

APRIL 2018



**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 April 2018. Volume was computed using all monthly data.

System Calibration

WIM #39 was most recently calibrated on 2017-10-27. 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 lane 2 but not 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: 295692 | Passenger Vehicles: 274499 | Heavy Commercial Vehicles: 21193

Monthly Average Daily Traffic (MADT): 9856 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 706

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 21193 HCVs, 5869 of them were overweight ³. These overweight HCVs contributed to 2% of total monthly volume, and 27.8% of total monthly HCV volume. NB overweight vehicles typically reached highest numbers on Thursdays, with lowest volumes reported on Sundays. SB overweight vehicles tended to reach highest volumes on Thursdays, with lowest volumes reported on Sundays. 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 53.8% 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 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 ,1648 NB vehicles exceeded 88,000 pounds (1480 vehicles were Class 9's; 82 vehicles were Class 10's). Of vehicles traveling SB,

503 NB vehicles exceeded 88,000 pounds (480 vehicles were Class 9's; 22 vehicles were Class 10's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from April 2018.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9s and 10s in April 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 225355 tons of freight was recorded to have crossed the WIM. More freight was shipped SB (53.8%) than NB (46.2%). 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 295692 vehicles with a combined GVW of 2288315 kips (1 kip = 1,000 pounds = 0.5 tons) in April 2018. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 26316 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 51% of all ESALs were recorded NB while 49% was observed SB. In particular, 84% of all ESALs were generated by the Class 9's (Class 9's were also responsible for generating 35% 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).

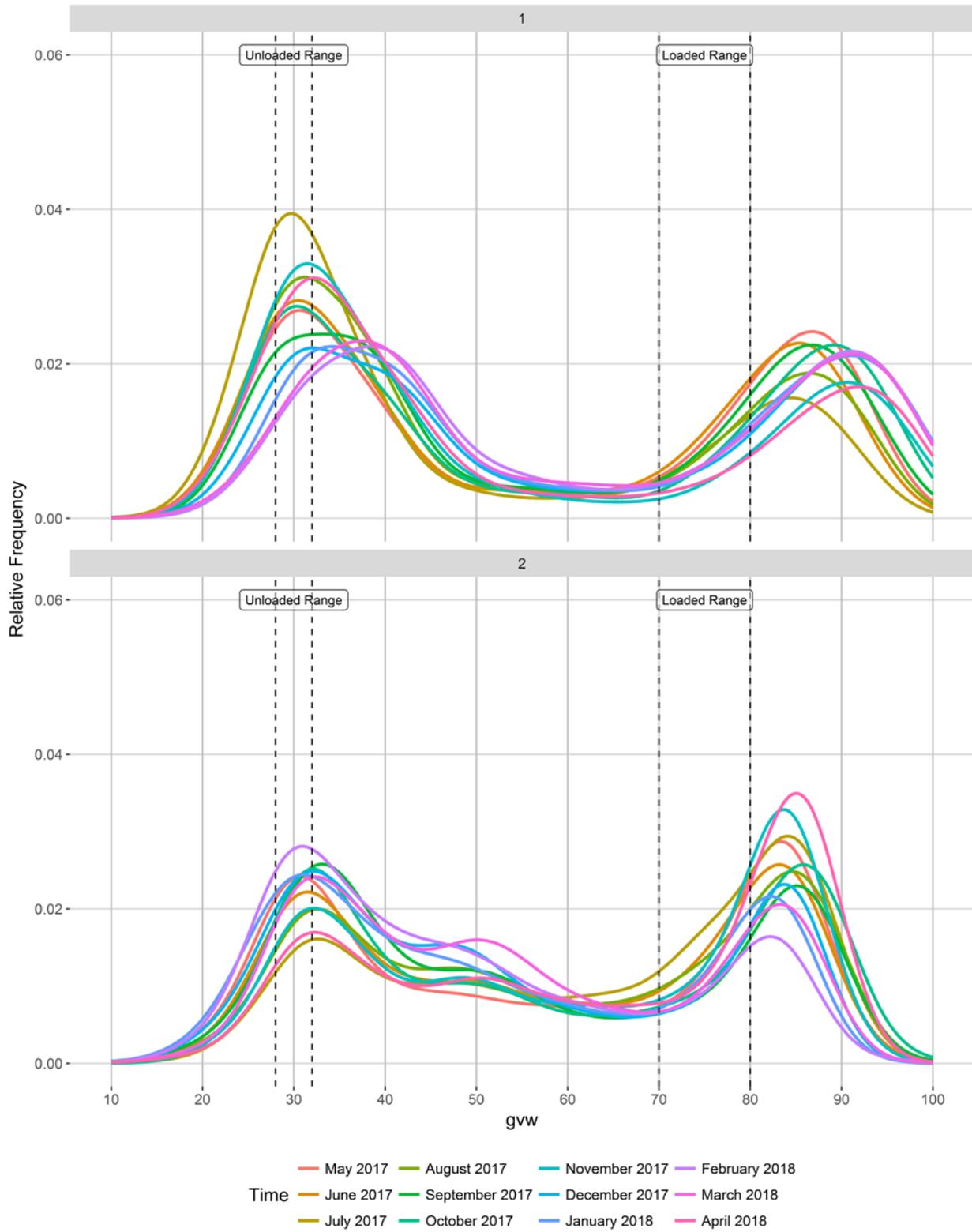
WIM monthly reports can be found at: <http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html>

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.

