

FEBRUARY 2019



**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 2019. 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. 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: 114260 | Passenger Vehicles: 94070 | Heavy Commercial Vehicles: 20190

Monthly Average Daily Traffic (MADT): 4081 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 721

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 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 20190 HCVs, 4190 of them were overweight ³. These overweight HCVs contributed to 3.8% of total monthly volume, and 21.4% of total monthly

HCV volume. EB overweight vehicles typically reached highest numbers on Wednesdays, with lowest volumes reported on Sundays. WB overweight vehicles tended to reach highest volumes on Thursdays, with lowest volumes reported on Fridays. See Figure 3 .

The top two overweight violators by class were the class 13 and class 9 vehicles . Overall, overweight vehicles tended to reach peak volume concentrations during typical business hours, with 72.5% 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 April.

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 ⁴.

Using normal load limits ,162 EB vehicles exceeded 88,000 pounds (89 vehicles were Class 13's; 50 vehicles were Class 10's). Of vehicles traveling WB,

1420 EB vehicles exceeded 88,000 pounds (1356 vehicles were Class 13's; 58 vehicles were Class 10's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from February 2019.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9s and 10s in February 2019. 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 empty Class 10's than fully_loaded traveling in the EB direction. In the WB direction, there were more empty class 10 vehicles.

Freight Totals. A total of 216113 tons of freight was recorded to have crossed the WIM. More freight was shipped WB (62.7%) than EB (37.3%). 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 114260 vehicles with a combined GVW of 1421645 kips (1 kip = 1,000 pounds = 0.5 tons) in February 2019. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 15992 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 54.6% of all ESALs were recorded WB while 45.4% was observed EB. In particular, 59% of all ESALs were generated by the Class 9's (Class 9's were also responsible for generating 38% 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).

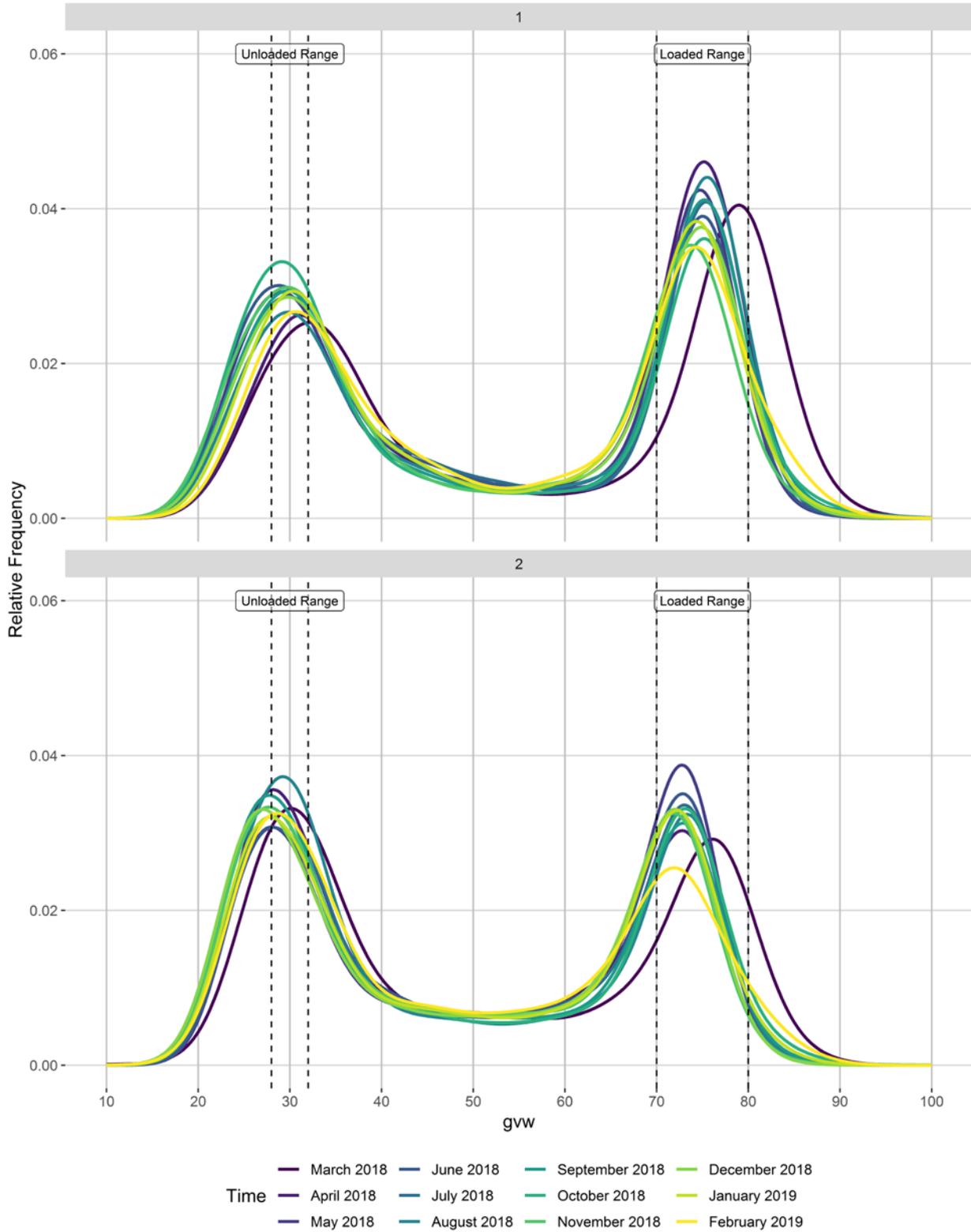
WIM monthly reports can be found at: <http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html>

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.

