

DECEMBER 2019



**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 December 2019. Volume was computed using all monthly data.

## System Calibration

WIM #47 was most recently calibrated on 2018-11-20. Table 1 summarizes the front axle weights of class 9s by lane <sup>1</sup>. Figure 1 shows the distribution of gross vehicle weights (GVW) in the Class 9s at this site for the last 12 months <sup>2</sup>. 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: 545079 | Passenger Vehicles: 523358 | Heavy Commercial Vehicles: 21721

Monthly Average Daily Traffic (MADT): 17583 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 701

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 15's.

### Overweight HCVs

**Volume trends.** Of a total of 21721 HCVs, 2129 of them were overweight <sup>3</sup>. These overweight HCVs contributed to 0.4% of total monthly volume, and 10.2% 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 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 report <sup>4</sup>.

Using normal load limits ,362 WB vehicles exceeded 88,000 pounds (222 vehicles were Class 9's; 96 vehicles were Class 10's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from December 2019.

**Loaded vs. Unloaded HCVs.** Figure 10 shows the GVW distributions of Class 9's and 10's in December 2019. 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 143465 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 545079 vehicles with a combined GVW of 3152883 kips (1 kip = 1,000 pounds = 0.5 tons) in December 2019. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

**Pavement Design.** A total of 13481 equivalent single axle loads (ESALs) passed over the pavement at this site. In particular, 54% 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>

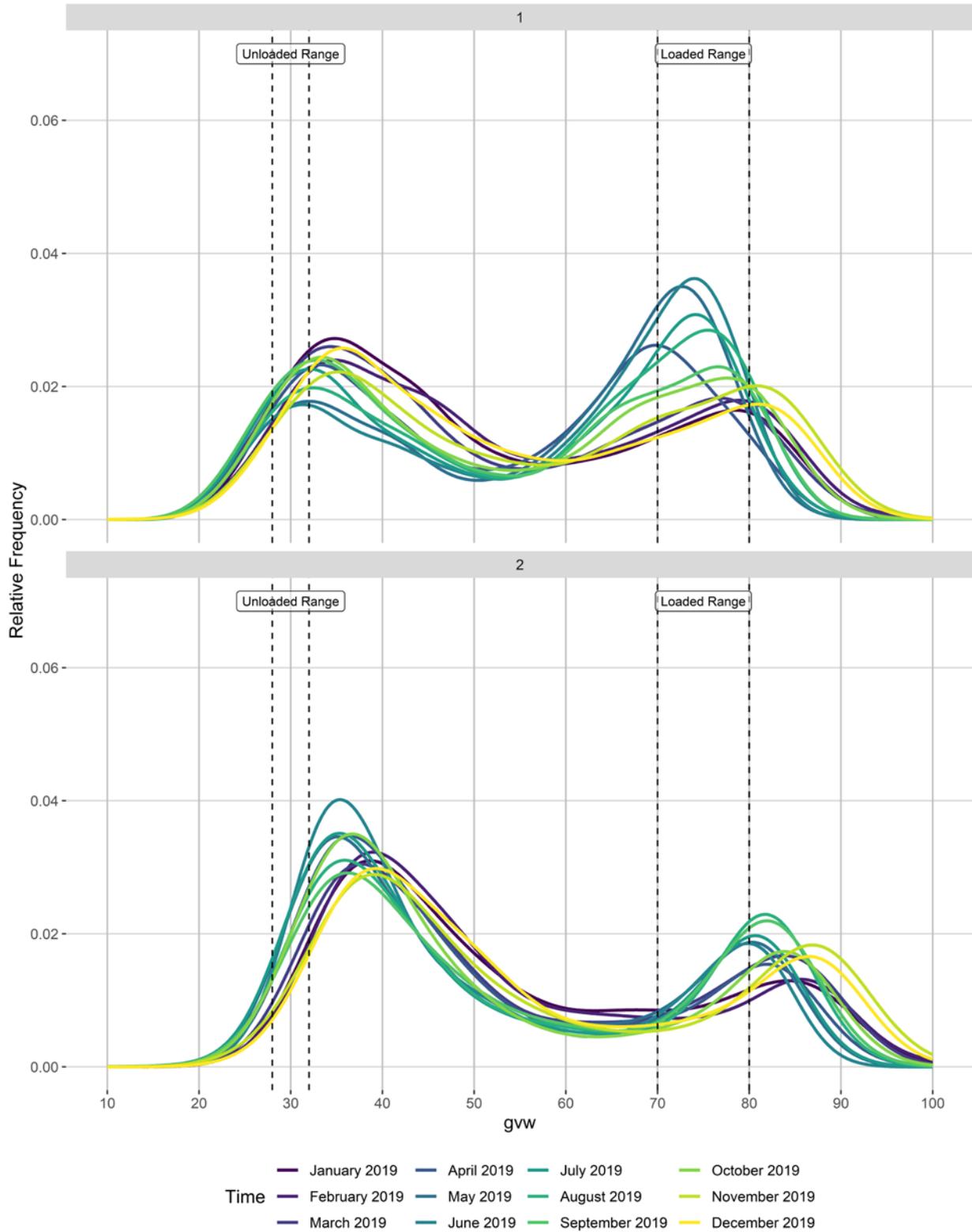
- <sup>1</sup> Front axle weights of Class 9s are monitored on a monthly basis to assure performance between calibrations. The current goal of the WIM scale calibration is to have each individual axle weight stay within a range of +/-9% of baseline calibration values
- <sup>2</sup> Previous WIM research 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.

- <sup>3</sup> 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](http://www.mrr.dot.state.mn.us/research/seasonal_load_limits/sllindex.asp)
- <sup>4</sup> 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.

