

FEBRUARY 2018



**WIM #47
MN 36, MP 202.9
OAK PARK
HEIGHTS, MN**

**MONTHLY
REPORT**



Your Destination... Our Priority



WIM Site Location

WIM #47 is located on MN 36 near Oak Park Heights in Washington county. The WIM is located only on the westbound (WB) side of MN 36, meaning that all data mentioned in this report pertains to WB traffic only (Lanes 1 and 2).

System Operation

WIM #47 was operational for the entire month of February 2018. Volume was computed using all monthly data.

System Calibration

WIM #47 was most recently calibrated on 2017-09-18. 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 the Class 9s at this site for the last 12 months 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: 448352 | Passenger Vehicles: 430066 | Heavy Commercial Vehicles: 18286

Monthly Average Daily Traffic (MADT): 16013 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 653

See Table 2 for vehicle class breakdown

Passenger Vehicles (PVs) and Heavy Commercial Vehicles (HCVs)

Volume trends. WB vehicles typically reached highest volume levels on Wednesdays, 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), WB PVs generally reached peak volume levels between 07 AM and 04 PM.

Heavy Commercial Vehicles (HCVs)

Volume trends. On an average 24-hour day, HCVs traveling WB typically reached peak volume levels between 07 AM and 04 PM. See Figure 6. Out of all HCVs, the two highest traffic volumes were generated by Class 5's and Class 9's.

Overweight HCVs

Volume trends. Of a total of 18286 HCVs, 3016 of them were overweight ³. These overweight HCVs contributed to 0.7% of total monthly volume, and 16.8% of total monthly

HCV volume. WB overweight vehicles typically reached highest numbers 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 (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 February.

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 ,565 WB vehicles exceeded 88,000 pounds (393 vehicles were Class 9's; 137 vehicles were Class 10's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from February 2018.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9's and 10's in February 2018. Data suggests that there were greater numbers of fully_loaded Class 9's than empty Class 9's traveling WB Data also suggests that there were more NA Class 10's than NA traveling in the WB direction.

Freight Totals. A total of 153149 tons of freight was recorded to have crossed the WIM. See Table 4 and Figure 11 for more freight information.

Infrastructure Considerations

Bridge. Bridge No. 82045 (an extradosed cable stayed) is approximately 1 mile east of WIM #47. WIM #47 recorded a total of 448352 vehicles with a combined GVW of 2602167 kips (1 kip = 1,000 pounds = 0.5 tons) in February 2018. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 15184 equivalent single axle loads (ESALs) passed over the pavement at this site. In particular, 68% of all ESALs were generated by the Class 9's (Class 9's were also responsible for generating 16% 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>

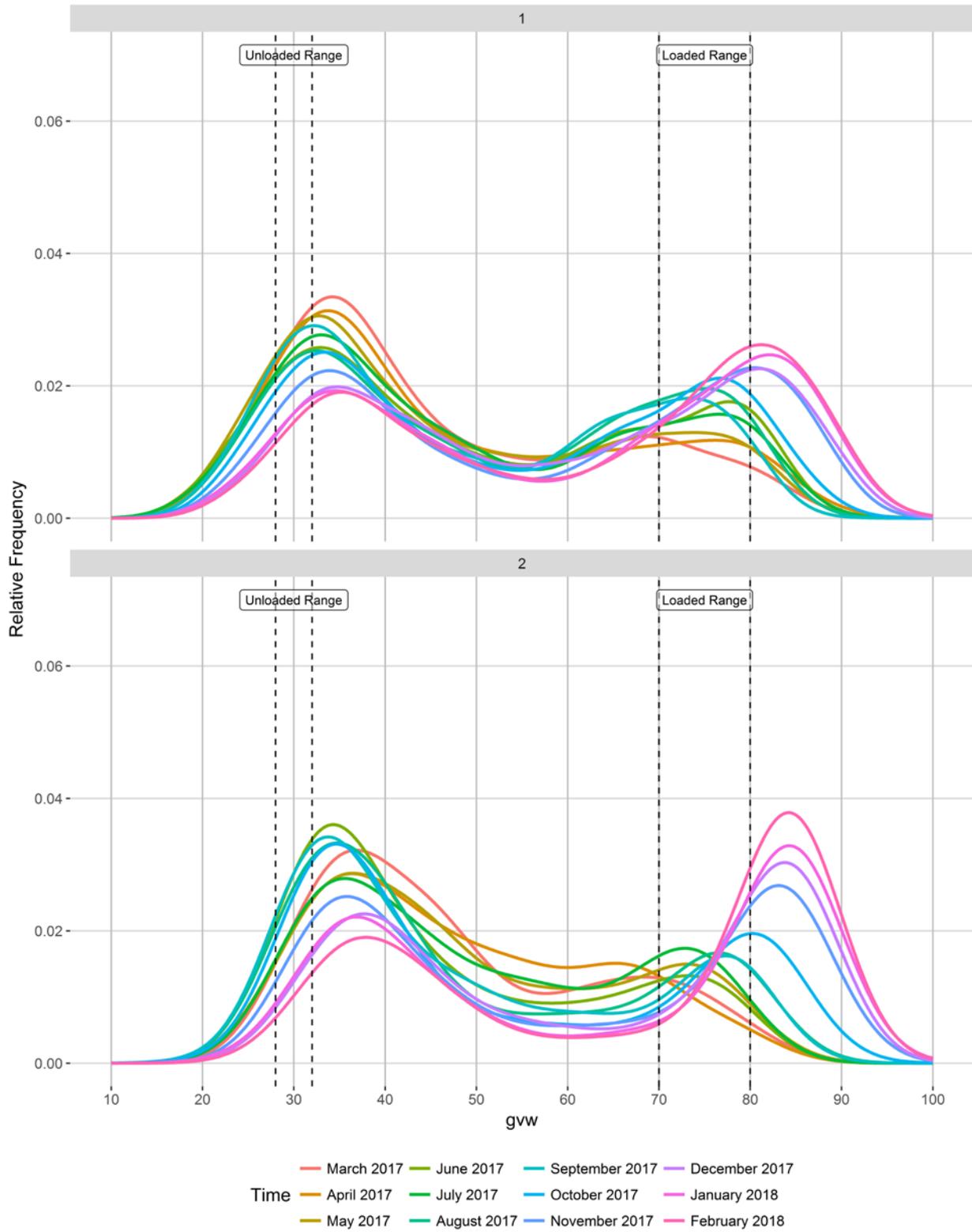
- ¹ Front axle weights of Class 9s are monitored on a monthly basis to assure performance between calibrations. The current goal of the WIM scale calibration is to

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.

