



**WIM #33  
US 212, MP 78.5  
OLIVIA, MN**

**JULY 2010**

**MONTHLY  
REPORT**



*Your Destination... Our Priority*



In order to understand the vehicle classes and groupings the Mn/DOT “Vehicle Classification Scheme” and the “Vehicle Class Groupings for Forecasting” are shown on the WIM Reports home page at

[http://www.dot.state.mn.us/traffic/data/html/wim\\_reports.html](http://www.dot.state.mn.us/traffic/data/html/wim_reports.html)

### **VOLUME**

For WIM #33 on US 212 at mile post 78.5 near Olivia, there were 156,462 vehicles that passed the site for the month of July. The Average Daily Traffic (ADT) and Heavy Commercial Average Daily Traffic (HCADT) for July 2010 was 4,966 and 611, respectively. Of the heavy commercial vehicles, the top two in volume were the Class 9's, and 5's. Figure 1 shows the average number of vehicles, broken down by direction, versus day of the week. The average numbers of vehicles for both directions peaked on Fridays and were lowest on the weekends. Figure 2 shows the passenger vehicles (Class 1, 2, and 3), and heavy commercial vehicles (Class 4 to 13) by direction versus hour of day. For July the eastbound (EB) and westbound (WB) passenger vehicles peaked between 10 am and 6 pm. The passenger vehicles were reviewed for directional volume differences and it appears that there were almost the same. For July the heavy commercial vehicles in both directions had a peak between 7 am and 5 pm. The heavy commercial vehicles were reviewed for directional volume differences and it appears that they were almost the same.

### **VEHICLE CLASSIFICATION**

The traffic volume consisted of 137,510 passenger vehicles (87.9%) and 18,952 heavy commercial vehicles (12.1%). Table 1 summarizes vehicle class volumes and percentages; and overweight vehicles and the percentages as compared to total overweight vehicles.

### **OVERWEIGHT VEHICLES**

Without a permit, the maximum allowable weight for a single axle is 20,000 pounds; tandem axles, spaced 8' or less, can be up to 34,000 pounds; tridem axles, spaced 9' or less, can be up to 43,000 pounds; quad axles, spaced 13' or less, can be up to 51,000 pounds; and the maximum GVW is 80,000 pounds. The total volume and total heavy commercial volume for July 2010 was 156,462 and 18,952, respectively. The total number of vehicles that were overweight was 5,441 or 3.5% of the total traffic or 28.7% of the heavy commercial vehicles. Figure 1 shows the average number of overweight vehicles, broken down by direction, versus day of the week. The average numbers of overweight vehicles for EB peaked on Thursdays and for WB it peaked on Tuesdays and for both directions it was lowest on weekends. The top two overweight violators by class were the Class 9's and the Class 10's. Overweight vehicles by class versus hour of the day are shown in Figure 3. The Class 9 overweight vehicles peaked between 7 am and 5 pm. The overweight vehicles were also reviewed to determine if there is an EB and WB difference. Figure 4 shows the total, EB, and WB overweight vehicles versus hour of the day. Figure 4 shows that for July 2010, about 1.6 times as many overweight vehicles were moving EB as compared to WB.

Figure 5 shows the gross vehicle weight for Class 9's and 10's in both the EB and WB direction. From Figure 5 it is apparent that the Class 9's had more full vehicles than empty vehicles EB and more empty than full vehicles WB. The Class 10's had about the same number of vehicles empty and full in both directions.

For weight enforcement the WIMs are a screening tool. Currently, piezo-quartz WIM systems are considered to be accurate within 5% to 10% on Gross Vehicle Weight (GVW). With an accuracy of about 10% anything over a GVW of 88,000 pounds is overweight. These may still be permitted loads. For the most efficient use of personnel and equipment, these are the vehicles that should be weighed on static scales and reviewed for permits. In the EB direction there were 1,837 vehicles over 88,000 pounds, 1,633 were Class 9's and 136 were Class 10's. In the WB direction there were 260 vehicles over 88,000 pounds, 97 were Class 9's and 82 were Class 10's. Table 2 summarizes the Top 10 Gross Vehicle Weight for Class 9 and Class 10 vehicles for the month of July 2010.

### **SPEED**

The speed limit on US 212 at the WIM site is 55 mph. For July 2010 for both lanes, WIM #33 recorded an average speed of 58 mph, the median speed was 58 mph, and the 85<sup>th</sup> percentile speed was 61 mph. Table 3 summarizes the vehicle data for the Top 20 speeders that crossed WIM #33 in the month of July. The speed of the Top 20 ranged from 89 mph up to 119 mph. It is interesting to note that it looks like 3 in the top 20 may have been racing. Within 25 seconds, three vehicles went over the sensors EB on Friday, July 30<sup>th</sup> at 8:41 pm going between 99 and 116 mph. Figure 6 shows the average speed of passenger vehicles and heavy commercial vehicles in both the EB and WB direction. Depending on the hour of the day there is only a 1 to 1.5 mph difference between the average slowest vehicles and the average fastest vehicles. Figure 7 shows the average speed versus the day of the week. For July 2010 the average speeds varied between 56.5 mph and 60 mph. There was not a significant variation in speed by day of the week. Figure 8 shows the average speed by lane. As expected, there is not much difference based on direction.

### **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. For the month of July 2010, WIM #33 saw 156,462 vehicles and recorded a total weight of 1,592,000 kips (1 kip = 1,000 pounds). Figure 9 summarizes the total GVW by direction and class and Figure 10 summarizes the percentages each class contributes to the total GVW. Table 4 provides details on the class breakdowns versus direction for GVW.

### **MATERIALS**

For July 2010 a total of 23,660 ESALs passed over the pavement at WIM #33. Approximately 60.7% of the ESALs were EB and 39.3% were WB. Figure 11 graphically depicts the total ESALs by class and direction. Figure 12 summarizes the percentages that each vehicle class contributes to the total ESALs. It is interesting to note that the Class 9's provide 79.5% of the ESALs while they are only 44.3% of the total

gross vehicle weight. Table 5 provides details on the class breakdowns versus direction for ESALs. Table 5 also provides the flexible ESAL factors for each vehicle class using a terminal serviceability of 2.5 and a structural number of 5.

For July there were 4,167 Class 9 trucks and 327 Class 10 trucks over 80,000 pounds. These 4,494 vehicles generated 16,382 ESALs. If all of these trucks weighed just 80,000 pounds they would have generated 11,617 ESALs, 4,765 ESALs lower. If you take the July ESALs of 23,660 and multiply it by 12 to get an annual ESAL number and then multiply it by 20 to get a 20-year BESAL you get 5,678,000. If you go through the same process but start with a monthly value of 18,895, i.e. subtracting out all of the overweight Class 9 and 10 vehicles, you come up with 4,535,000 20-year BESALs. If you take the 20-year BESAL with all Class 9's and 10's weighing 80,000 pounds or less and divide that by 23,660, the BESALs with the overweight Class 9's and 10's you get 192, or the overweight Class 9's and 10's cause the pavement to reach its 20-year design life 48 months early.

This is a quick, back of the napkin calculation, this only looks at Class 9's and 10's, not the other 8 heavy commercial classes. As part of a technical implementation research project we are looking at developing a report function that will perform this calculation for all heavy commercial classes. Because the heavy commercial haulers are looking to move that tonnage of freight we will add additional legal-weight trucks so that the total tonnage being shipped stays the same.

### **FREIGHT**

For WIM #33 for July 2010, it was calculated that approximately 210,000 tons of freight crossed the sensors. More freight was shipped EB (121,000 tons) versus WB (89,000 tons). Table 6 summarizes the number of vehicles by class and the number of empty vehicles. Table 6 and Figure 13 summarize the freight shipment by class, direction, and tonnage.

### **CALIBRATION**

WIM #33 was calibrated on February 3, 2010. As part of the on-going monitoring to assure the performance between calibrations, gross vehicle weights and front axle weights of Class 2's, 3's, and 9's are being monitored on a monthly basis. Table 7 summarizes the gross vehicle weight of the Class 2's and 3's by lane. Currently, all Class 2's and 3's are included in this data. In the future, the goal would be to only monitor the Class 2's and 3's that are not pulling trailers. Table 8 summarizes the front axle weight of the Class 2's, 3's, and 9's by lane. The current goal of the calibration is to first have the GVW for each class and each lane stay within a range of  $\pm 5\%$  and then secondly to have each individual axle stay within a range of  $\pm 9\%$ . As you can see in Table 7, the GVW was within outside the range for both Lanes in both Classes. In Table 8 the front axle weight stayed within  $\pm 9\%$  for all Classes in both Lanes.

Past WIM research indicates that an unloaded Class 9 should weigh 28 to 32 kips. Data from the MnROAD site indicates that this unloaded range may have moved a little higher. The range for loaded Class 9's is generally in the 70 to 80 kip range but varies

more by site and season. Figures 14 and 15 shows histograms of the monthly GVW of Class 9's over the last 6 months for Lanes 1 and 2. Figure 16 is a graph of the unloaded and loaded peaks by lane versus date. There are enough Class 9's in Lanes 1 and 2 that a weekly histogram can be developed. Based on the results in Tables 7 and 8 and Figures 14 to 16, it looks like WIM #33 should be recalibrated. It is currently scheduled for recalibration in September.

### **SUMMARY**

For July 2010 the average volume peaked on Fridays in both directions and was lowest on the weekend. The overweight vehicles peaked on Thursdays EB and on Tuesdays WB. The average numbers of overweight vehicles was about 1.6 times higher in the EB direction as compared to the WB direction. The overweight vehicles peaked from 7 am to 5 pm. For July 2010, for the Class 9's, 37.6% of them were overweight and for the Class 10's, 60.4% of them were overweight. The speed of the traffic did not significantly vary by vehicle class, lane, day of the week, or hour of the day. The GVW was higher in the EB direction 835,000 kips versus 757,000 kips WB. This agrees with the ESALs and freight data. The EB ESALs were higher 14,373 versus 9,288 WB. For July, the overweight Class 9's and 10's were shortening the 20-year BESAL design life by 48 months. The tonnage of freight was also higher in the EB direction 121,000 versus 89,000 WB.

