

MARCH 2019



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 March 2019. Volume was computed using all monthly data.

System Calibration

WIM #26 was most recently calibrated on 2018-11-09. 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: 613996 | Passenger Vehicles: 475238 | Heavy Commercial Vehicles: 138758

Monthly Average Daily Traffic (MADT): 19806 | Monthly Heavy Commercial Average Daily Traffic (MHCADT): 4476

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 Fridays, with lowest volumes reported on Tuesdays. SB vehicles typically reached highest volume levels on Fridays, 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 138758 HCVs, 25784 of them were overweight ³. These overweight HCVs contributed to 4.4% of total monthly volume, and 19.4% of total monthly

HCV volume. NB overweight vehicles typically reached highest numbers on Thursdays, with lowest volumes reported on Saturdays. SB overweight vehicles tended to reach highest volumes on Tuesdays, 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 83.4% 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 January.

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 ,3497 NB vehicles exceeded 88,000 pounds (3048 vehicles were Class 9's; 235 vehicles were Class 10's). Of vehicles traveling SB,

255 NB vehicles exceeded 88,000 pounds (133 vehicles were Class 13's; 71 vehicles were Class 10's). Refer to Table 3 for the Top 10 highest recorded GVWs from Classes 9 and 10 from March 2019.

Loaded vs. Unloaded HCVs. Figure 10 shows the GVW distributions of Class 9s and 10s in March 2019. 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 1600246 tons of freight was recorded to have crossed the WIM. More freight was shipped NB (59.4%) than SB (40.6%). 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 613996 vehicles with a combined GVW of 9474191 kips (1 kip = 1,000 pounds = 0.5 tons) in March 2019. See Table 5 and Figures 12-13 for GVW information by vehicle class and lane.

Pavement Design. A total of 153736 equivalent single axle loads (ESALs) passed over the pavement at this site. Approximately 64.2% of all ESALs were recorded NB while 35.8% 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).

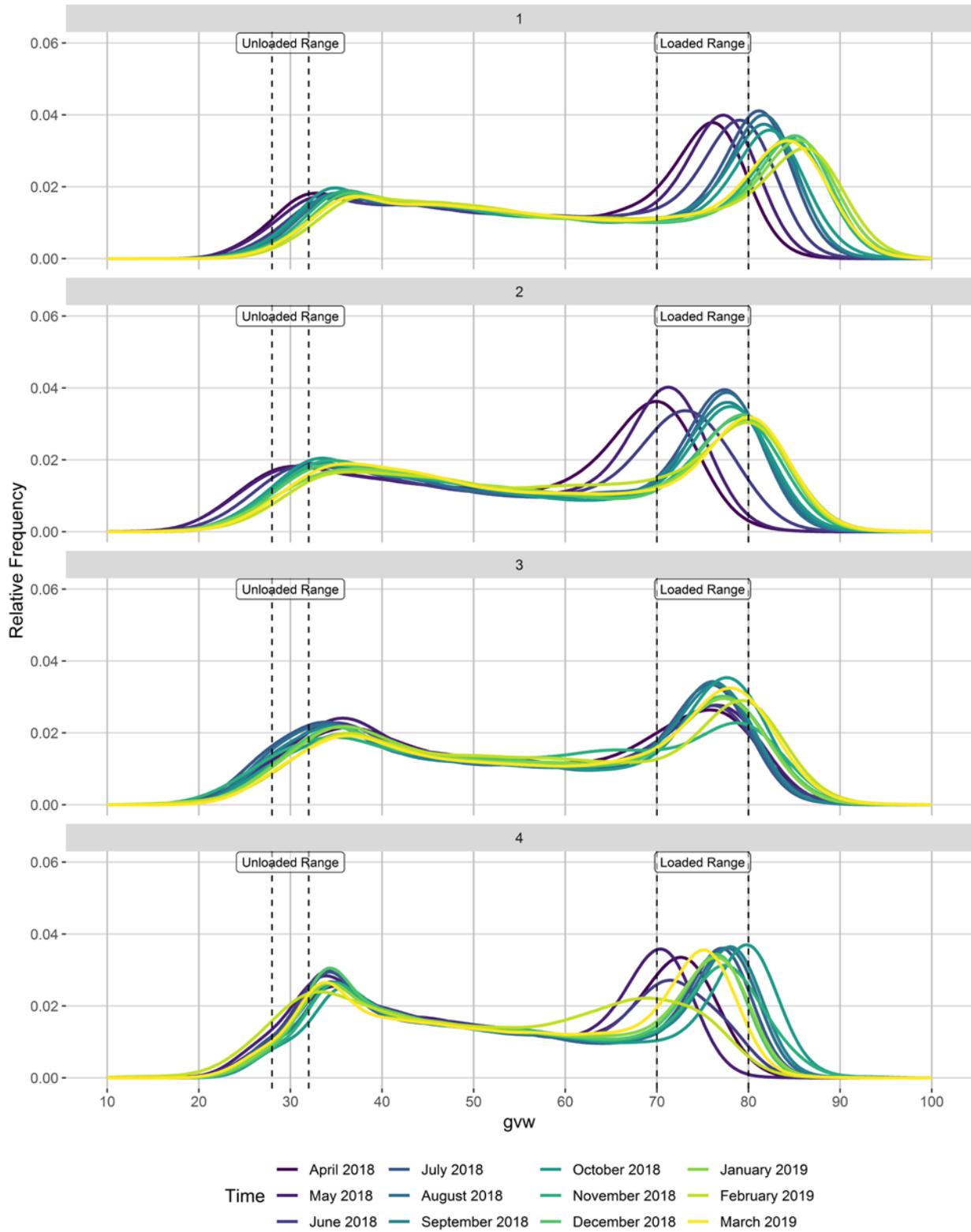
WIM monthly reports can be found at: <http://www.dot.state.mn.us/traffic/data/reports-monthly-wim.html>

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.

