INTERNATIONAL ROAD DYNAMICS INC.

LTPP SPS PHASE II

WEIGH-IN-MOTION SITE ACCEPTABILITY ASSESSMENT REPORT

MARYLAND SPS-5
LTPP ID 240500
MARCH 9, 2005
CLIN 1001 TASK ORDER 1

CONTRACT NO. DTFH61-05-D-00001

U.S. Department of Transportation
Federal Highway Administration

LONG TERM Pavement PERFORMANCE

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1.0 EXECUTIVE SUMMARY

The proposed Maryland SPS-5 WIM site was visited on February 22nd through 24th, 2005, and a site acceptability assessment was performed. The site is located on US15 at Mile Post 4.7 near the town of Frederick. It is proposed to install a Weigh-in-Motion (WIM) system for the northbound lane between existing SPS-5 pavement test sections 240559 and 240561. Based upon our site evaluation, service considerations, and discussions with the State, it is recommended that this Site be instrumented with Bending Plate Technology.

The site is located on a straightaway with no curves immediately before or after the WIM location and the grade is relatively flat. Vehicles track smoothly through this area at speeds between 55 and 65 MPH. Traffic flow is medium to heavy on this two lane, two direction roadway.

The existing roadway pavement at this location consists of 11 inches of Asphalt Concrete (AC). The State has installed a blanket ground 400 foot Portland Cement Concrete (PCC) slab to accommodate the WIM system's in-pavement sensors. Both the approach and departure pavement and the PCC slab are in good condition with no noticeable distress conditions. The PCC slab smoothness is marginal and requires attention.

There is AC power and telephone service available at the existing controller cabinet located approximately 450 feet from the proposed WIM controller cabinet location. The State will need to extend these services from this existing cabinet to the proposed WIM cabinet location.

Based upon our on-site observations and analyses of the profiler data, it is recommended that additional corrective action to the profiled surface be performed prior to the installation of the WIM system. The slab smoothness is currently questionable and as a result WIM accuracy may or may not be met. Upon completion of corrective action, new profiling data will need to be provided to our team for review to confirm the slab smoothness is adequate for the WIM system to meet accuracy requirements. Once this is performed and deemed acceptable, this site can be instrumented with Bending Plate technology.

2.0 EXISTING ROADWAY

2.1 PAVEMENT AND GEOMETRICS

The northbound lane is 12 feet wide with a 10 foot wide outside shoulder. The horizontal alignment is tangent with minimal grade (positive 0.62%).

In regard to cross slope, the northbound lane is crowned at the lane line with the southbound lane, each lane sloping 1.6% away from the lane line.

2.2 PCC WIM SLAB

A 400 foot non-reinforced plain PCC jointed slab has been installed to accommodate the WIM system's in-pavement sensors. The slab thickness is 11 inches and the transverse joints are on nominal 15 foot centers. These joints are dowelled. The shoulder has not been disturbed and remains AC.

2.3 OBSERVED TRAFFIC OPERATING CHARACTERISTICS

The medium to heavy traffic flow exhibited good lane discipline, staying well within the lane and shoulder line markings. Traffic is free flowing at all times at speeds between 55 and 65 MPH (posted speed limit is 55 MPH for all vehicles). Although tailgating can occasionally occur, this can be accommodated by adjustments in the system's software. There are no signals or merging in the WIM site vicinity. Trucks are "cruising" through the site at constant speeds. The only on/off locations between the WIM site and the SPS sites exist at the Basford and Whiten Road exits. It should be noted that these exits are residential roadways and will not accept heavy truck traffic

3.0 SITE CONFORMANCE TO EVALUATION CRITERIA

3.1 PAVEMENT TYPE AND CONDITION- PASS

The 400 foot PCC slab installed in October 2004 specifically for the WIM system sensors appears to be structurally sound with no evidence of distress conditions. It is recommended that the WIM system scales be installed approximately 75 feet from the end of the PCC slab.

The AC approach and departure pavements appear to be in fair condition, although there is cracking and spalling in and around the slab location. Since the proposed WIM will be located approximately 75 feet from the back end of the slab, this should not be an issue as it relates to WIM performance.

3.2 OBSERVED PAVEMENT SMOOTHNESS- REQUIRES ATTENTION

The AC approach and departure pavements appear to be quite smooth. Although the blanket ground PCC slab appears to be smooth in general, there are some profile anomalies within the pad that were not corrected during the grinding process. These include several low spots approximately 6 inches to 2 feet in size (Appendix D.1.13 Slab Anomaly (Low Spot)). The ride through this area is somewhat rough and observations of trucks approaching and passing through the proposed scale location indicated some degree of both suspension and body motion dynamics.

3.3 ANALYSIS OF PAVEMENT PROFILE DATA- REQUIRES ATTENTION

Profiling was performed by Stantec on April 26, 2005 and provided to IRD on April 29, 2005. Based on analysis of pavement profile data there is indication that the lack of adequate pavement smoothness may cause body and/or suspension dynamics in the trucks traversing the site sufficiently large enough to cause inaccurate weight measurements.

3.4 ROADWAY GEOMETRICS- PASS

The grade is minimal and the lane in which the sensors are to be installed is 12 feet wide. The pavement cross slope is adequate for proper roadway drainage. The adjacent lane's having an opposite cross slope poses no problem.

3.5 TRAFFIC OPERATING CHARACTERISTICS- PASS

The general traffic pattern is free flowing with good lane discipline. There are no interchanges or signals affecting traffic flow. The truck traffic is cruising through the site and staying within the lane lines.

3.6 TRUCK TRAFFIC COMPARISON BETWEEN WIM AND TEST SITE- PASS

There are exit/entrance locations between the WIM site and the SPS-5 pavement test sections, however, these are access routes for residential roadways and pose no risk of diversion for truck traffic.

3.7 POTENTIAL WIM INTERFERENCE SOURCES- PASS

The nearest source of any potential interference, overhead power lines, is 450 feet upstream of the proposed WIM system location.

3.8 ACCESS TO POWER AND PHONE SERVICES- PASS

The State will run AC power and telephone service to the proposed WIM controller cabinet location from the existing ATR # 68 controller cabinet.

3.9 EQUIPMENT INSTALLATION CAPABILITY- PASS

There is an adequate location for the WIM controller cabinet behind the guard rail by the existing junction box that will be used by the State for supply of AC power and telephone services. There is good visibility from this location of the sensors and approaching vehicles. There is adequate room adjacent to the cabinet location for service facilities. Roadway and overall site drainage is adequate. There is no foreseen potential for ponding or flooding at the cabinet and pullboxes and there is adequate topography for scale pit drainage. There is the ability to provide safe clearance in the work zone from live traffic during installation of the WIM system.

3.10 POTENTIAL TRAFFIC CONTROL / WORK ZONE SAFETY ISSUES- PASS

The traffic control should go smoothly, given the good approaching sight distance and the lack of nearby intersections or interchanges. Lane closures will need to be performed either at night or on weekends due to the high volume of traffic on the roadway during the day and flagmen will be needed for the required one lane reversible traffic control. No other work zone safety issues are foreseen at this rural site.

3.11 CALIBRATIONS AND EVALUATIONS USING TEST TRUCKS- PASS

The nearest usable NB truck turnaround location is the Whiten Road Exit, a distance of 0.8 miles from the WIM site. The nearest usable SB turnaround location is the Basford Road Exit, a distance of 1.2 miles from the WIM site.

The test truck round trip circuit route is approximately 5 miles. In that Basford and Whiten Exits are residential roadways, the best way to route test vehicles into the Basford and Whiten Exits and back onto the roadway will need to be determined. Due to potential constraints, the estimated lap time is 20 minutes.

3.12 TRUCK CIRCUIT MAP - PASS

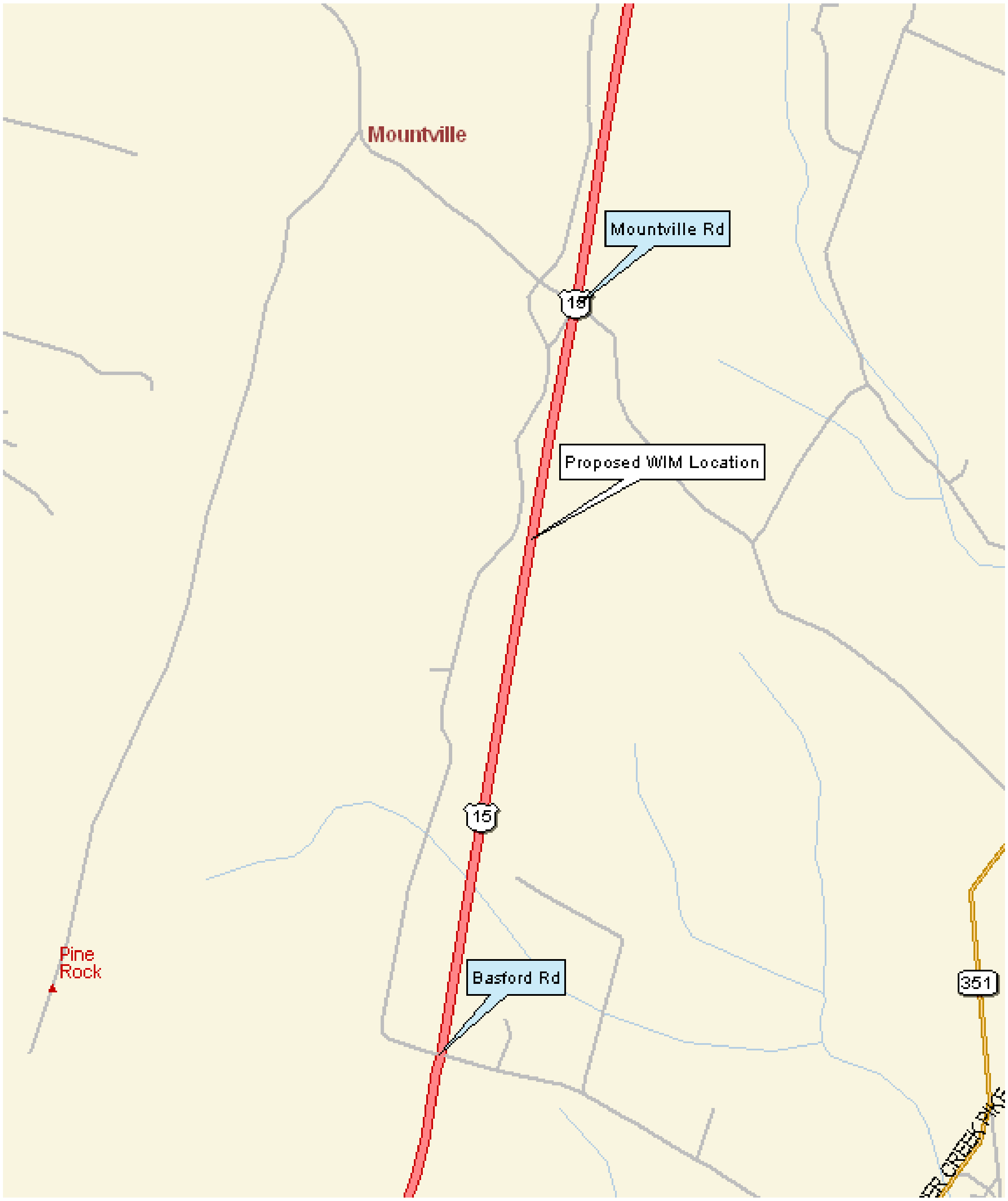

Figure 3: Truck Circuit Map

3.13 RECOMMENDATIONS ON SITE ACCEPTANCE / CORRECTIVE ACTIONS

The Bending Plate Weigh Pads should be installed halfway between 2 transverse weakened plane joints, approximately 75 feet from the end of the 400 foot PCC slab. This would put the sensors almost directly across and within 20 feet from the proposed WIM cabinet.

The State will run AC power and telephone service to the proposed WIM controller cabinet location from the existing ATR # 68 controller cabinet. (Appendix D.1.8 Recommended Cabinet Location)

In addition, based on analysis of the pavement profiling data there is indication that the lack of adequate pavement smoothness may cause body and/or suspension dynamics in the trucks traversing the site sufficiently large enough to cause inaccurate weight estimate measurements. Due to this, corrective action is necessary prior to the installation of the WIM system to ensure the system will meet the specified accuracy requirements.

4.0 TRAFFIC DATA REVIEW

Vehicle distributions of all trucks (FHWA Class 4 and higher) - 12.96%

Vehicle distributions for heavy trucks (FHWA Class 6 and higher) – 7.68%

Volume of trucks comprising of 10 % or more of truck population

Class 4 vehicles – 10.7%
Class 5 vehicles – 29.9%
Class 9 vehicles – 44.5%

Volume of trucks comprising 10 % or more of heavy truck population

Class 8 vehicles – 16.1%
Class 9 vehicles – 75.0%

The data as noted has been collected by Maryland State Highway Administration as supplied from the ATR # 68 Permanent Piezo Weigh-in-Motion System. The State has been collecting data through their continuous classification program at this location for quite some time.

The 2004 Traffic Volumes provided by ATR # 68 indicate the ADT to be 15,380.

5.0 PAVEMENT EVALUATION

In determining WIM site acceptability, the pavement was evaluated by the team. Various data was collected and analyzed. The data included: geometric information provided by the State, visual surface condition data, and profile data collected by the NRSC.

5.1 GEOMETRIC INFORMATION

The SPS-5 is a flexible pavement study. As part of the WIM installation, the State has installed 400 ft of PCC pavement to accommodate the system. There will be approximately 325 ft of PCC prior to the WIM and 75 ft of PCC after the WIM. The pavement has a thickness of 11 in with joint spacing of 15 ft.

Lane width of the SPS-5 and PCC pavement is 12 ft. The shoulders are AC throughout the pavement study and are 10 ft in width.

The PCC pavement is relatively straight with little horizontal curvature. There are no curves immediately before or after the WIM. The grade is relatively flat throughout the project area. A grade of 0.62% was reported by the State.

The cross slope was reported to be 1.6% by the State. The drainage was reported to be adequate.

5.2 SURFACE CONDITION

IRD performed a site evaluation on February 22-23, 2005. Pictures were taken to document the surface condition and are presented in Appendix D. The site evaluation observed the range of pavement from 1000 ft prior to the WIM to 500 ft after the WIM. The PCC pavement is located within this observed area.

5.2.1 PCC PAVEMENT

The PCC pavement was constructed October, 2004. It was reported by the State that grinding was performed on the PCC using a 36 in wide blanket grinder. Some anomalies are located within the PCC were not entirely removed (i.e., several low spots approximately 1-2 ft in size).

