

FEBRUARY 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 February 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: 121042 | Passenger Vehicles: 102947 | Heavy Commercial Vehicles: 18095

Monthly Average Daily Traffic (MADT): 4323 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 646

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 Fridays, with lowest volumes reported on Saturdays. WB vehicles typically reached highest volume levels on Fridays, with lowest volumes reported on Saturdays (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 03 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 03 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 18095 HCVs, 3639 of them were overweight³. These overweight HCVs contributed to 3% of total monthly volume, and 20.3% of total monthly HCV volume. EB overweight vehicles typically reached highest numbers on Wednesdays, with lowest volumes reported on Saturdays. WB 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 13 vehicles . Overall, overweight vehicles tended to reach peak volume concentrations during typical business hours, with 60% 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 March.

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 ,444 EB vehicles exceeded 88,000 pounds (146 vehicles were Class 9's; 146 vehicles were Class 13's). Of vehicles traveling WB,

548 EB vehicles exceeded 88,000 pounds (480 vehicles were Class 13's; 45 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 9s and 10s in February 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 empty class 10 vehicles.

Freight Totals. A total of 187413 tons of freight was recorded to have crossed the WIM. More freight was shipped EB (50.6%) than WB (49.4%). 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 121042 vehicles with a combined GVW of 1373356 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 17282 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 46% 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).

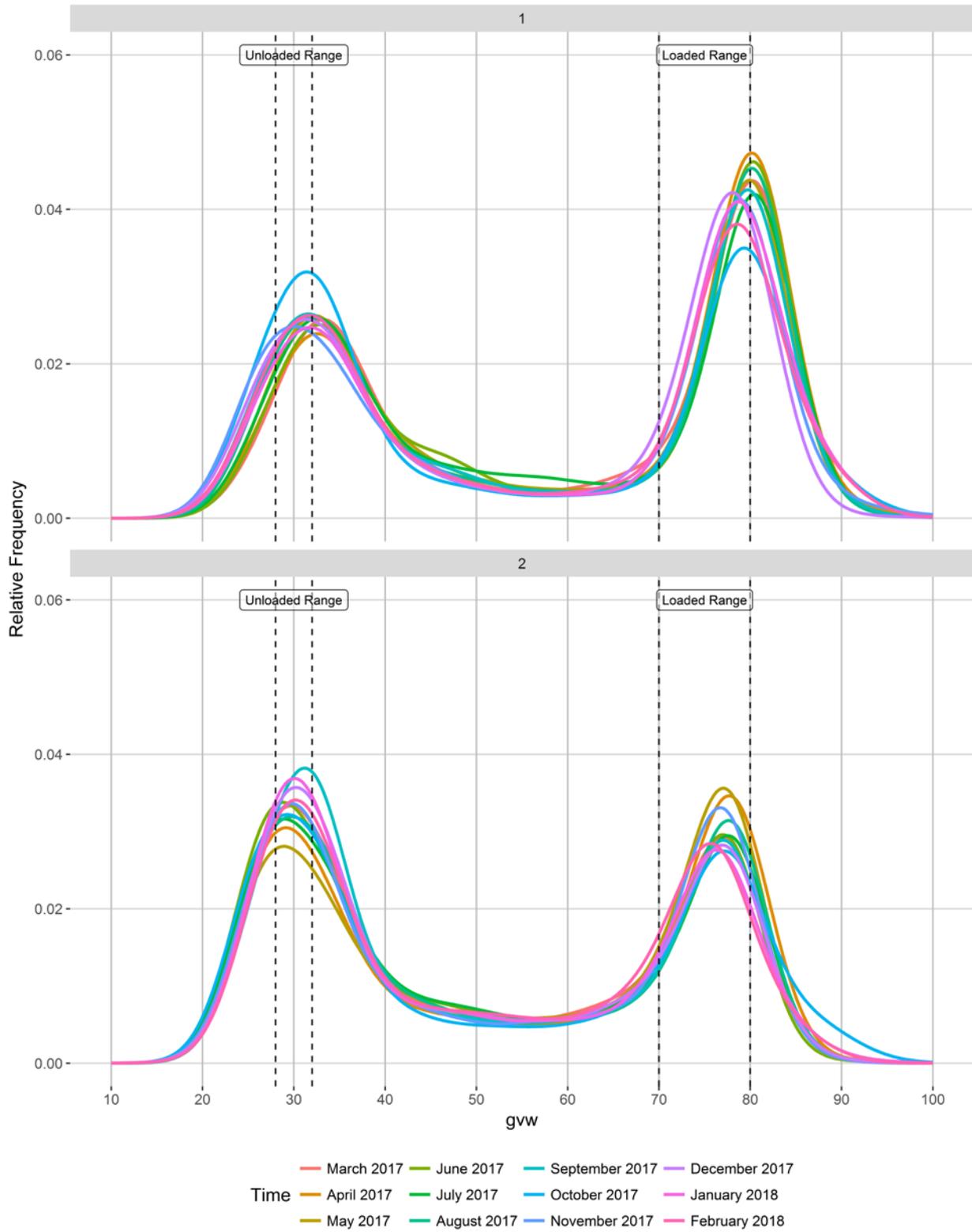
WIM monthly reports can be found at: <http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html>

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.

