

MARCH 2018



**WIM #46  
CSAH 1,  
MP 11.4  
WEST  
CONCORD, MN**

**MONTHLY  
REPORT**



*Your Destination...Our Priority*



## WIM Site Location

WIM #46 is located on CSAH 1 near West Concord in Dodge county.

## System Operation

WIM #46 was operational for the entire month of March 2018. Volume was computed using all monthly data.

## System Calibration

WIM #46 was most recently calibrated on 2016-12-19. Table 1 summarizes the front axle weights of class 9s by lane <sup>1</sup>. Table 1 indicates that the class 9 front axle weights were all within +/- 9% of baseline calibration values for all lanes except lane 1. Figure 1 shows the distribution of gross vehicle weights (GVW) in Class 9 vehicles at this site for the last 12 months of operation <sup>2</sup>. Figure 2 depicts the average front axle weight as a percent difference from the first full month following calibration.

## Summary of Volume Statistics

Total Monthly Volume: 10822 | Passenger Vehicles: 9412 | Heavy Commercial Vehicles: 1410

Monthly Average Daily Traffic (MADT): 349 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 45

See Table 2 for vehicle class breakdown

## Passenger Vehicles (PVs) and Heavy Commercial Vehicles (HCVs)

**Volume trends.** NB vehicles typically reached highest volume levels on Fridays, with lowest volumes reported on Tuesdays. SB vehicles typically reached highest volume levels on Fridays, with lowest volumes reported on Sundays (see Figure 3 and 4).

### Passenger Vehicles (PVs)

**Volume trends.** On an average 24-hour day (see Figure 5), NB PVs generally reached peak volume levels between 03 PM and 05 PM. Similarly, SB PVs peaked in volume between 06 AM and 05 PM

### Heavy Commercial Vehicles (HCVs)

**Volume trends.** On an average 24-hour day, HCVs traveling NB typically reached peak volume levels between 03 PM and 05 PM, while volume going SB peaked between 06 AM and 05 PM. See Figure 6. Out of all HCVs, the two highest traffic volumes were generated by Class 9's and Class 5's.

## Overweight HCVs

**Volume trends.** Of a total of 1410 HCVs, 316 of them were overweight<sup>3</sup>. These overweight HCVs contributed to 3.1% of total monthly volume, and 23.6% of total monthly HCV volume. NB overweight vehicles typically reached highest numbers on Thursdays, with lowest volumes reported on Saturdays. SB overweight vehicles tended to reach highest volumes on Wednesdays, with lowest volumes reported on NAs. See Figure 3 .

The top two overweight violators by class were the class 9 and class 6 vehicles . Overall, overweight vehicles tended to reach peak volume concentrations during typical business hours, with 53.8% of all overweight vehicles traveling SB this month (see Figure 7 & 8). Figure 9 shows the number of vehicles exceeding 88,000 pounds that crossed the WIM over the last 12 months. The highest number of 88,000+ vehicles within the last 12 months occurred in November.

WIMs are currently used as a screening tool for weight enforcement, and it is estimated that the WIM scales can measure gross vehicle weights (GVW) within 90-95% of static weight scale measurements. Due to the possibility of measurement error, vehicles exceeding 10% of their legal weight limits (or 1.1 times their legal weight limits) are considered overweight in this report<sup>4</sup>.

Using normal load limits ,7 NB vehicles exceeded 88,000 pounds (5 vehicles were Class 13's; 2 vehicles were Class 9's). Of vehicles traveling SB,

5 NB vehicles exceeded 88,000 pounds (4 vehicles were Class 10's; 1 vehicles were Class 9's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from March 2018.

**Loaded vs. Unloaded HCVs.** Figure 10 shows the GVW distributions of Class 9s and 10s in March 2018. Data suggests that there were greater numbers of empty Class 9's than fully\_loaded Class 9's traveling NB, while there were more fully\_loaded Class 9's than empty traveling SB. Data also suggests that there were more empty Class 10's than fully\_loaded traveling in the NB direction. In the SB direction, there were more fully\_loaded class 10 vehicles.

**Freight Totals.** A total of 11918 tons of freight was recorded to have crossed the WIM. More freight was shipped SB (53.2%) than NB (46.8%). See Table 4 and Figure 11 for more freight information.

## Infrastructure Considerations

**Bridge.** Bridge No. 91587 ( a precast pipe arch) is approximately 4.2 miles south of WIM #46. Bridge No. 91588 ( a precast pipe arch) is approximately 7.8 miles south of WIM #46. WIM #46 recorded a total of 10822 vehicles with a combined GVW of 105656 kips (1 kip = 1,000 pounds = 0.5 tons) in March 2018. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

**Pavement Design.** A total of 1170 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 53.8% of all ESALs were recorded SB while 46.2% was observed NB. In particular, 80% of all ESALs were generated by the Class 9's (Class 9's were also responsible for generating 42% of total GVW observed this month). See Table 6

and Figures 14-15 for more information on ESALs (Table 6 also provides flexible ESAL factors for each vehicle class using a terminal serviceability of 2.5 and a structural number of 5).

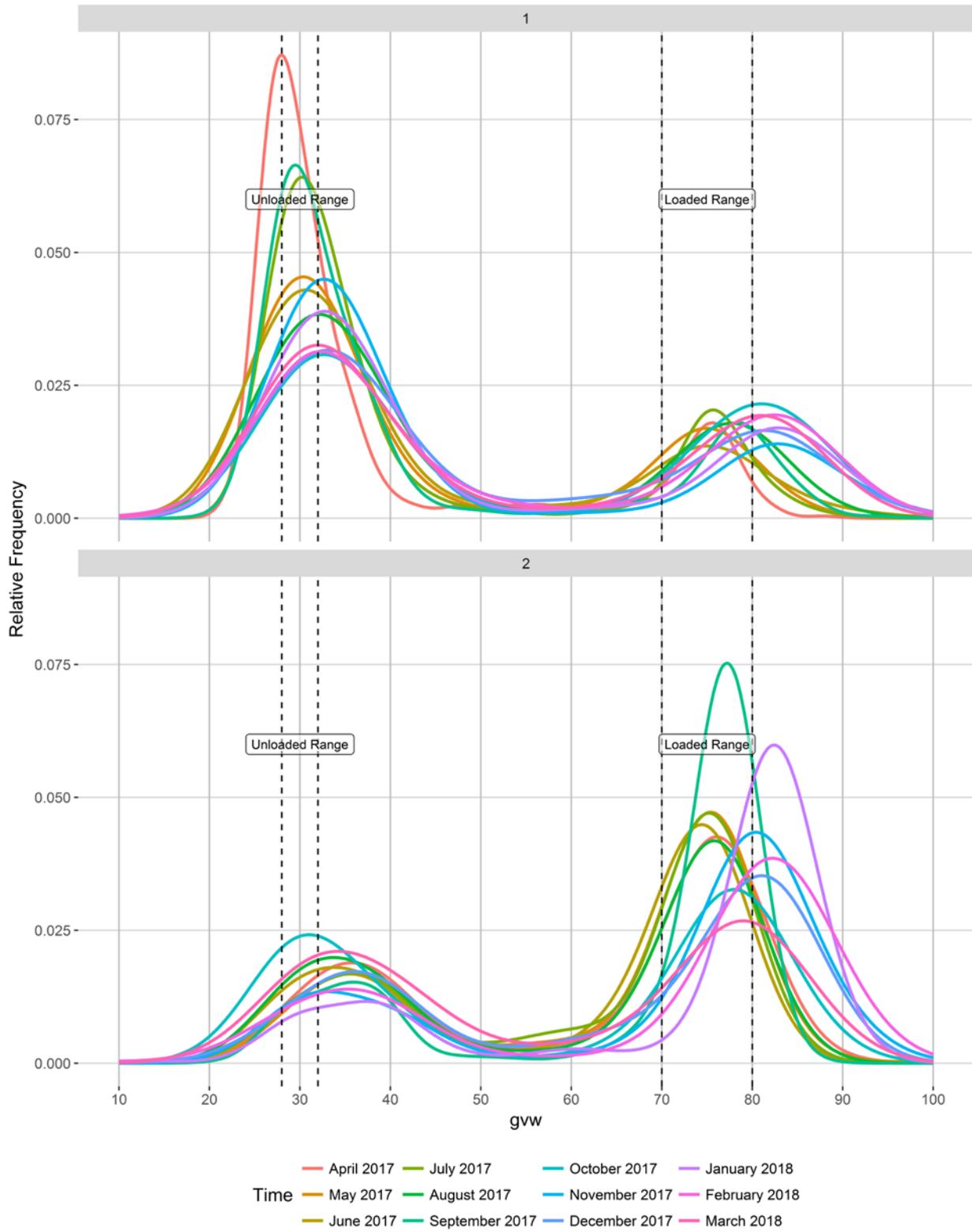
*WIM monthly reports can be found at: <http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html>*

