

MAY 2018



**WIM #45
CSAH 14, MP
10.1
BLAINE, MN**

**MONTHLY
REPORT**



Your Destination...Our Priority



WIM Site Location

WIM #45 is located on CSAH 14 near Blaine in Anoka county.

System Operation

WIM #45 was operational for the entire month of May 2018. Volume was computed using all monthly data.

System Calibration

WIM #45 was most recently calibrated on 2016-01-19. 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: 474991 | Passenger Vehicles: 459934 | Heavy Commercial Vehicles: 15057

Monthly Average Daily Traffic (MADT): 15322 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 486

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 Sundays. 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), EB PVs generally reached peak volume levels between 07 AM 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 07 AM 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 5's and Class 6's.

Overweight HCVs

Volume trends. Of a total of 15057 HCVs, 1082 of them were overweight³. These overweight HCVs contributed to 0.2% of total monthly volume, and 7.2% of total monthly HCV volume. EB overweight vehicles typically reached highest numbers on Wednesdays, with lowest volumes reported on NAs. WB overweight vehicles tended to reach highest volumes on Mondays, with lowest volumes reported on Sundays. See Figure 3 .

The top two overweight violators by class were the class 10 and class 6 vehicles . Overall, overweight vehicles tended to reach peak volume concentrations during typical business hours, with 61.2% of all overweight vehicles traveling WB 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 May.

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 ,28 EB vehicles exceeded 88,000 pounds (13 vehicles were Class 10's; 9 vehicles were Class 13's). Of vehicles traveling WB,

73 EB vehicles exceeded 88,000 pounds (53 vehicles were Class 10's; 15 vehicles were Class 13's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from May 2018.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9s and 10s in May 2018. Data suggests that there were greater numbers of empty Class 9's than fully_loaded 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 95024 tons of freight was recorded to have crossed the WIM. More freight was shipped WB (54.6%) than EB (45.4%). See Table 4 and Figure 11 for more freight information.

Infrastructure Considerations

Bridge. Bridge No. 02051 (a prestressed concrete beam span) is approximately 2.8 miles west of WIM #45 on CSAH 14, and Bridge No. 02006 (a prestressed concrete beam span) is approximately 5.2 miles east of WIM #45 on CSAH 14. WIM #45 recorded a total of 474991 vehicles with a combined GVW of 2459277 kips (1 kip = 1,000 pounds = 0.5 tons) in May 2018. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 7164 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 53% of all ESALs were recorded WB while 47% was observed EB. In particular, 24% of all ESALs were generated by the Class 6's (Class 6's were also responsible for generating 3% 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).

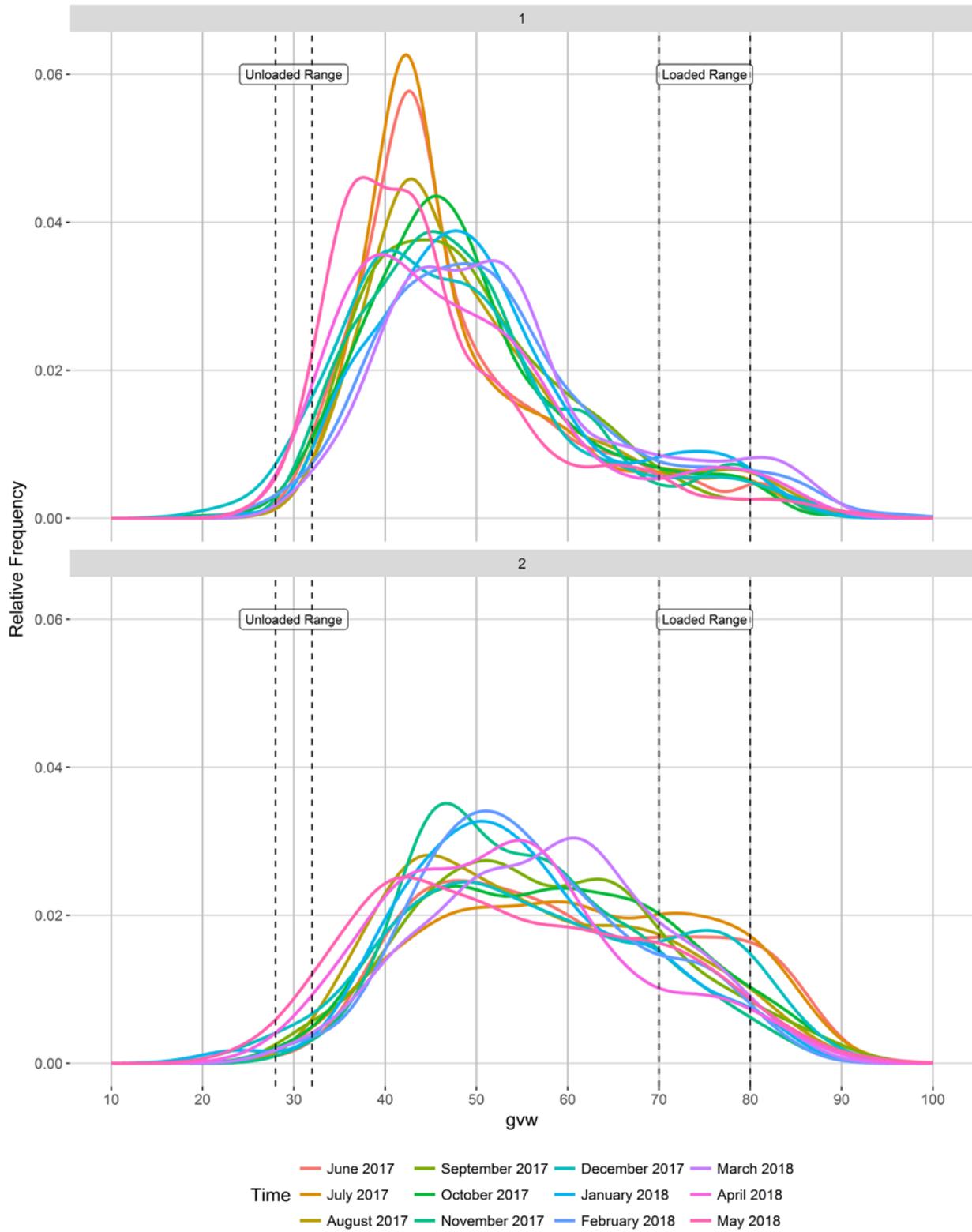
WIM monthly reports can be found at: <http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html>

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.

