

JULY 2018



**WIM #33
US 212, MP 78.5
OLIVIA, MN**

**MONTHLY
REPORT**



Your Destination...Our Priority



WIM Site Location

WIM #33 is located on US 212 near Olivia in Renville county.

System Operation

WIM #33 was operational for the entire month of July 2018. Volume was computed using all monthly data.

System Calibration

WIM #33 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 within +/- 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: 158910 | Passenger Vehicles: 138715 | Heavy Commercial Vehicles: 20195

Monthly Average Daily Traffic (MADT): 5126 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 651

See Table 2 for vehicle class breakdown

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

Volume trends. EB vehicles typically reached highest volume levels on Sundays, with lowest volumes reported on Wednesdays. WB vehicles typically reached highest volume levels on Fridays, with lowest volumes reported on Wednesdays (see Figure 3 and 4).

Passenger Vehicles (PVs)

Volume trends. On an average 24-hour day (see Figure 5), EB PVs generally reached peak volume levels between 03 PM and 05 PM. Similarly, WB PVs peaked in volume between 12 PM and 05 PM

Heavy Commercial Vehicles (HCVs)

Volume trends. On an average 24-hour day, HCVs traveling EB typically reached peak volume levels between 03 PM and 05 PM, while volume going WB peaked between 12 PM and 05 PM. 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 20195 HCVs, 1667 of them were overweight³. These overweight HCVs contributed to 1.1% of total monthly volume, and 8.3% of total monthly HCV volume. EB overweight vehicles typically reached highest numbers on Tuesdays, with lowest volumes reported on Saturdays. WB overweight vehicles tended to reach highest volumes on Mondays, with lowest volumes reported on Saturdays. 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 73.4% of all overweight vehicles traveling EB 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 December.

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 ,310 EB vehicles exceeded 88,000 pounds (226 vehicles were Class 13's; 55 vehicles were Class 10's). Of vehicles traveling WB,

57 EB vehicles exceeded 88,000 pounds (39 vehicles were Class 13's; 10 vehicles were Class 10's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from July 2018.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9s and 10s in July 2018. Data suggests that there were greater numbers of fully_loaded Class 9's than empty Class 9's traveling EB, while there were more fully_loaded Class 9's than empty traveling WB. Data also suggests that there were more fully_loaded Class 10's than empty traveling in the EB direction. In the WB direction, there were more fully_loaded class 10 vehicles.

Freight Totals. A total of 177372 tons of freight was recorded to have crossed the WIM. More freight was shipped EB (54%) than WB (46%). See Table 4 and Figure 11 for more freight information.

Infrastructure Considerations

Bridge. Bridge No. 6299 (a box culvert) is approximately 13.4 miles east of WIM #33, and Bridge No. 96640 (a box culvert) is 2.5 miles west of WIM #33. WIM #33 recorded a total of 158910 vehicles with a combined GVW of 1556948 kips (1 kip = 1,000 pounds = 0.5 tons) in July 2018. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 15054 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 54.6% of all ESALs were recorded EB while 45.4% was observed WB. In particular, 76% of all ESALs were generated by the Class 9's (Class 9's were also responsible for generating 43% 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).

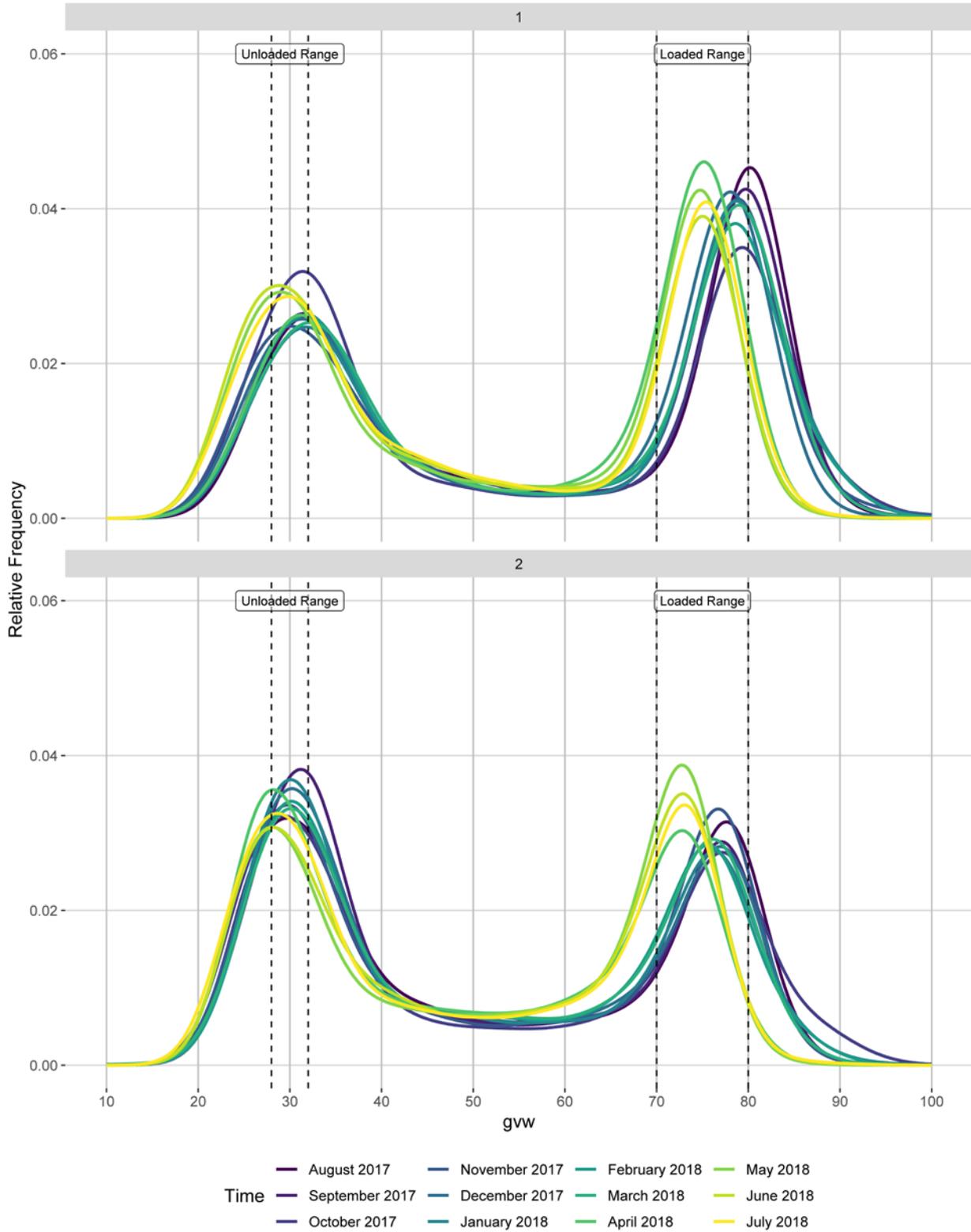
WIM monthly reports can be found at: <http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html>

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.

