

SEPTEMBER 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 September 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 all lanes. 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: 581367 | Passenger Vehicles: 558536 | Heavy Commercial Vehicles: 22831

Monthly Average Daily Traffic (MADT): 19379 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 761

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 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), WB PVs generally reached peak volume levels between 02 PM and 04 PM.

Heavy Commercial Vehicles (HCVs)

Volume trends. On an average 24-hour day, HCVs traveling WB typically reached peak volume levels between 02 PM 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 22831 HCVs, 1567 of them were overweight ³. These overweight HCVs contributed to 0.3% of total monthly volume, and 7% of total monthly

HCV volume. WB overweight vehicles typically reached highest numbers on Wednesdays, 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 ,96 WB vehicles exceeded 88,000 pounds (53 vehicles were Class 13's; 28 vehicles were Class 10's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from September 2018.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9's and 10's in September 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 151578 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 581367 vehicles with a combined GVW of 3213591 kips (1 kip = 1,000 pounds = 0.5 tons) in September 2018. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 12521 equivalent single axle loads (ESALs) passed over the pavement at this site. In particular, 52% of all ESALs were generated by the Class 9's (Class 9's were also responsible for generating 11% 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>

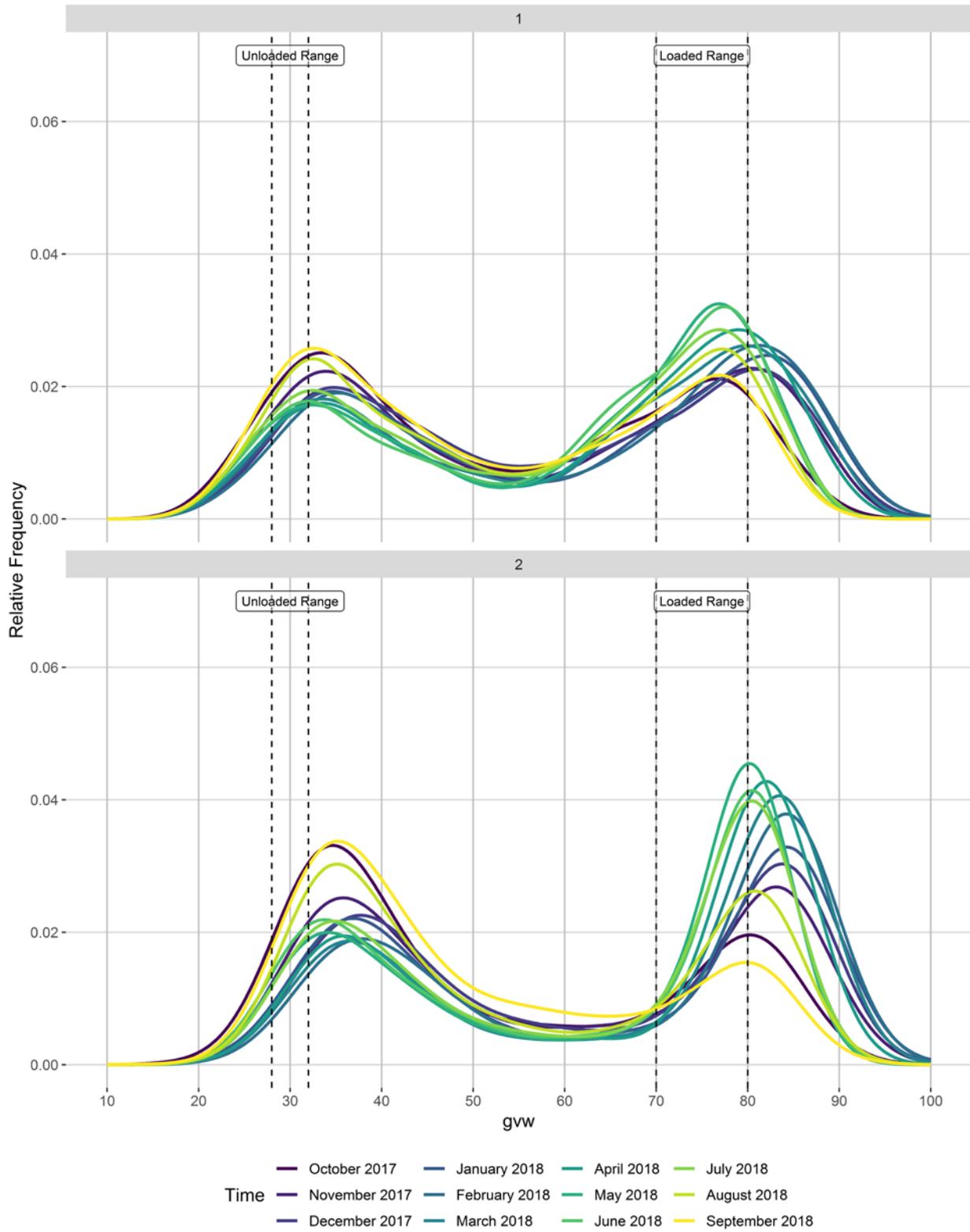
- ¹ Front axle weights of Class 9s are monitored on a monthly basis to assure performance between calibrations. The current goal of the WIM scale calibration is to

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.