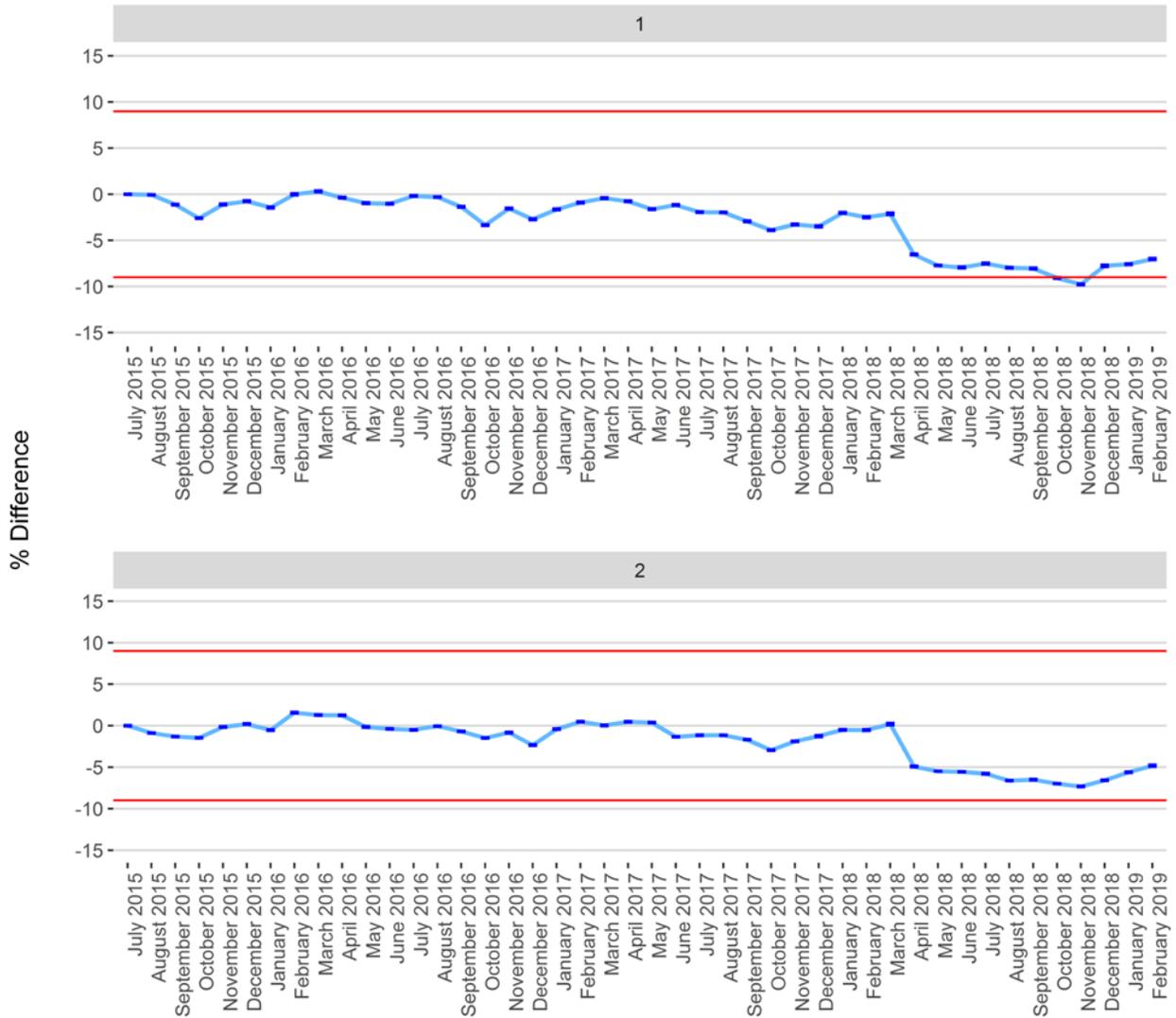
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Figure 1 - Monthly Class 9 GVW Histogram