MnDOT's vehicle classification scheme and vehicle class groupings for traffic forecasting can be found at: <http://www.dot.state.mn.us/traffic/data/data-products.html#weight>

- <sup>1</sup> Front axle weights of Class 9s are monitored on a monthly basis to assure performance between calibrations. The current goal of the WIM scale calibration is to have each individual axle weight stay within a range of ±9% of baseline calibration values
- <sup>2</sup> Previous WIM research indicates that unloaded Class 9s typically weigh 28-32 kips, while loaded Class 9s generally fall in the 70-80 kip range. More recent data from several WIM sites suggests that the unloaded Class 9 range may have moved a little higher over time (due to increased presence of sleeper cabs, etc.), although these ranges are also thought to be site-specific.
- <sup>3</sup> An HCV is considered overweight during normal load limits in this report if they satisfy any of the following 1) exceed a gross vehicle weight (GVW) of 80,000 pounds, 2) exceed any of the legal weight maximums on any axle configurations (legal maximums are: single axle = 20,000 pounds; tandem axles spaced 8' or less = 34,000 pounds; tridem axles spaced 9' or less = 43,000 pounds; quad axles spaced 13' or less = 51,000 pounds). Monthly reports use this standard regardless of the time of year however, the Winter Load Increase (WLI) allows a 10% across the board increase in axle and gross vehicle weights without a permit on US, state routes, and county roads. An HCV is considered overweight during Winter Load Increase(WLI) if they satisfy any of the following 1) exceed a gross vehicle weight (GVW) of 88,000 pounds, 2) exceed any of the legal weight maximums on any axle configurations (legal maximums are: single axle = 22,000 pounds; tandem axles spaced 8' or less = 37,400 pounds; tridem axles spaced 9' or less = 47,300 pounds; quad axles spaced 13' or less = 56,100 pounds). An overweight HCV is only included once in the overweight volume calculations regardless of how many of the aforementioned conditions are violated. For information on MN weight limit dates and statutes: [http://www.mrr.dot.state.mn.us/research/seasonal\\_load\\_limits/sllindex.asp](http://www.mrr.dot.state.mn.us/research/seasonal_load_limits/sllindex.asp)
- <sup>4</sup> For example, Class 9s and 10s can legally have gross vehicle weights up to 80,000 lbs (with the exception of permitted loads) during normal load limits. To account for measurement error on the WIM scales, those exceeding 10% of the legal GVW maximum (or 1.1 times the legal GVW) should be screened (e.g., 80,000 lbs + 8,000 lbs = 88,000 lbs). Similarly during WLI vehicles weighing 96,800 lbs should be screened.

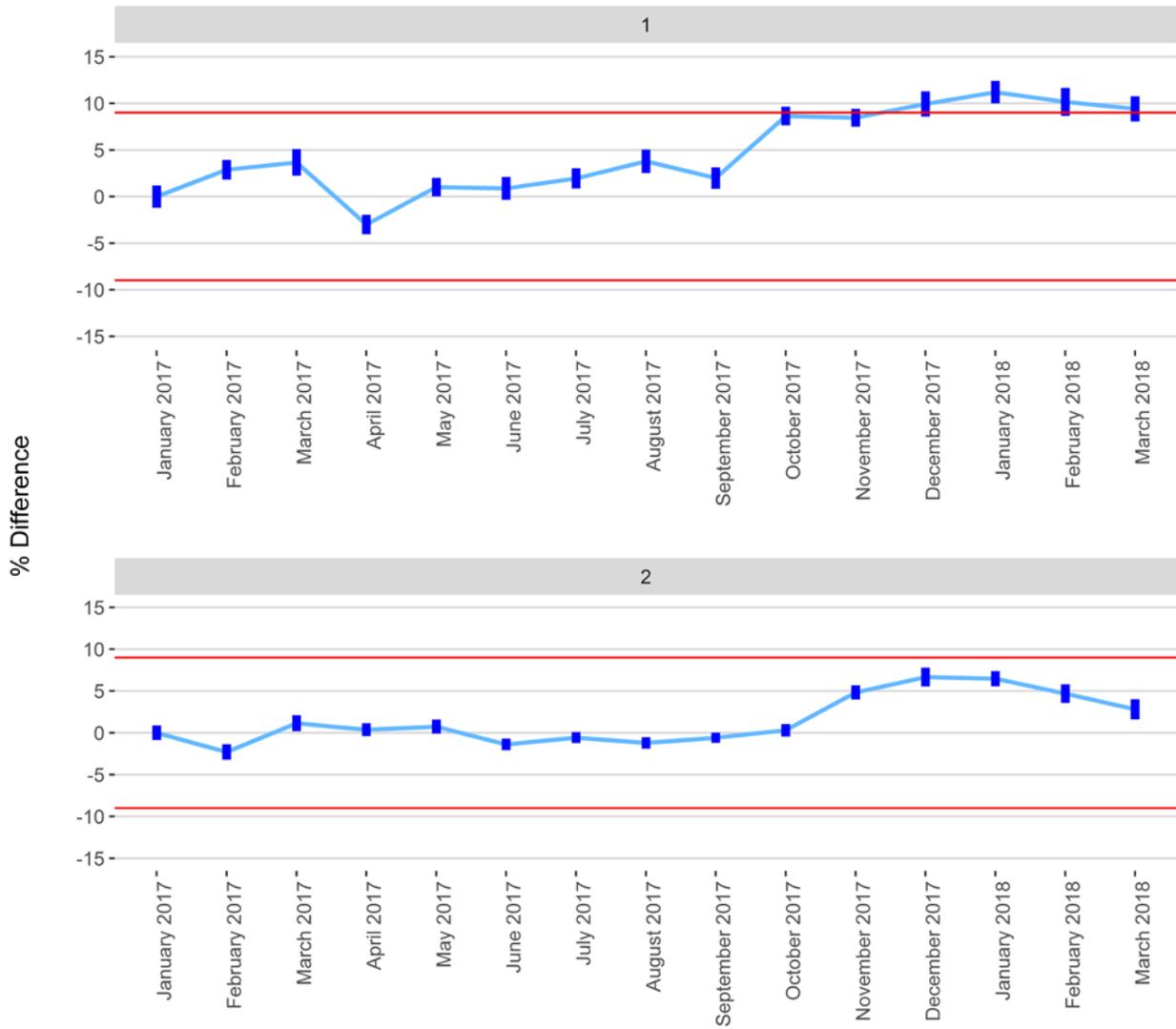
**To request this document in an alternative format, please call 651-366-4718 or 1-800-657-3774, or email your request to [ADArequest.dot@state.mn.us](mailto:ADArequest.dot@state.mn.us). Please request at least one week in advance.**

Figure 1 - Monthly Class 9 GVW Histogram



Months that have not passed QC parameters are not displayed

Figure 2 - Percent Difference of Front Axle Weight from Last Calibration (+/- 95% CI)



