

DECEMBER 2019



**WIM #59/61
I-90,
MP 276.8
DRESBACH,
MN**

**MONTHLY
REPORT**



Your Destination...Our Priority



WIM Site Location

WIM #59 is located on I-90 near Dresbach in Winona county.

System Operation

WIM #59 was operational for the entire month of December 2019. Volume was computed using all monthly data.

System Calibration

WIM #59 was most recently calibrated on 2016-12-20. 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: 661757 | Passenger Vehicles: 584511 | Heavy Commercial Vehicles: 77246

Monthly Average Daily Traffic (MADT): 21347 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 2492

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 Thursdays (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 02 PM and 04 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 02 PM and 04 PM. See Figure 6. Out of all HCVs, the two highest traffic volumes were generated by Class 9's and Class 13's.

Overweight HCVs

Volume trends. Of a total of 77246 HCVs, 16932 of them were overweight ³. These overweight HCVs contributed to 2.9% of total monthly volume, and 24.2% of total monthly

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

The top two overweight violators by class were the class 9 and class 11 vehicles . Overall, overweight vehicles tended to reach peak volume concentrations during typical business hours, with 92% 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 November.

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 ,8808 EB vehicles exceeded 88,000 pounds (8249 vehicles were Class 9's; 227 vehicles were Class 10's). Of vehicles traveling WB,

598 EB vehicles exceeded 88,000 pounds (533 vehicles were Class 9's; 24 vehicles were Class 14's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from December 2019.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9s and 10s in December 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 empty Class 9's than fully_loaded 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 804083 tons of freight was recorded to have crossed the WIM. More freight was shipped EB (78.6%) than WB (21.4%). See Table 4 and Figure 11 for more freight information.

####Infrastructure Considerations Bridge. Bridge No. 85802 and 85801 (Prestressed Beam Span) are approximately .02 miles east of WIM #59. Bridge No. 85849 and 85850 (Continuous Steel Beam Span) are appoximately .3 miles west of WIM #59. WIM #59 recorded a total of 661757 vehicles with a combined GVW of 6074643 kips (1 kip = 1,000 pounds = 0.5 tons) in December 2019. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 114654 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 69.9% of all ESALs were recorded EB while 30.1% was observed WB. In particular, 68% of all ESALs were generated by the Class 9's (Class 9's were also responsible for generating 51% 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:

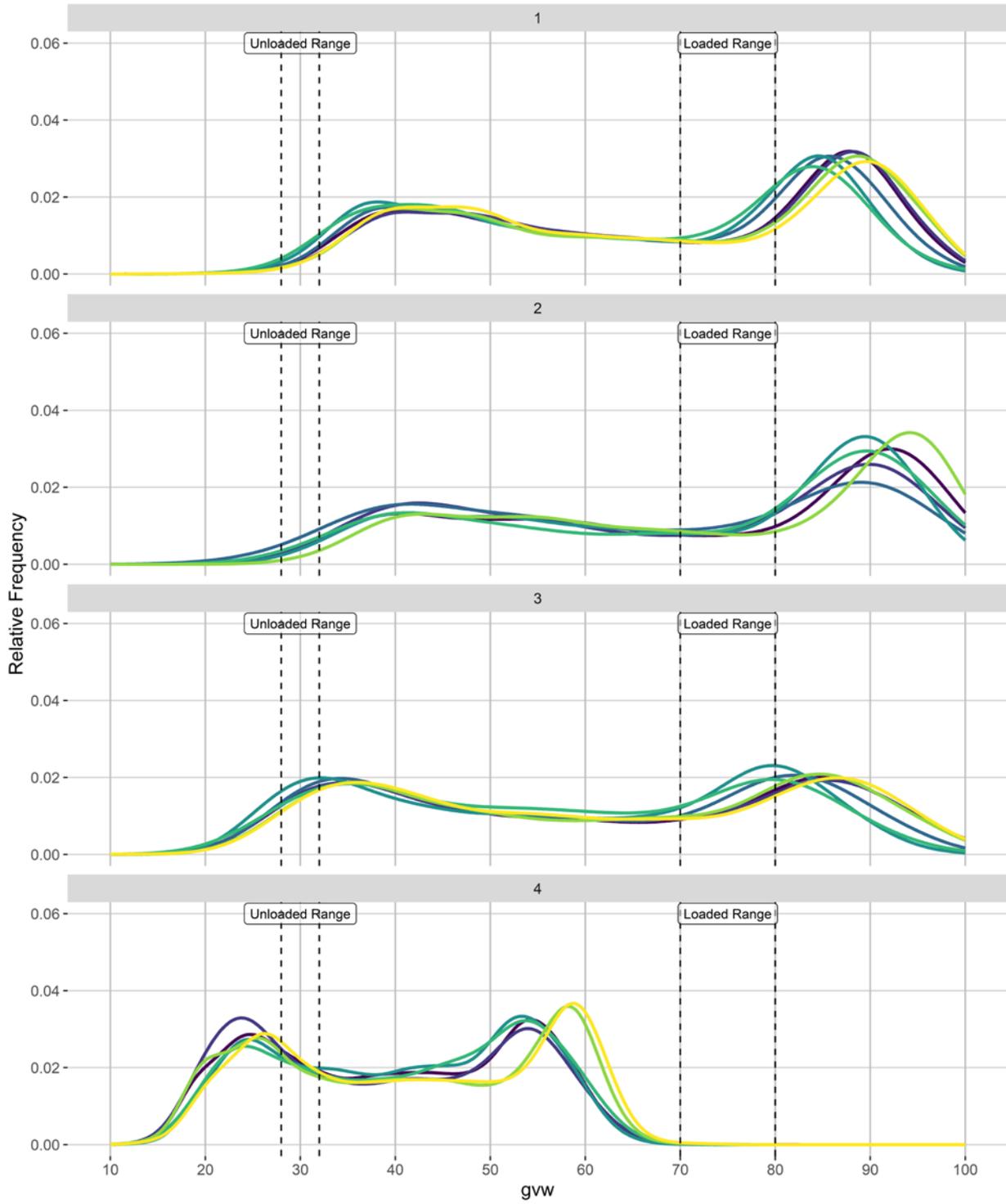
<http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html> MnDOT's vehicle

