

DECEMBER 2018



**WIM #34
MN 23, MP 122.1
CLARA CITY, MN**

**MONTHLY
REPORT**



Your Destination... Our Priority



WIM Site Location

WIM #34 is located on MN 23 near Clara City in Chippewa county.

System Operation

WIM #34 was operational for the entire month of December 2018. Volume was computed using all monthly data.

System Calibration

WIM #34 was most recently calibrated on 2015-06-17. Table 1 summarizes the front axle weights of class 9s by lane ¹. Table 1 indicates that the class 9 front axle weights exceeded +/- 9% of baseline calibration values for all lanes. 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: 89419 | Passenger Vehicles: 75130 | Heavy Commercial Vehicles: 14289

Monthly Average Daily Traffic (MADT): 2884 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 461

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 Mondays. SB vehicles typically reached highest volume levels on Fridays, with lowest volumes reported on Mondays (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 02 PM and 04 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 02 PM and 04 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 5's.

Overweight HCVs

Volume trends. Of a total of 14289 HCVs, 870 of them were overweight³. These overweight HCVs contributed to 1% of total monthly volume, and 6.1% 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 Tuesdays, with lowest volumes reported on Saturdays. See Figure 3 . The top two overweight violators by class were the class 9 and class 10 vehicles . Overall, overweight vehicles tended to reach peak volume concentrations during typical business hours, with 59.9% 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 March.

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 report⁴.

Using normal load limits ,39 NB vehicles exceeded 88,000 pounds (31 vehicles were Class 13's; 6 vehicles were Class 10's). Of vehicles traveling SB,

23 NB vehicles exceeded 88,000 pounds (10 vehicles were Class 10's; 9 vehicles were Class 13's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from December 2018.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9s and 10s in December 2018. Data suggests that there were greater numbers of fully_loaded Class 9's than empty 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 110925 tons of freight was recorded to have crossed the WIM. More freight was shipped NB (56.8%) than SB (43.2%). See Table 4 and Figure 11 for more freight information.

Infrastructure Considerations

Bridge. Bridge No. 12012 is approximately 3.8 miles north of WIM #34, and Bridge No. 12004 is 3.1 miles south of WIM #34. WIM #34 recorded a total of 89419 vehicles with a combined GVW of 957430 kips (1 kip = 1,000 pounds = 0.5 tons) in December 2018. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 8678 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 54.9% of all ESALs were recorded NB while 45.1% was observed SB. In particular, 65% of all ESALs were generated by the Class 9's (Class 9's were also responsible for generating 41% 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).

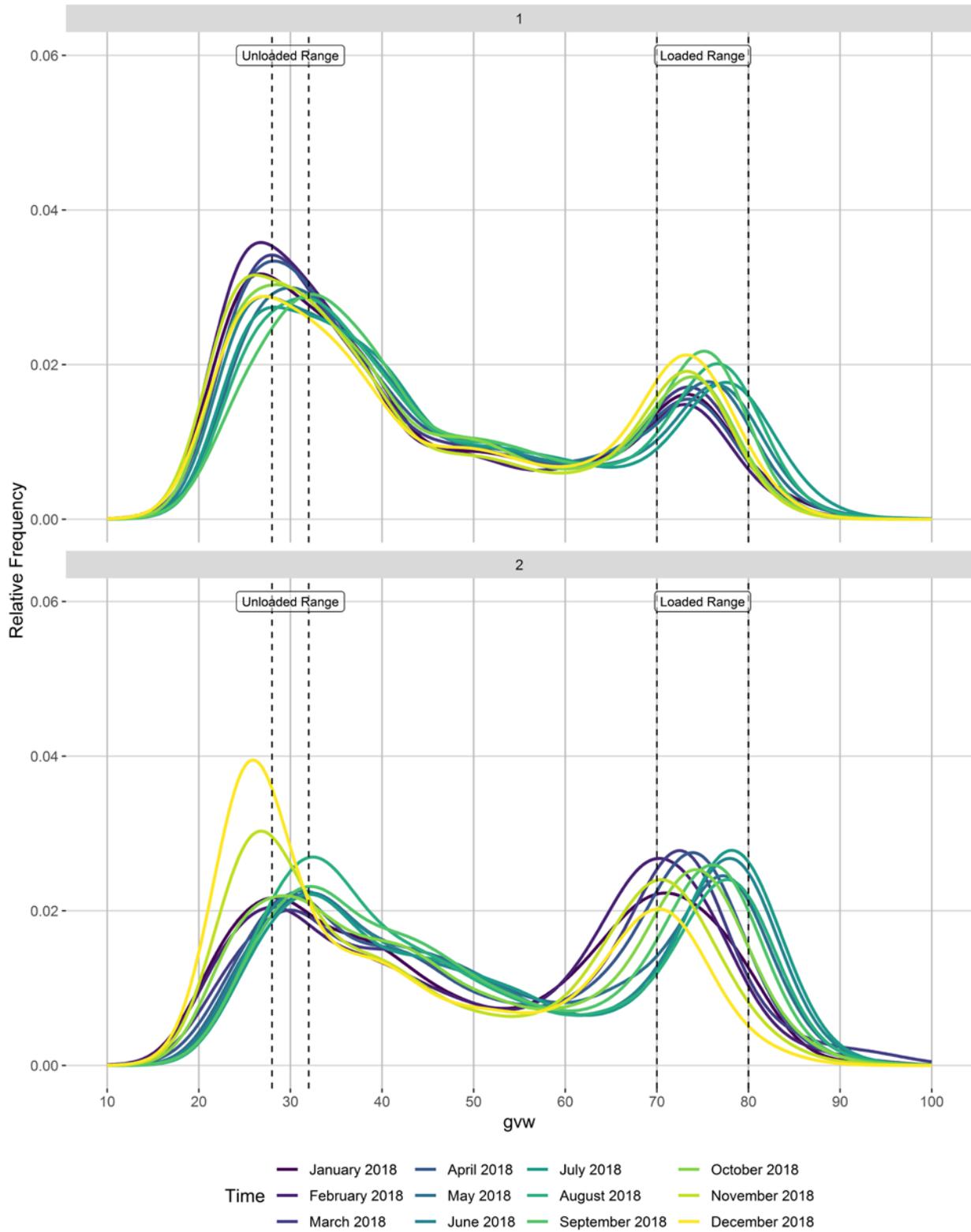
WIM monthly reports can be found at: <http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html>

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.