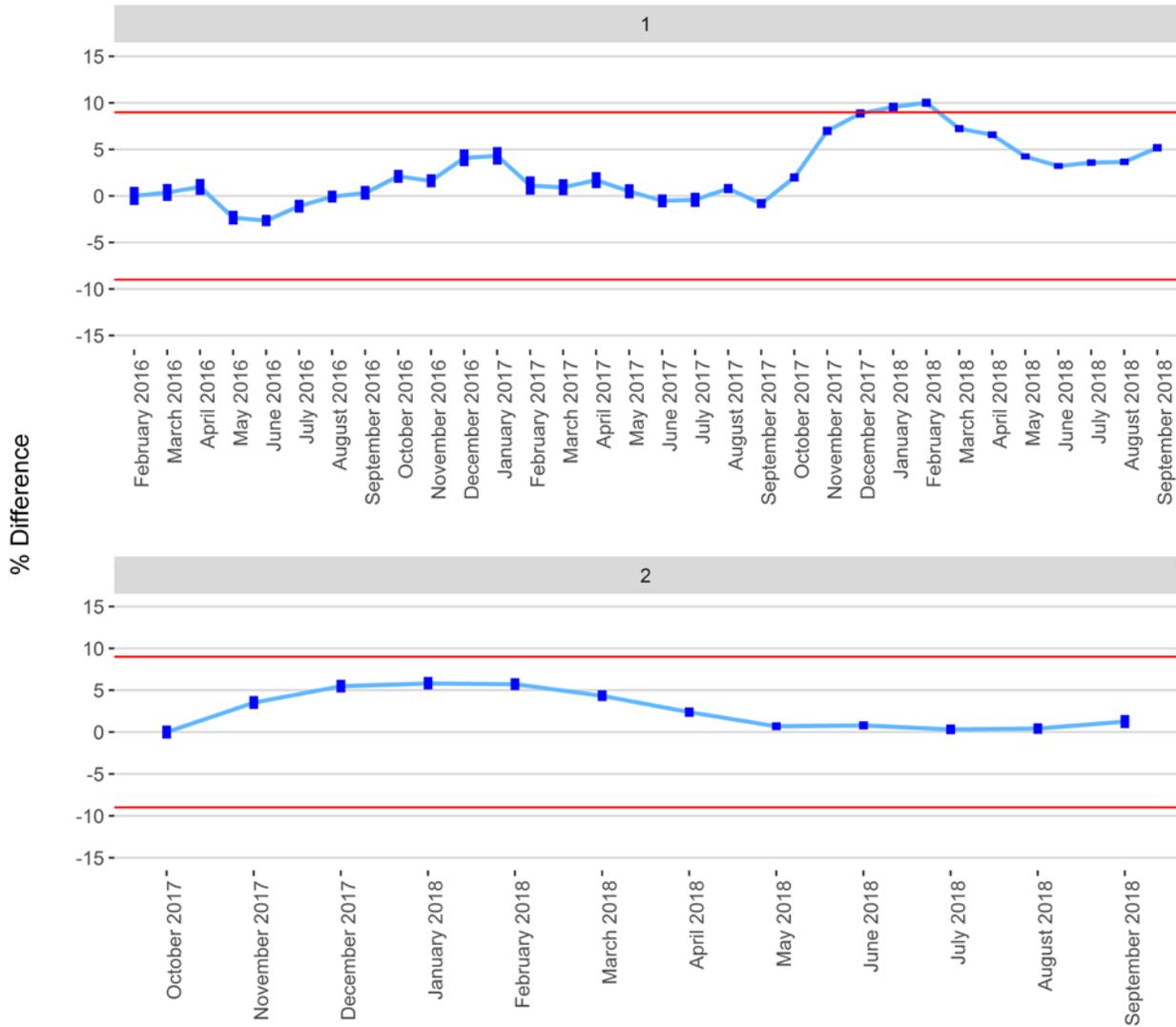
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Figure 1 - Monthly Class 9 GVW Histogram



