

NOVEMBER 2018



05/18/2010

**WIM #26
I-35, MP 30.1
OWATONNA, MN**

**MONTHLY
REPORT**



06/28/2010

Your Destination...Our Priority



WIM Site Location

WIM #26 is located on I-35 near Owatonna in Steele county.

System Operation

WIM #26 was operational for the entire month of November 2018. Volume was computed using all monthly data.

System Calibration

WIM #26 was most recently calibrated on 2018-06-21. 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: 597456 | Passenger Vehicles: 466424 | Heavy Commercial Vehicles: 131032

Monthly Average Daily Traffic (MADT): 20602 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 4368

See Table 2 for vehicle class breakdown

Passenger Vehicles (PVs) and Heavy Commercial Vehicles (HCVs)

Volume trends. NB vehicles typically reached highest volume levels on Saturdays, with lowest volumes reported on Tuesdays. SB vehicles typically reached highest volume levels on Sundays, with lowest volumes reported on Tuesdays (see Figure 3 and 4).

Passenger Vehicles (PVs)

Volume trends. On an average 24-hour day (see Figure 5), NB PVs generally reached peak volume levels between 02 PM and 04 PM. Similarly, SB PVs peaked in volume between 02 PM and 04 PM

Heavy Commercial Vehicles (HCVs)

Volume trends. On an average 24-hour day, HCVs traveling NB typically reached peak volume levels between 02 PM and 04 PM, while volume going SB 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 5's.

Overweight HCVs

Volume trends. Of a total of 131032 HCVs, 27648 of them were overweight³. These overweight HCVs contributed to 4.7% of total monthly volume, and 21.4% of total monthly HCV volume. NB overweight vehicles typically reached highest numbers on Wednesdays, with lowest volumes reported on Saturdays. SB 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 9 and class 6 vehicles. Overall, overweight vehicles tended to reach peak volume concentrations during typical business hours, with 68.8% of all overweight vehicles traveling NB 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 report⁴.

Using normal load limits, 2792 NB vehicles exceeded 88,000 pounds (2466 vehicles were Class 9's; 154 vehicles were Class 13's). Of vehicles traveling SB,

364 NB vehicles exceeded 88,000 pounds (125 vehicles were Class 9's; 115 vehicles were Class 10'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 fully_loaded Class 9's than empty Class 9's traveling NB, while there were more fully_loaded Class 9's than empty traveling SB. Data also suggests that there were more fully_loaded Class 10's than empty traveling in the NB direction. In the SB direction, there were more fully_loaded class 10 vehicles.

Freight Totals. A total of 1550843 tons of freight was recorded to have crossed the WIM. More freight was shipped NB (55.3%) than SB (44.7%). See Table 4 and Figure 11 for more freight information.

Infrastructure Considerations

Bridge. Bridge No. 91086 (a box culvert) is approximately 0.5 miles north of WIM #26, and Bridge No. 91095 (also a box culvert) is 6.9 miles south of WIM #26. WIM #26 recorded a total of 597456 vehicles with a combined GVW of 9216758 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 150013 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 58.7% of all ESALs were recorded NB while 41.3% was observed SB. In particular, 83% of all ESALs were generated by the Class 9's (Class 9's were also responsible for generating 63% 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).

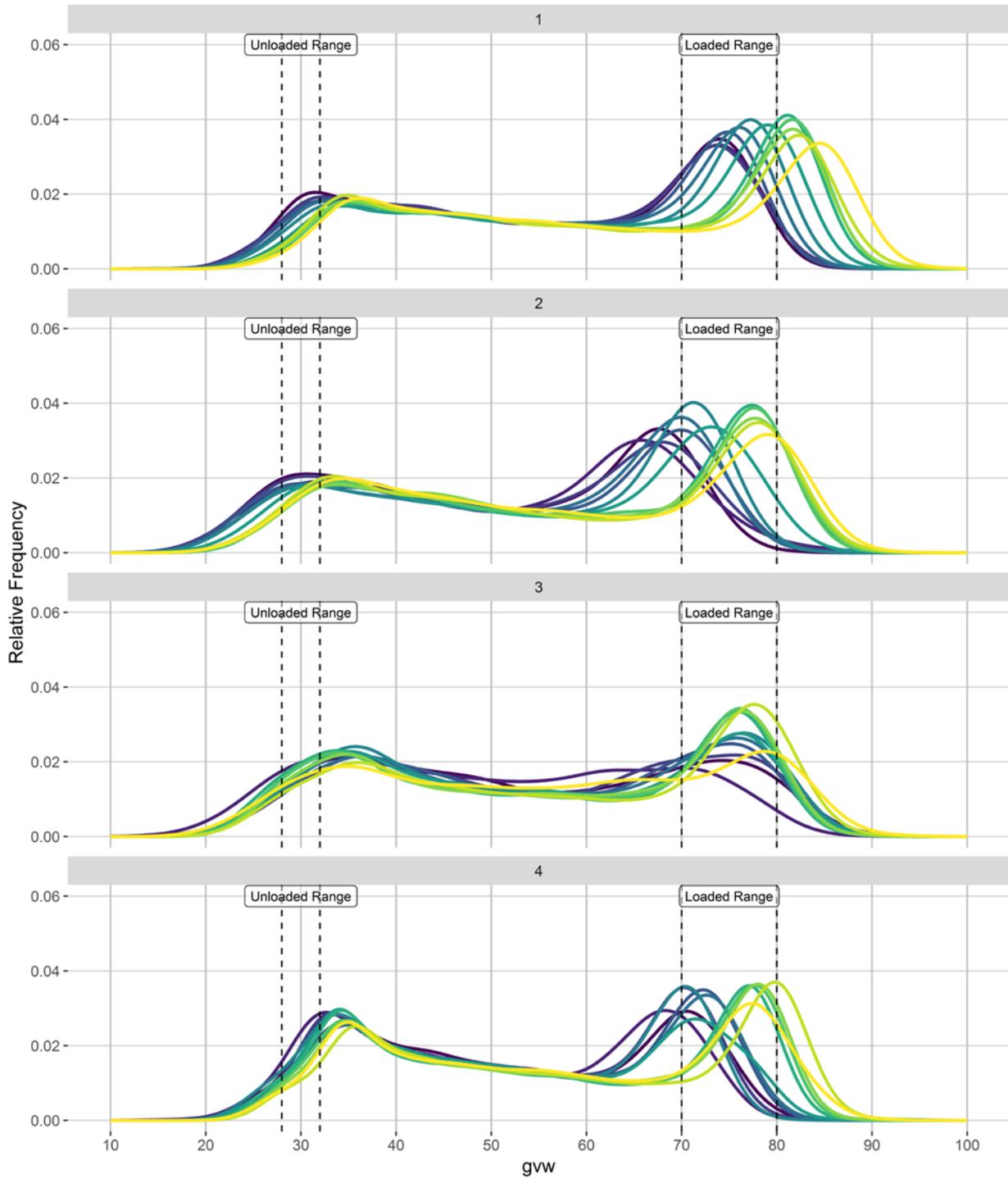
WIM monthly reports can be found at: <http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html>