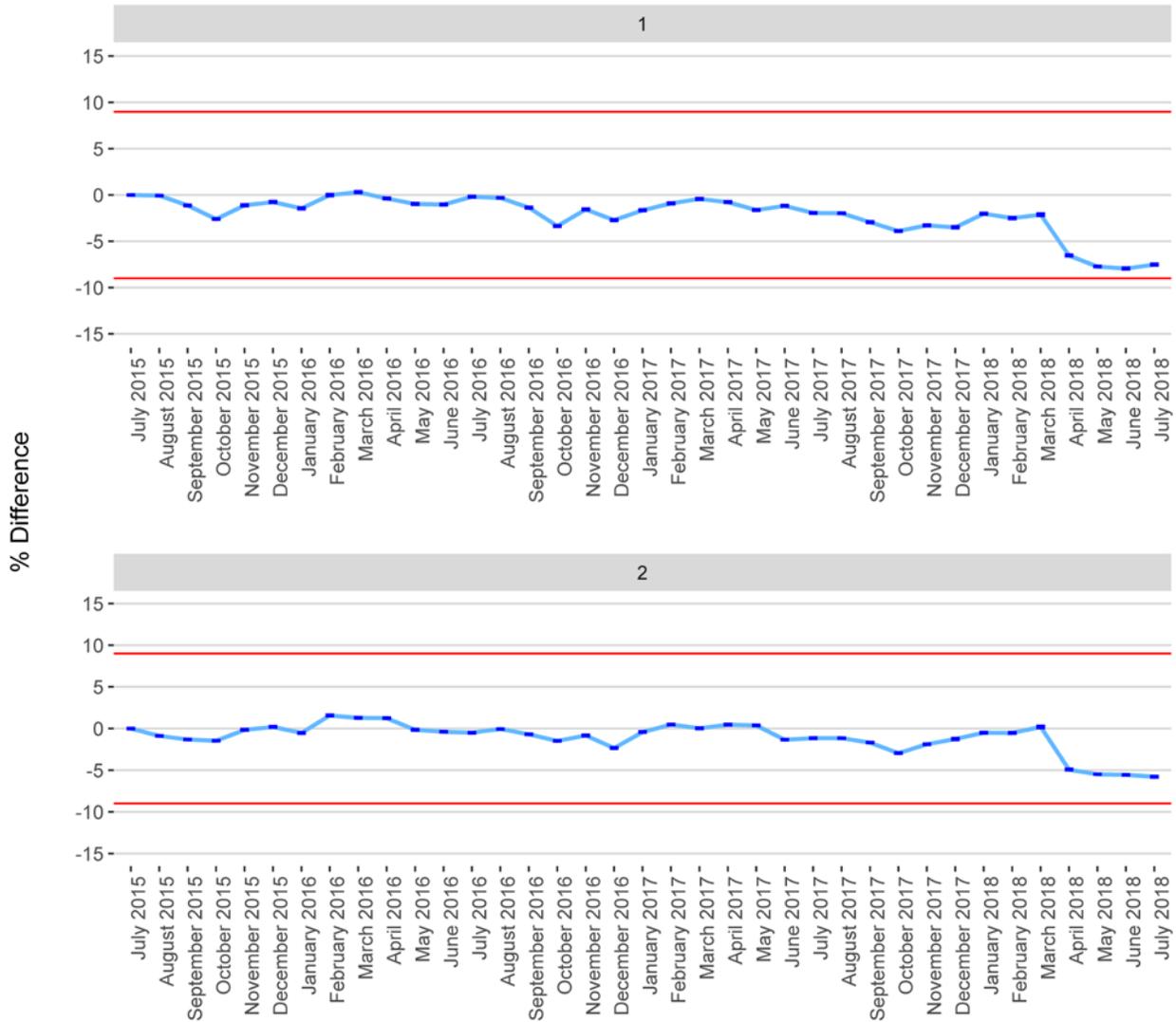
To request this document in an alternative format, please call 651-366-4718 or 1-800-657-3774, or email your request to ADArequest.dot@state.mn.us. Please request at least one week in advance.

Figure 1 - Monthly Class 9 GWW 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