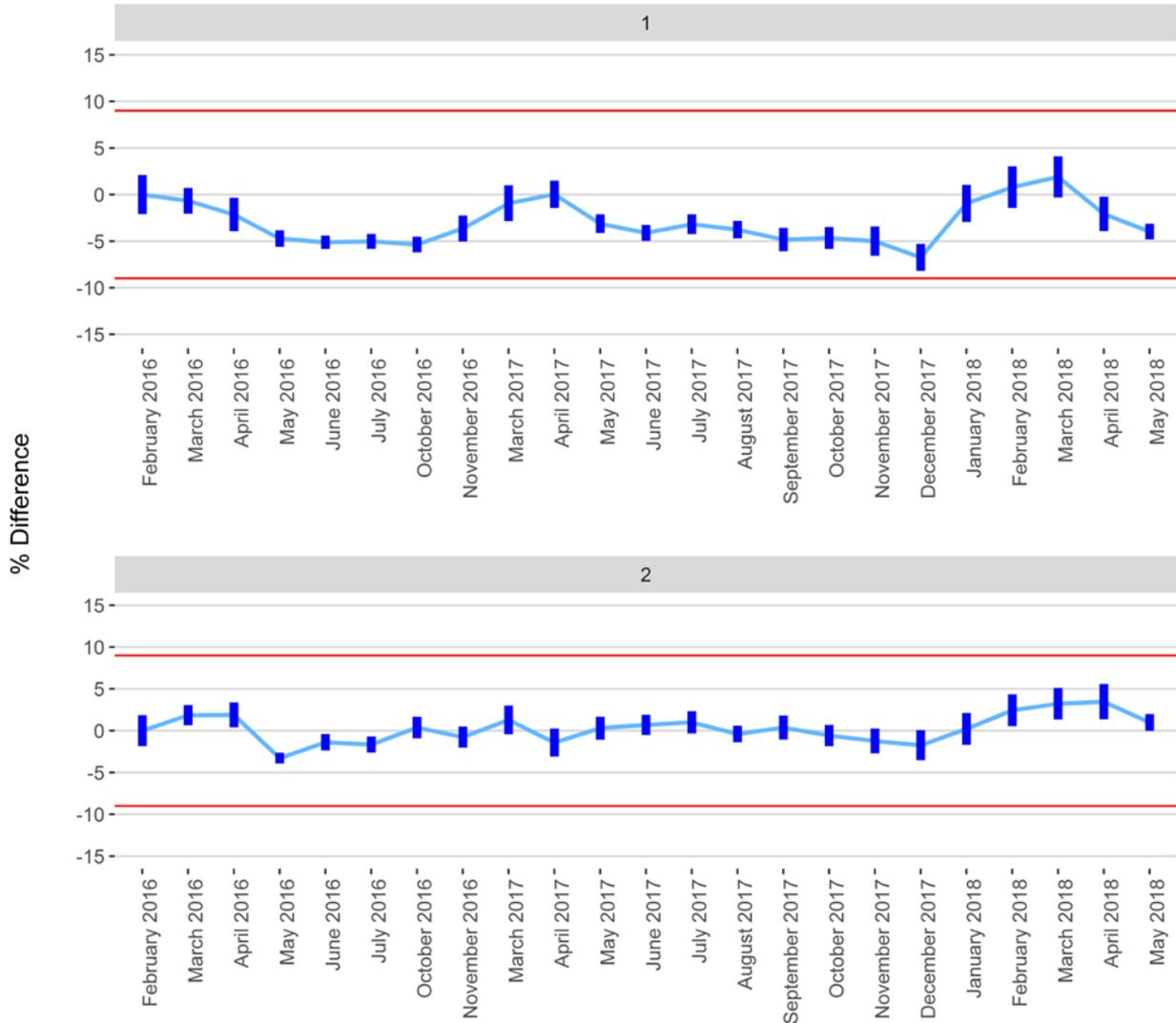
To request this document in an alternative format, please call 651-366-4718 or 1-800-657-3774, or email your request to ADArequest.dot@state.mn.us. Please request at least one week in advance.