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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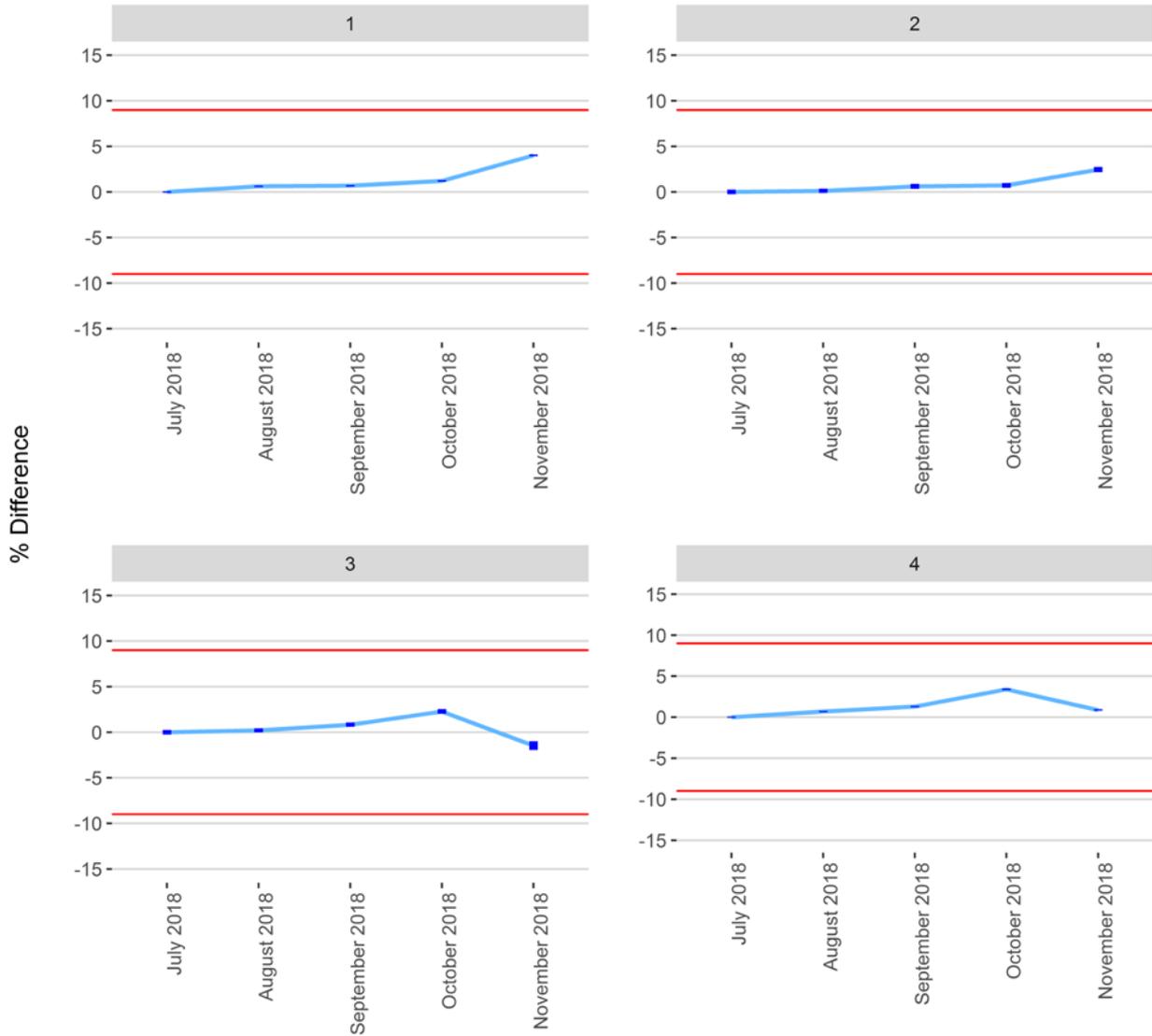
Figure 1 - Monthly Class 9 GVW Histogram



December 2017	March 2018	June 2018	September 2018
January 2018	April 2018	July 2018	October 2018
February 2018	May 2018	August 2018	November 2018