Attach: Table 1 – Vehicle Classification Data  
Table 2 – Top 10 Gross Vehicle Weight, Class 9 and Class 10  
Table 3 – Top 20 Speeders  
Table 4 – Gross Vehicle Weight by Class and Direction  
Table 5 – ESALs by Class and Direction and Flexible ESAL Factors  
Table 6 – Freight Summary  
Table 7 – Gross Vehicle Weight by Class and Lane  
Table 8 – Front Axle Weight by Class and Lane  
Figure 1 – Average Volume and Average Overweight Volume vs. Day of the Week  
Figure 2 – Passenger and Heavy Commercial Vehicles vs. Hour of the Day  
Figure 3 – Overweight Vehicles by Class vs. Hour of the Day  
Figure 4 – Overweight Vehicles by Direction vs. Hour of the Day  
Figure 5 – Class 9's and 10's by Direction vs. Gross Vehicle Weight  
Figure 6 – Average Speed by Lane and Vehicle Type vs. Hour of the Day  
Figure 7 – Average Speed vs. Day of the Week  
Figure 8 – Average Speed by Lane and Direction vs. Hour of the Day  
Figure 9 – Total Gross Vehicle Weight by Class and Direction  
Figure 10 – Total Gross Vehicle Weight by Class  
Figure 11 – Total ESALs by Class and Direction  
Figure 12 – ESALs by Class  
Figure 13 – Freight Tonnage and Percentage by Direction and Class  
Figure 14 – Monthly Class 9 GVW Histogram – Lane 1 (EB)  
Figure 15 – Monthly Class 9 GVW Histogram – Lane 2 (WB)  
Figure 16 – Unloaded and Loaded Peaks by Lane vs. Date

**TABLE 1 - VEHICLE CLASSIFICATION DATA**  
**WIM #33 - OLIVIA**  
**July 2010**

<b>VEHICLE CLASS</b>	<b>MONTHLY AVERAGE DAILY VOLUME</b>	<b>MONTHLY TOTAL VOLUME</b>	<b>MONTHLY TOTAL VOLUME PERCENTAGE</b>	<b>MONTHLY TOTAL OVERWEIGHT VEHICLES</b>	<b>MONTHLY TOTAL OVERWEIGHT PERCENTAGE</b>
C1	0	5	0.0%	0	0.0%
C2	2,885	91,074	58.2%	0	0.0%
C3	1,470	46,431	29.7%	0	0.0%
C4	11	357	0.2%	77	1.4%
C5	116	3,544	2.3%	115	2.1%
C6	34	1,061	0.7%	108	2.0%
C7	3	95	0.1%	23	0.4%
C8	19	583	0.4%	57	1.0%
C9	389	12,073	7.7%	4,537	83.4%
C10	22	712	0.5%	430	7.9%
C11	9	289	0.2%	21	0.4%
C12	3	100	0.1%	43	0.8%
C13	4	138	0.1%	30	0.6%
<b>TOTAL =</b>	4,966	156,462	100.0%	5,441	100.0%

**TABLE 2 - TOP 10 GROSS VEHICLE WEIGHT, CLASS 9 AND CLASS 10**  
**WIM #33 - OLIVIA**  
**July 2010**

<b>DATE</b>	<b>DAY OF WEEK</b>	<b>TIME</b>	<b>VEHICLE CLASS</b>	<b>DIRECTION</b>	<b>LANE</b>	<b>GVW (lbs)</b>
7/28/10	Wednesday	18:21:47	10	Eastbound	1	138,000
7/22/10	Thursday	16:23:58	10	Westbound	2	134,000
7/6/10	Tuesday	12:39:52	10	Eastbound	1	129,000
7/19/10	Monday	15:42:03	10	Eastbound	1	124,000
7/1/10	Thursday	7:58:58	10	Westbound	2	124,000
7/20/10	Tuesday	12:26:06	10	Eastbound	1	121,000
7/14/10	Wednesday	12:26:24	10	Eastbound	1	119,000
7/25/10	Sunday	18:03:43	10	Eastbound	1	119,000
7/6/10	Tuesday	13:54:42	9	Westbound	2	118,000
7/22/10	Thursday	21:44:06	10	Westbound	2	118,000

**TABLE 3 - TOP 20 SPEEDERS**  
**WIM #33 - OLIVIA**  
**July 2010**

DATE	DAY OF WEEK	TIME	VEHICLE CLASS	DIRECTION	LANE	SPEED (mph)
7/25/10	Sunday	9:18:55	3	Westbound	2	119
7/30/10	Friday	20:41:26	2	Eastbound	1	116*
7/30/10	Friday	20:41:31	2	Eastbound	1	114*
7/10/10	Saturday	5:39:25	2	Westbound	2	109
7/15/10	Thursday	0:29:40	2	Westbound	2	109
7/24/10	Saturday	22:42:09	2	Eastbound	1	109
7/12/10	Monday	0:33:08	2	Westbound	2	100
7/13/10	Tuesday	17:03:41	2	Westbound	2	99
7/13/10	Tuesday	21:58:54	2	Westbound	2	99
7/30/10	Friday	20:41:06	2	Eastbound	1	99*
7/17/10	Saturday	7:21:14	2	Westbound	2	95
7/2/10	Friday	8:49:07	2	Westbound	2	94
7/17/10	Saturday	7:28:26	2	Eastbound	1	93
7/30/10	Friday	16:53:02	2	Eastbound	1	93
7/5/10	Monday	1:02:18	2	Eastbound	1	91
7/10/10	Saturday	22:12:17	3	Westbound	2	91
7/12/10	Monday	18:50:17	2	Westbound	2	91
7/17/10	Saturday	2:17:59	2	Westbound	2	91
7/10/10	Saturday	4:56:31	3	Eastbound	1	89
7/19/10	Monday	11:46:22	2	Eastbound	1	89

\* Appear to be racing.

**TABLE 4 - GROSS VEHICLE WEIGHT BY CLASS AND DIRECTION**  
**WIM #33 - OLIVIA**  
**July 2010**

VEHICLE CLASS	EB DRIVING LANE (Kips)	WB DRIVING LANE (Kips)	TOTAL (Kips)	PERCENTAGE
C1	375	332	707	0.0%
C2	191,339	168,901	360,241	22.6%
C3	150,958	151,888	302,846	19.0%
C4	4,634	4,686	9,320	0.6%
C5	36,999	31,007	68,006	4.3%
C6	16,254	16,814	33,068	2.1%
C7	2,862	813	3,675	0.2%
C8	14,559	10,813	25,372	1.6%
C9	376,079	329,160	705,239	44.3%
C10	29,542	27,878	57,420	3.6%
C11	6,529	8,686	15,216	1.0%
C12	2,148	3,417	5,565	0.3%
C13	2,818	2,155	4,973	0.3%

**TOTAL =** 835,096      756,552      1,591,648      100.0%  
**GVW/LANE =** 52.5%      47.5%

**TABLE 5 - ESALs BY CLASS AND DIRECTION AND FLEXIBLE ESAL FACTORS**  
**WIM #33 - OLIVIA**  
**July 2010**

VEHICLE CLASS	EB DRIVING LANE	WB DRIVING LANE	TOTAL	PERCENTAGE	FLEXIBLE ESAL FACTOR
C1	0	0	0	0.0%	0.0004
C2	49	33	82	0.3%	0.0010
C3	71	64	135	0.6%	0.0029
C4	156	140	297	1.3%	1.35
C5	575	497	1,072	4.5%	0.23
C6	354	253	606	2.6%	0.58
C7	70	19	89	0.4%	1.32
C8	263	164	427	1.8%	0.45
C9	11,777	7,040	18,817	79.5%	1.57
C10	741	630	1,372	5.8%	1.63
C11	124	223	347	1.5%	1.28
C12	58	150	208	0.9%	3.01
C13	135	73	208	0.9%	5.07

**TOTAL =** 14,373 9,288 23,660 100.0%  
**ESALS/LANE =** 60.7% 39.3%

**TABLE 6 - FREIGHT SUMMARY**  
**WIM #33 - OLIVIA**  
**July 2010**

**EASTBOUND**

VEHICLE CLASS	WEIGHT OF EMPTY VEHICLE (Kips)	TOTAL NUMBER OF VEHICLES	NUMBER OF EMPTY VEHICLES	PERCENTAGE OF EMPTY VEHICLES	TOTAL WEIGHT OF FREIGHT & VEHICLES (Kips)	WEIGHT OF EMPTY VEHICLES (Kips)	TOTAL WEIGHT OF FREIGHT (Tons)
C4	15.0	146	10	6.8%	4,961	132	1,395
C5	8.0	1,818	54	3.0%	30,031	396	7,762
C6	19.0	492	29	5.9%	16,365	506	3,531
C7	11.5	72	0	0.0%	3,970	0	1,571
C8	31.0	281	105	37.4%	9,681	1,974	1,126
C9	33.0	5,780	455	7.9%	378,081	13,879	94,239
C10	33.5	347	12	3.5%	24,450	329	6,449
C11	36.5	130	6	4.6%	6,640	146	984
C12	36.5	55	1	1.8%	4,334	30	1,167
C13	31.5	65	0	0.0%	6,890	0	2,421

**TOTAL =** 9,186 672 7.3% 485,403 -- 120,643

**WESTBOUND**

VEHICLE CLASS	WEIGHT OF EMPTY VEHICLE (Kips)	TOTAL NUMBER OF VEHICLES	NUMBER OF EMPTY VEHICLES	PERCENTAGE OF EMPTY VEHICLES	TOTAL WEIGHT OF FREIGHT & VEHICLES (Kips)	WEIGHT OF EMPTY VEHICLES (Kips)	TOTAL WEIGHT OF FREIGHT (Tons)
C4	15.0	200	25	12.5%	6,025	310	1,545
C5	8.0	1,687	117	6.9%	27,132	845	6,864
C6	19.0	568	53	9.3%	17,135	895	3,228
C7	11.5	30	0	0.0%	1,552	0	604
C8	31.0	267	138	51.7%	7,948	2,675	637
C9	33.0	6,288	1,669	26.5%	331,128	47,916	65,393
C10	33.5	371	53	14.3%	23,030	1,598	5,390
C11	36.5	160	12	7.5%	9,131	284	1,723
C12	36.5	49	0	0.0%	4,214	0	1,213
C13	31.5	73	1	1.4%	7,732	27	2,719