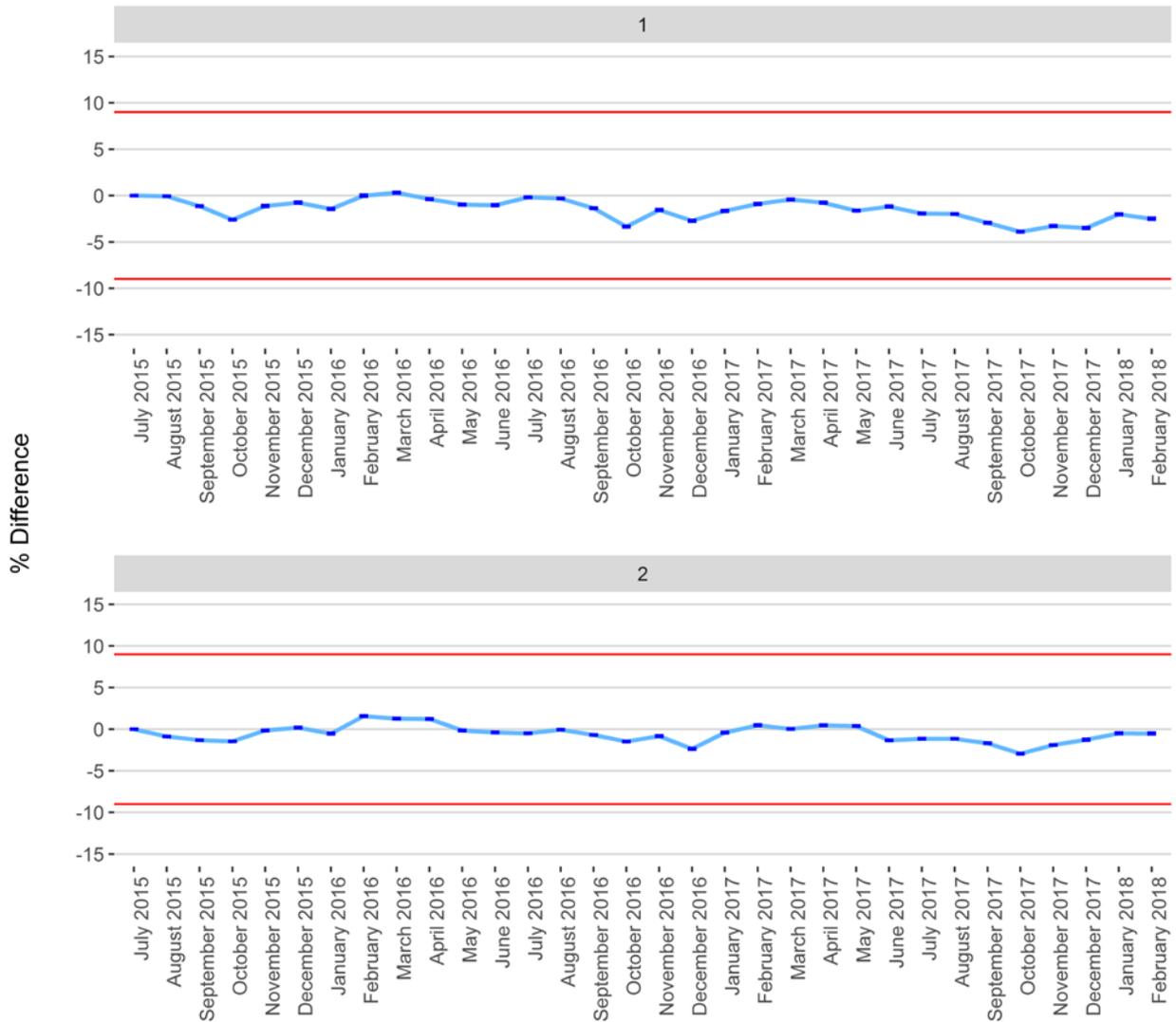
To request this document in an alternative format, please call 651-366-4718 or 1-800-657-3774, or email your request to ADArequest.dot@state.mn.us. Please request at least one week in advance.