The upstream PCC and AC joint is in poor condition. Sealant is no longer adhering to pavement edges and the AC pavement is deteriorating (i.e., fraying along the edge with a mean width between 6-19 mm).

5.2.2 AC PAVEMENT UPSTREAM OF WIM

The AC pavement upstream of the WIM is approximately 13 years old. There was some distress observed on the upstream pavement. Longitudinal cracking along the pavement edge and the construction joint along the centerline was observed. There was also a transverse crack at approximately 700 ft upstream of the WIM.

5.2.3 AC Pavement Downstream of WIM

The AC pavement downstream of the WIM is approximately 13 years old. There was some distress observed on the downstream pavement. The AC pavement at approximately 100 ft after the WIM has been grinded. Longitudinal cracking along the pavement edge and construction joint along the centerline was observed. There may be some raveling in the center of the travel lane. A transverse crack at approximately 500 ft downstream of the WIM was also observed.

5.2.4 Shoulder Condition

The shoulders are AC throughout the study area. The shoulder adjacent to the PCC pavement is approximately 13 years old. The drop off from the pavement edge to the right of way (ground) is variable. The condition of the pavement edge and shoulder joint is poor in several areas. Cracking (i.e., longitudinally along pavement edge and transversely from pavement edge to right of way) and deterioration of the AC is evident in many of the pictures shown in Appendix D.

5.3 Surface Profile

Profile data was collected by the NRSC on April 26, 2005 with the LTPP Profiler. The LTPP Profiler is manufactured by ICC and is a Class I Profiler as described in ASTM E950. The profile runs were performed on 1017 ft (310 m) of pavement. Five profile runs were performed along the center of the lane (i.e., along the usual wheel paths). Three profile runs were performed on the left side (i.e., inner edge of lane) and right side (i.e., close to shoulder) of the lane. The PCC pavement is located at approximately 485 ft to 885 ft (148 m to 270 m). The proposed WIM will be located at approximately 810 ft (246 m). The profile data was analyzed with ProVAL and LTPP WIM Index Software to evaluate the pavement smoothness at the site.

5.3.1 Profiling Conditions

Table 1 presents the profile runs used in the analysis. The profile runs were collected in the morning under partly cloudy skies. The air temperature was reported as 11^{o}C (52^{o}F). This information was reviewed to assess temporal or temperature related variables. In the case of PCC pavements, it is well documented that curling and warping can occur. Because of the short profiling time and no reported change in temperature, the profile data should not have differences due to weather.

Table 1. Profile Runs Used in Analysis.

Filename*	Date	Time	Location	Cloud Conditions	Air Temperature (°C)
24050Ca1	4/26/2005	9:13 AM	Center	P. Cloudy	11
24050Ca2	4/26/2005	9:15 AM	Center	P. Cloudy	11
24050Ca3	4/26/2005	9:18 AM	Center	P. Cloudy	11
24050Ca4	4/26/2005	9:21 AM	Center	P. Cloudy	11
24050Ca5	4/26/2005	9:23 AM	Center	P. Cloudy	11
24050La1	4/26/2005	9:26 AM	Left	P. Cloudy	11
24050La2	4/26/2005	9:28 AM	Left	P. Cloudy	11
24050La3	4/26/2005	9:31 AM	Left	P. Cloudy	11
24050Ra1	4/26/2005	9:35 AM	Right	P. Cloudy	11
24050Ra2	4/26/2005	9:38 AM	Right	P. Cloudy	11
24050Ra3	4/26/2005	9:41 AM	Right	P. Cloudy	11

*Converted to ERD format with ERD file extension.

5.3.2 PROFILE OBSERVATIONS

The profile runs were visually compared using ProVAL. The profile runs were compared with one another at each sensor position (i.e., left and right wheel path). Figures 1-4 present profile runs along the center of the lane. The red vertical lines represent the start and end of the PCC pavement.

The following observations can be made:

- The profile runs showed good agreement for each sensor position.
- Features such as peaks and valleys correspond well with each other.
- Within the data set, the PCC pavement is located between 147.5 m and 269.5 m.
- In the AC pavement, there are transverse cracks present, which are shown as sharp downward spikes.
- In the PCC pavement, there are either transverse cracks or joints present, which are shown as sharp downward spikes.
- AC and PCC pavement joints are noticeable. Roughness of joints can cause variations in profile as seen in Figure 4 at 269.5 m.

Figures 5 and 6 present profile runs from along the center of the lane versus the left and right edge. These figures show that the pavement has little variation along most of the profile. However, there is a noticeable variation at the downstream PCC joint. This is likely due to pavement distresses at the joint.

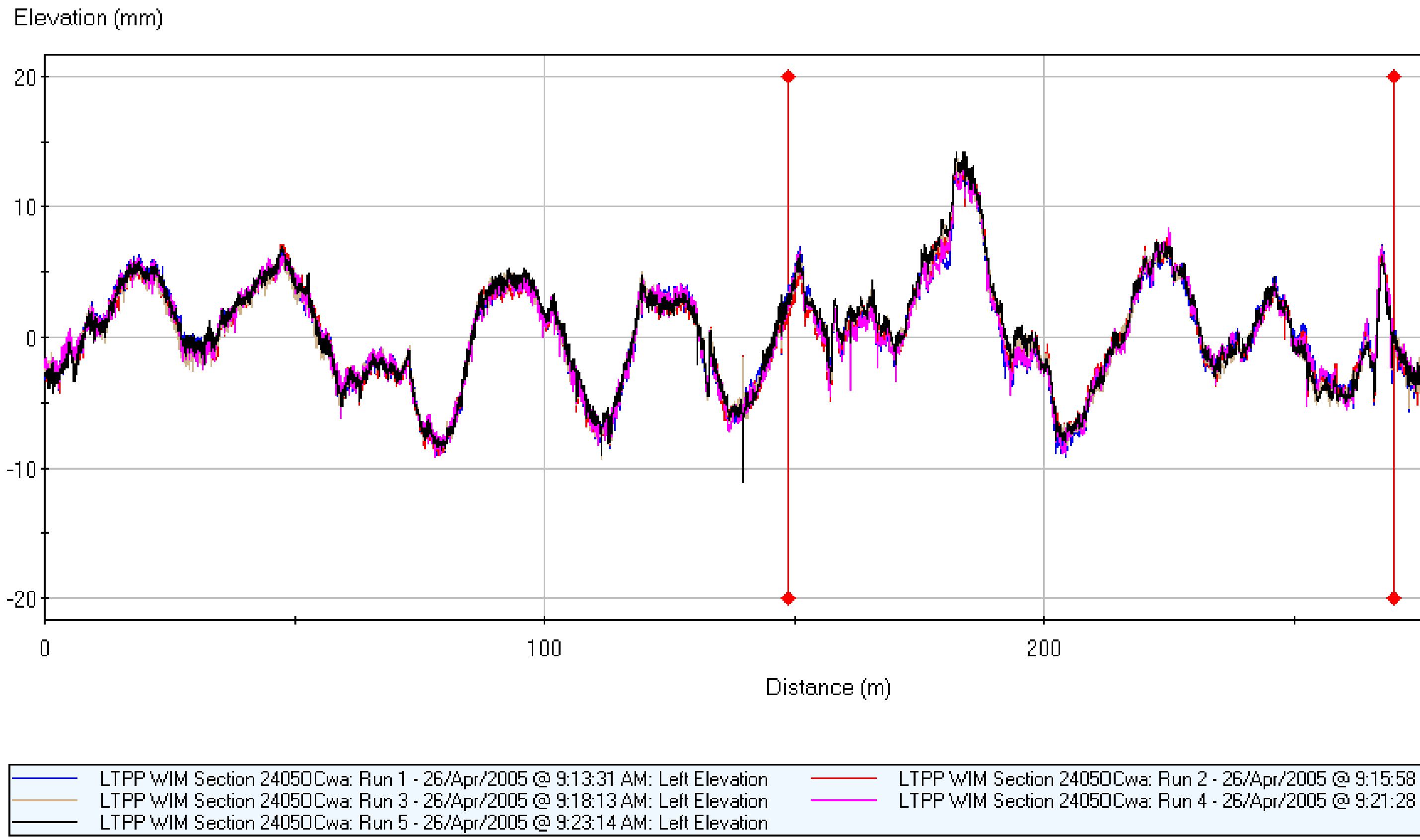

Figure 1. Left Wheel Path Along Center of the Lane.

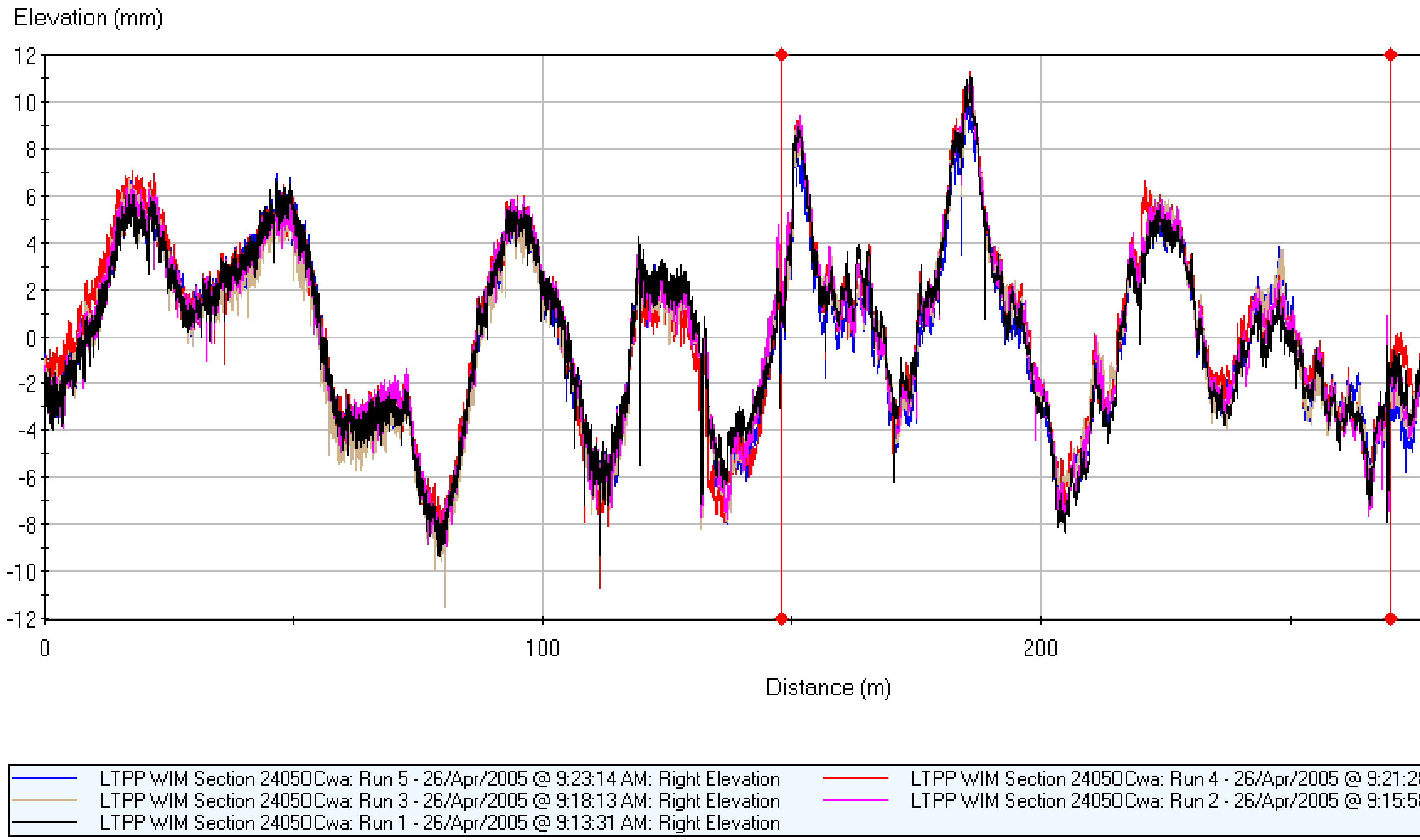

Figure 2. Right Wheel Path Along Center of the Lane.

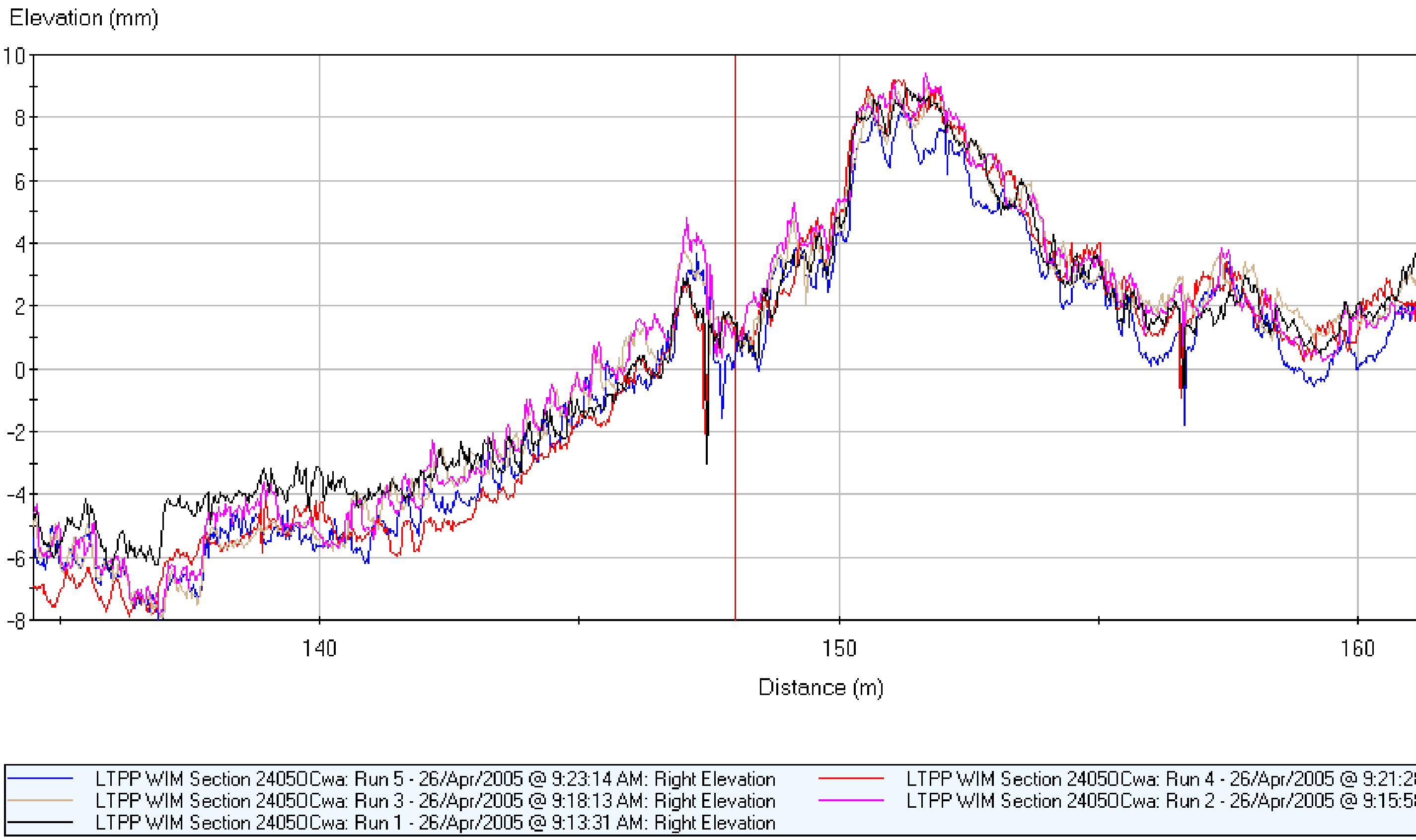

Figure 3. Right Wheel Path along Center of the Lane at Upstream PCC Pavement Joir