**TOTAL =** 9,693 2,068 21.3% 435,027 -- 89,312

**GRAND TOTAL =** 18,879 2,740 14.5% 920,430 -- 209,955

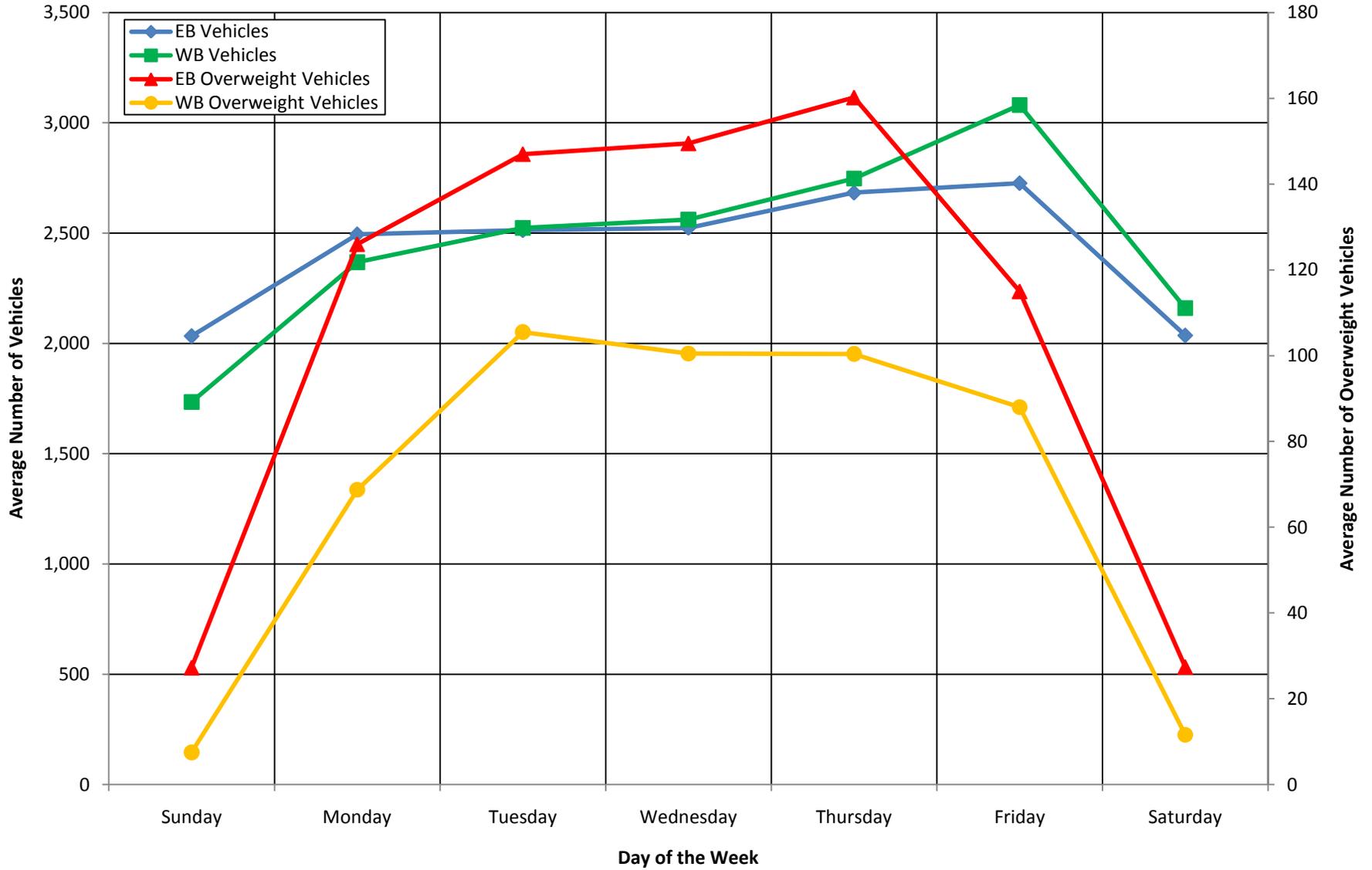
**TABLE 7 - GROSS VEHICLE WEIGHT BY CLASS AND LANE  
WIM #33 - OLIVIA  
July 2010**

MONTH	VEHICLE CLASS	LANE 1 (Kips)	GVW ± 5%	LANE 2 (Kips)	GVW ± 5%
February	C2	4.28	--	3.89	--
March		3.99	-6.78%	4.04	3.86%
April		4.39	2.57%	3.97	2.06%
May		4.52	5.61%	4.04	3.86%
June		4.58	7.01%	4.08	4.88%
July		4.60	7.48%	4.16	6.94%
February		C3	6.23	--	5.73
March	5.88		-5.62%	6.01	4.89%
April	6.54		4.98%	5.94	3.66%
May	6.78		8.83%	6.08	6.11%
June	6.88		10.43%	6.22	8.55%
July	6.94		11.40%	6.32	10.30%

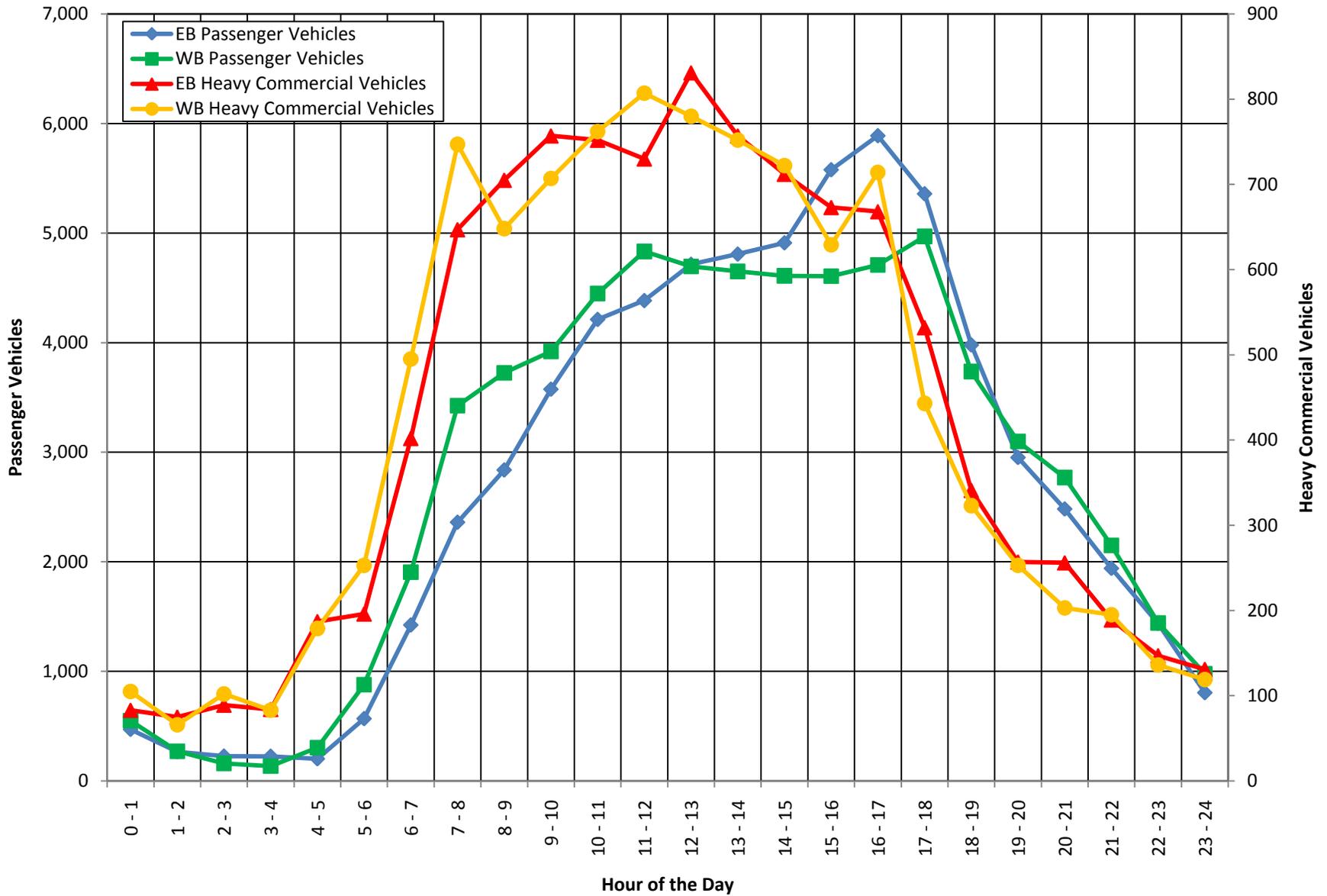
**TABLE 8 - FRONT AXLE WEIGHT BY CLASS AND LANE  
WIM #33 - OLIVIA  
July 2010**

MONTH	VEHICLE CLASS	LANE 1 (Kips)	FRONT AXLE ± 9%	LANE 2 (Kips)	FRONT AXLE ± 9%
February	C2	2.49	--	2.27	--
March		2.33	-6.43%	2.36	3.96%
April		2.57	3.21%	2.33	2.64%
May		2.63	5.62%	2.37	4.41%
June		2.67	7.23%	2.39	5.29%
July		2.68	7.63%	2.43	7.05%
February		C3	3.36	--	3.08
March	3.17		-5.65%	3.22	4.55%
April	3.48		3.57%	3.15	2.27%
May	3.57		6.25%	3.19	3.57%
June	3.62		7.74%	3.24	5.19%
July	3.63		8.04%	3.29	6.82%
February	C9		11.57	--	10.83
March		11.20	-3.20%	11.47	5.91%
April		12.13	4.84%	11.39	5.16%
May		12.33	6.57%	11.39	5.16%
June		12.40	7.17%	11.42	5.45%
July		12.42	7.35%	11.39	5.16%

