

MARCH 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 March 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 were all more than +/- 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: 95909 | Passenger Vehicles: 78620 | Heavy Commercial Vehicles: 17289

Monthly Average Daily Traffic (MADT): 3094 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 558

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 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 13's.

Overweight HCVs

Volume trends. Of a total of 17289 HCVs, 5260 of them were overweight³. These overweight HCVs contributed to 5.5% of total monthly volume, and 30.5% 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 Wednesdays, with lowest volumes reported on Sundays. See Figure 3. The top two overweight violators by class were the class 13 and class 9 vehicles. Overall, overweight vehicles tended to reach peak volume concentrations during typical business hours, with 92.3% 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 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, 116 NB vehicles exceeded 88,000 pounds (72 vehicles were Class 13's; 37 vehicles were Class 10's). Of vehicles traveling SB,

3071 NB vehicles exceeded 88,000 pounds (2866 vehicles were Class 13's; 121 vehicles were Class 10's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from March 2018.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9s and 10s in March 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 226871 tons of freight was recorded to have crossed the WIM. More freight was shipped SB (81.5%) than NB (18.5%). 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 95909 vehicles with a combined GVW of 1301027 kips (1 kip = 1,000 pounds = 0.5 tons) in March 2018. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 14797 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 76.5% of all ESALs were recorded SB while 23.5% was observed NB. In particular, 45% of all ESALs were generated by the Class 9's (Class 9's were also responsible for generating 31% 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).

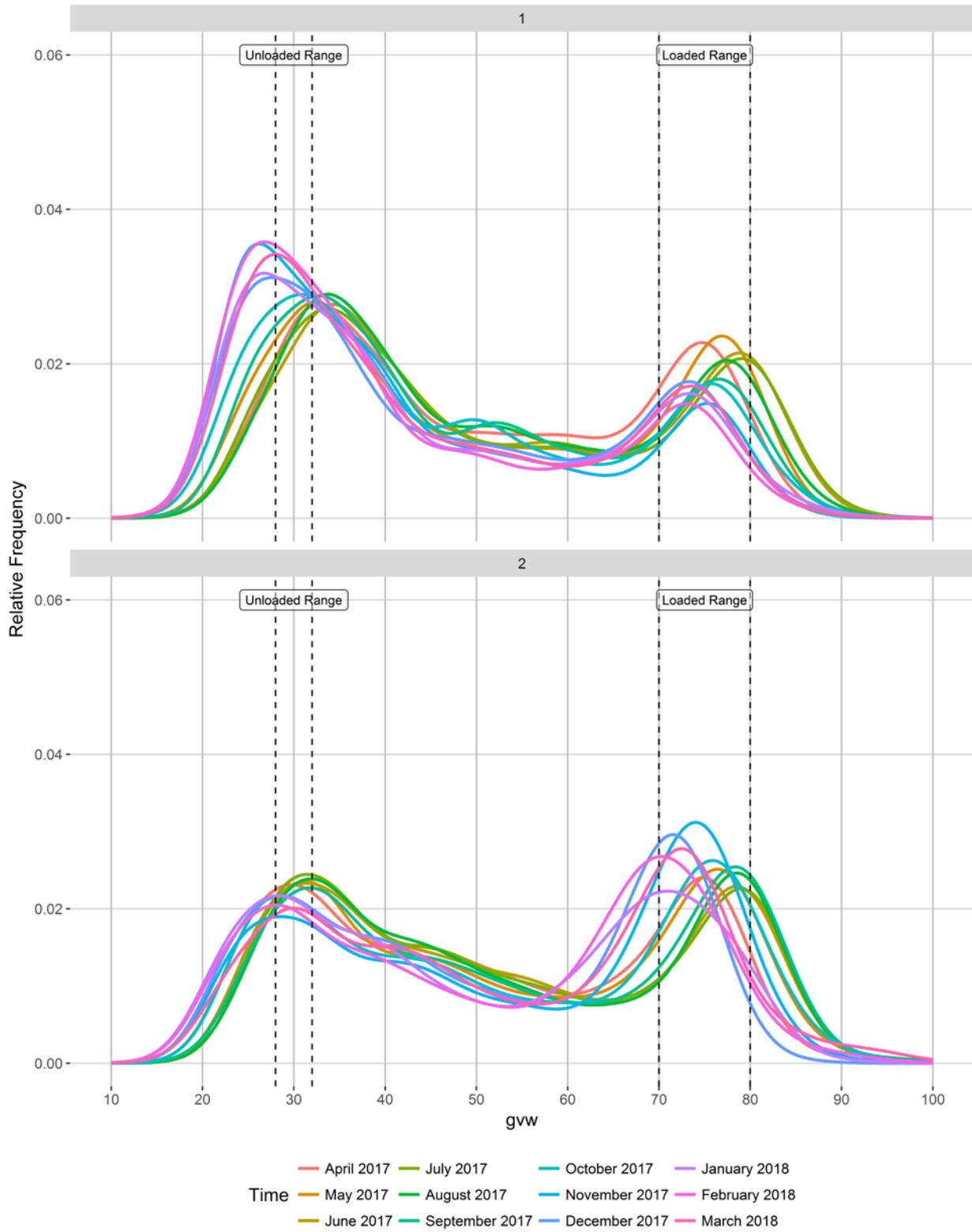
WIM monthly reports can be found at: <http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html>

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.