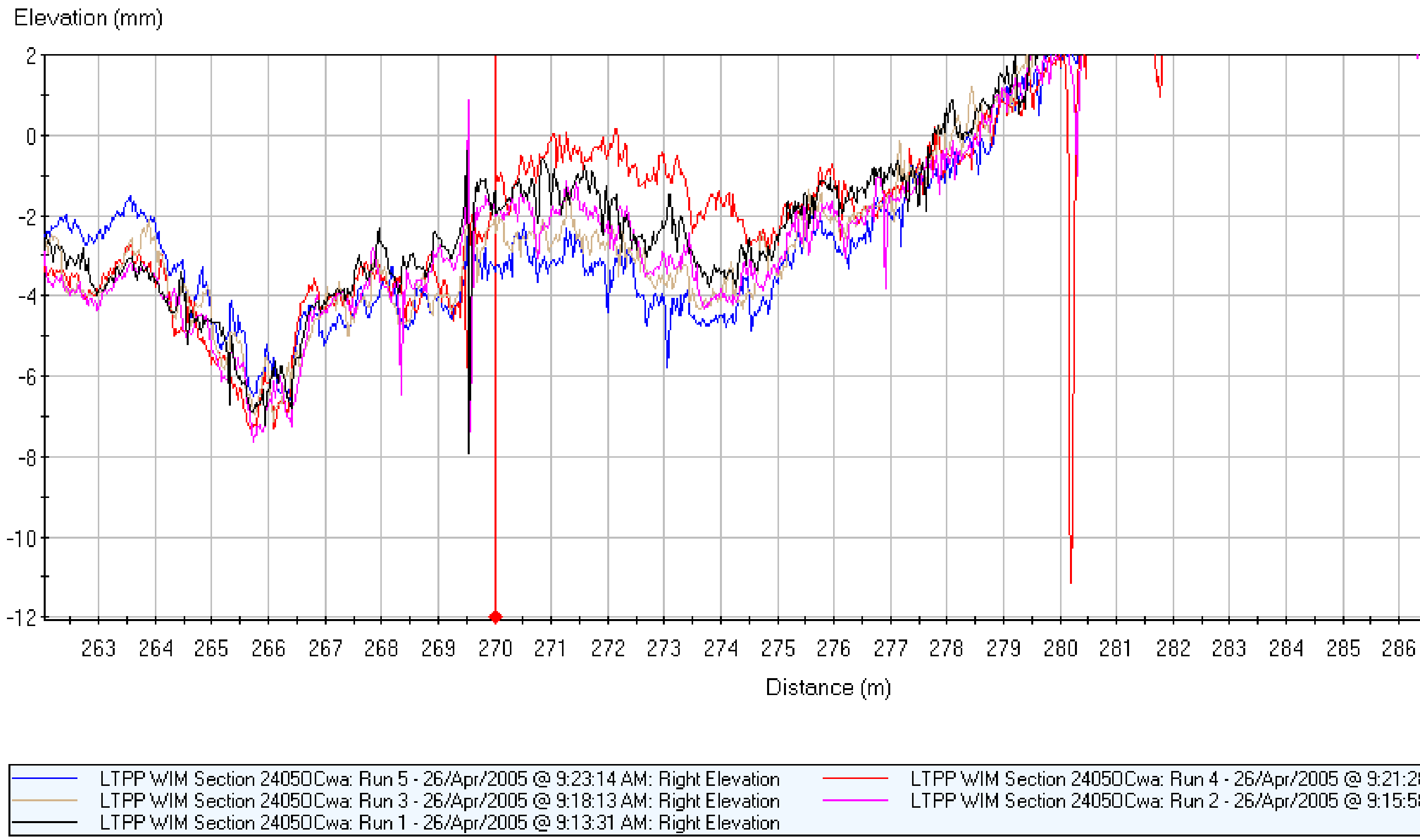

Figure 4. Right Wheel Path along Center of the Lane at Downstream PCC Pavement Jo

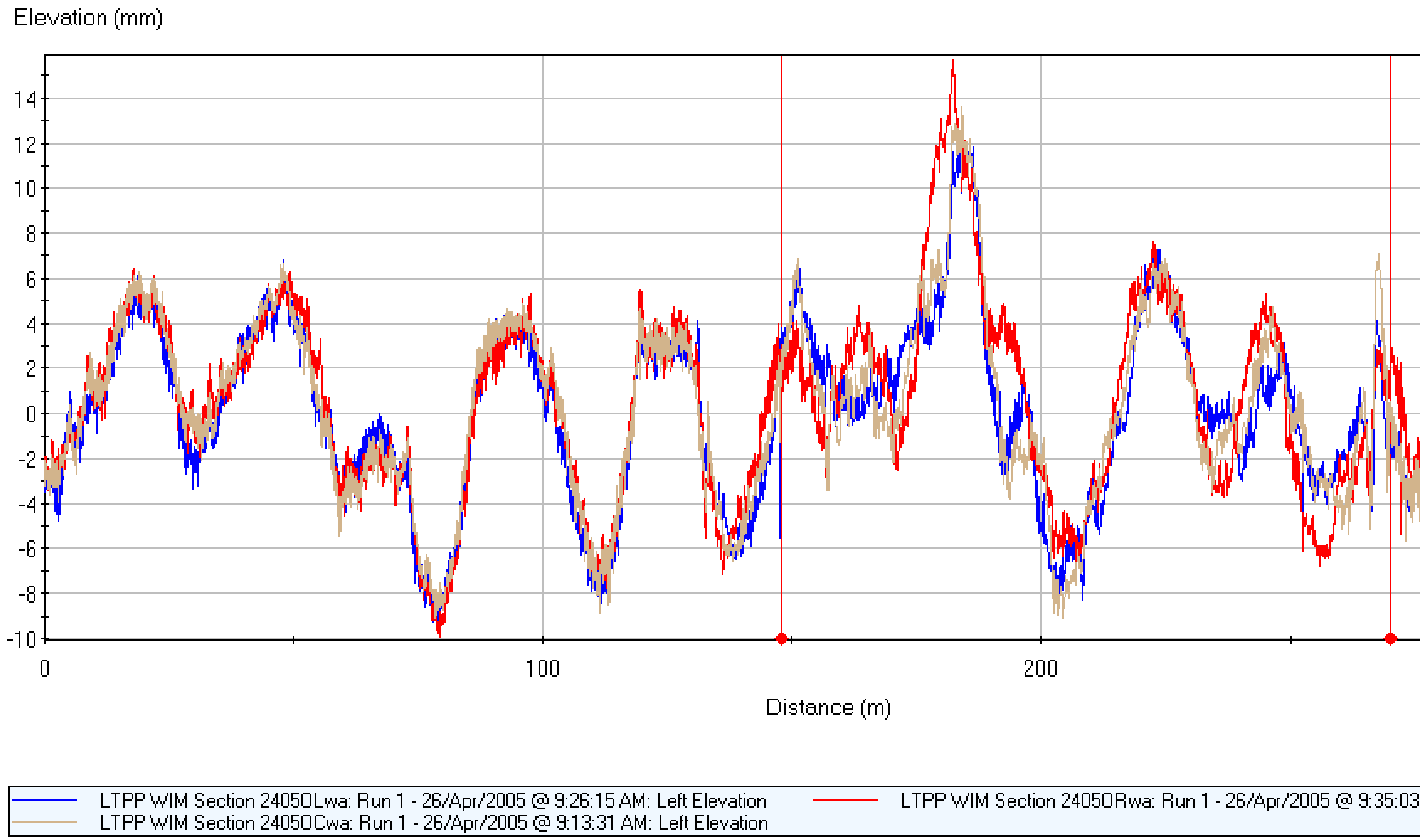

Figure 5. Left Wheel Path Comparison.

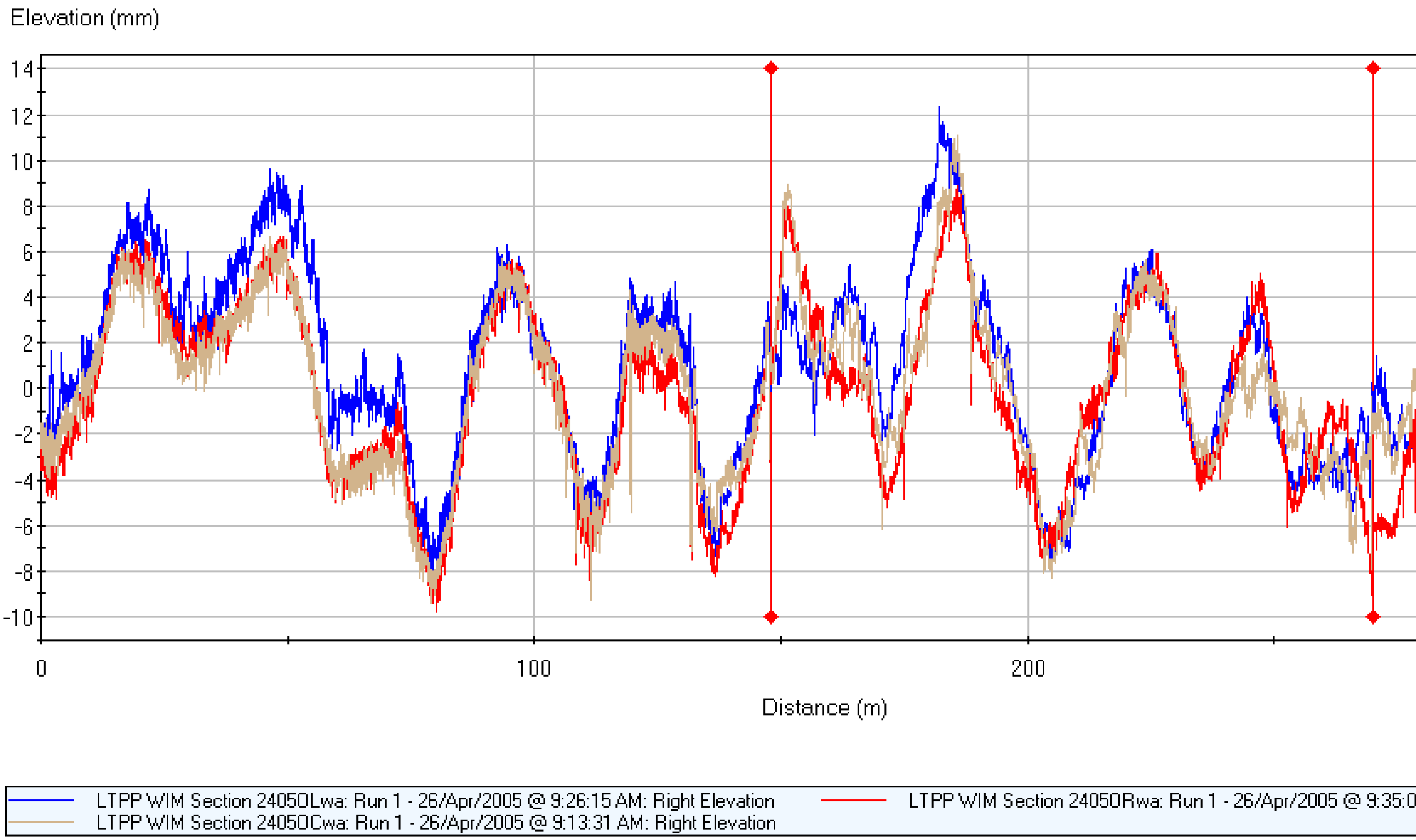

Figure 6. Right Wheel Path Comparison.

5.3.3 PROFILE RIDE STATISTICS

As part of the analysis, the profile runs were divided into 10 m segments and ride statistics were generated using ProVAL. Table 2 presents the average of each data set (i.e., center lane, left edge and right edge) as well as the standard deviation between the averages. IRI values over 2.00 m/km and standard deviations greater than 0.50 m/km have been depicted in red font. Heavy black border lines indicate edge of PCC pavement and heavy green border lines indicate proposed location of the WIM.

Several observations can be made from Table 2. The right wheel path is more variable than the left wheel path. Higher IRI values occur at the AC / PCC pavement joint, which is likely due to pavement distresses. These distresses were documented during the site evaluation.

Table 2. Summary of Profile Ride Statistics.

