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16. Abstract <p>The primary objective of this research was to examine the avoidance of weigh stations in Virginia by overweight trucks. Secondary objectives were (1) to determine the magnitude of overweight truck activity on selected routes and (2) to compare traffic loading data collected using static scales with enforcement with data collected using weigh-in-motion without enforcement.</p> <p>Two weigh stations on I-81 were studied for weigh station avoidance. It was found that 11 and 14 percent (respectively) of the trucks on routes used to bypass the Stephens City and Troutville stations were overweight. At the Stephens City station, 50 percent of the runbys (which are trucks that travel past the weigh station without being weighed because the entrance lane to the station is filled with a queue of trucks) were overweight on Sunday night. Based on the number and percentage of overweight runbys, there is a need to increase the truck weighing capacity of this weigh station.</p> <p>From 12 to 27 percent of the trucks on two primary routes and one interstate route were overweight.</p> <p>Traffic loadings collected with WIM without enforcement are 30 to 60 percent higher than loadings collected using static scales and enforcement.</p>					
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**FINAL REPORT**  
**THE AVOIDANCE OF WEIGH STATIONS IN VIRGINIA**  
**BY OVERWEIGHT TRUCKS**

**B. H. Cottrell, Jr.**  
**Senior Research Scientist**

(The opinions, findings, and conclusions expressed in this report are those of the author and not necessarily those of the sponsoring agencies.)

**Virginia Transportation Research Council**  
(A Cooperative Organization Sponsored Jointly by the  
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## ABSTRACT

The primary objective of this research was to examine the avoidance of weigh stations in Virginia by overweight trucks. Secondary objectives were (1) to determine the magnitude of overweight truck activity on selected routes and (2) to compare traffic loading data collected using static scales with enforcement with data collected using weigh-in-motion without enforcement.

Two weigh stations on I-81 were studied for weigh station avoidance. It was found that 11 and 14 percent (respectively) of the trucks on routes used to bypass the Stephens City and Troutville stations were overweight. At the Stephens City station, 50 percent of the runbys (which are trucks that travel past the weigh station without being weighed because the entrance lane to the station is filled with a queue of trucks) were overweight on Sunday night. Based on the number and percentage of overweight runbys, there is a need to increase the truck weighing capacity of this weigh station.

From 12 to 27 percent of the trucks on two primary routes and one interstate route were overweight.

Traffic loadings collected with WIM without enforcement are 30 to 60 percent higher than loadings collected using static scales and enforcement.



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**INTRODUCTION**

The primary purpose of a truck weigh station is to enforce truck weight laws. Truck weight laws and programs to enforce these laws are intended to preserve highway pavements and structures by controlling or limiting the damage caused by overweight vehicles. In Virginia, there are 14 permanent weigh stations (8 on interstate roads and 6 on primary roads) operated by the Virginia Department of Transportation (VDOT). A vehicle is determined overweight if it exceeds the axle or gross weight limits of the federal bridge formula. The single axle and tandem axle weight limits are 20,000 lb and 34,000 lb, respectively.<sup>1</sup> The gross vehicle weight limit is based on the vehicle type and wheelbase configuration.

It is well known that some truck drivers with overweight vehicles avoid or bypass weigh stations along their route to avoid being cited for weight violations. Typically, there are two ways of avoiding weigh stations: (1) taking an alternate or bypass route to avoid the station or (2) waiting at truck stops or rest areas until the weigh station is closed. Drivers also bypass weigh stations to avoid being cited for commercial motor carrier safety violations and vehicle/driver operating violations.

Ten mobile weigh units and one weigh-in-motion (WIM) mobile unit supplement permanent weigh stations (1) by enforcing weight laws in areas where permanent scales are inappropriate and (2) by monitoring bypass routes.<sup>2</sup> The mobile weigh units operate in two ways: by selection and by WIM screening. With selection (which is the most frequently used method), a mobile weigh unit operator selects and weighs suspected vehicles. Suspected overweight trucks are identified by observation of their suspension system. The suspected vehicles are pulled over and weighed using portable static scales. Selection has the advantage of being dynamic and more difficult to avoid because its mobility does not limit it to a specific segment of road. On the other hand, WIM screening is stationary. The WIM unit is set up about 1 mile in advance of a mobile unit. When an overweight truck crosses the WIM unit, the WIM operators provide the mobile unit with a description of the suspected overweight truck. The mobile unit then pulls over the suspected truck and weighs it on portable static scales.

Typically, truck traffic is normal during the first hour of a mobile weigh operation with WIM screening, and then it declines. Similarly, the number of overweight vehicles may be very high for the first hour and then decline to almost none.

It is likely that the first truckers through the mobile weigh operation use CB radios to warn other truckers. Consequently, the truck traffic monitored by a mobile weigh operation with WIM screening on a bypass route may not be representative of the overweight truck bypass problem after the first hour. This scenario was confirmed by truck avoidance studies of stationary mobile units in Wisconsin.<sup>3</sup>

In order to determine the magnitude of weigh station avoidance, especially overweight truck activity, WIM operation without enforcement is necessary. Data from Maryland and Arizona showed that the number of overweight trucks was 34 and 30 percent higher, respectively, without enforcement.<sup>4</sup> In Wisconsin, truck avoidance of one weigh station was found to range from 21 to 45 percent for overweight trucks.<sup>3</sup> Consequently, there is a need to examine weigh station avoidance using WIM without enforcement in Virginia. Moreover, the percentage of overweight trucks and traffic loadings on selected primary and interstate routes without weigh stations nearby are of interest. Finally, there is a need to compare data collected with static scales and enforcement with data collected using WIM without enforcement.

## PURPOSE AND SCOPE

The primary objective of this research was to determine the magnitude of weigh station avoidance by overweight trucks for selected weigh stations in Virginia. Eighteen-Kip equivalent single axle loads (ESAL), which are used in pavement design for traffic loadings, are determined and used as a measure of traffic loadings associated with weigh station avoidance. ESALs were used to determine the distribution of traffic loadings by vehicle type. Two portable WIM systems, a capacitance weigh mat system, and a bridge WIM system were used for data collection. The determination of weigh station avoidance was based on a short-term data collection period and did not take into account seasonal variations. Secondary objectives were: (1) to determine the magnitude of overweight truck activity on selected major primary routes that do not have permanent weigh stations and on sections of interstate routes away from weigh stations and (2) to compare traffic loading data collected using portable static scales with enforcement with that collected using WIM without enforcement.

## METHODOLOGY

### Data Collection Planning and Scheduling

For the primary objective, the data collection plan had two parts:

1. *Data were collected on the truck weighing activities at weigh stations.* Typically, a log is kept by each work shift on the number of trucks weighed by direction,

the number of loads shifted, and the number of summonses issued for exceeding weight limits. The number of runbys may also be recorded.

2. *WIM data were collected for at least 48 hours in both directions of a bypass route.* Initially, the collection of WIM data upstream (or downstream) of the weigh station on the main line was planned to be concurrent with that collected by WIM on the bypass route. However, this procedure was canceled after three attempts at two locations because of technical problems with the bridge WIM system. At one weigh station, WIM data were collected on the main line near the weigh station for at least 48 hrs in one direction to check on weigh station runbys.

A study of three weigh stations that were suspected of often being avoided by truckers was planned: I-95 Dumfries, I-81 Troutville, and I-81 Stephens City. Locations for the installation of the WIM systems for each station were identified, and data collection was scheduled. The I-95 Dumfries weigh station was not studied because of a lack of data on the weigh station's activities. More specifically, data on the number of trucks crossing the permanent WIM screening system at Dumfries are not recorded and therefore were not available. The Route 11 Middleton and Hollins weigh stations are in the corridor of the I-81 Stephens City and Troutville weigh stations, respectively. Therefore, data were collected at these Route 11 weigh stations also.

To firmly establish that a truck is bypassing the weigh station, it is necessary to observe the truck's departure from the main line, its travel on the bypass route and its return to the main line (that is, follow the truck through the route). Such observations are very labor intensive and impractical for an extended period of time. By locating the WIM system at one location on the bypass route, the truck activity at that point can be monitored and is treated as a measure of weigh station avoidance. In other words, all overweight trucks crossing the WIM system are assumed to be avoiding the weigh station.

