

JANUARY 2019



**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 January 2019. 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 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 ². 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: 8807 | Passenger Vehicles: 7777 | Heavy Commercial Vehicles: 1030

Monthly Average Daily Traffic (MADT): 284 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 33

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 Sundays. SB vehicles typically reached highest volume levels on Thursdays, 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 03 PM 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 03 PM and 05 PM. See Figure 6. Out of all HCVs, the two highest traffic volumes were generated by Class 9's and Class 14's.

Overweight HCVs

Volume trends. Of a total of 1030 HCVs, 321 of them were overweight ³. These overweight HCVs contributed to 5% of total monthly volume, and 40.1% of total monthly HCV volume.

NB overweight vehicles typically reached highest numbers on Wednesdays, with lowest volumes reported on Saturdays. SB overweight vehicles tended to reach highest volumes on Thursdays, with lowest volumes reported on Sundays. See Figure 3 .

The top two overweight violators by class were the class 9 and class 14 vehicles . Overall, overweight vehicles tended to reach peak volume concentrations during typical business hours, with 65.2% 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 ⁴.

Using normal load limits ,119 NB vehicles exceeded 88,000 pounds (96 vehicles were Class 9's; 21 vehicles were Class 13's). Of vehicles traveling SB,

52 NB vehicles exceeded 88,000 pounds (34 vehicles were Class 9's; 18 vehicles were Class 14's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from January 2019.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9s and 10s in January 2019. 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 fully_loaded Class 10's than empty traveling in the NB direction. In the SB direction, there were more fully_loaded class 10 vehicles.

Freight Totals. A total of 10578 tons of freight was recorded to have crossed the WIM. More freight was shipped NB (52.2%) than SB (47.8%). 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 8807 vehicles with a combined GVW of 74855 kips (1 kip = 1,000 pounds = 0.5 tons) in January 2019. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 9308 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 92.8% of all ESALs were recorded SB while 7.2% was observed NB. In particular, 86% of all ESALs were generated by the Class 14's (Class 14's were also responsible for generating % 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).

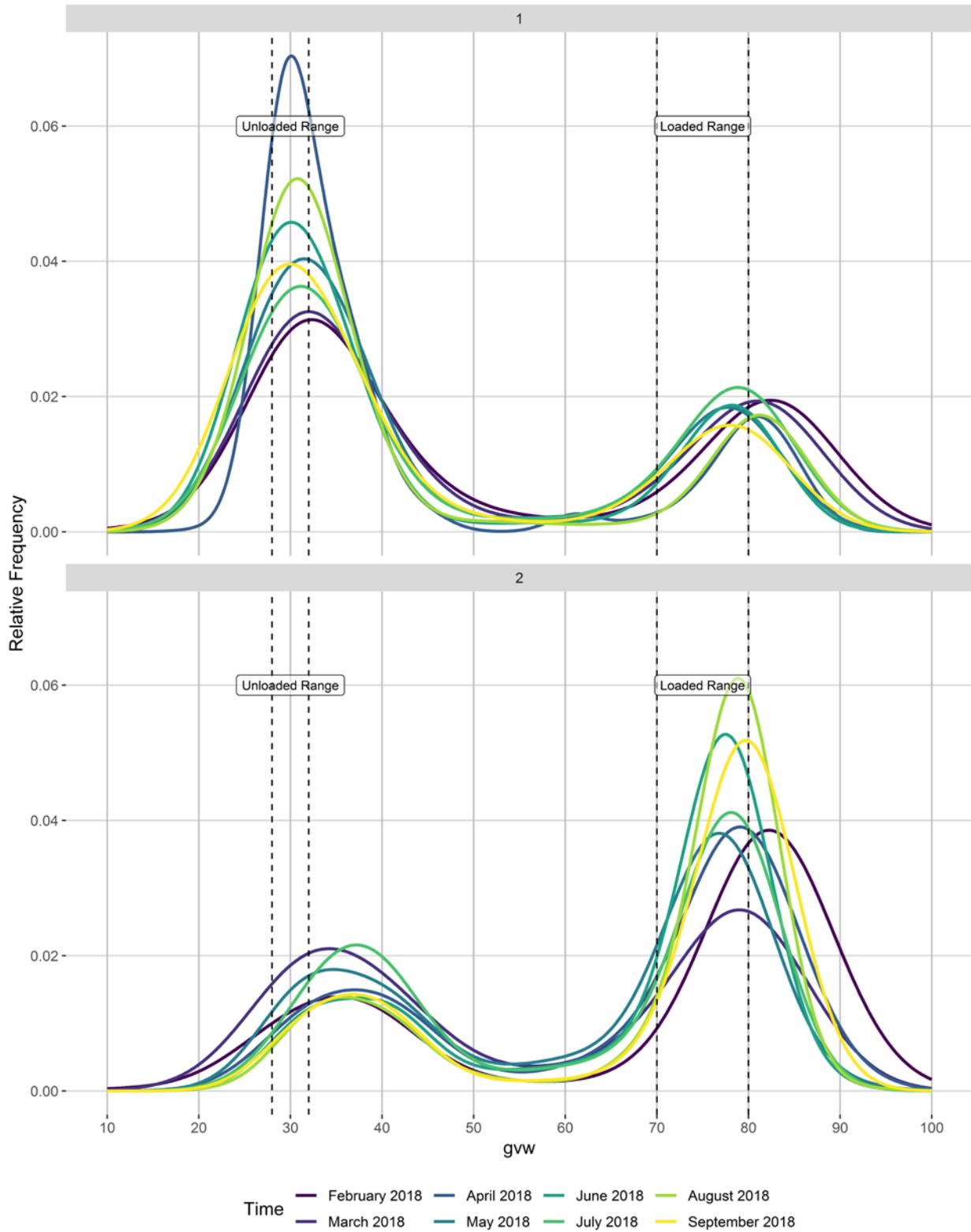
WIM monthly reports can be found at: <http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html>

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>

- ¹ 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
- ² 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.
- ³ 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
- ⁴ 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.

