

AUGUST 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 August 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 ¹. Table 1 indicates that the class 9 front axle weights were all within +/- 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: 13369 | Passenger Vehicles: 10655 | Heavy Commercial Vehicles: 2714

Monthly Average Daily Traffic (MADT): 431 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 88

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 Saturdays, 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 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 5's.

Overweight HCVs

Volume trends. Of a total of 2714 HCVs, 642 of them were overweight³. These overweight HCVs contributed to 6.2% of total monthly volume, and 30.6% of total monthly HCV volume. NB overweight vehicles typically reached highest numbers on Tuesdays, with lowest volumes reported on Sundays. SB overweight vehicles tended to reach highest volumes on Thursdays, 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 72% 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 report⁴.

Using normal load limits ,15 NB vehicles exceeded 88,000 pounds (10 vehicles were Class 13's; 4 vehicles were Class 9's). Of vehicles traveling SB,

7 NB vehicles exceeded 88,000 pounds (4 vehicles were Class 9's; 2 vehicles were Class 13's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from August 2018.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9s and 10s in August 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 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 21298 tons of freight was recorded to have crossed the WIM. More freight was shipped SB (69.2%) than NB (30.8%). 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 13369 vehicles with a combined GVW of 144793 kips (1 kip = 1,000 pounds = 0.5 tons) in August 2018. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 2137 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 69.8% of all ESALs were recorded SB while 30.2% was observed NB. In particular, 88% of all ESALs were generated by the Class 9's (Class 9's were also responsible for generating 58% 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).

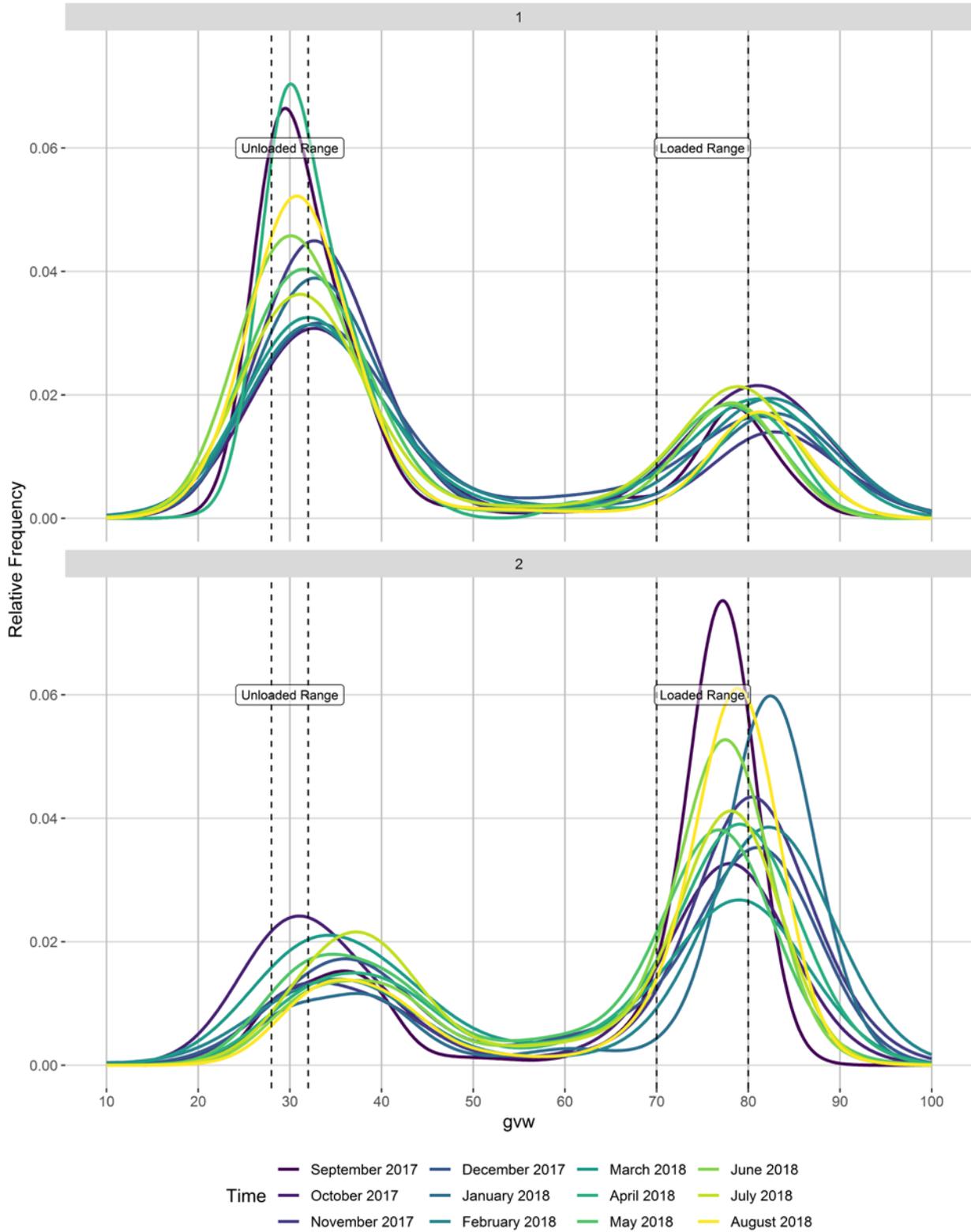
WIM monthly reports can be found at: <http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html>

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.