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

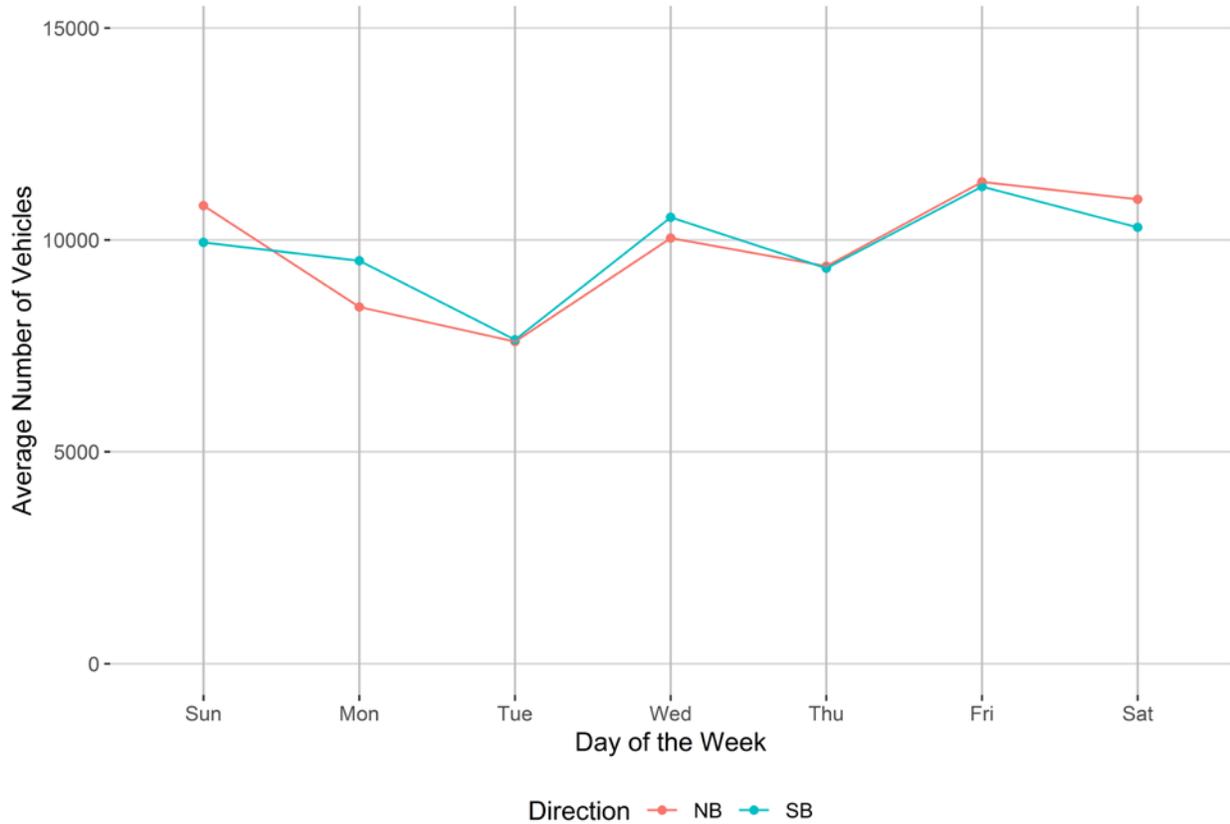


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

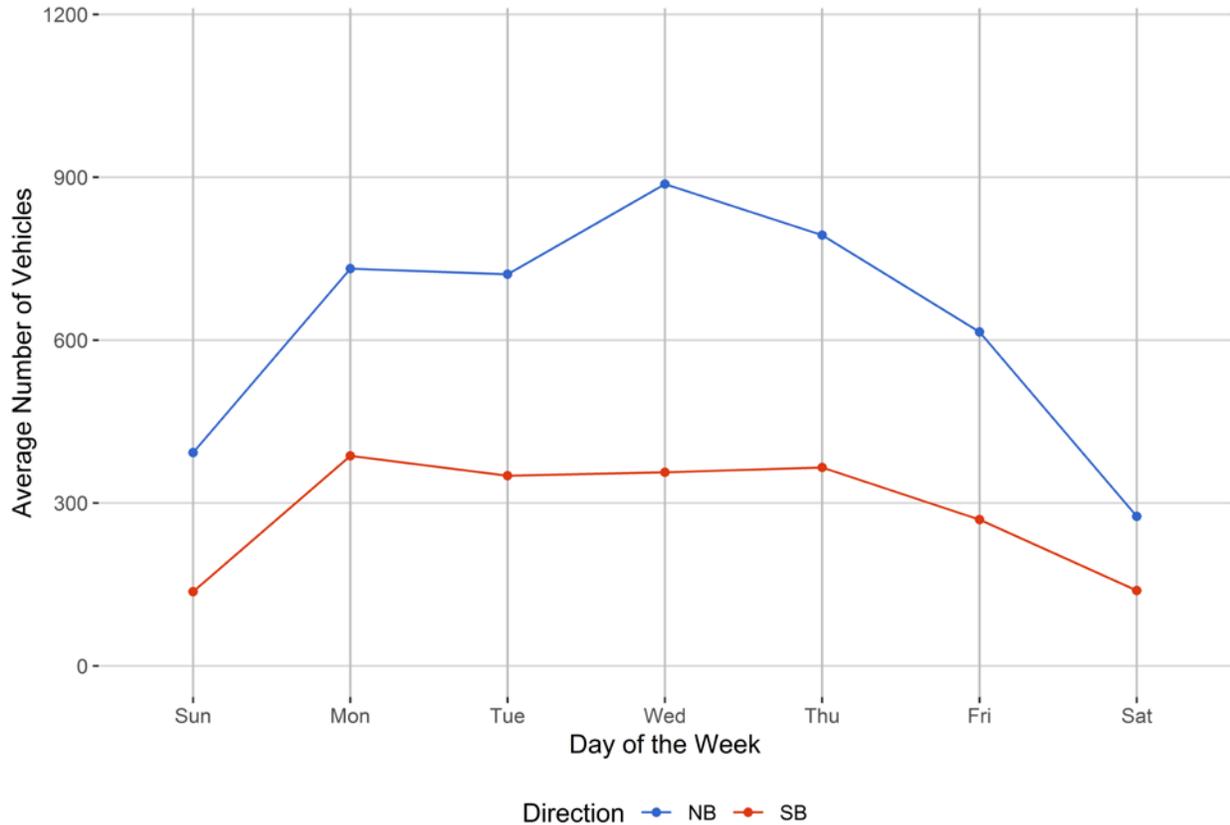


Figure 4 - Passenger Vehicles vs. Hour of the Day

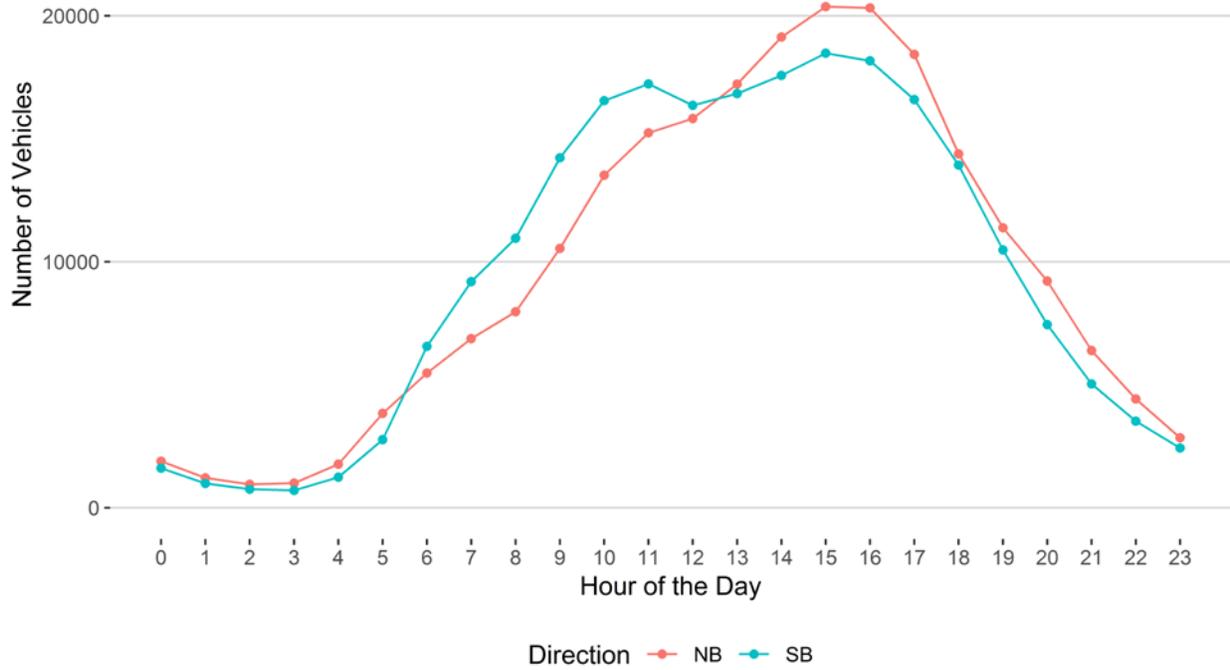


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

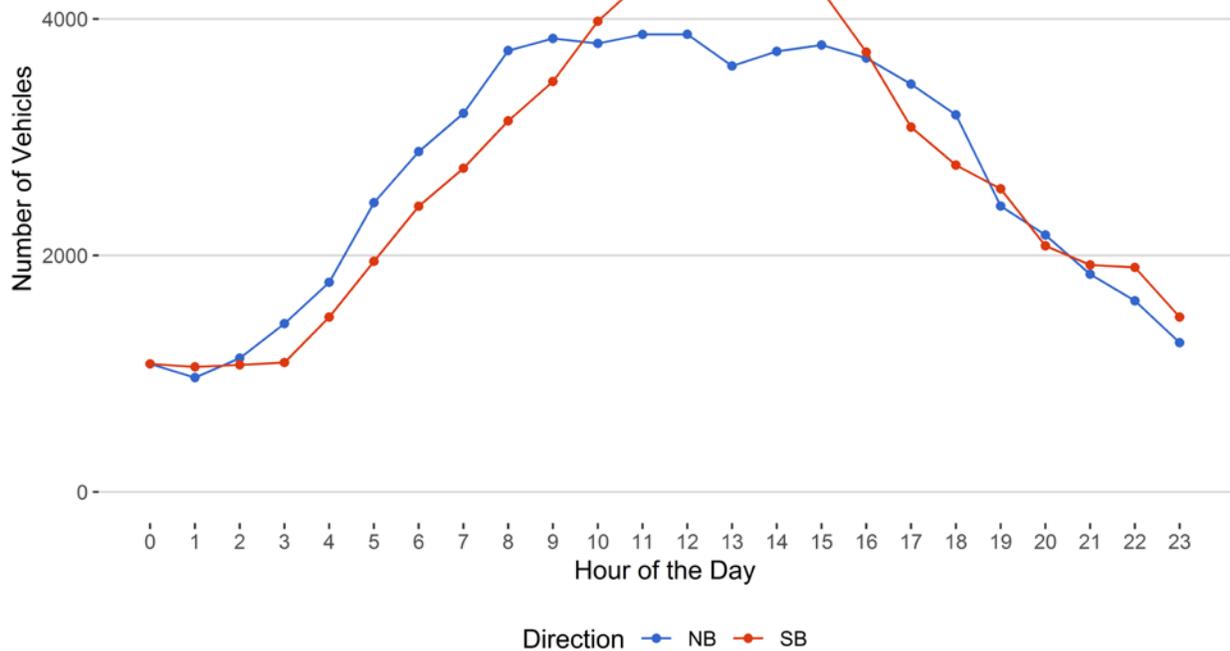


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

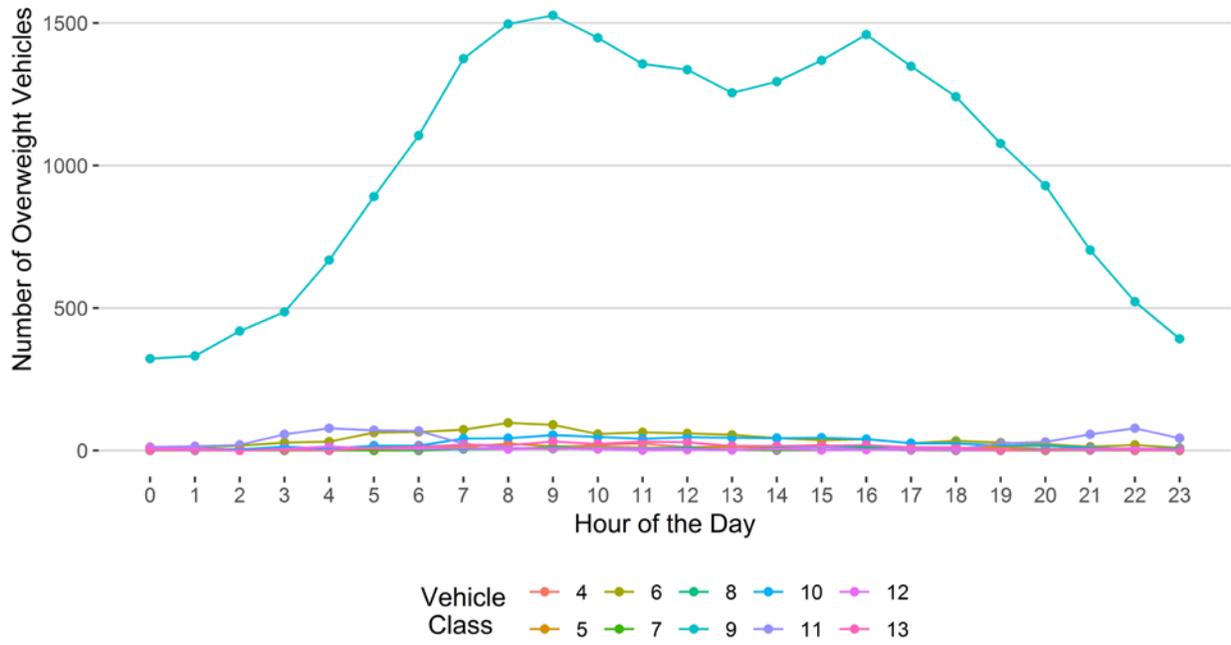


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