To achieve the study's secondary objectives, WIM data were collected on selected routes that are without permanent enforcement scales and are suspected of having a high volume of overweight truck traffic. The routes selected were I-64 and Route 29 in Albemarle County, Route 15 in Loudoun County, and Route 52 in Carroll County at Fancy Gap, which has an 8-ton weight restriction. Mobile weigh units also collected data using portable static scales near the I-64 and Route 15 sites as part of WIM system accuracy tests.

### **Data Collection and Reduction**

The data collection plan was executed for the two weigh stations and four routes. Subsequently, the data were reduced. Data measures that were used in the analysis were: (1) number and percentage of trucks, (2) number and percentage of overweight trucks, and (3) 18 Kip equivalent single axle loads and average ESALs for vehicles greater than 10,000 lb by vehicle class. To calculate ESALs for flexible (asphalt) pavements, a structural number (SN) of 5 was used, and for rigid

(concrete) pavements a 9-in thickness was used. A terminal serviceability (Pt) of 2.5 was used for both pavements.

## **Analysis**

The data were analyzed. Weigh station avoidance was determined using the analysis techniques described below.

- Using the data collected concurrently on the main line and on the bypass routes, the number and percentage of trucks and the number and percentage of overweight trucks were determined, and the 18 Kip ESALs were reviewed for the bypass routes.
- For the data collection sites on primary and interstate routes without enforcement scales nearby, the WIM data were analyzed, and the magnitude of truck activity was determined. All three data measures were used.
- A comparison of ESALs using WIM without enforcement and portable static scales with enforcement (also used to test WIM system accuracy) was made at two sites to determine the magnitude by which static weighing may under represent actual traffic loads.

## **RESULTS**

The results are presented here in six sections by location: (1) I-81, Stephens City, (2) I-81, Troutville, (3) I-64, Albemarle County, (4) Route 29, Albemarle County, (5) Route 15, Loudoun County, and (6) Route 52, Fancy Gap. The seventh section is a comparison of ESALs using WIM and static scales.

### **I-81, Stephens City**

A map of the I-81, Stephens City Weigh Station, Route 11, Middleton Weigh Station, potential bypass routes (I-66, Routes 340/522, and 277), and WIM locations is shown in Figure 1. The data were collected in order (1) to determine the weights of trucks running by the scale and (2) to measure the truck activity on a bypass route.

#### **Weigh Station Runbys**

Runbys are trucks that travel past the weigh station without being weighed because the queue of trucks waiting to be weighed extends to the deceleration or entrance lane into the weigh station. To avoid having trucks stopped in the travel

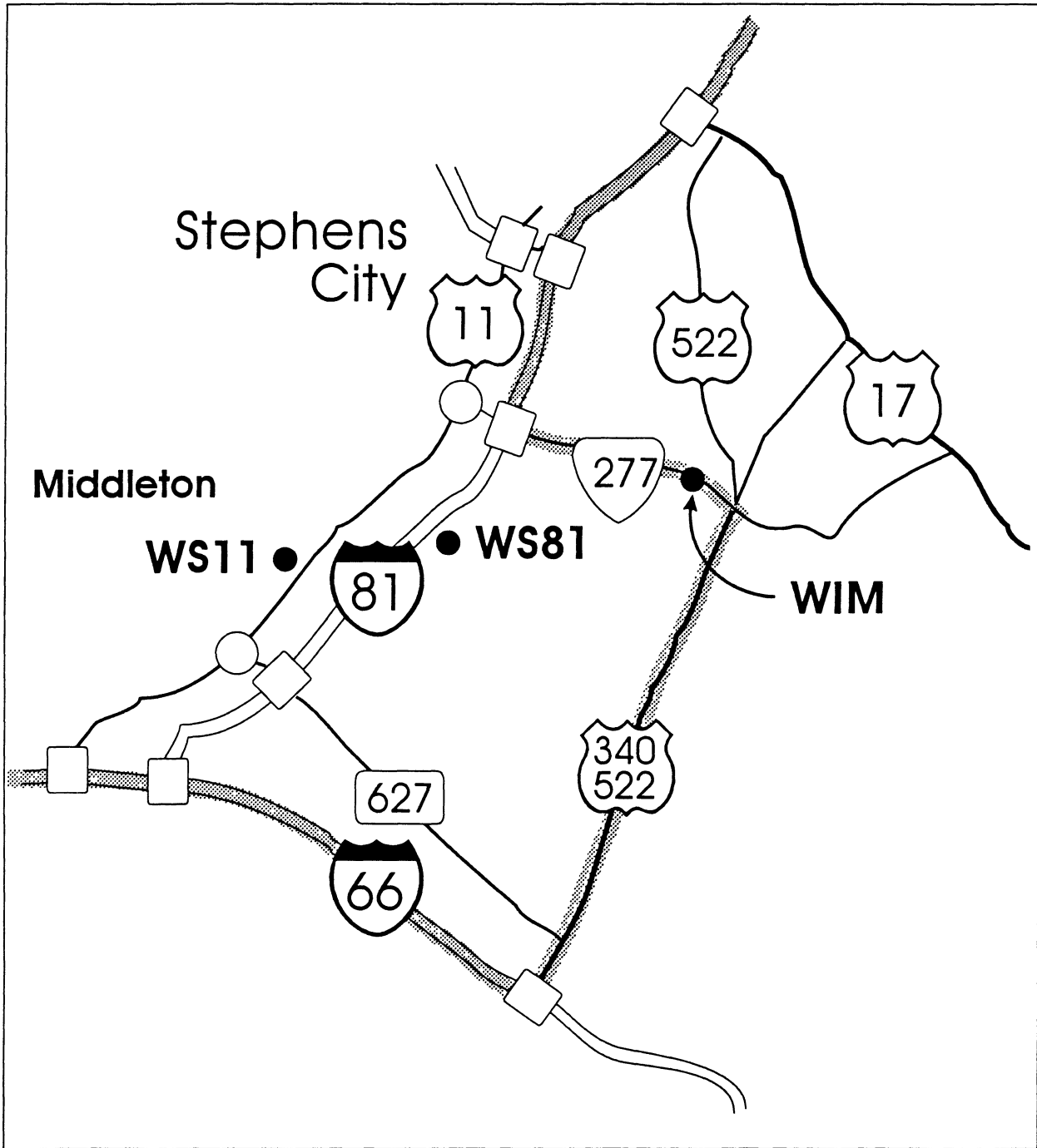


Figure 1. Map of the I-81, Stephens City area.

lane, trucks are directed (by a sign and flashing lights) not to enter the weigh station. Discussions with the weigh party chief and a perusal of log records revealed a pattern of especially heavy northbound runbys on Sunday night. The weigh party staff conjecture that the truck drivers form a caravan a few miles in advance of the weigh station with the empty trucks and trucks with lighter loads in front. Consequently, the heavier trucks runby the station because the lighter trucks have filled the queue.

A portable capacitance weigh mat WIM system was installed in front of the weigh station in both northbound lanes of I-81 to determine the weights of the runbys. The WIM system operated from Friday, August 17, 1990, through Monday, August 20, 1990. Table 1 shows the number of runbys by vehicle classification by day for the four-day period. The substantial differences in the counts between the WIM total and the manually recorded weigh station total can be attributed to a combination of the following: (1) the high number of class 15 vehicles, that is, large vehicles not classified in the 10 classes identified, (2) the fact that most recreation vehicles (RV) are configured like a truck and thus were classified as a class 5, 6, or 8, (3) the

Table 1  
RUNBYS BY VEHICLE CLASSIFICATION  
(I-81, STEPHENS CITY NBL)

	Class	Fri. 8/17/90 <sup>a</sup>	Sat. 8/18/90	Sun. 8/19/90	Mon. 8/20/90 <sup>b</sup>
buses	4	9	16	27	25
2 axle, 6 tire SU*	5	278	264	271	96
3 axle SU	6	52	17	26	11
4 or more axle SU	7	30	0	0	0
4 axle or less ST*	8	86	56	159	38
5 axle ST	9	23	18	701	145
6 axle or more ST	10	0	0	2	0
5 axle or less MT*	11	8	2	37	5
6 axle MT	12	1	0	4	3
7 axle or more MT	13	1	0	1	0
Other	15	106	96	285	83
	WIM Total	593	469	1513	406
	Weigh Station Total <sup>c</sup>	115	15	888	661

<sup>a</sup> 13 hr of data (11:00 A.M. - 12:00 A.M.)