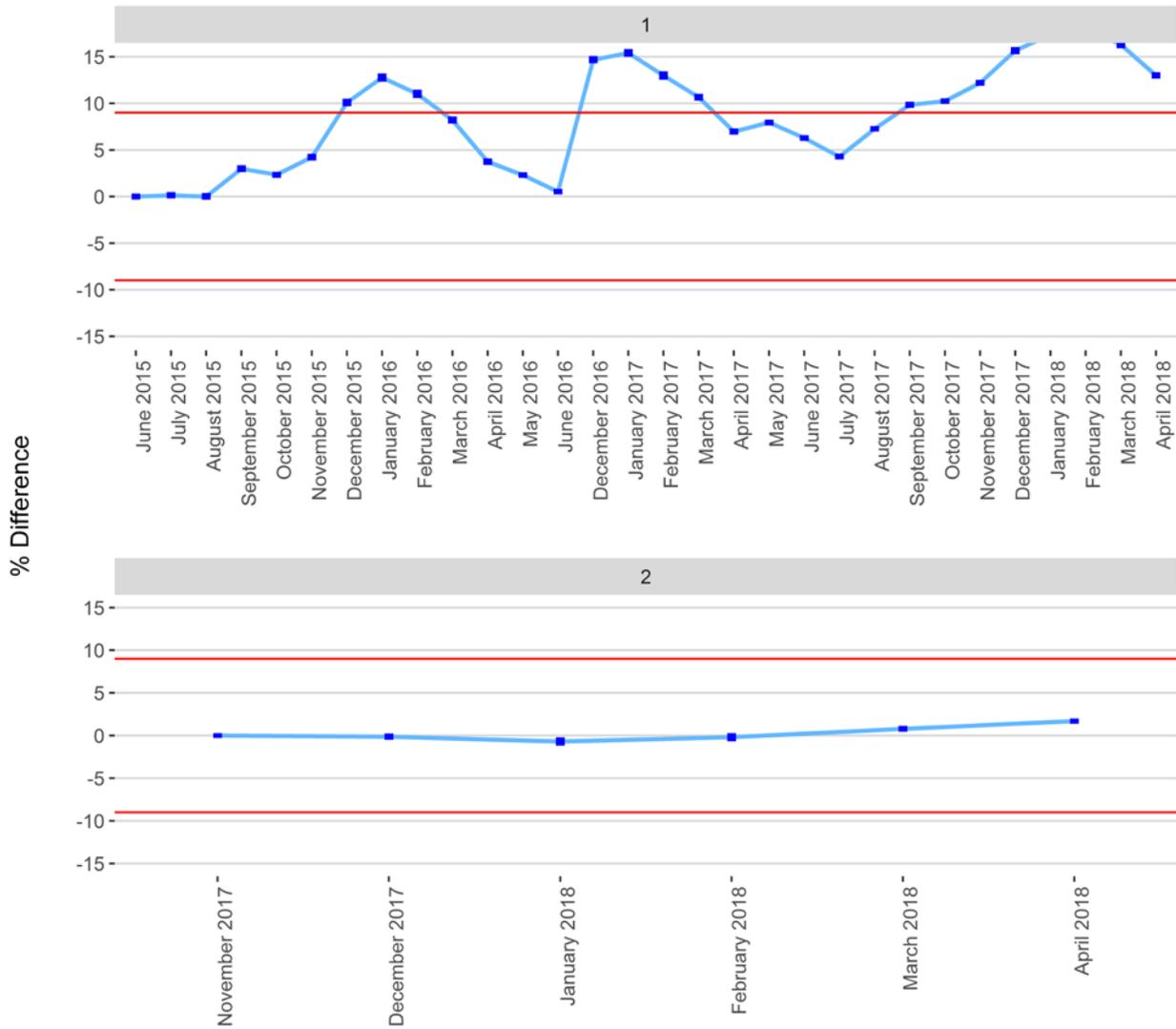
To request this document in an alternative format, please call 651-366-4718 or 1-800-657-3774, or email your request to ADArequest.dot@state.mn.us. Please request at least one week in advance.