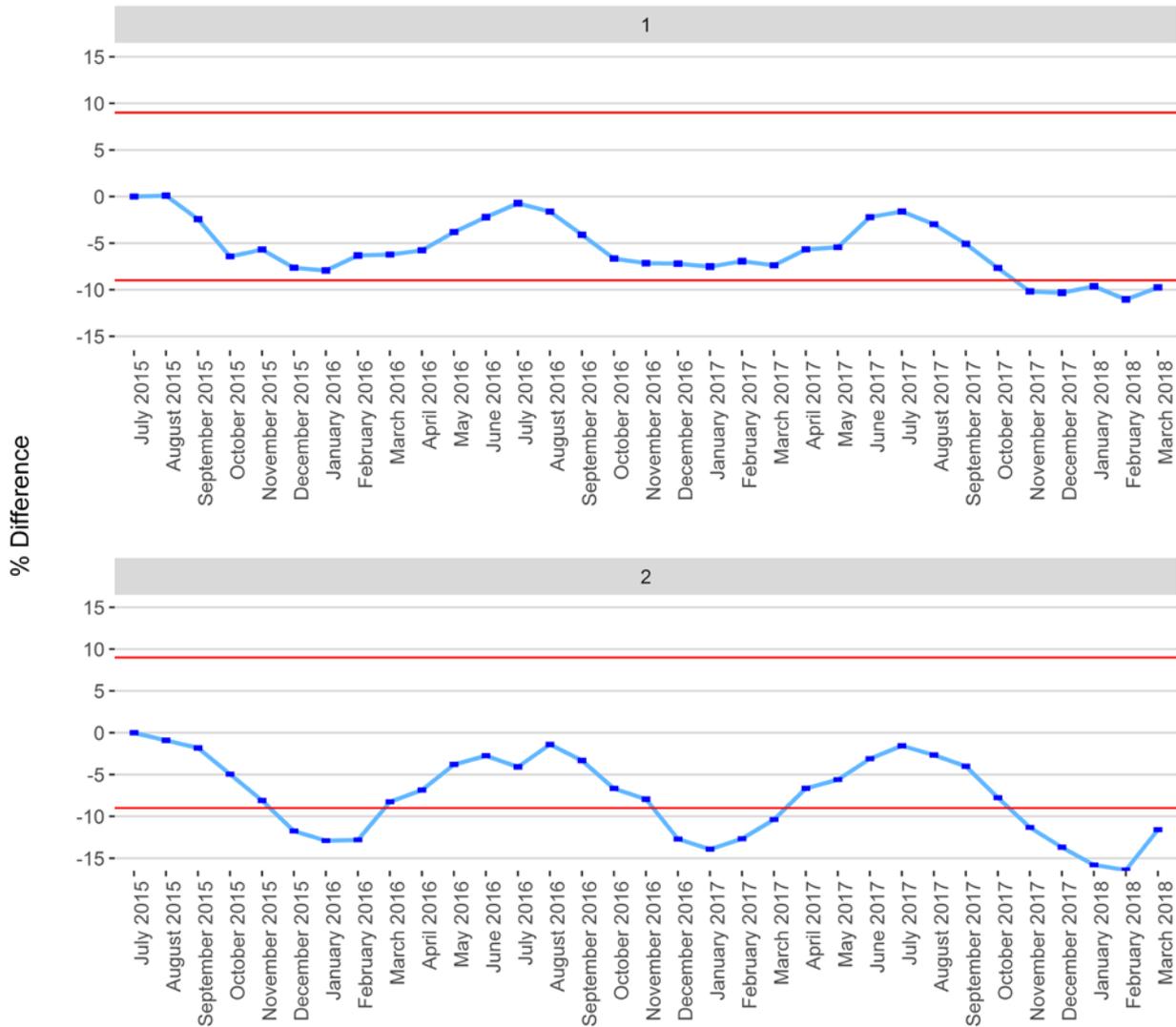
To request this document in an alternative format, please call 651-366-4718 or 1-800-657-3774, or email your request to ADArequest.dot@state.mn.us. Please request at least one week in advance.