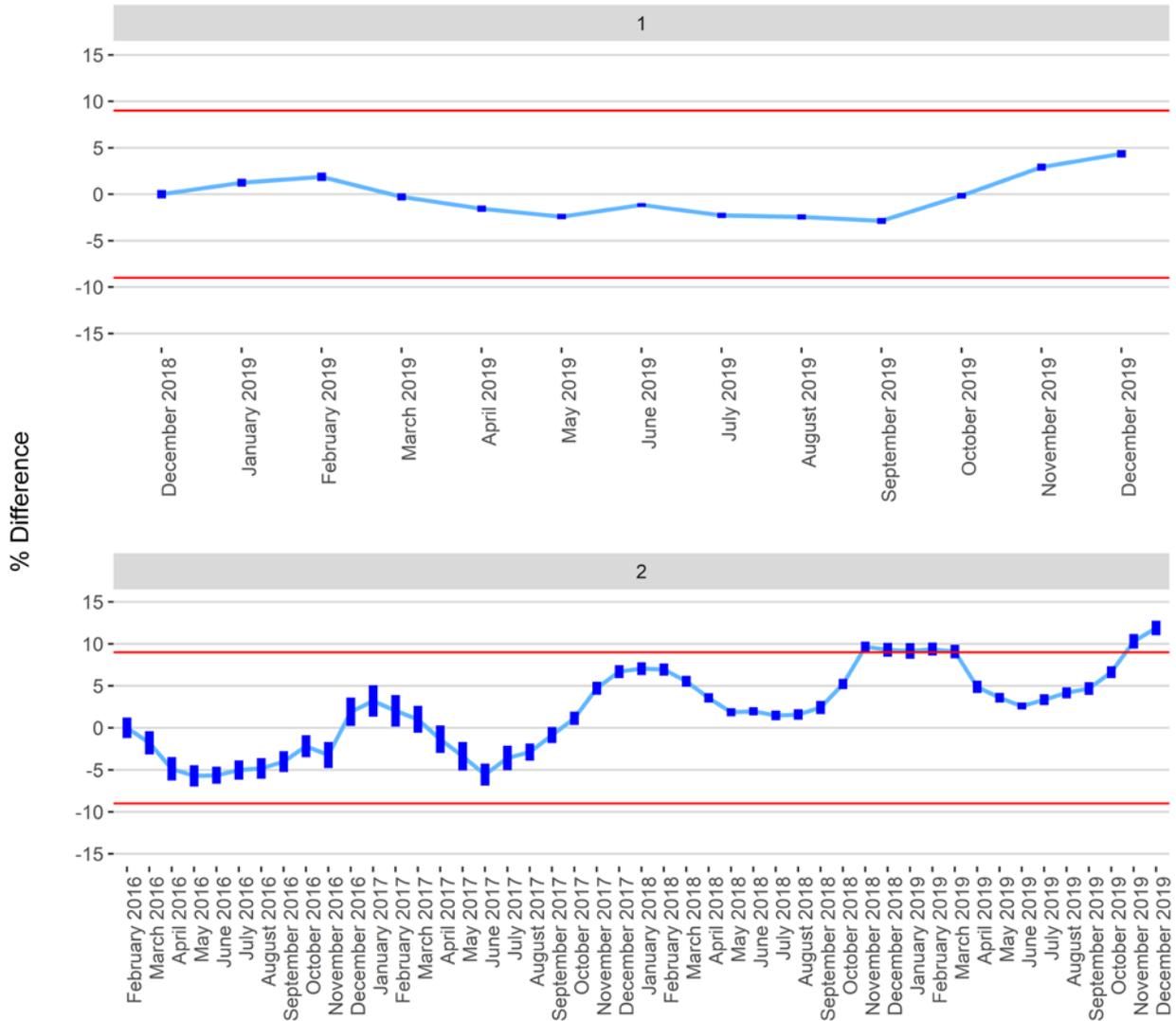
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Figure 1 - Monthly Class 9 GVW Histogram