	Center Lane Average		Left Edge Average		Right Edge Average			
Interval (m)	Left IRI (m/km)	Right IRI (m/km)	Left IRI (m/km)	Right IRI (m/km)	Left IRI (m/km)	Right IRI (m/km)	Left Stdev (m/km)	Right Stdev (m/km)
0.0 to 9.9750	1.06	0.88	1.00	1.67	1.14	0.87	0.07	0.46
10.0 to 19.9750	0.69	0.65	0.60	1.03	0.84	0.67	0.12	0.21
20.0 to 29.9750	0.68	0.82	0.96	1.94	1.63	0.82	0.49	0.64
30.0 to 39.9750	1.06	0.69	1.32	1.58	1.48	0.85	0.21	0.47
40.0 to 49.9750	0.69	0.53	0.76	0.83	0.82	0.54	0.07	0.17
50.0 to 59.9750	0.83	0.62	0.74	2.51	1.20	0.62	0.24	1.09
60.0 to 69.9750	0.98	0.67	0.75	1.27	1.11	0.69	0.19	0.34
70.0 to 79.9750	1.30	0.97	1.22	1.47	1.65	1.16	0.23	0.25
80.0 to 89.9750	1.15	1.08	0.90	1.16	1.25	1.18	0.18	0.05
90.0 to 99.9750	0.69	0.53	0.55	0.86	0.74	0.50	0.10	0.20
100.0 to 109.9750	0.94	0.89	0.91	0.77	0.92	0.70	0.01	0.10
110.0 to 119.9750	1.20	1.19	0.78	1.08	0.96	1.02	0.21	0.09
120.0 to 129.9750	1.07	0.88	0.93	1.12	1.30	1.03	0.19	0.12
130.0 to 139.9750	1.64	2.44	1.96	1.69	2.17	1.98	0.26	0.38
140.0 to 149.9750	0.84	1.30	0.75	1.47	1.00	0.96	0.13	0.26
150.0 to 159.9750	2.61	2.16	1.41	1.78	1.58	2.00	0.65	0.19
160.0 to 169.9750	1.73	2.08	1.16	1.58	1.41	1.45	0.29	0.33
170.0 to 179.9750	1.40	1.54	1.05	1.84	1.74	1.13	0.35	0.35
180.0 to 189.9750	1.97	1.43	2.05	1.19	1.69	0.96	0.19	0.24
190.0 to 199.9750	1.78	1.42	2.27	1.56	1.37	0.98	0.45	0.30
200.0 to 209.9750	1.65	1.29	1.60	1.24	1.13	0.87	0.29	0.23
210.0 to 219.9750	0.94	1.71	1.11	1.20	1.04	0.99	0.08	0.37
220.0 to 229.9750	1.41	0.76	0.83	1.12	1.07	0.77	0.29	0.21
230.0 to 239.9750	1.33	1.12	1.13	1.18	1.00	0.85	0.16	0.18
240.0 to 249.9750	1.00	1.18	1.12	1.25	1.16	1.24	0.08	0.04
250.0 to 259.9750	1.46	1.30	1.01	1.28	1.39	1.31	0.24	0.02
260.0 to 269.9750	3.15	1.47	2.45	1.85	1.98	1.15	0.59	0.35
270.0 to 279.9750	1.03	1.06	1.21	1.36	1.20	0.98	0.10	0.20
280.0 to 289.9750	1.22	1.04	1.02	1.36	1.27	1.37	0.13	0.19
290.0 to 299.9750	1.02	1.34	1.24	2.05	1.48	1.27	0.23	0.43
300.0 to 310.0000	0.84	1.04	0.84	1.94	1.12	1.05	0.16	0.52
Average 0 to 310	1.27	1.16	1.15	1.43	1.29	1.03	0.07	0.20

5.3.4 LOCALIZED ROUGHNESS ANALYSIS

The profile runs were further analyzed using the localized roughness module in ProVAL. It is based on the Texas Department of Transportation (TXDOT) Specification, Tex-1001-S. The specification computes an average of each elevation point (i.e., average of left and right wheel paths together). Next, a 25 ft moving average filter is applied. The difference between the average wheel path profile and the 25 ft moving average filtered profile is computed. If the deviation is greater than 0.15 in, it is considered an area of localized roughness. Positive deviations are considered bumps and negative deviations are considered dips.

The parameters of the localized roughness module were modified to be consistent with ASTM 1318-02, where the deviation is 0.125 in (3 mm) over a 20 ft (6 m) interval. Figure 7 presents the locations that can be considered localized roughness from the profile data. The heavy black lines represent the PCC pavement edge and the heavy green line represents the proposed location of the WIM. As can be seen from the figure, there are many small areas of localized roughness around the PCC joints. There are also a couple of areas located at 170.4 m and 188.6 m, which are within the PCC pavement, that should be assessed more thoroughly prior to WIM installation.

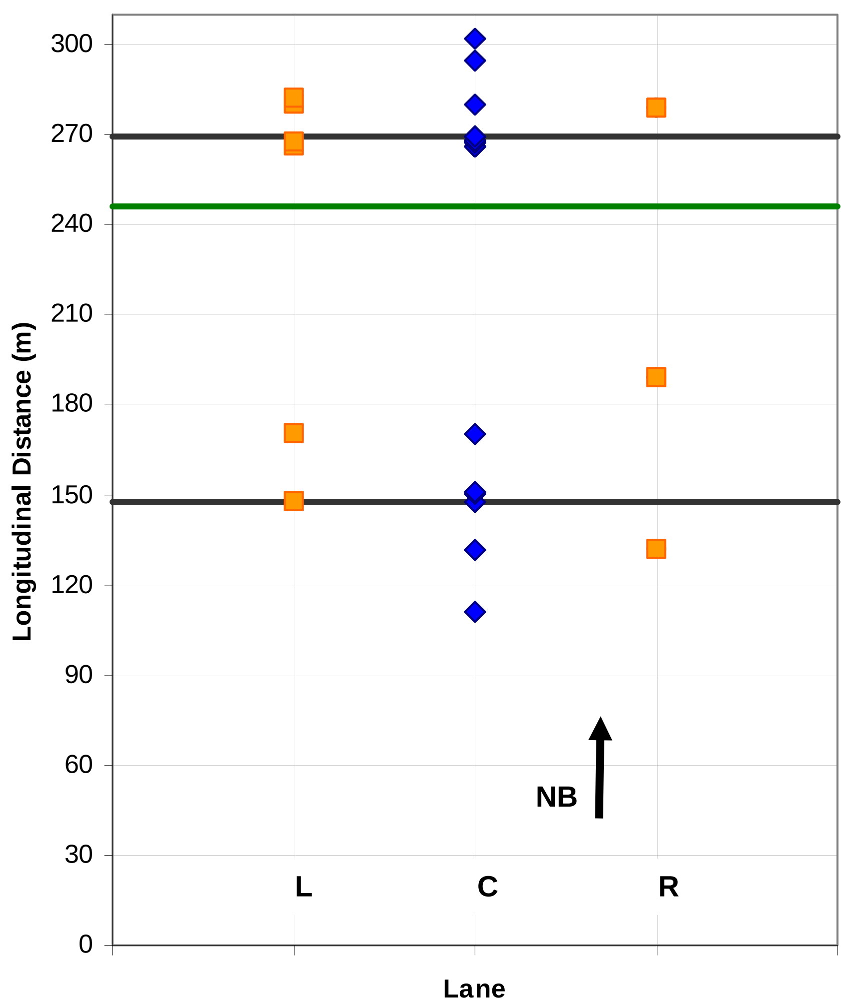

Figure 7. Localized Roughness Locations.

5.3.5 LTPP WIM INDEX ANALYSIS

The profile runs were further analyzed using the LTPP WIM Index Software developed by the LTPP Technical Support Services Contractor (TSSC). The software computes two indices called the Long Range Index (LRI) and the Short Range Index (SRI). These indices are based on research conducted by the University of Michigan Transportation Research Institute (UMTRI).

The LRI represents the vertical deviations of the pavement surface from a horizontal reference within a range of pavement from 25.8 m preceding a WIM scale to 3.2 m beyond it. This characterizes the “background” roughness for a relatively long distance leading up to the scale and a short distance beyond it. A Peak LRI is also computed by the software and compares against the LRI thresholds.

The SRI represents the vertical deviations of the pavement surface from a horizontal reference within a range of pavement from 2.8 m preceding a WIM scale to 0.5 m beyond it. It characterizes the roughness directly at the scale. The very presence of a WIM scale will often create localized roughness within the pavement in its vicinity. Because of this case, a Peak SRI threshold value was established.

Threshold values were developed as part of the research to describe the anticipated performance of a WIM site. The lower threshold values are those below in which a WIM site is very likely to produce an acceptable level of weighing error. The upper threshold values of these indices are those above which a site is very likely to produce an unacceptable level of weighing error. Values which fall between the upper and lower thresholds indicate the pavement condition may or may not cause dynamic loading in the trucks traversing the site sufficiently large enough to cause inaccurate weight measurements.

Table 3 presents the roughness index thresholds for a Type 1 WIM. The SPS-5 profile runs were compared to these thresholds to evaluate the proposed WIM’s accuracy.

Table 3. Roughness Index Thresholds.

WIM Index	Lower Threshold (m/km)	Upper Threshold (m/km)
Long Range Index (LRI)	0.5	2.1
Short Range Index (SRI)	0.5	2.1
Peak Short Range Index	0.75	2.9

The *Site Evaluation* option of the software was used to compute the desired indices. The default settings were used with a WIM location of 246 m. Tables 4-6 present the index values that were calculated and their comparison with the lower and upper threshold values. Red values would indicate a value above the upper threshold, blue values would indicate below the lower threshold and orange values would be in between.

Table 4. Comparison of WIM Index Thresholds for Center of Lane Data Set.

Computed WIM Index

	24050Ca1		24050Ca2		24050Ca3		24050Ca4		24050Ca5	
WIM Index	LWP (m/km)	RWP (m/km)	LWP (m/km)	RWP (m/km)	LWP (m/km)	RWP (m/km)	LWP (m/km)	RWP (m/km)	LWP (m/km)	RWP (m/km)
LRI	1.021	1.141	1.056	1.138	0.948	1.044	1.194	1.106	1.095	1.069
Peak LRI	1.088	1.267	1.195	1.217	1.028	1.063	1.208	1.293	1.103	1.069
SRI	0.470	1.067	0.474	1.126	0.638	1.202	0.627	1.206	0.600	1.018
Peak SRI	1.106	1.255	0.994	1.236	0.981	1.253	1.138	1.262	0.897	1.032

Comparison of WIM Index Versus WIM Index Thresholds

	24050Ca1		24050Ca2		24050Ca3		24050Ca4		24050Ca5	
WIM Index	LWP	RWP	LWP	RWP	LWP	RWP	LWP	RWP	LWP	RWP
LRI	Between	Between	Between	Between	Between	Between	Between	Between	Between	Between
Peak LRI	Between	Between	Between	Between	Between	Between	Between	Between	Between	Between
SRI	Below	Between	Below	Between	Between	Between	Between	Between	Between	Between
Peak SRI	Between	Between	Between	Between	Between	Between	Between	Between	Between	Between

Table 5. Comparison of WIM Index Thresholds for Left Edge Data Set.

Computed WIM Index

	24050La1		24050La2		24050La3	
WIM Index	LWP (m/km)	RWP (m/km)	LWP (m/km)	RWP (m/km)	LWP (m/km)	RWP (m/km)
LRI	0.980	0.797	0.950	0.780	0.975	0.880
Peak LRI	1.018	1.030	1.025	1.088	0.996	0.987
SRI	1.000	0.781	0.888	0.826	0.682	0.779
Peak SRI	1.002	0.794	0.970	0.926	0.799	0.841

Comparison of WIM Index Versus WIM Index Thresholds

	24050La1		24050La2		24050La3	
WIM Index	LWP	RWP	LWP	RWP	LWP	RWP
LRI	Between	Between	Between	Between	Between	Between
Peak LRI	Between	Between	Between	Between	Between	Between
SRI	Between	Between	Between	Between	Between	Between
Peak SRI	Between	Between	Between	Between	Between	Between

Table 6. Comparison of WIM Index Thresholds for Right Edge Data Set.

Computed WIM Index

	24050Ra1		24050Ra2		24050Ra3	
WIM Index	LWP (m/km)	RWP (m/km)	LWP (m/km)	RWP (m/km)	LWP (m/km)	RWP (m/km)
LRI	1.036	0.903	0.970	0.847	0.992	0.855
Peak LRI	1.284	0.952	1.227	1.027	1.237	1.011
SRI	1.132	0.619	1.152	0.526	0.869	0.531
Peak SRI	1.421	0.841	1.160	0.884	1.030	0.862

Comparison of WIM Index Versus WIM Index Thresholds

	24050Ra1		24050Ra2		24050Ra3	
WIM Index	LWP	RWP	LWP	RWP	LWP	RWP
LRI	Between	Between	Between	Between	Between	Between
Peak LRI	Between	Between	Between	Between	Between	Between
SRI	Between	Between	Between	Between	Between	Between
Peak SRI	Between	Between	Between	Between	Between	Between

In almost all cases, the computed indices were in between the lower and upper threshold values. This indicates the pavement may or may not cause dynamic loading in the trucks traversing the site sufficiently large enough to cause inaccurate weight measurements. The *Site Evaluation* option assumed the WIM is already installed. In this case, there is only a proposed location with in-place PCC pavement. These values will likely change once the WIM is installed.

Another option in the WIM Index Software is *Location Selection*. This option computes the profiles of LRI and SRI values along the entire profiled pavement so that the location most suitable for the WIM can be identified. Generally, the LRI profiles were between the lower and upper threshold values. Figure 8 presents a LRI plot for profile run 1 on the left edge of pavement. This is a typical plot for all profile runs. The green vertical line represents the proposed WIM location.

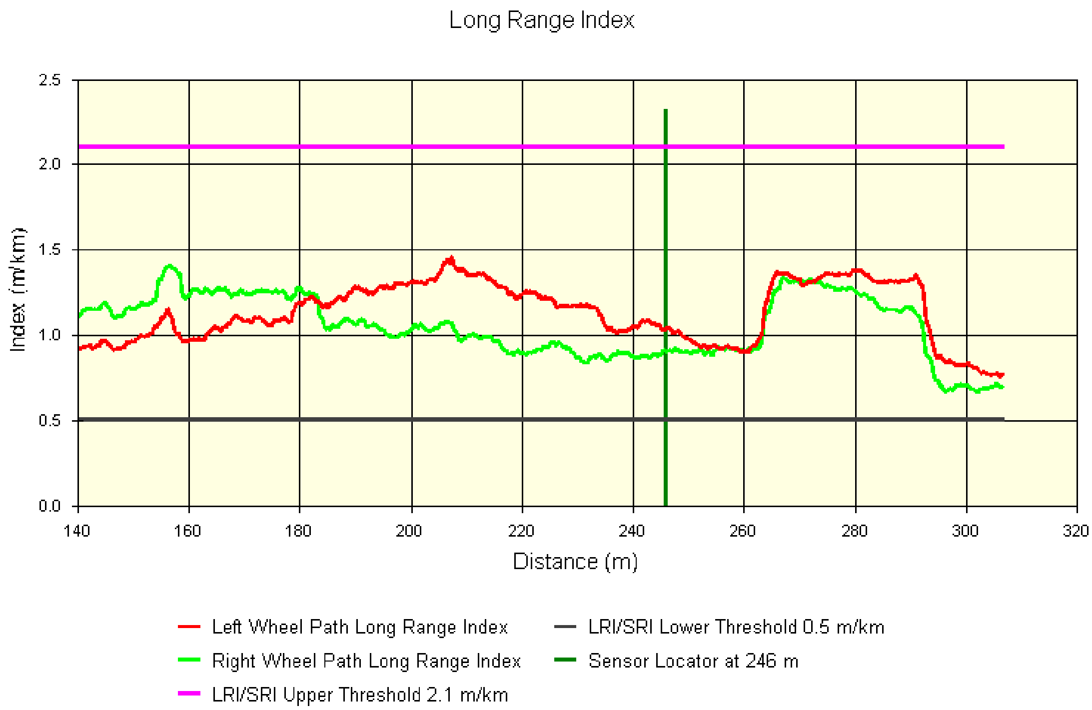

Figure 8. Typical LRI Plot.