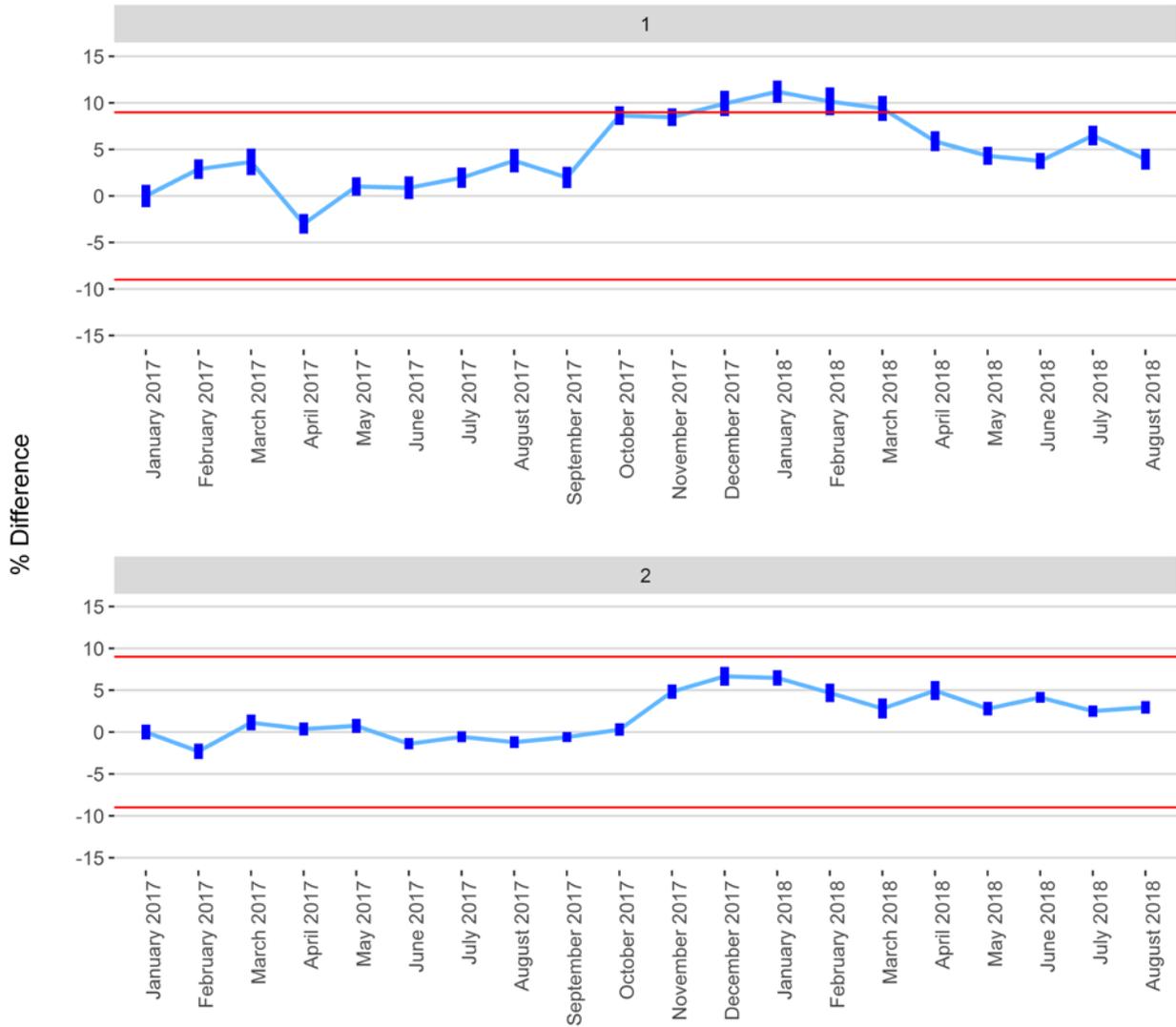
To request this document in an alternative format, please call 651-366-4718 or 1-800-657-3774, or email your request to ADArequest.dot@state.mn.us. Please request at least one week in advance.

