

JANUARY 2019



**WIM #39
MN 43, MP 45.2
WINONA, MN**

**MONTHLY
REPORT**



Your Destination...Our Priority



WIM Site Location

WIM #39 is located on MN 43 near Winona in Winona county.

System Operation

WIM #39 was operational for the entire month of January 2019. Volume was computed using all monthly data.

System Calibration

WIM #39 was most recently calibrated on 2018-11-28. 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: 265163 | Passenger Vehicles: 250711 | Heavy Commercial Vehicles: 14452

Monthly Average Daily Traffic (MADT): 8554 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 466

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 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 08 AM

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 08 AM. 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 14452 HCVs, 2016 of them were overweight ³. These overweight HCVs contributed to 0.8% of total monthly volume, and 14.1% 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 Saturdays. See Figure 3 . The top two overweight violators by class were the class 9 and class 7 vehicles . Overall, overweight vehicles tended to reach peak volume concentrations during typical business hours, with 80.1% of all overweight vehicles traveling NB 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 October.

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 ,64 NB vehicles exceeded 88,000 pounds (40 vehicles were Class 12's; 15 vehicles were Class 9's). Of vehicles traveling SB,

12 NB vehicles exceeded 88,000 pounds (7 vehicles were Class 10's; 4 vehicles were Class 9'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 fully_loaded Class 9's than empty Class 9's traveling NB, while there were more empty Class 9's than fully_loaded 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 114137 tons of freight was recorded to have crossed the WIM. More freight was shipped NB (65%) than SB (35%). See Table 4 and Figure 11 for more freight information.

Infrastructure Considerations

Bridge. Bridge No. 5930 is approximately 0.1 miles north of WIM #39, and Bridge No. 5900 is 0.3 miles south of WIM #39. WIM #39 recorded a total of 265163 vehicles with a combined GVW of 1699029 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 10335 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 67.3% of all ESALs were recorded NB while 32.7% was observed SB. In particular, 71% of all ESALs were generated by the Class 9's (Class 9's were also responsible for generating 24% 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).

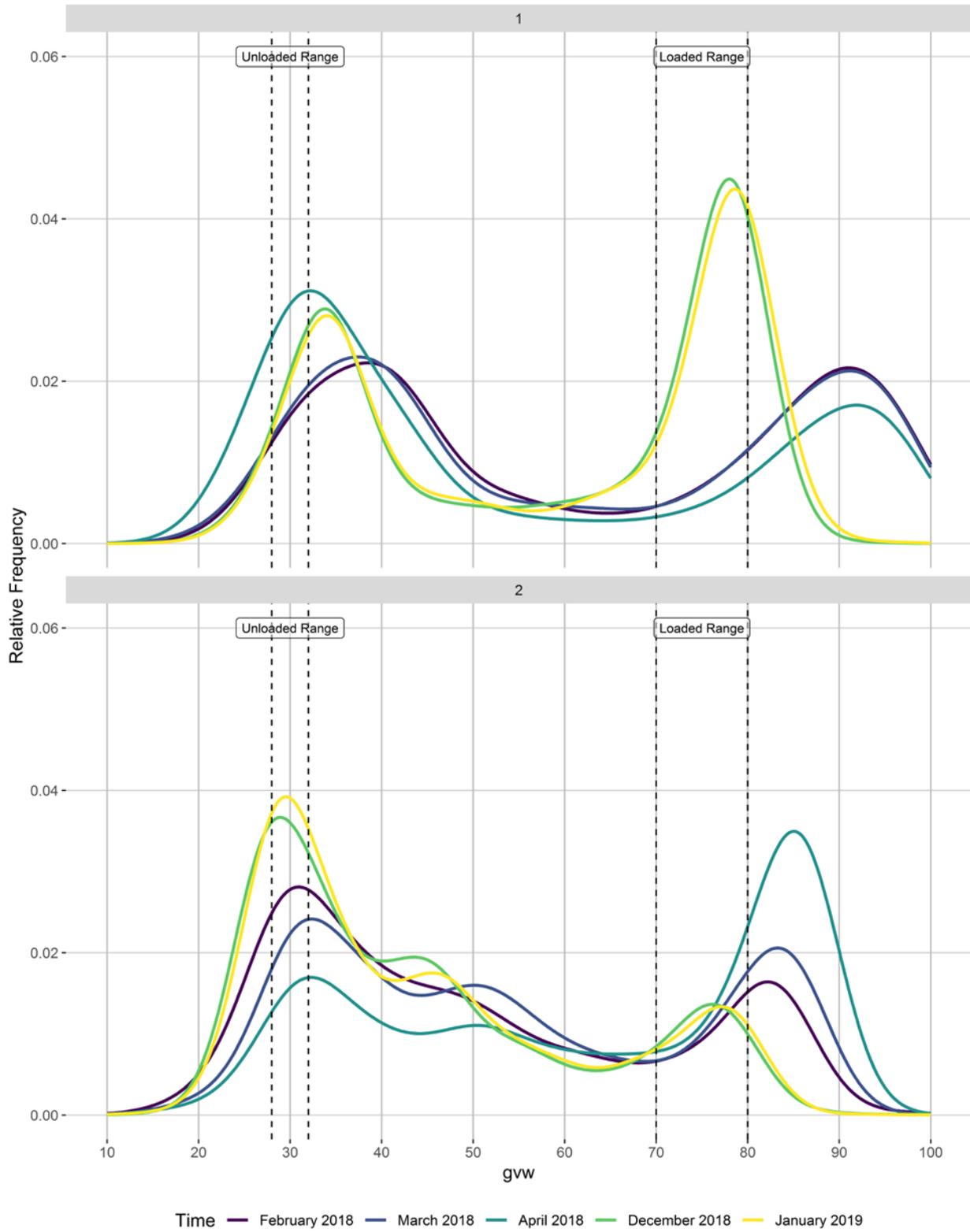
WIM monthly reports can be found at: <http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html>

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.

