

NOVEMBER 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 November 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: 398210 | Passenger Vehicles: 387448 | Heavy Commercial Vehicles: 10762

Monthly Average Daily Traffic (MADT): 13274 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 359

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 Wednesdays, 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 10762 HCVs, 604 of them were overweight³. These overweight HCVs contributed to 0.2% of total monthly volume, and 5.6% of total monthly HCV volume. EB overweight vehicles typically reached highest numbers on Tuesdays, with lowest volumes reported on Sundays. 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 6 and class 9 vehicles . Overall, overweight vehicles tended to reach peak volume concentrations during typical business hours, with 53.2% 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 October.

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 ,27 EB vehicles exceeded 88,000 pounds (11 vehicles were Class 13's; 8 vehicles were Class 9's). Of vehicles traveling WB,

21 EB vehicles exceeded 88,000 pounds (13 vehicles were Class 10's; 8 vehicles were Class 13's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from November 2018.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9s and 10s in November 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 61781 tons of freight was recorded to have crossed the WIM. More freight was shipped EB (52.6%) than WB (47.4%). 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 398210 vehicles with a combined GVW of 1985615 kips (1 kip = 1,000 pounds = 0.5 tons) in November 2018. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 4793 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 52.4% of all ESALs were recorded EB while 47.6% was observed WB. In particular, 27% of all ESALs were generated by the Class 5's (Class 5's

were also responsible for generating 5% 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).

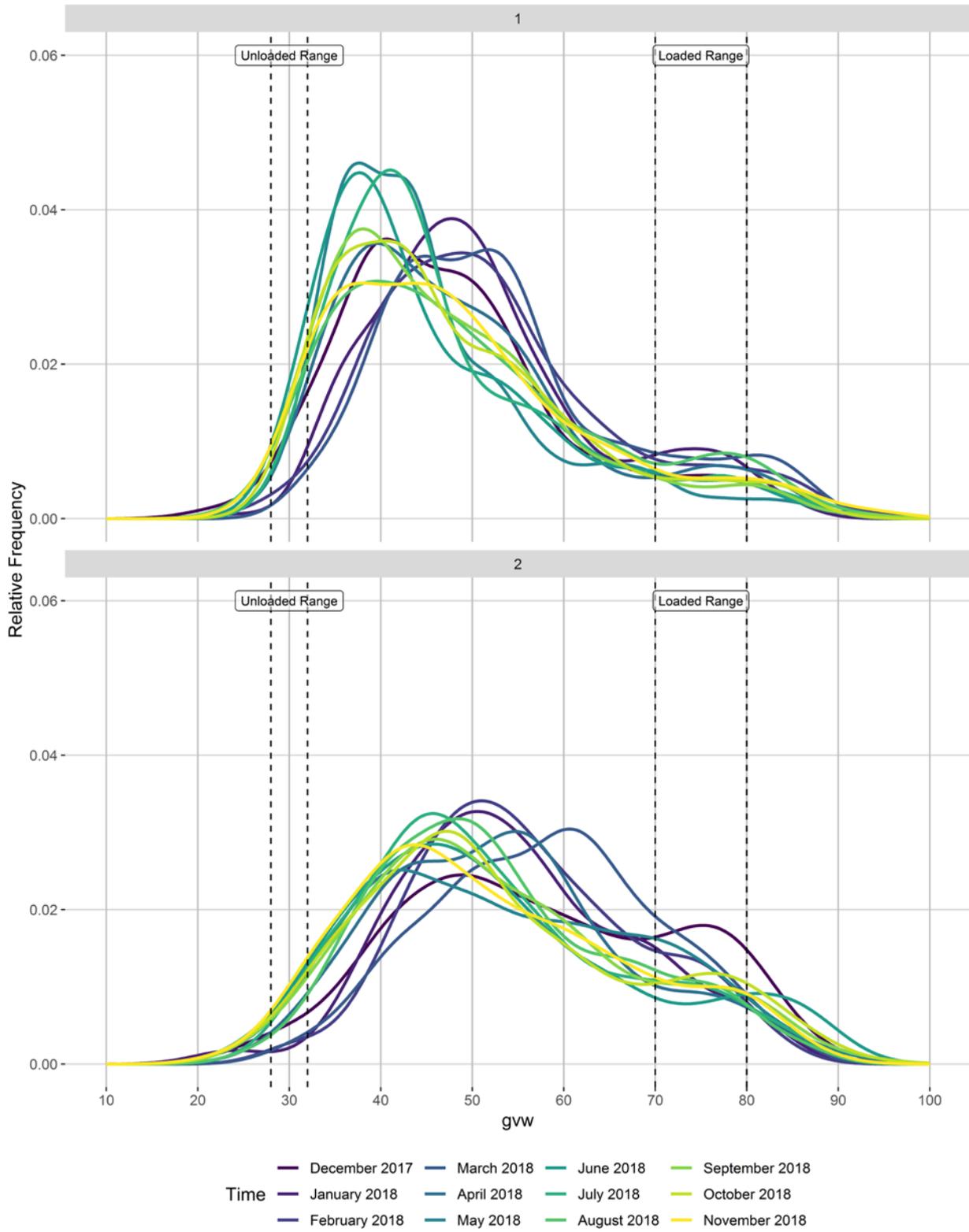
WIM monthly reports can be found at: <http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html>

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.