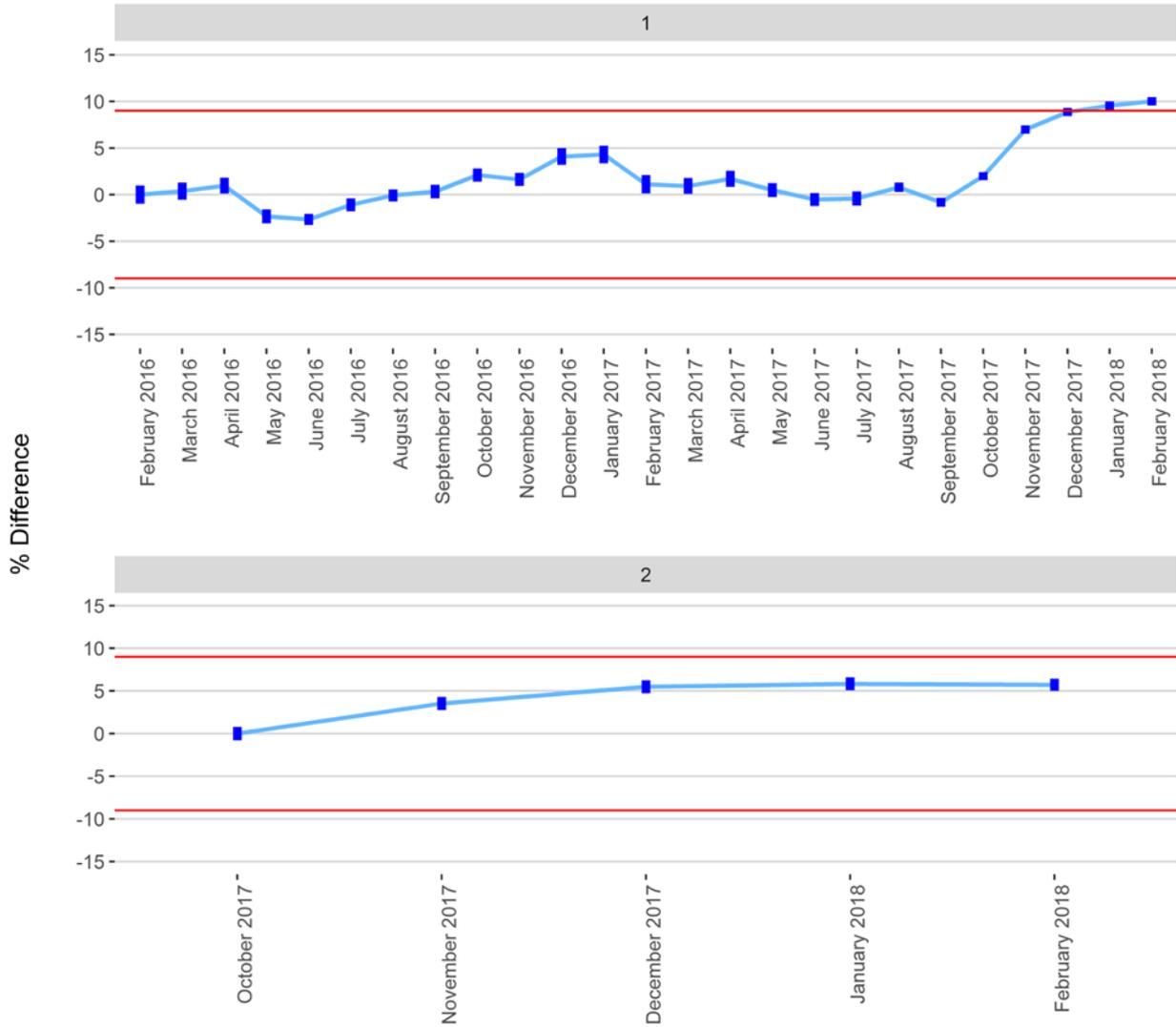
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Figure 1 - Monthly Class 9 GVW Histogram



