

FEBRUARY 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 February 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: 230485 | Passenger Vehicles: 217063 | Heavy Commercial Vehicles: 13422

Monthly Average Daily Traffic (MADT): 8232 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 479

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 13422 HCVs, 2124 of them were overweight ³. These overweight HCVs contributed to 0.9% of total monthly volume, and 16% of total monthly

HCV volume. NB overweight vehicles typically reached highest numbers on Mondays, with lowest volumes reported on Sundays. 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 83.3% 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 ,80 NB vehicles exceeded 88,000 pounds (42 vehicles were Class 12's; 23 vehicles were Class 9's). Of vehicles traveling SB,

17 NB vehicles exceeded 88,000 pounds (11 vehicles were Class 10's; 5 vehicles were Class 9's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from February 2019.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9s and 10s in February 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 112867 tons of freight was recorded to have crossed the WIM. More freight was shipped NB (67.3%) than SB (32.7%). 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 230485 vehicles with a combined GVW of 1517463 kips (1 kip = 1,000 pounds = 0.5 tons) in February 2019. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 9967 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 68.9% of all ESALs were recorded NB while 31.1% was observed SB. In particular, 60% of all ESALs were generated by the Class 9's (Class 9's were also responsible for generating 22% 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).

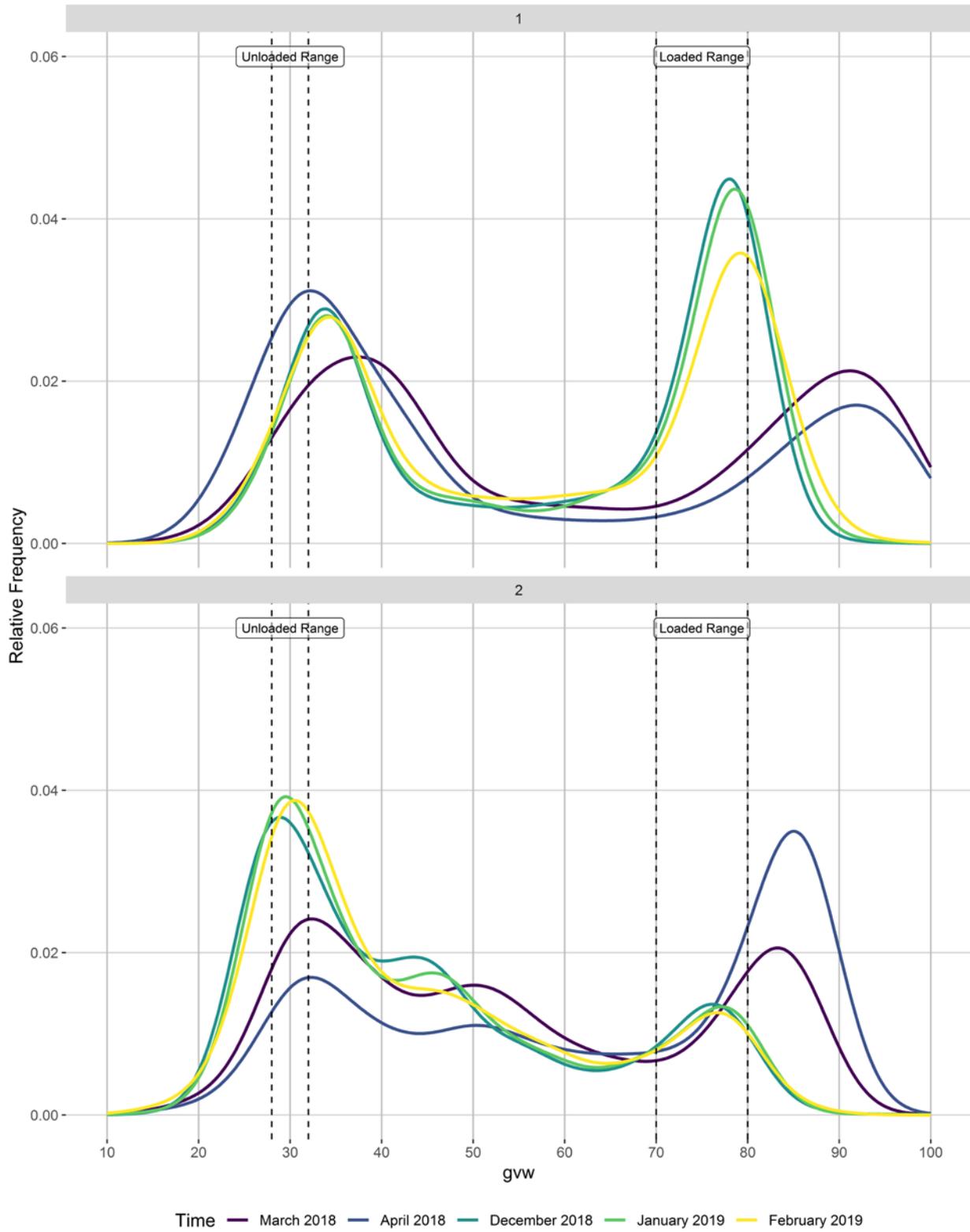
WIM monthly reports can be found at: <http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html>

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.

