Validation Report

Colorado, SPS-2
Task Order 22, CLIN 2
October 16 to 17, 2007

List of Tables

List of Figures

1 Executive Summary

A visit was made to the Colorado 0200 on October 16 to 17, 2007 for the purposes of conducting a validation of the WIM system located on I-76, approximately 1 mile north of the Keenesburg exit. The SPS-2 is located in the righthand, northbound lane of a four-lane divided facility. The posted speed limit at this location is 75 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 is located 19.5 miles east of the original installation. This is the second validation visit to this location. The site was installed on April 25 to 27, 2006 by International Road Dynamics (IRD).

This site meets all LTPP precision requirements except speed, which is not considered sufficient to disqualify the site as having research quality data. 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.

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 76,790 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 an air suspension loaded to 64,890 lbs., the "partial" truck.

The validation speeds ranged from 51 to 73 miles per hour. The pavement temperatures ranged from 37 to 66 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 – 080200 – 17-Oct-2007

SPS-1, -2, -5, -6 and -8	95 %Confidence Limit of Error	Site Values	Pass/Fail
Steering axles	±20 percent	-2.3 ± 9.2%	Pass
Tandem axles	±15 percent	1.5 ± 7.8%	Pass
GVW	±10 percent	0.9 ± 5.2%	Pass
Speed	**±1 mph [2 km/hr]**	**0.2 ± 2.1 mph**	**Fail**
Axle spacing	± 0.5 ft [150mm]	0.0 ± 0.1 ft	Pass

Prepared: djw *Checked: bko*

The pavement condition 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. No profile data has been collected at this site since installation. When profile data becomes available for this site, WIMIndex values will be computed and an amended report submitted.

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*

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

2 Corrective Actions Recommended

No corrective actions are required for this site at this time.

3 Post Calibration Analysis

This final analysis is based on test runs conducted October 17, 2007 during the mid-morning to late afternoon hours at test site 080200 on I-76. This SPS-2 site is at milepost 39.7 on the northbound, righthand of a four-lane divided facility. No auto-calibration was used during test runs. The two trucks used for the calibration 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 76,790 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 an air suspension loaded to 64,890 lbs., the "partial" truck.

Each truck made a total of 20 passes over the WIM scale at speeds ranging from approximately 51 to 73 miles per hour. The desired speed range was achieved during this validation. Pavement surface temperatures were recorded during the test runs ranging from about 37 to 66 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.

As shown in Table 3-1, this site met all LTPP requirements for research quality loading data except speed, which is not considered sufficient to disqualify the site as having research quality data.

Table 3-1 Post-Validation Results – 080200 – 17-Oct-2007

SPS-1, -2, -5, -6 and -8	95 %Confidence Limit of Error	Site Values	Pass/Fail
Steering axles	±20 percent	-2.3 ± 9.2%	Pass
Tandem axles	±15 percent	1.5 ± 7.8%	Pass
GVW	±10 percent	0.9 ± 5.2%	Pass
Speed	**±1 mph [2 km/hr]**	**0.2 ± 2.1 mph**	**Fail**
Axle spacing	± 0.5 ft [150mm]	0.0 ± 0.1 ft	Pass

Prepared: djw *Checked: bko*

The test runs were conducted primarily during the mid-morning to late afternoon 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 two temperature groups. 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 – 51 to 57 mph, Medium speed – 58 to 67 mph and High speed – 68 + mph. The two temperature groups were created by splitting the runs between those at 37 to 50 degrees Fahrenheit for Low temperature and 51 to 66 degrees Fahrenheit for High temperature. While the temperature range was nearly thirty degrees there were insufficient data points in the lowest fifteen degrees of the range to support three temperature groups.

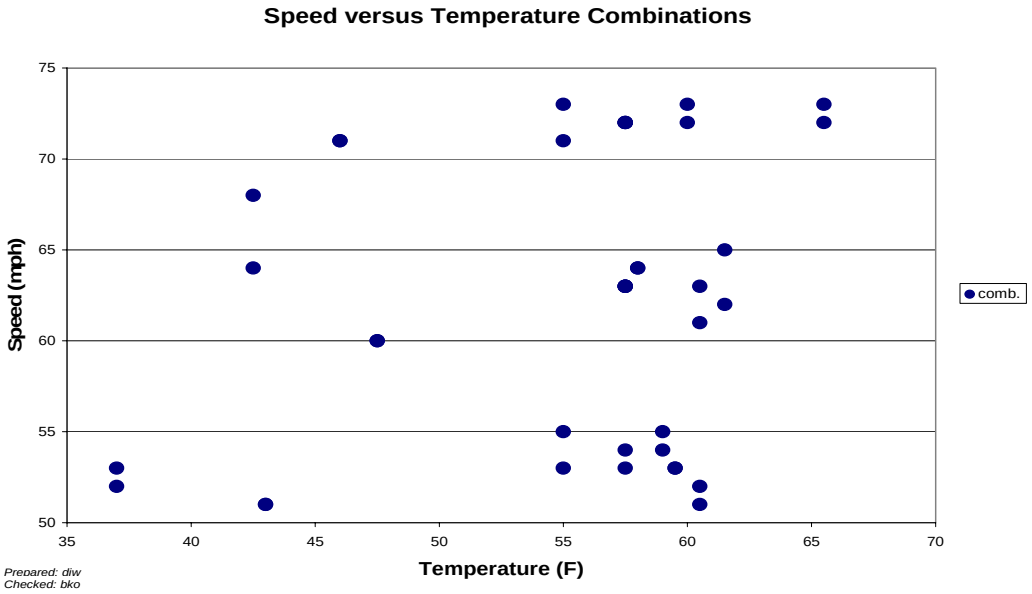

Figure 3-1 Post-Validation Speed-Temperature Distribution – 080200 – 17-Oct-2007

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 that the GVW is generally estimated accurately by the WIM equipment over the entire speed range, with a slight overestimation at the medium and higher speeds. The scatter of error is also greater at the medium and high speeds.

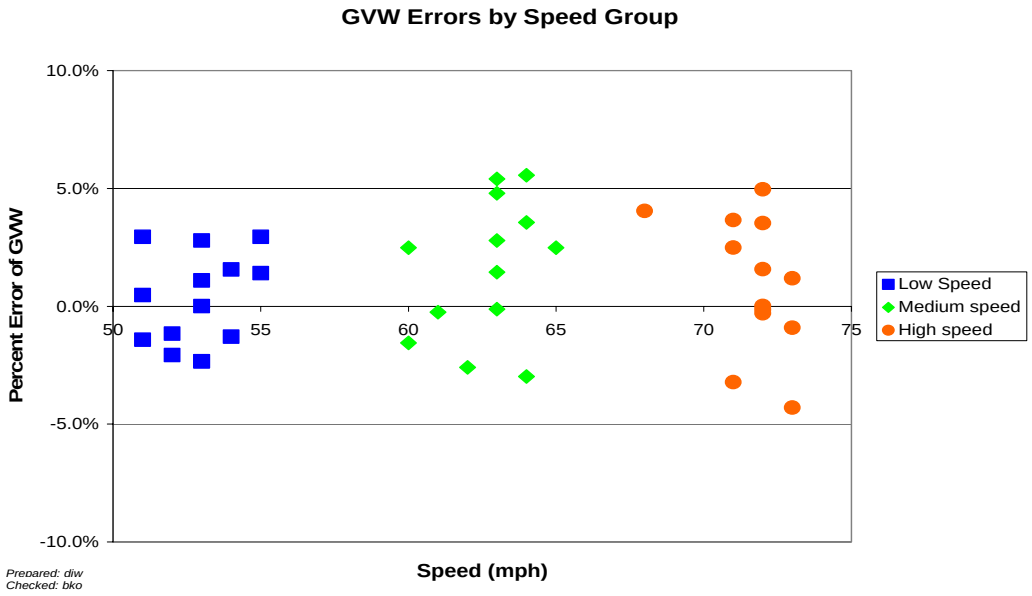

Figure 3-2 Post-validation GVW Percent Error vs. Speed – 080200 – 17-Oct-2007

Figure 3-3 shows the relationship between temperature and GVW percentage error. The graph illustrates that there does not appear to be a relationship between GVW error and pavement temperature.

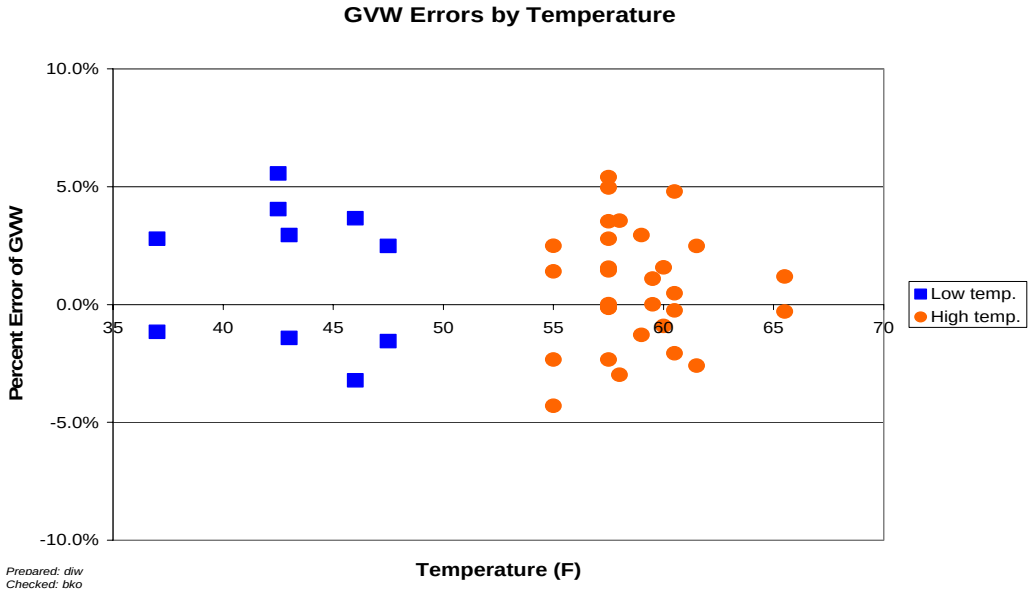

Figure 3-3 Post-Validation GVW Percent Error vs. Temperature – 080200 – 17-Oct-2007

Figure 3-4 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. Axle spacing errors appear to be consistent throughout the test truck speed range and are limited to about 1.2 inches (0.1 feet). Vehicle speeds appear to have no effect on the error of measured axle spacing.

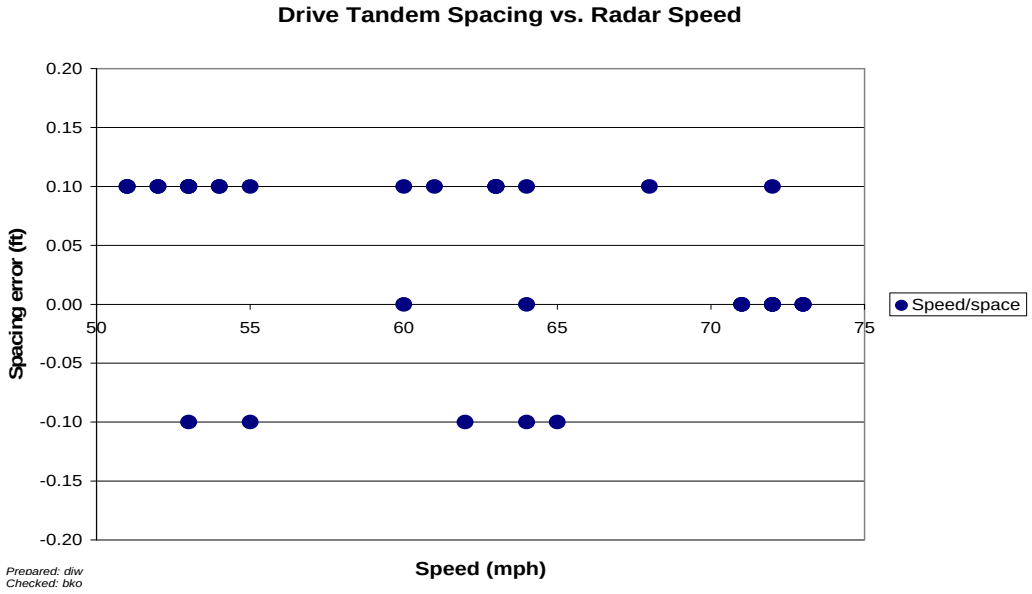

Figure 3-4 Post-Validation Spacing vs. Speed – 080200 – 17-Oct-2007

3.1 Temperature-based Analysis

The two temperature groups were created by splitting the runs between those at 37 to 50 degrees Fahrenheit for Low temperature and 51 to 66 degrees Fahrenheit for High temperature.

Table 3-2 Post-Validation Results by Temperature Bin – 080200 – 17-Oct-2007

Element	95% Limit	Low Temperature 37 to 50 °F	High Temperature 51 to 66 °F
Steering axles	±20 %	0.8 ± 10.2%	-3.3 ± 8.4%
Tandem axles	±15 %	1.6 ± 9.8%	1.5 ± 7.3%
GVW	±10 %	1.4 ± 6.7%	0.7 ± 5.1%
Speed	±1 mph	1.3 ± 2.1 mph	-0.2 ± 1.6 mph
Axle spacing	± 0.5 ft	0.1 ± 0.1 ft	0.0 ± 0.2 ft

Prepared: djw *Checked: bko*

From Table 3-2, it appears that changes in temperature do not significantly affect mean errors of GVW and Tandem axle weight estimates. For steering axles, the equipment appears to underestimate at higher temperatures. The scatter of errors appears to decrease as temperature increases.

Figure 3-5 is the distribution of GVW Errors versus Temperature by Truck graph. GVW estimation appears to be reasonably consistent over the entire temperature range for the population as a whole. The GVW results for both the Golden Truck (squares) and the partially loaded truck (diamonds) indicate similar results for both mean error and scatter.

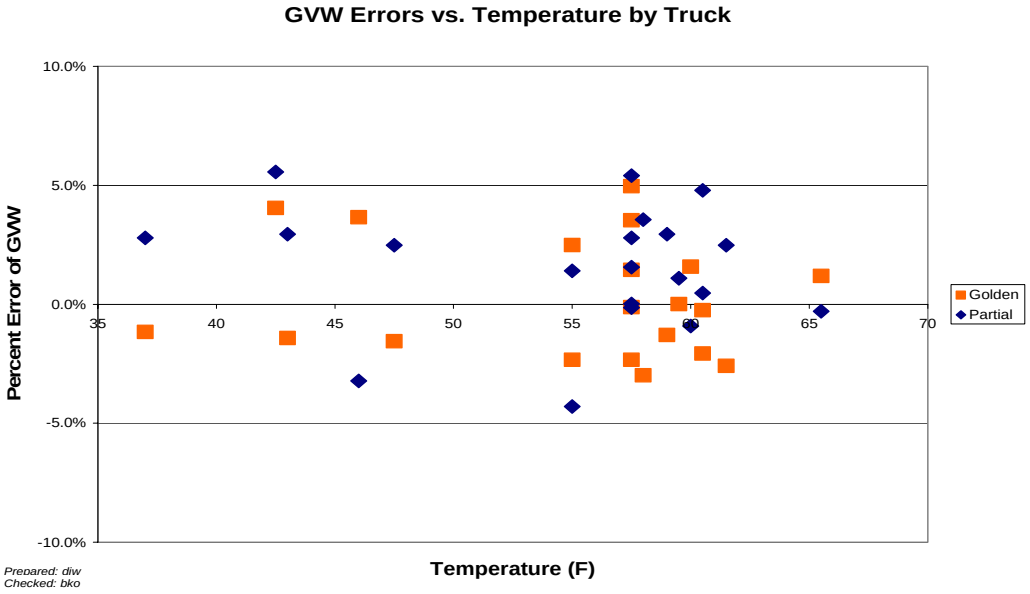

Figure 3-5 Post-Validation GVW Percent Error vs. Temperature by Truck – 080200 – 17-Oct-2007

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. The figure illustrates a tendency for the equipment to underestimate weights of steering axles at the higher pavement temperatures. The tendency may be a reflection of the number of points at the lower end of the observed range.

