Validation Report

Maryland, SPS-5
Task Order 26, CLIN 2
May 13 to 14, 2008

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1 Executive Summary

A visit was made to the Maryland 0500 on May 13 to 14, 2008 for the purposes of conducting a validation of the WIM system located on US 15, approximately 10 miles south of Fredrick, Maryland. The SPS-5 is located in the righthand, northbound lane of a two lane facility. The posted speed limit at this location is 55 mph. The LTPP lane is the only lane that is instrumented at this site. The validation procedures were in accordance with LTPP's SPS WIM Data Collection Guide dated August 21, 2001.

This site was installed in a new portland cement concrete slab in place of the original installation. This is the third validation visit to this location. The site was installed on October 17 to 26, 2005 by International Road Dynamics Inc..

This site demonstrates the ability to produce research quality loading data under the observed conditions. The classification algorithm is not currently providing research quality classification information.

The site is instrumented with bending plate and iSync electronics. It is installed in portland cement concrete, 400 feet long. The WIM sensors are approximately 350 feet from the pavement transition.

The validation used the following trucks:

1) 5-axle tractor-trailer with a tractor having an air suspension and a trailer with a standard rear tandem and an air suspension loaded to 77,220 lbs., the "golden" truck.
2) 5-axle tractor semi-trailer with a tractor having an air suspension and a trailer with a standard rear tandem and a 3 tapered steel leaf suspension loaded to 66,040 lbs., the "partial" truck.

The validation speeds ranged from 43 to 55 miles per hour. The pavement temperatures ranged from 68 to 79 degrees Fahrenheit. The desired speed range was achieved during this validation. The desired 30 degree Fahrenheit temperature range was not achieved.

Table 1-1 Post-Validation results – 240500 – 14-May-2008

SPS-1, -2, -5, -6 and -8	95 %Confidence Limit of Error	Site Values	Pass/Fail
Steering axles	±20 percent	1.5 ± 10.2%	Pass
Tandem axles	±15 percent	2.3 ± 7.3%	Pass
GVW	±10 percent	2.2 ± 6.9%	Pass
Axle spacing	± 0.5 ft [150mm]	0.0 ± 0.0 ft	Pass

Prepared: djw *Checked: bko*

The pavement condition was appeared to be satisfactory for conducting a performance evaluation. There were no distresses observed that would influence truck motions significantly. A visual survey determined that there is no discernable bouncing or avoidance by trucks in the sensor area. According to the last available pavement smoothness evaluation,

the WIM index was exceeded 6 locations. This information is nearly two years old and may not represent current pavement smoothness.

If this site had been evaluated using ASTM E-1318-02 it would have met the conditions for a Type I site exclusive of wheel loads. LTPP does not validate WIM performance with respect to wheel loads.

Table 1-2 Results Based on ASTM E-1318-02 Test Procedures

Characteristic	Limits for Allowable Error	Percent within Allowable Error	Pass/Fail
Single Axles	± 20%	100%	Pass
Axle Groups	± 15%	100%	Pass
GVW	± 10%	100%	Pass

Prepared: djw *Checked: bko*

Upon our arrival at the site, we found the system parameters were the same as we left them at the conclusion of our last validation on September 5, 2007.

This site needs three years of data to meet the goal of five years of research quality data.

2 Corrective Actions Recommended

The loop input cables are not shielded which was noted as part of the last Validation Report and remains an open item. There are no other corrective actions identified at this time.

3 Post Calibration Analysis

This final analysis is based on test runs conducted May 14, 2008 during the afternoon and early evening hours at test site 240500 on US 15. This SPS-5 site is at milepost 4.7 on the northbound, righthand of a two lane facility. No auto-calibration was used during test runs. The two trucks used for the calibrations and for the subsequent validation included:

1. 5-axle tractor-trailer with a tractor having an air suspension and trailer with a standard rear tandem and air suspension loaded to 77,220 lbs., the "golden" truck.
2. 5-axle tractor semi-trailer with a tractor having an air suspension and a trailer with a standard rear tandem and a 3 tapered steel leaf suspension loaded to 66,040 lbs., the "partial" truck.

Each truck made a total of 20 passes over the WIM scale at speeds ranging from approximately 43 to 55 miles per hour. The desired speed range was achieved during this validation. Pavement surface temperatures were recorded during the test runs ranging from about 68 to 79 degrees Fahrenheit. The desired 30 degree Fahrenheit temperature range was not achieved. The computed values of 95% confidence limits of each statistic for the total population are in Table 3-1.

The statistics in Table 3-1 indicate that the loading data meets the conditions for research quality data.

Table 3-1 Post-Validation Results – 240500 – 14-May-2008

SPS-1, -2, -5, -6 and -8	95 %Confidence Limit of Error	Site Values	Pass/Fail
Steering axles	±20 percent	1.5 ± 10.2%	Pass
Tandem axles	±15 percent	2.3 ± 7.3%	Pass
GVW	±10 percent	2.2 ± 6.9%	Pass
Axle spacing	± 0.5 ft [150mm]	0.0 ± 0.0 ft	Pass

Prepared: djw *Checked: bko*

The test runs were conducted primarily during the late afternoon and early evening hours under mostly cloudy weather conditions, resulting in a narrow range of pavement temperatures. The runs were also conducted at various speeds to determine the effects of these variables on the performance of the WIM scale. To investigate these effects, the data set was split into three speed groups and left in one temperature group. The distribution of runs by speed and temperature is illustrated in Figure 3-1. The figure indicates that the desired distribution of speed and temperature combinations was not achieved for this set of validation runs.

The three speed groups were divided as follows: Low speed – 43 to 47 mph, Medium speed – 48 to 51 mph and High speed – 52 + mph. The one temperature group contains all the runs and is designated Medium temperature.

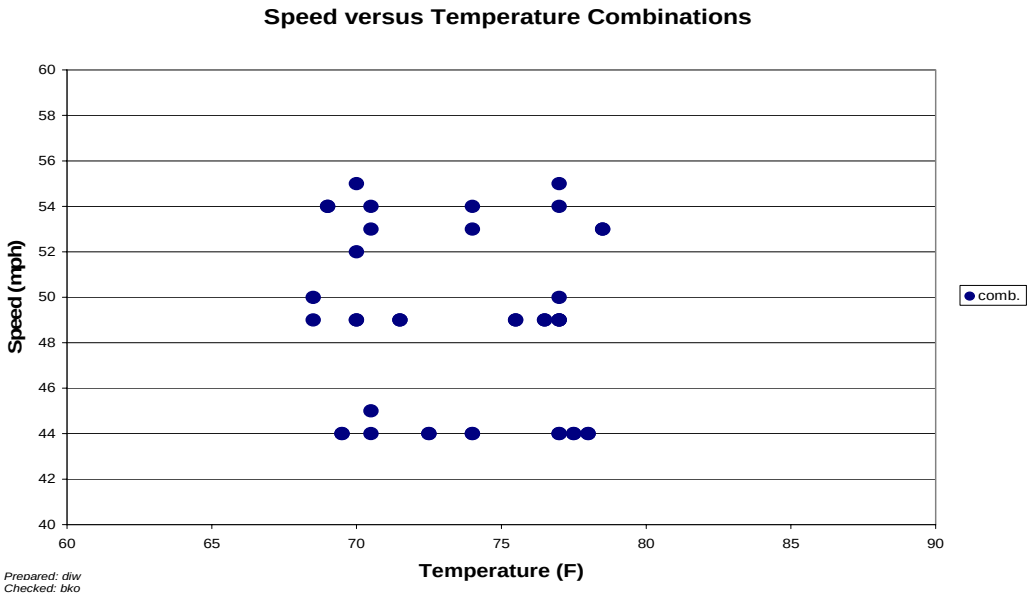

Figure 3-1 Post-Validation Speed-Temperature Distribution – 240500 – 14-May-2008

A series of graphs was developed to investigate visually any sign of a relationship between speed or temperature and the scale performance.

Figure 3-2 shows the GVW Percent Error vs. Speed graph for the population as a whole. It can be seen in the figure that the equipment generally overestimates GVW at all speeds. Variability appears to remain reasonably constant throughout the entire speed range.

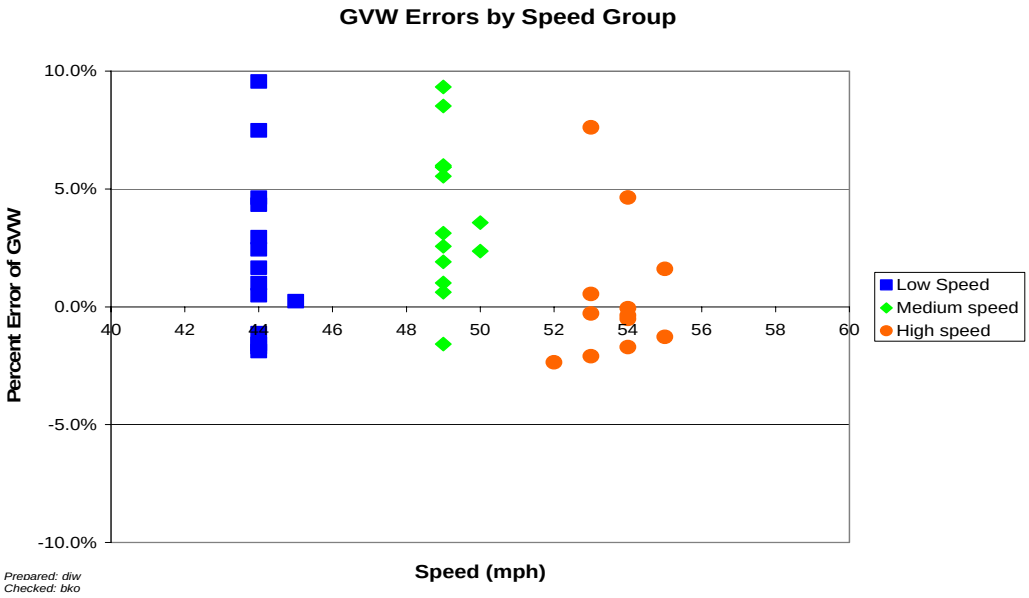

Figure 3-2 Post-validation GVW Percent Error vs. Speed – 240500 – 14-May-2008

Figure 3-3 shows the relationship between temperature and GVW percentage error. There is no apparent influence of temperature on the error estimates.

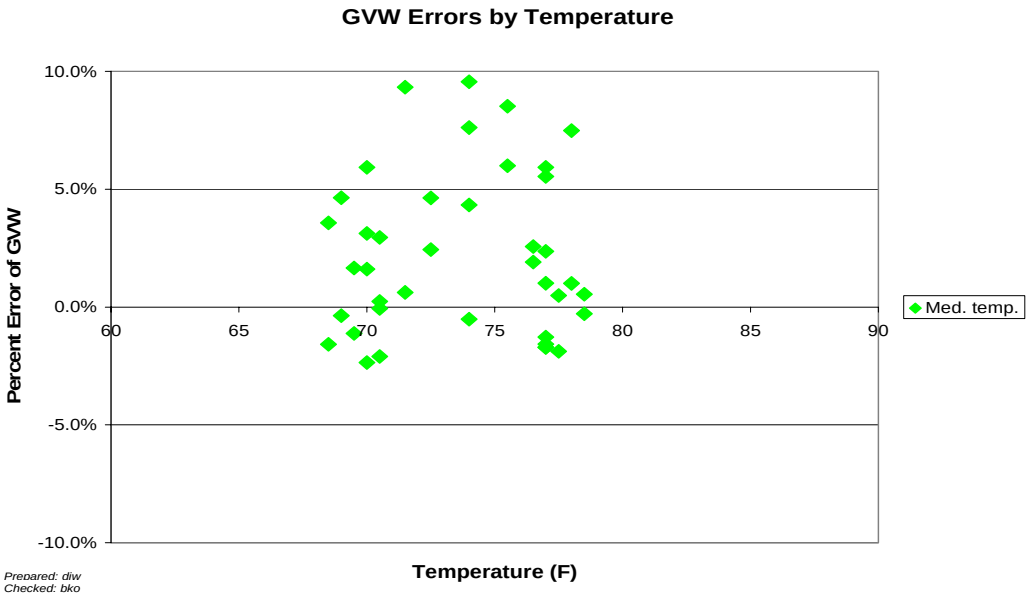

Figure 3-3 Post-Validation GVW Percent Error vs. Temperature – 240500 – 14-May-2008

Figure 3-4 shows the relationship between the drive tandem spacing errors in feet and speed. This graph is used as a potential indicator of classification errors due to failure to correctly

identify spacings on a vehicle. Since the most common reference value is the drive tandem on a Class 9 vehicle, this is the spacing evaluated and plotted for validations. There is no apparent influence of speed on spacing errors.

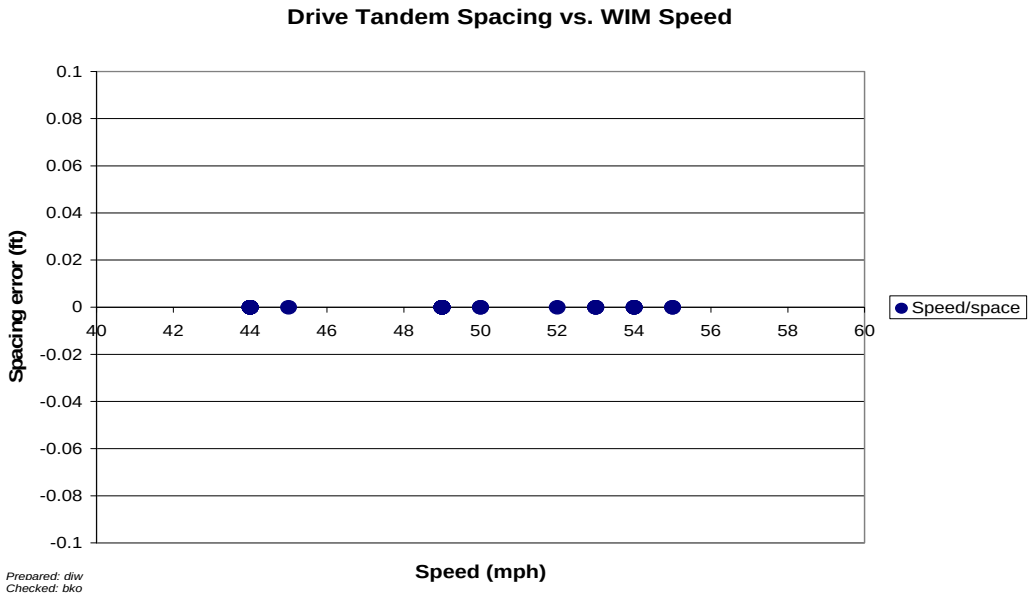

Figure 3-4 Post-Validation Spacing vs. Speed – 240500 – 14-May-2008

3.1 Temperature-based Analysis

The one temperature group was created by grouping the runs between 68 to 79 degrees Fahrenheit as Medium temperature.

Table 3-2 Post-Validation Results by Temperature Bin – 240500 – 14-May-2008

Element	95% Limit	Medium Temperature 68 to 79 °F
Steering axles	±20 %	1.5 ± 10.2%
Tandem axles	±15 %	2.3 ± 7.3%
GVW	±10 %	2.2 ± 6.9%
Axle spacing	± 0.5 ft	0.0 ± 0.0 ft

Table 3-2 demonstrates the tendency of the equipment to overestimate all weights. Variability in steering axle error appears greater when compared with GVW and tandem axle errors.

Figure 3-5 is the distribution of GVW Errors versus Temperature by Truck graph.
From the graph it can be seen that the equipment equally overestimates GVW for each truck over the entire temperature range. Variability in error for each truck individually appears to be similar throughout the entire temperature range.

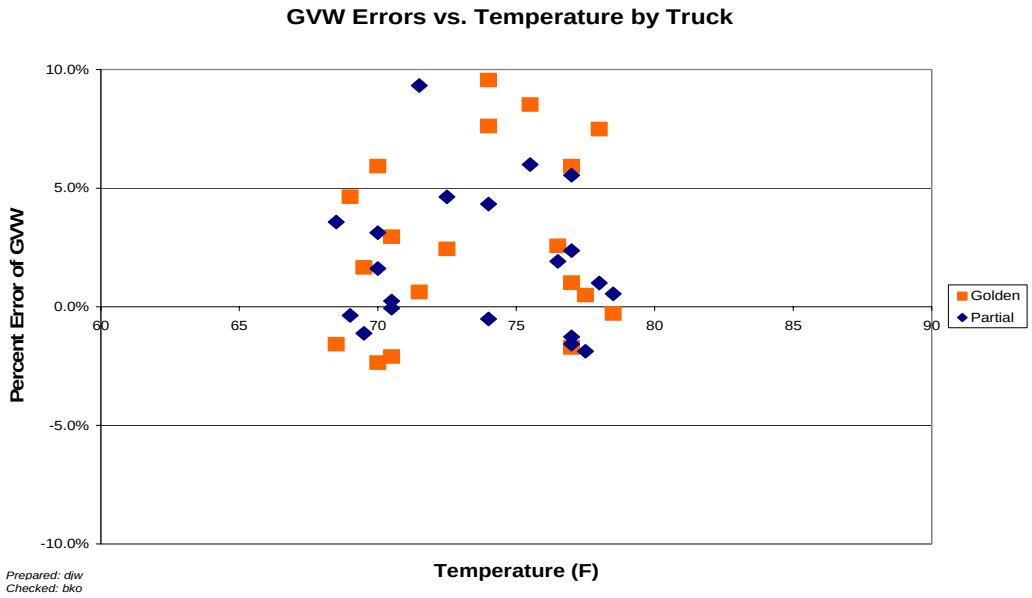

Figure 3-5 Post-Validation GVW Percent Error vs. Temperature by Truck – 240500 – 14-May-2008

Figure 3-6 shows the relationship between steering axle errors and temperature. This graph is included due to the frequent use of steering axle weights of Class 9 vehicles for calibration. This site does not use auto-calibration. The steering axles in this graph are associated only with Class 9 vehicles. There is apparently no temperature trend associated with steering axle estimates.

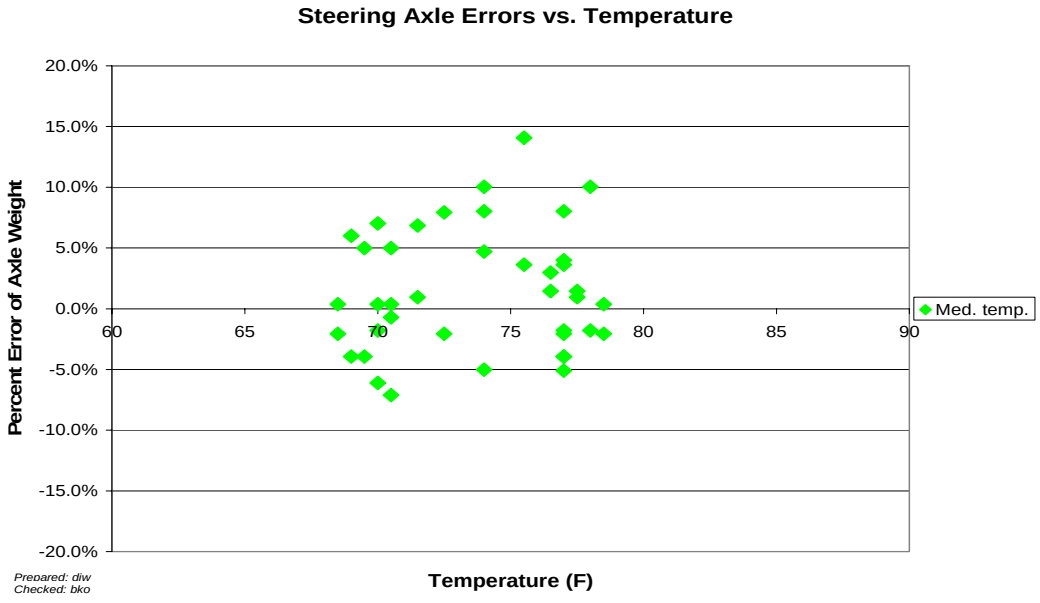

Figure 3-6 Post-Validation Steering Axle Error vs. Temperature by Group – 240500 – 14-May-2008

3.2 Speed-based Analysis

The three speed groups were divided using 43 to 47 mph for Low speed, 48 to 51 mph for Medium speed and 52+ mph for High speed.

Table 3-3 Post-Validation Results by Speed Bin – 240500 – 14-May-2008

Element	95% Limit	Low Speed 43 to 47 mph	Medium Speed 48 to 51 mph	High Speed 52+ mph
Steering axles	±20 %	2.4 ± 10.2%	3.4 ± 9.9%	-1.8 ± 10.3%
Tandem axles	±15 %	2.0± 8.0%	4.0 ± 6.6%	0.8 ± 6.9%
GVW	±10 %	2.0 ± 7.5%	3.9 ± 6.7%	0.5 ± 6.5%
Axle spacing	± 0.5 ft	0.0 ± 0.0 ft	0.0 ± 0.0 ft	0.0 ± 0.0 ft

Prepared: djw *Checked: bko*

From Table 3-3, it can bee seen that for GVW and tandem axle weights, the equipment overestimates at the low and medium speeds, and estimates with reasonable accuracy at the high speeds. Variability in these errors appears be slightly greater at the low speeds. For steering axle weights, the equipment overestimates at the low and medium speeds and underestimates at the high speeds. Variability in error is consistent throughout the entire speed range.

From Figure 3-7 and Figure 3-8, it appears that each truck exhibits different tendencies with regard to speed. GVW for the Golden truck (squares) is overestimated at the low and medium speeds and variability appears to remain reasonably consistent over the entire speed range. For the Partial truck (diamonds), GVW is estimated accurately at low and high speeds and overestimated at medium speeds. Variability in error appears to be greater at the medium speeds when compared with low and high speeds.