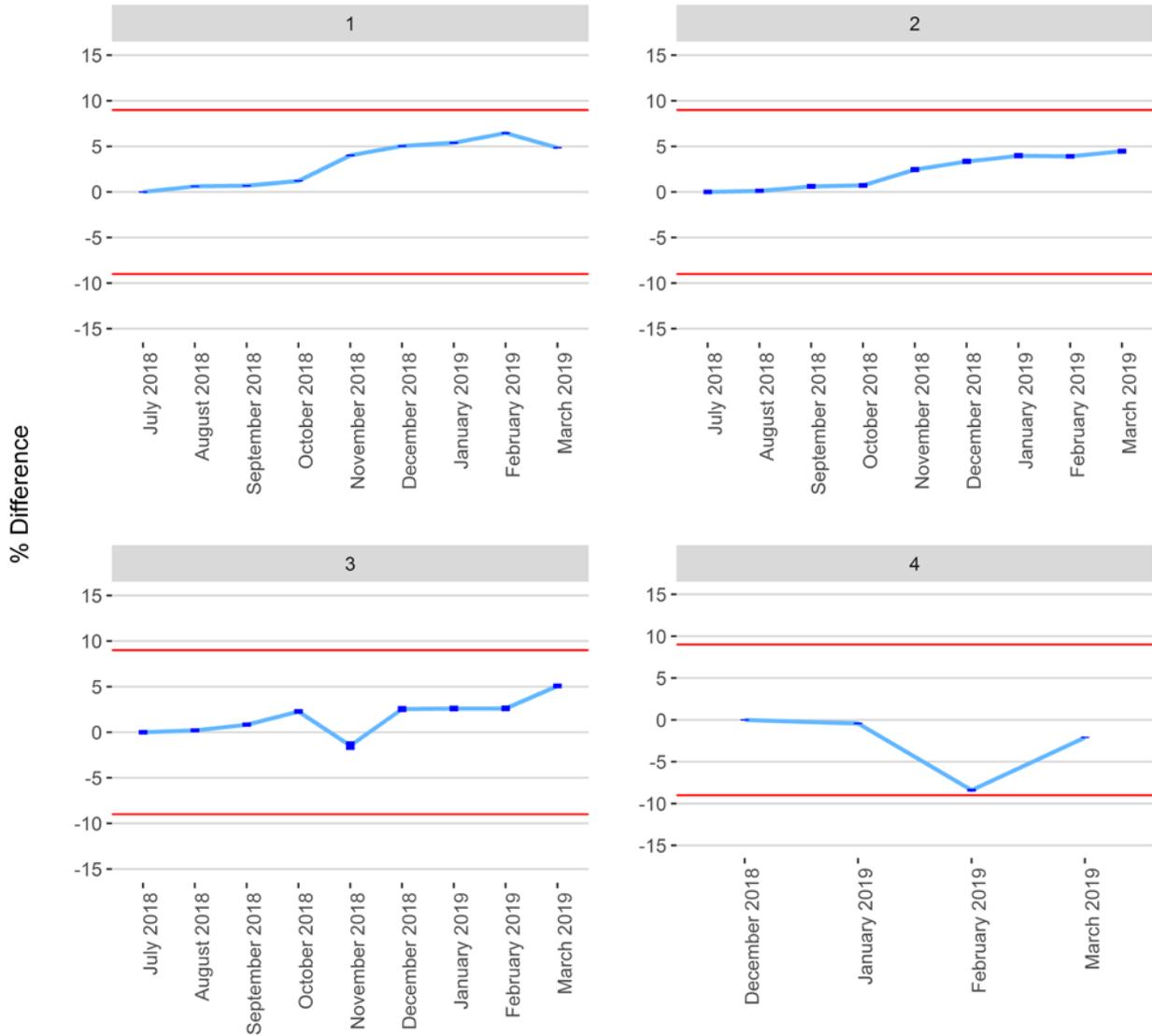
To request this document in an alternative format, please call 651-366-4718 or 1-800-657-3774, or email your request to ADArequest.dot@state.mn.us. Please request at least one week in advance.