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

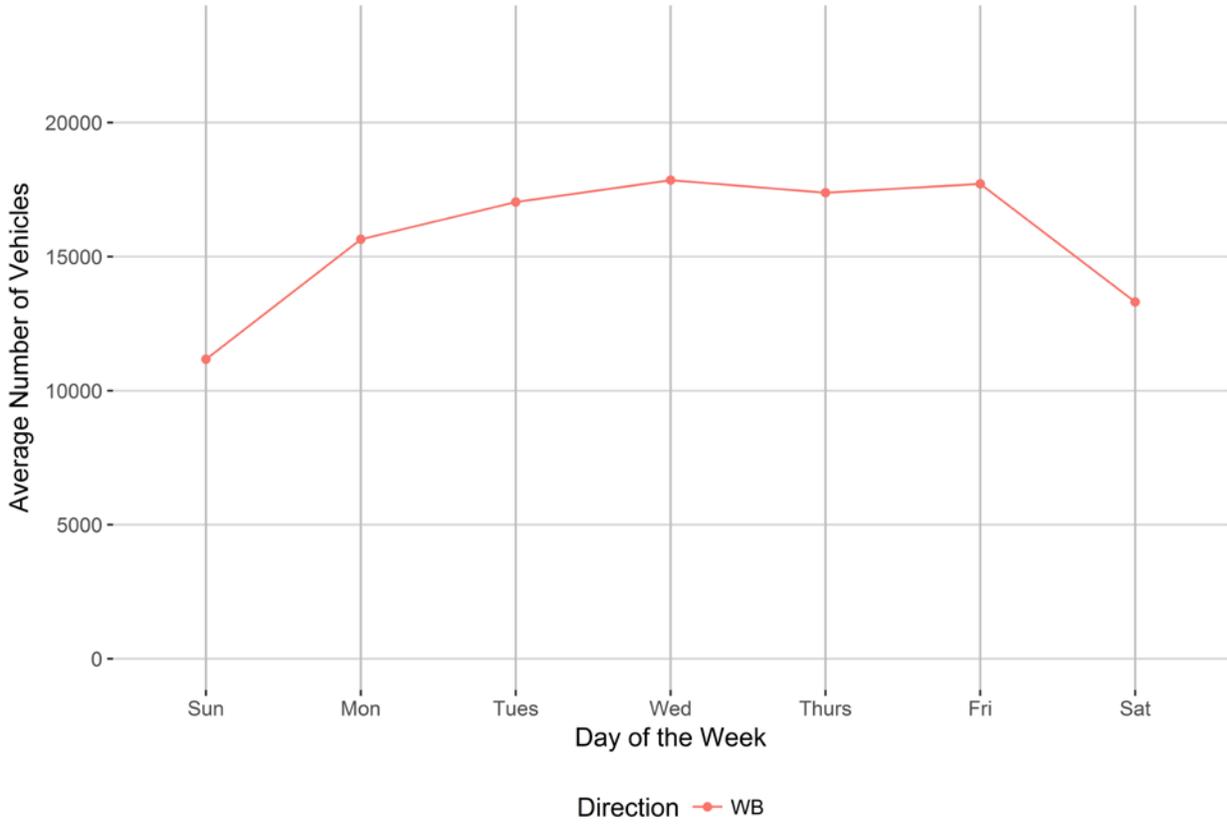


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

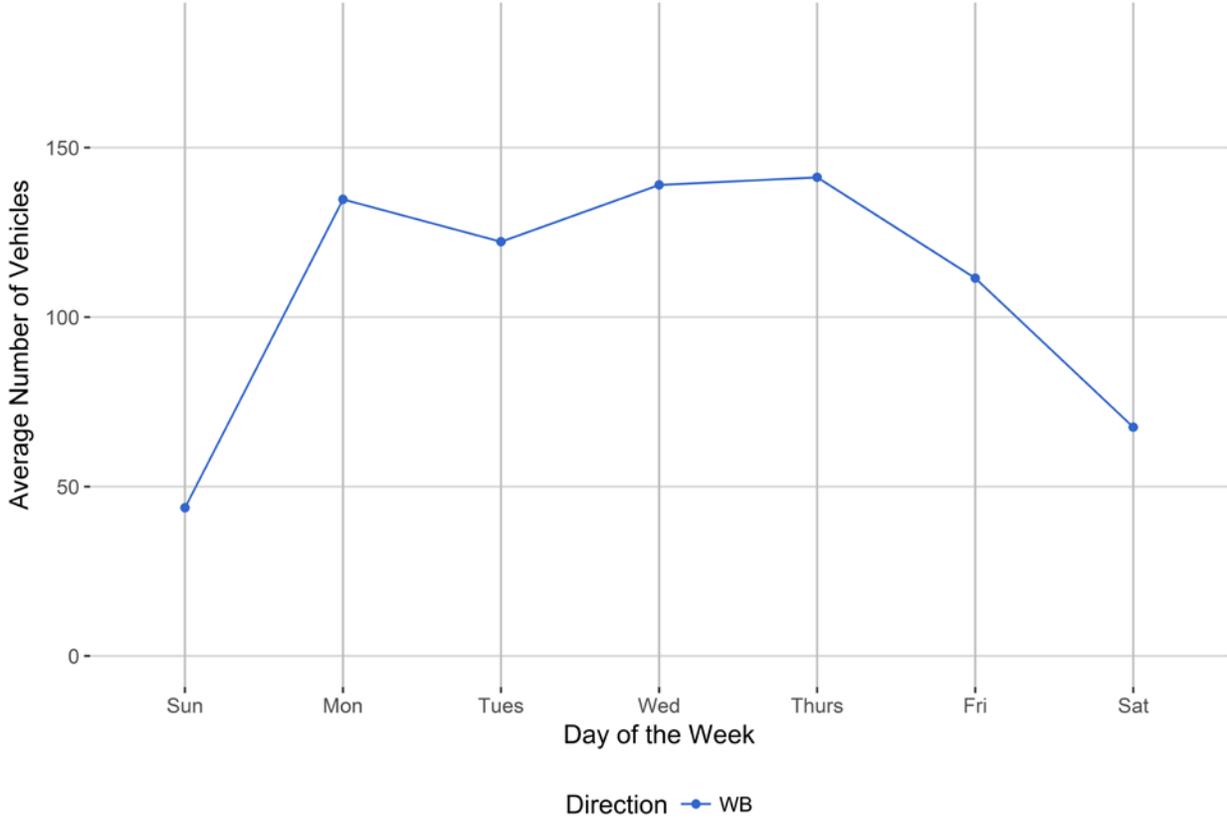


Figure 4 - Passenger Vehicles vs. Hour of the Day

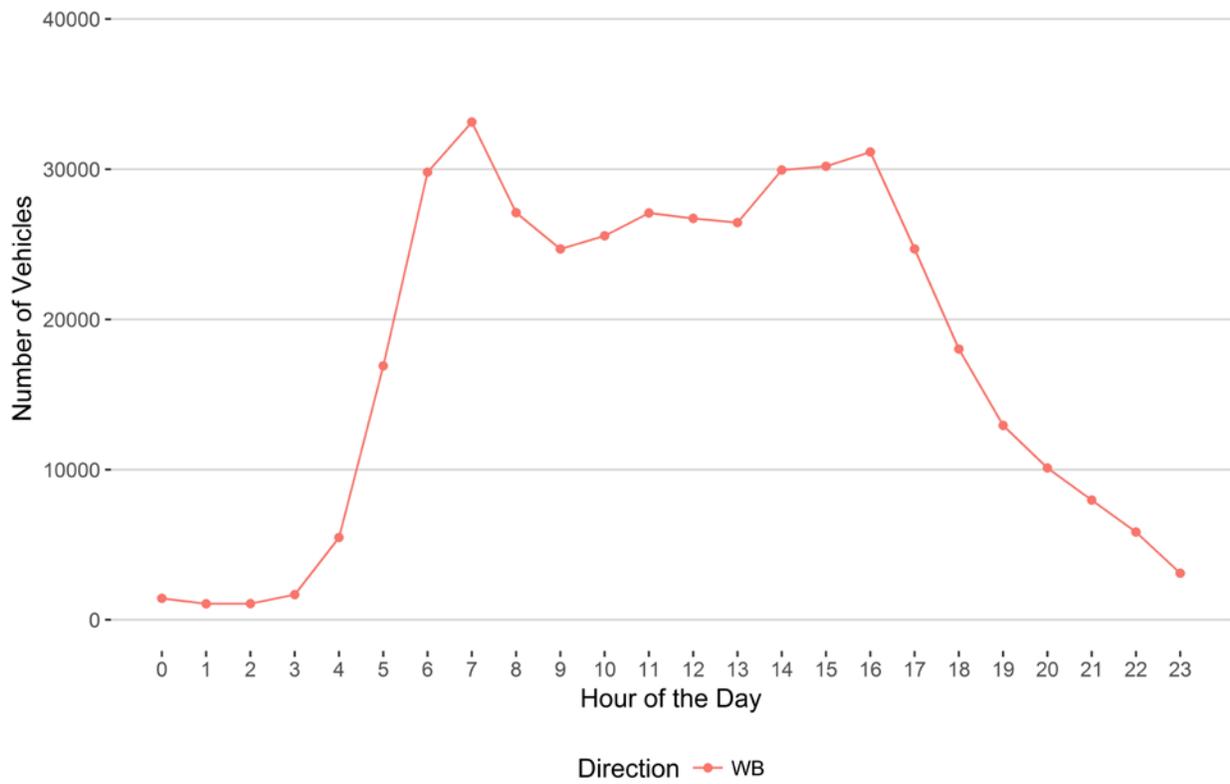


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

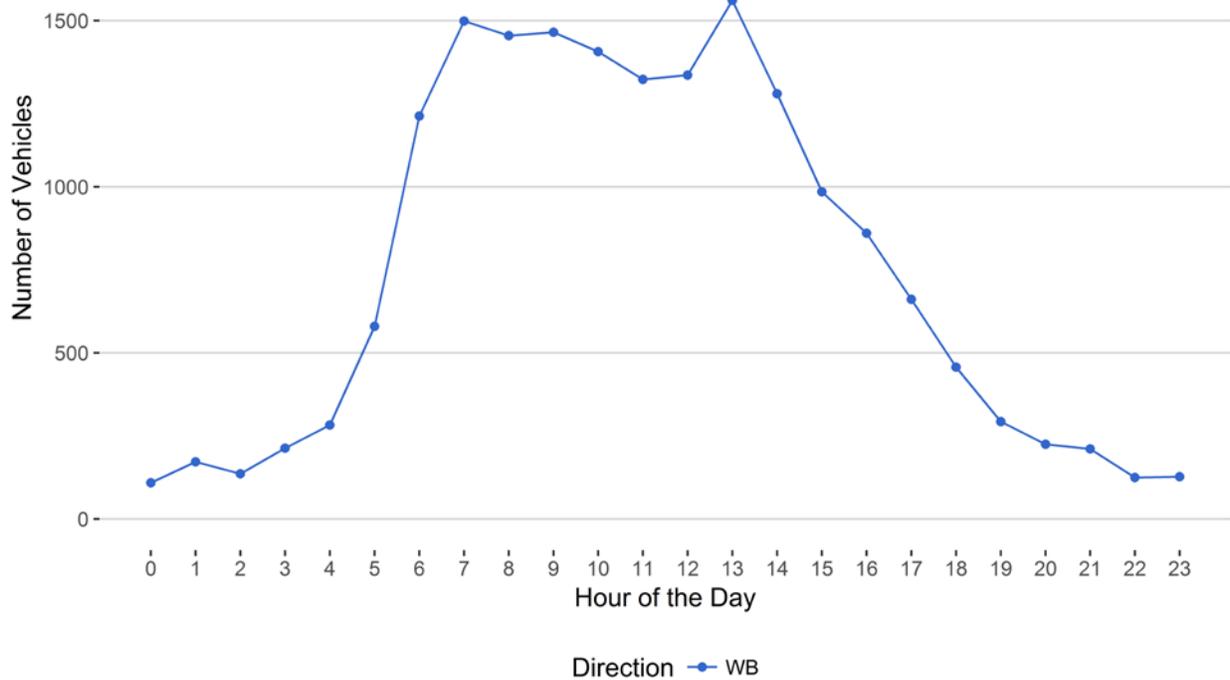