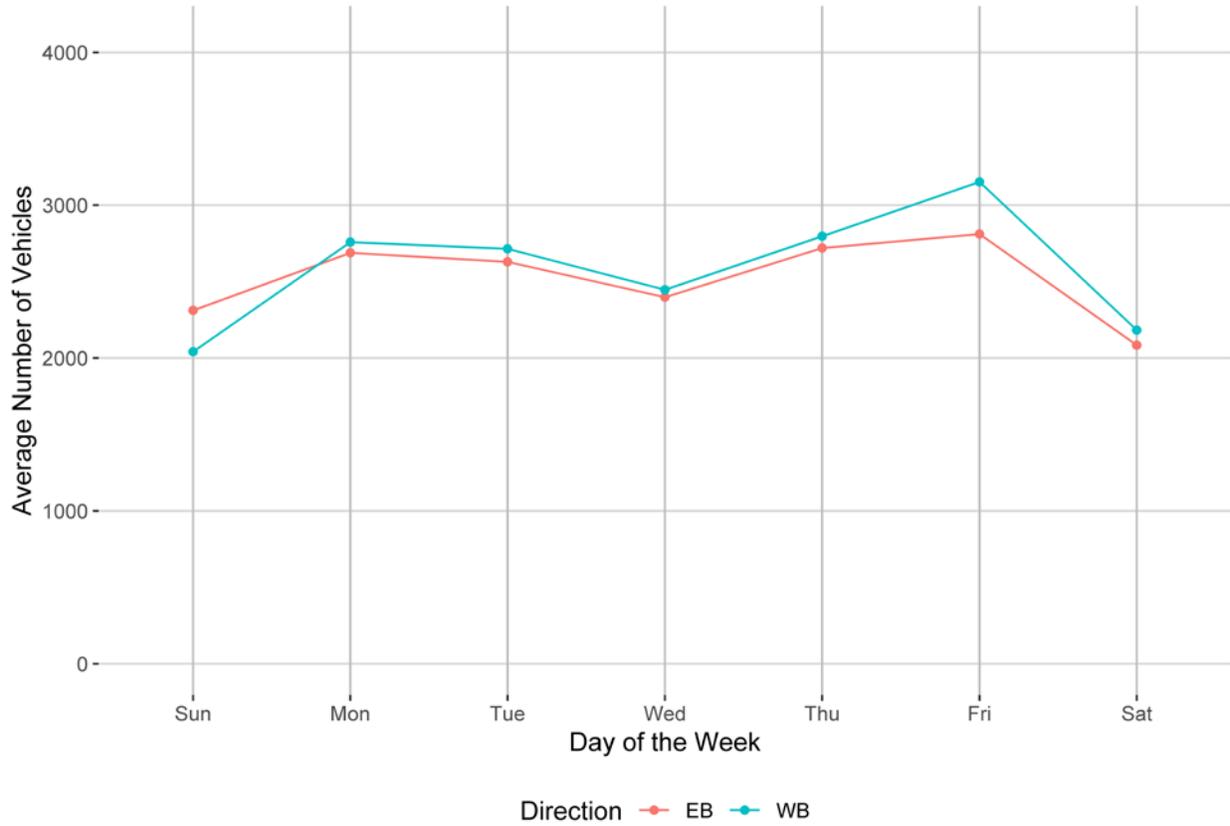


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

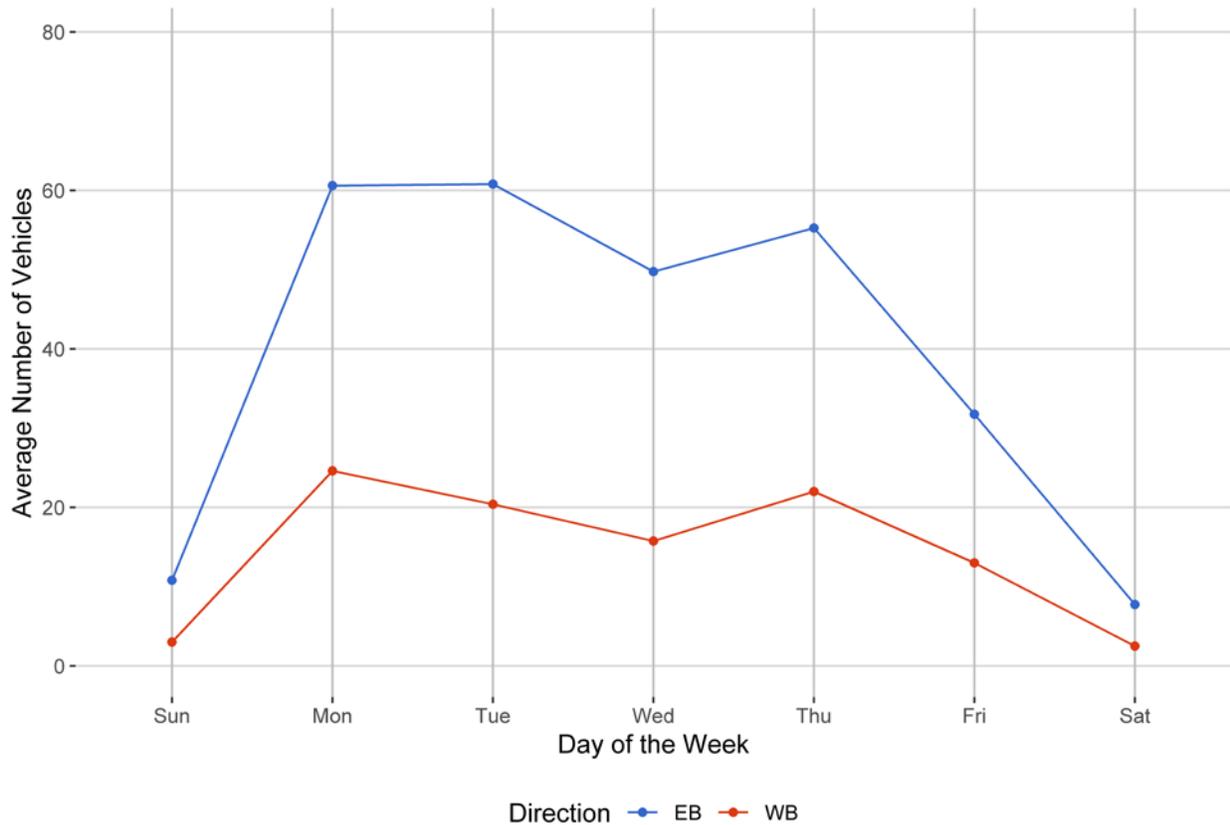


Figure 4 - Passenger Vehicles vs. Hour of the Day

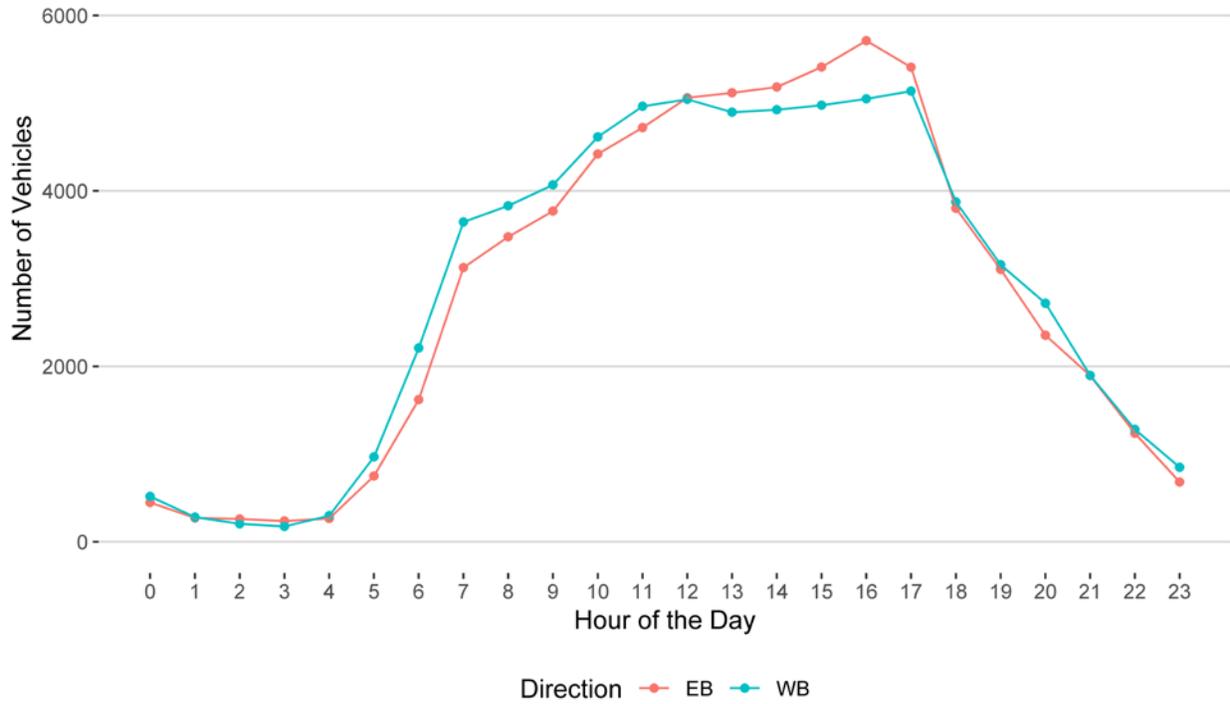