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

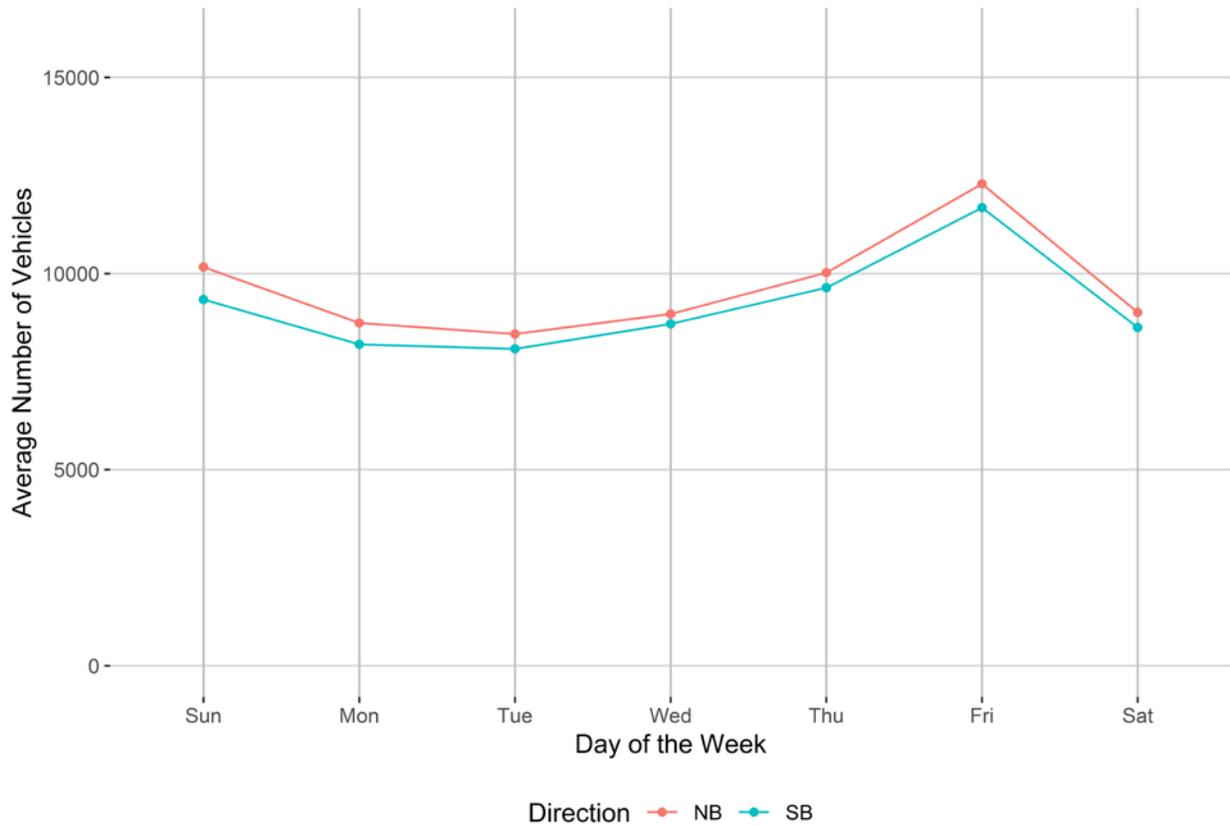


Figure 3 - Average Overweight Vehicle Volume vs. Day of the Week

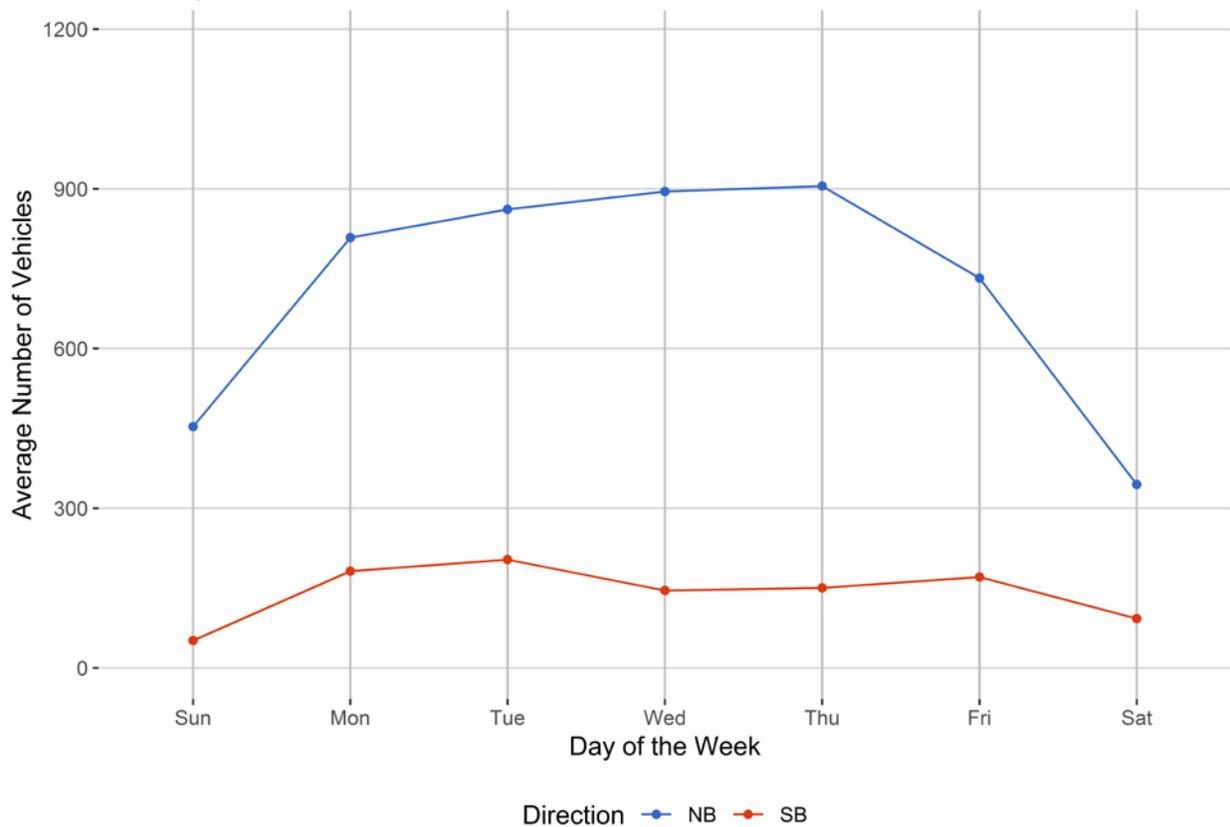


Figure 4 - Passenger Vehicles vs. Hour of the Day

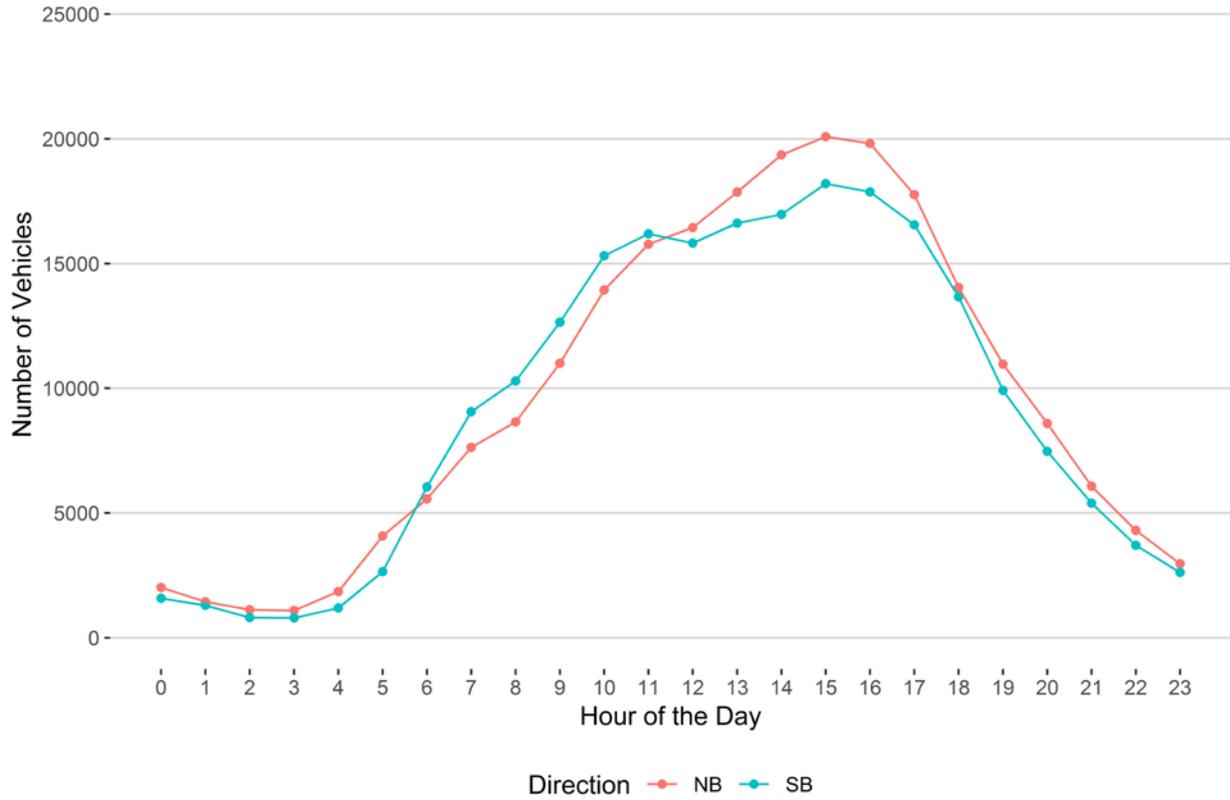


Figure 5 - Heavy Commercial Vehicles vs. Hour of the Day

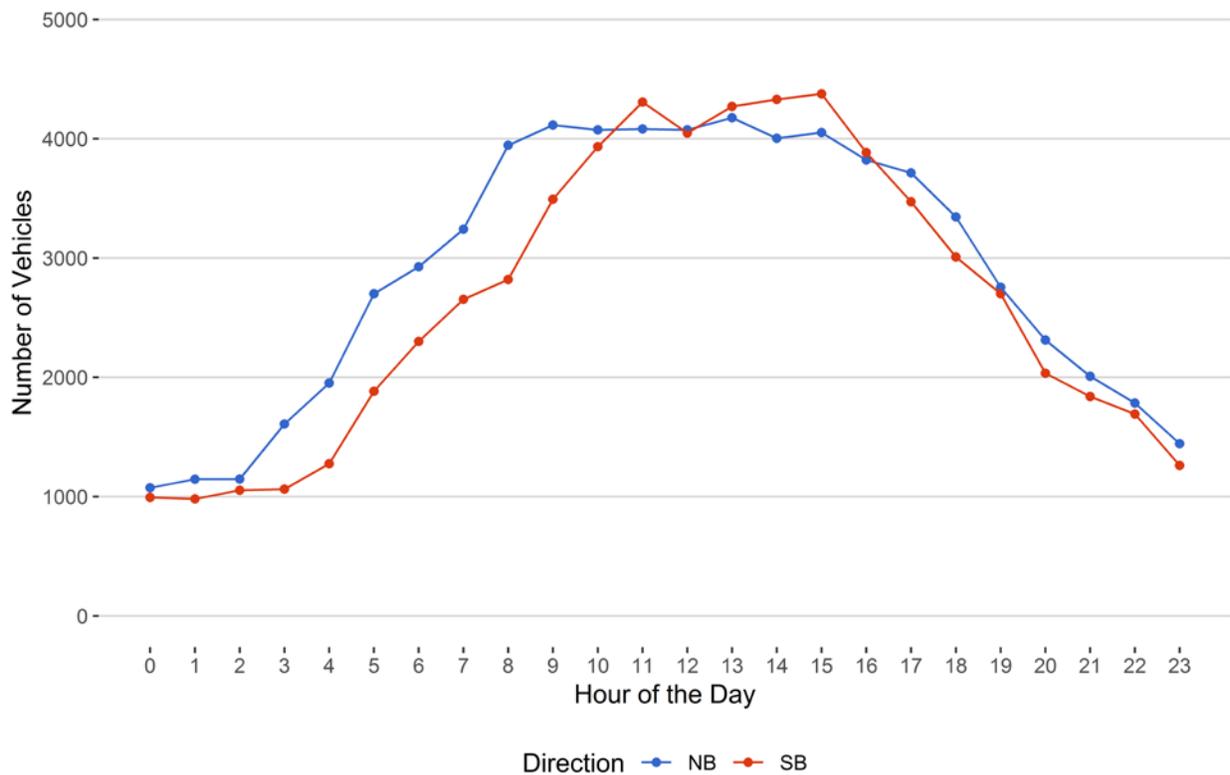