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

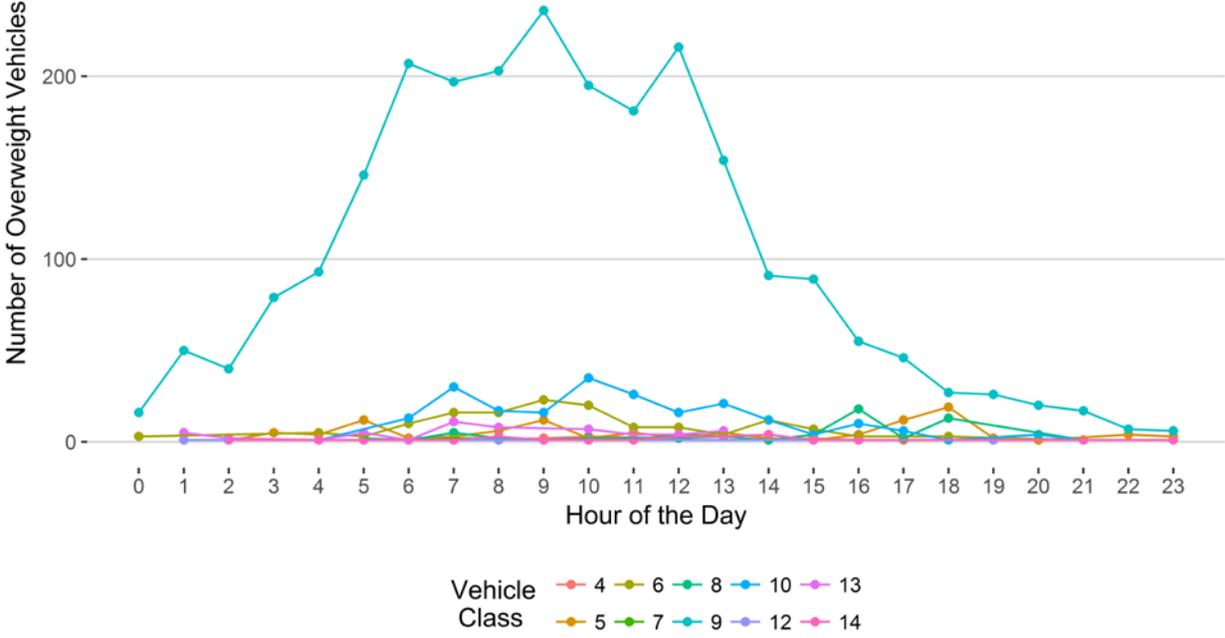


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

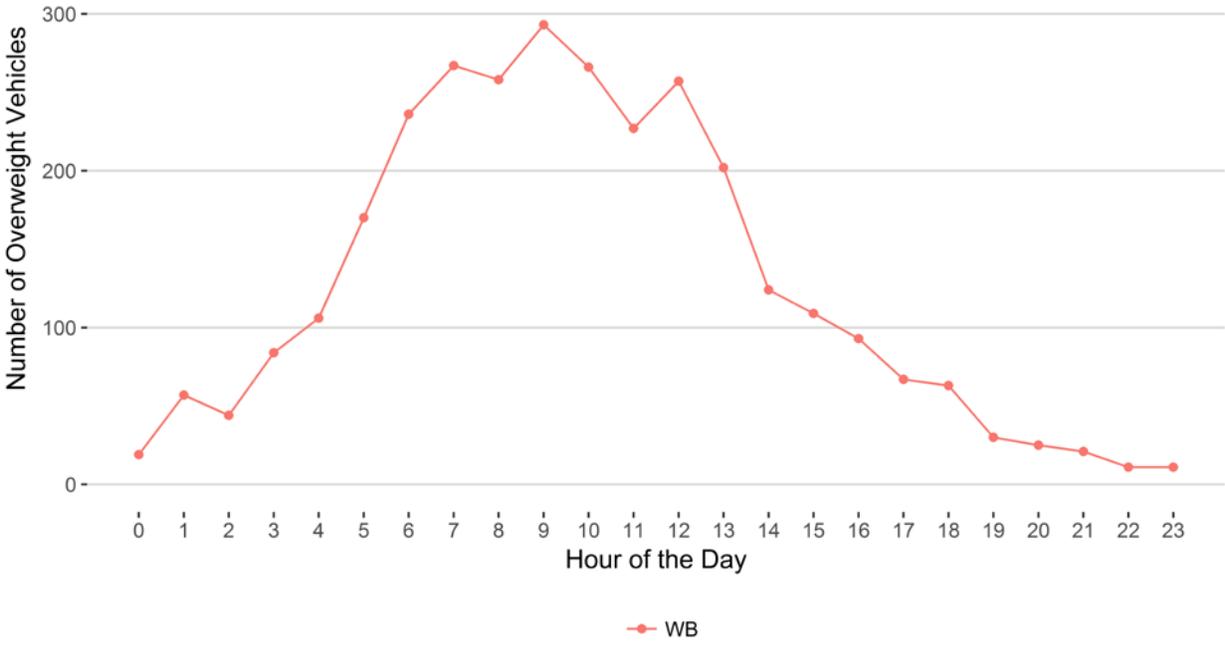
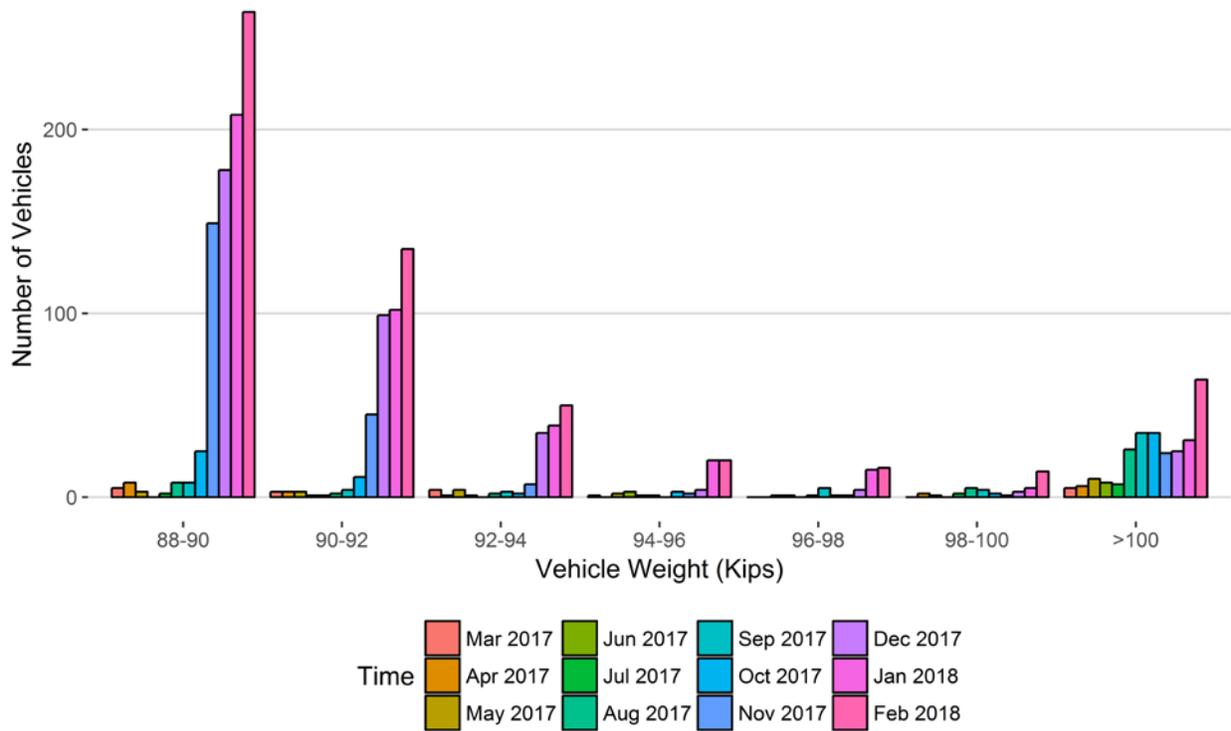


Figure 8 - Histogram of Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Mar 2017	Apr 2017	May 2017	Jun 2017	Jul 2017	Aug 2017	Sep 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018
88-90	5	8	3	0	2	8	8	25	149	178	208	264
90-92	3	3	3	1	1	2	4	11	45	99	102	135
92-94	4	1	4	1	0	2	3	2	7	35	39	50
94-96	1	0	2	3	1	1	0	3	2	4	20	20
96-98	0	0	1	1	0	1	5	1	1	4	15	16
98-100	0	2	1	0	2	5	4	2	1	3	5	14
>100	5	6	10	8	7	26	35	35	24	25	31	64
Total	18	20	24	14	13	45	59	79	229	348	420	563