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

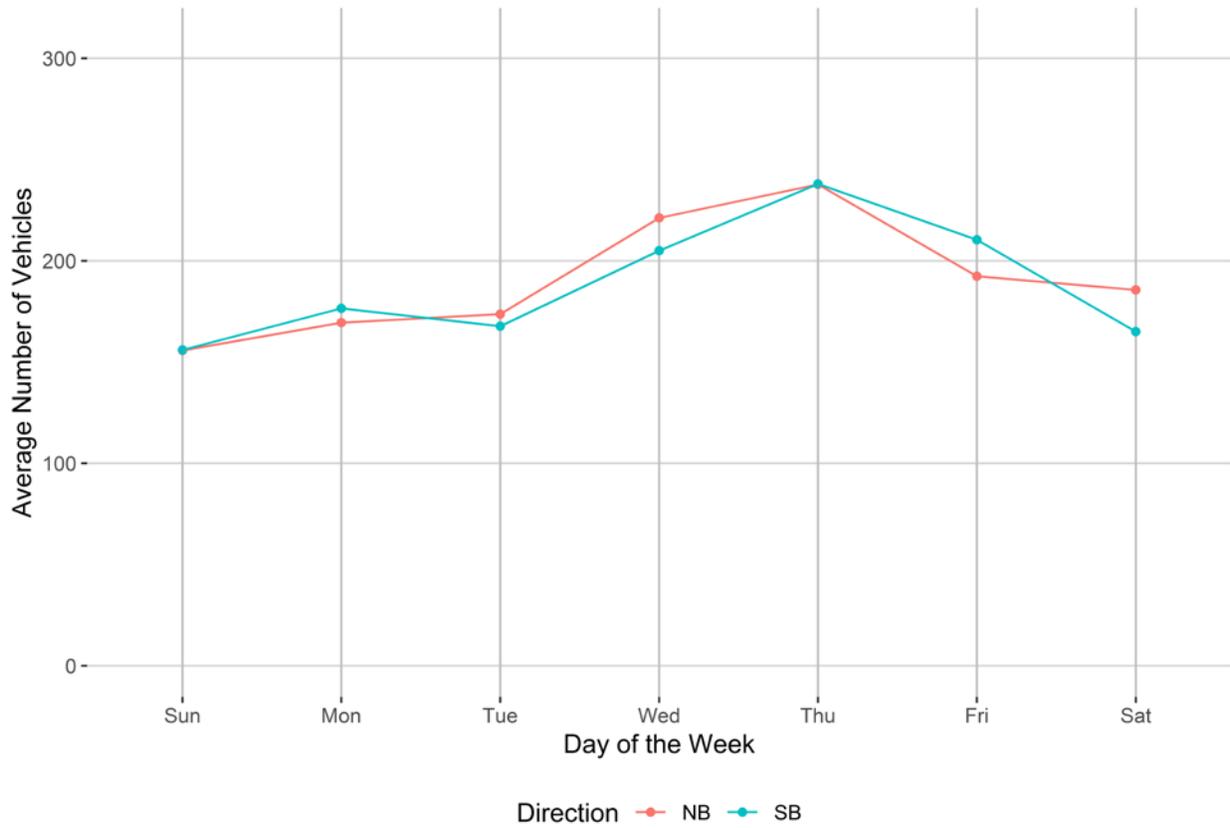


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

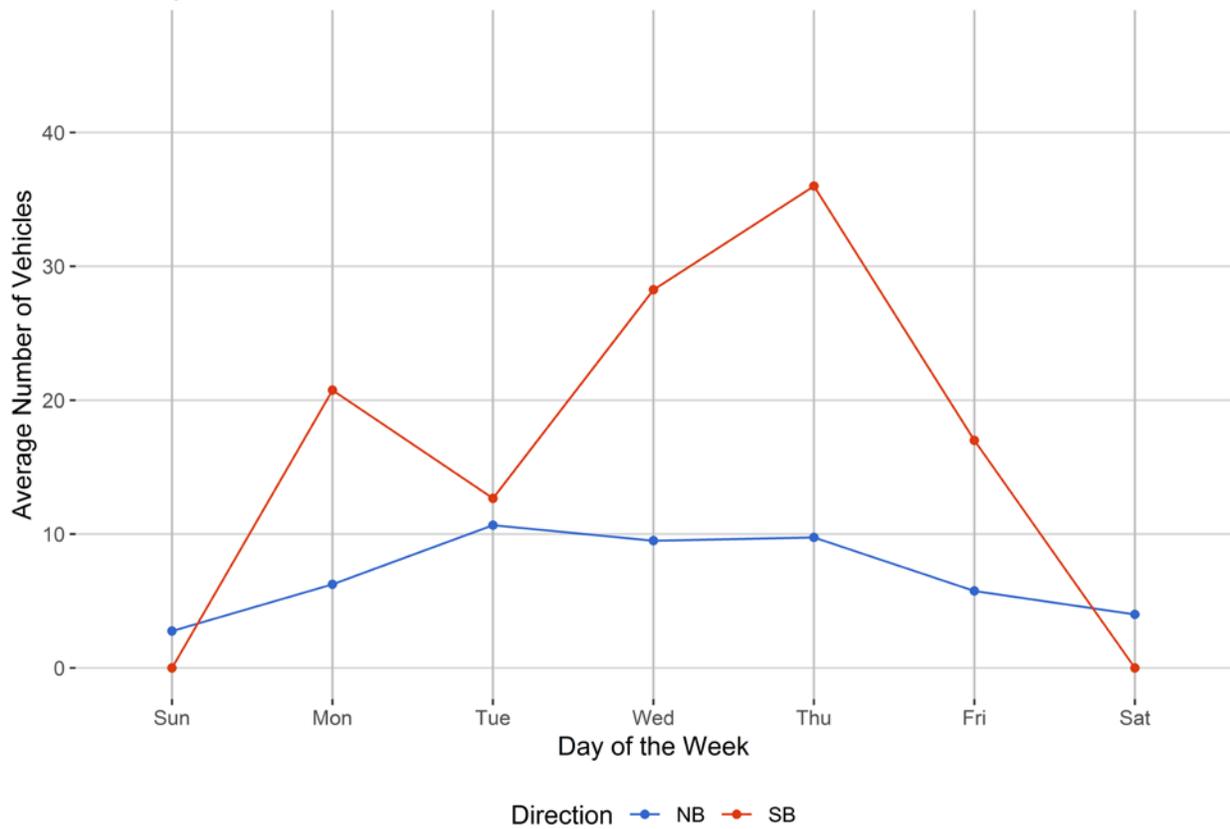


Figure 4 - Passenger Vehicles vs. Hour of the Day