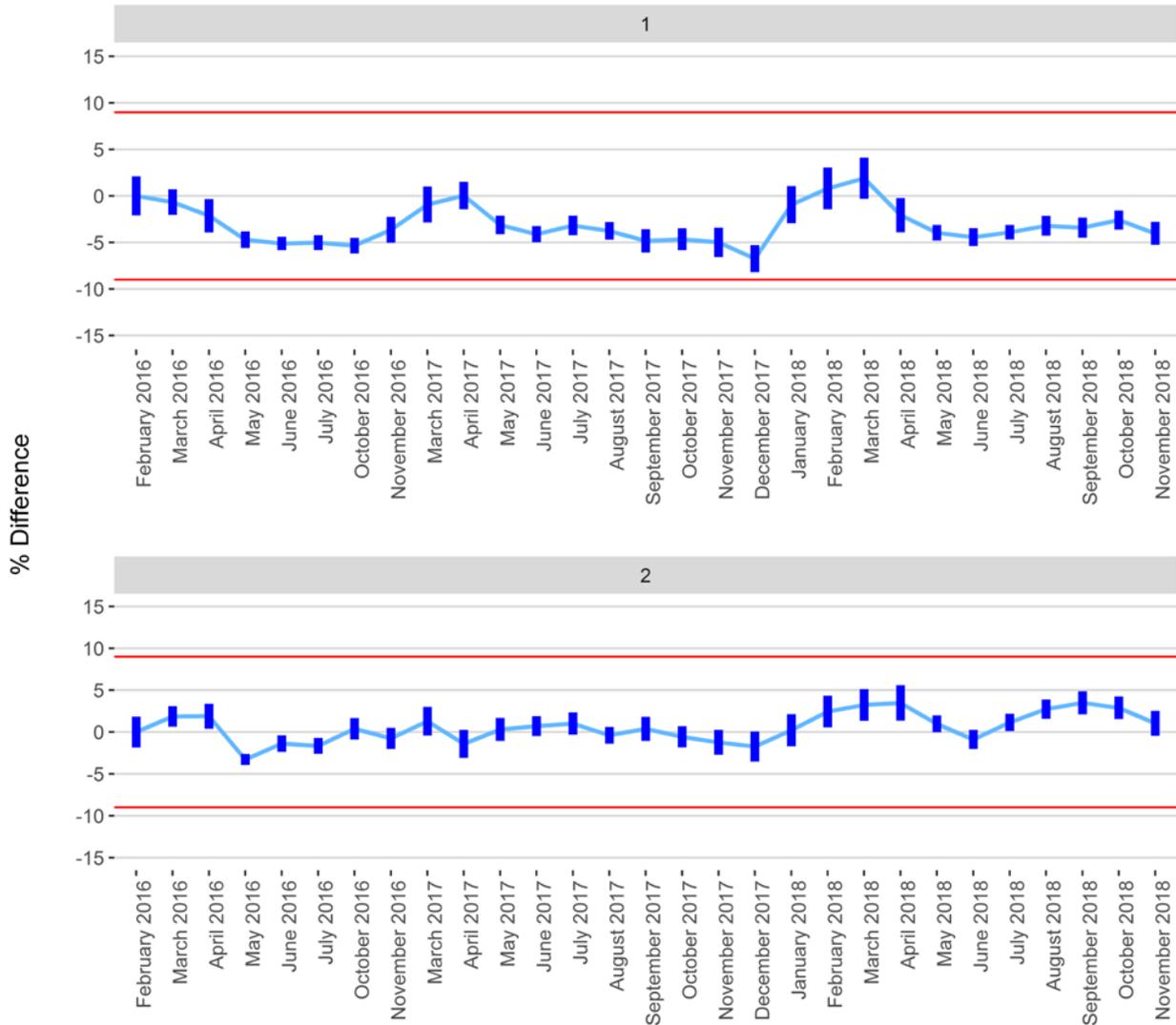
To request this document in an alternative format, please call 651-366-4718 or 1-800-657-3774, or email your request to ADArequest.dot@state.mn.us. Please request at least one week in advance.