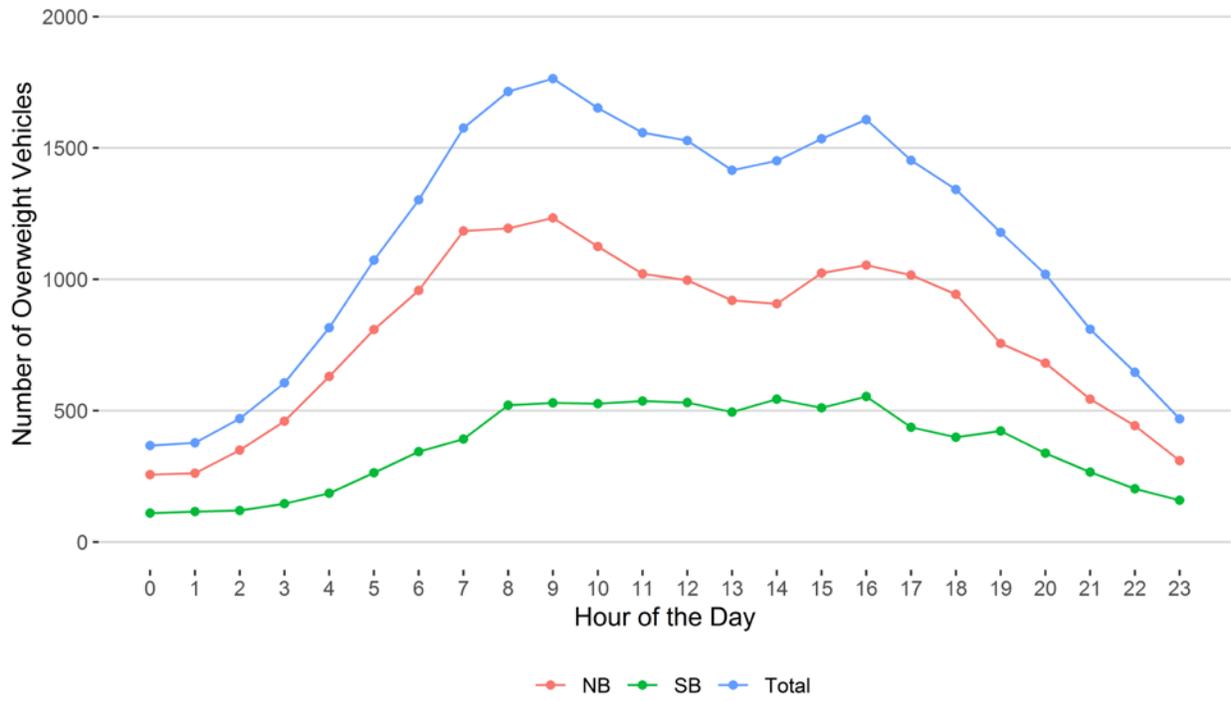
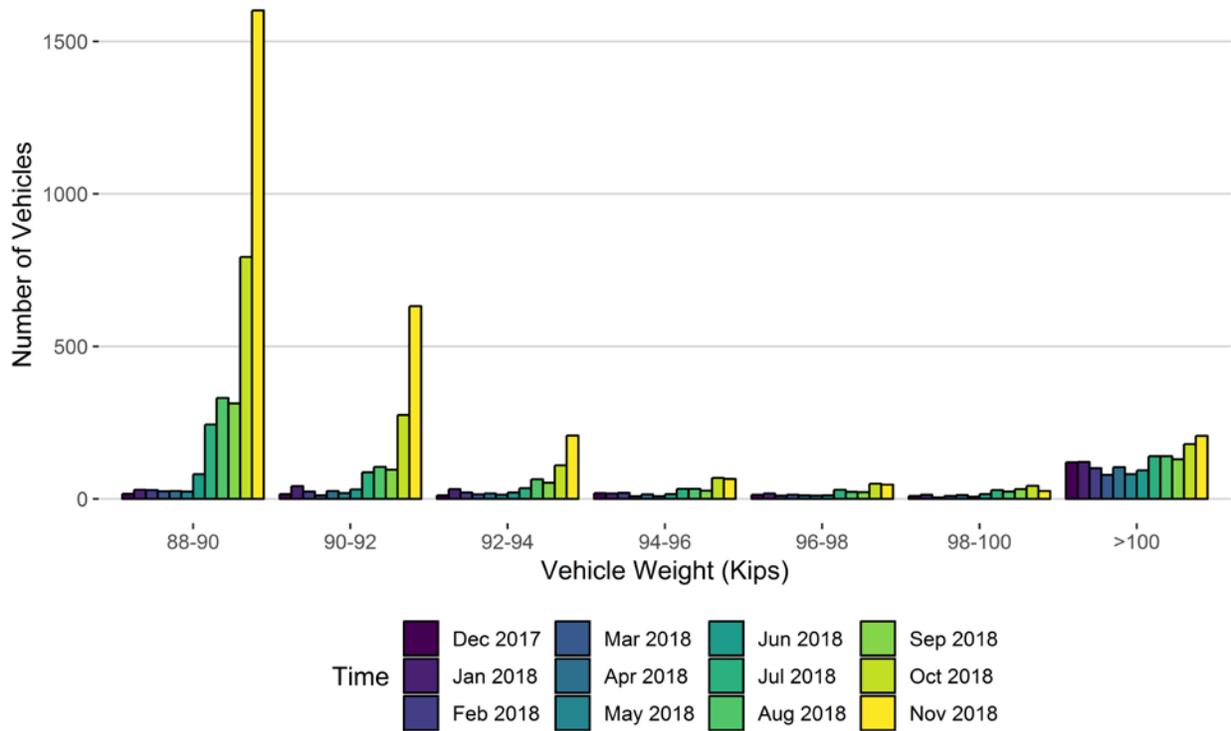
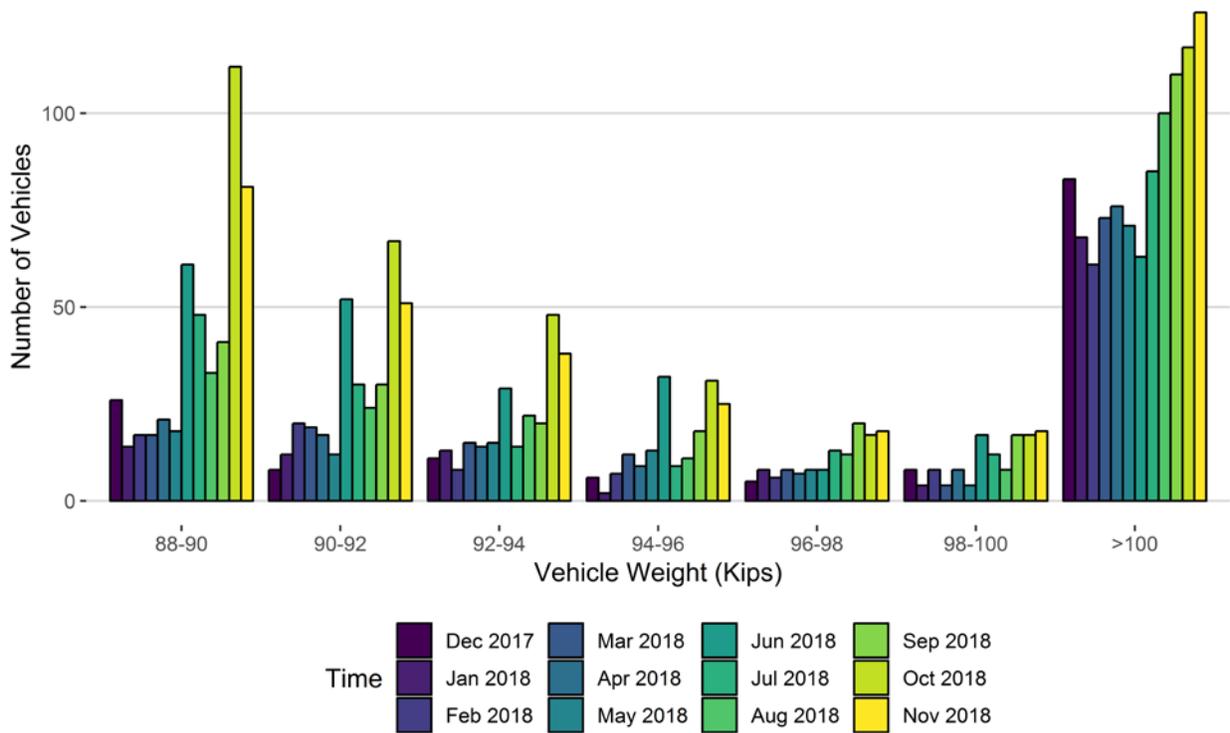


Figure 8 - Histogram of NB Vehicles Over 88,000 Pounds for Current Month



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	17	30	29	25	26	24	81	244	331	313	793	1601
90-92	16	42	24	12	26	19	31	87	105	96	275	632
92-94	12	32	21	15	18	14	21	35	64	53	110	208
94-96	19	18	20	9	15	9	16	33	33	27	69	65
96-98	14	18	11	14	12	11	12	30	23	22	50	47
98-100	10	14	5	10	13	7	16	29	24	32	43	26
>100	120	121	101	79	104	81	94	140	140	130	180	207
Total	208	275	211	164	214	165	271	598	720	673	1520	2786

Figure 8 - Histogram of SB 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	26	14	17	17	21	18	61	48	33	41	112	81
90-92	8	12	20	19	17	12	52	30	24	30	67	51
92-94	11	13	8	15	14	15	29	14	22	20	48	38
94-96	6	2	7	12	9	13	32	9	11	18	31	25
96-98	5	8	6	8	7	8	8	13	12	20	17	18
98-100	8	4	8	4	8	4	17	12	8	17	17	18
>100	83	68	61	73	76	71	63	85	100	110	117	126
Total	147	121	127	148	152	141	262	211	210	256	409	357