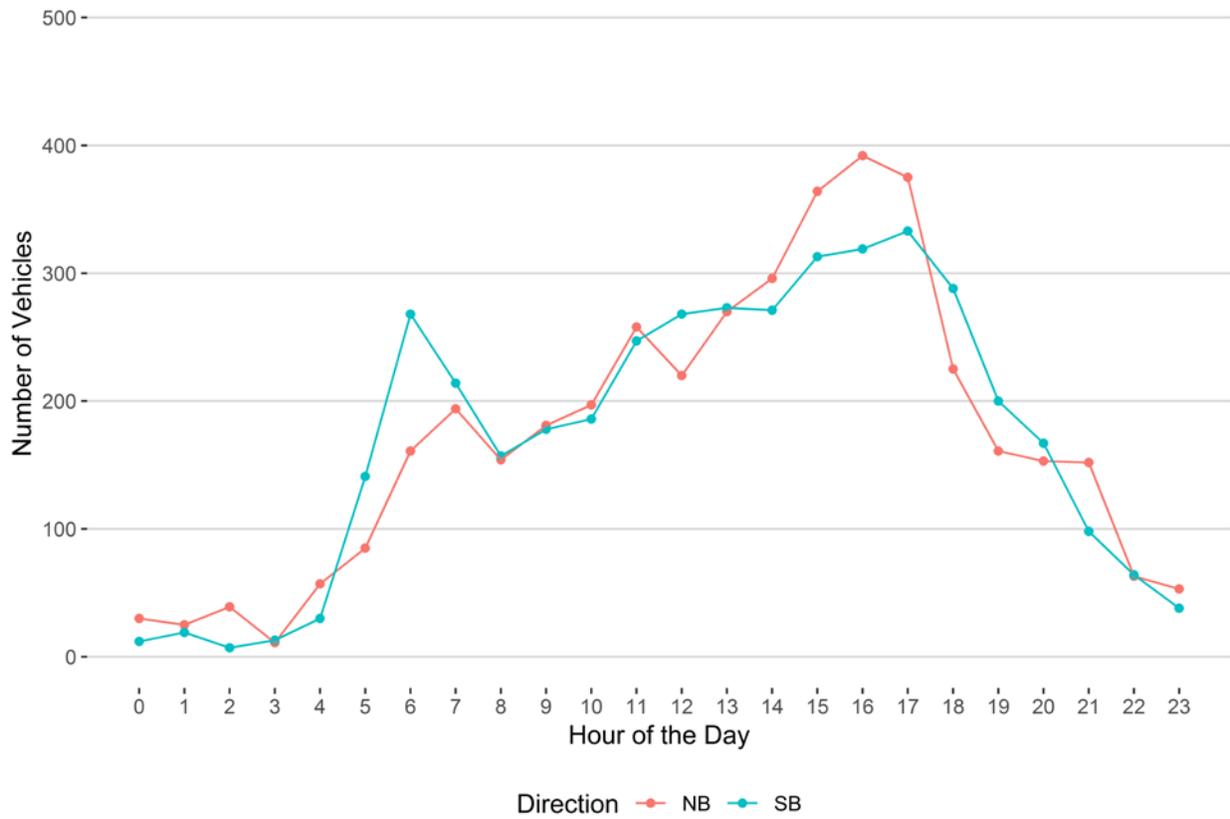


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

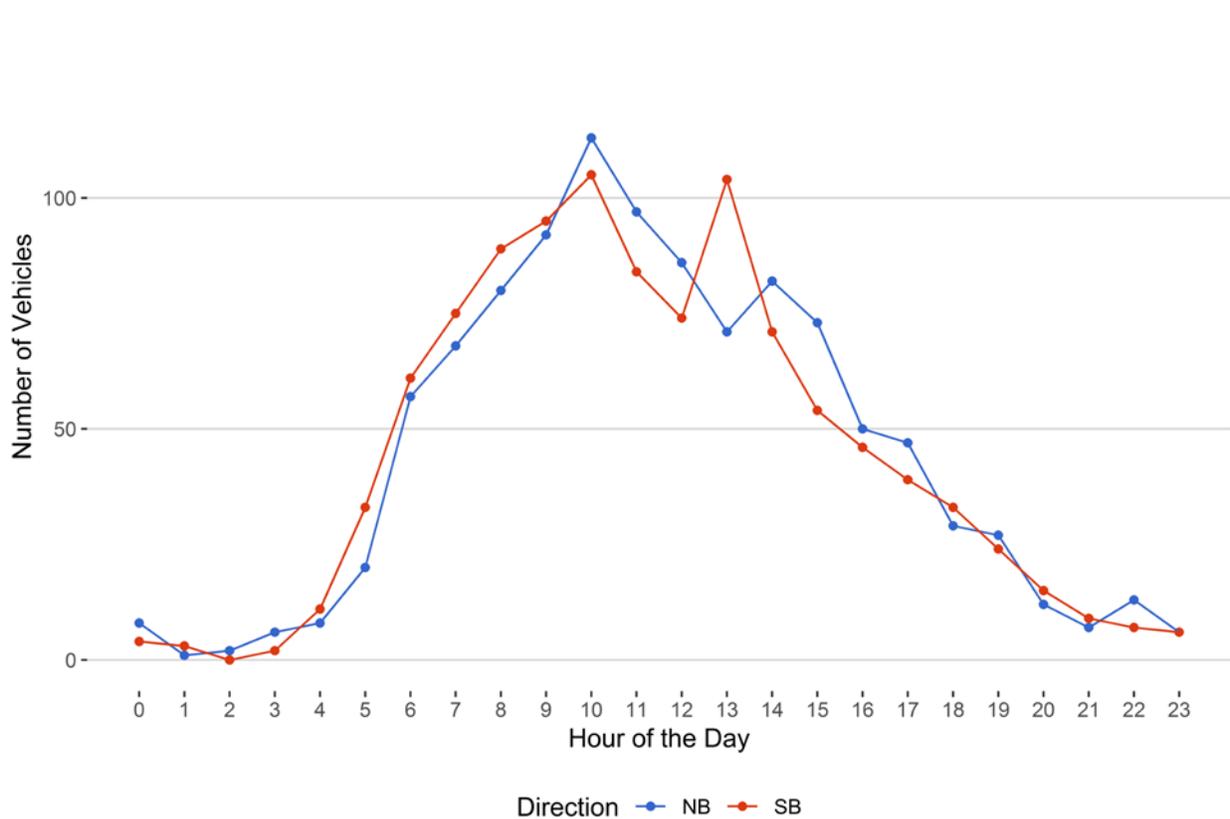


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