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

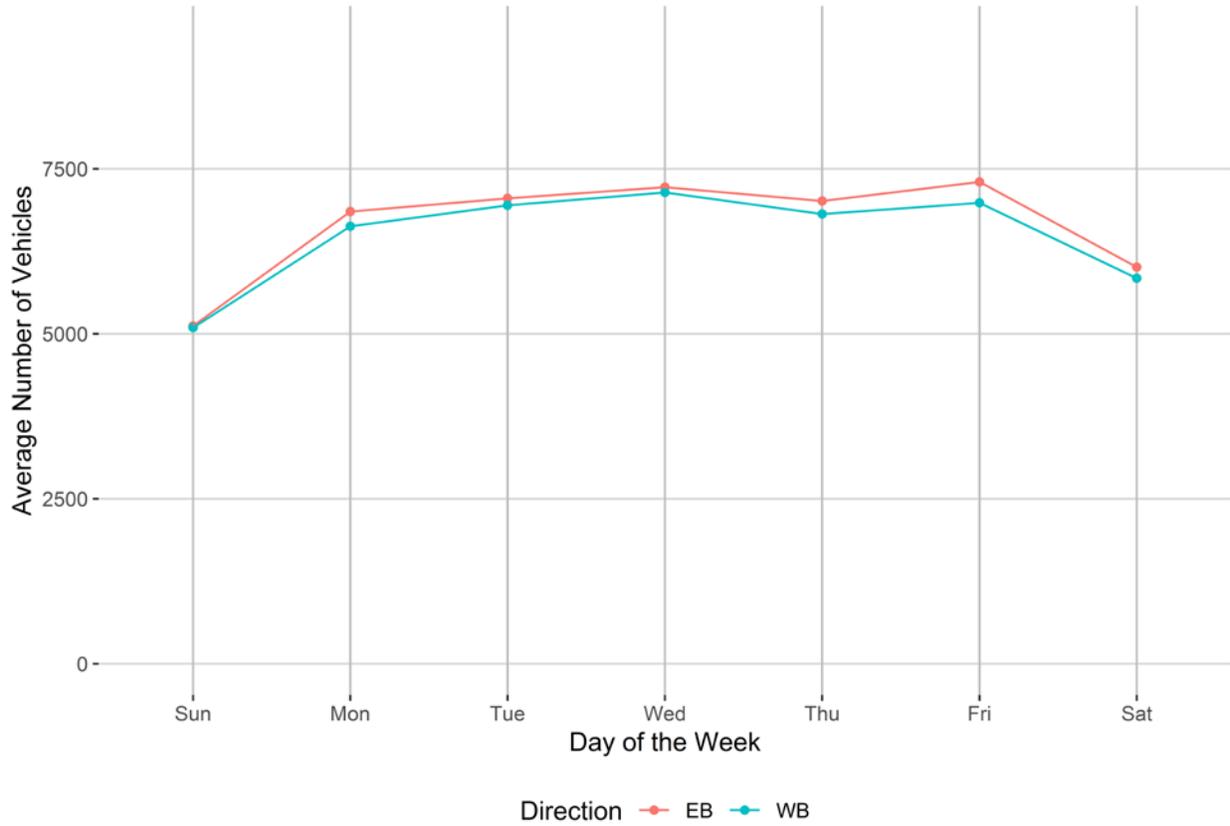


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

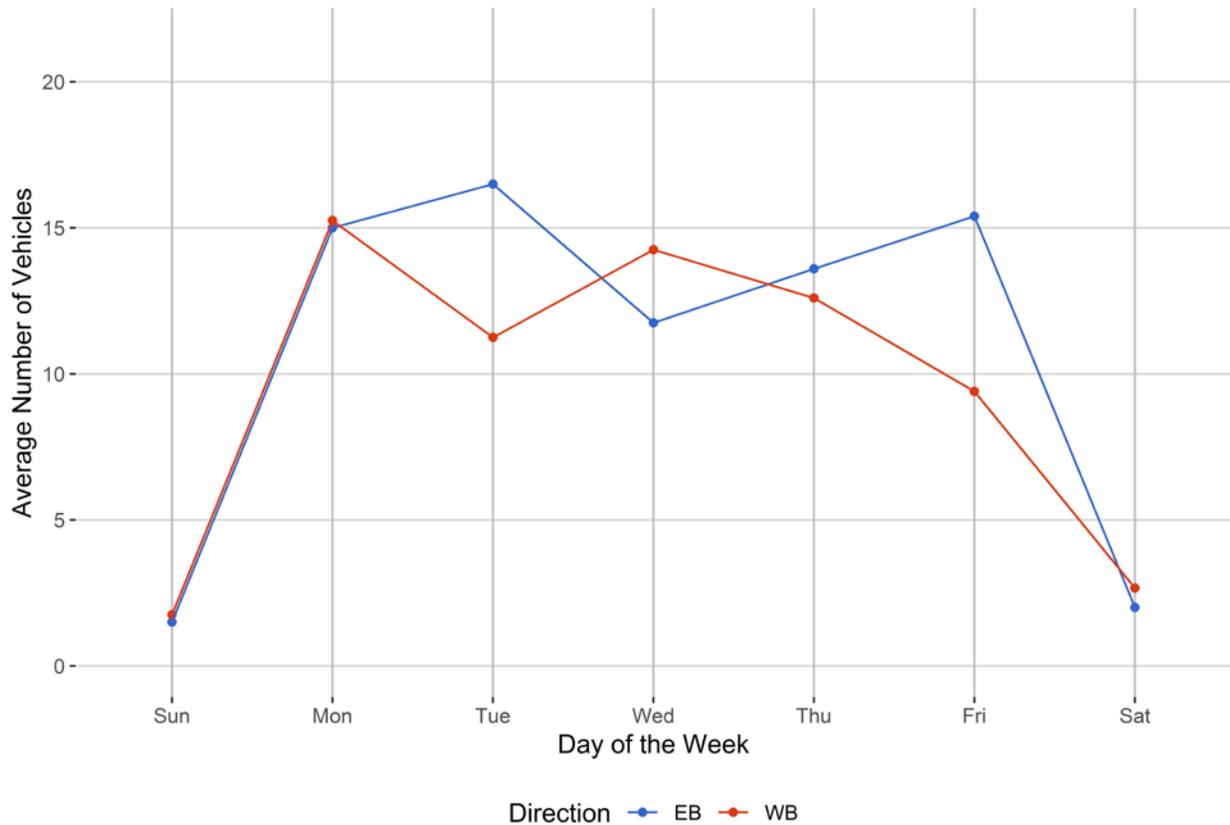


Figure 4 - Passenger Vehicles vs. Hour of the Day