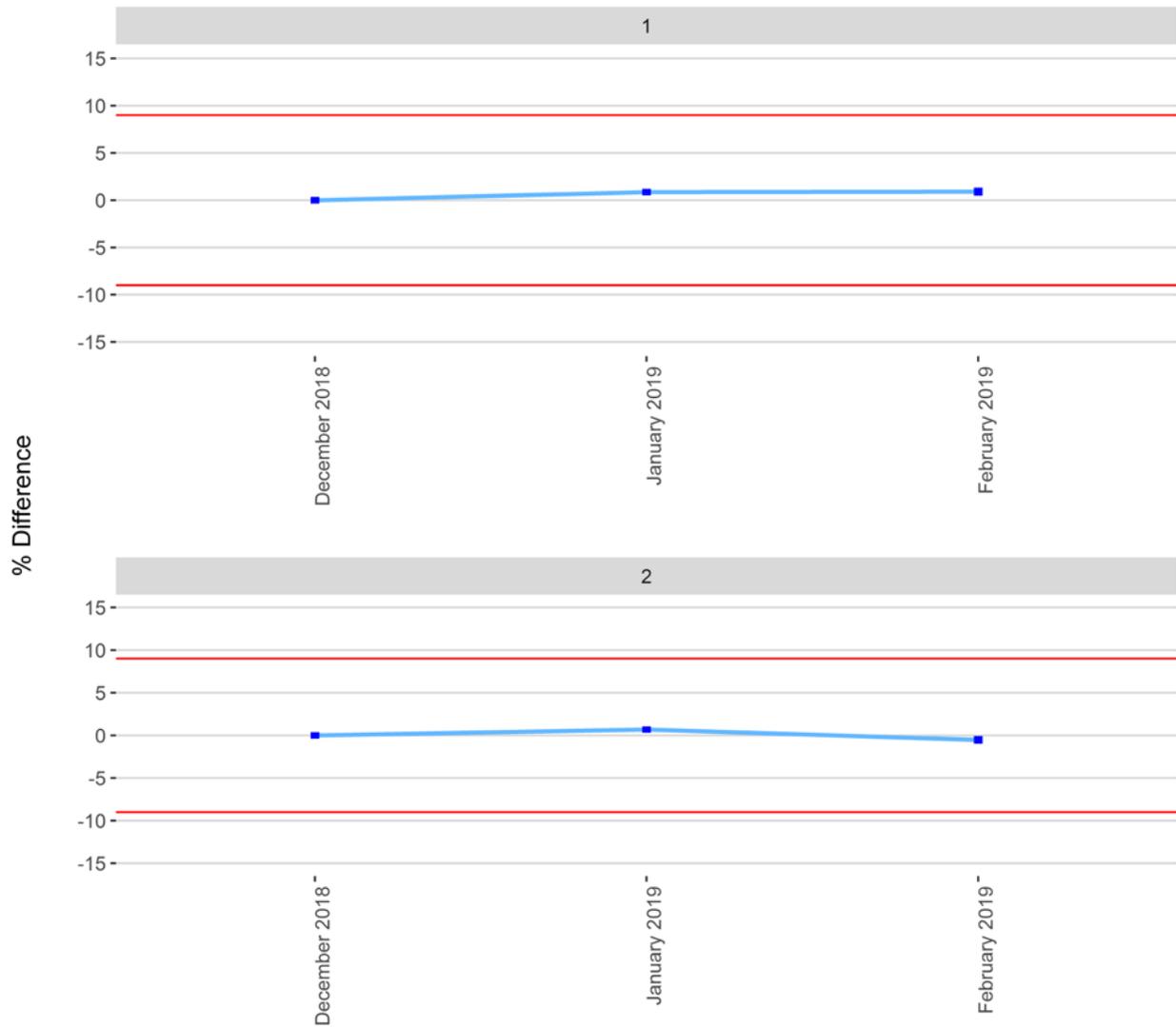
To request this document in an alternative format, please call 651-366-4718 or 1-800-657-3774, or email your request to ADArequest.dot@state.mn.us. Please request at least one week in advance.