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

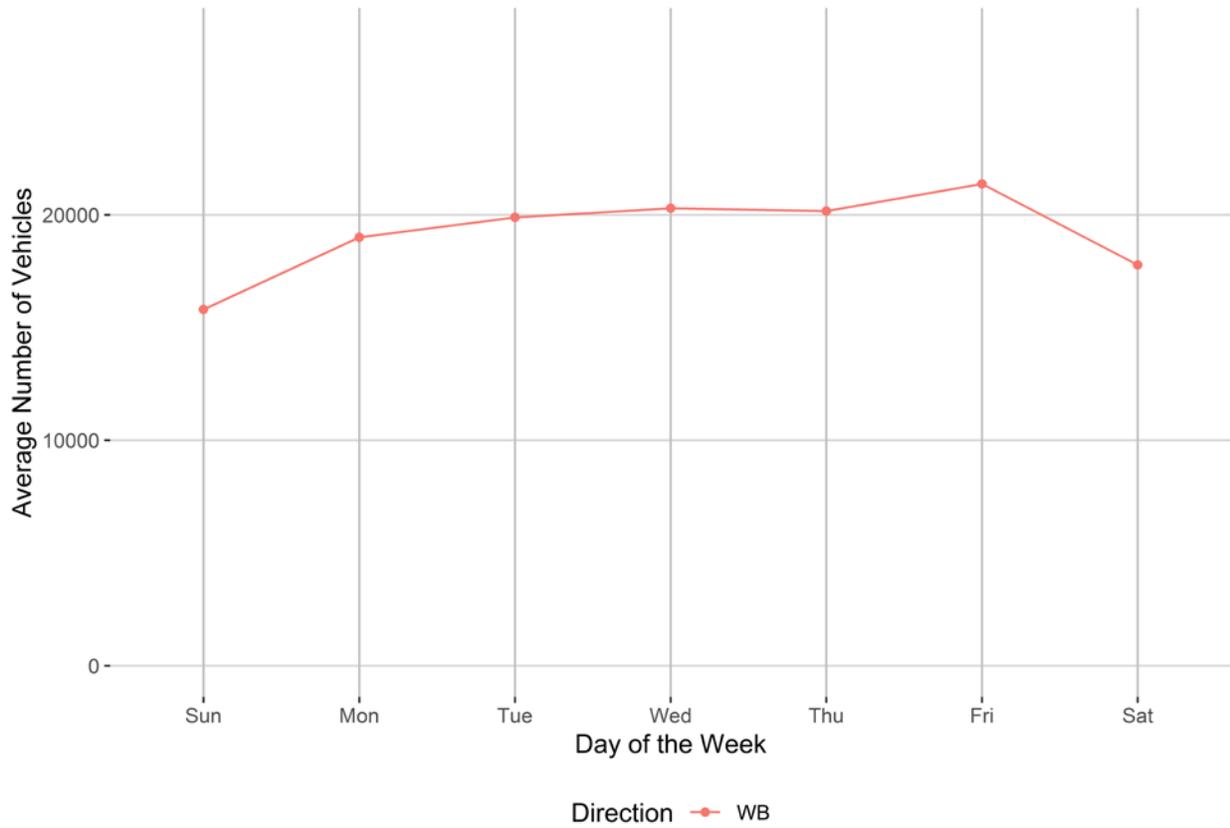


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

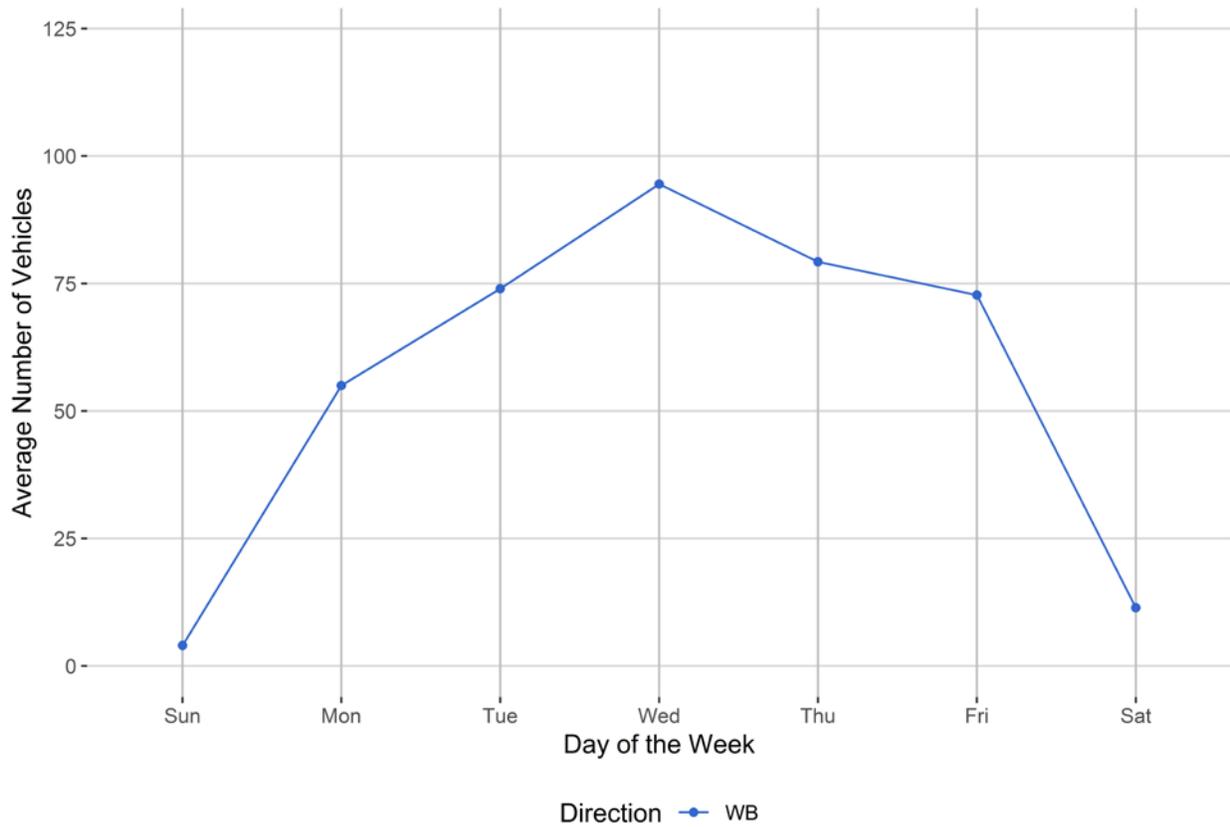


