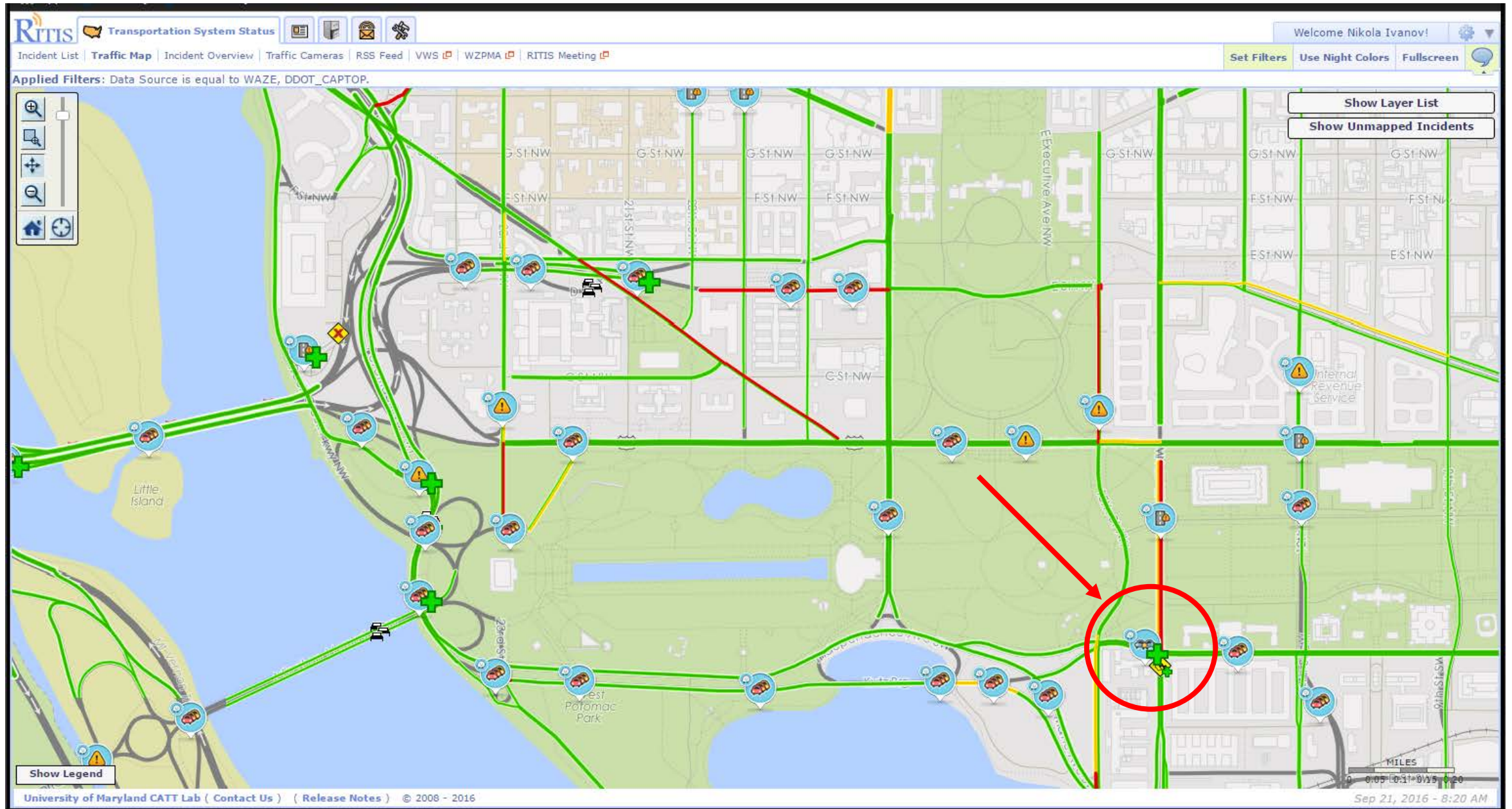
Sep 21, 2016 - 7:34 AM

# Waze on RITIS Map





# Local View





# Key Incident Information

The screenshot displays the RITIS Transportation System Status interface. The top navigation bar includes links for Incident List, Traffic Map, Incident Overview, Traffic Cameras, RSS Feed, VWS, WZPMA, and RITIS Meeting. A user profile for Nikola Ivanov is visible in the top right. The main map area shows a network of roads with various incident icons. Three pop-up windows are open:

- Collision (Incident 1 of 3):** Located at 14TH ST, District Of Columbia County, District of Columbia. Started: 9/21/2016 7:56 AM, Updated: 9/21/2016 8:12 AM. Reliability level: 5, Contributor level: 2.
- Congestion Due to Closure (Incident 1 of 2):** Located on I-395, District Of Columbia County, District of Columbia. Started: 9/21/2016 7:44 AM, Updated: 9/21/2016 8:12 AM. Reliability level: 6, Contributor level: 0.
- Obstructions (Incident 1 of 2):** Located on I-395, District Of Columbia County, District of Columbia. Started: 9/21/2016 8:09 AM, Updated: 9/21/2016 8:12 AM. Reliability level: 7, Contributor level: 2.

Two red circles and arrows highlight the 'Reliability level: 7' and 'Contributor level: 2' fields in the Obstructions pop-up. The bottom of the interface features a 'Show Legend' button, the University of Maryland CATT Lab logo, and a scale bar in miles (0 to 0.20). The date and time are shown as Sep 21, 2016 - 8:22 AM.

# Filtering for Reliability

The screenshot displays a map application interface with several panels and controls. At the top right, there are buttons for "Set Filters", "Use Night Colors", and "Fullscreen".

The main map area shows a street grid with green lines and a building labeled "Cannon House Office Building".

On the left, a panel titled "Options for Waze Incidents and Events" is open. It includes an "Opacity" slider set to 100% and a checked checkbox for "Filter out incidents with a reliability level lower than 5".

In the center, a panel titled "Incidents and Events Sub-Layers" is open, showing three checked sub-layers: "CAD Incidents and Events", "Waze Incidents and Events", and "DOT Incidents and Events".

On the right, a "Hide Layer List" panel is open, showing a list of map layers with checkboxes and icons:

- Incidents and Events (Warning icon)
- Road Weather (Weather icon)
- Traffic Cameras (Camera icon)
- Public Transit (Bus icon)
- Traffic Detectors (Traffic light icon)
- Dynamic Message Signs (Sign icon)
- FITM Plans (Map icon)
- Radio Scanners (Radio icon)