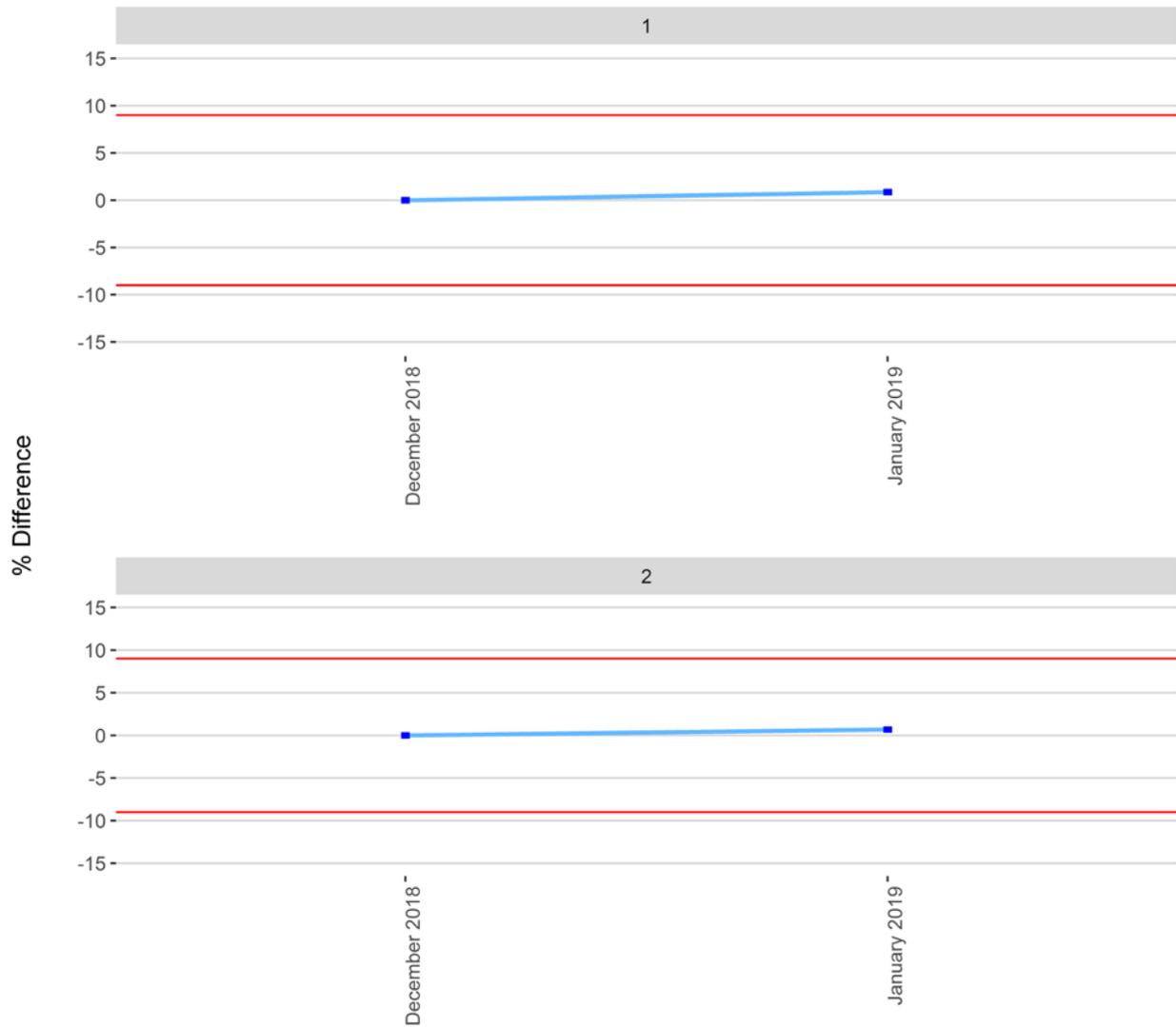
To request this document in an alternative format, please call 651-366-4718 or 1-800-657-3774, or email your request to ADArequest.dot@state.mn.us. Please request at least one week in advance.

