



# Transportation Pooled Fund Program

To create Web-based Traffic Data Visualization and Analysis Tools

## *Task 5 Report*

*Albany Visualization And Informatics Lab (AVAIL)  
Lewis Mumford Center, University at Albany, SUNY*

***Catherine T. Lawson, Ph.D.***

*Chair, Geography and Planning Department*

*Director, Lewis Mumford Center*

*Director, Masters in Urban and Regional Planning (MRP) Program*

*AS 218 1400 Washington Avenue*

*Albany, New York 12222*

*(518) 442-4775*

*lawsonc@albany.edu*

## CONTENTS

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Figures and Tables .....	3
1 Introduction .....	4
2 Project Overview and Scope of Task 5.....	4
2.1 Overview .....	4
2.2 SCOPE.....	4
2.3 Task 5 -- Establish Web-Based User Friendly Data Visualization Tool to Generate Appropriate Reports and Outputs.....	4
2.3.1 Deliverables.....	5
3 Chart of Features by Completion.....	6
4 User Guide By Feature .....	7
4.1 Statewide Average Traffic and HPMS Graphs and HPMS View: .....	7
4.1.1 Overview Dashboard.....	8
4.1.2 Single Station - Class Counts .....	9
4.1.3 Single Station - Weight Counts .....	10
4.1.4 Single Station - Weight Distribution (Load Spectra) .....	11
4.1.5 Class Tab.....	13
4.1.6 WIM Tab.....	15
4.1.7 WIM and Class Tab Filters.....	16
4.1.8 HPMS Tab.....	16
4.1.9 Enforcement Tab.....	18
4.1.10 Single Station Enforcement Graphs .....	19
4.2 Data Management .....	21
4.3 Data Upload .....	22
4.4 Calendar Graph of Uploaded Data.....	22

## FIGURES AND TABLES

---

Figure 1 .....	7
Figure 2 .....	7
Figure 3 .....	8
Figure 4 .....	8
Figure 5 .....	9
Figure 6 .....	9
Figure 7 .....	10
Figure 8 .....	10
Figure 9 .....	10
Figure 10 .....	11
Figure 11 .....	11
Figure 12 .....	11
Figure 13 .....	12
Figure 14 .....	12
Figure 15 .....	12
Figure 16 .....	12
Figure 17 .....	13
Figure 18 .....	13
Figure 19 .....	14
Figure 20 .....	14
Figure 21 .....	14
Figure 22 .....	14
Figure 23 .....	15
Figure 24 .....	15
Figure 25 .....	15
Figure 26 .....	16
Figure 27 .....	16
Figure 28 .....	17
Figure 29 .....	17
Figure 30 .....	18
Figure 31 .....	18
Figure 32 .....	19
Figure 33 .....	19
Figure 34 .....	20
Figure 35 .....	21
Figure 36 .....	21
Figure 37 .....	22
Figure 38 .....	22
Figure 39 .....	22

Table 1: Data Tool Establishment Table of Features by Percent Completion .....	6
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# 1 INTRODUCTION

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The Task 5 Report of the FHWA Transportation Pooled Fund Program, *To create Web-based Traffic Data Visualization and Analysis Tool*, highlights the suite of tool features. Section 2 is an overview of the Project and Scope of Task 5. Section 3 is a table of features with percent completion by tool feature. Section 4 is a feature by feature user guide.

## 2 PROJECT OVERVIEW AND SCOPE OF TASK 5

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### 2.1 OVERVIEW

The objective of this work is to develop a web-based user friendly vehicle volume, classification, weigh-in-motion (WIM), and speed traffic data visualization analysis tool; where it accommodates traffic data in the Traffic Monitoring Guide (TMG) data formats, Highway Performance Monitoring System (HPMS) traffic data attributes, and global traffic data loading formats. The resulting product will offer: (1) data quality review and control functions; (2) GIS data visualization capabilities and analysis and (3) GIS data output controls to meet pavement design, freight analysis, and truck weight and load trend analysis, bridge load trend analysis and related truck travel data analysis.

The work involves investigating proven technologies and systems, e.g. "Travel Monitoring Analysis System (TMAS), Vehicle Travel Information System (VTRIS) Environmental Systems Research Institute (ESRI) Mapping, HPMS, Google map, SAS" to design and develop specific requirements that will process and generate quantitative analytical reports using easily assessable visualization output tools.

State Departments of Transportation (DOT), local agencies, universities and private industry may voluntarily contribute advice related to this research as non-paid participants. Periodic reviews will be arranged to keep participating States and agencies up-to-date on current developments.

### 2.2 SCOPE

It is essential to have an effective data visualization analysis tool that will assure quality traffic data for transportation program and project development. To meet freight transportation needs, infrastructure (pavement and bridge) preservation needs, and weight enforcement needs, an integrated traffic data analysis tool with both data quality control functions and data visualization capabilities is to be designed for ease of use by all agencies. Fundamentally, the designed tool is to be a user friendly web-based application handling truck WIM and other traffic characterization data to generate quality data summaries that meet pavement design input, freight analysis, truck weight load trend analysis, bridge load trend analysis and other needs.

### 2.3 TASK 5 -- ESTABLISH WEB-BASED USER FRIENDLY DATA VISUALIZATION TOOL TO GENERATE APPROPRIATE REPORTS AND OUTPUTS

The contractor shall develop tools that display / report:

- Highway specific estimates of truck volumes and loadings by time of day, day of week, week of year and year to year.



- Monthly truck class adjustment factors.
- Heavy vehicle travel monthly trends.
- Axle loading trends.
- Highway ton-miles of freight moved each month.
- Flow maps linking all roadways seamlessly locally, regionally and nationally.
- Truck weight road groups locally, regionally and nationally.
- Load spectra by standard truck class and axle group type.
- Loading trends for bridge stress.
- Size & Weight and Enforcement

### 2.3.1 Deliverables

The contractor shall provide a copy of the finished executable software program to the FHWA PC and all participating TA State members of this pooled fund study.

The contractor shall deliver to the FHWA PC and all TA State members contributing funds and participating in this pooled fund study a functional requirement document with methods in which traffic data attributes are processed including all specifications, source codes, etc. related to the all tasks.

The contractor shall validate and verify the system is performing all functions correctly described in the tasks.

The contractor shall provide to the FHWA PC and all TA member States contributing funds and participating in this pooled fund study a copy of all related documented processes and related programming associated with the work.

The contractor shall be available to assist the FHWA PC and all TA member States contributing funds and participating in this pooled fund study with the initial installation if needed.

The contractor shall maintain the system and provide technical assistance to the FHWA PC and all TA member States contributing funds and participating in this pooled fund study for a period of 1 year after the period of performance ends.

### 3 CHART OF FEATURES BY COMPLETION

Table 1: Data Tool Establishment Table of Features by Percent Completion

Data Tool Establishment			
Category	Functionality Name	Data Displayed	Development
Site Wide	Design		100%
Server	Site Wide Data Querying	All Data Sitewide	100%
Dashboard	U.S. Map	TMAS by state	100%
Dashboard	Data Drop Down (top right corner)	Controls all Datasets available for use by web-tool	100%
Dashboard			
State Map	State Maps	Station locations by WIM and Class	100%
State Map	AADT Year Change Bar Chart	Year over Year AADT Change by station	100%
State Map	AADT Line Graph	MADT (average, by year) (by Class) Traffic can be filtered by hour	100%
State Map	AADT Avg. by Station Bar Chart	AADT of all stations (by Avg of All years, or individual year) (by Vehicle Class)	100%
Single Station Overview	Info Tab	Basic Station Card information	100%
Single Station Overview	Info Tab	More station specific overview graphs	100%
Single Station Overview	Truck Volume Graph Tab	Volume by Time Graph	100%
Single Station Overview	Truck Volume Graph Tab	Weight by Time Graph	100%
Single Station Overview	Truck Volume Graph Tab	Weight Distribution Graph	100%
Single Station Overview	Calendar View	Traffic Volume by day by class	100%
Single Station Overview	Overweight Deployment Grid	Overweight Traffic Volume by day by direction	100%
Road Network Analysis	HMPS Road Network Map	Maps to include HPMS by route	100%
Road Network Analysis	Truck/Vehicle/Ton Miles Travelled by Month	no longer in scope	0%
Road Network Analysis	HPMS Corridor Analysis Tab	This was previously included in the site. No plans for reimplementation	100%
Enforcement Dashboard	Rank stations by forecasted overweight percent and count	Enforcement Chart	100%
Enforcement Dashboard	Maps of corridors showing most likely overweight segments	This is no longer in scope	0%
Enforcement Dashboard	Map of stations visualized by overweight percent or count	Groundwork is laid but Inclusion of this feature is not currently an objective	50%
Data Management	Upload Data, Manage Data	data uploader works but ought to include delete data file	85%
Download Graphs/Maps	Sitewide	svg to png	100%

## 4 USER GUIDE BY FEATURE

### 4.1 STATEWIDE AVERAGE TRAFFIC AND HPMS GRAPHS AND HPMS VIEW:

1. Sign in to the site: <http://wim.availabs.org>

**NOTE: whenever the page seems to be stuck, you should refresh your browser and start over again.**

2. If you are a user at a state agency you will start by landing on a map of your state and the data will default to your state agency data.
3. If you are a national user your landing map is of the U.S. and your dataset defaults to TMAS. When you scroll over a state it should animate blue. To select a state control+click (ctrl+click) on a state.