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

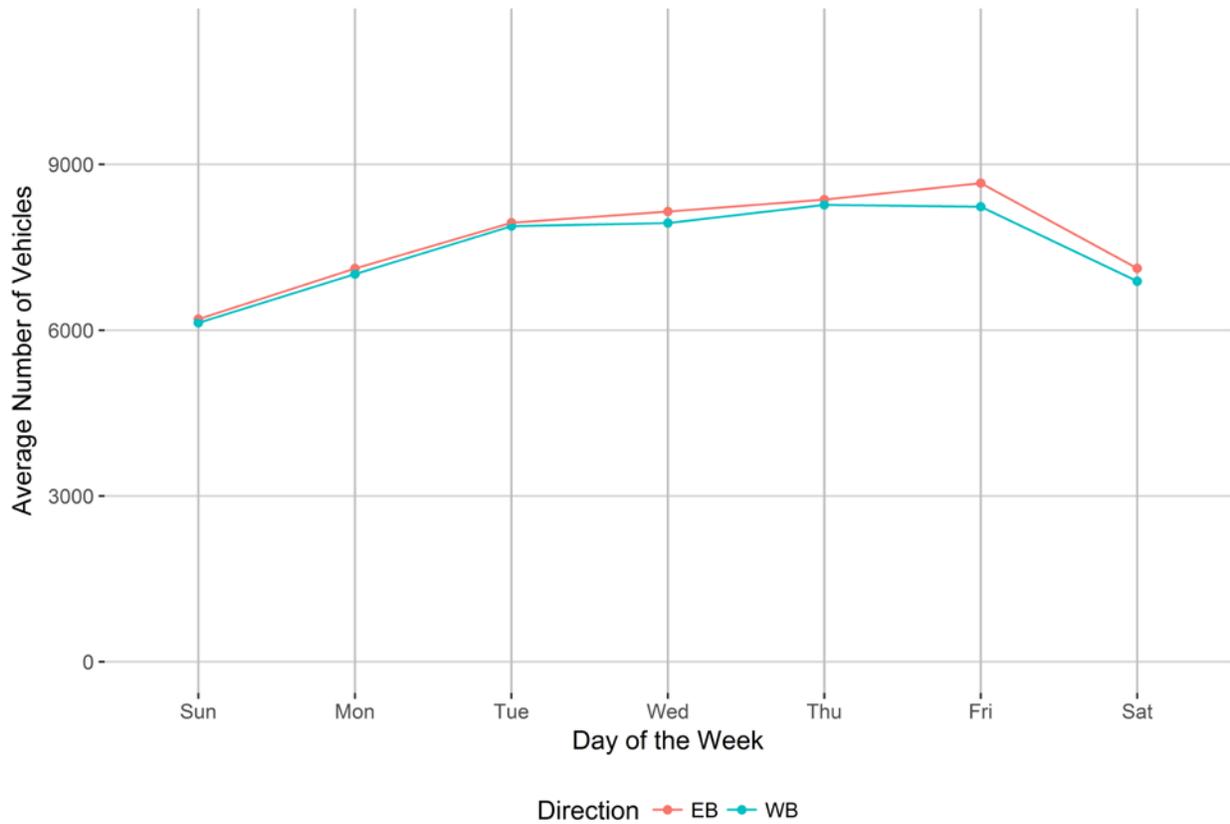


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

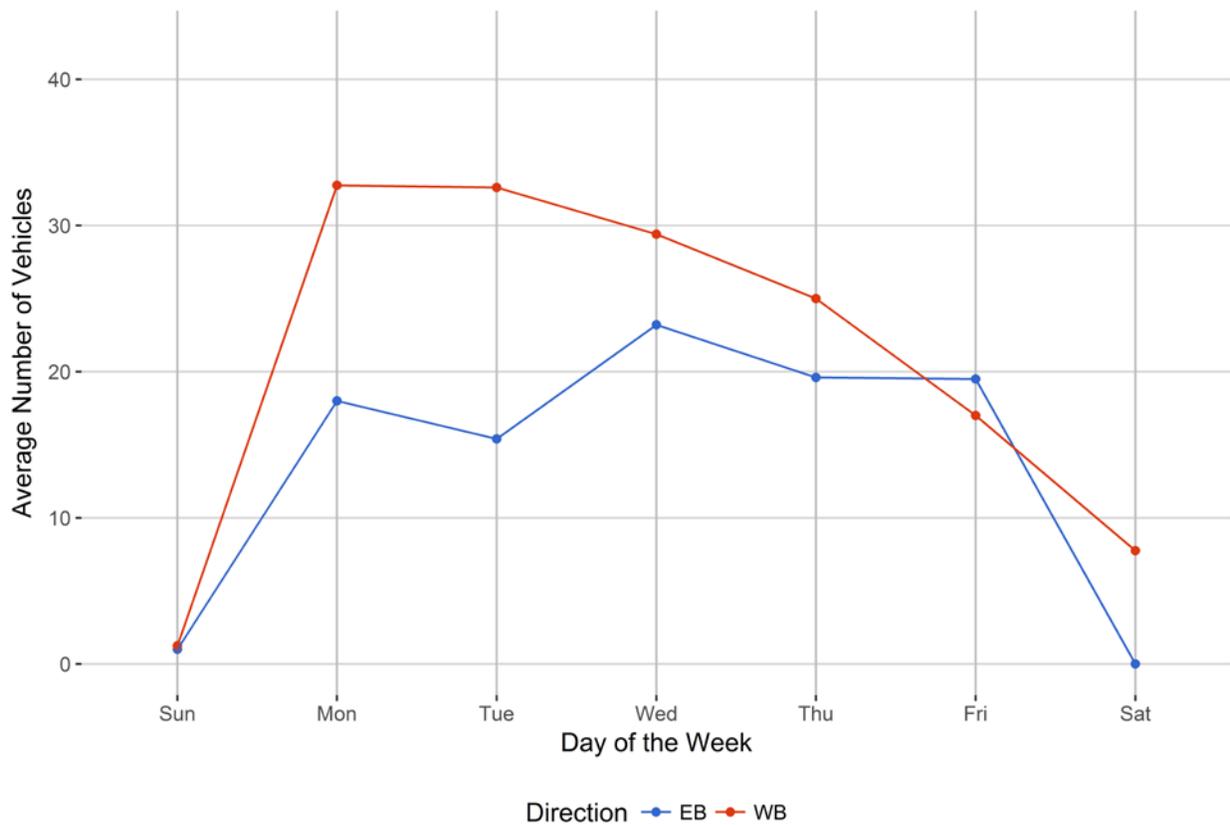


Figure 4 - Passenger Vehicles vs. Hour of the Day

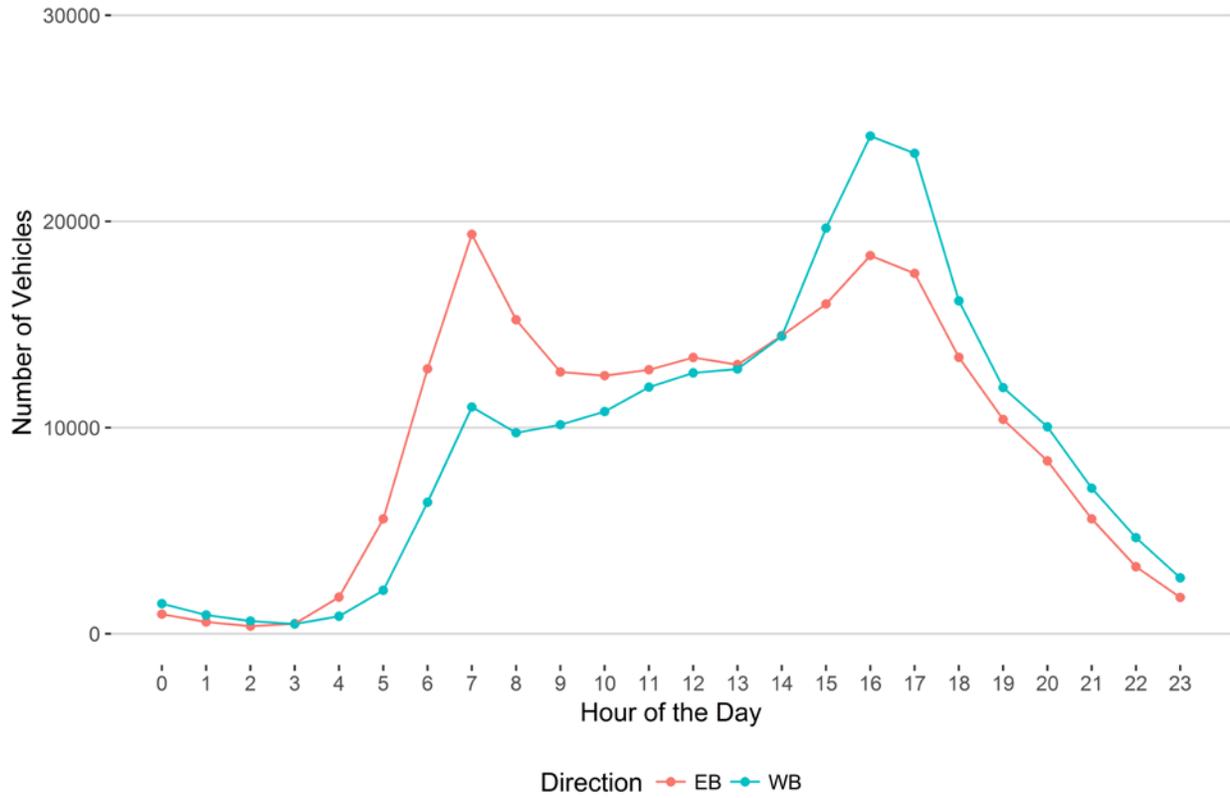


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