Months that have not passed QC parameters are not displayed

Figure 2 - Average Vehicle Volume vs. Day of the Week

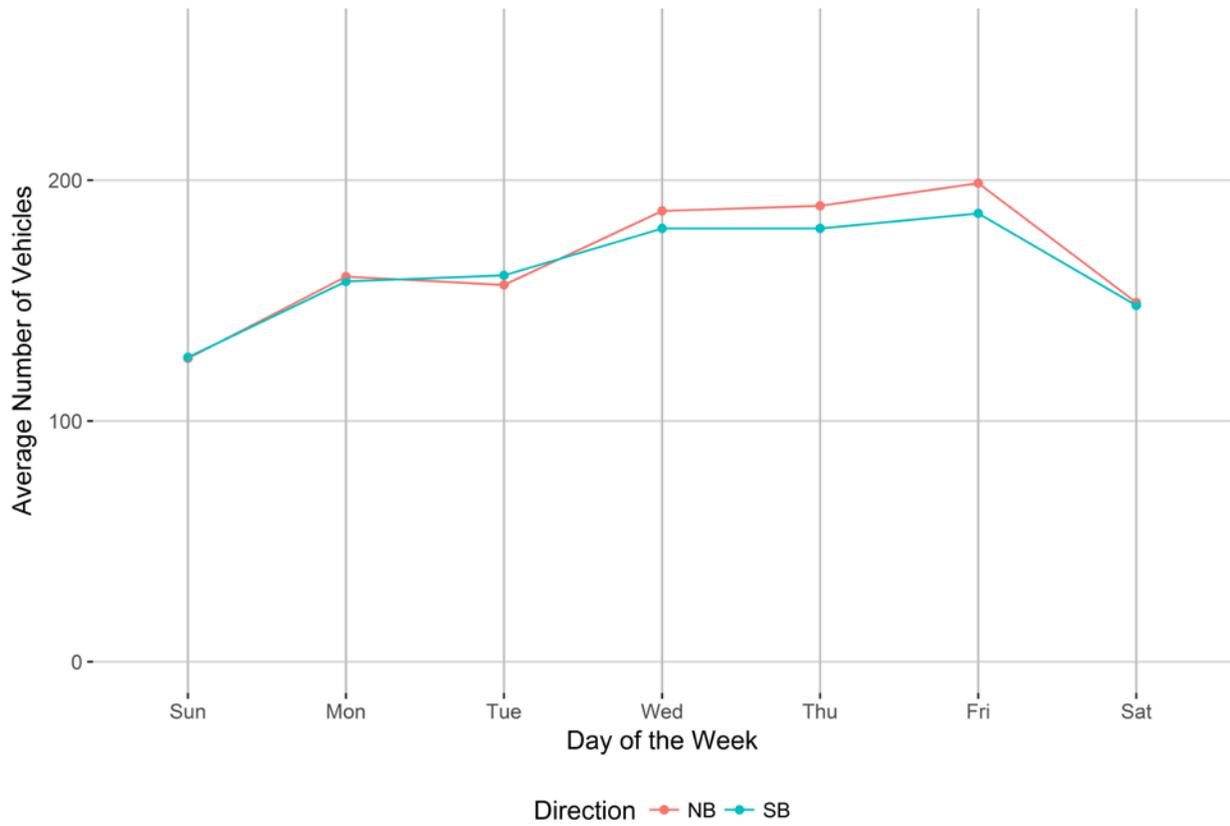


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

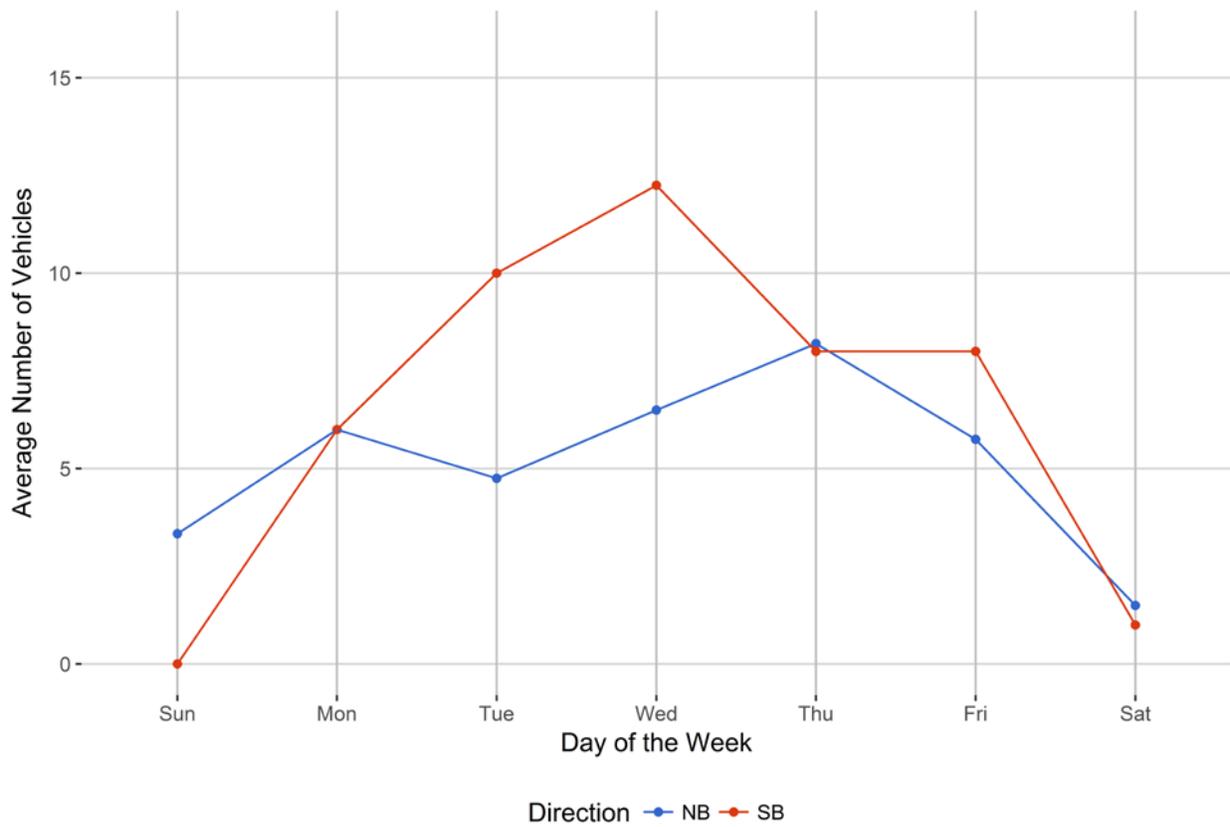


Figure 4 - Passenger Vehicles vs. Hour of the Day

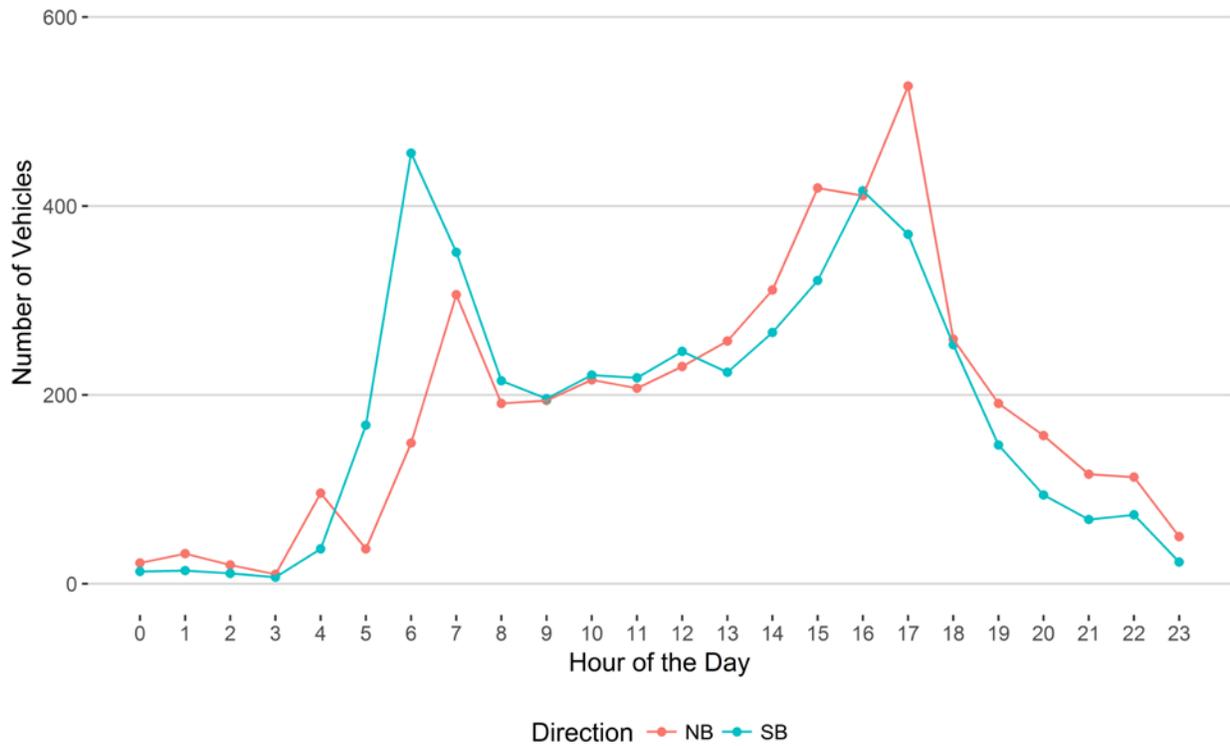


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

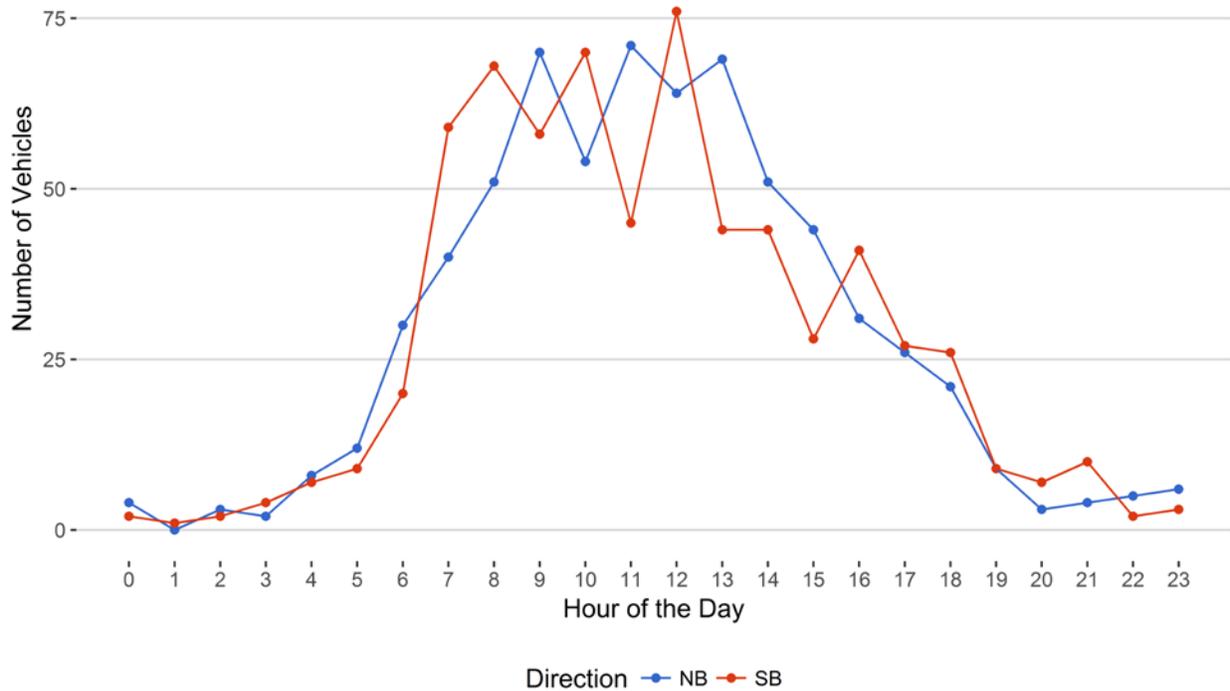


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

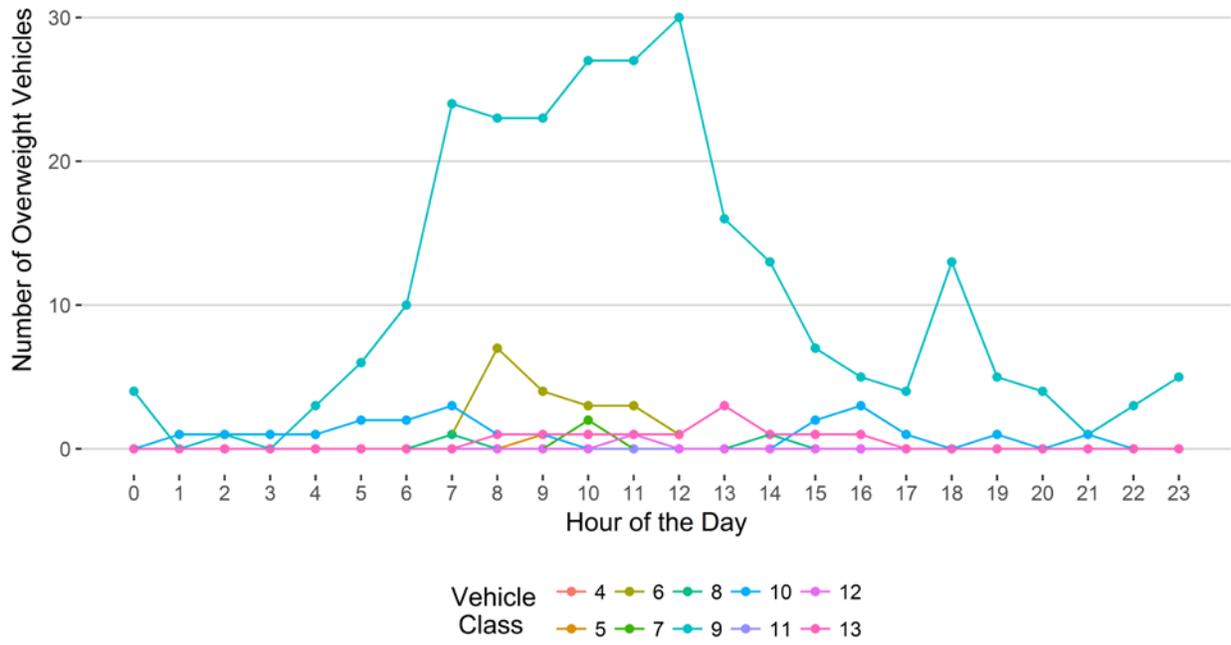