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

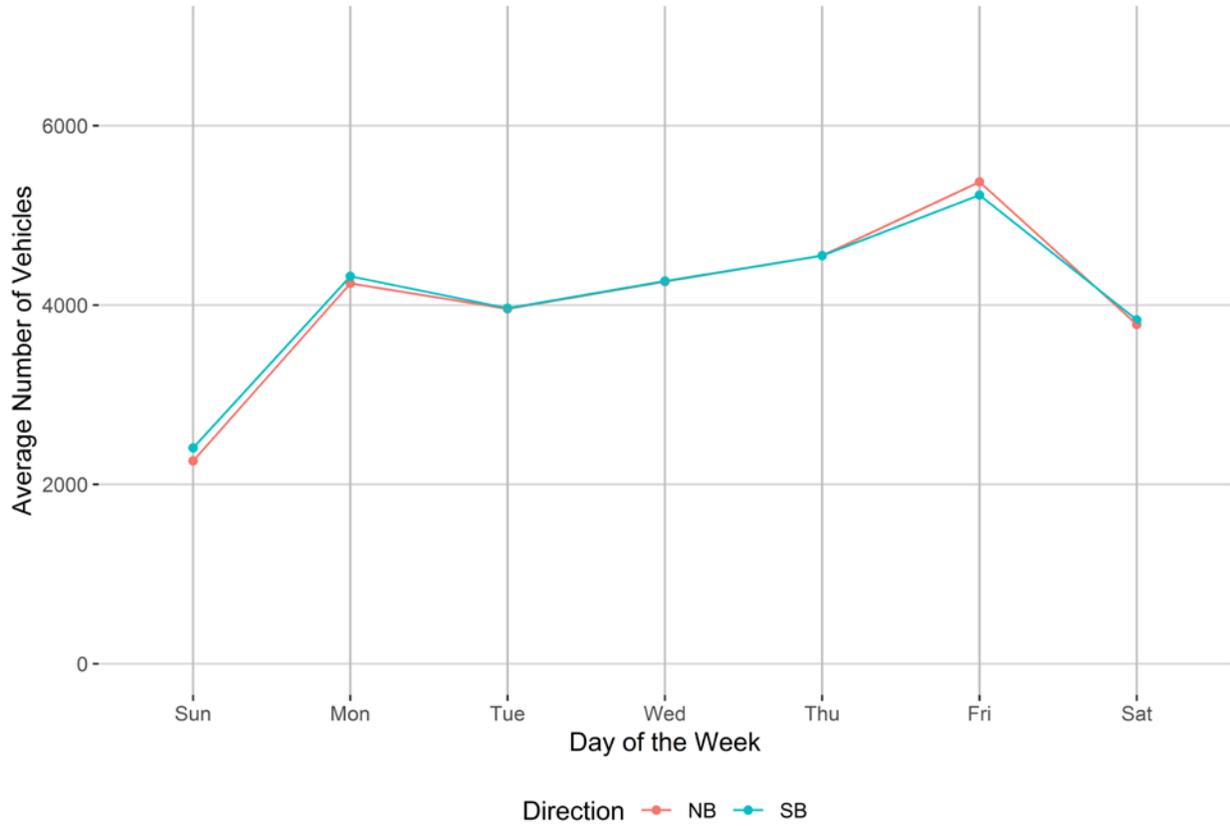


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

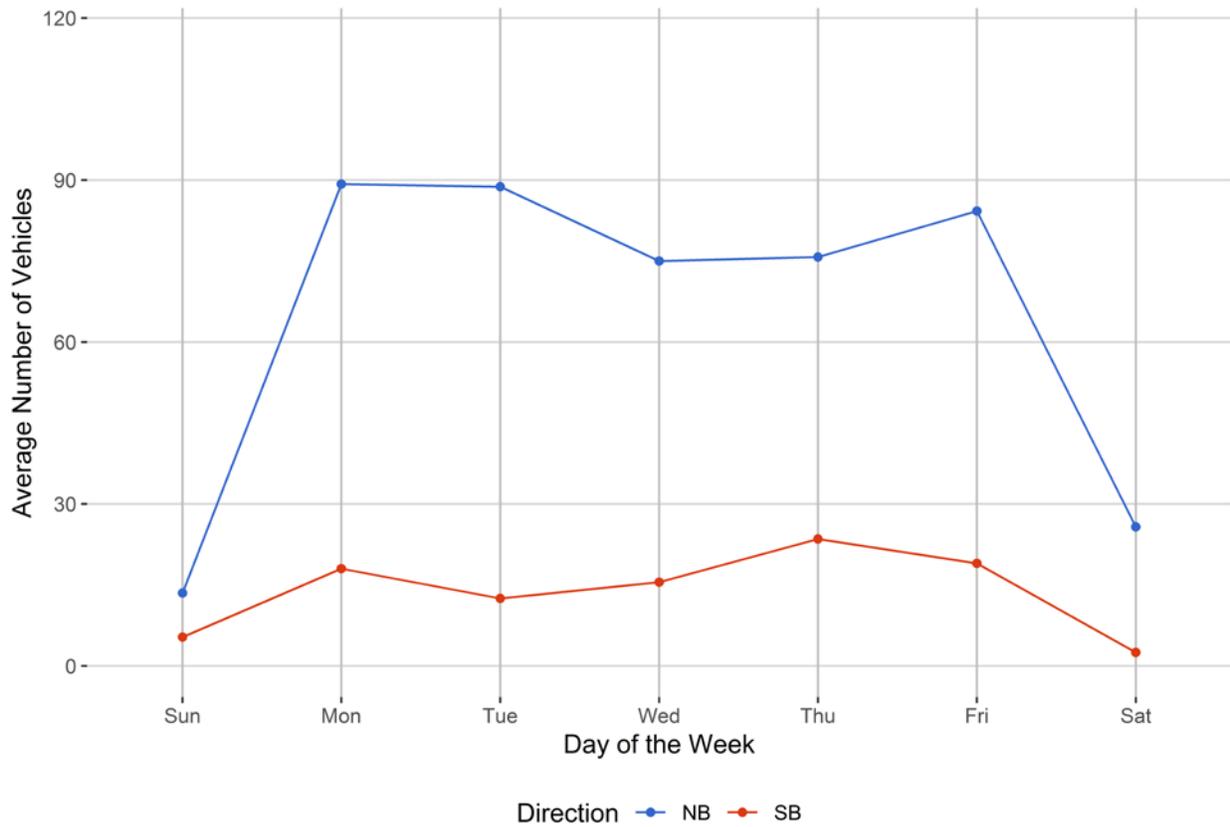


Figure 4 - Passenger Vehicles vs. Hour of the Day