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

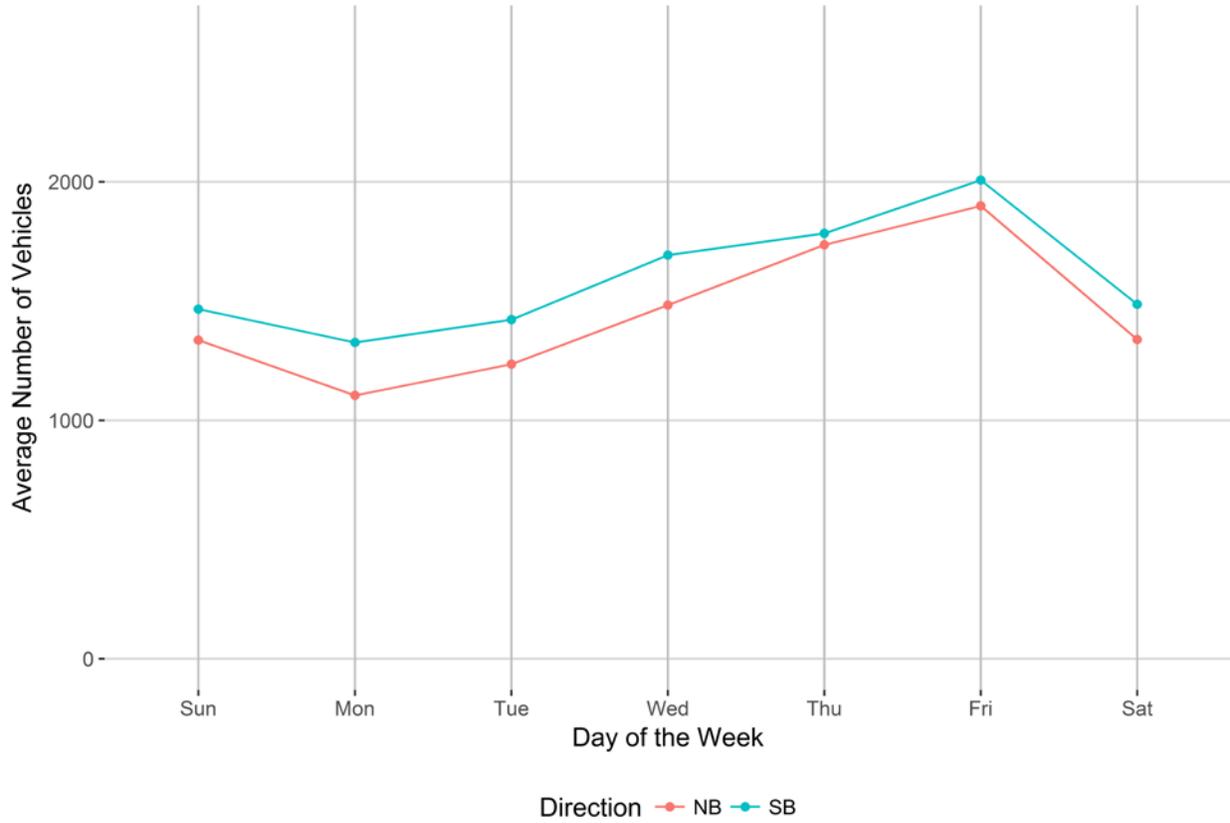


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

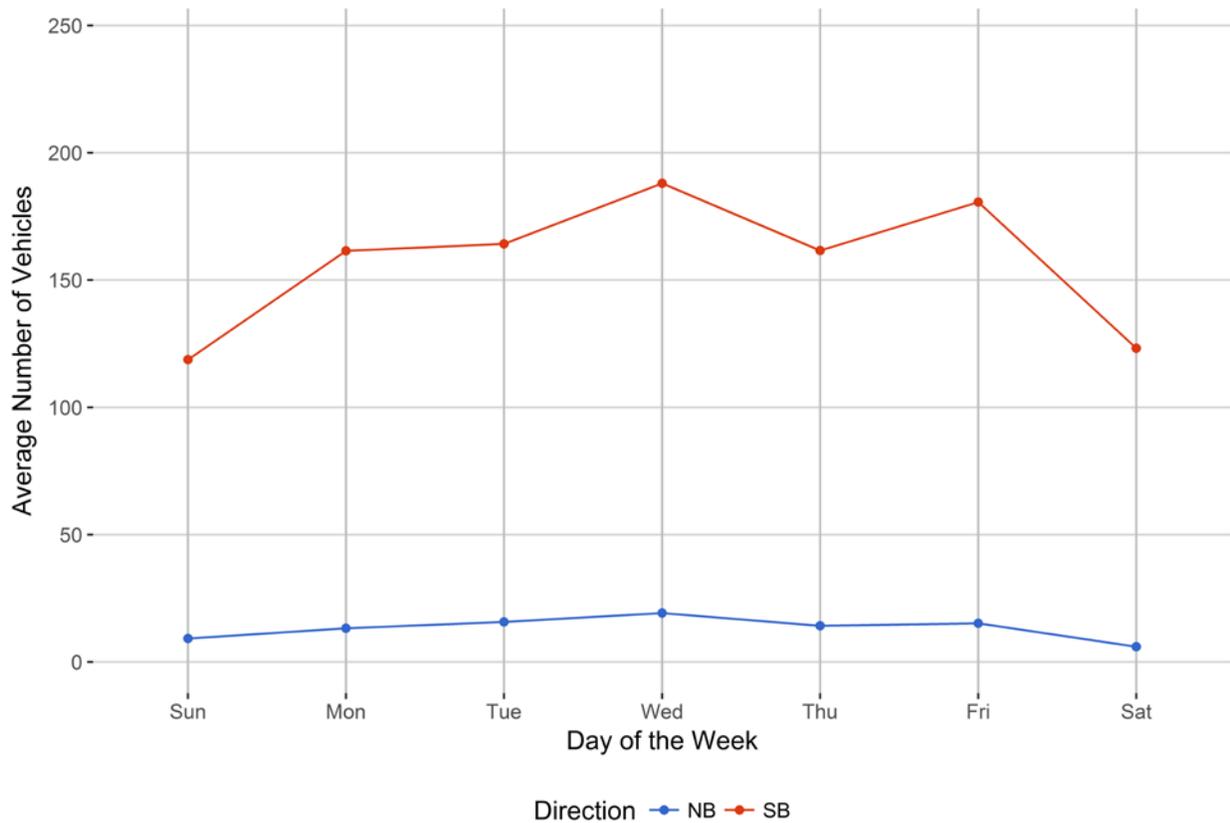


Figure 4 - Passenger Vehicles vs. Hour of the Day

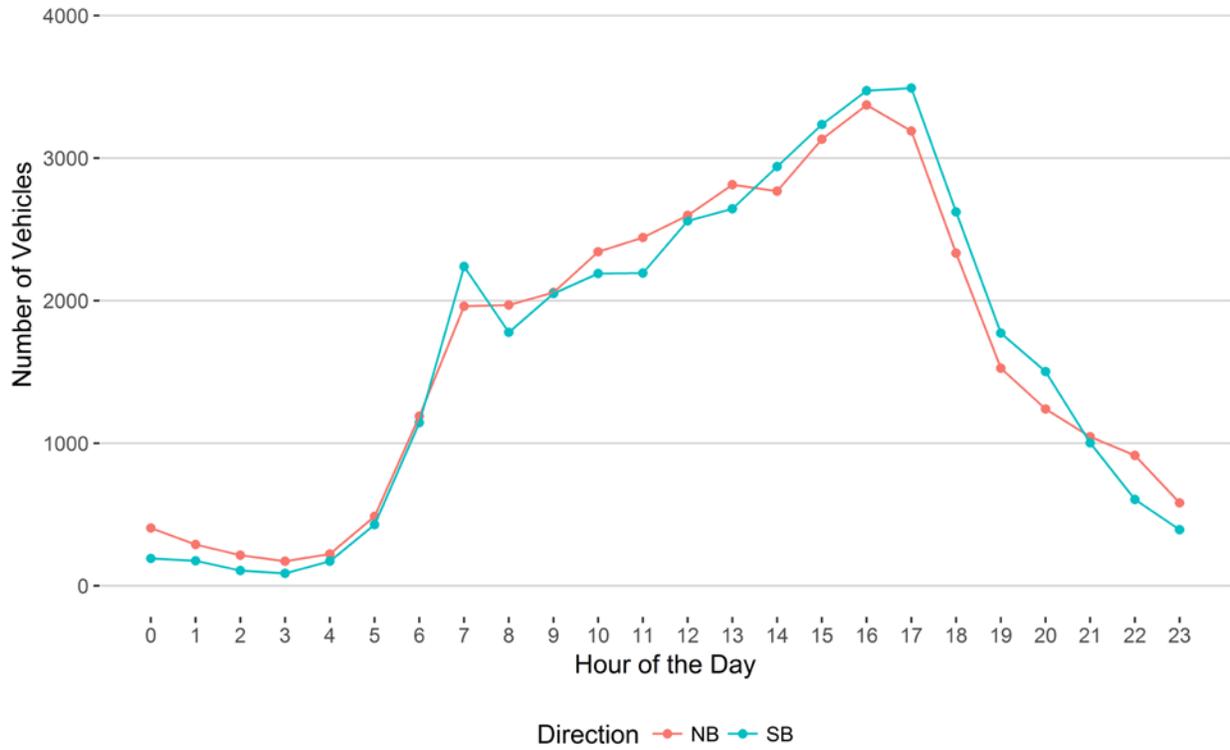


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

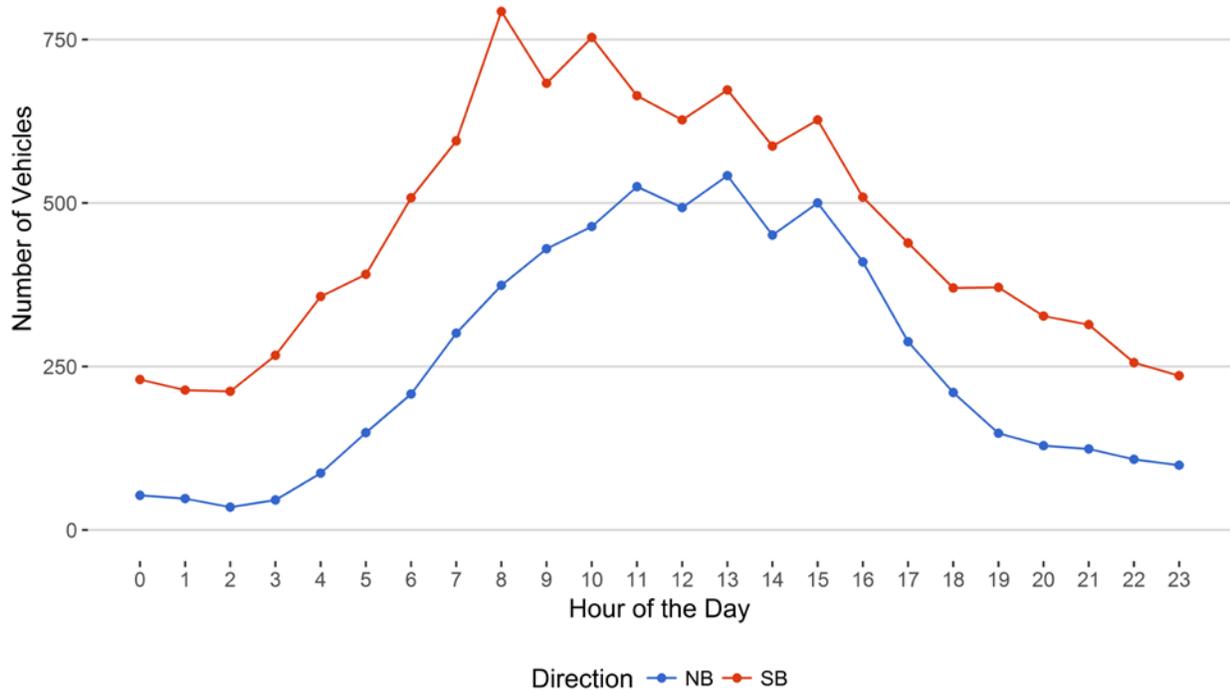