Figures 9-19 present the SRI plot for each profile run. The downstream edge of the PCC pavement is very noticeable in the left and center data sets. The SRI values are above the upper threshold of 2.1 m/km. Although a higher SRI is expected at the interface, the SRI is sometimes even surpassing the Peak SRI upper threshold of 2.9 m/km. This pavement edge should be assessed for possible maintenance (e.g., grinding or sealant).

The upstream edge of the PCC pavement is only noticeable in the center data sets. It is only slightly greater than the upper threshold.

There is an additional area within the PCC pavement should be assessed for possible maintenance. Located between 158-160 m, it is a spike which goes above the SRI upper threshold.

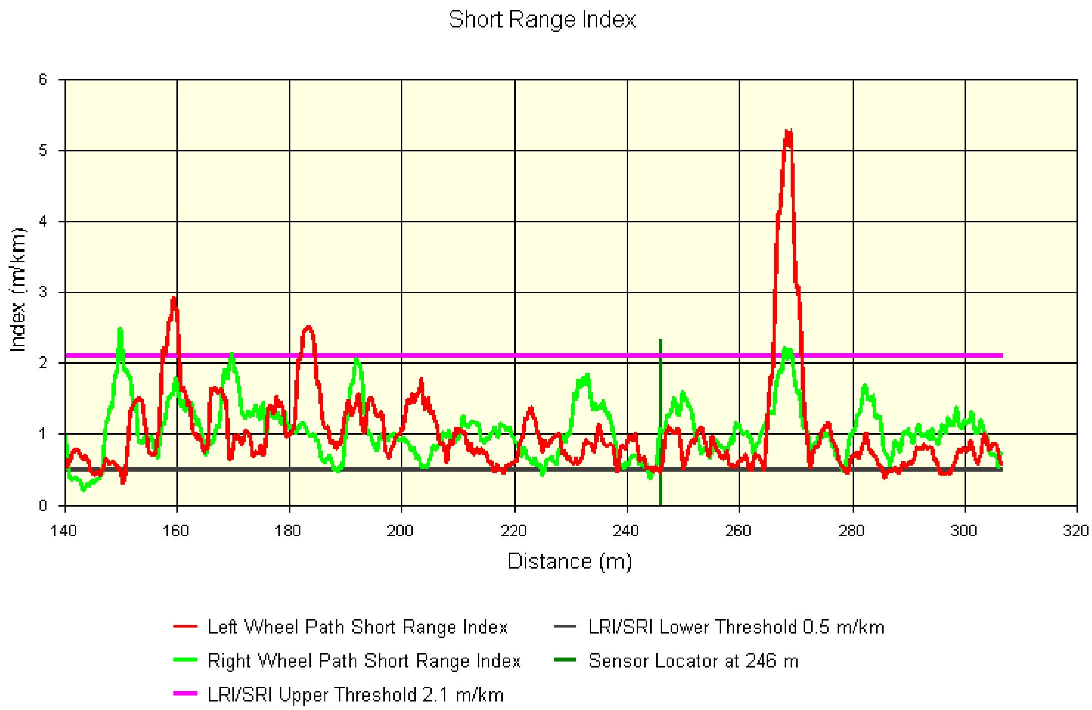

Figure 9. SRI Plot for Center Profile 1.

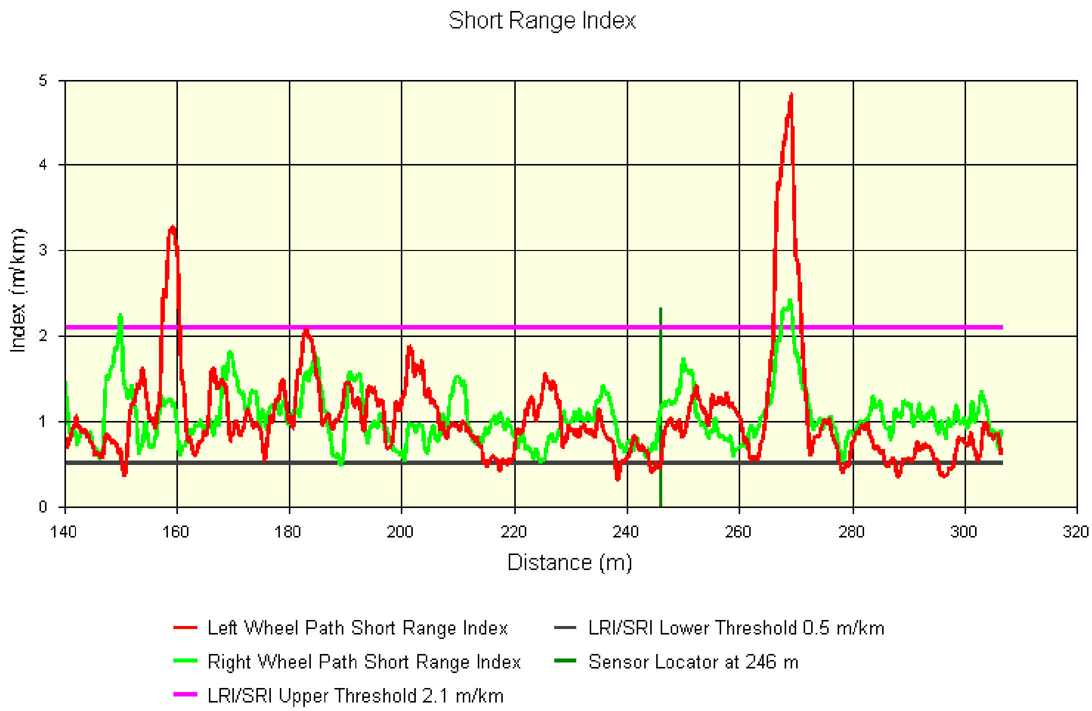

Figure 10. SRI Plot for Center Profile 2.

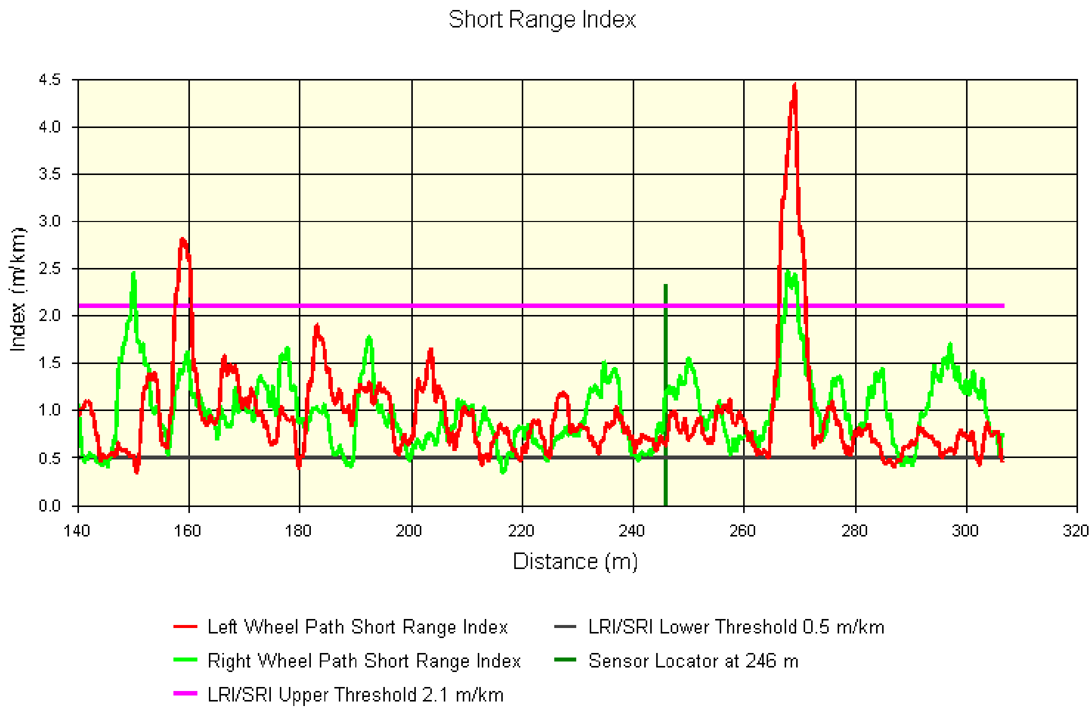

Figure 11. SRI Plot for Center Profile 3.

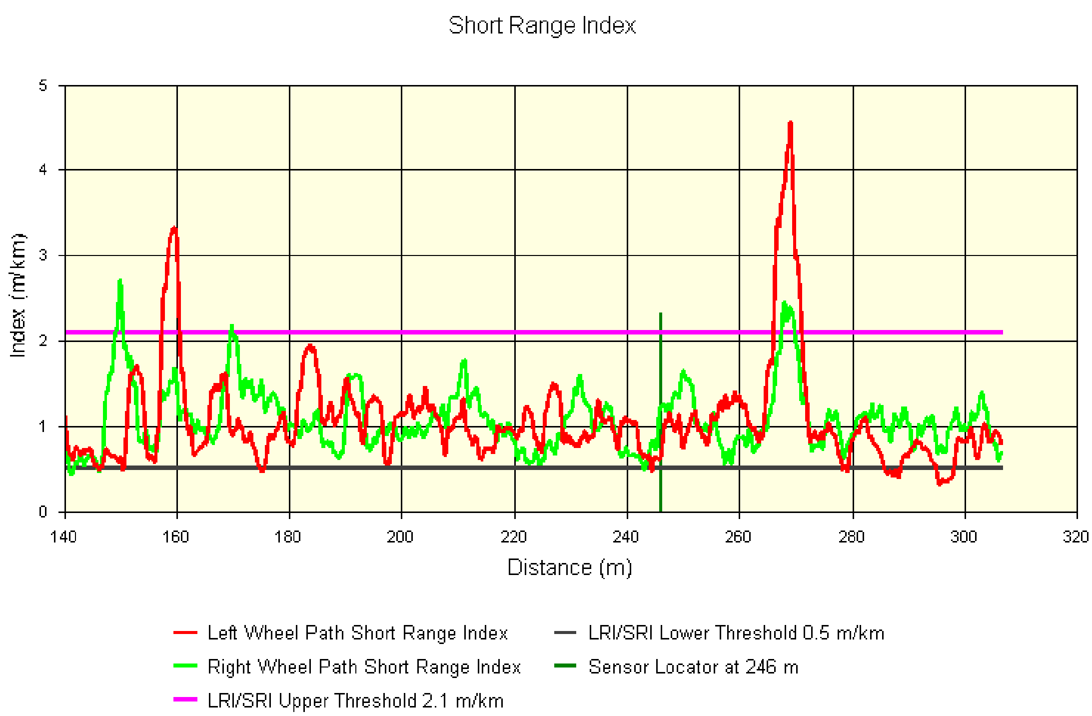

Figure 12. SRI Plot for Center Profile 4.

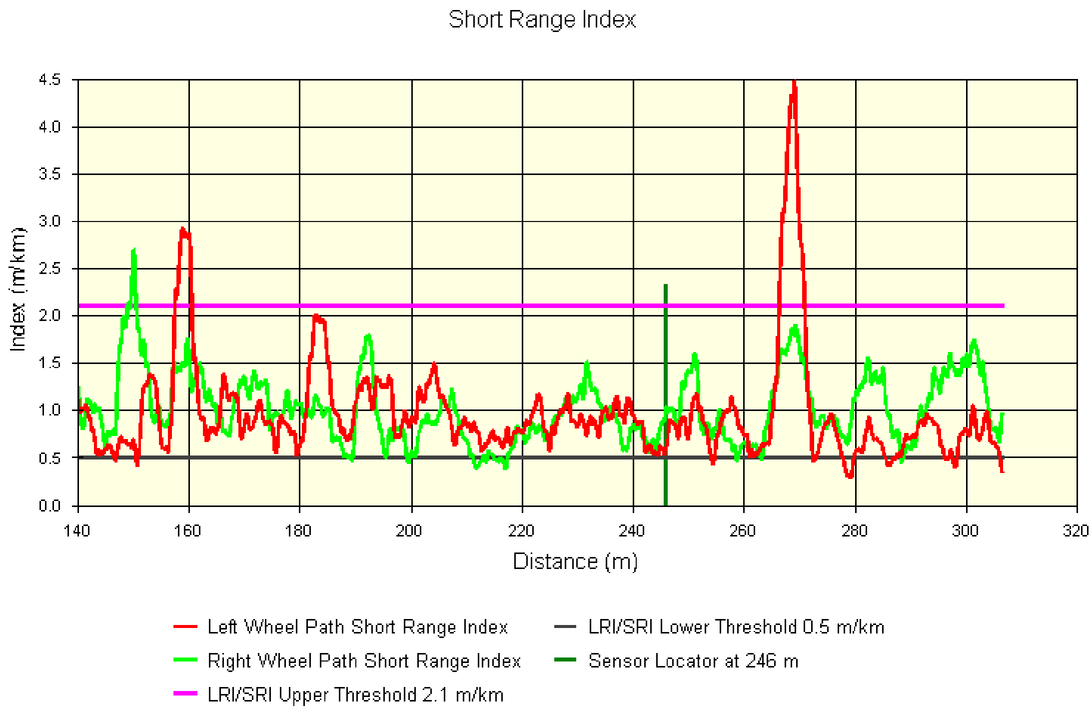

Figure 13. SRI Plot for Center Profile 5.