Figure 6 - Overweight Vehicles by Class vs. Hour of the Day

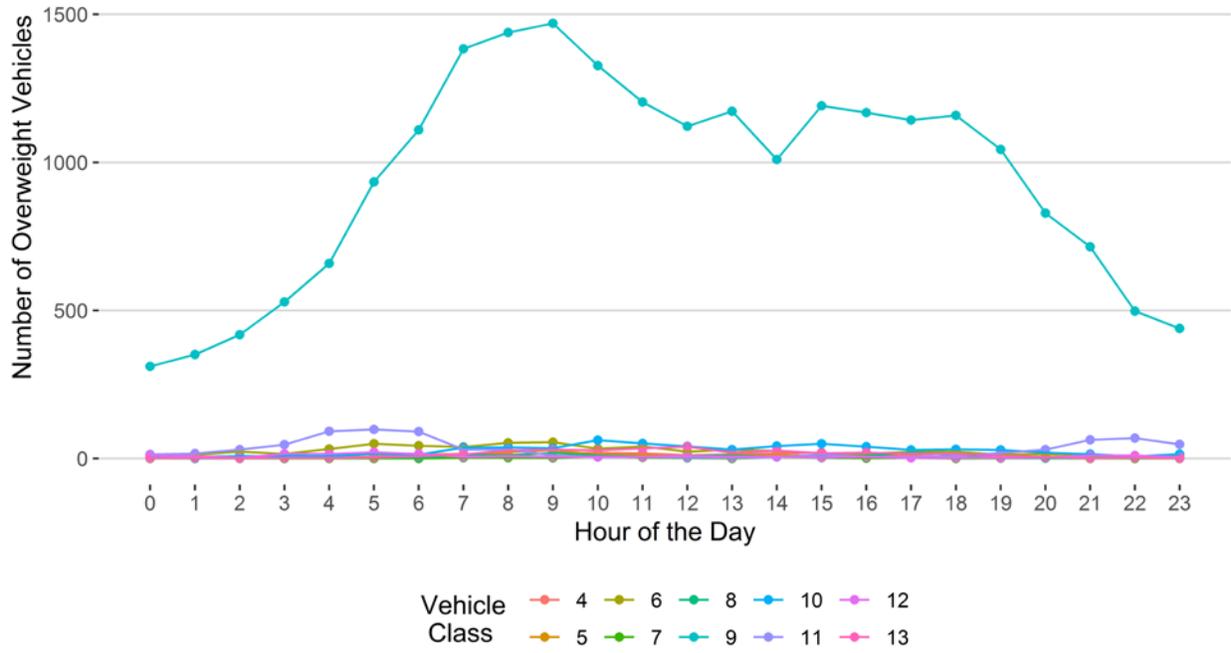


Figure 7 - Overweight Vehicles by Direction
Hour of the Day

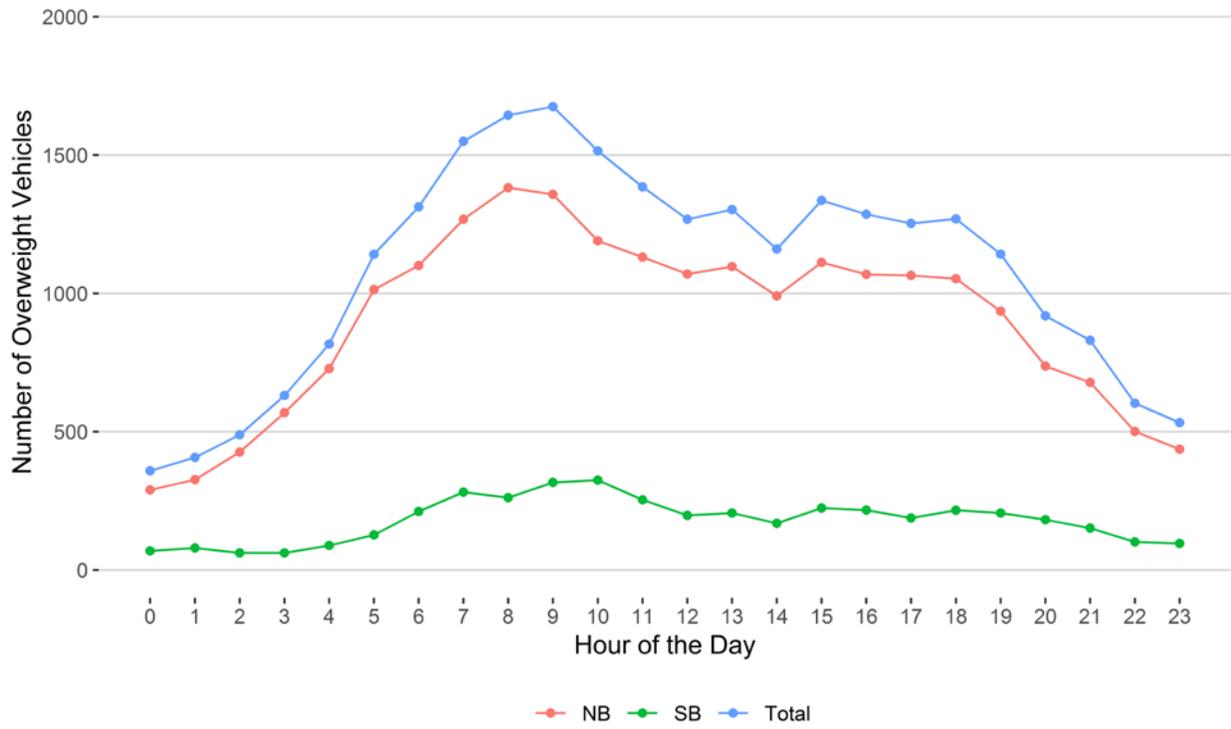
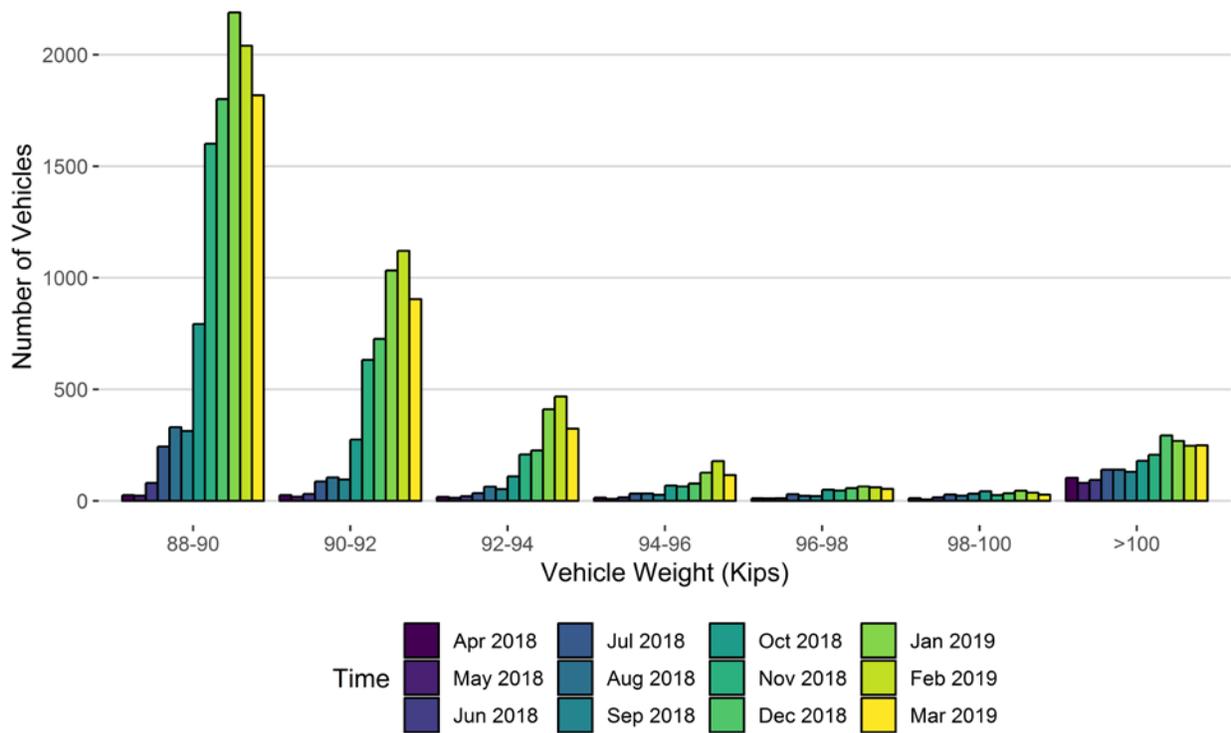
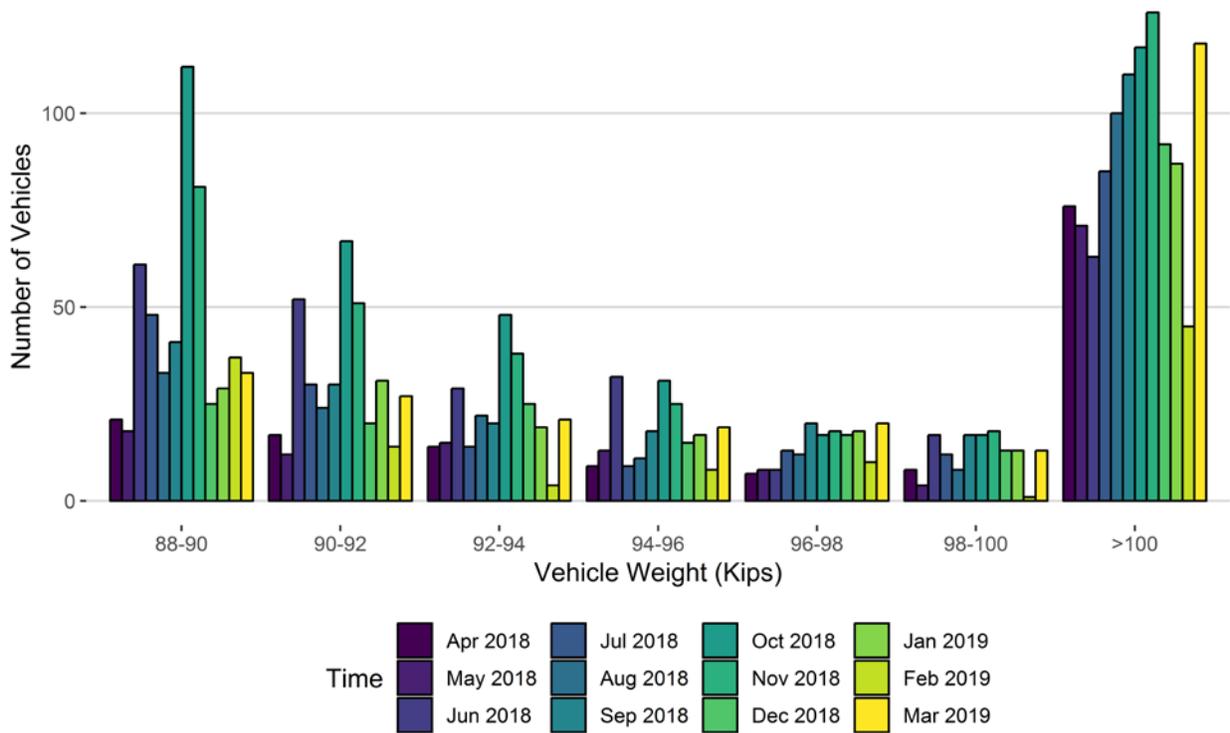


Figure 8 - Histogram of NB Vehicles Over 88,000 Pounds for Current Month



Vehicle Weights (Kips)	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Oct 2018	Nov 2018	Dec 2018	Jan 2019	Feb 2019	Mar 2019
88-90	26	24	81	244	331	313	793	1601	1801	2189	2040	1818
90-92	26	19	31	87	105	96	275	632	726	1033	1121	904
92-94	18	14	21	35	64	53	110	208	226	411	468	324
94-96	15	9	16	33	33	27	69	65	78	127	178	116
96-98	12	11	12	30	23	22	50	47	57	65	61	54
98-100	13	7	16	29	24	32	43	26	34	46	37	28
>100	104	81	94	140	140	130	180	207	293	269	247	249
Total	214	165	271	598	720	673	1520	2786	3215	4140	4152	3493