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

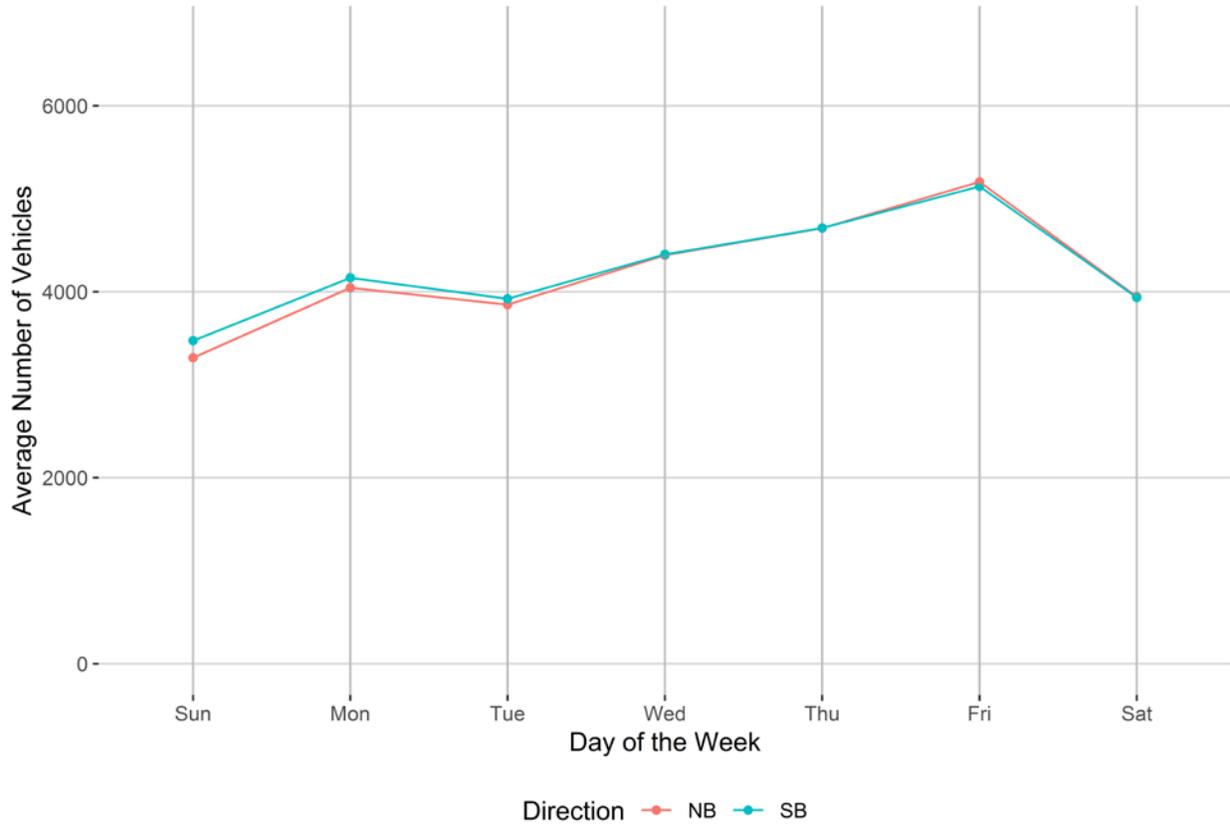


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

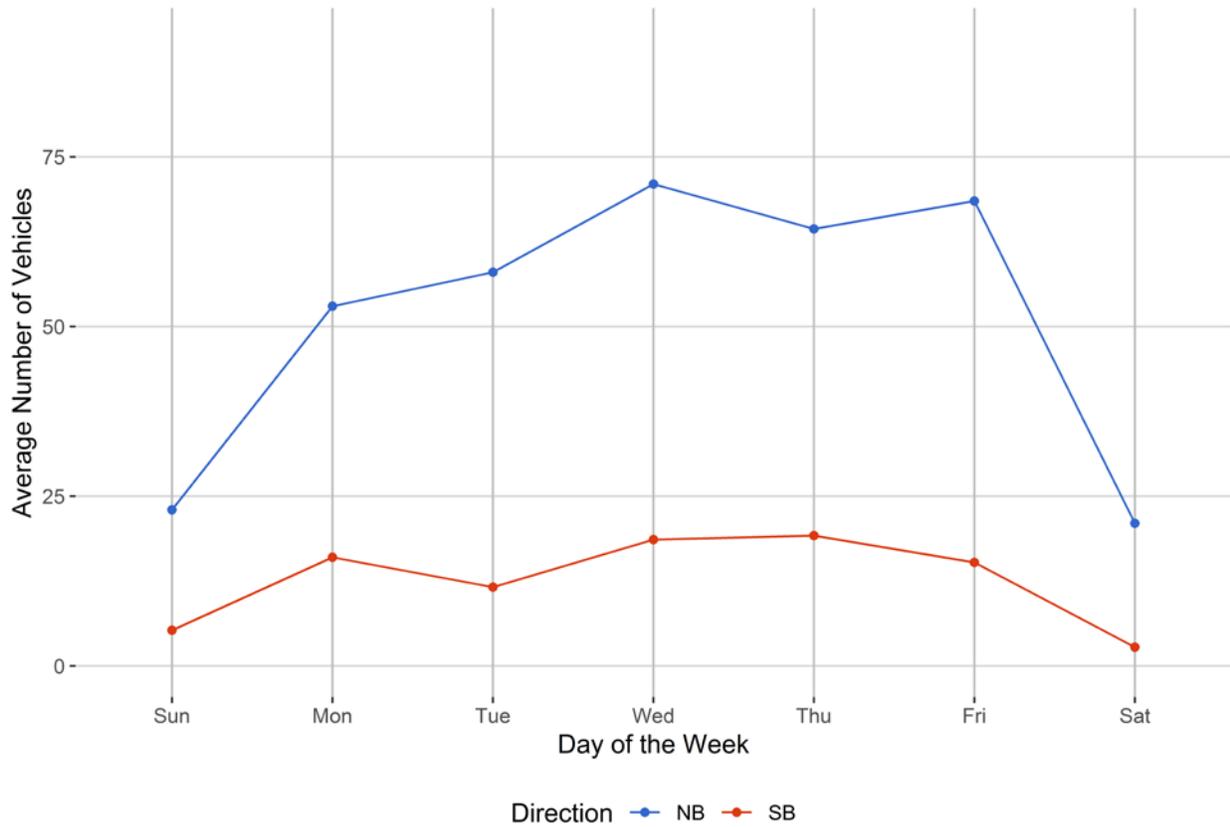


Figure 4 - Passenger Vehicles vs. Hour of the Day