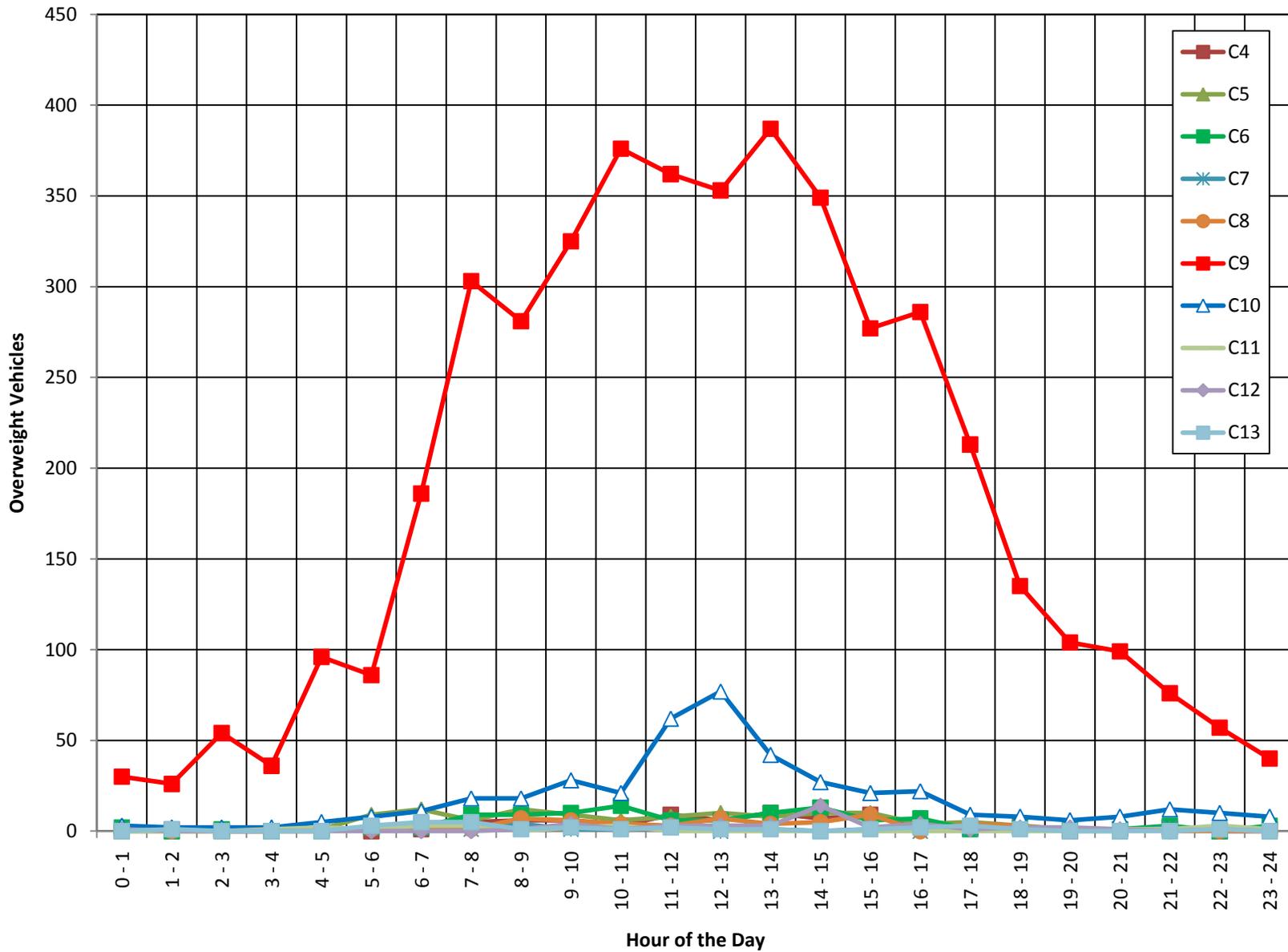
**Figure 1 - Average Volume and Average Overweight Volume vs. Day of the Week**



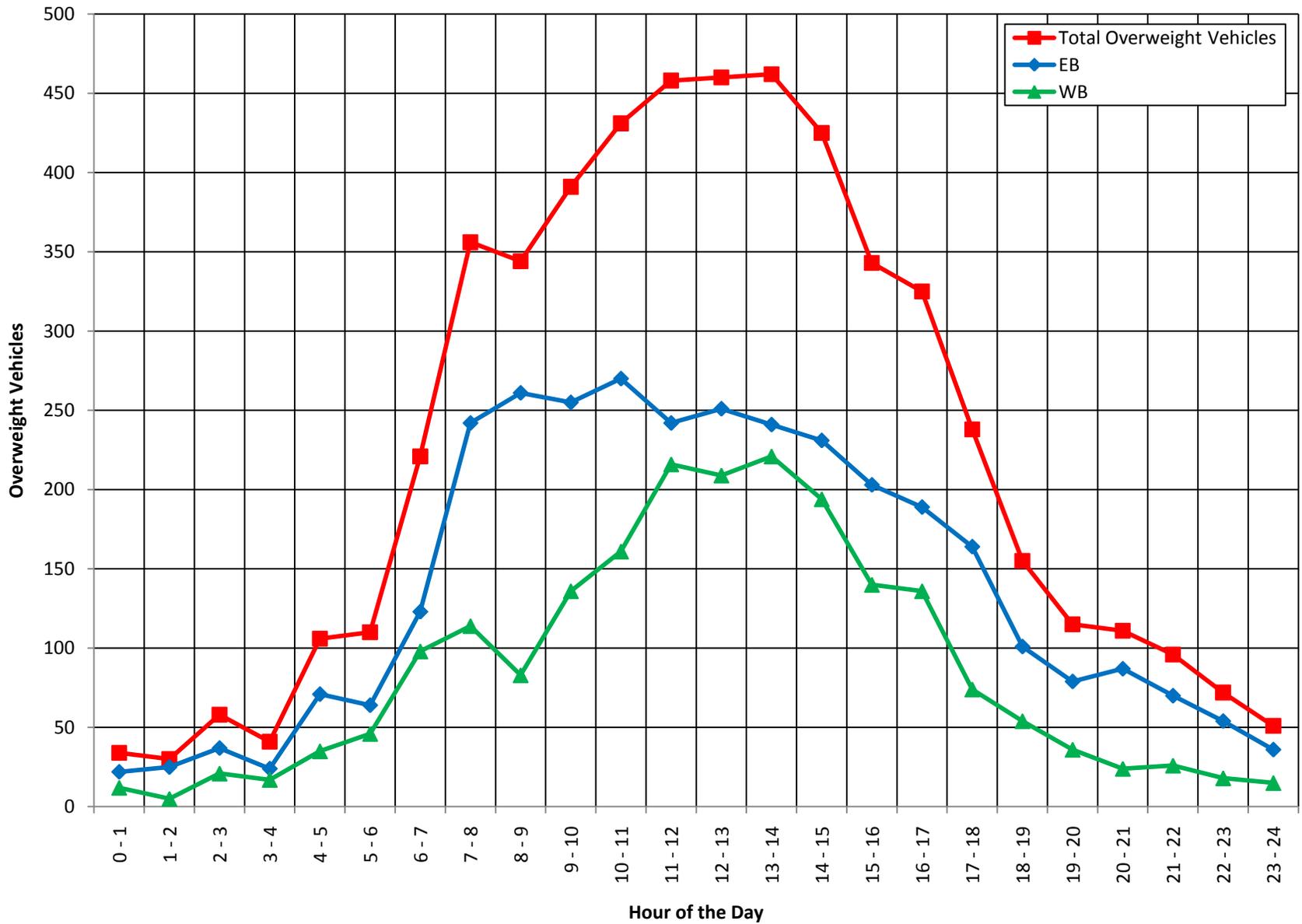
**Figure 2 - Passenger and Heavy Commercial Vehicles vs. Hour of the Day**



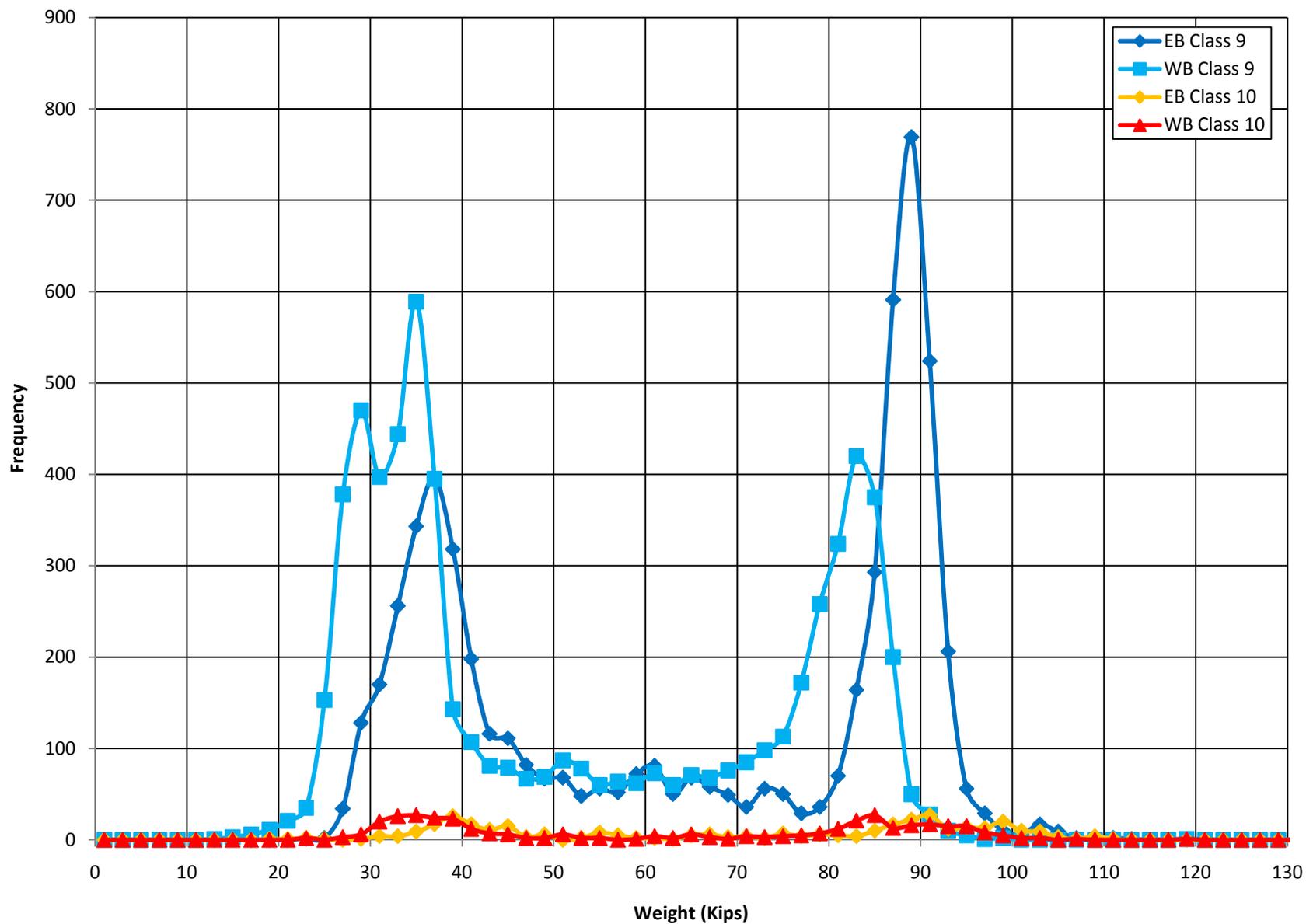
**Figure 3 - Overweight Vehicles by Class vs. Hour of the Day**