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

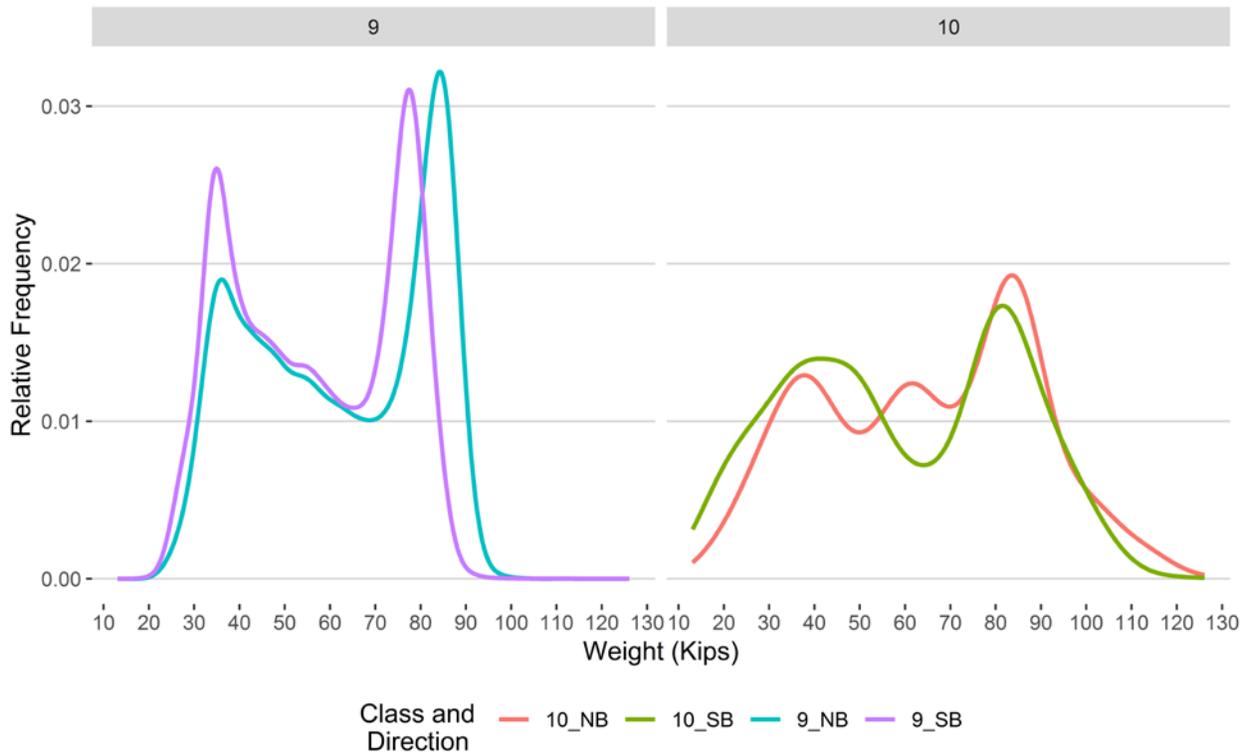


Figure 9 - Freight Percentage by Direction and Class

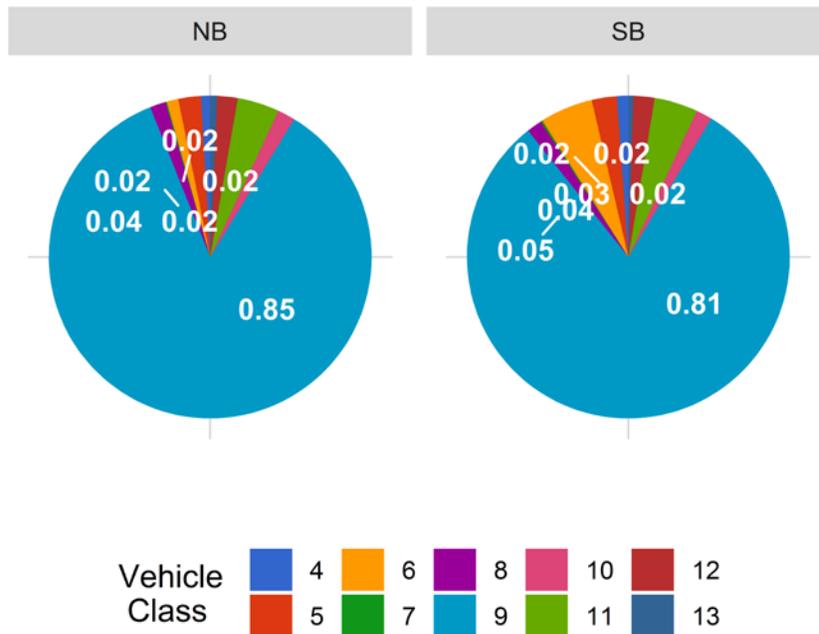


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

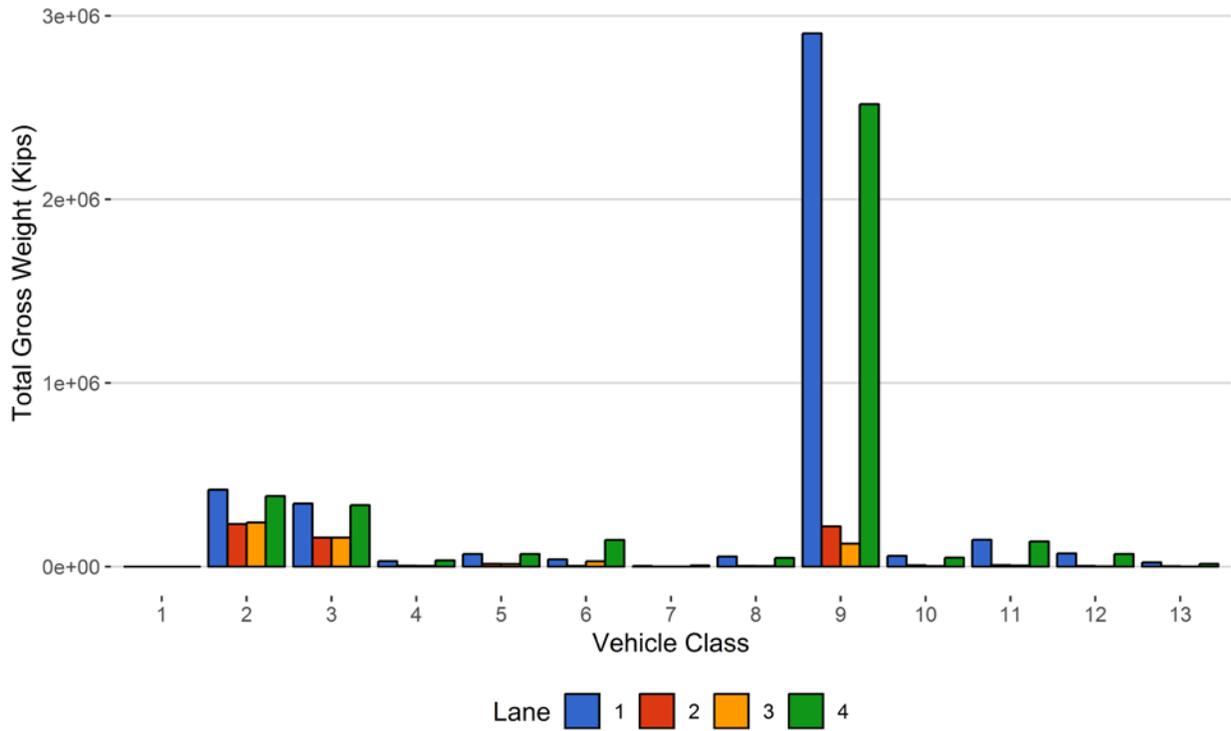


Figure 11 - Total Gross Vehicle Weight t

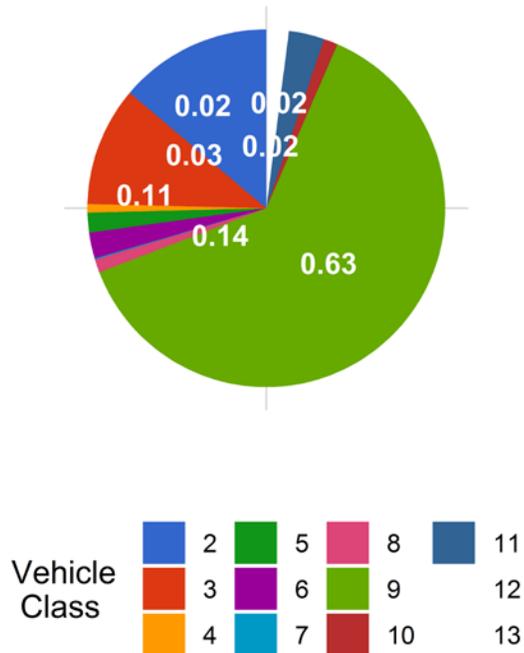


Figure 12 - Total ESALs by Class and Lane

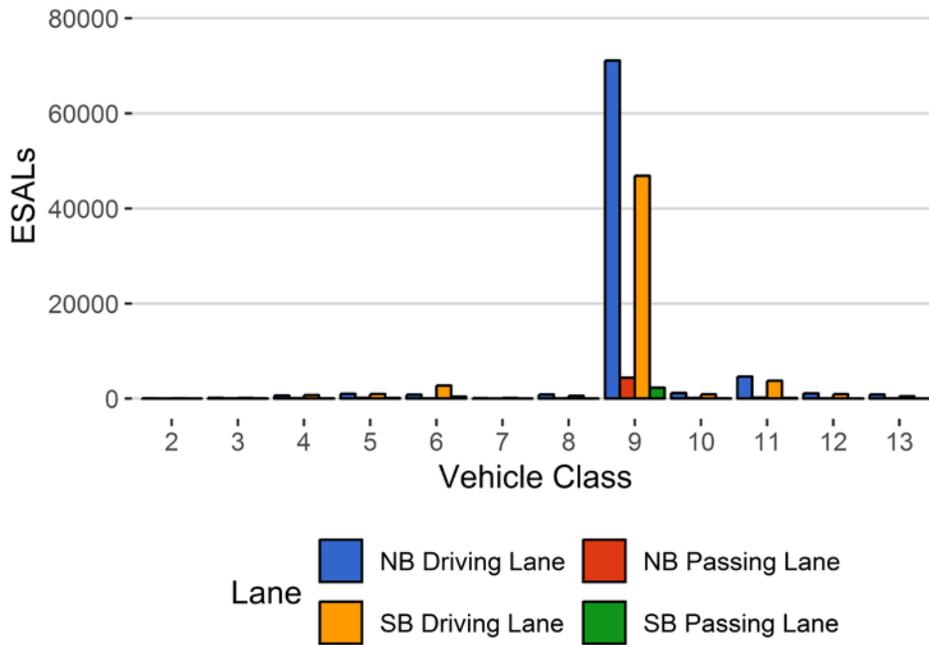


Figure 13 - ESALs by Class

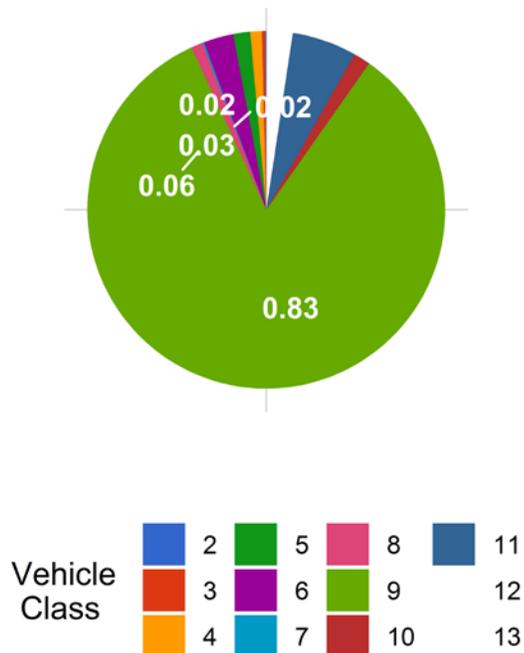


Table 1 Class 9 Front Axle Weight by Lane

<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>
July 2018	11.67	0.00	11.30	0.00	11.46	0.00	11.42	0.00
August 2018	11.75	0.62	11.31	0.12	11.49	0.20	11.50	0.69
September 2018	11.75	0.68	11.37	0.61	11.56	0.83	11.57	1.30
October 2018	11.82	1.21	11.38	0.71	11.72	2.28	11.81	3.39
November 2018	12.14	4.01	11.58	2.45	11.30	-1.46	11.52	0.88

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	10431	312923	52.4	0	0
3	5117	153501	25.7	0	0
4	78	2353	0.4	213	0.8
5	371	11143	1.9	219	0.8
6	230	6896	1.2	993	3.6
7	7	217	0	53	0.2
8	109	3262	0.5	138	0.5
9	3262	97865	16.4	24350	88.1
10	63	1900	0.3	626	2.3
11	157	4709	0.8	654	2.4
12	77	2301	0.4	118	0.4
13	13	387	0.1	284	1
TOTAL	19915	597456	100	27648	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>
2018-11-11	Sunday	09:11:19	10	NB	1	126.12
2018-11-26	Monday	13:00:25	10	SB	4	120.14
2018-11-18	Sunday	03:58:26	10	NB	1	120.11
2018-11-28	Wednesday	04:28:02	10	NB	1	117.56
2018-11-25	Sunday	09:00:55	10	NB	1	116.38
2018-11-18	Sunday	15:37:43	10	NB	1	116.09
2018-11-10	Saturday	15:57:10	10	NB	1	115.68
2018-11-24	Saturday	09:55:33	10	NB	1	115.13
2018-11-02	Friday	17:50:48	10	NB	1	114.79
2018-11-30	Friday	16:58:21	10	NB	1	114.65