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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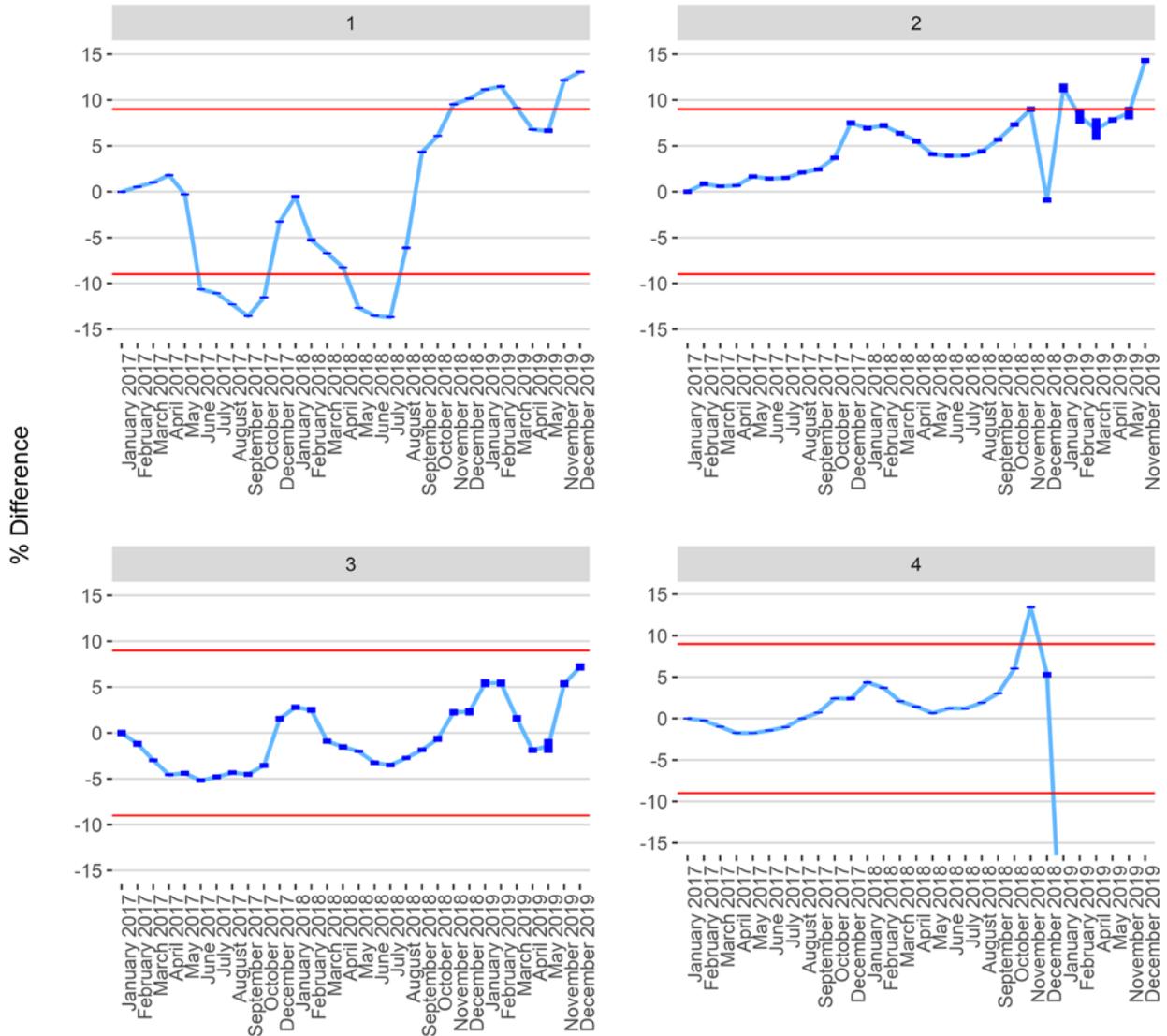
Figure 1 - Monthly Class 9 GVW Histogram



Time January 2019 March 2019 May 2019 December 2019
 February 2019 April 2019 November 2019