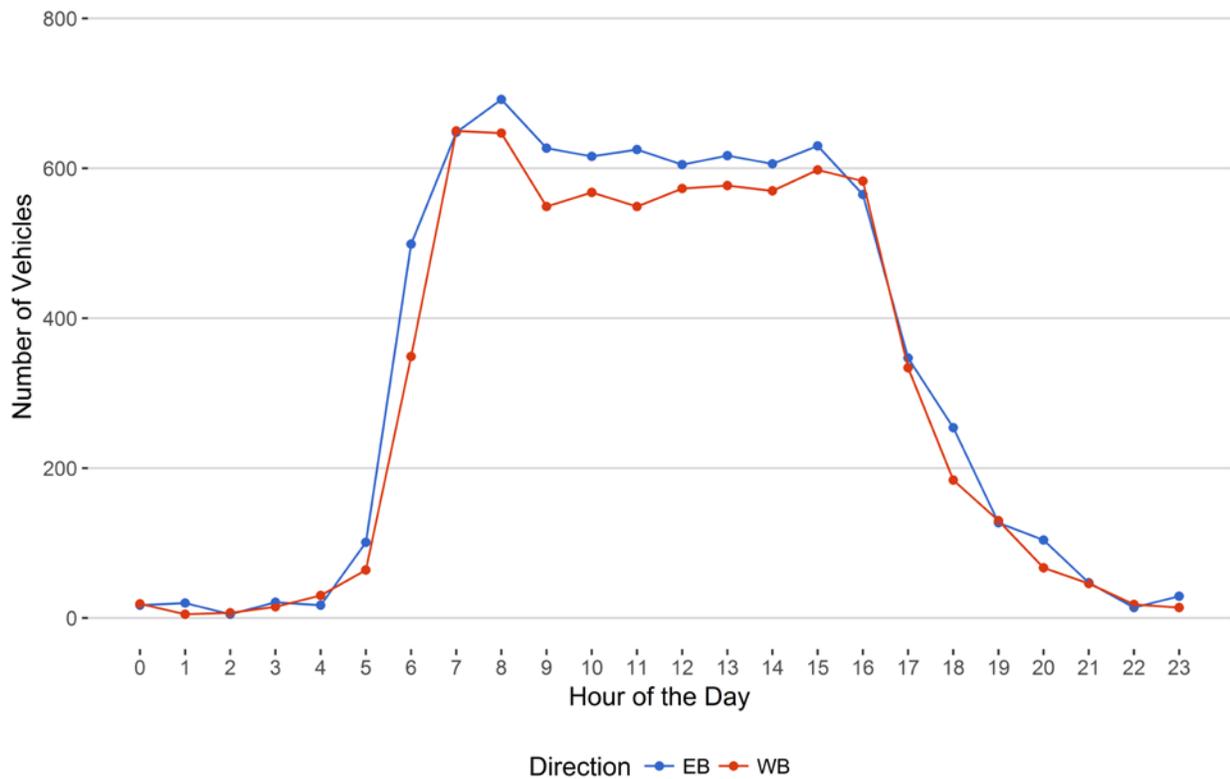


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

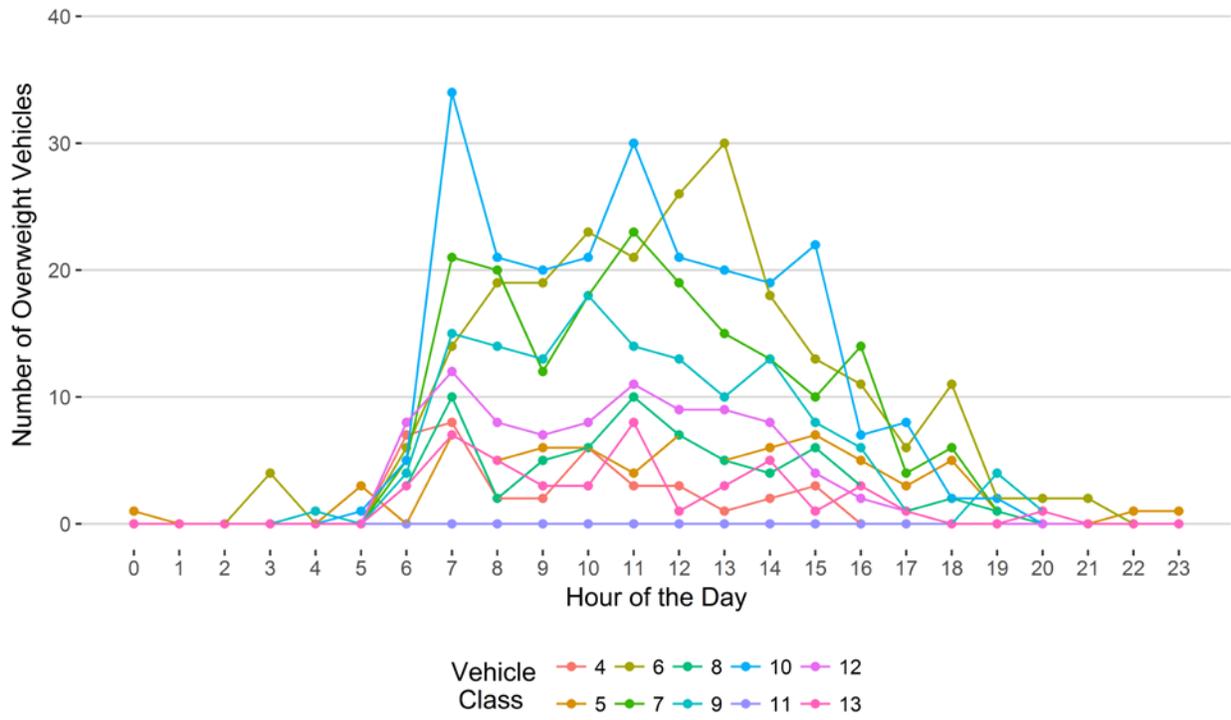


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

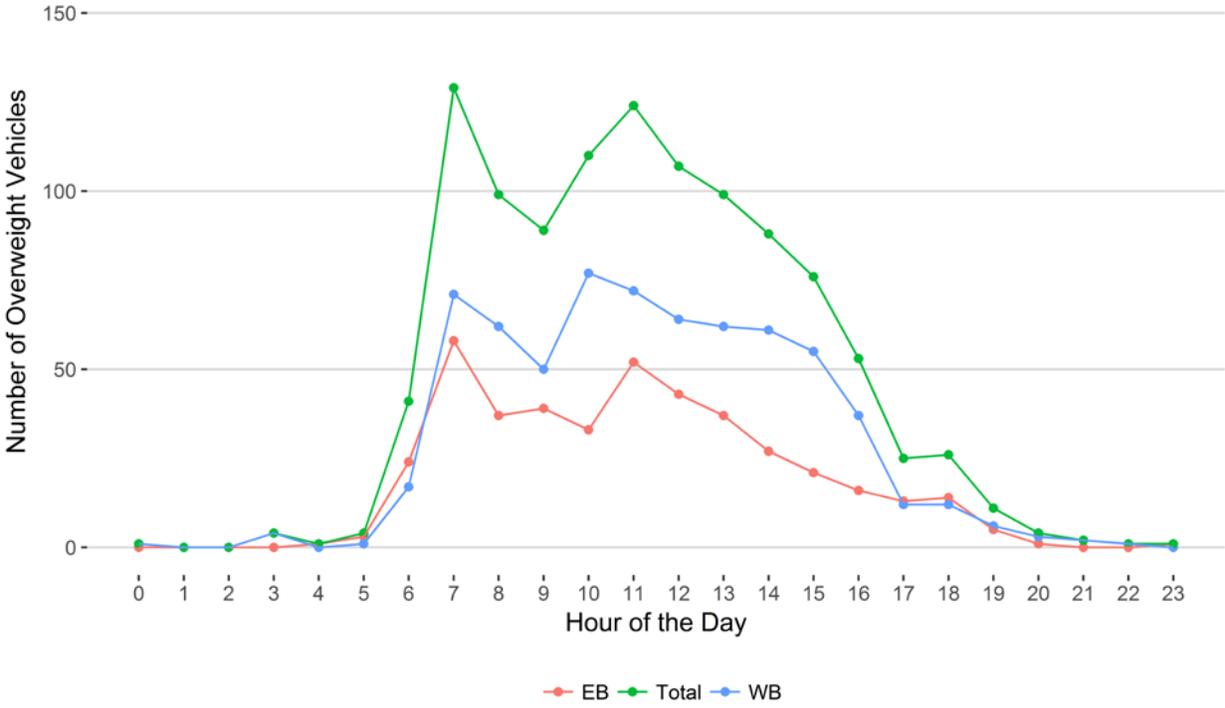
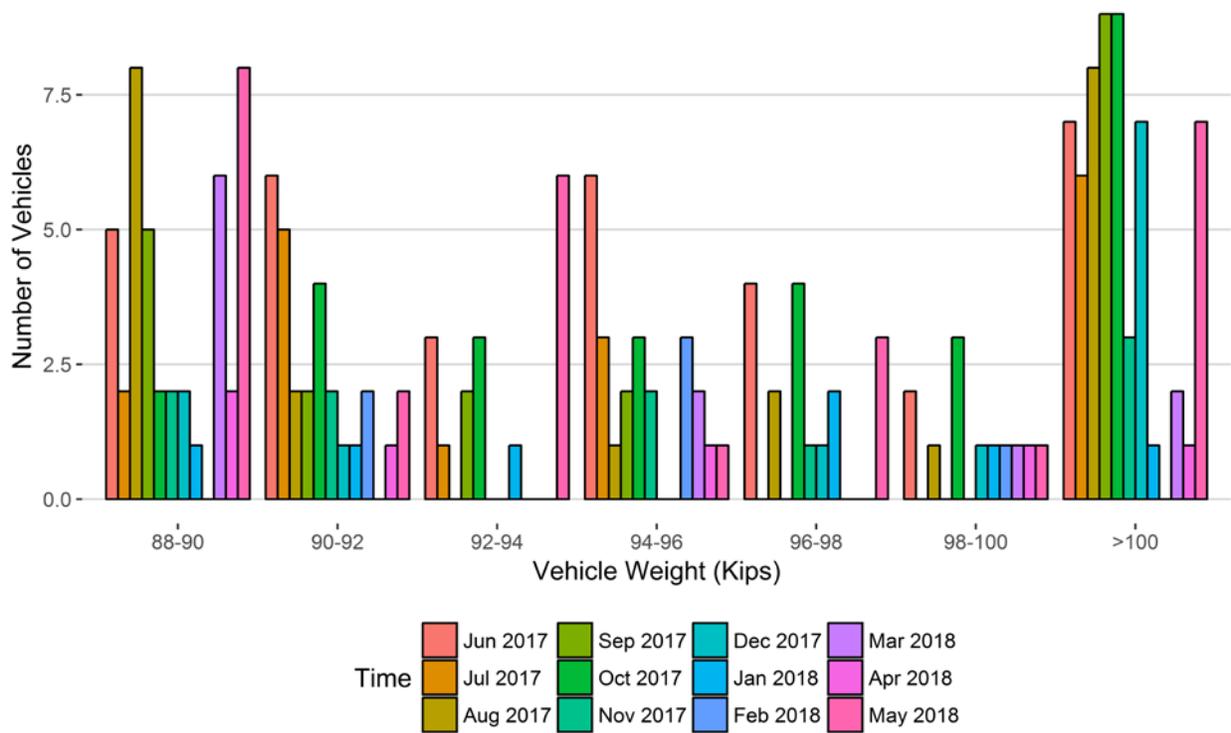
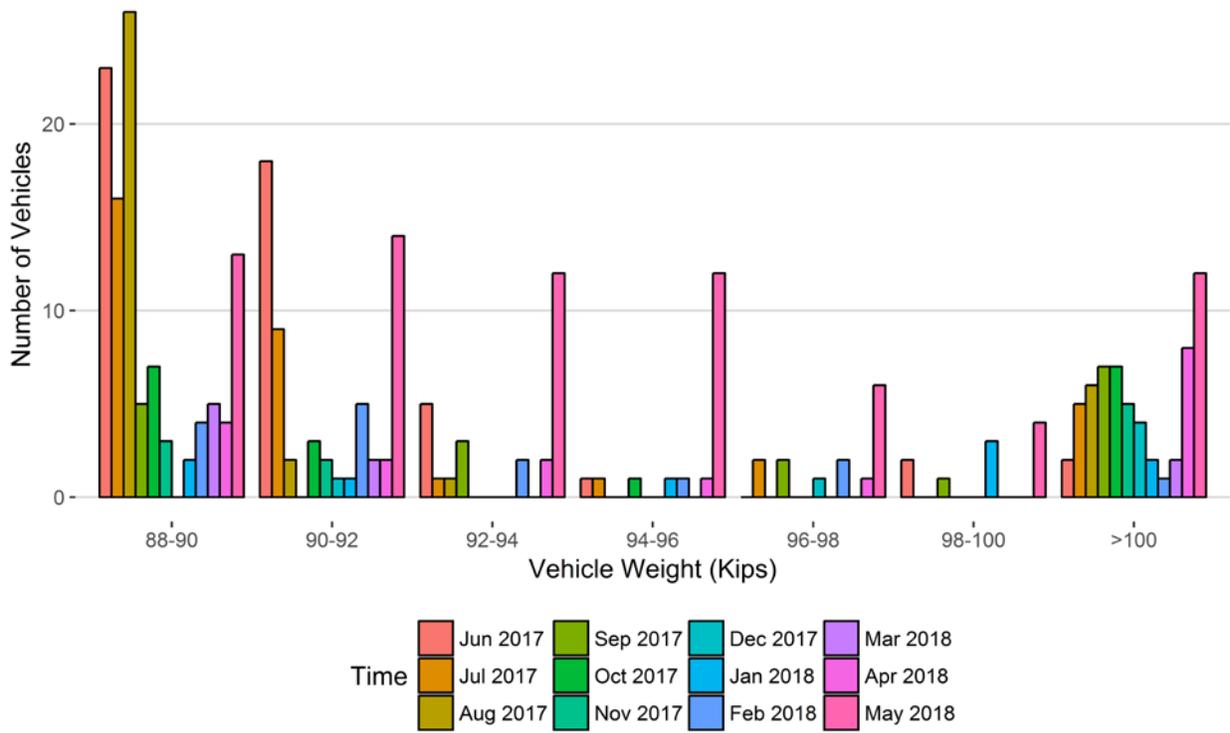


Figure 8 - Histogram of EB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Jun 2017	Jul 2017	Aug 2017	Sep 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018
88-90	5	2	8	5	2	2	2	1	0	6	2	8
90-92	6	5	2	2	4	2	1	1	2	0	1	2
92-94	3	1	0	2	3	0	0	1	0	0	0	6
94-96	6	3	1	2	3	2	0	0	3	2	1	1
96-98	4	0	2	0	4	1	1	2	0	0	0	3
98-100	2	0	1	0	3	0	1	1	1	1	1	1
>100	7	6	8	9	9	3	7	1	0	2	1	7
Total	33	17	22	20	28	10	12	7	6	11	6	28