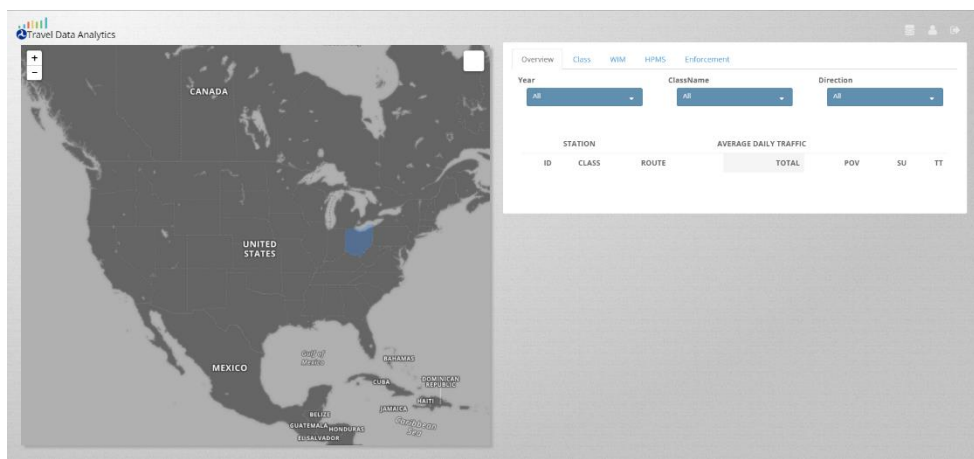


Figure 1

4. The data dropdown at the top right of the page contains the different datasets. For the purposes of this test we will use the TMAS dataset.

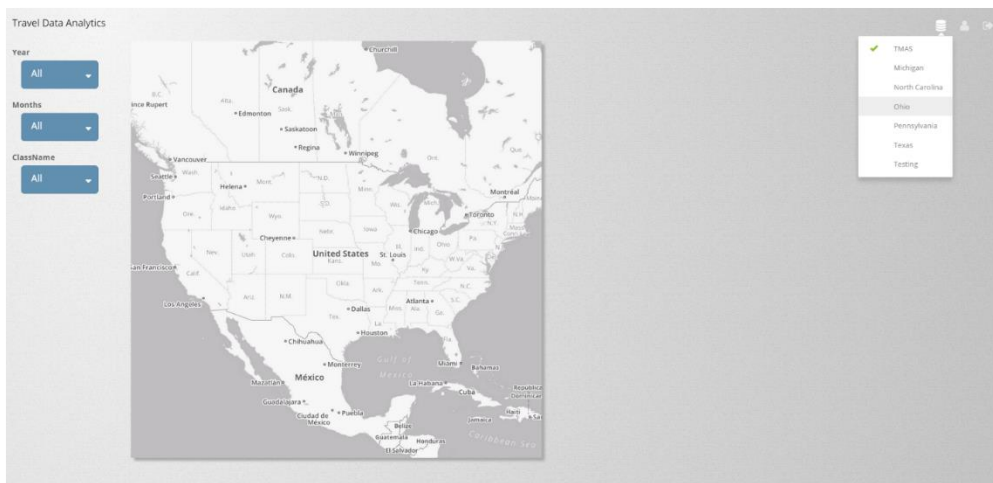


Figure 2



**Note:** TMAS dataset. Michigan, North Carolina, Ohio and Pennsylvania should all have excellent statewide data. If you'd like to explore the graphs and map features discussed in this document using those statewide datasets, you can access them using the dropdown menu pictured in figure 2 above.

5. Your statewide dashboard should appear like this

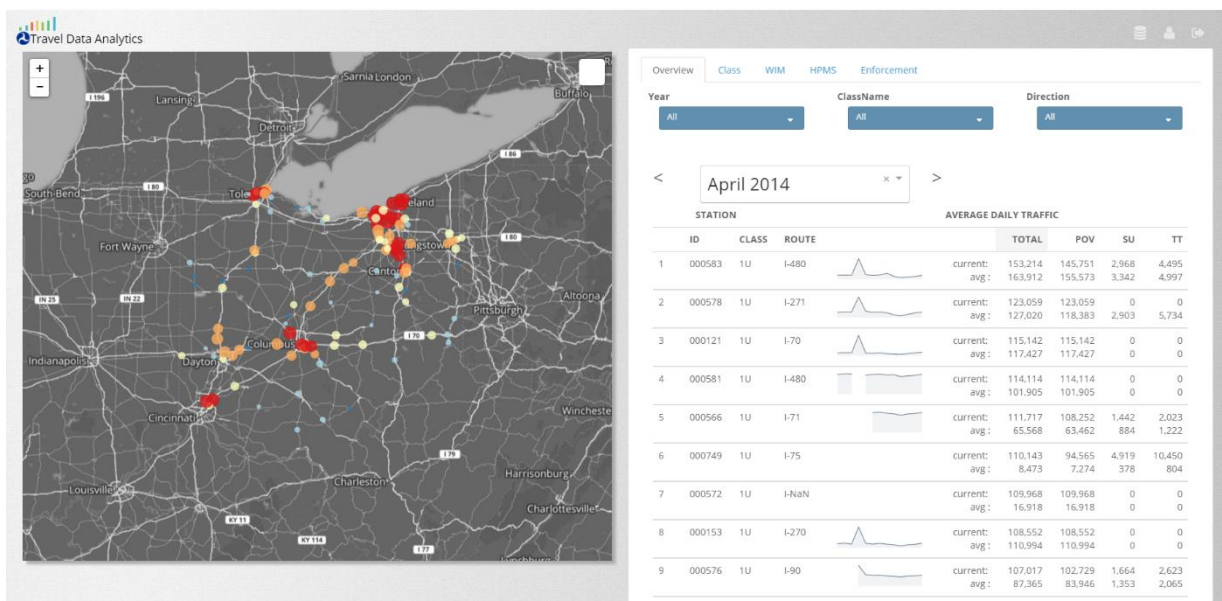


Figure 3

#### 4.1.1 Overview Dashboard

6. First we'll take a look at the dashboard at right.

We see a table of data. Each row in the data indicates one continuous class count station. The columns include:

- Station ID and Type (WIM/Class)
- Class of the road the station is located on
- Route name
- A spark graph showing the counts recorded at this station over the last 12 months
- And a table of Avg. Daily Traffic showing the current month (top sub-row) over the avg of all months (bottom sub-row) for Total AADT, Personal Occupancy Vehicle, Single Unit and Tractor Trailer.

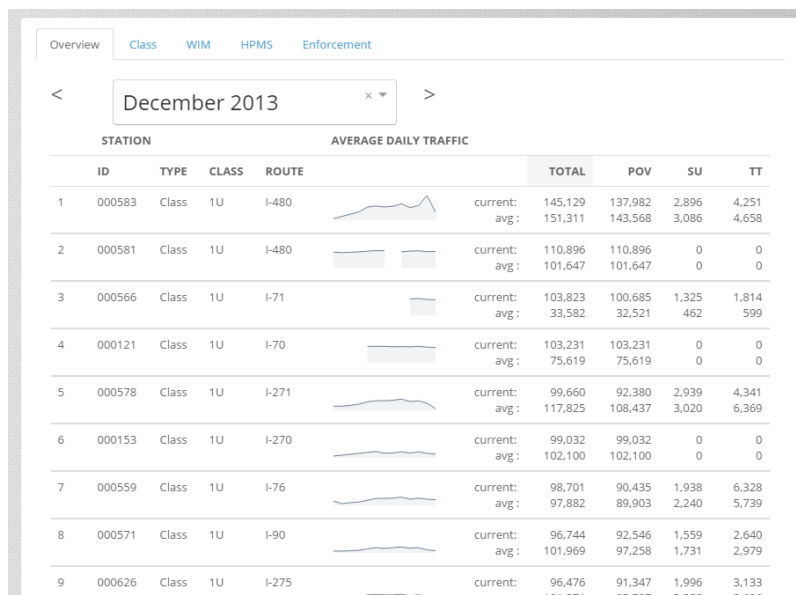


Figure 4



#### 4.1.2 Single Station - Class Counts

- You can select any single station to view the raw continuous counts data for that station either by clicking on the station row or by clicking on a station on the map:

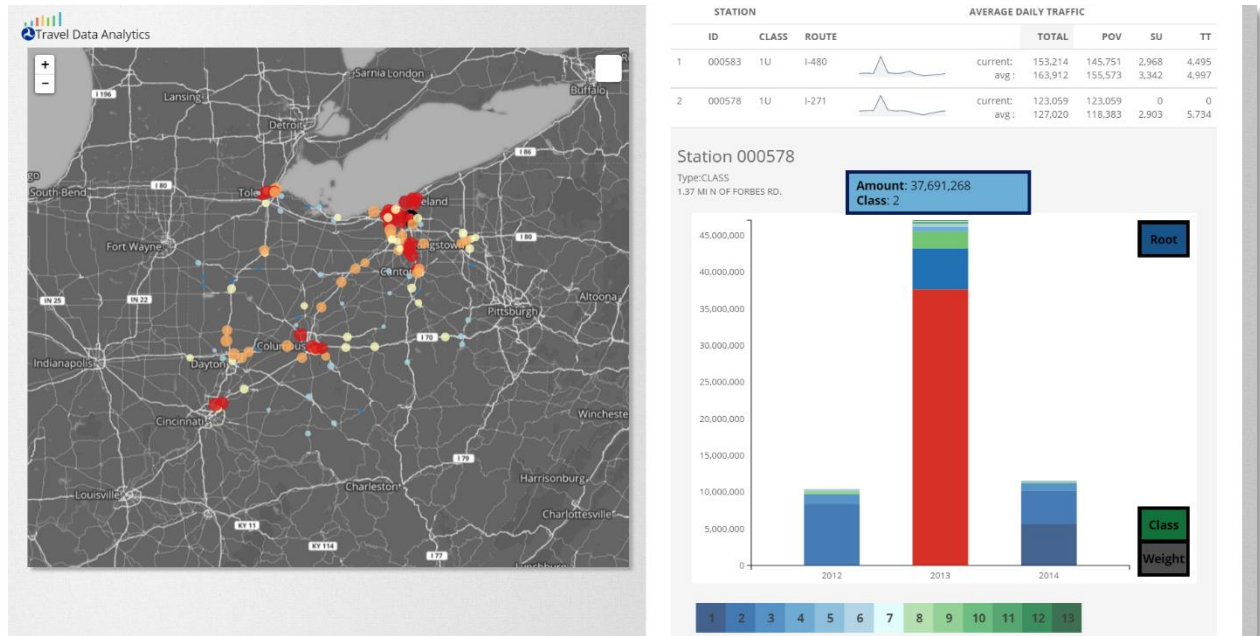


Figure 5

- Click around on the class filters by clicking on the filters labeled 1-13

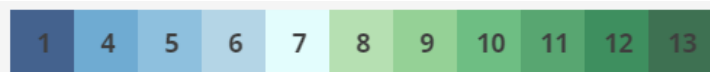


Figure 6

#### 4.1.3 Single Station - Weight Counts

9. WIM Stations allow you to also look at raw WIM data for that station by clicking on the green “Weight” button.
10. You can dig deeper into the raw data by clicking on any bar to view data for the year:

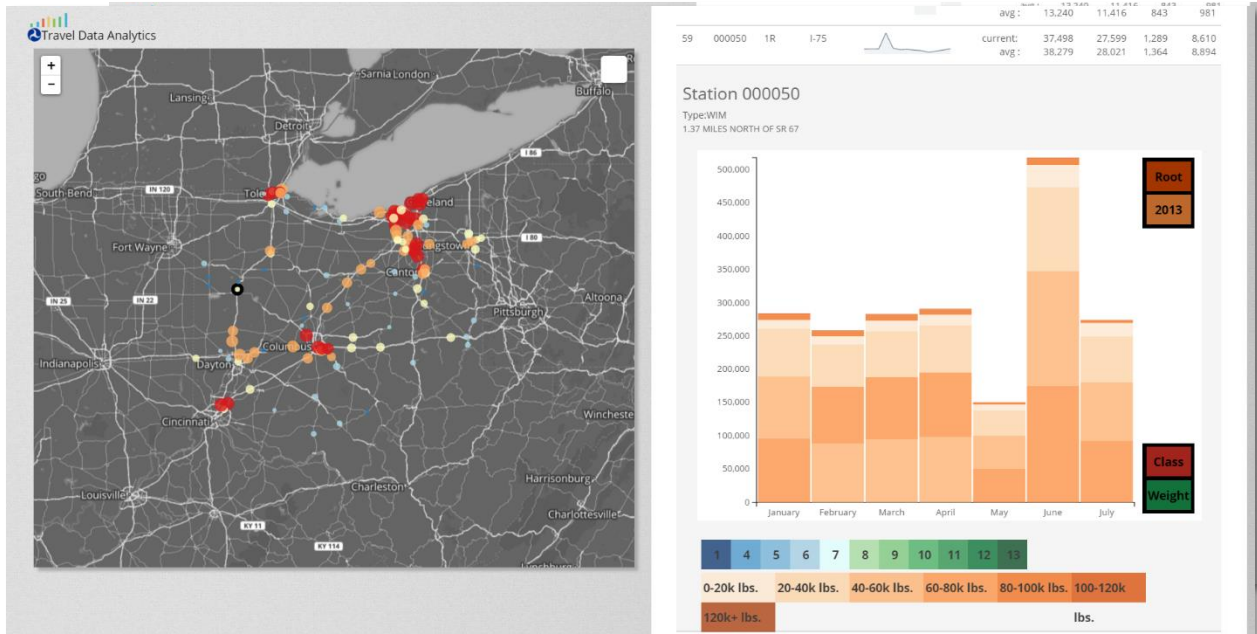


Figure 8

11. The site should now show a number of bars as seen in Figure 8. These bars represent months of a year of available data for this station. The bars in the graph show the months of January through August.
12. Click around on the weight filters to filter the graph.