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

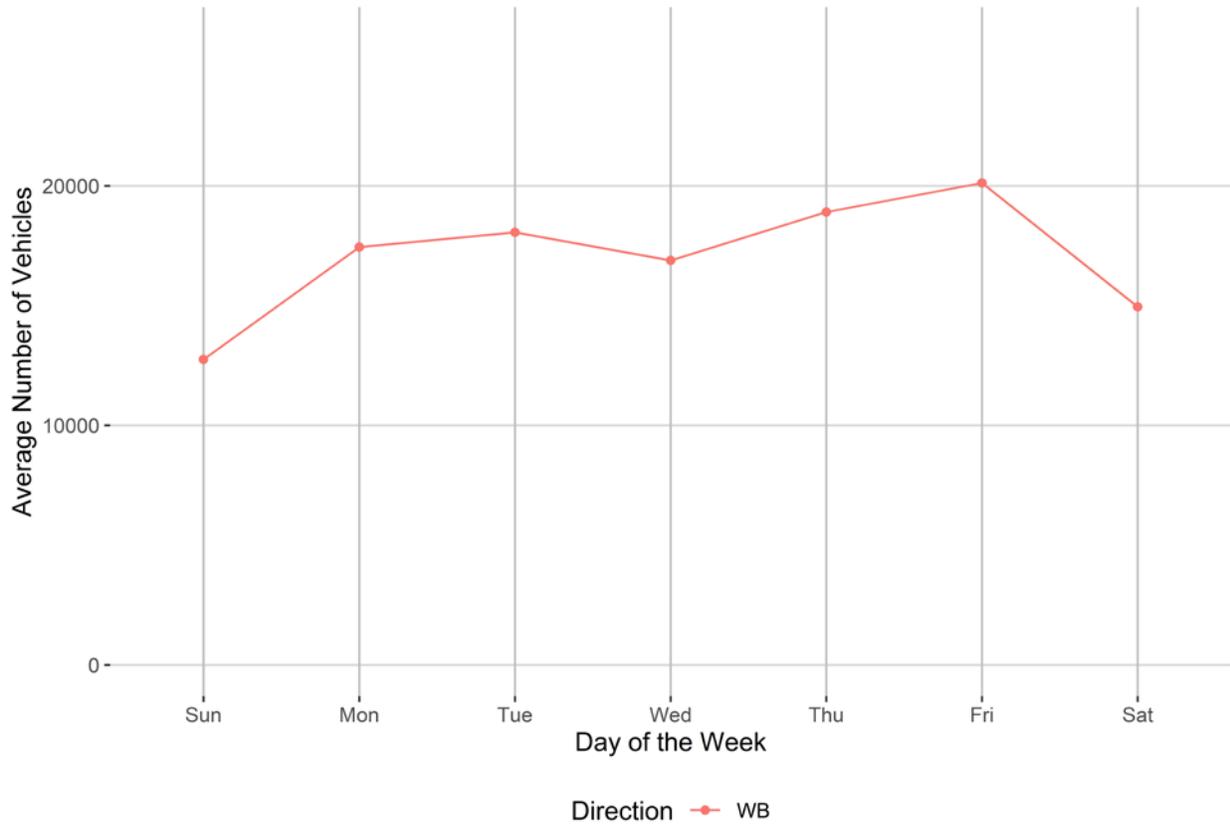


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

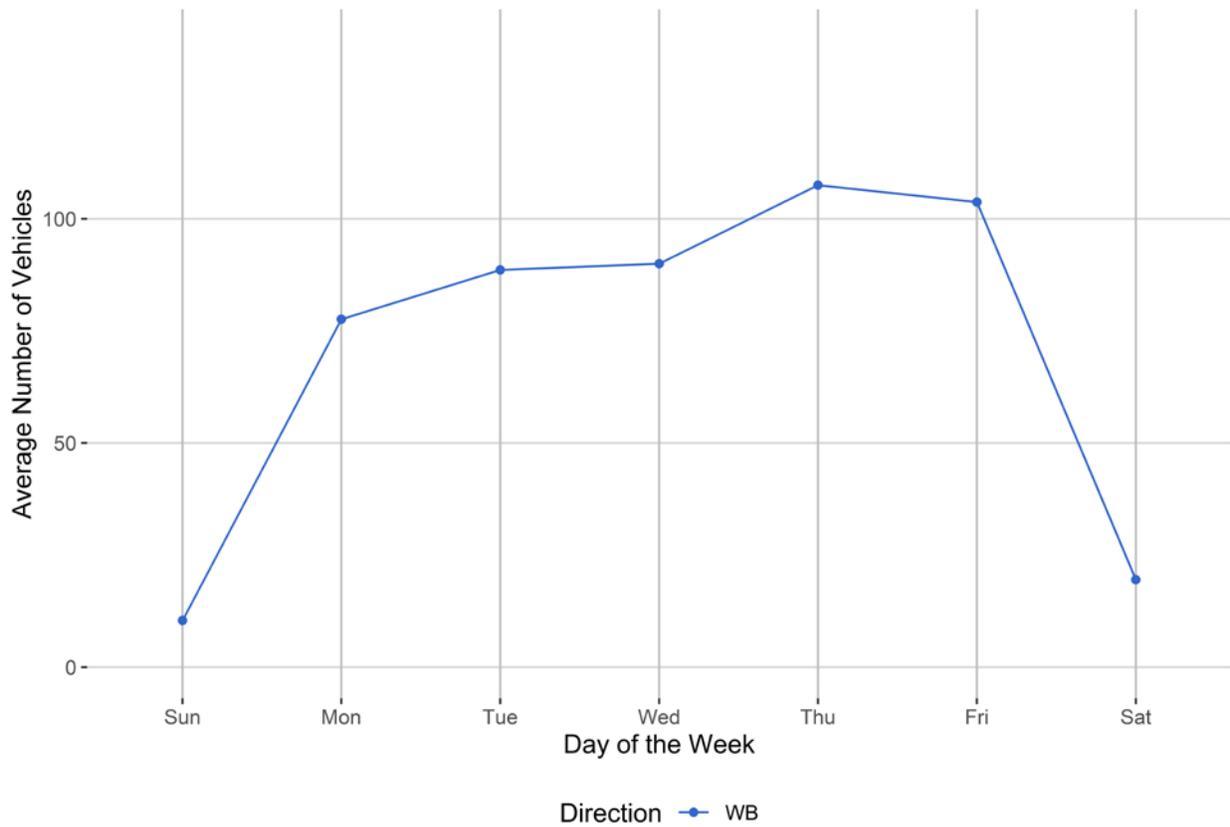


Figure 4 - Passenger Vehicles vs. Hour of the Day

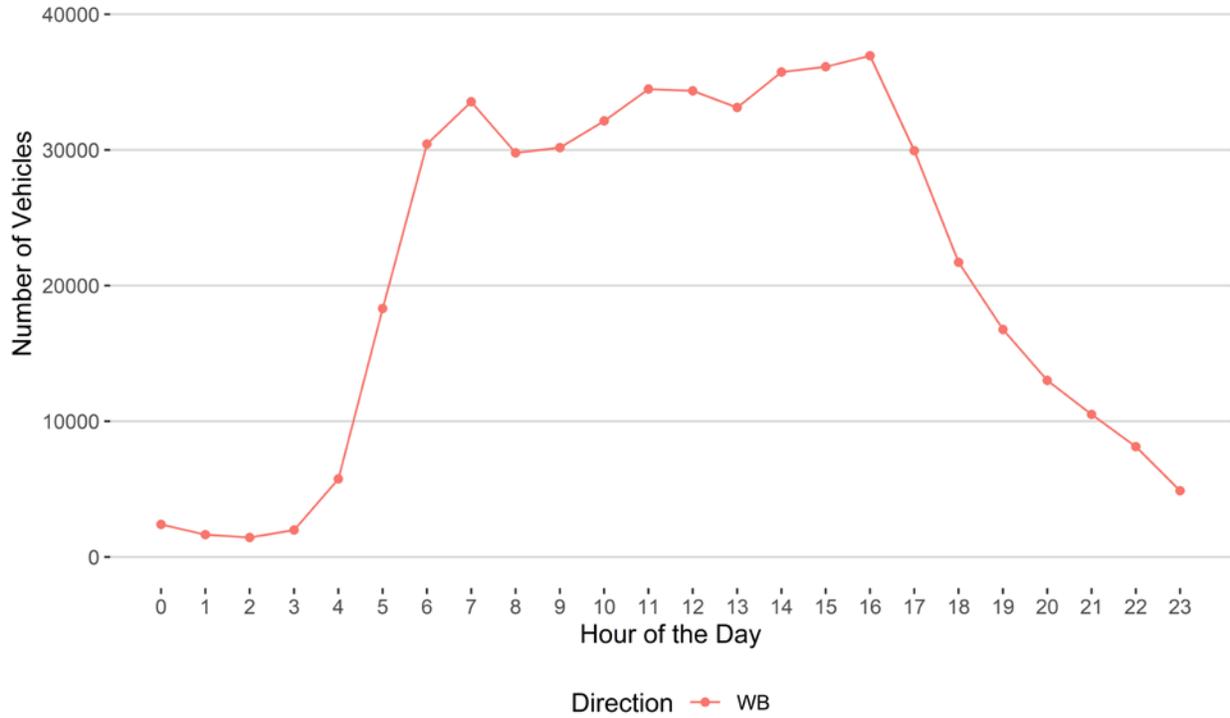


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

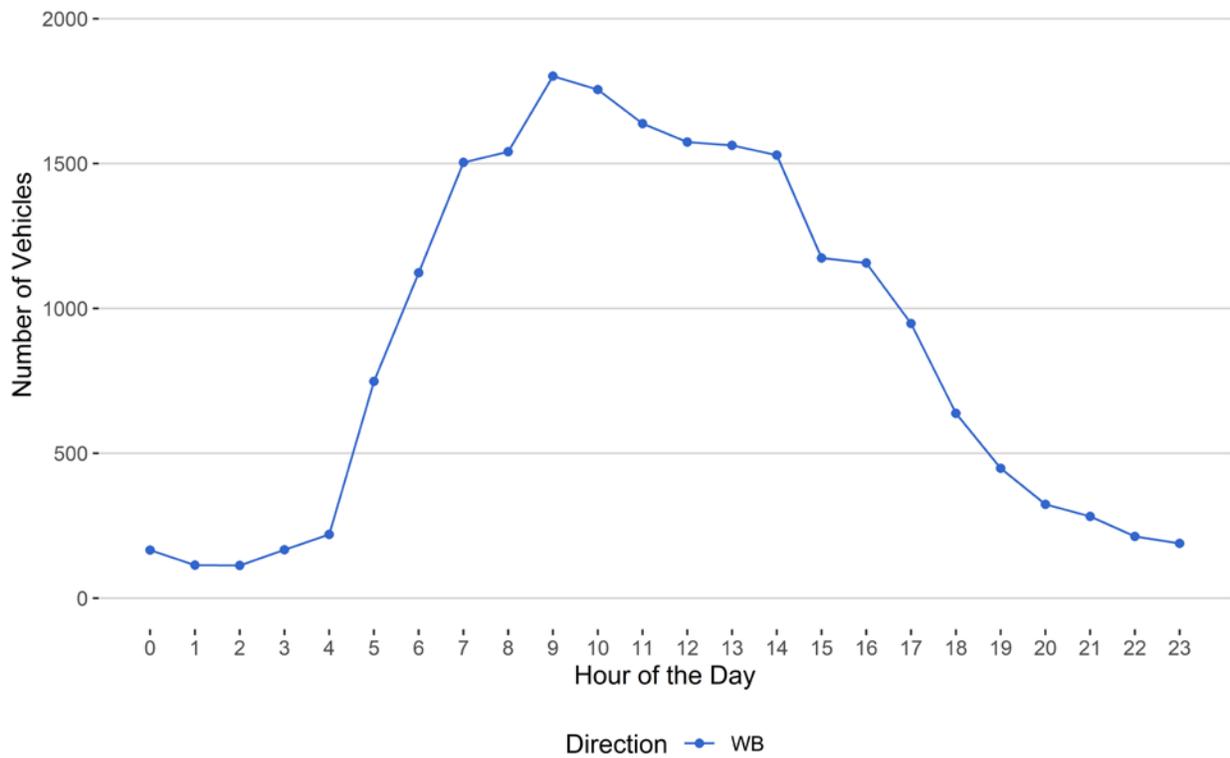