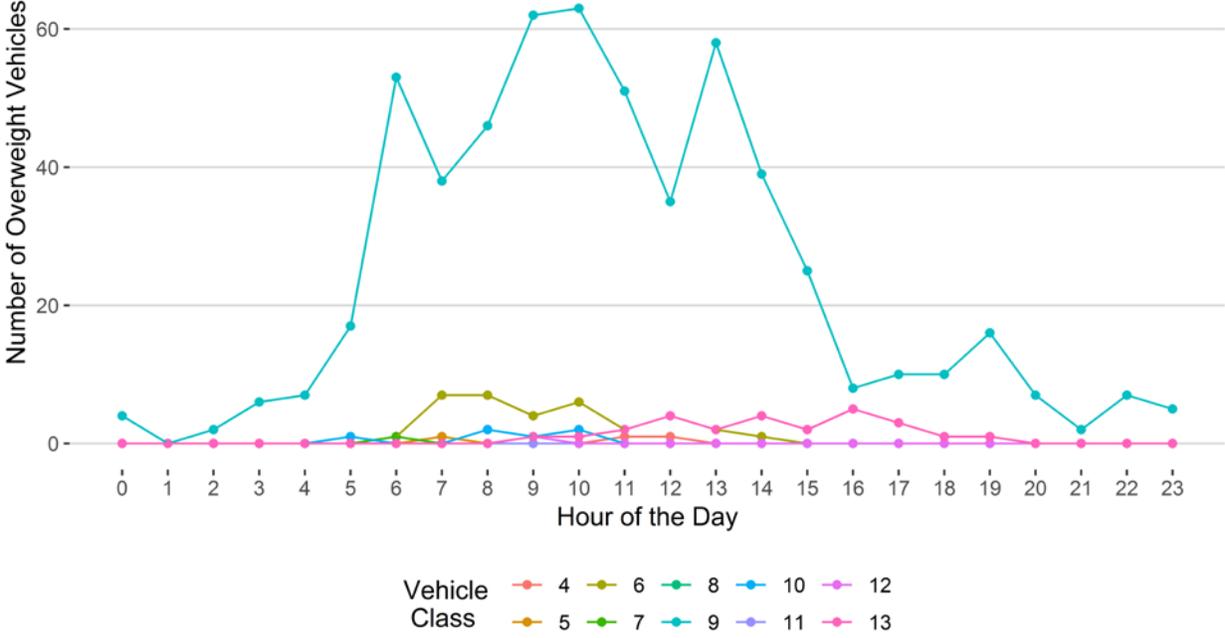


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

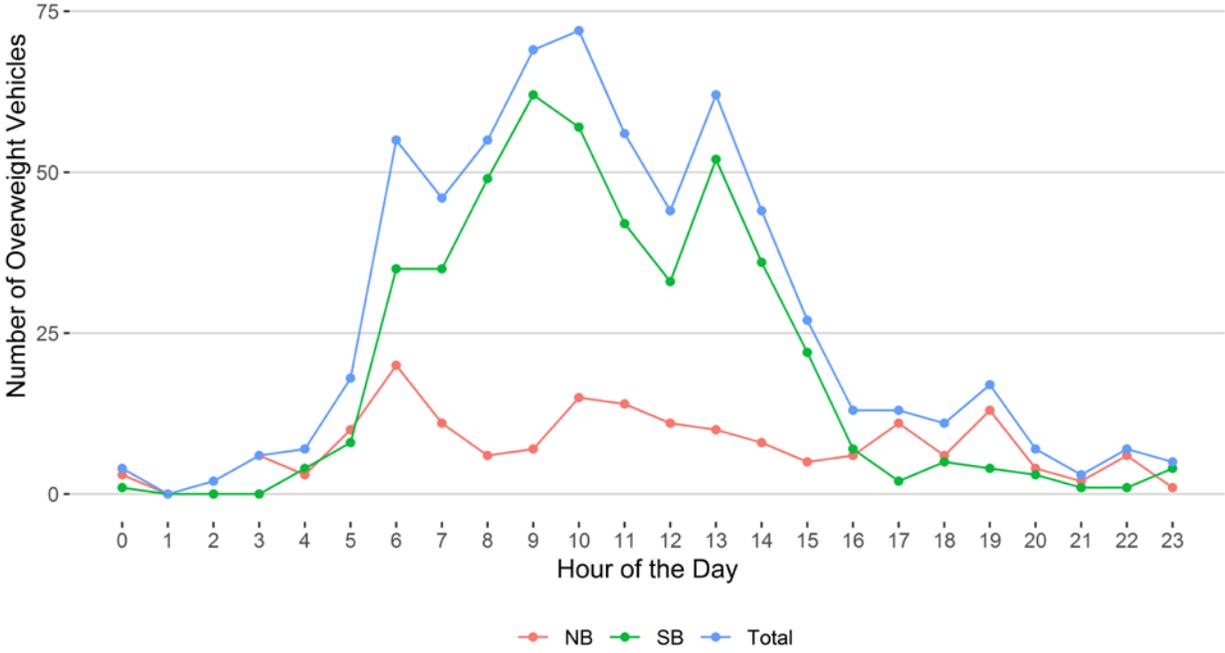
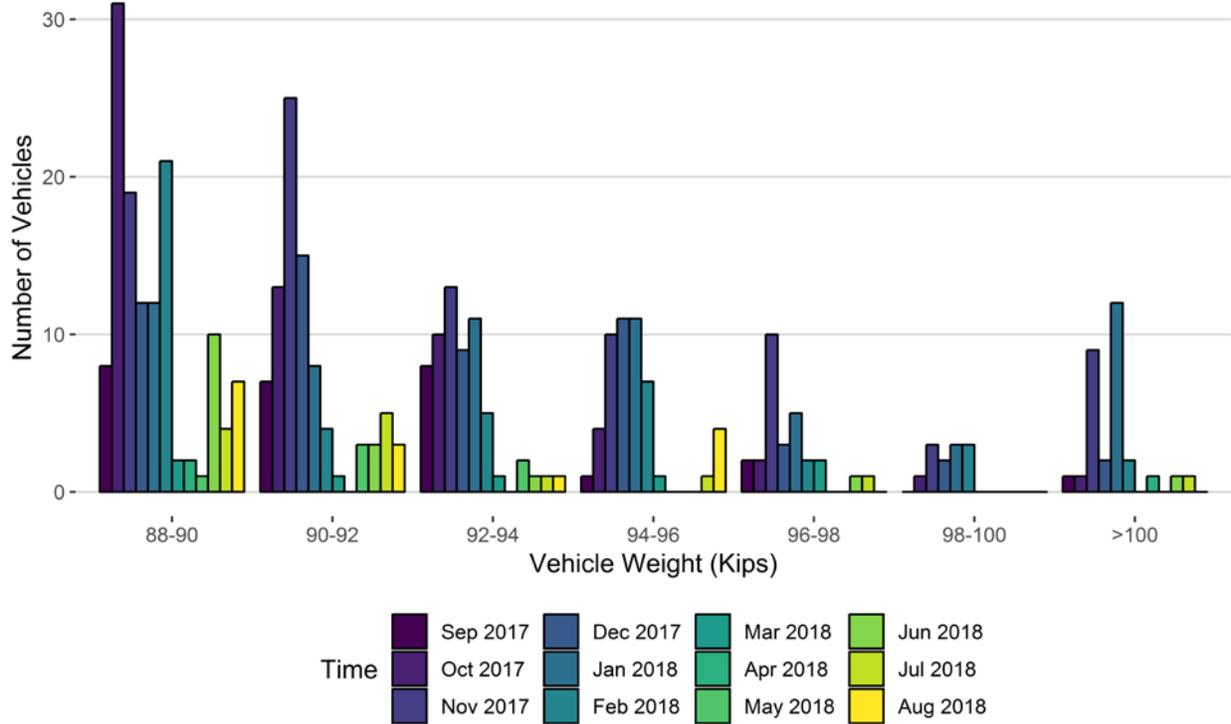
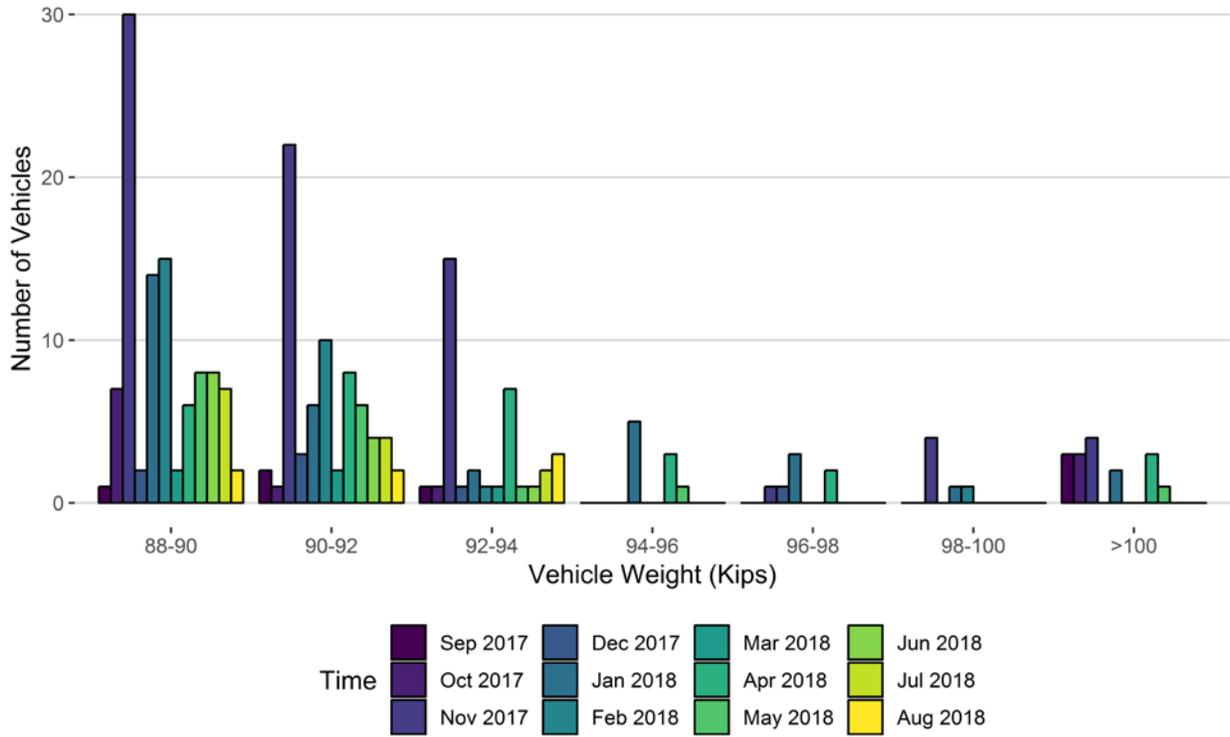