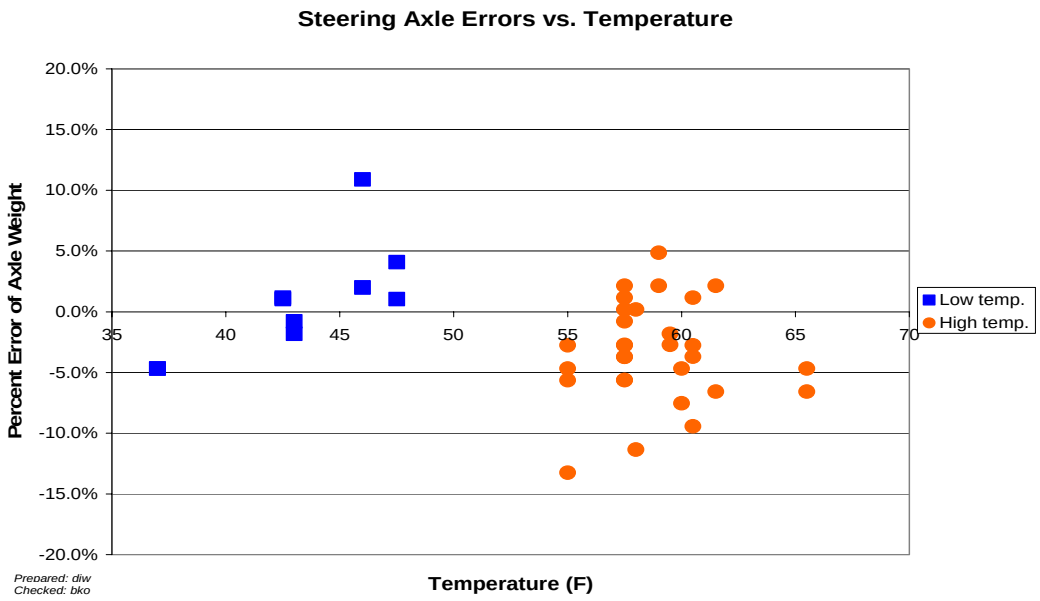

Figure 3-6 Post-Validation Steering Axle Error vs. Temperature by Group – 080200 – 17-Oct-2007

3.2 Speed-based Analysis

The three speed groups were divided using 51 to 57 mph for Low speed, 58 to 67 mph for Medium speed and 68+ mph for High speed.

Table 3-3 Post-Validation Results by Speed Bin – 080200 – 17-Oct-2007

Element	95% Limit	Low Speed 51 to 57 mph	Medium Speed 58 to 67 mph	High Speed 68+ mph
Steering axles	±20 %	-2.7 ± 9.2%	-1.7 ± 10.4%	-2.4 ± 10.7%
Tandem axles	±15 %	0.8 ± 7.3%	2.2 ± 8.5%	1.4 ± 8.3%
GVW	±10 %	0.2 ± 4.3%	1.6 ± 6.4%	1.0 ± 6.1%
Speed	±1 mph	0.4 ± 2.0 mph	0.4 ± 2.7 mph	-0.3 ± 1.9 mph
Axle spacing	± 0.5 ft	0.1 ± 0.2 ft	0.0 ± 0.2 ft	0.0 ± 0.1 ft

Prepared: djw *Checked: bko*

From Table 3-3, it appears that the mean error for Tandem axle weights and GVW is generally larger at the Medium Speed. The equipment underestimates Steering axle weights at all speeds. Error scatter for all weights appears to be greater at Medium and High Speeds when compared with Low Speeds.

Figure 3-7 illustrates the tendency of the WIM equipment to present opposing estimating trends for GVW for each of the two test trucks. For the golden truck, GVW is underestimated at Low and Medium Speeds, and overestimated at the High Speeds. For the partially loaded truck, GVW is overestimated at the Low and Medium Speeds and underestimated at the High Speeds. Scatter in error for each truck and for the truck

population as a whole appear to increase as speed increases. The diverging errors by truck is probably a greater contributor to the observed variability than speed itself.

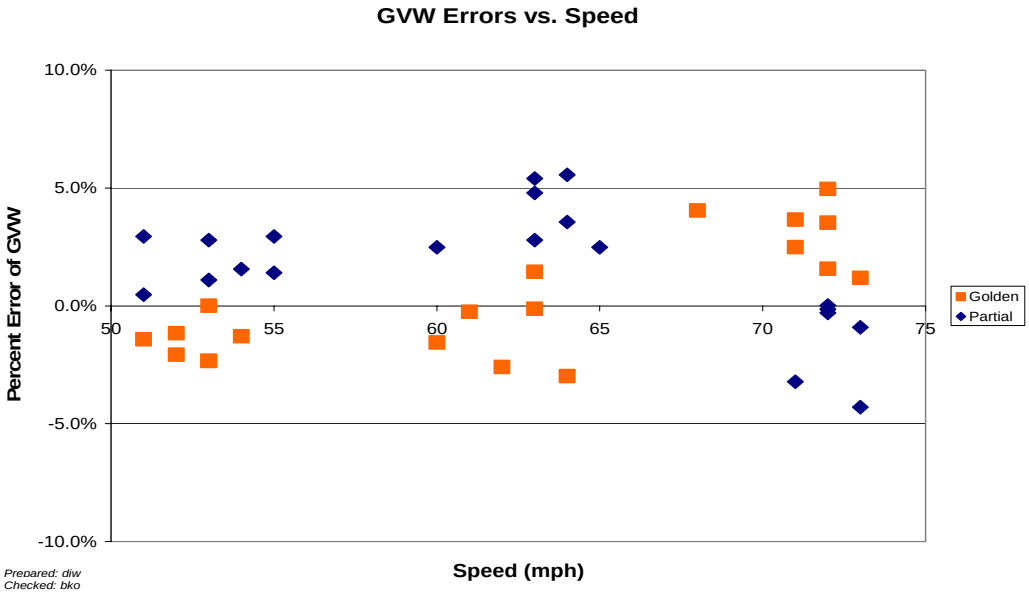

Figure 3-7 Post-Validation GVW Percent Error vs. Speed by Truck – 080200 – 17-Oct-2007

Figure 3-8 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 auto-calibration. This site does not use auto-calibration. The steering axles in this graph are associated only with Class 9 vehicles. Figure 3-8 shows how the WIM equipment generally underestimates steering axle weights at all speeds.

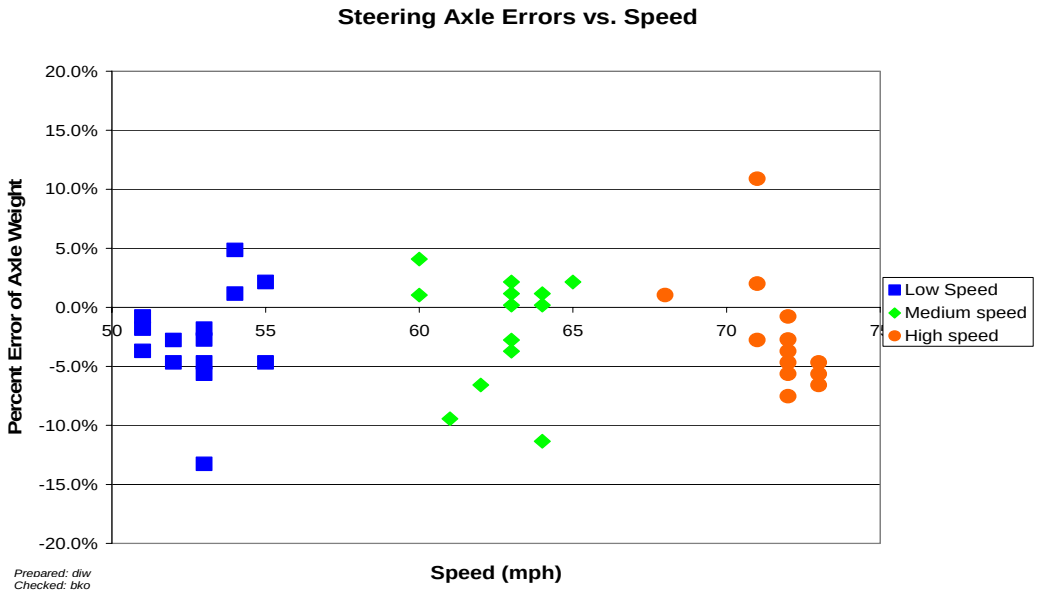

Figure 3-8 Post-Validation Steering Axle Percent Error vs. Speed by Group – 080200 – 17-Oct-2007

3.3 Classification Validation

The agency uses the LTPP ETG Mod 3 algorithm to classify vehicles in the FHWA 13-bin classification scheme at this site. The classification scheme includes a class 15 for unclassified vehicles. At the time of the prior validation, the Mod 2 algorithm was used. **The site was changed to the mod 3 version at an unknown date. The mod 3 version modified classification of Class 3, 4 and 5 vehicles.**

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 a 100 percent 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 percent. The misclassification rate is the result of Class 4 being assigned as a Class 5.

Table 3-4 Truck Misclassification Percentages for 080200 – 17-Oct-2007

Class	Percent Error	Class	Percent Error	Class	Percent Error
4	100	5	11	6	N/A
7	N/A				
8	0	9	0	10	N/A
11	0	12	0	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 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 080200 – 17-Oct-2007

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

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

4.1 Profile Analysis

Profile data collected since the sensor installation were not available as of October 31, 2007. A site visit to collect profile data has not been scheduled yet. An amended report will be submitted when the data is available.

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. Trucks appear to track down the wheel path and daylight cannot be seen between the tires of any of the sensors for the equipment.

5 Equipment Discussion

The traffic monitoring equipment at this location includes bending plate and an iSYNC controller. These sensors are installed in a portland cement concrete pavement.

All equipment and sensors were installed from April 25 to April 27, 2006 as part of the SPS WIM Phase II contract. **The classification algorithm was upgraded from Mod 2 to Mod 3 since the previous validation on June 28, 2006.**

5.1 Pre-Evaluation Diagnostics

A complete electronic and electrical check of all system components including in-road sensors, electrical power, and telephone service were performed immediately prior to the validation. All sensors and system components were found to be operating within acceptable tolerances.

5.2 Calibration Process

The equipment required one-iteration of the calibration process between the initial 40 runs and the final 40 runs.

5.2.1 Calibration Iteration 1

There are 5 speed designated weight compensation factors that are adjusted to directly affect the weight reported by the WIM equipment. To reduce overestimation of weights these factors are reduced by the same percentage of the overestimation, and if the weights are underestimated, these factors are increased by the same percentage as the mean error.

For this equipment, the original compensation factors were:

- 55 mph – 3675
- 60 mph – 3600
- 65 mph – 3550
- 70 mph – 3615
- 75 mph – 3630

As a result of the pre-validation runs, where all weights were generally underestimated, the compensation factors were adjusted as follows:

- 55 mph – increased 0.6% to 3698
- 60 mph – increased 3.2% to 3715
- 65 mph – increased 5.9% to 3759
- 70 mph – increased 5.3% to 3808
- 75 mph – increased 4.8% to 3804

The computations for the changes were made by the Phase I Task Leader. There were no agency personnel on-site to review or execute the modifications. The changes were reviewed by the Principal Investigator.

Results of the first iteration are shown in Table 5-1.

Table 5-1 Calibration Iteration 1 Results – 080200 – 17-Oct-2007 (07:39 AM)

SPS-1, -2, -5, -6 and -8	95 %Confidence Limit of Error	Site Values	Pass/Fail
Steering axles	±20 percent	-1.5 ± 10%	Pass
Tandem axles	±15 percent	0.7 ± 9.5%	Pass
GVW	±10 percent	0.3 ± 7.0%	Pass
Speed	**±1 mph**	**1.1 ± 2.2 mph**	**Fail**
Axle spacing	± 0.5 ft	0.1 ± 0.1 ft	Pass

Prepared: djw *Checked: bko*

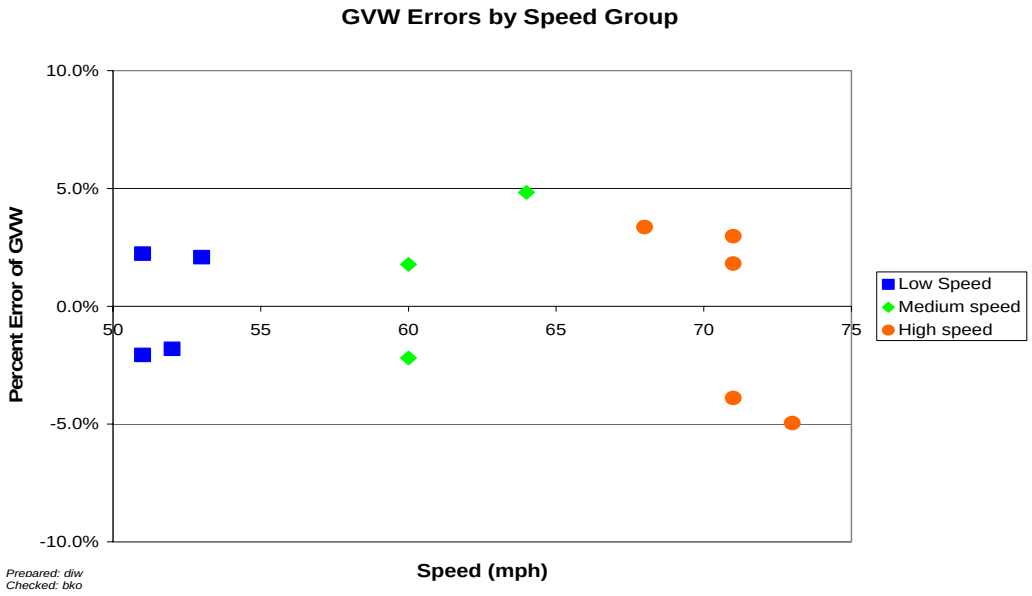

Figure 5-1 Calibration Iteration 1 GVW Percent Error vs. Speed Group – 080200 – 17-Oct-2007 (07:39 AM)

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 5-2 has the information for TRF_CALIBRATION_AVC for Sheet 16s submitted prior to this validation as well as the information for the current visit. There is no Sheet 16 classification information on the prior installation.

Table 5-2 Classification Validation History – 080200 – 17-Oct-2007

Date	Method	Mean Difference				Percent Unclassified
		Class 9	Class 8	Other 1	Other 2	
10/17/2007	Manual	0.0	0.0			0%
10/16/2007	Manual	0.0	0.0			0%
06/28/06	Manual	0.0	0.0			1%
06/27/06	Manual	0.0	0.0			0%

Prepared: djw *Checked: bko*

Table 5-3 has the information for TRF_CALIBRATION_WIM for Sheet 16s submitted prior to this validation as well as the information for the current visit. There is no Sheet 16 weight information on the prior installation.

Table 5-3 Weight Validation History – 080200 – 17-Oct-2007

Date	Method	Mean Error and (SD)		
		GVW	Single Axles	Tandem Axles
10/17/2007	Test Trucks	0.9 (2.6)	-2.3 (4.5)	1.5 (3.9)
10/16/2007	Test Trucks	-3.5 (3.3)	-7.5 (4.7)	-2.8 (4.5)
06/28/06	Test Trucks	-0.6 (1.8)	-1.2 (3.2)	-0.5 (3.1)
06/27/06	Test Trucks	3.3 (2.4)	3.1 (2.8)	3.3 (3.2)

Prepared: djw *Checked: bko*

As a result of the validation performed on June 27, 2006, the compensation factors were decreased by approximately 4% due to the overestimation of GVW presented by the equipment at that time. As a result of the validation performed on October 16, 2007, the compensation factors were increased by a similar percentage due to an underestimation of GVW by the equipment.

5.4 Projected Maintenance/Replacement Requirements

Under a separate contract with the Phase II Contractor, this site is to be visited semi-annually for routine preventive equipment diagnostics and inspection.

No corrective actions are required at this time.