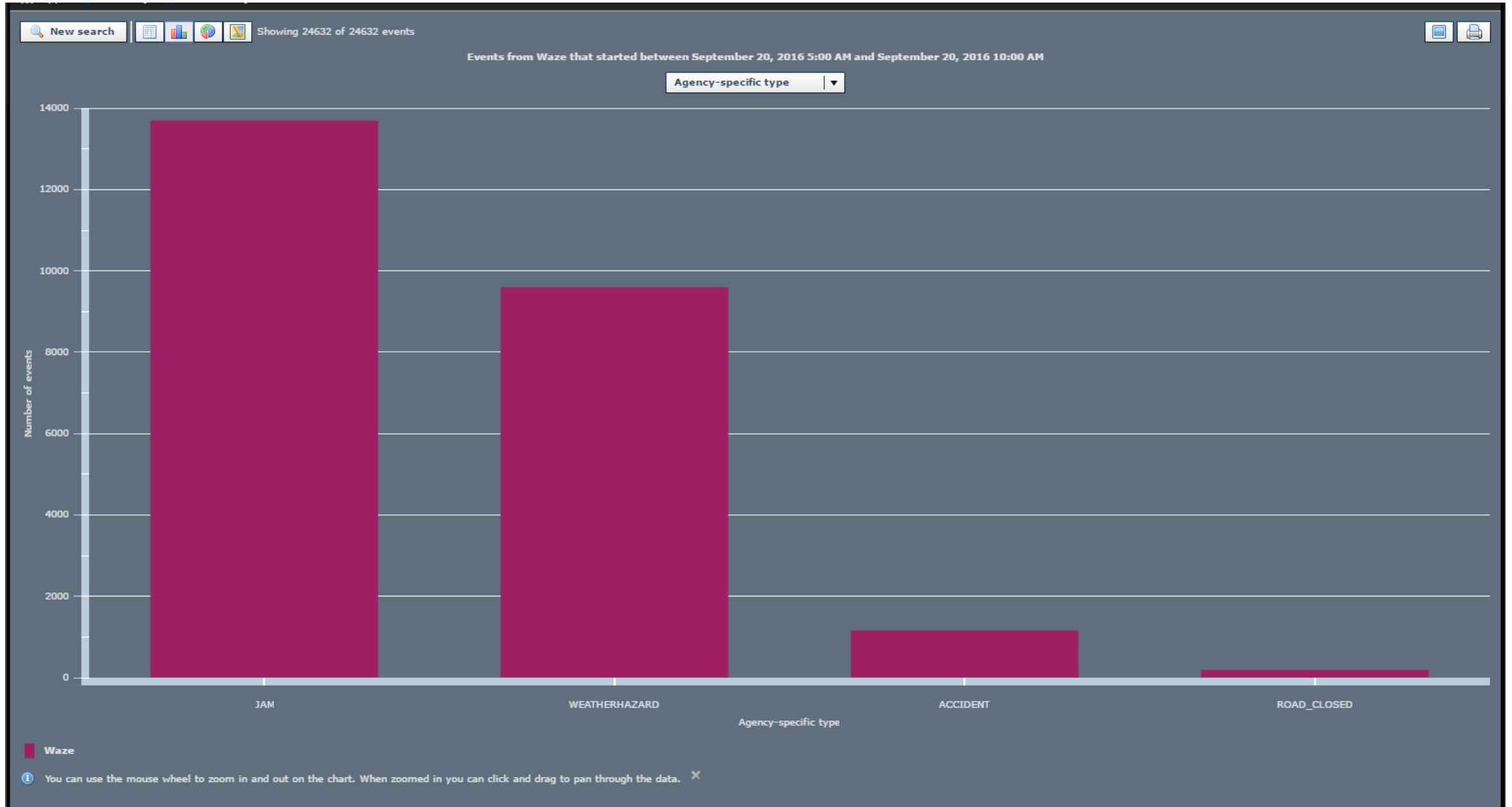
# Archived Data Analysis

New search     Showing 24632 of 24632 events Choose Columns  

Events from Waze that started between September 20, 2016 5:00 AM and September 20, 2016 10:00 AM

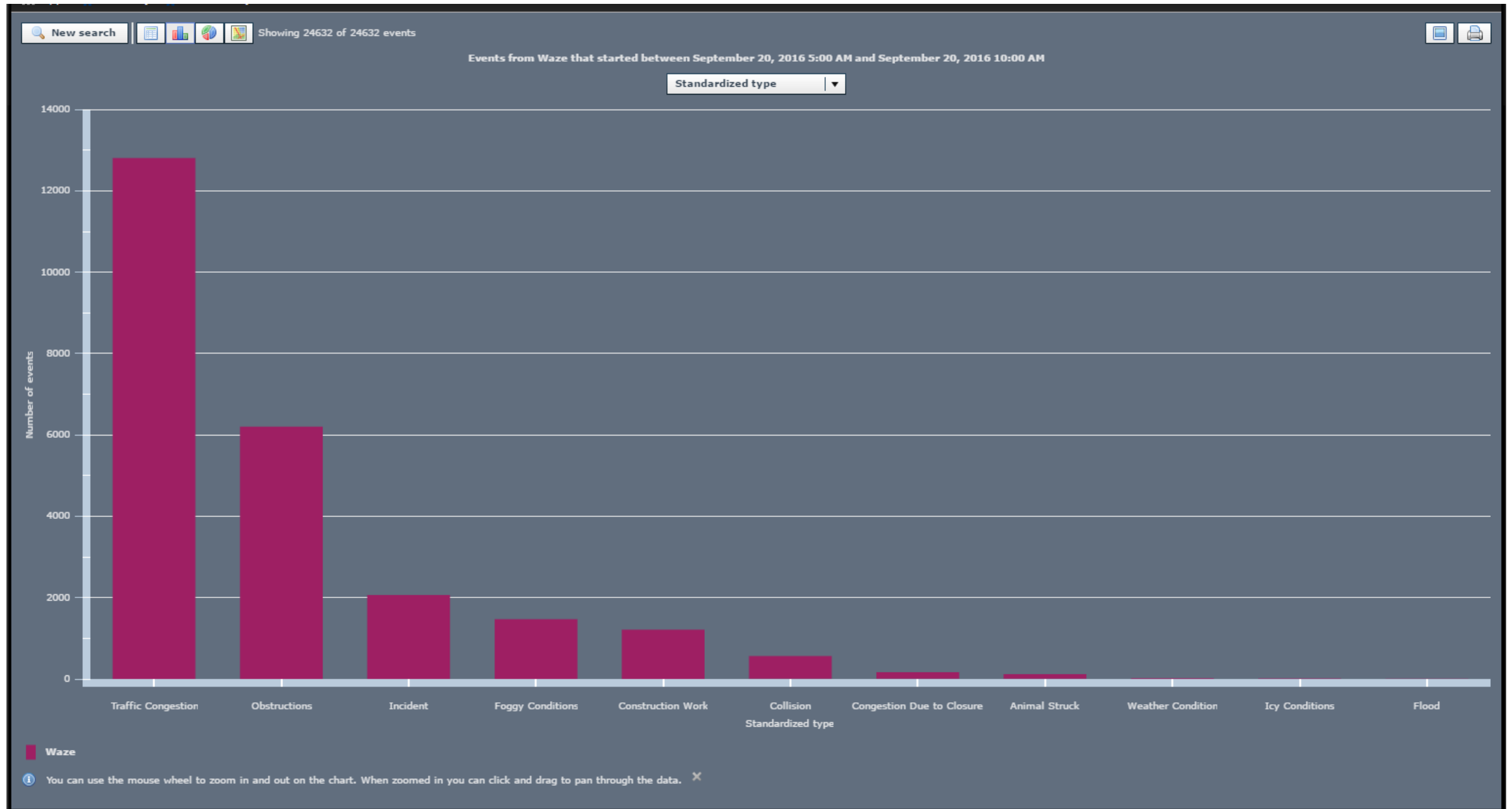
System	Agency	Standardized Type	Agency-specific Type	Location	County	Time Opened	Time Closed	Duration
Type to filter	Type to filter	Type to filter	Type to filter	Type to filter	Type to filter	Type to filter	Type to filter	Type to filter
Waze	Waze	Obstructions	WEATHERHAZARD	I-15	Riverside	9/20/16 7:23 AM -0400	9/20/16 9:30 AM -0400	2 hours 7 minutes
Waze	Waze	Obstructions	WEATHERHAZARD	I-4	Polk	9/20/16 5:07 AM -0400	9/20/16 7:14 AM -0400	2 hours 7 minutes
Waze	Waze	Construction Work	WEATHERHAZARD	SR-127	Inyo	9/20/16 8:00 AM -0400	9/20/16 10:06 AM -0400	2 hours 6 minutes
Waze	Waze	Incident	ACCIDENT	ALTON RD	Miami-Dade	9/20/16 8:40 AM -0400	9/20/16 10:46 AM -0400	2 hours 6 minutes
Waze	Waze	Foggy Conditions	WEATHERHAZARD	SR-28	Allegheny	9/20/16 6:32 AM -0400	9/20/16 8:38 AM -0400	2 hours 6 minutes
Waze	Waze	Obstructions	WEATHERHAZARD	CROW CANYON RD	Alameda	9/20/16 8:06 AM -0400	9/20/16 10:12 AM -0400	2 hours 6 minutes
Waze	Waze	Obstructions	WEATHERHAZARD	FLORIDA'S TPKE	Palm Beach	9/20/16 7:53 AM -0400	9/20/16 9:59 AM -0400	2 hours 5 minutes
Waze	Waze	Foggy Conditions	WEATHERHAZARD	I-79	Allegheny	9/20/16 7:09 AM -0400	9/20/16 9:14 AM -0400	2 hours 5 minutes
Waze	Waze	Obstructions	WEATHERHAZARD	FLORIDA'S TPKE	Palm Beach	9/20/16 7:59 AM -0400	9/20/16 10:04 AM -0400	2 hours 4 minutes
Waze	Waze	Obstructions	WEATHERHAZARD	FLORIDA'S TPKE	Broward	9/20/16 7:25 AM -0400	9/20/16 9:30 AM -0400	2 hours 4 minutes
Waze	Waze	Collision	ACCIDENT	ACCIDENT at Discovery Bay Blvd in Contra Cos	Contra Costa	9/20/16 9:40 AM -0400	9/20/16 11:44 AM -0400	2 hours 4 minutes
Waze	Waze	Congestion Due to Closure	ROAD_CLOSED	STEBEN RD	Northampton	9/20/16 8:37 AM -0400	9/20/16 10:40 AM -0400	2 hours 3 minutes