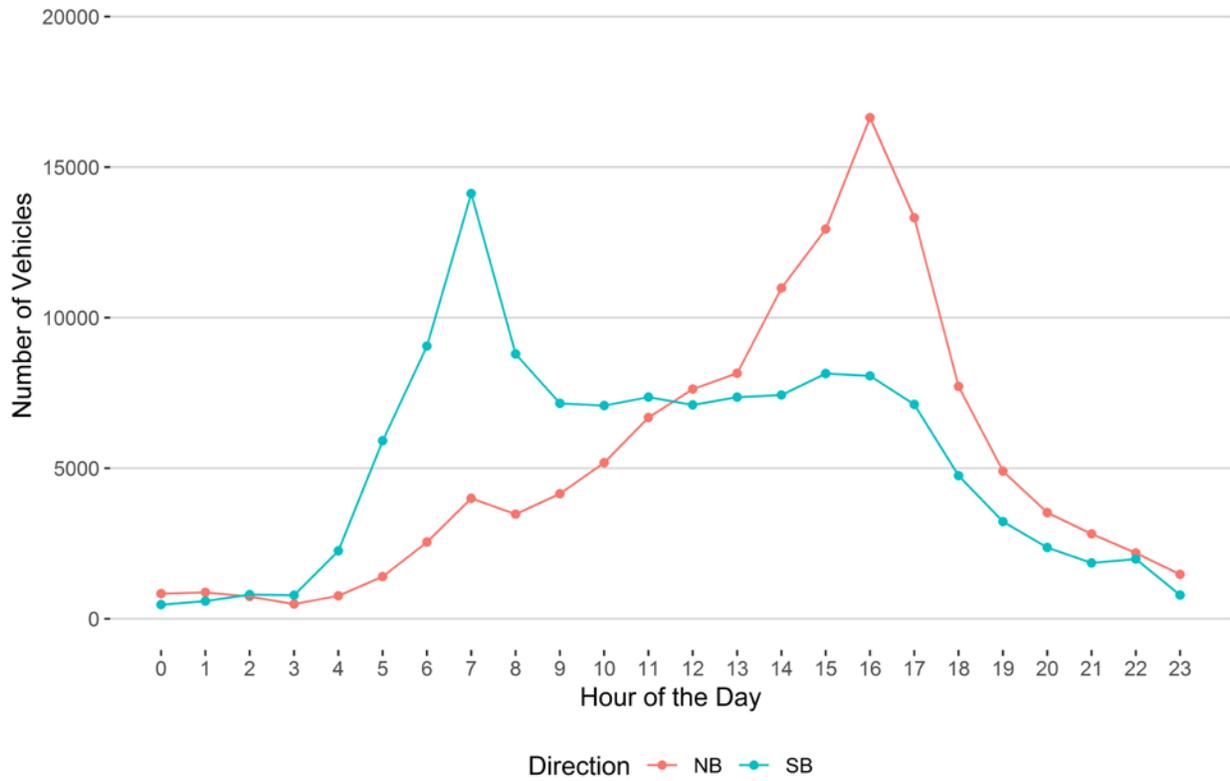


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

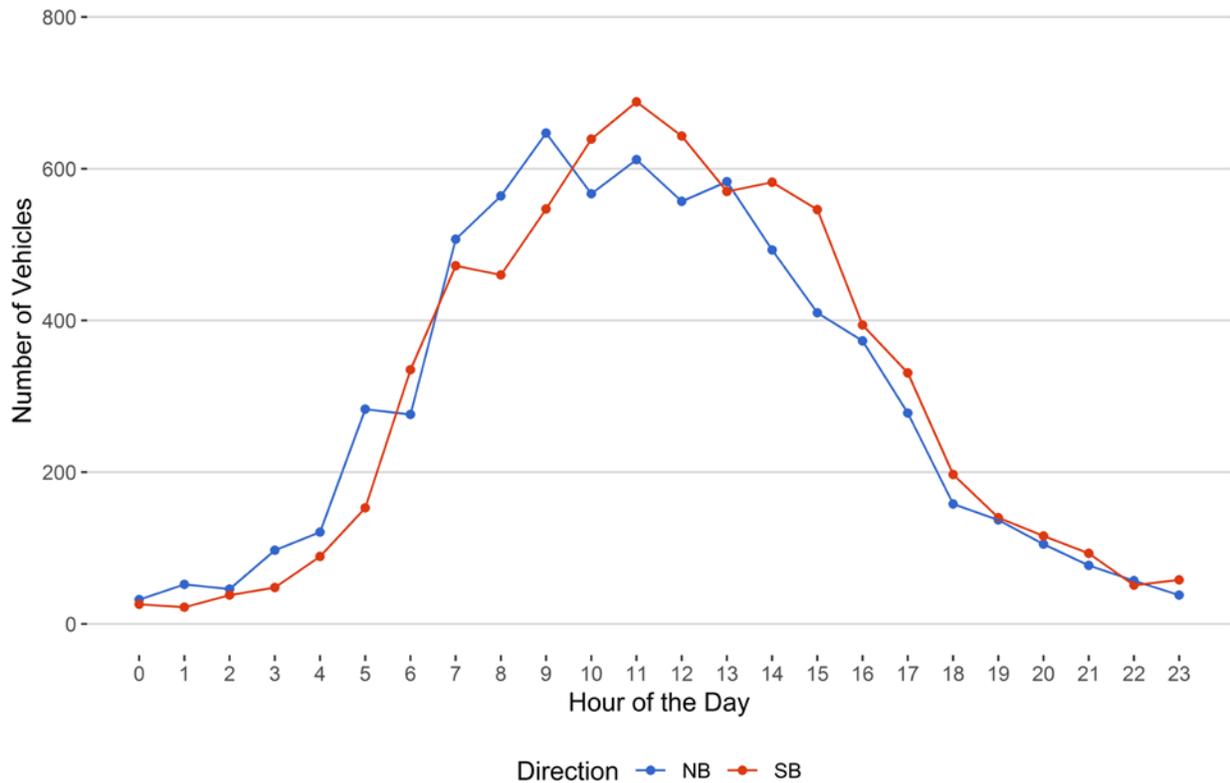


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