Figure 8 - Histogram of NB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Sep 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018
88-90	8	31	19	12	12	21	2	2	1	10	4	7
90-92	7	13	25	15	8	4	1	0	3	3	5	3
92-94	8	10	13	9	11	5	1	0	2	1	1	1
94-96	1	4	10	11	11	7	1	0	0	0	1	4
96-98	2	2	10	3	5	2	2	0	0	1	1	0
98-100	0	1	3	2	3	3	0	0	0	0	0	0
>100	1	1	9	2	12	2	0	1	0	1	1	0
Total	27	62	89	54	62	44	7	3	6	16	13	15

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



Vehicle Weights (Kips)	Sep 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018
88-90	1	7	30	2	14	15	2	6	8	8	7	2
90-92	2	1	22	3	6	10	2	8	6	4	4	2
92-94	1	1	15	1	2	1	1	7	1	1	2	3
94-96	0	0	0	0	5	0	0	3	1	0	0	0
96-98	0	0	1	1	3	0	0	2	0	0	0	0
98-100	0	0	4	0	1	1	0	0	0	0	0	0
>100	3	3	4	0	2	0	0	3	1	0	0	0
Total	7	12	76	7	33	27	5	29	17	13	13	7

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

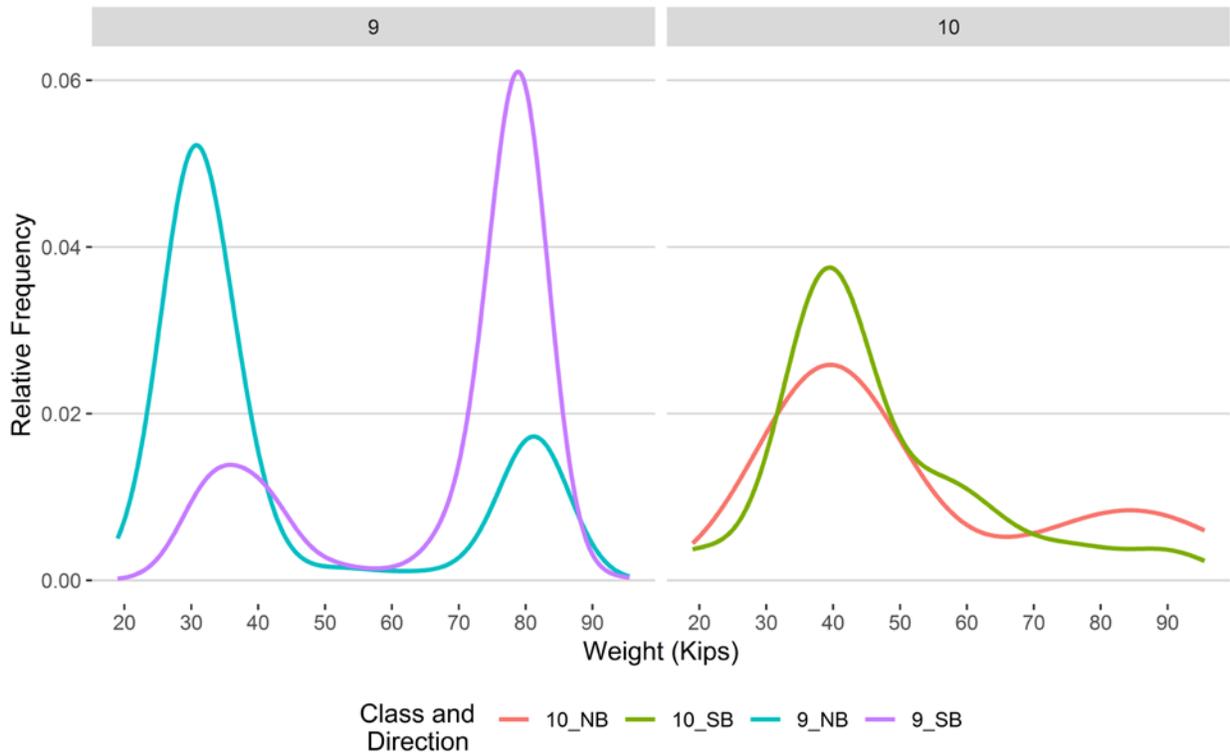


Figure 9 - Freight Percentage by Direction and Class

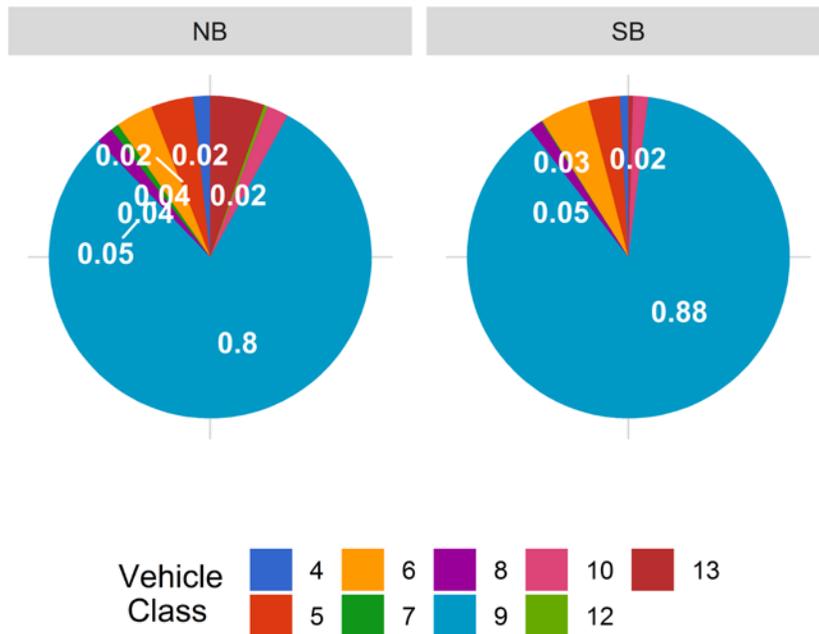


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

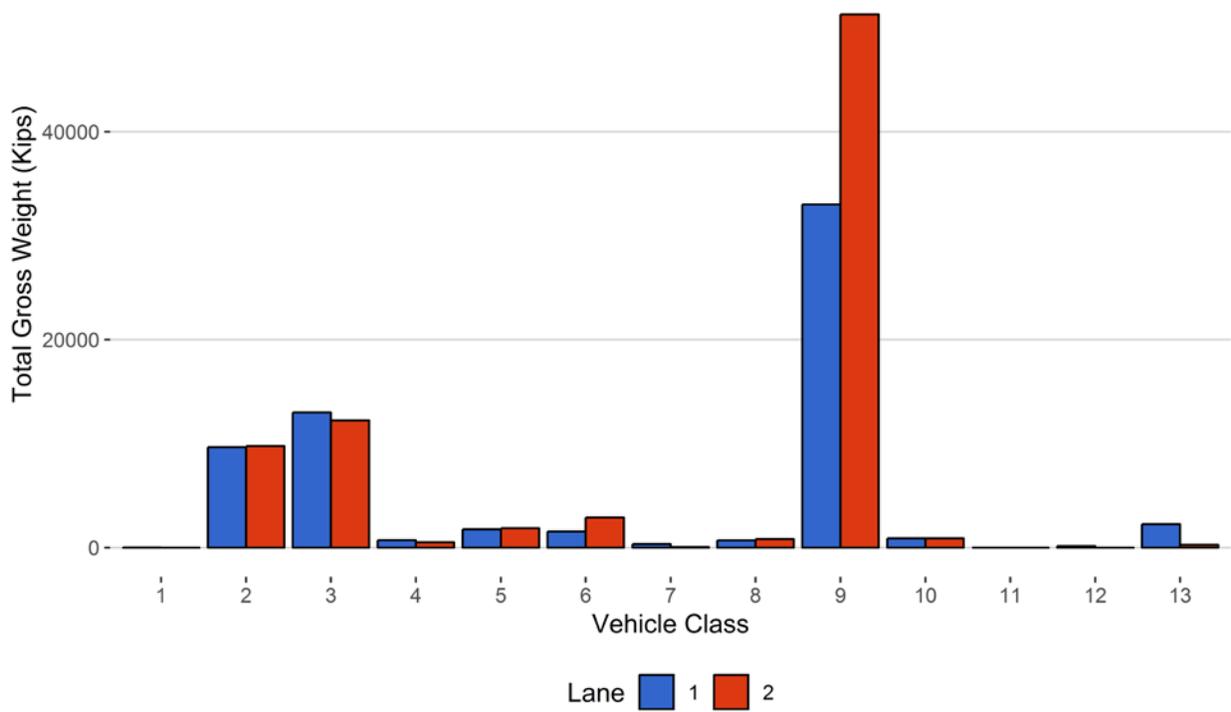


Figure 11 - Total Gross Vehicle Weight t

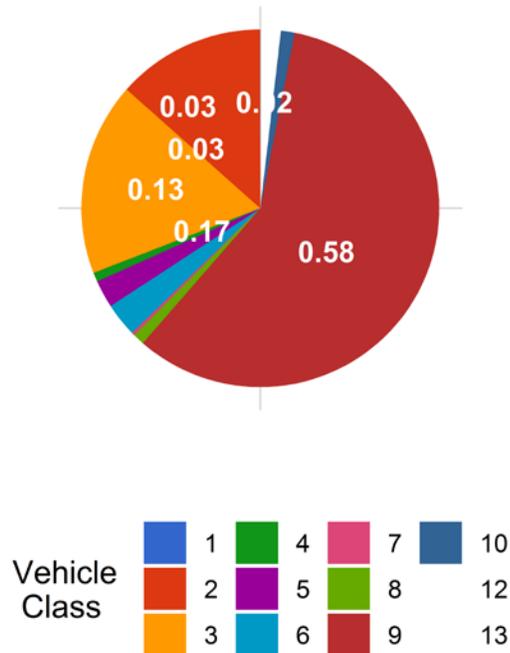


Figure 12 - Total ESALs by Class and Lane

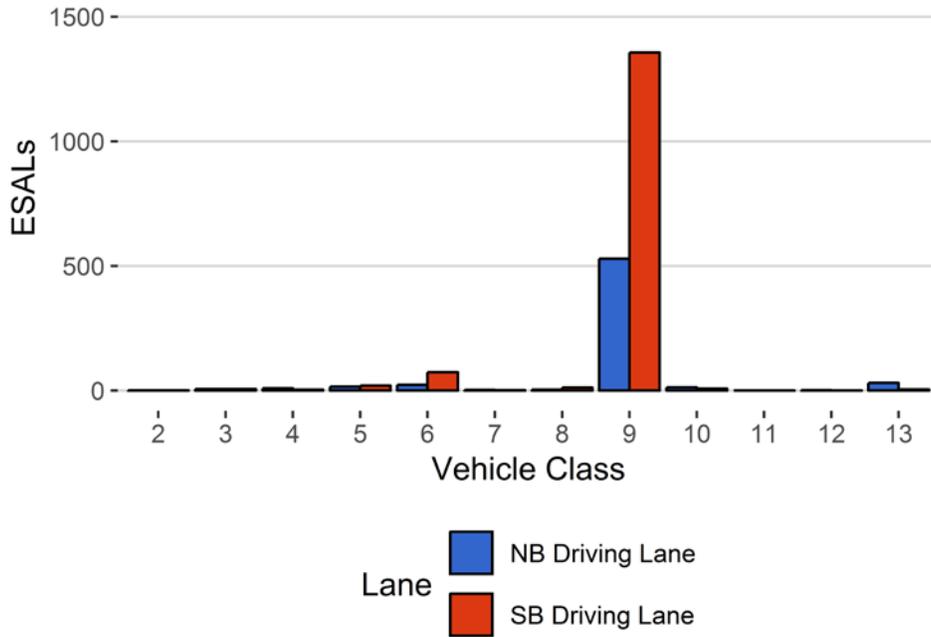


Figure 13 - ESALs by Class

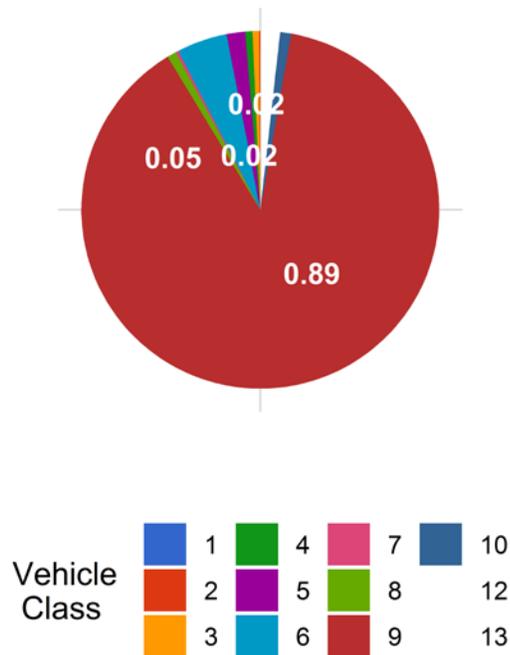


Table 1 Class 9 Front Axle Weight by Lane

<i>Month</i>	<i>Lane 1 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 2 (Kips)</i>	<i>Front Axle +/- 9%</i>
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

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	4	0	0	0
2	195	6039	45.2	0	0
3	149	4612	34.5	0	0
4	2	63	0.5	2	0.3
5	12	362	2.7	1	0.2
6	5	167	1.2	34	5.3