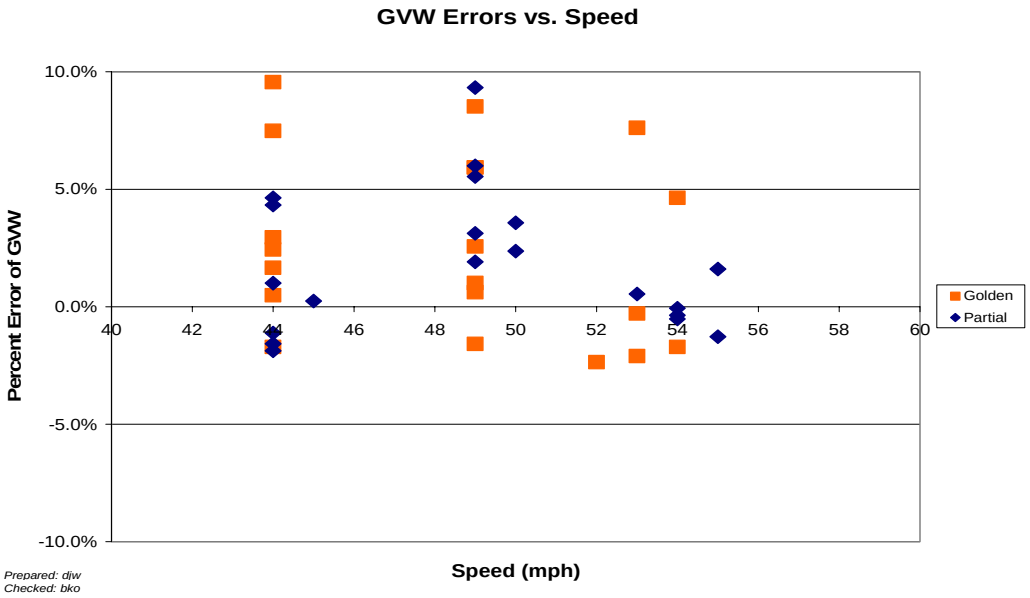

Figure 3-7 Post-Validation GVW Percent Error vs. Speed by Truck – 240500 – 14-May-2008

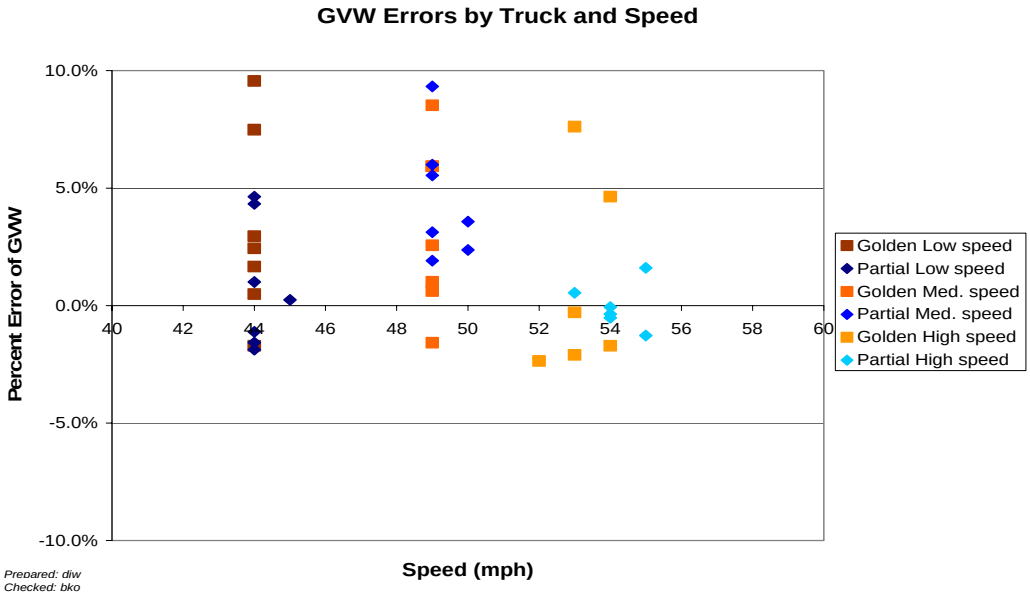

Figure 3-8 - Post-validation GVW Errors by Truck and Speed Group – 240500 – 14-May-2008

Figure 3-9 shows the relationship between steering axle errors and speed. This graph is included due to the frequent use of steering axle weights of Class 9 vehicles for auto-calibration. This site does not use auto-calibration. The steering axles in this graph are associated only with Class 9 vehicles. The figure shows a trend from overestimation at low and medium speeds to underestimation of steering axle weights at high speeds.

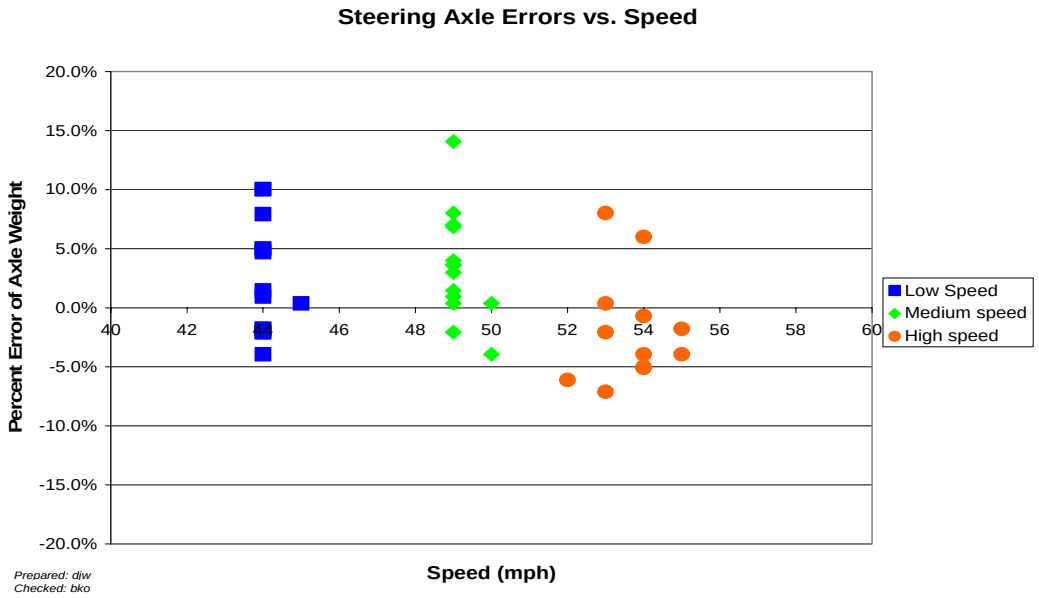

Figure 3-9 Post-Validation Steering Axle Percent Error vs. Speed by Group – 240500 – 14-May-2008

3.3 Classification Validation

This LTPP installed site uses the FHWA 13-bin classification scheme and the LTPP ETG mod 3 classification algorithm. Classification 15 had been added to define unclassified vehicles. The Post-Validation download also contains Class 14 for which no definition has been provided.

The classification validation is intended to find gross errors in vehicle classification, not to validate the installed algorithm. A sample of 100 trucks was collected at the site. Video was taken at the site to provide ground truth for the evaluation. Based on the sample it was determined that there are zero percent unknown vehicles and zero percent unclassified vehicles.

The second check is the ability of the algorithm to correctly distinguish between truck classes with no more than 2% errors in such classifications. Table 3-4 has the classification error rates by class. The overall misclassification rate is 2.0 percent. This is attributed to the misclassification of a Class 10 vehicle.

Table 3-4 Truck Misclassification Percentages for 240500 – 14-May-2008

Class	Percent Error	Class	Percent Error	Class	Percent Error
4	N/A	5	0	6	0
7	0				
8	0	9	0	10	100
11	N/A	12	N/A	13	100

Prepared: djw *Checked: bko*

The misclassification percentage is computed as the probability that a pair containing the class of interest does NOT include a match. Thus if there are eight pairs of observations with at least one Class 9 and only six of them are matches, the error rate is 25 percent. The percent error and the mean differences reported below do not represent the same statistic. It is possible to have error rates greater than 0 with a mean difference of zero.

Table 3-5 Truck Classification Mean Differences for 240500 – 14-May-2008

Class	Mean Difference	Class	Mean Difference	Class	Mean Difference
4	N/A	5	0	6	0
7	0				
8	0	9	0	10	-100
11	N/A	12	N/A	13	UNK

Prepared: djw *Checked: bko*

These error rates are normalized to represent how many vehicles of the class are expected to be over or under-counted for every hundred of that class observed by the equipment. Thus a value of 0 means the class is identified correctly on average. A number between –1 and –100 indicates at least that number of vehicles either missed or not assigned to the class by the equipment. It is not possible to miss more than all of them or one hundred out of one hundred. Numbers 1 or larger indicate at least how many more vehicles are assigned to the class than the actual "hundred observed". Classes marked Unknown (UNK) are those identified by the equipment but no vehicles of the type were seen by the observer. There is no way to tell how many vehicles of that type might actually exist. N/A means no vehicles of the class were recorded by either the equipment or the observer.

A limited investigation of the precision and bias of the speeds reported by the equipment was undertaken. The values were not within the expected tolerances. Since the classification data for heavy trucks met research quality standards, with the exception of one Class 10 in the sample, the observed bias and variability are thought to be more strongly related to radar speed precision than errors in the WIM equipment.

3.4 Evaluation by ASTM E-1318 Criteria

The ASTM E-1318 criteria for a successful validation of Type I sites is 95% of the observed errors within the limits for allowable errors for each of the relevant statistics. If this site had been evaluated using ASTM E-1318-02 it would have met the conditions for a Type I site

exclusive of wheel loads. LTPP does not validate WIM performance with respect to wheel loads.

Table 3-6 Results of Validation Using ASTM E-1318-02 Criteria

Characteristic	Limits for Allowable Error	Percent within Allowable Error	Pass/Fail
Single Axles	± 20%	100%	Pass
Axle Groups	± 15%	100%	Pass
GVW	± 10%	100%	Pass

Prepared: djw *Checked: bko*

4 Pavement Discussion

The pavement smoothness may or may not have contributed to out-of-range results observed in the initial validation.

The pavement condition did not appear to influence truck movement across the sensors.

4.1 Profile Analysis

Profile data collected in the year prior to the site visit does not exist. A site visit to collect profile data has not been scheduled yet. An amended report will be submitted when more recent data is available.

Profile data was available for the initial validation and is included for reference in this report.

The WIM site is a section of pavement that is 305 meters long with the WIM scale located at 274.5 meters from the beginning of the test section. An ICC profiler was used to collect longitudinal profiles of the test section with a sampling interval of 25 millimeters.

Profile data collected at the SPS WIM location by Stantec on June 15, 2006 were processed through the LTPP SPS WIM Index software, version 1.1. This WIM scale is installed on a portland cement concrete pavement.

A total of 15 profiler passes were conducted over the WIM site. Since the issuance of the LTPP directive on collection of longitudinal profile data for SPS WIM sections, the requirements have been a minimum of 3 passes in the center of the lane and one shifted to each side. For this site the RSC has completed 9 passes at the center of the lane, 3 passes shifted to the left side of the lane, and 3 passes shifted to the right side of the lane. Shifts to the sides of the lanes were made such that data were collected as close to the lane edges as was safely possible. For each profiler pass, profiles were recorded under the left wheel path (LWP) and the right wheel path (RWP).

The SPS WIM Index software, version 1.0 was developed with four different indices: LRI, SRI, Peak LRI and Peak SRI. The LRI incorporates the pavement profile starting 25.8 m prior to the scale and ending 3.2 m after the scale in the direction of travel. The SRI incorporates a shorter section of pavement profile beginning 2.74 m prior to the WIM scale and ending 0.46

m after the scale. The LRI and SRI are the index values for the actual location of the WIM scale. Peak LRI is the highest value of LRI, within 30 m prior to the scale. Peak SRI indicates the highest value of SRI that is located between 2.45 m prior to the scale and 1.5 m after the scale. Also, a range for each of the indices was developed to provide the smoothness criteria. The ranges are shown in Table 4-1. When all of the values are below the lower thresholds, it is presumed unlikely that pavement smoothness will significantly influence sensor output. When one or more values exceed an upper threshold there is a reasonable expectation that the pavement smoothness will influence the outcome of the validation. When all values are below the upper threshold but not all below the lower threshold, the pavement smoothness may or may not influence the validation outcome.

Table 4-1 Thresholds for WIM Index Values

Index	Lower Threshold (m/km)	Upper Threshold (m/km)
LRI	0.50	2.1
SRI	0.50	2.1
Peak LRI	0.50	2.1
Peak SRI	0.75	2.9

Prepared: bx Checked: als

Table 4-2 shows the computed index values for the prior site validation. From the table it can be seen that all but 7 of the indices computed from the profiles are between the upper and lower threshold values. One of the index values is below the lower threshold and the remaining 6 are above the upper threshold. The level of these values indicates that it is likely that the pavement smoothness would interfere with the ability of the sensor to produce accurate data.

Table 4-2 WIM Index Values - 240500 –15-Jun-2006

Profiler Passes			1	2	3	4	5	6	7	8	9	Ave.
Center	LWP	LRI (m/km)	0.943	0.849	0.971	0.860	0.980	0.874	0.968	0.968	0.817	0.914
		SRI (m/km)	0.872	*0.277*	0.574	0.559	0.658	0.554	0.719	0.663	*0.497*	0.597
		Peak LRI (m/km)	1.108	1.033	1.251	1.225	1.293	1.149	1.162	1.156	1.138	1.168
		Peak SRI (m/km)	1.008	*0.645*	1.083	1.185	1.221	0.898	1.117	1.103	0.989	1.028
	RWP	LRI (m/km)	0.886	0.864	0.881	0.847	0.919	0.856	0.846	0.843	0.848	0.866
		SRI (m/km)	0.967	0.731	0.916	0.797	0.941	1.054	0.965	0.941	1.286	0.955
		Peak LRI (m/km)	0.980	1.069	0.981	0.905	0.920	0.930	1.070	0.981	0.850	0.965
		Peak SRI (m/km)	1.304	0.934	0.966	0.983	1.133	1.141	1.058	1.144	1.420	1.120
Left Shift	LWP	LRI (m/km)	0.874	0.840	0.772							0.829
		SRI (m/km)	0.815	0.788	0.584							0.729
		Peak LRI (m/km)	1.031	1.196	1.047							1.091

Profiler Passes			**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Ave.**
		Peak SRI (m/km)	0.963	1.127	0.872							0.987
	RWP	LRI (m/km)	0.898	0.951	0.938							0.929
		SRI (m/km)	0.831	0.741	0.561							0.711
		Peak LRI (m/km)	0.955	1.058	0.972							0.995
		Peak SRI (m/km)	1.005	1.071	0.776							0.951
Right Shift	LWP	LRI (m/km)	0.779	0.904	0.960							0.881
		SRI (m/km)	0.599	0.523	0.596							0.573
		Peak LRI (m/km)	0.784	1.023	1.066							0.958
		Peak SRI (m/km)	*0.705*	*0.583*	*0.694*							*0.661*
	RWP	LRI (m/km)	0.857	**2.223**	1.676							1.585
		SRI (m/km)	0.703	**3.639**	**3.951**							**2.764**
		Peak LRI (m/km)	0.863	**2.236**	2.069							1.723
		Peak SRI (m/km)	0.959	**3.651**	**4.009**							2.873

Prepared: als Checked: jrn

4.2 Distress Survey and Any Applicable Photos

During a visual survey of the pavement no distresses that would influence truck movement across the WIM scales were noted.

4.3 Vehicle-pavement Interaction Discussion

A visual observation of the trucks as they approach, traverse and leave the sensor area did not indicate any visible motion of the trucks that would affect the performance of the WIM scales.

As with the prior validations, it was observed that the northbound lane is sometimes used by southbound traffic for passing.

5 Equipment Discussion

The traffic monitoring equipment at this location includes bending plate sensors and iSync electronics. The sensors are installed in a portland cement concrete pavement about 400 ft in length. The roadway outside this short section is asphalt.

There were no changes in basic equipment operating condition since the validation on September 5, 2007.

5.1 Pre-Evaluation Diagnostics

The electrical components of the system were checked and found to be operating within acceptable limits. It was noted in the last validation report that the loop input cables are not shielded and remains an open item.

5.2 Calibration Process

Upon arrival at the site, the system parameters were verified to be the same as at the conclusion of the last validation on September 5, 2007.

The equipment required three iterations of the calibration process between the initial 40 runs and the final 40 runs. None of the iterations produced the expected result.

The operating system weight compensation parameters that were in place prior to the Pre-Validation are in Table 5-1.

Table 5-1 Initial System Parameters - 240500 - 13-May-2008

Speed Bins	Right Sensor 1	Left Sensor 2
72 kph	3775	3775
80 kph	3850	3850
88 kph	3900	3900
96 kph	3900	3900
105 kph	3900	3900

Prepared: djw *Checked: bko*

5.2.1 Calibration Iteration 1

As a result of the Pre-Validation, where the GVW was generally overestimated by 1.7%, the compensation factors were adjusted as shown in Table 5-2.

Table 5-2 Calibration 1 - Change in Parameters - 240500- 14-May-2008

Speed Bins	Right Sensor 1	Change	Left Sensor 2	Change
72 kph	3686	-2.4%	3686	-2.4%
80 kph	3784	-1.7%	3784	-1.7%
88 kph	3865	-0.9%	3865	-0.9%
96 kph	3900	N/A	3900	N/A
105 kph	3900	N/A	3900	N/A

Prepared: djw *Checked: bko*

As shown in Table 5-3, the factor adjustment did not produce the expected results. The equipment was underestimating all weights by an average of 2.6%.

Table 5-3 Calibration Iteration 1 Results – 240500 – 14-May-2008 (09:02 AM)

SPS-1, -2, -5, -6 and -8	95 %Confidence Limit of Error	Site Values	Pass/Fail
Steering axles	±20 percent	-3.7 ± 9.0%	Pass
Tandem axles	±15 percent	-1.9 ± 6.4%	Pass
GVW	±10 percent	-2.1 ± 6.0%	Pass
Axle spacing	± 0.5 ft	0.0 ± 0.1 ft	Pass

Prepared: djw *Checked: bko*

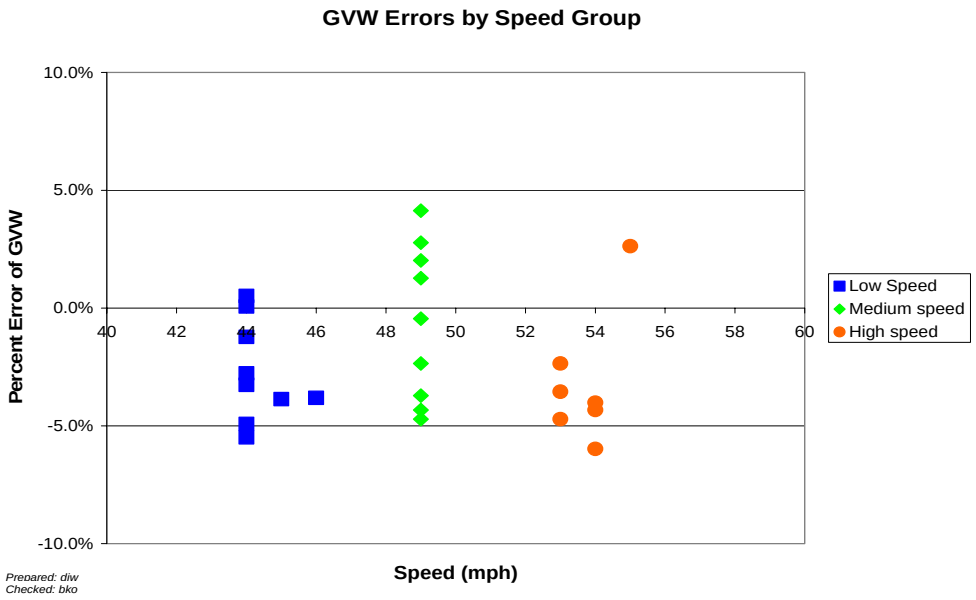

Figure 5-1 Calibration Iteration 1 GVW Percent Error vs. Speed Group – 240500 – 14-May-2008 (09:02 AM)

5.2.2 Calibration Iteration 2

At the end of the first iteration verification, the weights were generally underestimated by 2.6%. Since the changes to the compensation factors in first iteration did not produce the expected result, the compensation factors were adjusted to improve the statistics, and not necessarily compensate for the error bias presented after the first iteration. The changes to the factors and new factors are in Table 5-4.

Table 5-4 Calibration 2 - Change in Parameters - 240500- 14-May-2008

Speed Bins	Right Sensor 1	Change	Left Sensor 2	Change
72 kph	3723	+ 1.0%	3723	+ 1.0%
80 kph	3822	+ 1.0%	3822	+ 1.0%
88 kph	3903	+ 1.0%	3903	+ 1.0%
96 kph	3900	N/A	3900	N/A
105 kph	3900	N/A	3900	N/A

Prepared: djw *Checked: bko*

As shown in Table 5-5, the changes to the factors did not produce the expected result. Instead of decreasing the underestimate by 1.0%, the equipment presented an even greater underestimation of all weights of 3.5%.