Waze	Waze	Congestion Due to Closure	ROAD_CLOSED	BAYSHORE DR	Okaloosa	9/20/16 8:37 AM -0400	9/20/16 10:40 AM -0400	2 hours 3 minutes
Waze	Waze	Congestion Due to Closure	ROAD_CLOSED	TAYLOR ST	San Francisco	9/20/16 8:37 AM -0400	9/20/16 10:40 AM -0400	2 hours 3 minutes
Waze	Waze	Congestion Due to Closure	ROAD_CLOSED	30TH ST	Orange	9/20/16 8:37 AM -0400	9/20/16 10:40 AM -0400	2 hours 3 minutes
Waze	Waze	Congestion Due to Closure	ROAD_CLOSED		San Bernardino	9/20/16 8:37 AM -0400	9/20/16 10:40 AM -0400	2 hours 3 minutes
Waze	Waze	Construction Work	WEATHERHAZARD	I-495	New Castle	9/20/16 8:15 AM -0400	9/20/16 10:18 AM -0400	2 hours 3 minutes
Waze	Waze	Obstructions	WEATHERHAZARD	WEATHERHAZARD at Exit: 25 in Miami-dade Co	Miami-Dade	9/20/16 8:23 AM -0400	9/20/16 10:26 AM -0400	2 hours 2 minutes
Waze	Waze	Construction Work	WEATHERHAZARD	WEATHERHAZARD at US30 west in Lancaster C	Lancaster	9/20/16 8:46 AM -0400	9/20/16 10:48 AM -0400	2 hours 2 minutes
Waze	Waze	Incident	ACCIDENT	BIRD DR	Miami-Dade	9/20/16 6:13 AM -0400	9/20/16 8:14 AM -0400	2 hours 1 minute
Waze	Waze	Obstructions	WEATHERHAZARD	CANAL RD	District of Columbia	9/20/16 5:37 AM -0400	9/20/16 7:38 AM -0400	2 hours 1 minute
Waze	Waze	Incident	ACCIDENT	ACCIDENT at CA4 in Contra Costa County	Contra Costa	9/20/16 9:40 AM -0400	9/20/16 11:40 AM -0400	2 hours
Waze	Waze	Obstructions	WEATHERHAZARD	I-78	Northampton	9/20/16 5:14 AM -0400	9/20/16 7:14 AM -0400	2 hours
Waze	Waze	Obstructions	WEATHERHAZARD	I-476	Montgomery	9/20/16 9:48 AM -0400	9/20/16 11:48 AM -0400	2 hours
Waze	Waze	Incident	WEATHERHAZARD	WEATHERHAZARD at I10 west in Riverside Cou	Riverside	9/20/16 8:01 AM -0400	9/20/16 10:00 AM -0400	1 hour 59 minutes
Waze	Waze	Incident	ACCIDENT	26TH ST	Manatee	9/20/16 9:15 AM -0400	9/20/16 11:14 AM -0400	1 hour 59 minutes
Waze	Waze	Incident	ACCIDENT	FLORIDAS TPKE	Orange	9/20/16 8:07 AM -0400	9/20/16 10:06 AM -0400	1 hour 59 minutes
Waze	Waze	Obstructions	WEATHERHAZARD	WEATHERHAZARD at Lincoln Hwy in York Coun	York	9/20/16 6:15 AM -0400	9/20/16 8:14 AM -0400	1 hour 58 minutes