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

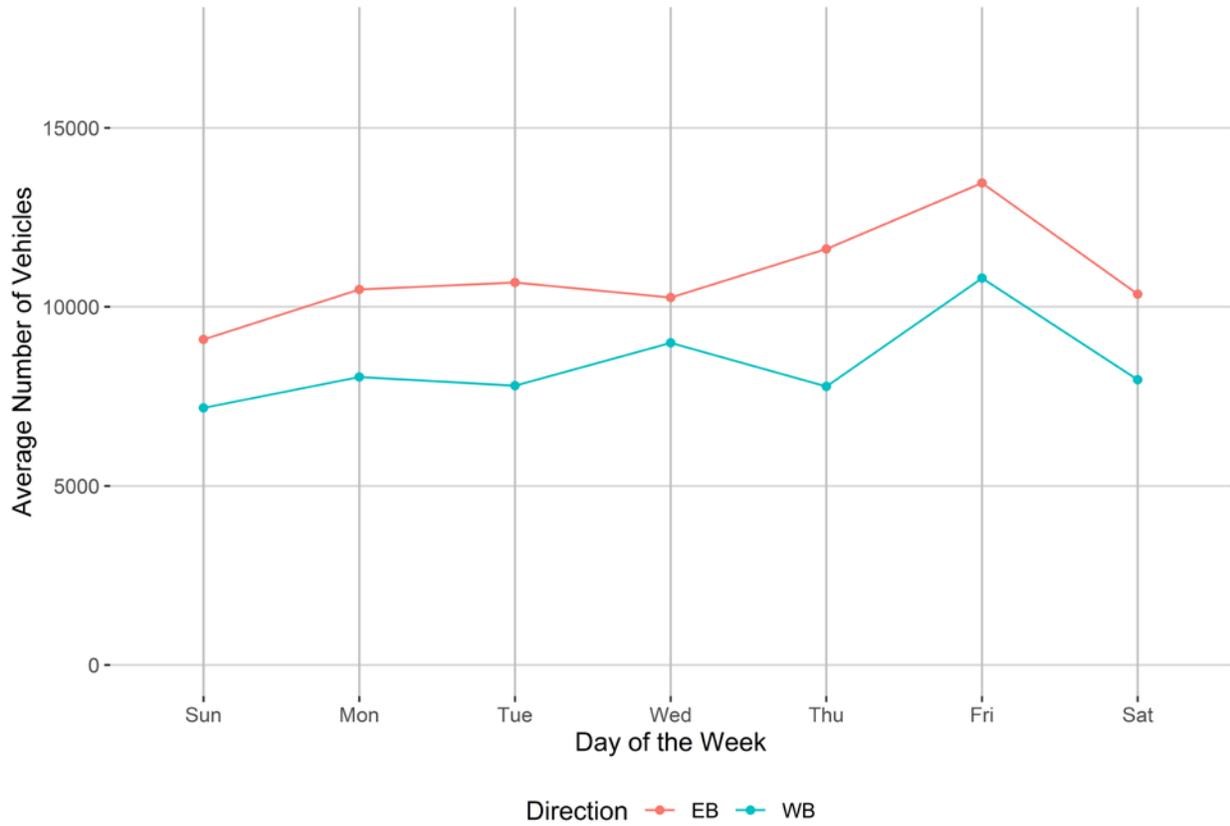


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

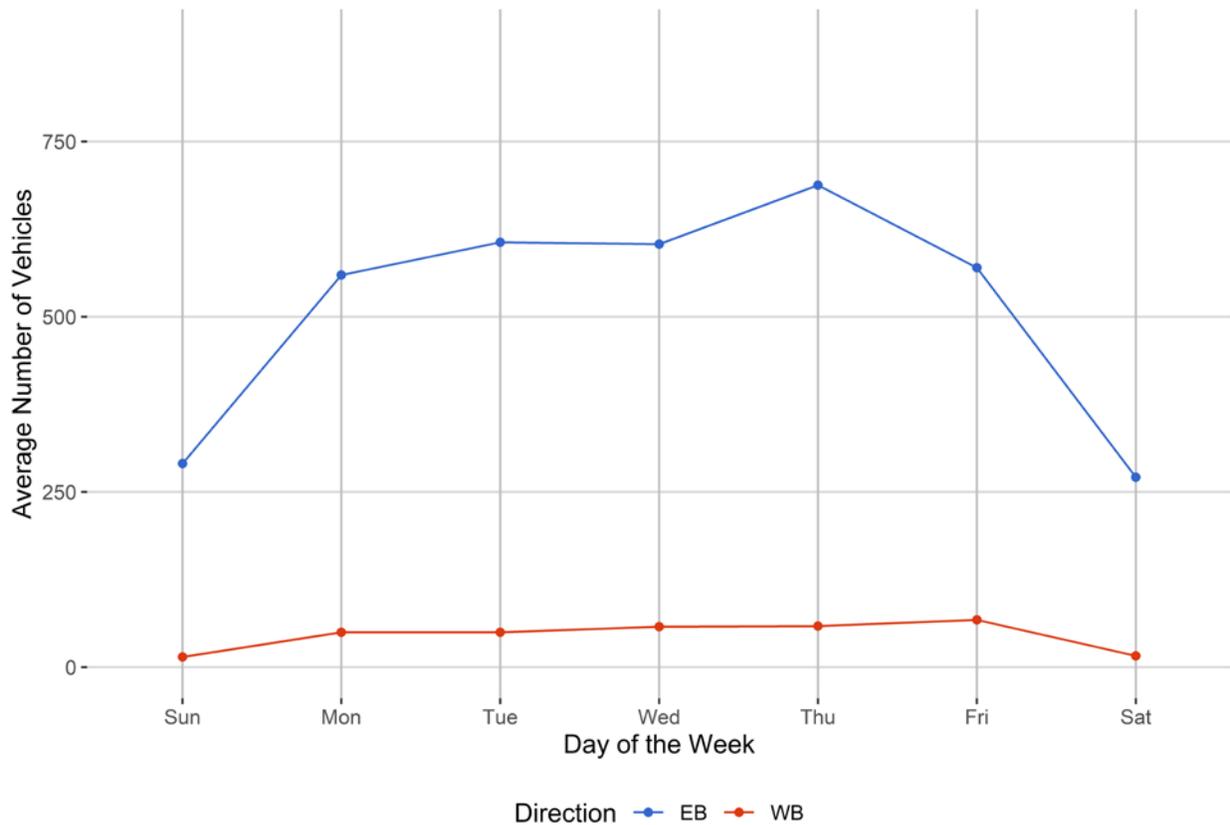


Figure 4 - Passenger Vehicles vs. Hour of the Day

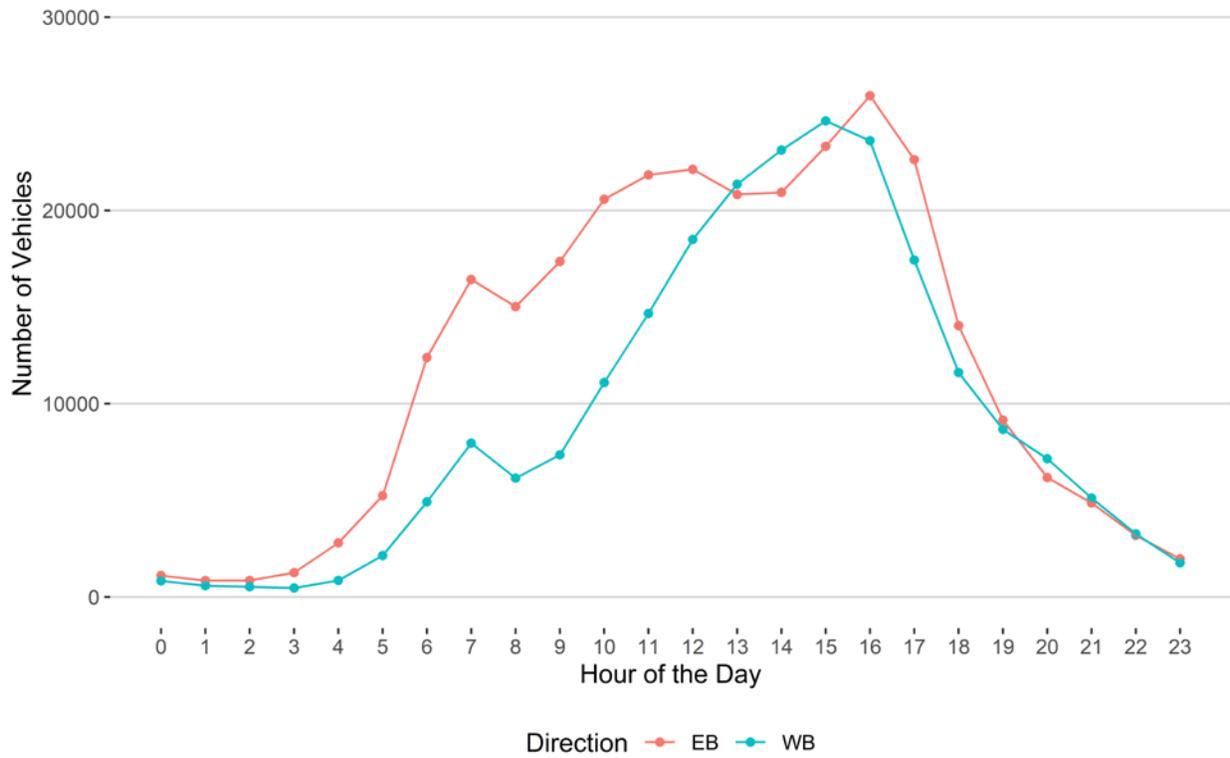


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

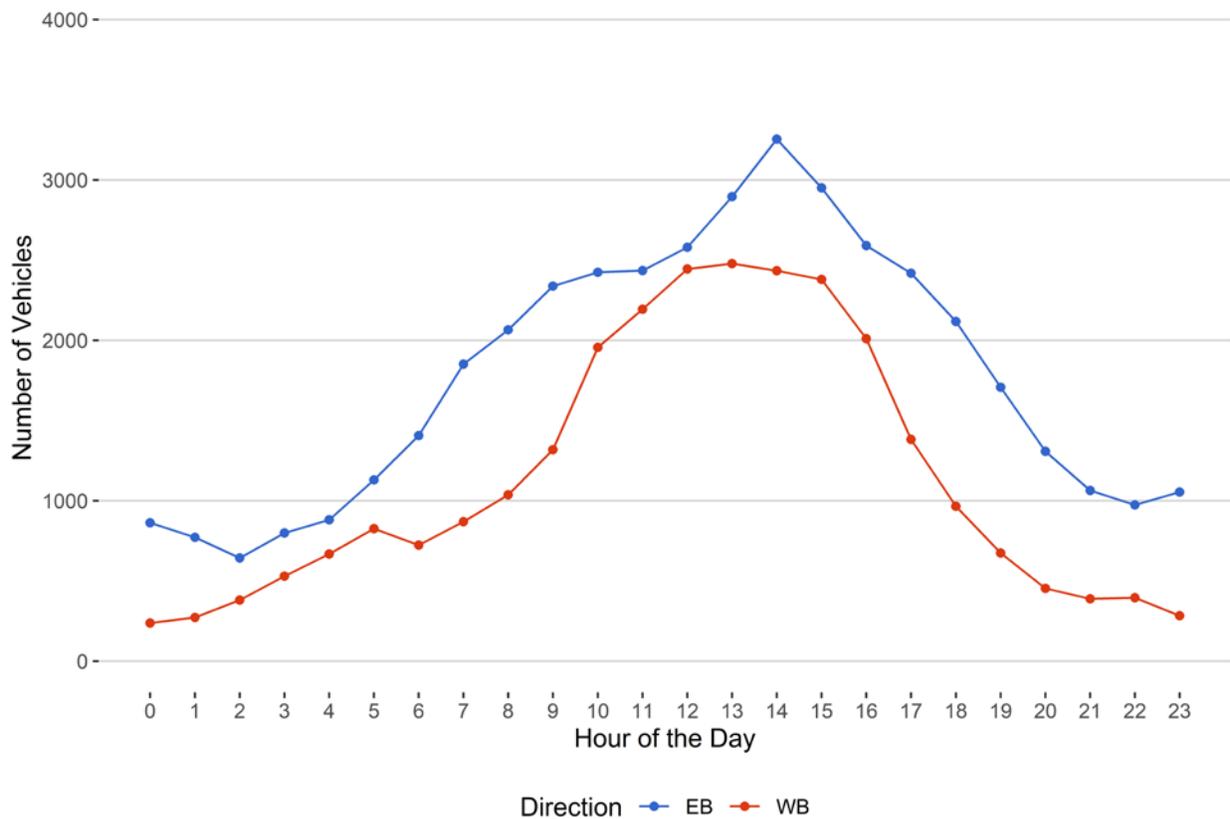


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

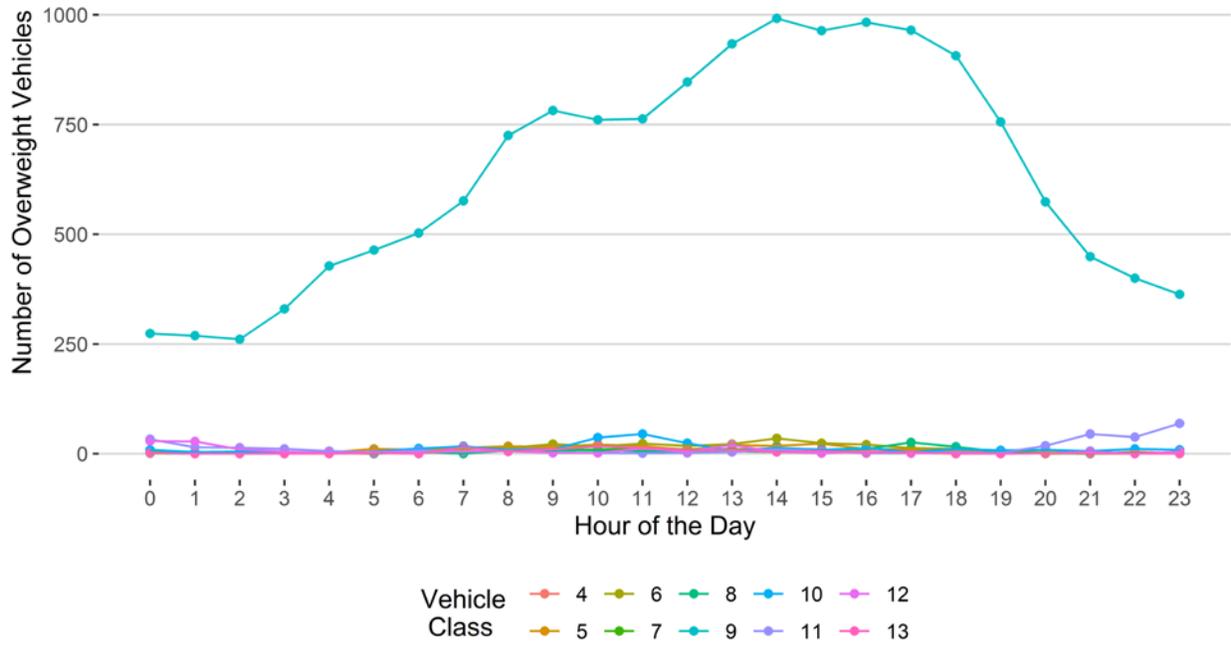