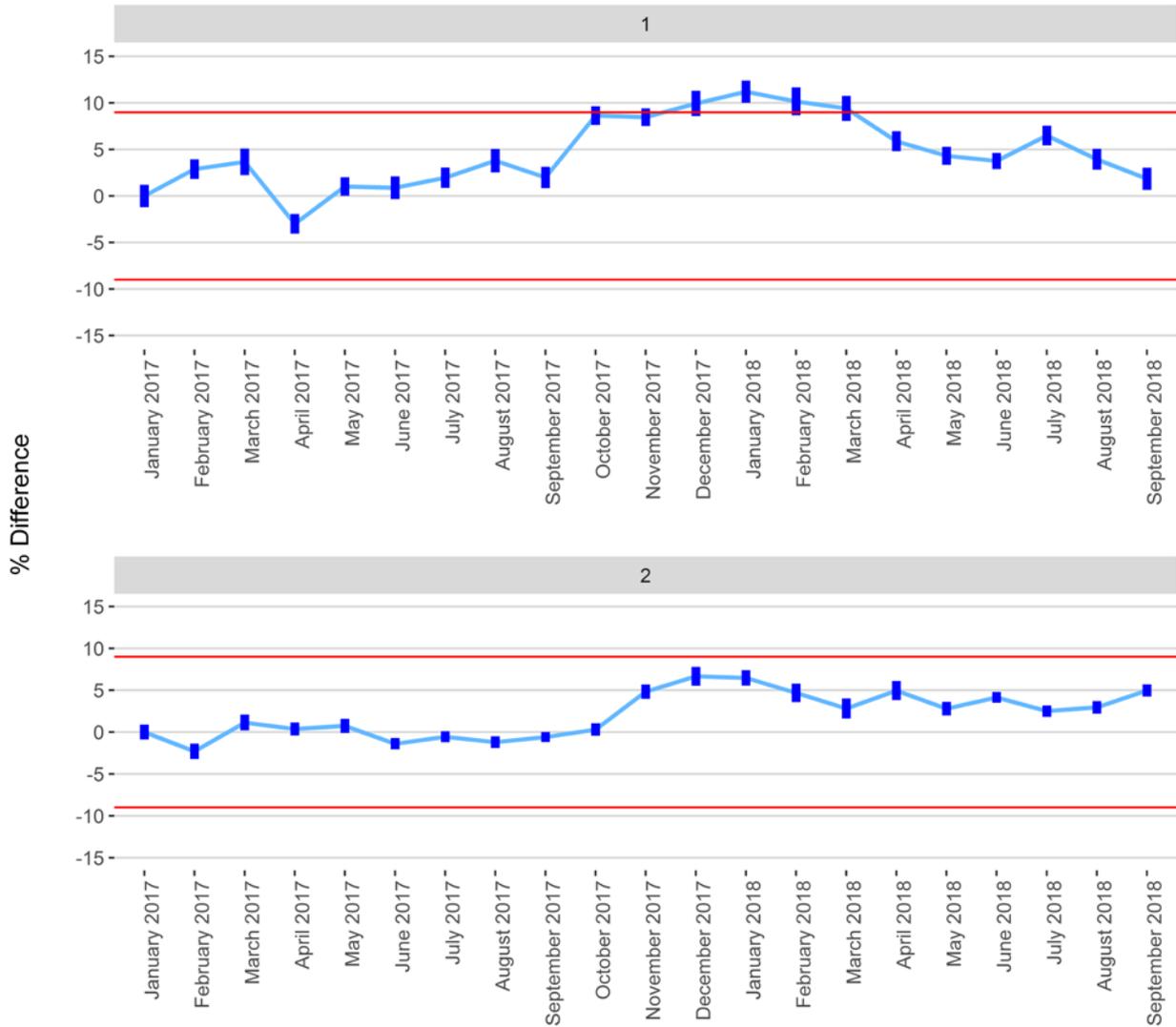
To request this document in an alternative format, please call 651-366-4718 or 1-800-657-3774, or email your request to ADArequest.dot@state.mn.us. Please request at least one week in advance.