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

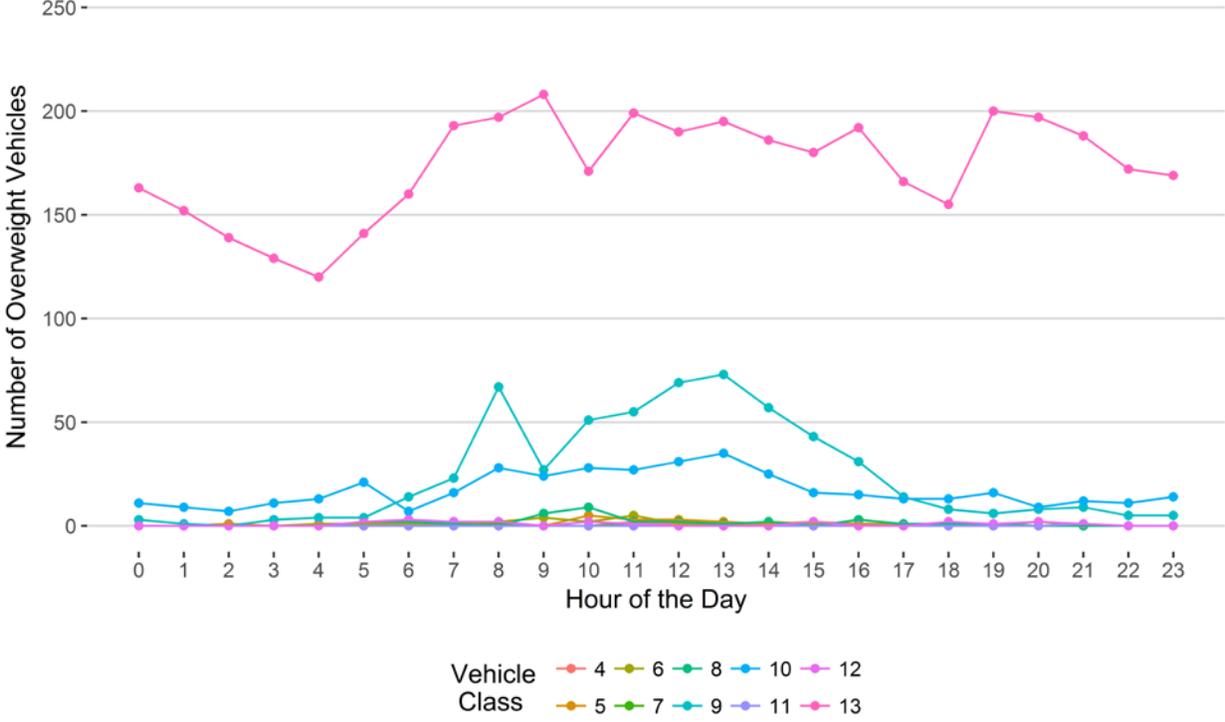


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

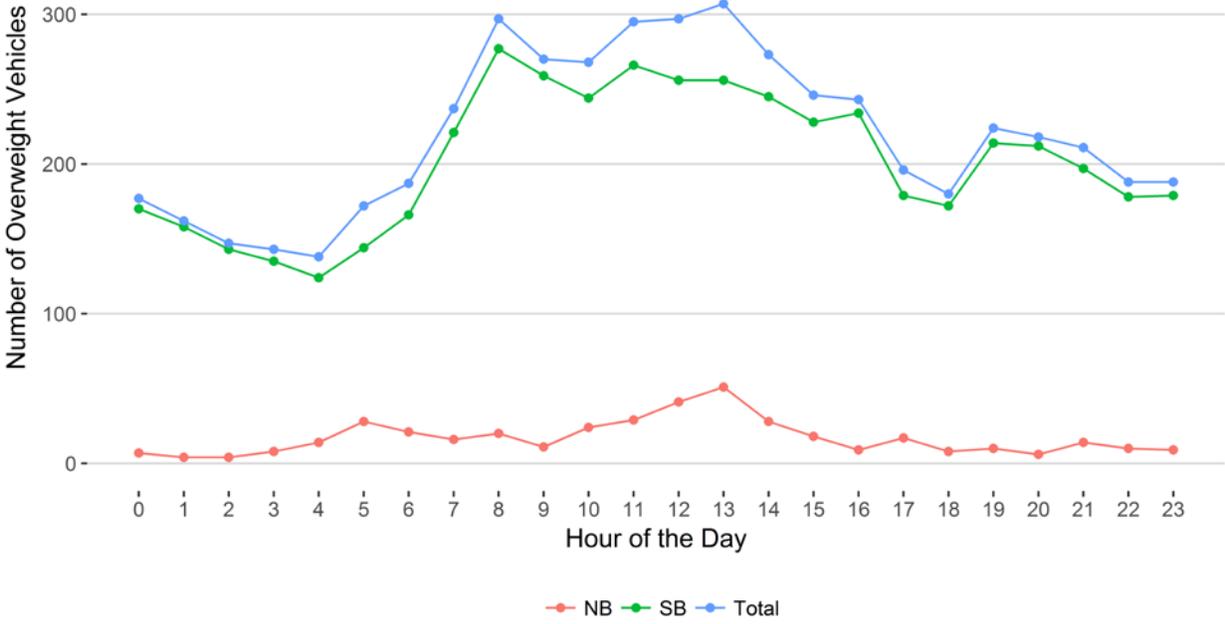
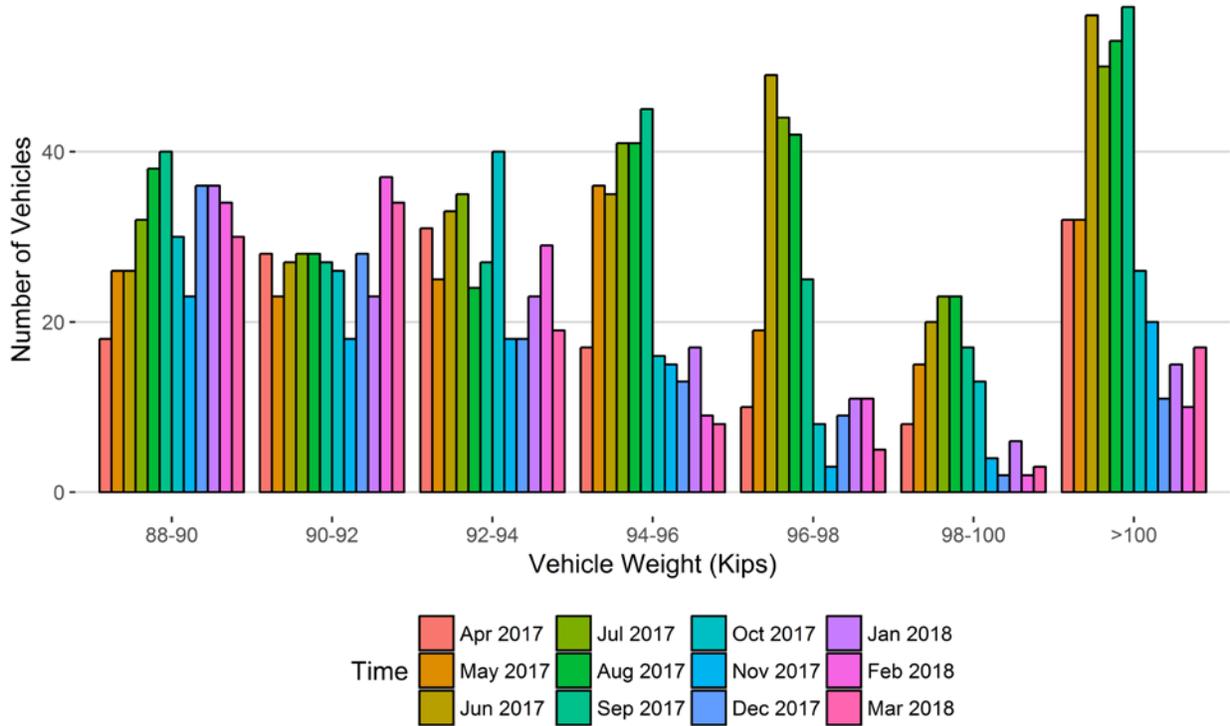
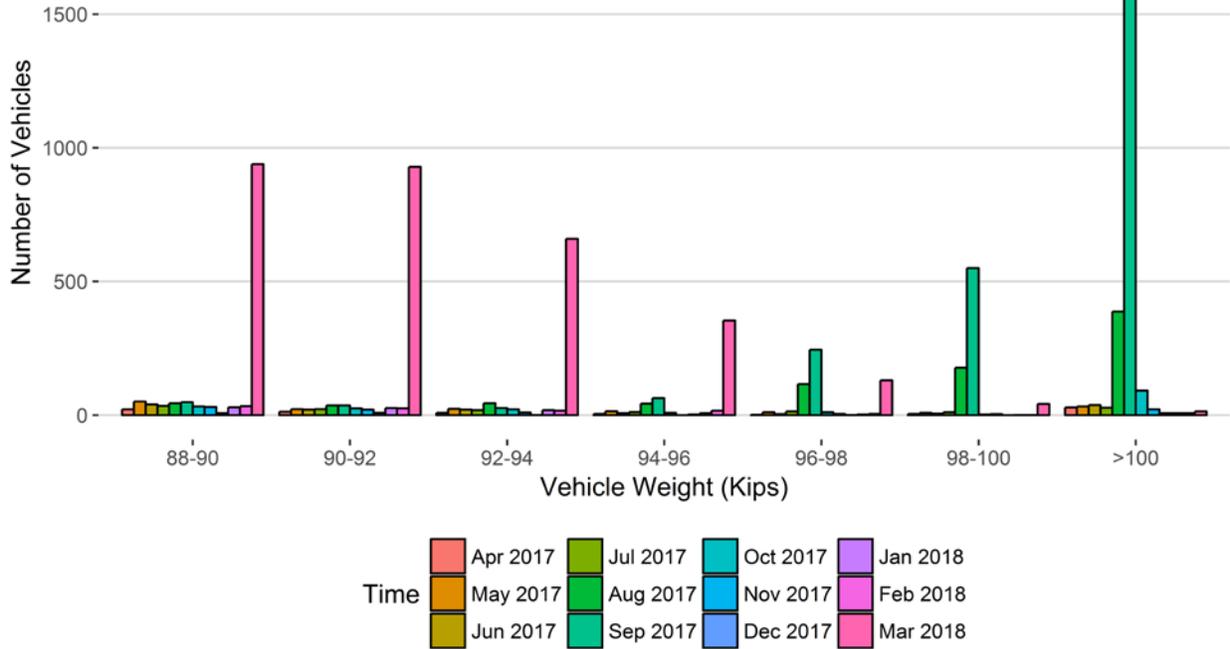


Figure 8 - Histogram of NB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Apr 2017	May 2017	Jun 2017	Jul 2017	Aug 2017	Sep 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018
88-90	18	26	26	32	38	40	30	23	36	36	34	30
90-92	28	23	27	28	28	27	26	18	28	23	37	34
92-94	31	25	33	35	24	27	40	18	18	23	29	19
94-96	17	36	35	41	41	45	16	15	13	17	9	8
96-98	10	19	49	44	42	25	8	3	9	11	11	5
98-100	8	15	20	23	23	17	13	4	2	6	2	3
>100	32	32	56	50	53	57	26	20	11	15	10	17
Total	144	176	246	253	249	238	159	101	117	131	132	116