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

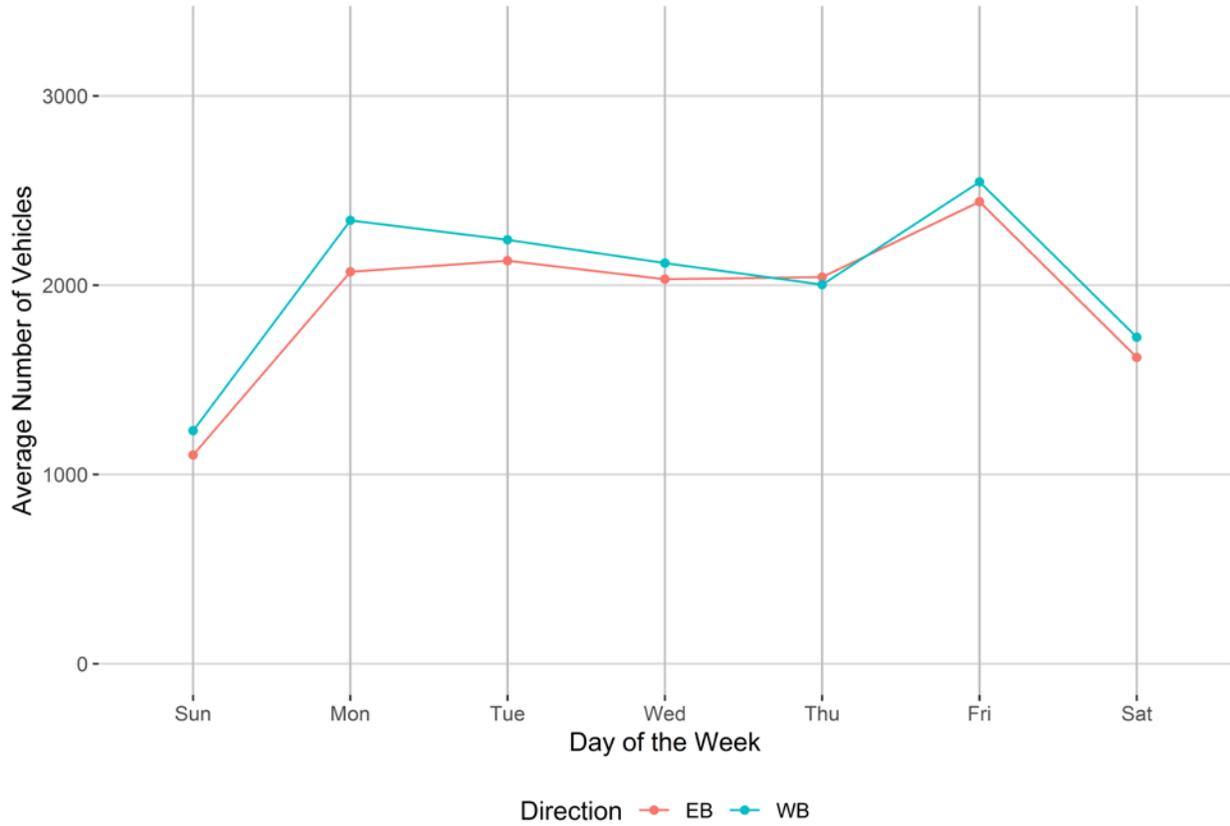


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

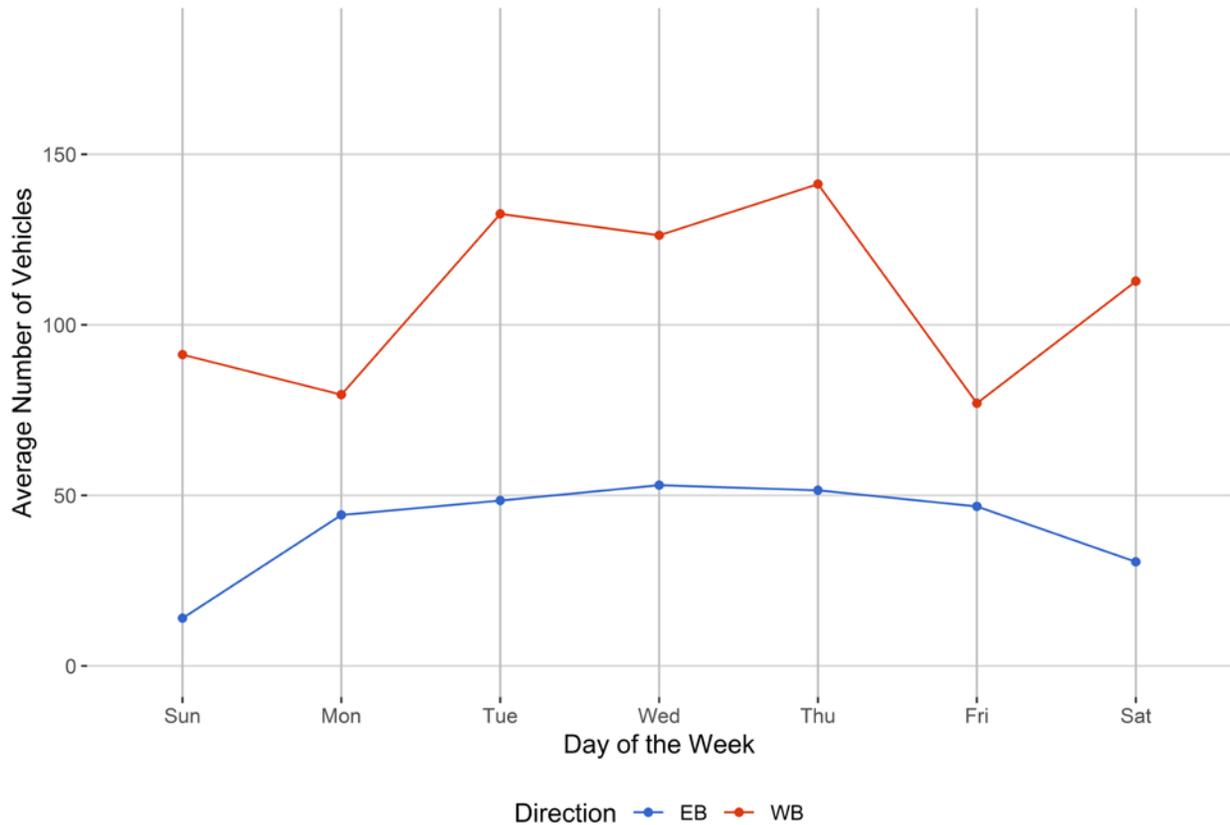


Figure 4 - Passenger Vehicles vs. Hour of the Day

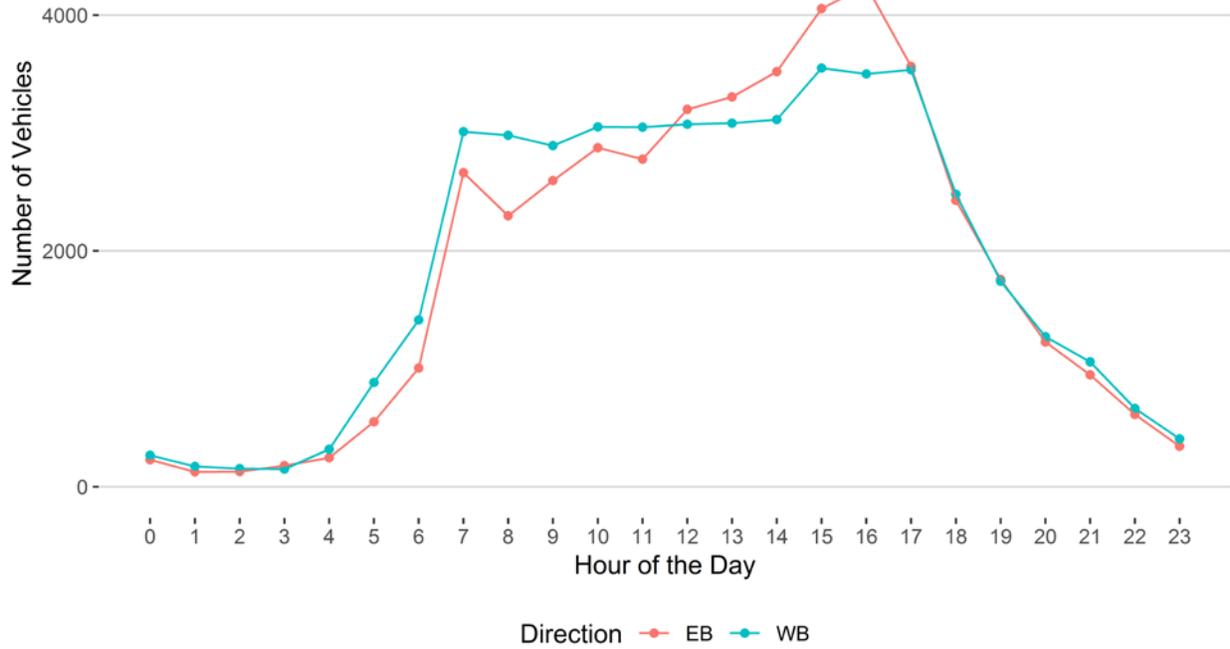


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

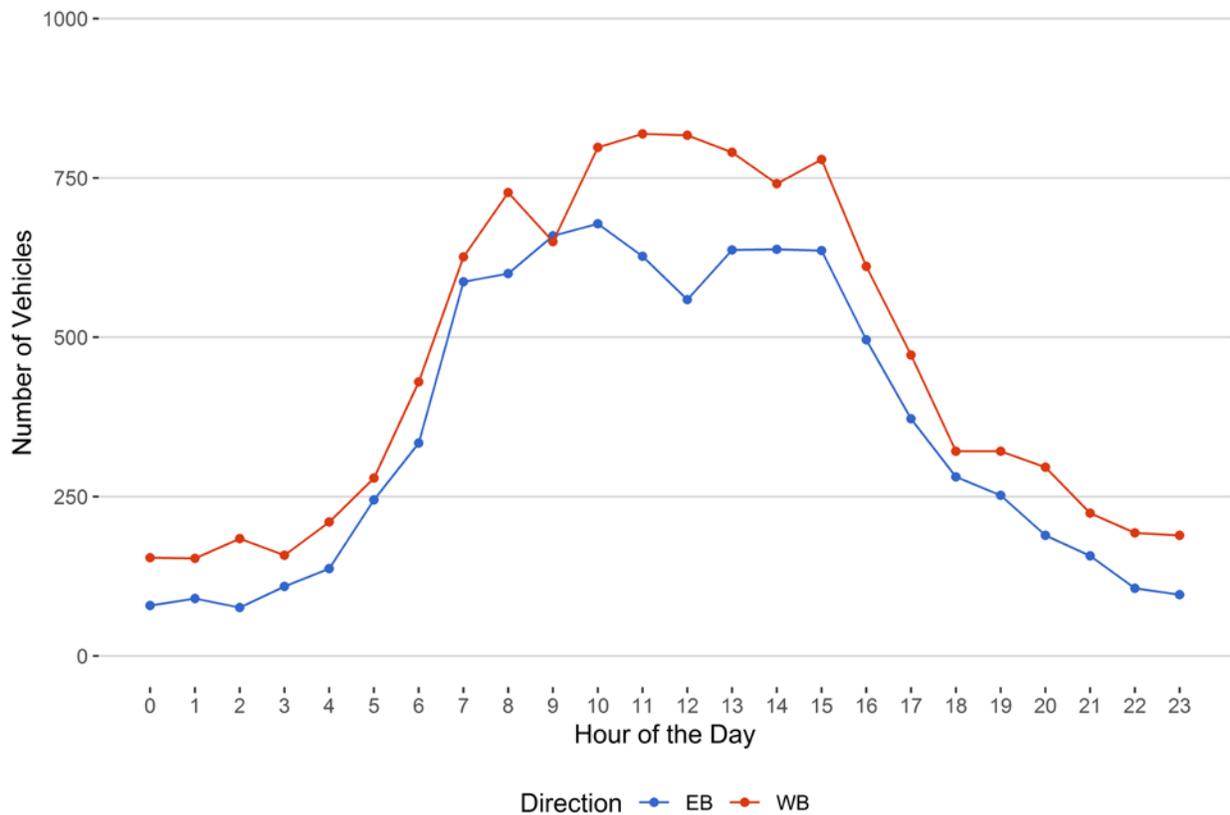


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

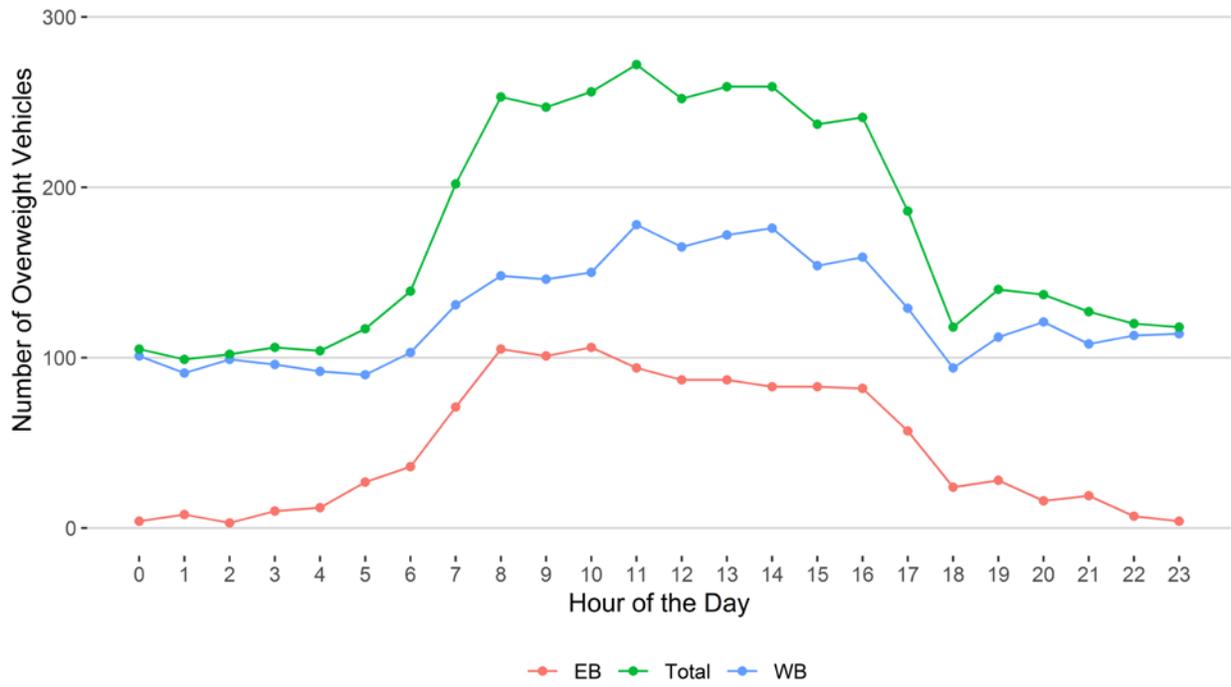
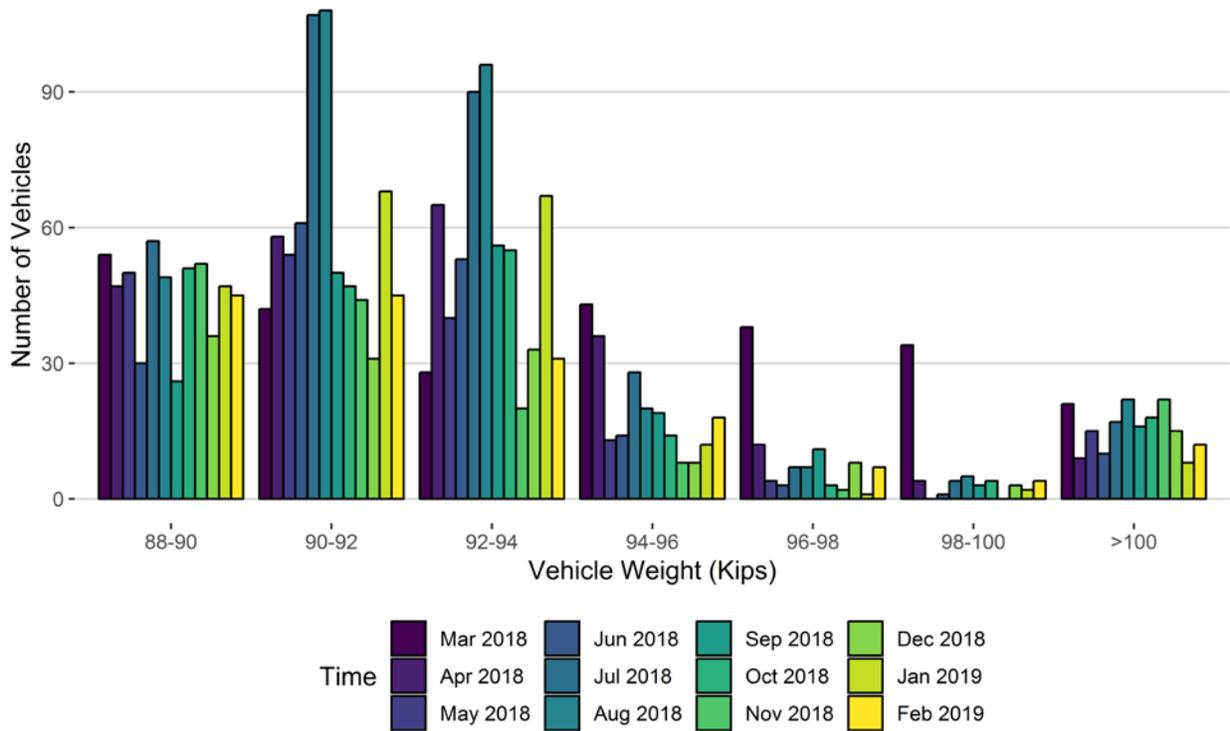