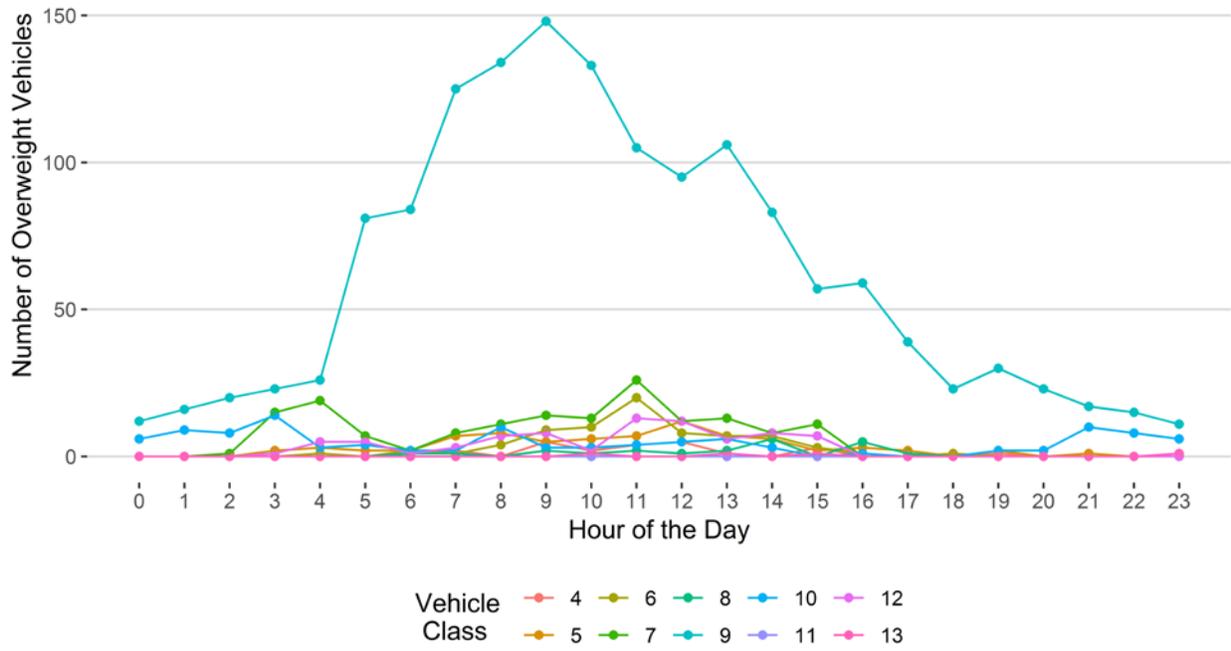


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

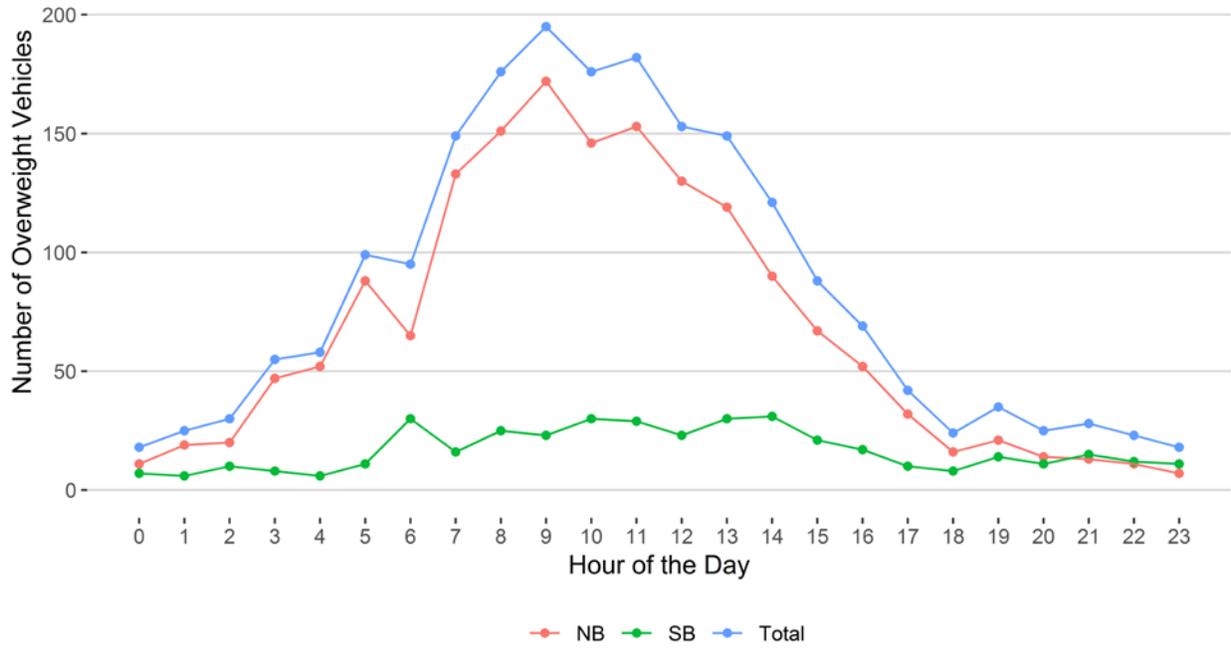
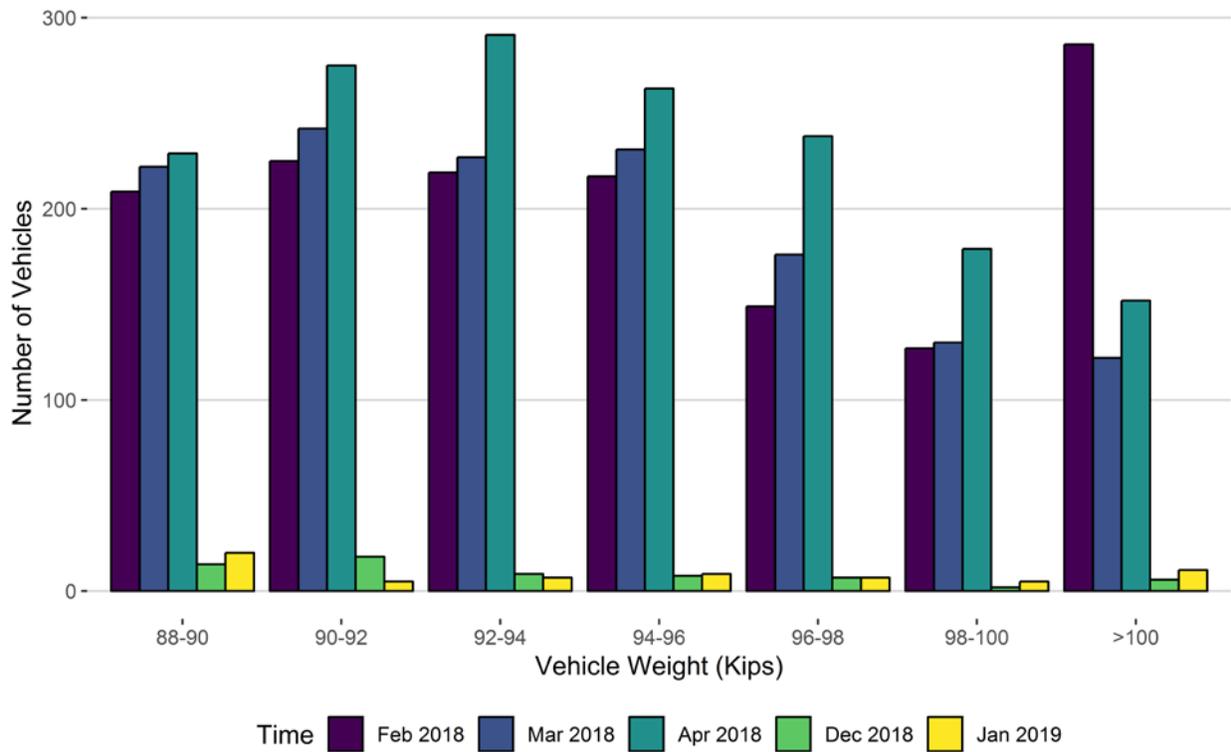
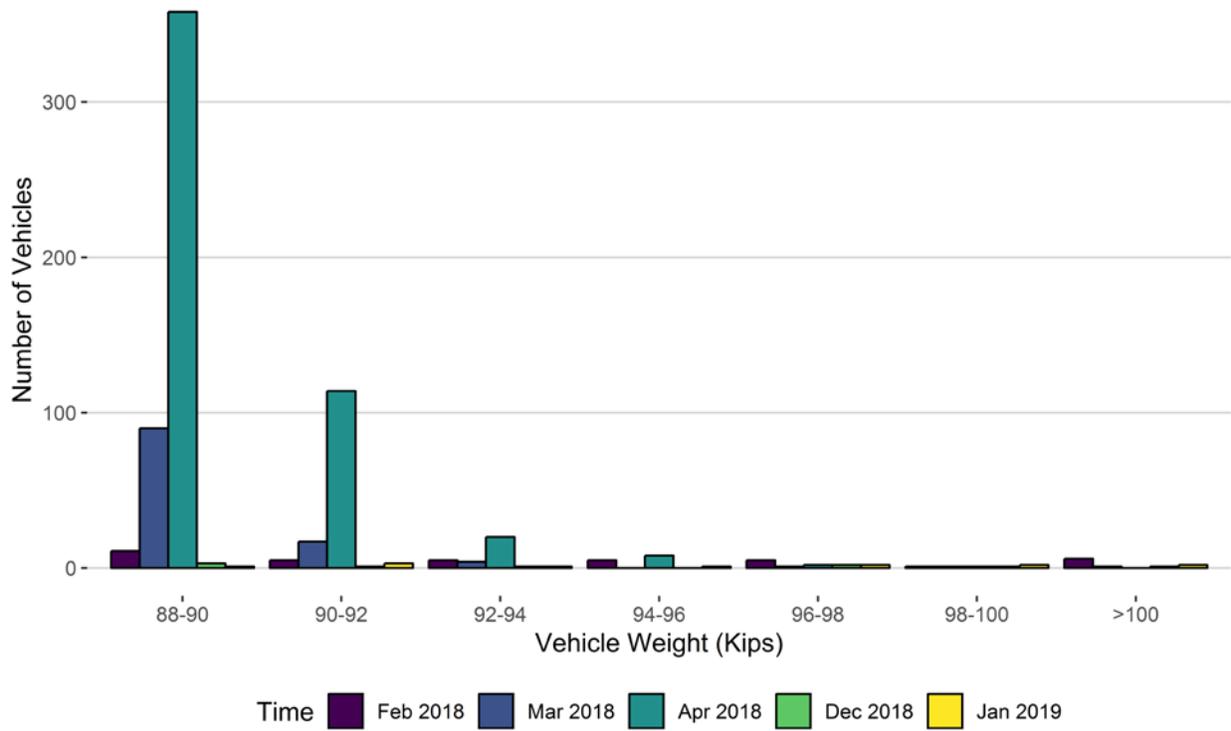