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



Vehicle Weights (Kips)	Apr 2017	May 2017	Jun 2017	Jul 2017	Aug 2017	Sep 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018
88-90	22	51	40	35	45	49	33	31	8	30	34	939
90-92	13	23	21	23	37	37	26	21	9	27	26	929
92-94	9	24	21	19	45	27	22	10	1	19	17	660
94-96	5	15	8	12	43	64	9	0	3	8	17	354
96-98	2	11	4	14	116	245	11	5	1	3	5	131
98-100	5	9	6	11	178	550	3	4	0	1	1	42
>100	29	33	38	28	388	1815	92	22	8	8	8	14
Total	85	166	138	142	852	2787	196	93	30	96	108	3069

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

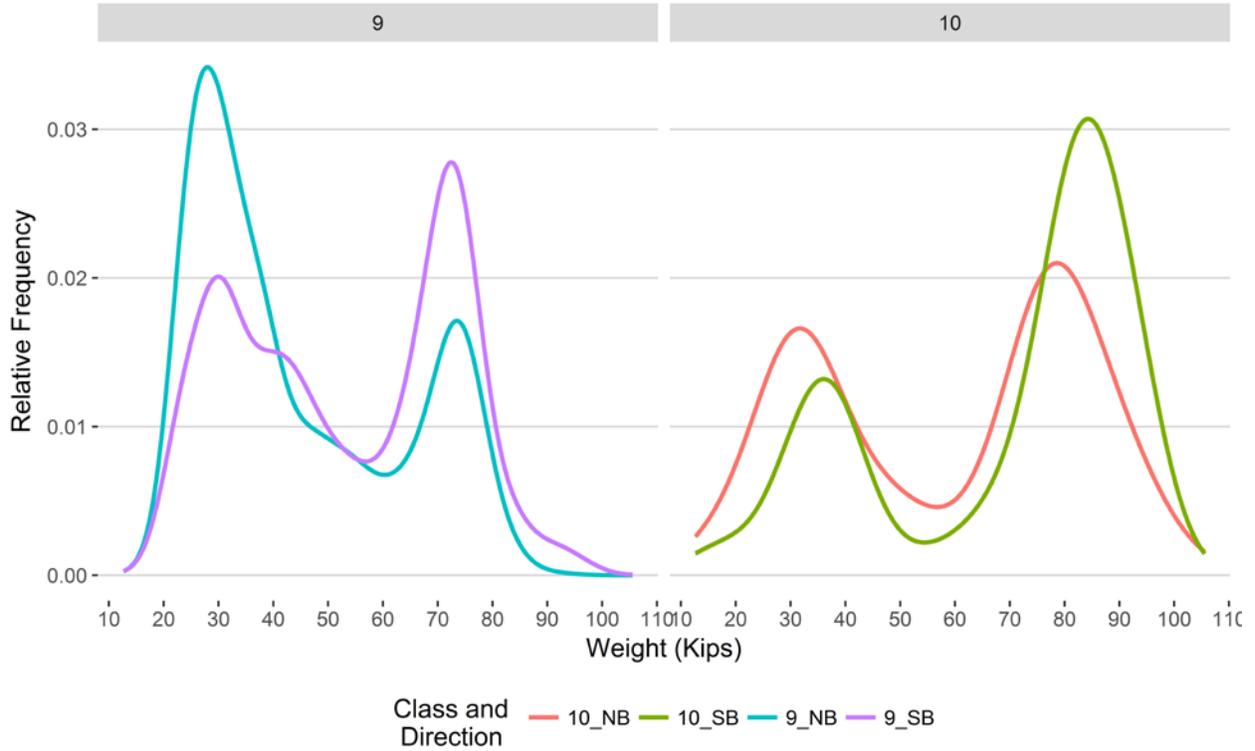


Figure 9 - Freight Percentage by Direction and Class

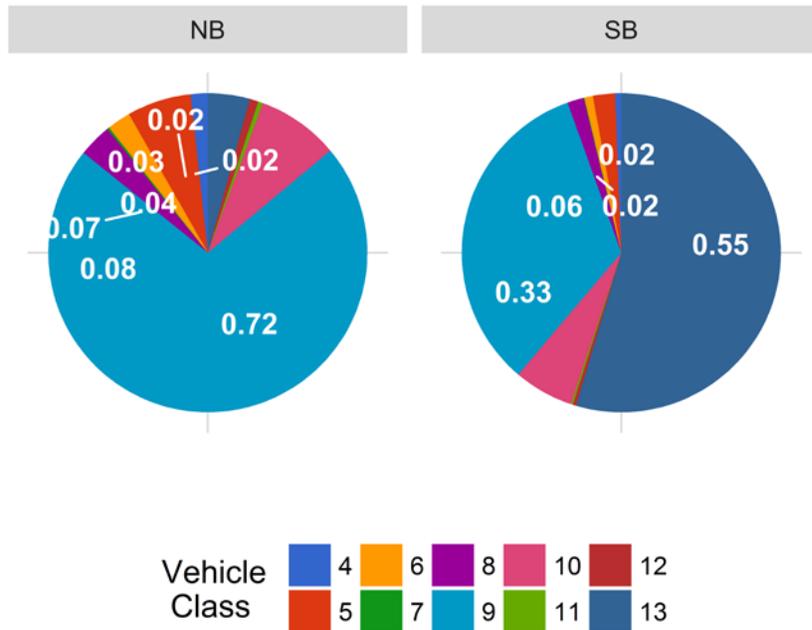


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

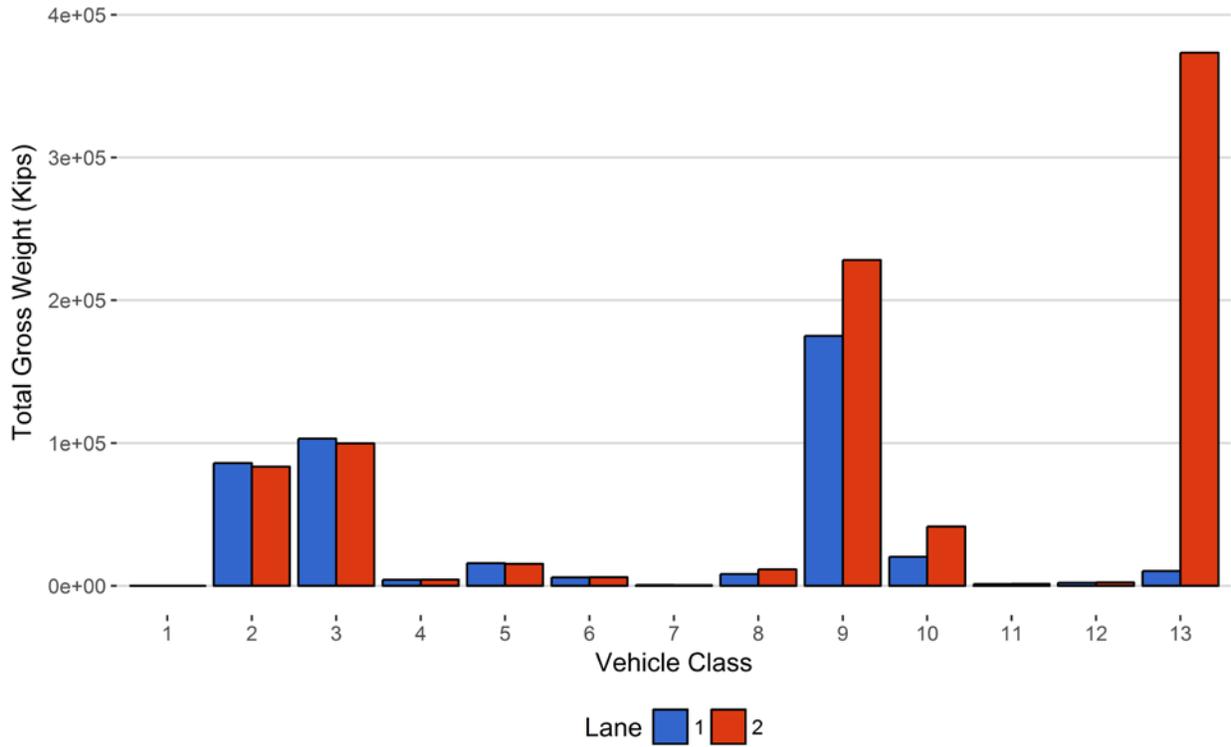


Figure 11 - Total Gross Vehicle Weight I

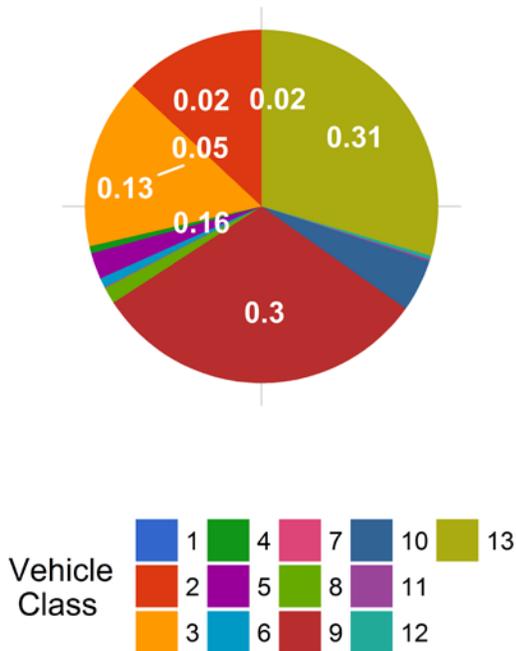


Figure 12 - Total ESALs by Class and Lane

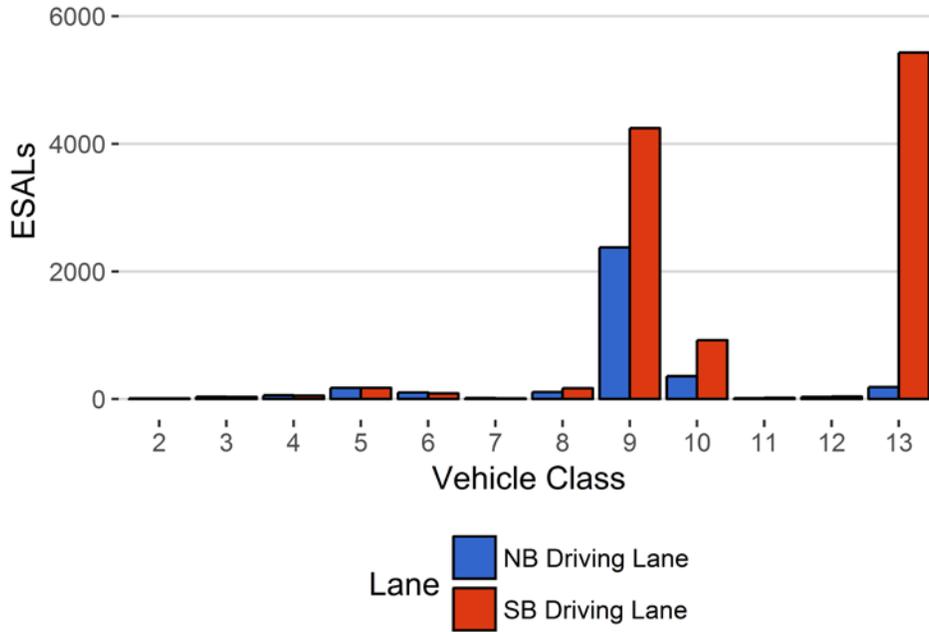