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

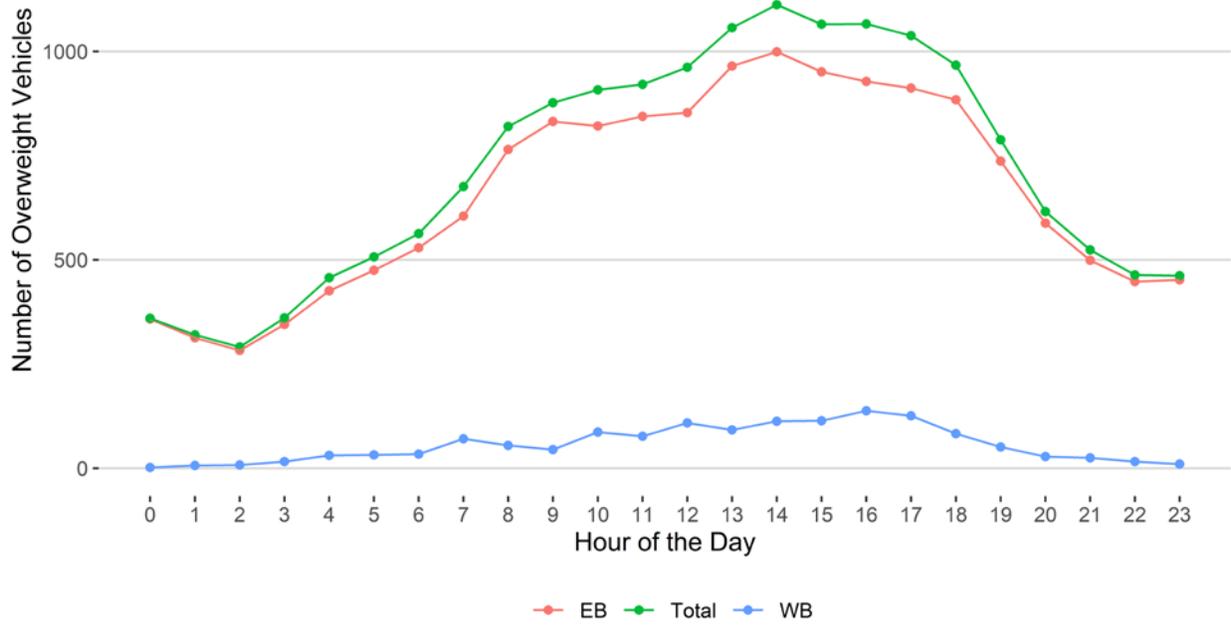
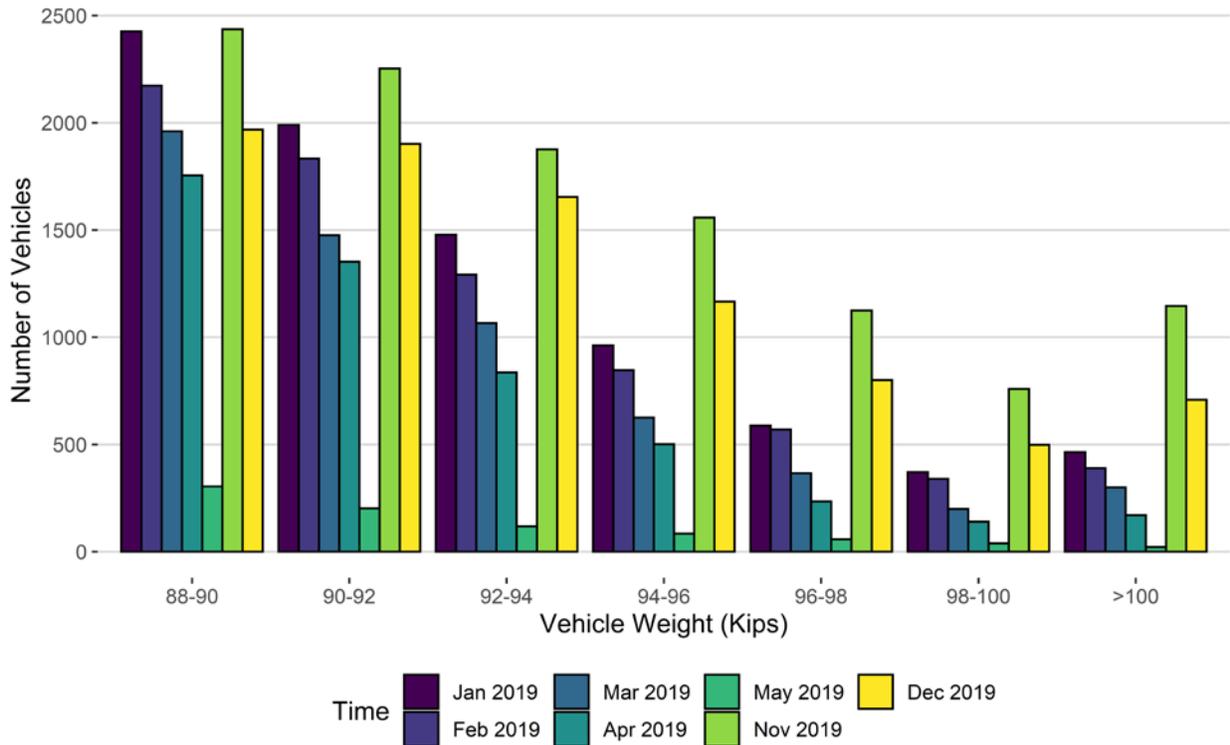
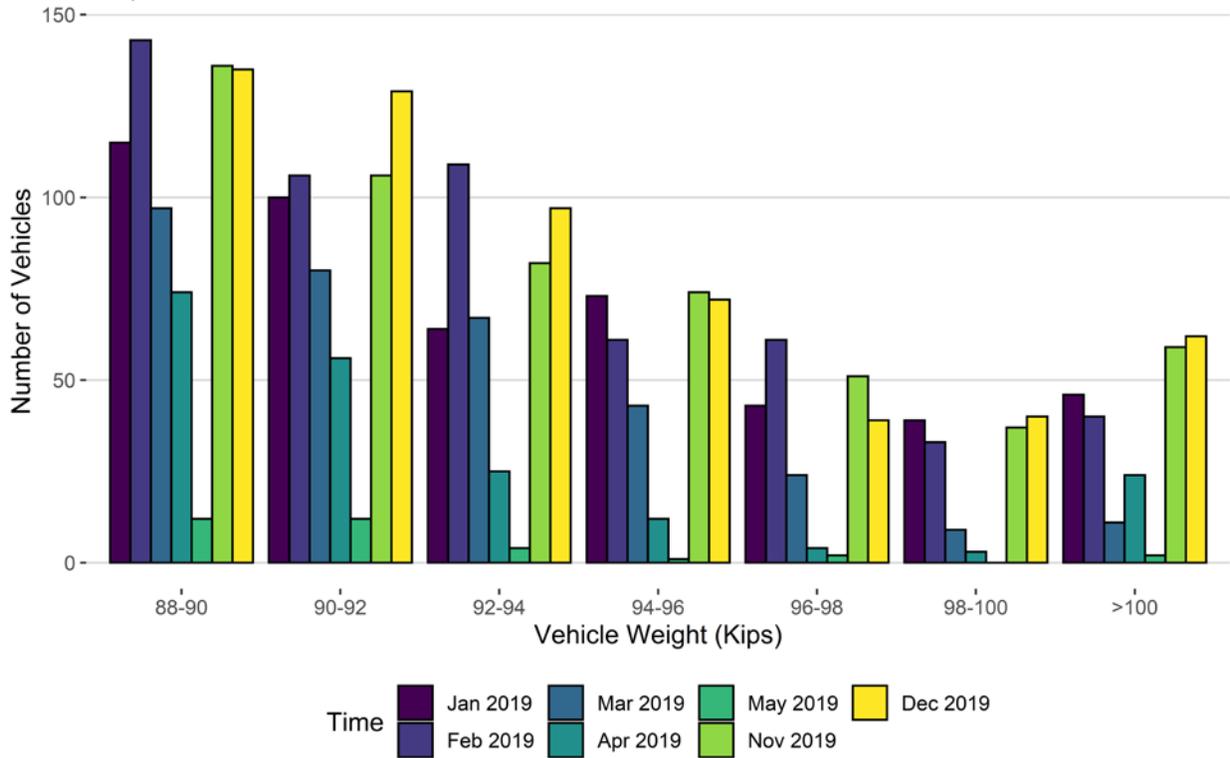


Figure 8 - Histogram of EB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Jan 2019	Feb 2019	Mar 2019	Apr 2019	May 2019	Nov 2019	Dec 2019
88-90	2426	2173	1960	1755	304	2436	1968
90-92	1990	1833	1476	1352	202	2253	1902
92-94	1478	1292	1066	836	118	1876	1654
94-96	962	847	625	501	84	1558	1166
96-98	588	570	366	234	58	1125	800
98-100	371	340	199	140	39	759	498
>100	464	390	300	170	22	1146	708
Total	8279	7445	5992	4988	827	11153	8696

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



Vehicle Weights (Kips)	Jan 2019	Feb 2019	Mar 2019	Apr 2019	May 2019	Nov 2019	Dec 2019
88-90	115	143	97	74	12	136	135
90-92	100	106	80	56	12	106	129
92-94	64	109	67	25	4	82	97
94-96	73	61	43	12	1	74	72
96-98	43	61	24	4	2	51	39
98-100	39	33	9	3	0	37	40
>100	46	40	11	24	2	59	62
Total	480	553	331	198	33	545	574