6 Pre-Validation Analysis

This pre-validation analysis is based on test runs conducted October 16, 2007 during the mid-morning to late afternoon hours at test site 080200 on I-76. This SPS-2 site is at milepost 39.7 on the northbound, righthand of a four-lane divided 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 76,910 lbs.
2. 5-axle tractor semi-trailer with a tractor having an air suspension and a trailer with a standard rear tandem and an air suspension loaded to 65,030 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 49 to 73 miles per hour. The desired speed range was achieved during this validation. Pavement surface temperatures were recorded during the test runs ranging from about 42 to 76degrees Fahrenheit. The desired 30 degree Fahrenheit temperature range was achieved. The computed values of 95% confidence limits of each statistic for the total population are in Table 6-1.

As shown in Table 6-1 this site did not meet the GVW and Speed LTPP requirements for research quality loading data. As a result of the GVW failure, it was determined that the equipment would require at least one calibration iteration to bring the equipment to within acceptable performance tolerances.

Table 6-1 Pre-Validation Results – 080200 – 16-Oct-2007

SPS-1, -2, -5, -6 and -8	95 %Confidence Limit of Error	Site Values	Pass/Fail
Steering axles	±20 percent	-7.5 ± 9.5%	Pass
Tandem axles	±15 percent	-2.8 ± 9.0%	Pass
GVW	**±10 percent**	**-3.5 ± 6.6%**	**Fail**
Speed	**±1 mph [2 km/hr]**	**1.1 ± 2.3 mph**	**Fail**
Axle spacing	± 0.5 ft [150mm]	0.0 ± 0.1 ft	Pass

Prepared: djw *Checked: bko*

The test runs were conducted primarily during the mid-morning to late 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 49 to 57 mph for Low speed, 58 to 67 mph for Medium speed and 68+ mph for High speed. The three temperature groups were created by splitting the runs between those at 42 to 54 degrees Fahrenheit for Low temperature, 55 to 66 degrees Fahrenheit for Medium temperature and 67 to 76 degrees Fahrenheit for High temperature.

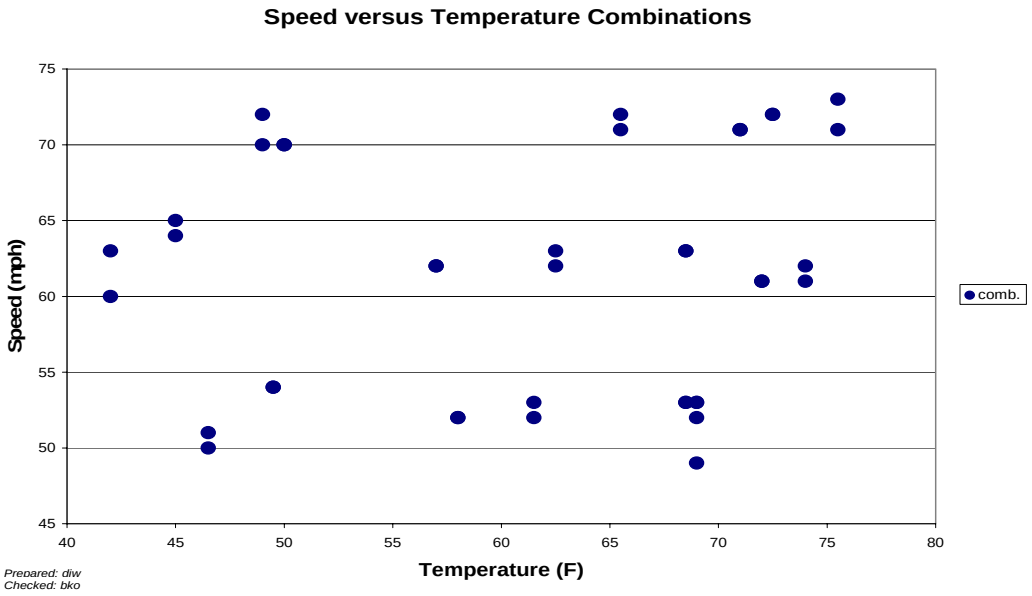

Figure 6-1 Pre-Validation Speed-Temperature Distribution – 080200 – 16-Oct-2007

A series of graphs was developed to investigate visually 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. The equipment appears to underestimate GVW at all speeds, with greater underestimation at Medium and High speeds. Variability in error appears to be slightly greater at the Medium and High Speeds.

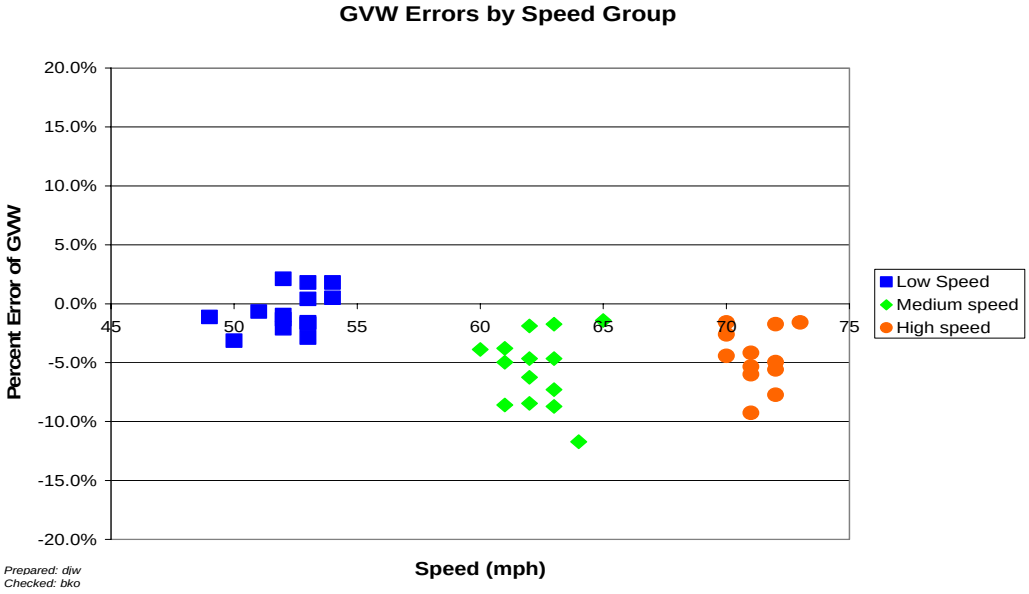

Figure 6-2 Pre-validation GVW Percent Error vs. Speed – 080200 – 16-Oct-2007

Figure 6-3 shows the relationship between temperature and GVW percentage error. From the figure, it appears that the equipment has a tendency to underestimate GVW at all pavement temperatures.

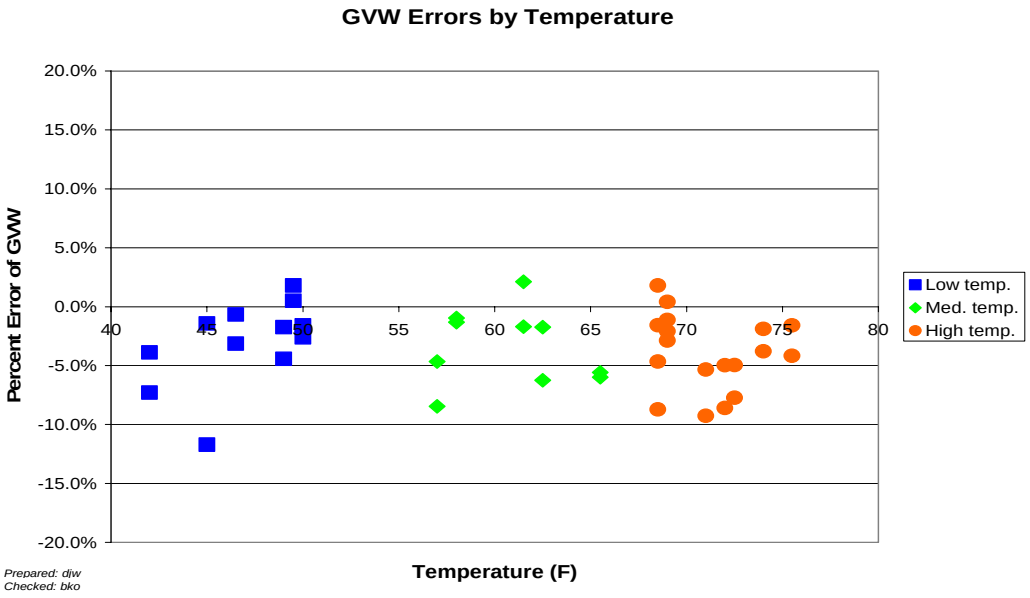

Figure 6-3 Pre-Validation GVW Percent Error vs. Temperature – 080200 – 16-Oct-2007

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. The trend goes from overestimating spacing to underestimating it to unbiased estimates.

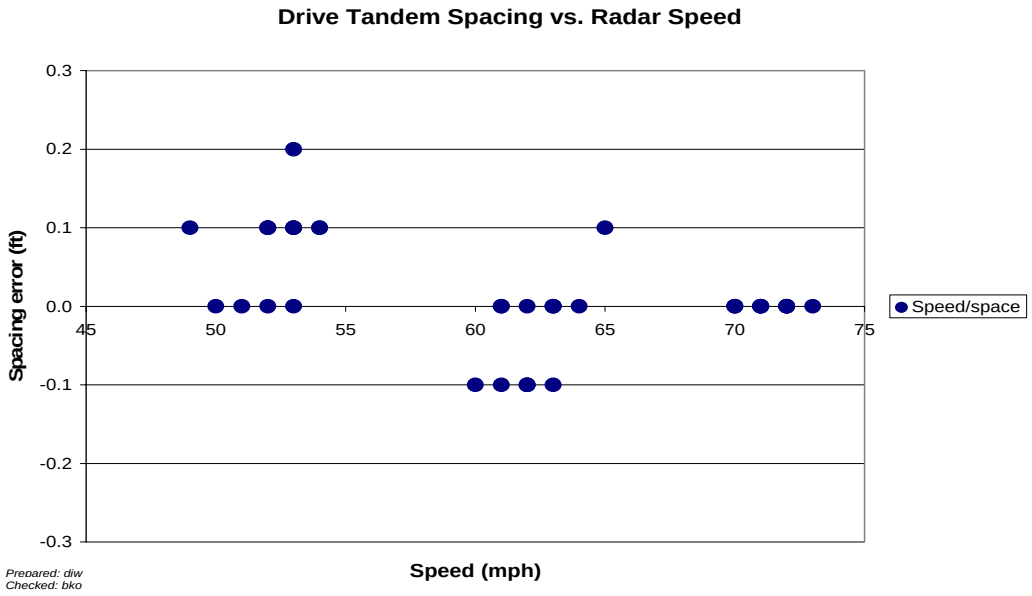

Figure 6-4 Pre-Validation Spacing vs. Speed - 080200 – 16-Oct-2007

6.1 Temperature-based Analysis

The three temperature groups were created by splitting the runs between those at 42 to 54 degrees Fahrenheit for Low temperature, 55 to 66 degrees Fahrenheit for Medium temperature and 67 to 76 degrees Fahrenheit for High temperature.

Table 6-2 Pre-Validation Results by Temperature Bin – 080200 – 16-Oct-2007

Element	95% Limit	Low Temperature 42 to 54 °F	Medium Temperature 55 to 66 °F	High Temperature 67 to 76 °F
Steering axles	±20 %	-7.7 ± 9.9%	-7.3 ± 11.9%	-7.5 ± 10.1%
Tandem axles	±15 %	-2.0 ± 10.6%	-2.7 ± 8.4%	-3.3 ± 9.0%
GVW	±10 %	-3.0 ± 8.0%	-3.5 ± 7.3%	-3.9 ± 6.7%
Speed	±1 mph	1.0 ± 3.1 mph	0.9 ± 1.7 mph	1.3 ± 2.4 mph
Axle spacing	± 0.5 ft	0.0 ± 0.1 ft	0.0 ± 0.2 ft	0.0 ± 0.2 ft

Prepared: djw *Checked: bko*

From Table 6-2, it appears that all weights are increasingly underestimated as temperature increases. Variability in error appears to be reasonably consistent throughout the entire temperature range.

Figure 6-5 shows the distribution of GVW Errors versus Temperature by Truck. The WIM equipment appears to underestimate GVW for both trucks over the course of the entire temperature range. There is no apparent variation in underestimation with temperature.

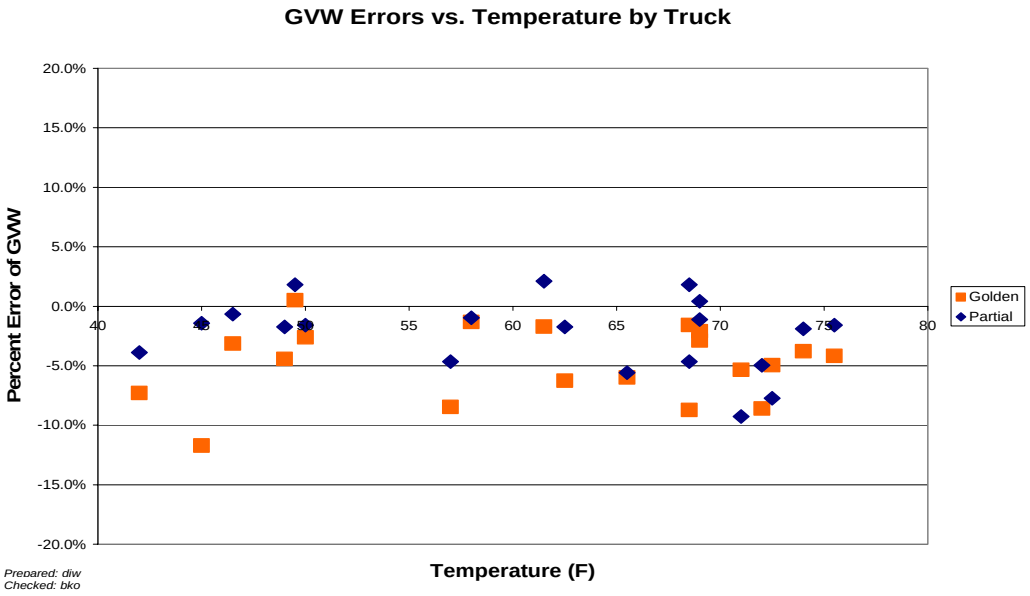

Figure 6-5 Pre-Validation GVW Percent Error vs. Temperature by Truck – 080200 – 16-Oct-2007

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. From the figure, it can be seen that the equipment consistently underestimates steering axle weights at all temperatures. Variability in error appears to be slightly greater at the High temperatures.

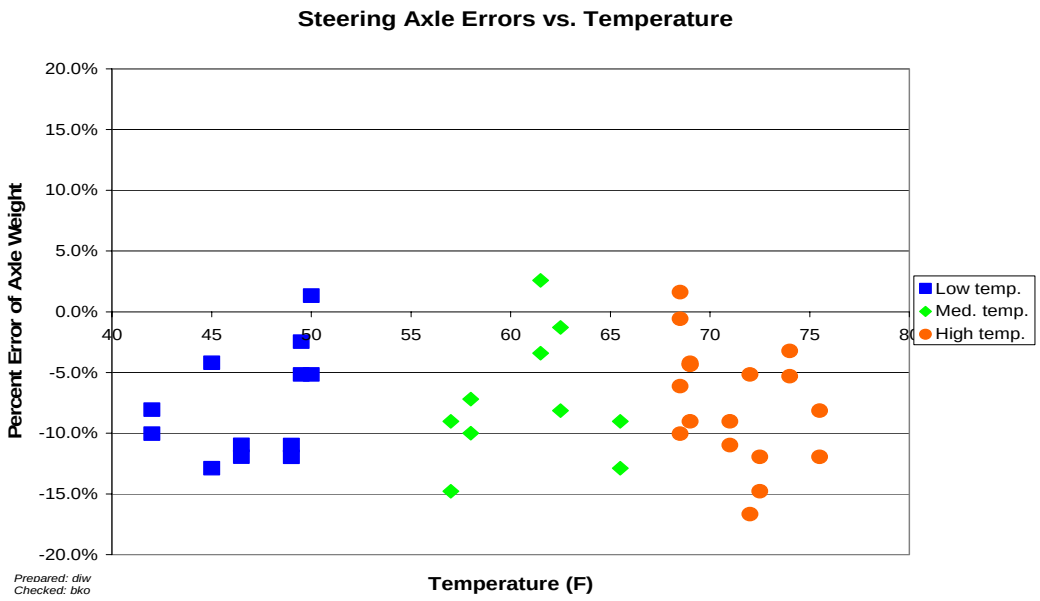

Figure 6-6 Pre-Validation Steering Axle Error vs. Temperature by Group – 080200 – 16-Oct-2007

6.2 Speed-based Analysis

The speed groups were divided as follows: Low speed – 49 to 57 mph, Medium speed – 58 to 67 mph and High speed – 68+ mph.