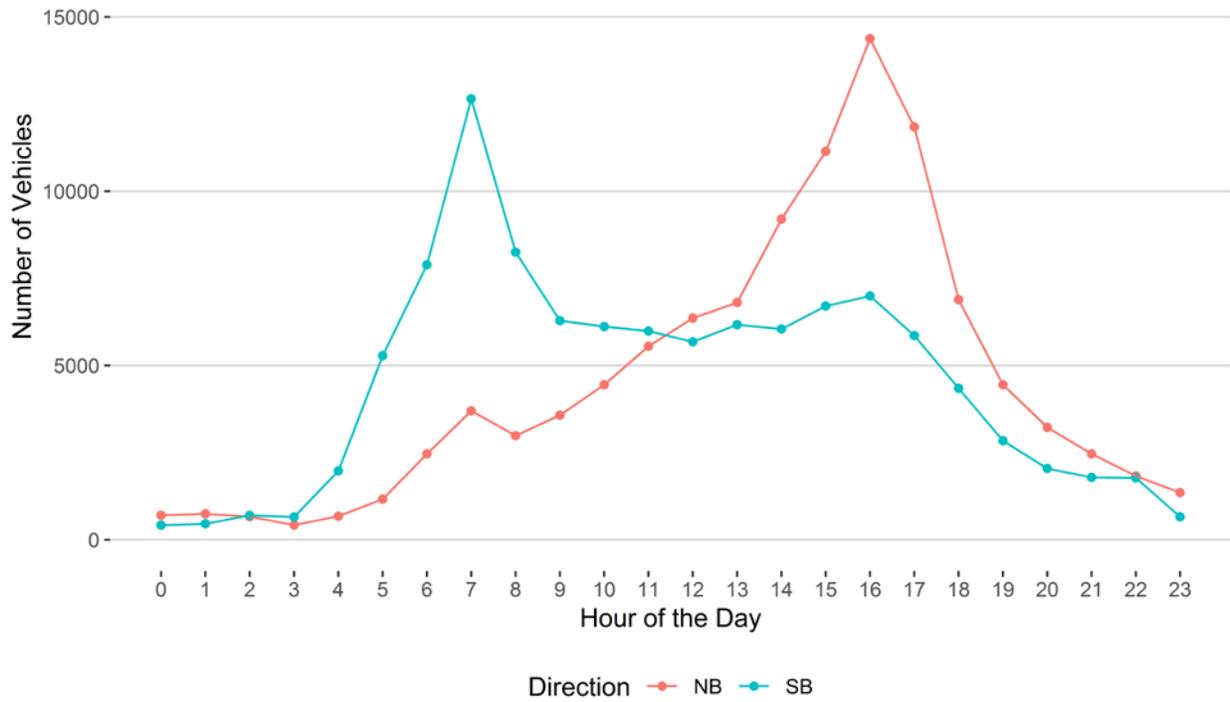


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

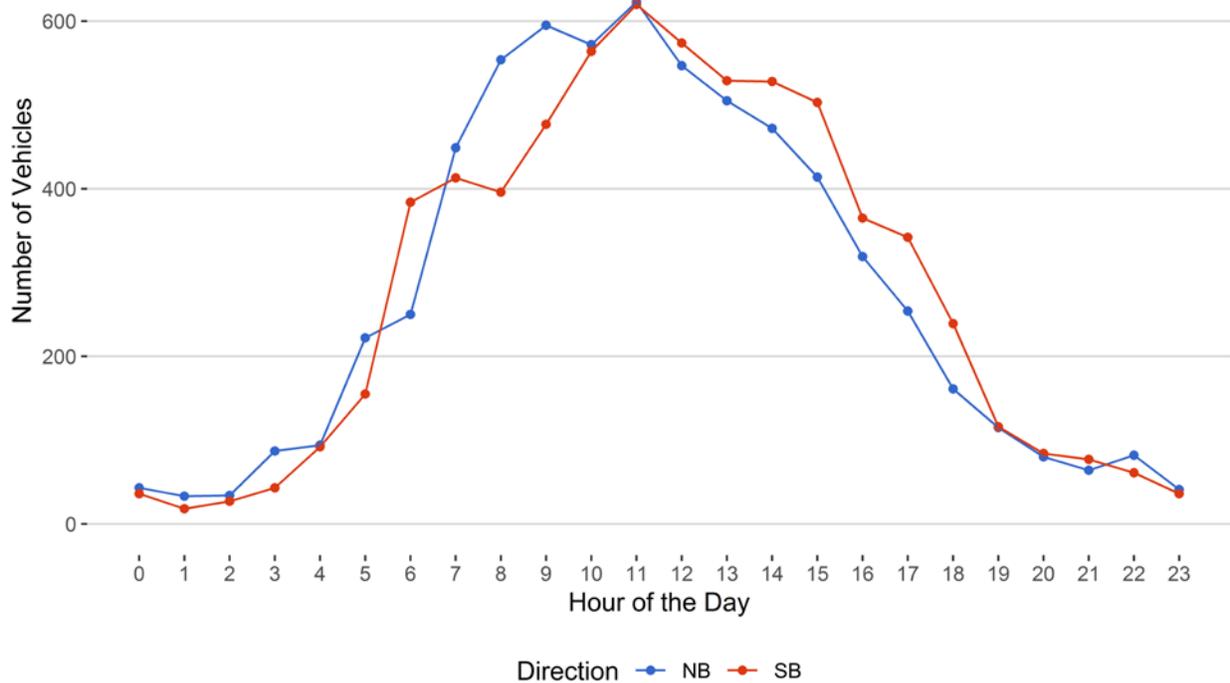


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