Figure 9

13. Click on one of the bars to zoom into the data for one of the months.

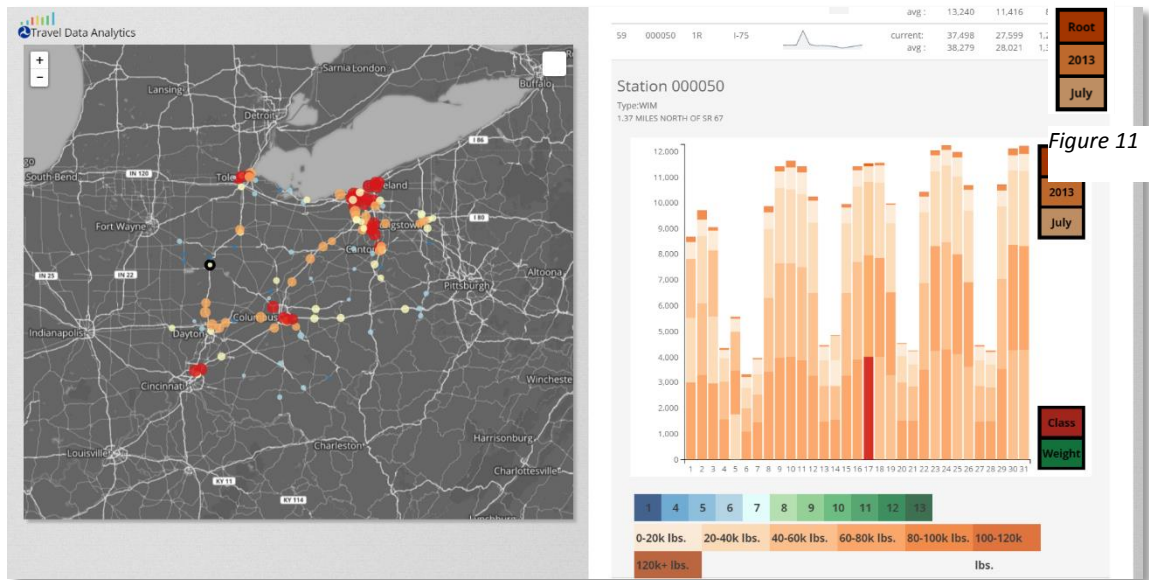


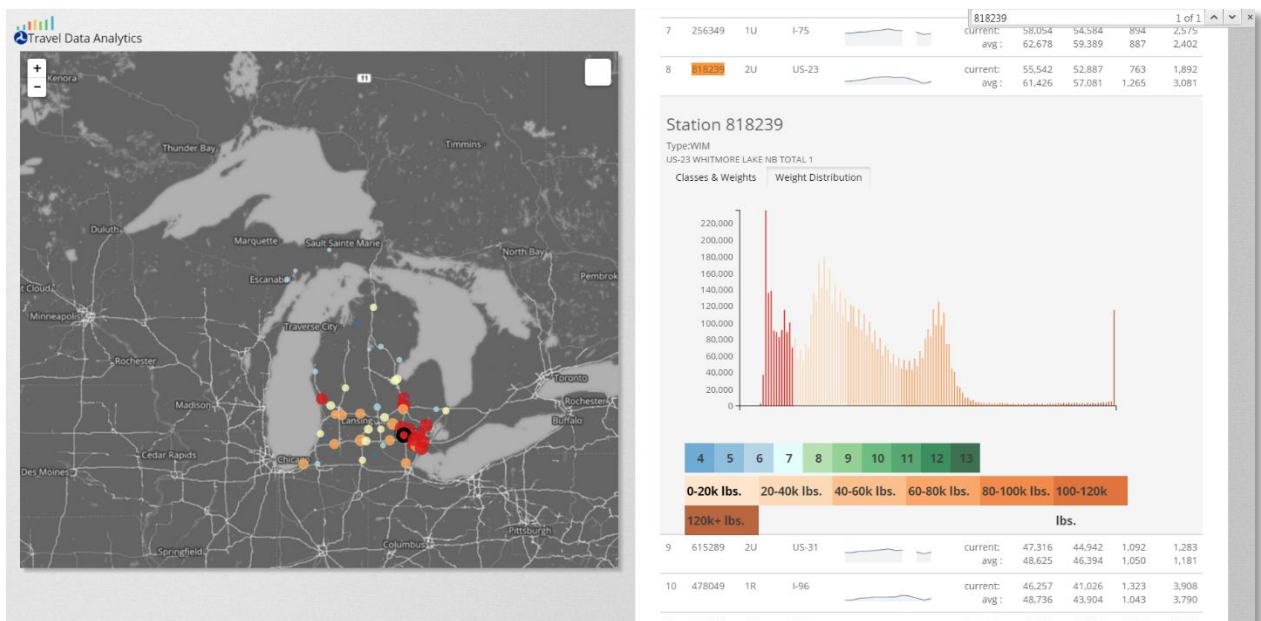
Figure 10

14. Notice on the right side of the screen that the year and month are listed for context. In this case it is July, 2013 as seen in Figures 10 and 11. To reset the filters, click on the “Root” button in the top right corner of the graph.

#### 4.1.4 Single Station - Weight Distribution (Load Spectra)

15. Next, let’s look at the Load Spectra Graph. On the site it is labeled Weight Distribution.

16. Click on the Weight Distribution tab.



17. Similar to the stacked graph for Weight Counts (Section 2.1.2 Nos. 9-14), The Weight Distribution graph is filterable by weight bin. Click on the weight bin bars to remove them from the spectra graph.
18. The time settings for the Load Spectra Graph are set by the Class & Weights tab. Click on the Classes and Weights tab to view the time settings. When years are listed, as seen in Figure 15, the Load Spectra Graph is showing data for all-time. Click on a year to drill in to that year, a month to drill in to that month.

Figure 13

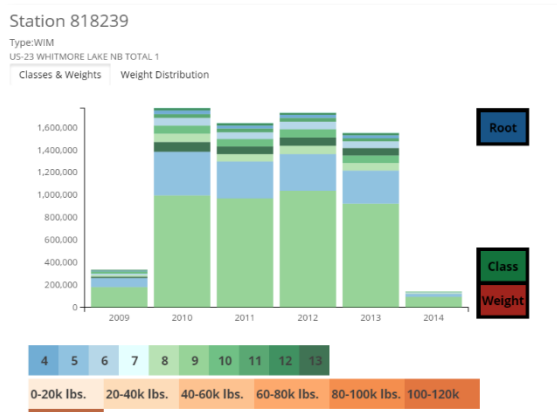


Figure 15

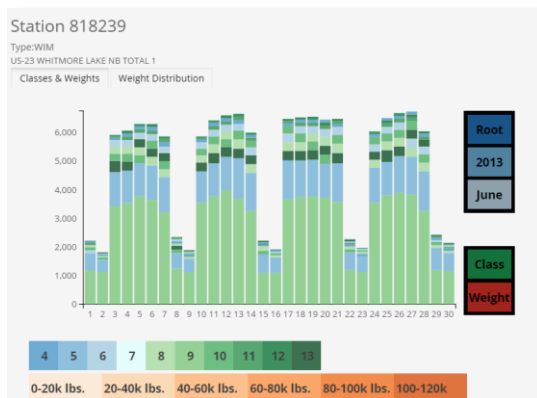


Figure 14

19. Then, once you've set your time parameters (Figure 14 shows June 2013), click on the Weight Distribution tab to view Load Spectra for the month you selected.



Figure 16

#### 4.1.5 Class Tab

20. Scroll back up to the top of the page and click on the “Class” tab

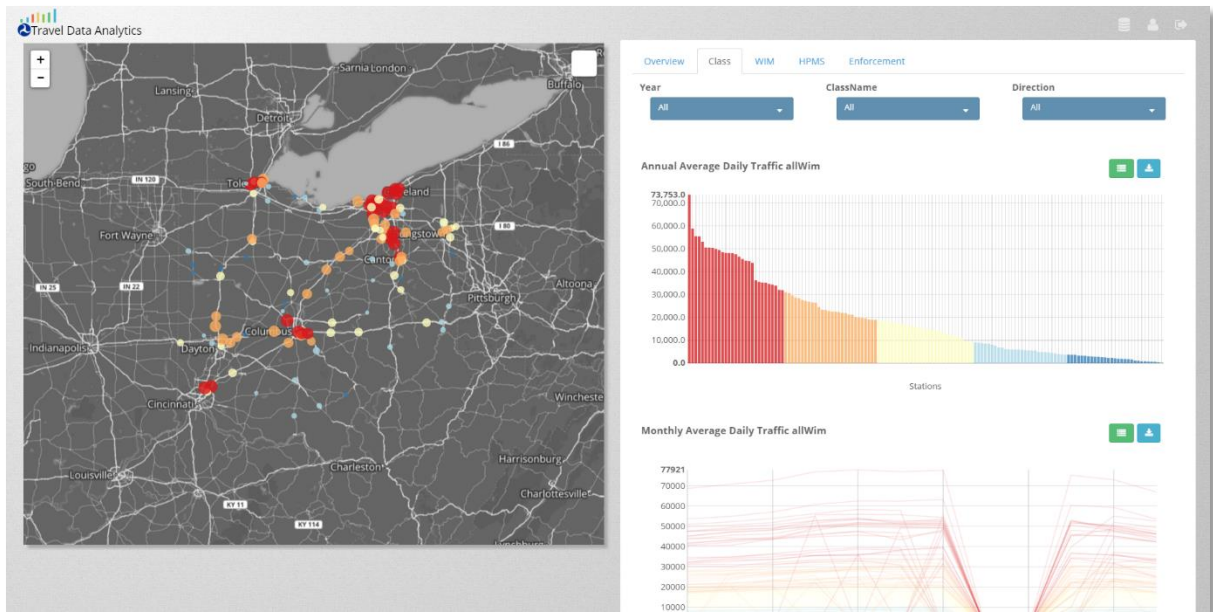


Figure 17

21. Now let’s take a look at the map on the left side. The map shows all of the stations in the state for which there is data. They are represented by circles. The size and color of the circle correspond with the Annual Average Daily Traffic for that station.

22. Also notice, in Figure 18, how when you scroll your cursor over a station the station card appears as a tool tip. The station also highlights yellow in the AADT graph on the right.

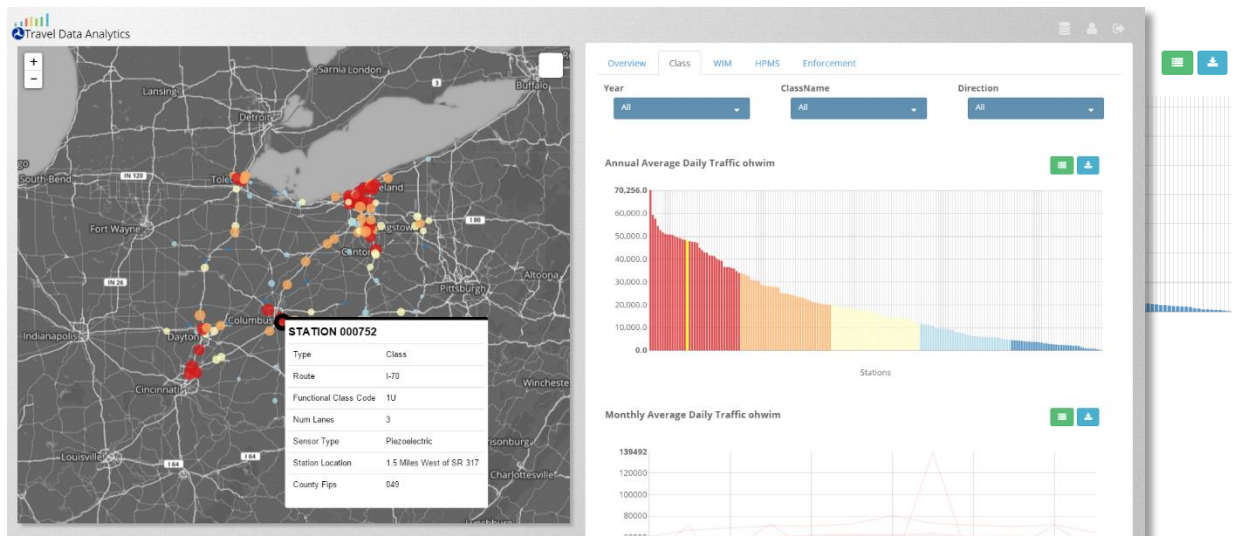


Figure 18

23. **Annual Average Daily Traffic.** To find data for this graph, AVAIL uses the class data and takes the simple average of all days (when data for a day is missing, the denominator is reduced by one) as per the Traffic Monitoring Guide:



- a. AADT – Annual Average Daily Traffic – The total volume of vehicle traffic of a highway or road for a year divided by 365 days. It is meant to represent traffic on a typical day of the year. The Traffic Monitoring Guide lists two basic procedures for calculating AADT. In the first of these techniques, AADT is computed as the simple average of all 365 days in a given year (unless a leap year).