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

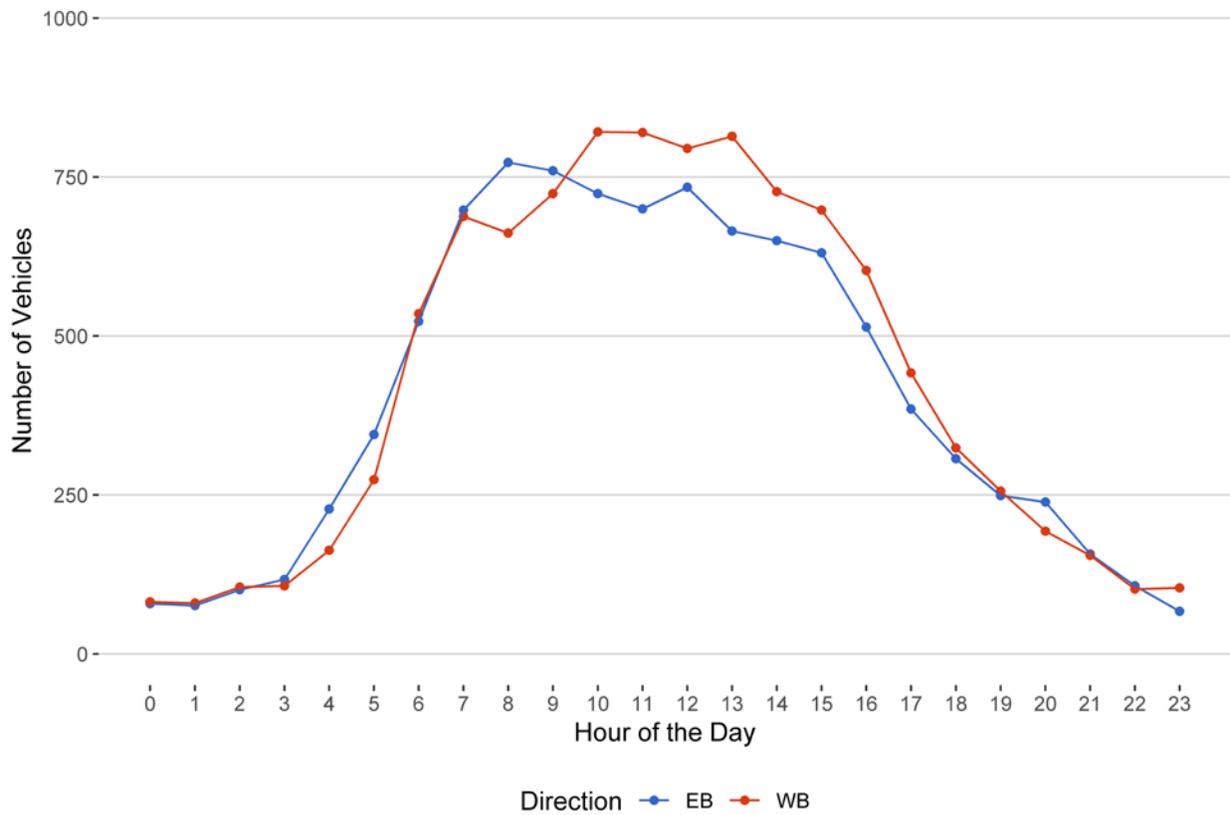


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

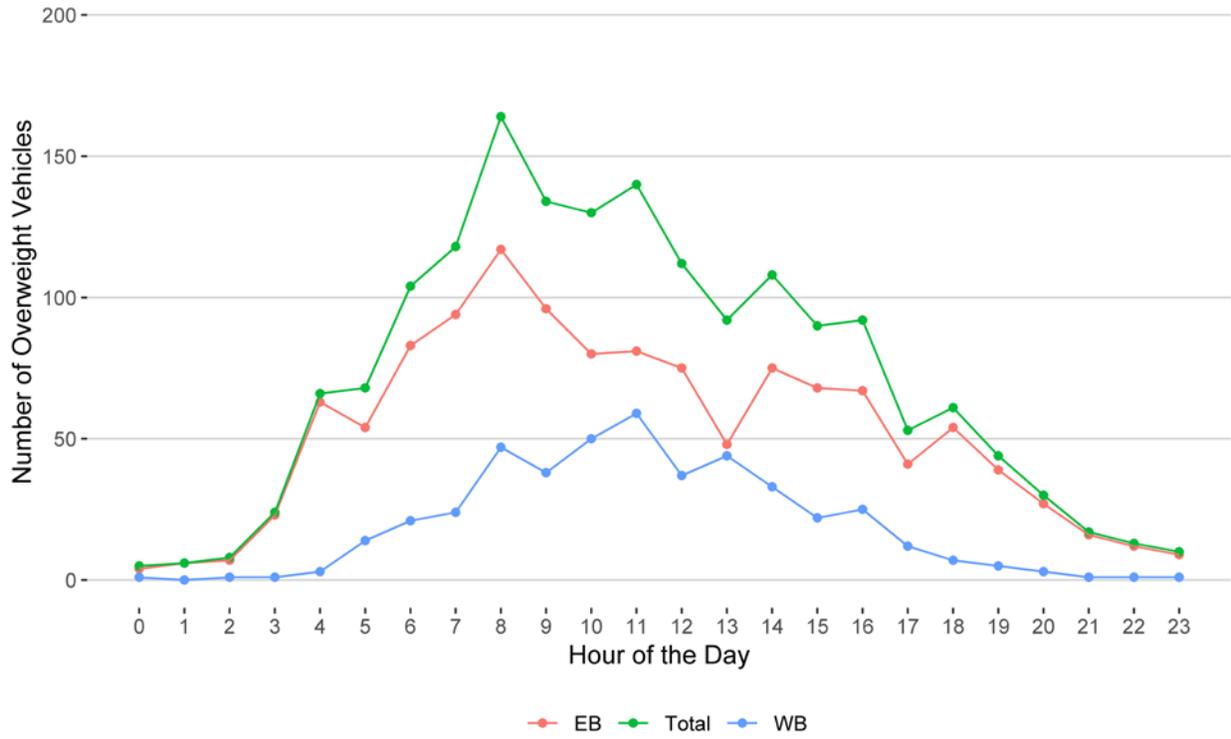
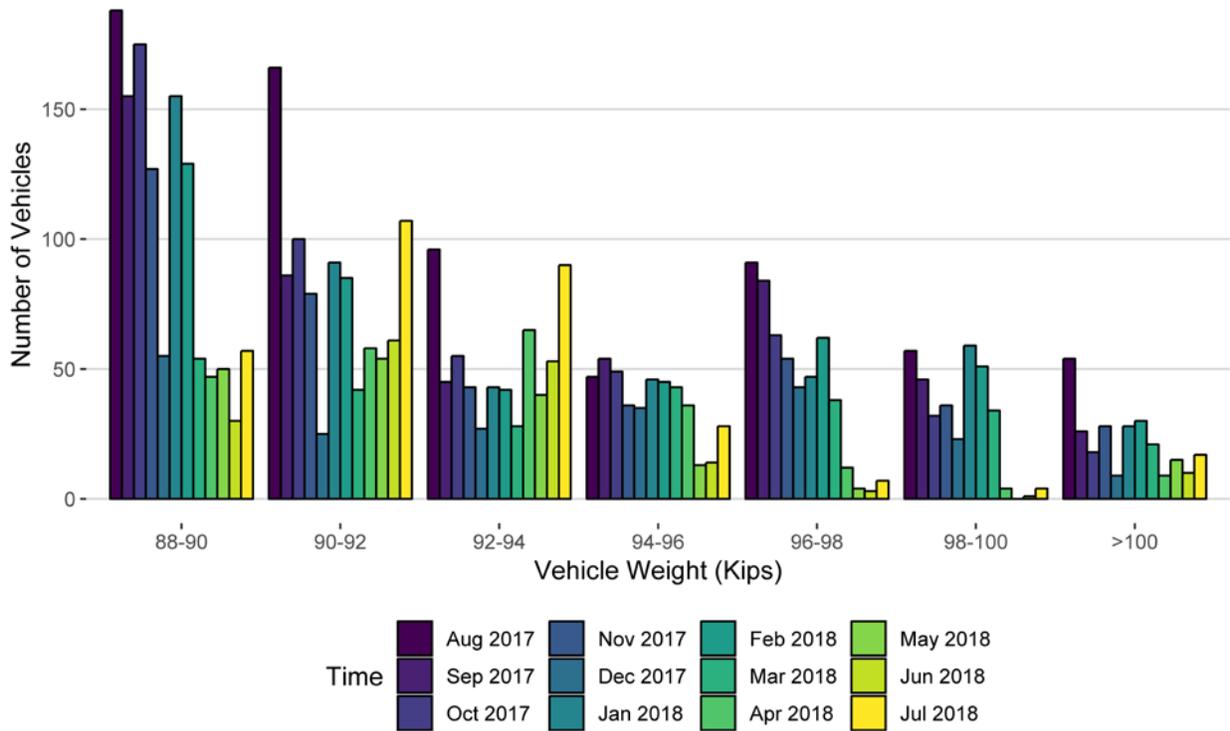
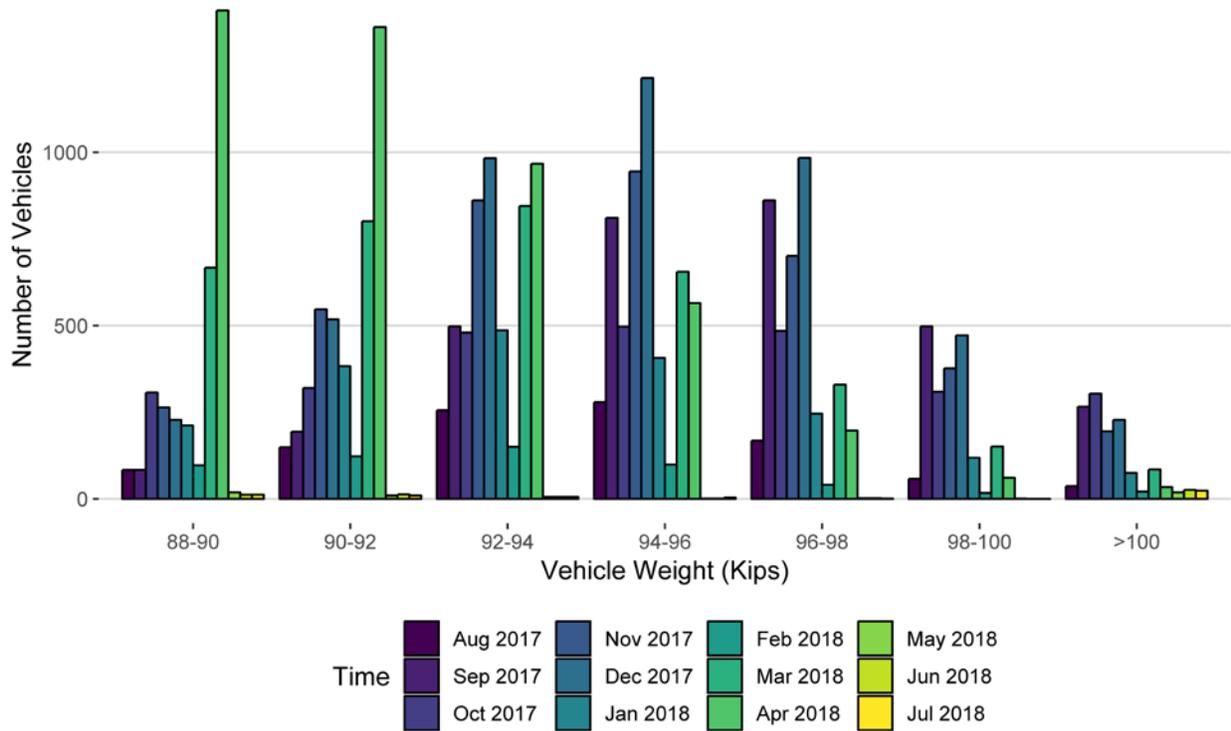