# Breakdown by Type of Report

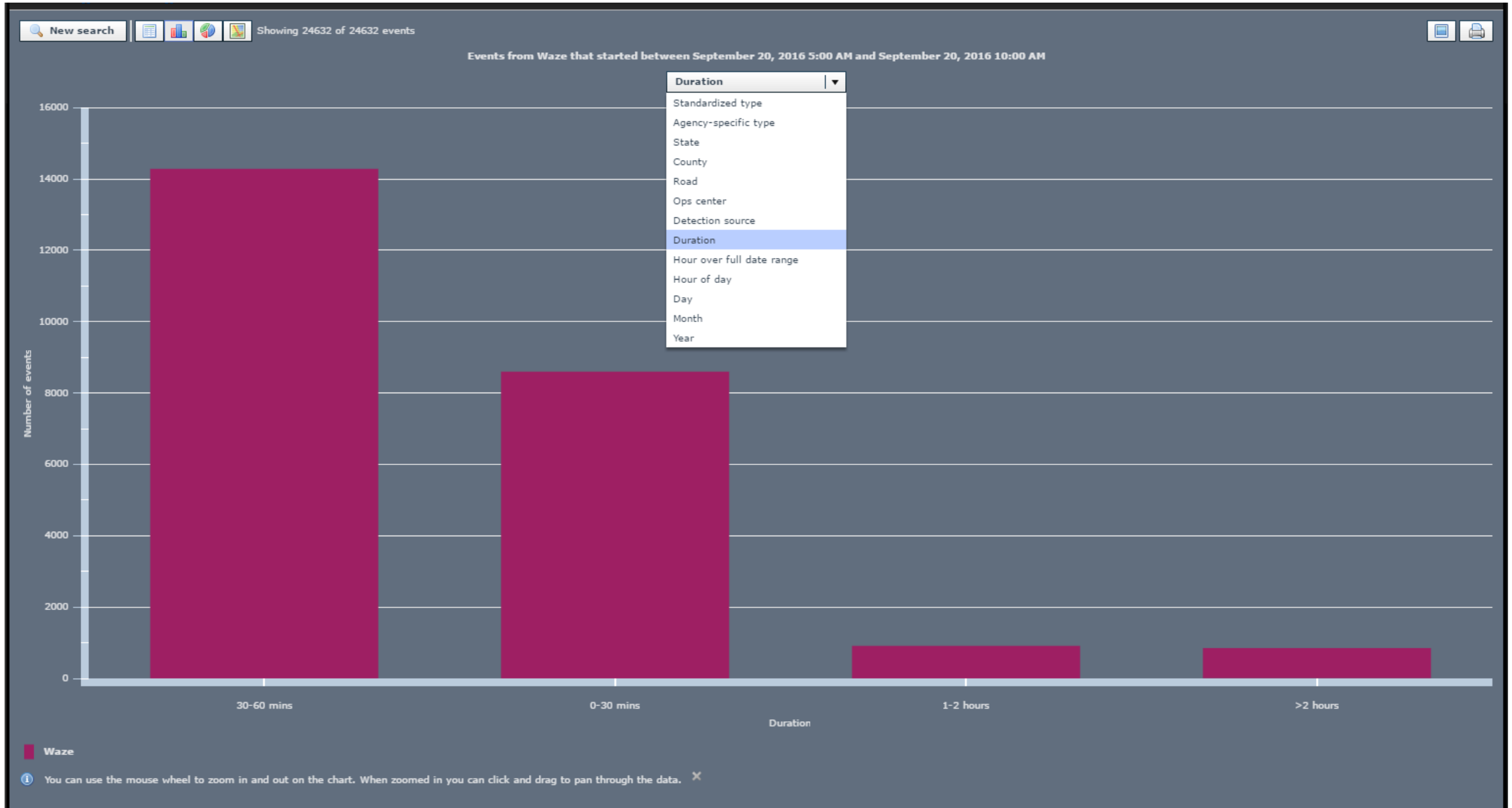




# Standardizing for DOTs

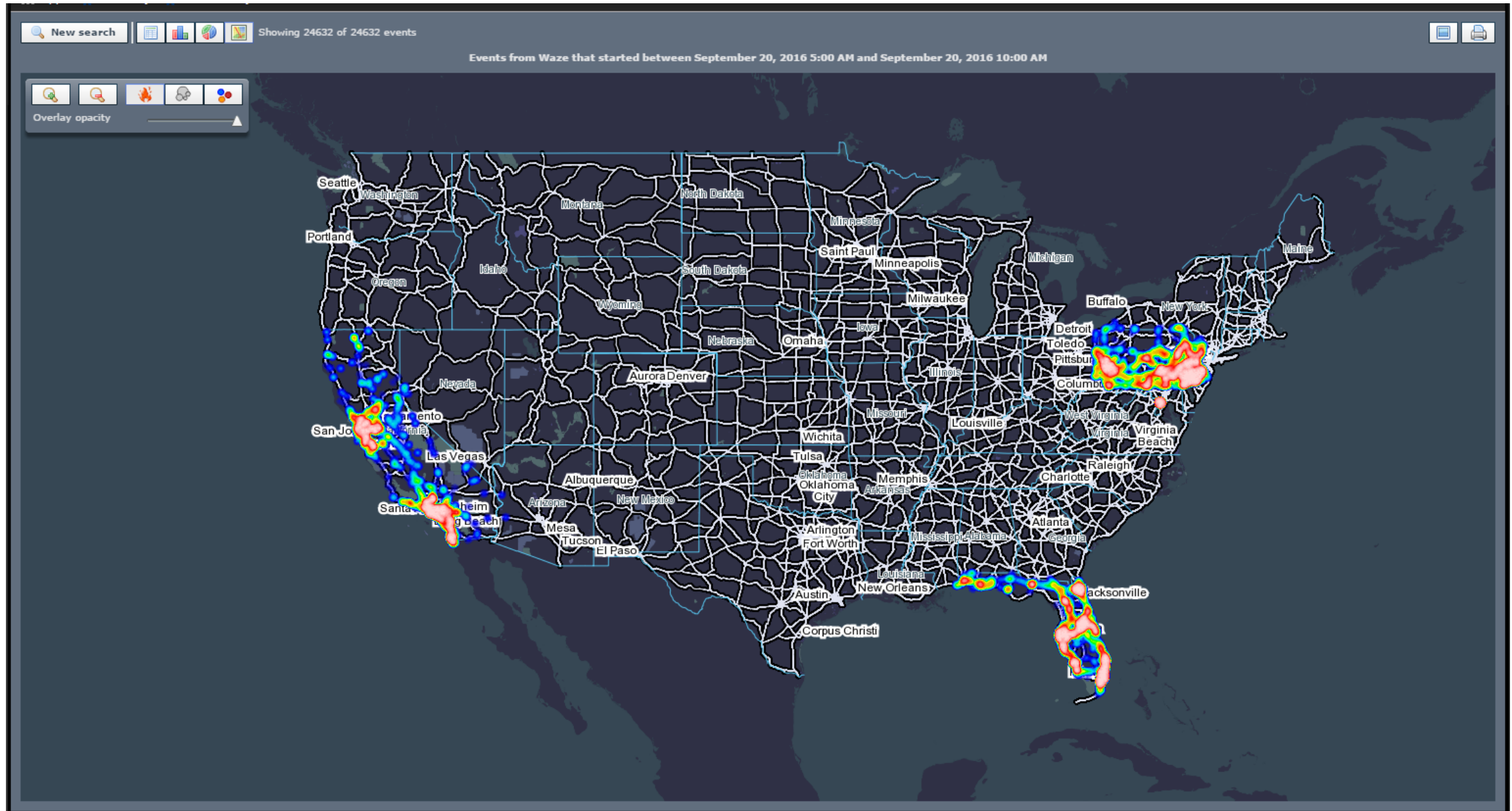


# Event Duration



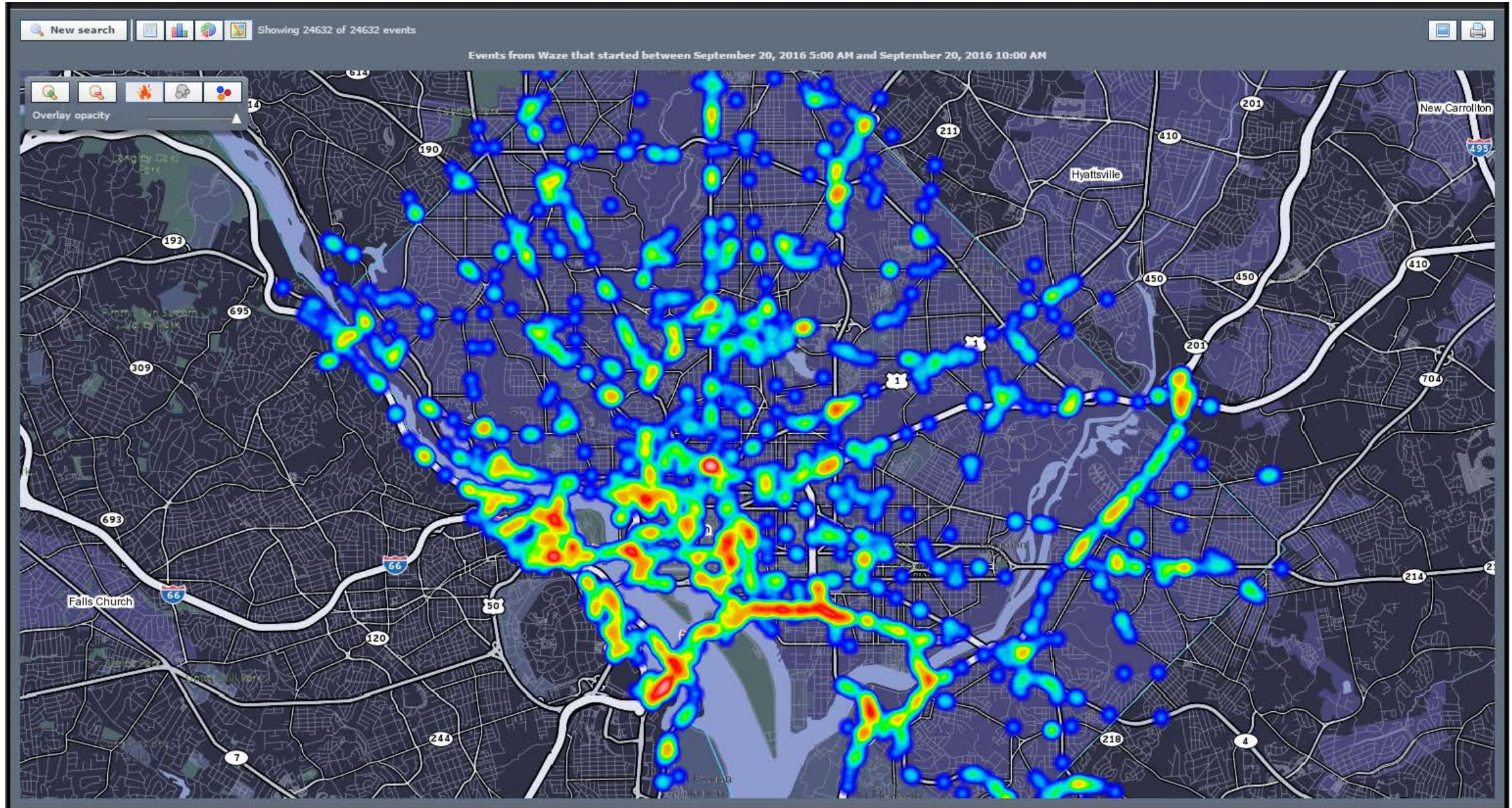


# Geospatial Overview of Archived Data



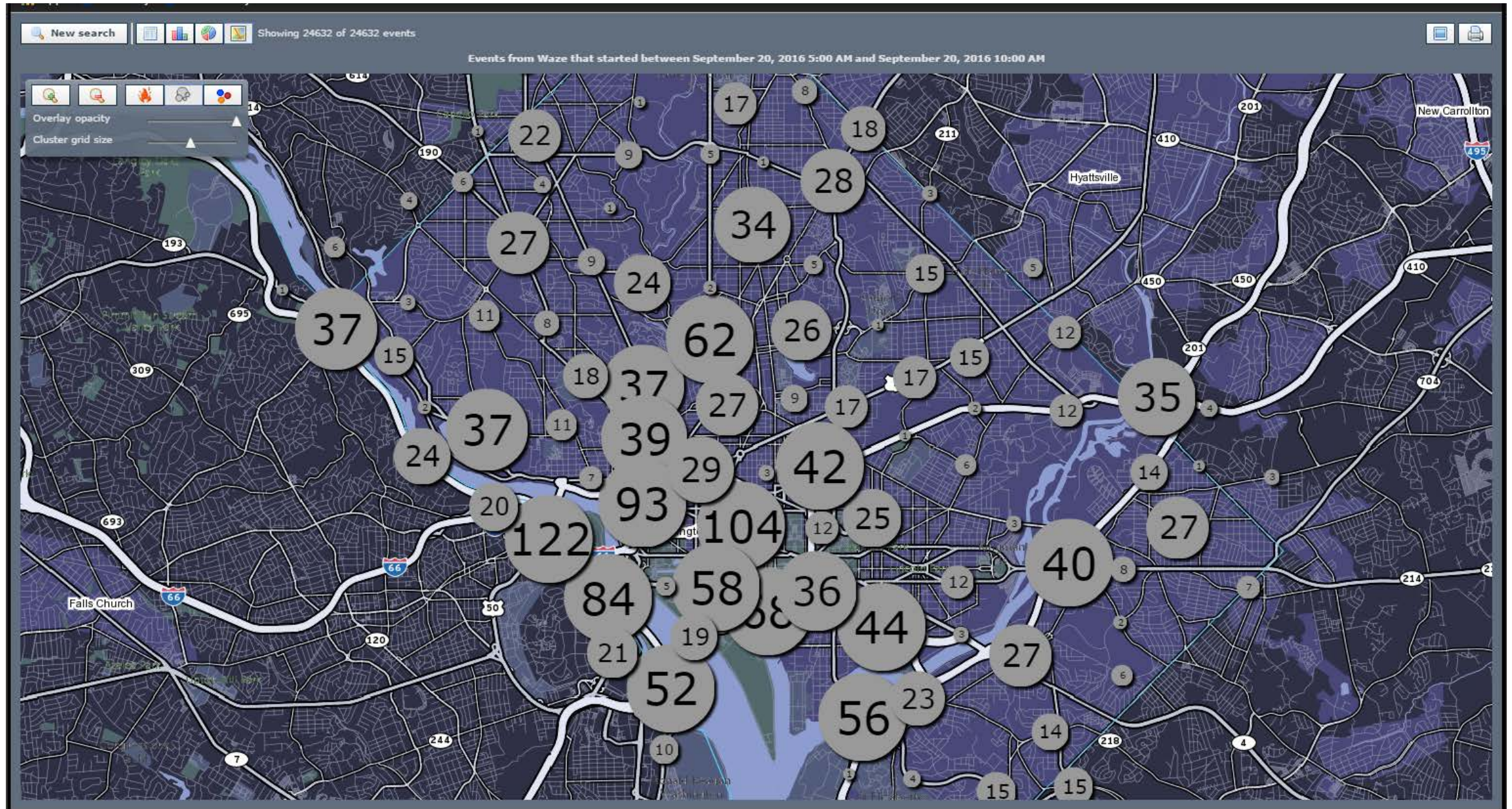