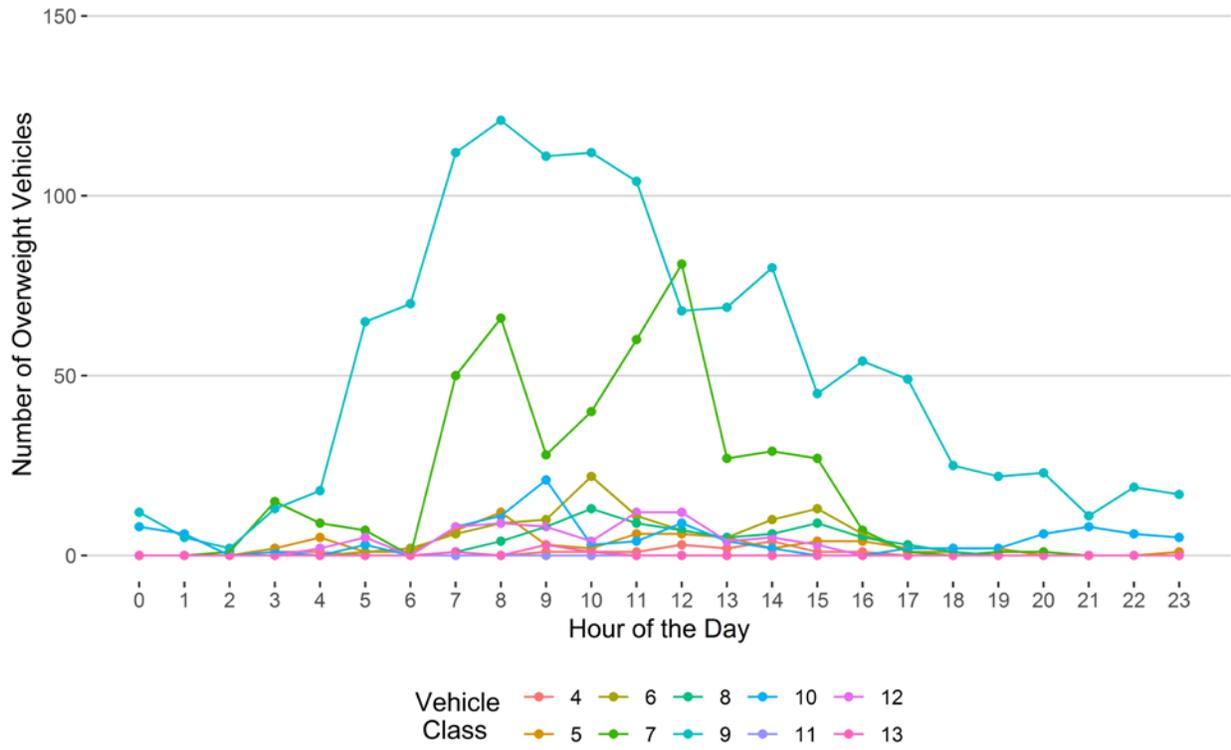


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

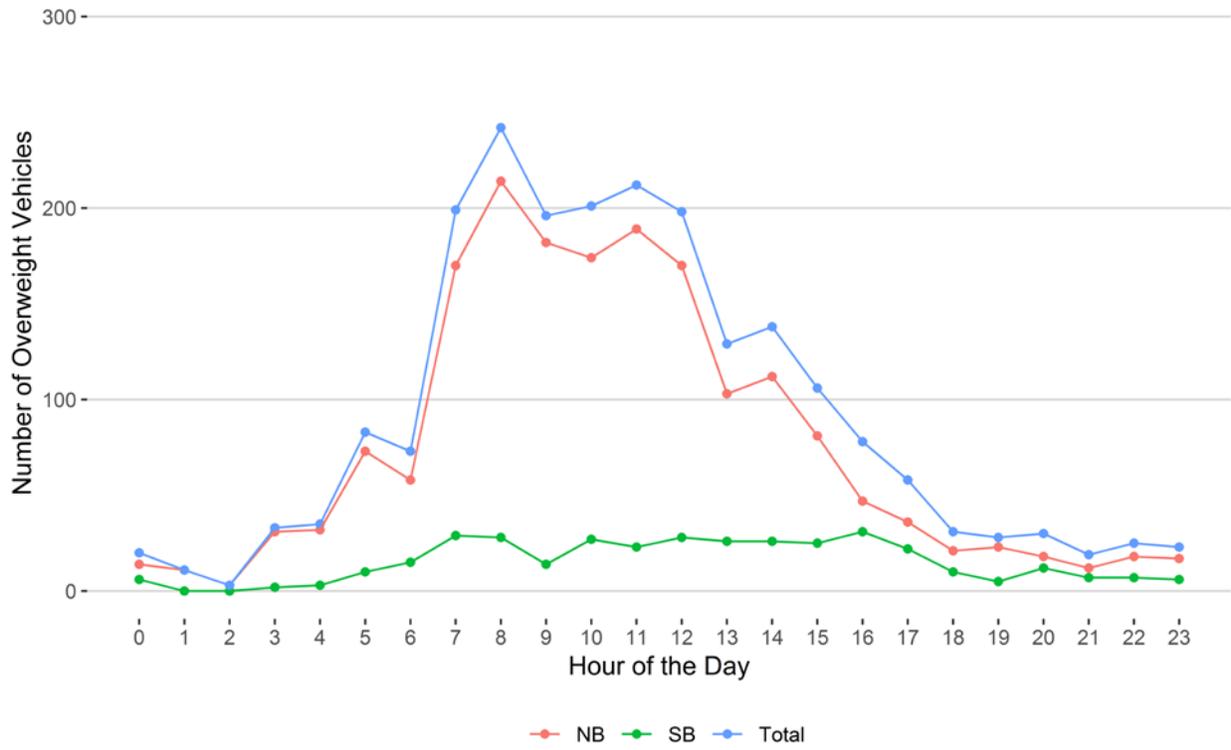
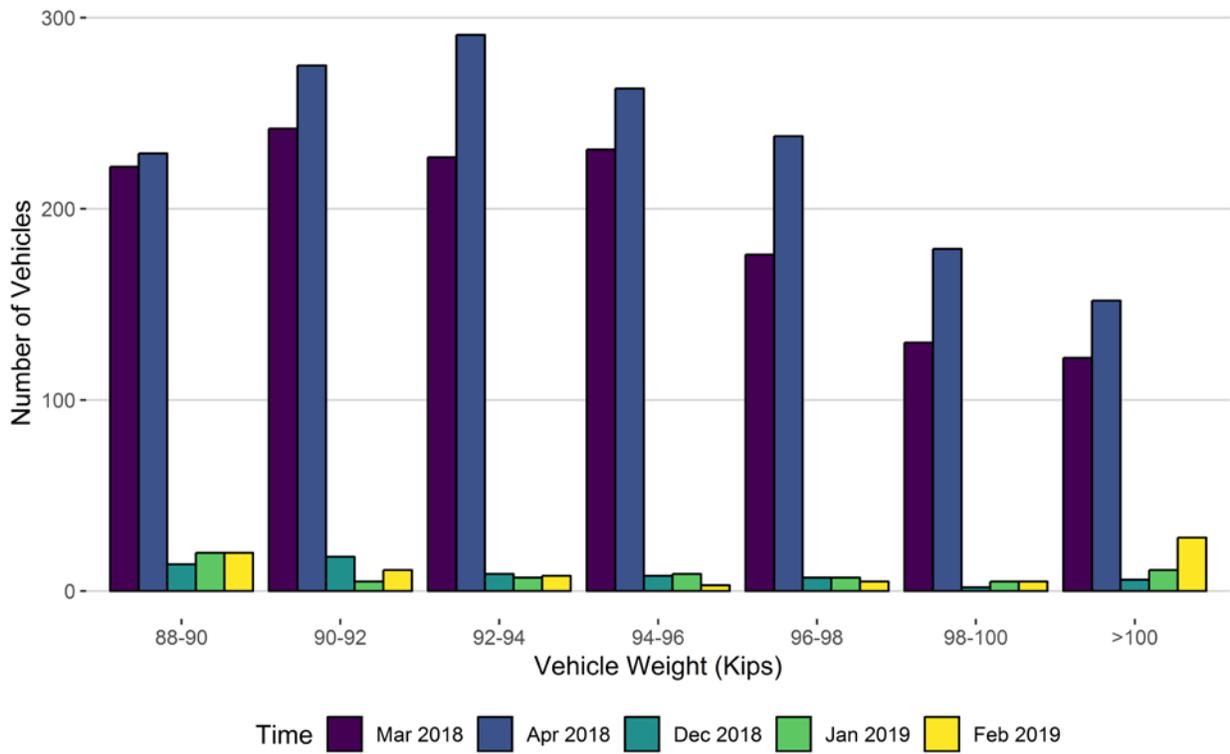
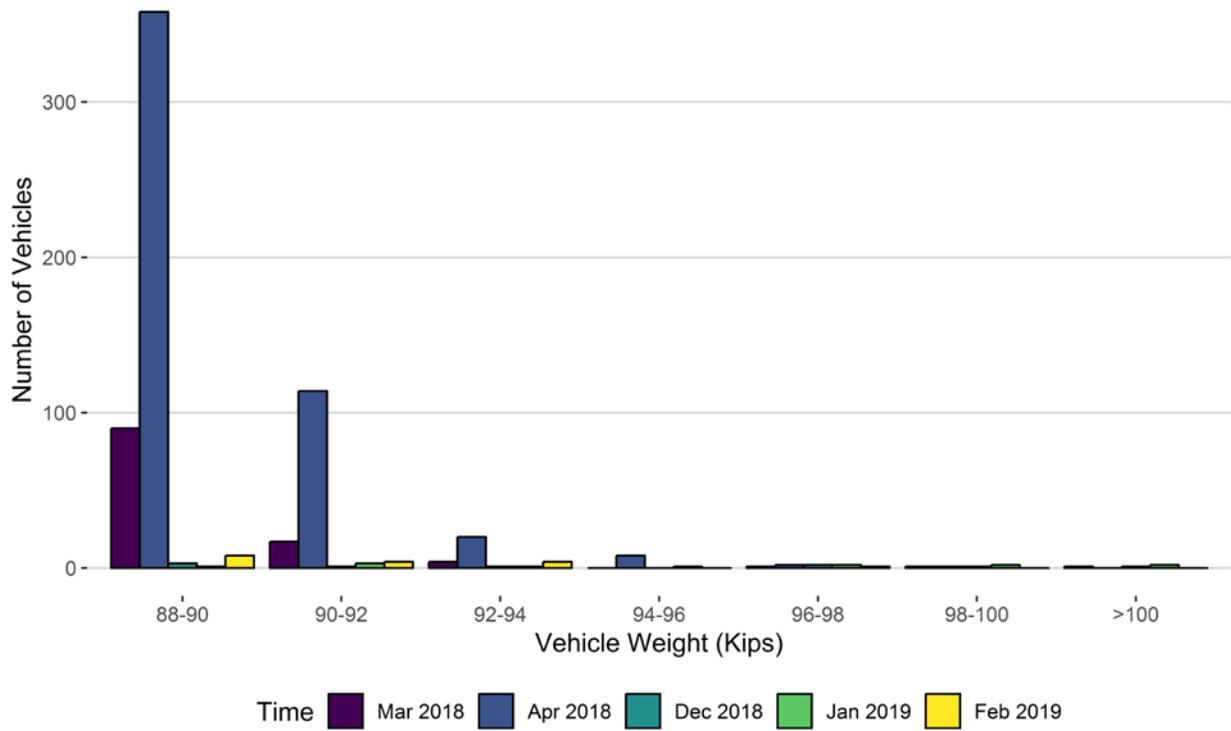