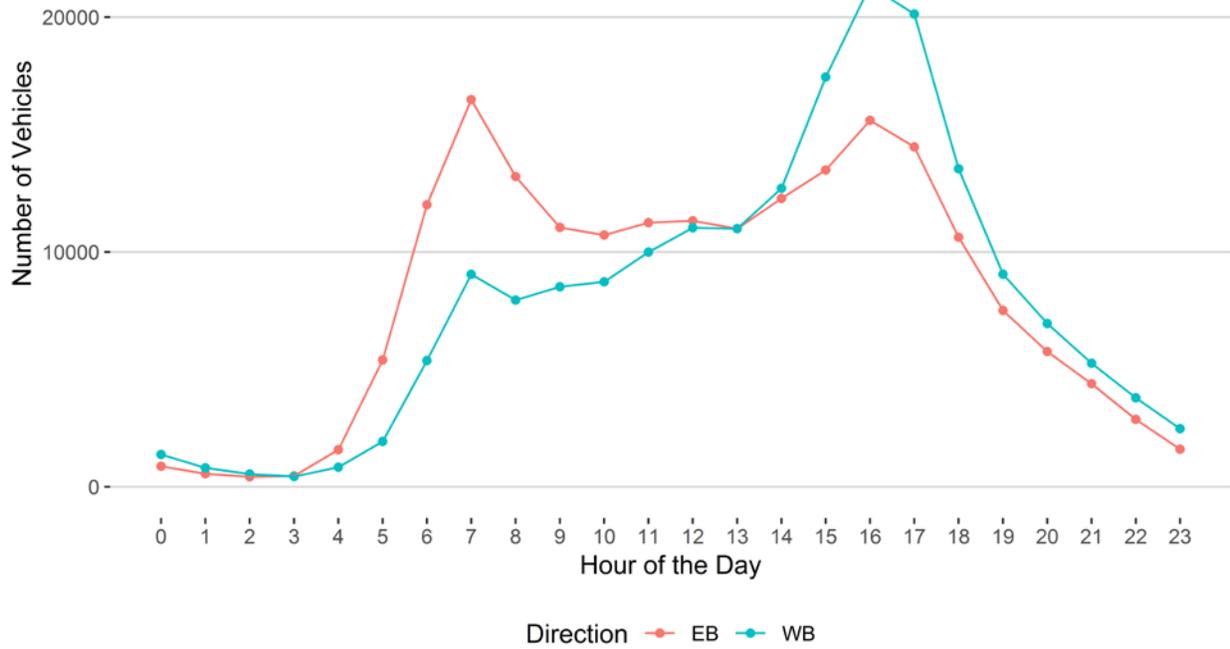


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

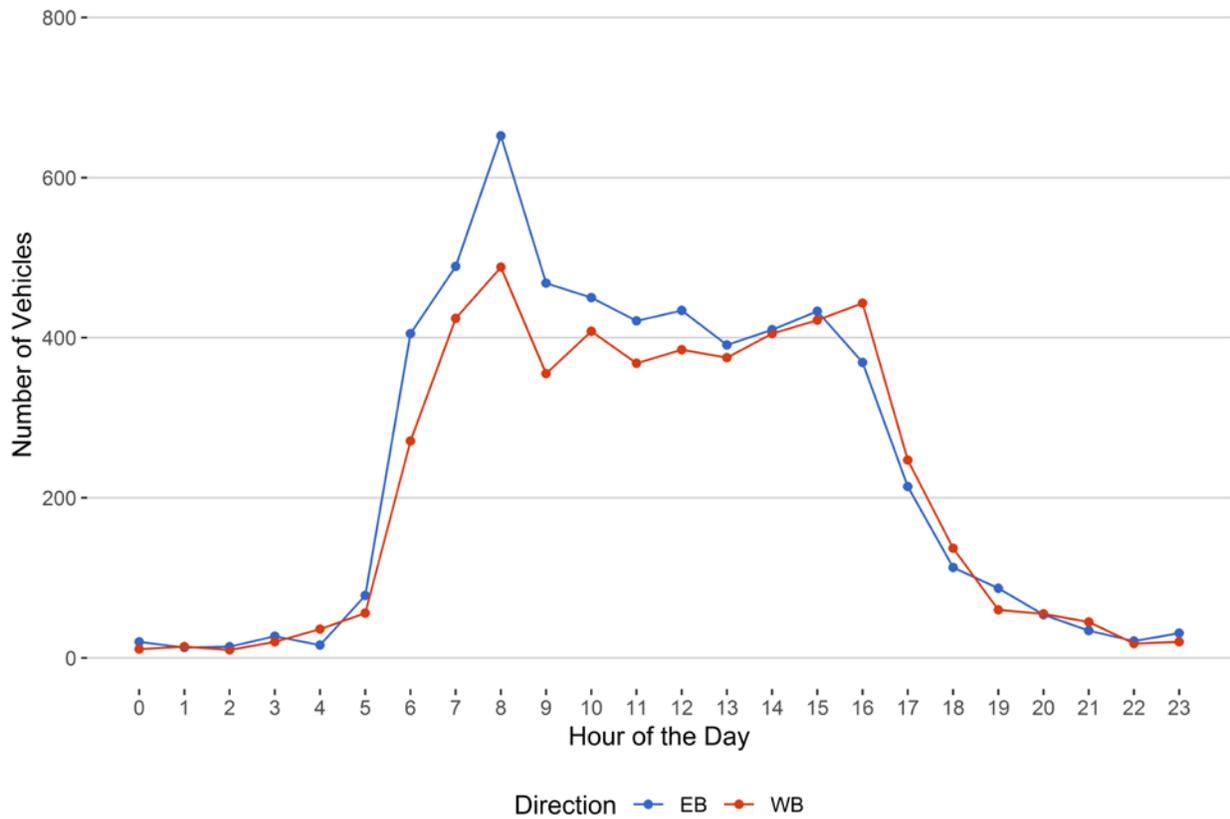


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