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

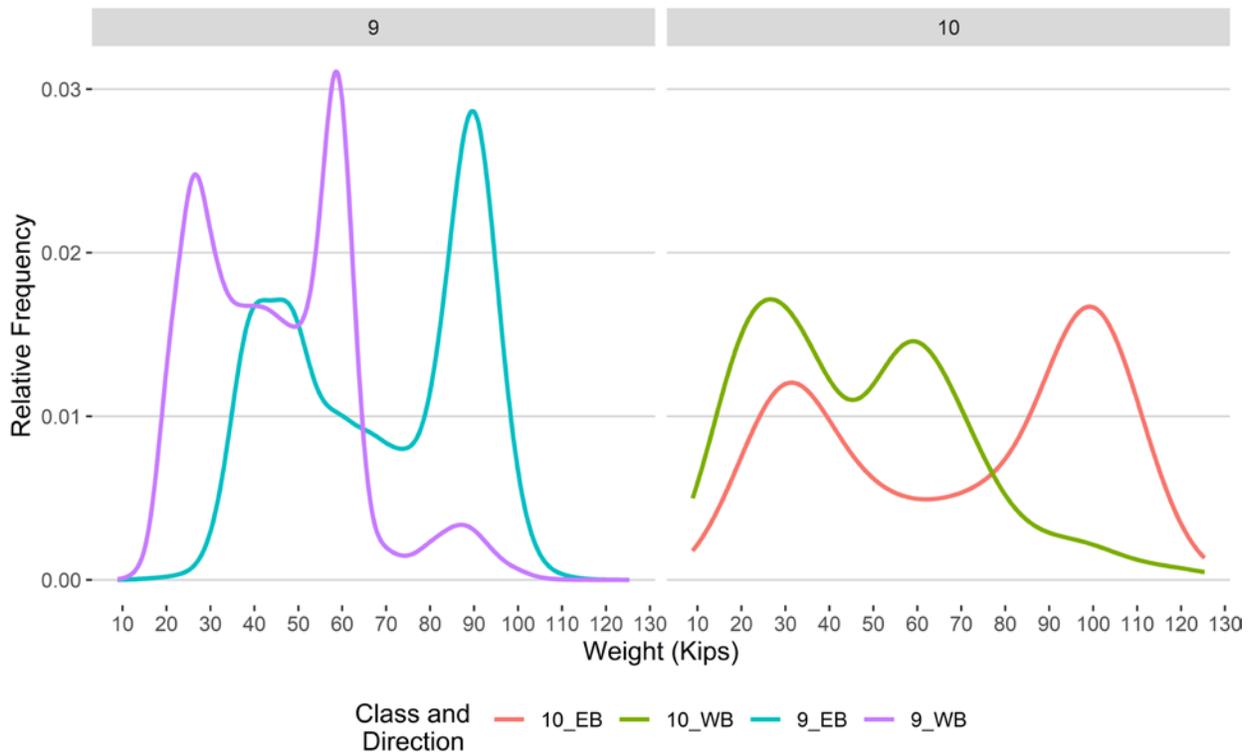


Figure 9 - Freight Percentage by Direction and Class

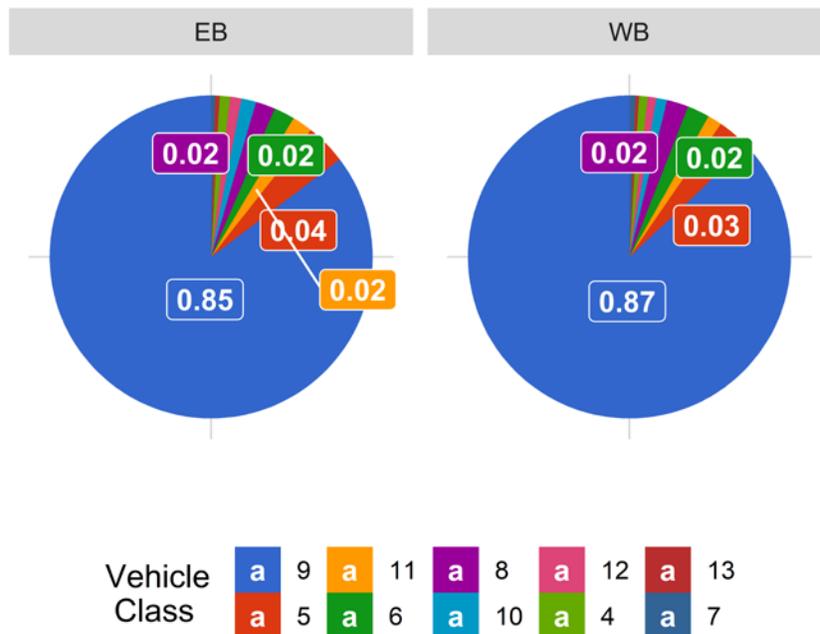


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

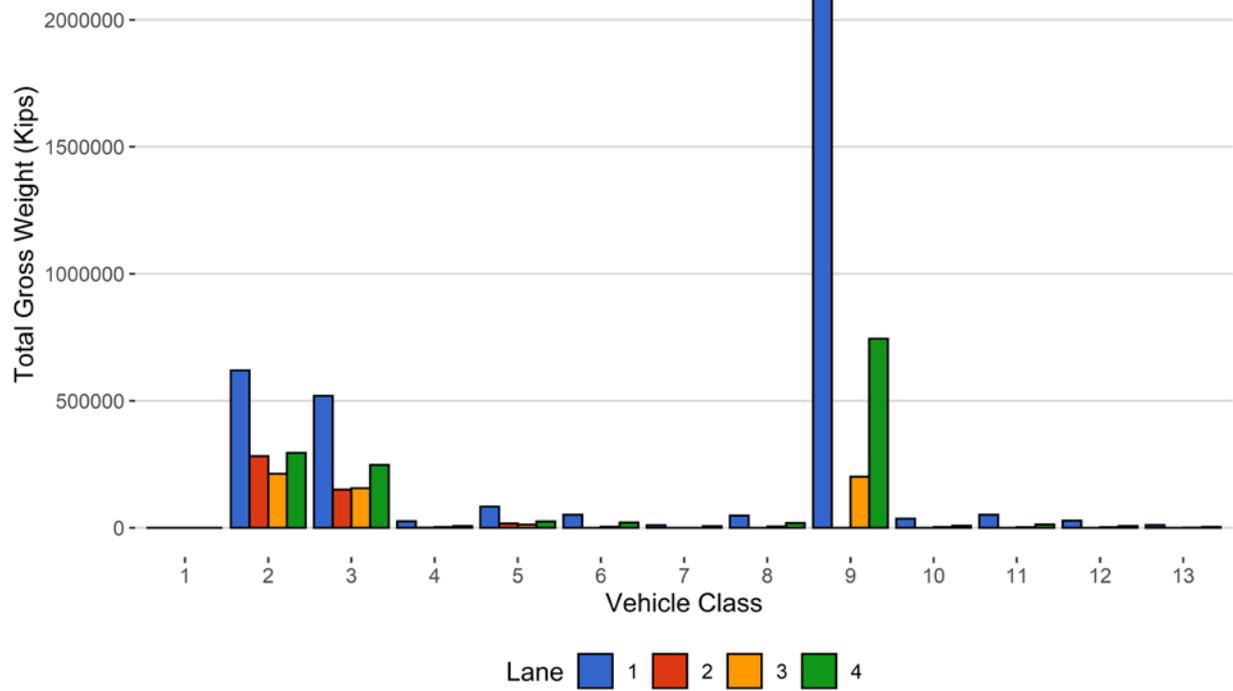


Figure 11 - Total Gross Vehicle Weight t

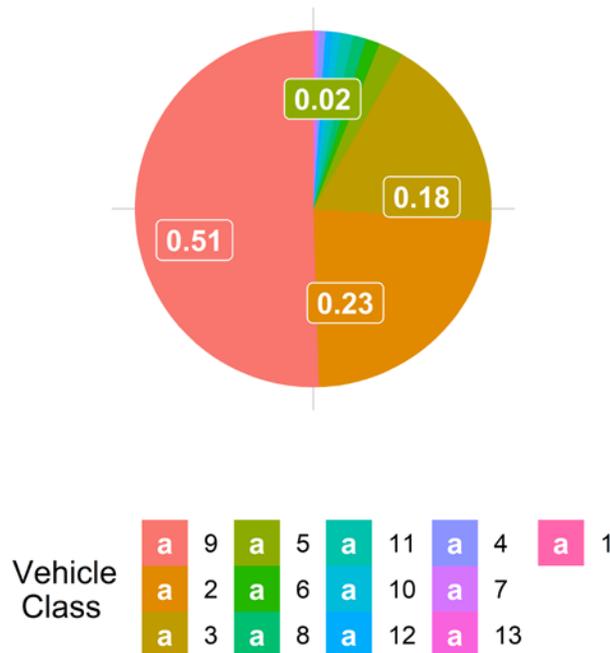


Figure 12 - Total ESALs by Class and Lane

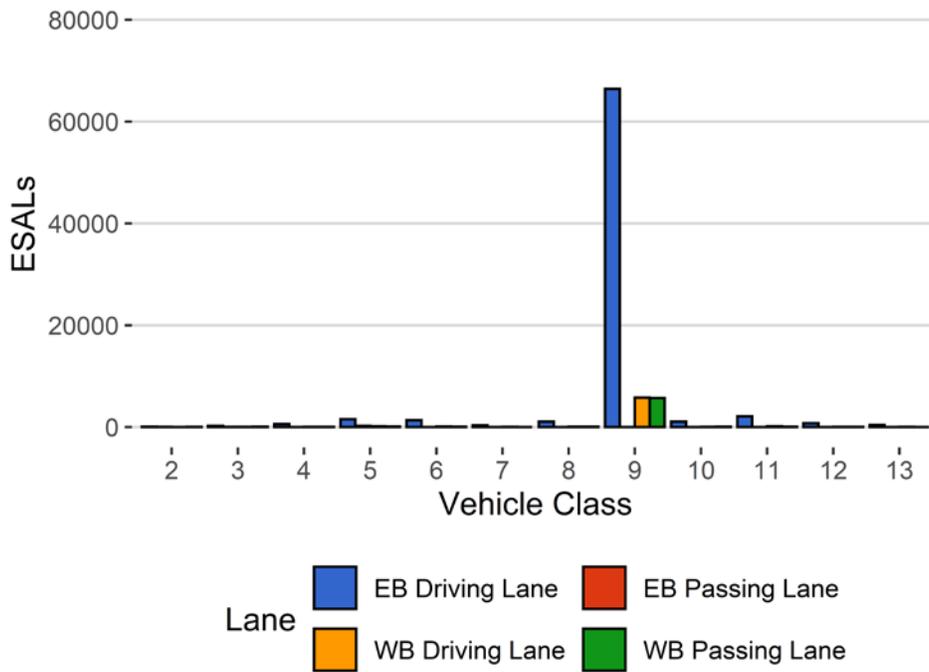


Figure 13 - ESALs by Class

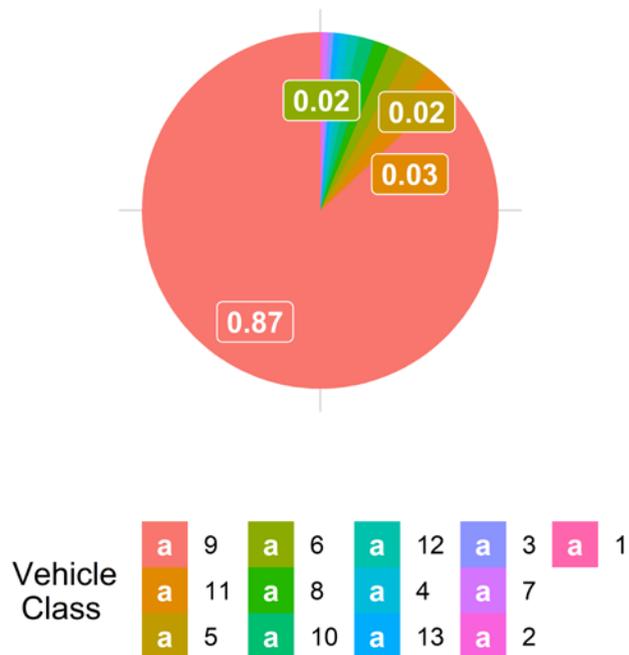


Table 1 Class 9 Front Axle Weight by Lane

<i>Month</i>	<i>Lane 1 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 2 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 3 (Kips)</i>	<i>Front Axle +/- 9%</i>	<i>Lane 4 (kips)</i>	<i>Front Axle +/- 9%</i>
January 2017	11.32	0.00	12.24	0.00	12.06	0.00	11.96	0.00
February 2017	11.38	0.53	12.34	0.86	11.92	-1.18	11.93	-0.24
March 2017	11.43	1.01	12.31	0.58	11.71	-2.97	11.84	-0.98
April 2017	11.52	1.80	12.32	0.66	11.52	-4.55	11.75	-1.74
May 2017	11.29	-0.29	12.44	1.67	11.53	-4.39	11.75	-1.74
June 2017	10.11	-10.64	12.42	1.43	11.44	-5.18	11.79	-1.43
July 2017	10.07	-11.07	12.43	1.51	11.49	-4.78	11.84	-1.04
August 2017	9.93	-12.30	12.50	2.10	11.54	-4.33	11.96	0.00
September 2017	9.78	-13.58	12.54	2.43	11.52	-4.51	12.04	0.71
October 2017	10.01	-11.53	12.69	3.70	11.64	-3.54	12.25	2.42
December 2017	10.95	-3.27	13.16	7.50	12.25	1.55	12.25	2.40
January 2018	11.26	-0.54	13.09	6.93	12.40	2.80	12.48	4.35
February 2018	10.72	-5.27	13.12	7.22	12.37	2.50	12.40	3.70
March 2018	10.56	-6.70	13.02	6.37	11.96	-0.89	12.21	2.08
April 2018	10.39	-8.25	12.91	5.51	11.88	-1.52	12.13	1.44