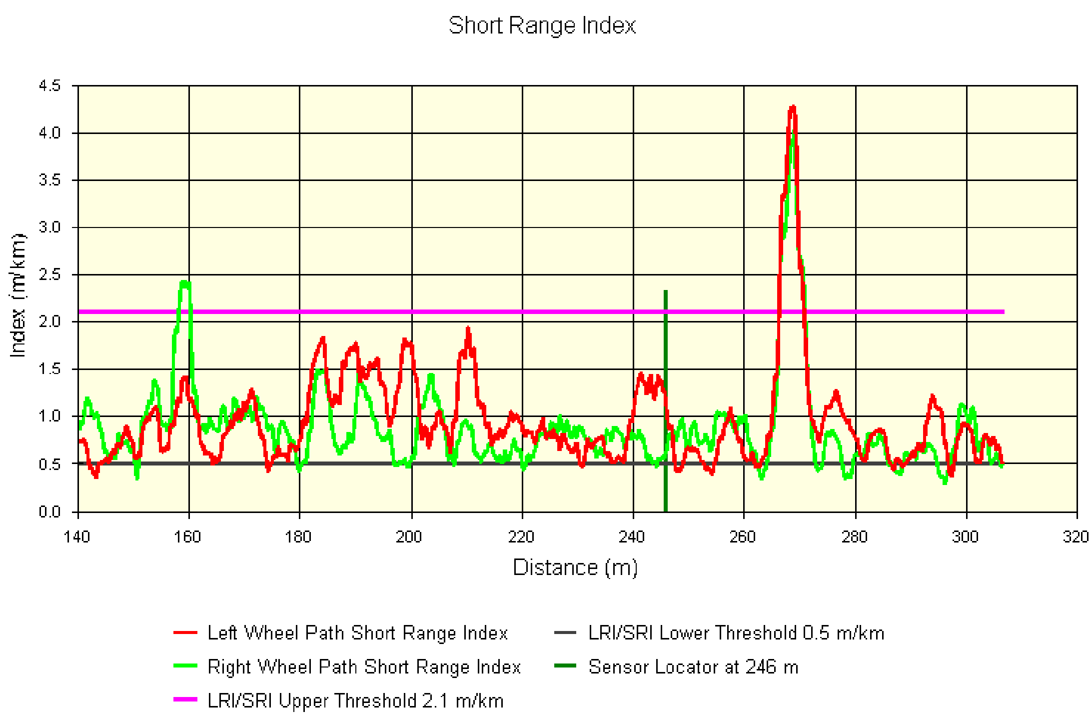

Figure 14. SRI Plot for Left Profile 1.

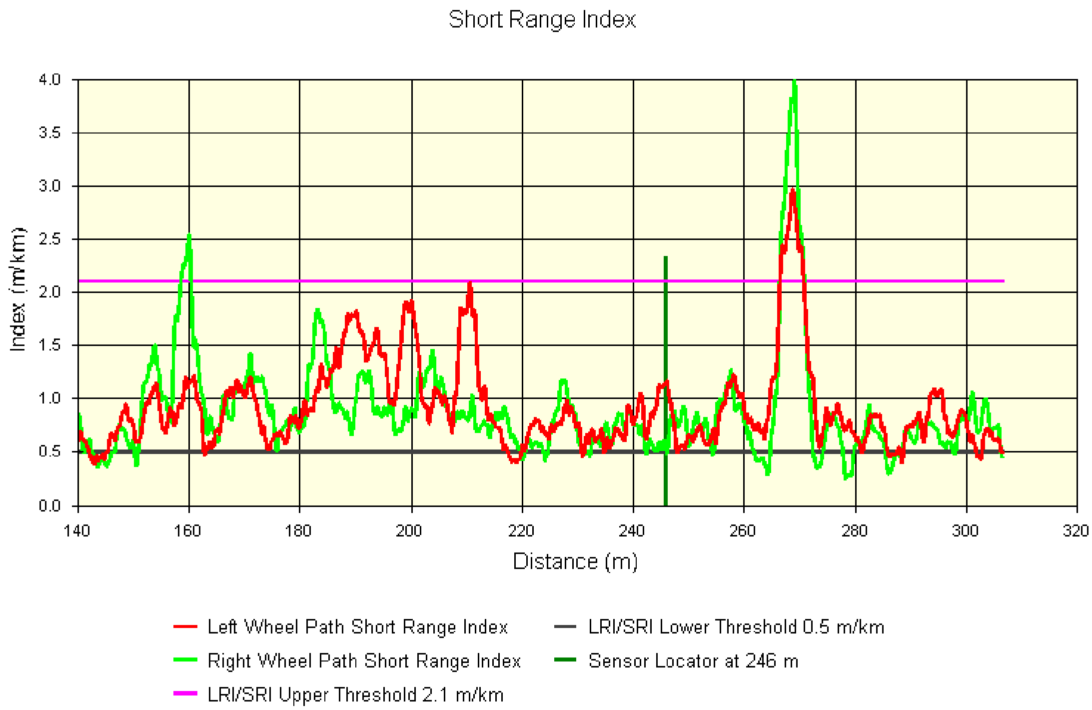

Figure 15. SRI Plot for Left Profile 2.

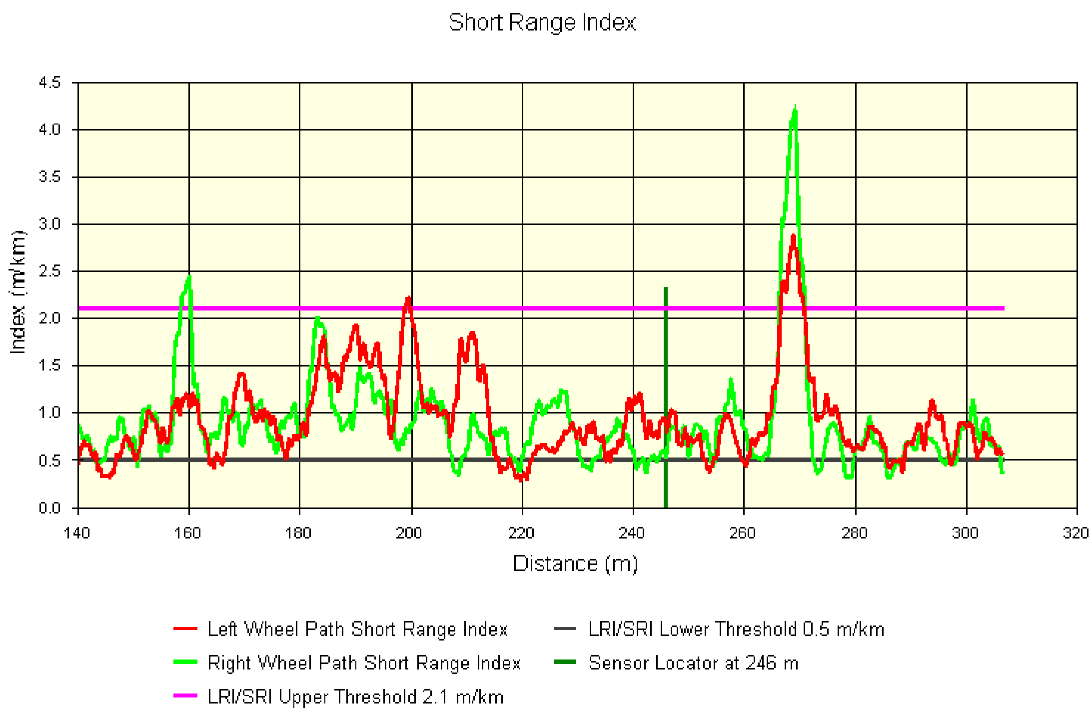

Figure 16. SRI Plot for Left Profile 3.

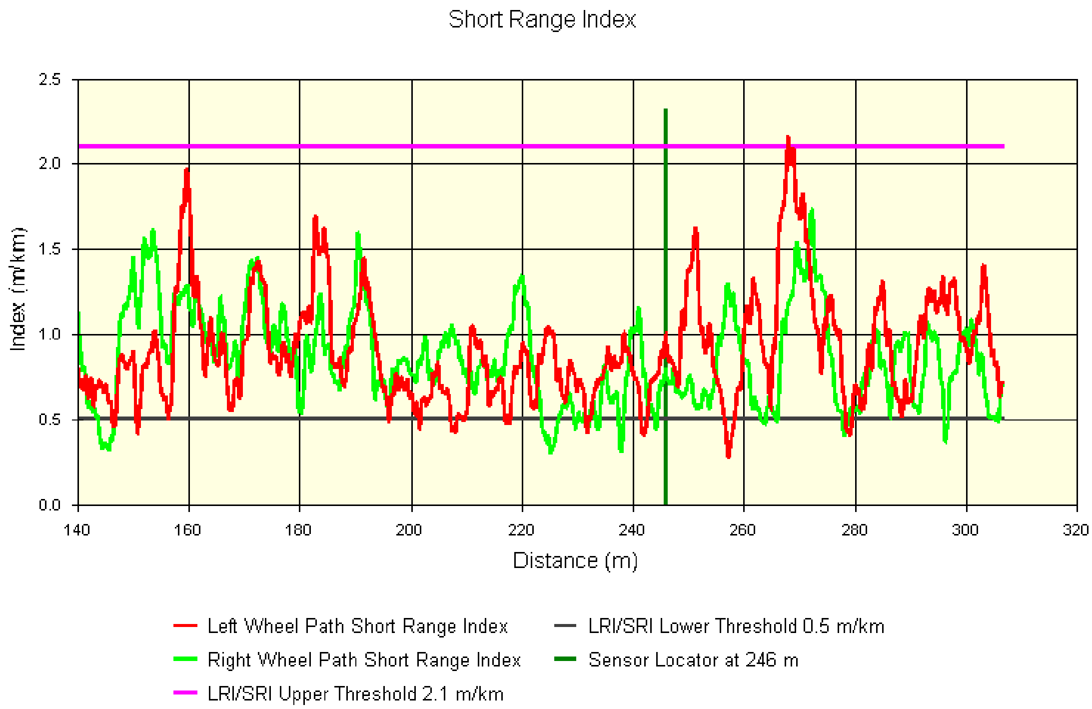

Figure 17. SRI Plot for Right Profile 1.

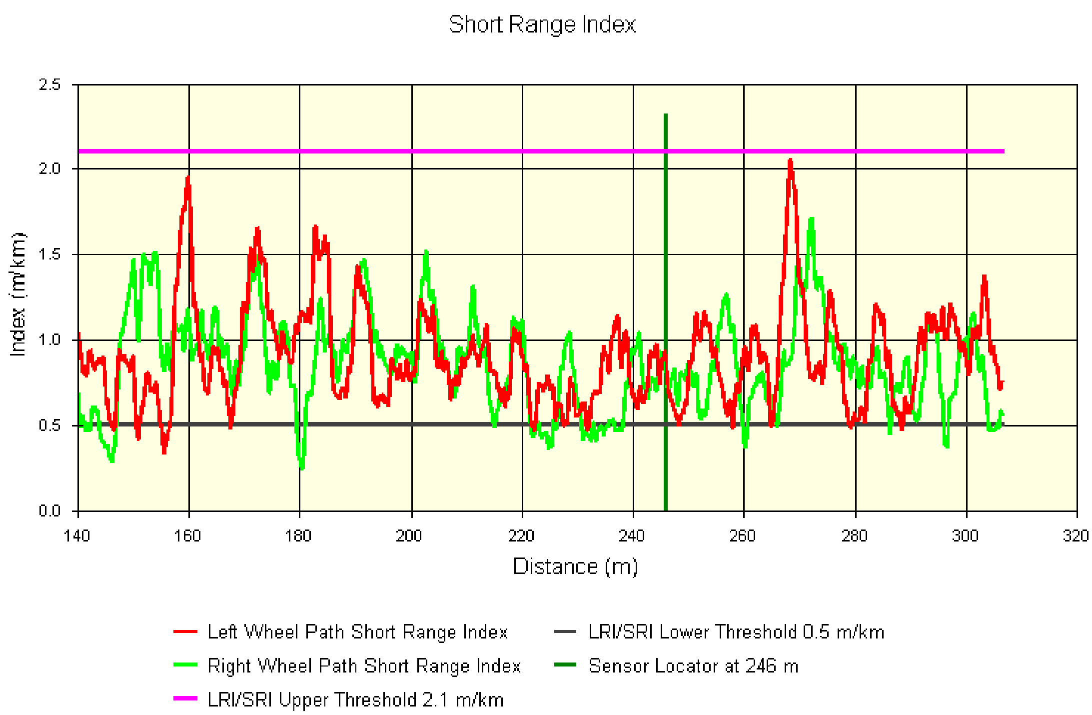

Figure 18. SRI Plot for Right Profile 2.

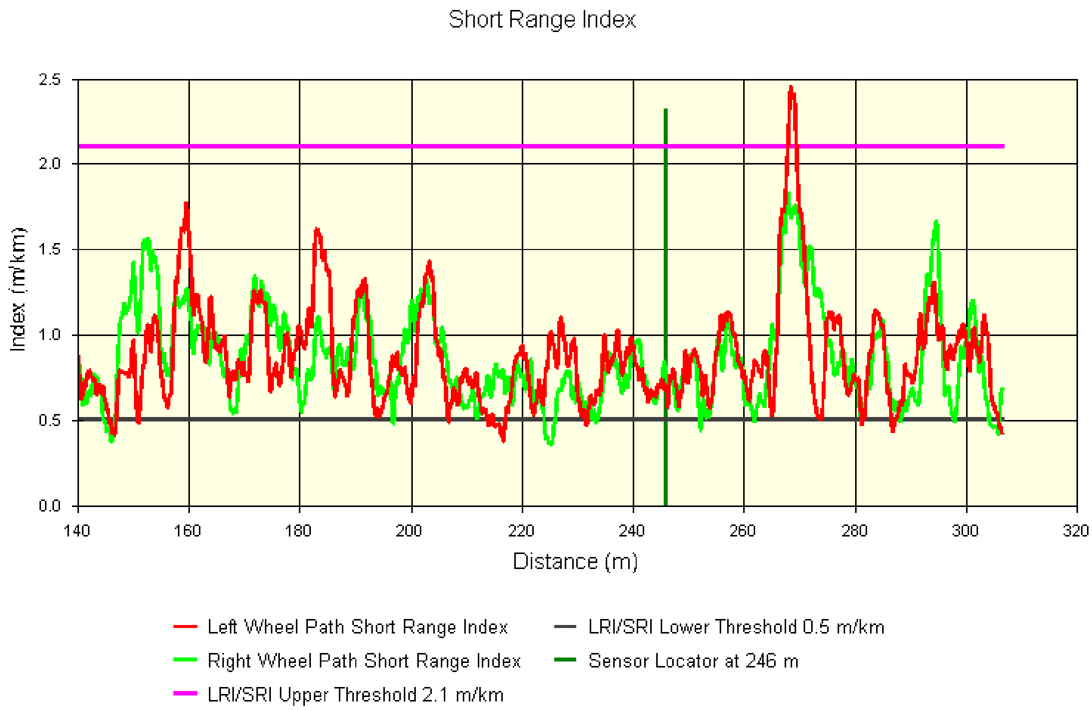

Figure 19. SRI Plot for Right Profile 3.