7	0	9	0.1	1	0.2
8	2	67	0.5	0	0
9	63	1956	14.6	571	88.9
10	2	47	0.3	6	0.9
11	0	0	0	0	0
12	0	5	0	1	0.2
13	1	37	0.3	26	4
TOTAL	431	13369	100	642	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>
2018-08-01	Wednesday	10:51:00	10	NB	1	95.53
2018-08-16	Thursday	07:01:27	9	SB	2	93.16
2018-08-16	Thursday	06:50:07	9	SB	2	92.14
2018-08-17	Friday	06:51:11	9	NB	1	90.95
2018-08-20	Monday	08:20:52	10	SB	2	90.09
2018-08-03	Friday	03:44:50	9	NB	1	89.25
2018-08-16	Thursday	17:28:02	9	NB	1	88.69
2018-08-20	Monday	15:39:25	9	SB	2	88.65
2018-08-16	Thursday	07:31:12	9	SB	2	88.55
2018-08-22	Wednesday	05:26:37	9	NB	1	88.02

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	25	4	16	648	57	166
5	NB	8	136	4	2.9	1729	27	337
6	NB	19	57	24	42.1	1125	419	249
7	NB	11.5	6	0	0	338	0	135
8	NB	31	26	18	69.2	278	417	15
9	NB	33	758	399	52.6	21346	11663	4749
10	NB	33.5	17	0	0	890	0	160
12	NB	36.5	4	3	75	86	64	25
13	NB	31.5	26	0	0	2248	0	715
TOTAL	****	****	1055	452	****	28689	****	6551
<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	24	4	16.7	442	56	71
5	SB	8	144	14	9.7	1759	104	359
6	SB	19	72	1	1.4	2873	18	762
7	SB	11.5	1	0	0	57	0	23
8	SB	31	26	12	46.2	559	250	62
9	SB	33	755	55	7.3	49597	1699	13248
10	SB	33.5	19	1	5.3	872	19	135
13	SB	31.5	3	0	0	268	0	87
TOTAL	****	****	1044	87	****	56426	****	14747
GRAND TOTAL	****	****	2099	539	344	85115	14792	21298

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	4	0	4	0
2	9658	9759	19416	13.4
3	12996	12224	25220	17.4
4	705	498	1204	0.8
5	1756	1863	3619	2.5
6	1543	2891	4434	3.1
7	338	57	395	0.3
8	695	809	1504	1
9	33008	51295	84304	58.3
10	890	892	1782	1.2
12	150	0	150	0.1
13	2248	268	2516	1.7
TOTAL	63992	80555	144547	100
GVW/LANE	44.27	55.73	100	0.07