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

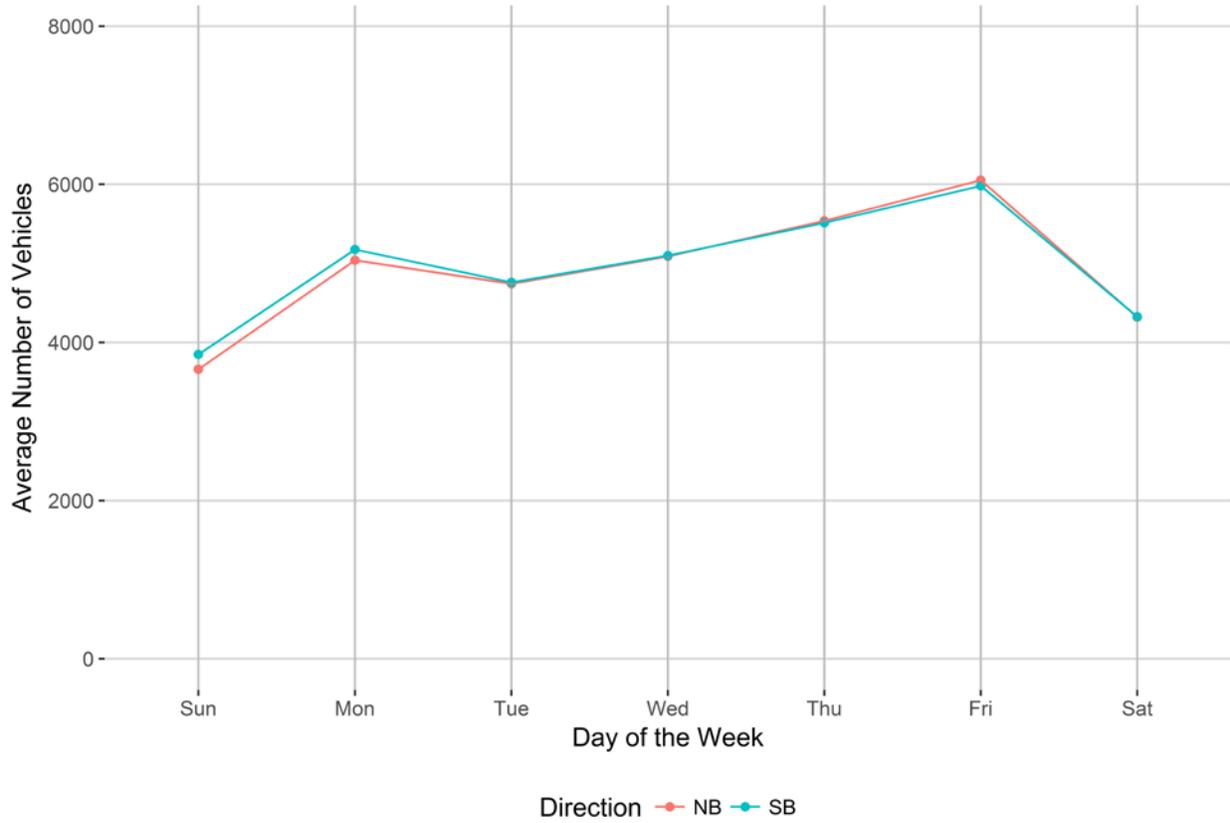


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

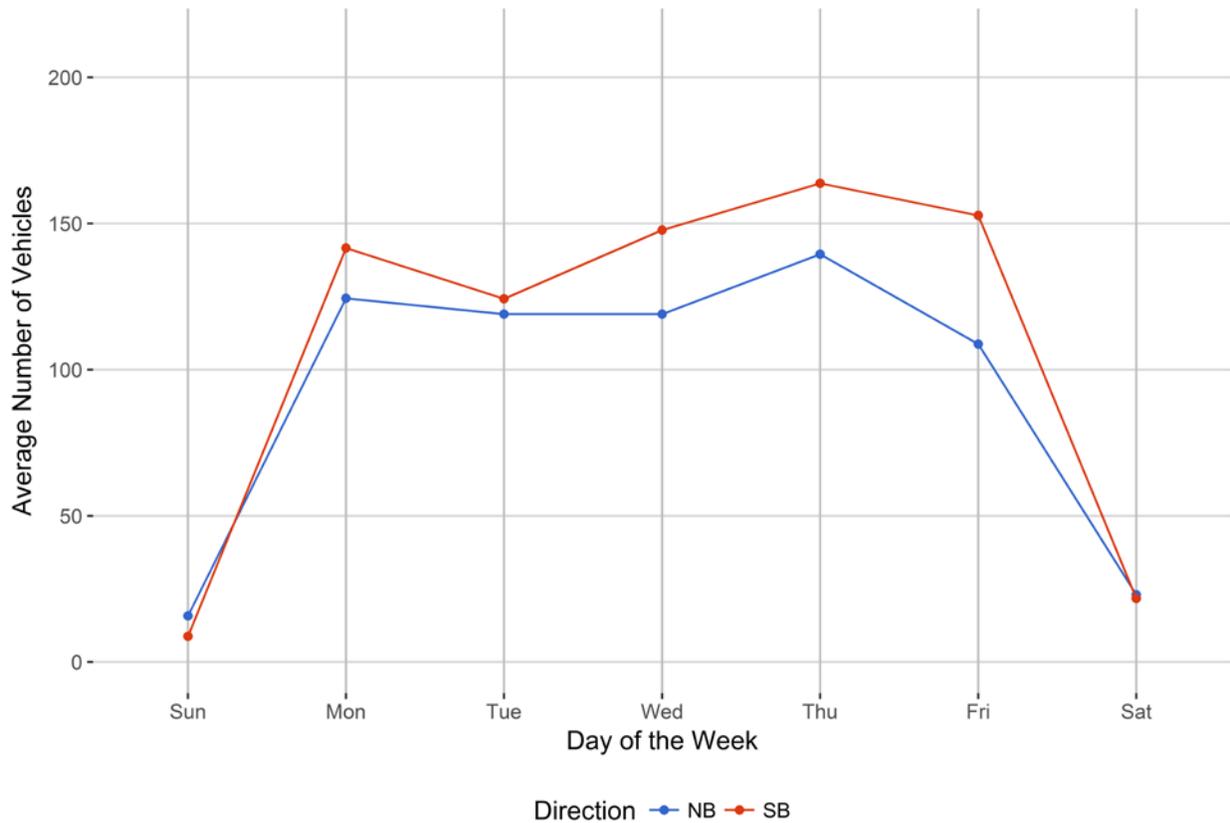


Figure 4 - Passenger Vehicles vs. Hour of the Day

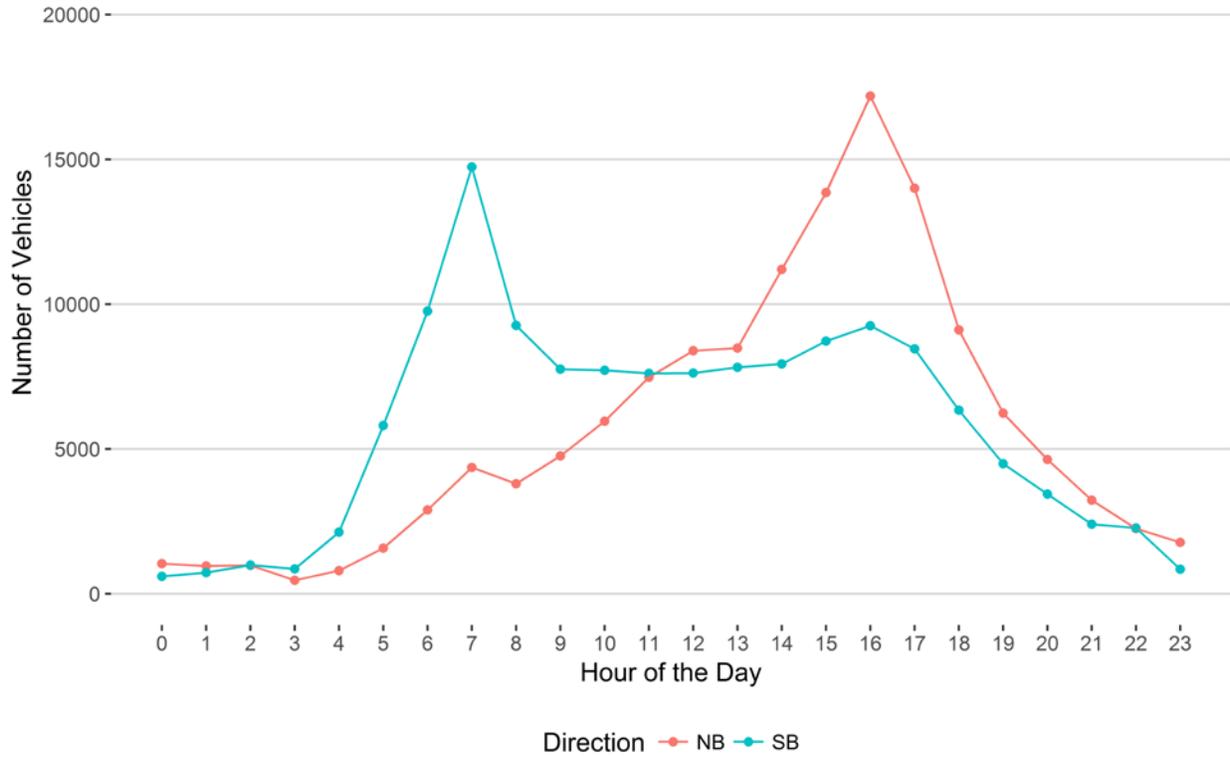


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

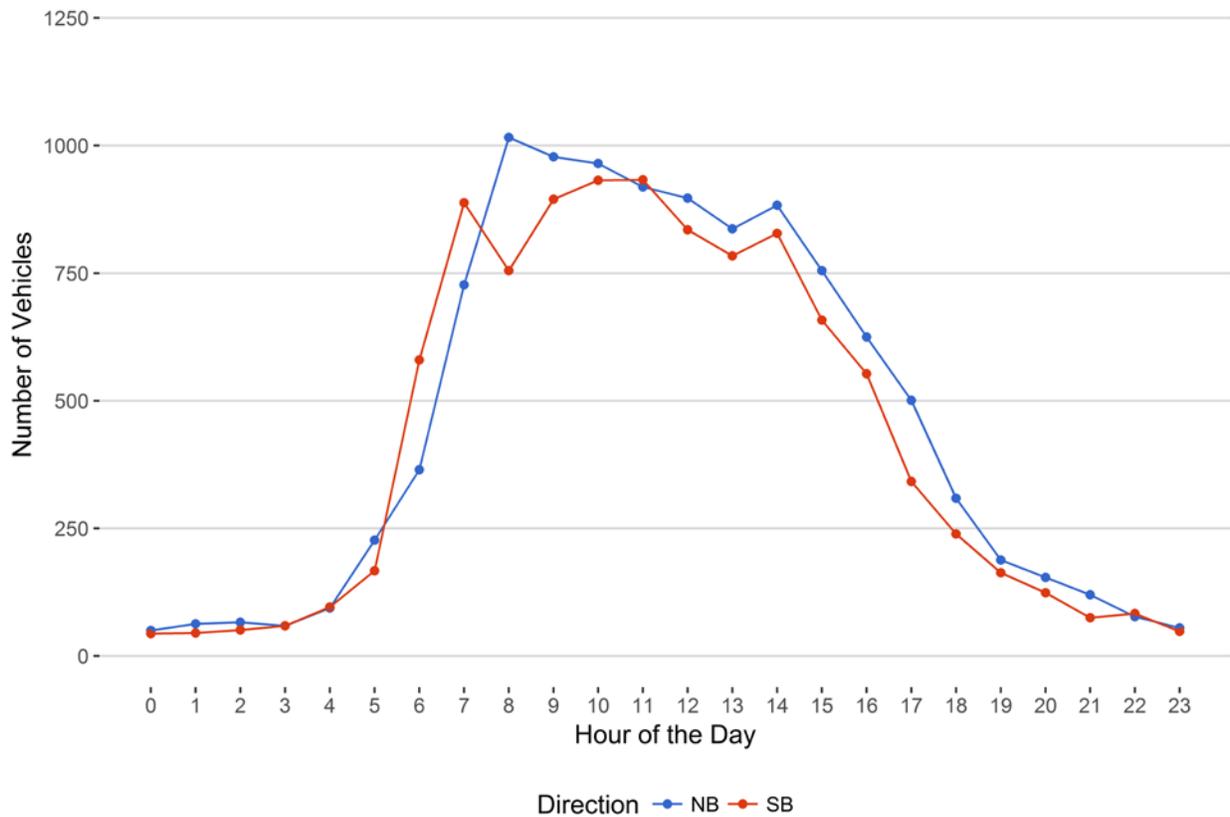


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

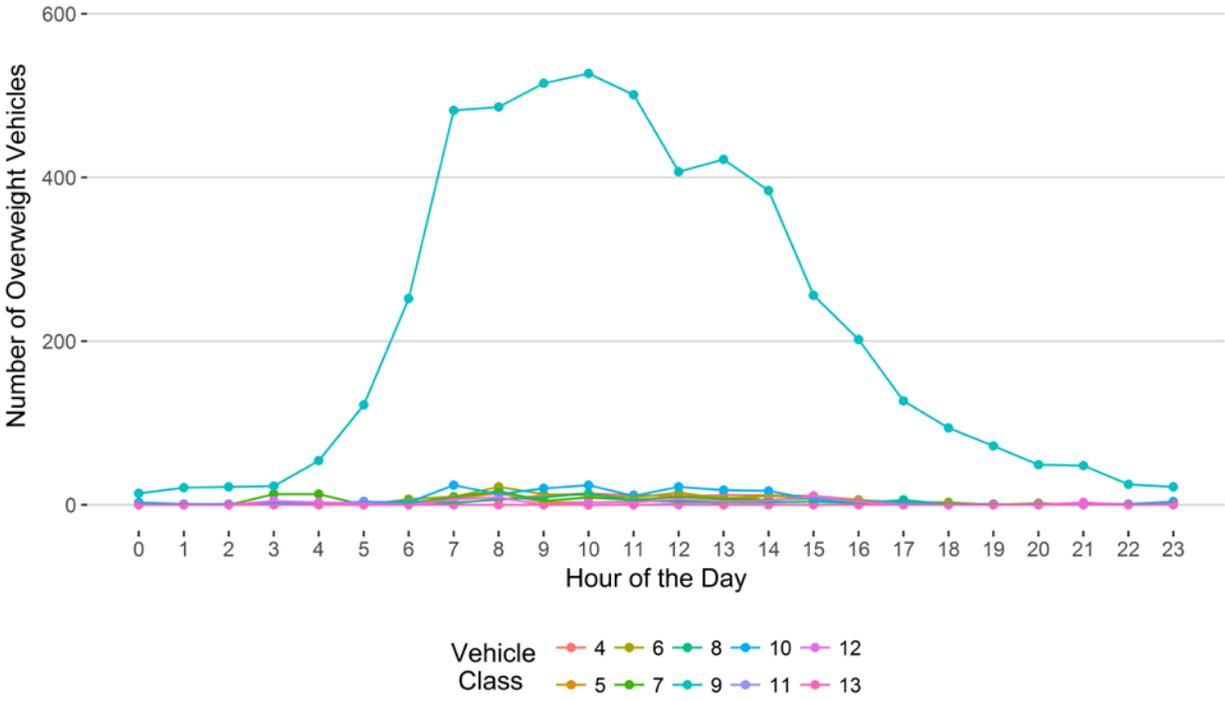


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

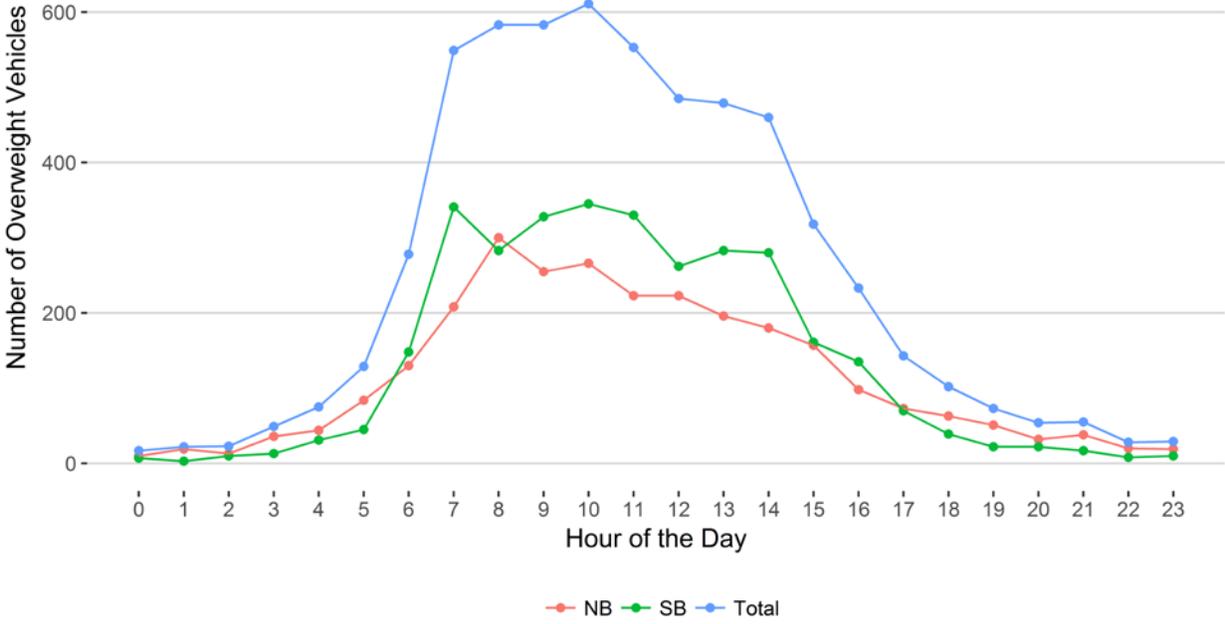