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	NB	15	1095	118	10.8	32426	1549	8885
5	NB	8	5516	446	8.1	79420	3231	19430
6	NB	19	1447	205	14.2	39027	3618	7714
7	NB	11.5	82	0	0	4462	0	1759
8	NB	31	1708	611	35.8	44055	14486	5024
9	NB	33	50102	2873	5.7	3037013	86590	739228
10	NB	33.5	1002	109	10.9	62225	2934	16155
11	NB	36.5	2354	10	0.4	153524	340	33984
12	NB	36.5	1175	3	0.3	75015	80	16118
13	NB	31.5	238	0	0	25363	0	8933
TOTAL	****	****	64719	4375	****	3552529	****	857231
<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	SB	15	1229	114	9.3	35889	1521	9582
5	SB	8	5491	524	9.5	78523	3759	19393
6	SB	19	5365	255	4.8	168744	4521	35827
7	SB	11.5	132	0	0	6269	0	2375
8	SB	31	1514	602	39.8	36036	14088	3882
9	SB	33	46567	4171	9	2519451	123773	560192
10	SB	33.5	875	147	16.8	48695	3600	12154
11	SB	36.5	2297	47	2	141261	1510	29568
12	SB	36.5	1098	8	0.7	69649	188	14932
13	SB	31.5	144	0	0	15950	0	5707
TOTAL	****	****	64712	5868	****	3120467	****	693612
GRAND TOTAL	****	****	129431	10243	178	6672996	265790	1550843

Table 5 Gross Vehicle Weight by Class and Lane

<i>Vehicle Class</i>	<i>NB Driving Lane</i>	<i>NB Passing Lane</i>	<i>SB Passing Lane</i>	<i>SB Driving Lane</i>	<i>Total</i>	<i>Percentage</i>
2	418093	231608	240020	383585	1273306	13.8
3	342879	157776	157628	334414	992697	10.8
4	29141	4834	3737	33673	71384	0.8
5	68013	14638	14086	68196	164933	1.8
6	39023	3621	28322	144943	215909	2.3
7	3753	709	274	5995	10731	0.1
8	54641	3901	2800	47324	108666	1.2
9	2904592	219011	124737	2518487	5766827	62.7
10	57665	7494	3173	49122	117455	1.3
11	146092	7772	5769	137002	296635	3.2
12	71420	3675	1372	68465	144933	1.6
13	22764	2600	699	15251	41314	0.4
TOTAL	4158076	657638	582617	3806458	9204789	100
GVW/LANE	45.17	7.14	6.33	41.35	100	0