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	0.25
2	1	1	2	0.1	0.0015
3	6	6	12	0.6	0.008
4	10	4	14	0.6	0.61
5	16	20	36	1.7	0.27
6	24	74	97	4.6	1.52
7	4	2	5	0.3	1.3
8	4	13	18	0.8	0.73
9	530	1357	1886	88.6	2.54
10	13	8	21	1	1.16
12	2	0	2	0.1	1
13	31	5	36	1.7	2.06
TOTAL	640	1490	2130	100	11
ESALS/LANE	30	70	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>
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
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
TOTAL	148538	-	-	121571	-	26968	-
AVERAGE	12378	407	74	10131	82	2247	18

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>
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
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
TOTAL	9241	-	-	-
AVERAGE	770	1270	2040	5

Gross Vehicle Weight

<i>Month</i>	<i>GVW NB Driving Lane</i>	<i>GVW SB Driving Lane</i>	<i>Total GVW Kips</i>
Sep 2017	55605	68986	124591
Oct 2017	53051	55564	108616
Nov 2017	53496	52160	105656
Dec 2017	54103	59595	113698
Jan 2018	81509	84194	165703
Feb 2018	83916	92328	176243
Mar 2018	84746	82653	167398
Apr 2018	64139	80654	144793
May 2018	74076	92119	166195
Jun 2018	91106	87939	179046
Jul 2018	80715	103216	183930
Aug 2018	54550	54404	108954
TOTAL	831012	913811	1744823
AVERAGE	69251	76151	145402

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>
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
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
TOTAL	6720	-	-	645	64
AVERAGE	560	5.1	27.8	53.8	5.3

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>
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
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
TOTAL	97430	151088	248518	-	-
AVERAGE	8119.2	12590.6	20709.8	39.7	60.3