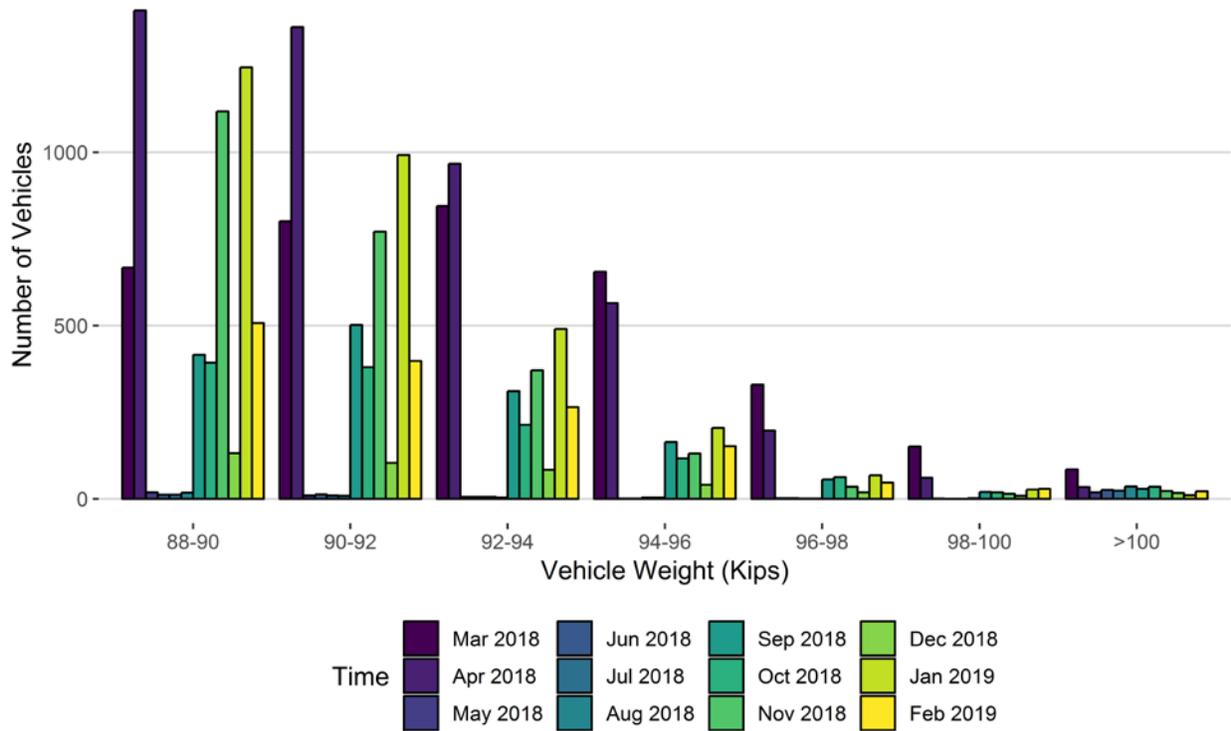


Figure 8 - Histogram of EB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Oct 2018	Nov 2018	Dec 2018	Jan 2019	Feb 2019
88-90	54	47	50	30	57	49	26	51	52	36	47	45
90-92	42	58	54	61	107	108	50	47	44	31	68	45
92-94	28	65	40	53	90	96	56	55	20	33	67	31
94-96	43	36	13	14	28	20	19	14	8	8	12	18
96-98	38	12	4	3	7	7	11	3	2	8	1	7
98-100	34	4	0	1	4	5	3	4	0	3	2	4
>100	21	9	15	10	17	22	16	18	22	15	8	12
Total	260	231	176	172	310	307	181	192	148	134	205	162

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



Vehicle Weights (Kips)	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Oct 2018	Nov 2018	Dec 2018	Jan 2019	Feb 2019
88-90	667	1409	19	12	12	18	416	393	1118	132	1245	507
90-92	801	1361	10	13	10	9	502	380	771	104	992	398
92-94	845	967	6	6	6	4	311	214	371	84	490	265
94-96	655	565	1	1	4	4	164	117	131	41	205	152
96-98	330	197	2	2	1	1	56	63	35	19	68	47
98-100	151	61	1	0	0	2	20	19	15	9	27	29
>100	85	34	19	26	24	36	29	35	23	17	11	22
Total	3534	4594	58	60	57	74	1498	1221	2464	406	3038	1420