Figure 4 - Passenger Vehicles vs. Hour of the Day

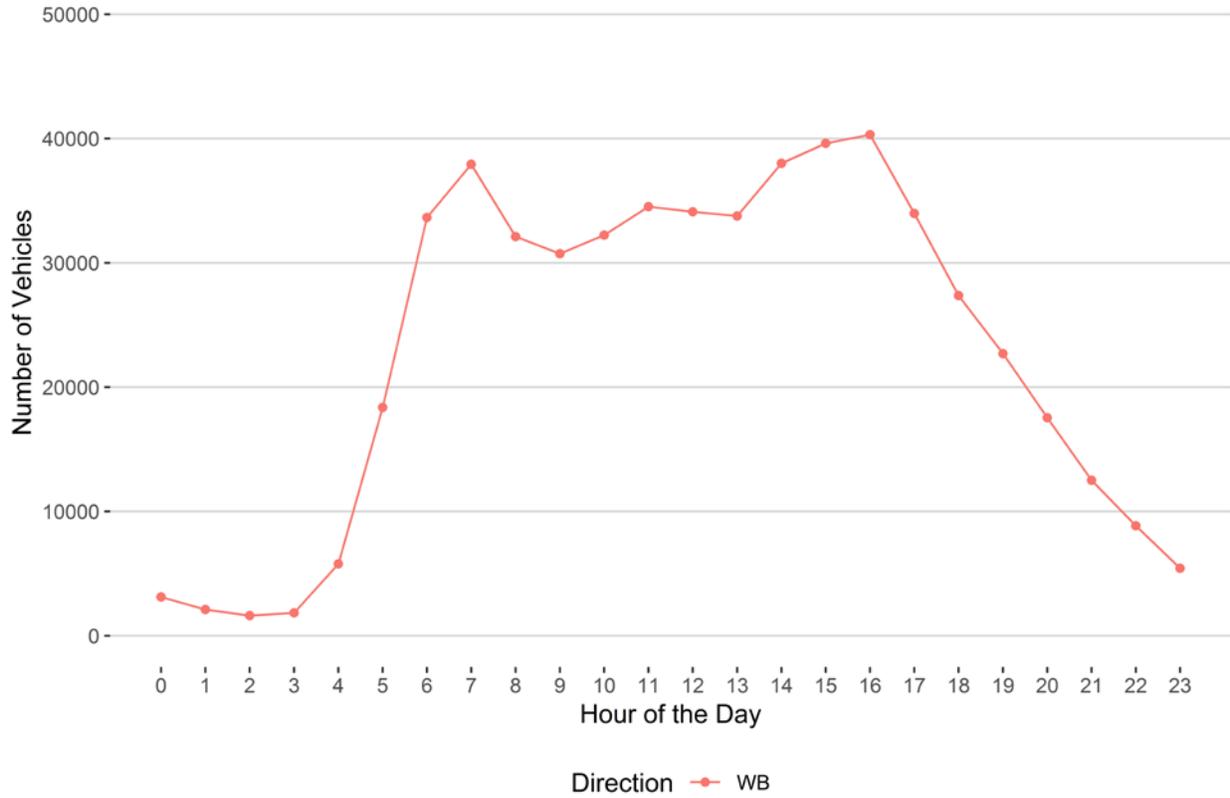


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

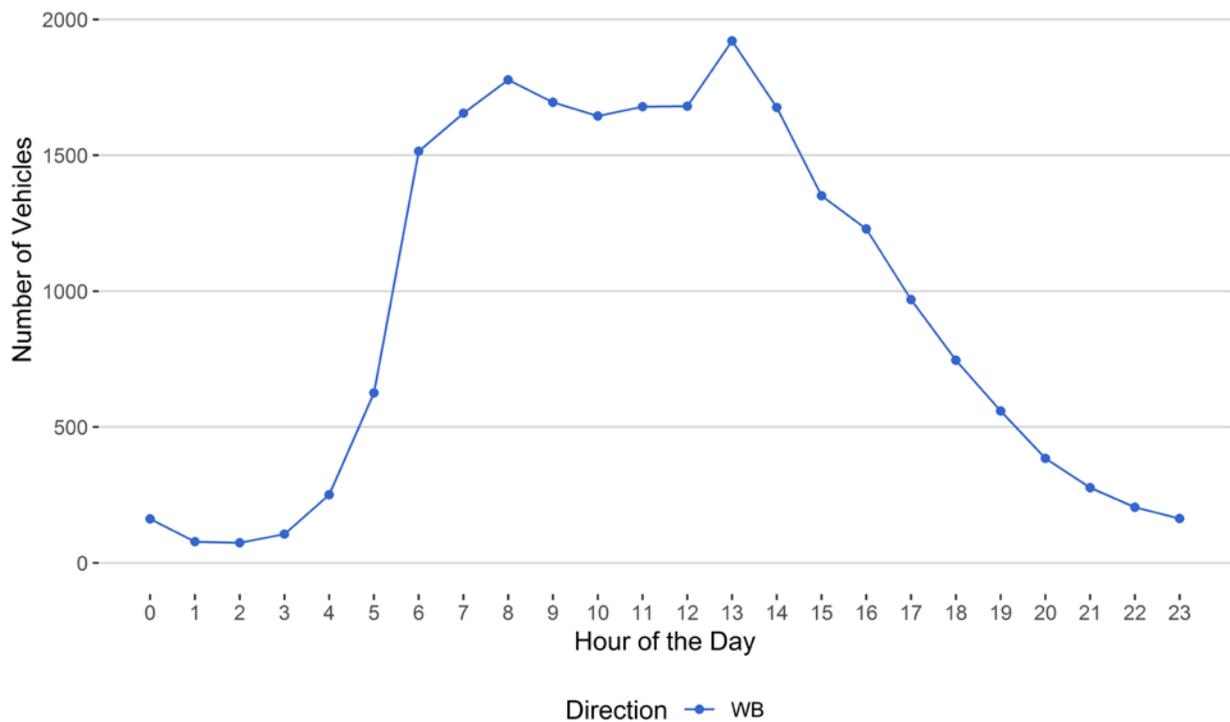


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