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

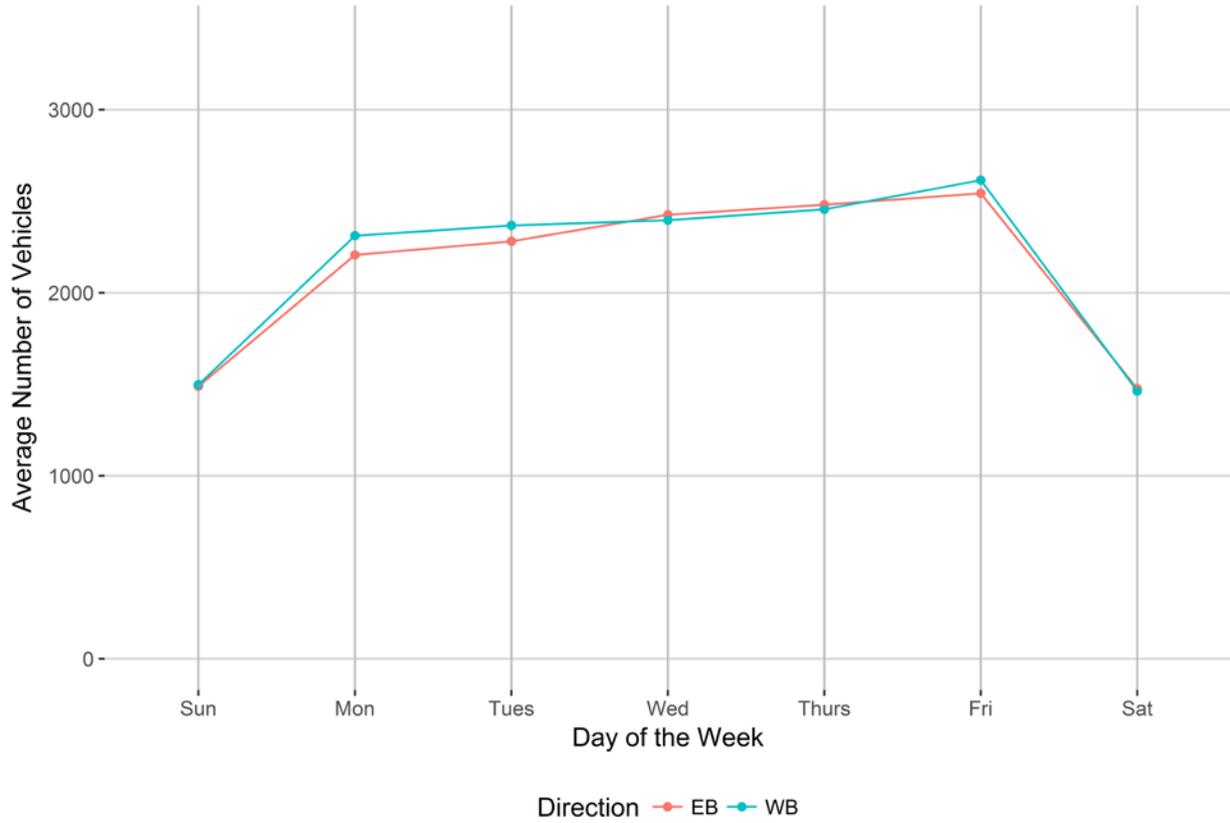


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

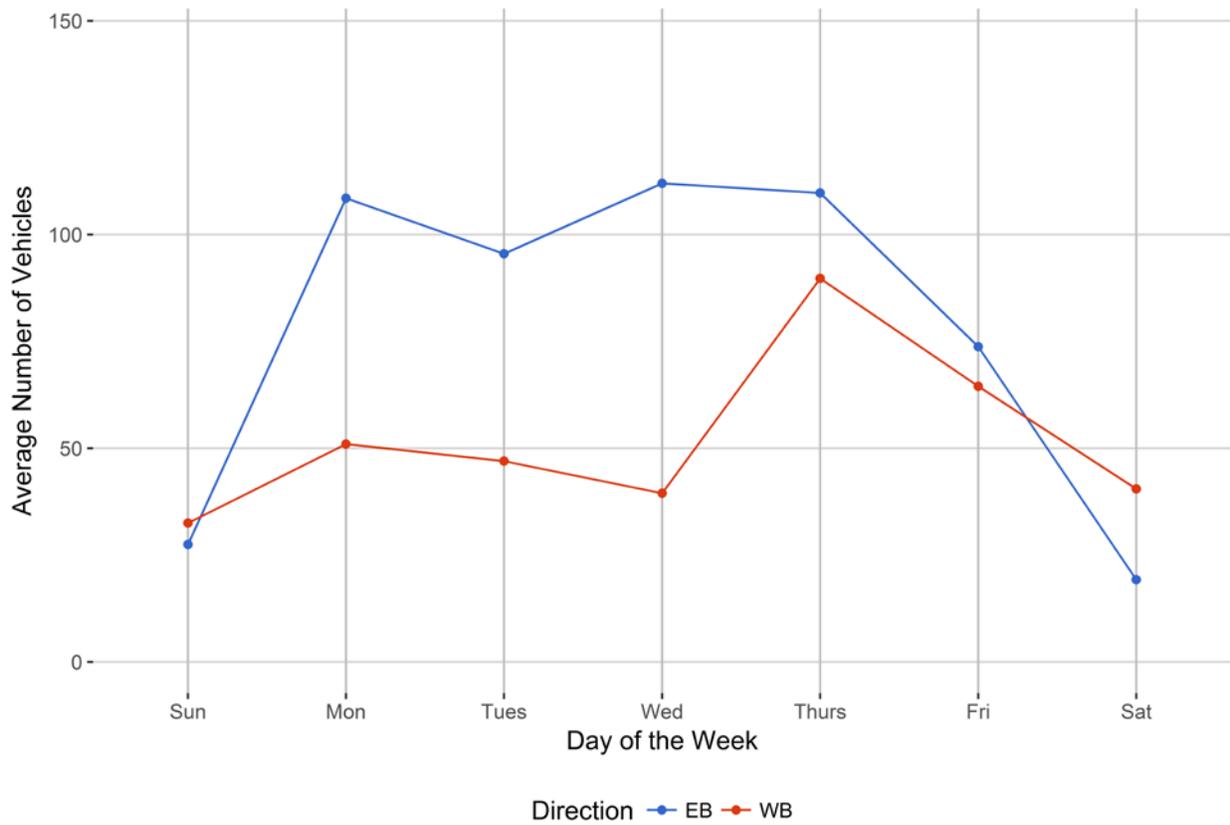


Figure 4 - Passenger Vehicles vs. Hour of the Day