<sup>b</sup> 10 hr of data (12:00 A.M. - 10:00 A.M.)

<sup>c</sup> All totals are for 24 hr.

\*SU single unit trucks; ST single trailer trucks; MT multi-trailer trucks.

Table 2  
**18 KIP ESALS BY DAY BY LANE**  
**I-81, STEPHENS CITY RUNBYS NORTHBOUND**

	Fri. 8/17/90 <sup>a</sup>	Sat. 8/18/90	Sun. 8/19/90	Mon. 8/20/90 <sup>b</sup>	Total
<b>Right Lane</b>					
Trucks Weighed	416	372	1078	307	2173
18 Kip ESALs	120.3	108.2	1404.2	401.0	2033.7
Average ESALs	0.3	0.3	1.3	1.3	0.94
<b>Left Lane</b>					
Trucks Weighed	177	97	435	99	808
18 Kip ESALs	82.9	42.4	714.0	170.0	1009.3
Average ESALs	0.5	0.4	1.6	1.7	1.25

<sup>a</sup> 13 hr of data.

<sup>b</sup> 10 hr of data.

small number of buses (class 4) included in the WIM tables, (4) the fact that only vehicles registered as trucks are required to enter a weigh station and are counted as runbys, and (5) human or WIM system error in counting. As expected, the number of runbys is highest for Sunday night when the truck caravans are suspected.

In Table 2, the 18 Kip ESALs by day by lane for the northbound runbys are shown. As expected, the number of 18 Kip ESALs and average ESALs are much higher for Sunday and Monday. For a closer examination, 18 Kip ESALs by vehicle classification by quarter of day for Sunday and Monday are shown in Table 3. Over 62 percent of the 18 Kip ESALs are from class 9 vehicles.

Table 4 shows the number and percentage of overweight runby vehicles by day and quarter of day. The number and percentage of overweight runbys are highest (138 to 348 vehicles or 35 to 51 percent) during the third and fourth quarters on Sunday and during the first quarter on Monday. These data confirm the suspicions that a high number of runbys on Sunday night are overweight trucks. There is a need to deter this activity by increasing the weigh station's capacity to weigh trucks.

Table 3

18 KIP ESALS BY VEHICLE CLASSIFICATION BY QUARTER  
I-81, STEPHENS CITY STATION RUNBYS NORTHBOUND

Sun. 8/19/90 Right Lane		18 Kip ESALs															
Quarter	Vehicles Weighed	Total	Class														
			4	5	6	7	8	9	10	11	12	13	15				
0-6	19	6.1	0.0	2.8	0.3	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9
6-12	131	39.7	6.0	8.4	0.2	0.0	2.3	11.0	0.0	0.0	0.0	0.0	9.8	0.0	0.0	0.0	2.1
12-18	434	465.0	7.1	22.2	4.9	0.0	7.0	279.6	0.0	0.0	0.0	0.0	56.5	1.2	0.0	0.0	86.5
18-24	494	893.4	7.2	16.0	15.4	0.0	38.4	678.2	0.1	0.0	0.0	0.0	30.0	1.3	0.0	0.0	106.8
Total	1,078	1,404.2	20.2	49.4	20.7	0.0	47.9	968.8	0.1	0.0	0.0	0.0	96.3	2.5	0.0	0.0	198.3
Average ESALs		1.3	1.0	0.3	1.0	0.0	0.4	2.0	0.1	0.1	0.1	0.1	3.4	1.3	0.0	0.0	1.0
Percent ESAL		1.4	3.5	1.5	0.0	3.4	69.0	0.0	0.0	0.0	0.0	0.0	6.9	0.2	0.0	0.0	14.1
Mon. 8/20/90 Right Lane		18 Kip ESALs															
0-6	201	354.2	15.9	8.4	8.9	0.0	13.0	229.0	0.0	0.0	0.0	0.0	9.8	6.1	0.0	0.0	63.1
6-10	106	46.8	14.7	6.3	0.1	0.0	0.4	22.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4
Total	307	401.0	30.6	14.7	9.0	0.0	13.3	251.9	0.0	0.0	0.0	0.0	9.8	6.1	0.0	0.0	65.5
Average ESALs		1.3	1.5	0.2	0.8	0.0	0.5	2.6	0.0	0.0	0.0	0.0	4.9	3.1	0.0	0.0	0.9
Percent ESALs		7.63	3.7	2.3	0.0	3.3	62.8	0.0	0.0	0.0	0.0	0.0	2.4	1.5	0.0	0.0	16.4



Table 4  
**OVERWEIGHT VEHICLES BY DAY AND QUARTER OF DAY  
 I-81, STEPHENS CITY STATION RUNBYS**

Quarter	Fri. 8/17/90 <sup>a</sup>		Sat. 8/18/90		Sun. 8/19/90		Mon. 8/20/90 <sup>b</sup>		Total
	No.	Percent	No.	Percent	No.	Percent	No.	Percent	
0-6	— <sup>c</sup>	— <sup>c</sup>	10	24	2	8	138	51	
6-12	22	14	2	1	21	14	15	11	
12-18	16	5	14	7	223	35	— <sup>c</sup>	— <sup>c</sup>	
18-24	7	6	13	14	348	49	— <sup>c</sup>	— <sup>c</sup>	
<b>Total No.</b>									
Overweight		45		39		594		153	831
Total Weighed		593		469		1513		406	2981
Percent Overweight		8		8		39		38	28

<sup>c</sup> No data were collected.

<sup>a</sup> 13 hr of data

<sup>b</sup> 10 hr of data

### Weigh Station Bypassing

A WIM system was installed in both lanes on Route 277 to study a suspected bypass route, which included portions of I-66, Route 340/522, and Route 277. Data were collected from Friday, October 26, 1990, through Thursday, November 1, 1990. The vehicle classification counts by day for Route 277 are shown in Table 5. The data in Table 6 show that (1) more trucks travel east than west, (2) the 18 Kip ESALs are highest on Friday in both directions, and (3) the weekday average ESAL has little variance. The 18 Kip ESALs by vehicle classification for the highest 18 Kip ESALs day of the week (see Table 7), reveals that class 9 trucks are responsible for more than half (54 percent eastbound) of the 18 Kip ESALs. Eleven percent of the trucks during the study period in each direction were overweight, and 5 to 13 percent of trucks were overweight on different days of the week (see Table 8).

Between 1 and 2 percent of the trucks at the I-81, Stephens City weigh station were consistently overweight; 6 to 20 percent of the trucks were runbys (on the average, 15 percent of the trucks were runbys) (see Table 9). Similar information is provided in Table 10 for the Route 11, Middleton weigh station; Route 11 is also an alternate route for the I-81 weigh station. By including all three routes, all travel by large vehicles in this corridor is shown in Table 11. The percentage of trucks in the corridor traveling southbound and northbound that used Route 277 were 7.1 and 5.2, respectively.

**Table 5**  
**VEHICLE CLASSIFICATION BY DAY**  
**RTE. 277**  
**BOTH LANES**

Class	Fri. 10/26	Sat. 10/27	Sun. 10/28	Mon. 10/29	Tue. 10/30	Wed. 10/31	Thu.* 11/01	Total	
1	4	0	2	1	0	1	3	11	
2	4,433	4,734	4,788	4,410	4,513	4,740	1,722	29,340	
3	820	766	553	214	75	24	3	2,455	
4	3	1	2	4	10	6	0	26	
5	102	26	21	80	85	69	28	411	
6	87	27	16	86	111	69	36	432	
7	4	0	2	3	3	3	0	15	
8	68	9	15	38	33	34	13	210	
9	149	65	50	120	142	151	68	745	
10	5	2	1	3	5	2	1	19	
11	0	0	0	0	0	0	0	0	
12	0	0	0	0	0	0	0	0	
13	1	2	0	1	0	0	0	4	
15	285	190	140	147	102	99	43	1,006	
<b>Total</b>	<b>5,961</b>	<b>5,822</b>	<b>5,590</b>	<b>5,107</b>	<b>5,079</b>	<b>5,198</b>	<b>1,917</b>	<b>34,674</b>	
<b>Total of Classes 4-13</b>	<b>419</b>	<b>132</b>	<b>107</b>	<b>335</b>	<b>389</b>	<b>334</b>	<b>146</b>	<b>1,862</b>	
<b>Percent Classes</b>									<b>Weekday</b>
<b>4-13</b>	<b>7.0%</b>	<b>2.3%</b>	<b>1.9%</b>	<b>6.6%</b>	<b>7.7%</b>	<b>6.4%</b>	<b>7.6%</b>	<b>5.4%</b>	<b>7.0%</b>

\*10 hr of data (12:00 A.M. – 10:00 A.M.)