Table 5-5 Calibration Iteration 2 Results – 240500 – 14-May-2008 (11:54 AM)

SPS-1, -2, -5, -6 and -8	95 %Confidence Limit of Error	Site Values	Pass/Fail
Steering axles	±20 percent	-4.4 ± 9.6%	Pass
Tandem axles	±15 percent	-3.0 ± 4.7%	Pass
GVW	±10 percent	-3.2 ± 4.5%	Pass
Axle spacing	± 0.5 ft [150mm]	0.0 ± 0.1 ft	Pass

Prepared: djw *Checked: bko*

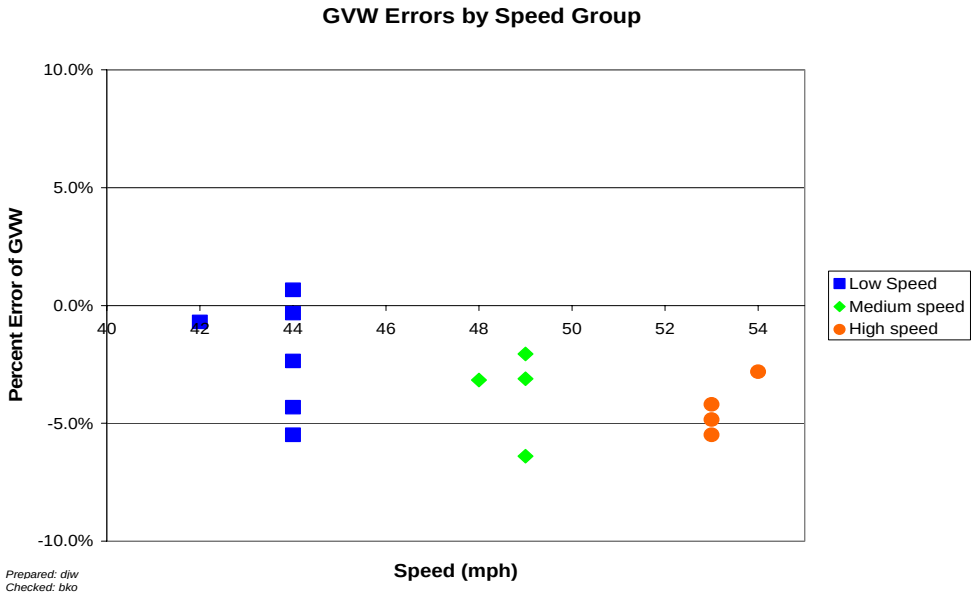

Figure 5-2 Calibration Iteration 2 GVW Percent Error vs. Speed Group – 240500 – 14-May-2008 (11:54 AM)

5.2.3 Calibration Iteration 3

As a result of the second iteration verification, where the GVW was increasingly underestimated by -2.1% to -4.3% as speed increased. The compensation factors were again adjusted to eliminate the underestimate in weights as shown in Table 5-6.

Table 5-6 Calibration 3 - Change in Parameters - 240500 - 14-May-2008

Speed Bins	Right Sensor 1	Change	Left Sensors 2	Change
72 kph	3835	+3.0%	3835	+3.0%
80 kph	3937	+3.0%	3937	+3.0%
88 kph	4020	+3.0%	4020	+3.0%
96 kph	3900	N/A	3900	N/A
105 kph	3900	N/A	3900	N/A

Prepared: djw *Checked: bko*

As shown in Table 5-7, the changes to the compensation factors again did not produce the expected result. Weight estimations were increased by an average of 4.3%, resulting in an overestimation of weights by an average of 1.3%.

Table 5-7 Calibration Iteration 3 Results – 240500 – 14-May-2008 (02:55 PM)

SPS-1, -2, -5, -6 and -8	95 %Confidence Limit of Error	Site Values	Pass/Fail
Steering axles	±20 percent	0.0 ± 12.3%	Pass
Tandem axles	±15 percent	2.1 ± 8.1%	Pass
GVW	±10 percent	1.9 ± 7.8%	Pass
Axle spacing	± 0.5 ft [150mm]	0.0 ± 0.0 ft	Pass

Prepared: djw *Checked: bko*

Figure 5-3 Calibration Iteration 3 GVW Percent Error vs. Speed Group – 240500 – 14-May-2008 (02:55 PM)

The factors that were put into place for the third iteration remained in place during the Post-Validation and were left in the system at the end of the validation.

5.3 Summary of Traffic Sheet 16s

This site has validation information from previous visits as well as the current one in the tables below. Table 5-8 has the information for TRF_CALIBRATION_AVC for Sheet 16s submitted prior to this validation as well as the information for the current visit. The Sheet 16s available reflect agency and this contractor's validation visits.

Table 5-8 Classification Validation History – 240500 – 14-May-2008

Date	Method	Mean Difference				Percent Unclassified
		Class 9	Class 8	Other 1	Other 2	
5/14/2008	Manual	0	0			0.0
5/13/2008	Manual	-4	33			0.0
9/5/2007	Manual	0	0			0.0
9/4/2007	Manual	0	0			0.0
3/22/2006	Manual	0	0			0.0
3/21/2006	Manual	0	0			0.0
5/24/2004	Unknown					
3/7/2003	Unknown					
11/12/1999	Parallel Classifiers	77	132	10 (CL 10)	4 (CL 7)	0.0

Prepared: djw *Checked: bko*

Table 5-9 has the information for TRF_CALIBRATION_WIM for Sheet 16s submitted prior to this validation as well as the information for the current visit. The Sheet 16s available reflect agency and this contractor's validation visits.

Table 5-9 Weight Validation History – 240500 – 14-May-2008

Date	Method	Mean Error and (SD)		
		GVW	Single Axles	Tandem Axles
5/14/2008	Test Trucks (2)	2.2 (3.4)	1.5 (5.0)	2.3 (3.7)
5/13/2008	Test Trucks (2)	1.7 (5.1)	1.1 (6.0)	1.8 (5.3)
9/5/2007	Test Trucks (2)	1.1 (3.4)	0.5 (5.5)	1.3 (4.1)
9/4/2007	Test Trucks (2)	0.5 (2.8)	0.3 (4.7)	0.6 (3.4)
3/22/2006	Test Trucks (2)	2.8 (3.1)	2.5 (3.7)	2.9 (3.3)
3/21/2006	Test Trucks (2)	1.0 (2.6)	1.1 (4.2)	0.9 (2.8)
7/22/2005	Test Trucks (1)	0.6 (5.5)	0.9 (3.8)	
1/27/2005	Test Trucks (1)	5.2 (11.6)	-0.3 (10.5)	
5/24/2004	Test Trucks (1)	2.3 (3.7)	1.1 (10.2)	
5/7/2003	Test Trucks (1)	10.6 (18.8)	6.5 (21.1)	
4/30/2002	Test Trucks (2)	-0.1 (11.5)	5.9 (12.9)	
6/12/2001	Test Trucks (2)			
11/12/1999	Traffic Stream (25)			

Prepared: djw *Checked: bko*

5.4 Projected Maintenance/Replacement Requirements

This site is scheduled for semi-annual maintenance under the installation contract.

6 Pre-Validation Analysis

Upon arrival at the site, the system parameters were found to be the same as at the conclusion of the last validation on September 5, 2007.

This pre-validation analysis is based on test runs conducted May 13, 2008 during the late morning and early afternoon hours at test site 240500 on US 15. This SPS-5 site is at milepost 4.7 on the northbound, righthand of a two lane facility. No auto-calibration was used during test runs. The two trucks used for initial validation included:

1. 5-axle tractor semi-trailer combination with a tractor having an air suspension and trailer with standard rear tandem and an air suspension loaded to 77,290 lbs., the "golden" truck.
2. 5-axle tractor semi-trailer with a tractor having an air suspension and a trailer with a standard rear tandem and a 3 tapered steel leaf suspension loaded to 66,680 lbs., the "partial" truck.

For the initial validation each truck made a total of 20 passes over the WIM scale at speeds ranging from approximately 40 to 55 miles per hour. The desired speed range was achieved during this validation. Pavement surface temperatures were recorded during the test runs ranging from about 62 to 102degrees Fahrenheit. The desired 30 degree Fahrenheit temperature range was also achieved. The computed values of 95% confidence limits of each statistic for the total population are in Table 6-1.

Table 6-1 indicates that due to variability in GVW error, the conditions for research quality loading data were not met.

Table 6-1 Pre-Validation Results – 240500 – 13-May-2008

SPS-1, -2, -5, -6 and -8	95 %Confidence Limit of Error	Site Values	Pass/Fail
Steering axles	±20 percent	1.1 ± 12.1%	Pass
Tandem axles	±15 percent	1.8 ± 10.5%	Pass
GVW	**±10 percent**	**1.7 ± 10.3%**	**Fail**
Axle spacing	± 0.5 ft [150mm]	0.1 ± 0.1 ft	Pass

Prepared: djw *Checked: bko*

The test runs were conducted primarily during the morning and early afternoon hours under mostly sunny weather conditions, resulting in a range of pavement temperatures. The runs were also conducted at various speeds to determine the effects of these variables on the performance of the WIM scale. To investigate these effects, the dataset was split into three speed groups and three temperature groups. The distribution of runs within these groupings is illustrated in Figure 6-1. The figure indicates that the desired distribution of speed and temperature combinations was achieved for this set of validation runs.

The three speed groups were divided into 40 to 47 mph for Low speed, 48 to 51 mph for Medium speed and 52+ mph for High speed. The three temperature groups were created by splitting the runs between those at 62 to 75 degrees Fahrenheit for Low temperature, 76 to 94 degrees Fahrenheit for Medium temperature and 95 to 102 degrees Fahrenheit for High temperature.

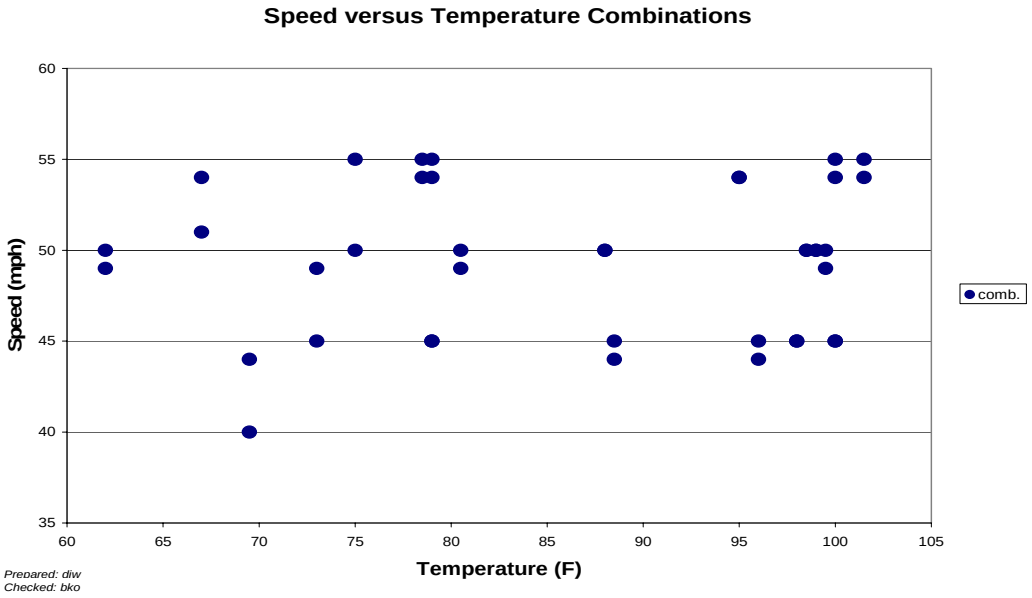

Figure 6-1 Pre-Validation Speed-Temperature Distribution – 240500 – 13-May-2008

A series of graphs was developed to investigate visually for any sign of any relationship between speed or temperature and the scale performance.

Figure 6-2 shows the GVW Percent Error vs. Speed graph for the population as a whole. As can be seen in the figure, the system generally overestimates GVW at all speeds. Variability is greater at the low and high speeds when compared with medium speed.

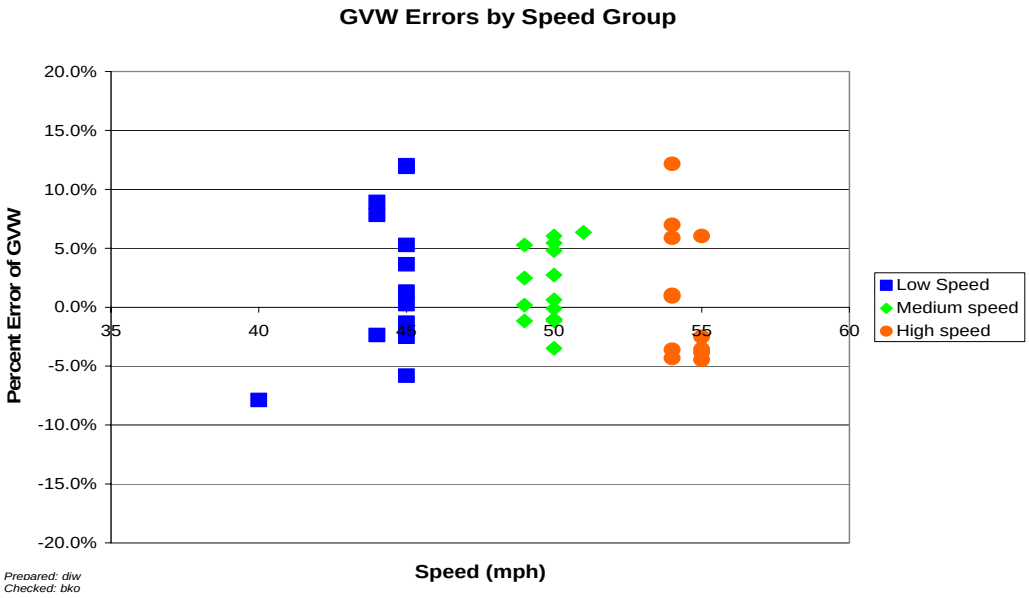

Figure 6-2 Pre-validation GVW Percent Error vs. Speed – 240500 – 13-May-2008

Figure 6-3 shows the relationship between temperature and GVW percentage error. There is no apparent relationship between GVW error and temperature.

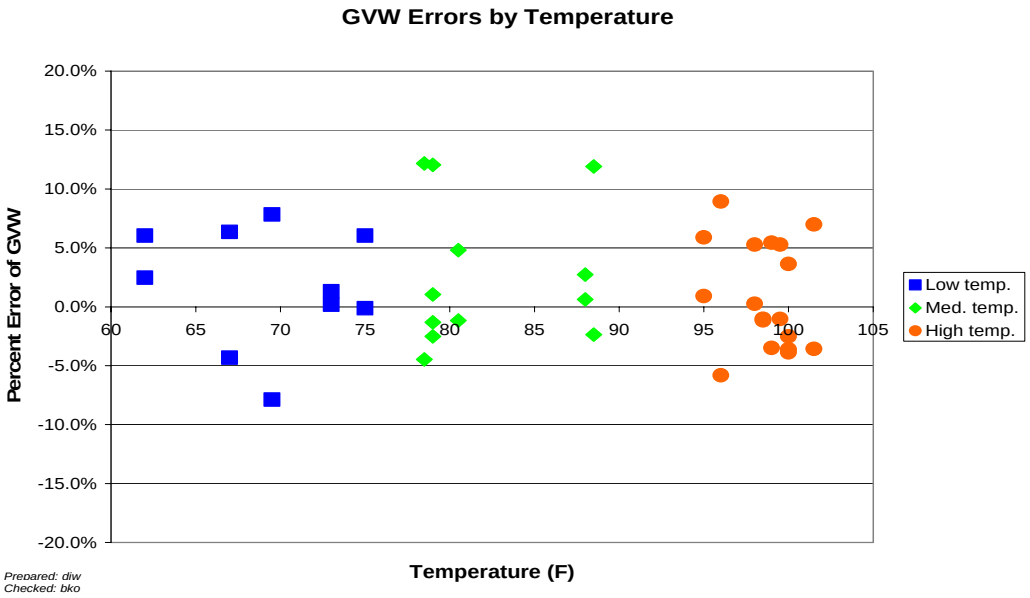

Figure 6-3 Pre-Validation GVW Percent Error vs. Temperature – 240500 – 13-May-2008

Figure 6-4 shows the relationship between the drive tandem spacing errors in feet and speeds. This graph is used as a potential indicator of classification errors due to failure to correctly identify spacings on a vehicle. Since the most common reference value is the drive tandem on a Class 9 vehicle, this is the spacing evaluated and plotted for validations. There is no apparent influence of speed on spacing error.

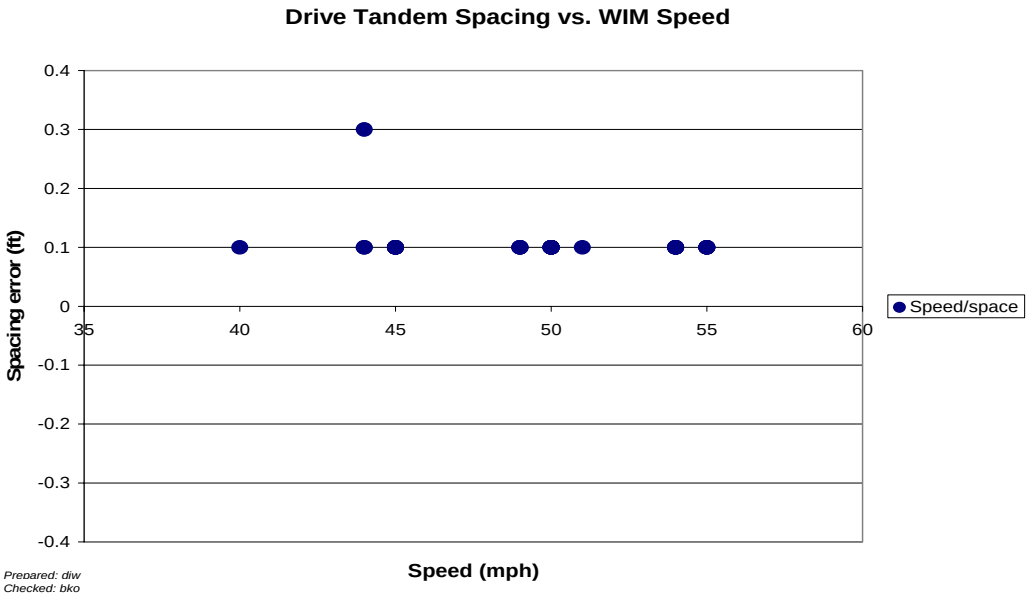

Figure 6-4 Pre-Validation Spacing vs. Speed - 240500 – 13-May-2008

6.1 Temperature-based Analysis

The three temperature groups were created by splitting the runs between those at 62 to 75 degrees Fahrenheit for Low temperature, 76 to 94 degrees Fahrenheit for Medium temperature and 95 to 102 degrees Fahrenheit for High temperature.

Table 6-2 Pre-Validation Results by Temperature Bin – 240500 – 13-May-2008

Element	95% Limit	Low Temperature 62 to 75 °F	Medium Temperature 76 to 94 °F	High Temperature 95 to 102 °F
Steering axles	±20 %	0.9 ± 14.3%	2.2 ± 16.2%	0.4 ± 10.5%
Tandem axles	±15 %	1.9 ± 10.7%	2.9 ± 12.7%	1.1 ± 9.6%
GVW	±10 %	1.8 ± 11.5%	2.8 ± 13.4%	0.9 ± 9.5%
Axle spacing	± 0.5 ft	0.1 ± 0.0 ft	0.1 ± 0.0 ft	0.1 ± 0.1 ft

Prepared: djw *Checked: bko*

From Table 6-2, it can be seen that the equipment generally produces an overestimation of all weights at all temperatures. For all weights, variability appears to be greater at medium temperatures when compared with low and high temperatures.

Figure 6-5 shows the distribution of GVW Errors versus Temperature by Truck.
At the lower and higher temperatures, the patterns for the two trucks are similar. At the medium temperatures, the patterns are opposite. At these speeds, GVW for the partial truck (diamonds) is underestimated and GVW for the golden truck (squares) is overestimated. These trends result in higher variability in GVW error for the truck population as a whole at the medium speeds.

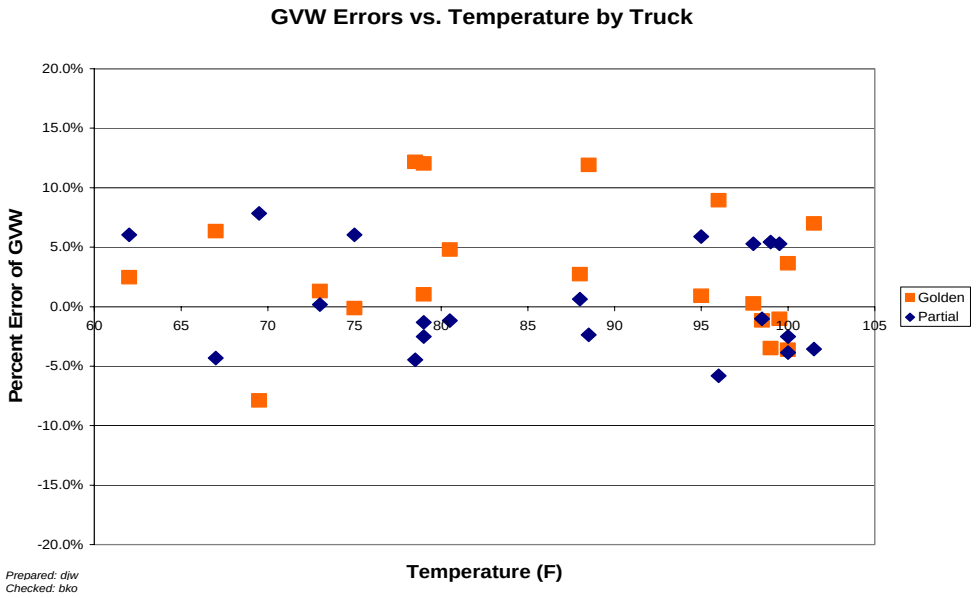

Figure 6-5 Pre-Validation GVW Percent Error vs. Temperature by Truck – 240500 – 13-May-2008

Figure 6-6 shows the relationship between steering axle errors and temperature. This graph is included due to the frequent use of steering axle weights of Class 9 vehicles for auto-calibration. This site does not use auto-calibration. The steering axles in this graph are associated only with Class 9 vehicles. There is no obvious visual trend in steering axle errors with temperature.