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



Vehicle Weights (Kips)	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Oct 2018	Nov 2018	Dec 2018	Jan 2019	Feb 2019	Mar 2019
88-90	21	18	61	48	33	41	112	81	25	29	37	33
90-92	17	12	52	30	24	30	67	51	20	31	14	27
92-94	14	15	29	14	22	20	48	38	25	19	4	21
94-96	9	13	32	9	11	18	31	25	15	17	8	19
96-98	7	8	8	13	12	20	17	18	17	18	10	20
98-100	8	4	17	12	8	17	17	18	13	13	1	13
>100	76	71	63	85	100	110	117	126	92	87	45	118
Total	152	141	262	211	210	256	409	357	207	214	119	251

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

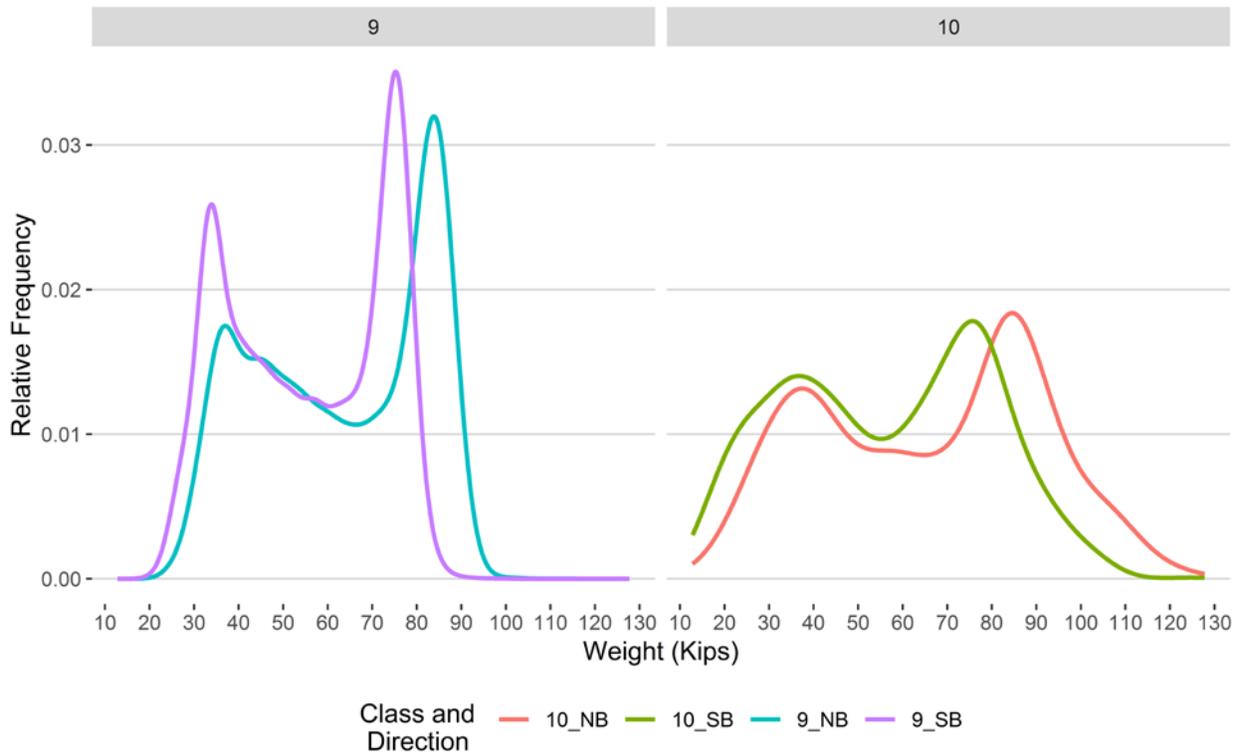


Figure 9 - Freight Percentage by Direction and Class

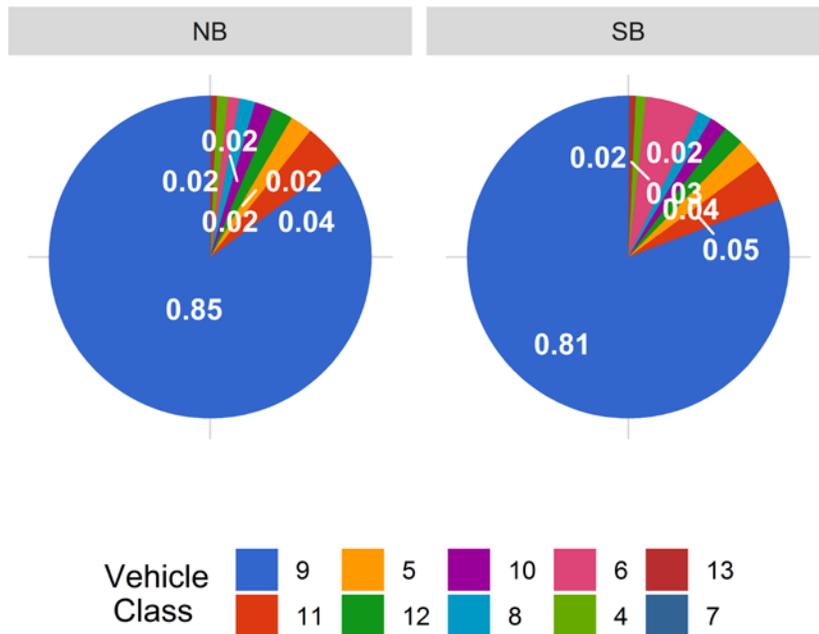


Figure 10 - Total Gross Vehicle Weight Percentage by Class and Lane