**Table 6**  
**18 KIP ESALS BY DAY BY LANE**  
**RTE. 277**

	Fri. 10/26	Sat. 10/27	Sun. 10/28	Mon. 10/29	Tue. 10/30	Wed. 10/31	Thu.* 11/01	Total
<b>Lane 1 – EB</b>								
Vehicles Weighed	352	171	136	189	215	194	95	1,352
18 KIP ESALS	194.9	47.3	42.3	149.3	130.8	101.5	57.5	723.6
Average ESALS	0.6	0.3	0.3	0.8	0.6	0.5	0.6	0.5
<b>Lane 2 – WB</b>								
Vehicles Weighed	210	71	46	171	198	173	59	928
18 KIP ESALS	131.3	60.3	41.7	92.2	111	63.6	20.8	520.9
Average ESALS	0.6	0.8	0.9	0.5	0.6	0.4	0.4	0.6

\*10 hr of data (12:00 A.M.–10:00 A.M.).

Table 7

18 KIP ESALS BY VEHICLE CLASSIFICATION FOR  
HIGHEST 18 KIP ESALS DAY OF THE WEEK—RTE. 277

Date - 10/26/90	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10	Class 11	Class 12	Class 13	Class 15
Direction - EB											
Total	2	46	35	2	34	69	2	0	0	0	162
Vehicles Weighed	194.9	19.7	18.0	1.4	36.9	105.2	2.0	0.0	0.0	0.0	11.4
18 KIP ESALS	0.60	0.43	0.51	0.71	1.09	1.53	1.02	0.00	0.00	0.00	0.07
Average ESALS	0.1%	10.1%	9.2%	18.9%	54.0%	1.0%	0.0%	0.0%	0.0%	0.0%	5.8%
Percentage ESALS	0.6%	13.1%	9.9%	0.6%	9.7%	19.6%	0.6%	0.0%	0.0%	0.0%	46.0%
Percentage Vehicles											

52

Table 8  
OVERWEIGHT VEHICLES BY DAY  
RTE. 277

	Fri. 10/26	Sat. 10/27	Sun. 10/28	Mon. 10/29	Tue. 10/30	Wed. 10/31	Thu.* 11/01	Total
<b>EASTBOUND</b>								
No. Overweight	39	15	1	34	38	16	5	148
Total Weighed	352	171	136	189	413	194	95	1550
% Overweight	11%	9%	1%	18%	9%	8%	5%	11%
<b>WESTBOUND</b>								
No. Overweight	29	10	12	13	28	5	3	100
Total Weighed	210	71	46	171	215	173	59	945
% Overweight	14%	14%	26%	8%	13%	3%	5%	11%
<b>TOTAL</b>								
No. Overweight	68	25	13	47	66	21	8	248
Total Weighed	562	242	182	360	628	367	154	2495
% Overweight	12%	10%	7%	13%	11%	6%	5%	10%

\*10 hr of data (12:00 A.M. - 10:00 A.M.).

Table 9  
OVERWEIGHT AND RUNBY TRUCKS BY DAY  
I-81, STEPHENS CITY WEIGH STATION

	Fri. 10/26	Sat. 10/27	Sun. 10/28	Mon. 10/29	Tue. 10/30	Wed. 10/31	Thu. 11/01	Total
<b>Total Weighed</b>								
North	2,334	1,691	2,227	2,480	1,679	2,710	2,813	15,934
South	2,572	2,228	1,552	1,983	2,623	2,623	2,637	16,218
Total	4,906	3,919	3,779	4,463	4,302	5,333	5,450	32,152
<b>No. Summonses</b>								
No. Summonses	22	20	27	23	21	43	30	186
% Summonses	0.4%	0.5%	0.7%	0.5%	0.5%	0.8%	0.6%	0.6%
<b>No. Shifted</b>								
No. Shifted	45	48	31	41	48	59	64	336
% Shifted	0.9%	1.2%	0.8%	0.9%	1.1%	1.1%	1.2%	1.0%
<b>No. Overweight</b>								
(No. Summonses + Shifted)	67	68	58	64	69	102	94	522
% Overweight	1.4%	1.7%	1.5%	1.4%	1.6%	1.9%	1.7%	1.6%
<b>No. of Runbys</b>								
North	89	0	882	392	446	421	687	2917
South	525	268	15	185	664	565	661	2883
Total	614	268	897	577	1110	986	1348	5800
<b>% of Total</b>								
Runbys	11.1%	6.4%	19.2%	11.4%	20.5%	15.6%	19.8%	15.3%

Table 10  
OVERWEIGHT AND RUNBY TRUCKS BY DAY  
ROUTE 11, MIDDLETON WEIGH STATION

	Fri.* 10/26	Sat.** 10/27	Sun.*** 10/28	Mon. 10/29	Tue. 10/30	Wed. 10/31	Thu. 11/01	Total
<b>Total Weighed</b>								
North	85		23	130	162	133	156	689
South	97		12	147	194	154	155	759
Total	82		35	277	356	287	311	1,448
No. Summonses	2		2	0	4	2	4	14
% Summonses	1.1%		5.7%	0.0%	1.1%	0.7%	1.3%	1.0%
No. Shifted Loads	5		1	7	12	9	7	41
% Shifted	2.7%		2.9%	2.5%	3.4%	3.1%	2.3%	2.8%
No. Overweight (No. Summonses + Shifted)	7		3	7	16	11	11	55
% Overweight	3.8%		8.6%	2.5%	4.5%	3.8%	3.5%	3.8%
No. of Runbys	2		1	0	6	4	4	17
% of Runbys	1.1%		2.8%	0.0%	1.7%	1.4%	1.3%	1.2%

\* Station open 12:00 A.M. – 4:00 P.M.

\*\* Station closed.

\*\*\* Station open 4:00 P.M. – 12:00 A.M.

Table 11  
VEHICLE CLASSES 4 THROUGH 15 IN CORRIDOR  
I-81, STEPHENS CITY

	Fri. 10/26	Sat. 10/27	Sun. 10/28	Mon. 10/29	Tue. 10/30	Wed. 10/31	Thu.* 11/01	Totals
<b>East/Southbound</b>								
Bypass Volume —Rte. 277	352	171	136	189	215	194	95	1,257
Secondary Route —Scales	99	0	13	147	200	158	159	617
Mainline Volume —Scales	3,097	2,496	1,567	2,168	3,287	3,188	3,298	15,803
Total Bypass & Scales	3,548	2,667	1,716	2,504	3,702	3,540	3,552	17,677
Bypass % Scales	9.9%	6.4%	7.9%	7.5%	5.8%	5.5%	2.7%	7.1%
<b>West/Northbound</b>								
Bypass Volume Rte. 277	210	71	46	171	198	173	59	869
Secondary Route —Rte. 11 Scales	85	0	23	130	162	133	156	533
Mainline Volume —Scales	2,423	1,691	3,109	2,872	2,125	3,131	3,500	15,351
Total Bypass & Scales	2,718	1,762	3,178	3,173	2,485	3,437	3,715	16,753
Bypass % Scales	7.7%	4.0%	1.4%	5.4%	8.0%	5.0%	1.6%	5.2%

\* 10 hr of WIM data (12:00 A.M. – 10:00 A.M.) and not included in the totals.

## I-81, Troutville

A map of the I-81, Troutville Weigh Station, Route 11, Hollins Weigh Station, potential bypass routes, and the WIM location is shown in Figure 2. The data were collected to measure the truck activity on the bypass route that included Alternate Route 220. An attempt was made to determine the number of runbys and the 18 Kip ESALs on I-81 by installing a bridge WIM system about 1 mile south of the weigh station. After much consultation with the WIM system vendor, it was concluded that testing would be required to collect reliable data on reinforced concrete bridges because cracks in the concrete girders affect the strain and weight measurements. It is also suspected by the vendor that variability of the material composition of reinforced concrete girders may be a factor. Therefore, no reliable WIM data were obtained on I-81 at the Troutville site.