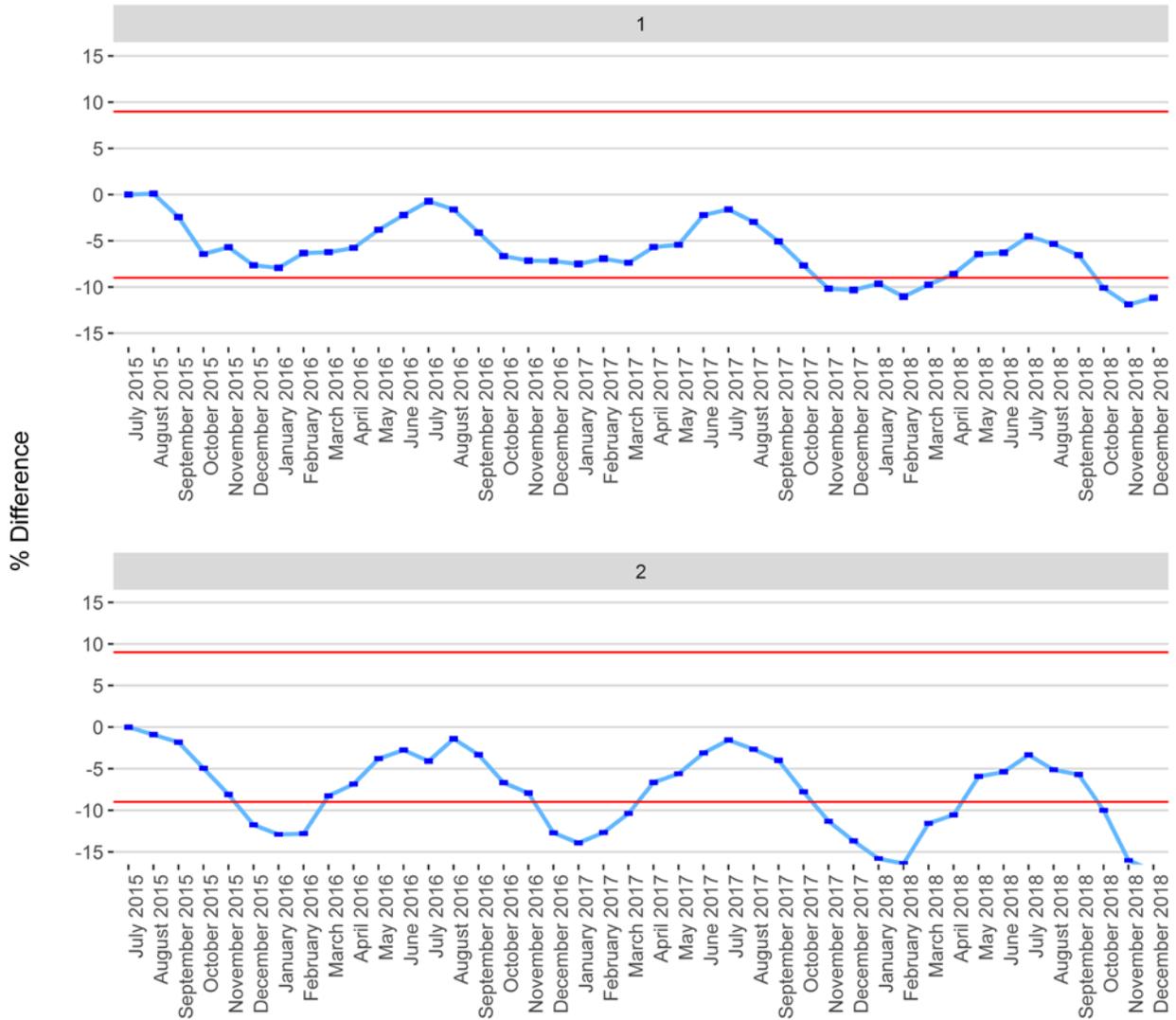
To request this document in an alternative format, please call 651-366-4718 or 1-800-657-3774, or email your request to ADArequest.dot@state.mn.us. Please request at least one week in advance.