Figure 7 - Overweight Vehicles by Direction  
Hour of the Day

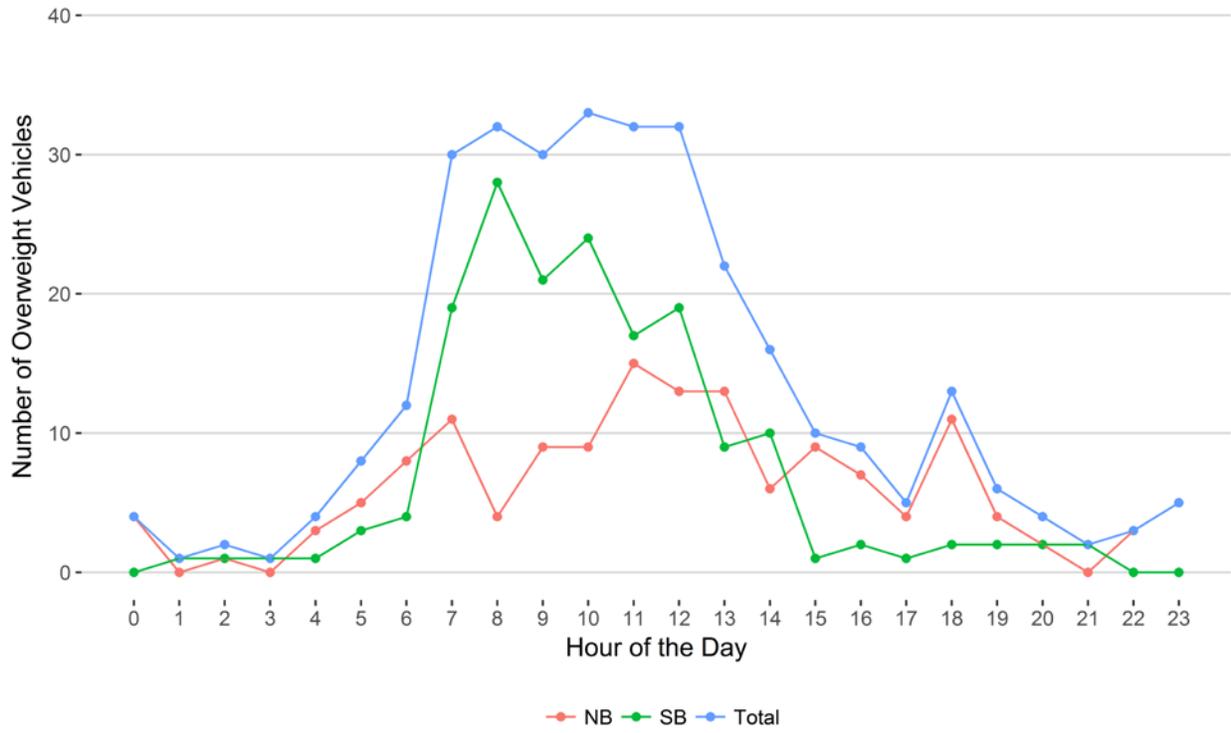
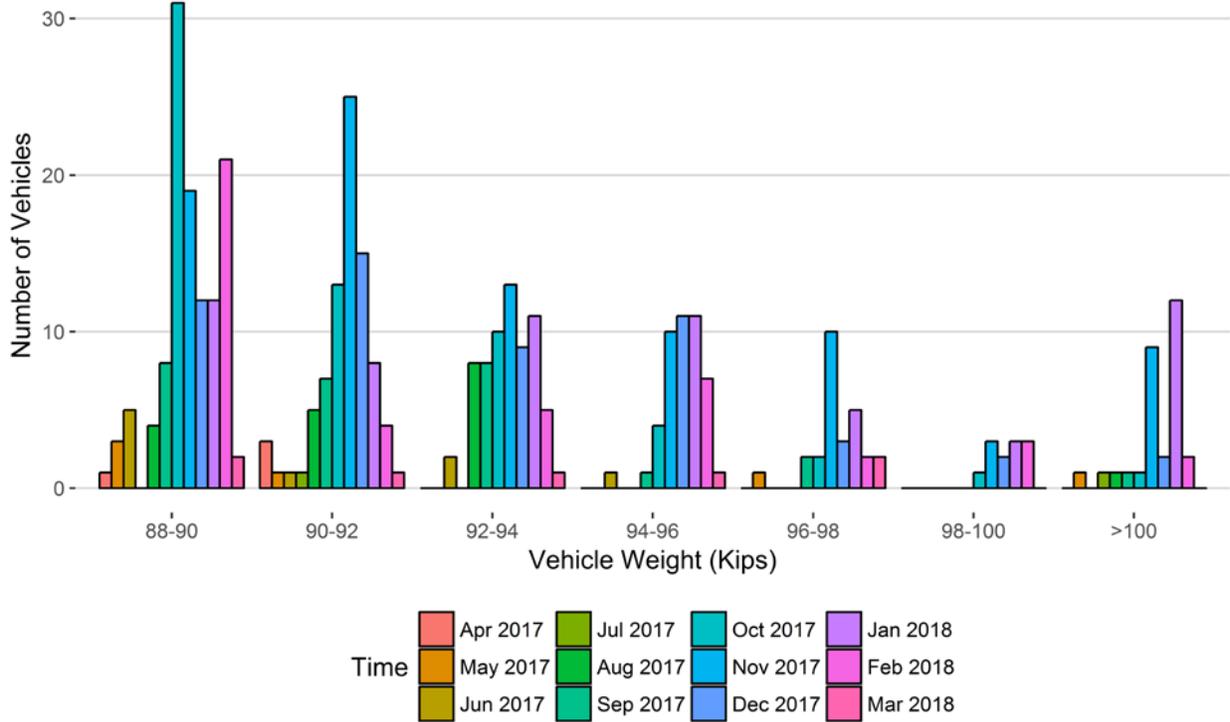
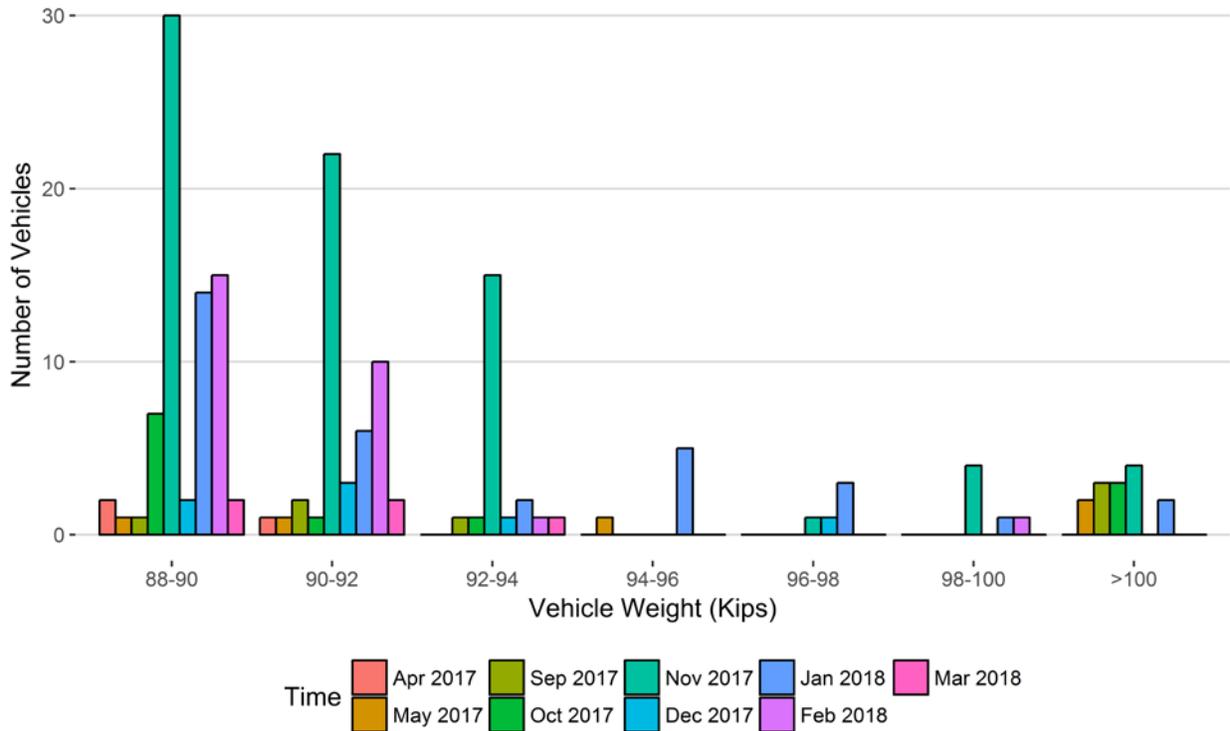


Figure 8 - Histogram of NB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Apr 2017	May 2017	Jun 2017	Jul 2017	Aug 2017	Sep 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018
88-90	1	3	5	0	4	8	31	19	12	12	21	2
90-92	3	1	1	1	5	7	13	25	15	8	4	1
92-94	0	0	2	0	8	8	10	13	9	11	5	1
94-96	0	0	1	0	0	1	4	10	11	11	7	1
96-98	0	1	0	0	0	2	2	10	3	5	2	2
98-100	0	0	0	0	0	0	1	3	2	3	3	0
>100	0	1	0	1	1	1	1	9	2	12	2	0
<b>Total</b>	<b>4</b>	<b>6</b>	<b>9</b>	<b>2</b>	<b>18</b>	<b>27</b>	<b>62</b>	<b>89</b>	<b>54</b>	<b>62</b>	<b>44</b>	<b>7</b>

Figure 8 - Histogram of SB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Apr 2017	May 2017	Sep 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018
88-90	2	1	1	7	30	2	14	15	2
90-92	1	1	2	1	22	3	6	10	2
92-94	0	0	1	1	15	1	2	1	1
94-96	0	1	0	0	0	0	5	0	0
96-98	0	0	0	0	1	1	3	0	0
98-100	0	0	0	0	4	0	1	1	0
>100	0	2	3	3	4	0	2	0	0
<b>Total</b>	<b>3</b>	<b>5</b>	<b>7</b>	<b>12</b>	<b>76</b>	<b>7</b>	<b>33</b>	<b>27</b>	<b>5</b>