Table 6 ESALs by Class and Lane and Flexible ESAL Factors

<i>Vehicle Class</i>	<i>NB Driving Lane</i>	<i>NB Passing Lane</i>	<i>SB Passing Lane</i>	<i>SB Driving Lane</i>	<i>Total</i>	<i>Percentage</i>	<i>Flexible ESAL Factor</i>
2	56	29	29	47	160	0.11	0.001
3	168	57	52	157	434	0.29	0.0057
4	672	93	68	732	1565	1.05	1.35
5	1010	170	138	982	2299	1.54	0.42
6	809	58	407	2746	4020	2.69	1.18
7	86	12	6	127	230	0.15	2.12
8	869	46	24	627	1566	1.05	0.97
9	71105	4422	2314	46862	124702	83.38	2.58
10	1203	118	47	917	2285	1.53	2.43
11	4646	210	136	3761	8754	5.85	3.76
12	1100	52	16	933	2101	1.41	1.85
13	852	65	16	510	1443	0.96	7.34
TOTAL	82573	5332	3255	58400	149560	100	24
ESALS/LANE	55.2	3.6	2.2	39	100	-	-

Table 7 Site Summary: Volume and Vehicle Class

<i>Month</i>	<i>Total Volume</i>	<i>Monthly ADT</i>	<i>Monthly HCAD T</i>	<i>Passenger Vehicles</i>	<i>Passenger Vehicles %</i>	<i>Heavy Commercial Vehicles</i>	<i>Heavy Commercial Vehicles %</i>	<i>Heavy Commercial Vehicles in Driving Lane %</i>	<i>Heavy Commercial Vehicles in Passing Lane %</i>
Dec 2017	598759	19315	3752	482443	80.6	116315.6	19.4	91.9	8.1
Jan 2018	498163	16070	3966	375222	75.3	122941	24.7	88.4	11.6
Feb 2018	464482	16589	4150	348276	75	116206.3	25	92	8
Mar 2018	610968	19709	4160	482021	78.9	128946.7	21.1	93.1	6.9
Apr 2018	580205	19340	4325	450468	77.6	129736.9	22.4	91.8	8.2
May 2018	719401	23206	4783	571124	79.4	148276.5	20.6	91.1	8.9
Jun 2018	747544	24918	4473	613365	82.1	134179	17.9	90.9	9.1
Jul 2018	778261	25105	4938	625188	80.3	153073.3	19.7	90	10
Aug 2018	761407	24562	5156	601556	79	159850.7	21	87.3	12.7
Sep 2018	657910	21930	4758	515162	78.3	142748	21.7	89	11
Oct 2018	661987	21354	5213	500370	75.6	161617.4	24.4	89.5	10.5
Nov 2018	597456	20602	4368	466424	78.1	131032	21.9	91.9	8.1
TOTAL	7676543	-	-	6031619	-	1644923	-	-	-
AVERAGE	639712	21058	4504	502635	78	137077	22	91	9

ESALS

<i>Month</i>	<i>ESALS NB Passing Lane</i>	<i>ESALS NB Driving Lane</i>	<i>ESALS SB Driving Lane</i>	<i>ESALS SB Passing Lane</i>	<i>Total ESALS</i>	<i>Driving Lane ESALS %</i>	<i>Passing Lane ESALS %</i>	<i>Pavement Life Decrease Months</i>
Dec 2017	151523	2537	4138	37192	195390	97	3	1.5
Jan 2018	46740	3145	5747	31738	87370	90	10	2.6
Feb 2018	45003	2704	4412	36670	88789	92	8	1.3
Mar 2018	51869	2660	4158	45512	104199	93	7	0.8
Apr 2018	53425	3150	5206	45592	107375	92	8	1.2
May 2018	65022	3953	6376	43927	119277	91	9	0.8
Jun 2018	65146	4085	5477	43627	118334	92	8	1.6
Jul 2018	84400	6449	5875	59420	156145	92	8	3.5
Aug 2018	87730	8168	7986	62288	166172	90	10	4
Sep 2018	78475	5239	7369	58608	149690	92	8	4.4
Oct 2018	90986	6433	8273	76282	181974	92	8	8.5
Nov 2018	82693	5342	3406	58572	150013	94	6	16.2
TOTAL	903012	53864	68422	599429	1624728	-	-	-
AVERAGE	75251	4489	5702	49952	135394	92	8	4

Gross Vehicle Weight

<i>Month</i>	<i>GVW NB Passing Lane</i>	<i>GVW NB Driving Lane</i>	<i>GVW SB Passing Lane</i>	<i>GVW SB Driving Lane</i>	<i>Total GVW Kips</i>
Dec 2017	3275872	466854	698236	2966421	7407383
Jan 2018	3170037	420956	496963	3061183	7149139
Feb 2018	3711268	525438	606268	3615881	8458855
Mar 2018	3624977	545528	630879	3546495	8347880
Apr 2018	4186867	740631	818945	3906425	9652869
May 2018	4025326	788976	859885	3638548	9312736
Jun 2018	4721860	908715	910021	4255066	10795661
Jul 2018	4778193	996057	1037615	4252269	11064134
Aug 2018	4333349	700326	885304	3901307	9820285
Sep 2018	4750482	755225	896476	4525612	10927794
Oct 2018	4161406	658051	585158	3812142	9216758
Nov 2018	3245594	531065	608746	3263953	7649358
TOTAL	47985231	8037822	9034497	44745301	109802851
AVERAGE	3998769	669819	752875	3728775	9150238

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	3916	0.7	3.4	479	326
Jan 2018	4115	0.9	3.5	400	207
Feb 2018	4373	1	3.9	340	176
Mar 2018	5137	0.9	4.1	314	166
Apr 2018	6713	1.2	5.4	367	201
May 2018	8892	1.3	6.2	310	163
Jun 2018	13748	1.9	10.7	534	191
Jul 2018	25547	3.4	17	823	274
Aug 2018	28197	3.8	17.9	935	276
Sep 2018	26035	4	18.5	932	289
Oct 2018	36341	5.6	22.9	1950	369
Nov 2018	27732	4.7	21.4	3156	384
TOTAL	190746	-	-	10540	3022
AVERAGE	15895.5	2.5	11.2	878.3	251.8

Freight

<i>Month</i>	<i>NB Freight Tons</i>	<i>SB Freight Tons</i>	<i>Total Freight</i>	<i>NB Freight %</i>	<i>SB Freight %</i>
Dec 2017	542161	526583	1068744	50.7	49.3
Jan 2018	600277	513278	1113555	53.9	46.1
Feb 2018	574758	537046	1111805	51.7	48.3
Mar 2018	650592	625947	1276539	51	49
Apr 2018	658557	636211	1294768	50.9	49.1
May 2018	777383	660394	1437777	54.1	45.9
Jun 2018	752229	604505	1356734	55.4	44.6
Jul 2018	944419	750020	1694439	55.7	44.3
Aug 2018	986853	794470	1781322	55.4	44.6
Sep 2018	864472	740989	1605461	53.8	46.2
Oct 2018	986542	909358	1895900	52	48
Nov 2018	857231	693612	1550843	55.3	44.7
TOTAL	9195475	7992413	17187888	-	-
AVERAGE	766289.6	666034.4	1432324	53.3	46.7