Figure 8 - Histogram of NB Vehicles Over 88,000 Pounds for Current Month



<i>Vehicle Weights (Kips)</i>	<i>Feb 2018</i>	<i>Mar 2018</i>	<i>Apr 2018</i>	<i>Dec 2018</i>	<i>Jan 2019</i>
88-90	209	222	229	14	20
90-92	225	242	275	18	5
92-94	219	227	291	9	7
94-96	217	231	263	8	9
96-98	149	176	238	7	7
98-100	127	130	179	2	5
>100	286	122	152	6	11
Total	1432	1350	1627	64	64

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



Vehicle Weights (Kips)	Feb 2018	Mar 2018	Apr 2018	Dec 2018	Jan 2019
88-90	11	90	358	3	1
90-92	5	17	114	1	3
92-94	5	4	20	1	1
94-96	5	0	8	0	1
96-98	5	1	2	2	2
98-100	1	1	1	1	2
>100	6	1	0	1	2
Total	38	114	503	9	12

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

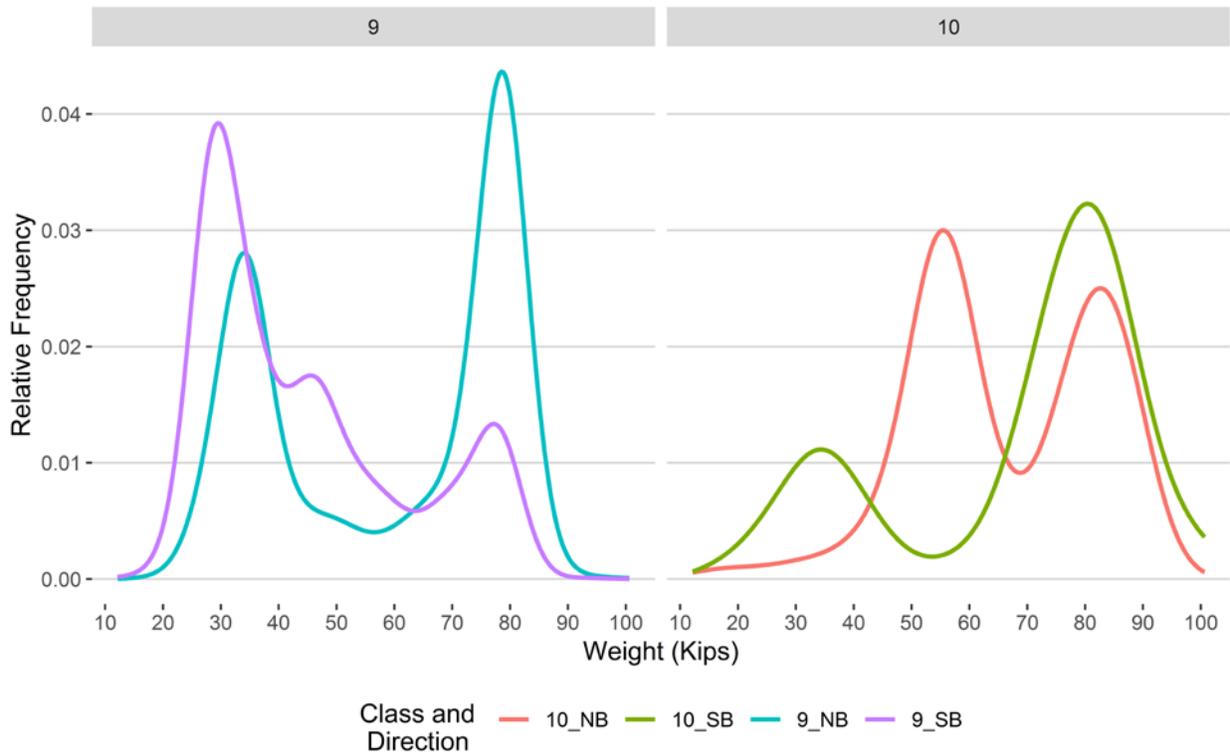


Figure 9 - Freight Percentage by Direction and Class

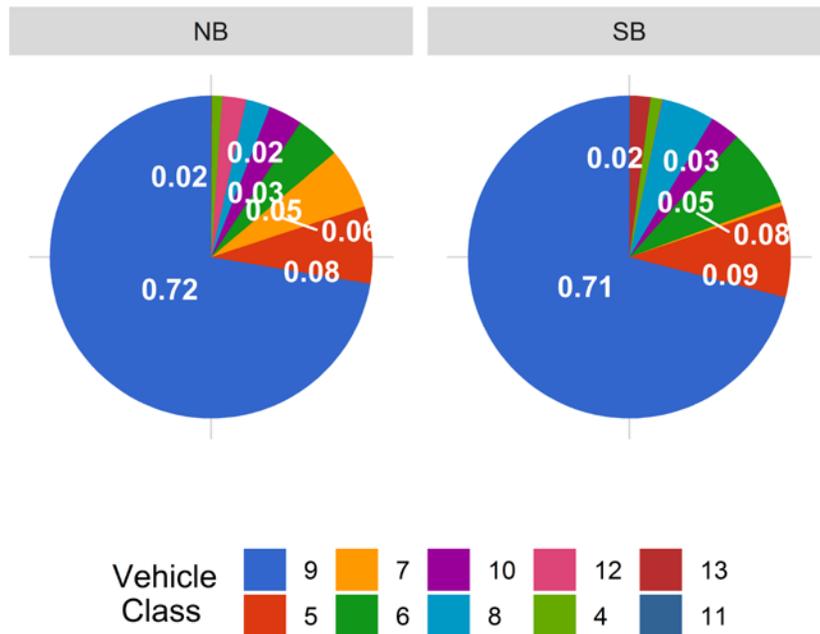


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

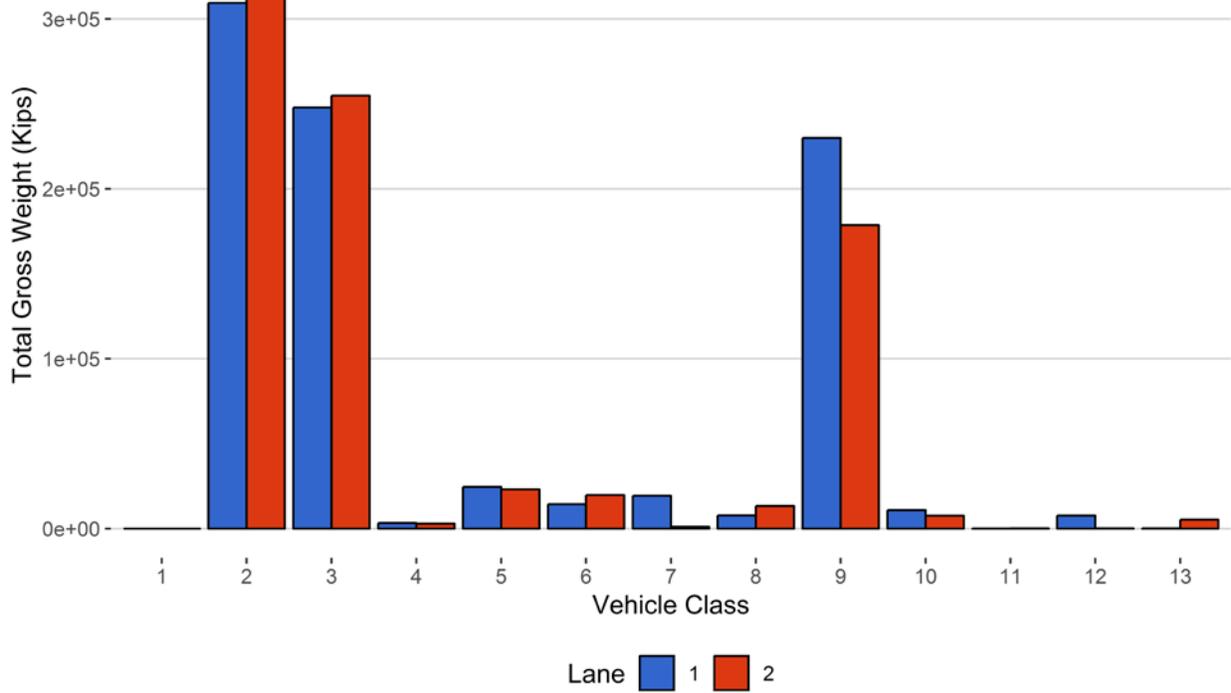


Figure 11 - Total Gross Vehicle Weight t

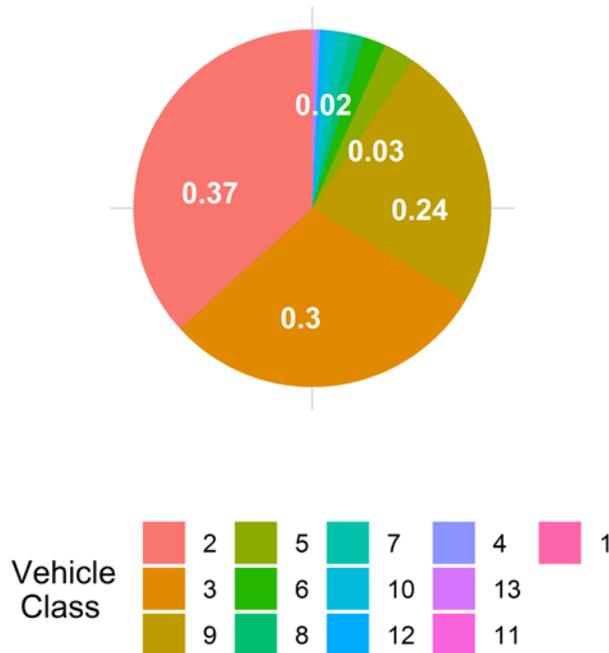


Figure 12 - Total ESALs by Class and Lane

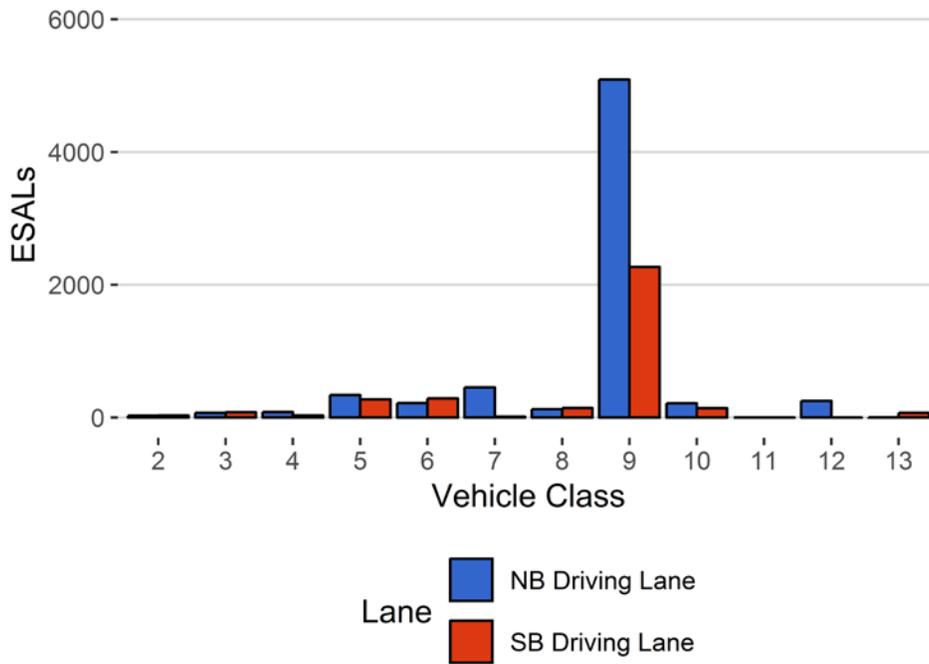


Figure 13 - ESALs by Class

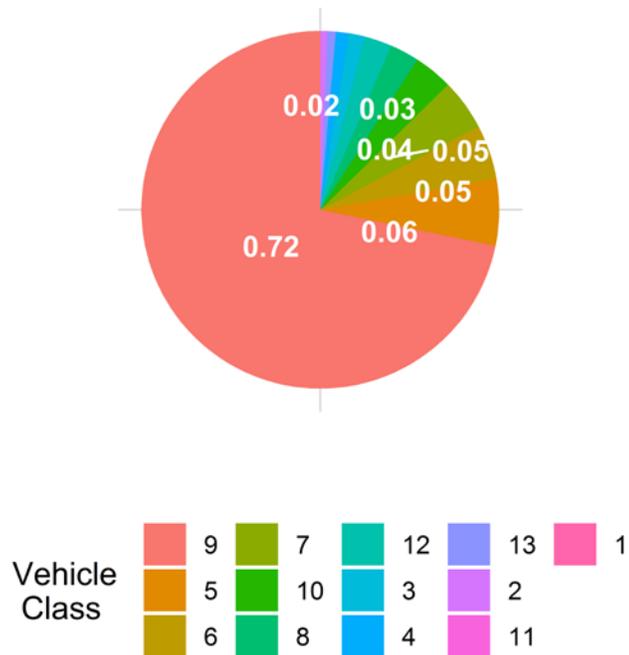


Table 1 Class 9 Front Axle Weight by Lane

<i>Month</i>	<i>Lane 1 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 2 (Kips)</i>	<i>Front Axle +/- 9%</i>
December 2018	10.79	0.00	10.54	0.00
January 2019	10.88	0.85	10.62	0.68

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	5	0	0	0
2	5264	163169	61.5	0	0
3	2824	87537	33	0	0
4	7	226	0.1	25	1.2
5	119	3697	1.4	77	3.8
6	38	1191	0.4	74	3.7
7	10	296	0.1	160	7.9
8	21	663	0.2	22	1.1
9	256	7939	3	1465	72.7
10	9	275	0.1	111	5.5
11	0	4	0	0	0
12	3	90	0	78	3.9
13	2	72	0	4	0.2
TOTAL	8554	265163	100	2016	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>