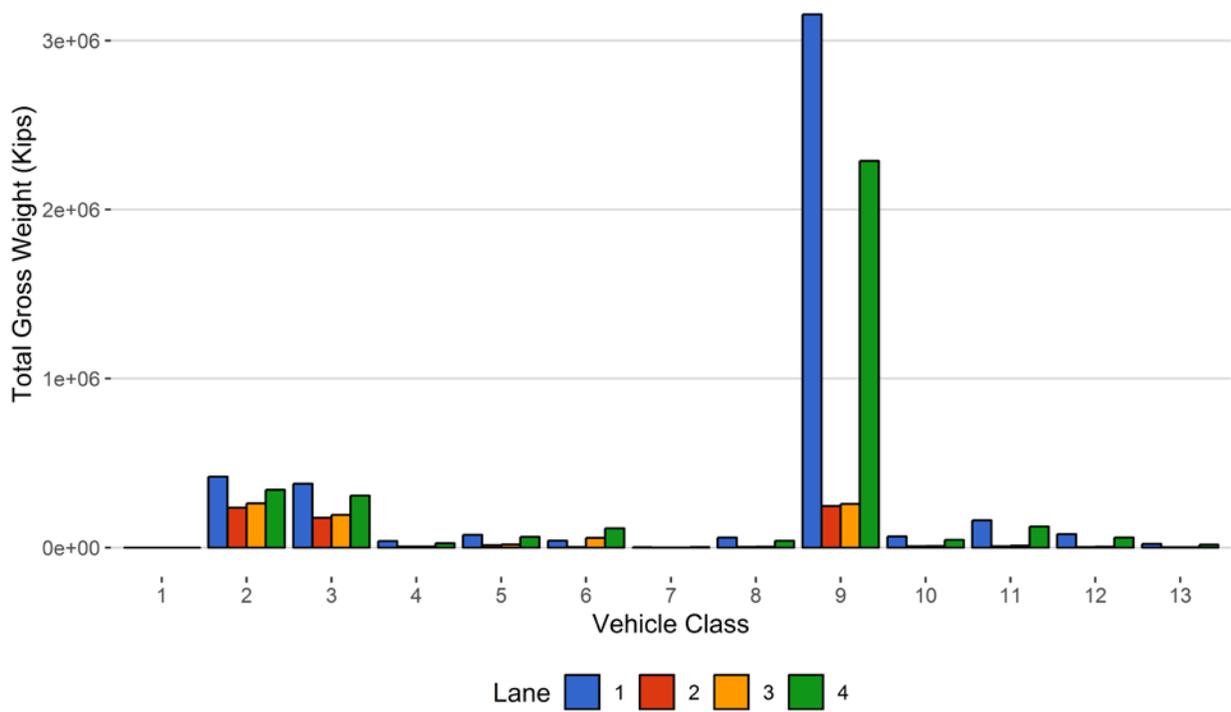


Figure 11 - Total Gross Vehicle Weight t

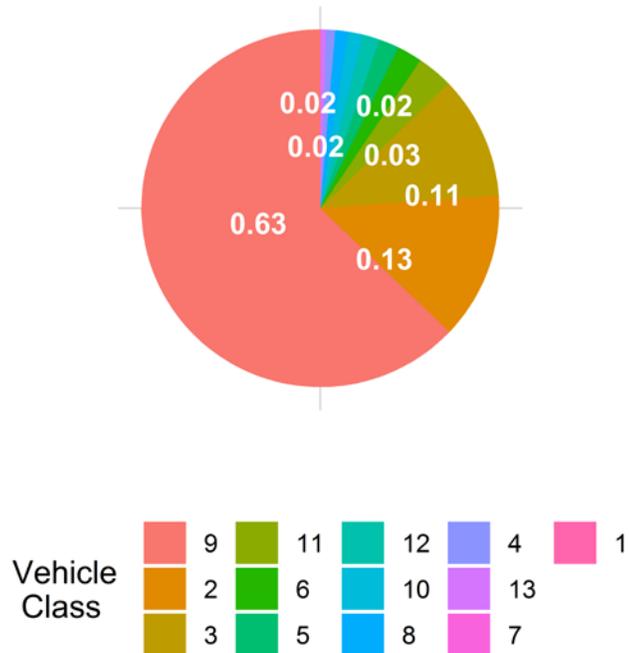


Figure 12 - Total ESALs by Class and Lane

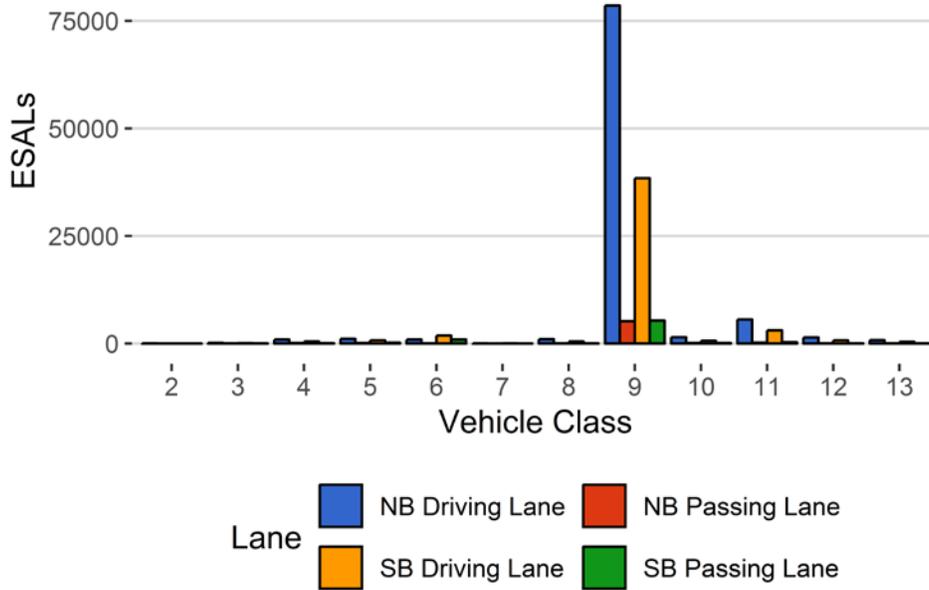


Figure 13 - ESALs by Class

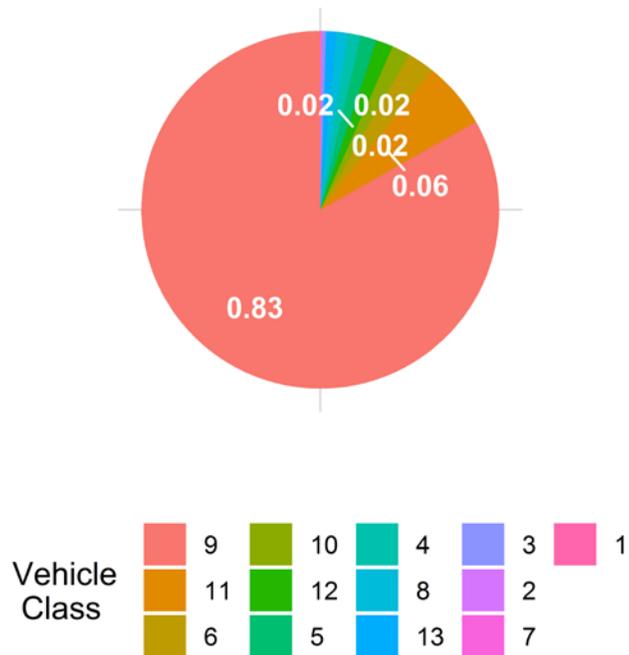


Table 1 Class 9 Front Axle Weight by Lane

<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	NA	NA
August 2018	11.75	0.62	11.31	0.12	11.49	0.20	NA	NA
September 2018	11.75	0.68	11.37	0.61	11.56	0.83	NA	NA
October 2018	11.82	1.21	11.38	0.71	11.72	2.28	NA	NA
November 2018	12.14	4.01	11.58	2.45	11.30	-1.46	NA	NA
December 2018	12.26	5.04	11.68	3.35	11.75	2.54	11.30	0.00
January 2019	12.30	5.39	11.75	3.97	11.76	2.60	11.25	-0.42
February 2019	12.43	6.46	11.74	3.90	11.76	2.61	10.35	-8.40
March 2019	12.24	4.85	11.80	4.47	12.05	5.08	11.06	-2.10