Data on bypassing were collected by using the portable capacitance weigh mat in both lanes of Alternate Route 220 from Wednesday, November 28, 1990, through Tuesday, December 4, 1990. Data were not collected westbound Wednesday through Friday because a road sensor cable was damaged. There was evidence (skid marks) that the damage was intentionally done by the driver of a truck. The vehicle classification by day is shown in Table 12. Vehicle classes 4 through 13 account for 19 percent of the weekday volume and 14.7 percent of the weekly volume. From Table 13, it can be seen that (1) more trucks travel east than west, (2) the average ESALs are greater eastbound, and (3) 18 Kip ESALs were highest eastbound on Wednesday. The 18 Kip ESALs by vehicle classification for Wednesday (see Table 14) reveal that class 9 trucks contributed 86 percent of the 18 Kip ESALs, and the class 9 average ESAL is 37 percent greater than the average for all vehicles. During the study period, 15 percent of the eastbound trucks and 9 percent of the westbound trucks (14 percent overall) were overweight. There was much variation by day in the percentage of overweight trucks (see Table 15).

About 1 percent of the vehicles weighed at the I-81, Troutville weigh station were overweight (see Table 16). Although the number of runbys was not routinely recorded at Troutville, during a recent 4-month period when runbys were recorded, about 50,000 to 60,000 runbys were noted each month for a daily total between 1,600 to 2,000.<sup>5</sup> Table 17 presents similar data from the Route 11, Hollins Weigh Station.

All truck travel recorded in the corridor is presented in Table 18. The percentage of trucks in the corridor that use Alternate Route 220 east/southbound and west/northbound were 20.1 and 14.1, respectively. Assuming 800 runbys per day in each direction on I-81, 15 percent of the southbound trucks used Alternate Route 220, and 10.6 percent of the westbound trucks used this alternate route.

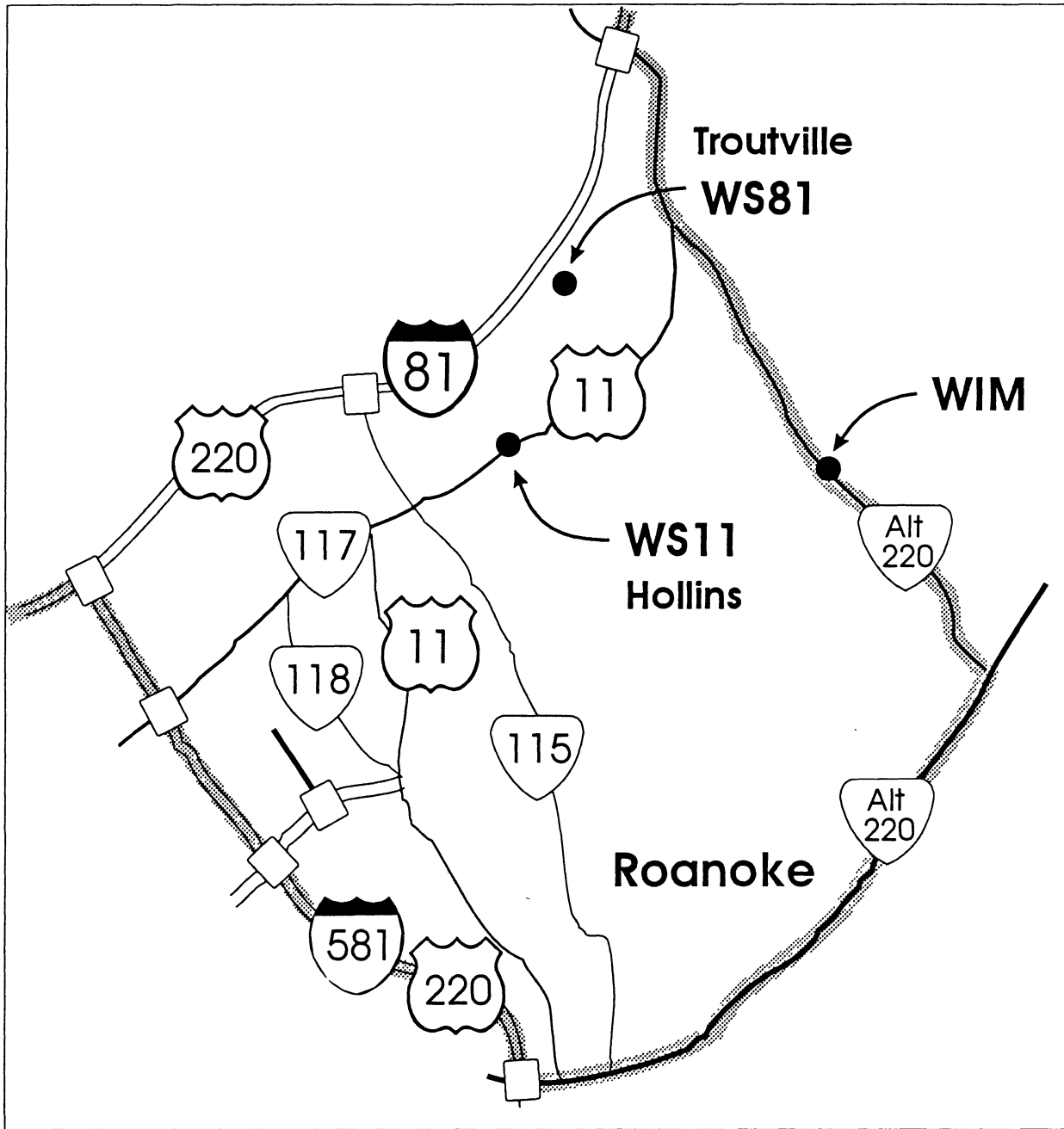


Figure 2. Map of the I-81, Troutville area.

Table 12  
 VEHICLE CLASSIFICATION BY DAY  
 ALTERNATE RTE. 220  
 BOTH LANES

Class	Wed. 11/28	Thu. 11/29	Fri. 11/30	Sat. 12/01	Sun. 12/02	Mon. 12/03	Tue.* 12/04	Totals	
1	3	3	0	2	0	29	0	37	
2	2,501	2,659	1,126	6,644	2,780	5,681	122	21,513	
3	457	480	52	343	22	15	1	1,370	
4	4	5	3	9	3	11	7	42	
5	96	91	37	51	12	130	4	421	
6	60	69	27	62	11	86	2	317	
7	1	1	1	1	0	5	0	9	
8	55	43	18	27	5	166	17	331	
9	595	570	264	437	185	784	56	2,891	
10	1	2	1	0	1	7	4	16	
11	12	12	3	9	1	18	1	56	
12	0	0	0	0	0	0	0	0	
13	0	0	0	0	3	4	0	7	
15	175	140	36	87	38	378	36	890	
<b>Total</b>	<b>3,960</b>	<b>4,075</b>	<b>1,568</b>	<b>7,672</b>	<b>3,061</b>	<b>7,314</b>	<b>250</b>	<b>27,900</b>	
<b>Total of Classes 4-13</b>	<b>824</b>	<b>793</b>	<b>354</b>	<b>596</b>	<b>221</b>	<b>1,211</b>	<b>91</b>	<b>4,090</b>	
<b>% of Classes 4-13</b>	<b>20.8%</b>	<b>19.5%</b>	<b>22.6%</b>	<b>7.8%</b>	<b>7.2%</b>	<b>16.6%</b>	<b>36.4%</b>	<b>14.7%</b>	<b>Weekday 19.1%</b>

\*4 hr of data (12:00 A.M. – 4:00 A.M.).

Data not available WB Wed–Fri.

Table 13  
 18 KIP ESALS BY DAY BY LANE  
 ALTERNATE RTE. 220

	Wed. 11/28	Thu. 11/29	Fri. 11/30	Sat. 12/01	Sun. 12/02	Mon. 12/03	Tue.* 12/04	Total
<b>Lane 1 – EB</b>								
Vehicles Weighed	924	842	377	295	235	645	35	3,353
18 KIP ESALS	1043.6	848.0	310.2	242.8	188.1	230.9	7.9	2,871.5
Average ESALS	1.1	1.0	0.8	0.8	0.8	0.4	0.2	0.9
<b>Lane 2 – WB</b>								
Vehicles Weighed				318	176	533	26	1,053
18 KIP ESALS				169.6	91.6	529.4	50.8	841.4
Average ESALS				0.5	0.5	1.0	2.0	0.8

\* 4 hr of data (12:00 A.M. – 4:00 A.M.).