# Washington DC – Morning Rush





# Washington DC – By the Numbers





# Crowd-Sourced Origin-Destination Data



# Trip Waypoints (July 2015)

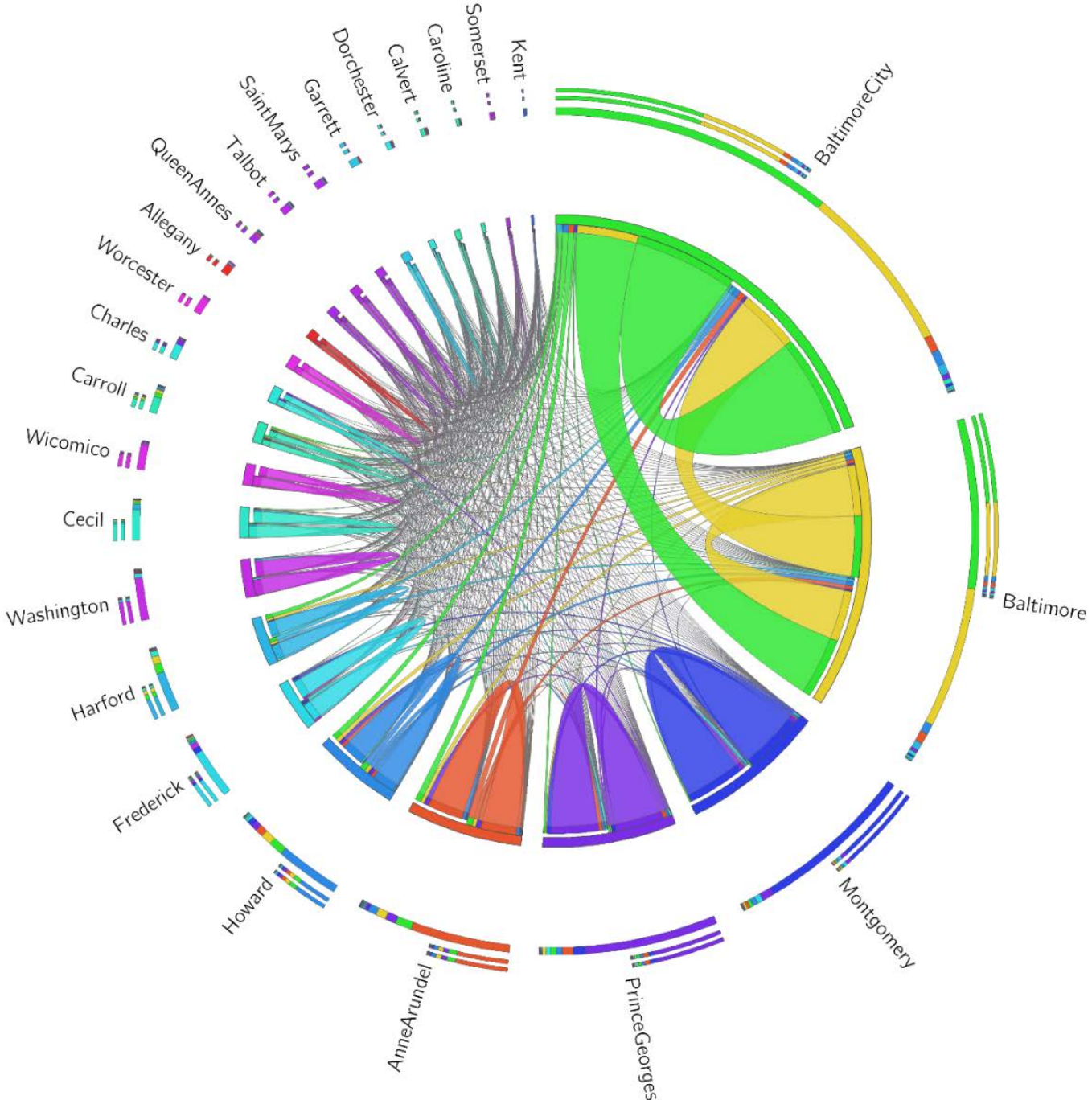


**Waypoint Locations**

100 M waypoints (7 GB)