Figure 8 - Histogram of NB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Mar 2018	Apr 2018	Dec 2018	Jan 2019	Feb 2019
88-90	222	229	14	20	20
90-92	242	275	18	5	11
92-94	227	291	9	7	8
94-96	231	263	8	9	3
96-98	176	238	7	7	5
98-100	130	179	2	5	5
>100	122	152	6	11	28
Total	1350	1627	64	64	80

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



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

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

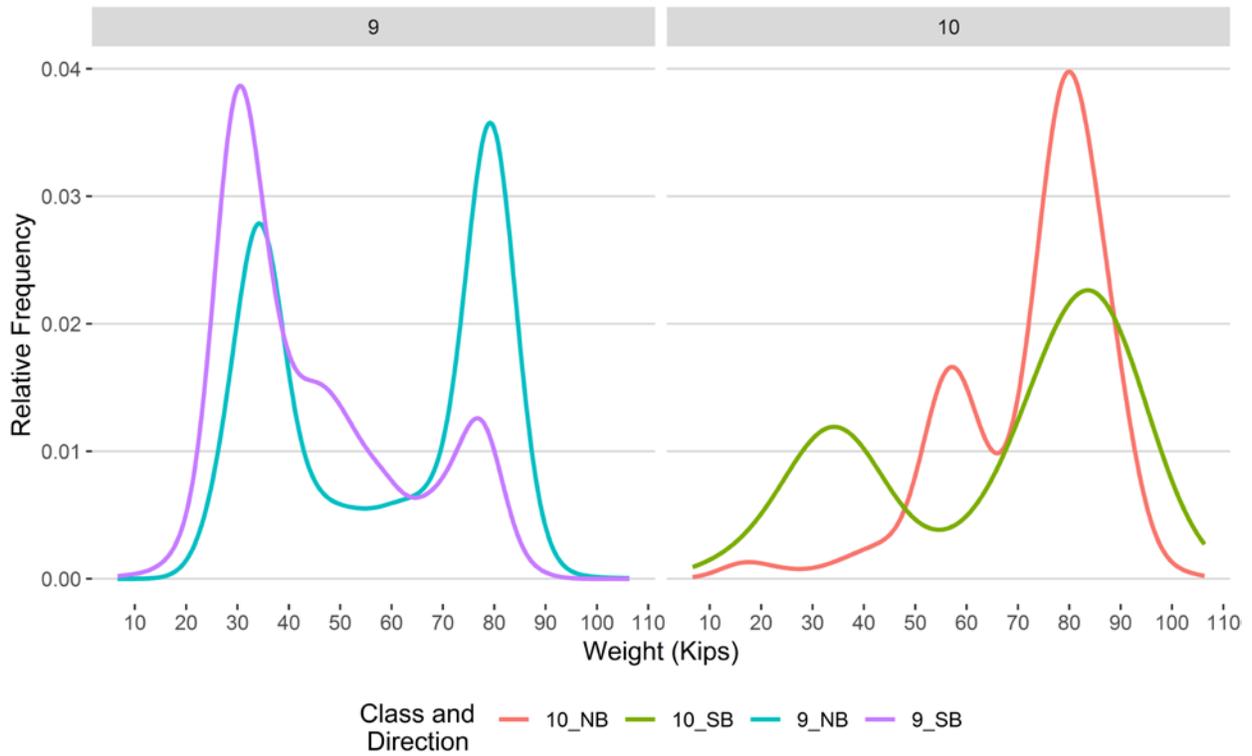


Figure 9 - Freight Percentage by Direction and Class

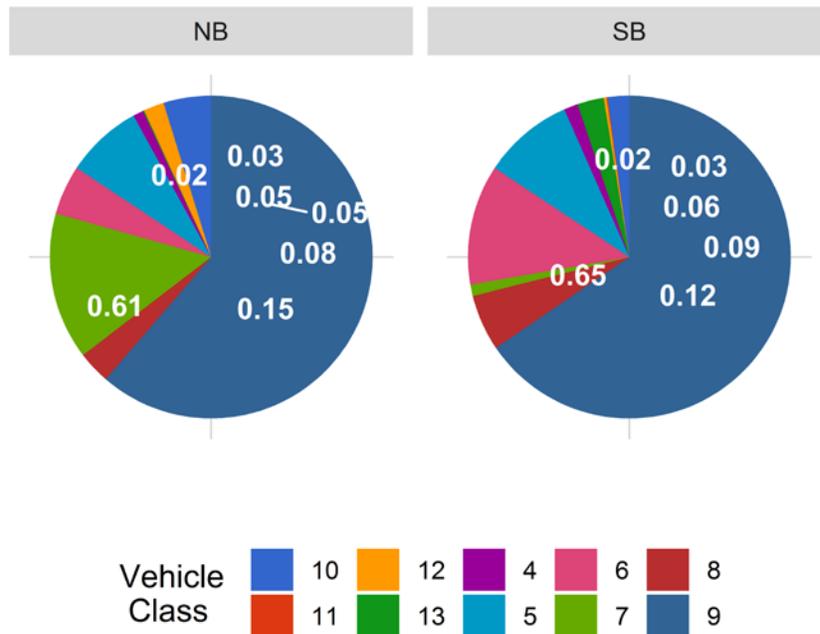


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

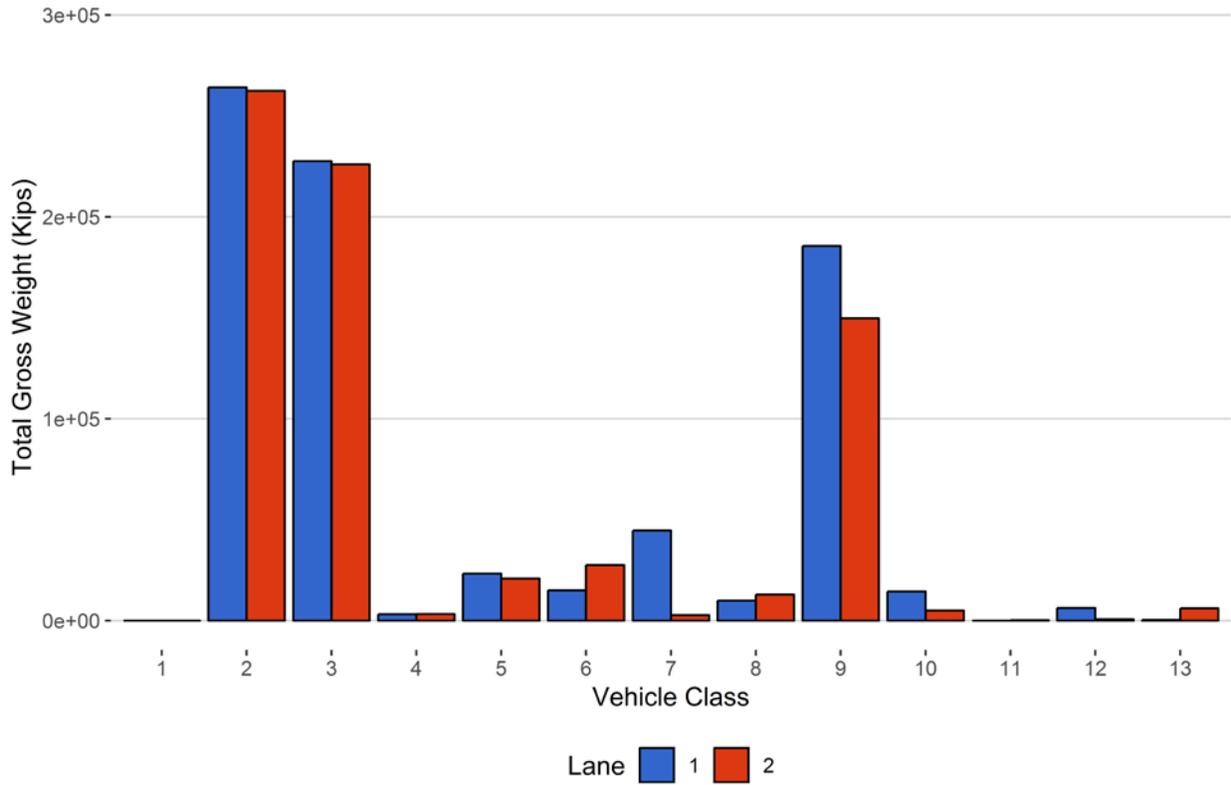


Figure 11 - Total Gross Vehicle Weight t

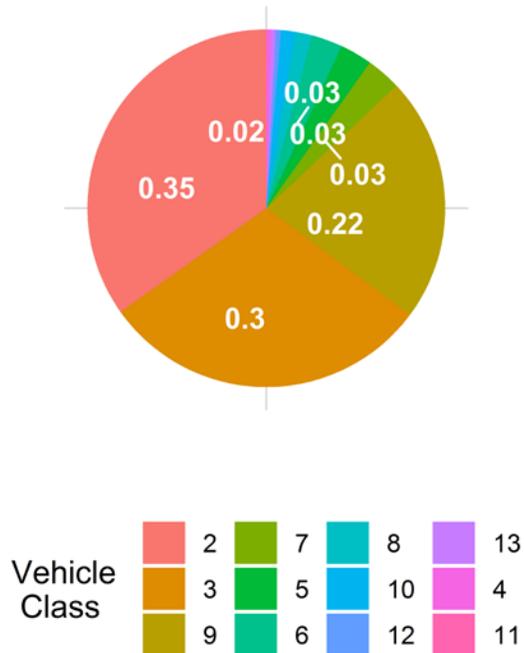


Figure 12 - Total ESALs by Class and Lane

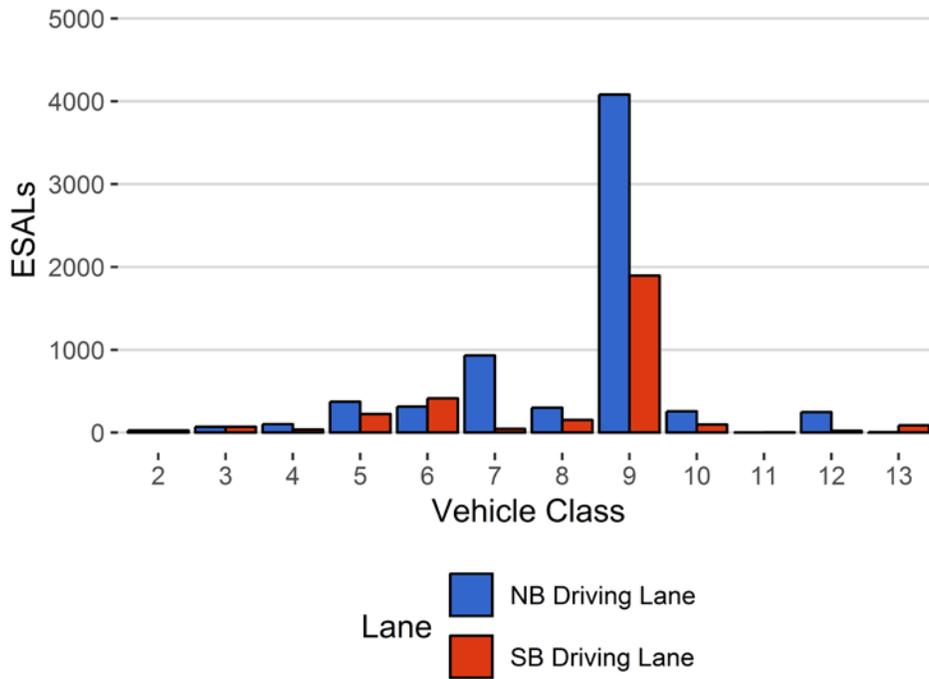


Figure 13 - ESALs by Class

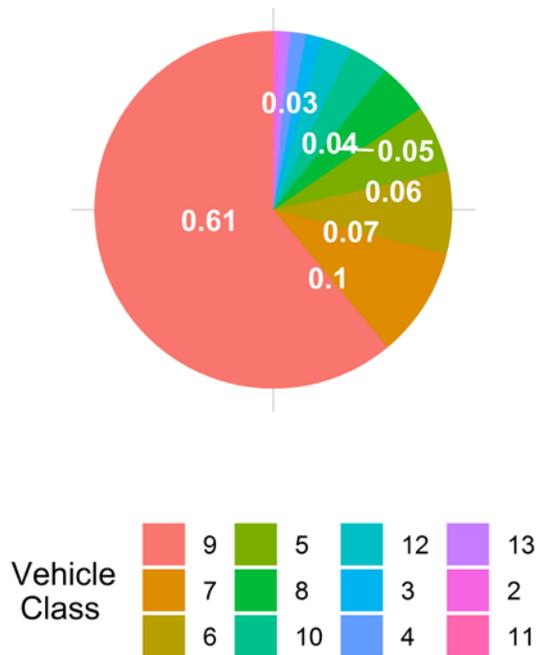


Table 1 Class 9 Front Axle Weight by Lane

<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
February 2019	10.89	0.90	10.49	-0.53

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	4936	138200	60	0	0
3	2817	78863	34.2	0	0
4	8	221	0.1	17	0.8
5	121	3395	1.5	67	3.2
6	52	1453	0.6	104	4.9
7	24	683	0.3	450	21.2
8	22	623	0.3	71	3.3
9	236	6602	2.9	1227	57.8
10	10	277	0.1	111	5.2
11	0	5	0	0	0
12	3	76	0	72	3.4
13	3	87	0	5	0.2
TOTAL	8232	230485	100	2124	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>
2019-02-01	Friday	09:16:21	9	NB	1	106.34
2019-02-22	Friday	14:22:17	10	NB	1	100.69