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

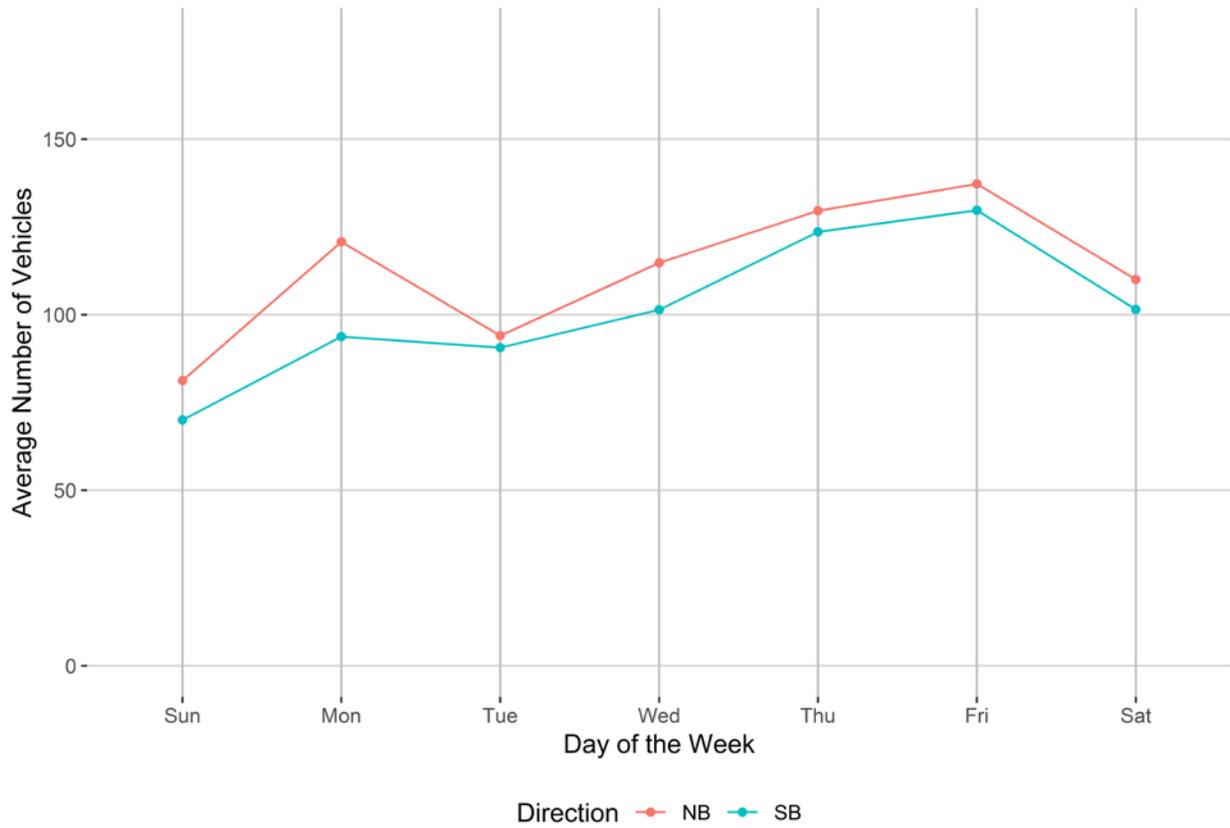


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

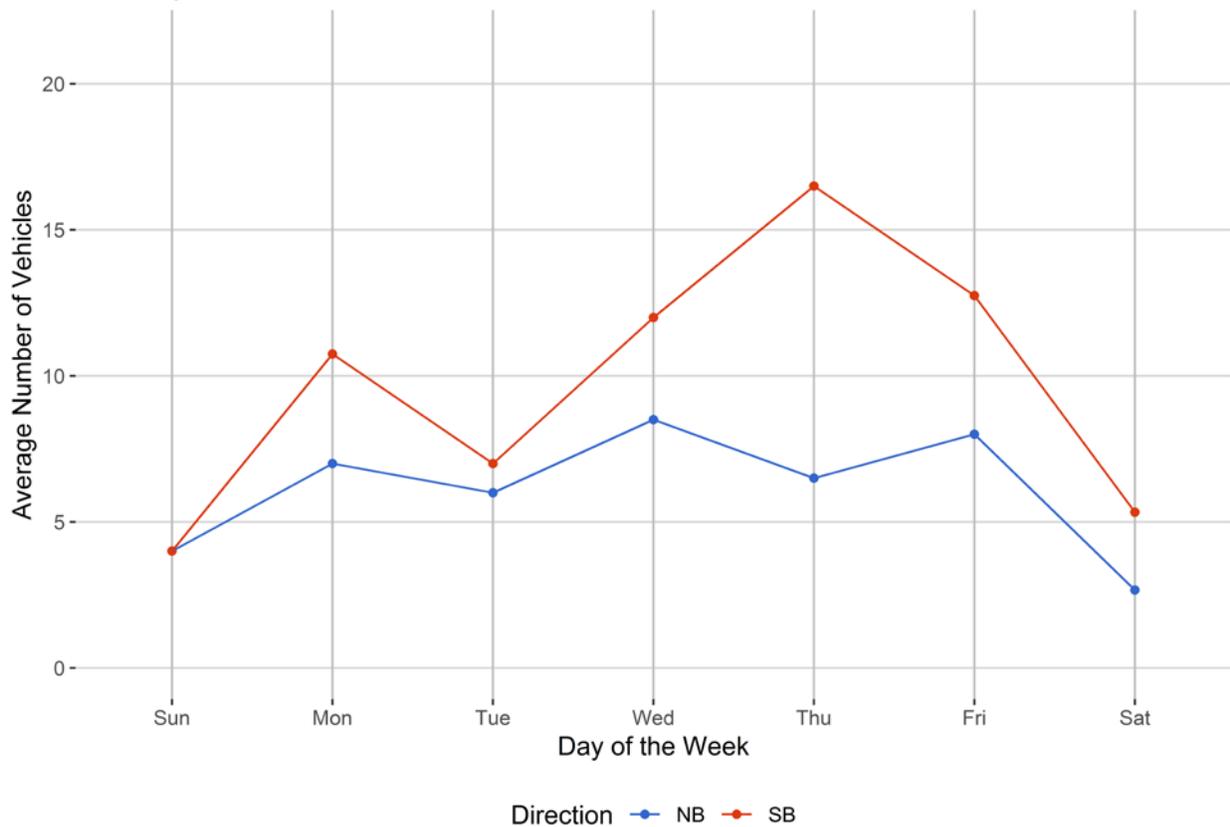


Figure 4 - Passenger Vehicles vs. Hour of the Day