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

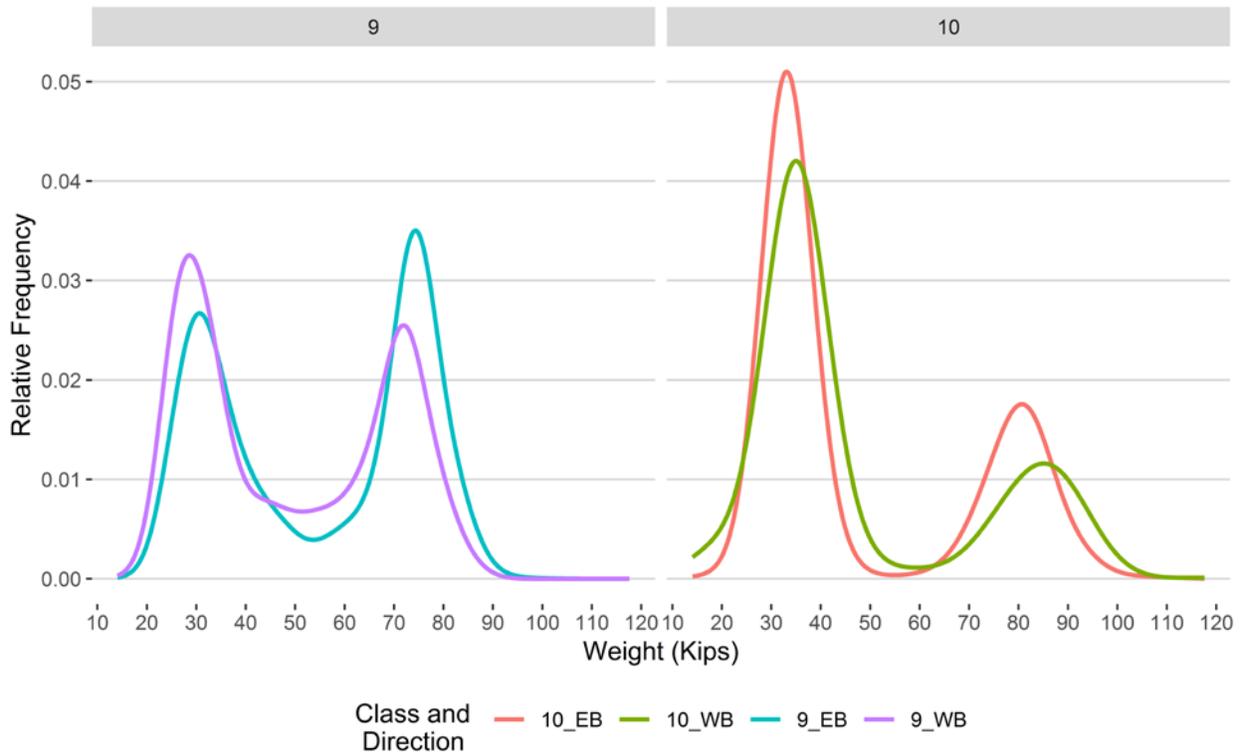


Figure 9 - Freight Percentage by Direction and Class

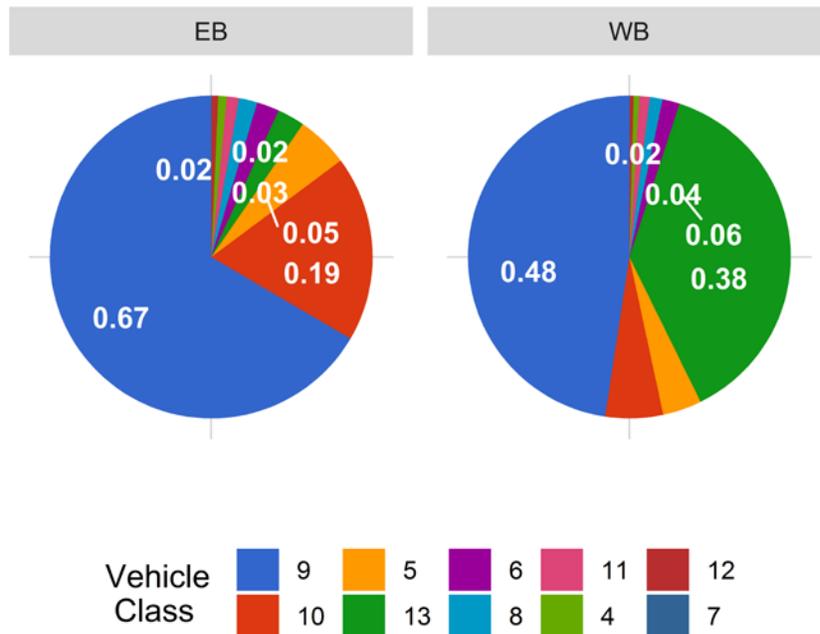


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

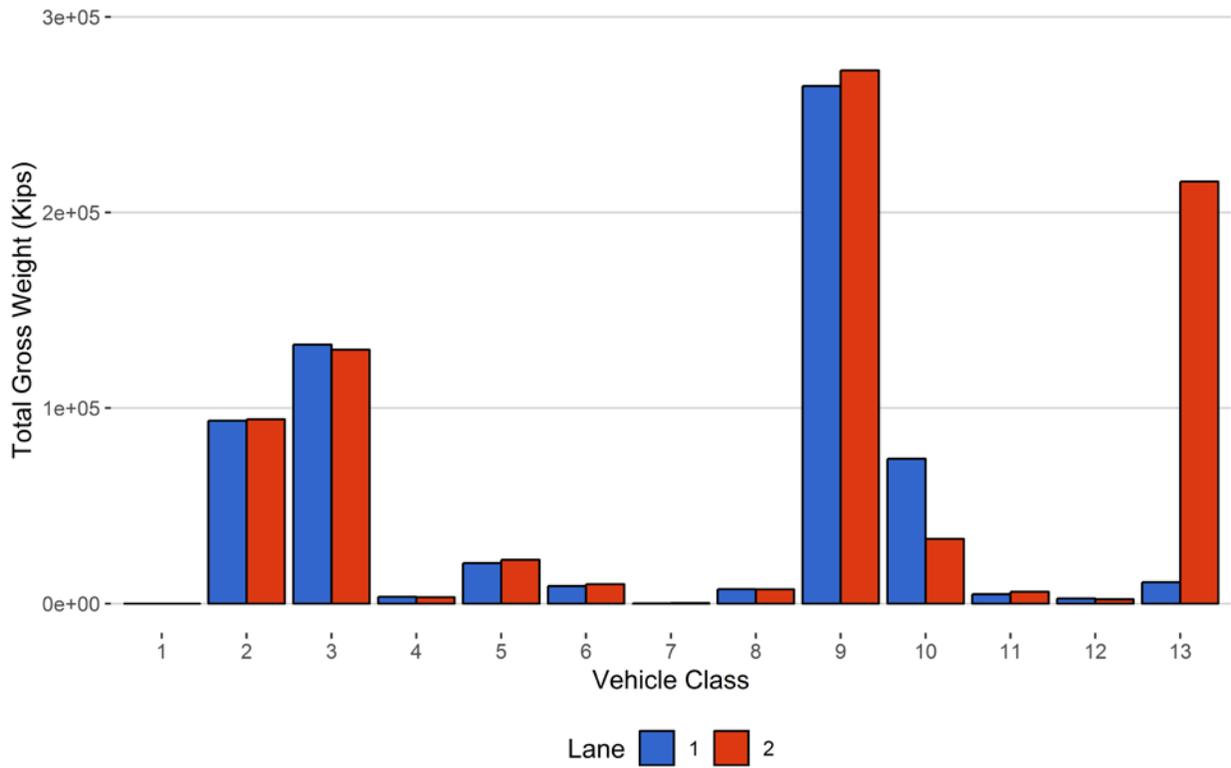


Figure 11 - Total Gross Vehicle Weight t

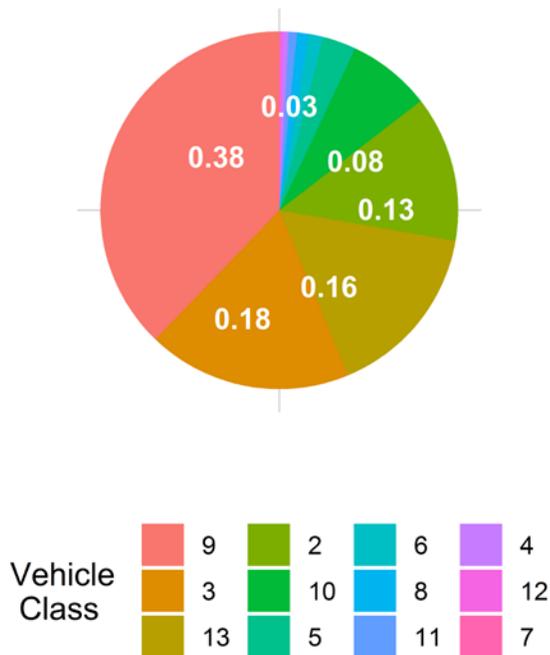


Figure 12 - Total ESALs by Class and Lane

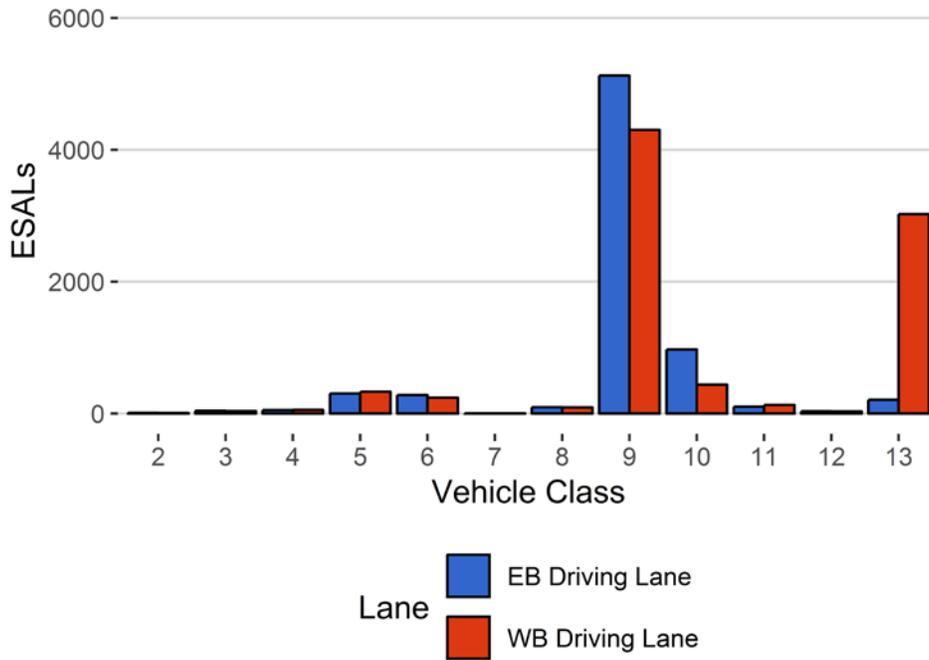