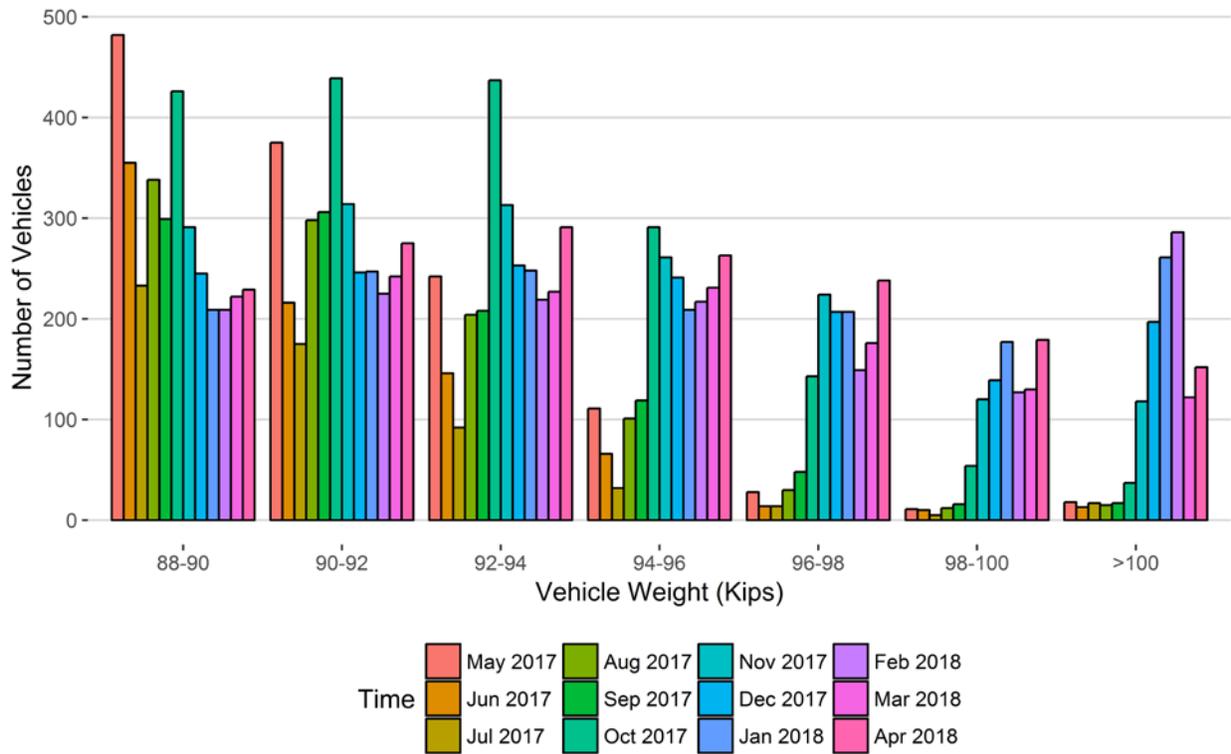
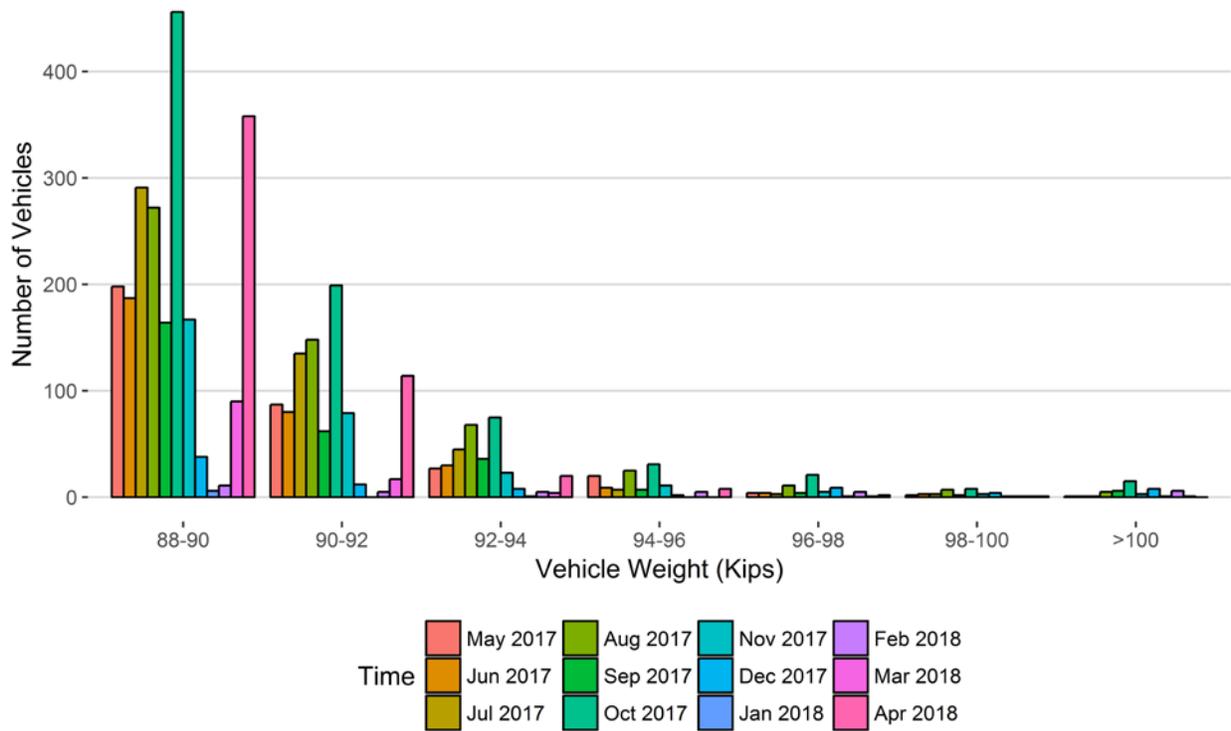


Figure 8 - Histogram of NB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	May 2017	Jun 2017	Jul 2017	Aug 2017	Sep 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018
88-90	482	355	233	338	299	426	291	245	209	209	222	229
90-92	375	216	175	298	306	439	314	246	247	225	242	275
92-94	242	146	92	204	208	437	313	253	248	219	227	291
94-96	111	66	32	101	119	291	261	241	209	217	231	263
96-98	28	14	14	30	48	143	224	207	207	149	176	238
98-100	11	10	5	12	16	54	120	139	177	127	130	179
>100	18	13	17	15	17	37	118	197	261	286	122	152
Total	1267	820	568	998	1013	1827	1641	1528	1558	1432	1350	1627

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



Vehicle Weights (Kips)	May 2017	Jun 2017	Jul 2017	Aug 2017	Sep 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018
88-90	198	187	291	272	164	456	167	38	6	11	90	358
90-92	87	80	135	148	62	199	79	12	0	5	17	114
92-94	27	30	45	68	36	75	23	8	1	5	4	20
94-96	20	9	7	25	7	31	11	2	0	5	0	8
96-98	4	4	3	11	4	21	5	9	1	5	1	2
98-100	2	3	3	7	2	8	3	4	1	1	1	1
>100	1	1	1	5	6	15	3	8	1	6	1	0
Total	339	314	485	536	281	805	291	81	10	38	114	503