Data were not available WB Wed.–Fri.



Table 14  
 18 KIP ESALS BY VEHICLE CLASSIFICATION FOR  
 HIGHEST 18 KIP ESALS  
 ALTERNATE RTE. 220

Date- 11/28/90															
Direction - EB	Total	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10	Class 11	Class 12	Class 13	Class 15			
Vehicles Weighed	924	4	89	59	1	53	594	1	12	0	0	111			
18 KIP ESALS	1043.6	0.7	27.5	42.7	1.0	23.2	898.2	0.3	10.5	0.0	0.0	39.3			
Average ESALS	1.10	0.18	0.31	0.72	1.02	0.44	1.51	0.31	0.88	0.00	0.00	0.35			
Percent ESALS		0.1%	2.6%	4.1%	0.1%	2.2%	86.1%	0.0%	1.0%	0.0%	0.0%	3.8%			
Percent Vehicles		0.4%	9.6%	6.4%	0.1%	5.7%	64.3%	0.1%	1.3%	0.0%	0.0%	12.0%			

Table 15  
**OVERWEIGHT VEHICLES BY DAY  
 ALTERNATE RTE. 220**

	Wed. 11/28	Thu. 11/29	Fri. 11/30	Sat. 12/01	Sun. 12/02	Mon. 12/03	Tue.* 12/04	Total
<b>Eastbound</b>								
No. Overweight	270	176	37	22	5	0	0	510
Total Weighed	924	842	377	295	235	645	35	3353
% Overweight	29%	21%	10%	7%	2%	0%	0%	15%
<b>Westbound</b>								
No. Overweight				32	11	43	4	90
Total Weighed				318	176	533	26	1053
% Overweight				10%	6%	8%	15%	9%
<b>Total</b>								
No. Overweight	270	176	37	54	16	43	4	600
Total Weighed	924	842	377	613	411	1178	61	4406
% Overweight	29%	21%	10%	9%	4%	4%	7%	14%

\*4 hr of data (12:00 A.M. - 4:00 A.M.)  
 Data not available WB for Wed.-Fri.

Table 16  
**TRUCK WEIGHING ACTIVITY  
 I-81, TROUTVILLE WEIGH STATION**

	Wed. 11/28	Thu. 11/29	Fri. 11/30	Sat. 12/01	Sun. 12/02	Mon. 12/03	Tue.* 12/04	Total
<b>Total Weighed</b>								
North	2,524	2,335	2,035	1,614	2,169	2,389	2,347	15,413
South	2,534	2,287	2,344	2,230	1,700	2,019	2,334	15,448
Total	5,058	4,622	4,379	3,844	3,869	4,408	4,681	30,861
<b>No. Summonses</b>								
No. Summonses	21	21	12	12	13	19	17	115
% Summonses	0.4%	0.5%	0.3%	0.3%	0.3%	0.4%	0.4%	0.4%
<b>No. Shifted</b>								
No. Shifted	39	31	31	32	30	25	29	217
% Shifted	0.8%	0.7%	0.7%	0.8%	0.8%	0.6%	0.6%	0.7%
<b>No. Overweight (No. Summonses + Shifted)</b>								
No. Overweight	60	52	43	44	43	44	46	332
% Overweight	1.2%	1.1%	1.0%	1.1%	1.1%	1.0%	1.0%	1.1%

\* 4 hr of data (12:00 A.M. - 4:00 A.M.).

Table 17  
**TRUCK WEIGHING ACTIVITY**  
**RTE. 11, HOLLINS WEIGH STATION**

	Mon.* 12/03	Tue.** 12/04	TOTAL
<b>TOTAL WEIGHED</b>			
NORTH	62	147	209
SOUTH	49	141	190
TOTAL	111	288	399
No. Summonses	3	5	8
Percent Summonses	2.7%	1.7%	2.0%
No. Shifted	1	5	6
Percent Shifted	0.9%	1.7%	1.5%
No. Overweight (No. Summonses + Shifted)	4	10	14
Percent Overweight	3.6%	3.5%	3.5%

The station was closed Wed.–Sun.

\* Open 8 hr (2:00 P.M. – 10:00 P.M.)

\*\* Open 13 hr (9:00 A.M. – 10:00 P.M.)

Table 18  
**VEHICLE CLASSES 4 THROUGH 15 IN CORRIDOR**  
**I-81, TROUTVILLE**

	Wed. 11/28	Thu. 11/29	Fri. 11/30	Sat. 12/01	Sun. 12/02	Mon. <sup>a</sup> 12/03	Tue. <sup>b</sup> 12/04	Total <sup>c</sup>
<b>East/Southbound</b>								
Bypass Volume	924	842	377	295	235	645	35	3,318
—Alt 220								
Secondary Route	49	141	49					
—Rte. 11 Scales								
Mainline Volume	2,534	2,287	2,344	2,230	1,700	2,019	2,334	13,114
—Scales								
Total Bypass & Scales	3,458	3,129	2,721	2,525	1,935	2,713	2,510	16,481
Bypass % Scales	26.7%	26.9%	13.9%	11.7%	12.1%	23.8%	1.4%	20.1%
<b>West/Northbound</b>								
Bypass Volume				318	176	533	26	1,027
—Alt 220								
Secondary Route						62	147	62
—Rte. 11 Scales								
Mainline Volume	2,524	2,335	2,035	1,614	2,169	2,389	2,347	6,172
—Scales								
Total Bypass & Scales				1,932	2,345	2,984	2,520	7,261
Bypass % Scales				16.5%	7.5%	17.9%	1.0%	14.1%

<sup>a</sup> Rte.11 scales open 2:00 P.M. – 10:00 P.M.

<sup>b</sup> 4 hr of WIM data (12:00 A.M. – 4:00 A.M.); Rte. 11 scales open 9:00 A.M. – 10:00 P.M.

<sup>c</sup> WB total includes Sat.–Mon. only; EB total includes Wed.–Mon.

Data not available WB Wed.–Fri.

### I-64, Albemarle County

Truck weight data were collected on I-64 in Albemarle County between Route 631 and Route 29 from Monday, December 10, 1990, through Thursday, December 13, 1990. A bridge WIM system was installed on both eastbound lanes on a steel girder bridge over Route 781. Vehicle classification data by days reveal that over half (54.1 percent) of the trucks were in class 9 (see Table 19). The average ESAL for the study period is 1.00, and 11.9 percent of the trucks were overweight (see Table 20). Most trucks (94.1 percent) were in the right lane. Table 21 shows that (1) the highest 18 Kip ESAL, average ESAL, and percent ESAL are for class 9 vehicles;

Table 19  
VEHICLE CLASSIFICATION BY DAY  
I-64, ALBEMARLE COUNTY  
EASTBOUND

Class	Mon.* 12/10	Tue. 12/11	Wed. 12/12	Thu.** 12/13	Total
4	0	0	0	0	0
5	166	328	320	94	908
6	57	121	136	42	356
7	8	1	0	0	9
8	49	118	135	44	346
9	318	671	740	283	2,012
10	4	4	12	4	24
11	14	18	23	7	62
12	1	2	0	1	4
13	0	0	0	0	0
15	13	13	24	12	62
<b>Total</b>	<b>630</b>	<b>1,276</b>	<b>1,390</b>	<b>487</b>	<b>3,783</b>
<b>Total of Classes 4-13</b>	<b>617</b>	<b>1,263</b>	<b>1,366</b>	<b>475</b>	<b>3,721</b>

\* 13 hr of data (11:00 A.M. - 12:00 A.M.)

\*\* 10 hr of data (12:00 A.M. - 10:00 A.M.)

Table 20  
18 KIP ESALS AND OVERWEIGHT VEHICLES BY DAY  
I-64, ALBEMARLE COUNTY  
EASTBOUND

	Mon.* 12/10	Tue. 12/11	Wed. 12/12	Thu.** 12/13	Total
Vehicles Weighed	635	1,289	1,400	496	3,820
18 KIP ESALS	459.4	1276.4	1427.5	666.0	3829.3
Average ESALS	0.72	0.99	1.02	1.34	1.00
No. Overweight	57	151	159	88	455
Percentage Overweight	9.0%	11.7%	11.4%	13.2%	11.9%
Percentage of Trucks in Right Lane	92.8%	94.8%	93.6%	95.2%	94.1%

\* 13 hr of data (11:00 A.M. - 12:00 A.M.)