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

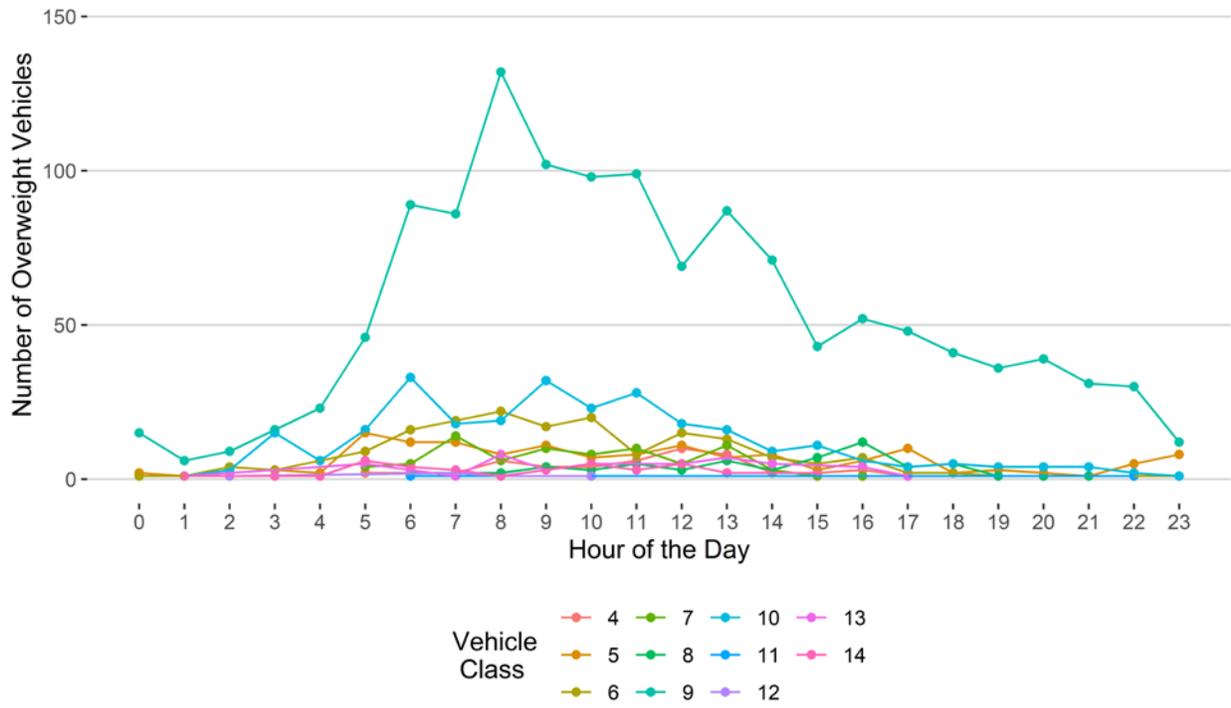


Figure 7 - Overweight Vehicles by Direction  
Hour of the Day

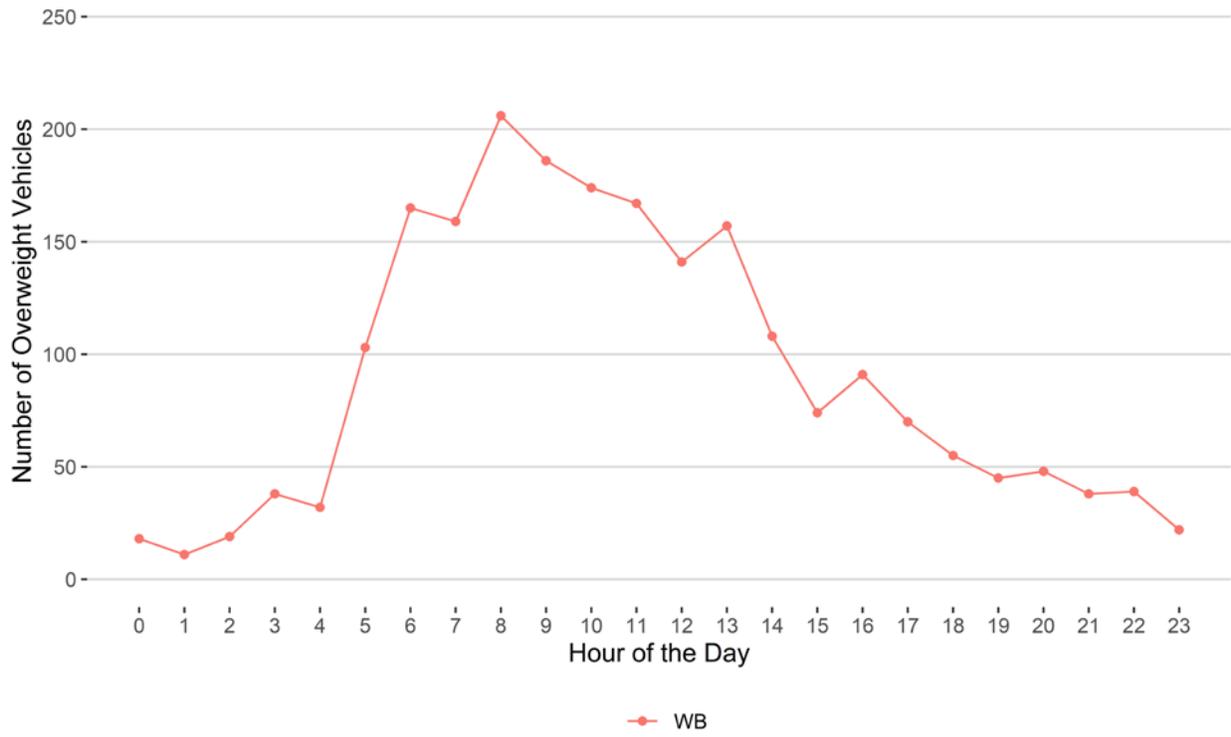
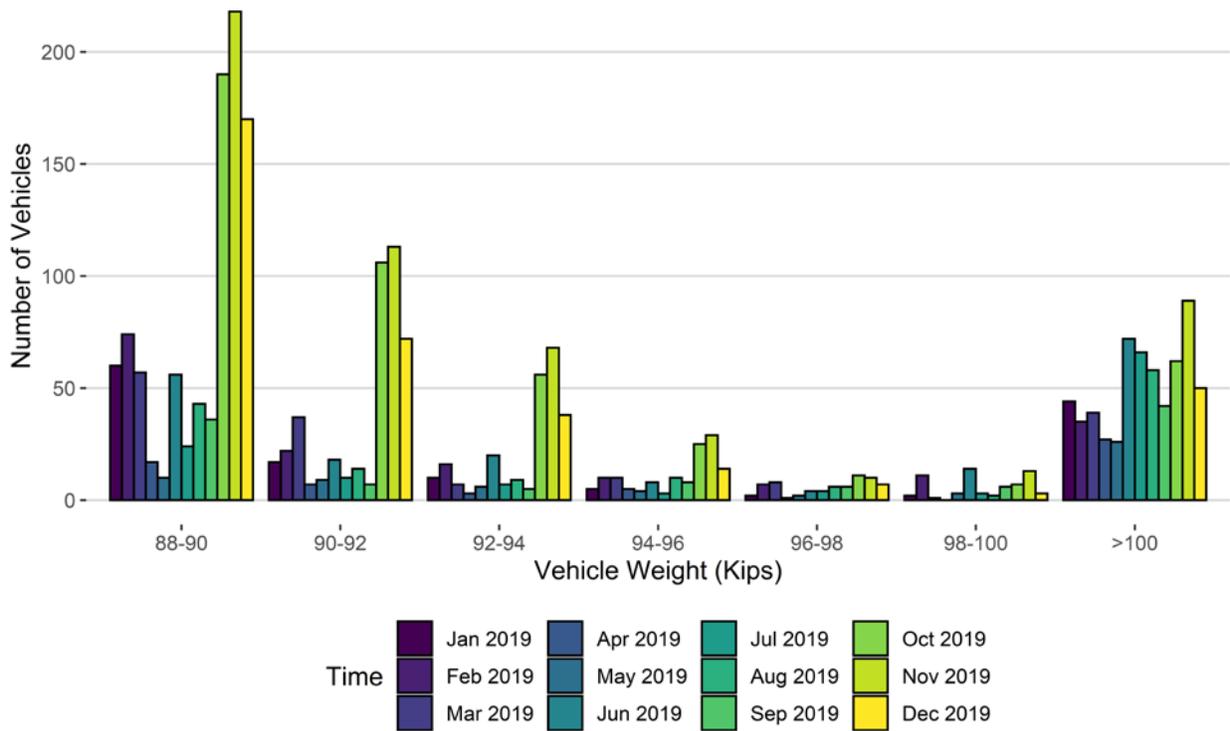


Figure 8 - Histogram of Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Jan 2019	Feb 2019	Mar 2019	Apr 2019	May 2019	Jun 2019	Jul 2019	Aug 2019	Sep 2019	Oct 2019	Nov 2019	Dec 2019
88-90	60	74	57	17	10	56	24	43	36	190	218	170
90-92	17	22	37	7	9	18	10	14	7	106	113	72
92-94	10	16	7	3	6	20	7	9	5	56	68	38
94-96	5	10	10	5	4	8	3	10	8	25	29	14
96-98	2	7	8	1	2	4	4	6	6	11	10	7
98-100	2	11	1	0	3	14	3	2	6	7	13	3
>100	44	35	39	27	26	72	66	58	42	62	89	50
Total	140	175	159	60	60	192	117	142	110	457	540	354