Figure 19

When days of data are missing, the denominator is simply reduced by the number of missing days:

- i. A simple average of all days; and
- ii. An average of averages (the American Association of State Highway Transportation Officials (AASHTO) method).

The AASHTO formulation for AADT is as follows:

$$AADT = \frac{1}{7} \sum_{i=1}^7 \left[ \frac{1}{12} \sum_{j=1}^{12} \left( \frac{1}{n} \sum_{k=1}^n VOL_{ijk} \right) \right]$$

Where:

- $VOL$  = daily traffic for day  $k$ , of DOW  $i$ , and month  $j$   
 $i$  = day of the week  
 $j$  = month of the year  
 $k$  = 1 when the day is the first occurrence of that day of the week in a month, 4 when it is the fourth day of the week  
 $n$  = the number of days of that day of the week during that month (usually between one and five, depending on the number of missing data)

- b. **NOTE:** AVAIL is capable of employing the AASHTO method of calculating AADT if the TA Panel deems it necessary.

Figure 20

24. The second graph is **Monthly Average Daily Traffic**.

- a. Monthly Avg. Daily Traffic sums all traffic in a month and divides by the number of days in that month. For all of the days of data that are missing from a given month, the graphing algorithm reduces the denominator by one.

Monthly Average Daily Traffic allWim

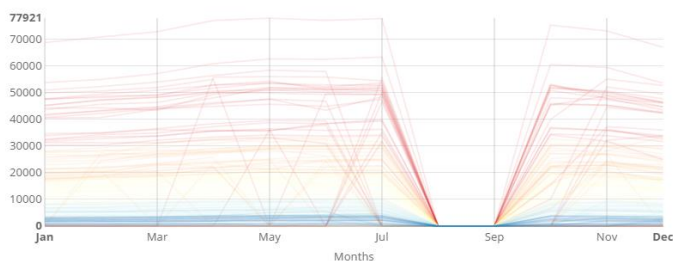


Figure 21

- b. **MADT = Sum of Traffic in Month / Number of Day of Data in Month**

25. The Bottom graph on this page is the **Seasonal Adjustment Factor** graph.

- a. To calculate the Seasonal Adjustment Factor, AVAIL takes the Monthly Average Daily Traffic and Divides it by the Annual Average Daily Traffic.

$$SAF = MADT / AADT$$

- b. The Seasonal Adjustment factor shows how much more or less traffic than average, a station sees in any given month.

Seasonal Adjustment Factor (MADT / AADT) ohwim

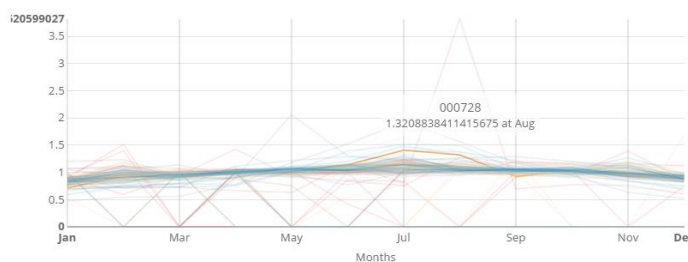
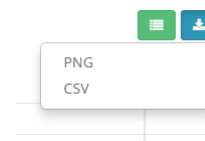


Figure 22



26. Also notice, some of the graphs have a set of icons in the top right.

- The green icon is a table icon. You can view tabular data for the graph by clicking on it.
- The blue icon is to download an image of the graph or a comma separated values file of the tabular data.
- Figure 23 is an example of the tabular data of the MADT Graph:



Station Id	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
16421	1.10	0.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.89	1.16	0.94
109511	1.49	0.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.82	1.44	0.64
16411	1.17	1.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.58	1.14	1.07
16811	1.10	1.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80	1.10	0.99

Figure 23

#### 4.1.6 WIM Tab

27. Scroll back up to the top of the page and click on the WIM tab.

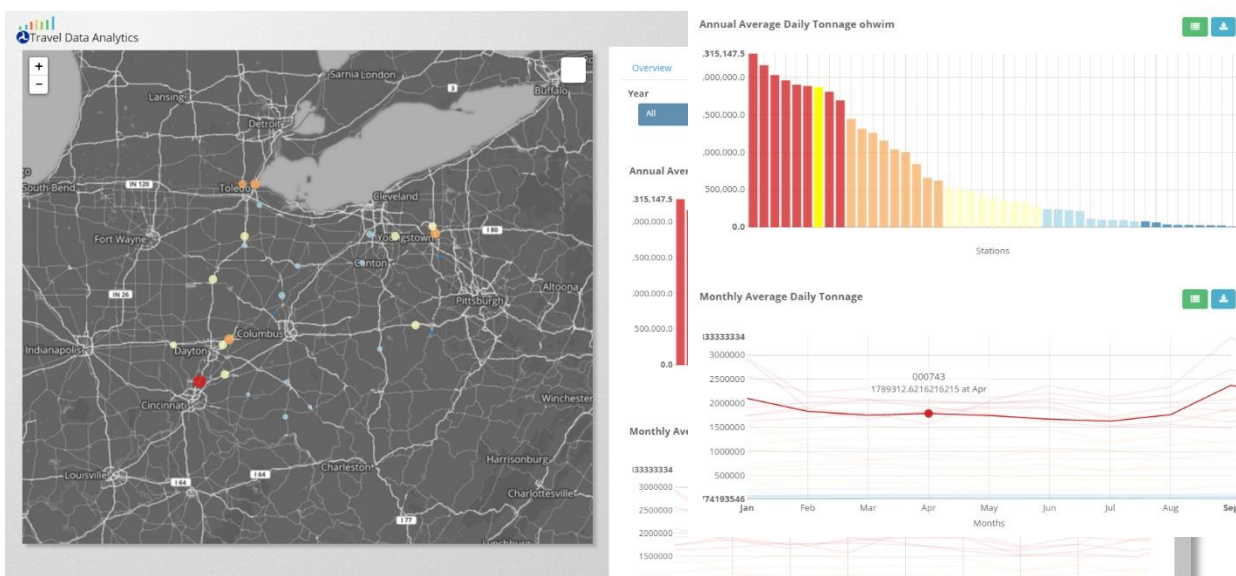


Figure 24

- Notice first in Figure 24 that the stations appearing on the map have been filtered. The only stations appearing now are the WIM stations.
- The WIM Graphs are exact replicas of the Class Graphs but are generated using weight data (in tons) instead of counts data.
- The **Annual Average Daily Tonnage** graph is an exact replica of the Annual Average Daily Traffic graph listed above (Bullet Number 18). The algorithm for creating the AADTonnage graph is the same as the one used to make the AADTraffic graph except using Tons instead of Counts
- MADTonnage and Seasonality of Tonnage Graphs are replicas of the MADTraffic (Bullet Number 19) and Seasonality of Traffic (Bullet Number 20) graphs.

Figure 25

#### 4.1.7 WIM and Class Tab Filters

32. Let's take a look at how the filters effect the graphs



Figure 26

a. There are three filters to choose from for the Class and WIM tabs:

- i. Year
- ii. Classname
- iii. Direction

33. The Year filter is default to All. When All is selected the graphs show an average of all data in the system. By clicking on the Year filter you can select data for a given year for which there is data.

a. After selecting a year, a new filter will appear. You can now select a given month.