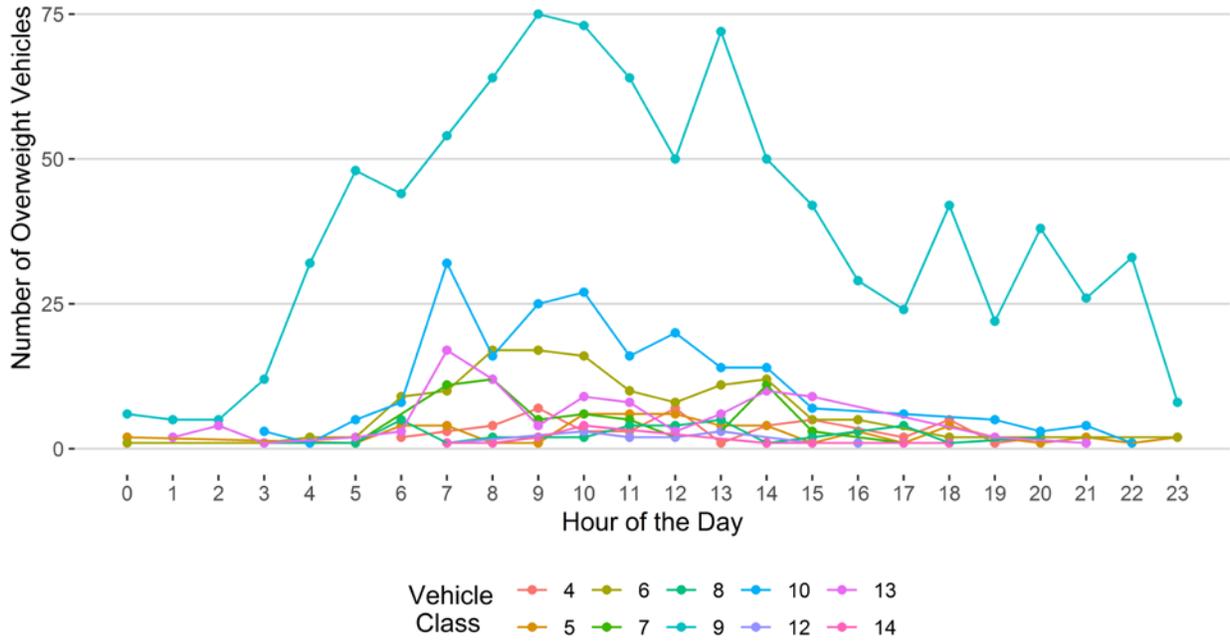


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

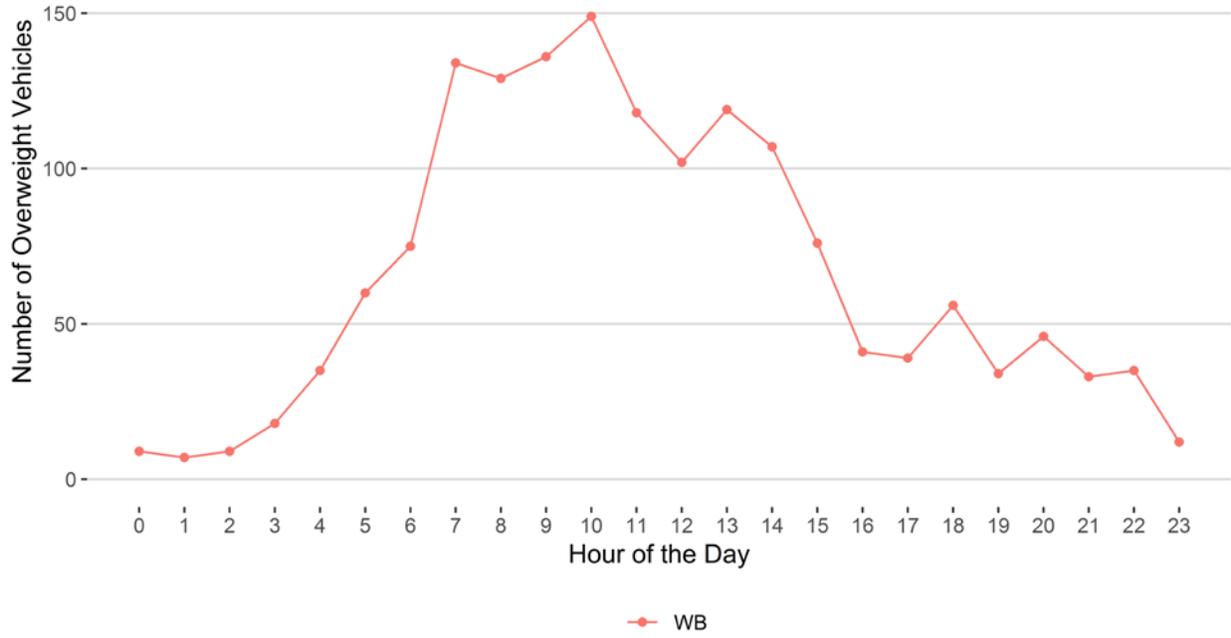
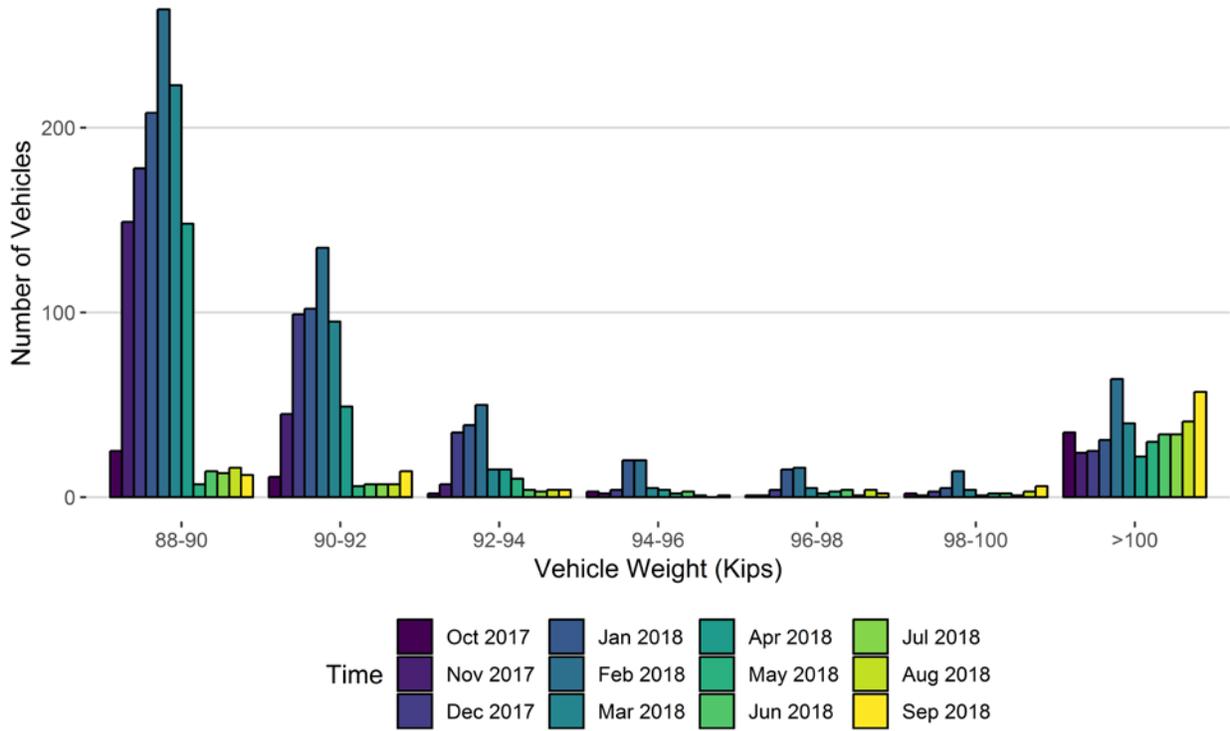