5.4 RESULTS DISCUSSION

The results of the pavement evaluation were based on the geometrics of the pavement, photographs of the pavement surface condition and analysis of the profile data.

The geometric information indicated that a PCC pavement had been constructed at a quality location near the MD SPS-5. There is very little horizontal curvature, grade or cross slope.

The surface condition evaluation showed that the AC / PCC joints are in poor condition. Sealant is no longer adhering to pavement interfaces and the AC pavement is deteriorating (i.e., fraying along the edge with a mean width between 6-19 mm). There was some distress observed on the upstream and downstream AC pavement. Longitudinal cracking along the pavement edge and the construction joint along the centerline was observed. Raveling along the center of the travel lane was also observed. The condition of the pavement edge and shoulder joint is in poor condition in several areas. Cracking (i.e., longitudinally along pavement edge and transversely from pavement edge to right of way) and deterioration of the AC is evident in many of the pictures shown in Appendix D.

The profile data was analyzed with ProVAL and LTPP WIM Index Software to evaluate the pavement smoothness at the site. The profile runs showed good agreement for each sensor position with features such as peaks and valleys corresponding well with each other. The following analysis comments can be made:

- Higher IRI values occurred at the AC / PCC joints.
- Localized roughness is located at the AC / PCC joints.
- Additional localized roughness was observed at 170.4 m and 188.6 m, which are within the PCC pavement. These should be assessed more thoroughly prior to WIM installation.
- The computed WIM indices were in between the lower and upper threshold values. This indicates the pavement may or may not cause dynamic loading in the trucks traversing the site sufficiently large enough to cause inaccurate weight measurements. *Note: The Site Evaluation option assumed the WIM is already installed. These values will likely change once the WIM is installed.*
- Using the *Location Selection* option of the WIM Index Software, the LRI profiles were between the lower and upper threshold values. This indicates that the WIM could be placed anywhere within the profile.
- Using the *Location Selection* option of the WIM Index Software, the SRI profiles showed several areas of concern, the AC / PCC joints especially the downstream joint and an area located between 158 - 160 m.

6.0 PROPOSED WIM SITE- INFORMATION

6.1 LOCATION – US15 MP 4.7

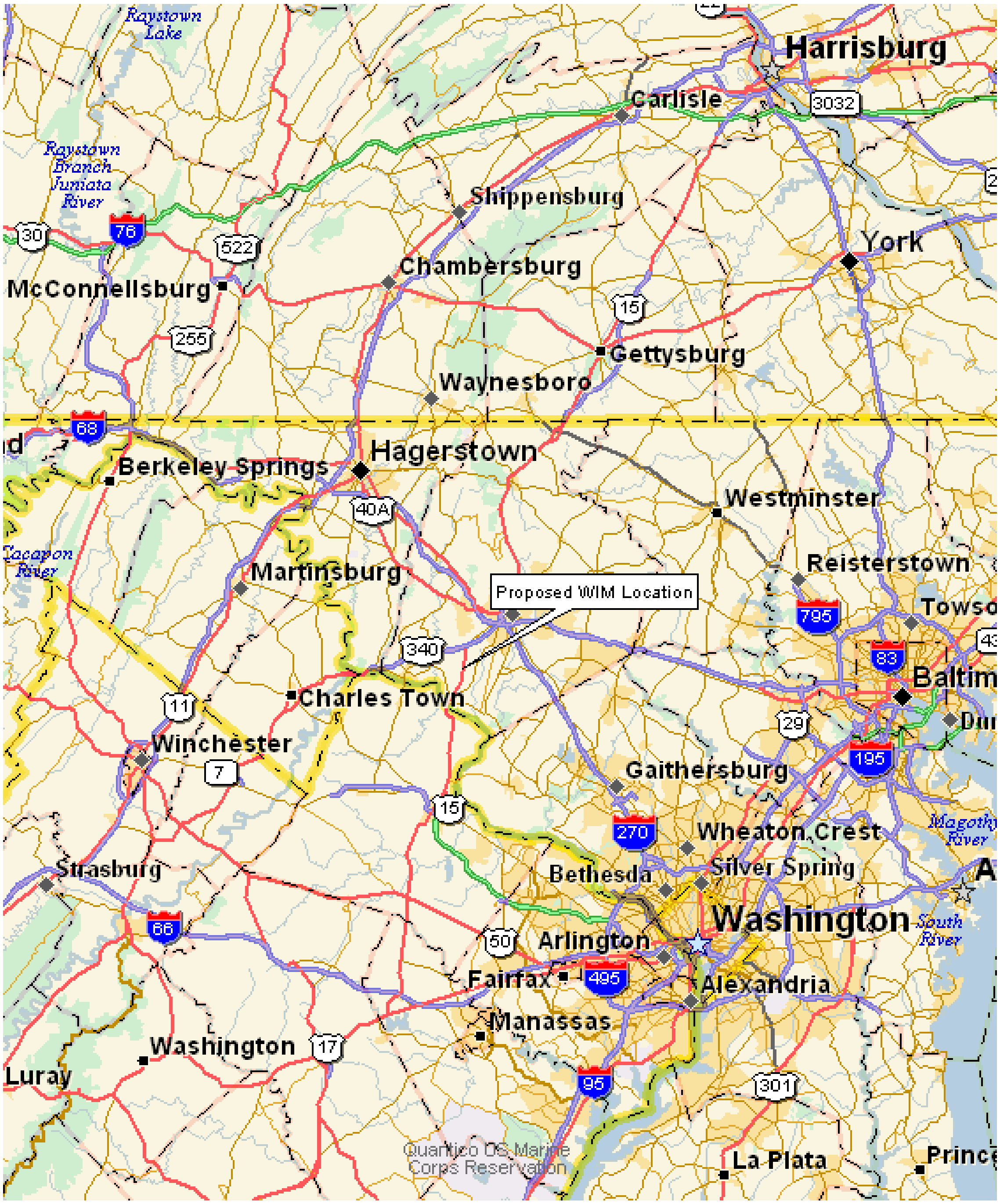

Figure 1: Map of US15 WIM Site

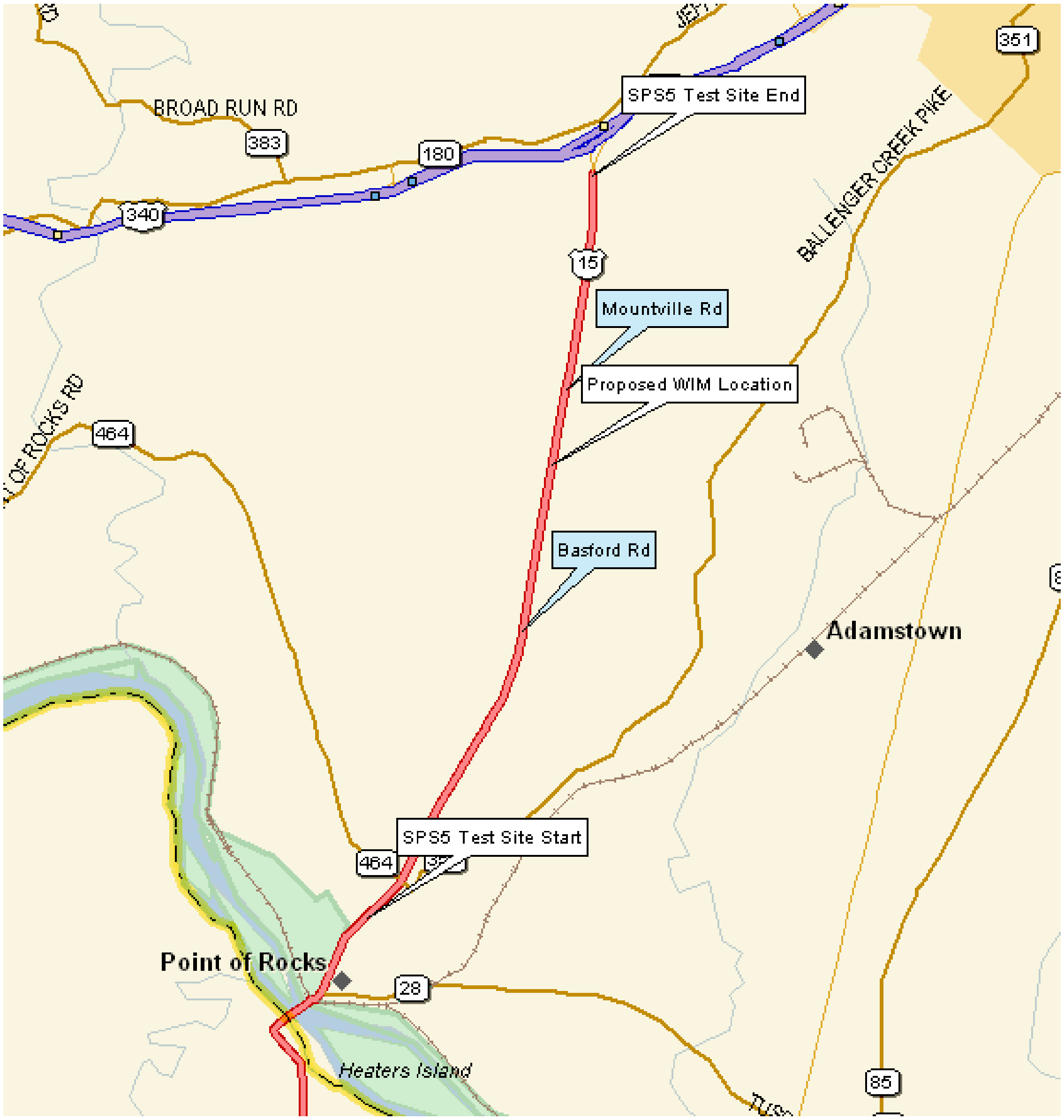

Figure 2: Map of US15 WIM Site at Milepost 4.7

The LTPP SPS-5 test sections, approximately 60 miles from Baltimore, are located in the northbound lane of US15 between mileposts 1 and 8, just north of the Potomac River.

The proposed site for the WIM system installation is located at milepost 4.7, 0.5 miles North of test section 240559 and immediately South of test section 240561 in the SPS-5 experiment, with scales to be installed in the northbound lane. The controller cabinet and power utility pole from the existing ATR # 68 PEEK Piezo Weigh-in-Motion traffic data collection system is located approximately 400 feet upstream of this location behind the southbound guardrail.

7.0 RECOMMENDED WIM TECHNOLOGY

Based upon the site conditions and discussions with the State, the bending plate technology is recommended for use at this site. It will fit the performance expectations of the State, and accommodate installation and future maintenance so as to minimize lane closures and provide the highest degree of reliability.

Both Kistler and Single Load Cell were ruled out due to lane closure/serviceability constraints on this busy two lane, two direction roadway.

7.1 RECOMMENDED LOCATION FOR THE WIM SYSTEM SENSORS

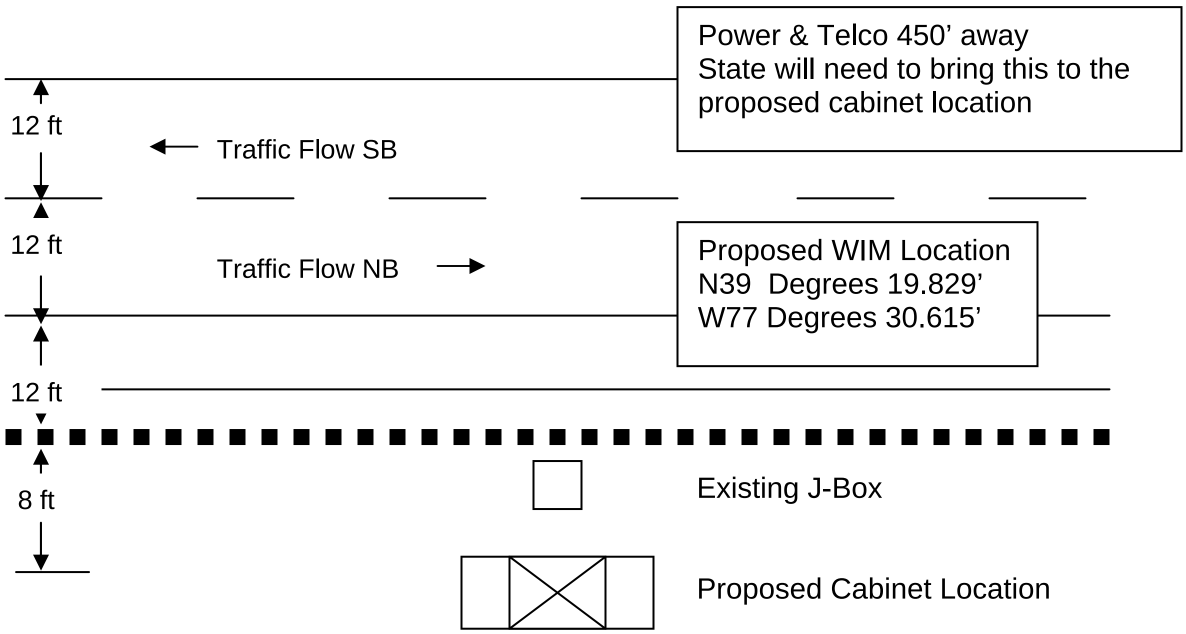

Figure 4: Proposed WIM Site Layout

A.0 COORDINATION DETAILS

Task Order #1, which authorized the CLIN 1001 "Determine Acceptability of Proposed Site" for the Maryland SPS-5 Site (LTPP ID 240500), was issued on January 3, 2005.