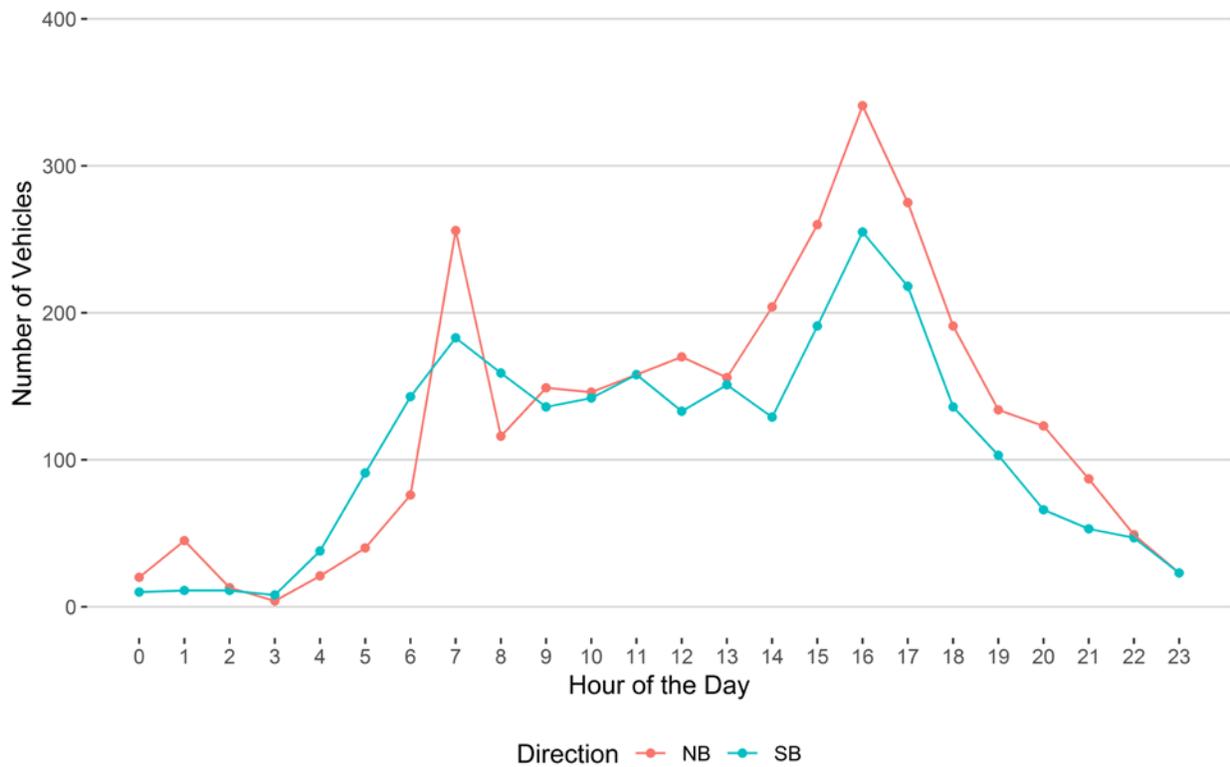


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

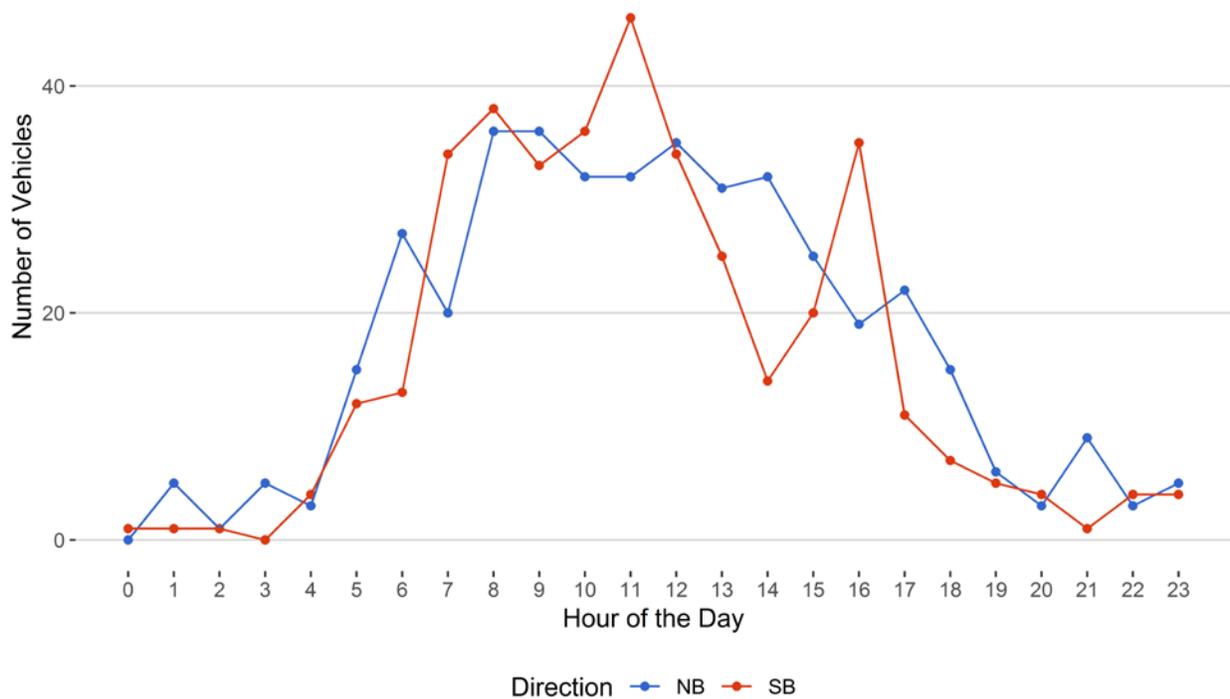


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