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

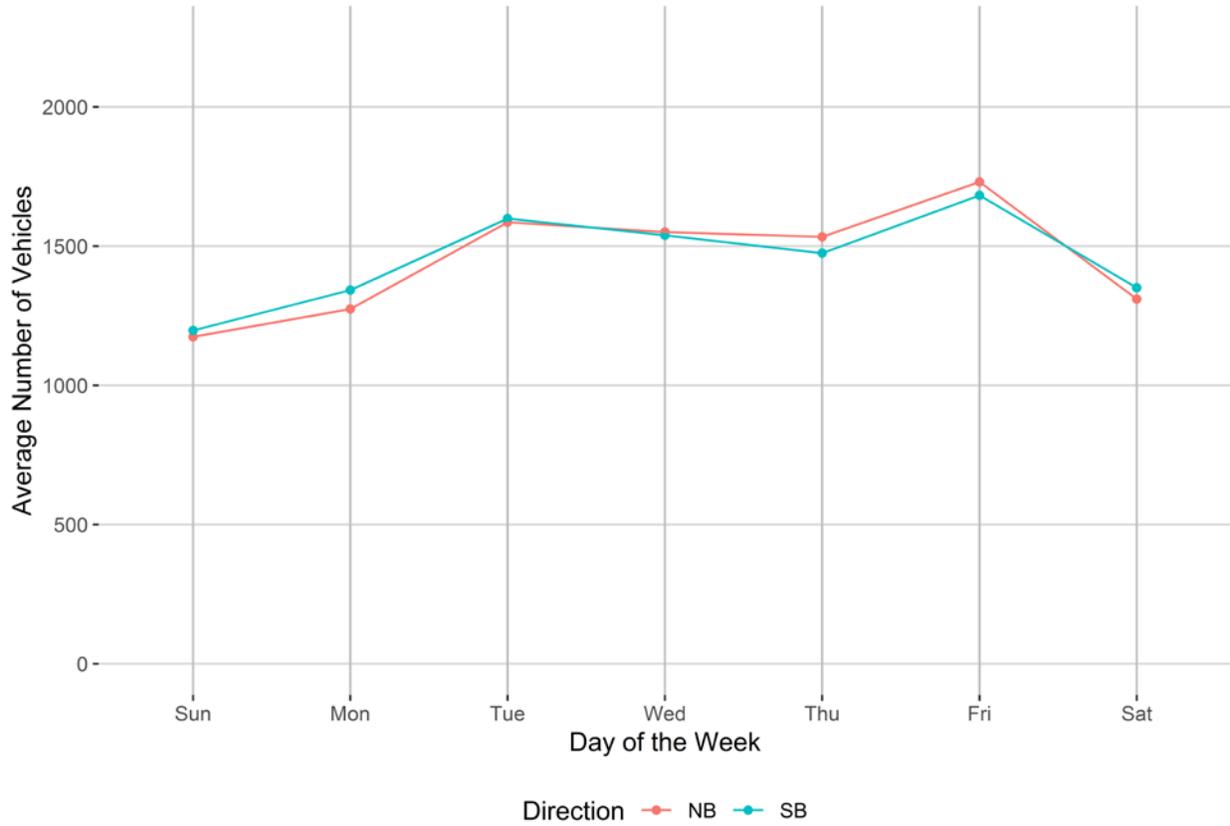


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

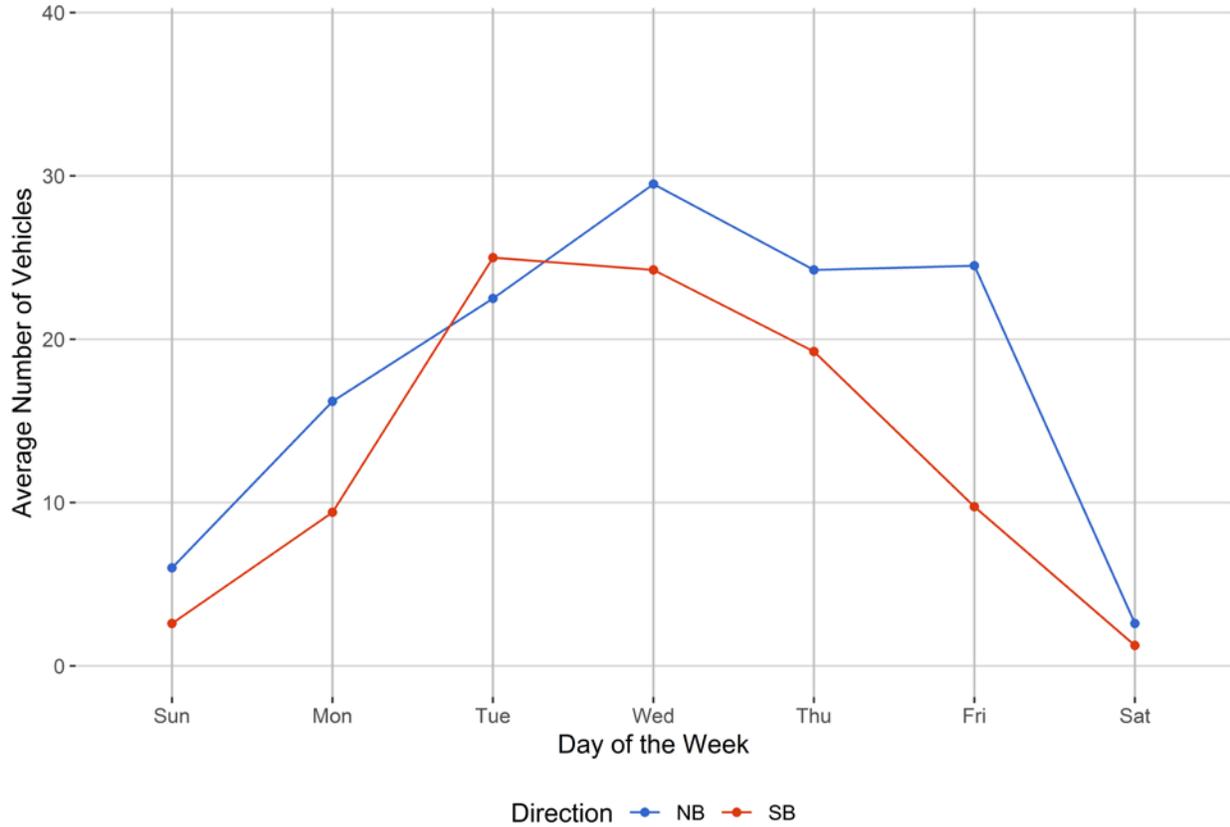


Figure 4 - Passenger Vehicles vs. Hour of the Day

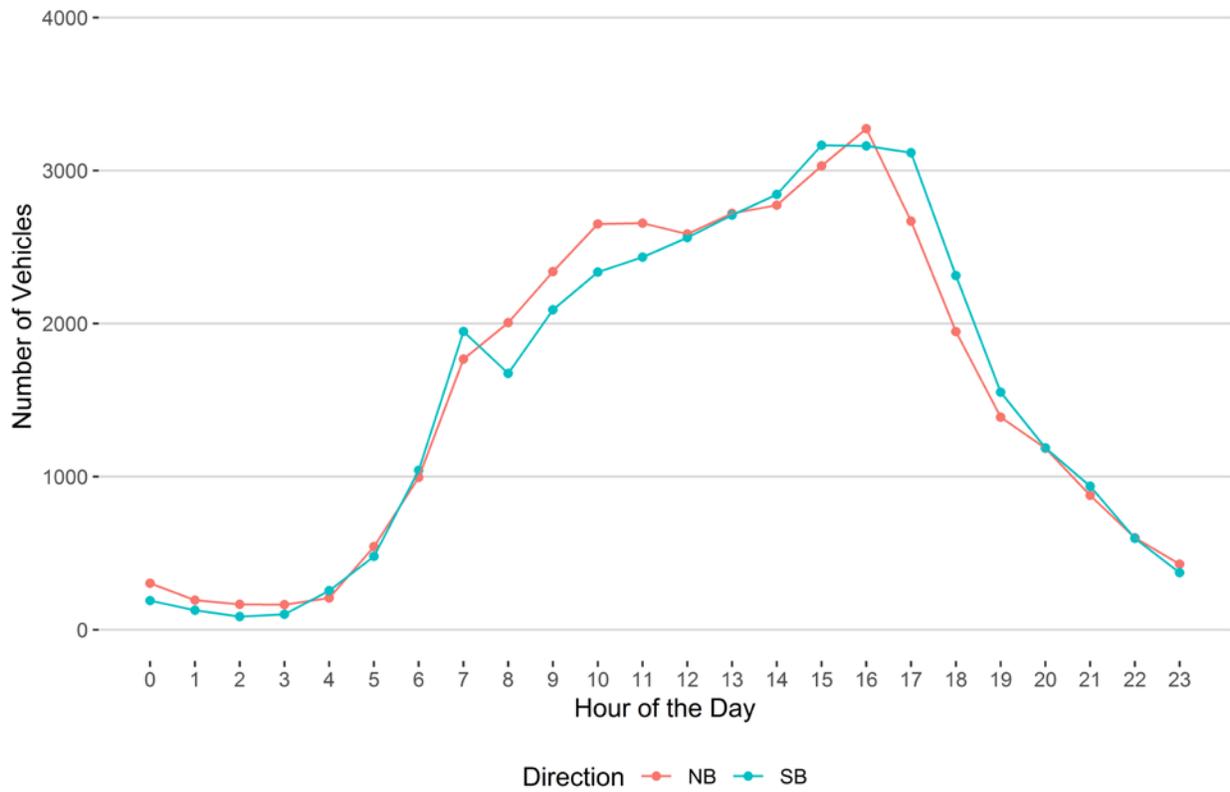