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

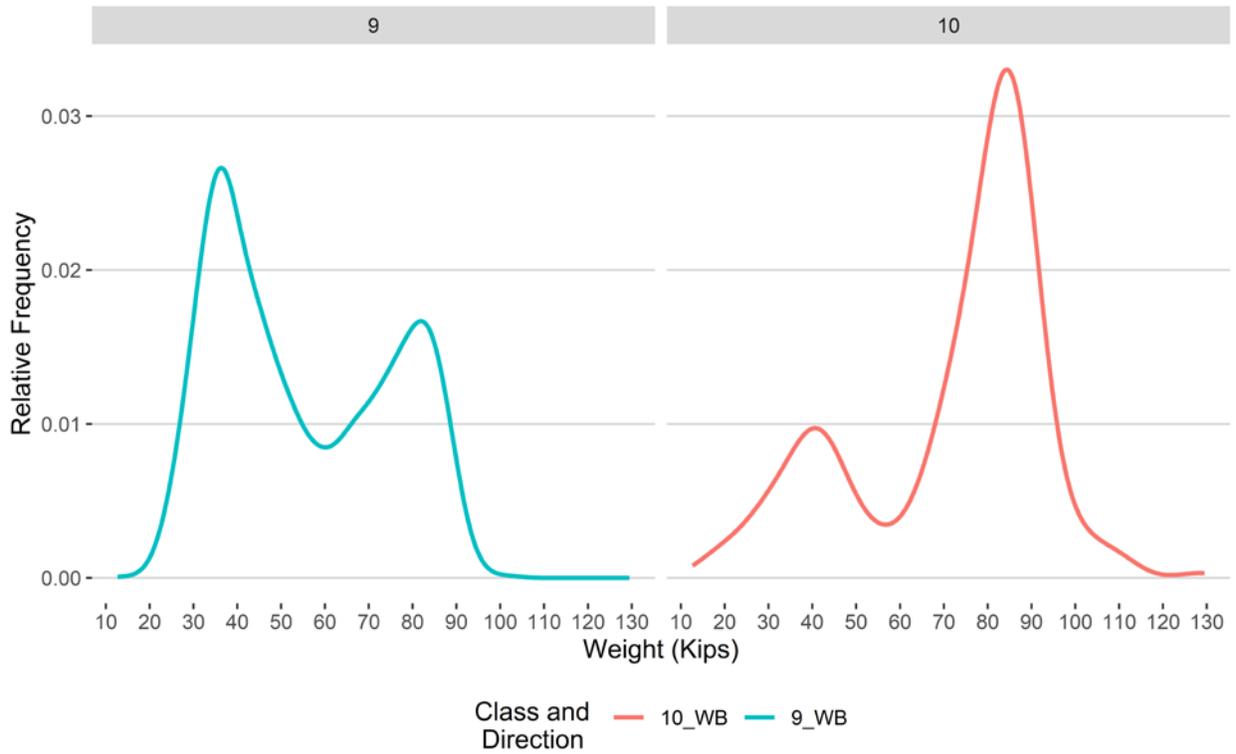
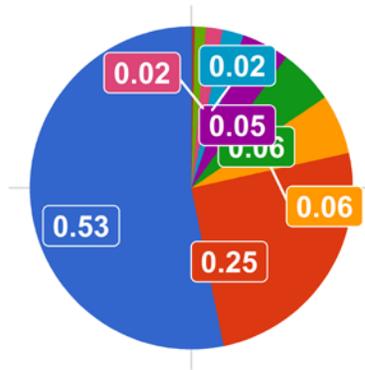