2019-02-11	Monday	05:36:46	9	NB	1	99.34
2019-02-15	Friday	04:49:32	9	NB	1	98.2
2019-02-01	Friday	00:24:23	10	SB	2	97.64
2019-02-21	Thursday	08:16:41	9	NB	1	97.07
2019-02-13	Wednesday	15:19:27	9	NB	1	94.96
2019-02-19	Tuesday	08:45:14	9	NB	1	93.76
2019-02-21	Thursday	13:38:50	10	SB	2	93.68
2019-02-19	Tuesday	07:55:51	10	SB	2	92.62

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	92	18	19.6	2889	245	889
5	NB	8	1721	232	13.5	21606	1693	4847
6	NB	19	491	115	23.4	12999	1972	2928
7	NB	11.5	630	0	0	44595	0	18675
8	NB	31	233	43	18.5	8949	928	1529
9	NB	33	3173	433	13.6	172710	12850	41145
10	NB	33.5	199	4	2	14377	77	3922
12	NB	36.5	66	0	0	6226	0	1909
13	NB	31.5	5	0	0	364	0	103
TOTAL	****	****	6610	845	****	284716	****	75948
<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	127	25	19.7	2844	343	657
5	SB	8	1640	301	18.4	18630	2163	3959
6	SB	19	948	135	14.2	25298	2248	4925
7	SB	11.5	46	0	0	2623	0	1047
8	SB	31	384	132	34.4	9548	3332	868
9	SB	33	3364	1234	36.7	114813	34965	22261
10	SB	33.5	75	8	10.7	4762	214	1259
11	SB	36.5	5	1	20	178	35	16
12	SB	36.5	9	0	0	650	0	161
13	SB	31.5	81	0	0	6083	0	1766
TOTAL	****	****	6679	1836	****	185428	****	36919
GRAND TOTAL	****	****	13289	2681	245	470144	61063	112867

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	264168	262429	526596	34.8
3	227623	225972	453595	30
4	3134	3187	6321	0.4
5	23299	20793	44092	2.9
6	14971	27546	42516	2.8
7	44595	2623	47219	3.1
8	9876	12880	22756	1.5
9	185560	149778	335338	22.2
10	14453	4975	19429	1.3
11	0	213	213	0
12	6226	650	6877	0.5
13	364	6083	6446	0.4
TOTAL	794269	717129	1511398	100