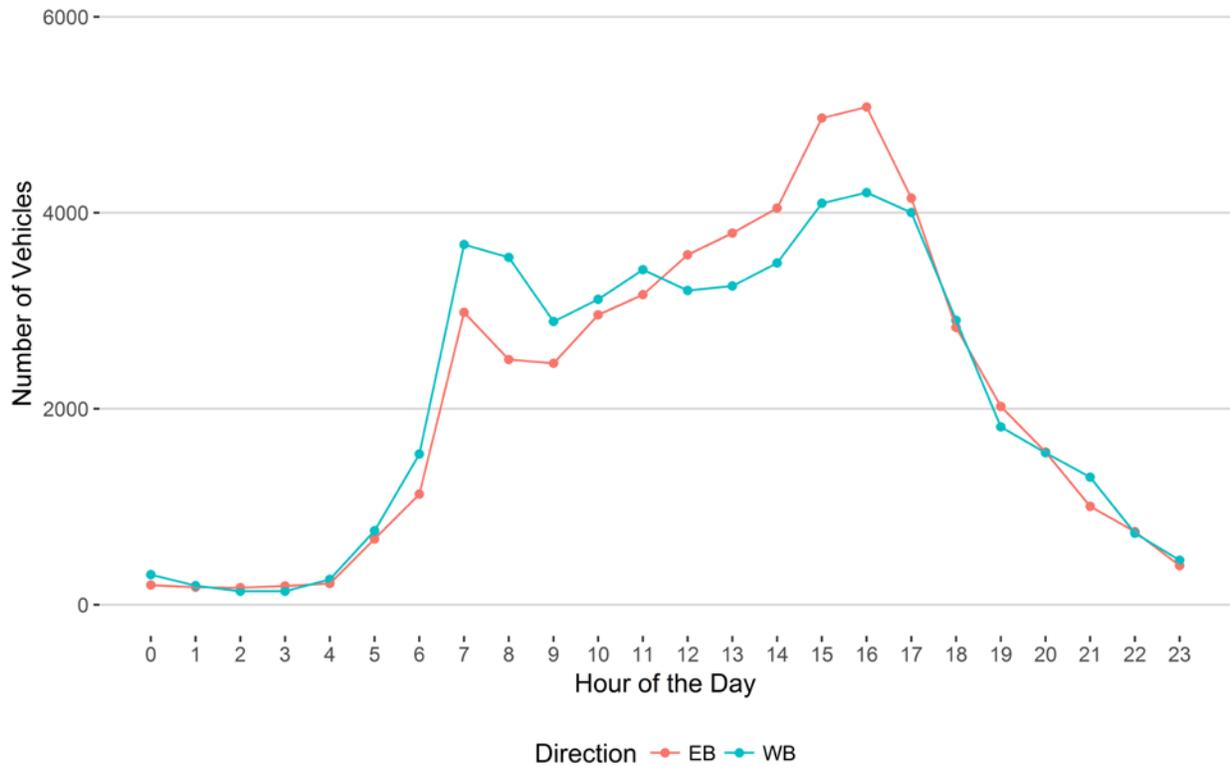


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

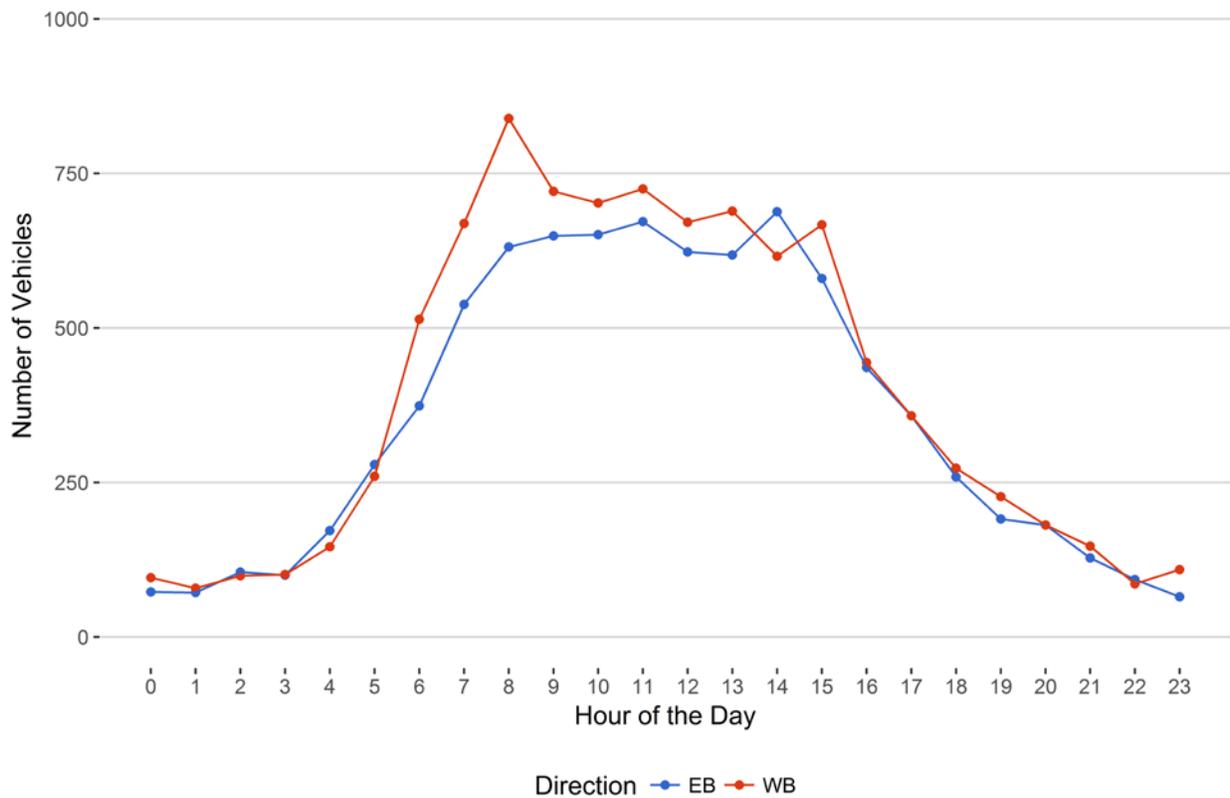


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