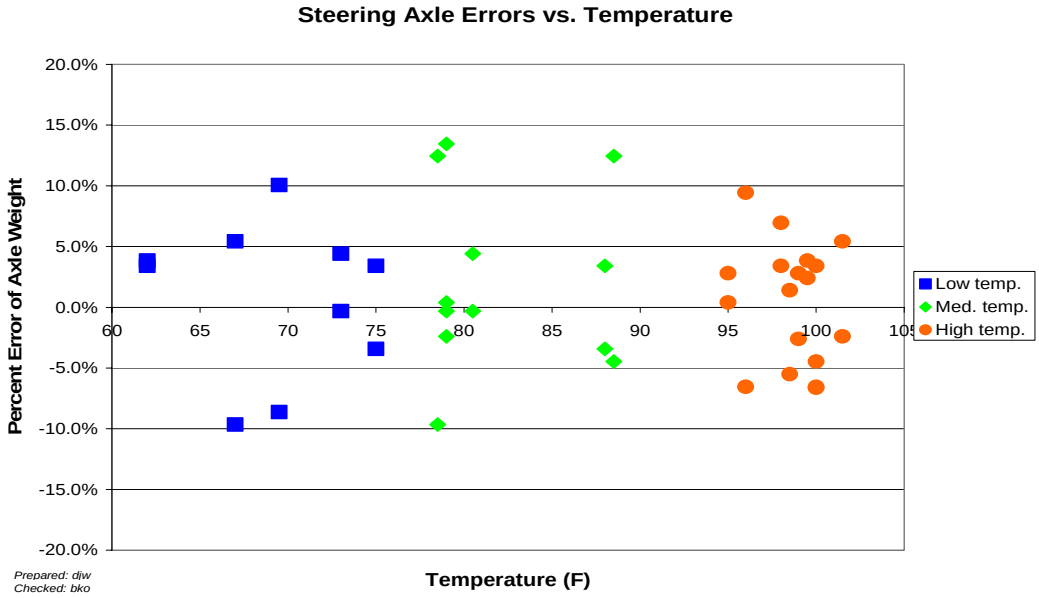

Figure 6-6 Pre-Validation Steering Axle Error vs. Temperature by Group – 240500 – 13-May-2008

6.2 Speed-based Analysis

The speed groups were divided as follows: Low speed – 40 to 47 mph, Medium speed – 48 to 51 mph and High speed – 52+ mph.

Table 6-3 Pre-Validation Results by Speed Bin – 240500 – 13-May-2008

Element	95% Limit	Low Speed 40 to 47 mph	Medium Speed 48 to 51 mph	High Speed 52+ mph
Steering axles	±20 %	2.9 ± 16.3%	1.5 ± 6.9%	-1.4 ± 14.2%
Tandem axles	±15 %	2.4 ± 13.1%	1.8 ± 7.2%	1.3 ± 12.2%
GVW	±10 %	2.4 ± 14.1%	1.7 ± 6.9%	0.9 ± 12.3%
Axle spacing	± 0.5 ft	0.1 ± 0.1 ft	0.1 ± 0.0 ft	0.1 ± 0.0 ft

Prepared: djw *Checked: bko*

Table 6-3 shows the tendency for the equipment to overestimate tandem axles and GVW at all speeds. For steering axles, the equipment produces an overestimation at low and medium speeds, and an underestimation at the high speeds. Variability in all weight errors at the medium speeds is much less when compared with low and high speeds.

From Figure 6-7 the patterns of the two trucks appear similar at the medium and high speeds, with generally the same overestimation. At the lower speeds, there are slightly opposing patterns, where GVW for the golden truck (squares) is generally overestimated while GVW for the partial truck (diamonds) is generally underestimated. Variability for the truck population as a whole is much less at the medium speeds when compared with patterns at the low and high speeds.

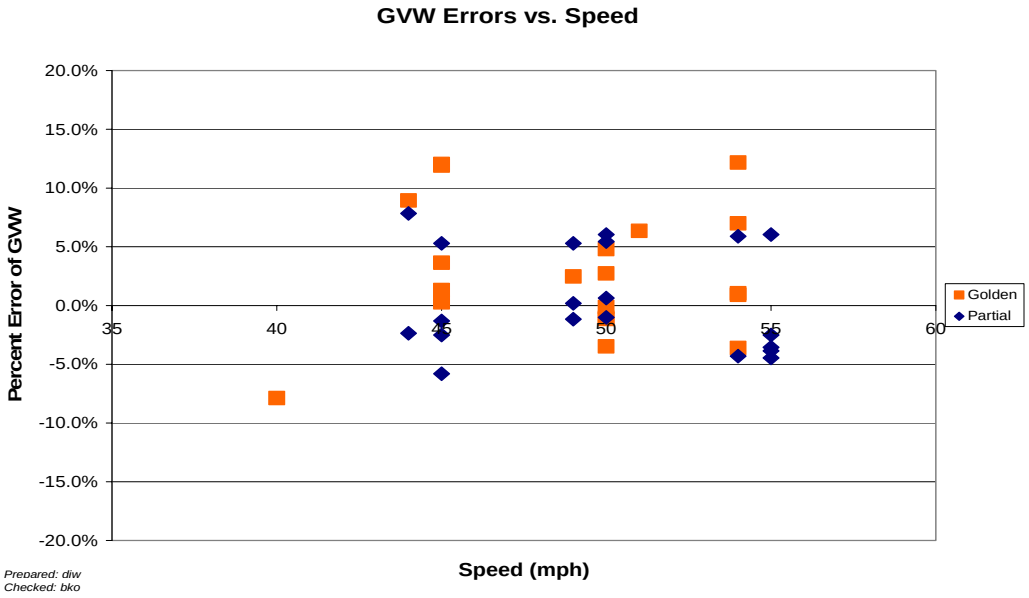

Figure 6-7 Pre-Validation GVW Percent Error vs. Speed Group - 240500 –13-May-2008

Figure 6-8 shows the relationship between steering axle errors and speed. This graph is included due to the frequent use of steering axle weights of Class 9 vehicles for calibration. This site does not use auto-calibration. The steering axles in this graph are associated only with Class 9 vehicles. The figure illustrates the tendency for the equipment to transition from an overestimation of steering axle weights at the low speeds to an underestimation at the higher speeds. Variability in error is much less at the medium speed when compared with low and high speeds.

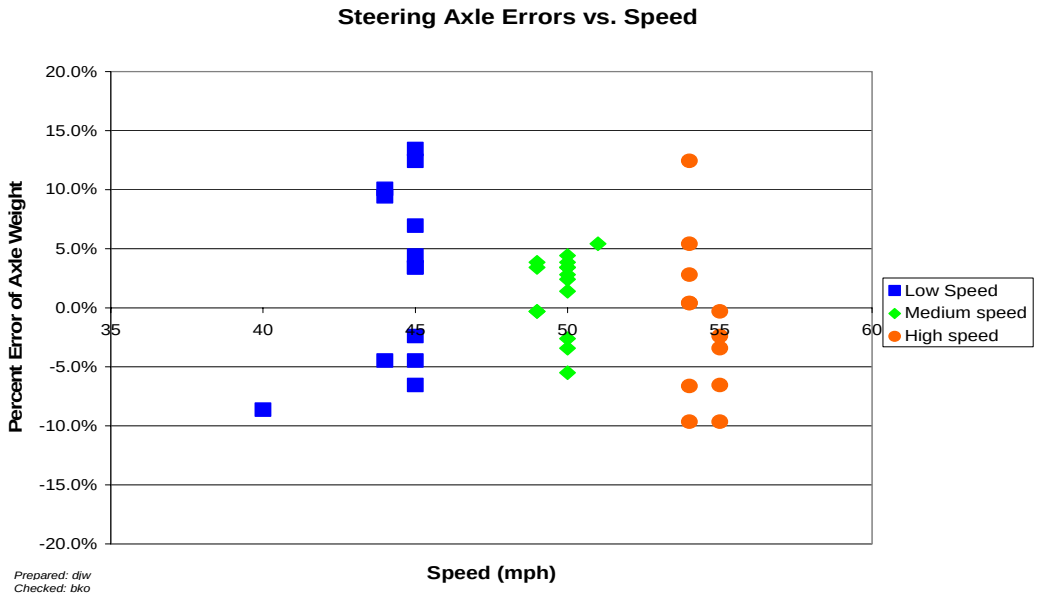

Figure 6-8 Pre-Validation Steering Axle Percent Error vs. Speed Group - 240500 –13-May-2008

6.3 Classification Validation

This LTPP installed site uses the FHWA 13-bin classification scheme and the LTPP ETG mod 3 classification algorithm. Classification 15 had been added to define unclassified vehicles. Class 14 also exists in the data downloaded after the validation but there is no definition provided for the class.

The classification validation is intended to find gross errors in vehicle classification, not to validate the installed algorithm. A sample of 100 trucks was collected at the site. The classification identification is to identify gross errors in classification, not validate the classification algorithm. Video was taken at the site to provide ground truth for the evaluation. Based on the sample it was determined that there are zero percent unknown vehicles and one percent unclassified vehicles. The unclassified vehicle was a single Class 13 with an apparently atypical axle configuration.

The second check is the ability of the algorithm to correctly distinguish between truck classes with no more than 2% errors in such classifications. Table 6-4 has the classification error rates by class. The overall misclassification rate is 8.0 percent.

Table 6-4 Truck Misclassification Percentages for 240500 – 13-May-2008

Class	Percent Error	Class	Percent Error	Class	Percent Error
4	N/A	5	7	6	14
7	N/A				
8	25	9	4	10	N/A
11	N/A	12	N/A	13	N/A

Prepared: djw *Checked: bko*

The misclassification percentage is computed as the probability that a pair containing the class of interest does NOT include a match. Thus if there are eight pairs of observations with at least one Class 9 and only six of them a re matches, the error rate is 25 percent. The percent error and the mean differences reported below do not represent the same statistic. It is possible to have error rates greater than 0 with a mean difference of zero.

Table 6-5 Truck Classification Mean Differences for 240500 – 13-May-2008

Class	Mean Difference	Class	Mean Difference	Class	Mean Difference
4	N/A	5	2	6	- 14
7	N/A				
8	33	9	- 4	10	N/A
11	N/A	12	N/A	13	N/A

Prepared: djw *Checked: bko*

These error rates are normalized to represent how many vehicles of the class are expected to be over- or under-counted for every hundred of that class observed by the equipment. Thus a value of 0 means the class is identified correctly on average. A number between –1 and –100 indicates at least that number of vehicles either missed or not assigned to the class by the equipment. It is not possible to miss more than all of them or one hundred out of one hundred. Numbers 1 or larger indicate at least how many more vehicles are assigned to the class than the actual "hundred observed". Classes marked Unknown are those identified by the equipment but no vehicles of the type were seen the observer. There is no way to tell how many vehicles of that type might actually exist. N/A means no vehicles of the class were recorded by either the equipment or the observer.

A limited investigation of the precision and bias of the speeds reported by the equipment was undertaken. The values were not within the expected tolerances. Since the classification data for heavy trucks met research quality standards with the exception of a small sample of Class 8 and Class 9 vehicles, the observed bias and variability are thought to be more strongly related to radar speed precision than errors in the WIM equipment.

6.4 Evaluation by ASTM E-1318 Criteria

The ASTM E-1318 criteria for a successful validation of Type I sites is 95% of the observed errors within the limits for allowable errors for each of the relevant statistics. If this site had been evaluated using ASTM E-1318-02 it would have met the conditions for a Type I site

exclusive of wheel loads. LTPP does not validate WIM performance with respect to wheel loads.

Table 6-6 Results of Validation Using ASTM E-1318-02 Criteria

Characteristic	Limits for Allowable Error	Percent within Allowable Error	Pass/Fail
Single Axles	± 20%	100%	Pass
Axle Groups	± 15%	100%	Pass
GVW	± 10%	92.5%	Fail

Prepared: djw *Checked: bko*

6.5 Prior Validations

The last validation for this site was completed on September 5, 2007. It was the second validation of the site. The site was producing research quality data. Figure 6-9 shows the GVW Percent Error vs. Speed for the post validation runs. The site was validated with two trucks. The "Golden" truck was loaded to 72,460 lbs. The "partial" truck which had air suspension on both tandems was loaded to 65,300lbs.

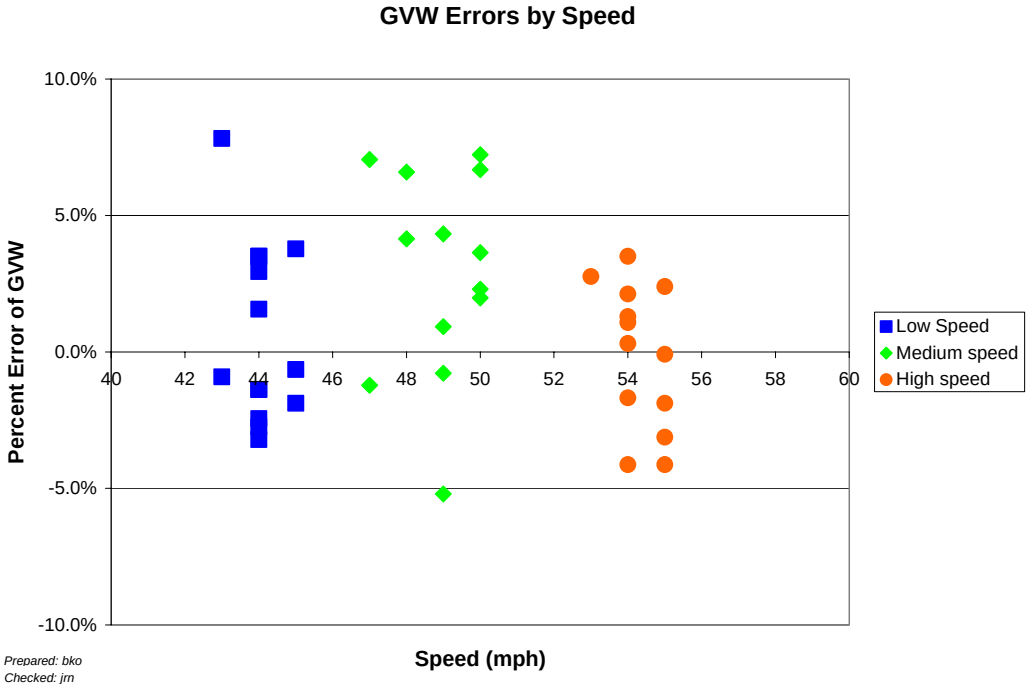

Figure 6-9 Last Validation GVW Percent Error vs. Speed – 240500 – 05-Sep-2007

Table 6-7 shows the overall results from the last validation. The site was slightly overestimating weights and had less variability than was observed at the beginning of the validation.

Table 6-7 Last Validation Final Results – 240500 – 05-Sep-2007

SPS-1, -2, -5, -6 and -8	95 %Confidence Limit of Error	Site Values	Pass/Fail
Steering axles	±20 percent	0.5 ± 11%	Pass
Tandem axles	±15 percent	1.3 ± 8.1%	Pass
Gross vehicle weights	±10 percent	1.1 ± 6.9%	Pass
Axle spacing	± 0.5 ft [150 mm]	0.0 ± 0.1 ft	Pass

Prepared: djw *Checked: bko*

Table 6-8 has the results at the end of the last validation by temperature. The equipment appears to have estimated all weights with reasonable accuracy at all temperatures at that time. Through this validation the equipment has been observed at temperature from 25 to 117 degrees Fahrenheit.

Table 6-8 Last Validation Results by Temperature Bin – 240500 – 05-Sep-2007

Element	95% Limit	Low Temperature 70 to 80 °F	Medium Temperature 80 to 94 °F	High Temperature 95 to 106 °F
Steering axles	±20 %	0.3 ± 10.8%	1.0 ± 12.7%	0.0 ± 13.0%
Tandem axles	±15 %	1.3 ± 9.4%	1.0 ± 7.8%	1.7 ± 7.8%
GVW	±10 %	1.1 ± 8.6%	0.9 ± 6.6%	1.4 ± 7.8%
Axle spacing	± 0.5 ft	0.0 ± 0.1 ft	0.0 ± 0.1 ft	0.0 ± 0.2 ft

Prepared: djw *Checked: bko*

Table 6-9 has the results of the prior post validation by speed groups. The equipment overestimated all weights at the medium speeds during this validation.

Table 6-9 Last Validation Results by Speed Bin – 240500 – 05-Sep-2007

Element	95% Limit	Low Speed 43 to 45 mph	Medium Speed 46 to 50 mph	High Speed 51+ mph
Steering axles	±20 %	1.8 ± 11.4%	2.2 ± 11.1%	-2.5 ± 11.0%
Tandem axles	±15 %	0.4 ± 7.5%	3.1 ± 8.9%	0.4 ± 7.6%
GVW	±10 %	0.6 ± 7.0%	2.9 ± 8.2%	-0.1 ± 5.7%
Axle spacing	± 0.5 ft	0.0 ± 0.1 ft	0.0 ± 0.1 ft	0.0 ± 0.1 ft

Prepared: djw *Checked: bko*

7 Data Availability and Quality

As of May 13, 2008 this site does not have at least 5 years of research quality data. Research quality data is defined to be at least 210 days in a year of data of known calibration meeting LTPP's precision requirements.

Data that has validation information available has been reviewed in light of the patterns present in the two weeks immediately following a validation/calibration activity. A determination of research quality data is based on the consistency with the validation pattern.

Data that follows consistent and rational patterns in the absence of calibration information may be considered nominally of research quality pending validation information with which to compare it. Data that is inconsistent with expected patterns and has no supporting validation information is not considered research quality.

The amount and coverage for the site is shown in Table 7-1. The value for months is a measure of the seasonal variation in the data. The indicator of coverage indicates whether day of week variation has been accounted for on an annual basis. As can be seen from the table 2000 through 2007 have a sufficient quantity to be considered complete years of data. The validations for previous equipment installations do not indicate the existence of research quality data. **As a result, it can be seen that at least three additional years of research quality data are needed to meet the goal of a minimum of 5 years of research weight data.**

Table 7-1 Amount of Traffic Data Available 240500 – 13-May-2008

Year	Classification Days	Months	Coverage	Weight Days	Months	Coverage
1994	153	6	Full Week	154	6	Full Week
1996	12	3	Full Week	None		
1999	54	2	Weekday(s)	19	2	Full Week
2000	292	12	Full Week	37	3	Full Week
2001	327	12	Full Week	353	12	Full Week
2002	340	12	Full Week	343	12	Full Week
2003	316	12	Full Week	316	12	Full Week
2004	283	12	Full Week	284	12	Full Week
2005	283	10	Full Week	283	10	Full Week
2006	304	10	Full Week	304	10	Full Week
2007	290	10	Full Week	292	10	Full Week

Prepared: djw *Checked: bko*

GVW graphs and characteristics associated with them are used as data screening tools. As a result classes constituting more that ten percent of the truck population are considered major sub-groups whose evaluation characteristics should be identified for use in screening. The typical values to be used for reviewing incoming data after a validation are determined starting with data from the day after the completion of a validation.

Class 9s and Class 5s constitute more than 10 percent of the truck population. Based on the data collected following this validation the following are the expected values for these populations. The precise values to be used in data review will need to be determined by the Regional Support Contractor on receipt of the first 14 days of data after the successful validation. For sites that do not meet LTPP precision requirements, this period may still be used as a starting point from which to track scale changes.

Table 7-2 is generated with a column for every vehicle class 4 or higher that represents 10 percent or more of the truck (class 4-20) population. In creating Table 7-2 the following definitions are used:

- Class 9 overweights are defined as the percentage of vehicles greater than 88,000 pounds
- Class 9 underweights are defined as the percentage of vehicles less than 20,000 pounds.
- Class 9 unloaded peak is the bin less than 44,000 pounds with the greatest percentage of trucks.
- Class 9 loaded peak is the bin 60,000 pounds or larger with the greatest percentage of trucks.
- For all other trucks the typical axle configuration is used to determine the maximum allowable weight based on 18,000 pounds for single axles and 34,000 pounds for tandem axles. A ten percent cushion above that maximum is used to set the overweight threshold.
- For all other trucks in the absence of site specific information the computation of under weights assumes the power unit weighs 10,000 pounds and each axle on a trailer 5,000 pounds. Ninety percent of the total for the unloaded configuration is the value below which a truck is considered under weight.
- For all trucks other than class 9s that have a bi-modal distribution the unloaded peak is defined to be in a bin less than or equal to half of the allowable maximum weight.
- For all trucks other than class 9s that have a bi-modal distribution the loaded peak is defined to be in a bin greater than or equal to half of the allowable maximum weight.

There may be more than one bin identified for the unloaded or loaded peak due to the small sample size collected after validation. Where only one peak exists, the peak rather than a loaded or unloaded peak is identified. This may happen with single unit trucks. It is not expected to occur with combination vehicles.

Table 7-2 GVW Characteristics of Major sub-groups of Trucks – 240500 – 14-May-2008

Characteristic	Class 9	Class 5
Percentage Overweights	2.7%	0%
Percentage Underweights	0.0%	0%
Unloaded Peak	36,000	
Loaded Peak	80,000	
Peak		12,000

Prepared: djw *Checked: bko*

The expected percentage of unclassified vehicles is 0.5%. This is based on the percentage of unclassified vehicles in the post-validation data download.

The graphical screening comparison figures are found in Figure 7-2 through Figure 7-4. These are based on data collected immediately after the validation and may not be wholly representative of the population at the site. They should however provide a sense of the statistics expected when SPS comparison data is computed for the post-validation period.