Figure 13 - ESALs by Class

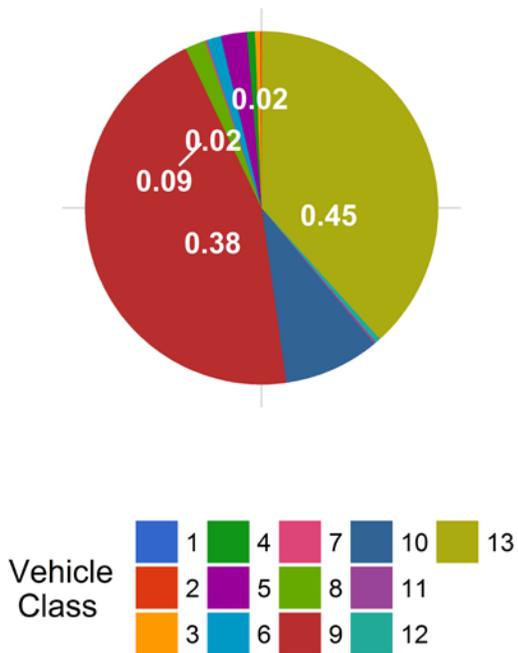


Table 1 Class 9 Front Axle Weight by Lane

<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

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	1433	44437	46.3	0	0
3	1103	34181	35.6	0	0
4	11	350	0.4	5	0.1
5	71	2215	2.3	22	0.4
6	14	427	0.4	23	0.4
7	1	18	0	2	0
8	21	654	0.7	33	0.6
9	266	8244	8.6	580	11
10	30	942	1	412	7.8
11	2	55	0.1	1	0
12	2	71	0.1	20	0.4
13	139	4313	4.5	4162	79.1
TOTAL	3094	95909	100	5260	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>
2018-03-29	Thursday	05:40:55	10	NB	1	108.51
2018-03-18	Sunday	05:42:44	10	NB	1	105.56
2018-03-05	Monday	04:26:10	10	NB	1	104.73
2018-03-14	Wednesday	13:28:42	9	SB	2	99.86
2018-03-04	Sunday	17:18:23	10	NB	1	99.44
2018-03-02	Friday	14:56:44	9	SB	2	99.09
2018-03-21	Wednesday	05:09:18	10	NB	1	99.01
2018-03-15	Thursday	16:06:53	9	SB	2	98.88
2018-03-22	Thursday	14:53:16	10	SB	2	98.32
2018-03-02	Friday	14:21:30	10	SB	2	98.29