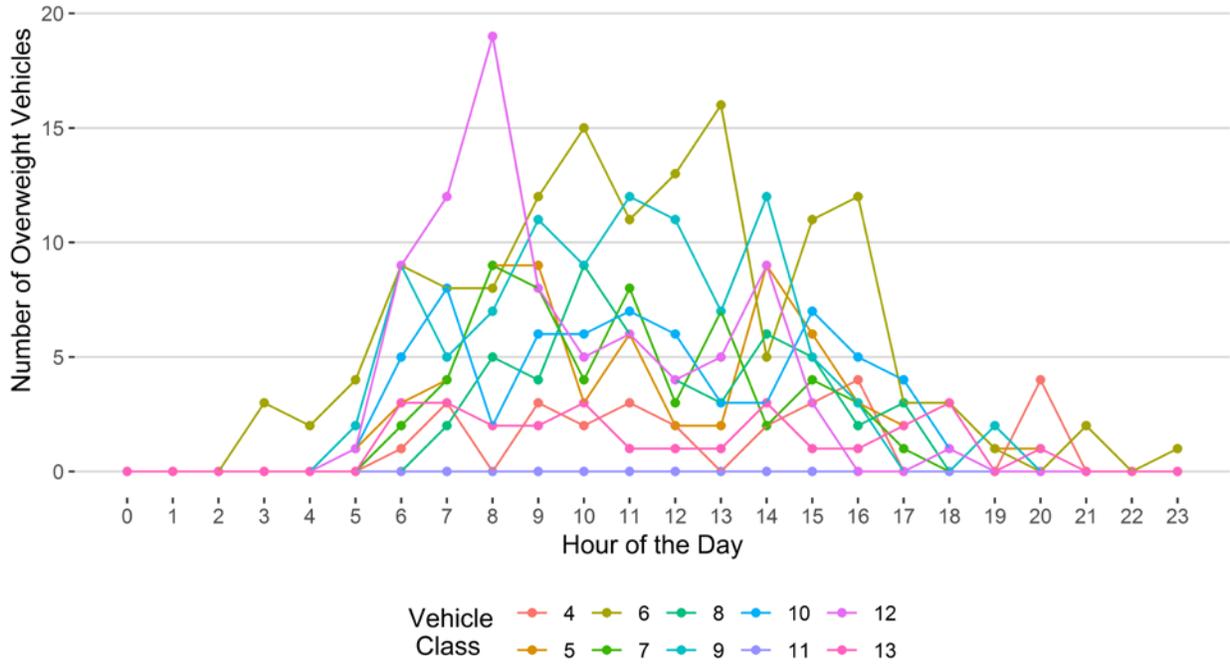


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

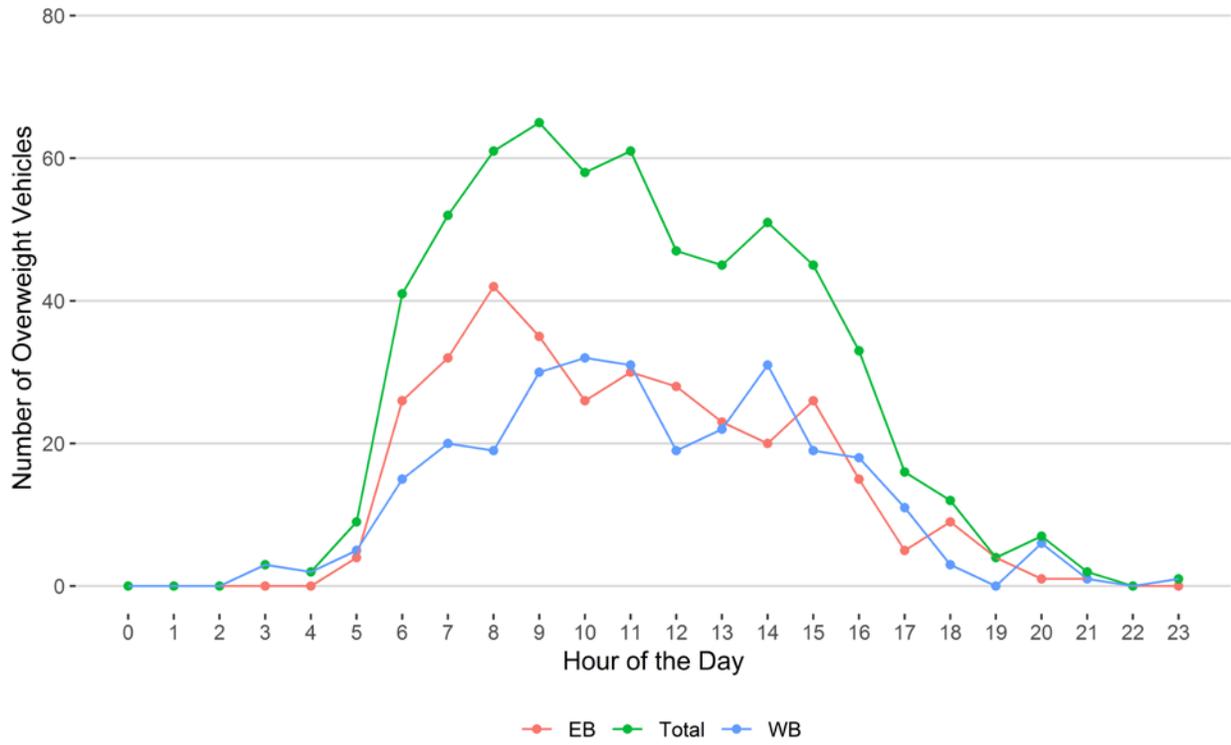
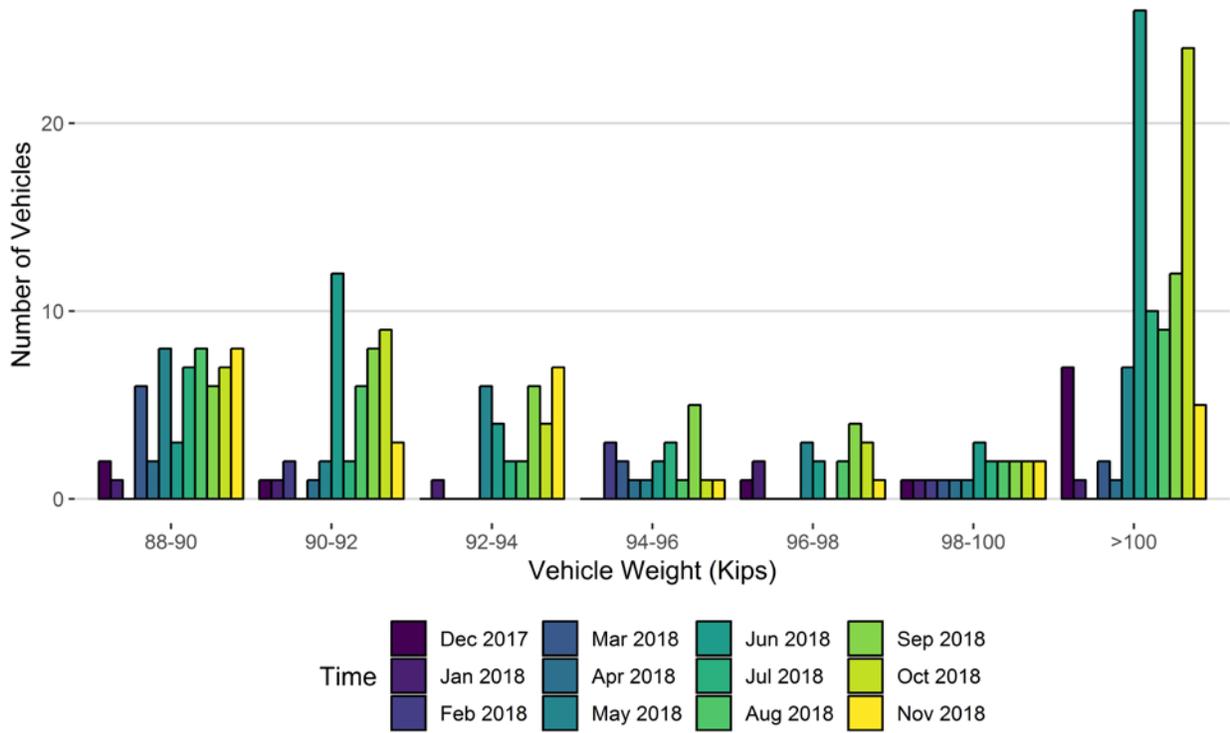
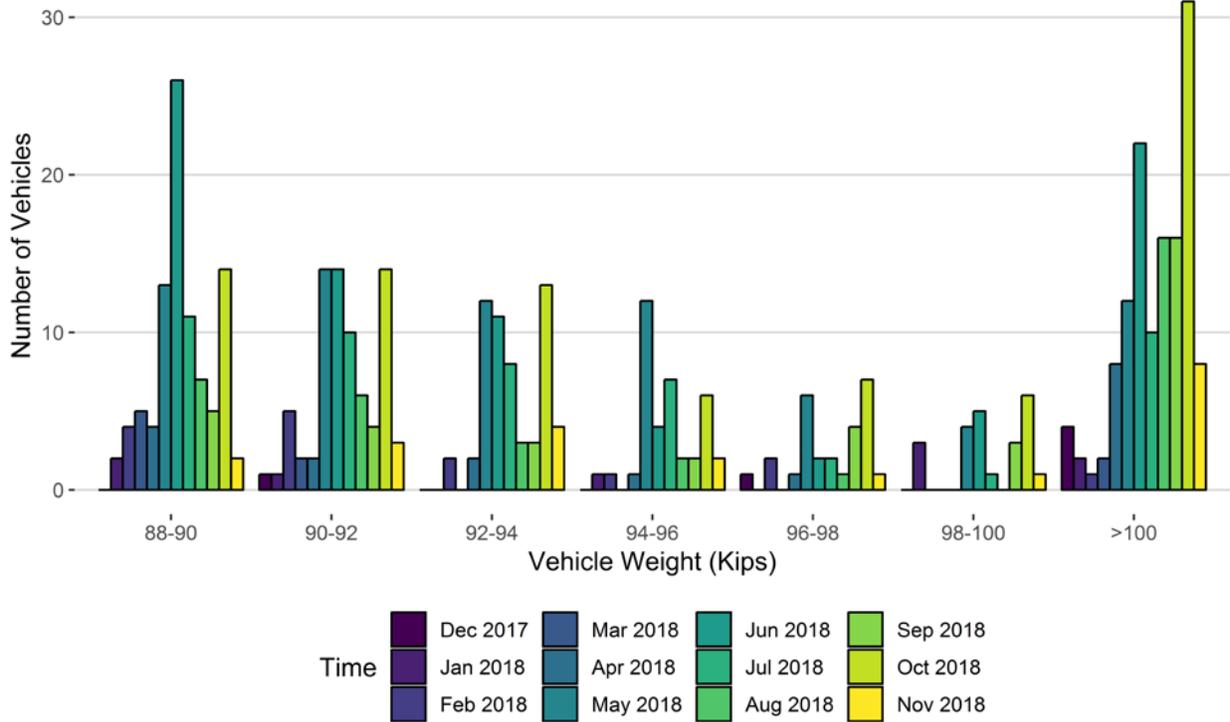