- Average distance: 0.9 miles
- Average duration: ~1.5 min

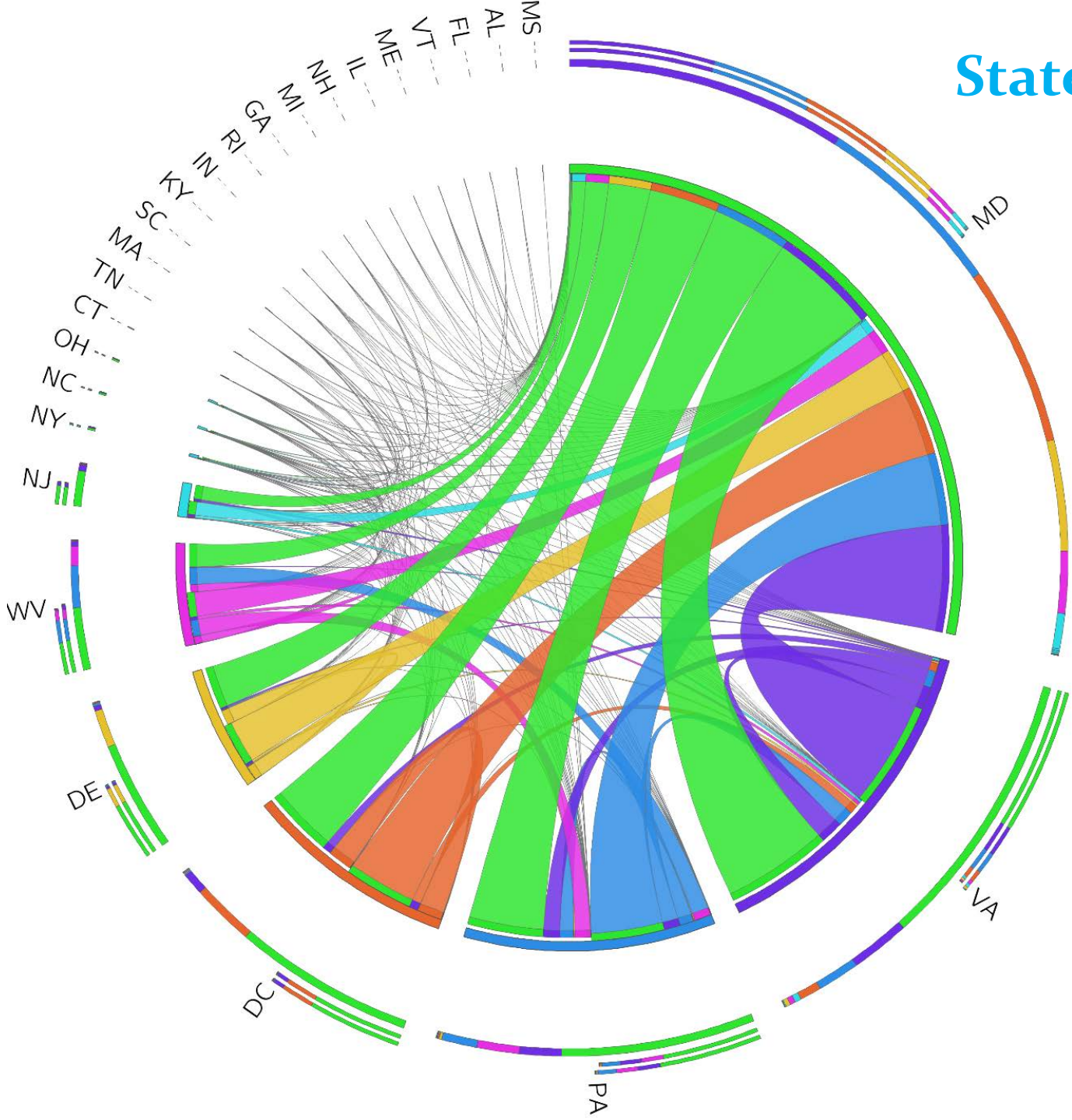
# County OD matrix for MD-MD trips (July 2015)



- Focus: OD of trips that originate and end in MD
- Most trips are within the same county