May 2018	9.89	-12.66	12.74	4.09	11.82	-2.00	12.04	0.66
June 2018	9.79	-13.53	12.72	3.92	11.67	-3.25	12.11	1.23
July 2018	9.77	-13.68	12.72	3.95	11.64	-3.50	12.10	1.21
August 2018	10.63	-6.13	12.78	4.40	11.73	-2.73	12.19	1.91
September 2018	11.81	4.33	12.94	5.68	11.84	-1.84	12.32	3.03
October 2018	12.01	6.10	13.14	7.33	11.99	-0.64	12.68	6.03
November 2018	12.40	9.55	13.34	9.00	12.34	2.26	13.57	13.43
December 2018	12.47	10.15	12.13	-0.92	12.34	2.33	12.59	5.28
January 2019	12.58	11.15	13.63	11.32	12.72	5.44	7.96	-33.49
February 2019	12.62	11.48	13.24	8.20	12.72	5.44	7.91	-33.84

March 2019	12.35	9.13	13.08	6.83	12.26	1.60	NA	NA
April 2019	12.09	6.79	13.20	7.84	11.84	-1.88	7.85	-34.34
May 2019	12.07	6.66	13.29	8.57	11.89	-1.42	7.97	-33.36
November 2019	12.70	12.17	13.99	14.32	12.71	5.37	8.14	-31.91
December 2019	12.80	13.08	NA	NA	12.93	7.20	8.29	-30.66

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	14	0	0	0
2	12308	381547	57.7	0	0
3	6547	202950	30.7	0	0
4	43	1343	0.2	116	0.7
5	344	10670	1.6	228	1.3
6	91	2823	0.4	253	1.5
7	11	330	0	86	0.5
8	75	2325	0.4	131	0.8
9	1838	56974	8.6	15270	90.2
10	27	841	0.1	281	1.7
11	37	1139	0.2	309	1.8
12	20	626	0.1	157	0.9
13	6	175	0	101	0.6
TOTAL	21347	661757	100	16932	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>
2019-12-27	Friday	11:42:08	10	EB	2	143.67
2019-12-26	Thursday	12:33:51	9	EB	2	127.99
2019-12-12	Thursday	08:22:39	10	WB	3	125.34
2019-12-20	Friday	19:59:38	9	EB	2	124.79
2019-12-23	Monday	16:05:18	9	EB	2	124.59
2019-12-22	Sunday	13:56:20	9	EB	2	122.85
2019-12-04	Wednesday	14:26:54	10	EB	1	122.22
2019-12-02	Monday	16:33:25	9	EB	2	121.88
2019-12-15	Sunday	08:34:33	9	EB	1	121.62
2019-12-27	Friday	18:22:21	9	EB	2	121.34