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

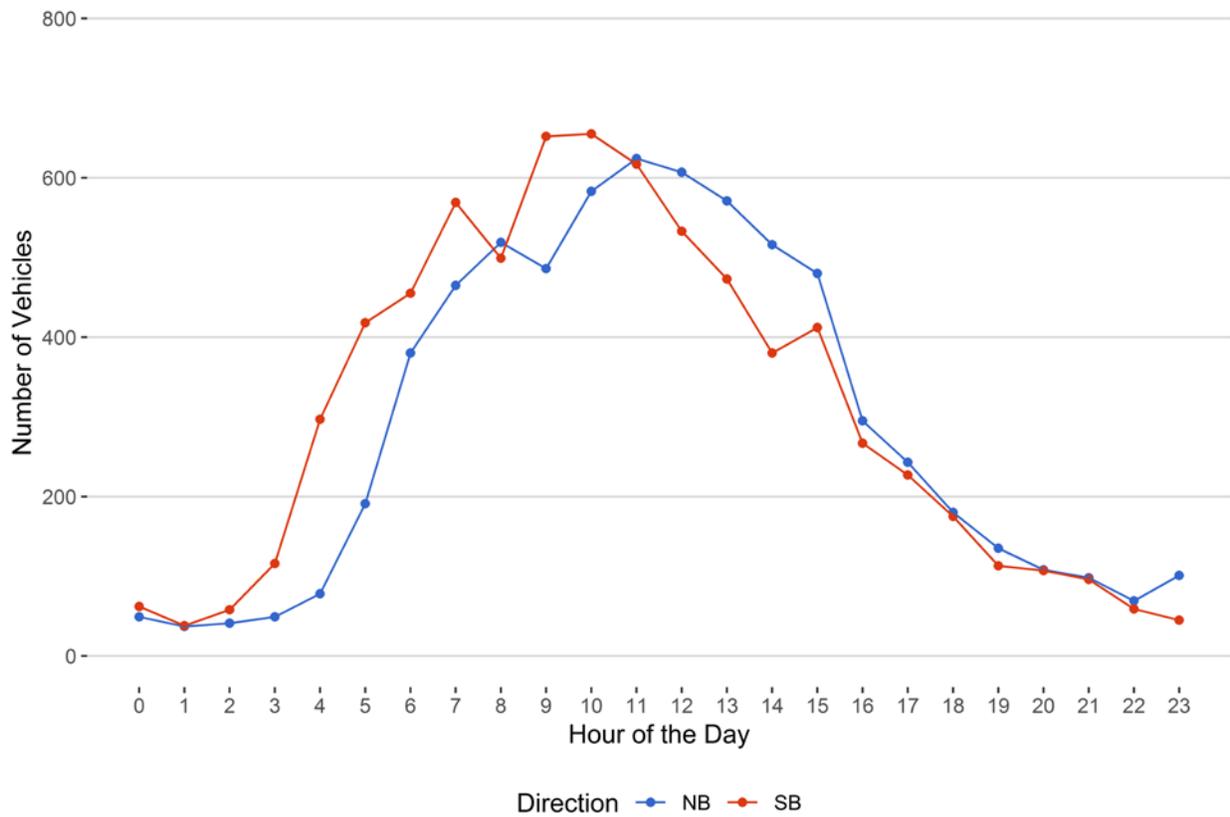


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

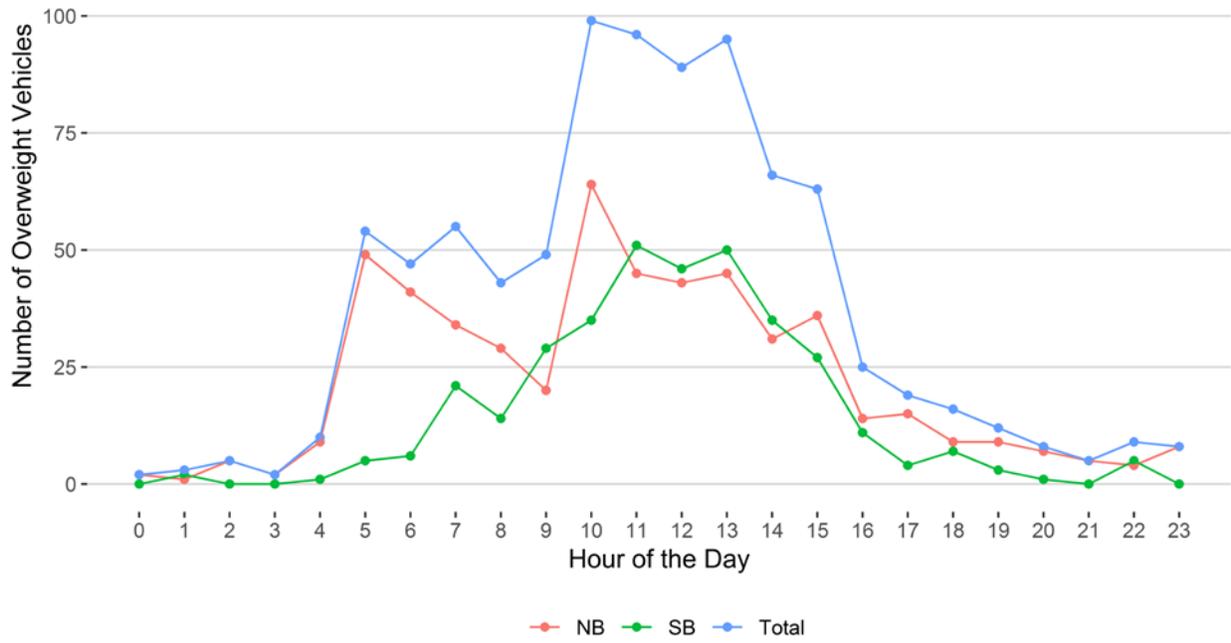
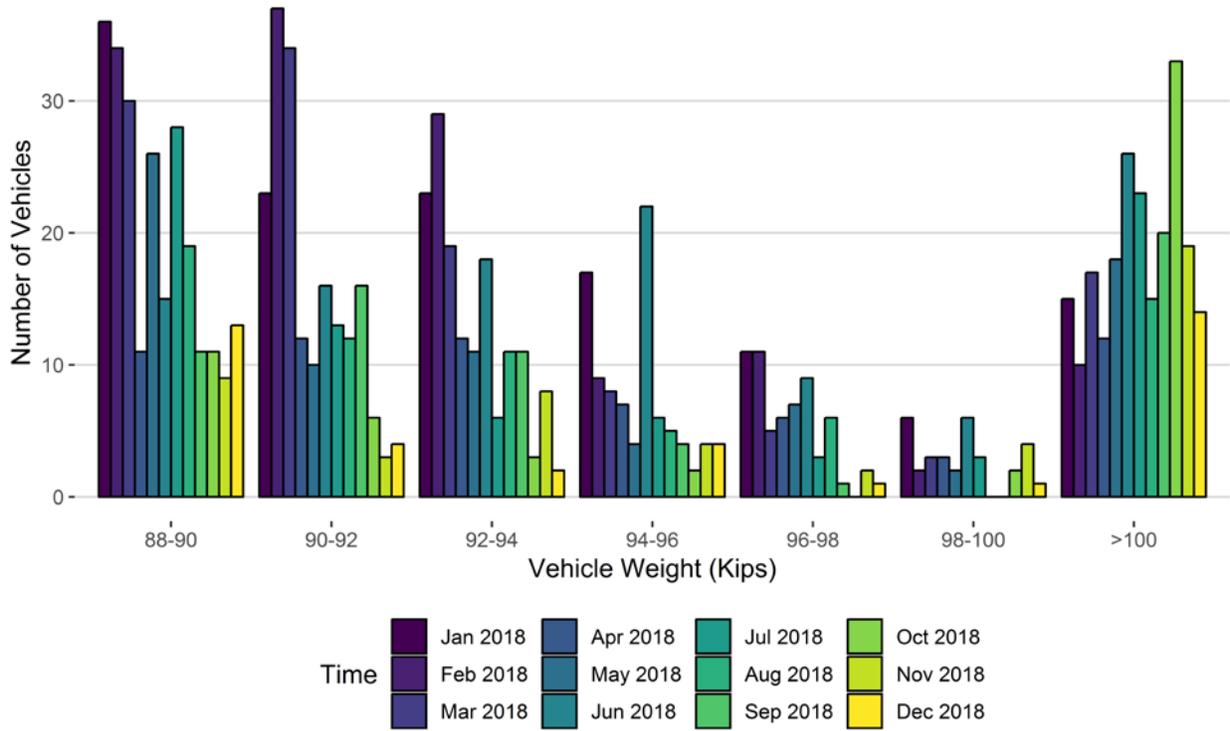
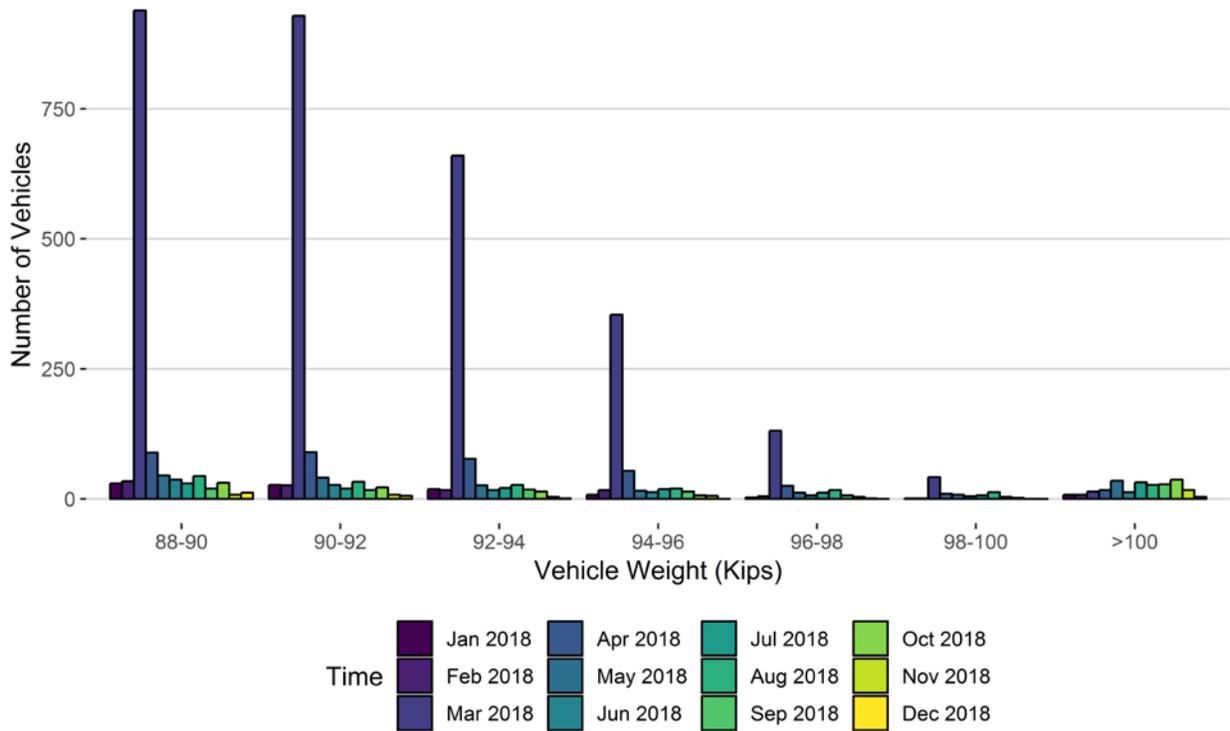