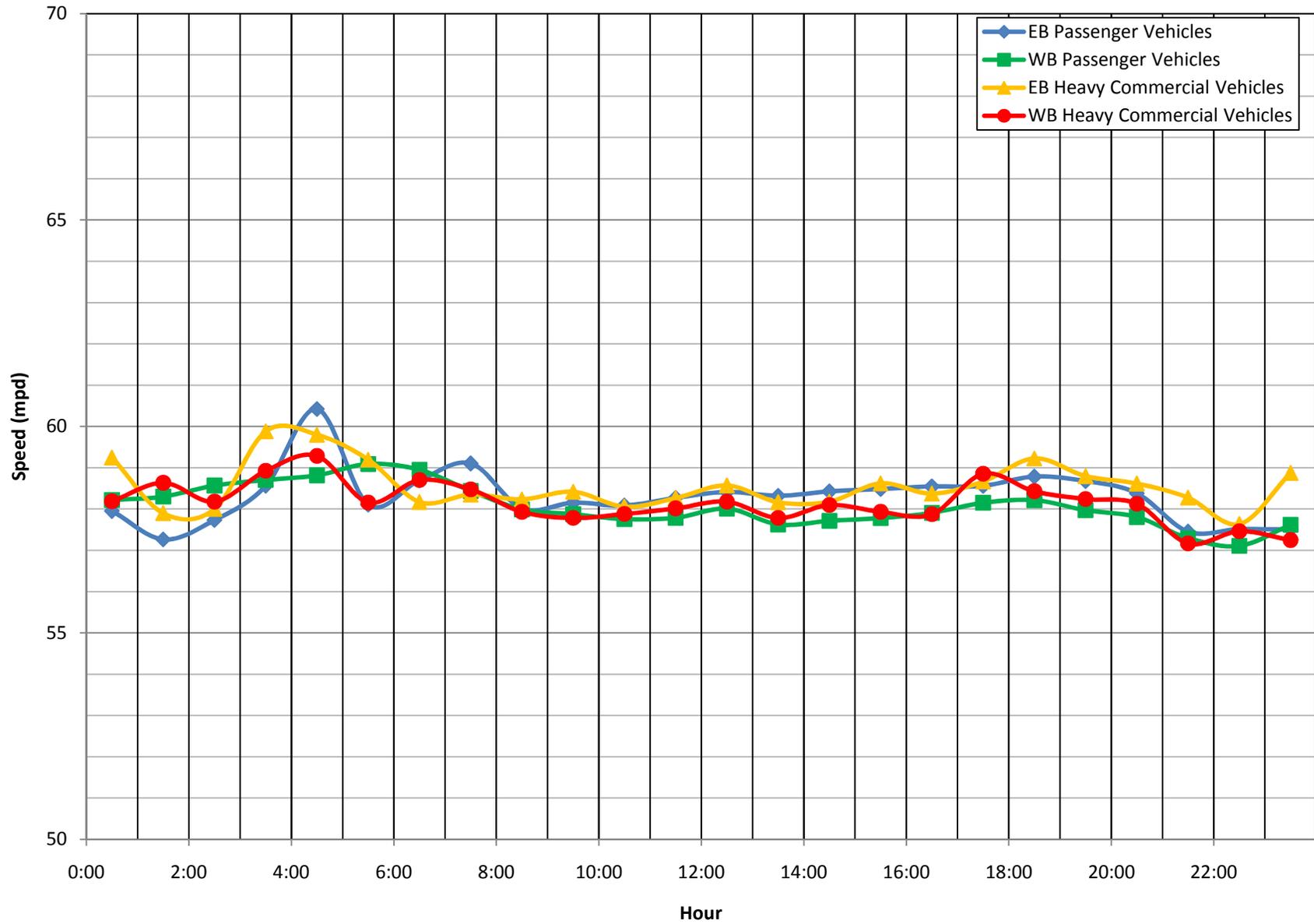
**Figure 4 - Overweight Vehicles by Direction vs. Hour of the Day**



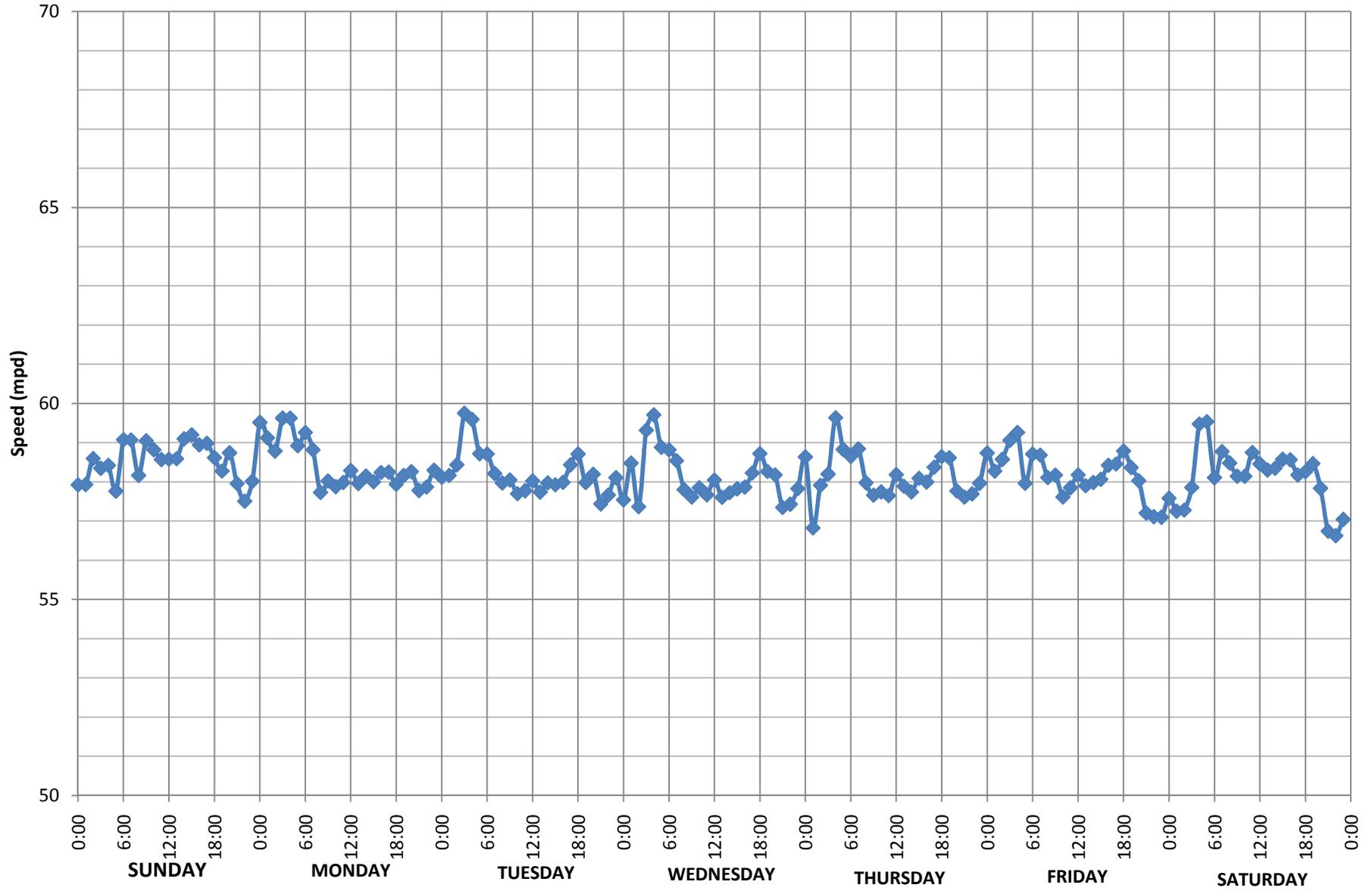
**Figure 5 - Class 9's and 10's by Direction vs. Gross Vehicle Weight**



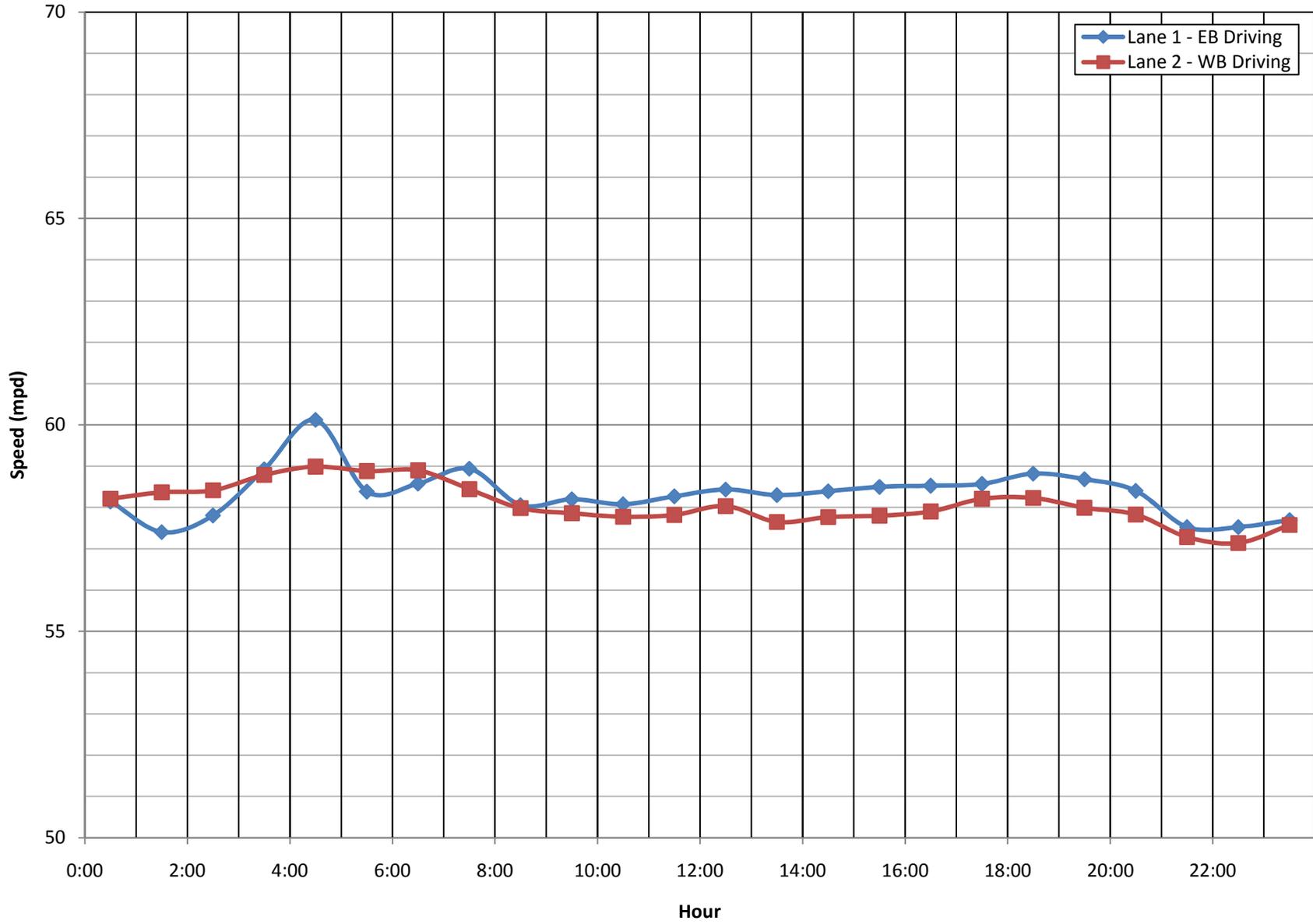
**Figure 6 - Average Speed by Lane and Vehicle Type vs. Hour of the Day**