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

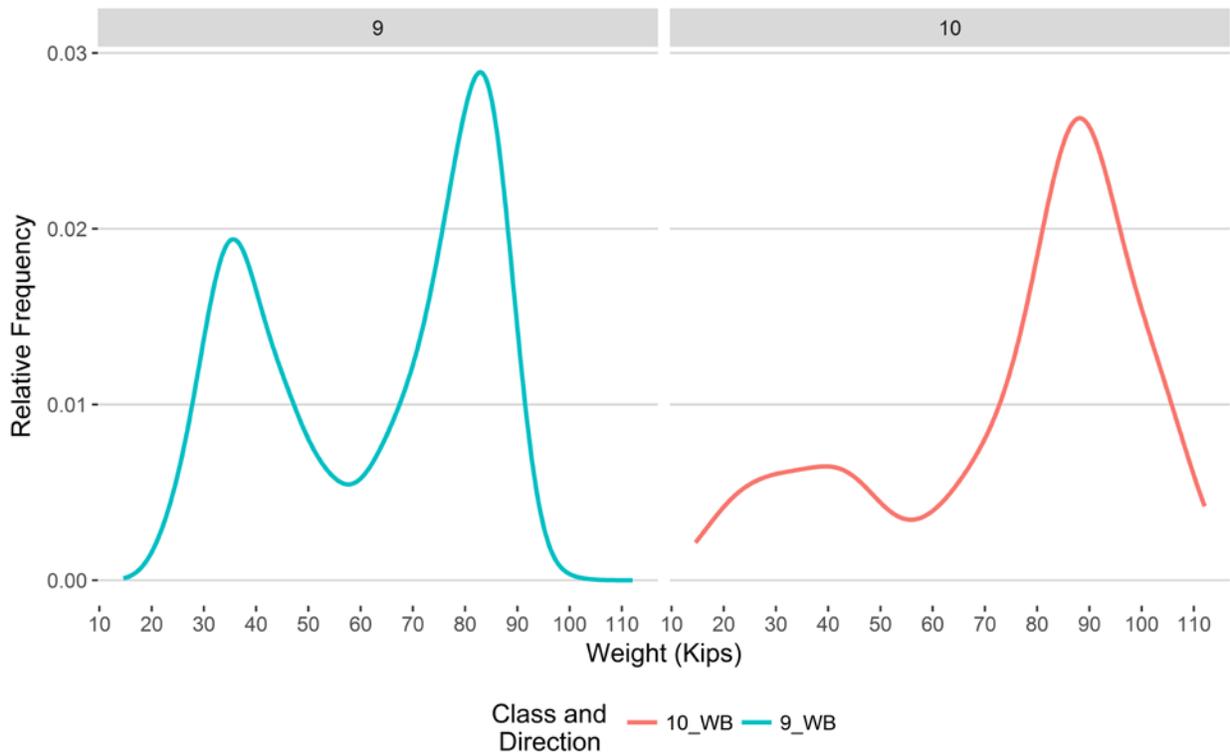


Figure 9 - Freight Percentage by Direction and Class

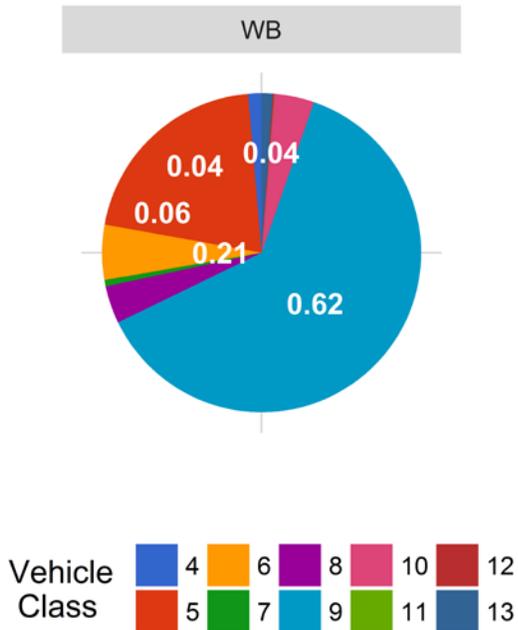


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

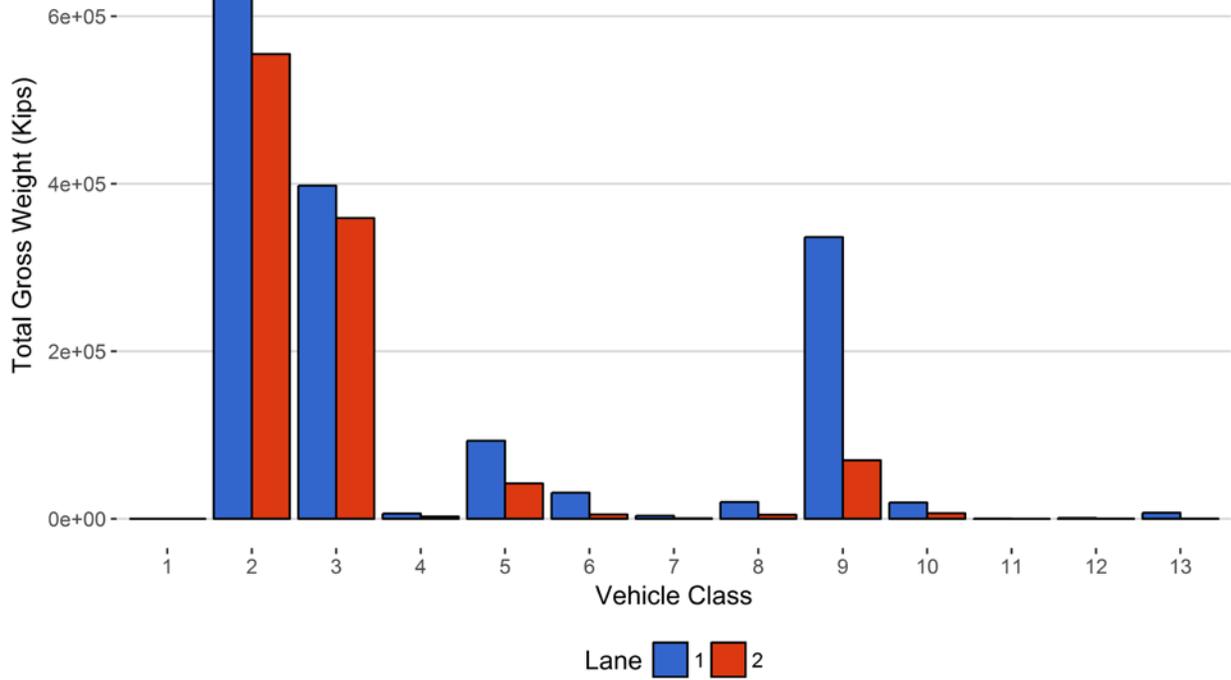


Figure 11 - Total Gross Vehicle Weight I

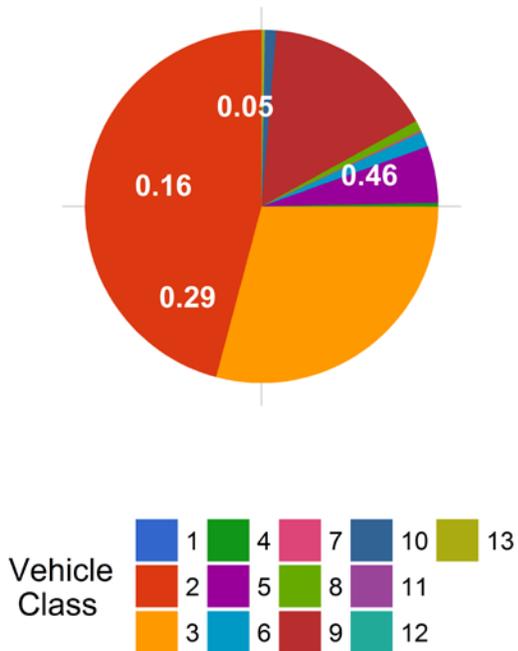


Figure 12 - Total ESALs by Class and Lane

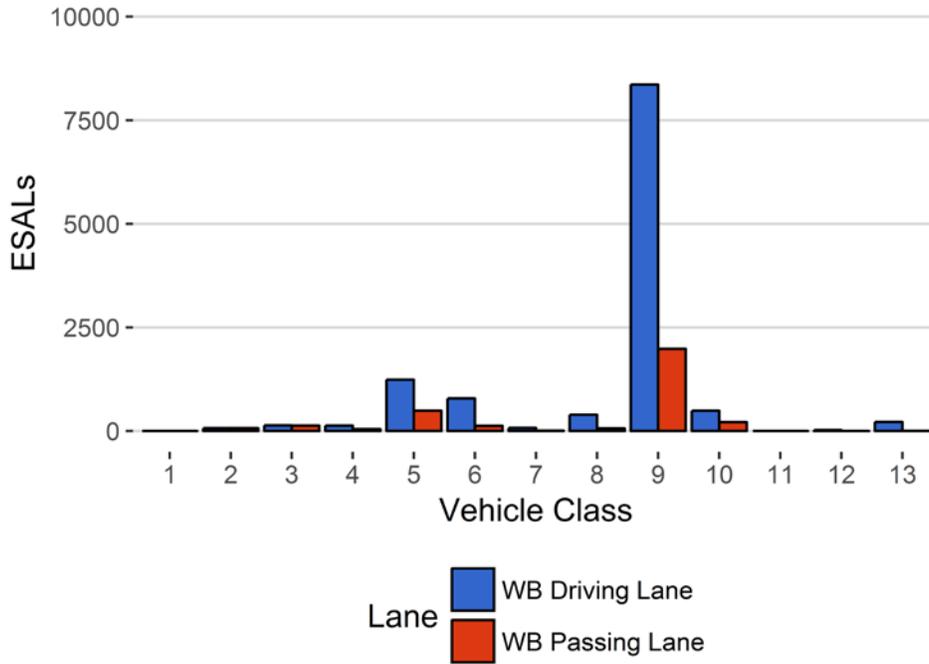


Figure 13 - ESALs by Class

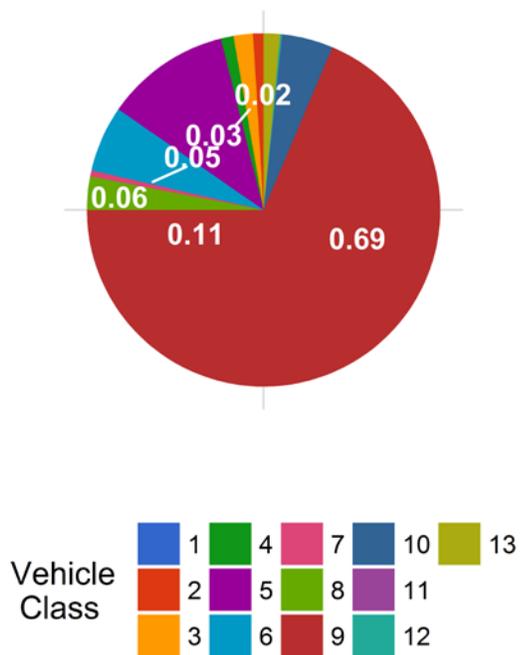


Table 1 Class 9 Front Axle Weight by Lane

<i>Month</i>	<i>Lane 1 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 2 (Kips)</i>	<i>Front Axle +/- 9%</i>
February 2016	10.70	0.00	NA	NA
March 2016	10.74	0.38	NA	NA
April 2016	10.80	0.97	NA	NA
May 2016	10.45	-2.34	NA	NA
June 2016	10.41	-2.66	NA	NA
July 2016	10.58	-1.10	NA	NA
August 2016	10.69	-0.08	NA	NA
September 2016	10.73	0.32	NA	NA
October 2016	10.92	2.10	NA	NA
November 2016	10.87	1.63	NA	NA
December 2016	11.14	4.10	NA	NA
January 2017	11.16	4.31	NA	NA
February 2017	10.82	1.12	NA	NA
March 2017	10.80	0.93	NA	NA
April 2017	10.88	1.70	NA	NA