Figure 9 - Freight Percentage by Direction and Class

WB



Vehicle Class	a	9	a	6	a	8	a	7	a	12
	a	5	a	10	a	4	a	13	a	11

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

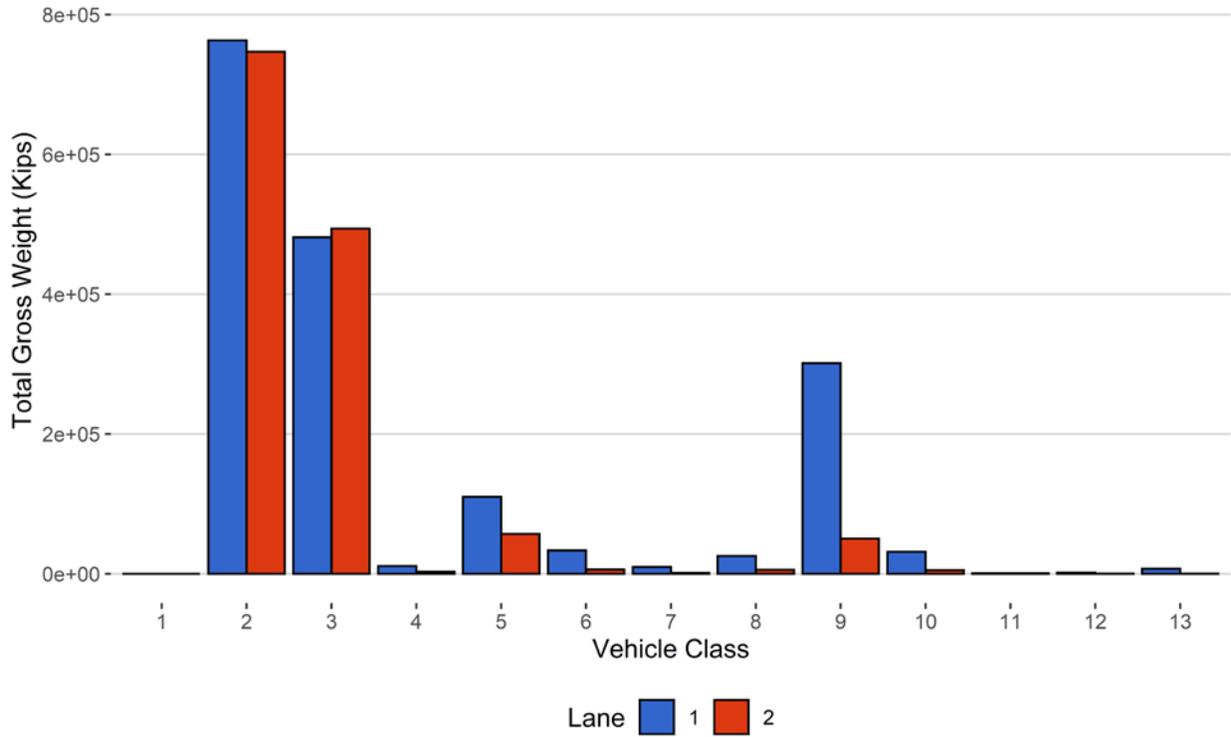


Figure 11 - Total Gross Vehicle Weight t

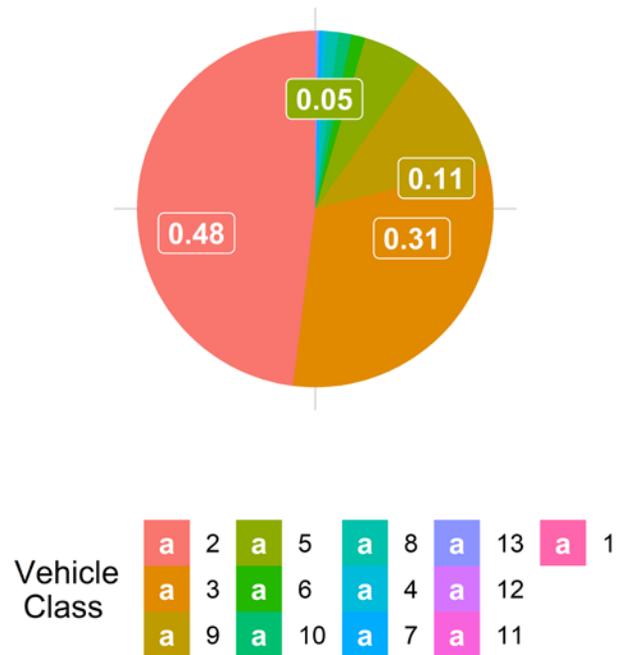


Figure 12 - Total ESALs by Class and Lane

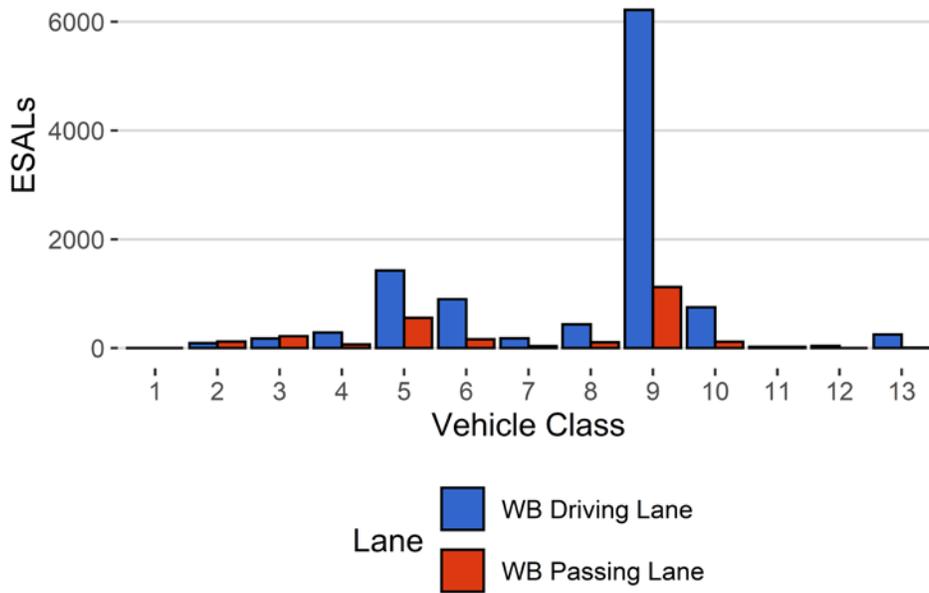
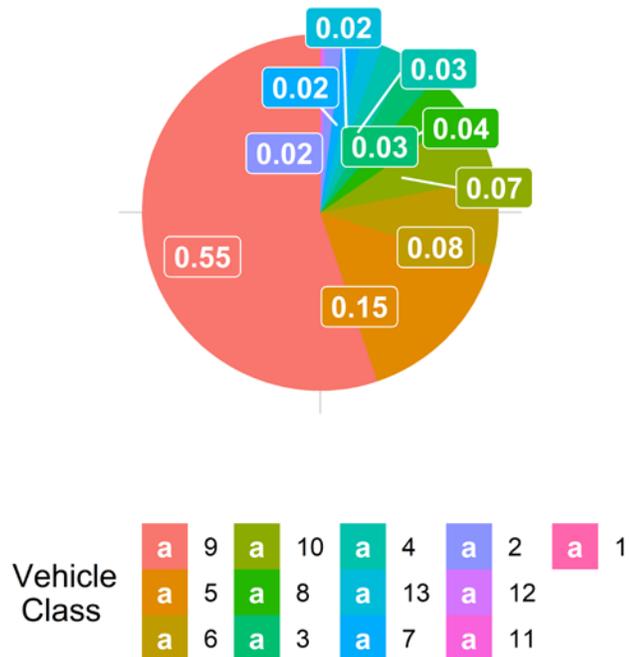


Figure 13 - ESALs by Class



**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	NA	NA	10.50	0.00
March 2016	NA	NA	10.31	-1.79
April 2016	NA	NA	9.99	-4.88
May 2016	NA	NA	9.90	-5.72
June 2016	NA	NA	9.90	-5.65
July 2016	NA	NA	9.97	-5.03
August 2016	NA	NA	9.99	-4.84
September 2016	NA	NA	10.08	-4.03
October 2016	NA	NA	10.27	-2.18
November 2016	NA	NA	10.16	-3.24
December 2016	NA	NA	10.70	1.90
January 2017	NA	NA	10.83	3.19
February 2017	NA	NA	10.71	2.03
March 2017	NA	NA	10.60	1.01
April 2017	NA	NA	10.36	-1.35
May 2017	NA	NA	10.14	-3.38
June 2017	NA	NA	9.91	-5.57
July 2017	NA	NA	10.12	-3.59
August 2017	NA	NA	10.19	-2.89
September 2017	NA	NA	10.41	-0.87
October 2017	NA	NA	10.62	1.15
November 2017	NA	NA	10.99	4.72
December 2017	NA	NA	11.20	6.70
January 2018	NA	NA	11.24	7.04
February 2018	NA	NA	11.23	6.94
March 2018	NA	NA	11.08	5.54
April 2018	NA	NA	10.87	3.56
May 2018	NA	NA	10.69	1.85
June 2018	NA	NA	10.70	1.96
July 2018	NA	NA	10.65	1.48
August 2018	NA	NA	10.66	1.58
September 2018	NA	NA	10.75	2.42
October 2018	NA	NA	11.05	5.22
November 2018	NA	NA	11.51	9.65
December 2018	11.51	0.00	11.47	9.29
January 2019	11.65	1.23	11.46	9.15
February 2019	11.72	1.87	11.48	9.37
March 2019	11.48	-0.29	11.45	9.08
April 2019	11.33	-1.56	11.01	4.87

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May 2019	11.23	-2.42	10.87	3.58
June 2019	11.38	-1.16	10.77	2.59
July 2019	11.25	-2.28	10.85	3.35
August 2019	11.23	-2.46	10.94	4.17
September 2019	11.18	-2.87	10.99	4.69
October 2019	11.49	-0.16	11.19	6.63
November 2019	11.85	2.93	11.58	10.30
December 2019	12.01	4.36	11.75	11.89

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**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	11811	366140	67.2	0	0
3	5071	157216	28.8	0	0
4	15	462	0.1	53	2.5
5	375	11616	2.1	149	7
6	37	1153	0.2	174	8.2
7	6	182	0	78	3.7
8	33	1025	0.2	61	2.9
9	214	6637	1.2	1280	60.1
10	17	526	0.1	278	13.1
11	0	9	0	3	0.1
12	1	28	0	5	0.2
13	3	83	0	48	2.3
<b>TOTAL</b>	<b>17583</b>	<b>545079</b>	<b>100</b>	<b>2129</b>	<b>100</b>

**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>
2019-12-18	Wednesday	17:46:11	10	WB	1	129.5
2019-12-09	Monday	12:49:43	10	WB	1	127.98
2019-12-27	Friday	11:20:40	10	WB	2	111.86
2019-12-09	Monday	06:01:25	10	WB	1	111.46
2019-12-31	Tuesday	10:04:39	10	WB	1	110.9
2019-12-27	Friday	07:04:49	10	WB	2	110.65
2019-12-20	Friday	05:17:48	10	WB	1	109.34
2019-12-06	Friday	10:54:39	10	WB	1	109.03
2019-12-24	Tuesday	09:04:03	10	WB	1	108.48
2019-12-23	Monday	06:19:50	10	WB	1	107.64