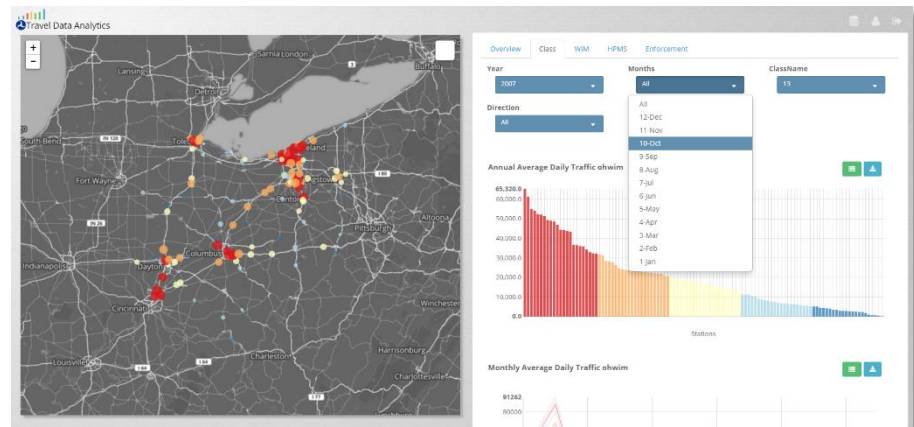


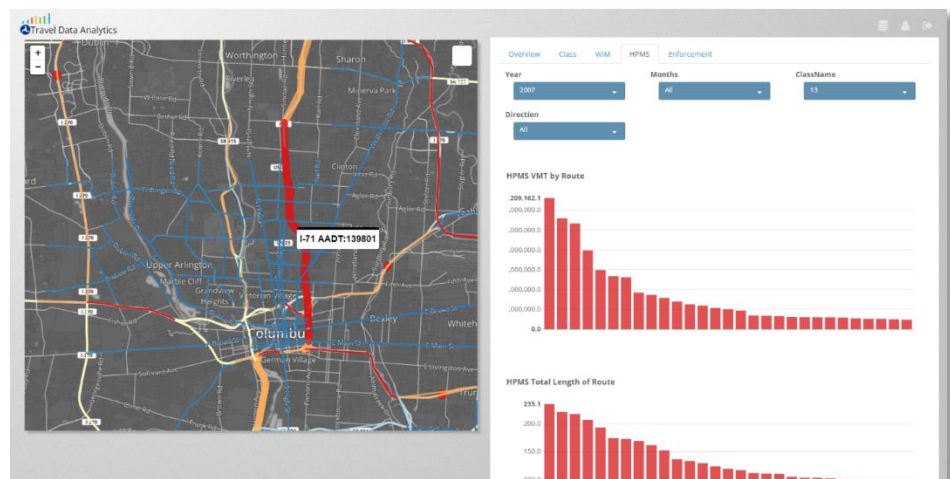
Figure 27

34. The

ClassName and Direction filters also default to "All." When All is selected the graphs below show the AADTraffic or AADTonnage of all classes. Filter for Class 9 to see Class or WIM graphs of Class 9 vehicles. Filter by direction to see data from stations traveling in a given direction.

#### 4.1.8 HPMS Tab

35. To view HPMS Data for road segments in a state, click the HPMS Tab.



36. When you scroll over an HPMS road segment, a box displays HPMS road segment and AADT information (figure 28).
37. You can zoom in to the map by putting your cursor on the map and scrolling in or out.
38. Map tools include magnification (+/-) and layer switch (Terrain, Light and Dark Colored Maps and Satellite).

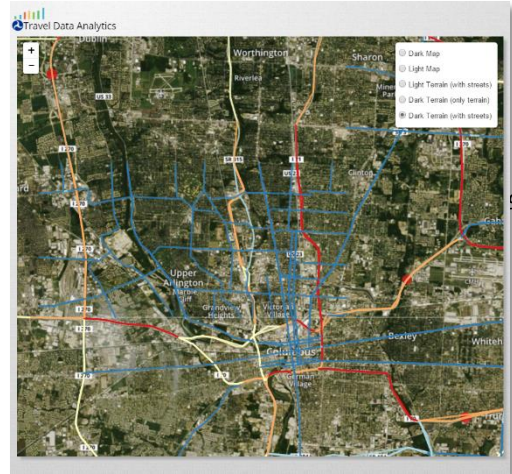


Figure 28

#### 4.1.9 Enforcement Tab

39. Click on the Enforcement Tab

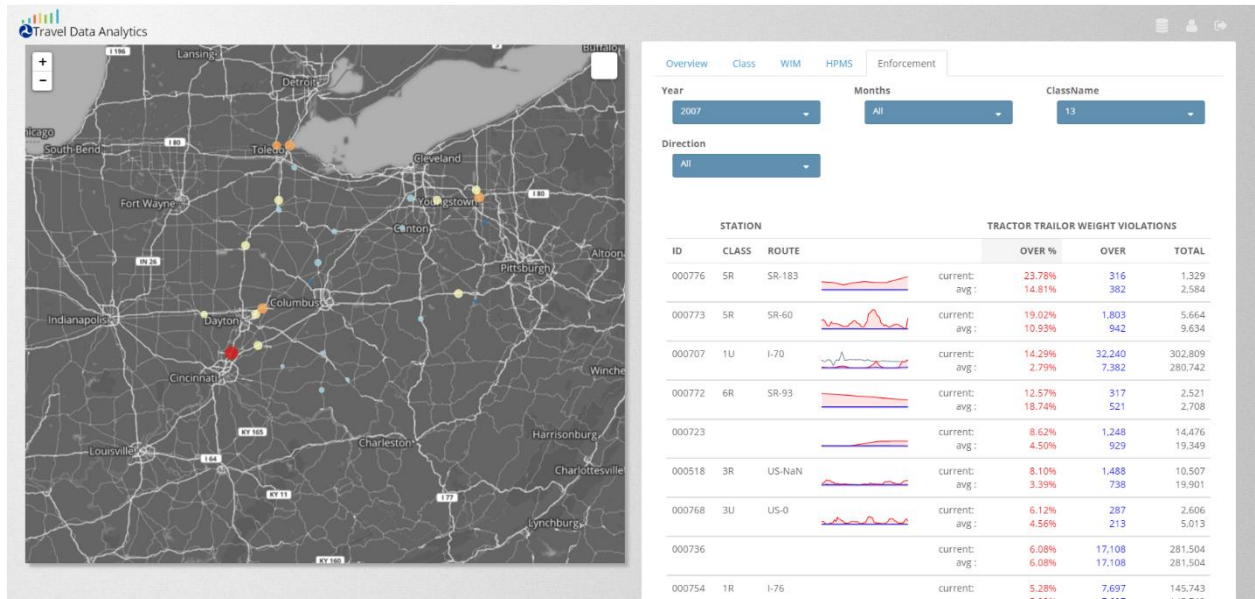


Figure 30

40. The Map once again filters stations, leaving only WIM stations. Scroll over the stations in the Enforcement list to see their location on the map.

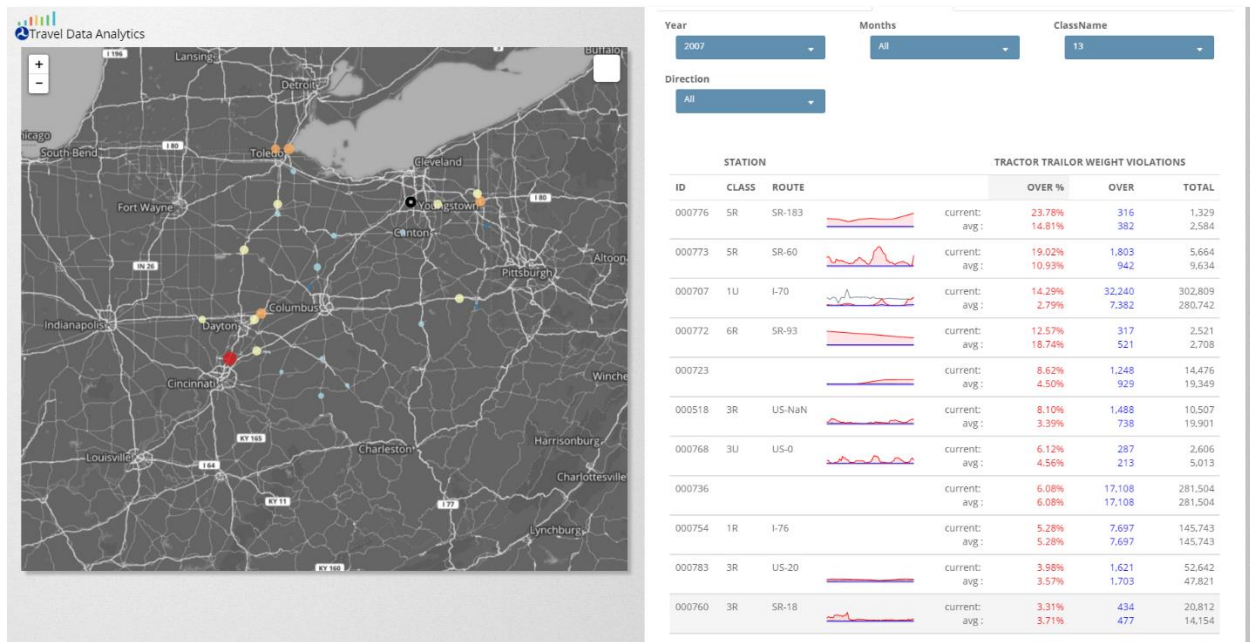


Figure 31



41. The Enforcement Table shows all of the WIM stations in the state. Similar to the Overview Table. The Enforcement Table defaults to the latest month of data in the system and shows a series of Columns (Station ID, Route Class, Route Name, Overweight %, Overweight Total, and Total Counts). The rows show each station. The sub-rows show the all-time average and the current month.