Figure 8 - Class 9's and 10's by Direction vs Gross Vehicle Weight

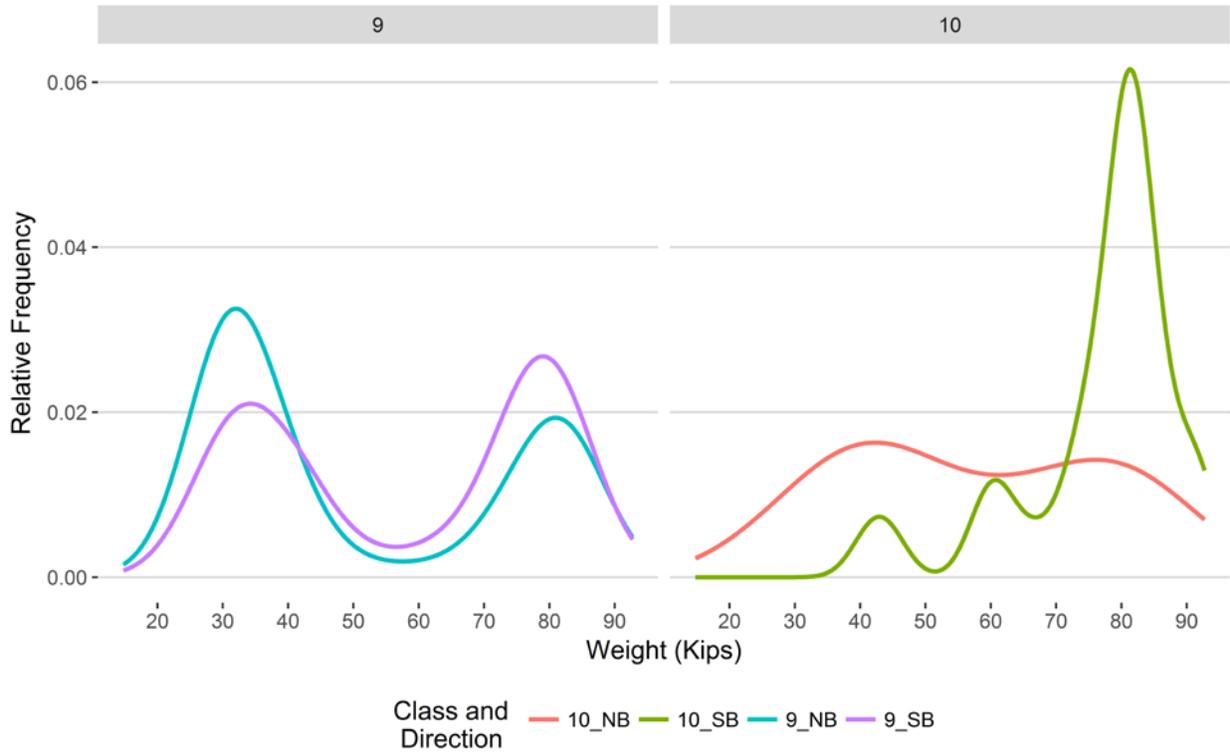


Figure 9 - Freight Percentage by Direction and Class

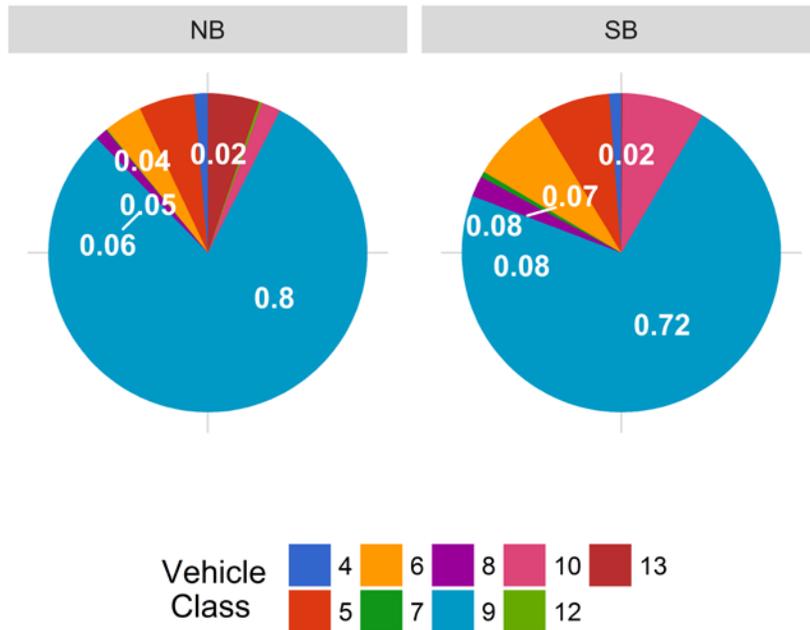


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

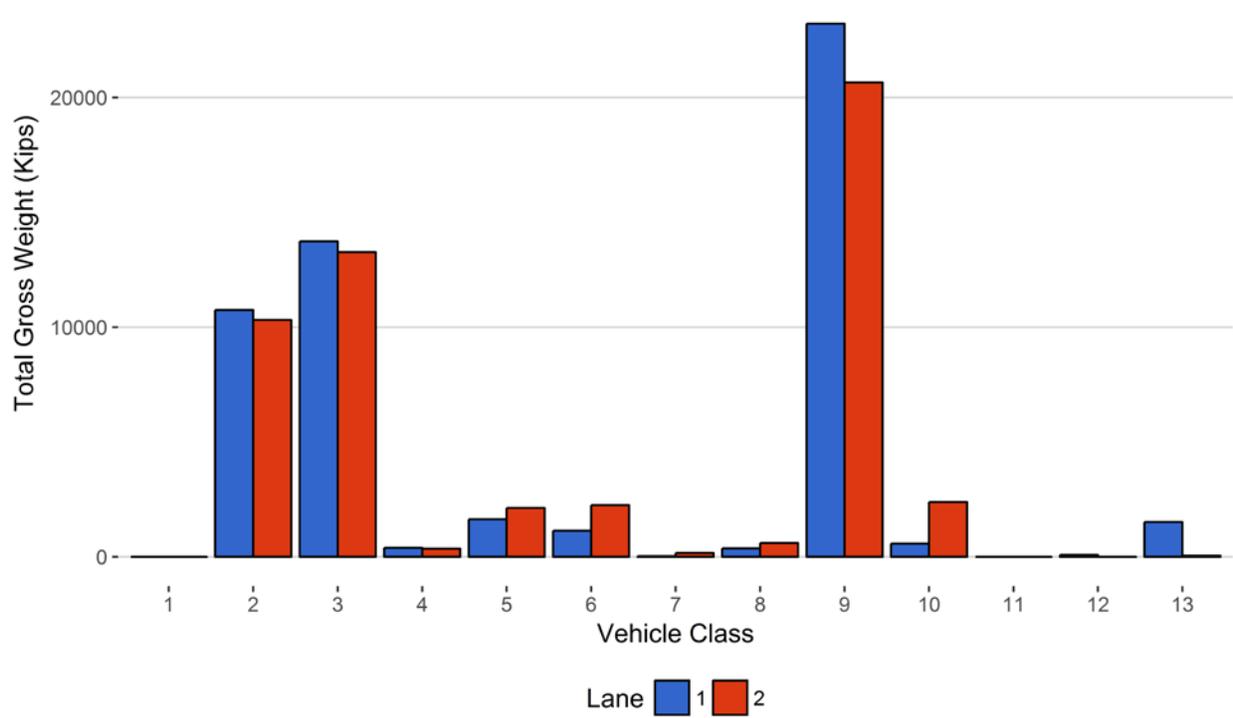


Figure 11 - Total Gross Vehicle Weight I

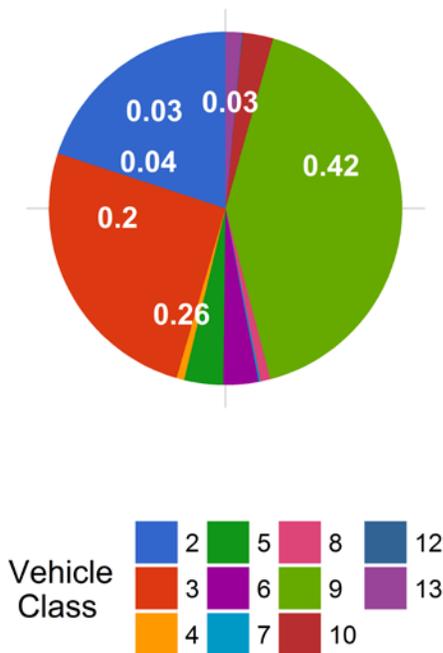


Figure 12 - Total ESALs by Class and Lane

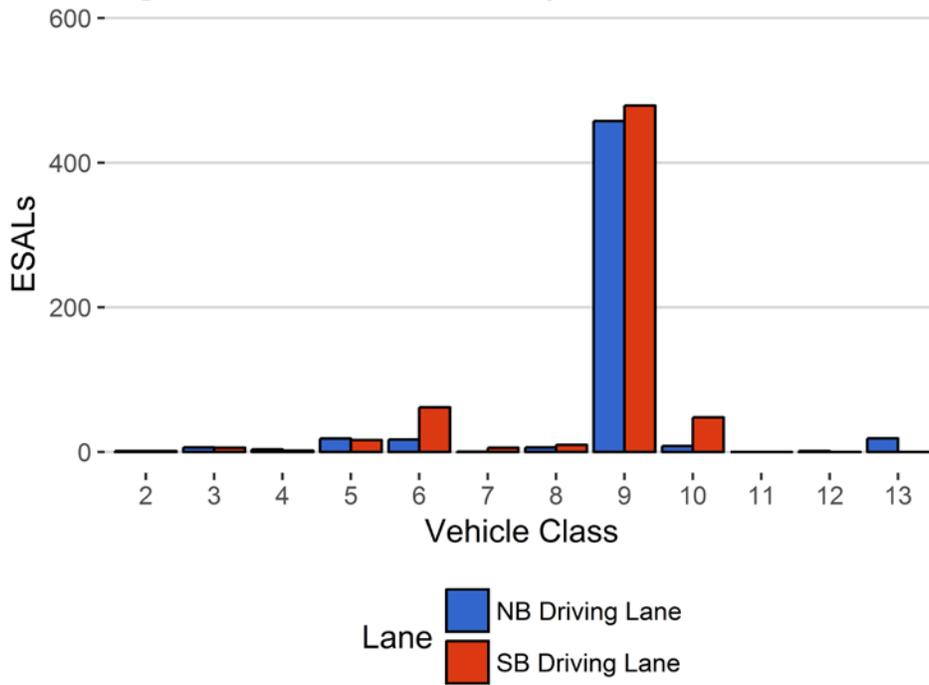
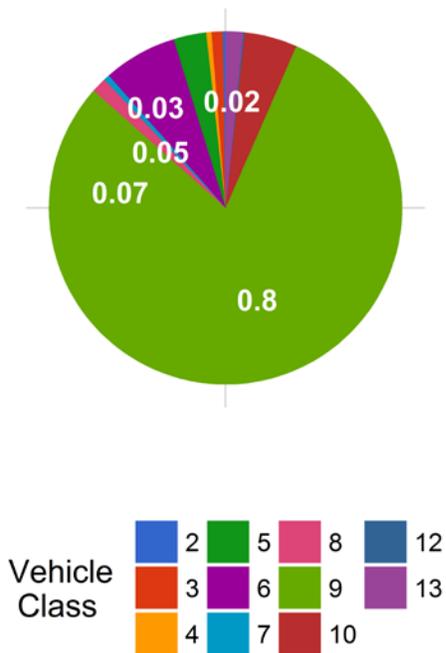


Figure 13 - ESALs by Class



**Table 1 Class 9 Front Axle Weight by Lane**

<i>Month</i>	<i>Lane 1 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 2 (Kips)</i>	<i>Front Axle +/- 9%</i>
January 2017	9.68	0.00	9.86	0.00
February 2017	9.96	2.88	9.63	-2.29
March 2017	10.04	3.66	9.97	1.14
April 2017	9.39	-3.00	9.90	0.37
May 2017	9.78	1.02	9.93	0.74
June 2017	9.77	0.87	9.72	-1.39
July 2017	9.87	1.95	9.80	-0.56
August 2017	10.05	3.79	9.74	-1.21
September 2017	9.87	1.99	9.80	-0.60
October 2017	10.52	8.64	9.89	0.31
November 2017	10.50	8.46	10.34	4.83
December 2017	10.64	9.94	10.52	6.66
January 2018	10.77	11.21	10.50	6.47
February 2018	10.66	10.16	10.32	4.68
March 2018	10.59	9.41	10.14	2.82

**Table 2 Vehicle Classification Data**

<i>Vehicle Class</i>	<i>Monthly Average Daily Volume</i>	<i>Monthly Total Volume</i>	<i>Monthly Total Volume Percentage</i>	<i>Monthly Total Overweight Vehicles</i>	<i>Monthly Total Overweight Percentage</i>
1	0	0	0	0	0
2	169	5234	48.4	0	0
3	135	4178	38.6	0	0
4	1	33	0.3	0	0
5	10	320	3	2	0.6
6	3	103	1	23	7.3
7	0	3	0	2	0.6
8	1	32	0.3	2	0.6
9	28	855	7.9	254	80.4
10	1	43	0.4	21	6.6
11	0	0	0	0	0
12	0	1	0	1	0.3
13	1	20	0.2	11	3.5
<b>TOTAL</b>	<b>349</b>	<b>10822</b>	<b>100</b>	<b>316</b>	<b>100</b>

**Table 3 Top 10 Gross Vehicle Weight, Class 9 and 10**

<i>Date</i>	<i>Day of Week</i>	<i>Time</i>	<i>Vehicle Class</i>	<i>Direction</i>	<i>Lane</i>	<i>GVW (lbs)</i>