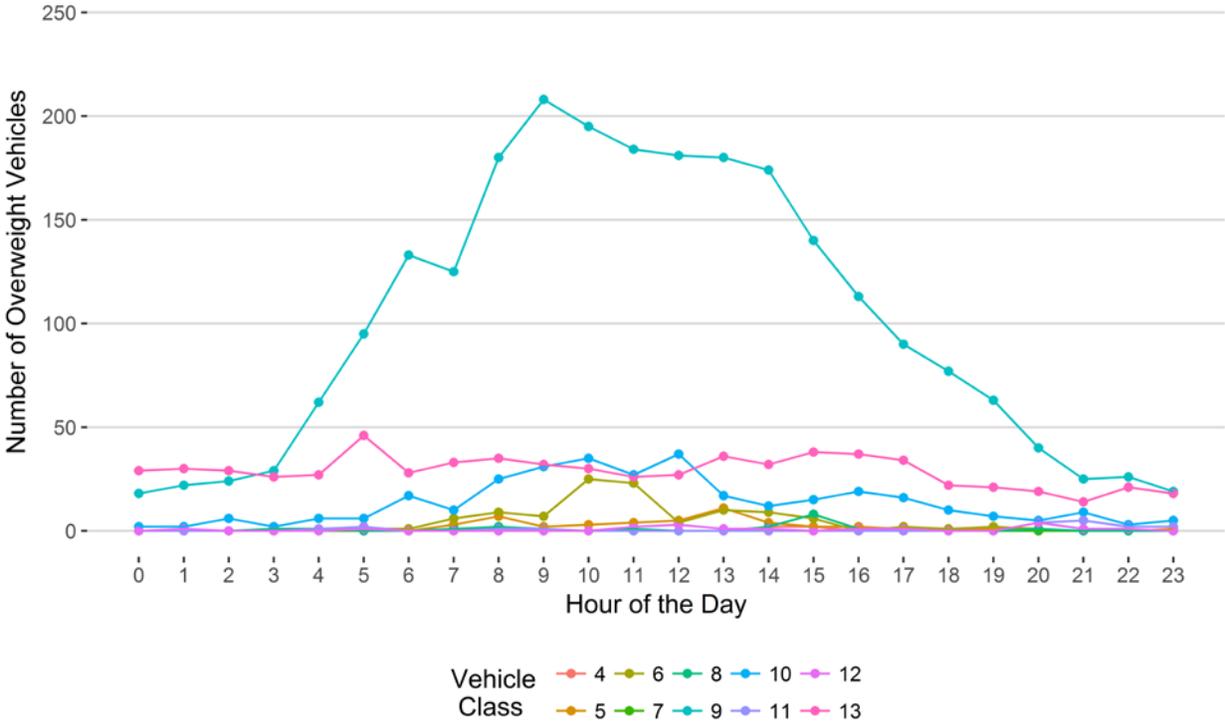


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

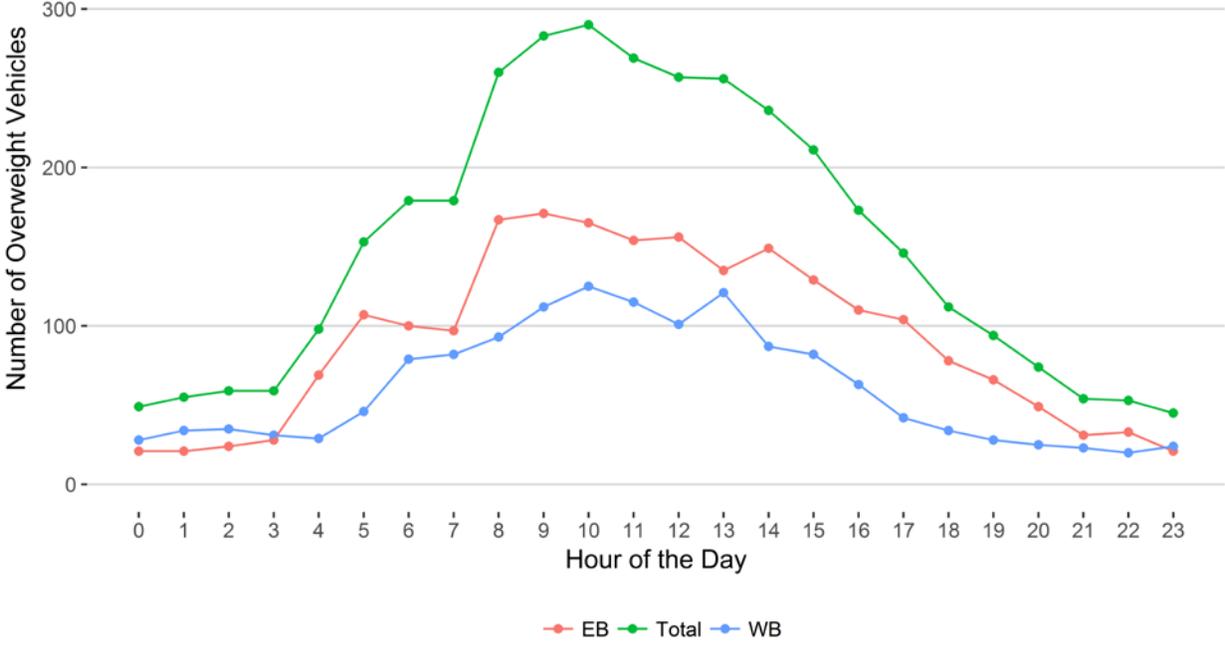
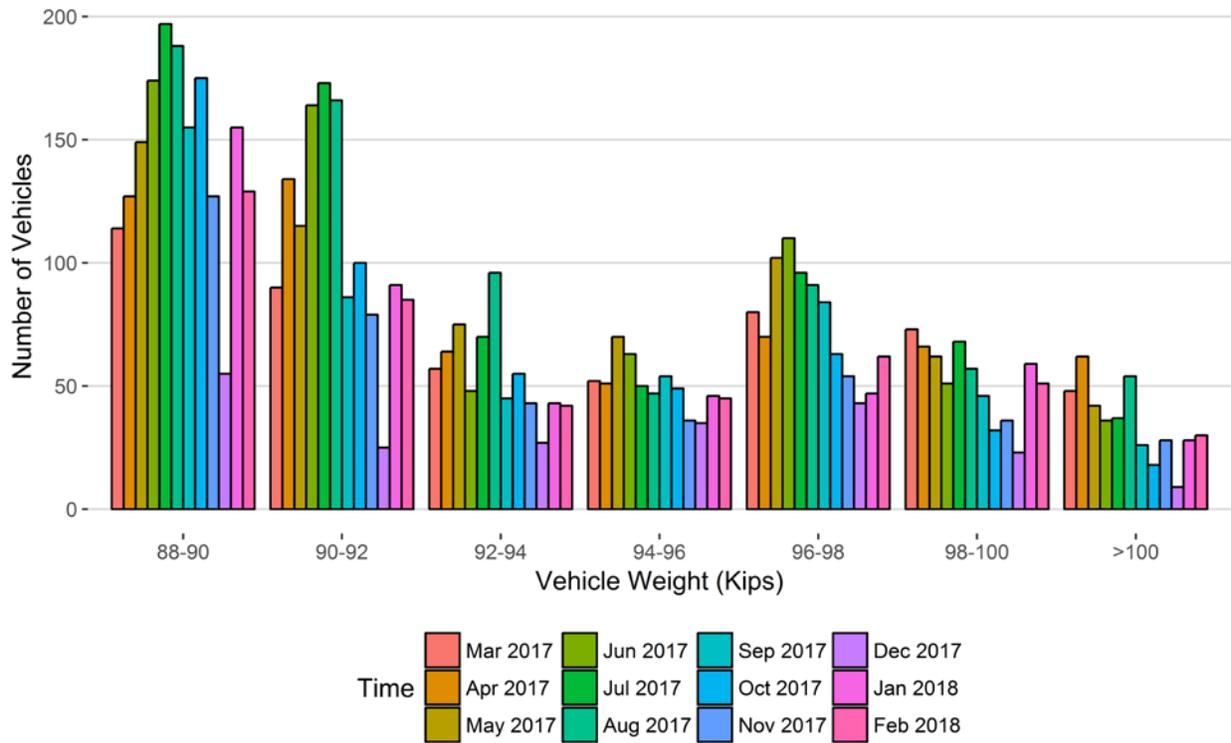
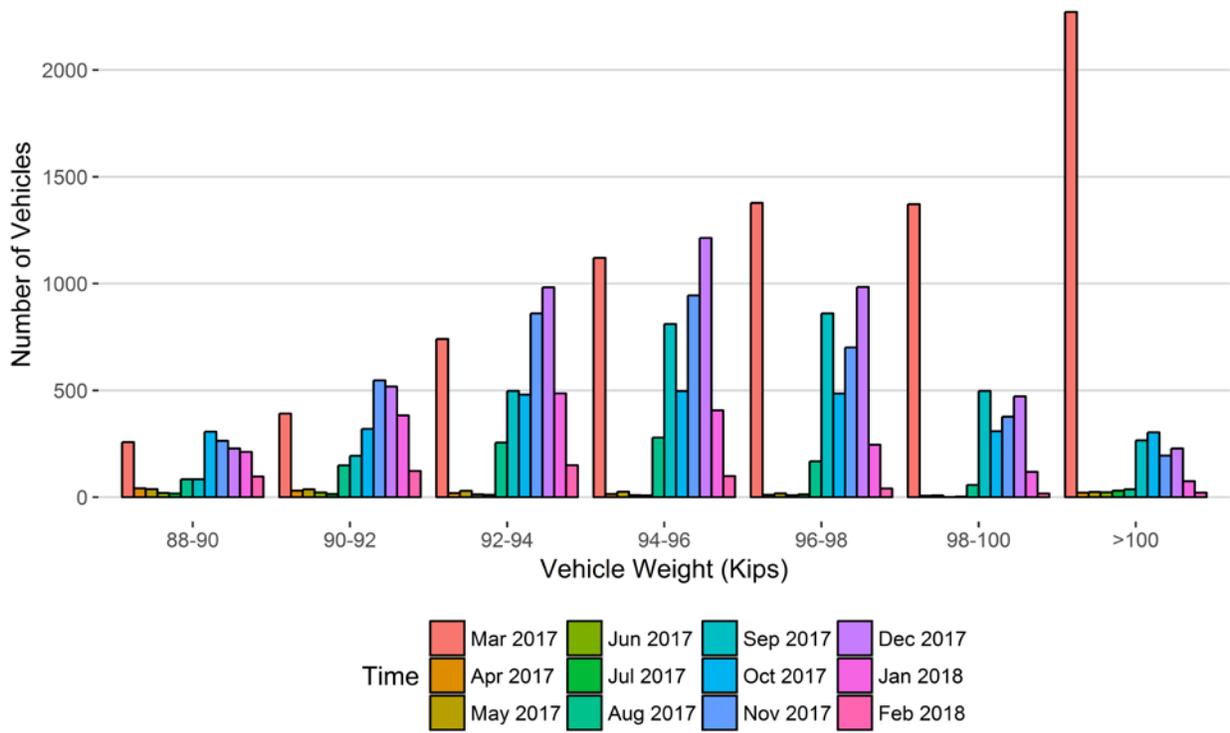