Contacts were made with interested parties as follows:

- Contracting Officer's Technical Representative (COTR)
  - Debbie Walker – FHWA-LTPP ph: 202-493-3068
  - Initial contact made February 8, 2005

- State Highway Agency (SHA)
  - Al Blazucki – SHA/OOTS ph: 410-321-3118
  - Initial contact made February 8, 2005

- LTPP Regional Support Contractor (RSC)
  - Basel Abukhater – RSC/Stantec ph: 716-632-0804
  - Initial contact made February 8, 2005

- FHWA Division Office
  - Jitesh Parikh – FHWA Div Rep ph: 410-779-7136
  - Initial contact made February 11, 2005

The "Pre-Visit Handout Guide" (Appendix A) was distributed on February 18, 2005, to the following individuals:

- Al Blazucki
- Debbie Walker
- Basel Abukhater

The site was visited on February 22nd through 24th, 2005, by Roy Czinku (IRD). Roy Czinku, Debbie Walker, Chris Strain (SHA), and Michael Moravec (FHWA) were all on-site February 23 to confirm location and availability of the AC Power and existing conduit between the existing ATR # 68 controller cabinet and the proposed WIM cabinet location.

A briefing session was held at 9:00 AM on February 23rd, 2005, at the State Highway Agency's District 7 Office, located approximately ½ mile South of I-270 Exit 31 on Maryland Route 85. A complete list of all attendees is attached (Appendix F.0 Sign In Sheet – Site Acceptability Briefing Session).

INTERNATIONAL ROAD DYNAMICS INC.

LTPP SPS PHASE II

WEIGH-IN-MOTION
SITE ACCEPTABILITY
PRE-VISIT HANDOUT GUIDE

MARYLAND SPS-5
LTPP ID 240500

Date: February 18, 2005

CONTRACT NO. DTFH61-05-D-00001

U.S. Department of Transportation
Federal Highway Administration

LONG TERM Pavement PERFORMANCE

B.0 PRE-VISIT HANDOUT GUIDE

B.1 SCHEDULE

a. Briefing session
   i. Meeting is scheduled for 9:00 a.m. February 23, 2005 at the District 7 Office in Frederick (Located approximately ½ mile South of I-270 Exit 31 on Maryland Route 85).
b. Site visit
   i. February 22, 2005 thru February 24, 2005

B.2 BRIEFING SESSION FEBRUARY 23, 2005, POINTS OF CONTACT, PHONE NO.S

c. Contracting Officer's Technical Representative (COTR)
   i. Debbie Walker – FHWA-LTPP ph: 202-493-3068
d. State Highway Agency (SHA)
   i. Al Blazucki – SHA/OOTS ph: 410-321-3118
e. LTPP Regional Support Contractor (RSC)
   i. Basel Abukhater – RSC/Stantec ph: 716-632-0804
f. FHWA Division Office
   i. Jetesh Parikh – FHWA Div Rep ph: 410-779-7136

B.3 INFORMATION REQUESTS

g. From COTR
   i. FHWA Division contact person
   ii. New pavement profile from RSC if recent profile data unavailable
h. From RSC
   i. SHA contact person
   ii. SPS roadway section layouts (plan view and/or stationing or mileposts)
   iii. Recent pavement profile data
i. From SHA
   i. As-built info on roadway at proposed site
      1. Pavement cross section and structural section
      2. Alignment and grade
      3. Any utilities located in WIM install work area
   ii. Location and general availability of power and phone services, service providers, service provider contacts and phone numbers (may be beneficial if power and phone utility reps be requested to participate in briefing session and/or site visit)
   iii. Will SHA agree to extend power and phone services from existing available access points to demarcation points near planned controller cabinet location?
   iv. If existing roadway pavement is AC or inadequate PCC will SHA consider replacement with 400' PCC slab if recommended per site assessment?
   v. What permits will be needed to install equipment and what are procedures and time frames for obtainment
   vi. Required cabinet clear zone from edge of traveled way

vii. If no detour routing available at proposed site (or three or more adjacent lanes), will SHA permit shifting inside lane traffic partially onto inside shoulder to provide safe clearance during installation in outside lane?
viii. Historic truck traffic data

B.4 SITE LOCATION INFORMATION

j. Proposed WIM site
   i. US15 Mile Post 4.7 Northbound Lane
k. Briefing session location
   i. District 7 Office approximately ½ mile South of I-270 Exit 31 on Maryland Route 85
l. Nearest major airport
   i. Baltimore Washington International Airport

Distribution --- COTR, RSC, SHA, FHWA Division, Site Assessment Team

INTERNATIONAL ROAD DYNAMICS INC.

LTPP SPS PHASE II

WEIGH-IN-MOTION
SITE ACCEPTABILITY

SITE VISIT EVALUATION FORM

MARYLAND SPS-5
LTPP ID 240500

Date of Site Visit: February 22-24, 2005

CONTRACT NO. DTFH61-05-D-00001

U.S. Department of Transportation
Federal Highway Administration

LONG TERM Pavement PERFORMANCE

C.0 SITE EVALUATION FORM

☑ Site Evaluation Forms
☑ Graph paper and note paper
☐ Clipboard
☑ Pens & pencils
☐ Small stapler
☑ Digital camera, with PC cable
☑ GPS receiver
☑ Notebook PC
☑ Calculator
☑ Cell phone
☑ Site Pre-visit Handout Guide
☑ Metal tape measure (25 ft.)
☑ Measuring wheel (ft.) and/or 100 ft. rag tape
☐ Folding rule (6 foot)
☐ Hand level
☐ Small torpedo level
☑ Keel markers
☐ Spray can white paint
☑ String Line ____________
☑ Line Level ____________
☑ Hammer and Concrete Nails ____
☐ ______________________________

Request furnish on-site by Highway Agency:
☐ Spray can white paint
☐ Lath, 4 ft.
☐ Hammer
☐ Misc. small tools
☑ Keys for known Agency service cabinets
Note: Key for existing cabinet is a standard Type II

Proper attire for field work and expected weather:
☑ Durable shoes
☑ Cold weather layering
☐ Rain gear
☐ ______________________________

Safety equipment per State Highway Agency requirements:
☑ Hard hat
☑ Safety vest – type Hi-Vis Safety Yellow
☐ Other required equipment __________

C.1 PROPOSED WIM LOCATION

Proposed WIM Site Location – 2 Lane Roadway (1 lane each Direction)

Route US 15 Mile Post 4.7 Direction NB Lane Outside .

Proximity to applicable SPS test section 3588 feet Downstream from the start of SPS Test Section 240559

C.1.1 EXISTING ROADWAY AT PROPOSED WIM SITE

Type Pavement Asphalt Lane Width 12 feet Thickness 11 inches

Observed Structural Soundness Moderate

Observed Smoothness Moderate

Outside NB Shoulder Type Asphalt Width 10 feet

Outside NB Shoulder Condition Moderate

Outside SB Shoulder Type Asphalt Width 10 feet

Outside SB Shoulder Condition Moderate

C.1.2 PAVEMENT 325' PRIOR AND 75' FOLLOWING WIM SCALE LOCATION

Type Rigid Structural Soundness Good Smoothness Moderate

Thickness 11inches Jointed or Continuous Jointed Concrete (15 ft joints) dowelled

Notes/Comments on Pavement

The State has installed a 400 foot Portland Cement Concrete Slab to accommodate the WIM System. Grinding has been performed on the slab using a 36 inch wide blanket grinder. There are some anomalies within the pad that were not taken out (several low spots approximately 6 inches to 2 feet in size) . A road profile should be performed to confirm that the roadway meet required smoothness specs and confirm straightedge findings.

C.1.3 ROADWAY GEOMETRICS

Horizontal Alignment Straightaway Grade Minimal Grade(0.62%)

Cross-slope Approximately 2% (1.6%) Lane width 12 feet

C.1.4 OBSERVED TRAFFIC OPERATING CHARACTERISTICS

Passing, merging, not following lane lines? Good Lane Discipline

Stop and go traffic, congestion periods? Free Flowing at all Times

Traffic signals or interchanges affecting traffic flow? No Signals or Merging

Other adverse traffic flow conditions? None, Traffic Flow is Medium/Heavy

Truck traffic at "cruising" speed and no lugging? No Lugging, Smooth Flow

Truck traffic staying within lane lines? Yes, Trucks Track within Lane Lines

Observed truck suspension or body motion dynamics? Minimal

Truck traffic composition same at WIM site and SPS site? Yes

Truck traffic on/off locations between WIM site and SPS site? Two Exits (Basford Rd & Whiten Rd) between Test Site and WIM Location. (note: these are residential roadways that will not accept heavy truck traffic)

Notes/Comments on Geometrics and/or Traffic Operating Characteristics

The site is located on a straightaway with no curves immediately before or after the WIM location. The grade is relatively flat throughout the area with no significant grade. Vehicles track smoothly through this area at speeds between 55 and 65 MPH (posted speed is 55 MPH). There is very good lane discipline at this site. Traffic flows medium to heavy on this two lane, two direction roadway. Please note, tailgating of vehicles can occur at times on this roadway.

C.1.5 ACCESS TO UTILITY SERVICES

Potential source(s) for power Existing WIM Cabinet c/w AC Power is approximately 450 feet from proposed WIM location. This service needs to be extended from existing WIM to proposed WIM location.

Potential source(s) for telephone Existing WIM Cabinet c/w Telco is approximately 450 feet from proposed WIM location. Conduit and Junction boxes already exist between the existing WIM and proposed WIM .

C.1.6 EQUIPMENT INSTALLATION CAPABILITY

Adequate location for controller cabinet? Yes, behind Guard Rail

Distance from edge of traveled way to cabinet 20 feet Off Roadway

Visibility from cabinet of sensors and approaching vehicles? Very Good

Adequate location for service facilities? Existing, State extend to new WIM

Adequate drainage for scale pits? Yes

Adequate roadway and overall site drainage? Yes

Potential for ponding or flooding at cabinet or pullboxes? No

Potential for traffic control problems during installation? Possibly

Ability to provide safe clearance in work zone from live traffic via:
- ☑ OK from State Agency to use opposite shoulder for traffic shift
- ☑ OK from State Agency to use 1 Lane Reversible Traffic Control

Notes/Comments on Equipment Installation Capability

The State will need to extend the existing power and telephone from the existing WIM Location to the new WIM location. Also we will need to work together on best way to perform lane closure in this area.

C.1.7 POTENTIAL WIM SENSOR/EQUIPMENT INTERFERENCE SOURCES

Overhead power lines? 450 ft upstream of WIM Adjacent railroad? None

C.1.8 CONDITIONS FOR USE OF TEST TRUCKS FOR CALIBRATION AND EVALUATIONS

Direction NB - Nearest usable truck turnaround location:

Whiten Rd, Maryland Distance from WIM 0.8 Miles

Direction SB - Nearest usable truck turnaround location:

Basford Rd, Maryland Distance from WIM 1.2 Miles

Circuit travel distance 5 Miles Estimated lap time 20 Minutes

Potential circuit route restrictions? Residential Area is part of Truck Loop

Identification and location of certified static scales:

Name LaFarge Frederick Quarry Contact Ben Tyeryar

Address 1000 Block East South Street, Frederick MD 21701

Phone 301-694-4820 Hours 6:00 a.m. to 4:00 p.m. Mon-Fri

Cost per initial weighing None Cost per additional weighing None .

Notes/Comments on Test Truck Circuit and Static Weighing Facility

Ben will be able to assist us with Calibration Vehicles. He Assisted MDDOT in the past and will not charge for initial or additional weighing provided we use one of the trucking firms recommended by LaFarge. He can provide us a load of Rock for no charge provided it is returned after testing is complete

D.0 SHEET 17

Sheet 17	*STATE_CODE	LTPP	
LTPP Traffic Data	*SPS PROJECT ID	240500	__
WIM SITE INVENTORY	*SPS WIM ID	SPS-5	

1.* ROUTE US 15 MILEPOST 4.7 LTPP DIRECTION - N S E W (arrow: N)

2.* WIM SITE DESCRIPTION - Grade 0.62 % Sag vertical Y / N (arrow: N)
Nearest SPS section upstream of the site 240559
Distance from sensor to nearest upstream SPS Section 3588 ft

3.* LANE CONFIGURATION
Lanes in LTPP direction 1 Lane NB 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 11 inch iointed PCC

8. RAMPS OR INTERSECTIONS
Intersection/driveway within 300 m upstream of sensor location Y / N - distance No
Intersection/driveway within 300 m downstream of sensor location Y / N- distance No
Is shoulder routinely used for turns or passing? Y / N No

Form completed by Roy Czinku - IRD Date Feb 25, 2005

E.0 PHOTOGRAPHS

E.1.1 SPS TEST SECTION MARKER

E.1.2 GENERAL SITE VIEW OF THE CONCRETE SLAB

E.1.3 GENERAL SITE VIEW OF THE CONCRETE SLAB FROM SHOULDER

E.1.4 DOWNSTREAM VIEW OF ROADWAY AND TRAILING EDGE OF SLAB

E.1.5 UPSTREAM VIEW OF ROADWAY AND LEADING EDGE OF SLAB

E.1.6 SLAB JOINT DETAIL

E.1.7 RECOMMENDED SCALE LOCATION

E.1.8 RECOMMENDED CABINET LOCATION

E.1.9 POTENTIAL POWER SERVICE

E.1.10 EXISTING TELEPHONE SERVICE

E.1.11 EXISTING WIM CABINET

E.1.12 ROADWAY DRAINAGE

E.1.13 SLAB ANOMOLY (LOW SPOT)

F.0 SIGN IN SHEET – SITE ACCEPTABILITY BRIEFING SESSION

Name / Title	Email Address	Telephone #
David James – SHA	djames@sha.state.md.us	301-624-8204
Debbie Walker – FHWA-LTPP	deborah.walker@fhwa.dot.gov	202-493-3068
Roy Czinku - IRD	roy.czinku@irdinc.com	306-653-6627
Chris Strain – SHA/OOTS	cstrain@sha.state.md.us	410-787-5857
Al Blazucki – SHA/OMT	ablazucki@sha.state.md.us	410-321-3118
Barry Catterton – SHA/OMT	bcatterton@sha.state.md.us	410-321-4102
Karl Hess – SHA/HISD	khess@sha.state.md.us	410-545-5523
Barry Balzanna – SHA/HISD-TMS	bbalzanna@sha.state.md.us	410-545-5509
Michael Moravec – FHWA/RC-LTTP	mike.moravec@fhwa.dot.gov	410-962-5623
William McNeil – SHA/OOTS	wmcneil@sha.state.md.us	410-787-7601