\*\* 10 hr of data (12:00 A.M. - 10:00 A.M.)

Table 21  
 18 KIP ESALS AND OVERWEIGHT VEHICLES BY  
 VEHICLE CLASSIFICATION FOR HIGHEST 18 KIP ESALS DAY  
 I-64, ALBEMARLE COUNTY  
 EASTBOUND

Date - 12/12/90	Total	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10	Class 11	Class 12	Class 13	Class 15
Vehicles Weighed	1,400	0	322	136	0	135	740	12	23	0	0	32
18 KIP ESALS	1427.5	0.0	57.96	104.7	0.0	143.1	1058.2	11.8	22.3	0.0	0.0	29.4
Average ESALS	1.02	0.00	0.18	0.77	0.00	1.06	1.43	0.98	0.97	0.00	0.00	0.92
Percentage ESALS	0.0%	0.0%	4.1%	7.3%	0.0%	10.0%	74.1%	0.8%	1.6%	0.0%	0.0%	2.1%
Percentage Vehicles	0.0%	0.0%	23.0%	9.7%	0.0%	9.6%	52.9%	0.9%	1.6%	0.0%	0.0%	2.3%
No. Overweight	159	0	7	18	0	22	105	3	0	0	0	4
Percentage Overweight	0.0%	0.0%	4.4%	11.3%	0.0%	13.8%	66.0%	1.9%	0.0%	0.0%	0.0%	2.5%
Percentage of Trucks in Right Lane	93.6%											

(2) 66 percent of the overweight vehicles were class 9; and (3) 93.6 percent of the trucks were in the right lane.

### Route 29, Albemarle County

Truck weight data were collected on Route 29, Albemarle County, near I-64 at two locations on Thursday, February 22, 1990, and from Tuesday, September 4, 1990, through Wednesday, September 5, 1990. At each location, a capacitance weigh mat WIM system was installed in the northbound right lane. Vehicle classification data revealed that 15.1 percent of the vehicles were trucks, and slightly over half of the trucks were in class 9 (see Table 22). The average ESAL was 1.04 for the study period, and 27.4 percent of the trucks were overweight (see Table 23). In Table 24, it is shown that (1) the average ESAL for a class 9 truck is 2.05 and (2) the unclassified vehicles (class 15) are second to class 9 vehicles in 18 Kip ESALs and percentage of overweight. Some adjustments were made in the software to reduce the number of unclassified vehicles.

Table 22  
 VEHICLE CLASSIFICATION BY DAY  
 RTE. 29, ALBEMARLE COUNTY,  
 NORTHBOUND RIGHT LANE ONLY

Class	Thu.* 02/22/90	Tue.** 09/04/90	Wed.** 09/05/90	Totals
1	0	0	0	0
2	3,180	3,372	1,126	7,678
3	269	240	52	561
4	3	14	3	20
5	110	233	37	380
6	47	52	27	126
7	1	5	1	7
8	58	57	18	133
9	448	116	264	828
10	5	2	1	8
11	39	14	3	56
12	10	0	0	10
13	0	0	0	0
15	86	475	36	597
<b>Total</b>	<b>4,256</b>	<b>4,580</b>	<b>1,568</b>	<b>10,404</b>
<b>Total of Classes 4-13</b>	<b>721</b>	<b>493</b>	<b>354</b>	<b>1,568</b>
<b>Percentage of Classes 4-13</b>	<b>16.9%</b>	<b>10.8%</b>	<b>22.6%</b>	<b>15.1%</b>

\* Data were collected 2 mi south of I-64 for 24 hr.

\*\* Data were collected 0.5 mi north of I-64 for 14 hr Tue and 10 hr Wed.

**Table 23**  
**18 KIP ESALS AND OVERWEIGHT VEHICLES BY DAY**  
**RTE. 29, ALBEMARLE COUNTY,**  
**NORTHBOUND RIGHT LANE ONLY**

	Thu.* 02/22/90	Tue.** 09/04/90	Wed.** 09/05/90	Total
Vehicles Weighed	727	606	359	1,692
18 KIP ESALS	584.3	736.5	439.7	1,761
Average ESALS	0.80	1.22	1.22	1.04
No. Overweight	163	189	112	464
Percentage Overweight	22.4%	31.2%	31.2%	27.4%

\* Data were collected 2 mi south of I-64 for 24 hr.

\*\* Data were collected 0.5 mi north of I-64 for 14 hr Tue. and 10 hr Wed.

### Route 15, Loudoun County

Data were collected from Tuesday, March 12, 1991, to Tuesday, March 19, 1991, northbound on Route 15 about 3 miles north of Leesburg using a piezoelectric cable WIM system. The truck weight data collected revealed that (1) of the 1,972 large vehicles, 76.6 percent were class 9 trucks, (2) the average ESALs for all vehicles were 1.12 and for class 9 truck were 1.31, and (3) 12.0 percent of the trucks were overweight (see Table 25).

### Route 52, Fancy Gap Mountain

Data were collected from Wednesday, July 10, 1991, through Thursday, July 11, 1991, southbound on Route 52 at the top of Fancy Gap Mountain in Carroll County using a piezoelectric cable WIM system. Because of accidents involving large trucks on the downgrade, Route 52 southbound is restricted to vehicles over 8 tons. From the truck weight data presented in Table 26, it can be seen that (1) 97 trucks were counted with 68 percent being class 5 trucks and (2) 21 vehicles (21.6 percent) were over the 8-ton restriction.

### A Comparison of ESALs Using WIM and Static Scales

In the Introduction, it was stated that the truck traffic monitored by a mobile weigh operation on a bypass route may not be representative of the overweight truck bypass problem after the first hour of monitoring. The underrepresentation

Table 24  
 18 KIP ESALS AND OVERWEIGHT VEHICLES BY  
 VEHICLE CLASSIFICATION FOR HIGHEST 18 KIP ESALS DAY  
 RTE. 29, ALBEMARLE COUNTY  
 NORTHBOUND

Date - 09/04/90	Total	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10	Class 11	Class 12	Class 13	Class 15
Vehicles Weighed	606	12	214	51	5	55	117	2	14	0	0	137
18 KIP ESALS	736.5	20.1	110.0	49.3	5.2	44.7	240.1	0.6	44.5	0.0	0.0	221.9
Average ESALS	1.22	1.68	0.51	0.97	1.04	0.81	2.05	0.30	3.18	0.00	0.00	1.62
Percent ESALS		2.7%	14.9%	6.7%	0.7%	6.1%	32.6%	0.1%	6.0%	0.0%	0.0%	30.1%
Percentage Vehicles		2.0%	35.3%	8.4%	0.8%	9.1%	19.3%	0.3%	2.3%	0.0%	0.0%	22.6%
No. Overweight	.189	2	14	25	5	11	65	0	8	0	0	59
Percentage Overweight		7.4%	13.2%	2.6%	5.8%	34.4%	0.0%	4.2%	0.0%	0.0%	0.0%	31.2%

\*14 hr of data (10:00 A.M. - 12:00 A.M.)



Table 25

TRUCK WEIGHT DATA  
 RTE. 15, LOUDOUN COUNTY  
 NORTHBOUND

3/12/91 - 3/19/91	Total	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10	Class 11	Class 12
<b>NORTHBOUND</b>									
Number	1972	5	146	26	256	1511	12	16	0
Percentage by Class	100.0	0.3	7.4	1.3	13.0	76.6	0.6	0.8	0
18 Kip ESALs	2,201.49	0	67.16	14.56	99.84	1,979.41	13.32	27.2	0
Average ESALs	1.12	0.00	0.46	0.56	0.39	1.31	1.11	1.70	0
Percentage ESALs		0	3.1	0.9	4.6	88.4	1.3	1.7	0
No. Overweight	234	0	1	0	0	225	5	3	0
Percentage Overweight of All Vehicles	12.0								

Table 26

TRUCK WEIGHT DATA  
 RTE. 52, FANCY GAP MOUNTAIN, CARROLL COUNTY,  
 SOUTHBOUND

7/10/91 -7/11/91	Total	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10
Vehicles Weighed	97	66	13	2	9	6	1
Percentage by Class	68.0	13.4	2.1	9.3	6.2	1.0	
No. over 8 tons	21	2	12	0	2	5	0
Percentage over 8 tons	21.6						

of traffic loadings being monitored with static scales and enforcement is likely on any road. Underrepresentation is a major reason for using WIM without enforcement to collect traffic loadings for pavement design. To determine the magnitude by which portable static weighing and enforcement underrepresent traffic loadings, a comparison of ESALs using WIM without enforcement and portable static scales with enforcement was made at two sites, Route 15, Loudoun County, and I-64, Albemarle County. The average ESAL for all vehicles and class 9 vehicles are discussed instead of total ESALs to avoid differences in truck volumes.