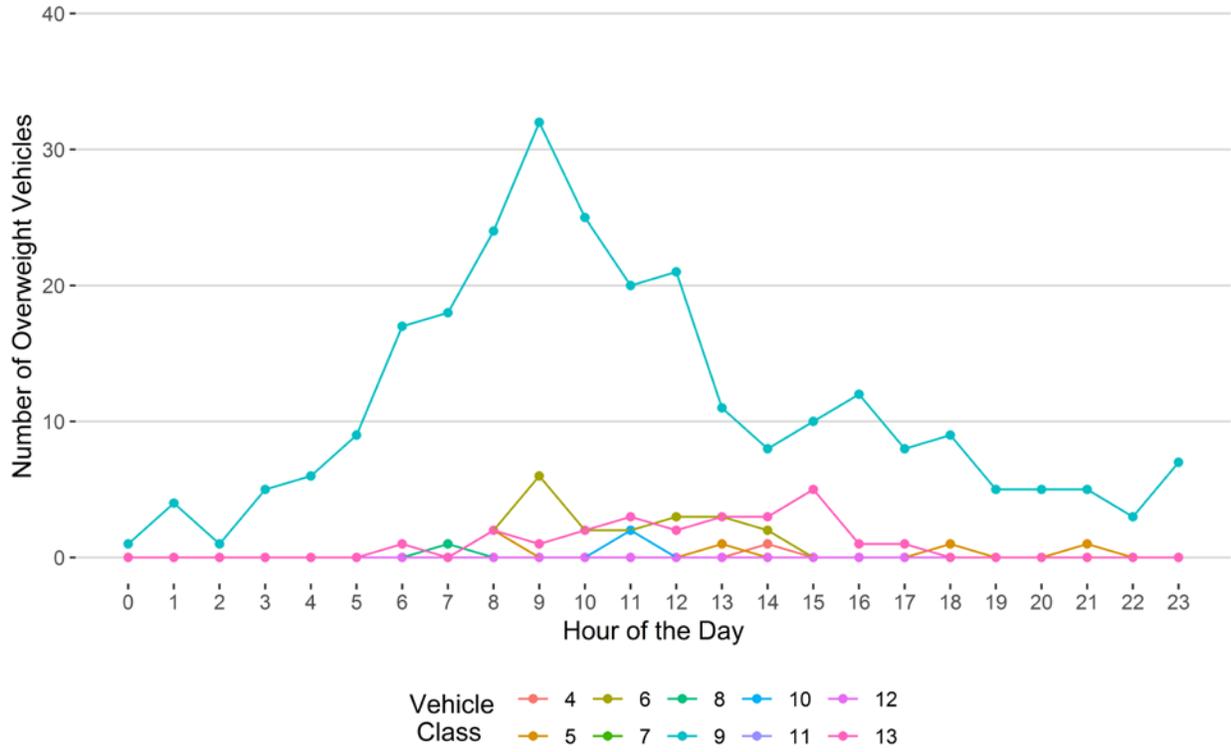


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

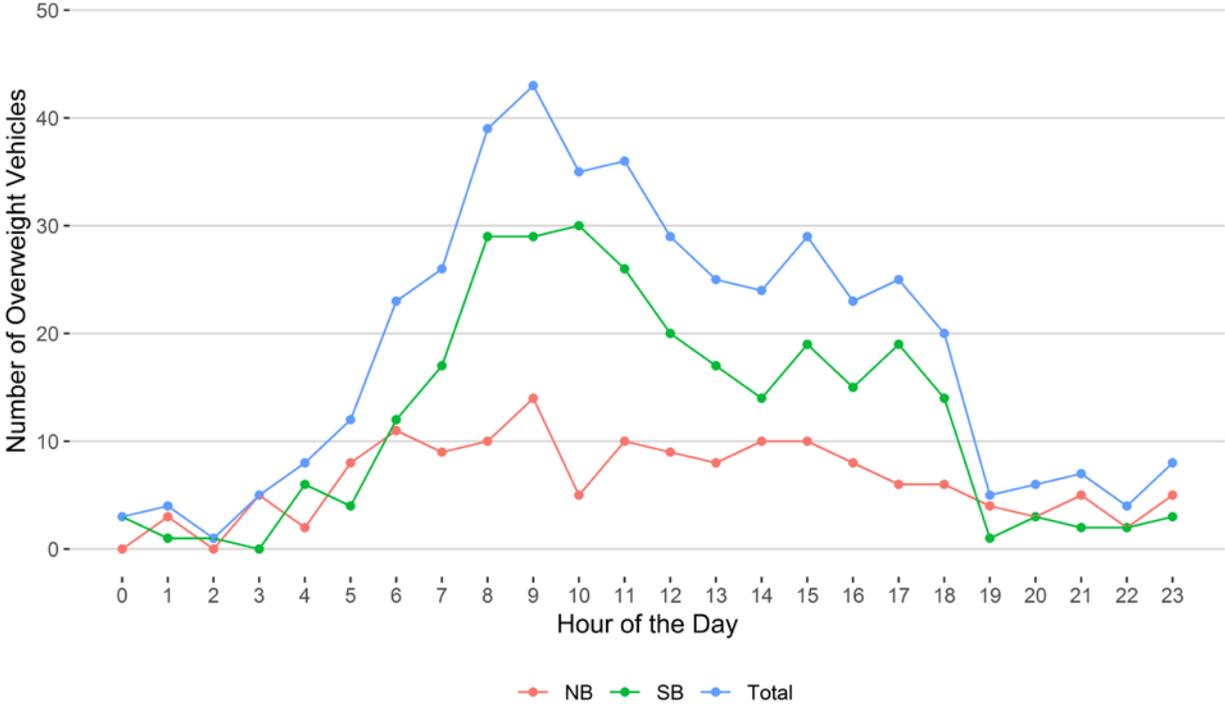
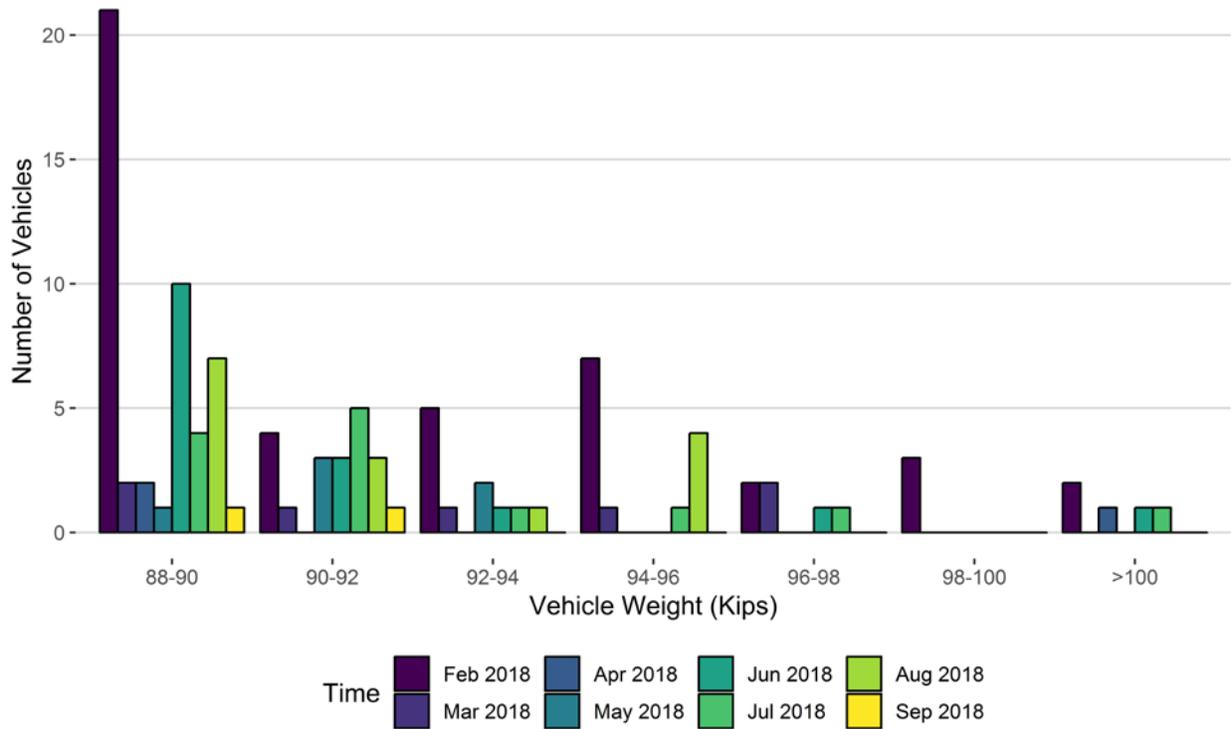
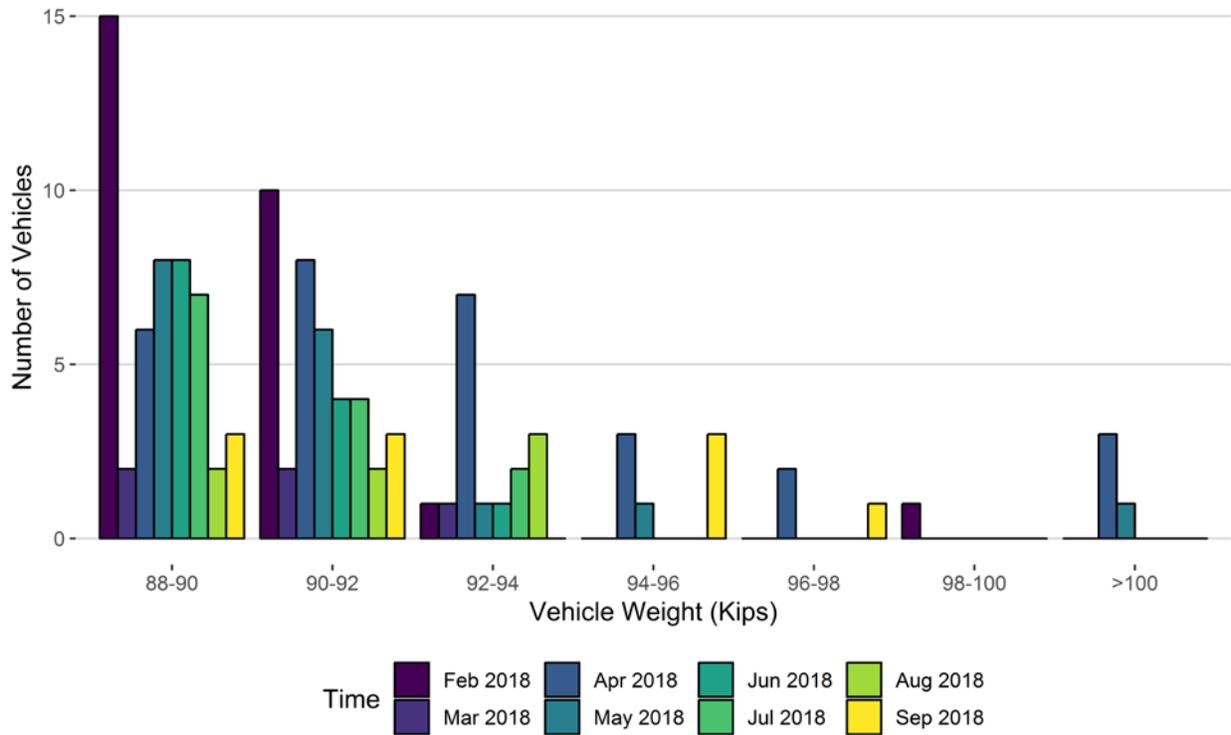