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



Vehicle Weights (Kips)	Jun 2017	Jul 2017	Aug 2017	Sep 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018
88-90	23	16	26	5	7	3	0	2	4	5	4	13
90-92	18	9	2	0	3	2	1	1	5	2	2	14
92-94	5	1	1	3	0	0	0	0	2	0	2	12
94-96	1	1	0	0	1	0	0	1	1	0	1	12
96-98	0	2	0	2	0	0	1	0	2	0	1	6
98-100	2	0	0	1	0	0	0	3	0	0	0	4
>100	2	5	6	7	7	5	4	2	1	2	8	12
Total	51	34	35	18	18	10	6	9	15	9	18	73

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

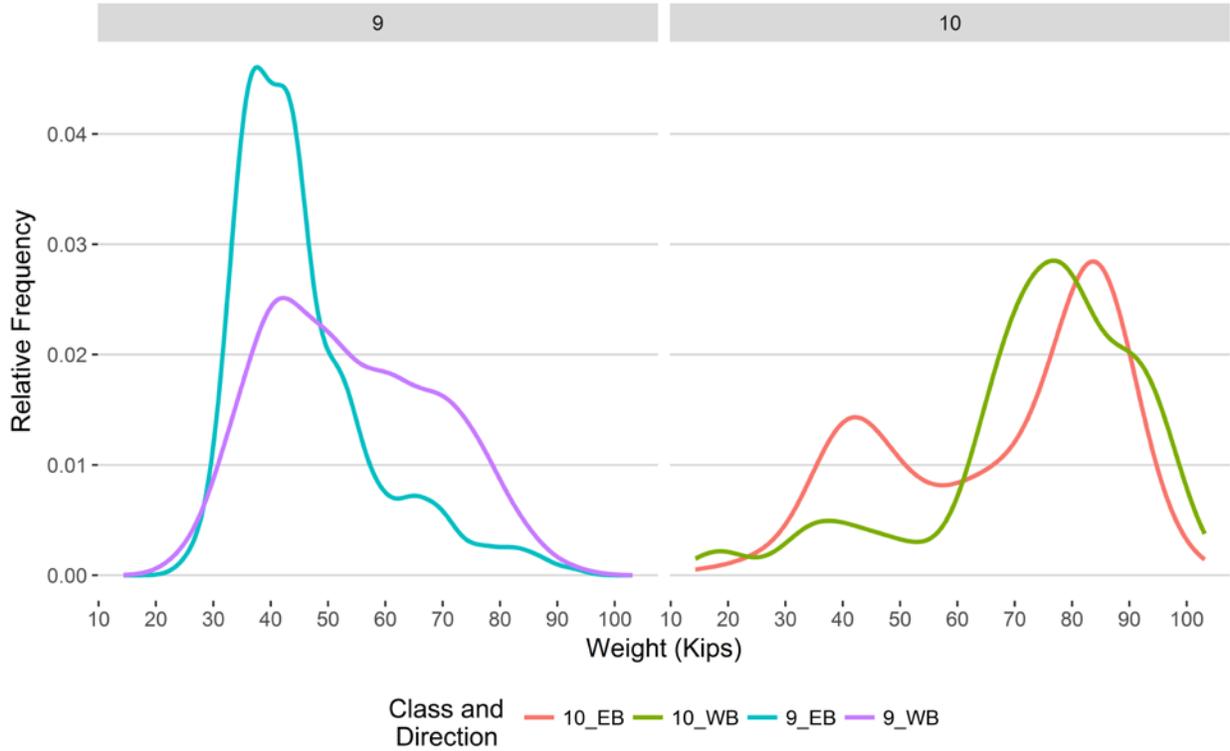


Figure 9 - Freight Percentage by Direction and Class

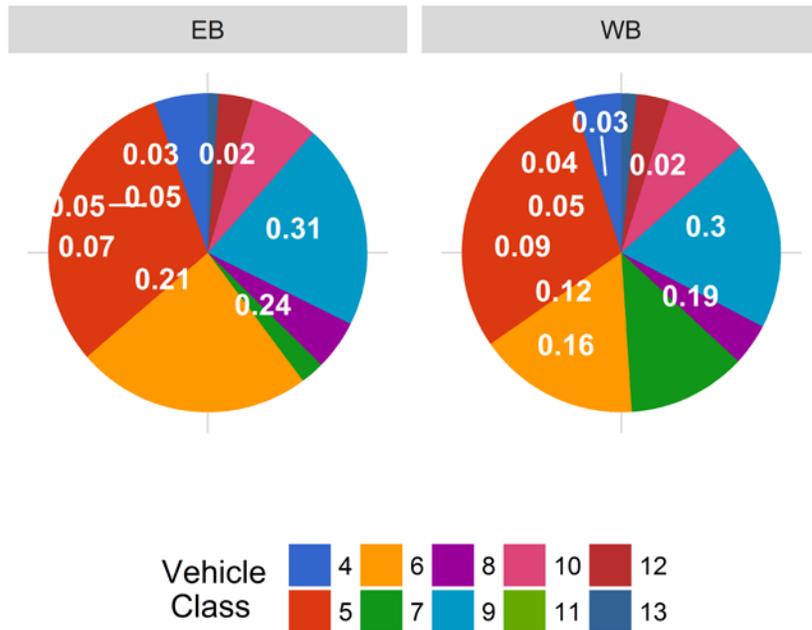


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

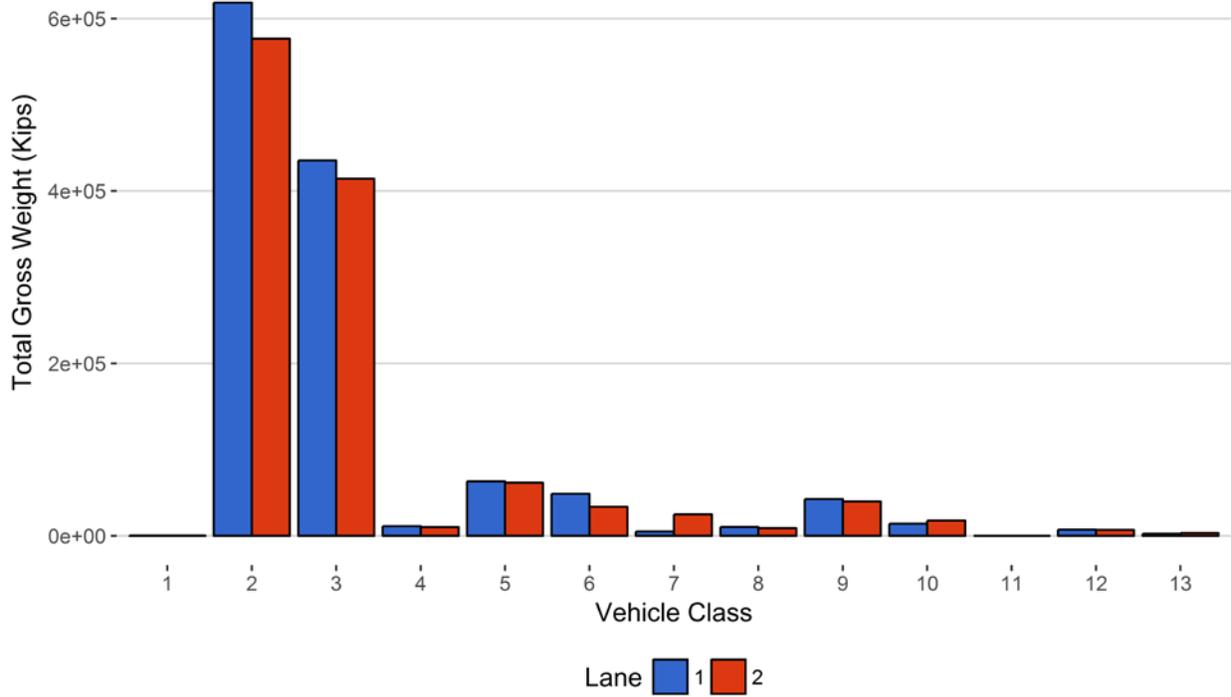


Figure 11 - Total Gross Vehicle Weight I

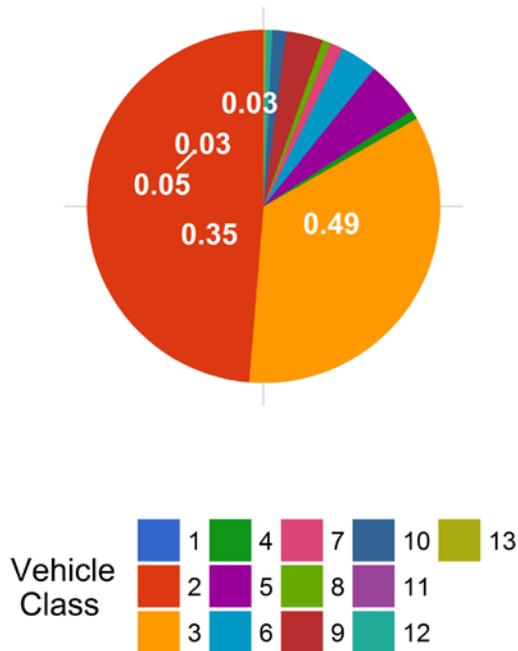


Figure 12 - Total ESALs by Class and Lane

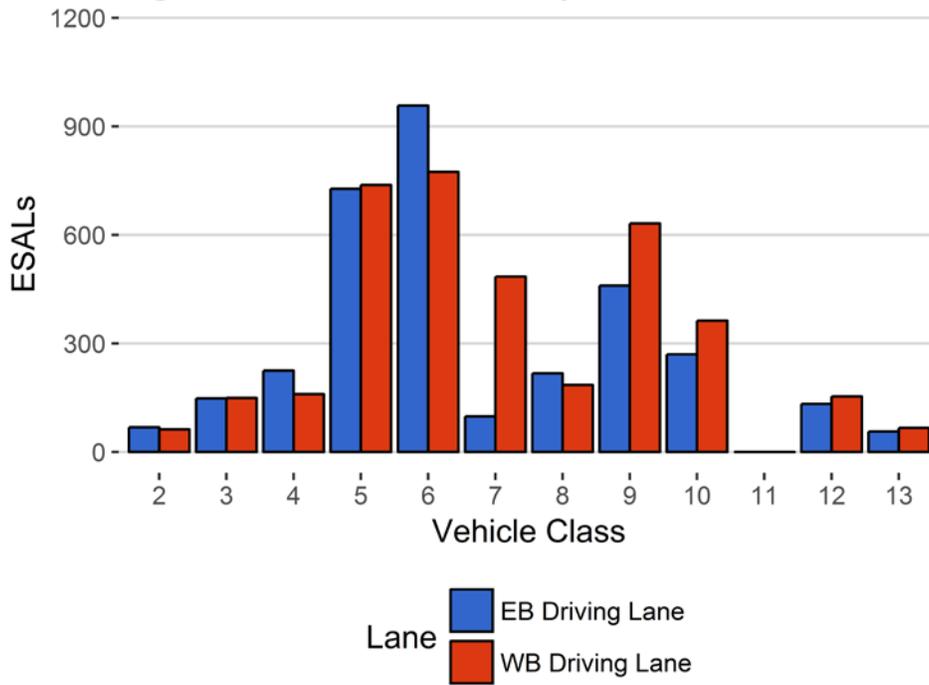


Figure 13 - ESALs by Class