Figure 13 - ESALs by Class

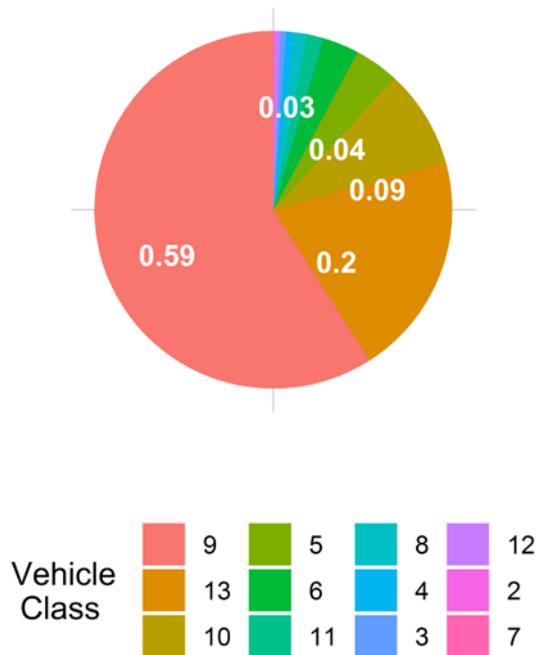


Table 1 Class 9 Front Axle Weight by Lane

<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
August 2018	10.82	-7.97	10.26	-6.62
September 2018	10.81	-8.05	10.27	-6.50

October 2018	10.69	-9.08	10.22	-6.98
November 2018	10.61	-9.77	10.18	-7.32
December 2018	10.84	-7.77	10.26	-6.58
January 2019	10.86	-7.59	10.37	-5.61
February 2019	10.93	-7.03	10.45	-4.83