Figure 8 - Histogram of NB Vehicles Over 88,000 Pounds for Current Month



<i>Vehicle Weights (Kips)</i>	<i>Feb 2018</i>	<i>Mar 2018</i>	<i>Apr 2018</i>	<i>May 2018</i>	<i>Jun 2018</i>	<i>Jul 2018</i>	<i>Aug 2018</i>	<i>Sep 2018</i>
88-90	21	2	2	1	10	4	7	1
90-92	4	1	0	3	3	5	3	1
92-94	5	1	0	2	1	1	1	0
94-96	7	1	0	0	0	1	4	0
96-98	2	2	0	0	1	1	0	0
98-100	3	0	0	0	0	0	0	0
>100	2	0	1	0	1	1	0	0
Total	44	7	3	6	16	13	15	2

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



<i>Vehicle Weights (Kips)</i>	<i>Feb 2018</i>	<i>Mar 2018</i>	<i>Apr 2018</i>	<i>May 2018</i>	<i>Jun 2018</i>	<i>Jul 2018</i>	<i>Aug 2018</i>	<i>Sep 2018</i>
88-90	15	2	6	8	8	7	2	3
90-92	10	2	8	6	4	4	2	3
92-94	1	1	7	1	1	2	3	0
94-96	0	0	3	1	0	0	0	3
96-98	0	0	2	0	0	0	0	1
98-100	1	0	0	0	0	0	0	0
>100	0	0	3	1	0	0	0	0
Total	27	5	29	17	13	13	7	10