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	798	57	7.1	24877	772	6881
5	EB	8	6519	220	3.4	98735	1607	24172
6	EB	19	1490	61	4.1	50031	1062	11440
7	EB	11.5	145	0	0	10065	0	4199
8	EB	31	1233	276	22.4	42166	6149	6250
9	EB	33	30620	583	1.9	2082788	17164	545784
10	EB	33.5	514	116	22.6	32899	3106	9783
11	EB	36.5	721	1	0.1	51141	36	12431
12	EB	36.5	383	3	0.8	27977	86	7054
13	EB	31.5	102	0	0	10728	0	3758
TOTAL	****	****	42525	1317	****	2431407	****	631749
<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	416	135	32.5	7843	1651	1814
5	WB	8	3126	735	23.5	31977	4841	6424
6	WB	19	1062	352	33.1	19178	5125	2844
7	WB	11.5	153	2	1.3	6405	17	2334
8	WB	31	869	626	72	9436	14093	951
9	WB	33	20881	6456	30.9	778538	166801	151256
10	WB	33.5	246	95	38.6	9324	2246	2133
11	WB	36.5	309	25	8.1	14641	748	2138
12	WB	36.5	183	19	10.4	8738	622	1376
13	WB	31.5	56	2	3.6	3827	59	1063
TOTAL	****	****	27301	8447	****	889906	****	172334
GRAND TOTAL	****	****	69826	9764	316	3321314	226185	804083

Table 5 Gross Vehicle Weight by Class and Lane

<i>Vehicle Class</i>	<i>EB Driving Lane</i>	<i>EB Passing Lane</i>	<i>WB Passing Lane</i>	<i>WB Driving Lane</i>	<i>Total</i>	<i>Percentage</i>
1	10	0	0	3	12	0
2	619624	281474	212384	295253	1408735	23.4
3	519586	149949	155689	247461	1072684	17.8
4	25328	321	2615	6880	35144	0.6
5	83531	16811	12316	24501	137159	2.3
6	51093	0	3814	20489	75396	1.3
7	10065	0	0	6423	16488	0.3
8	48316	0	4947	18582	71844	1.2
9	2099952	0	200961	744377	3045290	50.5
10	36004	0	3052	8518	47574	0.8
11	51177	0	2422	12967	66567	1.1
12	28063	0	2451	6908	37423	0.6
13	10728	0	573	3312	14613	0.2
TOTAL	3583478	448554	601224	1395673	6028929	100
GVW/LANE	59.44	7.44	9.97	23.15	100	0

Table 6 ESALs by Class and Lane and Flexible ESAL Factors

<i>Vehicle Class</i>	<i>EB Driving Lane</i>	<i>EB Passing Lane</i>	<i>WB Passing Lane</i>	<i>WB Driving Lane</i>	<i>Total</i>	<i>Percentage</i>	<i>Flexible ESAL Factor</i>
1	0	0	0	0	0	0	0.0714
2	104	51	48	19	221	0.25	0.0013
3	240	68	81	42	430	0.48	0.0047
4	631	6	55	44	737	0.82	1.21
5	1571	234	116	146	2067	2.31	0.43
6	1385	0	104	122	1610	1.8	1.26
7	365	0	0	62	428	0.48	2.83
8	1076	0	98	105	1279	1.43	1.22
9	66431	0	5730	5798	77959	86.96	3.03
10	1083	0	88	61	1232	1.37	3.21
11	2120	0	105	150	2375	2.65	4.58
12	748	0	46	46	840	0.94	2.93
13	429	0	10	35	475	0.53	5.63
TOTAL	76181	360	6479	6633	89652	100	26
ESALS/LANE	85	0.4	7.2	7.4	100	-	-

Table 7 Site Summary: Volume and Vehicle Class

Month	Total Volume	Monthly ADT	Monthly HCAD T	Passenger Vehicles	Passenger Vehicles %	Heavy Commercial Vehicles	Heavy Commercial Vehicles %	Heavy Commercial Vehicles in Driving Lane %	Heavy Commercial Vehicles in Passing Lane %
Jan 2019	559580	18051	2561	480175	85.8	79405.3	14.2	90.8	9.2
Feb 2019	491557	17556	2257	428359	87.1	63197.7	12.9	88.6	11.4
Mar 2019	659731	21282	1948	599351	90.8	60379.6	9.2	89	11
Apr 2019	683555	22785	2973	594371	87	89183.8	13	87.1	12.9
May 2019	117200	23440	443	103470	88.3	13729.5	11.7	85.1	14.9
Nov 2019	663336	22111	3118	569798	85.9	93537.8	14.1	86.8	13.2
Dec 2019	661757	21347	2492	584511	88.3	77246.1	11.7	91.6	8.4
TOTAL	3836716	-	-	3360035	-	476680	-	-	-
AVERAGE	548102	20939	2256	480005	88	68097	12	88	12

###ESALs

Month	ESALS EB Passing Lane	ESALS EB Driving Lane	ESALS WB Driving Lane	ESALS WB Passing Lane	Total ESALS	Driving Lane ESALS %	Passing Lane ESALS %	Pavement Life Decrease Months
Jan 2019	77135	7565	5894	47024	137618	90	10	52.1
Feb 2019	71402	1382	7023	30065	109872	92	8	53.5
Mar 2019	74055	794	6312	7503	88665	92	8	40.3
Apr 2019	67646	8632	6462	269610	352350	96	4	0
May 2019	10615	1969	932	316076	329592	99	1	0
Nov 2019	84661	15242	6882	28655	135440	84	16	61.3
Dec 2019	77228	2870	6531	28025	114654	92	8	64.2
TOTAL	462742	38454	40036	726958	1268191	-	-	-
AVERAGE	66106	5493	5720	103851	181170	92	8	39

###Gross Vehicle Weight

Month	GVW EB Passing Lane	GVW EB Driving Lane	GVW WB Passing Lane	GVW WB Driving Lane	Total GVW Kips
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Jan 19	3487847	362792	461944	1183423	5496006
Feb 19	3175748	237878	499984	581432	4495042
Mar 19	3660437	264992	592313	474238	4991981
Apr 19	3626632	674426	655448	1608209	6564715
May 19	600380	149864	114919	299861	1165024
Nov 19	3789671	858930	625805	1796904	7071310
Dec 19	3603515	449716	602981	1418431	6074643
TOTAL	21944231	2998597	3553394	7362498	35858720
AVERAGE	3134890	428371	507628	1051785	5122674

###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>
Jan 2019	18969	3.9	25.5	8920	970
Feb 2019	17198	4.3	30	8122	836
Mar 2019	18015	3.2	32.1	6411	530
Apr 2019	19093	3	21.9	5516	544
May 2019	3710	3.4	25.1	1190	315
Nov 2019	21995	3.6	23.5	11837	2041
Dec 2019	17182	2.9	22.4	9406	1346
TOTAL	116162	-	-	51402	6582
AVERAGE	16594.6	3.5	25.8	7343.1	940.3

###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>
Jan 2019	682552	136589	819140	83.3	16.7
Feb 2019	607655	89278	696932	87.2	12.8
Mar 2019	658384	58631	717015	91.8	8.2
Apr 2019	697463	177154	874617	79.7	20.3
May 2019	114442	26727	141170	81.1	18.9
Nov 2019	792067	215904	1007971	78.6	21.4
Dec 2019	631749	172334	804083	78.6	21.4
TOTAL	4184311	876617	5060928	-	-
AVERAGE	597758.7	125231	722989.7	82.9	17.1