2019-01-14	Monday	10:03:52	10	SB	2	100.64
2019-01-21	Monday	05:13:09	9	NB	1	100.13
2019-01-23	Wednesday	03:54:36	9	NB	1	98.73
2019-01-23	Wednesday	21:10:37	9	SB	2	98.72
2019-01-31	Thursday	05:52:49	10	SB	2	98.31
2019-01-31	Thursday	03:40:55	10	SB	2	97.22
2019-01-31	Thursday	16:58:16	10	SB	2	96.87
2019-01-22	Tuesday	03:52:32	9	NB	1	96.54
2019-01-31	Thursday	19:44:45	10	SB	2	94.73
2019-01-28	Monday	15:59:32	9	NB	1	94.61

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	106	20	18.9	2997	271	853
5	NB	8	1853	322	17.4	22217	2368	4985
6	NB	19	499	131	26.3	12039	2279	2524
7	NB	11.5	270	0	0	19362	0	8128
8	NB	31	230	69	30	6243	1449	626
9	NB	33	3858	497	12.9	215074	14892	52080
10	NB	33.5	163	5	3.1	10674	126	2690
11	NB	36.5	2	0	0	79	0	3
12	NB	36.5	87	1	1.1	7649	16	2255
13	NB	31.5	2	0	0	145	0	41
TOTAL	****	****	7070	1045	****	296478	****	74186
<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	118	24	20.3	2589	323	589
5	SB	8	1807	325	18	20727	2386	4436
6	SB	19	680	136	20	17344	2353	3504
7	SB	11.5	23	0	0	1026	0	381
8	SB	31	426	234	54.9	7522	5800	785
9	SB	33	4002	1495	37.4	136185	42416	26727
10	SB	33.5	109	11	10.1	7207	316	1962
11	SB	36.5	2	0	0	106	0	16
12	SB	36.5	2	0	0	119	0	23
13	SB	31.5	69	0	0	5230	0	1528
TOTAL	****	****	7238	2225	****	198055	****	39952
GRAND TOTAL	****	****	14308	3270	270	494534	74993	114137

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	1	4	5	0
2	309432	313883	623315	36.8
3	247863	254838	502701	29.6
4	3268	2912	6179	0.4
5	24585	23113	47698	2.8
6	14318	19697	34015	2
7	19362	1026	20388	1.2
8	7692	13322	21014	1.2
9	229965	178601	408567	24.1
10	10800	7523	18322	1.1
11	79	106	184	0
12	7665	119	7784	0.5
13	145	5230	5375	0.3
TOTAL	875173	820374	1695547	100
GVW/LANE	51.62	48.38	100	0.01