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

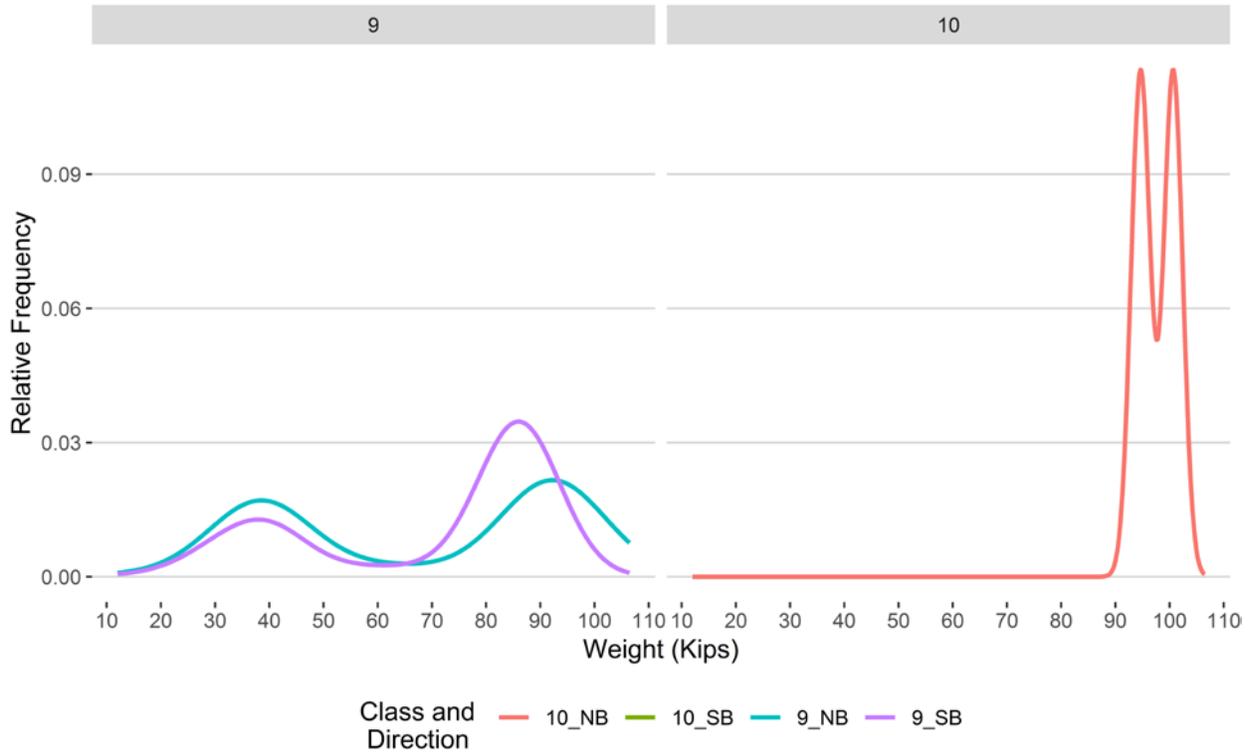


Figure 9 - Freight Percentage by Direction and Class

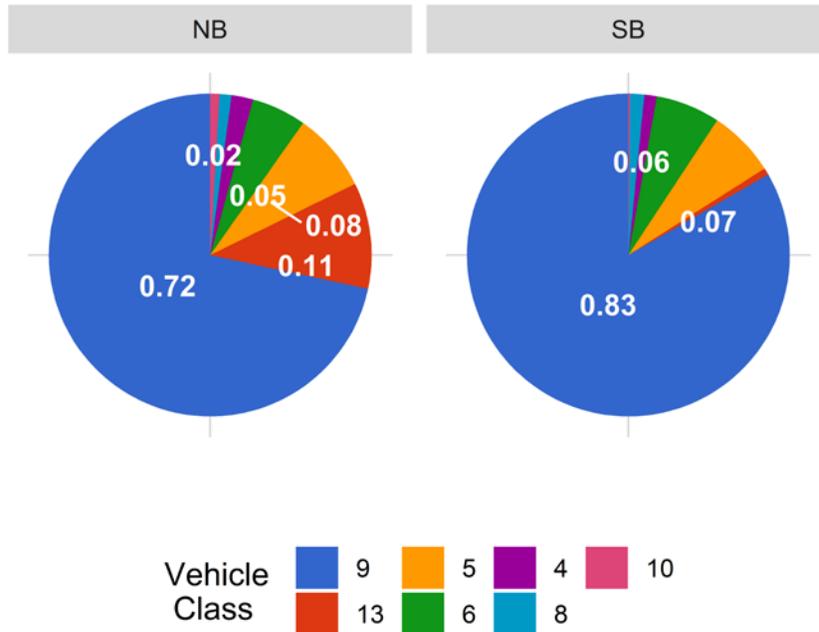


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

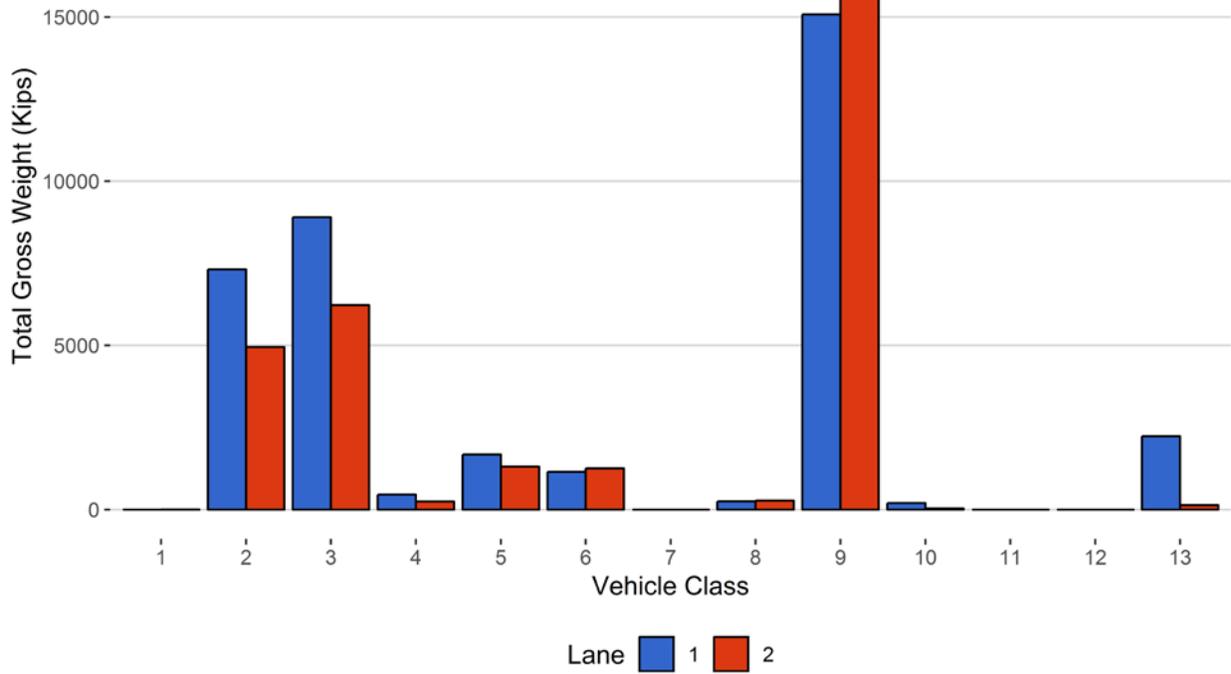


Figure 11 - Total Gross Vehicle Weight by

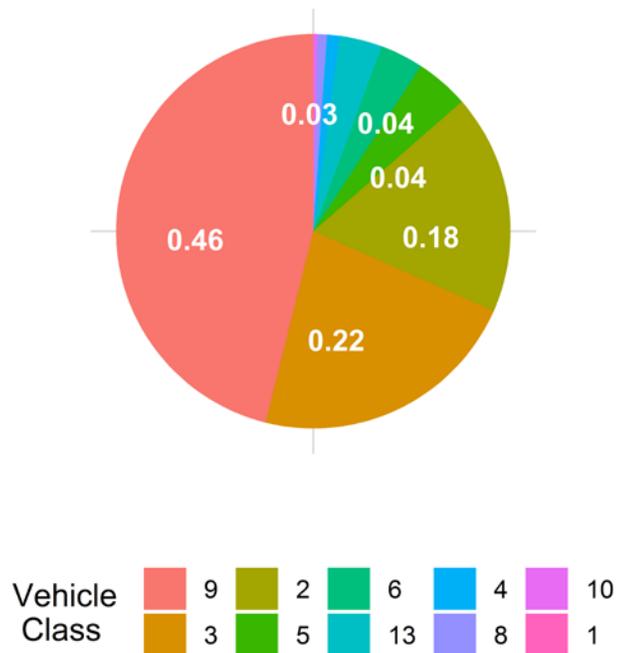


Figure 12 - Total ESALs by Class and Lane

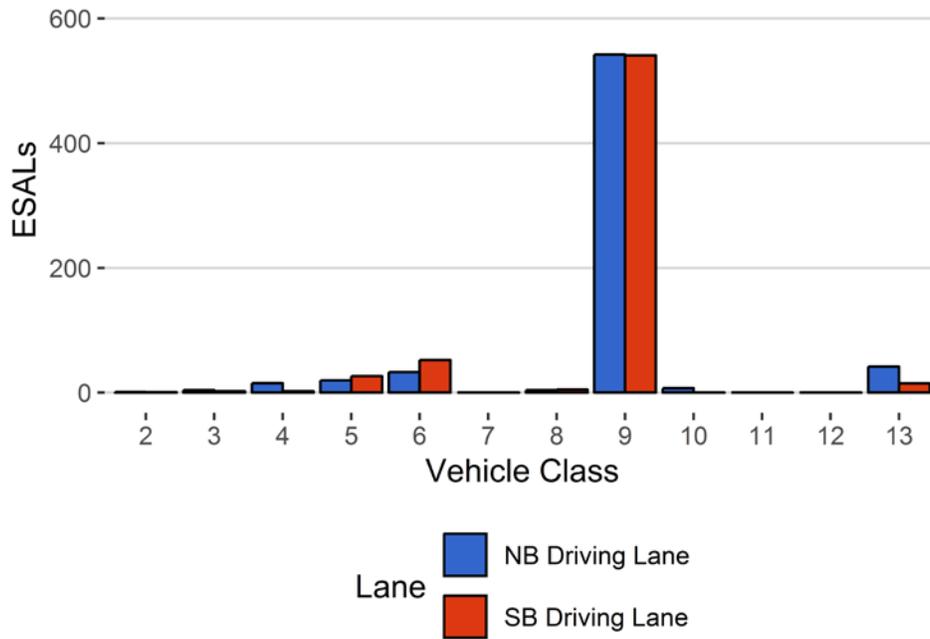


Figure 13 - ESALs by Class

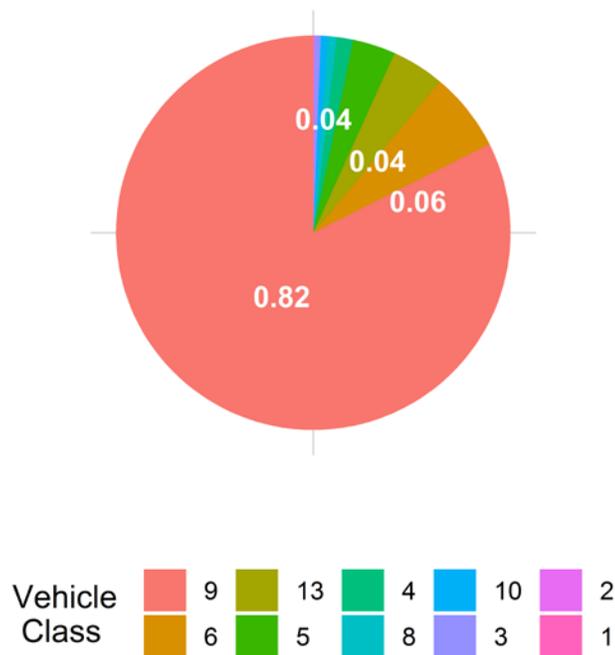


Table 1 Class 9 Front Axle Weight by Lane

<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
April 2018	10.25	5.88	10.35	4.96
May 2018	10.10	4.32	10.14	2.79
June 2018	10.04	3.75	10.27	4.15
July 2018	10.31	6.49	10.11	2.51
August 2018	10.06	3.94	10.15	2.95
September 2018	9.86	1.84	10.35	4.97