2018-03-08	Thursday	09:57:40	10	NB	1	94.28
2018-03-09	Friday	07:48:13	10	SB	2	92.74
2018-03-05	Monday	07:29:01	10	SB	2	91.65
2018-03-23	Friday	11:12:48	9	SB	2	90.52
2018-03-12	Monday	06:02:06	10	SB	2	90.01
2018-03-01	Thursday	07:06:05	9	SB	2	89.17
2018-03-08	Thursday	05:49:45	9	NB	1	88.8
2018-03-09	Friday	05:44:49	10	SB	2	88.45
2018-03-08	Thursday	07:02:24	9	NB	1	88.42
2018-03-29	Thursday	13:12:56	9	SB	2	87.9

**Table 4 Freight Summary**

<i>Vehicle Class</i>	<i>Direction</i>	<i>Weight of Empty Vehicle (Kips)</i>	<i>Total Number of Vehicles</i>	<i>Number of Empty Vehicles</i>	<i>Percentage of Empty Vehicles</i>	<i>Total Weight of Vehicles with Freight (Kips)</i>	<i>Total Weight of Empty Vehicles (Kips)</i>	<i>Total Weight of Freight (Tons)</i>
4	NB	15	15	1	6.7	380	14	85
5	NB	8	126	9	7.1	1569	66	317
6	NB	19	39	9	23.1	970	162	200
7	NB	11.5	1	0	0	28	0	8
8	NB	31	10	2	20	318	46	35
9	NB	33	458	185	40.4	17643	5578	4317
10	NB	33.5	10	1	10	545	31	122
12	NB	36.5	1	0	0	80	0	22
13	NB	31.5	18	0	0	1513	0	473
<b>TOTAL</b>	<b>****</b>	<b>****</b>	<b>678</b>	<b>207</b>	<b>****</b>	<b>23046</b>	<b>****</b>	<b>5578</b>
<i>Vehicle Class</i>	<i>Direction</i>	<i>Weight of Empty Vehicle (Kips)</i>	<i>Total Number of Vehicles</i>	<i>Number of Empty Vehicles</i>	<i>Percentage of Empty Vehicles</i>	<i>Total Weight of Vehicles with Freight (Kips)</i>	<i>Total Weight of Empty Vehicles (Kips)</i>	<i>Total Weight of Freight (Tons)</i>
4	SB	15	16	2	12.5	324	27	57
5	SB	8	178	12	6.7	2039	90	355
6	SB	19	59	3	5.1	2190	55	563
7	SB	11.5	2	0	0	165	0	71
8	SB	31	20	8	40	448	151	38
9	SB	33	355	71	20	18529	2132	4579
10	SB	33.5	31	0	0	2381	0	671
13	SB	31.5	1	0	0	43	0	6
<b>TOTAL</b>	<b>****</b>	<b>****</b>	<b>662</b>	<b>96</b>	<b>****</b>	<b>26119</b>	<b>****</b>	<b>6340</b>
<b>GRAND TOTAL</b>	<b>****</b>	<b>****</b>	<b>1340</b>	<b>303</b>	<b>192</b>	<b>49165</b>	<b>8351</b>	<b>11918</b>