**Route 15, Loudoun County**

The portable static weight data were collected Thursday, January 17, 1991, and Thursday, March 7, 1991. The WIM data were collected from March 12 through 19, 1991. All data in Table 27 are for northbound traffic only. The trucks that were weighed were from the traffic stream.

Table 27

AVERAGE ESAL  
 RTE. 15, LOUDOUN COUNTY

	Static	WIM	Percentage Difference
Average ESAL for all vehicles	0.69	1.12	+ 62.3%
Average ESAL for class 9 vehicles	0.79	1.31	+ 65.8%

The WIM ESALs are more than 60 percent greater than the static ESALs in both cases.

**I-64, Albemarle County**

The portable static weight data were collected Wednesday, March 27, 1991, westbound at the rest area near Ivy. The WIM data were collected about 6 miles

Table 28  
**AVERAGE ESAL**  
**I-64, ALBEMARLE COUNTY**

	Static	WIM	Percentage Difference
Average ESAL for all vehicles	0.99	1.34	+ 35.4%
Average ESAL for class 9 vehicles	1.12	1.45	+ 29.5%

east of the portable static weight site eastbound from Monday, December 10, through Thursday, December 13, 1990 (see Table 28).

The WIM ESALs are about 30 percent greater than the static ESALs in both cases. This percentage may be influenced by direction: static weight-westbound, WIM-eastbound. Because of the directional differences, the comparison at this site is subject to an additional extraneous influence. Therefore, the results should be viewed with caution. The WIM daily average ESAL for all vehicles varied from 0.93 to 1.69.

Data from these two sites indicate that traffic loadings from WIM may be 30 to 60 percent greater than traffic loadings from static scales.

## DISCUSSION

### Overweight Trucks and Pavement Damage

Because of the fourth power relationship between axle weight and serviceability loss (that is, ESAL), a two-unit increase in weight per axle causes a 16 unit increase in ESALs of pavement damage.<sup>6</sup> There is thus a need to deter overweight vehicles because of the pavement damage they cause.

Also, a limited comparison of ESALs using WIM versus portable static scales with enforcement confirms the need for using WIM to collect data for pavement management. A separate research project examined a program for routinely collecting truck weight data for pavement design and other purposes using WIM.<sup>7</sup>

### Enforcement Activities

Because of the high percentage of overweight runbys, there is a need to increase the capacity of the I-81 weigh stations. The Maintenance Division has plans to increase the capacity of several weigh stations (including both I-81 stations) by

constructing a new larger weigh station. In fact, the Troutville Station is under construction. There are also plans to use WIM to screen vehicles for static weighing. To maintain comprehensive records on the weigh station's activities, it is suggested that data management software be installed for the WIM screening. When the new stations open, there is a chance that the number of trucks on the bypass route will increase. Therefore, additional monitoring of the bypass route may be beneficial especially on Sunday night at Stephens City.

In the interim, at the I-81, Stephens City weigh station, several strategies could be pursued to disrupt the Sunday night runby caravan. For example, personnel with a state radio could be posted (in a crossover median) 2 to 3 miles in advance of the weigh station (the monitor). When the caravan is sighted, a message could be relayed to the station. At the station, the lights could be flashed on for first 10 or so trucks to runby. Then, the lights would be switched off so that the middle trucks are forced to enter the station. The objective would be to weigh samples of the caravan that are not in the front. This scheme could be attempted several times Sunday night and Monday morning. Weigh station personnel could also monitor truck activity by listening to the CB radio for information. If successful, this or a similar scheme should be attempted periodically at all weigh stations with heavy runbys at specific time periods.

The mobile weigh crews periodically monitor bypass routes. A graded 24-foot-wide pad or pull-off area with lighting was constructed on Alternate Route 220 to facilitate weighing suspected overweight trucks with portable static scales. Additionally, several mobile weigh crews periodically conduct extensive weighing operations for a 72-hr period along bypass routes. Continued monitoring of bypass routes (especially Alternate Route 220) is encouraged. Permanent WIM sensors installed on Alternate 220 would be useful in monitoring truck traffic and loads to determine the period during which the highest volumes of overweight trucks occur, which would be the best time for enforcement.

On Route 29, Albemarle County, loop detectors were installed in the pavement in both directions, and a pull-out area was developed for use by the WIM mobile unit to monitor and screen trucks. Increased monitoring of Route 29 and other primary routes is encouraged.

### **Motor Carrier Safety and Driver Violations**

This study was limited to determining the magnitude of scale avoidance because of weight violations. A Wisconsin DOT scale avoidance study concluded that scale avoidance was primarily to evade the detection of motor carrier safety and driver violations as opposed to size and weight violations.<sup>3</sup> On all bypasses, 20.3 percent of the trucks were in violation of size and weight laws, whereas 69.7 percent were in violation of motor carrier safety and driver regulations.<sup>3</sup> This suggests that VDOT scale avoidance efforts should also consider addressing motor carrier safety and driver violations.

## CONCLUSIONS

1. There is a substantial number of overweight trucks (11 to 14 percent of trucks on bypass routes) avoiding the Stephens City and Troutville weigh stations on I-81. The truck volume, percentage of trucks, and average ESALs are higher for the Troutville weigh station bypass route than for the Stephens City station bypass route.
2. The number and percentage of runbys indicate that there is a need to increase the capacity of both I-81 weigh stations. The suspicion that heavier trucks run by the I-81 Stephens City weigh station northbound on Sunday nights was confirmed by data that showed that 38 percent of the runbys weighed by a portable WIM system were overweight.
3. Twelve percent of all the trucks on Route 15, Loudoun County, and I-64, Albemarle County, and 27 percent of the trucks on Route 29, Albemarle County, were overweight.
4. A limited comparison of ESALs using WIM without enforcement versus portable static scales with enforcement revealed that ESALs collected with WIM are 30 to 60 percent higher (although the lower of these figures has to be viewed with caution because of the directional influence). This confirms the need for using WIM to collect data for pavement design.

## RECOMMENDATIONS

1. VDOT should continue its efforts to increase the capacity of the two weigh stations on I-81 and use WIM for screening trucks for static weighing. To maintain comprehensive records of the station's weighing activity, it is recommended that a data management/monitoring system for the WIM screening be installed. It is also recommended that strategies to improve enforcement activities noted in the Discussion section be considered.
2. VDOT should continue monitoring potential bypass routes (especially Alternate Route 220) and other routes without weigh stations nearby and implementing methods to improve enforcement activities.
3. VDOT should consider deterring motor carrier safety and driver violations in conjunction with deterring weigh station avoidance.

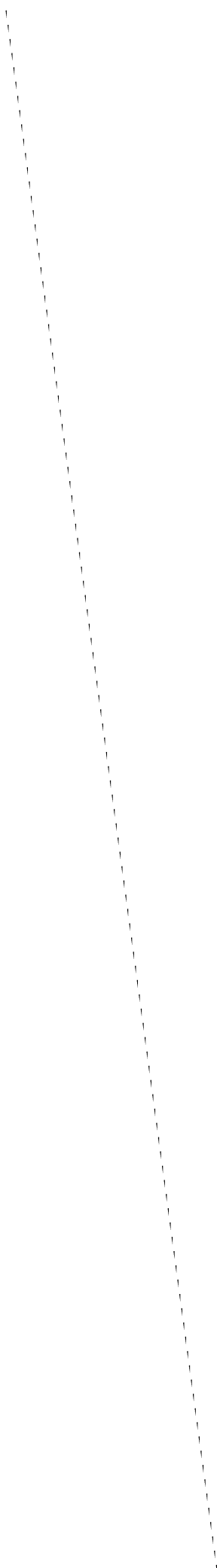


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