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	1	0	0	0
2	141	4370	49.6	0	0
3	110	3406	38.7	0	0
4	1	32	0.4	3	0.9
5	9	273	3.1	5	1.6
6	2	77	0.9	20	6.2
7	0	0	0	0	0
8	1	24	0.3	1	0.3
9	19	583	6.6	266	82.9
10	0	4	0	2	0.6
11	0	0	0	0	0
12	0	0	0	0	0
13	1	36	0.4	24	7.5
TOTAL	284	8807	100	321	100

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>
2019-01-25	Friday	09:19:53	9	NB	1	106.45
2019-01-31	Thursday	08:09:12	9	NB	1	103.47
2019-01-21	Monday	03:42:50	9	NB	1	102.67
2019-01-29	Tuesday	08:04:57	9	NB	1	102.16
2019-01-24	Thursday	08:23:31	10	SB	2	101.95
2019-01-29	Tuesday	05:26:18	9	NB	1	100.97
2019-01-26	Saturday	03:43:18	9	NB	1	100.69
2019-01-24	Thursday	11:27:44	10	NB	1	100.67
2019-01-21	Monday	15:47:59	9	NB	1	100.58
2019-01-25	Friday	07:41:40	9	NB	1	99.8

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	13	0	0	459	0	132
5	NB	8	116	1	0.9	1671	8	375
6	NB	19	32	4	12.5	1081	68	275
8	NB	31	9	6	66.7	110	140	9
9	NB	33	222	12	5.4	14757	320	3914
10	NB	33.5	2	0	0	195	0	64
13	NB	31.5	23	0	0	2237	0	756
TOTAL	****	****	417	23	****	20510	****	5524
<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	12	3	25	206	37	36
5	SB	8	96	10	10.4	1236	72	274
6	SB	19	28	0	0	1256	0	362
8	SB	31	10	7	70	134	140	21
9	SB	33	231	18	7.8	15733	504	4352
10	SB	33.5	1	0	0	36	0	1
13	SB	31.5	5	3	60	80	55	8
TOTAL	****	****	383	41	****	18681	****	5054
GRAND TOTAL	****	****	800	64	259	39191	1343	10578

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>
1	0	1	1	0
2	7315	4948	12263	18.1
3	8902	6224	15126	22.3
4	459	243	702	1
5	1679	1309	2987	4.4
6	1149	1256	2405	3.5
8	250	274	524	0.8
9	15077	16237	31314	46.1
10	195	36	231	0.3
13	2237	134	2371	3.5
TOTAL	37262	30662	67924	100
GVW/LANE	54.86	45.14	100	0.15

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>
1	0	0	0	0	0.5
2	1	1	2	0.1	0.0018
3	4	2	6	0.5	0.0062
4	15	2	18	1.4	1.4
5	20	26	46	3.5	0.47
6	33	52	85	6.5	2.77
8	4	5	9	0.7	1.01
9	542	541	1083	82.4	4.89
10	7	0	8	0.6	1.97
13	42	15	57	4.3	3.19
TOTAL	669	645	1314	100	16
ESALS/LANE	50.9	49.1	100	-	-

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>
Feb 2018	9024	322	56	7467	82.7	1557.3	17.3
Mar 2018	10822	349	45	9412	87	1410	13
Apr 2018	10759	359	54	9130	84.9	1628.7	15.1
May 2018	14659	473	82	12128	82.7	2530.7	17.3
Jun 2018	14918	497	87	12313	82.5	2604.8	17.5
Jul 2018	13748	444	78	11319	82.3	2429.3	17.7
Aug 2018	13369	431	88	10655	79.7	2714.1	20.3
Sep 2018	12670	422	74	10446	82.4	2223.9	17.6
TOTAL	99969	-	-	82870	-	17099	-
AVERAGE	12496	412	70	10359	83	2137	17

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>
Feb 2018	724	1115	1839	9.4
Mar 2018	541	630	1170	3.3
Apr 2018	462	863	1325	3.7
May 2018	753	1132	1885	6
Jun 2018	760	1414	2173	1.1
Jul 2018	931	1121	2053	0.3
Aug 2018	646	1491	2137	1.8
Sep 2018	476	1503	1979	2.5
TOTAL	5292	-	-	-
AVERAGE	662	1159	1820	4

Gross Vehicle Weight

<i>Month</i>	<i>GVW NB Driving Lane</i>	<i>GVW SB Driving Lane</i>	<i>Total GVW Kips</i>
Feb 18	53051	55564	108616
Mar 18	53496	52160	105656
Apr 18	54103	59595	113698
May 18	81509	84194	165703
Jun 18	83916	92328	176243
Jul 18	84746	82653	167398
Aug 18	64139	80654	144793
Sep 18	53654	85064	138718
TOTAL	528614	592211	1120825
AVERAGE	66077	74026	140103

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>
Feb 2018	552	6.6	37.6	71	6
Mar 2018	316	3.1	23.4	12	0
Apr 2018	365	3.6	23.6	32	4
May 2018	432	3.1	17.8	23	1
Jun 2018	518	3.6	20.5	29	1
Jul 2018	539	4.1	23	26	1
Aug 2018	643	6.2	30.5	22	0
Sep 2018	543	5	28.3	12	0
TOTAL	3908	-	-	227	13
AVERAGE	488.5	4.4	25.6	28.4	1.6

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>
Feb 2018	7290	9801	17090	42.7	57.3
Mar 2018	5578	6340	11918	46.8	53.2
Apr 2018	4982	9019	14001	35.6	64.4
May 2018	8683	12489	21172	41	59
Jun 2018	8623	15037	23660	36.4	63.6
Jul 2018	10708	12144	22852	46.9	53.1
Aug 2018	6551	14747	21298	30.8	69.2
Sep 2018	5185	14955	20140	25.7	74.3
TOTAL	57599	94533	152132	-	-
AVERAGE	7199.9	11816.6	19016.5	38.2	61.8