Figure 8 - Histogram of Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018
88-90	25	149	178	208	264	223	148	7	14	13	16	12
90-92	11	45	99	102	135	95	49	6	7	7	7	14
92-94	2	7	35	39	50	15	15	10	4	3	4	4
94-96	3	2	4	20	20	5	4	2	3	1	0	1
96-98	1	1	4	15	16	5	2	3	4	1	4	2
98-100	2	1	3	5	14	4	1	2	2	1	3	6
>100	35	24	25	31	64	40	22	30	34	34	41	57
Total	79	229	348	420	563	387	241	60	68	60	75	96

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

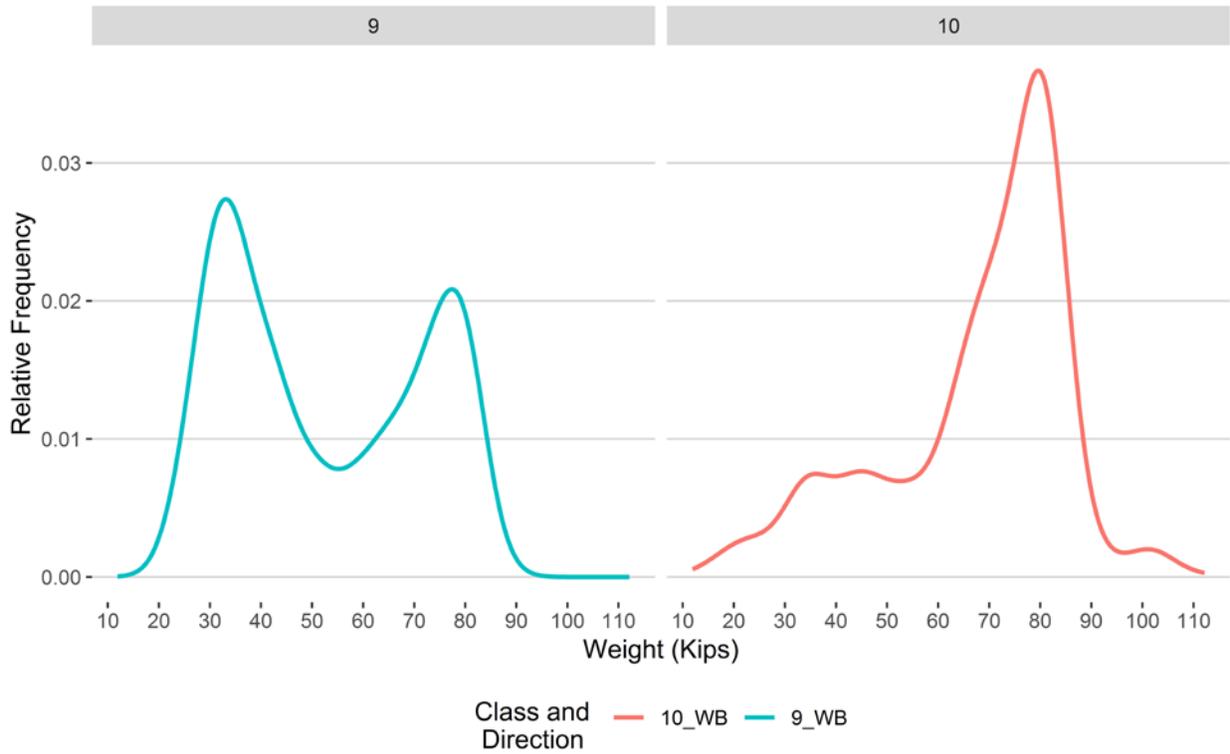


Figure 9 - Freight Percentage by Direction and Class

WB

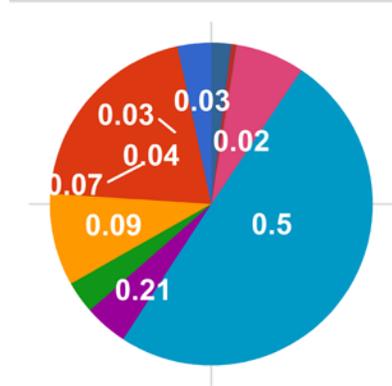


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

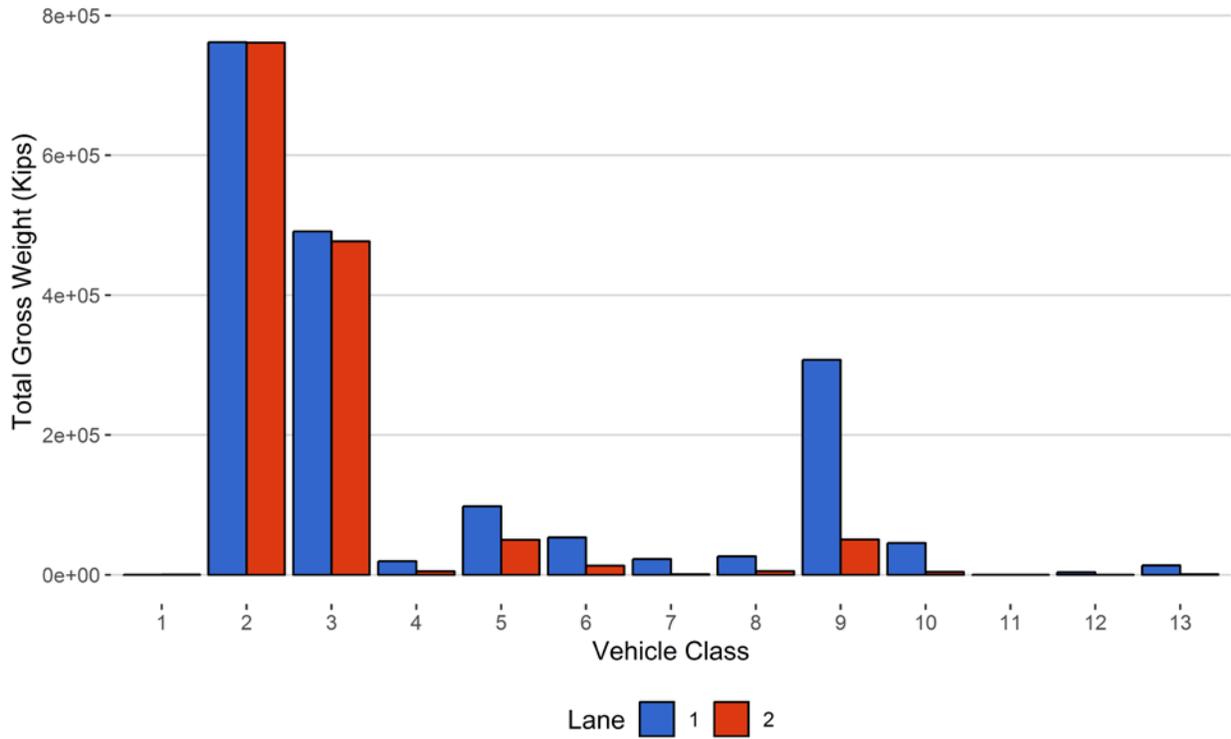