Figure 8 - Histogram of EB Vehicles Over 88,000 Pounds for Current Month



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	114	127	149	174	197	188	155	175	127	55	155	129
90-92	90	134	115	164	173	166	86	100	79	25	91	85
92-94	57	64	75	48	70	96	45	55	43	27	43	42
94-96	52	51	70	63	50	47	54	49	36	35	46	45
96-98	80	70	102	110	96	91	84	63	54	43	47	62
98-100	73	66	62	51	68	57	46	32	36	23	59	51
>100	48	62	42	36	37	54	26	18	28	9	28	30
Total	514	574	615	646	691	699	496	492	403	217	469	444

Figure 8 - Histogram of WB 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	258	42	38	20	17	84	84	307	264	228	212	97
90-92	392	31	37	22	15	149	194	320	547	518	383	123
92-94	741	19	30	13	11	256	498	480	861	983	486	150
94-96	1121	15	26	10	8	279	811	497	945	1214	407	99
96-98	1378	11	18	9	13	168	861	485	701	984	246	41
98-100	1372	7	8	1	3	58	498	309	377	472	119	17
>100	2272	21	24	23	31	37	266	304	195	228	75	21
Total	7534	146	181	98	98	1031	3212	2702	3890	4627	1928	548

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

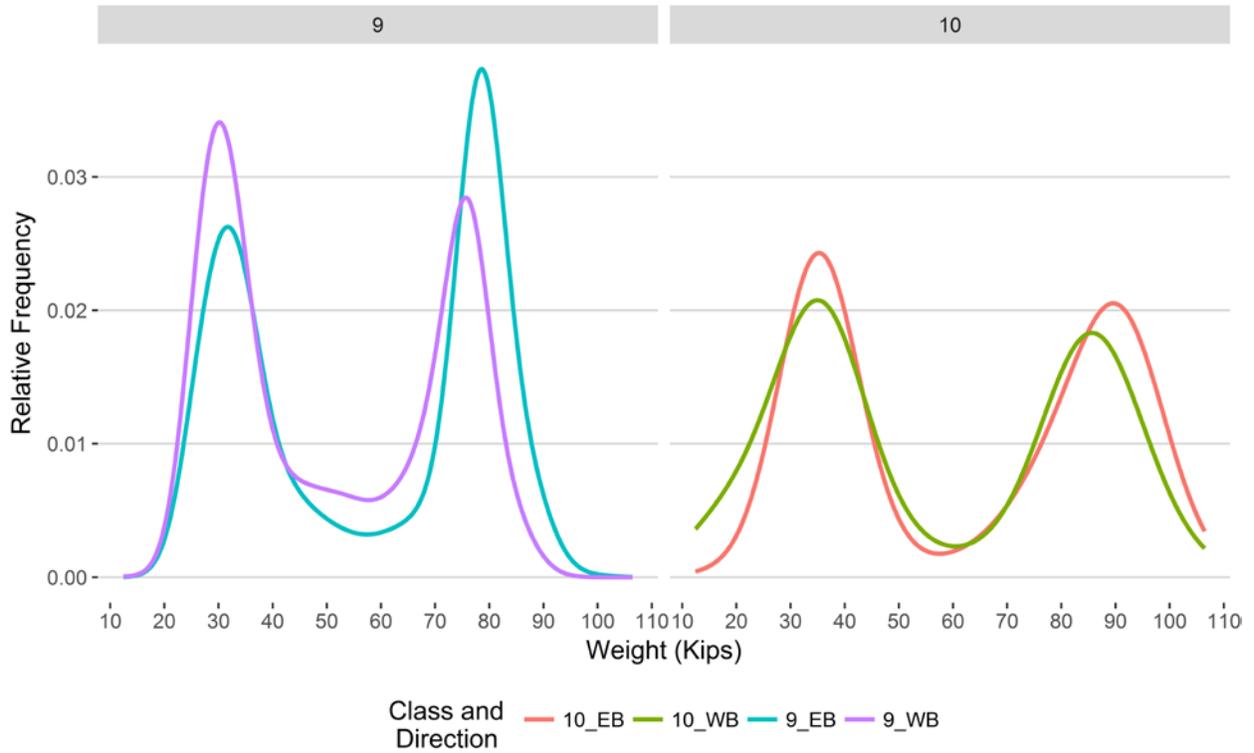


Figure 9 - Freight Percentage by Direction and Class

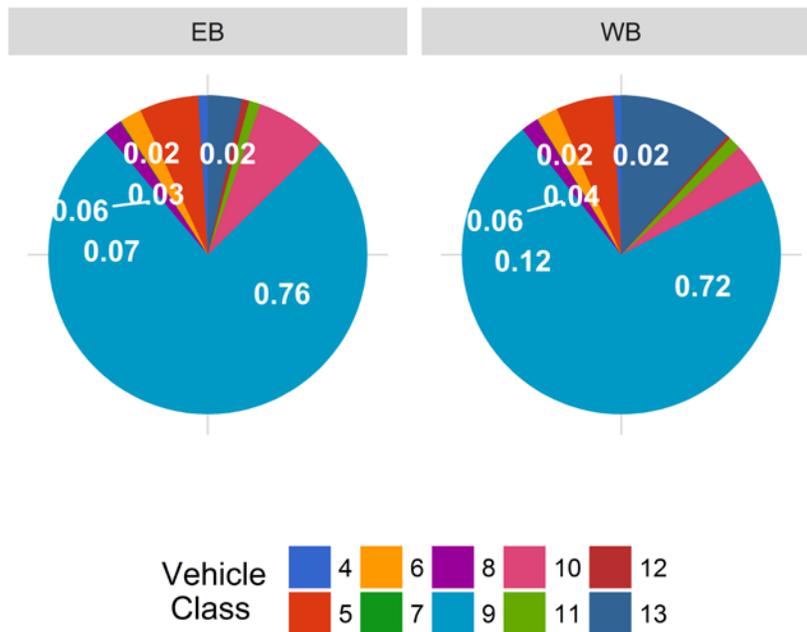


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

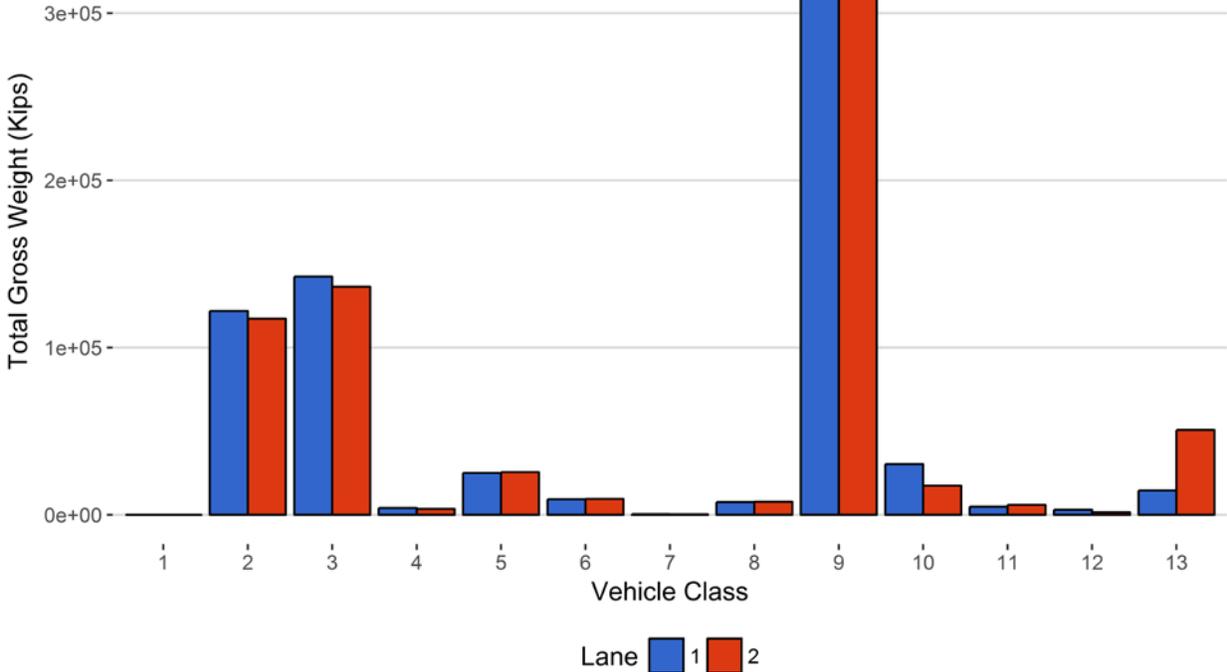


Figure 11 - Total Gross Vehicle Weight I

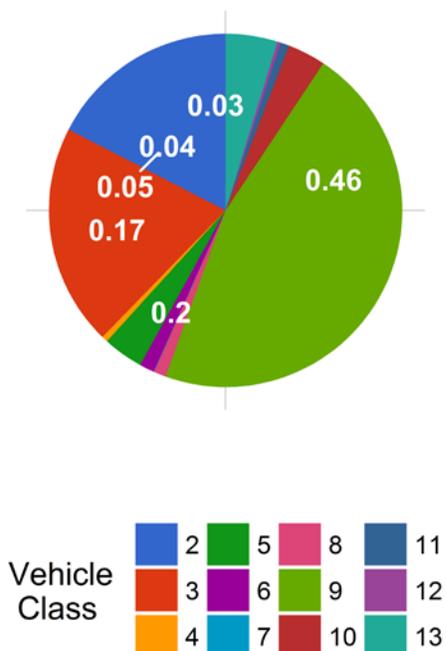


Figure 12 - Total ESALs by Class and Lane

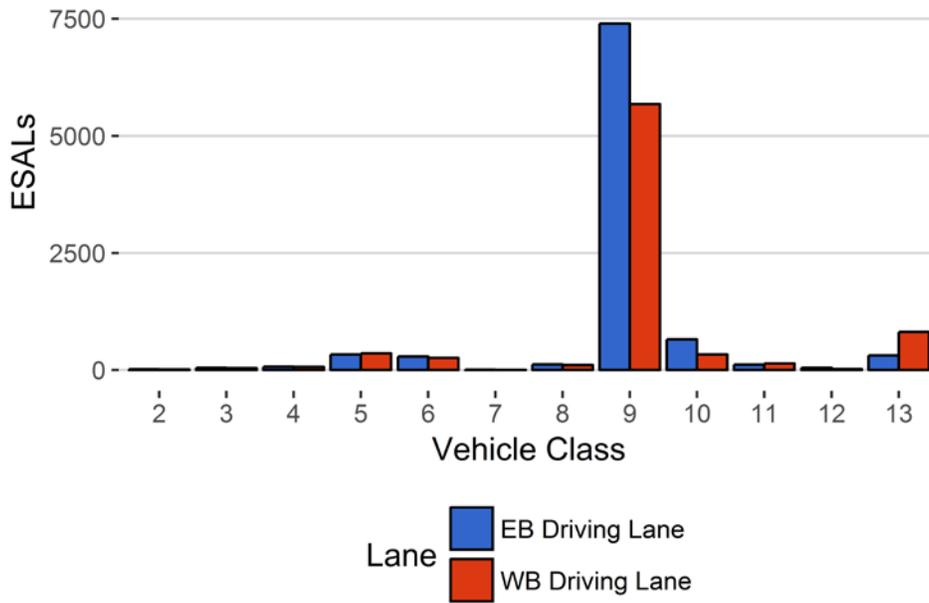


Figure 13 - ESALs by Class

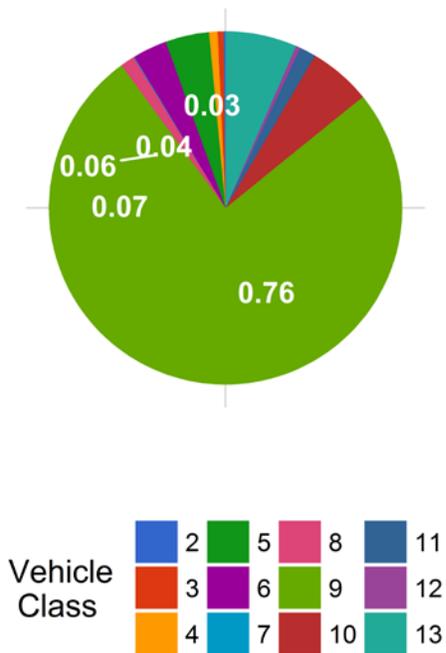


Table 1 Class 9 Front Axle Weight by Lane

<i>Month</i>	<i>Lane 1 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 2 (Kips)</i>	<i>Front Axle +/- 9%</i>
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