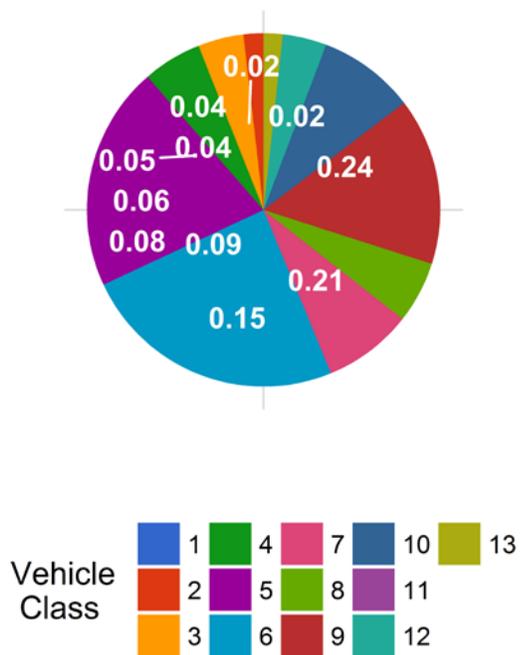


Table 1 Class 9 Front Axle Weight by Lane

<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	11.29	0.00	10.54	0.00
March 2016	11.21	-0.66	10.73	1.86
April 2016	11.05	-2.13	10.74	1.89
May 2016	10.75	-4.71	10.19	-3.28
June 2016	10.71	-5.12	10.39	-1.38
July 2016	10.72	-5.02	10.36	-1.66
October 2016	10.68	-5.35	10.58	0.39
November 2016	10.87	-3.64	10.46	-0.76
March 2017	11.18	-0.93	10.67	1.29
April 2017	11.29	0.03	10.39	-1.41
May 2017	10.93	-3.13	10.57	0.31
June 2017	10.82	-4.11	10.61	0.71
July 2017	10.93	-3.18	10.65	1.01
August 2017	10.86	-3.76	10.50	-0.39
September 2017	10.74	-4.83	10.58	0.39
October 2017	10.76	-4.66	10.48	-0.58
November 2017	10.72	-5.00	10.41	-1.23
December 2017	10.53	-6.74	10.36	-1.74
January 2018	11.18	-0.95	10.56	0.22
February 2018	11.38	0.81	10.80	2.44
March 2018	11.50	1.90	10.88	3.23
April 2018	11.05	-2.07	10.90	3.47
May 2018	10.84	-3.96	10.64	0.98