Table 6-3 Pre-Validation Results by Speed Bin – 080200 – 16-Oct-2007

Element	95% Limit	Low Speed 49 to 57 mph	Medium Speed 58 to 67 mph	High Speed 68+ mph
Steering axles	±20 %	-5.0 ± 9.7%	-8.2 ± 9.6%	-9.6 ± 9.4%
Tandem axles	±15 %	0.3 ± 7.3%	-5.1 ± 7.9%	-3.6 ± 9.1%
GVW	±10 %	-0.6 ± 3.7%	-5.6 ± 6.6%	-4.6 ± 5.4%
Speed	±1 mph	1.2 ± 2.3 mph	1.3 ± 2.9 mph	0.8 ± 2.1 mph
Axle spacing	± 0.5 ft	0.1 ± 0.1 ft	0.0 ± 0.1 ft	0.0 ± 0.0 ft

Prepared: djw *Checked: bko*

From Table 6-3, it appears that for the truck population as a whole, underestimations of all weights are greater at Medium and High speeds when compared with estimates at Low speeds. For Tandem axle weights, variability increases as speed increases. GVW error scatter is greatest at the medium speeds.

Figure 6-7 illustrates the tendency for the equipment to estimate GVW for both trucks with reasonable accuracy at Low speeds and underestimate GVW at Medium and High speeds. Variability in error for the population as a whole appears to be slightly greater at the Medium speeds. Individually, GVW scatter is larger for the partially loaded truck (diamonds) at the High speeds and larger for the Golden Truck (squares) at the Medium speeds.

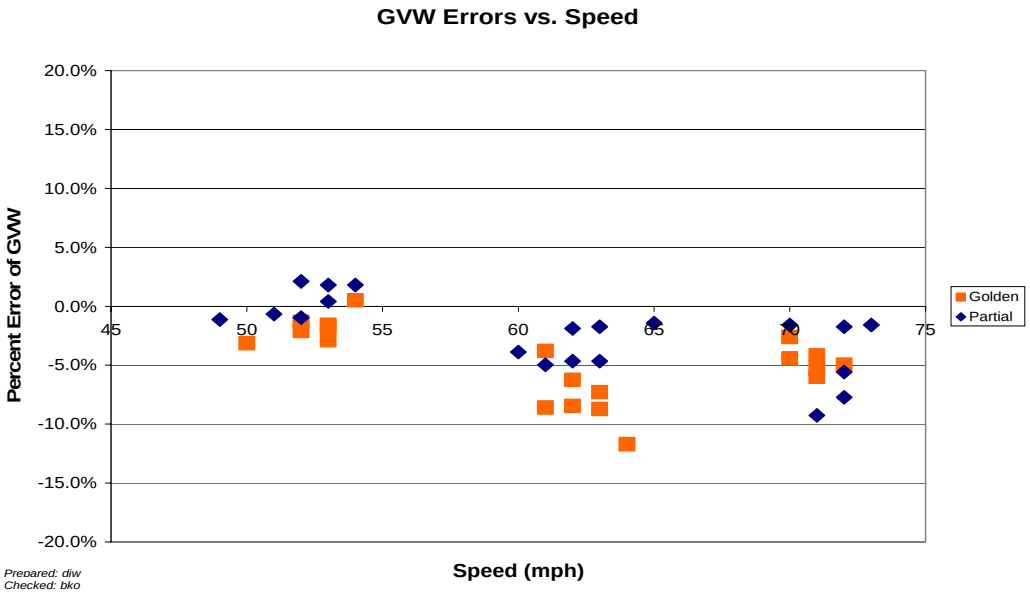

Figure 6-7 Pre-Validation GVW Percent Error vs. Speed Group - 080200 –16-Oct-2007

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. From the figure, it can be seen that the equipment underestimates steering axle weights at all speeds with a greater underestimation at the Medium and High speeds. Scatter of error appears to be reasonably consistent over the entire speed range.

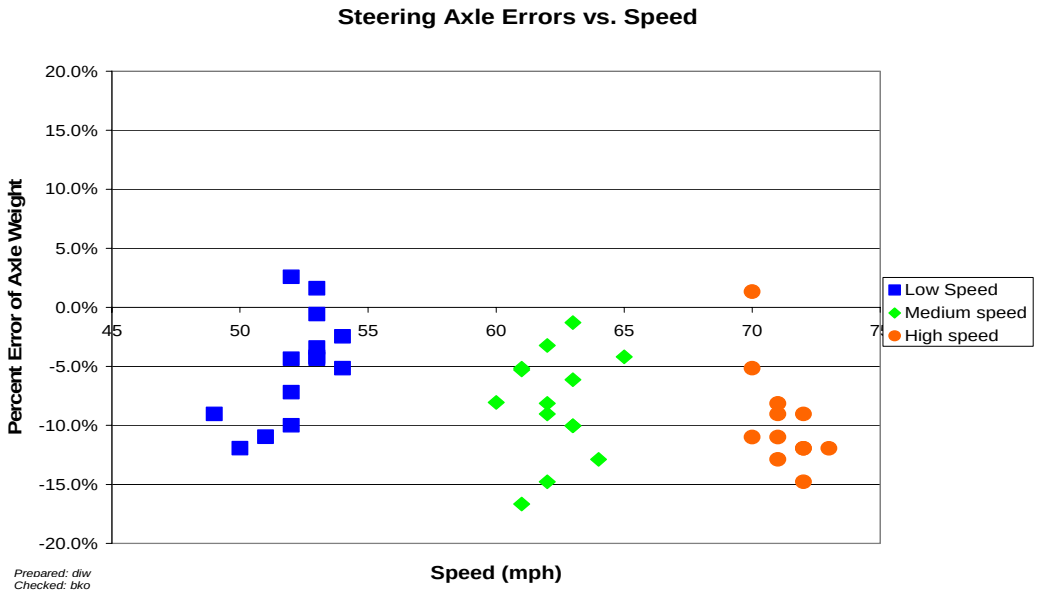

Figure 6-8 Pre-Validation Steering Axle Percent Error vs. Speed Group - 080200 – 16-Oct-2007

6.3 Classification Validation

This site uses the LTPP ETG Mod 3 algorithm to classify vehicles in the FHWA 13-bin classification scheme at this site. The classification scheme includes a class 15 for unclassified vehicles. When this site was originally validated the Mod 2 algorithm was used. **The site was changed to the mod 3 version at an unknown date. The mod 3 version modified classification of Class 3, 4 and 5 vehicles.**

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 a 100 percent 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 6-4 has the classification error rates by class. The overall misclassification rate is zero percent.

Table 6-4 Truck Misclassification Percentages for 080200 – 16-Oct-2007

Class	Percent Error	Class	Percent Error	Class	Percent Error
4	N/A	5	0	6	0
7	N/A				
8	0	9	0	10	N/A
11	0	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 080200 – 16-Oct-2007

Class	Mean Difference	Class	Mean Difference	Class	Mean Difference
4	N/A	5	0	6	0
7	N/A				
8	0	9	0	10	N/A
11	0	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.

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%	98.8%	Pass
GVW	± 10%	97.5%	Pass

Prepared: djw *Checked: bko*

6.5 Prior Validations

The last validation for this site was done June 28, 2006. It was the first 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 75,560 lbs. The "partial" truck which had air suspension on both tandems was loaded to 63,130lbs.

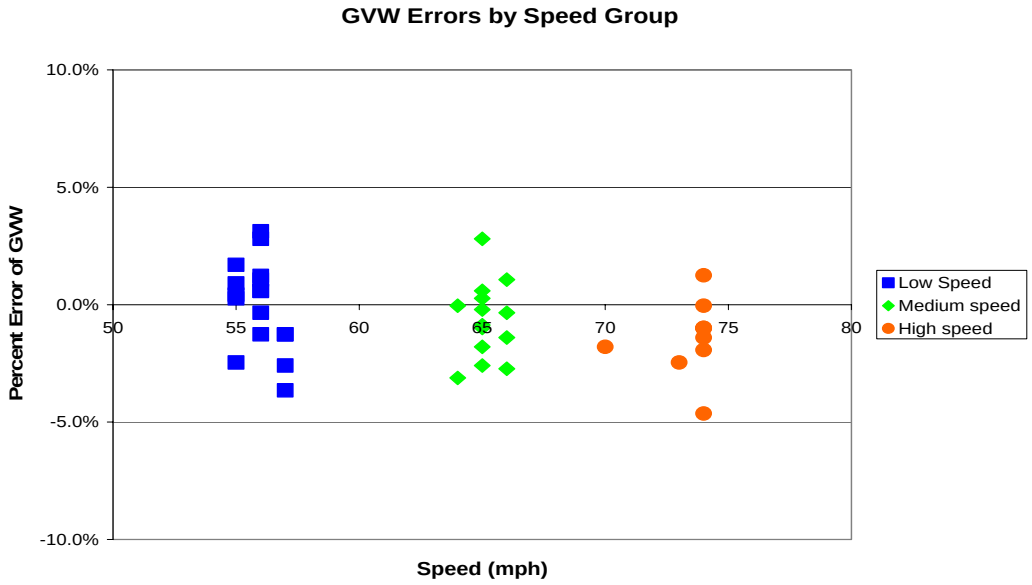

Figure 6-9 Last Validation GVW Percent Error vs. Speed – 080200 – 28-Jun-2006

Table 6-7 shows the overall results from the last validation.

Table 6-7 Last Validation Final Results – 080200 – 28-Jun-2006

SPS-1, -2, -5, -6 and -8	95 %Confidence Limit of Error	Site Values	Pass/Fail
Steering axles	±20 percent	-1.2% ± 6.6%	Pass
Tandem axles	±15 percent	-0.5% ± 6.2%	Pass
Gross vehicle weights	±10 percent	-0.6% ± 3.6%	Pass
Speed	±1 mph [2 km/hr]	-0.1 mph ± 0.8 mph	Pass
Axle spacing	± 0.5 ft [150 mm]	-0.2 ft ± 0.0 ft	Pass

Prepared: djw *Checked: bko*

Table 6-8 shows the results of the last validation by temperature.

Table 6-8 Last Validation Results by Temperature Bin – 080200 – 28-Jun-2006

Element	95% Limit	Low Temperature 75 to 95 °F	High Temperature 96 to 110 °F
Steering axles	±20 %	0.2% ± 5.1%	-1.4% ± 7.0%
Tandem axles	±15 %	-0.6% ± 7.6%	-0.5% ± 6.1%
GVW	±10 %	-0.6% ± 4.4%	-0.6% ± 3.6%
Speed	±1 mph	-0.0 ± 0.0 mph	-0.1 ± 0.8 mph
Axle spacing	± 0.5 ft	-0.2 ft ± 0.0 ft	-0.2 ft ± 0.0 ft

Prepared: djw *Checked: bko*

Weather conditions during the first validation and through this validation have resulted in the equipment being observed at temperatures from 37 to 110 degrees Fahrenheit.

Table 6-9 has the results of the prior post validation by speed groups. The equipment appears to have estimated all weights with reasonable consistency throughout the entire speed range, with a slight underestimation of Steering axle weights at the High speeds.

Table 6-9 Last Validation Results by Speed Bin – 080200 – 28-Jun-2006

Element	95% Limit	Low Speed 55 to 60 mph	Medium Speed 61 to 69 mph	High Speed 70+ mph
Steering axles	±20 %	-1.3% ± 8.0%	0.2% ± 3.1%	-3.0%±7.7%
Tandem axles	±15 %	0.2% ± 6.4%	-1.2% ± 4.9%	-0.9%±7.9%
GVW	±10 %	0.0% ± 4.0%	-0.7% ± 3.5%	-1.4%±3.5%
Speed	±1 mph	-0.1 ± 0.9 mph	-0.2 ± 0.9 mph	-0.0 ± 0.0 mph
Axle spacing	± 0.5 ft	-0.2 ft ± 0.0 ft	-0.2 ft ± 0.0 ft	-0.2 ft ± 0.0 ft

Prepared: djw *Checked: bko*

7 Data Availability and Quality

As of October 16, 2007 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 neither year has a sufficient quantity to be considered complete years of data. **Together with the previously gathered calibration information it can be seen that at least five 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 080200 – 16-Oct-2007

Year	Classification Days	Months	Coverage	Weight Days	Months	Coverage
2006	177	8	Full Week	194	8	Full Week
2007	201	7	Full Week	203	7	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.

Only Class 9s constitute more than 10 percent of the truck population. Based on the data collected from the end of the last calibration iteration 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.

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 – 080200 – 17-Oct-2007

Characteristic	**Class 9**
Percentage Overweights	1.2 %
Percentage Underweights	0.0 %
Unloaded Peak	32,000 lbs
Loaded Peak	78,000 lbs

Prepared: djw *Checked: bko*

The expected percentage of unclassified vehicles is 0.3%. This is based on the percentage of unclassified vehicles in the post-validation data download.

The graphical screening comparison figures are found in Figure 7-1 through Figure 7-3. 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 Sheet 16.