Figure 11 - Total Gross Vehicle Weight t

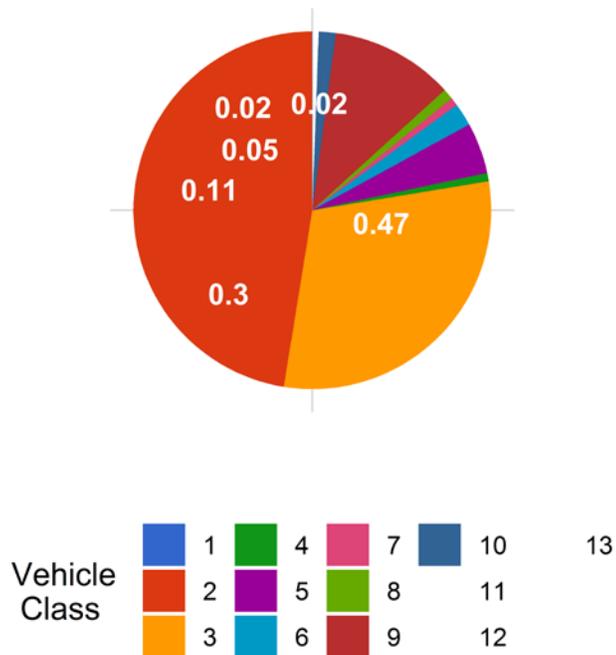


Figure 12 - Total ESALs by Class and Lane

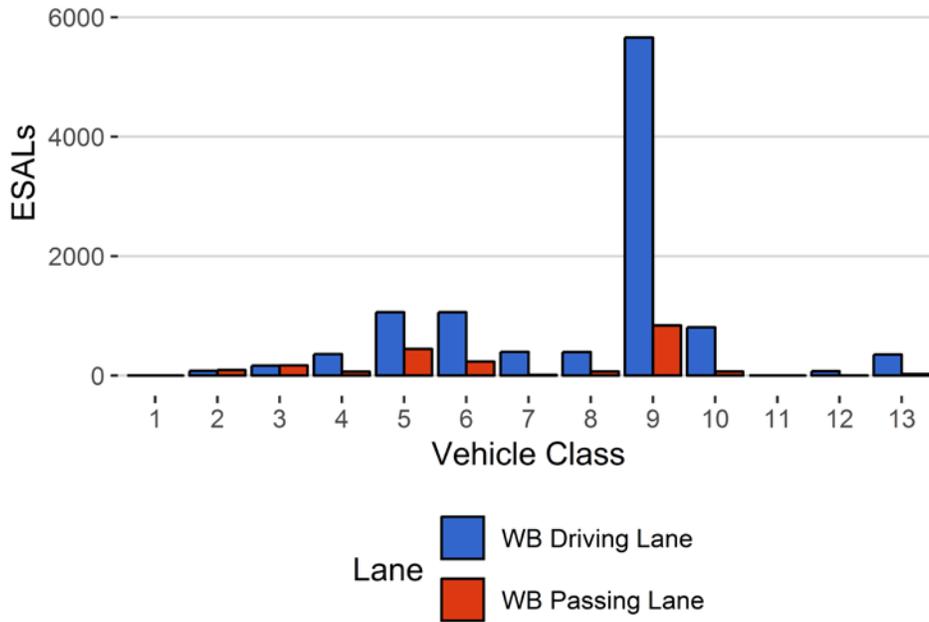


Figure 13 - ESALs by Class

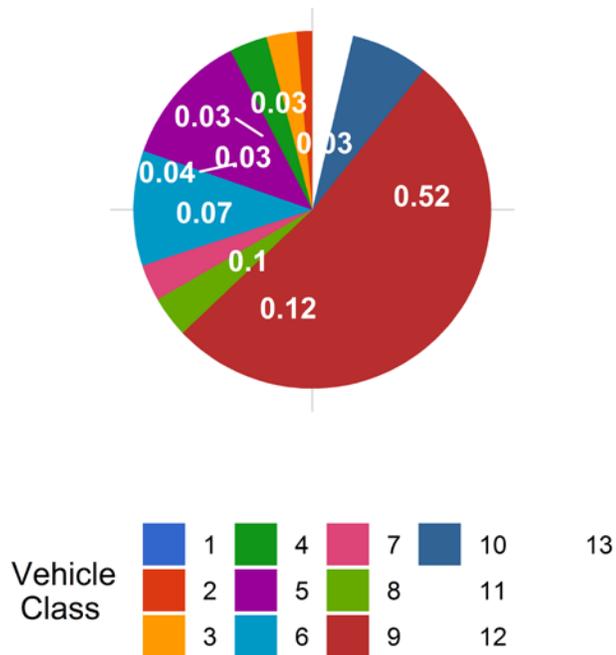


Table 1 Class 9 Front Axle Weight by Lane

<i>Month</i>	<i>Lane 1 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 2 (Kips)</i>	<i>Front Axle +/- 9%</i>
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
March 2018	11.47	7.24	11.08	4.34
April 2018	11.40	6.58	10.87	2.38
May 2018	11.15	4.24	10.69	0.70
June 2018	11.04	3.22	10.70	0.81
July 2018	11.08	3.59	10.65	0.33
August 2018	11.09	3.67	10.66	0.42
September 2018	11.25	5.17	10.75	1.26