Figure 8 - Histogram of EB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Oct 2018	Nov 2018
88-90	2	1	0	6	2	8	3	7	8	6	7	8
90-92	1	1	2	0	1	2	12	2	6	8	9	3
92-94	0	1	0	0	0	6	4	2	2	6	4	7
94-96	0	0	3	2	1	1	2	3	1	5	1	1
96-98	1	2	0	0	0	3	2	0	2	4	3	1
98-100	1	1	1	1	1	1	3	2	2	2	2	2
>100	7	1	0	2	1	7	26	10	9	12	24	5
Total	12	7	6	11	6	28	52	26	30	43	50	27

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



Vehicle Weights (Kips)	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Oct 2018	Nov 2018
88-90	0	2	4	5	4	13	26	11	7	5	14	2
90-92	1	1	5	2	2	14	14	10	6	4	14	3
92-94	0	0	2	0	2	12	11	8	3	3	13	4
94-96	0	1	1	0	1	12	4	7	2	2	6	2
96-98	1	0	2	0	1	6	2	2	1	4	7	1
98-100	0	3	0	0	0	4	5	1	0	3	6	1
>100	4	2	1	2	8	12	22	10	16	16	31	8
Total	6	9	15	9	18	73	84	49	35	37	91	21

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

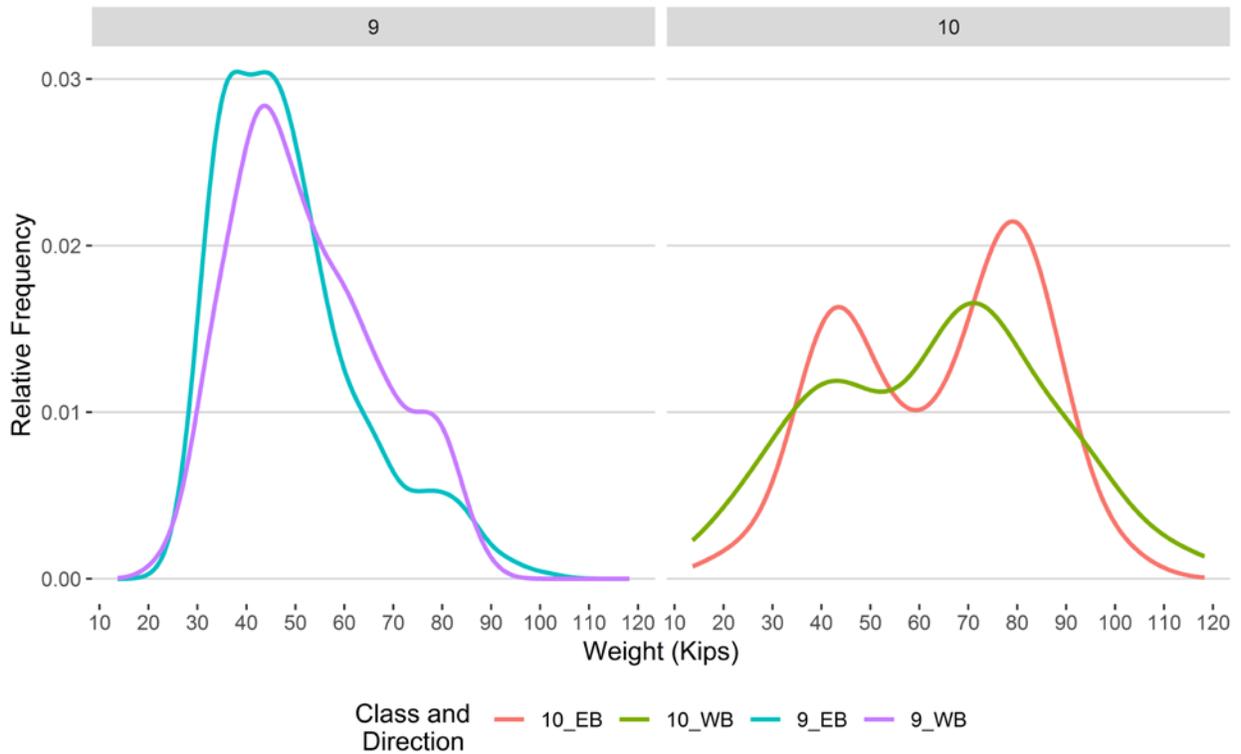