Figure 8 - Histogram of NB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Oct 2018	Nov 2018	Dec 2018
88-90	36	34	30	11	26	15	28	19	11	11	9	13
90-92	23	37	34	12	10	16	13	12	16	6	3	4
92-94	23	29	19	12	11	18	6	11	11	3	8	2
94-96	17	9	8	7	4	22	6	5	4	2	4	4
96-98	11	11	5	6	7	9	3	6	1	0	2	1
98-100	6	2	3	3	2	6	3	0	0	2	4	1
>100	15	10	17	12	18	26	23	15	20	33	19	14
Total	131	132	116	63	78	112	82	68	63	57	49	39

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



Vehicle Weights (Kips)	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Oct 2018	Nov 2018	Dec 2018
88-90	30	34	939	89	45	37	30	44	20	31	8	12
90-92	27	26	929	90	41	27	20	33	17	22	8	6
92-94	19	17	660	77	26	17	21	27	18	14	4	1
94-96	8	17	354	54	16	13	19	20	14	7	6	0
96-98	3	5	131	25	12	7	12	17	7	4	1	0
98-100	1	1	42	10	8	5	7	13	4	2	0	0
>100	8	8	14	17	35	13	32	27	28	37	17	4
Total	96	108	3069	362	183	119	141	181	108	117	44	23