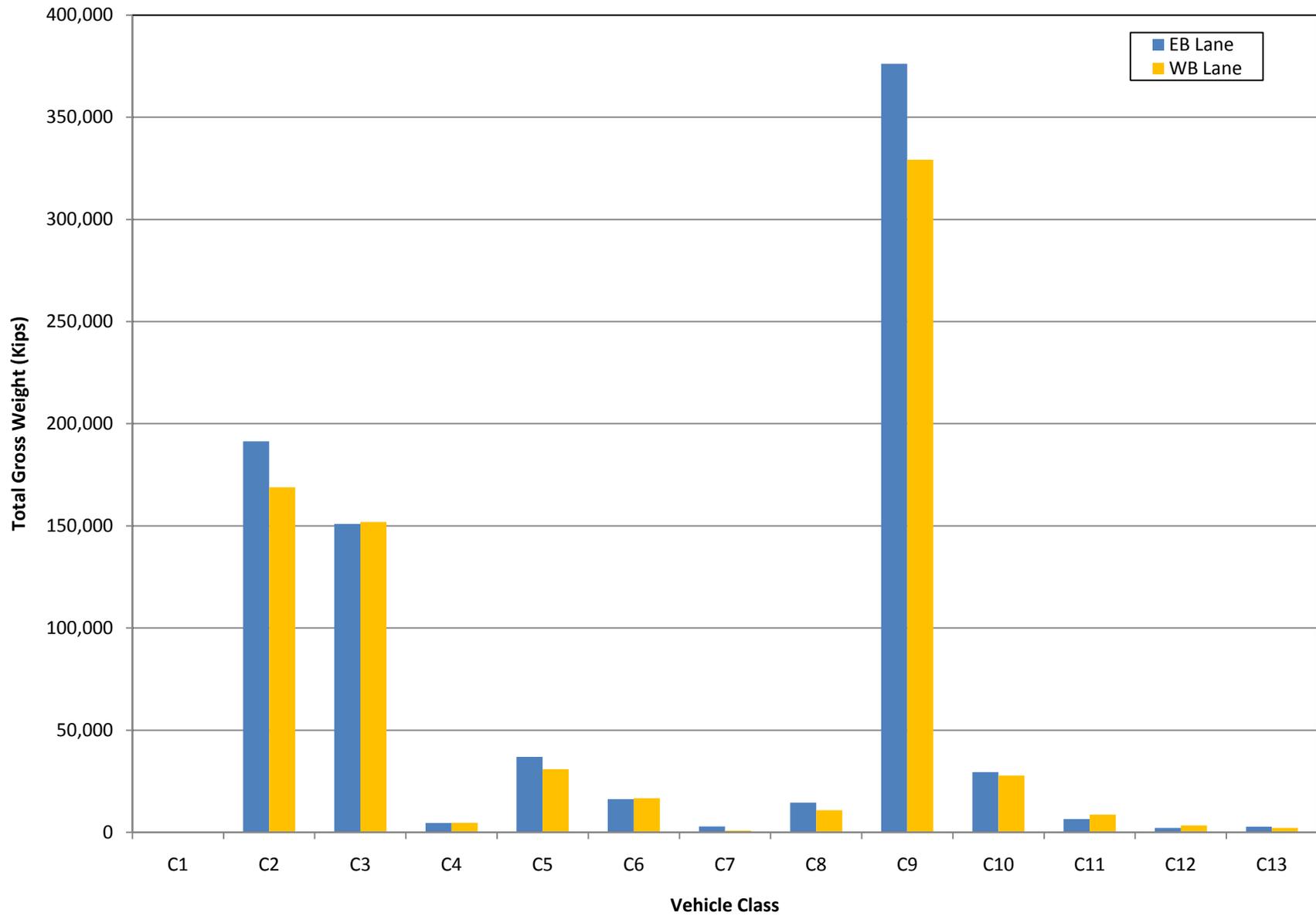
**Figure 7 - Average Speed vs. Day of the Week**



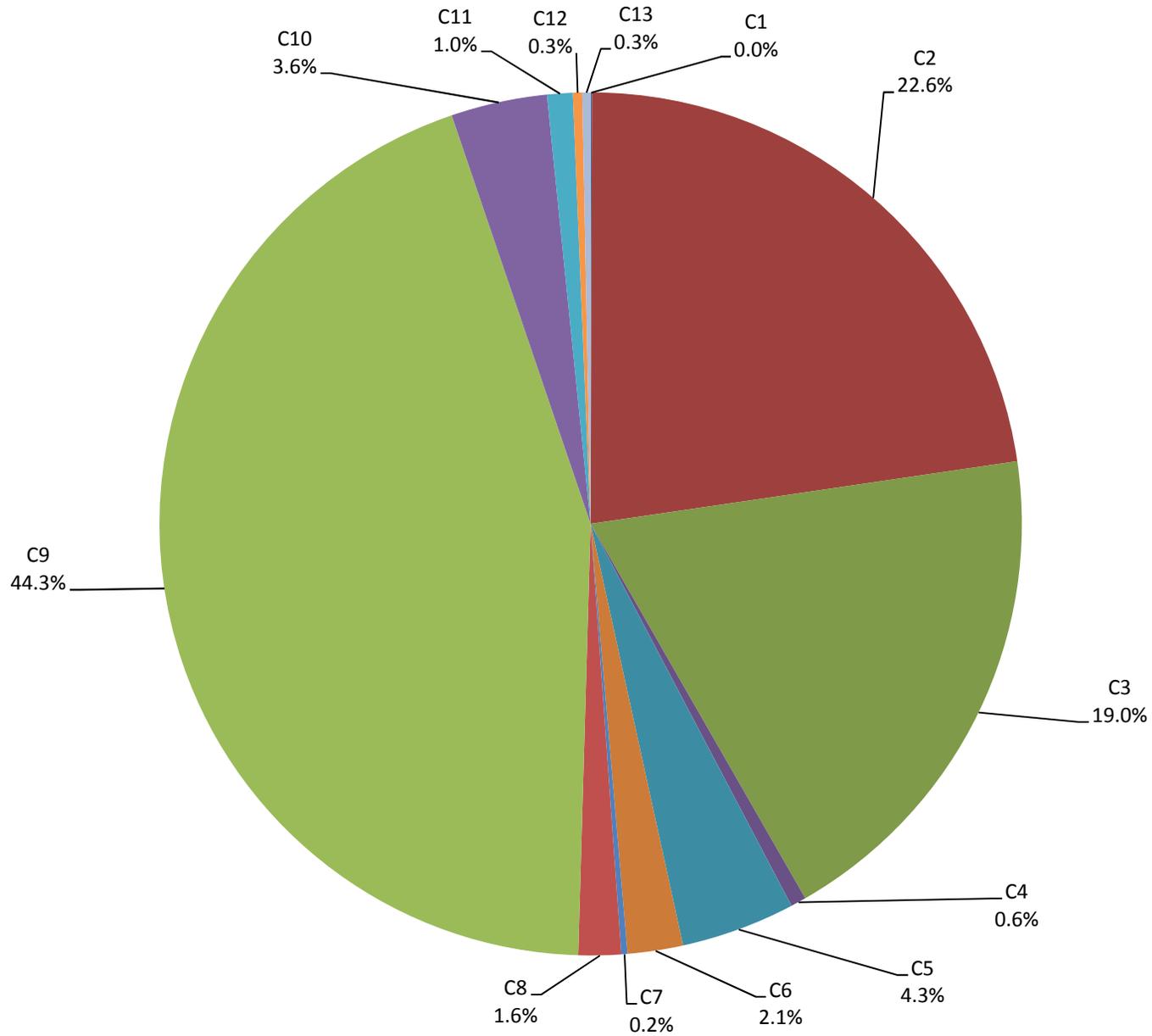
**Figure 8 - Average Speed by Lane and Direction vs. Hour of the Day**



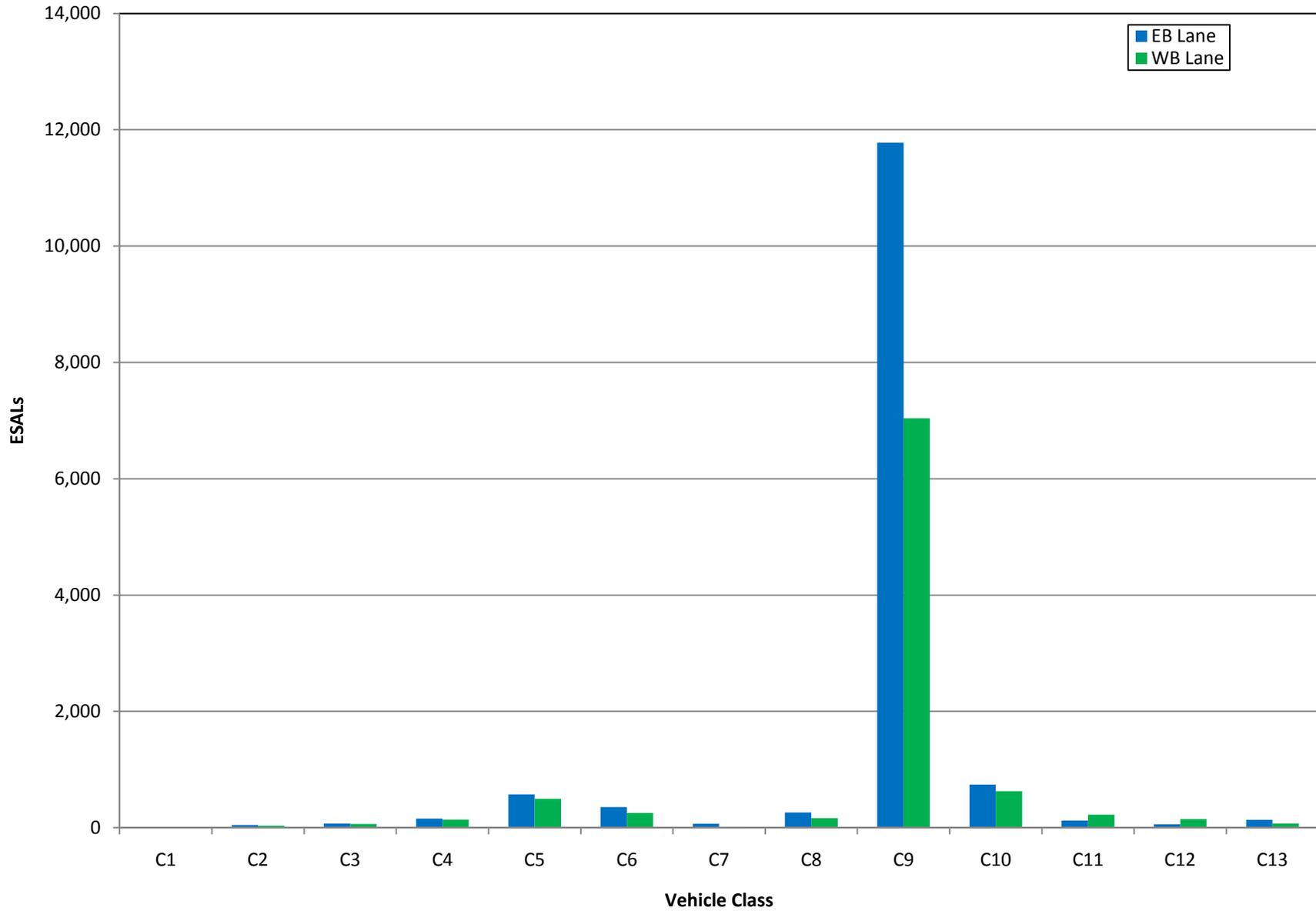
**Figure 9 - Total Gross Vehicle Weight by Class and Direction**