May 2017	10.75	0.50	NA	NA
June 2017	10.64	-0.53	NA	NA
July 2017	10.65	-0.41	NA	NA
August 2017	10.78	0.79	NA	NA
September 2017	10.61	-0.82	NA	NA
October 2017	10.91	1.99	10.62	0.00
November 2017	11.45	6.99	10.99	3.53
December 2017	11.65	8.87	11.20	5.49
January 2018	11.72	9.56	11.24	5.83
February 2018	11.77	10.02	11.23	5.72

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	2	0	0	0
2	10826	303115	67.6	0	0
3	4534	126949	28.3	0	0
4	11	312	0.1	17	0.6
5	318	8913	2	108	3.6
6	38	1076	0.2	143	4.7
7	3	73	0	20	0.7
8	29	814	0.2	57	1.9
9	237	6645	1.5	2397	79.5
10	12	349	0.1	213	7.1
11	0	3	0	0	0
12	1	16	0	7	0.2
13	3	83	0	54	1.8
TOTAL	16013	448352	100	3016	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>
2018-02-12	Monday	06:32:43	10	WB	1	112.06
2018-02-22	Thursday	07:11:55	10	WB	2	111.92
2018-02-19	Monday	17:06:17	10	WB	1	111.22
2018-02-01	Thursday	07:57:21	10	WB	1	109.16
2018-02-12	Monday	10:52:26	10	WB	2	108.68
2018-02-20	Tuesday	12:02:14	10	WB	1	108.19
2018-02-09	Friday	09:08:04	10	WB	1	107.74
2018-02-13	Tuesday	13:27:11	10	WB	1	107.55
2018-02-21	Wednesday	10:28:29	10	WB	2	107.28
2018-02-28	Wednesday	06:47:01	10	WB	2	107.2