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

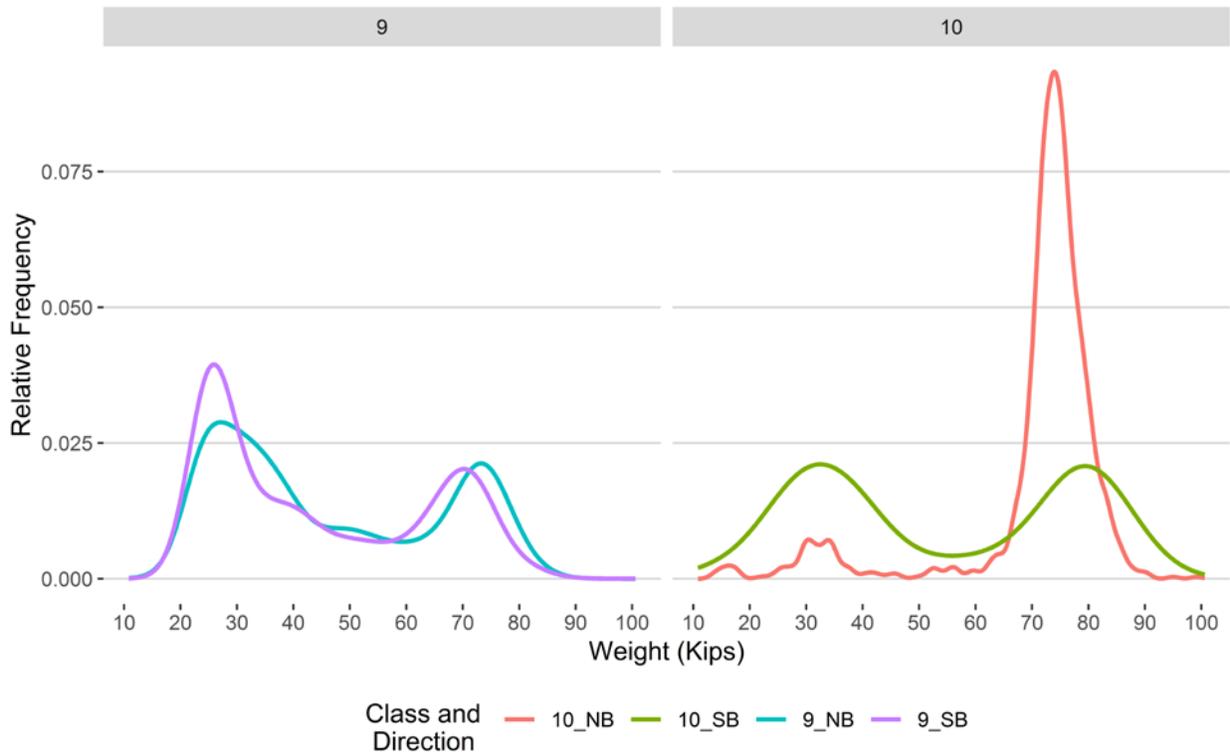


Figure 9 - Freight Percentage by Direction and Class

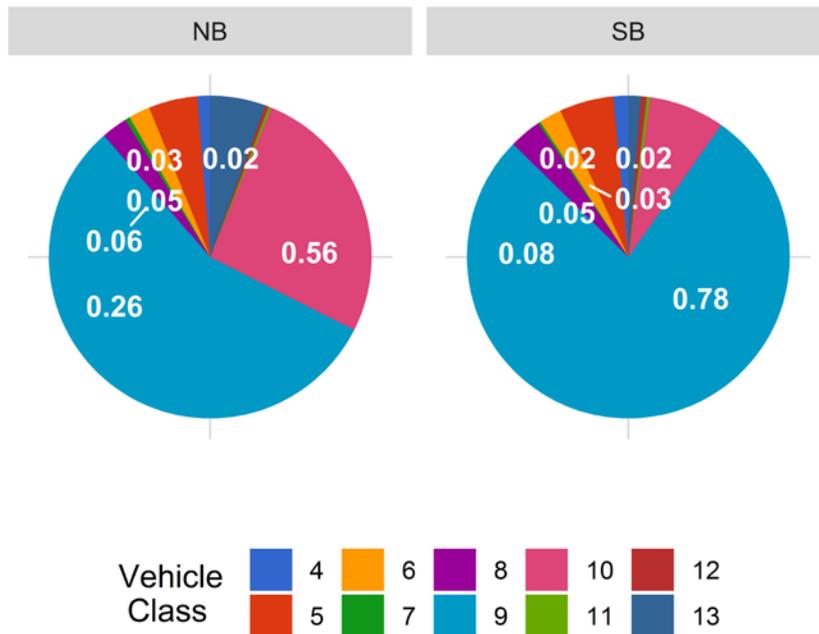


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

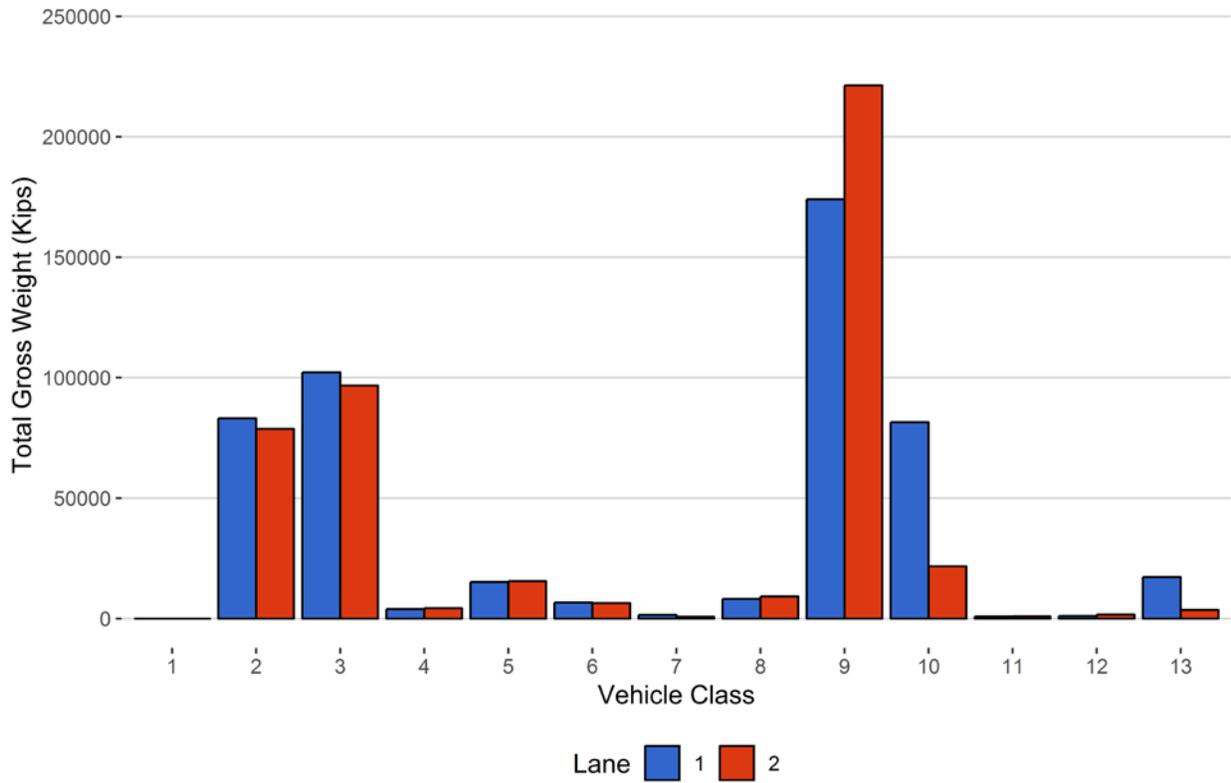


Figure 11 - Total Gross Vehicle Weight t

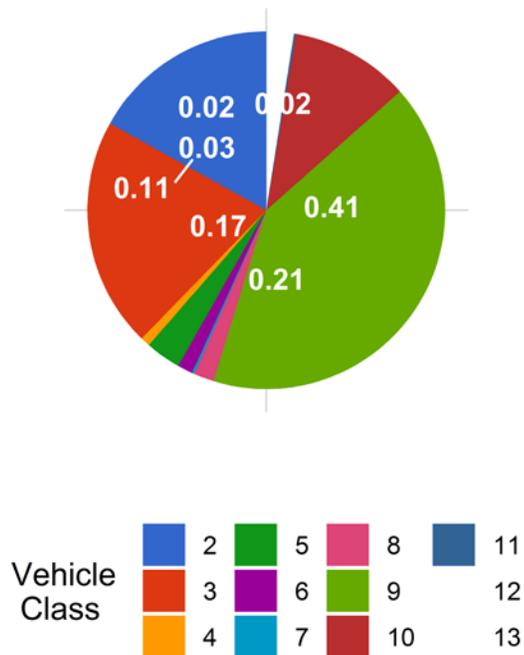


Figure 12 - Total ESALs by Class and Lane

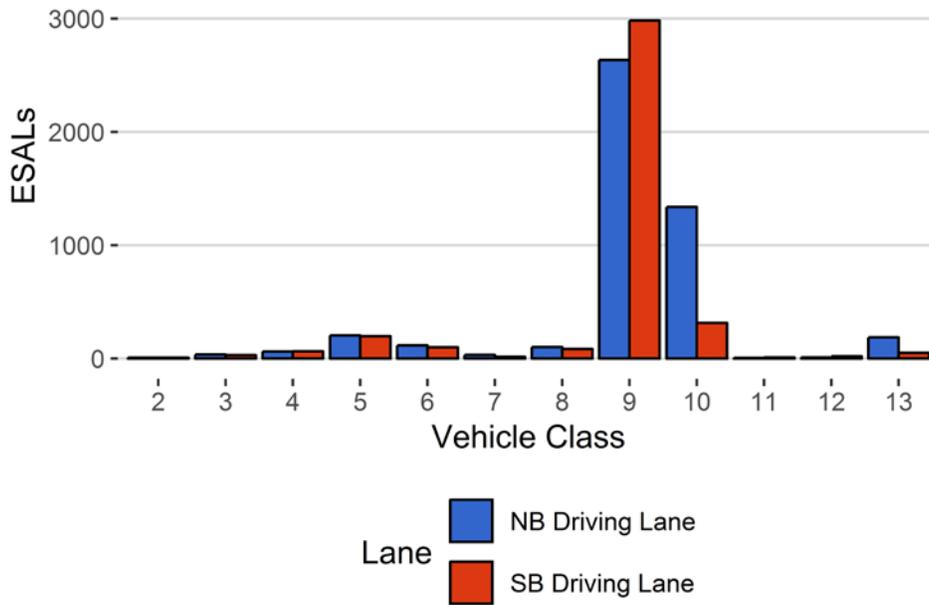


Figure 13 - ESALs by Class

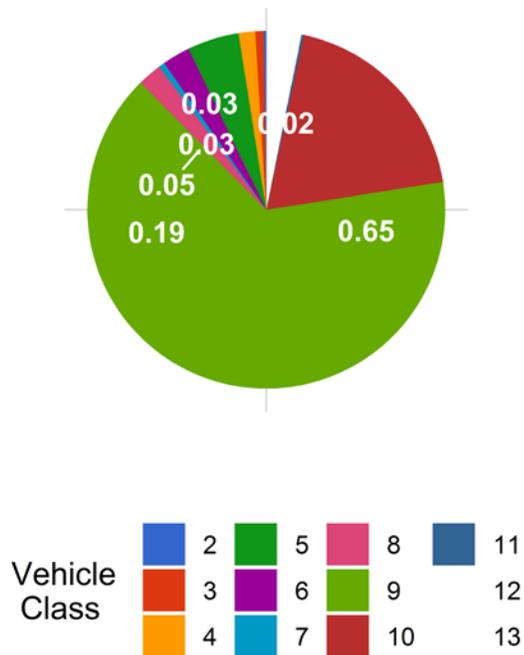


Table 1 Class 9 Front Axle Weight by Lane

<i>Month</i>	<i>Lane 1 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 2 (Kips)</i>	<i>Front Axle +/- 9%</i>
July 2015	11.97	0.00	12.29	0.00
August 2015	11.98	0.10	12.18	-0.91
September 2015	11.67	-2.43	12.07	-1.82
October 2015	11.20	-6.43	11.68	-4.95
November 2015	11.28	-5.69	11.29	-8.10
December 2015	11.05	-7.65	10.84	-11.75
January 2016	11.02	-7.92	10.70	-12.91
February 2016	11.21	-6.33	10.71	-12.81
March 2016	11.22	-6.23	11.27	-8.26
April 2016	11.28	-5.77	11.45	-6.85
May 2016	11.51	-3.81	11.82	-3.79
June 2016	11.70	-2.21	11.95	-2.75
July 2016	11.88	-0.72	11.79	-4.08
August 2016	11.77	-1.61	12.12	-1.39
September 2016	11.47	-4.10	11.88	-3.32
October 2016	11.17	-6.65	11.47	-6.67
November 2016	11.11	-7.15	11.31	-7.94
December 2016	11.10	-7.19	10.73	-12.70
January 2017	11.07	-7.51	10.58	-13.92
February 2017	11.14	-6.94	10.73	-12.67
March 2017	11.08	-7.37	11.01	-10.37
April 2017	11.29	-5.67	11.47	-6.64