**Figure 10 - Total Gross Vehicle Weight by Class**



**Figure 11 - Total ESALs by Class and Direction**



**Figure 12 - ESALs by Class**

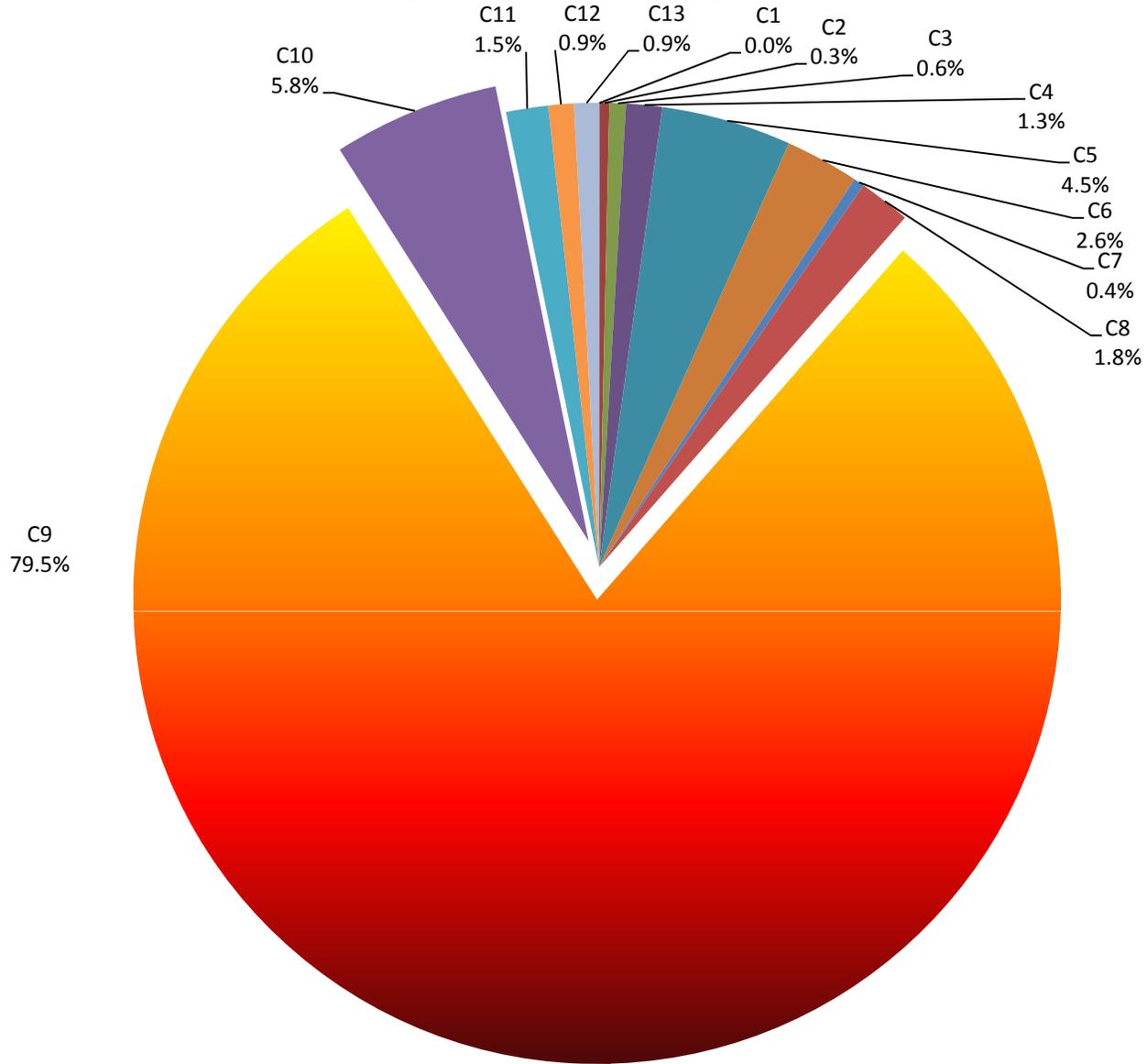


Figure 13 - Freight Tonnage and Percentage by Direction and Class

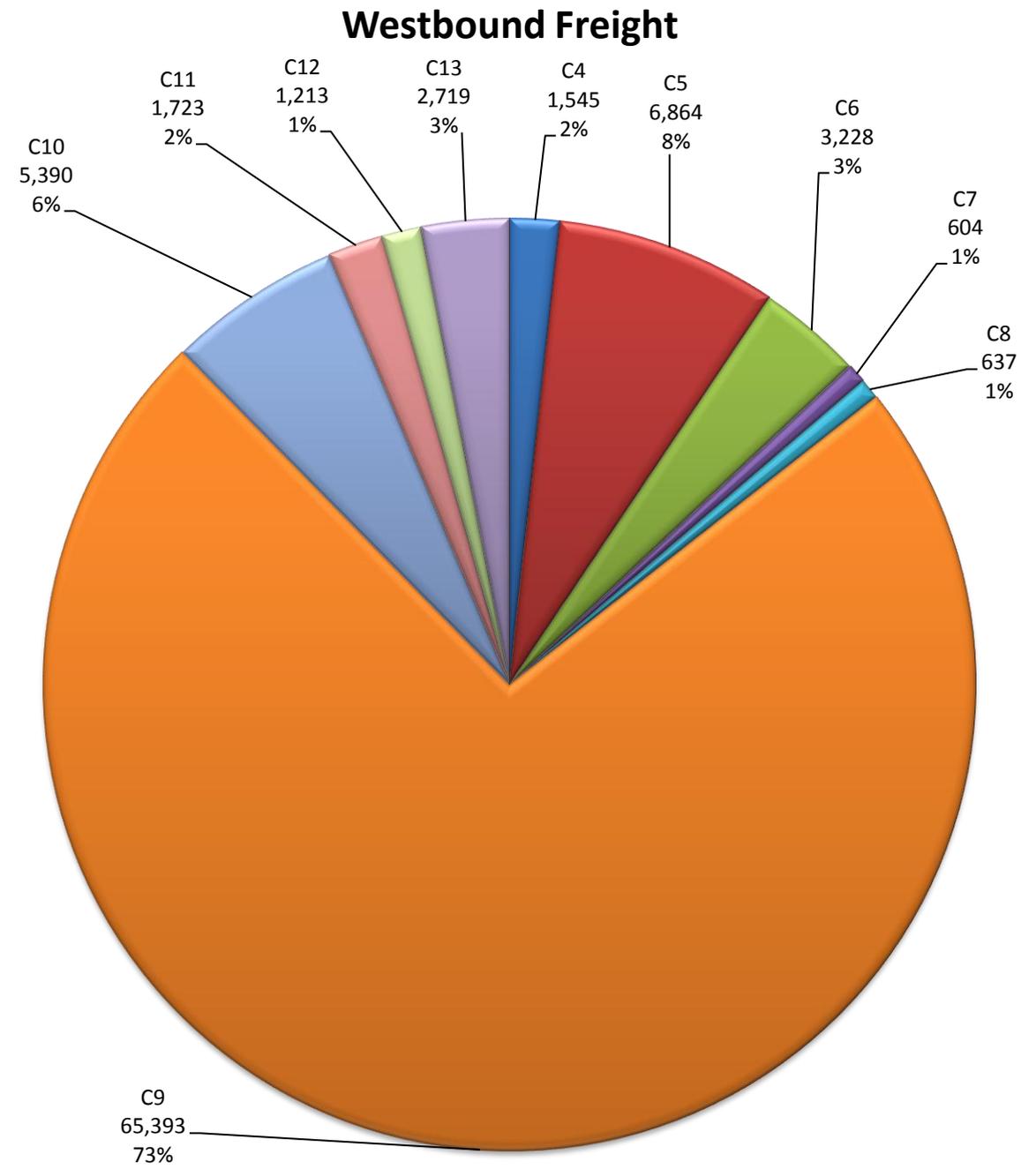
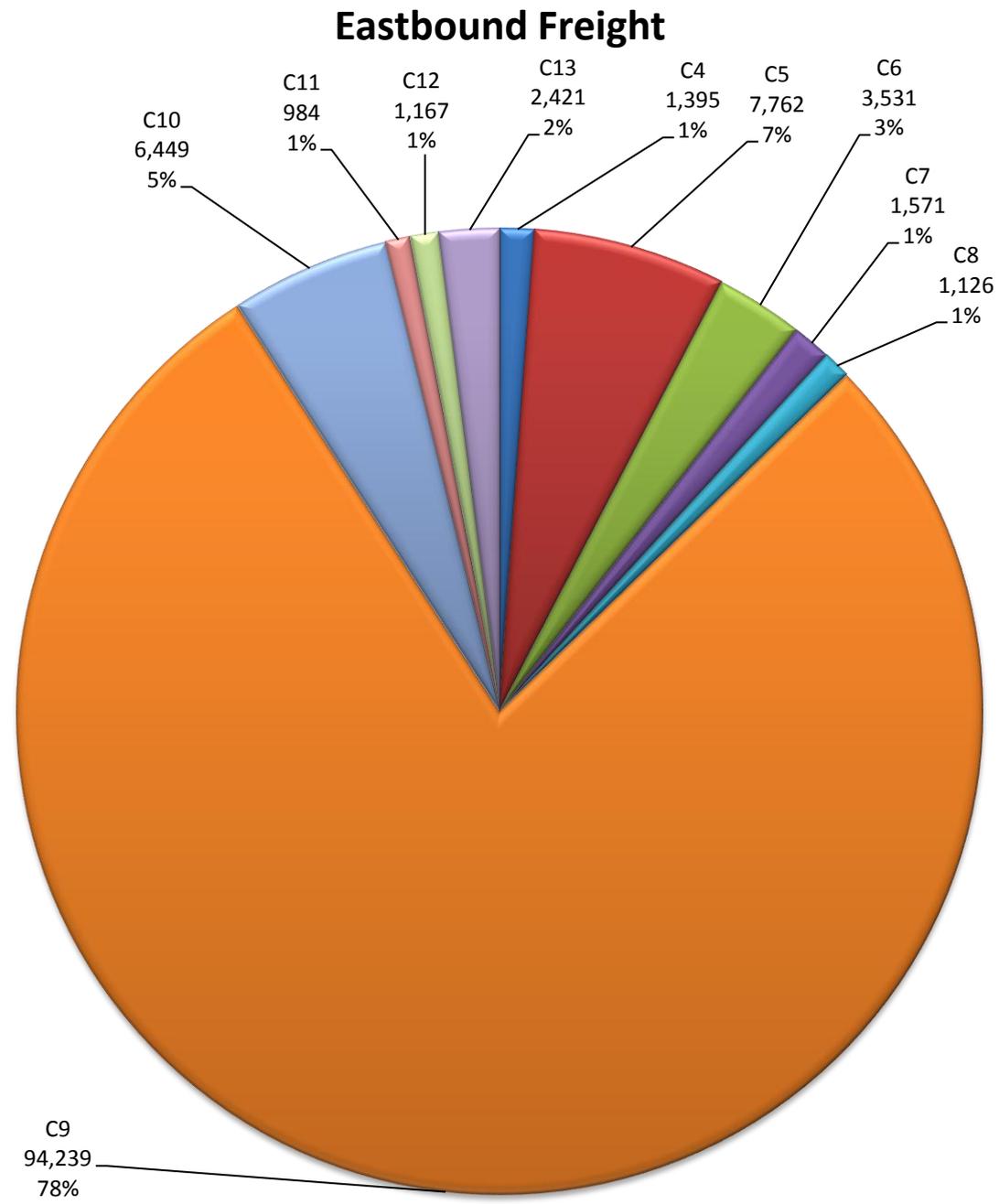