Figure 8 - Histogram of EB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Aug 2017	Sep 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018
88-90	188	155	175	127	55	155	129	54	47	50	30	57
90-92	166	86	100	79	25	91	85	42	58	54	61	107
92-94	96	45	55	43	27	43	42	28	65	40	53	90
94-96	47	54	49	36	35	46	45	43	36	13	14	28
96-98	91	84	63	54	43	47	62	38	12	4	3	7
98-100	57	46	32	36	23	59	51	34	4	0	1	4
>100	54	26	18	28	9	28	30	21	9	15	10	17
Total	699	496	492	403	217	469	444	260	231	176	172	310

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



Vehicle Weights (Kips)	Aug 2017	Sep 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018
88-90	84	84	307	264	228	212	97	667	1409	19	12	12
90-92	149	194	320	547	518	383	123	801	1361	10	13	10
92-94	256	498	480	861	983	486	150	845	967	6	6	6
94-96	279	811	497	945	1214	407	99	655	565	1	1	4
96-98	168	861	485	701	984	246	41	330	197	2	2	1
98-100	58	498	309	377	472	119	17	151	61	1	0	0
>100	37	266	304	195	228	75	21	85	34	19	26	24
Total	1031	3212	2702	3890	4627	1928	548	3534	4594	58	60	57