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

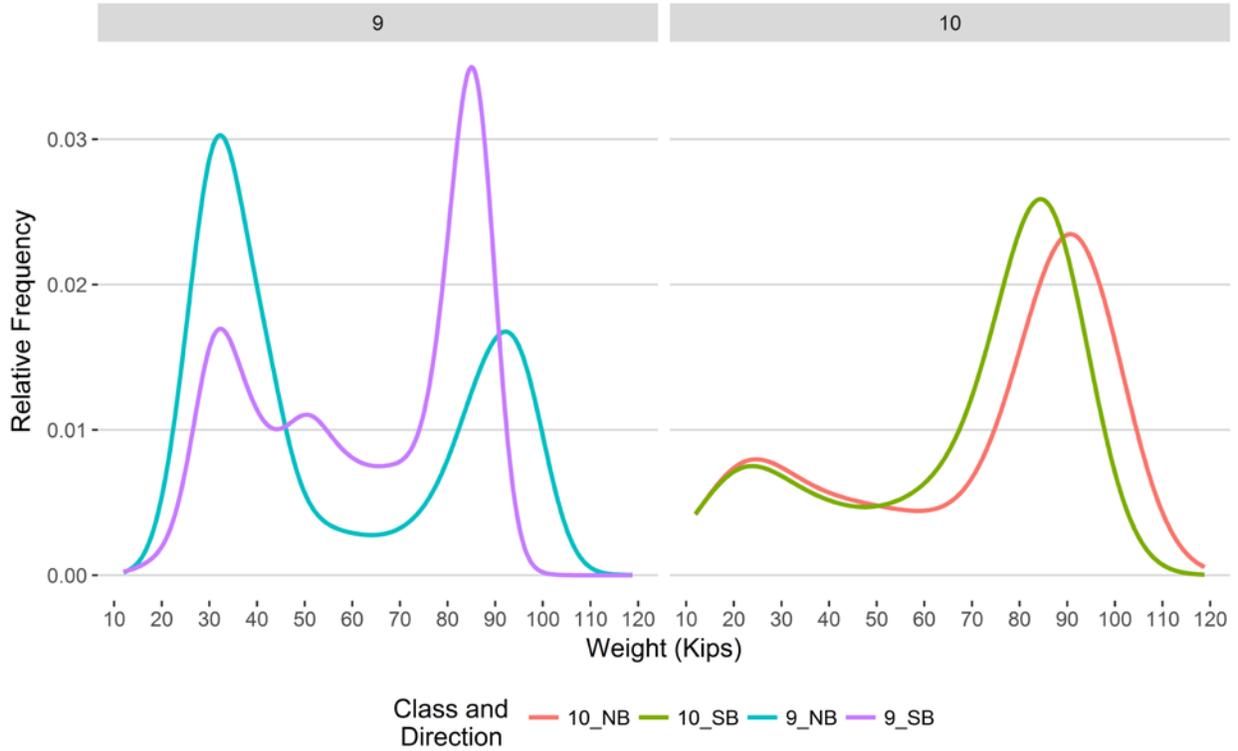


Figure 9 - Freight Percentage by Direction and Class

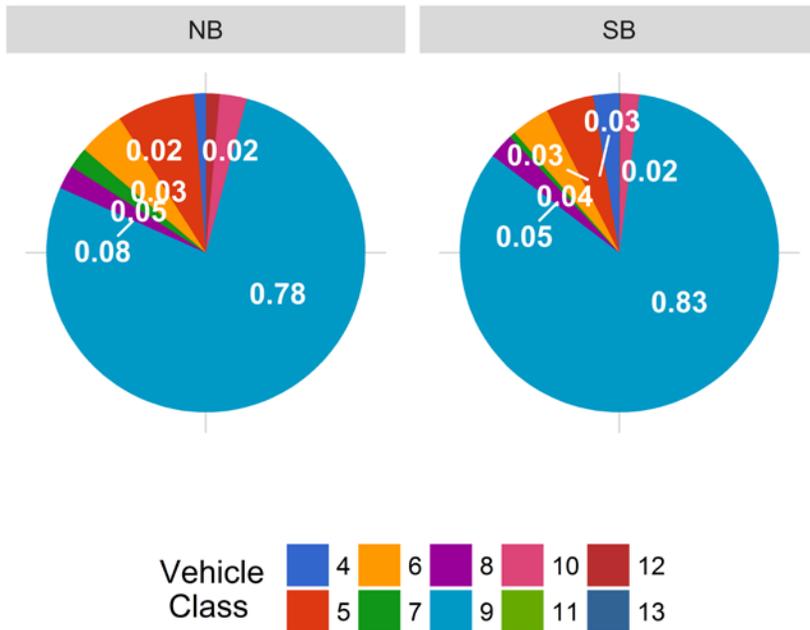


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

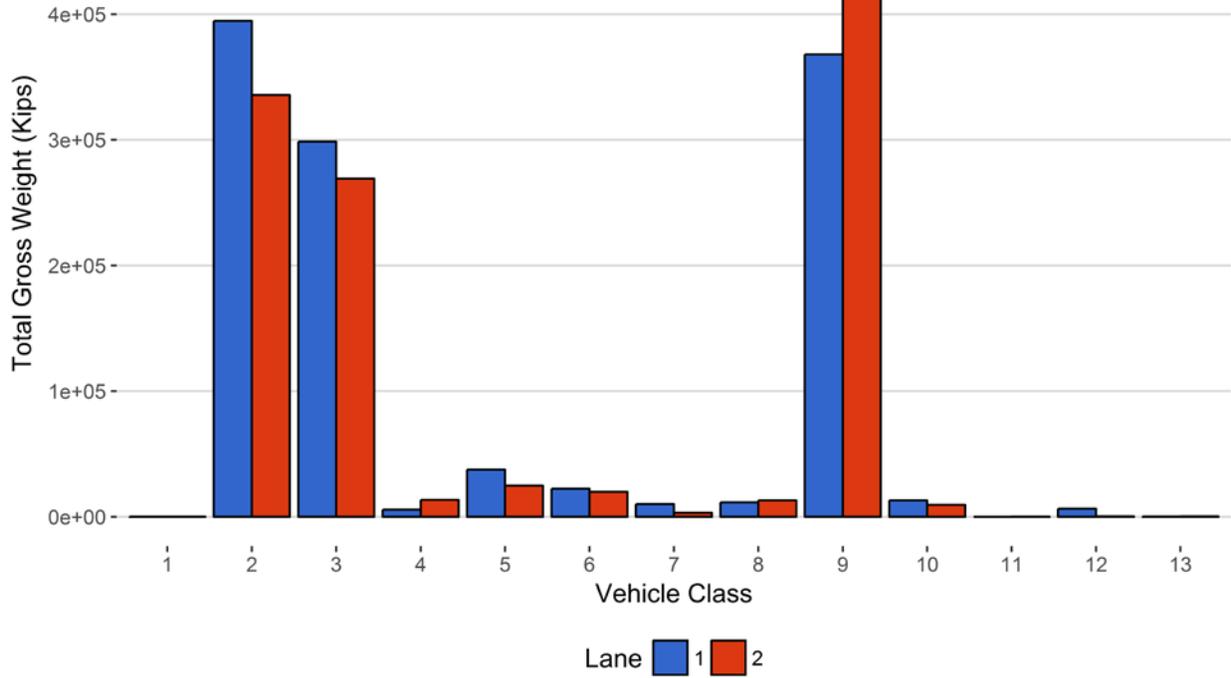


Figure 11 - Total Gross Vehicle Weight I

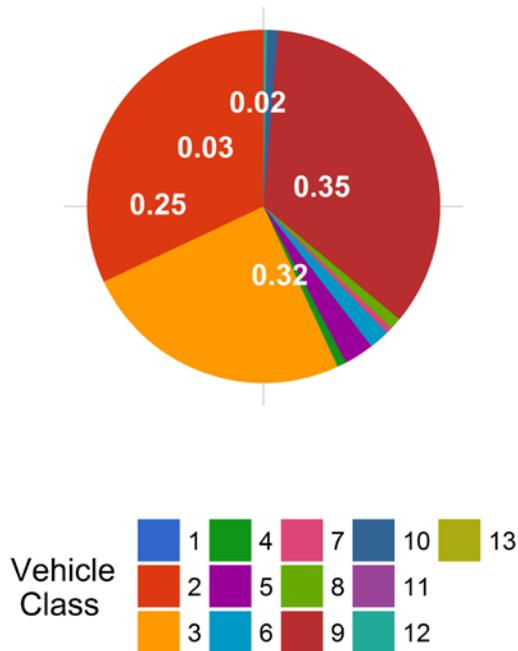


Figure 12 - Total ESALs by Class and Lane

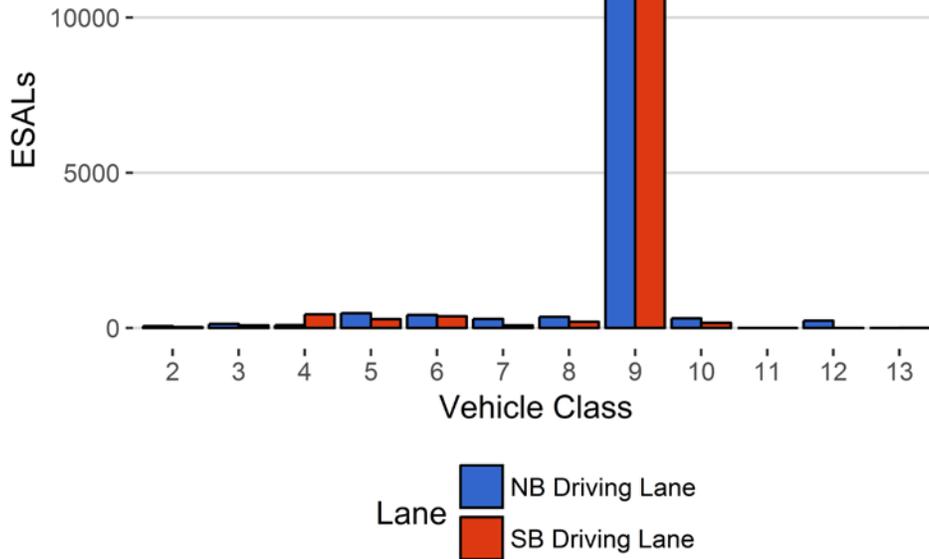


Figure 13 - ESALs by Class

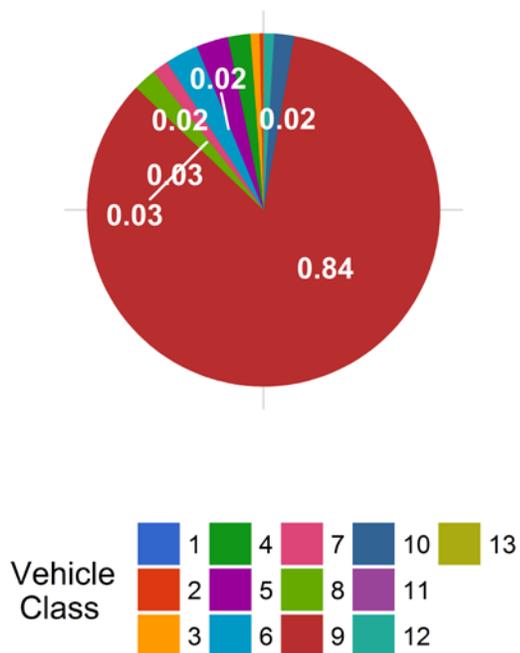


Table 1 Class 9 Front Axle Weight by Lane

<i>Month</i>	<i>Lane 1 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 2 (Kips)</i>	<i>Front Axle +/- 9%</i>
June 2015	10.67	0.00	NA	NA
July 2015	10.69	0.14	NA	NA
August 2015	10.67	0.01	NA	NA
September 2015	10.99	2.99	NA	NA
October 2015	10.92	2.34	NA	NA
November 2015	11.12	4.23	NA	NA
December 2015	11.75	10.09	NA	NA
January 2016	12.04	12.78	NA	NA
February 2016	11.85	11.02	NA	NA
March 2016	11.55	8.21	NA	NA
April 2016	11.07	3.74	NA	NA
May 2016	10.92	2.32	NA	NA
June 2016	10.73	0.53	NA	NA
December 2016	12.24	14.68	NA	NA
January 2017	12.32	15.42	NA	NA
February 2017	12.06	12.99	NA	NA
March 2017	11.81	10.66	NA	NA
April 2017	11.42	6.97	NA	NA
May 2017	11.52	7.95	NA	NA
June 2017	11.34	6.28	NA	NA
July 2017	11.13	4.29	NA	NA
August 2017	11.45	7.28	NA	NA
September 2017	11.72	9.85	NA	NA
October 2017	11.77	10.24	NA	NA
November 2017	11.98	12.20	10.97	0.00
December 2017	12.35	15.66	10.95	-0.13
January 2018	12.53	17.39	10.89	-0.70
February 2018	12.61	18.15	10.95	-0.19
March 2018	12.41	16.31	11.06	0.79
April 2018	12.06	13.00	11.16	1.70