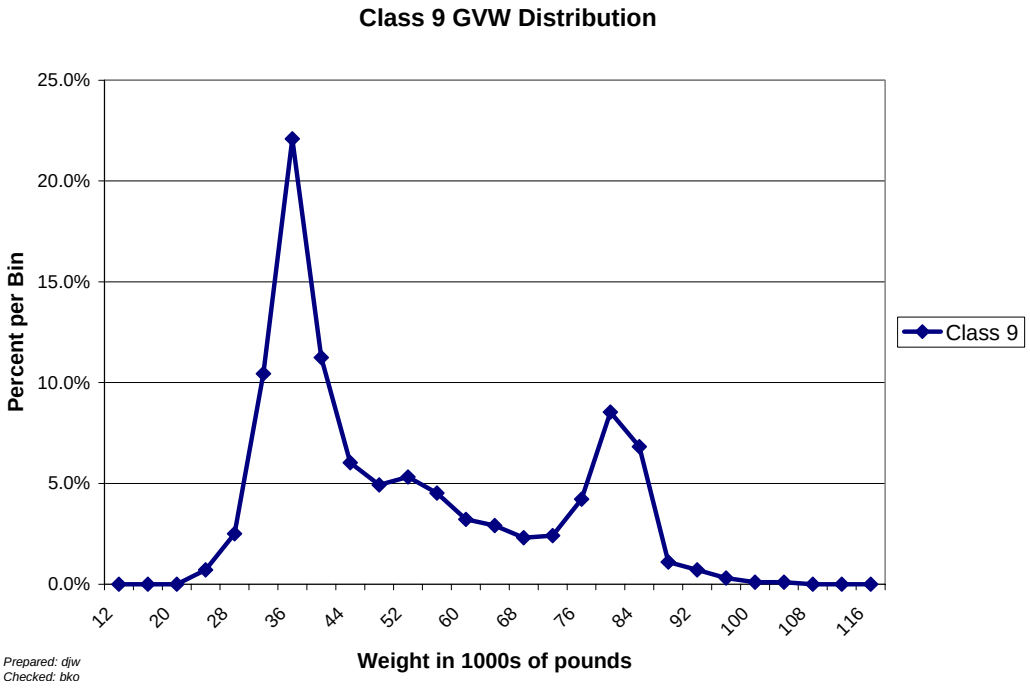

Figure 7-1 Expected GVW Distribution Class 9 – 080200 – 17-Oct-2007

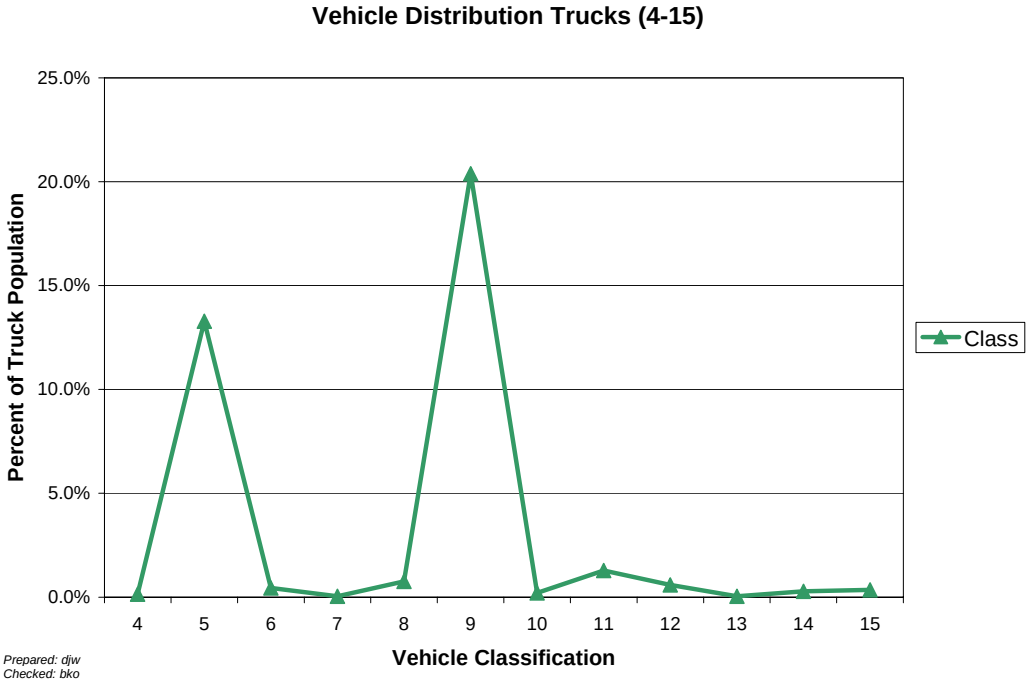

Figure 7-2 Expected Vehicle Distribution – 080200 – 17-Oct-2007

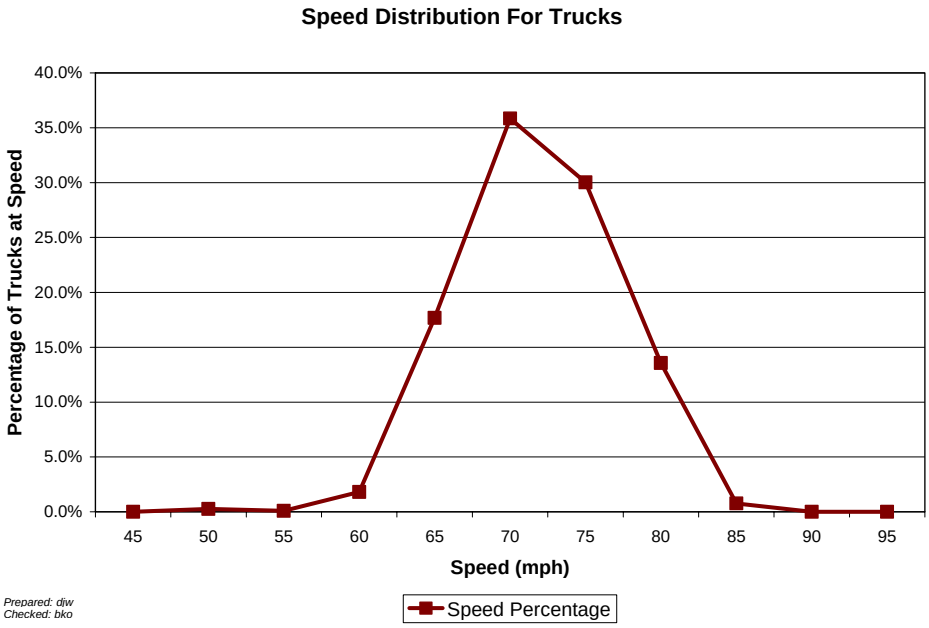

Figure 7-3 Expected Speed Distribution – 080200 – 17-Oct-2007

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 – (1 page)
Sheet 21 – Post-Validation (2 pages)

Calibration Iteration 1 Worksheets – (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 page 29. It includes a current Sheet 17 with all applicable maps and photographs. State contact information has been updated as per information received as a result of this visit.

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 FIELD VALIDATION

STATE: Colorado

SHRP ID: 0200

Figures

1. General Information

SITE ID: *080200*

LOCATION: *Interstate 76 East at M.P. 39.7*

VISIT DATE: *October 16, 2007*

VISIT TYPE: *Validation*

2. Contact Information

POINTS OF CONTACT:

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

Highway Agency: *Skip Outcalt, 303-757-9984, skip.outcalt@dot.state.co.us*

Liz Stolz, 303- 757-9495, elizabeth.stolz@dot.state.co.us

Dave Smith, 303-757-9816, david.e.smith@dot.state.co.us

Roberto DeDios, 303-757-9975, Roberto.DeDios@dot.state.co.us

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

FHWA Division Office Liaison: *Donna Harmelink, 720-963-3021, donna.harmelink@fhwa.dot.gov*

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

3. Agenda

BRIEFING DATE: *Briefing not requested for this visit.*

ON SITE PERIOD: *October 16, 2007 through October 17, 2007 beginning at 9:00 a.m.*

TRUCK ROUTE CHECK: *See truck route.*

4. Site Location/ Directions

NEAREST AIRPORT: *Denver International Airport, Denver, Colorado*

DIRECTIONS TO THE SITE: *I-76, approximately 1.0 mile East of Exit 39 (Keenesburg)*

MEETING LOCATION: *October 16, 2007 on site beginning at 9.00 a.m.*

WIM SITE LOCATION: *Interstate 76 East at M.P. 39.7 (Latitude: N 40.1183^0 and Longitude: W -104.5083^0)*

WIM SITE LOCATION MAP: *See Figure 4.1*

Figure 4-1 - Site 080200 in Colorado

5. Truck Route Information

ROUTE RESTRICTIONS: *None.*

SCALE LOCATION: *Tomahawk Truck Stops, 12060 Sable Blvd, Brighton, CO, I-76, exit 17; Latitude: 39.9154^0, Longitude: -104.8181^0; Phone No: (303) 659-0810, open 24 hours and 7days a week, $8.00 per weight.*

TRUCK ROUTE:

North to Exit 48, approximately 8.3 miles from the site
South to Exit 34, approximately 5.4 miles from the site

Total miles = 27.4

Total time = 25 minutes

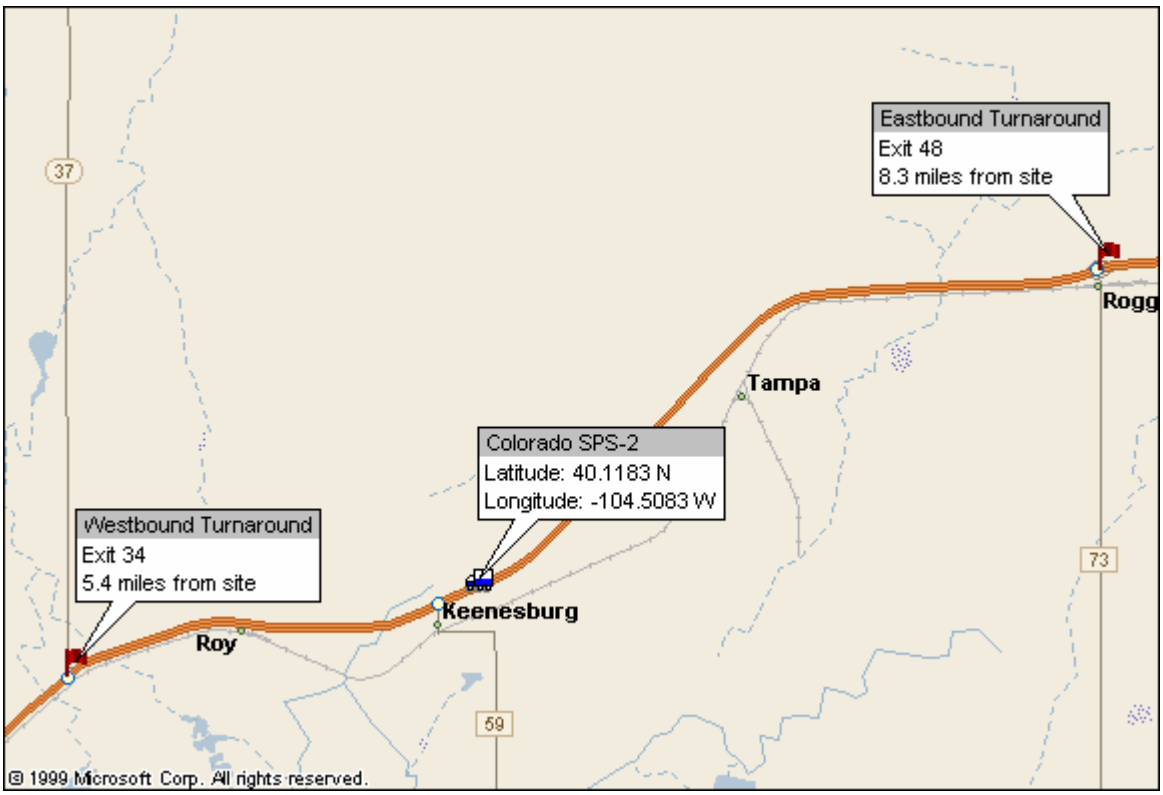

Figure 5-1 - Truck Route for 080200 in Colorado

6. Sheet 17 – Colorado (080200)

1.* ROUTE ___I-76___MILEPOST _39.7____LTPP DIRECTION - N S E W

2.* WIM SITE DESCRIPTION - Grade ___<1___ % Sag vertical Y / N
Nearest SPS section upstream of the site __0_8_0_2_2_3__
Distance from sensor to nearest upstream SPS Section __1_9_._2__ miles

3.* LANE CONFIGURATION
Lanes in LTPP direction _2___ Lane width _1_2_ 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 __1_0__ ft

4.* PAVEMENT TYPE ____PCC_____

5.* PAVEMENT SURFACE CONDITION – Distress Survey
Date 10/22/2007__ Photo Filename: 08_0200_Upstream_10_16_07.jpg_____
Date 10/22/2007__ Photo Filename: 08_0200_Downstream_10_16_07.jpg_____
Date _____Distress Photo Filename _____

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 ___ __ 4.0 ___ 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 _4_5__ ft

Distance from system _5_5_ __ ft

TYPE ____M_____

CABINET ACCESS controlled by LTPP / STATE / JOINT?

Contact - name and phone number _Dave Price (303) 757-9976_____

Alternate - name and phone number_Liz Stulz (303) 757-9495 ___

11. * POWER

Distance to cabinet from drop _2_8_7_____ ft Overhead / underground / solar / AC in cabinet?

Service provider _____ Phone number_____

12. * TELEPHONE

Distance to cabinet from drop __2_2_8___ ft Overhead / underground / cell?

Service provider _____ Phone Number_____

13.* SYSTEM (software & version no.)-___iSINC_____

Computer connection – RS232 / Parallel port / USB / Other _____

14. * TEST TRUCK TURNAROUND time __25__ minutes DISTANCE _28_ mi.

15. PHOTOS FILENAME

Power source	08_0200_Power_Service_10_16_07.jpg
Phone source	08_0200_Telephone_Drop_10_16_07.jpg
	08_0200_Telephone_Pedestal_10_16_07.jpg
Cabinet exterior	08_0200_Cabinet_Exterior_10_16_07.jpg
Cabinet interior	08_0200_Cabinet_Interior_Front_10_16_07.jpg
	08_0200_Cabinet_Interior_Back_10_16_07.jpg
Weight sensors	08_0200_Leading_WIM_Sensor_10_16_07.jpg
	08_0200_Trailing_WIM_Sensor_10_16_07.jpg
Other sensors	08_0200_Leading_Loop_Sensor_10_16_07.jpg
	08_0200_Trailing_Loop_Sensor_10_16_07.jpg

Description _Loops _____

Downstream direction at sensors on LTPP lane:

08_0200_Downstream_10_16_07.jpg

Upstream direction at sensors on LTPP lane:

08_0200_Upstream_10_16_07.jpg

COMMENTS __

_____Gas/Restaurants at exit 39, approximately 1 mile west of site_____

COMPLETED BY _____Dean J. Wolf_____

PHONE __301-210-5105__DATE COMPLETED _1_0_ /_1_6_ /_2_0_0_7_ __

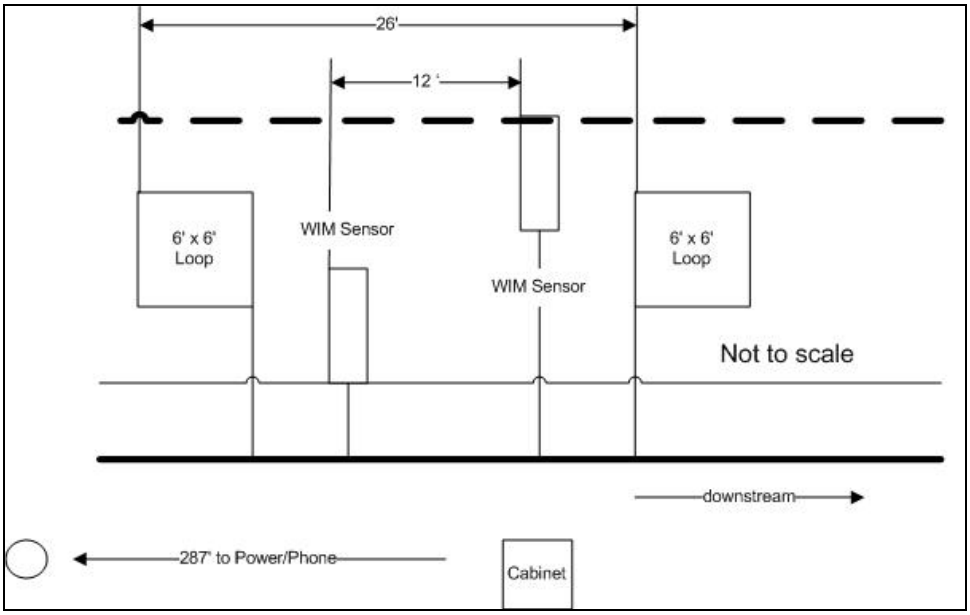

Figure 6-1 Sketch of equipment layout

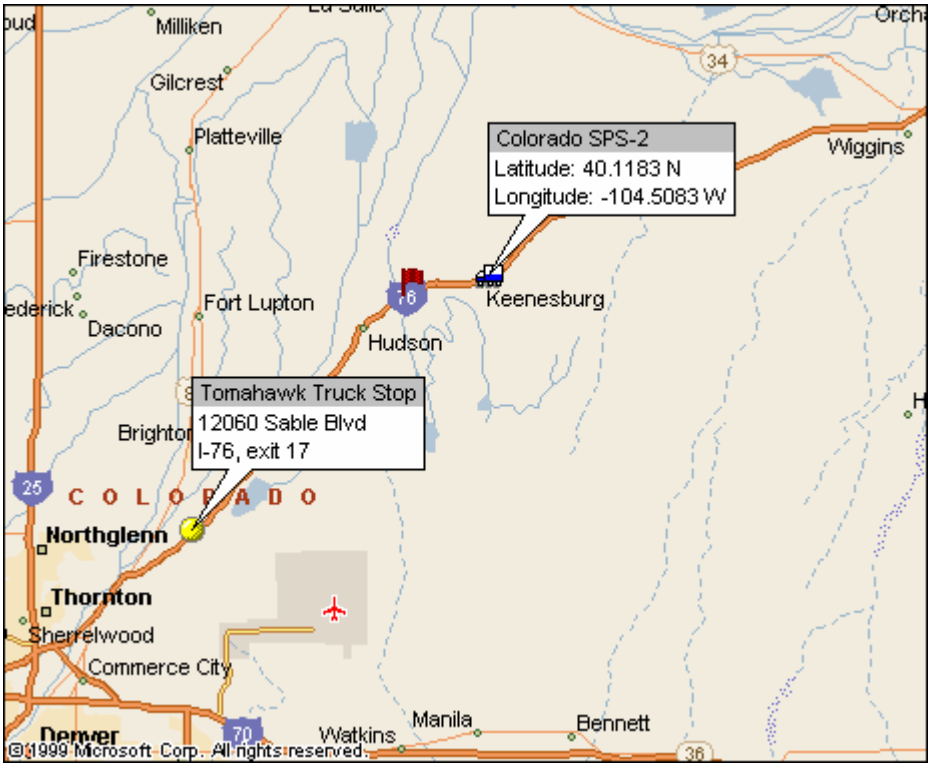

Figure 6-2 - Site Map for 080200 in Colorado

Photo 6-1 08_0200_Upstream_10_16_07.jpg

Photo 6-2 08_0200_Downstream_10_16_07.jpg

Photo 6-3 08_0200_Power_Service_10_16_07.jpg

Photo 6-4 08_0200_Telephone_Drop_10_16_07.jpg

Photo 6-5 08_0200_Telephone_Pedestal_10_16_07.jpg

Photo 6-6 08_0200_Cabinet_Exterior_10_16_07.jpg

Photo 6-7 08_0200_Cabinet_Interior_Front_10_16_07.jpg

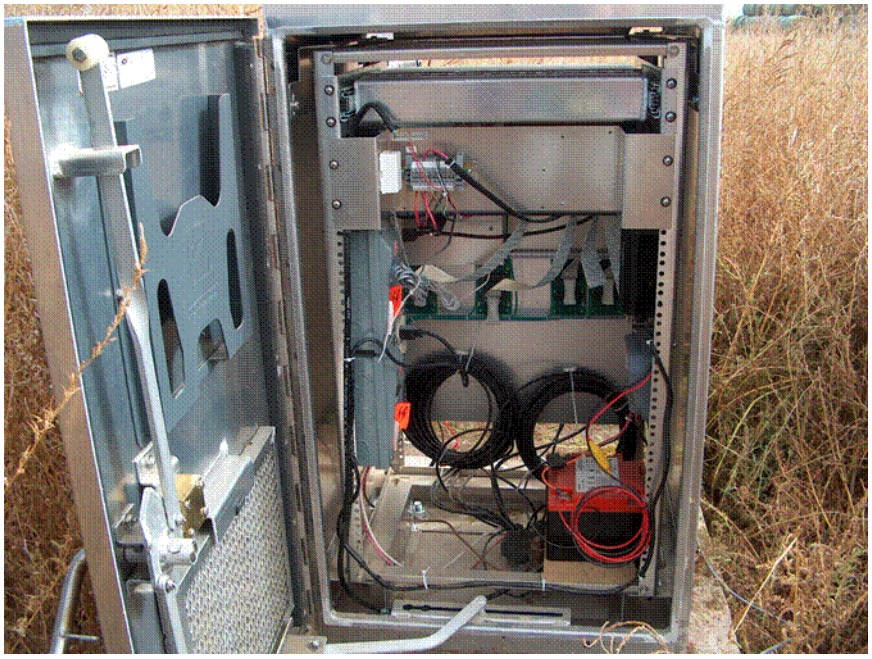

Photo 6-8 08_0200_Cabinet_Interior_Back_10_16_07.jpg

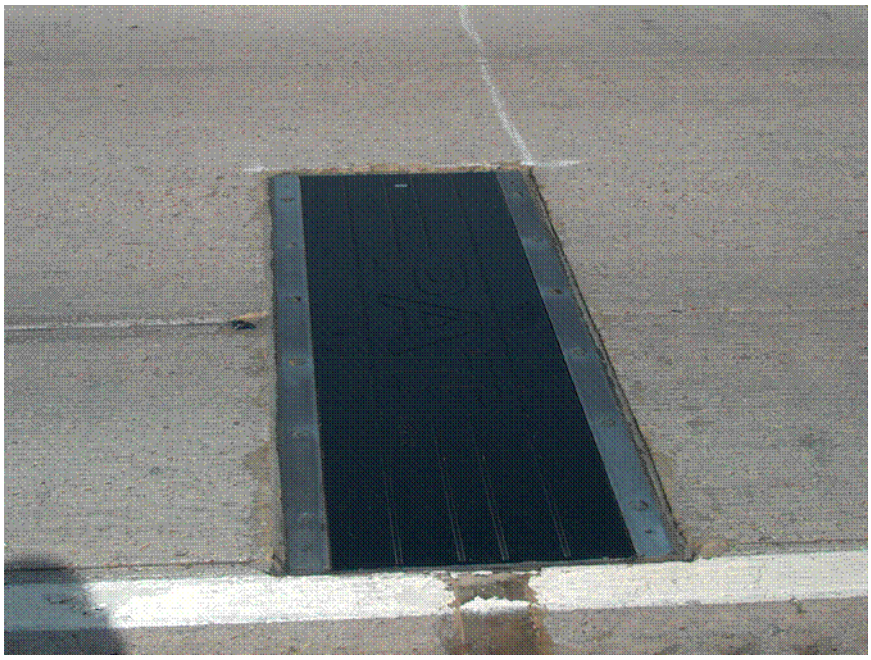

Photo 6-9 08_0200_Leading_WIM_Sensor_10_16_07.jpg

Photo 6-10 08_0200_Trailing_WIM_Sensor_10_16_07.jpg

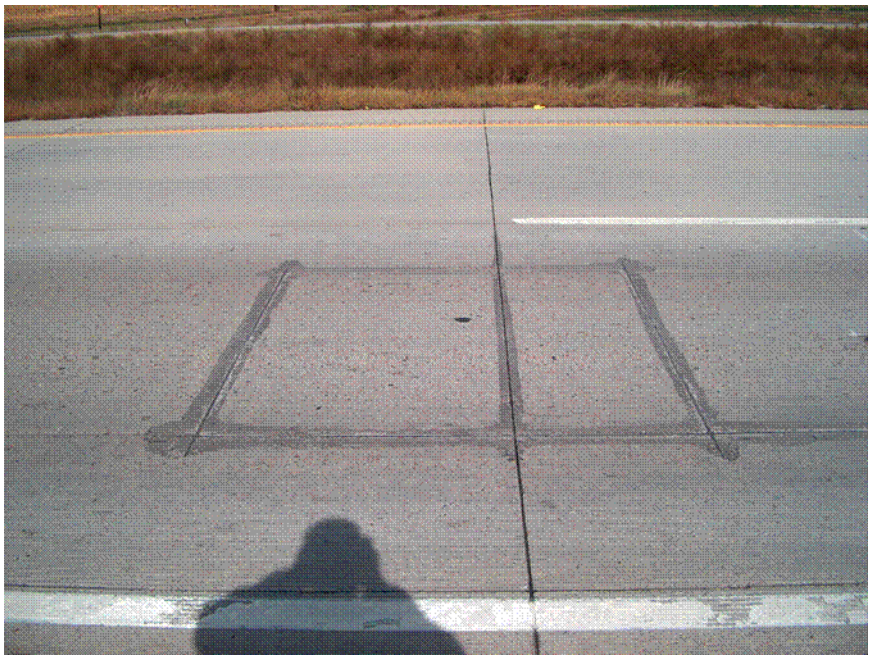

Photo 6-11 08_0200_Leading_Loop_Sensor_10_16_07.jpg

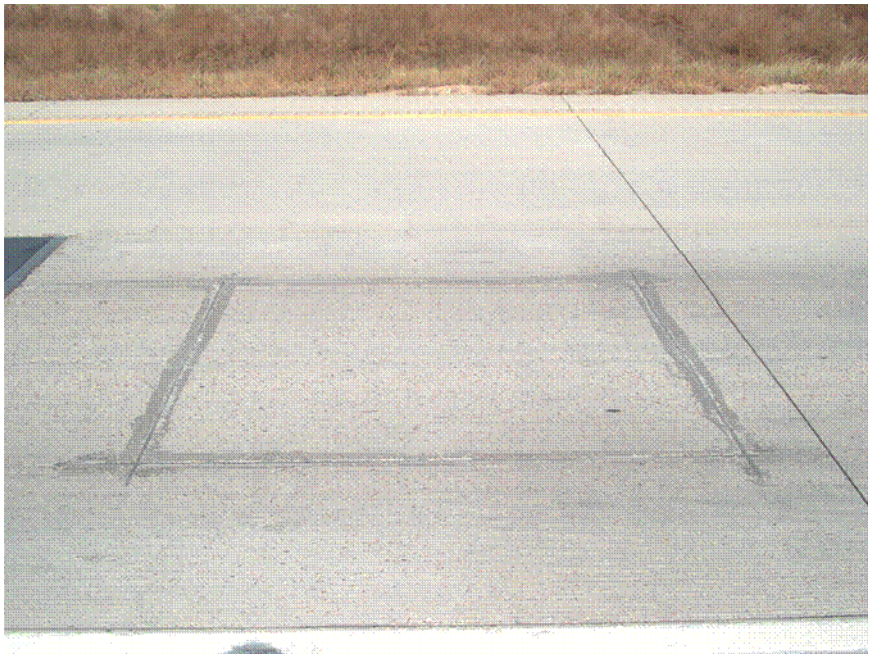

Photo 6-12 08_0200_Trailing_Loop_Sensor_10_16_07.jpg

SHEET 16 **LTPP MONITORED TRAFFIC DATA** **SITE CALIBRATION SUMMARY**	*STATE ASSIGNED ID [__ __ __ __] *STATE CODE [8] *SHRP SECTION ID [0200]

SITE CALIBRATION INFORMATION

1. * DATE OF CALIBRATION (MONTH/DAY/YEAR) [10/16/2007]

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

3. * REASON FOR CALIBRATION
   - ____ REGULARLY SCHEDULED SITE VISIT
   - ____ EQUIPMENT REPLACEMENT
   - ____ DATA TRIGGERED SYSTEM REVISION
   - ____ RESEARCH
   - ____ TRAINING
   - ____ 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____	___1_____
3	_____	_____

7. SUMMARY CALIBRATION RESULTS (EXPRESSED AS A PERCENT)

MEAN DIFFERENCE BETWEEN ---

DYNAMIC AND STATIC GVW	___-3.5	STANDARD DEVIATION ___3.3
DYNAMIC AND STATIC SINGLE AXLES	___-7.5	STANDARD DEVIATION ___4.7
DYNAMIC AND STATIC DOUBLE AXLES	___-2.8	STANDARD DEVIATION ___4.5

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

9. DEFINE THE SPEED RANGES USED (MPH) _____ _55_ __65__ __75_ __ __ __ __ _____ _____
_____ _____ _____ _____ _____ _____ _____ _____ _____ _____

10. CALIBRATION FACTOR (AT EXPECTED FREE FLOW SPEED) ___3615.00___

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

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 ____ 0.0	FHWA CLASS ____	____ ____ _____
*** FHWA CLASS 8 ____ 0.0	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

SHEET 16 **LTPP MONITORED TRAFFIC DATA** **SITE CALIBRATION SUMMARY**	*STATE ASSIGNED ID [__ __ __ __] *STATE CODE [8] *SHRP SECTION ID [0200]

SITE CALIBRATION INFORMATION

1. * DATE OF CALIBRATION (MONTH/DAY/YEAR) [10/17/2007]

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_____	___1_____
3	_____	_____

7. SUMMARY CALIBRATION RESULTS (EXPRESSED AS A PERCENT)

MEAN DIFFERENCE BETWEEN ---

DYNAMIC AND STATIC GVW	___0.9	STANDARD DEVIATION	___2.6
DYNAMIC AND STATIC SINGLE AXLES	____-2.3	STANDARD DEVIATION	___4.5
DYNAMIC AND STATIC DOUBLE AXLES	___1.5	STANDARD DEVIATION	___3.9

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

9. DEFINE THE SPEED RANGES USED (MPH) _____ _55_ __65__ __75_ __ __ __ _____ _____
_____ _____ _____ _____ _____ _____ _____ _____ _____ _____

10. CALIBRATION FACTOR (AT EXPECTED FREE FLOW SPEED) ___3808.00___

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

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 ____ 0.0	FHWA CLASS ____	____ ____	_____
*** FHWA CLASS 8 ____ 0.0	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

SHEET 18	STATE CODE [8]
LTPP MONITORED TRAFFIC DATA	SPS PROJECT ID [0200]
WIM SITE COORDINATION	DATE: (mm/dd/yyyy) 10/16/2007

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 _____
      - ☒ Separate contract LTPP – Expiration Date _5/31/2011_
      - ☐ 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 _7__ ☒ days ☐ weeks

b. Notice for straightedge and grinding check - __2_ ☐ 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:

   IRD

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: Debbie Walker Phone:(202)-493-3068

Agency: FHWA LTPP Team/ SPS WIM COTR

c. Data Processing and Pre-Visit Data –

Name: LTPP Customer Service e-mail:ltppinfo@fhwa.dot.gov

Agency: FHWA

d. Construction schedule and verification –

Name: Dave Smith Phone:303-757-9816

Name: Skip Outcalt Phone:303-757-9984

Agency: Colorado DOT

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

Name: Jim Sweetman Phone:303-289-2152

Agency: Sweetman Enterprises, Inc.

f. Traffic Control –

Name: N/A Phone:_____

Agency: _____

g. Enforcement Coordination –

Name: N/A Phone:_____

Agency: _____

h. Nearest Static Scale

Name: Tomahawk Truck Stop Location:12060 Sable Blvd, Brighton, CO, I-76, exit 17, Latitude 39.9154, Longitude -104.8181

Phone: 303-659-0810

APPENDIX A

Sheet 19	* STATE_CODE 08
LTPP Traffic Data	* SPS PROJECT ID 0200
*CALIBRATION TEST TRUCK # 1	* DATE 10/16/2007

Rev. 08/31/01

truck SW37 Robert
trailer TØ7-1

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: Peterbilt b) * Model: unk

10.* Trailer Load Distribution Description:

concrete sand

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 17.3 B to C 4.3 C to D 27.9

D to E 4.0 E to F _____

Wheelbase (measured A to last) _____ Computed _____

13. *Kingpin Offset From Axle B (units) +1.5 (_____)

(+ 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	11R24.5	AIR
E	11R24.5	AIR
F		

Sheet 19	* STATE_CODE 08
LTPP Traffic Data	* SPS PROJECT ID 0200
*CALIBRATION TEST TRUCK # 1	* DATE 10/16/2007

Rev. 08/31/01

PART II

Day 1

77413

*b) Average Pre-Test Loaded weight ~~77410~~

*c) Post Test Loaded Weight 76400

*d) Difference Post Test – Pre-test ~~1010~~ 1013

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

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1	10760	15450	15450	17870	17870		77400
2	10720	15490	15490	17860	17860		77420
3	10740	15490	15490	17850	17850		77420
Average	10740	~~15480~~ 15477	~~15480~~ 15477	~~17862~~	17860		~~77410~~ 77413

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	10380	15160	15160	17850	17850		76400
2							
3							
Average	10380	15160	15160	17850	17850		76400

Measured By NJW Verified By [signature] Weight date 10/16/07

Sheet 19	* STATE_CODE 08
LTPP Traffic Data	* SPS PROJECT ID 0200
*CALIBRATION TEST TRUCK # 1	* DATE 10/16/2007

Rev. 08/31/01

Day 2

7.2 *b) Average Pre-Test Loaded weight 77300 ✓
*c) Post Test Loaded Weight 76280
*d) Difference Post Test – Pre-test -1020

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

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1	10620	15520	15520	17820	17820		77300
2	10660	15450	15450	17870	17870		77300
3	10700	15440	15440	17860	17860		77300
Average	10660	15470	15470	17850	17850		77300