Figure 9 - Freight Percentage by Direction and Class

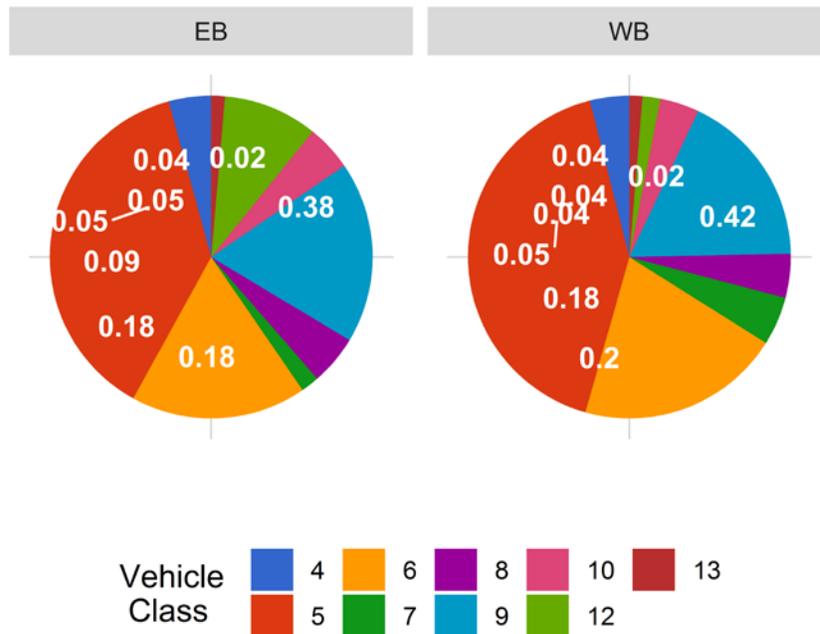


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

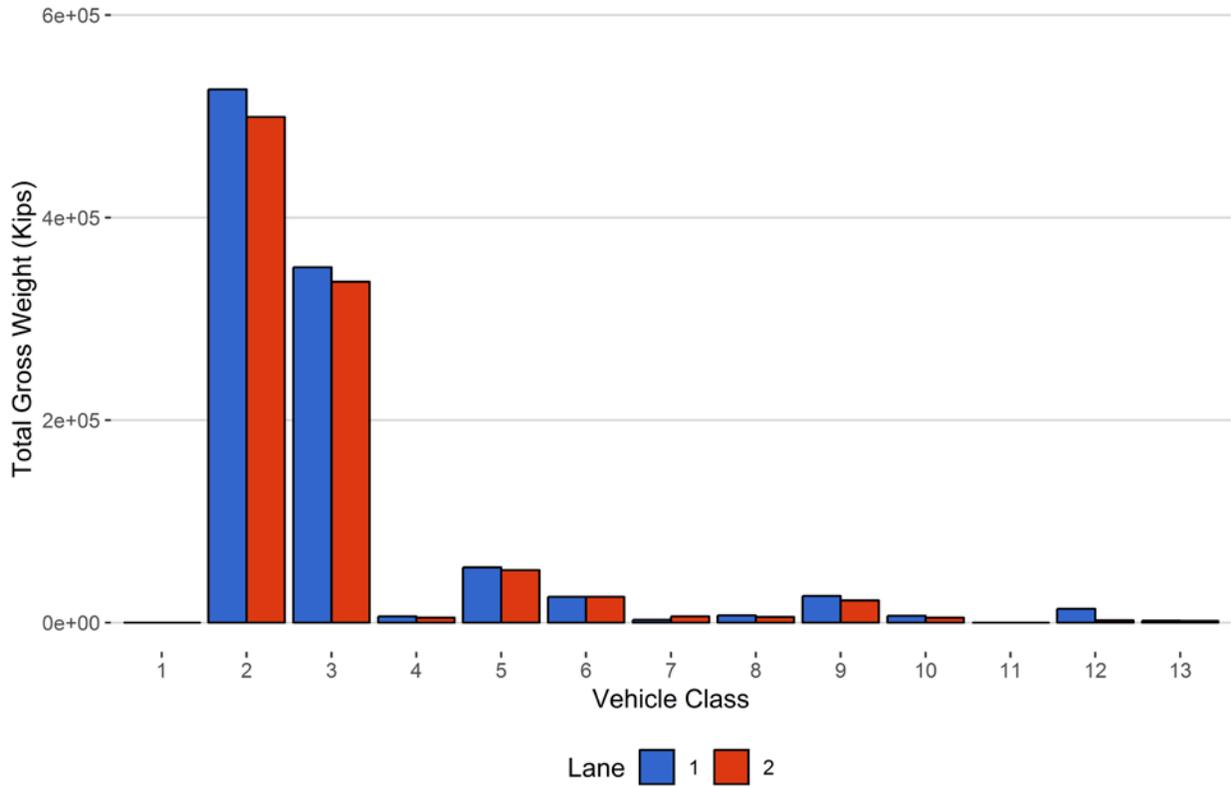


Figure 11 - Total Gross Vehicle Weight t

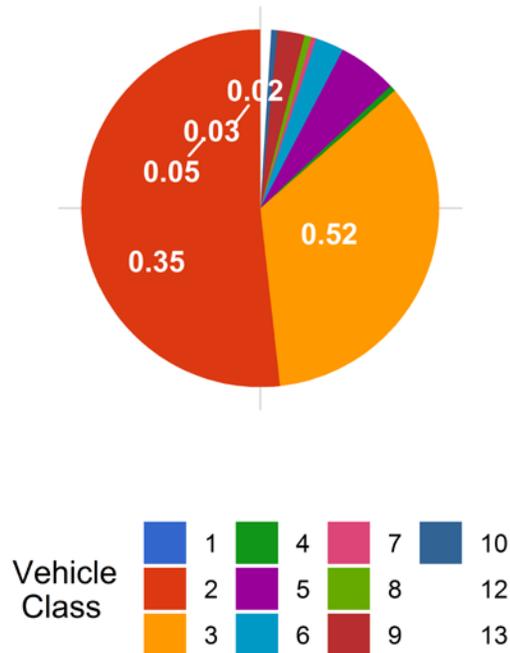


Figure 12 - Total ESALs by Class and Lane

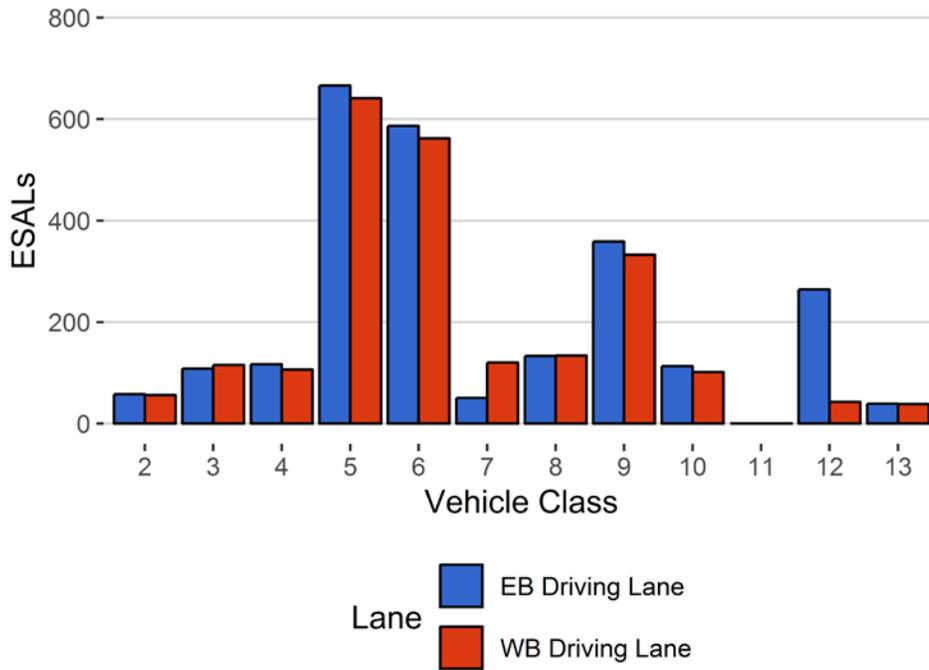


Figure 13 - ESALs by Class

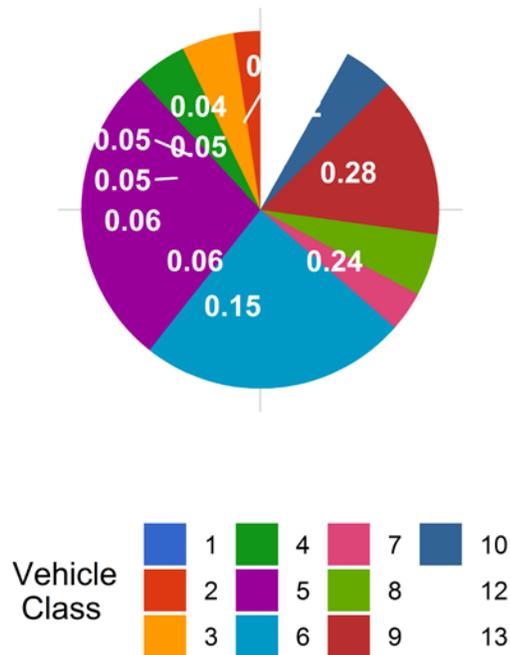


Table 1 Class 9 Front Axle Weight by Lane

<i>Month</i>	<i>Lane 1 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 2 (Kips)</i>	<i>Front Axle +/- 9%</i>
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
June 2018	10.79	-4.43	10.44	-0.89
July 2018	10.84	-3.91	10.66	1.15
August 2018	10.92	-3.21	10.83	2.74
September 2018	10.90	-3.41	10.91	3.49
October 2018	10.99	-2.60	10.84	2.89
November 2018	10.83	-4.03	10.65	1.04