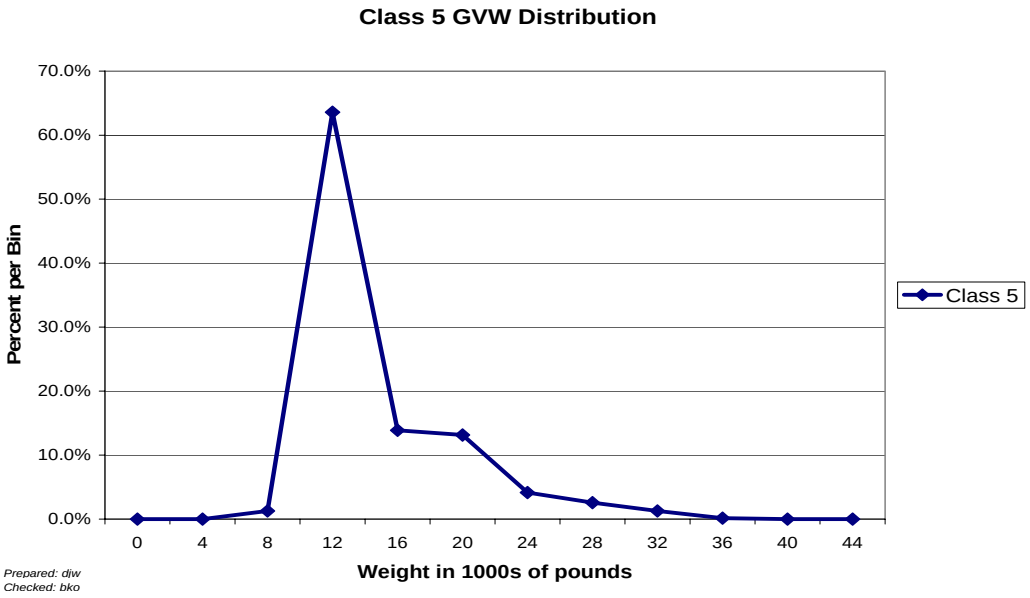

Figure 7-1 Expected GVW Distribution Class 5 – 240500 – 14-May-2008

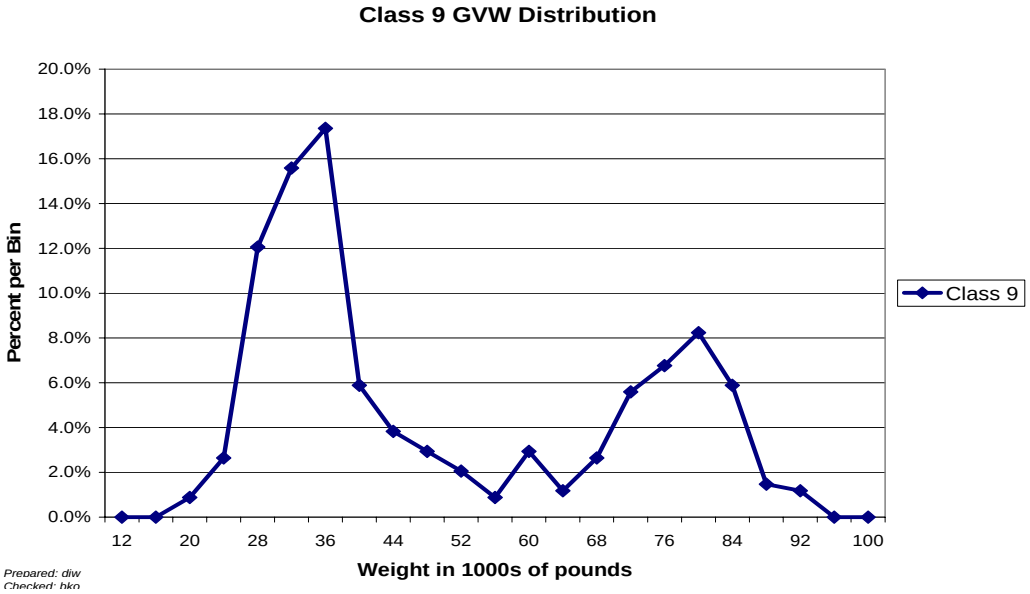

Figure 7-2 Expected GVW Distribution Class 9 – 240500 – 14-May-2008

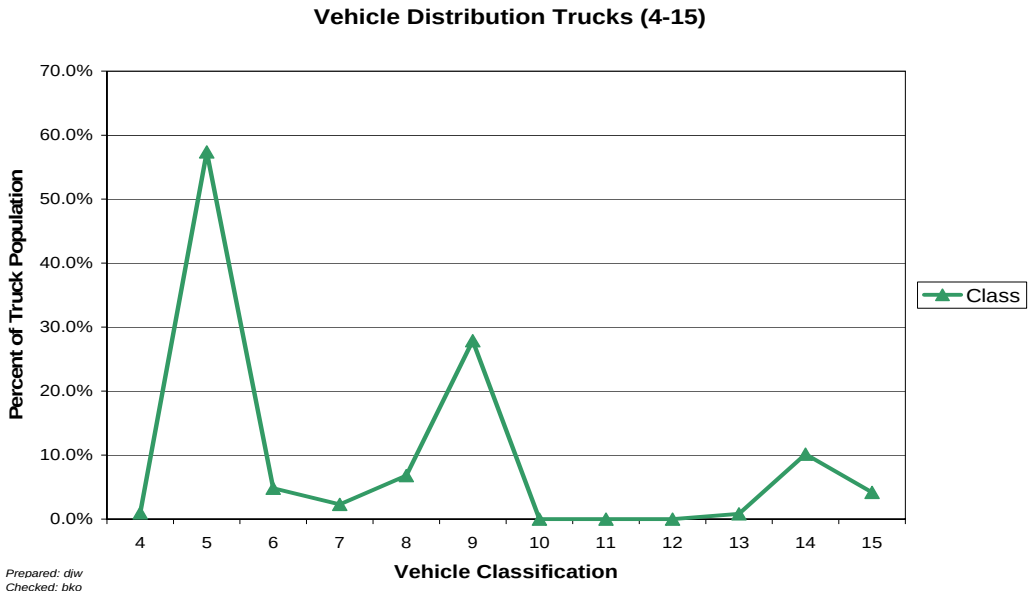

Figure 7-3 Expected Vehicle Distribution – 240500 – 14-May-2008

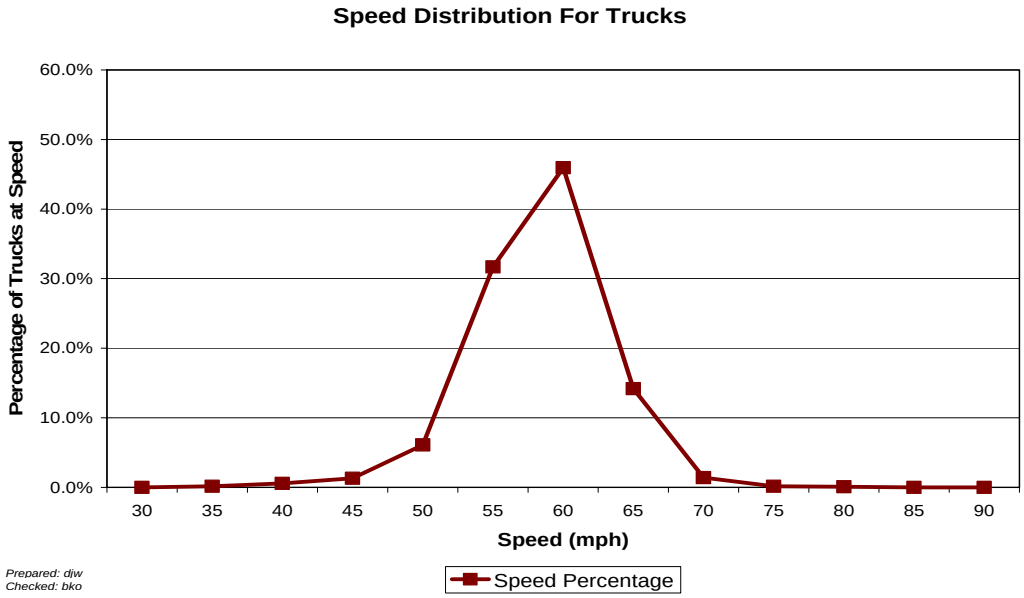

Figure 7-4 Expected Speed Distribution – 240500 – 14-May-2008

8 Data Sheets

The following is a listing of data sheets incorporated in Appendix A.

Sheet 19 – Truck 1 – 3S2 loaded air suspension (3 pages)
Sheet 19 – Truck 2 – 3S2 partially loaded air suspension (3 pages)

Sheet 20 – Speed and Classification verification Pre-Validation (2 pages)
Sheet 20 – Speed and Classification verification Post-Validation (2 pages)

Sheet 21 – Pre-Validation (3 pages)
Sheet 21 – Calibration Iteration 1 – (2 pages)
Sheet 21 – Calibration Iteration 2 – (1 page)
Sheet 21 – Calibration Iteration 3 - (1 page)
Sheet 21 – Post-Validation (2 pages)

Calibration Iteration 1 Worksheet – (1 page)
Calibration Iteration 2 Worksheet – (1 page)
Calibration Iteration 3 Worksheet – (1 page)

Test Truck Photographs (6 pages)

LTPP Mod 3 Classification Scheme (1 page)

Final System Parameters (1 page)

9 Updated Handout Guide and Sheet 17

A copy of the handout has been included following this page. It includes a current Sheet 17 with all applicable maps and photographs.

10 Updated Sheet 18

A current Sheet 18 indicating the contacts, conditions for assessments and evaluations has been attached following the updated handout guide.

11 Traffic Sheet 16(s)

Sheet 16s for the pre-validation and post-validation conditions are attached following the current Sheet 18 information at the very end of the report.

POST-VISIT HANDOUT GUIDE FOR SPS WIM VALIDATION

STATE: Maryland

SHRP ID: 0500

Figures

Photos

1. General Information

SITE ID: *240500*

LOCATION: *US-15 North, milepost 4.62, approximately 10 miles south of Frederick, Maryland.*

VISIT DATE: *May 13, 2008*

VISIT TYPE: *Validation*

2. Contact Information

POINTS OF CONTACT:

Validation Team: *Dean J. Wolf, 301-210-5105, djwolf@mactec.com*

Highway Agency: *Rodney Wynn, 410-321-4106, rwynn@sha.state.md.us*

Barry Balzanna, 410-545-5509, bbalzanna@sha.state.md.us

Michael Baxter, 410-545-5511, mbaxter@sha.state.md.us

Jim Brown, 301-624-8252, jbrown@sha.state.md.us

FHWA COTR: *Debbie Walker, 202-493-3068, deborah.walker@fhwa.dot.gov*

FHWA Division Office Liaison: *Azmat Hussain,410-779-7161, azmat.hussain@fhwa.dot.gov*

LTPP SPS WIM WEB PAGE: *http://www.tfhrc.gov/pavement/ltpp/spstraffic/index.htm*

3. Agenda

BRIEFING DATE: *No briefing was requested for this visit.*

ON SITE PERIOD: *Beginning May 13, 2008 at 9:00 am.*

TRUCK ROUTE CHECK: *Completed at previous validation visit – See Truck Route*

4. Site Location/ Directions

NEAREST AIRPORT: *Washington Dulles International Airport (26.4 miles).*

DIRECTIONS TO THE SITE: *Approximately 10 miles south of Frederick, Maryland on US 15.*

MEETING LOCATION: *On site beginning at 9:00 am.*

WIM SITE LOCATION: *Located in the northbound driving lane of US 15, milepost 4.62. GPS: 39°19.839'N, 77°30.610'W.*

WIM SITE LOCATION MAP:

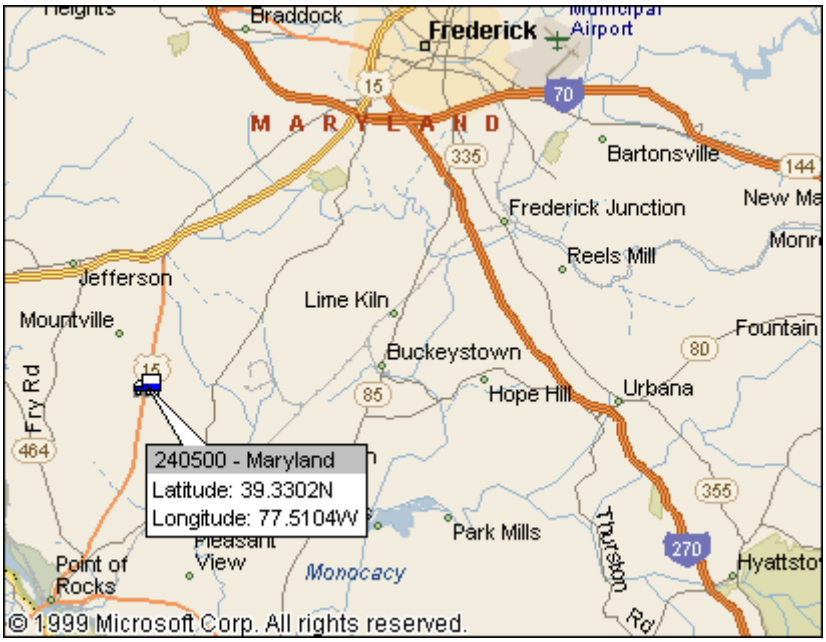

Figure 4-1 - WIM Site Location - 240500 - Maryland

5. Truck Route Information

ROUTE RESTRICTIONS: *None*

SCALE LOCATION: *New Market Certified Scales, I-70, Eastbound side, approximately 8.5 miles east of Frederick, MD.*

Trucks –

Company – William S. Fout, Inc., Frederick, MD
Contact – Jerry Pulliam, 301-662-1989

TRUCK ROUTE:

Southbound turnaround – 3.2 miles to Point of Rocks Road
Northbound turnaround - .6 miles to Mountville Road (MD 28)
Total distance = 7.6 miles
Total time = 10 minutes

Southbound vehicles make a left on Point of Rocks road followed by a left on to Ballenger Creek Pike, a left on East Basford Road and a right on to US 15 northbound. After crossing the scale the trucks proceed northbound on US 15 to interchange at MD 28 (Mountville Road).

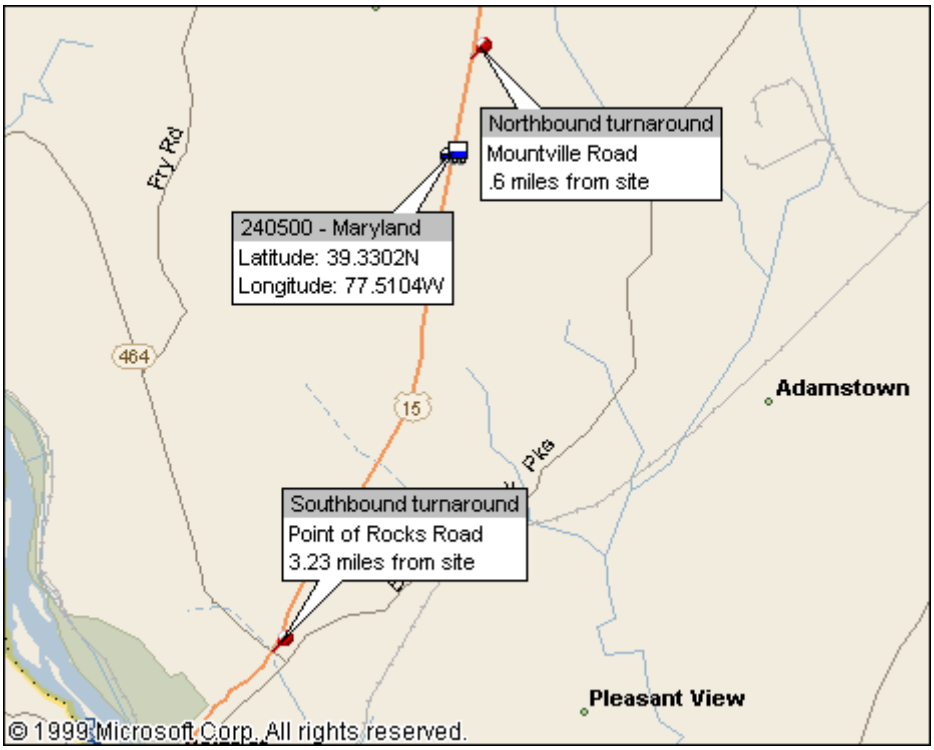

Figure 5-1 - Truck Route - 240500 - Maryland

6. Sheet 17 – Maryland (240500)

1.* ROUTE ___US-15_____ MILEPOST ___4.62____LTPP DIRECTION - N S E W

2.* WIM SITE DESCRIPTION - Grade ___<1_____ % Sag vertical Y / N
Nearest SPS section upstream of the site ___ 0_5_6_1___
Distance from sensor to nearest upstream SPS Section ___4_5_0___ ft.

3.* LANE CONFIGURATION
Lanes in LTPP direction _1___ Lane width __12__ ft

Median - 1 – painted
2 – physical barrier
3 – grass
4 – none

Shoulder - 1 – curb and gutter
2 – paved AC
3 – paved PCC
4 – unpaved
5 – none

Shoulder width __10__ ft

4.* PAVEMENT TYPE _____Portland concrete cement_____

5.* PAVEMENT SURFACE CONDITION – Distress Survey
Date 05/13/08 Distress Photo____24_0500_Upstream_05_13_08.jpg _____
Date 05/13/08 Distress Photo___24_0500_Downstream_05_13_08.jpg ____
Date _____ Distress Photo_____

6. * SENSOR SEQUENCE
_____Loop – Bending Plate – Bending Plate – Loop_____

7. * REPLACEMENT AND/OR GRINDING __ __ __ / __ __ / __ __ __ __
REPLACEMENT AND/OR GRINDING __ __ __ / __ __ / __ __ __ __
REPLACEMENT AND/OR GRINDING __ __ __ / __ __ / __ __ __ __

8. RAMPS OR INTERSECTIONS
Intersection/driveway within 300 m upstream of sensor location Y / N
distance _____
Intersection/driveway within 300 m downstream of sensor location Y / N
distance _____
Is shoulder routinely used for turns or passing? Y / N

9. DRAINAGE (*Bending plate and load cell systems only)*
1 – Open to ground
2 – Pipe to culvert
3 – None

Clearance under plate ___ __6_._0__ in
Clearance/access to flush fines from under system Y / N

10. * CABINET LOCATION

Same side of road as LTPP lane Y/N Median Y/N Behind barrier Y/N
Distance from edge of traveled lane __1_8__ ft
Distance from system __ 3_1 __ ft
TYPE _____

CABINET ACCESS controlled by _LTPP / STATE / JOINT?
Contact - name and phone number _____
Alternate - name and phone number _____

11. * POWER

Distance to cabinet from drop ___3_6_5 ___ ft Overhead / underground / solar / AC in cabinet?
Service provider _____ Phone number _____

12. * TELEPHONE

Distance to cabinet from drop ___3_6_5__ ft Overhead / under ground / cell?
Service provider _____Phone Number _301-874-0732_

13. * SYSTEM (software & version no.)- _____
Computer connection – RS232 / Parallel port / USB / Other _____

14. * TEST TRUCK TURNAROUND time __10__ minutes DISTANCE __6.7___ mi.