Table 6.2. Raw data – Axle scales –

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1	10320	15170	15170	17810	17810		76280
2							
3							
Average	10320	15170	15170	17810	17810		76280

Table 7.2 Raw data – Axle scales – post-test

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

Measured By DJW Verified By [signature] Weight date 10/19/07

Sheet 19	* STATE_CODE 08
LTPP Traffic Data	* SPS PROJECT ID 0200
*CALIBRATION TEST TRUCK # 2	* DATE 10/16/2007

Rev. 08/31/01

truck SW-55 B:11
trailer T-42

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: Peterbilt b) * Model: unk

10.* Trailer Load Distribution Description:

concrete sand

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 17.8 B to C 4.3 C to D 25.7

D to E 4.1 E to F _____

Wheelbase (measured A to last) _____ Computed _____

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	11R24.5	2 Fun Leaf
B	11R24.5	Air
C	11R24.5	Air
D	11R24.5	Air
E	11R24.5	Air
F		

Sheet 19	* STATE CODE 08
LTPP Traffic Data	* SPS PROJECT ID 0200
*CALIBRATION TEST TRUCK # 2	* DATE 10/16/2007

Rev. 08/31/01

PART II

Day 1

*b) Average Pre-Test Loaded weight 65473
*c) Post Test Loaded Weight 64580
*d) Difference Post Test – Pre-test -893

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

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1	10520	14330	14330	13150	13150		65480
2	10520	14320	14320	13150	13150		65460
3	10480	14350	14350	13150	13150		65480
Average	~~10510~~ 10507	~~14330~~ 14333	~~14330~~ 14333	13150	13150		~~65470~~ 65473

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	~~10480~~	~~15160~~	~~15160~~	~~13140~~	~~13140~~		~~64580~~
2	10160	14070	14070	13140	13140		64580
3							
Average	10160	14070	14070	13140	13140		64580

Measured By DJW Verified By [signature] Weight date 10/16/07

Sheet 19	* STATE_CODE 08
LTPP Traffic Data	* SPS PROJECT ID 0200
*CALIBRATION TEST TRUCK # 2	* DATE 10/16/2007

Rev. 08/31/01

Day 2

7.2 *b) Average Pre-Test Loaded weight 65340
*c) Post Test Loaded Weight 64440
*d) Difference Post Test – Pre-test -900 ✓

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

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1	10520	14280	14280	13130	13130		65340
2	10460	14310	14310	13120	13120		65320
3	10280	14450	14450	13090	13090		65360
Average	10420	~~14350~~ 14347	~~14350~~ 14349	~~13110~~ 13113	~~13110~~ 13113		65340

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	10140	14060	14060	13090	13090		64440
2							
3							
Average	10140	14060	14060	13090	13090		64440

Measured By DJW Verified By [signature] Weight date 10/17/07

Sheet 20	* STATE_CODE	08
LTPP Traffic Data	*SPS PROJECT_ID	0200
Speed and Classification Checks * 1 of* 2	* DATE	10 / 16 / 2007

Rev. 08/31/2001

WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class	WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class
62	11	408	61	9 11	65	9	553	62	9
69	5	418	69	5	73	9	560	73	9
70	8	426	70	8	70	9	561	68	9
70	8	428	68	8	72	9	564	71	9
67	9	429	66	9	66	9	565	68	9
69	9	430	68	9	73	9	566	71	9
75	9	438	74	9	70	9	568	69	9
68	9	442	69	9	76	9	585	76	9
66	9	445	65	9	67	9	586	68	9
64	9	451	64	9	66	9	589	67	9
64	9	454	63	9	68	9	593	69	9
63	11	456	61	11	73	9	594	73	9
70	9	457	67	9	75	9	597	73	9
62	9	472	62	9	72	9	599	71	9
67	9	482	65	9	62	9	601	62	9
69	9	485	69	9	63	9	602	66	9
75	9	486	75	9	67	9	603	66	9
73	9	492	73	9	63	9	605	62	9
73	9	527	71	9	70	9	609	66	9
71	9	529	70	9	70	9	610	68	9
72	9	536	72	9	77	9	611	75	9
76	9	540	75	9	64	9	613	65	9
70	6	542	70	6	69	9	614	69	9
66	9	546	66	9	70	9	618	67	9
68	9	550	68	9	66	9	619	65	9

Recorded by DJW Direction E Lane 1 Time from 11:47 to 1:10

Sheet 20	* STATE_CODE	08
LTPP Traffic Data	*SPS PROJECT_ID	0200
Speed and Classification Checks * 2 of* 2	* DATE	10 / 16 / 2007

Rev. 08/31/2001

WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class	WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class
69	9	622	68	9	74	9	719	73	9
66	9	627	66	9	74	9	720	73	9
63	9	628	63	9	68	9	721	67	9
78	9	630	77	9	73	9	723	72	9
64	9	631	63	9	67	9	724	66	9
64	9	634	63	9	72	9	732	72	9
65	9	637	65	9	70	8	733	70	8
72	9	642	72	9	73	9	736	71	9
66	11	643	69	9 11	74	5	737	74	5
66	11	644	63	9 11	74	9	741	74	9
76	9	647	76	9	70	9	743	69	9
73	9	650	74	9	70	9	744	68	9
67	9	661	66	9	64	12	748	63	12
68	9	665	69	9	75	6	749	75	6
75	9	669	72	9	74	9	750	84	9
73	79	670	75	9	75	9	751	75	9
74	9	671	73	9	73	9	752	72	9
54	9	672	52	9	73	9	758	72	9
53	9	673	49	9	71	9	759	69	9
68	9	691	65	9	65	9	764	65	9
74	9	698	74	9	80	9	766	78	9
61	8	706	61	8	71	12	767	70	12
68	9	704	68	9	73	5	768	72	5
70	9	710	70	9	71	9	770	71	9
62	9	718	61	9	72	9	773	70	9

Recorded by DW Direction E Lane 1 Time from 1:11 to 1:49

Sheet 20	* STATE_CODE	08
LTPP Traffic Data	*SPS PROJECT_ID	0200
Speed and Classification Checks * 1 of* 2	* DATE	10/17/2007

Rev. 08/31/2001

WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class	WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class
73	9	3459	73	9	70	9	3558	70	9
70	9	3462	70	9	68	9	3564	66	9
68	9	3464	68	9	80	5	3566	79	5
72	9	3473	71	9	65	9	3569	63	9
65	9	3474	64	9	64	9	3571	64	9
62	5	3478	64	5	66	9	3573	65	9
65	9	3483	66	9	65	9	3579	66	9
73	9	3491	73	9	60	9	3580	60	9
70	12	3496	71	12	65	9	3583	68	9
77	9	3498	77	9	71	9	3584	71	9
70	9	34	70	09	64	9	3586	64	9
70	9	3500	69	9	78	9	3591	78	9
67	9	3506	67	9	68	9	3592	73	9
64	9	3507	63	9	64	9	3605	62	9
54	5	3513	53	5	58	9	3606	59	9
67	9	3515	67	9	75	9	3607	75	9
62	9	3516	61	9	64	9	3608	65	9
64	9	3517	63	9	73	9	3610	68	9
75	9	3537	74	9	75	9	3611	74	9
70	9	3540	70	9	74	9	3614	74	9
77	12	3551	76	12	73	9	3620	73	9
67	9	3552	66	9	72	9	3621	71	9
66	9	3553	66	9	74	9	3645	75	9
67	9	3556	67	9	65	9	3646	73	9
64	9	3557	65	9	69	9	3647	70	9

Recorded by DJW Direction E Lane 1 Time from 2:25 to 3:10

Sheet 20	* STATE_CODE	08
LTPP Traffic Data	*SPS PROJECT_ID	0200
Speed and Classification Checks * 2 of* 2	* DATE	10/17/2007

Rev. 08/31/2001

WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class	WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class
80	9	3649	80	9	78	9	3735	75	9
65	9	3650	65	9	69	9	3738	69	9
73	9	3655	72	9	52	9	3739	52	9
68	9	3656	69	9	52	9	3740	51	9
67	9	3657	68	9	62	9	3743	64	9
71	5	3660	72	5	68	9	3755	70	9
76	5	3666	76	5	65	9	3756	65	9
68	9	3672	68	9	68	9	3758	67	9
69	8	3681	71	8	76	9	3761	76	9
64	12	3683	65	12	69	9	3762	72	9
70	9	3687	70	9	73	9	3767	75	9
72	5	3688	71	5	72	9	3768	71	9
75	9	3692	75	9	75	9	3770	73	9
76	9	3693	74	9	66	9	3771	65	9
67	9	3695	68	9	63	11	3773	63	11
75	9	3697	76	9	73	8	3775	73	8
67	9	3717	67	9	73	9	3782	73	9
65	9	3719	65	9	75	8	3783	77	8
73	9	3720	73	9	67	9	3785	67	9
68	9	3721	69	9	67	9	3786	66	9
77	5	3724	74	5	64	9	3796	67	9
75	12	3726	75	12	68	9	3797	69	9
68	5	3727	68	5	70	9	3800	70	9
77	5	3731	76	5	66	9	3818	66	9
62	11	3733	63	11	70	9	3820	70	9

24.0 facing

Recorded by DJW Direction E Lane 1 Time from 3:11 to 3:46

Sheet 21	* STATE_CODE	08
LTPP Traffic Data	*SPS PROJECT_ID	0200
WIM System Test Truck Records 1 of 3	* DATE	10 / 16 / 2007

Rev. 08/31/2001

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
49.5	54	1	1	9:25	35	54	53/51	29/85	27/81	33/34	74/88		77.3	17.9	4.4	24.5	4.0	
49.5	54	2	1	9:25	36	54	~~54~~ 48/50	69/79	64/84	60/76	65/60		66.2	17.9	4.4	26.0	4.2	
45	64	1	2	9:51	144	64	45/47	62/78	66/76	80/79	69/66		67.9	17.7	4.3	24.0	3.9	
45	65	2	2	9:52	145	65	43/56	68/77	70/86	59/69	60/73		64.1	18.1	4.4	26.0	4.1	
50	70	1	3	10:17	207	72	52/55	66/65	57/82	85/87	90/91		74.9	17.8	4.3	24.1	3.9	
50	70	2	3	10:17	208	72	49/49	59/81	55/87	49/72	63/76		67.0	17.8	4.3	25.5	4.1	
46.5	50	1	4	10:43	275	52	44/49	78/82	74/71	81/72	81/72		74.5	17.9	~~4~~ 4.3	24.1	4.0	
46.5	51	2	4	10:43	276	52	41/51	58/79	61/82	63/73	65/74		64.6	17.8	4.3	25.8	4.1	
42	60	2	5	11:09	~~328~~	64	44/51	65/79	61/64	58/72	66/67		62.5	18.1	4.2	25.8	4.0	
42	63	1	5	11:09	~~327~~	~~65~~ 62	48/47	71/84	74/78	80/73	87/80		71.3	18.1	4.2	24.0	3.9	
49	70	1	6	11:37	382	72	46/48	63/84	56/82	94/91	86/85		73.5	17.8	4.3	24.1	3.9	
49	72	2	6	11:37	383	72	45/46	62/77	51/81	66/75	71/66		63.9	17.8	4.3	25.4	4.0	
61.5	53	1	7	12:03	452	54	49/53	79/79	80/78	78/80	89/91		75.6	18.1	4.3	24.4	~~3.9~~	
61.5	52	2	7	12:03	453	54	49/57	70/74	64/79	58/74	69/73		66.4	18.0	4.4	25.8	4.1	
57	62	1	8	12:29	489	63	46/42	66/70	70/77	56/71	85/86		70.4	17.8	4.3	24.8	3.9	
57	62	2	8	12:29	490	63	46/48	64/61	60/78	60/71	65/65		62.0	18.1	4.2	25.7	4.0	

Converted on spreadsheet using bbb

Recorded by MARK 2 Checked by _____

6420070022_SPSWIM_TO_22_08_2.95_0200_~~Cal~~_____Sheet_21.doc

PRE-VALIDATION

Sheet 21	* STATE_CODE 08
LTPP Traffic Data	*SPS PROJECT_ID 0200
WIM System Test Truck Records 2 of 3	* DATE 10 / 16 / 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
71	71	1	9	12:54	564	72	48/46	69/79	68/82	86/85	86/80		72.8	17.7	4.3	24.1	3.9	
71	71	2	9	12:55	566	73	45/49	59/76	56/88	57/69	45/58		59.0	17.8	4.3	25.5	4.1	
69	52	1	10	1:24	672	54	47/54	80/82	80/74	83/88	79/85		75.3	18.0	4.4	24.3	4.0	
69	49	2	10	1:24	673	53	41/53	62/76	65/81	59/73	61/71		64.3	17.8	4.4	25.7	4.1	
74	61	1	11	1:50	775	64	48/52	67/83	69/77	88/86	84/85		74.0	17.8	4.3	24.0	3.9	
74	62	2	11	1:50	776	64	47/53	66/74	64/76	61/69	64/63		63.8	17.9	4.2	25.5	4.0	
~~25.5~~	~~68~~	~~1~~	~~12~~	~~2:15~~	~~830~~	~~68~~	~~45/48~~	~~39/45~~	~~43/41~~	~~41/44~~	~~48/42~~							
75.5	73	2	12	2:15	831	73	46/45	62/75	52/81	61/76	75/69		64.0	17.8	4.3	25.5	4.0	
75.5	71	1	12	2:15	829	71	48/49	66/80	58/82	93/89	90/82		73.7	17.8	4.3	24.1	3.9	
68.5	53	1	13	2:41	869	54	47/58	78/83	78/77	76/91	79/91		75.7	18.0	4.4	24.3	3.9	
68.5	53	2	13	2:41	867	54	50/55	71/74	65/78	60/74	62/72		66.2	18.1	4.4	25.8	4.1	
72	61	1	14	3:07	938	63	44/44	72/66	70/80	86/89	85/68		70.3	18.1	4.2	24.1	3.9	
72	61	2	14	3:07	939	63	45/53	61/72	58/74	53/68	63/69		61.8	17.8	4.3	25.4	4.0	
72.5	72	1	15	3:32	975	72	44/46	70/76	62/81	94/84	92/82		73.1	17.8	4.3	24.0	3.9	
72.5	72	2	15	3:33	976	72	45/46	60/69	55/83	61/65	51/65		60.0	17.8	4.3	25.4	4.1	
69	53	1	16	3:58	1027	54	47/54	78/84	77/76	75/87	80/89		74.7	18.1	4.4	24.4	3.9	

reversed on spreadsheet entry [illegible]

Recorded by MARK Z

Checked by __________

Sheet 21	* STATE_CODE	08
LTPP Traffic Data	*SPS PROJECT_ID	0200
WIM System Test Truck Records 3 of 3	* DATE	10 / 16 / 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
69	53	2	16	3:58	1028	54	48/51	59/75	62/80	56/74	64/74		65.3	17.7	4.5	25.9	4.1	
68.5	63	1	17	4:24	1079	63	46/49	65/66	69/81	87/64	89/86		70.2	17.8	4.3	24.0	3.9	
68.5	63	2	17	4:24	1080	64	45/52	62/76	59/70	57/78	63/54		62.0	17.8	4.3	25.8	4.0	
65.5	71	1	18	4:50	1117	71	44/46	67/79	68/83	83/87	84/81		72.3	17.8	4.3	24.1	3.9	
65.5	72	2	18	4:50	1118	72	44/50	60/78	50/81	52/71	63/65		61.4	17.8	4.3	25.5	4.0	
58	52	1	19	5:18	1155	53	50/48	78/85	76/82	76/93	81/91		75.9	17.8	4.4	24.4	4.0	
58	52	2	19	5:18	1156	52	44/49	69/76	62/79	59/72	65/69		64.4	17.6	4.3	25.8	4.0	
62.5	62	1	20	5:44	1185	64	44/53	79/84	66/77	87/87	86/67		72.1	18.2	4.2	24.4	3.8	
62.5	63	2	20	5:44	1186	64	47/55	62/75	61/78	59/73	64/65		63.9	17.8	4.3	25.7	4.1	