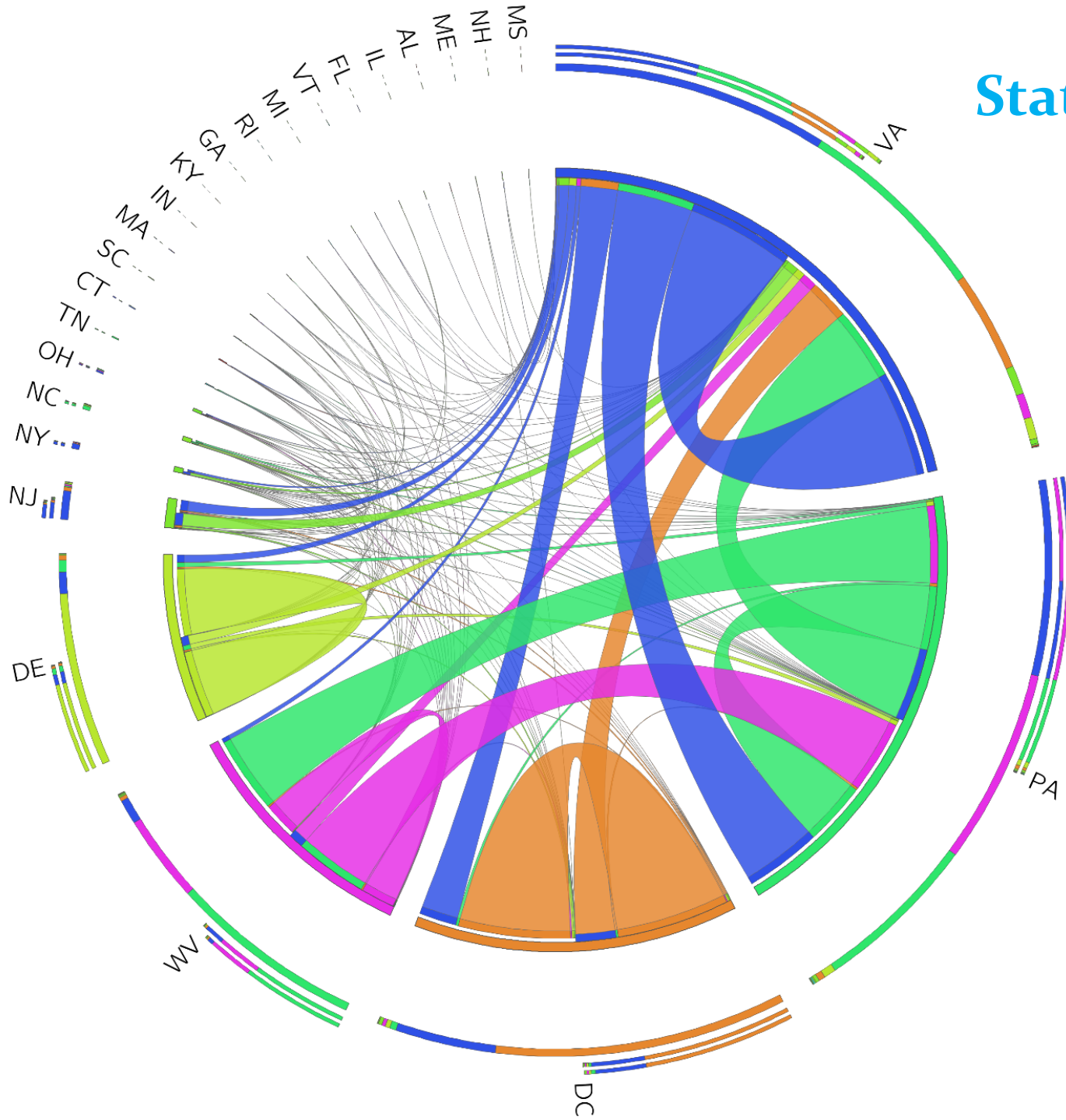


# State OD matrix visuals (July 2015)



- MD-MD trips are filtered out
- Focus: traffic between MD and other states

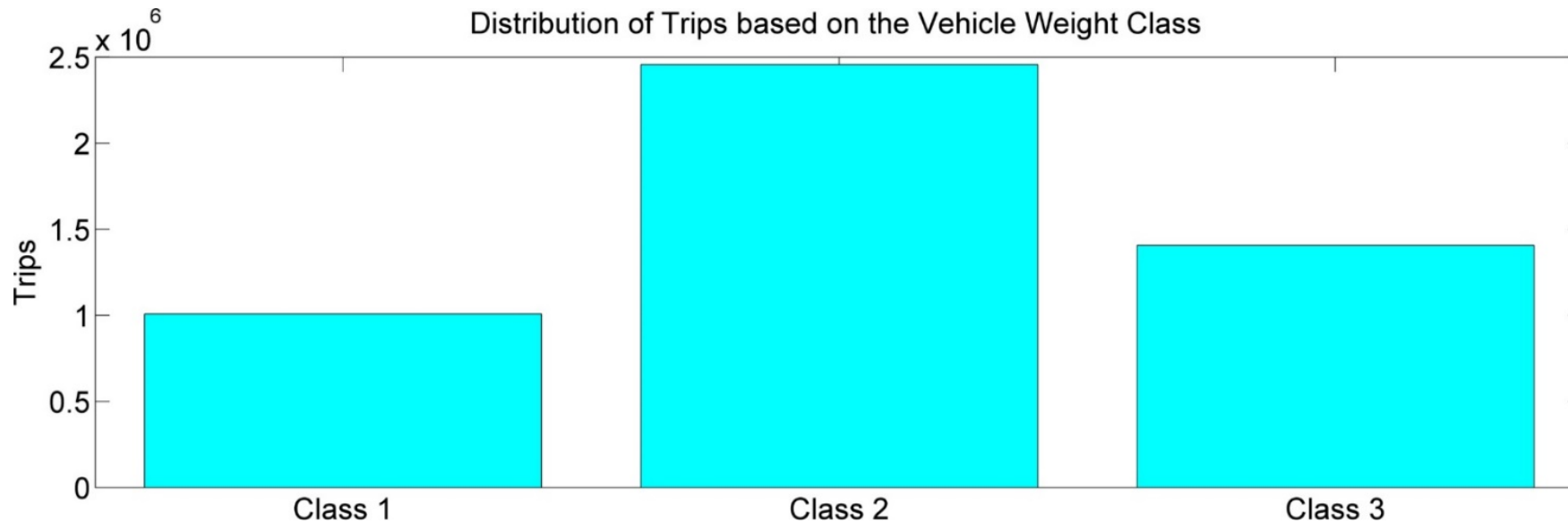
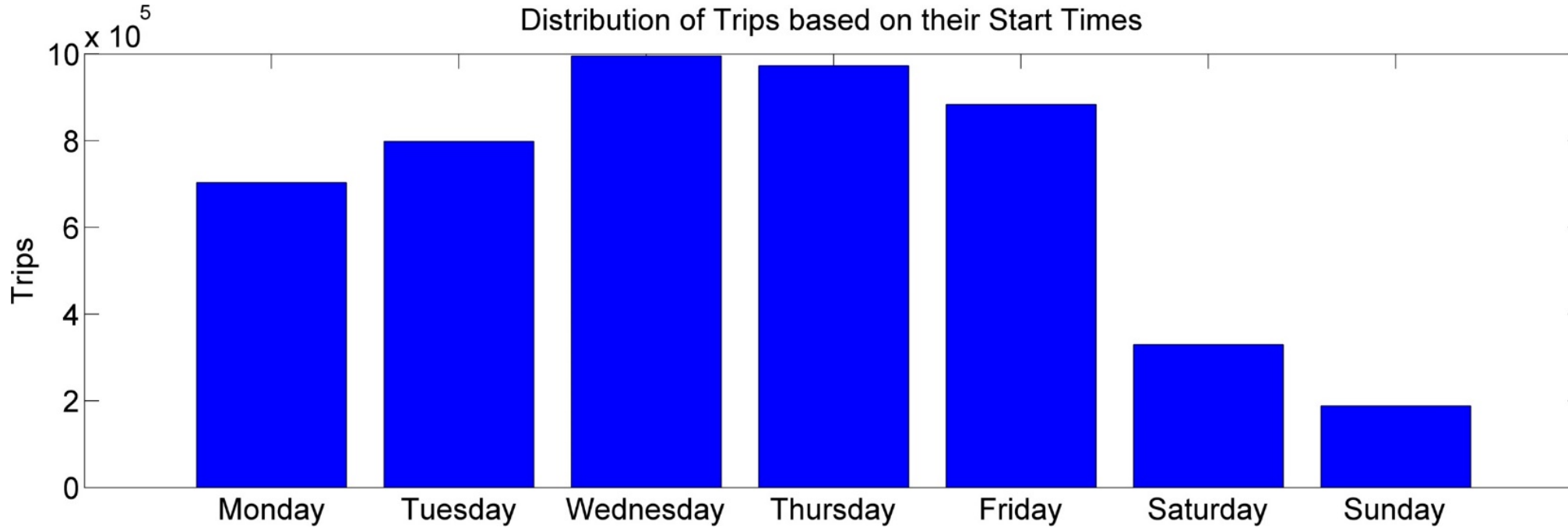
# State OD matrix visuals (July 2015)



- Trips with origins/destinations in MD are filtered out
- Focus: OD of trips that **traverse MD**



# Descriptive statistics (July 2015)



Fewer trips on weekends.



05:00 am



Crowd Sourced Connected Vehicles Data



Fuel used



ABS



Traction



Powerful automated reports



Bring your own device



Last mile routing



Stability



Odometer



Fault status reports



Driver behavior scorecards



Real-time alerts & automated reports



Fleet Intelligence Dashboard

1-million+ Vehicles On the Road Today that can provide this type of data



Road network feedback



Automated hours of service



Vehicle inspection reports



Mobile view for supervisors on the move



Weather



Traffic



Truck-specific commercial navigation



IFTA state miles reporting



Automated driver assignment



Animated vehicle history



DOT compliance



Speeding against posted speed limit



Crowd Sourced Probe-based Speed Data

# Current Providers & Services



- Speeds and travel times
- Data Feeds & APIs
- Tiles
- Some are working on volumes and turning movements
- Not all provide the same type of data, the same format, etc.
  - TMC segments/standards differ
  - Capped data at speed limit by TomTom
  - Additional elements (freeflow or historic average available by some, but not all)
  - Various types of quality indicators provided by each
  - Deviant data only (Waze/Google)



# Probe Data Recommendations

## ✓ RECOMMENDED

- **<= 1 signal per mile**
  - AADT > 40,000 vpd (2-way)
  - Limited curb cuts
- Principal Arterials  
Likely to be accurate...