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	1723	48258	42.2	0	0
3	1636	45812	40.1	0	0
4	8	237	0.2	9	0.2
5	108	3036	2.7	66	1.6
6	21	578	0.5	105	2.5
7	0	12	0	0	0
8	17	480	0.4	15	0.4
9	380	10643	9.3	1037	24.7
10	82	2290	2	432	10.3
11	7	201	0.2	12	0.3
12	3	75	0.1	23	0.5
13	94	2636	2.3	2491	59.5
TOTAL	4081	114260	100	4190	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>
2019-02-06	Wednesday	07:43:12	10	WB	2	117.62
2019-02-22	Friday	12:01:10	10	EB	1	111.33
2019-02-22	Friday	12:00:03	10	EB	1	106.57
2019-02-22	Friday	09:48:24	10	EB	1	104.68
2019-02-22	Friday	09:48:29	10	EB	1	103.95
2019-02-06	Wednesday	04:21:47	9	EB	1	101.66
2019-02-07	Thursday	09:46:37	10	WB	2	101.1
2019-02-21	Thursday	06:37:57	10	WB	2	100.38
2019-02-06	Wednesday	11:41:59	10	EB	1	99.5
2019-02-28	Thursday	21:03:06	10	WB	2	97.96

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	126	15	11.9	3273	183	804
5	EB	8	1427	196	13.7	19274	1409	4713
6	EB	19	263	56	21.3	7977	974	2022
7	EB	11.5	5	0	0	164	0	53
8	EB	31	236	134	56.8	3971	3399	405
9	EB	33	4797	1242	25.9	228902	35762	55794
10	EB	33.5	1529	612	40	54691	19338	11986
11	EB	36.5	93	15	16.1	4272	504	712
12	EB	36.5	42	0	0	2580	0	523
13	EB	31.5	122	1	0.8	10869	31	3529
TOTAL	****	****	8640	2271	****	335972	****	80540
<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	104	7	6.7	3133	80	839
5	WB	8	1518	226	14.9	20771	1599	5218
6	WB	19	298	78	26.2	8539	1336	2180
7	WB	11.5	7	0	0	265	0	92
8	WB	31	230	125	54.3	4026	3280	386
9	WB	33	5525	1958	35.4	218317	54376	50303
10	WB	33.5	692	168	24.3	28155	4936	5301
11	WB	36.5	102	1	1	5991	35	1152
12	WB	36.5	31	0	0	2191	0	530
13	WB	31.5	2435	0	0	215848	0	69573
TOTAL	****	****	10942	2563	****	507237	****	135572
GRAND TOTAL	****	****	19582	4834	349	843209	127242	216113

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	93539	94220	187759	13.2
3	132454	129854	262307	18.5
4	3455	3213	6668	0.5
5	20683	22371	43054	3
6	8950	9875	18826	1.3
7	164	265	429	0
8	7370	7307	14676	1
9	264664	272694	537358	37.8
10	74029	33091	107120	7.5
11	4775	6026	10802	0.8
12	2580	2191	4771	0.3
13	10900	215848	226748	16
TOTAL	623563	796954	1420518	100
GVW/LANE	43.9	56.1	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	12	11	22	0.1	0.001
3	44	40	84	0.5	0.0038
4	54	55	109	0.7	0.96
5	306	332	639	4	0.44
6	283	243	526	3.3	1.87
7	4	5	9	0.1	1.34
8	96	95	192	1.2	0.83
9	5126	4302	9428	59.1	1.83
10	973	440	1413	8.8	1.28
11	104	133	238	1.5	2.37
12	36	34	69	0.4	1.77
13	210	3025	3235	20.3	2.53
TOTAL	7248	8715	15963	100	15
ESALS/LANE	45.4	54.6	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 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
Aug 2018	170178	5490	762	146561	86.1	23616.9	13.9
Sep 2018	159803	5327	761	136968	85.7	22835.3	14.3
Oct 2018	168472	5435	901	140528	83.4	27944	16.6
Nov 2018	159326	5311	1002	129266	81.1	30060.4	18.9
Dec 2018	137277	4576	562	119844	87.3	17433.5	12.7
Jan 2019	136631	4407	857	110055	80.5	26575.5	19.5
Feb 2019	114260	4081	721	94070	82.3	20190.2	17.7
TOTAL	1823319	-	-	1536023	-	287296	-
AVERAGE	151943	5002	787	128002	84	23941	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 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
Aug 2018	10307	7791	18098	5
Sep 2018	8379	8992	17371	2
Oct 2018	9647	10834	20480	2.5
Nov 2018	8223	12550	20773	3
Dec 2018	6326	6234	12560	2.5
Jan 2019	7551	12934	20486	3.3
Feb 2019	7266	8726	15992	3.6
TOTAL	99257	-	-	-
AVERAGE	8272	9778	18049	4

Gross Vehicle Weight

<i>Month</i>	<i>GVW EB Driving Lane</i>	<i>GVW WB Driving Lane</i>	<i>Total GVW Kips</i>
Mar 18	711950	939405	1651356
Apr 18	727732	1226632	1954364
May 18	865371	861844	1727214
Jun 18	780636	785631	1566267
Jul 18	791746	765202	1556948
Aug 18	890959	859371	1750330
Sep 18	787783	920089	1707873
Oct 18	910823	1024892	1935715
Nov 18	876238	1195186	2071423
Dec 18	663511	704078	1367589
Jan 19	748717	1130601	1879318
Feb 19	624281	797364	1421645
TOTAL	9379747	11210296	20590043
AVERAGE	781646	934191	1715837

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 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
Aug 2018	2180	1.3	9.3	381	65
Sep 2018	3471	2.2	15.2	1680	69
Oct 2018	3913	2.3	14	1414	76
Nov 2018	6184	3.9	20.7	2613	60
Dec 2018	1711	1.2	9.6	540	44
Jan 2019	6767	5	25.7	3243	48
Feb 2019	4196	3.8	21.2	1582	67
TOTAL	47413	-	-	20908	947
AVERAGE	3951.1	2.8	16.5	1742.3	78.9

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 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
Aug 2018	116744	92910	209654	55.7	44.3
Sep 2018	95591	132764	228355	41.9	58.1
Oct 2018	107491	153333	260824	41.2	58.8
Nov 2018	93278	223361	316640	29.5	70.5
Dec 2018	71575	83742	155317	46.1	53.9
Jan 2019	81765	228122	309886	26.4	73.6
Feb 2019	80540	135572	216113	37.3	62.7
TOTAL	1118738	1767593	2886331	-	-
AVERAGE	93228.2	147299.4	240527.6	40.9	59.1