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	168	42	25	3660	535	885
5	NB	8	1121	128	11.4	14953	935	3504
6	NB	19	201	51	25.4	4968	872	1059
7	NB	11.5	10	0	0	561	0	223
8	NB	31	274	144	52.6	4912	3279	441
9	NB	33	3930	1570	39.9	132388	42692	27254
10	NB	33.5	342	94	27.5	17706	2638	4699
11	NB	36.5	28	5	17.9	1020	123	90
12	NB	36.5	34	3	8.8	2090	65	479
13	NB	31.5	114	0	0	10350	0	3380
TOTAL	****	****	6222	2037	****	192608	****	42014
<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	181	45	24.9	3780	544	870
5	SB	8	1086	201	18.5	13842	1445	3381
6	SB	19	224	75	33.5	4748	1205	959
7	SB	11.5	8	0	0	441	0	174
8	SB	31	378	221	58.5	6096	5365	615
9	SB	33	4283	1019	23.8	200374	27862	46331
10	SB	33.5	596	65	10.9	39684	1773	10948
11	SB	36.5	27	2	7.4	1238	67	163
12	SB	36.5	37	2	5.4	2349	57	536
13	SB	31.5	4183	1	0	373494	29	120881
TOTAL	****	****	11003	1631	****	646046	****	184856
GRAND TOTAL	****	****	17225	3668	391	838654	89485	226871

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	0	1	0
2	85991	83446	169437	13
3	103147	99705	202852	15.6
4	4195	4324	8519	0.7
5	15888	15287	31175	2.4
6	5840	5954	11794	0.9
7	561	441	1001	0.1
8	8192	11461	19653	1.5
9	175080	228236	403316	31
10	20344	41458	61801	4.8
11	1142	1305	2447	0.2
12	2154	2406	4560	0.4
13	10350	373523	383873	29.5
TOTAL	432884	867545	1300429	100
GVW/LANE	33.29	66.71	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	0.5
2	10	9	19	0.1	9e-04
3	37	32	69	0.5	0.0042
4	58	51	109	0.7	0.63
5	175	173	349	2.4	0.32
6	104	89	193	1.3	0.91
7	14	8	23	0.2	2.11
8	110	168	277	1.9	0.85
9	2377	4247	6623	45.2	1.62
10	359	923	1282	8.7	2.72
11	13	18	31	0.2	1.11
12	34	39	73	0.5	1.91
13	188	5430	5618	38.3	2.62
TOTAL	3478	11188	14666	100	15
ESALS/LANE	23.7	76.3	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>
Apr 2017	97926	3264	442	84667	86.5	13259.1	13.5
May 2017	109380	3528	601	90758	83	18621.7	17
Jun 2017	108669	3622	532	92713	85.3	15956.3	14.7
Jul 2017	112064	3615	503	96468	86.1	15596.4	13.9
Aug 2017	116450	3756	564	98963	85	17487.3	15
Sep 2017	111812	3727	661	91971	82.3	19840.6	17.7
Oct 2017	108353	3495	533	91844	84.8	16509.1	15.2
Nov 2017	98568	3286	494	83733	84.9	14834.6	15.1
Dec 2017	91321	2946	385	79385	86.9	11936.2	13.1
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
TOTAL	1211709	--	--	1025412	--	186297	--
AVERAGE	100976	3317	510	85451	85	15525	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>
Apr 2017	4329	4838	9167	4.4
May 2017	7146	7801	14947	7.5
Jun 2017	6707	6628	13335	16.9
Jul 2017	6373	6484	12857	7.9
Aug 2017	6362	8803	15164	9.2
Sep 2017	5677	12779	18455	6.5
Oct 2017	4963	7456	12418	6
Nov 2017	3611	7436	11047	2.9
Dec 2017	3215	4055	7270	0.5
Jan 2018	3494	4778	8272	7.6
Feb 2018	3112	5050	8161	10.4
Mar 2018	3482	11316	14797	11.2
TOTAL	58469	--	--	--
AVERAGE	4872	7285	12158	8

Gross Vehicle Weight

<i>Month</i>	<i>GVW NB Driving Lane</i>	<i>GVW SB Driving Lane</i>	<i>Total GVW Kips</i>
Apr 2017	410686	456795	867481
May 2017	380931	430105	811036
Jun 2017	433134	867894	1301027
Jul 2017	476333	494468	970801
Aug 2017	649983	673775	1323758
Sep 2017	602069	592284	1194353
Oct 2017	593697	609564	1203261
Nov 2017	613330	711571	1324900
Dec 2017	611951	868853	1480804
Jan 2018	554209	621491	1175700
Feb 2018	472927	566640	1039567
Mar 2018	417109	450095	867205
TOTAL	6216358	7343535	13559894
AVERAGE	518030	611961	1129991

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>
Apr 2017	1036	1.1	7.8	229	74
May 2017	2127	2	11.4	342	89
Jun 2017	2246	2.1	14.1	388	124
Jul 2017	2235	2	14.3	399	115
Aug 2017	2972	2.6	16.9	1101	642
Sep 2017	4799	4.3	24.1	3027	2439
Oct 2017	1944	1.8	11.7	357	136
Nov 2017	1341	1.4	9	196	52
Dec 2017	773	0.8	6.5	148	22
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
TOTAL	26892	--	--	9842	3822
AVERAGE	2241	2.2	13.6	820.2	318.5

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>
Apr 2017	52897	55584	108481	48.8	51.2
May 2017	89024	91721	180744	49.3	50.7
Jun 2017	73585	68710	142295	51.7	48.3
Jul 2017	69479	67954	137433	50.6	49.4
Aug 2017	72589	98882	171472	42.3	57.7
Sep 2017	63832	164954	228787	27.9	72.1
Oct 2017	60584	79341	139925	43.3	56.7
Nov 2017	43921	72755	116676	37.6	62.4
Dec 2017	39190	50579	89769	43.7	56.3
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
TOTAL	686053	1049573	1735626	--	--
AVERAGE	57171.1	87464.5	144635.5	41.3	58.7