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	3	0	0	0
2	10020	310611	50.6	0	0
3	5310	164624	26.8	0	0
4	84	2592	0.4	255	1
5	381	11803	1.9	184	0.7
6	234	7258	1.2	613	2.4
7	4	136	0	36	0.1
8	107	3328	0.5	164	0.6
9	3346	103724	16.9	22627	87.8
10	70	2168	0.4	640	2.5
11	160	4954	0.8	744	2.9
12	76	2360	0.4	191	0.7
13	14	435	0.1	330	1.3
TOTAL	19806	613996	100	25784	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>
2019-03-12	Tuesday	10:03:31	10	NB	1	127.76
2019-03-18	Monday	19:41:55	10	SB	3	124.79
2019-03-11	Monday	12:58:25	10	NB	1	124.14
2019-03-11	Monday	11:05:49	10	NB	1	123.59
2019-03-11	Monday	09:00:22	10	NB	1	121.08
2019-03-15	Friday	18:49:27	10	NB	1	120.93
2019-03-27	Wednesday	12:40:01	10	NB	1	120.41
2019-03-16	Saturday	12:03:36	10	NB	1	119.22
2019-03-15	Friday	18:10:29	10	NB	1	118.2
2019-03-06	Wednesday	22:22:03	9	SB	4	117.63

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	1427	110	7.7	42861	1453	11553
5	NB	8	5834	323	5.5	86694	2357	21303
6	NB	19	1533	211	13.8	41254	3712	8068
7	NB	11.5	59	0	0	2832	0	1077
8	NB	31	1821	561	30.8	50623	13183	5781
9	NB	33	53721	2528	4.7	3324802	76460	817716
10	NB	33.5	1119	137	12.2	70288	3710	18696
11	NB	36.5	2529	19	0.8	169319	545	38852
12	NB	36.5	1241	7	0.6	82919	183	18939
13	NB	31.5	226	2	0.9	24127	49	8536
TOTAL	****	****	69510	3898	****	3895719	****	950521
<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	1061	122	11.5	30437	1607	8176
5	SB	8	5495	485	8.8	77053	3513	18487
6	SB	19	5434	388	7.1	163833	6755	33980
7	SB	11.5	72	0	0	3585	0	1379
8	SB	31	1373	584	42.5	30703	13910	3122
9	SB	33	45840	5364	11.7	2385700	159321	524996
10	SB	33.5	962	190	19.8	49817	4730	11978
11	SB	36.5	2226	61	2.7	133464	2102	27221
12	SB	36.5	1024	14	1.4	63940	377	13538
13	SB	31.5	192	1	0.5	19718	29	6851
TOTAL	****	****	63679	7209	****	2958251	****	649726
GRAND TOTAL	****	****	133189	11107	183	6853970	293994	1600246

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>
1	0	3	2	0	5	0
2	419976	235504	261473	341761	1258714	13.3
3	376965	176451	193943	306980	1054339	11.1
4	38059	6255	6261	25784	76357	0.8
5	74516	14536	17951	62615	169618	1.8
6	41273	3693	57293	113296	215554	2.3
7	2419	413	563	3023	6418	0.1
8	59250	4556	4687	39926	108419	1.1
9	3155036	246225	257668	2287352	5946282	62.9
10	66202	7796	9112	45435	128545	1.4
11	161654	8210	11278	124288	305430	3.2
12	79395	3706	4696	59622	147419	1.6
13	22070	2106	2684	17062	43923	0.5
TOTAL	4496814	709454	827608	3427144	9461021	100
GVW/LANE	47.53	7.5	8.75	36.22	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>
1	0	0	0	0	0	0	0.25
2	59	31	36	41	167	0.11	0.0011
3	203	69	78	128	477	0.31	0.0061
4	947	132	119	510	1708	1.11	1.37
5	1125	138	232	760	2256	1.47	0.4
6	945	70	938	1868	3821	2.49	1.1
7	69	8	11	63	151	0.1	2.24
8	1046	48	60	506	1660	1.08	1.04
9	78543	5206	5363	38456	127568	83.2	2.56
10	1506	141	172	674	2493	1.63	2.39
11	5638	240	331	3071	9280	6.05	3.9
12	1456	48	71	793	2368	1.54	2.09
13	830	51	74	432	1386	0.9	6.46
TOTAL	92369	6182	7484	47300	153335	100	24
ESALS/LANE	60.2	4	4.9	30.8	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>
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
Dec 2018	589786	19025	4062	463876	78.7	125910	21.3	91.5	8.5
Jan 2019	487834	15737	4015	363372	74.5	124461.6	25.5	90.2	9.8
Feb 2019	416210	14865	3548	316874	76.1	99336	23.9	79.5	20.5
Mar 2019	613996	19806	4476	475238	77.4	138757.9	22.6	89.2	10.8
TOTAL	7611997	-	-	5963017	-	1648979	-	-	-
AVERAGE	634333	20871	4510	496918	78	137415	22	89	11

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>
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
Dec 2018	81402	4851	4543	49094	139891	93	7	19.3
Jan 2019	86706	5499	5287	42673	140165	92	8	24.5
Feb 2019	72647	9385	9155	15133	106321	83	17	28.9
Mar 2019	92512	6184	7553	47486	153736	91	9	18.4
TOTAL	941144	68739	76506	602703	1689091	-	-	-
AVERAGE	78429	5728	6376	50225	140758	91	9	11

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>
Apr 18	3624977	545528	630879	3546495	8347880
May 18	4186867	740631	818945	3906425	9652869
Jun 18	4025326	788976	859885	3638548	9312736
Jul 18	4721860	908715	910021	4255066	10795661
Aug 18	4778193	996057	1037615	4252269	11064134
Sep 18	4333349	700326	885304	3901307	9820285
Oct 18	4750482	755225	896476	4525612	10927794
Nov 18	4161406	658051	585158	3812142	9216758
Dec 18	4046068	610727	643364	3568946	8869105
Jan 19	4012005	511041	576641	3010193	8109880
Feb 19	3284544	700572	739086	1454897	6179098
Mar 19	4500785	709560	829970	3433877	9474191
TOTAL	50425862	8625409	9413343	43305776	111770390
AVERAGE	4202155	718784	784445	3608815	9314199

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>
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
Dec 2018	23996	4.1	19.3	3432	435
Jan 2019	25015	5.4	21.2	4357	418
Feb 2019	19560	5.3	21.9	4272	330
Mar 2019	25828	4.4	19.3	3752	416
TOTAL	267604	-	-	24820	3746
AVERAGE	22300.3	3.8	16.8	2068.3	312.2

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>
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
Dec 2018	830135	627727	1457862	56.9	43.1
Jan 2019	875454	561053	1436507	60.9	39.1
Feb 2019	776077	299212	1075289	72.2	27.8
Mar 2019	950521	649726	1600246	59.4	40.6
TOTAL	10259873	7927277	18187150	-	-
AVERAGE	854989.4	660606.4	1515595.8	56.8	43.2