15. PHOTOS FILENAME

Power source	24_0500_Service_Mast_05_13_08.jpg
	24_0500_Power_Meter_05_13_08.jpg
Phone source	24_0500_Telephone_Source_05_13_08.jpg
Cabinet exterior	24_0500_Cabinet_Exterior_05_13_08.jpg
Cabinet interior	24_0500_Cabinet_Interior_05_13_08.jpg
Weight sensors	24_0500_Leading_WIM_Sensor_05_13_08.jpg
	24_0500_Trailing_WIM_Sensor_05_13_08.jpg
Classification sensors	_____
Other sensors	24_0500_Leading_Loop_Sensor_05_13_08.jpg
	24_0500_Trailing_Loop_Sensor_05_13_08.jpg

_____

Description ___Loops_____
Downstream direction at sensors on LTPP lane __24_0500_Downstream_05_13_08.jpg
Upstream direction at sensors on LTPP lane _____24_0500_Upstream_05_13_08.jpg __

COMMENTS _____

COMPLETED BY _____Dean Wolf_____

PHONE _301-210-5105_____DATE COMPLETED _ 5_ _ /_ 13_ _ / _2008 _ _ _ _

Sketch of equipment layout

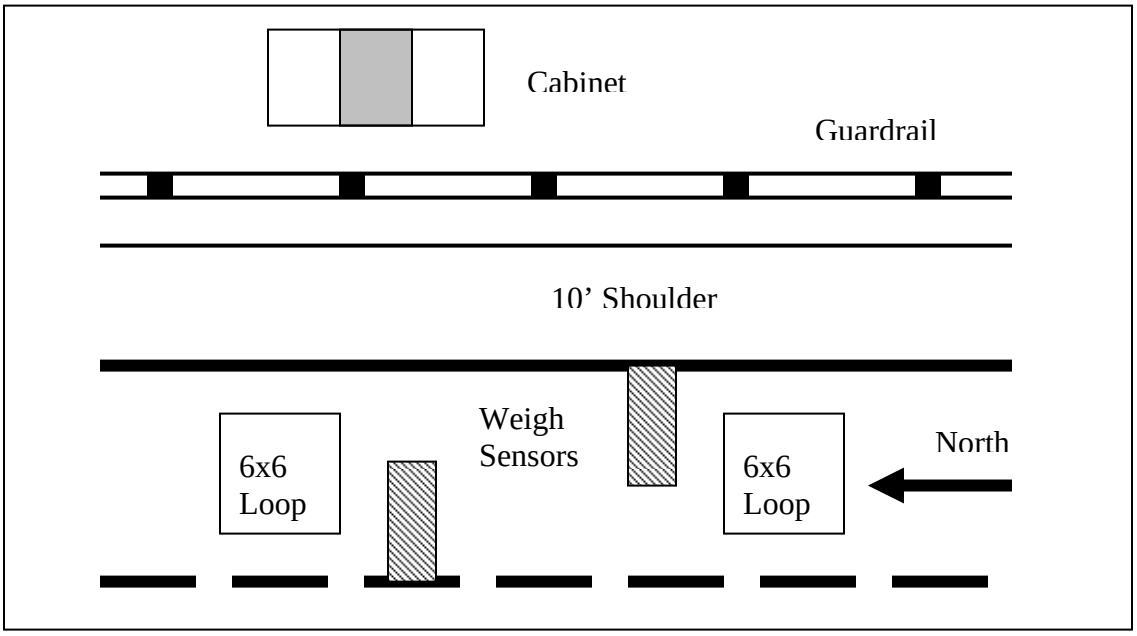

Figure 6-1 – Equipment Layout at Maryland SPS-5

Photo 1 - 24_0500_Upstream_05_13_08.jpg

Photo 2 - 24_0500_Downstream_05_13_08.jpg

Photo 3 - 24_0500_Power_Meter_05_13_08.jpg

Photo 4 - 24_0500_Service_Mast_05_13_08.jpg

Photo 5 - 24_0500_Telephone_Source_05_13_08.jpg

Photo 6 - 24_0500_Cabinet_Exterior_05_13_08.jpg

Photo 7 - 24_0500_Cabinet_Interior_Front_05_13_08.jpg

Photo 8 - 24_0500_Cabinet_Interior_Rear_05_13_08.jpg

Photo 9 - 24_0500_Leading_WIM_Sensor_05_13_08.jpg

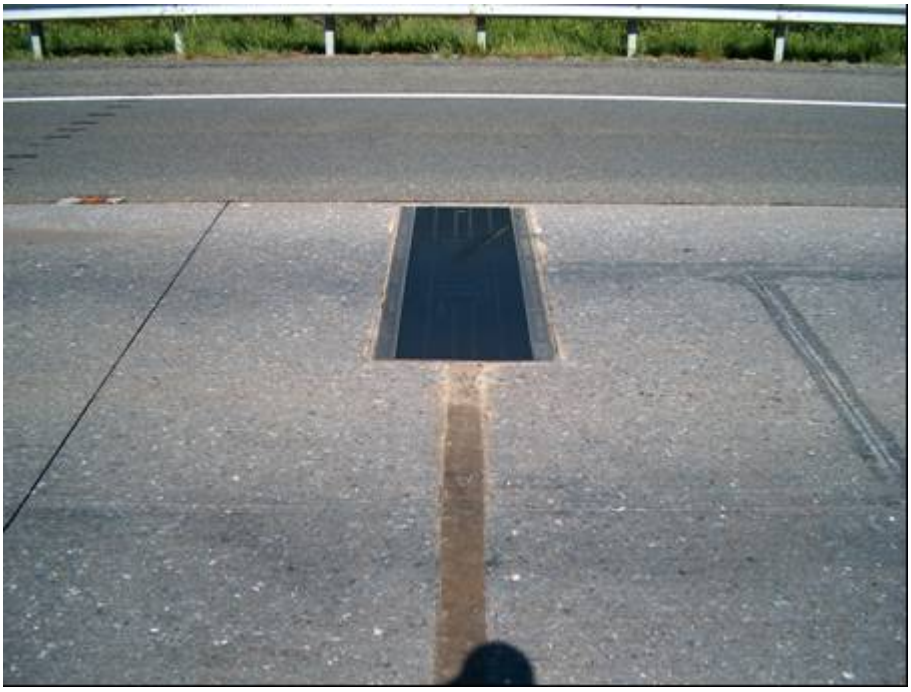

Photo 10 - 24_0500_Trailing_WIM_Sensor_05_13_08.jpg

Photo 11 - 24_0500_Leading_Loop_Sensor_05_13_08.jpg

Photo 12 - 24_0500_Trailing_Loop_Sensor_05_13_08.jpg

SHEET 18	STATE CODE [24]
LTPP MONITORED TRAFFIC DATA	SPS PROJECT ID [0500]
WIM SITE COORDINATION	DATE: (mm/dd/yyyy) 5/13/2008

Rev. 05/15/07

1. DATA PROCESSING –
   a. Down load –
      - ☐ State only
      - ☐ LTPP read only
      - ☐ LTPP download
      - ☒ LTPP download and copy to state

   b. Data Review –
      - ☐ State per LTPP guidelines
      - ☐ State – ☐ Weekly ☐ Twice a Month ☐ Monthly ☐ Quarterly
      - ☒ LTPP

   c. Data submission –
      - ☐ State – ☐ Weekly ☐ Twice a month ☐ Monthly ☐ Quarterly
      - ☒ LTPP

2. EQUIPMENT –
   a. Purchase –
      - ☐ State
      - ☒ LTPP

   b. Installation –
      - ☐ Included with purchase
      - ☐ Separate contract by State
      - ☐ State personnel
      - ☒ LTPP contract

   c. Maintenance –
      - ☒ Contract with purchase – Expiration Date _5 years from installation_
      - ☐ Separate contract LTPP – Expiration Date _____
      - ☐ Separate contract State – Expiration Date _____
      - ☐ State personnel

   d. Calibration –
      - ☒ Vendor
      - ☐ State
      - ☐ LTPP

   e. Manuals and software control –
      - ☐ State
      - ☒ LTPP

   f. Power –
      i. Type –
         - ☐ Overhead
         - ☒ Underground
         - ☐ Solar

      ii. Payment –
         - ☒ State
         - ☐ LTPP
         - ☐ N/A

g. Communication –

i. Type –
- ☒ Landline
- ☐ Cellular
- ☐ Other

ii. Payment –
- ☒ State
- ☐ LTPP
- ☐ N/A

3. PAVEMENT –

a. Type –
- ☒ Portland Concrete Cement
- ☐ Asphalt Concrete

b. Allowable rehabilitation activities –
- ☐ Always new
- ☐ Replacement as needed
- ☒ Grinding and maintenance as needed
- ☐ Maintenance only
- ☐ No remediation

c. Profiling Site Markings –
- ☐ Permanent
- ☒ Temporary

4. ON SITE ACTIVITIES –

a. WIM Validation Check - advance notice required _1__ ☐ days ☒ weeks

b. Notice for straightedge and grinding check - __1_ ☐ days ☒ weeks

i. On site lead –
- ☐ State
- ☒ LTPP

ii. Accept grinding –
- ☐ State
- ☒ LTPP

c. Authorization to calibrate site –
- ☐ State only
- ☒ LTPP

d. Calibration Routine –
- ☒ LTPP – ☐ Semi-annually ☐ Annually
- ☐ State per LTPP protocol – ☐ Semi-annually ☐ Annually
- ☐ State other – _____

e. Test Vehicles
   i. Trucks –
      1st – Air suspension 3S2 ☐ State ☒ LTPP
      2nd – _3S2 different weight/suspension__ ☐ State ☒ LTPP
      3rd – _____ ☐ State ☐ LTPP
      4th – _____ ☐ State ☐ LTPP
   ii. Loads – ☐ State ☒ LTPP
   iii. Drivers – ☐ State ☒ LTPP

f. Contractor(s) with prior successful experience in WIM calibration in state:

_____

g. Access to cabinet
   i. Personnel Access –
      ☐ State only
      ☐ Joint
      ☒ LTPP
   ii. Physical Access –
      ☒ Key
      ☐ Combination

h. State personnel required on site – ☐Yes ☒No

i. Traffic Control Required – ☐Yes ☒No

j. Enforcement Coordination Required – ☐Yes ☒No

5. SITE SPECIFIC CONDITIONS –
   a. Funds and accountability – _____
   b. Reports – _____
   c. Other – _____
   d. Special Conditions – _____

6. CONTACTS –
   a. Equipment (operational status, access, etc.) –

      Name: Roy Czinku Phone:(306) 653-6627

      Agency: IRD

b. Maintenance (equipment) –

Name: Roy Czinku Phone:(306) 653-6627

Agency: IRD

c. Data Processing and Pre-Visit Data –

Name: Roy Czinku Phone:(306) 653-6627

Agency: IRD

d. Construction schedule and verification –

Name: _____ Phone:_____

Agency: _____

e. Test Vehicles (trucks, loads, drivers) –

Name: Jerry Pulliam Phone:301-662-1989

Agency: Fout Crane & Rigging

f. Traffic Control –

Name: _____ Phone:_____

Agency: _____

g. Enforcement Coordination –

Name: _____ Phone:_____

Agency: _____

h. Nearest Static Scale

Name: New Market W/S Location:I- 70, mile 64 /2 miles past exit 62/E/B side

Phone: _____

SHEET 16 **LTPP MONITORED TRAFFIC DATA** **SITE CALIBRATION SUMMARY**	*STATE ASSIGNED ID [__ __ __ __] *STATE CODE [24] *SHRP SECTION ID [0500]

SITE CALIBRATION INFORMATION

1. * DATE OF CALIBRATION (MONTH/DAY/YEAR) [5/13/2008]

2. * TYPE OF EQUIPMENT CALIBRATED ___ WIM ___ CLASSIFIER _X_ BOTH

3. * REASON FOR CALIBRATION
   ___ REGULARLY SCHEDULED SITE VISIT ___ RESEARCH
   ___ EQUIPMENT REPLACEMENT ___ TRAINING
   ___ DATA TRIGGERED SYSTEM REVISION ___ NEW EQUIPMENT INSTALLATION
   _X_ OTHER (SPECIFY) ___LTPP Validation_____

4. * SENSORS INSTALLED IN LTPP LANE AT THIS SITE (CHECK ALL THAT APPLY):
   ___ BARE ROUND PIEZO CERAMIC ___ BARE FLAT PIEZO _X_ BENDING PLATES
   ___ CHANNELIZED ROUND PIEZO ___ LOAD CELLS ___ QUARTZ PIEZO
   ___ CHANNELIZED FLAT PIEZO _X_ INDUCTANCE LOOPS ___ CAPACITANCE PADS
   ___ OTHER (SPECIFY) _____

5. EQUIPMENT MANUFACTURER ___IRD/ PAT Traffic_____

WIM SYSTEM CALIBRATION SPECIFICS**

6.**CALIBRATION TECHNIQUE USED:
   ___ TRAFFIC STREAM -- ___STATIC SCALE (Y/N) _X_ TEST TRUCKS

   ___ NUMBER OF TRUCKS COMPARED __ 2__ NUMBER OF TEST TRUCKS USED

   __ 20__ PASSES PER TRUCK

   TYPE PER FHWA 13 BIN SYSTEM
   SUSPENSION: 1 - AIR; 2 - LEAF SPRING
   3 - OTHER (DESCRIBE)

TRUCK	TYPE	SUSPENSION
1	9	1
2	9	2
3		

7. SUMMARY CALIBRATION RESULTS (EXPRESSED AS A PERCENT)
   MEAN DIFFERENCE BETWEEN ---
   DYNAMIC AND STATIC GVW 1.7 STANDARD DEVIATION 5.1
   DYNAMIC AND STATIC SINGLE AXLES 1.1 STANDARD DEVIATION 6.0
   DYNAMIC AND STATIC DOUBLE AXLES 1.8 STANDARD DEVIATION 5.3

8. 3 ____ NUMBER OF SPEEDS AT WHICH CALIBRATION WAS PERFORMED

9. DEFINE THE SPEED RANGES USED (MPH) _____ 45 50 55 _____ __ __ _____ _____
   _____ _____ _____ _____ _____ _____ _____ _____ _____ _____

10. CALIBRATION FACTOR (AT EXPECTED FREE FLOW SPEED) _____

11.** IS AUTO-CALIBRATION USED AT THIS SITE? (Y/N) _N_
   IF YES, LIST AND DEFINE AUTO-CALIBRATION VALUE: __3900_____
   _____
   _____

CLASSIFIER TEST SPECIFICS***

12.*** METHOD FOR COLLECTING INDEPENDENT VOLUME MEASUREMENT BY VEHICLE CLASS:
   ___ VIDEO _X_ MANUAL ___ PARALLEL CLASSIFIERS

13. METHOD TO DETERMINE LENGTH OF COUNT ___ TIME _X_ NUMBER OF TRUCKS

14. MEAN DIFFERENCE IN VOLUMES BY VEHICLES CLASSIFICATION:
   *** FHWA CLASS 9 ____ -4 FHWA CLASS _5_ ____ ____ 2
   *** FHWA CLASS 8 ____ 33 FHWA CLASS ____ ____ ____ _____
   FHWA CLASS ____ ____ ____ _____
   FHWA CLASS ____ ____ ____ _____
   *** PERCENT "UNCLASSIFIED" VEHICLES: ____ 1.0

PERSON LEADING CALIBRATION EFFORT: __Dean J. Wolf, MACTEC_____
CONTACT INFORMATION: _____301-210-5105_____ rev. November 9, 1999

SHEET 16 **LTPP MONITORED TRAFFIC DATA** **SITE CALIBRATION SUMMARY**	*STATE ASSIGNED ID [__ __ _ __] *STATE CODE [24] *SHRP SECTION ID [0500]

SITE CALIBRATION INFORMATION

1. * DATE OF CALIBRATION (MONTH/DAY/YEAR) [5/14/2008]

2. * TYPE OF EQUIPMENT CALIBRATED ___ WIM ___ CLASSIFIER _X_ BOTH

3. * REASON FOR CALIBRATION
   ___ REGULARLY SCHEDULED SITE VISIT ___ RESEARCH
   ___ EQUIPMENT REPLACEMENT ___ TRAINING
   ___ DATA TRIGGERED SYSTEM REVISION ___ NEW EQUIPMENT INSTALLATION
   _X_ OTHER (SPECIFY) ___LTPP Validation_____

4. * SENSORS INSTALLED IN LTPP LANE AT THIS SITE (CHECK ALL THAT APPLY):
   ___ BARE ROUND PIEZO CERAMIC ___ BARE FLAT PIEZO _X_ BENDING PLATES
   ___ CHANNELIZED ROUND PIEZO ___ LOAD CELLS ___ QUARTZ PIEZO
   ___ CHANNELIZED FLAT PIEZO _X_ INDUCTANCE LOOPS ___ CAPACITANCE PADS
   ___ OTHER (SPECIFY) _____

5. EQUIPMENT MANUFACTURER ___IRD/ PAT Traffic_____

WIM SYSTEM CALIBRATION SPECIFICS**

6.**CALIBRATION TECHNIQUE USED:
   ___ TRAFFIC STREAM -- ___STATIC SCALE (Y/N) _X_ TEST TRUCKS

   ___ NUMBER OF TRUCKS COMPARED __ 2__ NUMBER OF TEST TRUCKS USED

   __ 20__ PASSES PER TRUCK

TYPE PER FHWA 13 BIN SYSTEM SUSPENSION: 1 - AIR; 2 - LEAF SPRING 3 - OTHER (DESCRIBE)	TRUCK	TYPE	SUSPENSION
	1	9	1
	2	9	2
	3		

7. SUMMARY CALIBRATION RESULTS (EXPRESSED AS A PERCENT)
   MEAN DIFFERENCE BETWEEN ---
   DYNAMIC AND STATIC GVW 2.2 STANDARD DEVIATION 3.4
   DYNAMIC AND STATIC SINGLE AXLES 1.5 STANDARD DEVIATION 5.0
   DYNAMIC AND STATIC DOUBLE AXLES 2.3 STANDARD DEVIATION 3.7

8. 3 ____ NUMBER OF SPEEDS AT WHICH CALIBRATION WAS PERFORMED

9. DEFINE THE SPEED RANGES USED (MPH) _____ 45 50 55 _____ __ __ _____ _____
   _____ _____ _____ _____ _____ _____ _____ _____ _____ _____

10. CALIBRATION FACTOR (AT EXPECTED FREE FLOW SPEED) _____

11.** IS AUTO-CALIBRATION USED AT THIS SITE? (Y/N) _N_
   IF YES, LIST AND DEFINE AUTO-CALIBRATION VALUE: __4020_____
   _____
   _____

CLASSIFIER TEST SPECIFICS***

12.*** METHOD FOR COLLECTING INDEPENDENT VOLUME MEASUREMENT BY VEHICLE CLASS:
   ___ VIDEO _X_ MANUAL ___ PARALLEL CLASSIFIERS

13. METHOD TO DETERMINE LENGTH OF COUNT ___ TIME _X_ NUMBER OF TRUCKS

14. MEAN DIFFERENCE IN VOLUMES BY VEHICLES CLASSIFICATION:
   *** FHWA CLASS 9 ____ 0 FHWA CLASS _5_ ____ ____ 0
   *** FHWA CLASS 8 ____ 0 FHWA CLASS ____ ____ ____ _____
   FHWA CLASS ____ ____ ____ _____
   FHWA CLASS ____ ____ ____ _____
   *** PERCENT "UNCLASSIFIED" VEHICLES: ____ 0.0

PERSON LEADING CALIBRATION EFFORT: __Dean J. Wolf, MACTEC_____
CONTACT INFORMATION: _____301-210-5105_____ rev. November 9, 1999

APPENDIX A

Sheet 19	* STATE_CODE	2 4
LTPP Traffic Data	* SPS PROJECT ID	0 5 0 0
*CALIBRATION TEST TRUCK # 1	* DATE	05/13/08

Rev. 08/31/01

Randy 240-674-3317

PART I.

1.* FHWA Class 9 2.* Number of Axles 5 Number of weight days 2

AXLES - units - (lbs)/ 100s lbs / kg

GEOMETRY

8 a) * Tractor Cab Style - Cab Over Engine / (Conventional) b) * Sleeper Cab? Y / (N)

9. a) * Make: KENWORTH b) * Model: _____

10.* Trailer Load Distribution Description:

CLOSE COUNTERWEIGHT OVER TRACTOR TANDEM / TRAILER TANDEM

FORWARD LOADED 2/3 WAY ON TRAILER

11. a) Tractor Tare Weight (units): _____

b). Trailer Tare Weight (units): _____

12.* Axle Spacing – units m / feet and inches / (feet and tenths)

A to B 15.4 B to C 9.5 C to D ~~32.1~~ 33.1

D to E 4.2 E to F _____

Wheelbase (measured A to last) _____ Computed 57.2

13. *Kingpin Offset From Axle B (units) +2.4 (_____)

(+ is to the rear)

SUSPENSION

Axle	14. Tire Size	15.* Suspension Description (leaf, air, no. of leaves, taper or flat leaf, etc.)
A	11R24.5	2 FULL LEAF
B	11R24.5	AIR
C	11R24.5	AIR
D	10R17.5	AIR
E	10R17.5	AIR
F		

Steve House - 301-865-3601

Sheet 19	* STATE_CODE	2 4
LTPP Traffic Data	* SPS PROJECT ID	0 5 0 0
*CALIBRATION TEST TRUCK # 1	* DATE	05/13/2008

Rev. 08/31/01

PART II

Day 1

*b) Average Pre-Test Loaded weight	77460
*c) Post Test Loaded Weight	77120
*d) Difference Post Test – Pre-test	- 340

Table 5. Raw data – Axle scales – pre-test

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
~~1~~	~~37600~~	~~15650~~	~~15650~~	~~12930~~	~~12930~~		~~66920~~
2 1	10060	17050	17050	16660	16660		77480
3 2	10040	17070	17070	16630	16630		77440
Average	10050	17060	17060	16645	16645		77460

Table 6. Raw data – Axle scales –

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1							
2							
3							
Average							

Table 7. Raw data – Axle scales – post-test

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1	9880	17000	17000	16630	16630		77140
2	9860	17000	17000	16620	16620		77100
3							
Average	9870	17000	17000	16625	16625		77120

Measured By _____ Verified By _____ Weight date 5/15/08

Sheet 19	* STATE_CODE	2 4
LTPP Traffic Data	* SPS PROJECT ID	0 5 0 0
*CALIBRATION TEST TRUCK # 1	* DATE	03 / 13 / 2006

Rev. 08/31/01

Day 2

7.2 *b) Average Pre-Test Loaded weight 77450

*c) Post Test Loaded Weight 76990

*d) Difference Post Test – Pre-test -460

Table 5.2. Raw data – Axle scales – pre-test

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1	9920	17170	17170	16600	16600		77460
2	10100	17040	17040	16630	16630		77440
3							
Average	10010	17105	17105	16615	16615		77450

Table 6.2. Raw data – Axle scales –

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1							
2							
3							
Average							

Table 7.2 Raw data – Axle scales – post-test

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1	9800	16960	16960	16630	16630		76980
2	9800	16960	16960	16640	16640		77000
3							
Average	9800	16960	16960	16635	16635		76990

Measured By _____ Verified By _____ Weight date 5/14/08

Sheet 19	* STATE_CODE	2 4
LTPP Traffic Data	* SPS PROJECT ID	0 5 0 0
*CALIBRATION TEST TRUCK # 2	* DATE	03/13/2008

Rev. 08/31/01

PART I.