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	0	0	0	0
2	2042	57163	47.2	0	0
3	1635	45784	37.8	0	0
4	9	251	0.2	8	0.2
5	121	3378	2.8	48	1.3
6	20	550	0.5	108	3
7	0	11	0	3	0.1
8	17	471	0.4	20	0.5
9	417	11682	9.7	2403	66
10	28	792	0.7	324	8.9
11	7	188	0.2	18	0.5
12	2	70	0.1	17	0.5
13	25	701	0.6	690	19
TOTAL	4323	121042	100	3639	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>
2018-02-16	Friday	15:46:00	10	WB	2	106.46
2018-02-08	Thursday	12:21:08	10	EB	1	104.95
2018-02-15	Thursday	11:04:21	10	WB	2	104.39
2018-02-07	Wednesday	11:34:47	10	EB	1	104.16
2018-02-13	Tuesday	14:52:30	10	EB	1	102.92
2018-02-03	Saturday	21:14:14	10	WB	2	100.74
2018-02-15	Thursday	16:11:03	10	WB	2	100.59
2018-02-21	Wednesday	17:48:07	9	EB	1	100.48
2018-02-19	Monday	09:26:25	9	EB	1	100.18
2018-02-26	Monday	00:12:32	10	EB	1	99.93

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	138	12	8.7	3906	151	1008
5	EB	8	1641	113	6.9	24228	817	6002
6	EB	19	277	34	12.3	8646	595	2014
7	EB	11.5	6	0	0	378	0	154
8	EB	31	231	104	45	4984	2649	523
9	EB	33	5474	1252	22.9	282536	36304	71605
10	EB	33.5	482	41	8.5	29057	1277	7142
11	EB	36.5	90	8	8.9	4539	286	773
12	EB	36.5	48	1	2.1	2978	35	631
13	EB	31.5	149	0	0	14508	0	4907
TOTAL	****	****	8536	1565	****	375760	****	94761
<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	111	12	10.8	3368	155	941
5	WB	8	1711	191	11.2	24117	1407	5979
6	WB	19	269	41	15.2	8731	701	2200
7	WB	11.5	5	0	0	233	0	88
8	WB	31	236	118	50	4619	3140	481
9	WB	33	6118	2006	32.8	257418	57710	60861
10	WB	33.5	304	63	20.7	15808	1651	3867
11	WB	36.5	97	0	0	5888	0	1174
12	WB	36.5	21	0	0	1439	0	336
13	WB	31.5	547	0	0	50682	0	16726
TOTAL	****	****	9419	2431	****	372303	****	92652
GRAND TOTAL	****	****	17955	3996	256	748063	106877	187413

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>
2	121887	117207	239094	17.4
3	142440	136315	278755	20.3
4	4057	3522	7580	0.6
5	25045	25525	50570	3.7
6	9241	9432	18673	1.4
7	378	233	610	0
8	7633	7759	15391	1.1
9	318840	315128	633968	46.2
10	30334	17459	47792	3.5
11	4825	5888	10713	0.8
12	3014	1439	4452	0.3
13	14508	50682	65190	4.7
TOTAL	682200	690589	1372789	100
GVW/LANE	49.69	50.31	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>
2	17	14	31	0.2	0.0011
3	51	43	94	0.5	0.0042
4	71	65	136	0.8	1.1
5	331	357	688	4	0.41
6	286	257	542	3.1	1.98
7	10	4	14	0.1	1.94
8	118	108	226	1.3	0.97
9	7396	5677	13074	75.8	2.26
10	655	333	988	5.7	2.5
11	117	142	258	1.5	2.67
12	50	22	72	0.4	1.92
13	314	814	1128	6.5	3.21
TOTAL	9415	7836	17251	100	19
ESALS/LANE	54.6	45.4	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	152250	4911	941	123065	80.8	29185	19.2
Apr 2017	143723	4791	696	122841	85.5	20882.1	14.5
May 2017	162226	5233	736	139415	85.9	22811.5	14.1
Jun 2017	169392	5646	808	145148	85.7	24243.7	14.3
Jul 2017	175467	5660	756	152027	86.6	23439.6	13.4
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
TOTAL	1895628	--	--	1590182	--	305446	--
AVERAGE	157969	5188	836	132515	84	25454	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>
Mar 2017	12092	23137	35228	14.3
Apr 2017	12270	9305	21576	13.5
May 2017	12391	9961	22351	13.3
Jun 2017	14427	8888	23315	12
Jul 2017	13642	9390	23032	15.7
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
TOTAL	150683	--	--	--
AVERAGE	12557	12691	25248	12

Gross Vehicle Weight

<i>Month</i>	<i>GVW EB Driving Lane</i>	<i>GVW WB Driving Lane</i>	<i>Total GVW Kips</i>
Mar 2017	793221	873170	1666391
Apr 2017	682600	690756	1373356
May 2017	847186	1520249	2367434
Jun 2017	836328	785120	1621448
Jul 2017	904776	873200	1777976
Aug 2017	1004884	871882	1876766
Sep 2017	1000624	888551	1889175
Oct 2017	1106394	1067194	2173587
Nov 2017	1071249	1199149	2270398
Dec 2017	1012456	1200320	2212776
Jan 2018	927055	1192270	2119325
Feb 2018	890224	1132994	2023218
TOTAL	11076995	12294856	23371851
AVERAGE	923083	1024571	1947654

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	12125	8	41.7	8048	3765
Apr 2017	5011	3.5	24.1	721	157
May 2017	4889	3	21.5	797	137
Jun 2017	5047	3	20.9	746	113
Jul 2017	5248	3	22.5	792	142
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
TOTAL	80337	--	--	32266	7790
AVERAGE	6694.8	4.3	25.9	2688.8	649.2

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>
Mar 2017	124219	347216	471436	26.3	73.7
Apr 2017	124975	102010	226984	55.1	44.9
May 2017	128781	111767	240548	53.5	46.5
Jun 2017	149152	96741	245893	60.7	39.3
Jul 2017	140199	101769	241969	57.9	42.1
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
TOTAL	1533841	2003623	3537464	--	--
AVERAGE	127820.1	166968.6	294788.7	45.6	54.4