Recorded by MARK 2 Checked by _____

Sheet 21	* STATE_CODE	08
LTPP Traffic Data	*SPS PROJECT_ID	0200
WIM System Test Truck Records 1 of 1	* DATE	10 / 17 / 2007

Rev. 08/31/2001

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
37	52	1	1	7:39	2566	54	49/51	80/86	77/81	73/94	79/91		75.9	17.9	4.4	24.5	3.9	
37	53	2	1	7:39	2567	54	48/50	73/80	64/83	62/73	64/69		66.7	17.8	4.4	25.9	4.1	
42.5	64	2	2	8:05	2605	64	44/58	70/85	72/85	59/70	62/71		68.5	18.2	4.4	26.0	4.0	
42.5	68	1	2	8:05	2604	68	49/57	77/90	81/83	92/88	88/93		79.9	18.1	4.4	24.2	3.9	
46	71	1	3	8:30	2663	72	56/51	68/90	65/87	95/96	93/94		79.6	17.7	4.3	24.0	3.9	
46	71	2	3	8:31	2664	72	54/60	66/73	58/82	60/63	48/66		62.8	17.7	4.3	25.4	4.1	
43	51	1	4	8:56	2720	52	50/52	78/84	69/81	80/89	84/89		75.7	18.1	4.4	24.4	4.0	
43	51	2	4	8:56	2721	53	49/53	70/77	64/84	62/72	64/73		66.8	17.9	4.4	25.9	4.1	
47.5	60	1	5	9:22	2763	62	47/59	78/78	77/71	92/89	92/73		75.6	18.1	4.3	24.5	3.9	
47.5	60	2	5	9:22	2764	63	47/60	70/79	73/67	61/74	77/58		66.5	18.1	4.4	26.0	4.1	
55	71	1	6	9:48	2808	71	53/49	70/78	74/82	10/92	94/95		78.7	17.7	4.3	24.0	3.9	
55	73	2	6	9:48	2809	73	44/53	59/75	51/84	53/79	52/71		62.1	17.8	4.3	25.5	4.1	

Recorded by MARK Z

Checked by _____

Sheet 21	* STATE_CODE	08
LTPP Traffic Data	*SPS PROJECT_ID	0200
WIM System Test Truck Records 1 of 2	* DATE	10 / 17 / 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	58	1	7	10:13	2849	53	48/51	80/85	75/79	78/93	79/90		75.0	17.8	4.2	24.4	4.0	
55	55	2	7	10:13	2850	55	51/47	73/77	62/82	62/71	66/68		65.8	17.8	4.2	25.8	4.1	
57.5	63	1	8	10:39	2904	63	52/52	73/90	76/84	95/91	90/66		76.7	18.1	4.4	24.1	4.0	
57.5	63	2	8	10:39	2905	63	47/56	71/78	71/81	60/72	70/61		66.7	18.1	4.4	25.9	4.0	
57.5	72	1	9	11:04	2958	71	50/51	68/85	69/88	91/99	95/98		79.5	17.8	4.3	24.0	3.9	
57.5	72	2	9	11:04	2959	72	48/52	62/79	54/89	56/80	54/75		64.8	17.8	4.4	25.4	4.1	
59	54	1	10	11:30	3013	55	54/56	81/80	77/75	80/87	77/90		75.8	18.0	4.4	24.4	3.9	
59	55	2	10	11:30	3014	55	49/56	73/75	65/76	69/71	73/69		66.8	18.0	4.4	25.8	4.1	
61.5	62	1	11	12:02	3080	62	47/51	77/88	76/72	95/76	93/74		74.8	18.1	4.2	24.3	3.8	
61.5	65	2	11	12:02	3081	64	48/57	71/81	65/69	60/74	68/73		66.5	18.1	4.2	25.8	3.9	
60	72	1	12	12:29	3144	72	50/47	76/96	68/82	92/87	98/94		78.0	17.8	4.3	24.1	3.9	
60	73	2	12	12:29	3145	72	47/51	64/80	53/86	63/73	64/61		64.3	17.7	4.3	25.4	4.1	
59.5	53	1	13	12:55	3196	54	47/56	79/79	70/80	94/91	81/90		76.8	18.1	4.4	24.4	3.9	
59.5	53	2	13	12:55	3197	52	43/58	60/76	64/80	61/75	68/73		65.6	18.0	4.4	25.8	4.1	
57.5	63	1	14	1:21	3286	63	47/54	74/89	81/84	92/93	91/23		77.9	18.1	4.4	24.3	3.9	
57.5	63	2	14	1:21	3287	64	47/58	71/84	75/69	61/77	69/72		68.4	18.1	4.4	25.9	4.0	

Recorded by MARK 2 Checked by _____

includes cal 1 as 1st truck final entry

Sheet 21	* STATE_CODE	08
LTPP Traffic Data	*SPS PROJECT_ID	0200
WIM System Test Truck Records 21 of 22	* DATE	10 / 17 / 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
57.5	72	1	15	1:46	3338	70	5.2/4.0	7.4/8.6	7.3/8.8	10.3/9.6	9.7/8.9		80.6	17.7	4.3	24.0	3.9	
57.5	72	2	15	1:46	3339	71	4.9/5.3	6.5/8.1	5.2/8.6	5.2/7.2	7.1/6.9		64.9	17.8	4.3	25.5	4.0	
57.5	53	1	16	2:12	3409	53	4.6/5.3	8.0/8.1	7.3/7.8	8.4/9.0	8.7/7.9		75.0	18.1	4.4	24.5	4.0	
57.5	54	2	16	2:12	3410	54	4.8/5.6	6.9/7.5	6.3/8.1	6.2/7.1	6.4/7.0		65.9	18.1	4.4	25.8	4.1	
60.5	61	1	17	2:38	3516	62	4.9/4.6	7.3/8.8	7.6/6.9	9.5/9.2	8.8/9.1		78.6	18.1	4.4	24.4	3.9	
60.5	63	2	17	2:38	3517	64	4.7/5.7	7.0/7.8	7.3/8.1	6.1/7.3	7.0/7.0		68.0	18.1	4.4	25.9	4.1	
65.5	73	1	18	3:04	3620	73	5.0/4.8	7.3/8.4	6.8/8.3	9.2/9.2	9.1/9.6		77.7	17.8	4.3	24.0	3.9	
65.5	72	2	18	3:04	3621	71	4.8/5.0	6.9/7.6	5.4/8.6	5.5/6.6	7.3/7.1		64.7	17.7	4.3	25.4	4.0	
60.5	52	1	19	3:29	3739	52	5.2/5.0	7.7/8.0	6.6/8.0	8.5/8.7	8.4/9.1		75.2	17.9	4.4	24.4	3.9	
60.5	51	2	19	3:29	3740	52	4.8/5.1	5.9/7.5	6.4/8.1	6.0/7.3	6.5/7.6		65.2	17.8	4.4	25.8	4.1	
58	64	1	20	3:56	3862	62	4.6/4.7	7.6/8.5	7.5/8.1	8.7/8.3	8.9/7.5		74.5	18.1	4.2	24.0	3.9	
58	64	2	20	3:56	3863	64	4.7/5.6	6.2/8.1	6.1/8.1	6.2/7.8	7.3/6.8		67.2	17.8	4.3	25.8	4.1	

Recorded by MARK Z

Checked by _____

Calibration Worksheet

Site: 080200

Calibration Iteration 1 Date 10/17/07

Beginning factors:

Speed Point (mph)	Name	Value
Overall		1 / 2
Front Axle		
1 – (88) 55	SPEED BIN 1	3675 / 3675
2 – (96) 60	2	3600 / 3600
3 – (105) 65	3	3550 / 3550
4 – (112) 70	4	3615 / 3615
5 – (120) 75	5	3630 / 3630

Errors:

	55 Speed Point 1	60 Speed Point 2	65 Speed Point 3	70 Speed Point 4	75 Speed Point 5
F/A	-5.0	-6.6	-8.2	-8.9	-9.6
Tandem	0.3	-2.4	-5.1	-4.4	-3.6
GVW	-0.6	-3.1	-5.6	-5.1	-4.6

Adjustments:

	Raise	Lower	Percentage	
Overall	☐	☐		
Front Axle	☐	☐		
Speed Point 1	☒	☐	+0.6 %	+0.6
Speed Point 2	☒	☐	+3.2 %	+3.2
Speed Point 3	☒	☐	+5.9 %	+5.9
Speed Point 4	☒	☐	+5.3 %	+5.3
Speed Point 5	☒	☐	+4.8 %	+4.8

End factors:

Speed Point (mph)	Name	Value	1 / 2
Overall		1 / 2	
Front Axle			
1 – (88) 55	SPEED BIN 1	3698 / 3698	3698 / 3698
2 – (96) 60	2	3720 / 3720	3715 / 3715
3 – (105) 65	3	3770 / 3770	3759 / 3759
4 – (112) 70	4	3809 / 3809	3808 / 3808
5 – (120) 75	5	3804 / 3804	3804 / 3804

TEST VEHICLE PHOTOGRAPHS FOR SPS WIM VALIDATION

October 16-17, 2007

STATE: Colorado

SHRP ID: 0200

Photo 1 - Truck_1_Tractor_ 08_0200_10_16_2007.JPG

Photo 2 - Truck_1_Trailer_Load_1_08_0200_10_16_2007.JPG

Photo 3 - Truck_1_Suspension_1_08_0200_10_16_2007.JPG

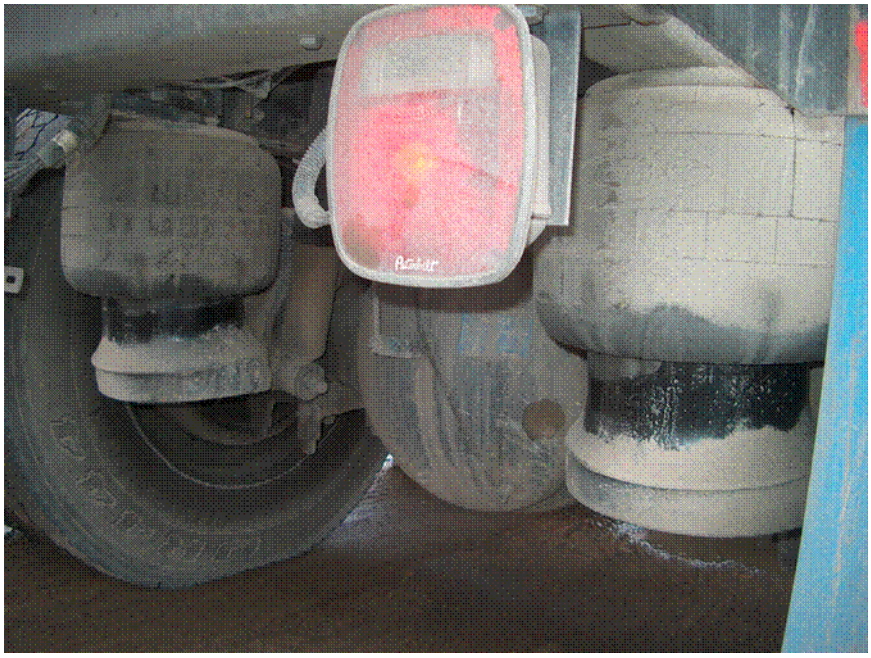

Photo 4 - Truck_1_Suspension_2_08_0200_10_16_2007.JPG

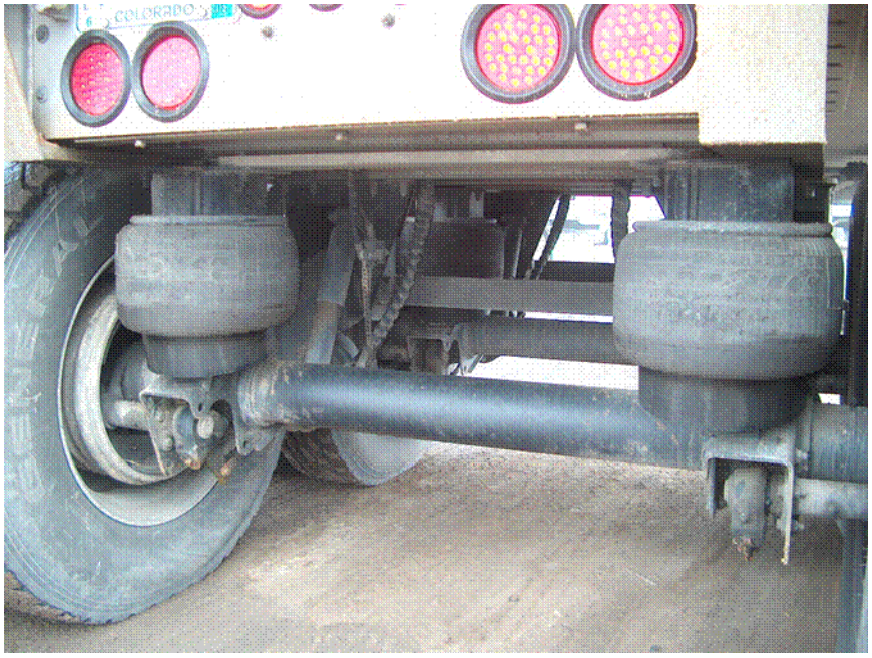

Photo 5 - Truck_1_Suspension_3_08_0200_10_16_2007.JPG

Photo 6 - Truck_2_Tractor_08_0200_10_16_2007.JPG

Photo 7 - Truck_2_Trailer_08_0200_10_16_2007.JPG

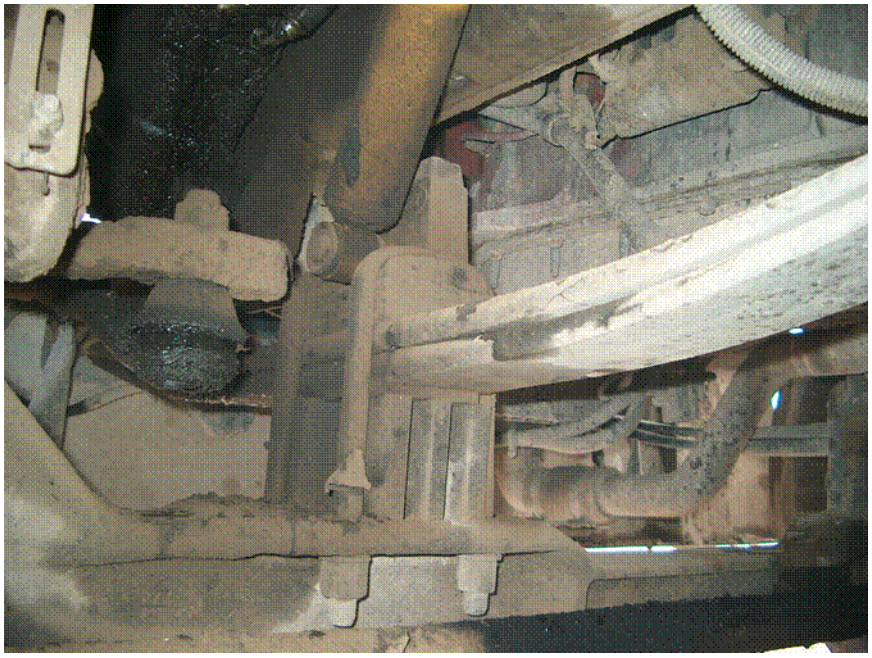

Photo 8 - Truck_2_Suspension_1_08_0200_10_16_2007.JPG

Photo 9 - Truck_2_Suspension_2_08_0200_10_16_2007.JPG

Photo 10 - Truck_2_Suspension_3_08_0200_10_16_2007.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

Colorado SPS-2 (Lane 1)

Validation Visit	**October 17, 2007**	**June 26, 2006**
Factor		
Overall		
Front axle		
Bin 1 88 kph (55 mph)	3698	3675
Bin 2 96 kph (60 mph)	3715	3600
Bin 3 105 kph (65 mph)	3759	3550
Bin 4 112 kph (70mph)	3808	3615
Bin 5 120 kph (75 mph)	3804	3630