1.* FHWA Class 9 2.* Number of Axles 5 Number of weight days 2

AXLES - units - (lbs) / 100s lbs / kg

GEOMETRY

8 a) * Tractor Cab Style - Cab Over Engine / (Conventional) b) * Sleeper Cab? Y / (N)

9. a) * Make: INTERNATIONAL b) * Model: _____

10.* Trailer Load Distribution Description:

CONCRETE BLOCKS LOADED OVER TRACTOR AND TRAILER TANDEM

EVENLY LOADED ON TRAILER

11. a) Tractor Tare Weight (units): _____

b). Trailer Tare Weight (units): _____

12.* Axle Spacing – units m / feet and inches / (feet and tenths)

A to B 12.2 B to C 4.3 C to D ~~29.0~~ 28.6

D to E 4.0 E to F _____

Wheelbase (measured A to last) _____ Computed 49.1

13. *Kingpin Offset From Axle B (units) -1.3 (_____)
(+ is to the rear)

SUSPENSION

Axle	14. Tire Size	15.* Suspension Description (leaf, air, no. of leaves, taper or flat leaf, etc.)
A	11R22.5	2 FULL LEAF
B	11R22.5	AIR
C	11R22.5	AIR
D	11R24.5	3 TAPERED LEAF
E	11R24.5	3 TAPERED LEAF
F		

Sheet 19	* STATE_CODE	2 4
LTPP Traffic Data	* SPS PROJECT ID	0 5 0 0
*CALIBRATION TEST TRUCK # 2	* DATE	05/13/2008

Rev. 08/31/01

[illegible] 10 3:11

304-579-7928

PART II

Day 1

*b) Average Pre-Test Loaded weight 66910
*c) Post Test Loaded Weight 66440
*d) Difference Post Test – Pre-test -470

Table 5. Raw data – Axle scales – pre-test

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1	9760	15650	15650	12930	12930		66920
2	9720	15650	15650	12940	12940		66900
3							
Average	9740	15650	15650	12935	12935		66910

Table 6. Raw data – Axle scales –

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1							
2							
3							
Average							

Table 7. Raw data – Axle scales – post-test

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1	9500	15610	15610	12860	12860		66440
2	9540	15580	15580	12870	12870		66440
3							
Average	9520	15595	15595	12865	12865		66440

Measured By NJW Verified By [illegible] Weight date 5/13/08

Sheet 19	* STATE_CODE	2 4
LTPP Traffic Data	* SPS PROJECT ID	0 5 0 0
*CALIBRATION TEST TRUCK # 2	* DATE	

Rev. 08/31/01

Day 2

7.2 *b) Average Pre-Test Loaded weight 66260

*c) Post Test Loaded Weight 65820

*d) Difference Post Test – Pre-test -440

Table 5.2. Raw data – Axle scales – pre-test

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1	9440	15520	15520	12900	12900		66280
2	9420	15550	15550	12860	12840		66240
3							
Average	9430	15535	15535	12880	12880		66260

Table 6.2. Raw data – Axle scales –

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1							
2							
3							
Average							

Table 7.2 Raw data – Axle scales – post-test

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1	9100	15530	15530	12830	12830		65820
2	9100	15520	15520	12840	12840		65820
3							
Average	9100	15525	15525	12835	12835		65820

Measured By DJW Verified By [signature] Weight date 5/14/08

Sheet 20	* STATE_CODE	24
LTPP Traffic Data	*SPS PROJECT_ID	0500
Speed and Classification Checks * 1 of* 2	* DATE	05/13/2008

Rev. 08/31/2001

WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class	WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class
51	9	52922	50	9	47	5	52838	47	5
52	9	52930	51	9	55	5	53245	55	5
49	5	52940	47	5	52	5	53263	52	5
51	9	52942	51	9	60	9	53278	60	9
52	5	52948	51	5	52	5	53281	51	5
53	5	52949	52	5	54	9	53283	54	9
58	9	52955	58	9	57	6	53284	57	6
45	6	52974	46	6	50	9	53287	50	9
58	5	52976	58	5	55	6	53296	55	6
55	9	53006	55	9	56	5	53300	55	5
51	9	53019	50	9	52	9	53322	52	9
59	9	53023	59	9	53	8	53331	52	8
53	9	53027	54	9	50	5	53384	50	5
44	9	53043	43	9	51	5	53330	51	5
57	9	53065	56	9	49	5	53341	49	5
55	9	53119	55	9	52	5	53351	51	5
60	5	53129	60	5	44	5	53370	45	5
52	9	53146	53	9	41	5	53374	46	5
49	5	53159	51	5	52	5	53392	52	5
58	9	53161	57	9	61	5	53383	62	5
56	5	53162	57	5	60	5	53388	59	5
56	9	53171	55	9	56	9	53390	56	9
57	5	53175	56	5	52	5	53394	52	5
55	9	53211	55	9	56	5	53395	56	5
52	9	53226	52	9	51	5	53402	53	6

Recorded by MARK Direction N Lane #1 Time from 10:00 AM to 11:28 AM

Sheet 20	* STATE_CODE	24
LTPP Traffic Data	*SPS PROJECT_ID	0500
Speed and Classification Checks * 2 of* 2	* DATE	05/13/2009

Rev. 08/31/2001

WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class	WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class
50	5	53405	50	5	56	9	53597	56	9
57	8	53427	57	5	54	5	53605	54	5
57	9	53445	57	9	53	9	53611	53	9
54	9	53447	54	9	57	9	53623	57	9
59	5	53473	60	5	54	9	53630	54	9
56	9	53481	55	9	56	9	53669	54	9
62	6	53487	61	6	56	5	53672	55	5
59	5	53493	56	5	52	8	53678	51	8
55	5	53494	55	5	51	15	53679	51	5
56	5	53503	56	5	59	9	53700	59	9
57	9	53509	57	9	59	9	53703	59	9
55	9	53516	54	9	53	5	53713	53	5
64	8	53522	62	8	51	5	53714	51	5
56	9	53532	56	9	49	5	53716	48	5
57	9	53548	58	9	59	9	53727	58	9
63	5	53544	62	5	55	5	53728	56	5
59	5	53557	58	5	59	6	53734	59	6
62	9	53562	61	9	49	5	53748	49	5
52	9	53570	51	9	52	9	53750	51	9
52	6	53575	52	6	61	9	53753	61	9
52	9	53577	52	9	52	9	53756	51	9
57	9	53590	53	9	50	9	53763	49	9
55	5	53592	56	9	52	9	53766	52	9
55	5	53593	55	9	52	9	53769	51	9
57	5	53595	56	5	52	5	53786	53	5

Recorded by MARK Direction N Lane 1 Time from 11:28 to 12:33

Sheet 20	* STATE_CODE	2 4
LTPP Traffic Data	*SPS PROJECT_ID	0 5 0 0
Speed and Classification Checks * 1 of* 2	* DATE	5 / 14 / 08

Rev. 08/31/2001

WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class	WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class
53	9	61285	52	9	57	9	61434	57	9
55	9	61288	54	9	53	9	61446	55	9
53	9	61302	52	9	55	5	61456	56	5
57	5	61311	57	5	60	6	61460	61	6
57	9	61323	55	9	59	5	61462	60	5
60	9	61327	59	9	43	9	61468	46	9
59	9	61331	58	9	42	9	61469	42	9
54	9	61340	54	9	54	9	61472	53	9
52	9	61349	52	9	52	5	61474	52	5
54	9	61352	54	9	51	8	61475	50	8
53	9	61356	53	9	52	9	61479	52	9
52	9	61358	51	9	60	9	61486	59	9
53	8	61363	53	8	58	9	61487	58	9
51	5	61364	51	5	55	9	61493	52	9
51	5	61370	52	5	51	9	61511	49	9
57	9	61373	57	9	48	9	61513	48	9
60	5	61381	61	5	51	8	61517	51	8
57	9	61387	56	9	45	9	61543	47	9
58	5	61391	60	5	47	9	61545	45	9
52	5	61395	54	5	49	5	61549	49	5
61	5	61408	61	5	50	5	61552	51	5
54	5	61421	55	5	57	9	61562	58	9
57	9	61424	58	9	57	5	61573	57	5
56	9	61431	57	9	56	9	61574	56	9
54	6	61433	55	6	53	9	61579	53	9

Recorded by MARK Z Direction N Lane 1 Time from 10:10 AM to 11 AM

Sheet 20	* STATE_CODE	24
LTPP Traffic Data	*SPS PROJECT_ID	0500
Speed and Classification Checks * 2 of* 2	* DATE	5/14/08

Rev. 08/31/2001

WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class	WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class
~~48~~	~~9~~	~~61539~~	~~48~~	~~9~~	60	5	61901	59	5
54	9	61584 61592	54	9	58	8	61902	58	8
54	5	61596	54	5	49	5	61903	49	5
59	5	61639	58	5	49	9	61905	49	9
60	9	61643	61	9	53	5	61907	54	5
50	9	61648	51	9	50	13	61912	50	10
64	9	61662	64	9	49	5	61913	49	5
52	5	61663	53	5	52	5	61918	52	5
52	9	61711	53	9	52	5	61925	51	5
54	9	61721	54	9	57	9	61933	58	9
54	9	61722	54	9	52	9	61940	51	9
46	8	61732	47	8	52	5	61941	51	5
45	5	61734	46	5	55	6	61943	54	6
42	9	61737	~~42~~ 52	9	56	9	61962	55	9
52	5	61751	53	5	65	9	61972	66	9
52	9	61772	53	9	45	5	61988	45	5
53	5	61785	55	5	46	9	61990	46	9
57	5	61786	56	5	52	5	61999	52	5
62	9	61789	62	9	51	5	62004	52	5
56	5	~~61841~~ ~~61856~~	56	5	54	9	62010	54	9
54	9	61842	54	9	52	9	62011	52	9
54	9	61866	54	9	51	7	62013	52	7
55	5	61871	55	5	60	5	62020	60	5
60	9	61873	60	9	54	7	62026	54	9
51	5	61882	51	5	51	9	62028	52	9

Recorded by MARK Z Direction N Lane 1 Time from 11AM to 12:13 PM

Sheet 21	* STATE_CODE 24
LTPP Traffic Data	*SPS PROJECT_ID 0500
WIM System Test Truck Records 1 of 3	* DATE 5/13/08

Pvmt temp	Radar Speed	Truck	Pass	Time	Record No.	WIM Speed	Axle A weight.	Axle B weight.	Axle C weight.	Axle D weight.	Axle E weight.	Axle F weight	GVW	A-B space	B-C space	C-D space	D-E space	E-F space
62	49	1	1	9:58	52815	49	55/48	95/77	94/77	102/77	88/79		79.2	15.5	4.6	33.7	4.2	
62	50	2	1	9:58	52822	50	57/47	98/70	102/68	82/55	66/65		70.7	12.2	4.4	29.2	4.1	
67	51	1	2	10:09	52894	51	55/50	104/78	110/77	108/76	98/76		82.2	15.5	4.6	33.5	4.2	
67	54	2	2	10:09	52895	54	46/41	88/64	88/64	73/55	61/58		63.8	12.1	4.4	29.2	4.1	
69.5	40	1	3	10:22	52969	40	50/41	91/69	86/65	95/65	87/64		71.2	15.5	4.6	33.7	4.2	
69.5	43	2	3	10:22	52971	44	52/54	98/72	95/71	80/61	74/62		71.9	12.2	4.4	29.3	4.1	
73	45	1	4	10:34	53040	45	55/49	95/75	94/76	103/74	84/78		78.3	15.6	4.6	33.7	4.2	
73	49	2	4	10:34	53050	49	48/48	94/66	95/63	74/49	71/58		66.8	12.2	4.4	29.4	4.1	
75	49	1	5	10:46	53106	50	54/49	96/74	97/71	109/72	87/72		77.2	15.6	4.6	33.8	4.2	
75	55	2	5	10:46	53107	55	44/49	98/72	95/72	76/61	75/65		70.7	12.2	4.4	29.2	4.0	
78.5	54	1	6	11:02	53198	54	62/50	105/87	97/87	111.4/87	93/84		86.7	15.5	4.6	33.5	4.2	
78.5	54	2	6	11:02	53199	55	44/43	93/62	95/60	73/53	59/56		63.7	12.2	4.4	29.3	4.1	
79	45	1	7	11:13	53267	45	60/53	102/84	99/86	112/81	99/89		86.6	15.6	4.6	33.8	4.2	
79	46	2	7	11:13	53268	45	52/42	92/64	100/58	75/49	68/58		65.8	12.2	4.4	29.4	4.1	
80.5	40	1	8	11:25	53332	45	58/46	105/73	102/73	112/76	99/71		81.0	15.6	4.6	33.7	4.2	
80.5	48	2	8	11:25	53333	49	51/45	92/62	91/62	75/50	72/58		65.9	12.2	4.4	29.2	4.1	

Recorded by MARK Z.

Checked by

Sheet 21	* STATE_CODE	2 4
LTPP Traffic Data	*SPS PROJECT_ID	0 5 0 0
WIM System Test Truck Records 2 of 3	* DATE	5 / 13 / 08

Pvmt temp	Radar Speed	Truck	Pass	Time	Record No.	WIM Speed	Axle A weight.	Axle B weight.	Axle C weight.	Axle D weight.	Axle E weight.	Axle F weight	GVW	A-B space	B-C space	C-D space	D-E space	E-F space
79	53	1	9	11:45	53446	54	55/45	95/74	90/74	10.6/75	90/78		78.1	15.5	4.6	33.7	4.2	
79	54	2	9	11:45	53448	55	51/45	95/64	9/57	68/53	65/60		65.0	12.2	4.4	29.2	4.1	
88.5	44	1	10	11:57	53514	45	60/52	10.3/64	10.3/87	11.3/81	97/85		86.5	15.6	4.6	33.7	4.2	
88.5	43	2	10	11:57	53515	44	48/44	90/63	92/53	73/53	72/58		65.1	12.2	4.4	29.4	4.1	
88	50	1	11	12:09	53568	50	56/47	97/77	95/76	10.3/76	90/78		79.4	15.6	4.6	33.7	4.2	
88	50	2	11	12:09	53569	50	47/46	97/65	96/60	72/53	77/59		67.1	12.2	4.4	29.3	4.1	
95	54	1	12	13:01	53868	54	55/45	95/78	92/74	102/76	86/78		78.0	15.5	4.6	33.7	4.2	
95	53	2	12	13:01	53869	54	50/40	96/71	96/69	68/62	76/69		70.6	12.2	4.4	29.2	4.0	
98	45	1	13	13:12	53941	45	56/47	93/74	93/75	10.2/73	84/76		77.5	15.5	4.6	33.7	4.2	
98	45	2	13	13:13	53942	45	58/45	98/67	98/64	78/59	72/63		[illegible]	[illegible]	[illegible]	29.2	4.0	
99	49	1	14	13:24	54008	50	52/45	97/68	94/65	100/64	90/70		70.2 / 74.6	12.2 / 15.5	4.6	33.7	4.2	
99	49	2	14	13:24	54011	50	50/49	10.2/72	98/64	80/62	66/61		70.3	12.2	4.4	29.2	4.0	
101.5	53	1	15	13:40	54105	54	58/47	10.2/80	99/77	11.1/80	94/84		82.7	15.5	4.6	33.7	4.2	
101.5	54	2	15	13:40	54107	55	49/45	87/69	87/61	79/56	63/56		64.3	12.2	4.4	29.2	4.1	
96	44	1	16	13:51	54169	44	59/51	99/80	10.0/82	11.1/80	98/82		84.2	15.5	4.8	33.7	4.2	
96	44	2	16	13:51	54173	45	53/37	84/61	83/60	72/54	67/58		62.8	12.2	4.4	29.3	4.1	

Recorded by MARK L.

Checked by

Sheet 21	* STATE_CODE 2 4
LTPP Traffic Data	*SPS PROJECT_ID 0 5 0 0
WIM System Test Truck Records 3 of 3	* DATE 5 / 13 / 08

Pvmt temp	Radar Speed	Truck	Pass	Time	Record No.	WIM Speed	Axle A weight.	Axle B weight.	Axle C weight.	Axle D weight.	Axle E weight.	Axle F weight	GVW	A-B space	B-C space	C-D space	D-E space	E-F space
98.5	49	1	17	14:02	54276	50	55/46	96/71	93/71	10.1/69	89/74		76.4	15.6	4.6	33.7	4.2	
98.5	50	2	17	14:02	54277	50	47/44	93/63	96/57	76/54	74/56		66.0	12.2	4.4	29.2	4.0	
100	54	1	18	14:18	54394	54	59/43	95/69	90/69	10.1/69	87/72		74.5	15.5	4.6	33.7	4.2	
100	54	2	18	14:18	54395	55	44/46	90/63	89/63	74/54	64/55		64.1	12.2	4.4	29.3	4.0	
100	43	1	19	14:29	54486	45	56/47	10.1/76	96/77	10.4/74	93/78		80.1	15.5	4.6	33.7	4.2	
100	44	2	19	14:29	54491	45	47/45	94/63	90/57	72/52	70/61		65.0	12.2	4.4	29.4	4.0	
99.5	50	1	20	14:44	54630	50	55/47	96/73	92/71	10.2/71	87/73	76.5	[illegible]	15.6	4.6	33.7	4.2	
99.5	49	2	20	14:44	54631	49	48/52	98/65	97/62	79/61	76/62		70.2	12.2	4.4	29.3	4.1	

Recorded by MAL Z.

Checked by

Sheet 21	* STATE_CODE 24
LTPP Traffic Data	*SPS PROJECT_ID 0500
WIM System Test Truck Records 1 of X2	* DATE 05/14/2007

Pvmt temp	Radar Speed	Truck	Pass	Time	Record No.	WIM Speed	Axle A weight.	Axle B weight.	Axle C weight.	Axle D weight.	Axle E weight.	Axle F weight	GVW	A-B space	B-C space	C-D space	D-E space	E-F space
55.5	46	1	1	9:02	60742	46	4.8/4.6	9.1/7.2	8.7/7.2	9.5/6.8	9.0/7.4		74.5	16.0	4.7	34.8	4.4	
55.5	49	2	1	9:10	60793	49	4.7/4.1	9.9/5.9	9.2/5.7	7.3/5.2	6.9/5.4		63.8	11.8	4.2	28.3	3.9	
56.0	48	1	2	9:13	60814	49	4.8/4.6	9.6/6.9	9.3/6.8	9.7/6.6	8.5/6.8		73.3	15.3	4.5	33.2	4.2	
56.5	55	2	2	9:20	60871	54	4.1/4.7	8.3/6.9	8.3/6.3	6.9/5.9	6.4/5.6		63.6	12.0	4.3	28.6	4.0	
56.5	54	1	3	9:28	60925	53	50/43	92/73	87/70	10.0/70	83/71		73.8	15.3	4.5	33.1	4.1	
57	44	2	3	9:30	60938	44	46/48	93/66	91/66	73/58	65/61		66.6	12.0	4.3	28.8	4.0	
57.5	44	1	4	9:39	60998	44	53/48	90/74	91/77	10.1/74	81/76		76.5	15.3	4.5	33.2	4.2	
57.5	50	2	4	9:39	60999	49	43/45	90/65	92/60	72/55	66/59		64.7	12.0	4.3	28.8	4.0	
58	49	1	5	9:49	61065	49	49/45	97/69	95/67	10.0/65	86/67		74.1	15.3	4.5	33.1	4.2	
58	55	2	5	9:49	61070	55	51/50	96/68	91/68	71/60	69/64		68.0	12.0	4.3	28.6	4.0	
	49	1	6	9:59	61065	49												
58.5	44	2	6	9:59	61137	44	45/46	89/64	87/60	71/50	71/58		64.1	12.0	4.3	28.8	4.0	
58.5	53	1	6	10:04	61176	53	48/43	93/73	88/71	10.1/69	85/74		74.7	15.3	4.5	33.1	4.1	

Recorded by DJW

Checked by DJW

Sheet 21	* STATE_CODE	2 4
LTPP Traffic Data	*SPS PROJECT_ID	0 5 0 0
WIM System Test Truck Records 1 of 2	* DATE	5 / 14 / 08

Pvmt temp	Radar Speed	Truck	Pass	Time	Record No.	WIM Speed	Axle A weight.	Axle B weight.	Axle C weight.	Axle D weight.	Axle E weight.	Axle F weight	GVW	A-B space	B-C space	C-D space	D-E space	E-F space
60	49	2	7	10:09	61207	49	45/48	95/63	97/64	77/50	68/61		67.6	12.0	4.3	28.8	4.0	
62.5	44	1	7	10:15	61242	44	46/47	98/76	93/77	101/75	84/77		77.5	15.0	4.5	33.2	4.2	
70	43	2	8	10:51	61466	44	47/44	90/63	86/59	65/52	66/57		63.0	12.0	4.3	28.8	4.0	
70	44	1	8	10:51	61467	44	49/46	92/68	91/70	109/65	83/68		73.2	15.3	4.5	33.2	4.2	
72	49	2	9	11:02	61541	49	44/48	96/68	91/70	78/62	71/61		69.0	12.0	4.3	28.7	4.0	
72	49	1	9	11:02	61548	49	57/50	99/76	96/75	103/75	90/76		79.6	15.3	4.5	33.1	4.2	
74	52	2	10	11:13	61595	53	46/43	90/66	90/61	72/56	69/54		64.7	12.0	4.3	28.8	4.0	
74.5	53	1	10	11:18	61620	54	49/43	93/71	91/70	101/68	86/68		74.1	15.3	4.5	33.1	4.2	
77.5	45	2	11	11:23	61644	45	47/44	87/62	87/59	77/55	64/55		63.7	12.0	4.3	28.7	4.0	
77.5	44	1	11	11:28	61672	44	53/46	90/70	95/73	99/69	87/74		75.3	15.3	4.5	33.2	4.2	
78	49	2	12	11:33	61699	49	43/47	91/68	93/65	73/56	76/60		67.1	12.0	4.3	28.7	4.0	
78.5	49	1	12	11:39	61728	49	56/47	94/74	92/72	101/74	82/78		77.1	15.3	4.5	33.2	4.1	
78.5	54	2	13	11:43	61770	54	44/43	88/64	84/62	62/54	64/58		62.3	12.0	4.3	28.7	4.0	

Recorded by MARK Z Checked by BWO

Cal 1

Sheet 21	* STATE_CODE 24
LTPP Traffic Data	*SPS PROJECT_ID 0500
WIM System Test Truck Records 1 of 1	* DATE 5/14/08