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	WB	15	307	49	16	8199	631	2165
5	WB	8	8762	501	5.7	131670	3556	32791
6	WB	19	1058	69	6.5	35035	1203	8122
7	WB	11.5	72	0	0	4214	0	1693
8	WB	31	800	396	49.5	15844	8891	1660
9	WB	33	6533	720	11	385123	20880	96647
10	WB	33.5	343	35	10.2	25206	881	7444
11	WB	36.5	3	1	33.3	123	31	25
12	WB	36.5	16	1	6.2	1012	29	232
13	WB	31.5	82	0	0	7324	0	2371
TOTAL	****	****	17976	1772	****	613750	****	153149

Table 5 Gross Vehicle Weight by Class and Lane

<i>Vehicle Class</i>	<i>WB Driving Lane</i>	<i>WB Passing Lane</i>	<i>Total</i>	<i>Percentage</i>
1	2	0	2	0
2	636477	554673	1191151	45.9
3	397661	359058	756719	29.1
4	6213	2618	8830	0.3
5	93110	42116	135226	5.2
6	31080	5158	36238	1.4
7	3731	483	4214	0.2
8	19903	4831	24735	1
9	336303	69699	406003	15.6
10	19477	6611	26087	1
11	123	31	154	0
12	978	62	1041	0
13	7200	125	7324	0.3
TOTAL	1552259	1045466	2597725	100
GVW/LANE	59.75	40.25	100	0

Table 6 ESALs by Class and Lane and Flexible ESAL Factors

<i>Vehicle Class</i>	<i>WB Driving Lane</i>	<i>WB Passing Lane</i>	<i>Total</i>	<i>Percentage</i>	<i>Flexible ESAL Factor</i>
1	0	0	0	0	0.3333
2	73	72	145	1	0.001
3	134	132	266	1.8	0.0043
4	128	47	175	1.2	1.14
5	1238	489	1727	11.5	0.4
6	786	125	912	6	1.72
7	73	10	84	0.6	2.21
8	392	67	459	3	1.15
9	8360	1981	10340	68.6	3.17
10	489	215	704	4.7	4.03
11	3	0	3	0	1.23
12	25	1	26	0.2	2.32
13	218	7	225	1.5	4.89
TOTAL	11920	3146	15066	100	23
ESALS/LANE	79.1	20.9	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 2017	392478	12661	348	381682	97.2	10796.1	2.8
Apr 2017	405809	13527	387	394208	97.1	11600.9	2.9
May 2017	441742	14250	435	428251	96.9	13490.9	3.1
Jun 2017	438826	14628	443	425525	97	13301	3
Jul 2017	439624	14181	402	427149	97.2	12475.3	2.8
Aug 2017	605893	19545	618	586728	96.8	19165.5	3.2
Sep 2017	567907	18930	644	548578	96.6	19329.4	3.4
Oct 2017	569972	18386	702	548201	96.2	21771	3.8
Nov 2017	507344	16912	660	487542	96.1	19801.8	3.9
Dec 2017	513763	16573	605	495000	96.3	18762.8	3.7
Jan 2018	490255	15815	599	471697	96.2	18557.6	3.8
Feb 2018	448352	16013	653	430066	95.9	18285.5	4.1
TOTAL	5821965	--	--	5624627	--	197338	--
AVERAGE	485164	15952	541	468719	97	16445	3

ESALS

<i>Month</i>	<i>ESALS WB Driving Lane</i>	<i>ESALS WB Passing Lane</i>	<i>Total ESALS</i>	<i>Pavement Life Decrease Months</i>
Mar 2017	3893	737	4630	1.6
Apr 2017	4281	679	4960	1.3
May 2017	5120	823	5942	1.6
Jun 2017	5445	809	6254	0.6
Jul 2017	4945	730	5675	0.7
Aug 2017	8013	1478	9491	1.1
Sep 2017	7296	1571	8867	1.5
Oct 2017	10395	2096	12491	1.4
Nov 2017	11298	2252	13549	5.2
Dec 2017	11223	2609	13832	8.7
Jan 2018	11608	2729	14337	12.2
Feb 2018	12022	3161	15184	15.1
TOTAL	95539	--	--	--
AVERAGE	7962	1640	9601	4

Gross Vehicle Weight

<i>Month</i>	<i>GVW WB Driving Lane</i>	<i>GVW WB Passing Lane</i>	<i>Total GVW Kips</i>
Mar 2017	1645395	1122207	2767602
Apr 2017	1554529	1047637	2602167
May 2017	1153579	735697	1889277
Jun 2017	1220524	724691	1945215
Jul 2017	1368815	782424	2151239
Aug 2017	1328916	819795	2148711
Sep 2017	1277397	780242	2057640
Oct 2017	1778497	1291716	3070213
Nov 2017	1662343	1234848	2897191
Dec 2017	1813979	1269402	3083381
Jan 2018	1690562	1154286	2844848
Feb 2018	1689383	1187534	2876918
TOTAL	18183921	12150480	30334401
AVERAGE	1515327	1012540	2527867

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 2017	638	0.2	5.9	18	5
Apr 2017	577	0.1	5	20	8
May 2017	702	0.2	5.2	24	11
Jun 2017	751	0.2	5.7	14	8
Jul 2017	702	0.2	5.8	13	9
Aug 2017	1056	0.2	5.5	45	31
Sep 2017	838	0.1	4.4	59	39
Oct 2017	1742	0.3	8.1	79	37
Nov 2017	2412	0.5	12.3	229	25
Dec 2017	2523	0.5	13.5	349	29
Jan 2018	2708	0.6	14.6	420	36
Feb 2018	3040	0.7	16.6	565	78
TOTAL	17689	--	--	1835	316
AVERAGE	1474.1	0.3	8.6	152.9	26.3

Freight

<i>Month</i>	<i>WB Freight Tons</i>
Mar 2017	61045
Apr 2017	65656
May 2017	79220
Jun 2017	81236
Jul 2017	74610
Aug 2017	121047
Sep 2017	116647
Oct 2017	156411
Nov 2017	153141
Dec 2017	146186
Jan 2018	144984
Feb 2018	153149
TOTAL	1353333
AVERAGE	112777.7