**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	445	63	14.2	13264	815	3767
5	WB	8	11193	558	5	162972	4007	38946
6	WB	19	1111	75	6.8	38374	1264	9345
7	WB	11.5	175	0	0	10891	0	4439
8	WB	31	988	457	46.3	20941	10324	2240
9	WB	33	6395	836	13.1	327144	24475	71848
10	WB	33.5	507	35	6.9	35626	916	9907
11	WB	36.5	9	0	0	630	0	151
12	WB	36.5	27	0	0	1715	0	365
13	WB	31.5	80	0	0	7434	0	2457
<b>TOTAL</b>	<b>****</b>	<b>****</b>	<b>20930</b>	<b>2024</b>	<b>****</b>	<b>618991</b>	<b>****</b>	<b>143465</b>

**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	1	1	1	0
2	763103	746792	1509895	48
3	481324	493777	975101	31
4	11030	3050	14079	0.4
5	110032	56947	166979	5.3
6	33531	6107	39638	1.3
7	9593	1298	10891	0.3
8	25546	5719	31265	1
9	301304	50315	351619	11.2
10	31421	5121	36541	1.2
11	630	0	630	0
12	1576	139	1715	0.1
13	7205	230	7434	0.2
<b>TOTAL</b>	<b>1776293</b>	<b>1369495</b>	<b>3145788</b>	<b>100</b>
<b>GVW/LANE</b>	<b>56.47</b>	<b>43.53</b>	<b>100</b>	<b>0</b>

**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	94	120	214	1.6	0.0012
3	179	218	397	3	0.0053
4	286	67	353	2.6	1.59
5	1427	558	1985	14.9	0.36
6	900	162	1062	8	1.91
7	181	36	216	1.6	2.42
8	437	106	543	4.1	1.1
9	6216	1122	7338	55.2	2.3
10	750	116	867	6.5	3.38
11	22	0	22	0.2	2.77
12	39	2	41	0.3	2.4
13	251	10	261	2	5.77
<b>TOTAL</b>	<b>10782</b>	<b>2517</b>	<b>13299</b>	<b>100</b>	<b>24</b>
<b>ESALS/LANE</b>	<b>81.1</b>	<b>18.9</b>	<b>100</b>	-	-

**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>
Jan 2019	495367	15980	561	477966	96.5	17401.3	3.5
Feb 2019	436896	15603	631	419227	96	17668.9	4
Mar 2019	516795	16671	611	497869	96.3	18926.3	3.7
Apr 2019	550362	18345	741	528132	96	22229.5	4
May 2019	620748	39752	926	592045	95.4	28702.5	4.6
Jun 2019	635004	21167	936	606916	95.6	28087.5	4.4
Jul 2019	657610	21213	957	627954	95.5	29656.5	4.5
Aug 2019	660942	21321	969	630896	95.5	30046.3	4.5
Sep 2019	607530	20251	887	580930	95.6	26599.9	4.4
Oct 2019	621342	20043	966	591411	95.2	29931.2	4.8
Nov 2019	536573	17886	785	513012	95.6	23560.7	4.4
Dec 2019	545079	17583	701	523358	96	21721	4
<b>TOTAL</b>	<b>6884248</b>	-	-	<b>6589716</b>	-	<b>294532</b>	-
<b>AVERAGE</b>	<b>573687</b>	<b>20485</b>	<b>806</b>	<b>549143</b>	<b>96</b>	<b>24544</b>	<b>4</b>

###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>
Jan 2019	7975	1784	9759	4.1
Feb 2019	7841	2152	9993	6.1
Mar 2019	8602	2101	10703	5.2
Apr 2019	10824	1999	12823	1
May 2019	15775	2934	18709	0.7
Jun 2019	33206	5496	38701	1.3
Jul 2019	16639	2943	19581	1.1
Aug 2019	18019	3022	21042	1.6
Sep 2019	13453	2712	16165	1.4
Oct 2019	16988	3215	20203	6.8
Nov 2019	13748	2602	16349	11.6
Dec 2019	10929	2552	13481	9.4
<b>TOTAL</b>	<b>173999</b>	-	-	-
<b>AVERAGE</b>	<b>14500</b>	<b>2792</b>	<b>17292</b>	<b>4</b>

###Gross Vehicle Weight

<i>Month</i>	<i>GVW WB Driving Lane</i>	<i>GVW WB Passing Lane</i>	<i>Total GVW Kips</i>
Jan 2019	1556468	1153319	2709787
Feb 2019	1413706	1050516	2464222

Mar 2019	1614148	1220912	2835061
Apr 2019	1792921	1303199	3096120
May 2019	2137126	1551629	3688754
Jun 2019	4374135	3175408	7549543
Jul 2019	2251469	1643482	3894952
Aug 2019	2302547	1646186	3948733
Sep 2019	2011831	1491947	3503778
Oct 2019	2201056	1575122	3776178
Nov 2019	1849859	1355587	3205447
Dec 2019	1779936	1372947	3152883
<b>TOTAL</b>	<b>25285202</b>	<b>18540255</b>	<b>43825457</b>
<b>AVERAGE</b>	<b>2107100</b>	<b>1545021</b>	<b>3652121</b>

### ###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>
Jan 2019	1371	0.3	8	140	46
Feb 2019	1436	0.3	8.2	176	46
Mar 2019	1444	0.3	7.7	159	40
Apr 2019	1251	0.2	5.7	60	27
May 2019	1959	0.3	7	61	29
Jun 2019	4272	0.3	7.7	192	86
Jul 2019	2437	0.4	8.4	117	69
Aug 2019	2967	0.5	10.1	145	61
Sep 2019	2043	0.3	7.9	110	48
Oct 2019	3372	0.6	11.6	462	70
Nov 2019	2843	0.6	12.3	542	102
Dec 2019	2166	0.4	10.1	362	53
<b>TOTAL</b>	<b>27561</b>	<b>-</b>	<b>-</b>	<b>2526</b>	<b>677</b>
<b>AVERAGE</b>	<b>2296.8</b>	<b>0.4</b>	<b>8.7</b>	<b>210.5</b>	<b>56.4</b>

### ###Freight

<i>Month</i>	<i>WB Freight Tons</i>
Jan 2019	106411
Feb 2019	106822
Mar 2019	119391
Apr 2019	164005
May 2019	245693
Jun 2019	497296
Jul 2019	242222

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Aug 2019	259378
Sep 2019	196459
Oct 2019	240476
Nov 2019	177099
Dec 2019	143465
<b>TOTAL</b>	<b>2498717</b>
<b>AVERAGE</b>	<b>208226.4</b>

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