STATION			TRACTOR TRAILOR WEIGHT VIOLATIONS				
ID	CLASS	ROUTE		OVER %	OVER	TOTAL	
000776	SR	SR-183		current: avg :	23.78% 14.81%	316 382	1,329 2,584

Figure 32

- a. The spark line in the station row of the Enforcement Table, shows the trend of overweight violations at this station over the last year ending at the selected month. The spark line shows overweight % (red line) and number of overweight (blue line).

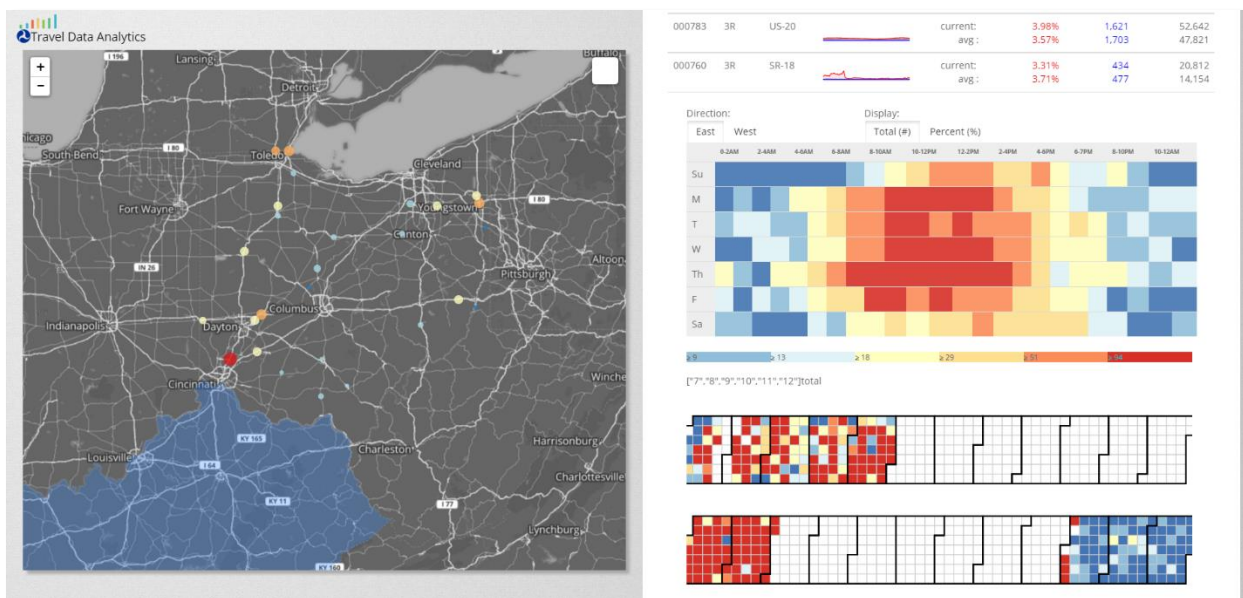
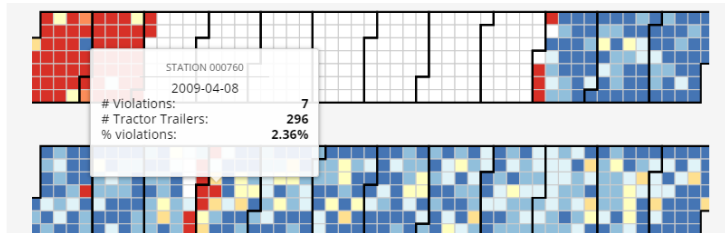


Figure 33

#### 4.1.10 Single Station Enforcement Graphs

42. Select a station to open up single station overweight graphs (figure 33).
43. Two overweight graphs appear.
- a. Heat Graph: The first shows overweight truck information for an average day. This “heat graph” has day of week as a y-axis, Sunday (top) through Saturday (bottom), and the x-axis shows the hours in a day. The heat graph shows the hours of the day with the highest average of overweight violations.

- b. Calendar Graph. This graph shows all of the available data for the chosen station, by day, month and year where days with highest numbers of violations are red and lowest are blue.



44. Filter in the single station enforcement graphs

- a. Both graphs can be viewed by Total (number of violations) and percent (number of violations/number of tractor trailer trucks).  
b. Both graphs can also be filtered by direction of travel.

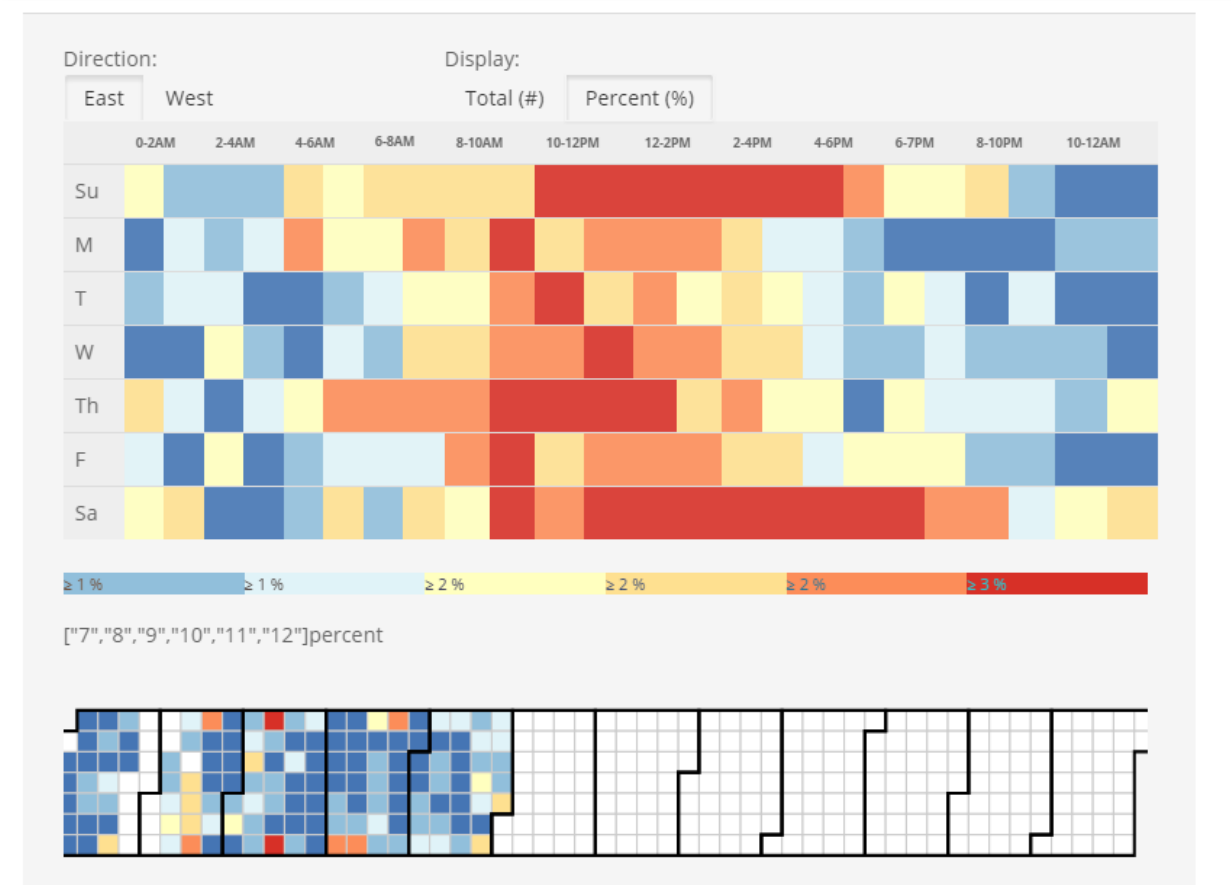


Figure 34



## 4.2 DATA MANAGEMENT

1. Log in to [wim.availabs.org](http://wim.availabs.org)
2. In the top right corner of the page there are three icons
3. Click on the icon of the person in the middle and a dropdown menu appears.