May 2017	11.32	-5.43	11.60	-5.59
June 2017	11.70	-2.21	11.91	-3.10
July 2017	11.77	-1.60	12.10	-1.55
August 2017	11.61	-2.96	11.96	-2.66
September 2017	11.36	-5.08	11.80	-4.01
October 2017	11.05	-7.67	11.33	-7.77
November 2017	10.75	-10.18	10.90	-11.32
December 2017	10.73	-10.32	10.61	-13.69
January 2018	10.81	-9.63	10.35	-15.81
February 2018	10.64	-11.04	10.27	-16.40
March 2018	10.80	-9.75	10.87	-11.58
April 2018	10.94	-8.59	10.99	-10.55
May 2018	11.19	-6.45	11.56	-5.93
June 2018	11.21	-6.30	11.63	-5.38
July 2018	11.43	-4.50	11.88	-3.33
August 2018	11.33	-5.34	11.66	-5.13
September 2018	11.18	-6.55	11.59	-5.68

October 2018	10.76	-10.10	11.06	-10.01
November 2018	10.54	-11.89	10.32	-16.01
December 2018	10.63	-11.16	10.16	-17.30

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	1344	41663	46.6	0	0
3	1080	33467	37.4	0	0
4	10	296	0.3	4	0.5
5	71	2210	2.5	42	4.8
6	15	452	0.5	18	2.1
7	1	40	0	6	0.7
8	20	612	0.7	20	2.3
9	283	8763	9.8	479	55.1
10	50	1557	1.7	220	25.3
11	1	41	0	0	0
12	2	48	0.1	6	0.7
13	9	269	0.3	75	8.6
TOTAL	2884	89419	100	870	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>
2018-12-28	Friday	07:48:29	9	SB	2	100.6
2018-12-14	Friday	14:14:27	10	NB	1	99.13
2018-12-17	Monday	11:39:57	10	NB	1	95.01
2018-12-26	Wednesday	23:54:42	9	NB	1	94.58
2018-12-14	Friday	09:21:43	10	SB	2	92.28
2018-12-13	Thursday	13:33:18	10	SB	2	91.86
2018-12-11	Tuesday	13:02:46	9	SB	2	91.08
2018-12-14	Friday	14:45:08	10	SB	2	91.06
2018-12-05	Wednesday	14:58:09	10	NB	1	90.45
2018-12-05	Wednesday	13:20:39	10	SB	2	90.3