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	17	520	0.1	0	0
2	10186	315777	66.5	0	0
3	4633	143637	30.2	0	0
4	23	719	0.2	37	3.4
5	275	8535	1.8	73	6.7
6	75	2326	0.5	227	21
7	15	459	0.1	181	16.7
8	21	646	0.1	65	6
9	54	1677	0.4	135	12.5
10	14	446	0.1	233	21.5
11	0	2	0	0	0
12	6	186	0	87	8
13	2	60	0	44	4.1
TOTAL	15322	474991	100	1082	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>
2018-05-29	Tuesday	15:06:40	10	WB	2	103.12
2018-05-21	Monday	11:57:01	10	WB	2	100.52
2018-05-21	Monday	09:58:58	10	WB	2	100.14
2018-05-21	Monday	12:08:15	10	WB	2	99.27
2018-05-21	Monday	08:53:42	10	WB	2	99.22
2018-05-21	Monday	14:17:39	10	WB	2	98.4
2018-05-21	Monday	12:10:30	10	WB	2	98.27
2018-05-24	Thursday	09:21:51	10	EB	1	97.8
2018-05-21	Monday	10:06:09	10	WB	2	97.63
2018-05-21	Monday	08:52:13	10	WB	2	97.42

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	372	58	15.6	10311	778	2800
5	EB	8	4358	474	10.9	59664	3404	14296
6	EB	19	1418	20	1.4	48332	351	10885
7	EB	11.5	81	0	0	4962	0	2015
8	EB	31	341	181	53.1	7121	3172	1080
9	EB	33	934	63	6.7	40703	1941	5980
10	EB	33.5	206	5	2.4	13882	119	3574
11	EB	36.5	2	2	100	0	44	0
12	EB	36.5	97	0	0	7111	0	1785
13	EB	31.5	24	0	0	2267	0	755
TOTAL	****	****	7833	803	****	194354	****	43173
<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	343	41	12	9456	542	2463
5	WB	8	4133	310	7.5	59327	2195	14371
6	WB	19	896	15	1.7	33465	237	8363
7	WB	11.5	376	0	0	24864	0	10270
8	WB	31	302	174	57.6	5728	3021	880
9	WB	33	734	46	6.3	38300	1378	7798
10	WB	33.5	238	10	4.2	17358	233	4860
12	WB	36.5	88	0	0	6821	0	1805
13	WB	31.5	36	0	0	3217	0	1042
TOTAL	****	****	7146	596	****	198536	****	51851
GRAND TOTAL	****	****	14979	1399	279	392889	17415	95024

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	292	240	532	0
2	618583	576737	1195320	48.7
3	435531	414315	849846	34.6
4	11089	9998	21087	0.9
5	63068	61522	124590	5.1
6	48683	33702	82385	3.4
7	4962	24864	29827	1.2
8	10293	8749	19042	0.8
9	42644	39678	82322	3.4
10	14001	17590	31591	1.3
11	44	0	44	0
12	7111	6821	13933	0.6
13	2267	3217	5484	0.2
TOTAL	1258569	1197434	2456003	100
GVW/LANE	51.24	48.76	100	0

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	0.0019
2	68	62	131	1.8	8e-04
3	148	150	298	4.2	0.0042
4	225	160	385	5.4	1.08
5	728	738	1466	20.6	0.35
6	958	774	1732	24.3	1.51
7	98	485	583	8.2	2.55
8	218	185	403	5.7	1.26
9	460	632	1092	15.3	1.32
10	270	363	633	8.9	2.83
11	0	0	0	0	0.85
12	133	154	287	4	2.99
13	57	67	124	1.7	3.59
TOTAL	3363	3770	7133	100	18
ESALS/LANE	47.1	52.9	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>
Jun 2017	453923	15131	415	441488	97.3	12435.4	2.7
Jul 2017	443990	14322	382	432147	97.3	11843.4	2.7
Aug 2017	449958	14515	431	436604	97	13354	3
Sep 2017	428575	14286	412	416216	97.1	12359.3	2.9
Oct 2017	431651	13924	387	419648	97.2	12002.7	2.8
Nov 2017	386452	12882	329	376587	97.4	9865.3	2.6
Dec 2017	376429	12143	262	368302	97.8	8127.3	2.2
Jan 2018	355465	11467	261	347380	97.7	8085	2.3
Feb 2018	325130	11612	263	317772	97.7	7358.3	2.3
Mar 2018	372037	12001	262	363916	97.8	8121	2.2
Apr 2018	380697	12690	315	371242	97.5	9455.4	2.5
May 2018	474991	15322	486	459934	96.8	15057	3.2
TOTAL	4879298	--	--	4751236	--	128064	--
AVERAGE	406608	13358	350	395936	97	10672	3

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>
Jun 2017	3121	3091	6212	3.7
Jul 2017	2944	2874	5818	2.5
Aug 2017	3339	3144	6484	1.5
Sep 2017	2556	2289	4845	1.6
Oct 2017	2635	2471	5106	5
Nov 2017	2032	1968	4000	1.9
Dec 2017	3283	1617	4900	0.8
Jan 2018	1757	1548	3305	1
Feb 2018	1598	1410	3008	1.6
Mar 2018	1922	1690	3612	2.3
Apr 2018	2022	1838	3860	0.9
May 2018	3365	3799	7164	6.9
TOTAL	30574	--	--	--
AVERAGE	2548	2312	4859	2

Gross Vehicle Weight

<i>Month</i>	<i>GVW EB Driving Lane</i>	<i>GVW WB Driving Lane</i>	<i>Total GVW Kips</i>
Jun 2017	863971	774480	1638451
Jul 2017	794931	697417	1492348
Aug 2017	906278	785702	1691980
Sep 2017	951084	865467	1816551
Oct 2017	1258909	1200368	2459277
Nov 2017	1127354	1007720	2135074
Dec 2017	1100039	981541	2081580
Jan 2018	1144199	1024598	2168797
Feb 2018	956898	854725	1811623
Mar 2018	1075078	966463	2041541
Apr 2018	936552	846652	1783204
May 2018	888219	819015	1707234
TOTAL	12003513	10824149	22827662
AVERAGE	1000293	902012	1902305

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>
Jun 2017	1043	0.2	5.9	89	18
Jul 2017	928	0.2	5.5	51	11
Aug 2017	986	0.2	5.6	57	15
Sep 2017	712	0.2	4.8	38	17
Oct 2017	701	0.2	4.4	46	19
Nov 2017	526	0.1	3.8	21	8
Dec 2017	413	0.1	3.6	23	17
Jan 2018	363	0.1	3.1	16	7
Feb 2018	348	0.1	3.2	21	2
Mar 2018	412	0.1	3.2	20	5
Apr 2018	427	0.1	3.6	24	10
May 2018	1095	0.2	7.1	101	24
TOTAL	7954	--	--	507	153
AVERAGE	662.8	0.2	4.5	42.2	12.8

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>
Jun 2017	42002	41361	83363	50.4	49.6
Jul 2017	37976	36984	74960	50.7	49.3
Aug 2017	43397	41766	85163	51	49
Sep 2017	34598	30379	64977	53.2	46.8
Oct 2017	35932	34011	69943	51.4	48.6
Nov 2017	27530	27260	54790	50.2	49.8
Dec 2017	21124	21090	42214	50	50
Jan 2018	21619	19888	41507	52.1	47.9
Feb 2018	19893	18452	38345	51.9	48.1
Mar 2018	23367	21391	44757	52.2	47.8
Apr 2018	25949	23798	49747	52.2	47.8
May 2018	43173	51851	95024	45.4	54.6
TOTAL	376560	368232	744792	--	--
AVERAGE	31380	30686	62066	50.9	49.1