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	3	83	0	0	0
2	6031	180932	61.2	0	0
3	3116	93483	31.6	0	0
4	19	558	0.2	105	1.8
5	153	4591	1.6	76	1.3
6	44	1334	0.5	128	2.2
7	6	183	0.1	109	1.9
8	23	704	0.2	72	1.2
9	447	13408	4.5	5127	87.4
10	11	326	0.1	184	3.1
11	0	4	0	0	0
12	3	77	0	65	1.1
13	0	7	0	3	0.1
TOTAL	9856	295692	100	5869	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>
2018-04-03	Tuesday	04:28:12	9	NB	1	118.85
2018-04-12	Thursday	09:11:47	9	NB	1	109.16
2018-04-24	Tuesday	09:08:08	9	NB	1	108.9
2018-04-27	Friday	06:18:27	9	NB	1	107.63
2018-04-16	Monday	08:49:37	9	NB	1	107.33
2018-04-30	Monday	05:37:52	9	NB	1	106.26
2018-04-23	Monday	08:16:27	9	NB	1	106.11
2018-04-05	Thursday	09:54:12	9	NB	1	106.07
2018-04-23	Monday	08:01:38	9	NB	1	105.81
2018-04-25	Wednesday	07:34:45	9	NB	1	105.71

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	219	24	11	5289	330	1182
5	NB	8	2697	177	6.6	36312	1222	8076
6	NB	19	698	30	4.3	21829	511	4568
7	NB	11.5	133	0	0	10098	0	4284
8	NB	31	312	94	30.1	9680	1812	1461
9	NB	33	6612	1889	28.6	313642	54376	78892
10	NB	33.5	185	34	18.4	12330	773	3636
12	NB	36.5	71	0	0	6351	0	1880
13	NB	31.5	3	0	0	216	0	61
TOTAL	****	****	10930	2248	****	415747	****	104039
<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	337	40	11.9	12919	513	4232
5	SB	8	1875	337	18	22463	2282	5080
6	SB	19	631	55	8.7	18985	927	4020
7	SB	11.5	49	0	0	3212	0	1324
8	SB	31	389	157	40.4	9235	3811	1021
9	SB	33	6742	958	14.2	396802	27592	102965
10	SB	33.5	140	25	17.9	8866	559	2507
11	SB	36.5	4	1	25	138	18	14
12	SB	36.5	6	0	0	326	0	54
13	SB	31.5	4	0	0	324	0	99
TOTAL	****	****	10177	1573	****	473269	****	121316
GRAND TOTAL	****	****	21107	3821	235	889016	94725	225355

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	40	59	99	0
2	394703	335748	730451	32
3	298597	269124	567721	24.9
4	5619	13432	19051	0.8
5	37533	24745	62278	2.7
6	22340	19912	42252	1.9
7	10098	3212	13310	0.6
8	11492	13046	24537	1.1
9	368018	424394	792412	34.7
10	13103	9425	22527	1
11	0	156	156	0
12	6351	326	6678	0.3
13	216	324	540	0
TOTAL	1168111	1113902	2282013	100
GVW/LANE	51.19	48.81	100	0

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	0.0119
2	61	35	96	0.4	0.0011
3	132	85	217	0.8	0.0047
4	97	439	535	2	1.92
5	475	285	760	2.9	0.33
6	419	378	798	3.1	1.2
7	291	90	381	1.5	4.07
8	362	197	558	2.1	1.59
9	10861	11155	22016	84.4	3.3
10	308	171	479	1.8	2.89
11	0	1	1	0	0.9
12	238	3	240	0.9	5.54
13	4	6	10	0	1.61
TOTAL	13247	12845	26091	100	23
ESALS/LANE	50.8	49.2	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>
May 2017	349177	11264	765	325468	93.2	23709.1	6.8
Jun 2017	349162	11639	736	327073	93.7	22089.1	6.3
Jul 2017	354079	11422	715	331913	93.7	22165.7	6.3
Aug 2017	354421	11433	730	331779	93.6	22642	6.4
Sep 2017	338356	11278	628	319523	94.4	18833.1	5.6
Oct 2017	343020	11065	824	317468	92.6	25552.3	7.4
Nov 2017	303958	10132	771	280842	92.4	23115.7	7.6
Dec 2017	285393	9206	517	269359	94.4	16033.9	5.6
Jan 2018	268418	8659	458	254206	94.7	14212.3	5.3
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
TOTAL	3790789	--	--	3551788	--	239001	--
AVERAGE	315899	10377	654	295982	94	19917	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>
May 2017	14149	12548	26697	37.9
Jun 2017	11864	13976	25840	11.1
Jul 2017	9377	12681	22058	14.9
Aug 2017	11833	10856	22689	35.5
Sep 2017	11326	7820	19146	39.6
Oct 2017	16158	14178	30336	54.8
Nov 2017	13931	13631	27562	64.3
Dec 2017	12322	15703	28025	6.1
Jan 2018	13225	63899	77125	1.3
Feb 2018	11909	24119	36029	6.6
Mar 2018	11420	6024	17444	68.7
Apr 2018	13423	12893	26316	74.2
TOTAL	150938	--	--	--
AVERAGE	12578	17361	29939	35

Gross Vehicle Weight

<i>Month</i>	<i>GVW NB Driving Lane</i>	<i>GVW SB Driving Lane</i>	<i>Total GVW Kips</i>
May 2017	1042006	768108	1810114
Jun 2017	948019	737183	1685202
Jul 2017	1086885	932878	2019763
Aug 2017	1173322	1114993	2288315
Sep 2017	1309307	1237339	2546646
Oct 2017	1254733	1166909	2421642
Nov 2017	1218934	1201483	2420417
Dec 2017	1281093	1117290	2398383
Jan 2018	1192872	886922	2079794
Feb 2018	1348963	1230966	2579929
Mar 2018	1193526	1151819	2345345
Apr 2018	1053347	897894	1951241
TOTAL	14103006	12443783	26546789
AVERAGE	1175250	1036982	2212232

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>
May 2017	6402	1.8	26.8	1623	32
Jun 2017	5388	1.6	24.4	1146	29
Jul 2017	5015	1.5	22.8	1077	27
Aug 2017	5251	1.6	23.9	1548	40
Sep 2017	4201	1.4	24.1	1299	42
Oct 2017	6940	2.1	27.6	2647	116
Nov 2017	6351	2.1	27.3	1950	249
Dec 2017	4001	1.4	24.8	1624	355
Jan 2018	3654	1.4	25.6	1662	489
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
TOTAL	60041	--	--	19722	2406
AVERAGE	5003.4	1.6	25.2	1643.5	200.5

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>
May 2017	121671	121456	243127	50	50
Jun 2017	105779	111019	216798	48.8	51.2
Jul 2017	83119	125679	208797	39.8	60.2
Aug 2017	105106	107931	213036	49.3	50.7
Sep 2017	101507	67273	168780	60.1	39.9
Oct 2017	135067	129224	264291	51.1	48.9
Nov 2017	110561	134530	245092	45.1	54.9
Dec 2017	95309	64155	159463	59.8	40.2
Jan 2018	99729	40337	140066	71.2	28.8
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
TOTAL	1243242	1126758	2370000	--	--
AVERAGE	103603.5	93896.5	197500	54.1	45.9