## 🔑 SHOULD BE TESTED

- **1 to 2 signals per mile**
  - AADT 20K to 40K vpd (2-way)
  - Moderate number of curb cuts
- Minor Arterials  
Possibly accurate, test ...

## ✘ NOT RECOMMENDED

- **>= 2 signals per mile**
  - AADT < 20K (2-way) - low volume
  - Substantial number of curb cuts
- Major Collectors  
Unlikely to be accurate...

# Don't make these mistakes

- DUAs – You have the power!
  - Fight for Great Acceptable use
  - Fight for Sharing with partners
  - Don't just do what your neighbor did
  - Look for model DUAs (I-95 CC for probe data)
- Sharing back with the provider the way YOU want to share it
  - (don't permanently dumb down)
- Payment terms based on quality and uptime (where applicable)



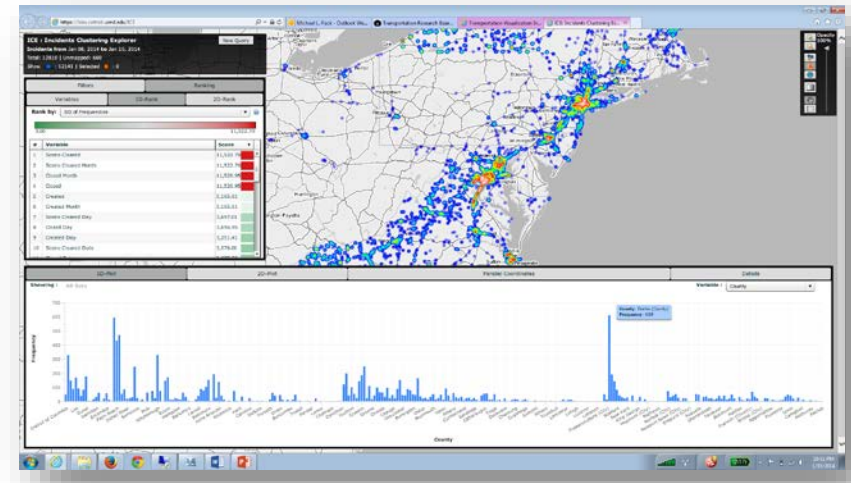
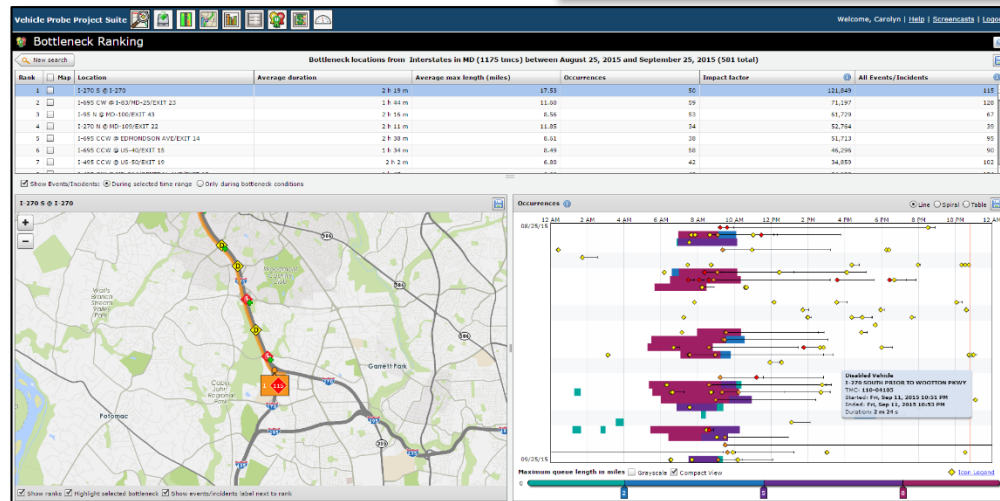
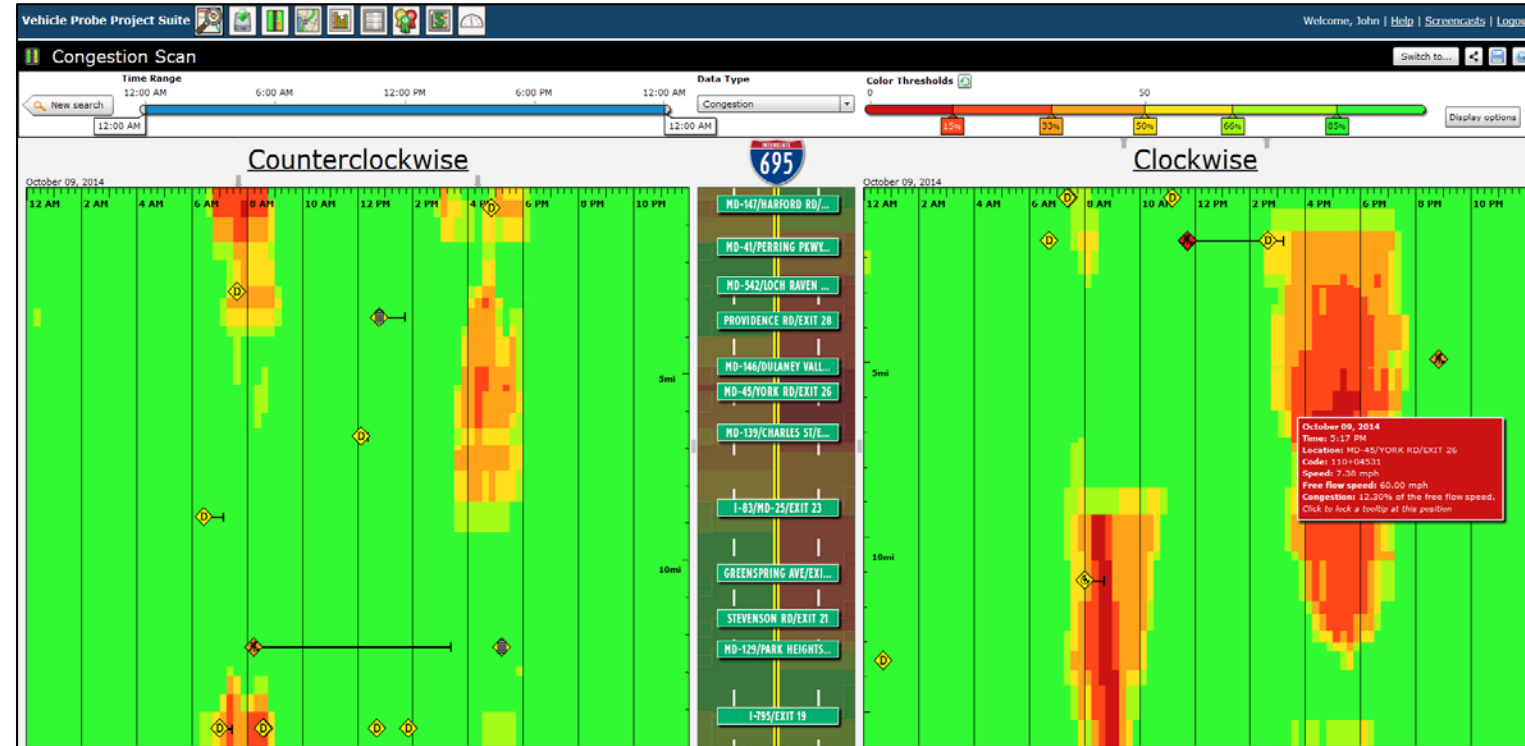
Vs.





# Next Steps

- Assist agencies in integration of this data into ATMS.
- Integrate Waze data in other tools in RITIS analytics suite.
- Analyze correlations between crowdsourced and DOT data.
- Examine better uses of reliability and contributor level scores.
- Identify case studies for successful utilization of combined crowdsourced and DOT data.



**Michael Pack**

**301-405-0722**

**[PackML@umd.edu](mailto:PackML@umd.edu)**

**<http://cattlab.umd.edu>**