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	19	568	0.1	0	0
2	13187	395621	68.1	0	0
3	5412	162347	27.9	0	0
4	30	888	0.2	49	3.1
5	345	10360	1.8	56	3.6
6	72	2155	0.4	132	8.4
7	13	395	0.1	61	3.9
8	36	1089	0.2	38	2.4
9	232	6964	1.2	918	58.6
10	25	748	0.1	207	13.2
11	0	5	0	0	0
12	2	62	0	13	0.8
13	5	165	0	93	5.9
TOTAL	19379	581367	100	1567	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>
2018-09-13	Thursday	19:37:10	10	WB	1	112.16
2018-09-21	Friday	03:26:24	10	WB	1	106.77
2018-09-13	Thursday	04:35:35	10	WB	1	105.65
2018-09-18	Tuesday	06:10:42	10	WB	1	104.85
2018-09-24	Monday	09:40:46	10	WB	1	103.46
2018-09-28	Friday	10:33:19	10	WB	1	103.39
2018-09-11	Tuesday	12:47:57	10	WB	1	103.26
2018-09-07	Friday	06:10:11	10	WB	1	102.83
2018-09-17	Monday	06:11:32	10	WB	1	101.58
2018-09-26	Wednesday	03:21:36	10	WB	1	100.74

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	872	169	19.4	22137	2148	5796
5	WB	8	10176	919	9	141617	6566	33780
6	WB	19	2117	125	5.9	64317	2155	13234
7	WB	11.5	388	1	0.3	23244	10	9397
8	WB	31	1070	601	56.2	18727	12645	2094
9	WB	33	6840	1452	21.2	316088	41782	69142
10	WB	33.5	735	44	6	48541	1127	12696
11	WB	36.5	5	4	80	43	90	3
12	WB	36.5	61	6	9.8	3734	140	863
13	WB	31.5	162	0	0	14245	0	4571
TOTAL	****	****	22426	3321	****	652693	****	151578

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	240	442	682	0
2	761856	761204	1523060	47.4
3	491186	476980	968166	30.1
4	19366	4918	24285	0.8
5	98072	50111	148183	4.6
6	53380	13092	66472	2.1
7	22461	793	23254	0.7
8	26202	5170	31372	1
9	307463	50408	357870	11.1
10	45478	4190	49668	1.5
11	133	0	133	0
12	3727	147	3874	0.1
13	13339	906	14245	0.4
TOTAL	1842901	1368362	3211263	100
GVW/LANE	57.39	42.61	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	0.0018
2	81	95	176	1.4	9e-04
3	169	171	339	2.7	0.0043
4	361	65	426	3.4	0.98
5	1061	446	1507	12.1	0.3
6	1062	235	1296	10.4	1.23
7	400	13	413	3.3	2.12
8	396	69	465	3.7	0.87
9	5661	841	6501	52.2	1.91
10	809	69	878	7	2.38
11	1	0	1	0	0.76
12	74	2	77	0.6	2.27
13	352	27	380	3	4.43
TOTAL	10427	2032	12458	100	17
ESALS/LANE	83.7	16.3	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>
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
Mar 2018	512513	16533	644	492548	96.1	19965.1	3.9
Apr 2018	517859	17262	753	495274	95.6	22584.9	4.4
May 2018	631604	20374	910	603386	95.5	28218.3	4.5
Jun 2018	616280	20543	896	589399	95.6	26881.2	4.4
Jul 2018	629397	20303	816	604106	96	25291	4
Aug 2018	639471	20628	852	613071	95.9	26399.6	4.1
Sep 2018	581367	19379	761	558536	96.1	22831	3.9
TOTAL	6658177	-	-	6388826	-	269350	-
AVERAGE	554848	18227	738	532402	96	22446	4

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>
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
Mar 2018	13230	3173	16403	7.6
Apr 2018	14271	3586	17857	4.5
May 2018	16136	4234	20371	1.3
Jun 2018	16381	4040	20421	0.5
Jul 2018	14428	3471	17899	0.6
Aug 2018	13904	2848	16752	0.8
Sep 2018	10477	2044	12521	1.9
TOTAL	155372	-	-	-
AVERAGE	12948	3020	15968	5

Gross Vehicle Weight

<i>Month</i>	<i>GVW WB Driving Lane</i>	<i>GVW WB Passing Lane</i>	<i>Total GVW Kips</i>
Oct 2017	1645395	1122207	2767602
Nov 2017	1554529	1047637	2602167
Dec 2017	1734424	1179053	2913477
Jan 2018	1792589	1215750	3008338
Feb 2018	2142694	1524224	3666919
Mar 2018	2130628	1470981	3601608
Apr 2018	2091423	1471775	3563198
May 2018	2108134	1515344	3623478
Jun 2018	1844835	1368756	3213591
Jul 2018	1813979	1269402	3083381
Aug 2018	1690562	1154286	2844848
Sep 2018	1689383	1187534	2876918
TOTAL	22238574	15526949	37765524
AVERAGE	1853215	1293912	3147127

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>
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
Mar 2018	3191	0.6	16.1	388	45
Apr 2018	3374	0.7	15	242	23
May 2018	3328	0.5	11.9	62	32
Jun 2018	3351	0.6	12.6	68	36
Jul 2018	2745	0.4	11	61	36
Aug 2018	2318	0.4	8.9	75	44
Sep 2018	1579	0.3	7	96	63
TOTAL	32311	-	-	2634	484
AVERAGE	2692.6	0.5	12.3	219.5	40.3

Freight

<i>Month</i>	<i>WB Freight Tons</i>
Oct 2017	156411
Nov 2017	153141
Dec 2017	146186
Jan 2018	144984
Feb 2018	153149
Mar 2018	171392
Apr 2018	193752
May 2018	241700
Jun 2018	239504
Jul 2018	211420
Aug 2018	203867
Sep 2018	151578
TOTAL	2167084
AVERAGE	180590.4