Pvmt temp	Radar Speed	Truck	Pass	Time	Record No.	WIM Speed	Axle A weight.	Axle B weight.	Axle C weight.	Axle D weight.	Axle E weight.	Axle F weight	GVW	A-B space	B-C space	C-D space	D-E space	E-F space
78	45	2	1	11:54	61845	44	43/43	89/62	88/60	73/53	62/61		63.4	12.0	4.3	28.8	4.0	
78	54	1	1	11:55	61848	53	50/44	95/70	89/70	102/68	84/70		74.2	15.3	4.5	33.1	4.2	
82	42	21	2	13:40	62501	44	52/42	91/68	93/70	96/64	89/66		73.2	15.3	4.5	33.2	4.2	
82	44	22	2	13:40	62502	44	54/48	87/66	87/67	73/63	57/64		66.0	12.1	4.4	28.8	4.1	
78.5	49	1	3	13:51	62586	49	54/40	96/67	90/65	102/64	84/63		72.5	15.3	4.5	33.2	4.1	
78.5	48	2	3	13:51	62587	49	44/48	89/66	87/64	71/55	67/58		64.9	12.0	4.3	28.9	4.0	
80	52	1	4	14:06	62725	53	49/44	94/63	89/68	104/68	85/66		73.7	15.3	4.5	33.1	4.2	
80	44	2	4	14:07	62726	42	~~49/55~~	~~79/34~~	91/61	71/54	72/62		65.8	12.0	4.3	28.9	4.0	
79.5	44	1	5	14:18	62820	44	46/44 52/46	89/67 85/71	98/73	106/69	92/70		77.2	15.4	4.5	33.3	4.2	
79.5	45	2	5	14:18	62821	44	44/48	67/63	90/62	72/55	69/57		64.7	12.0	4.3	28.8	4.0	
75.5	49	1	6	14:29	62923	48	50/40	97/69	96/67	104/63	93/63		75.0	15.3	4.5	33.1	4.2	
75.5	49	2	6	14:29	62924	49	43/45	88/63	89/61	73/57	69/56		64.2	12.0	4.3	28.8	4.0	
78.5	53	1	7	14:44	63080	53	50/41	93/69	88/66	104/66	89/66		73.2	15.3	4.5	33.1	4.2	
78.5	55	2	7	14:44	63085	54	44/43	85/65	86/66	70/60	68/57		64.4	12.0	4.3	28.7	4.0	

Recorded by MARK E

Checked by

CAL 2

Sheet 21	* STATE_CODE 24
LTPP Traffic Data	*SPS PROJECT_ID 0500
WIM System Test Truck Records 1 of 1	* DATE 5/14/08

Pvmt temp	Radar Speed	Truck	Pass	Time	Record No.	WIM Speed	Axle A weight.	Axle B weight.	Axle C weight.	Axle D weight.	Axle E weight.	Axle F weight	GVW	A-B space	B-C space	C-D space	D-E space	E-F space
78	44	#1	1	14:55	63228	44	59/50	98/81	99/81	11.1/80	91/79	[illegible]	83.0	15.3	4.5	33.1	4.2	
78	45	2	1	14:56	63242	44	45/46	95/69	93/69	72/60	53/66		66.7	12.1	4.3	28.8	4.1	
77	49	1	2	15:07	63394	49	56/47	98/74	96/73	10.3/74	88/72		78.0	15.3	4.5	33.1	4.2	
77	49	2	2	15:08	63400	50	43/46	96/69	98/64	80/57	66/57		67.6	12.0	4.3	28.8	4.0	
74	53	2	3	15:23	63565	54	44/44	89/72	88/67	68/64	61/59		65.7	12.0	4.3	28.7	4.0	
74	53	#1	3	15:23	63566	53	60/47	99/83	94/82	11.1/82	91/83		83.1	15.2	4.5	33.0	4.1	
77.5	44	2	4	15:33	63677	44	47/47	91/61	90/59	72/56	68/58		64.8	12.0	4.3	28.9	4.0	
77.5	44	1	4	15:33	63678	44	52/48	93/72	97/73	10.4/71	93/72		77.6	15.3	4.5	33.2	4.2	
77	49	#2	5	15:44	63814	49	49/47	99/69	109/62	75/55	78/62		69.7	12.0	4.3	28.8	4.0	
77	49	1	5	15:45	63842	49	60/47	99/79	98/78	10.7/80	93/77		81.8	15.3	4.5	33.2	4.2	
77	55	2	6	16:00	64057	55	41/48	86/69	87/63	75/57	61/65		65.2	12.0	4.3	28.8	4.0	
77	53	1	6	16:01	64058	54	50/44	97/74	89/70	10.8/78	89/69		75.9	15.3	4.5	33.1	4.2	

Recorded by MARK Z Checked by BLO

~~CAL 2~~

6420070022_SPSWIM_TO_26_24_2.107_0500_~~Post-Validation~~_Sheet_21.doc

~~[illegible]~~

CAL 3

Sheet 21	* STATE_CODE
LTPP Traffic Data	*SPS PROJECT_ID
WIM System Test Truck Records 1 of 2	* DATE 5/14/08

Pvmt temp	Radar Speed	Truck	Pass	Time	Record No.	WIM Speed	Axle A weight.	Axle B weight.	Axle C weight.	Axle D weight.	Axle E weight.	Axle F weight	GVW	A-B space	B-C space	C-D space	D-E space	E-F space
74	45	2	7	16:11	64212	44	48/49	97/68	93/65	73/59	75/61	[illegible]	68.9	12.0	4.3	28.8	4.0	
74	45	1	7	16:11	64217	44	60/49	106/81	99/83	109/82	96/82		84.6	15.3	4.5	33.2	4.2	
76.5	49	2	8	16:21	64355	49	46/48	90/64	94/64	81/58	69/59		67.3	12.0	4.3	28.8	4.0	
76.5	49	1	8	16:22	64356	49	55/47	102/74	98/73	106/72	92/72		79.2	15.3	4.5	33.2	4.2	
76.5	55	2	9	16:36	64580	54	47/46	90/68	93/63	77/59	56/64		66.4	12.0	4.3	28.8	4.0	
78.5	53	1	9	16:36	64581	53	53/44	96/75	94/72	106/73	90/69		77.0	15.3	4.5	33.1	4.1	
77	44	2	10	16:48	64760	44	46/45	89/62	92/63	74/53	65/61		65.0	12.1	4.3	28.9	4.0	
77	43	1	10	16:48	64775	44	55/42	101/69	97/69	106/64	89/66		75.9	15.3	4.5	33.2	4.2	
75.5	48	2	11	16:58	64914	49	49/47	100/70	99/65	79/58	74/58		70.0	12.0	4.3	28.8	4.0	
75.5	49	1	11	16:59	64929	49	[illegible]	[illegible]82	98/80	109/84	88/80		83.8	15.3	4.5	33.1	4.2	
70.5	55	2	12	17:55	[illegible]789	54	63/50 44/48	103/68	88/63	71/57	64/64		66.0	12.0	4.3	28.7	4.0	
70.5	53	1	12	17:55	790	53	49/43	97/72	90/68	107/70	88/70		75.6	15.3	4.5	33.1	4.2	
72.5	44	2	13	18:06	961	44	51/49	96/70	95/71	72/62	65/61		69.1	12.0	4.3	28.9	4.0	
72.5	44	1	13	18:06	964	44	49/48	92/78	95/81	109/79	86/77		79.1	15.0	4.5	33.2	4.2	
71.5	51	2	14	18:16	1138	49	52/47	99/74	95/71	78/66	74/66		72.2	12.0	4.3	28.7	4.0	
71.5	49	1	14	18:18	1167	49	54/46	97/73	94/74	102/73	91/73		77.7	15.3	4.5	33.2	4.2	

Recorded by MARK Z Checked by _____

64200 700 22 SPSWIM_TO 26 24 2 107 0500 Sheet_21.doc

Post-Validation

Sheet 21	* STATE_CODE
LTPP Traffic Data	*SPS PROJECT_ID
WIM System Test Truck Records 2 of 2	* DATE 5/14/08

Pvmt temp	Radar Speed	Truck	Pass	Time	Record No.	WIM Speed	Axle A weight.	Axle B weight.	Axle C weight.	Axle D weight.	Axle E weight.	Axle F weight	GVW	A-B space	B-C space	C-D space	D-E space	E-F space
70	55	2	15	1833	1405	53	46/45	88/71	86/70	72/61	64/66	[illegible]	67.1	12.0	4.3	28.7	4.0	
70	55	1	15	18:33	1406	52	51/42	97/72	90/69	106/78	88/69		75.4	15.3	4.5	33.1	4.1	
70.5	45	2	16	18:43	1539	45	46/47	94/64	92/66	73/52	66/63		66.2	12.0	4.3	28.8	4.0	
70.5	43	1	16	18:44	1543	44	58/46	94/76	88/78	106/78	92/78		79.5	15.3	4.5	33.3	4.2	
70	49	2	17	18:54	1653	49	45/48	97/66	96/64	80/53	72/60		68.1	12.0	4.3	28.8	4.0	
70	49	1	17	18:55	1677	49	68/46	101/78	98/79	107/82	87/79		81.8	15.3	4.5	33.1	4.1	
69	54	2	18	19:10	1834	54	41/48	92/72	89/64	74/60	56/62		65.8	12.0	4.3	28.8	4.0	
69	54	1	18	19:10	1835	54	56/49	101/79	95/76	110/76	96/76		80.8	15.3	4.5	33.1	4.1	
69.5	46	2	19	19:21	1953	44	47/42	93/63	91/63	74/55	68/57		65.3	12.0	4.3	28.9	4.0	
69.5	44	1	19	19:21	1958	44	57/47	93/76	96/77	109/75	88/77		78.5	15.3	4.5	33.2	4.2	
68	50	2	20	19:32	2062	50	47/46	98/67	99/63	80/56	72/56		68.4	12.0	4.3	28.8	4.0	
68	49	1	20	19:33	2064	49	53/54	98/70	95/69	105/69	90/68		76.0	15.3	4.5	33.2	4.2	

Recorded by MARK Z

Checked by _____

- FOR VALIDATION -

Calibration Worksheet

Site: 240500

Calibration Iteration 1 Date 5-13-08

Beginning factors:

Speed Point (mph)	Name	Left Sensor 1 / ~~3~~	Right Sensor 2 / ~~4~~
Overall			
Front Axle			
Distance	Sens distance	370	
1 – (45)	72 kph	3775	3775
2 – (50)	80 kph	3850	3850
3 – (55)	88 kph	3900	3900
4 – (60)	96 kph	3900	3900
5 – (65)	105 kph	3900	3900

Errors:

	Speed Point 1 (45)	Speed Point 2 (50)	Speed Point 3 (55)	Speed Point 4 ( )	Speed Point 5 ( )
F/A	+2.9	+1.5	-1.4		
Tandem	+2.4	+1.8	+1.3		
GVW	+2.4	+1.7	+0.9		

Adjustments:

	Raise	Lower	Percentage
~~Overall~~ distance	☒	☑	
Front Axle	☐	☐	
Speed Point 1	☒	☒	-2.4
Speed Point 2	☒	☑	-1.7
Speed Point 3	☒	☑	-0.9
Speed Point 4	☐	☐	
Speed Point 5	☐	☐	

End factors:

Speed Point (mph)	Name	Left Sensor 1 / ~~3~~	Right Sensor 2 / ~~4~~
Overall			
Front Axle			
Distance	Sens distance	~~382~~ 368	
1 – (45)	72 kph	3684	3686
2 – (50)	80 kph	3784	3784
3 – (55)	88 kph	3865	3865
4 – (60)	96 kph	3900	3900
5 – (65)	105 kph	3900	3901

Calibration Worksheet

Site: 240500

Calibration Iteration 2 Date 5-14-08

Beginning factors:

Speed Point (mph)	Name	Left Sensor 1 / ~~3~~	Right Sensor 2 / ~~4~~
Overall			
Front Axle			
Distance	~~sen~~ axl sen sep (cm)	364	
1 – (45)	72 kph	3686	3686
2 – (50)	80 kph	3784	3784
3 – (55)	88 kph	3865	3865
4 – (60)	96 kph	3900	3900
5 – (65)	105 kph	3900	3900

Errors:

	Speed Point 1 (45)	Speed Point 2 (50)	Speed Point 3 (55)	Speed Point 4 ( )	Speed Point 5 ( )
F/A	-3.4	-2.7	-5.3		
Tandem	-2.7	-0.3	-3.0		
GVW	-2.8	-0.6	-3.2		

Adjustments:

	Raise	Lower	Percentage
Overall	☐	☐	
Front Axle	☐	☐	
Speed Point 1	☑	☐	1.0 %
Speed Point 2	☑	☐	1.0 %
Speed Point 3	☑	☐	1.0 %
Speed Point 4	☐	☐	
Speed Point 5	☐	☐	

End factors:

Speed Point (mph)	Name	Left Sensor 1 / ~~3~~	Right Sensor 2 / ~~4~~
Overall			
Front Axle			
Distance	2x1 sen sep (cm)	364	
1 – (45)	72 kph	3723	3723
2 – (50)	80 kph	3822	3822
3 – (55)	88 kph	3903	3903
4 – (60)	96 kph	3900	3900
5 – (65)	105 kph	3900	3900

Calibration Worksheet

Site: 240500

Calibration Iteration 3 Date ~~5-14-08~~ 5-14-08

Beginning factors:

Speed Point (mph)	Name	Left Sensor 1 / ~~3~~	Right Sensor 2 / ~~4~~
Overall			
Front Axle			
Distance			
1 – (45)	72 kph	3723	3723
2 – (50)	80 kph	3822	3822
3 – (55)	88 kph	3903	3903
4 – (60)	96 kph	3900	3900
5 – (65)	105 kph	3900	3900

Errors:

	Speed Point 1 (45)	Speed Point 2 (50)	Speed Point 3 (55)	Speed Point 4 ( )	Speed Point 5 ( )
F/A	-2.6	-4.1	-7.5		
Tandem	-2.0	-3.5	-3.8		
GVW	-2.1	-3.7	-4.3		

Adjustments:

	Raise	Lower	Percentage
Overall	☐	☐	
Front Axle	☐	☐	
Speed Point 1	☑	☐	3.0 %
Speed Point 2	☑	☐	3.0 %
Speed Point 3	☑	☐	3.0 %
Speed Point 4	☐	☐	
Speed Point 5	☐	☐	

End factors:

Speed Point (mph)	Name	Left Sensor 1 / ~~3~~	Right Sensor 2 / ~~4~~
Overall			
Front Axle			
Distance			
1 – (45)	72 kph	3835	3835
2 – (50)	80 kph	3937	3937
3 – (55)	88 kph	4020	4020
4 – (60)	96 kph	3900	3900
5 – (65)	105 kph	3900	3900

TEST VEHICLE PHOTOGRAPHS FOR SPS WIM VALIDATION

May 13, 2008

STATE: Maryland

SHRP ID: 240200

Photo 1 24_0500_Truck_1_Tractor_05_13_08.jpg

Photo 2 24_0500_Truck_1_Trailer_05_13_08.jpg

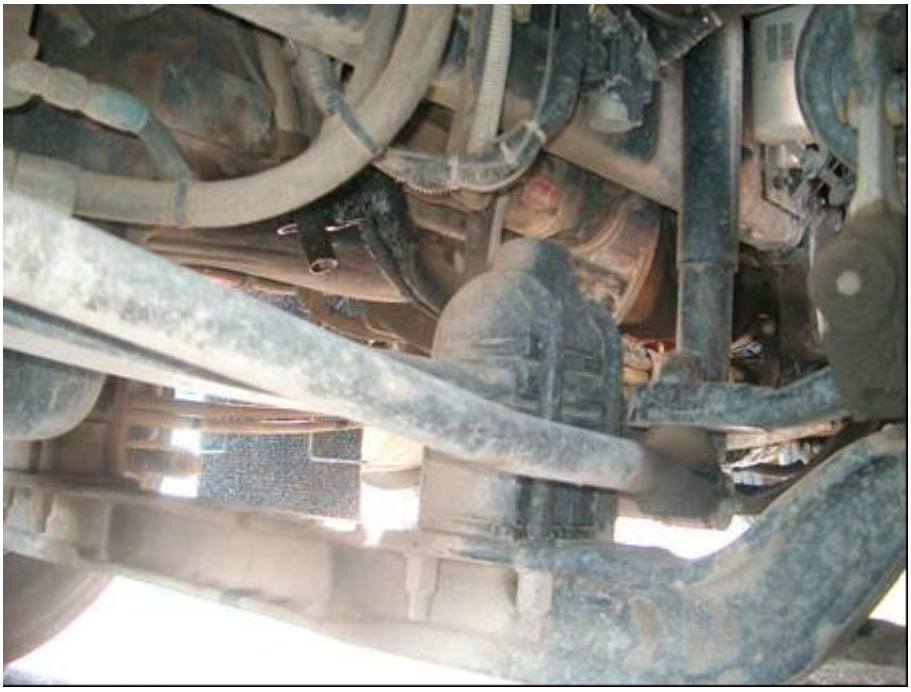

Photo 3 24_0500_Truck_1_Suspension_1_05_13_08.jpg

Photo 4 24_0500_Truck_1_Suspension_2_05_13_08.jpg

Photo 5 24_0500_Truck_1_Suspension_3_05_13_08.jpg

Photo 6 24_0500_Truck_2_Tractor_05_13_08.jpg

Photo 7 24_0500_Truck_2_Trailer_05_13_08.jpg

Photo 8 24_0500_Truck_2_Suspension_1_05_13_08.jpg

Photo 9 24_0500_Truck_2_Suspension_2_05_13_08.jpg

Photo 10 24_0500_Truck_2_Suspension_3_05_13_08.jpg

ETG LTPP CLASS SCHEME, MOD 3

Class	Vehicle Type	No. Axles	Spacing 1	Spacing 2	Spacing 3	Spacing 4	Spacing 5	Spacing 6	Spacing 7	Spacing 8	Gross Weight Min-Max	Axle 1 Weight Min *
1	Motorcycle	2	1.00-5.99								0.10-3.00	
2	Passenger Car	2	6.00-10.10								1.00-7.99	
3	Other (Pickup/Van)	2	10.11-23.09								1.00-7.99	
4	Bus	2	23.10-40.00								12.00 >	
5	2D Single Unit	2	6.00-23.09								8.00 >	2.5
2	Car w/ 1 Axle Trailer	3	6.00-10.10	6.00-25.00							1.00-11.99	
3	Other w/ 1 Axle Trailer	3	10.11-23.09	6.00-25.00							1.00-11.99	
4	Bus	3	23.10-40.00	3.00-7.00							20.00 >	
5	2D w/ 1 Axle Trailer	3	6.00-23.09	6.30-30.00							12.00-19.99	2.5
6	3 Axle Single Unit	3	6.00-23.09	2.50-6.29							12.00 >	3.5
8	Semi, 2S1	3	6.00-23.09	11.00-45.00							20.00 >	3.5
2	Car w/ 2 Axle Trailer	4	6.00-10.10	6.00-30.00	1.00-11.99						1.00-11.99	
3	Other w/ 2 Axle Trailer	4	10.11-23.09	6.00-30.00	1.00-11.99						1.00-11.99	
5	2D w/ 2 Axle Trailer	4	6.00-26.00	6.30-40.00	1.00-20.00						12.00-19.99	2.5
7	4 Axle Single Unit	4	6.00-23.09	2.50-6.29	2.50-12.99						12.00 >	3.5
8	Semi, 3S1	4	6.00-26.00	2.50-6.29	13.00-50.00						20.00 >	5.0
8	Semi, 2S2	4	6.00-26.00	8.00-45.00	2.50-20.00						20.00 >	3.5
3	Other w/ 3 Axle Trailer	5	10.11-23.09	6.00-25.00	1.00-11.99	1.00-11.99					1.00-11.99	
5	2D w/ 3 Axle Trailer	5	6.00-23.09	6.30-35.00	1.00-25.00	1.00-11.99					12.00-19.99	2.5
7	5 Axle Single Unit	5	6.00-23.09	2.50-6.29	2.50-6.29	2.50-6.30					12.00 >	3.5
9	Semi, 3S2	5	6.00-30.00	2.50-6.29	6.30-65.00	2.50-11.99					20.00 >	5.0
9	Truck+FullTrailer (3-2)	5	6.00-30.00	2.50-6.29	6.30-50.00	12.00-27.00					20.00>	3.5
9	Semi, 2S3	5	6.00-30.00	16.00-45.00	2.50-6.30	2.50-6.30					20.00 >	3.5
11	Semi+FullTrailer, 2S12	5	6.00-30.00	11.00-26.00	6.00-20.00	11.00-26.00					20.00 >	3.5
10	Semi, 3S3	6	6.00-26.00	2.50-6.30	6.10-50.00	2.50-11.99	2.50-10.99				20.00 >	5.0
12	Semi+Full Trailer, 3S12	6	6.00-26.00	2.50-6.30	11.00-26.00	6.00-24.00	11.00-26.00				20.00 >	5.0
13	7 Axle Multi's	7	6.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00			20.00 >	5.0
13	8 Axle Multi's	8	6.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00		20.00 >	5.0
13	9 Axle Multi's	9	6.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	20.00 >	5.0

Spacings in feet
Weights in kips (Lbs/1000)
* Suggested Axle 1 minimum weight threshold if allowed by WIM system's class algorithm programming

System Operating Parameters

Maryland SPS-5

Validation Visit – May 14, 2008

Calibration factors for Sensor #1

45 mph – 3835
50 mph – 3937
55 mph – 4020
60 mph – 3900
65 mph – 3900

Calibration factors for Sensor #2

45 mph – 3835
50 mph – 3937
55 mph – 4020
60 mph – 3900
65 mph – 3900

Validation Visit – September 4, 2007

Calibration factors for Sensor #1

45 mph – 3775
50 mph – 3850
55 mph – 3900
60 mph – 3900
65 mph – 3900

Calibration factors for Sensor #2

45 mph – 3775
50 mph – 3850
55 mph – 3900
60 mph – 3900
65 mph – 3900