Figure 14 - Monthly Class 9 GVW Histogram - Lane 1 (EB)

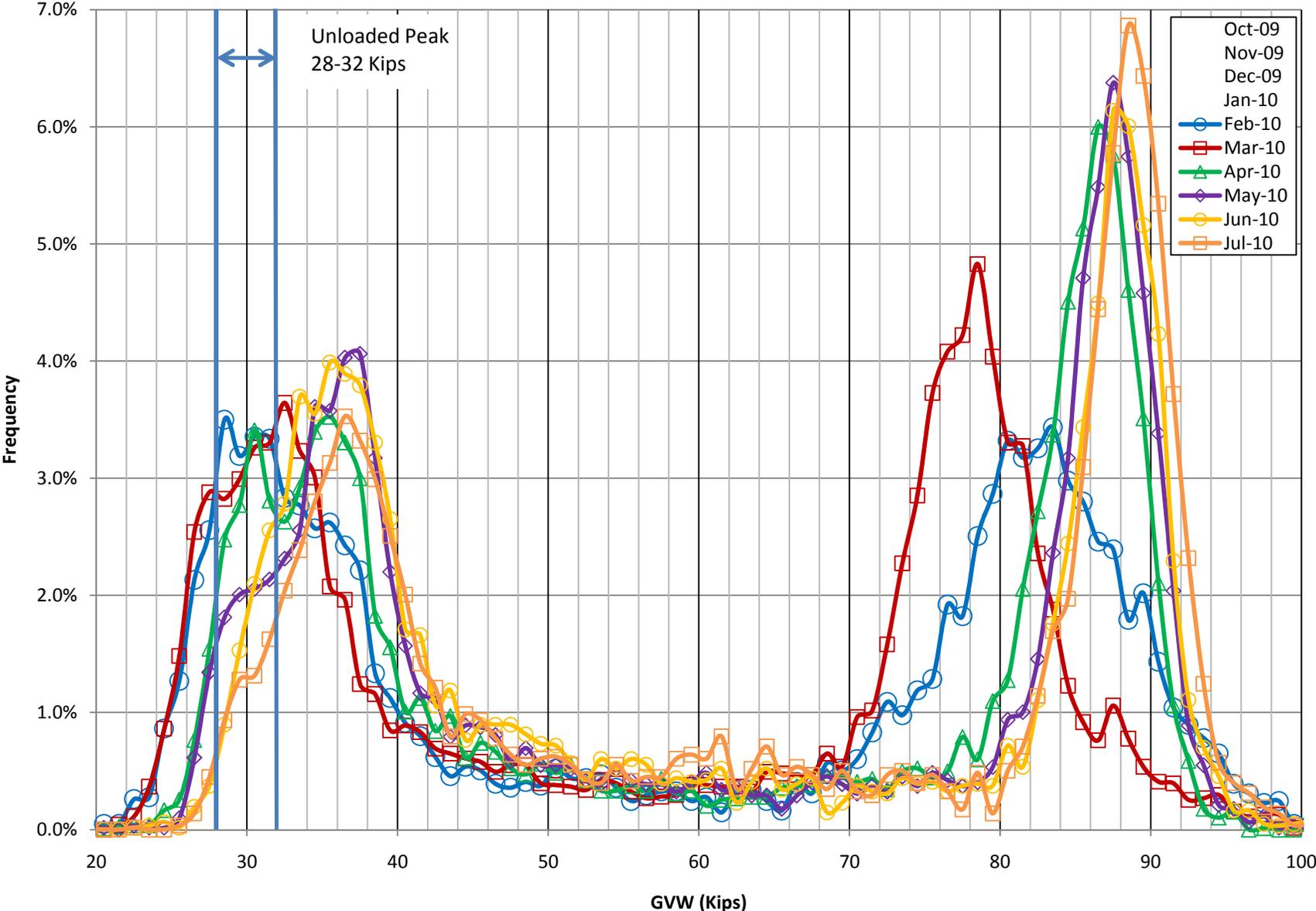


Figure 15 - Monthly Class 9 GVW Histogram - Lane 2 (WB)

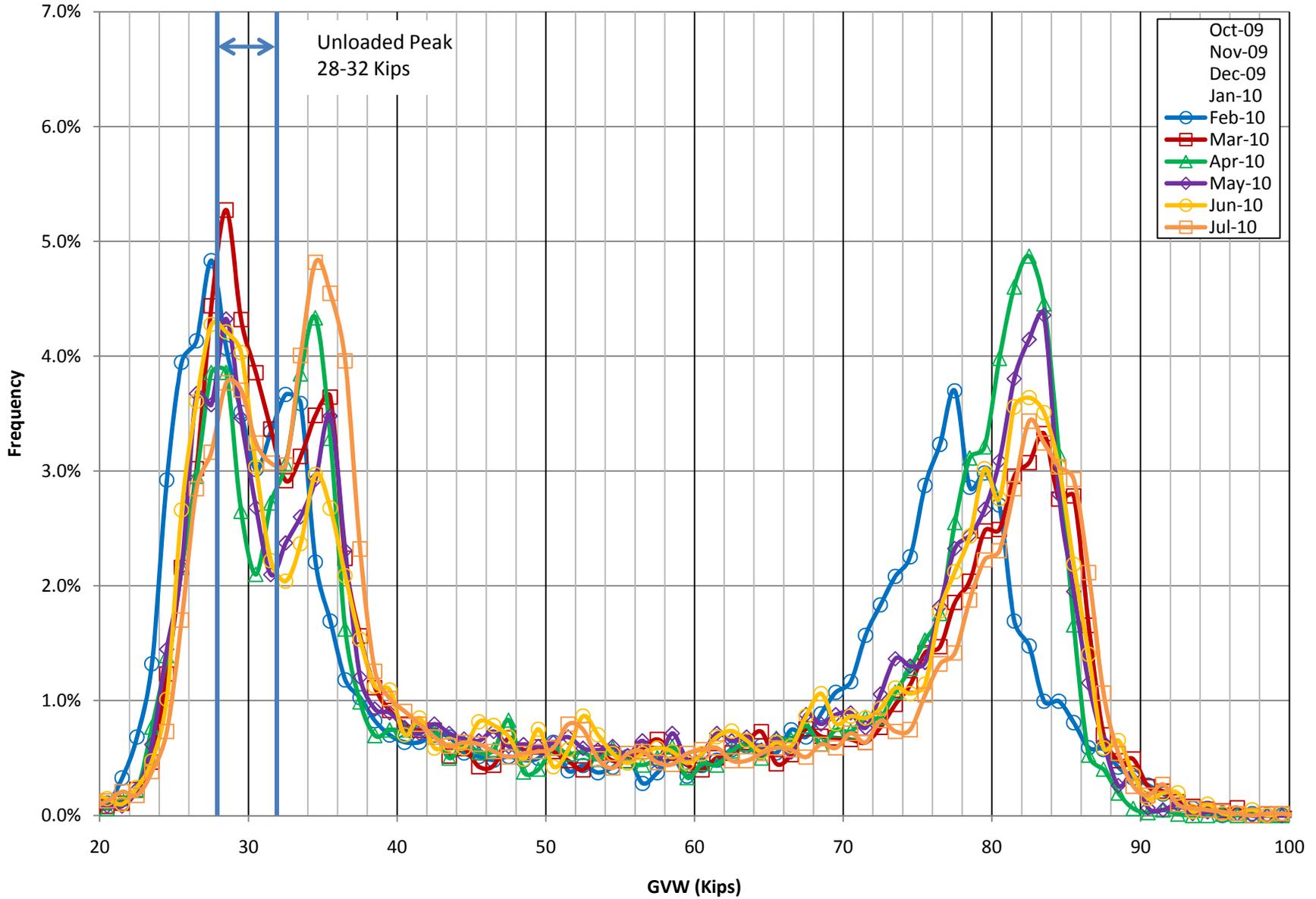


Figure 16 - Unloaded and Loaded Peaks by Lane vs. Date