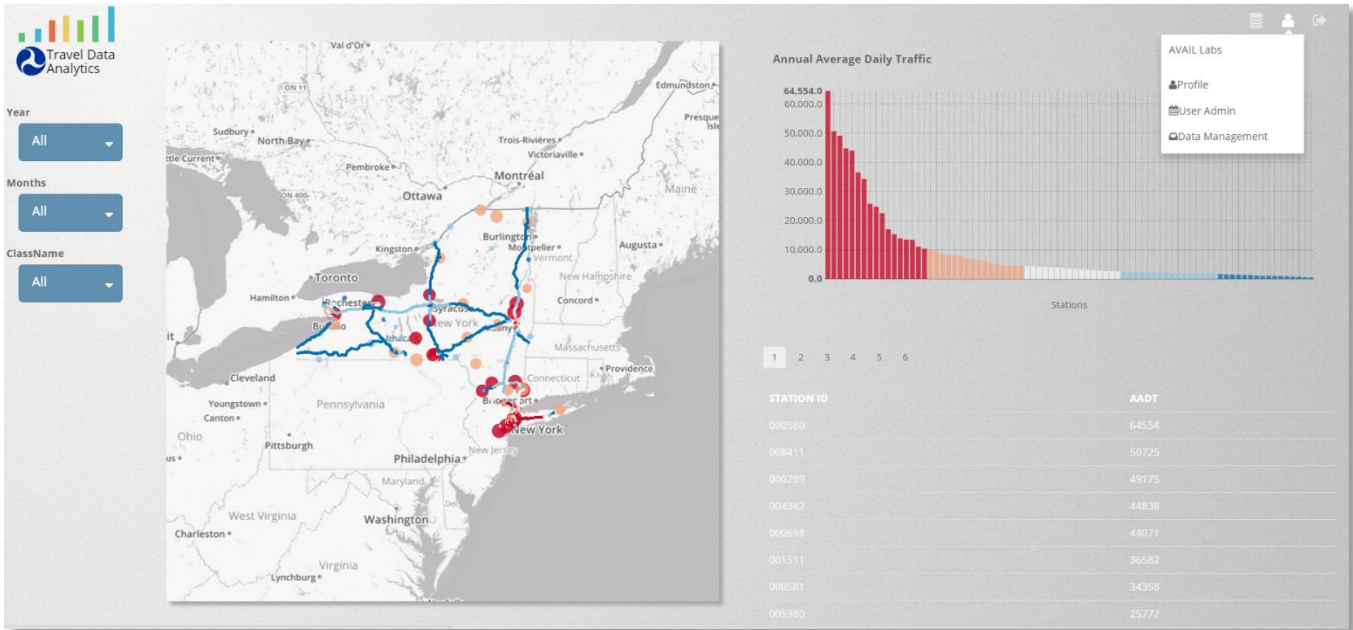


Figure 35

4. At the bottom of this menu, choose Data Management
5. You should now see the data management page shown in Figure 36

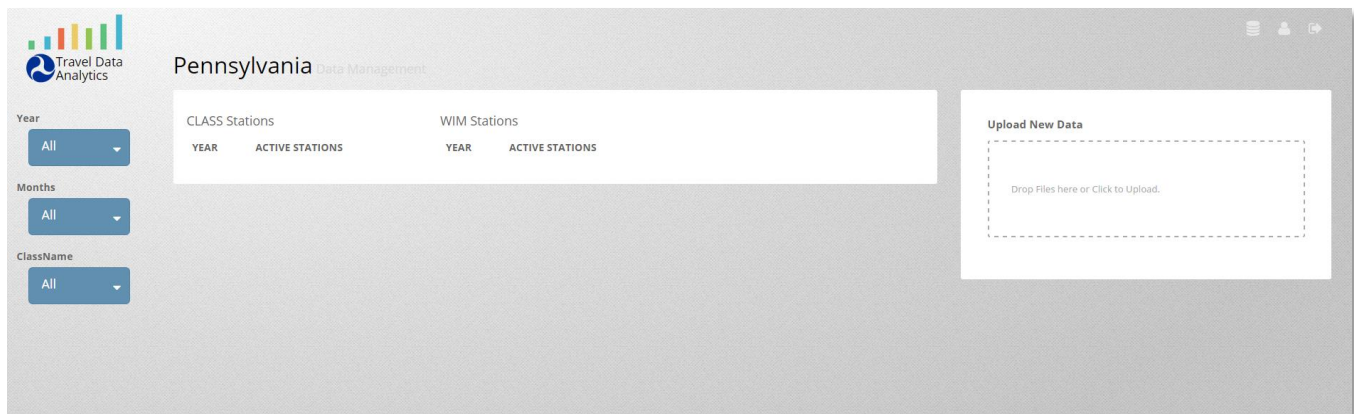


Figure 36

## 4.3 DATA UPLOAD

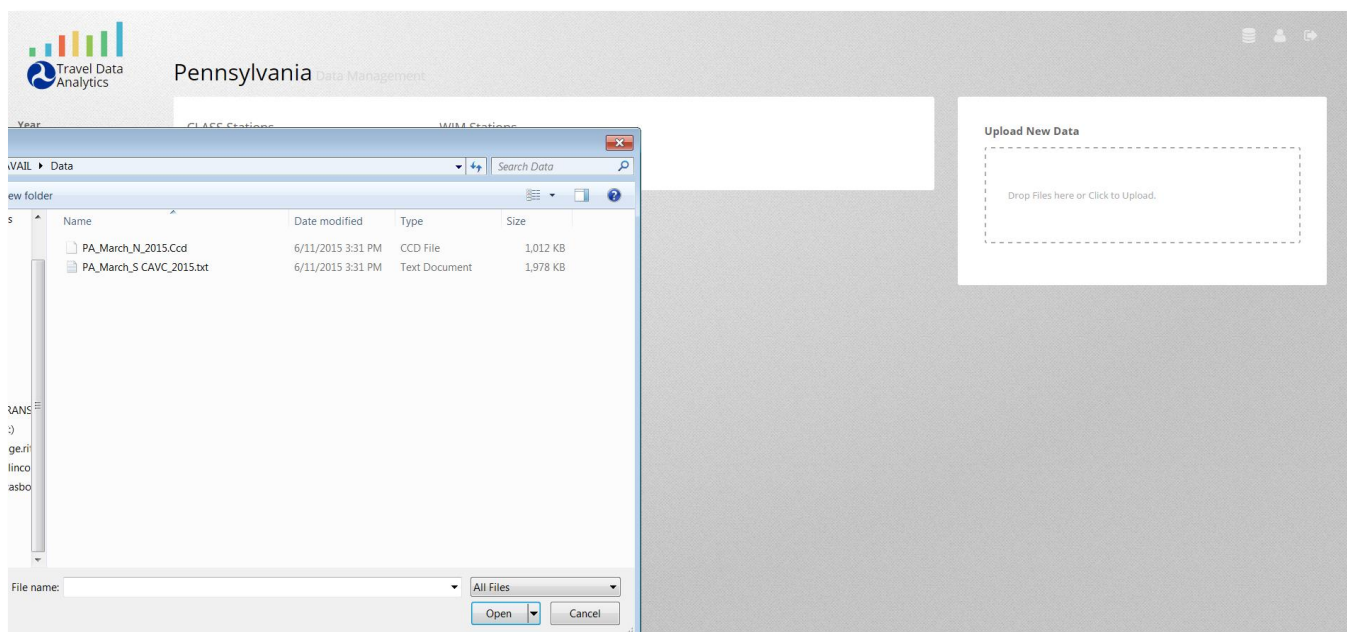


Figure 37

6. To upload new data, simply click in the box located on the right side of the page, labeled "Upload New Data."
7. As seen in Figure 37, you should now be able to search your files for a WIM or Class data file.
8. After clicking on the file, you should now see the status of the file upload on the right side of the page, as seen in Figure 38:

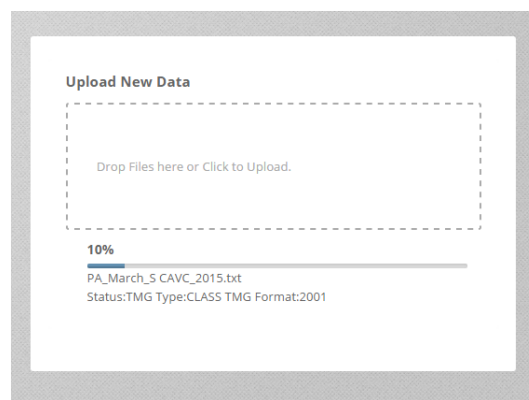


Figure 38

## 4.4 CALENDAR GRAPH OF UPLOADED DATA

9. The available data for your state appears in calendar form. This is a general overview of available data for your state. Class data is listed on the left and WIM data is listed on the right. Dates with more data appear red. Dates with less data appear blue.

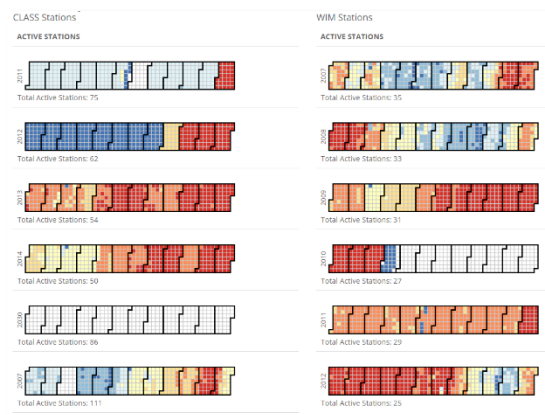


Figure 39