**Table 5 Gross Vehicle Weight by Class and Lane**

<i>Vehicle Class</i>	<i>NB</i>	<i>SB</i>	<i>Total</i>	<i>Percentage</i>
2	10747	10315	21062	19.9
3	13739	13265	27004	25.6
4	393	351	744	0.7
5	1635	2128	3763	3.6
6	1132	2245	3377	3.2
7	28	165	192	0.2
8	364	599	963	0.9
9	23221	20661	43882	41.6
10	576	2381	2957	2.8
12	80	0	80	0.1
13	1513	43	1557	1.5
<b>TOTAL</b>	<b>53428</b>	<b>52154</b>	<b>105582</b>	<b>100</b>
<b>GVW/LANE</b>	<b>50.6</b>	<b>49.4</b>	<b>100</b>	<b>0.09</b>

**Table 6 ESALs by Class and Lane and Flexible ESAL Factors**

<i>Vehicle Class</i>	<i>NB</i>	<i>SB</i>	<i>Total</i>	<i>Percentage</i>	<i>Flexible ESAL Factor</i>
2	1	1	3	0.2	0.0016
3	6	6	12	1	0.0072
4	4	2	6	0.5	0.45
5	19	16	35	3	0.25
6	17	62	79	6.7	1.64
7	1	6	6	0.6	2.04
8	6	10	16	1.4	1.1
9	458	479	936	80	2.39
10	8	48	56	4.8	2.5
12	1	0	1	0.1	1.14
13	19	0	19	1.6	1.64
<b>TOTAL</b>	<b>540</b>	<b>630</b>	<b>1170</b>	<b>100</b>	<b>13</b>
<b>ESALS/LANE</b>	<b>46.2</b>	<b>53.8</b>	<b>100</b>	--	--

**Table 7 Site Summary: Volume and Vehicle Class**

<i>Month</i>	<i>Total Volume</i>	<i>Monthly ADT</i>	<i>Monthly HCADT</i>	<i>Passenger Vehicles</i>	<i>Passenger Vehicles %</i>	<i>Heavy Commercial Vehicles</i>	<i>Heavy Commercial Vehicles %</i>
Apr 2017	12377	413	61	10538	85.1	1839.1	14.9
May 2017	14358	463	75	12043	83.9	2315.5	16.1
Jun 2017	14185	473	71	12062	85	2123.4	15
Jul 2017	13838	446	68	11733	84.8	2104.6	15.2
Aug 2017	14264	460	71	12064	84.6	2200.3	15.4
Sep 2017	13123	437	90	10422	79.4	2701.5	20.6
Oct 2017	14069	454	92	11212	79.7	2856.5	20.3
Nov 2017	13393	446	109	10138	75.7	3255.4	24.3
Dec 2017	10680	344	48	9198	86.1	1482.5	13.9
Jan 2018	9974	322	58	8177	82	1797.3	18
Feb 2018	9024	322	56	7467	82.7	1557.3	17.3
Mar 2018	10822	349	45	9412	87	1410	13
<b>TOTAL</b>	<b>150107</b>	--	--	<b>124466</b>	--	<b>25643</b>	--
<b>AVERAGE</b>	<b>12509</b>	<b>411</b>	<b>70</b>	<b>10372</b>	<b>83</b>	<b>2137</b>	<b>17</b>

## ESALS

<i>Month</i>	<i>ESALS NB Driving Lane</i>	<i>ESALS SB Driving Lane</i>	<i>Total ESALS</i>	<i>Pavement Life Decrease Months</i>
Apr 2017	374	864	1238	1.2
May 2017	575	1101	1676	3.1
Jun 2017	533	874	1406	0
Jul 2017	496	992	1488	0
Aug 2017	615	990	1605	0
Sep 2017	656	1623	2280	0.2
Oct 2017	1316	1374	2690	4.1
Nov 2017	1034	2181	3215	17.8
Dec 2017	635	793	1427	3.4
Jan 2018	784	1500	2284	10.6
Feb 2018	724	1115	1839	9.4
Mar 2018	541	630	1170	3.3
<b>TOTAL</b>	<b>8283</b>	--	--	--
<b>AVERAGE</b>	<b>690</b>	<b>1170</b>	<b>1860</b>	<b>4</b>

## Gross Vehicle Weight

<i>Month</i>	<i>GVW NB Driving Lane</i>	<i>GVW SB Driving Lane</i>	<i>Total GVW Kips</i>
Apr 2017	55605	68986	124591
May 2017	53051	55564	108616
Jun 2017	53496	52160	105656
Jul 2017	57005	67375	124381
Aug 2017	71698	81708	153406
Sep 2017	65868	73699	139567
Oct 2017	67343	76983	144326
Nov 2017	70590	77709	148299
Dec 2017	74076	92119	166195
Jan 2018	91106	87939	179046
Feb 2018	80715	103216	183930
Mar 2018	54550	54404	108954
<b>TOTAL</b>	<b>795104</b>	<b>891862</b>	<b>1686966</b>
<b>AVERAGE</b>	<b>66259</b>	<b>74322</b>	<b>140580</b>

## Overweight Vehicles

<i>Month</i>	<i>Total Number of Overweight Vehicles</i>	<i>Overweight / Total Volume</i>	<i>Overweight / Heavy Commercial Volume</i>	<i>Number Over 88,000 lbs</i>	<i>Number Over 98,000 lbs</i>
Apr 2017	216	1.8	12.1	7	0
May 2017	273	2	12.3	11	3
Jun 2017	199	1.5	10	9	0
Jul 2017	236	1.8	11.8	3	2
Aug 2017	335	2.5	16.2	18	1
Sep 2017	569	4.8	22.8	35	4
Oct 2017	743	5.8	28.3	74	5
Nov 2017	951	8.2	33.6	165	20
Dec 2017	407	4.1	29.7	61	4
Jan 2018	685	7.7	42.2	95	18
Feb 2018	552	6.6	37.6	71	6
Mar 2018	316	3.1	23.4	12	0
<b>TOTAL</b>	<b>5482</b>	<b>--</b>	<b>--</b>	<b>561</b>	<b>63</b>
<b>AVERAGE</b>	<b>456.8</b>	<b>4.2</b>	<b>23.3</b>	<b>46.8</b>	<b>5.2</b>

## Freight

<i>Month</i>	<i>NB Freight Tons</i>	<i>SB Freight Tons</i>	<i>Total Freight</i>	<i>NB Freight %</i>	<i>SB Freight %</i>
Apr 2017	4717	9880	14597	32.3	67.7
May 2017	6982	12372	19353	36.1	63.9
Jun 2017	6163	10117	16279	37.9	62.1
Jul 2017	6168	11634	17802	34.6	65.4
Aug 2017	7343	11016	18359	40	60
Sep 2017	7665	16870	24535	31.2	68.8
Oct 2017	13207	13672	26879	49.1	50.9
Nov 2017	10149	20105	30254	33.5	66.5
Dec 2017	6725	7700	14425	46.6	53.4
Jan 2018	7270	13162	20432	35.6	64.4
Feb 2018	7290	9801	17090	42.7	57.3
Mar 2018	5578	6340	11918	46.8	53.2
<b>TOTAL</b>	<b>89256</b>	<b>142669</b>	<b>231925</b>	--	--
<b>AVERAGE</b>	<b>7438</b>	<b>11889.1</b>	<b>19327.1</b>	<b>38.9</b>	<b>61.1</b>