GVW/LANE	52.55	47.45	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>
2	27	27	54	0.6	8e-04
3	70	71	140	1.4	0.0036
4	102	37	139	1.4	1.27
5	373	224	597	6.1	0.36
6	314	416	730	7.5	1.02
7	933	44	977	10	2.89
8	300	153	454	4.6	1.47
9	4082	1896	5978	61	1.84
10	256	99	355	3.6	2.55
11	0	3	3	0	1.06
12	248	23	270	2.8	6.39
13	5	88	93	1	2.03
TOTAL	6711	3080	9791	100	21
ESALS/LANE	68.5	31.5	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>
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
Feb 2019	230485	8232	479	217063	94.2	13422.1	5.8
TOTAL	1375519	-	-	1296612	-	78907	-
AVERAGE	275104	9097	523	259322	94	15781	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>
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
Feb 2019	6867	3100	9967	2.7
TOTAL	44949	-	-	-
AVERAGE	8990	5699	14689	30

Gross Vehicle Weight

<i>Month</i>	<i>GVW NB Driving Lane</i>	<i>GVW SB Driving Lane</i>	<i>Total GVW Kips</i>
Mar 18	1086885	932878	2019763
Apr 18	1173322	1114993	2288315
Dec 18	897732	839106	1736837
Jan 19	877835	821194	1699029
Feb 19	799415	718048	1517463
TOTAL	4835188	4426219	9261407
AVERAGE	967038	885244	1852281

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>
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
Feb 2019	2171	1	16.1	97	33
TOTAL	15482	-	-	3876	651
AVERAGE	3096.4	1.1	18.6	775.2	130.2

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>
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
Feb 2019	75948	36919	112867	67.3	32.7
TOTAL	413966	297414	711381	-	-
AVERAGE	82793.3	59482.9	142276.2	60.6	39.4