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	10	0	0	0
2	8955	268664	67.5	0	0
3	3959	118774	29.8	0	0
4	13	377	0.1	28	4.6
5	235	7062	1.8	64	10.6
6	46	1371	0.3	139	23
7	5	138	0	55	9.1
8	14	418	0.1	49	8.1
9	32	960	0.2	95	15.7
10	6	182	0	65	10.8
11	0	0	0	0	0
12	7	213	0.1	82	13.6
13	1	42	0	27	4.5
TOTAL	13274	398210	100	604	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>
2018-11-27	Tuesday	07:17:53	10	WB	2	118.26
2018-11-16	Friday	12:05:40	10	WB	2	108.47
2018-11-06	Tuesday	10:18:57	10	WB	2	107.71
2018-11-12	Monday	13:06:47	10	EB	1	103.2
2018-11-22	Thursday	14:04:53	9	EB	1	101.68
2018-11-09	Friday	08:20:54	10	WB	2	99.78
2018-11-01	Thursday	06:45:25	10	EB	1	99.76
2018-11-22	Thursday	08:56:07	9	EB	1	97.29
2018-11-15	Thursday	11:11:02	10	EB	1	95.52
2018-11-07	Wednesday	20:13:46	10	WB	2	95.05

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	205	31	15.1	5729	408	1559
5	EB	8	3622	349	9.6	52044	2492	12930
6	EB	19	695	9	1.3	25275	165	6121
7	EB	11.5	44	0	0	2645	0	1070
8	EB	31	231	109	47.2	5248	1941	733
9	EB	33	537	49	9.1	24764	1510	4330
10	EB	33.5	104	4	3.8	6567	101	1608
12	EB	36.5	182	0	0	13664	0	3511
13	EB	31.5	24	0	0	1980	0	612
TOTAL	****	****	5644	551	****	137916	****	32474
<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	170	26	15.3	4538	349	1189
5	WB	8	3411	251	7.4	50039	1728	12379
6	WB	19	670	5	0.7	25313	84	6339
7	WB	11.5	93	0	0	6047	0	2489
8	WB	31	185	108	58.4	3472	1982	542
9	WB	33	419	28	6.7	21088	838	4092
10	WB	33.5	77	10	13	4601	266	1178
12	WB	36.5	30	0	0	2232	0	568
13	WB	31.5	18	0	0	1627	0	530
TOTAL	****	****	5073	428	****	118955	****	29307
GRAND TOTAL	****	****	10717	979	188	256871	11864	61781

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	7	2	9	0
2	526726	499467	1026193	51.8
3	350955	336613	687567	34.7
4	6137	4887	11024	0.6
5	54535	51767	106302	5.4
6	25440	25397	50837	2.6
7	2645	6047	8692	0.4
8	7189	5454	12643	0.6
9	26274	21926	48200	2.4
10	6668	4867	11535	0.6
12	13664	2232	15896	0.8
13	1980	1627	3607	0.2
TOTAL	1022221	960284	1982505	100
GVW/LANE	51.56	48.44	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	0.0909
2	58	56	114	2.4	9e-04
3	108	115	224	4.7	0.0039
4	117	107	224	4.7	1.2
5	666	642	1308	27.5	0.38
6	586	562	1149	24.2	1.7
7	51	121	171	3.6	2.45
8	134	134	267	5.6	1.29
9	359	333	692	14.6	1.46
10	113	102	215	4.5	2.33
12	264	43	307	6.5	2.83
13	40	39	78	1.6	3.11
TOTAL	2496	2252	4748	100	17
ESALS/LANE	52.6	47.4	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>
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
Jun 2018	450683	15023	471	436568	96.9	14115.2	3.1
Jul 2018	438254	14137	398	425930	97.2	12323.7	2.8
Aug 2018	446876	14415	420	433854	97.1	13022.2	2.9
Sep 2018	419706	13990	419	407143	97	12563.1	3
Oct 2018	444856	14350	502	429296	96.5	15560	3.5
Nov 2018	398210	13274	359	387448	97.3	10761.7	2.7
TOTAL	4883334	-	-	4748785	-	134550	-
AVERAGE	406944	13369	368	395732	97	11212	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>
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
Jun 2018	3507	3885	7392	9.5
Jul 2018	2794	3073	5867	4.8
Aug 2018	3228	2941	6170	3.4
Sep 2018	2874	2745	5619	4.4
Oct 2018	3812	3986	7798	7.7
Nov 2018	2509	2284	4793	3.1
TOTAL	32671	-	-	-
AVERAGE	2723	2568	5291	4

Gross Vehicle Weight

<i>Month</i>	<i>GVW EB Driving Lane</i>	<i>GVW WB Driving Lane</i>	<i>Total GVW Kips</i>
Dec 2017	863971	774480	1638451
Jan 2018	794931	697417	1492348
Feb 2018	906278	785702	1691980
Mar 2018	951084	865467	1816551
Apr 2018	1258909	1200368	2459277
May 2018	1209273	1130898	2340171
Jun 2018	1148174	1088707	2236882
Jul 2018	1178091	1105327	2283419
Aug 2018	1098955	1038371	2137326
Sep 2018	1212321	1140085	2352405
Oct 2018	1022767	962848	1985615
Nov 2018	888219	819015	1707234
TOTAL	12532974	11608685	24141659
AVERAGE	1044414	967390	2011805

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>
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
Jun 2018	1168	0.3	8.1	138	57
Jul 2018	870	0.2	6.9	77	25
Aug 2018	902	0.2	6.8	65	27
Sep 2018	745	0.2	5.8	82	35
Oct 2018	1228	0.3	7.7	143	63
Nov 2018	615	0.2	5.6	48	16
TOTAL	8586	-	-	758	288
AVERAGE	715.5	0.2	5.4	63.2	24

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>
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
Jun 2018	43944	48196	92140	47.7	52.3
Jul 2018	35591	37365	72955	48.8	51.2
Aug 2018	40320	36068	76388	52.8	47.2
Sep 2018	37861	34874	72735	52.1	47.9
Oct 2018	49875	57608	107483	46.4	53.6
Nov 2018	32474	29307	61781	52.6	47.4
TOTAL	395188	399889	795078	-	-
AVERAGE	32932.4	33324.1	66256.5	50.3	49.7