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

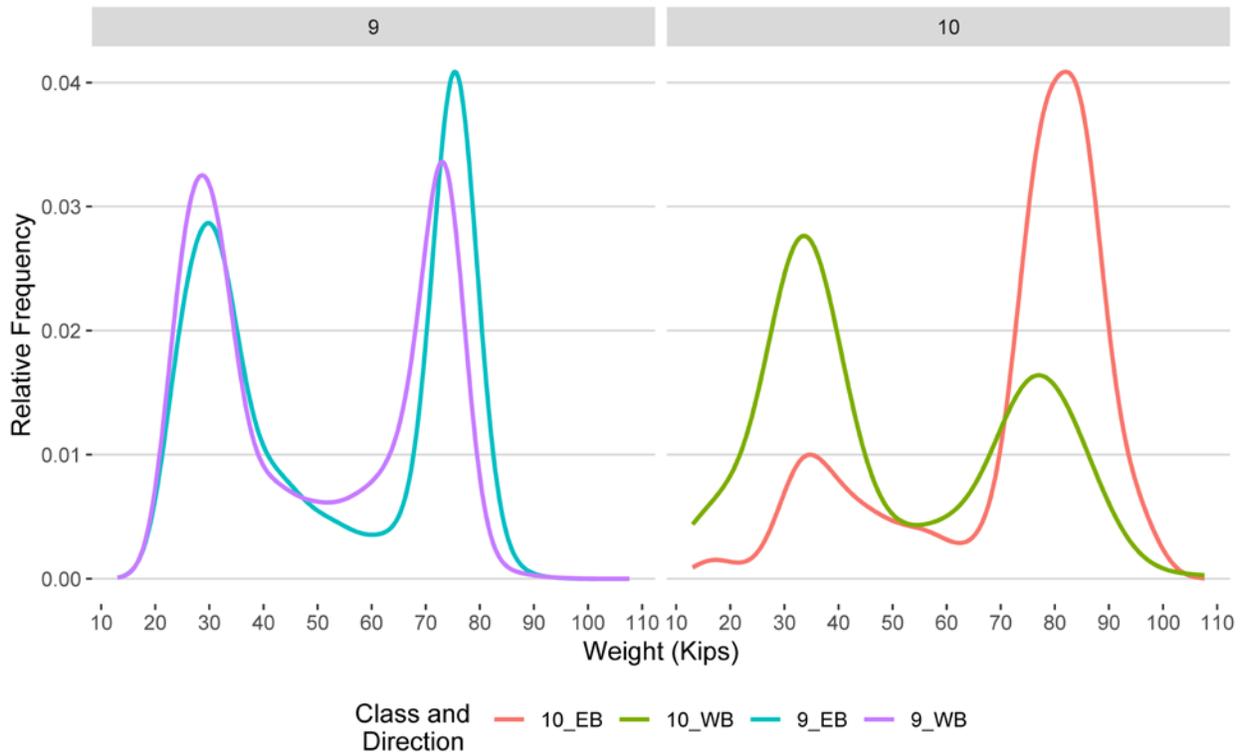


Figure 9 - Freight Percentage by Direction and Class

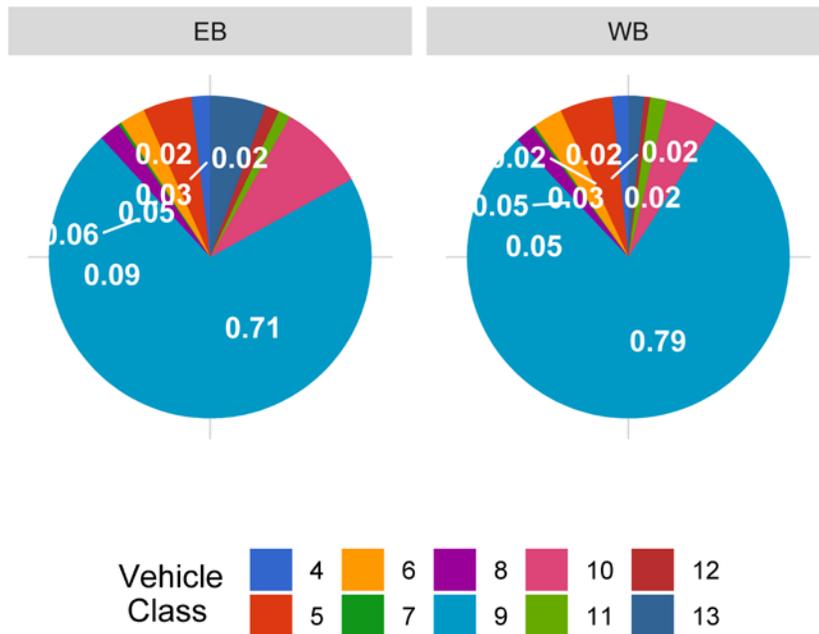


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

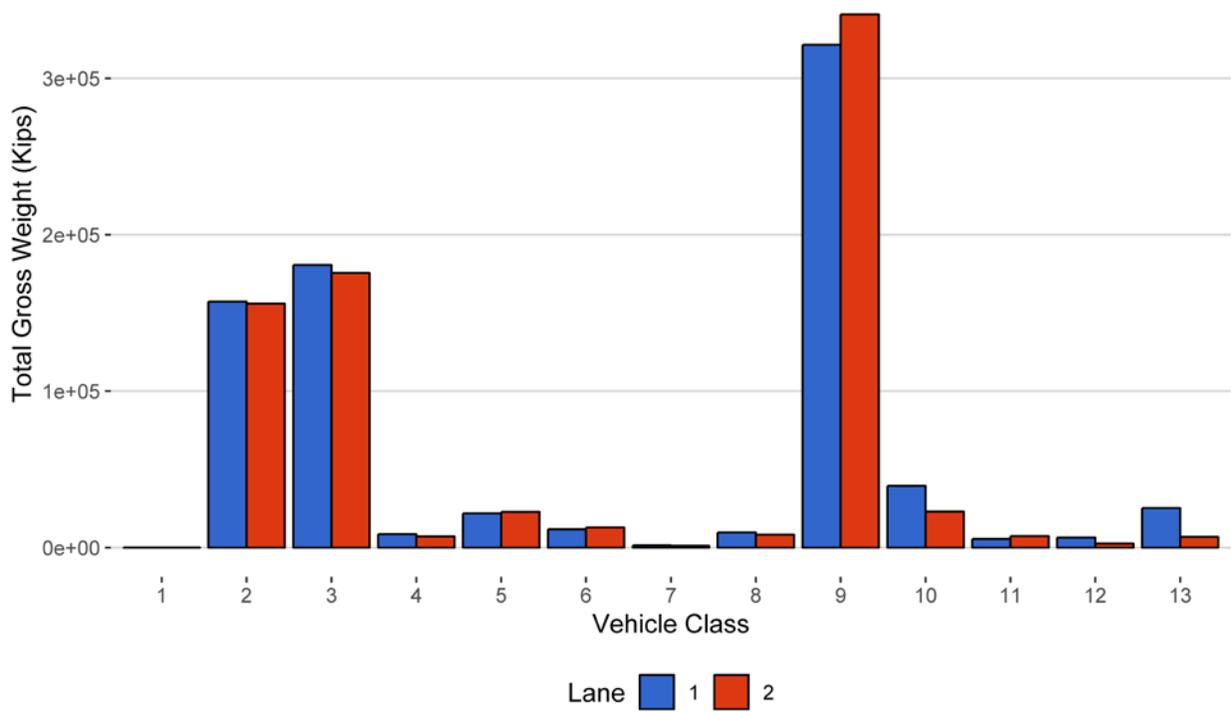


Figure 11 - Total Gross Vehicle Weight t

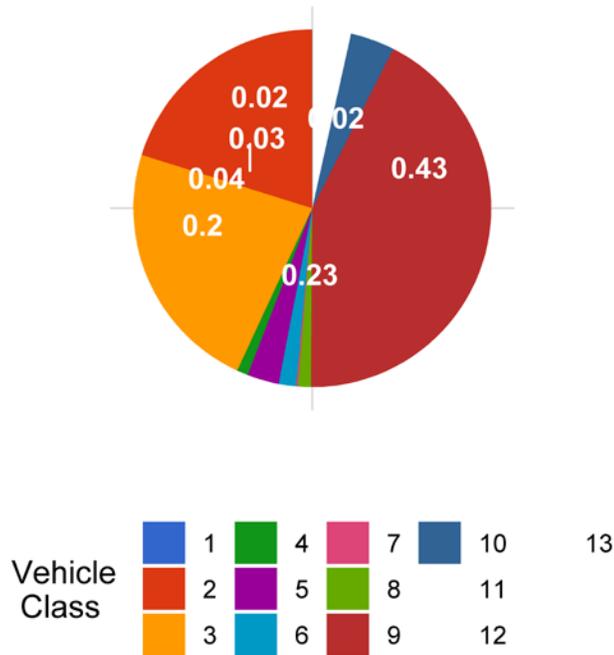


Figure 12 - Total ESALs by Class and Lane

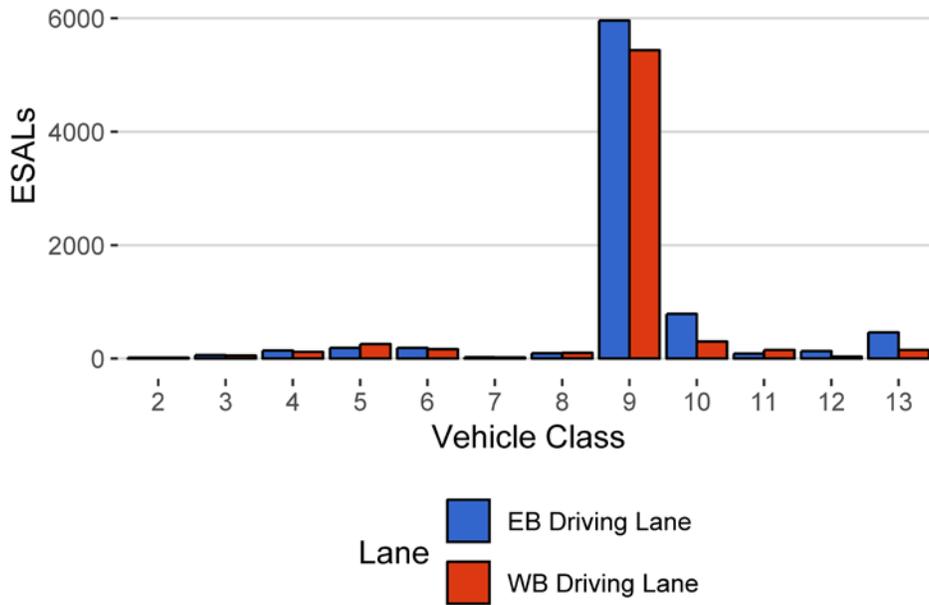


Figure 13 - ESALs by Class

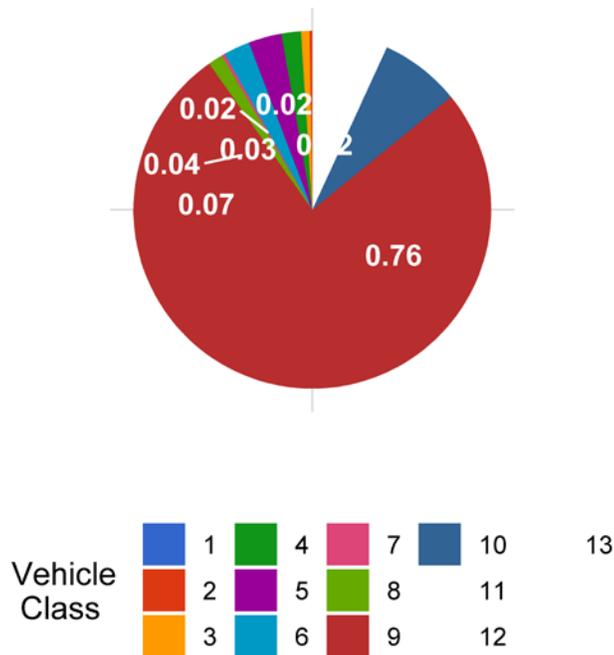


Table 1 Class 9 Front Axle Weight by Lane

<i>Month</i>	<i>Lane 1 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 2 (Kips)</i>	<i>Front Axle +/- 9%</i>
July 2015	11.76	0.00	10.98	0.00
August 2015	11.75	-0.07	10.89	-0.88
September 2015	11.62	-1.13	10.84	-1.31
October 2015	11.45	-2.60	10.82	-1.46
November 2015	11.63	-1.12	10.97	-0.15
December 2015	11.67	-0.76	11.00	0.20
January 2016	11.59	-1.44	10.92	-0.53
February 2016	11.76	-0.01	11.16	1.58
March 2016	11.79	0.31	11.12	1.28
April 2016	11.71	-0.37	11.12	1.23
May 2016	11.64	-0.97	10.97	-0.15
June 2016	11.64	-1.04	10.94	-0.39
July 2016	11.74	-0.19	10.93	-0.49
August 2016	11.72	-0.31	10.98	-0.05
September 2016	11.60	-1.36	10.91	-0.69
October 2016	11.36	-3.35	10.82	-1.48
November 2016	11.58	-1.55	10.89	-0.83
December 2016	11.44	-2.72	10.72	-2.35
January 2017	11.56	-1.65	10.94	-0.41
February 2017	11.65	-0.91	11.03	0.47