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	140	32	22.9	3586	406	983
5	NB	8	1084	132	12.2	14222	969	3303
6	NB	19	220	34	15.5	6097	581	1281
7	NB	11.5	26	0	0	1515	0	608
8	NB	31	278	170	61.2	4054	4099	353
9	NB	33	3743	1357	36.3	137696	36324	29479
10	NB	33.5	1150	62	5.4	79833	1670	21692
11	NB	36.5	20	2	10	780	70	61
12	NB	36.5	21	1	4.8	1068	14	169
13	NB	31.5	223	0	0	17269	0	5122
TOTAL	****	****	6905	1790	****	266119	****	63052
<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	155	33	21.3	3891	400	1030
5	SB	8	1117	221	19.8	13900	1596	3366
6	SB	19	230	57	24.8	5512	930	1113
7	SB	11.5	14	0	0	732	0	286
8	SB	31	331	238	71.9	3457	5741	287
9	SB	33	4983	2132	42.8	165604	55766	35760
10	SB	33.5	400	111	27.8	18707	2992	4513
11	SB	36.5	21	1	4.8	930	15	100
12	SB	36.5	27	0	0	1681	0	348
13	SB	31.5	45	0	0	3558	0	1070
TOTAL	****	****	7323	2793	****	217972	****	47873
GRAND TOTAL	****	****	14228	4583	382	484091	111573	110925

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	83148	78779	161927	16.9
3	102197	96759	198957	20.8
4	3993	4290	8283	0.9
5	15191	15495	30686	3.2
6	6678	6443	13121	1.4
7	1515	732	2247	0.2
8	8153	9199	17351	1.8
9	174021	221370	395391	41.3
10	81503	21699	103201	10.8
11	850	945	1795	0.2
12	1081	1681	2762	0.3
13	17269	3558	20828	2.2
TOTAL	495598	460950	956548	100
GVW/LANE	51.81	48.19	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	10	9	19	0.2	0.001
3	37	31	68	0.8	0.0042
4	63	65	128	1.5	0.88
5	205	198	403	4.7	0.37
6	117	100	217	2.5	0.97
7	33	16	49	0.6	2.23
8	102	85	187	2.2	0.62
9	2635	2983	5618	65.1	1.29
10	1338	314	1652	19.1	2.14
11	8	11	18	0.2	0.92
12	12	21	33	0.4	1.3
13	188	52	240	2.8	1.76
TOTAL	4748	3885	8633	100	12
ESALS/LANE	55	45	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>
Jan 2018	84152	2715	413	71364	84.8	12787.5	15.2
Feb 2018	77105	2754	435	64926	84.2	12178.7	15.8
Mar 2018	95909	3094	558	78620	82	17289.4	18
Apr 2018	89350	2978	453	75774	84.8	13576.4	15.2
May 2018	108754	3508	506	93068	85.6	15686.4	14.4
Jun 2018	109507	3650	512	94154	86	15353	14
Jul 2018	113876	3673	505	98216	86.2	15660.3	13.8
Aug 2018	116576	3760	558	99287	85.2	17289.3	14.8
Sep 2018	104355	3478	463	90479	86.7	13875.8	13.3
Oct 2018	108346	3495	550	91301	84.3	17045.5	15.7
Nov 2018	100582	3353	542	84315	83.8	16266.5	16.2
Dec 2018	89419	2884	461	75130	84	14289	16
TOTAL	1197931	-	-	1016634	-	181298	-
AVERAGE	99828	3279	496	84720	85	15108	15

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>
Jan 2018	3494	4778	8272	7.6
Feb 2018	3112	5050	8161	10.4
Mar 2018	3482	11316	14797	11.2
Apr 2018	3398	6249	9647	12.1
May 2018	4723	6847	11571	12.2
Jun 2018	4981	6868	11848	6.4
Jul 2018	5036	6999	12035	7.3
Aug 2018	5266	6869	12135	11
Sep 2018	4097	5652	9749	5.7
Oct 2018	4788	6405	11193	3.8
Nov 2018	4625	5107	9731	3.1
Dec 2018	4765	3913	8678	0.9
TOTAL	51767	-	-	-
AVERAGE	4314	6338	10652	8

Gross Vehicle Weight

<i>Month</i>	<i>GVW NB Driving Lane</i>	<i>GVW SB Driving Lane</i>	<i>Total GVW Kips</i>
Jan 2018	410686	456795	867481
Feb 2018	380931	430105	811036
Mar 2018	433134	867894	1301027
Apr 2018	422404	531030	953434
May 2018	542896	581854	1124749
Jun 2018	559697	574474	1134172
Jul 2018	558833	625054	1183887
Aug 2018	583793	652111	1235903
Sep 2018	502142	546473	1048616
Oct 2018	543677	598248	1141925
Nov 2018	532437	542085	1074522
Dec 2018	495872	461558	957430
TOTAL	5966501	6867680	12834181
AVERAGE	497208	572307	1069515

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>
Jan 2018	1134	1.4	8.9	227	30
Feb 2018	1021	1.3	8.4	241	22
Mar 2018	5264	5.5	30.5	3187	77
Apr 2018	1526	1.7	11.3	426	43
May 2018	1598	1.5	10.2	263	65
Jun 2018	1723	1.6	11.3	233	51
Jul 2018	1960	1.7	12.5	223	65
Aug 2018	1779	1.5	10.3	252	57
Sep 2018	1177	1.1	8.5	171	52
Oct 2018	1281	1.2	7.5	177	77
Nov 2018	901	0.9	5.6	94	40
Dec 2018	880	1	6.2	62	19
TOTAL	20244	-	-	5556	598
AVERAGE	1687	1.7	10.9	463	49.8

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>
Jan 2018	42006	57239	99245	42.3	57.7
Feb 2018	36931	56998	93928	39.3	60.7
Mar 2018	42014	184856	226871	18.5	81.5
Apr 2018	39020	76169	115188	33.9	66.1
May 2018	54882	70343	125225	43.8	56.2
Jun 2018	58453	65552	124005	47.1	52.9
Jul 2018	56615	72870	129484	43.7	56.3
Aug 2018	60703	72416	133119	45.6	54.4
Sep 2018	49651	61569	111220	44.6	55.4
Oct 2018	55838	73026	128864	43.3	56.7
Nov 2018	60616	62469	123084	49.2	50.8
Dec 2018	63052	47873	110925	56.8	43.2
TOTAL	619781	901379	1521160	-	-
AVERAGE	51648.4	75114.9	126763.3	42.4	57.6