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	0.1667
2	31	32	64	0.6	8e-04
3	72	81	153	1.5	0.0036
4	86	33	119	1.2	1.06
5	340	276	616	6	0.34
6	219	289	508	5	0.87
7	457	16	473	4.6	3.19
8	127	144	271	2.6	0.83
9	5091	2271	7362	71.8	1.88
10	218	143	361	3.5	2.61
11	0	2	3	0	1.11
12	251	1	252	2.5	5.14
13	4	73	77	0.8	1.99
TOTAL	6896	3361	10257	100	19
ESALS/LANE	67.2	32.8	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	248161	8863	485	234584	94.5	13577.4	5.5
Mar 2018	300952	9708	512	285074	94.7	15877.5	5.3
Apr 2018	295692	9856	706	274499	92.8	21192.8	7.2
Dec 2018	283227	9136	450	269265	95.1	13962.3	4.9
Jan 2019	265163	8554	466	250711	94.5	14452.3	5.5
TOTAL	1393195	-	-	1314133	-	79062	-
AVERAGE	278639	9224	524	262827	94	15812	6

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	11909	24119	36029	6.6
Mar 2018	11420	6024	17444	68.7
Apr 2018	13423	12893	26316	74.2
Dec 2018	6281	3102	9384	0.7
Jan 2019	6958	3377	10335	1.7
TOTAL	49992	-	-	-
AVERAGE	9998	9903	19902	30

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	948019	737183	1685202
Mar 18	1086885	932878	2019763
Apr 18	1173322	1114993	2288315
Dec 18	897732	839106	1736837
Jan 19	877835	821194	1699029
TOTAL	4983793	4445354	9429146
AVERAGE	996759	889071	1885829

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	3229	1.3	23.6	1516	439
Mar 2018	3678	1.2	23.1	1479	255
Apr 2018	5931	2	27.9	2151	333
Dec 2018	1669	0.6	12	73	10
Jan 2019	2033	0.8	14.1	76	20
TOTAL	16540	-	-	5295	1057
AVERAGE	3308	1.2	20.1	1059	211.4

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	90246	41109	131355	68.7	31.3
Mar 2018	91109	62730	153839	59.2	40.8
Apr 2018	104039	121316	225355	46.2	53.8
Dec 2018	68684	36498	105183	65.3	34.7
Jan 2019	74186	39952	114137	65	35
TOTAL	428265	301604	729869	-	-
AVERAGE	85652.9	60320.9	145973.8	60.9	39.1