March 2017	11.71	-0.43	10.99	0.03
April 2017	11.67	-0.77	11.03	0.46
May 2017	11.57	-1.63	11.02	0.37
June 2017	11.62	-1.18	10.84	-1.33
July 2017	11.53	-1.94	10.86	-1.15
August 2017	11.53	-1.98	10.86	-1.15
September 2017	11.41	-2.94	10.80	-1.68
October 2017	11.30	-3.90	10.66	-2.94
November 2017	11.37	-3.28	10.77	-1.89
December 2017	11.35	-3.49	10.84	-1.26
January 2018	11.52	-2.02	10.93	-0.49
February 2018	11.46	-2.50	10.93	-0.52
March 2018	11.51	-2.12	11.00	0.19
April 2018	10.99	-6.53	10.44	-4.92
May 2018	10.85	-7.73	10.38	-5.48
June 2018	10.82	-7.93	10.37	-5.55
July 2018	10.87	-7.53	10.35	-5.78

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	4	109	0.1	0	0
2	2566	79535	50.1	0	0
3	1906	59071	37.2	0	0
4	18	546	0.3	19	1.1
5	108	3350	2.1	22	1.3
6	28	879	0.6	50	3
7	2	51	0	13	0.8
8	20	624	0.4	15	0.9
9	419	12999	8.2	848	50.9
10	33	1016	0.6	335	20.1
11	8	249	0.2	3	0.2
12	4	131	0.1	55	3.3
13	11	350	0.2	307	18.4
TOTAL	5126	158910	100	1667	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>
2018-07-07	Saturday	09:09:34	9	WB	2	116.06
2018-07-12	Thursday	06:05:37	10	WB	2	107.67
2018-07-19	Thursday	14:53:46	10	WB	2	102.32
2018-07-24	Tuesday	20:04:46	10	EB	1	99.1
2018-07-17	Tuesday	11:50:10	10	EB	1	98.95
2018-07-17	Tuesday	08:44:10	10	EB	1	98.79
2018-07-03	Tuesday	05:31:28	10	EB	1	98.06
2018-07-17	Tuesday	18:59:25	10	EB	1	96.84
2018-07-06	Friday	09:56:03	10	EB	1	96.77
2018-07-18	Wednesday	11:45:38	10	EB	1	96.76

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	EB	15	295	44	14.9	7985	573	2110
5	EB	8	1639	221	13.5	20248	1637	4452
6	EB	19	407	93	22.9	10082	1577	2058
7	EB	11.5	28	0	0	1417	0	547
8	EB	31	340	226	66.5	4356	5292	411
9	EB	33	6082	1942	31.9	266874	54497	65127
10	EB	33.5	551	38	6.9	38394	1056	10604
11	EB	36.5	121	35	28.9	4403	1131	632
12	EB	36.5	89	0	0	6385	0	1568
13	EB	31.5	277	0	0	25263	0	8269
TOTAL	****	****	9829	2599	****	385407	****	95779
<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	249	39	15.7	6575	499	1712
5	WB	8	1696	271	16	20818	1960	4709
6	WB	19	468	122	26.1	10781	2058	2103
7	WB	11.5	23	0	0	1152	0	444
8	WB	31	281	170	60.5	4194	4032	376
9	WB	33	6858	2498	36.4	271479	69395	63799
10	WB	33.5	460	159	34.6	18579	4456	4248
11	WB	36.5	127	4	3.1	7260	82	1385
12	WB	36.5	41	3	7.3	2476	96	544
13	WB	31.5	71	0	0	6779	0	2271
TOTAL	****	****	10274	3266	****	350092	****	81593
GRAND TOTAL	****	****	20103	5865	385	735499	148341	177372

Table 5 Gross Vehicle Weight by Class and Lane

<i>Vehicle Class</i>	<i>EB</i>	<i>WB</i>	<i>Total</i>	<i>Percentage</i>
1	61	94	155	0
2	157256	155939	313194	20.2
3	180635	175568	356203	22.9
4	8557	7074	15631	1
5	21885	22778	44663	2.9
6	11659	12839	24498	1.6
7	1417	1152	2568	0.2
8	9648	8226	17874	1.2
9	321371	340873	662244	42.6
10	39450	23035	62485	4
11	5534	7342	12876	0.8
12	6385	2572	8957	0.6
13	25263	6779	32042	2.1
TOTAL	789122	764270	1553392	100
GVW/LANE	50.8	49.2	100	0.01

Table 6 ESALs by Class and Lane and Flexible ESAL Factors

<i>Vehicle Class</i>	<i>EB</i>	<i>WB</i>	<i>Total</i>	<i>Percentage</i>	<i>Flexible ESAL Factor</i>
1	0	0	0	0	0.0091
2	18	17	35	0.2	9e-04
3	62	55	117	0.8	0.004
4	144	120	264	1.8	0.97
5	190	258	448	3	0.27
6	190	168	357	2.4	0.82
7	24	20	44	0.3	1.64
8	97	103	200	1.3	0.65
9	5960	5438	11398	76.1	1.77
10	787	302	1090	7.3	2.15
11	88	153	241	1.6	1.91
12	134	34	168	1.1	2.46
13	463	154	617	4.1	3.47
TOTAL	8158	6821	14979	100	16
ESALS/LANE	54.5	45.5	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>
Aug 2017	184728	5959	907	156600	84.8	28127.6	15.2
Sep 2017	174582	5819	1022	143917	82.4	30665.3	17.6
Oct 2017	168933	5450	991	138200	81.8	30732.8	18.2
Nov 2017	157271	5242	946	128891	82	28380.1	18
Dec 2017	151645	4892	863	124901	82.4	26744.2	17.6
Jan 2018	134369	4334	714	112230	83.5	22139.3	16.5
Feb 2018	121042	4323	646	102947	85.1	18095.1	14.9
Mar 2018	148999	4806	935	120016	80.5	28983	19.5
Apr 2018	142113	4737	837	117010	82.3	25103.3	17.7
May 2018	166568	5373	771	142675	85.7	23892.8	14.3
Jun 2018	160782	5359	682	140315	87.3	20466.9	12.7
Jul 2018	158910	5126	651	138715	87.3	20194.6	12.7
TOTAL	1869942	-	-	1566417	-	303525	-
AVERAGE	155828	5118	830	130535	84	25294	16

ESALS

<i>Month</i>	<i>ESALS EB Driving Lane</i>	<i>ESALS WB Driving Lane</i>	<i>Total ESALS</i>	<i>Pavement Life Decrease Months</i>
Aug 2017	15767	12453	28221	13.5
Sep 2017	14359	14776	29134	4.4
Oct 2017	13340	16038	29378	10.4
Nov 2017	11998	15611	27609	7.5
Dec 2017	9912	14401	24312	6.4
Jan 2018	11044	10493	21537	13.7
Feb 2018	9442	7840	17282	15.9
Mar 2018	8342	12669	21011	17.3
Apr 2018	8199	14246	22446	3.3
May 2018	9112	8387	17499	1.6
Jun 2018	7690	7131	14821	1.5
Jul 2018	8215	6839	15054	3.2
TOTAL	127420	-	-	-
AVERAGE	10618	11740	22359	8

Gross Vehicle Weight

<i>Month</i>	<i>GVW EB Driving Lane</i>	<i>GVW WB Driving Lane</i>	<i>Total GVW Kips</i>
Aug 2017	793221	873170	1666391
Sep 2017	682600	690756	1373356
Oct 2017	711950	939405	1651356
Nov 2017	727732	1226632	1954364
Dec 2017	865371	861844	1727214
Jan 2018	780636	785631	1566267
Feb 2018	791746	765202	1556948
Mar 2018	1106394	1067194	2173587
Apr 2018	1071249	1199149	2270398
May 2018	1012456	1200320	2212776
Jun 2018	927055	1192270	2119325
Jul 2018	890224	1132994	2023218
TOTAL	10360633	11934568	22295201
AVERAGE	863386	994547	1857933

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>
Aug 2017	6914	3.8	24.7	1731	207
Sep 2017	8234	4.7	26.9	3710	837
Oct 2017	7755	4.6	25.3	3194	663
Nov 2017	8139	5.2	28.8	4294	637
Dec 2017	7745	5.2	29.1	4844	732
Jan 2018	5586	4.2	25.4	2397	281
Feb 2018	3644	3	20.2	992	119
Mar 2018	6820	6	30.5	3794	291
Apr 2018	7653	5.5	30.7	4826	109
May 2018	1525	0.9	6.4	235	36
Jun 2018	1304	0.8	6.4	233	37
Jul 2018	1689	1.1	8.4	367	45
TOTAL	67008	-	-	30617	3994
AVERAGE	5584	3.8	21.9	2551.4	332.8

Freight

<i>Month</i>	<i>EB Freight Tons</i>	<i>WB Freight Tons</i>	<i>Total Freight</i>	<i>EB Freight %</i>	<i>WB Freight %</i>
Aug 2017	161829	146070	307899	52.6	47.4
Sep 2017	147260	204769	352029	41.8	58.2
Oct 2017	130713	210740	341452	38.3	61.7
Nov 2017	120349	225464	345812	34.8	65.2
Dec 2017	100081	223681	323763	30.9	69.1
Jan 2018	111522	140745	252267	44.2	55.8
Feb 2018	94761	92652	187413	50.6	49.4
Mar 2018	82554	190642	273196	30.2	69.8
Apr 2018	96393	254998	351391	27.4	72.6
May 2018	107468	104264	211732	50.8	49.2
Jun 2018	89560	86293	175852	50.9	49.1
Jul 2018	95779	81593	177372	54	46
TOTAL	1338268	1961909	3300177	-	-
AVERAGE	111522.3	163492.4	275014.7	42.2	57.8