1. Report No. DDOT-TOA-CIP-07-001			2. Report Date August 29, 2008	
3. Title and Subtitle Feasibility Study for I-295 WIM Site Improvements			4. Contract or Grant No.	
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8. Sponsoring Agency Name and Address District Department of Transportation - TOD, TOA 2000 14th Street, N.W. 2nd Floor Washington, D.C. 20009				
9. Supplementary Notes				
10. Abstract This study involved an evaluation of the existing weigh-in-motion (WIM) sites on Northbound and Southbound I-295 near MD/DC state line to assess the feasibility of expanding the operations to include a scale house, parking spaces for trucks and enforcement vehicles, an inspection pit, and appropriate acceleration and deceleration lanes. The study also included a review of available technologies for detection of hazardous materials.				
11. Key Words weigh-in-motion WIM I-295 Feasibility study Inspection Trucks		12. Distribution Statement		
13. Security Classif.(of this report) Unclassified	14. Security Classif.(of this page) Unclassified		15. No. of Pages	16. Price

Technical Report Documentation Page

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EXECUTIVE SUMMARY

It is feasible and beneficial to improve the existing weigh-in-motion (WIM) sites along Southbound I-295 (Anacostia Freeway) to include inspection facilities along with technological components for detection of various hazardous materials such as radiological, chemical, and biological. However, the Northbound I-295 site was relocated further south along I-295 in order to provide additional distance between the site and the Laboratory Road interchange. The conceptual drawings developed for the two (2) station sites meet appropriate AASHTO design guidelines for deceleration and acceleration requirements for interstate highways. The sites have existing nearby utilities including electrical, water, and sanitary sewer. New technologies are available that can detect hazardous materials, as well as other mechanical malfunctions such as excessive heating associated with improper lubrication of bearings and motors, misalignments in rotating equipment, and improper tension in drive belts and pulley. The proposed improvements will enhance safety for both trucks and the general public. The commission of this feasibility study for improving the WIM sites on I-295 is an acknowledgement of District Department of Transportation (DDOT), Metropolitan Police Department (MPD), Federal Highway Administration (FHWA), and Federal Motor Carrier Safety Administration (FMCSA) contributions and commitment to transportation safety and the general public.

7. INTRODUCTION

This study was a collaborative effort with representatives from DDOT-IPMA, DDOT-TOD, MPD, FHWA, and FMCSA. A key objective of the study was to assess the feasibility of expanding the existing WIM sites to include additional detection and inspection capabilities in order to enhance the overall truck safety and enforcement operations along I-295. The study area is shown on Figure 1.

The District currently has WIM systems along the northbound and southbound lanes of I-295 near the Maryland State line. The WIM technology was installed as part of the rehabilitation of I-295 from the District of Columbia/Maryland State line to Laboratory Road. The load cells were installed in each lane at Station #114+60 for the Southbound and at Station #111+40 for the northbound direction (see Figures 8B and 9A for details). The northbound I-295 WIM load cells have been relocated to Sta. 108+00. The distances between the load cells and WIM sites are 441 meters (1,447’) and 465 meters (1,525’) for the southbound and northbound directions, respectively. The sites collect traffic count data by vehicle classification, weight, and speed. The data is utilized by DDOT. They are also equipped with cameras to photograph vehicles. In addition, vehicle data is transmitted to MPD’s Commercial Vehicle Enforcement Unit with downstream pull-off areas and portable scales. The constructed pull-off areas are 75 meters (246’) in length. In should be noted that as part of the I-295 reconstruction project, multiple 4” conduits along with manholes were installed on both sides of I-295 within the outside shoulders for TSM communication and electrical utilities. The District is planning to improve the pull-off areas with a small scale house and stationary platform scales to expand the inspection operations.

FIGURE 1

8. REVIEW OF COMPARABLE SITES

As part of this study, field reviews was conducted at comparable sites in Virginia and Maryland. On I-95 in Dumfries, Virginia, there are scale houses for both northbound and southbound directions. A pedestrian tunnel under I-95 provides access from the northbound administrative location to the southbound inspection site. The truck inspection area and pit are located approximately ½ mile north of the scale houses and platform scales. The project team also visited two (2) WIM sites in Maryland (Upper Marlboro and Hyattstown). The Maryland locations both have scale houses with considerable parking areas. The Hyattstown site also has an inspection pit.

9. AVAILABLE PRODUCTS AND DETECTION TECHNOLOGIES

The technologies for detection of hazardous materials have been evolving in recent years in support of homeland security. Such technologies have been in place for boarder crossings, as well as other applications, and can be applied to WIM systems in Washington, D.C.

3.1 Scale House

There is a variety of booth types available for use as a scale house. The units shown on Figure 2 are bullet resistant and can be custom-designed to meet various requirements such as HVAC, restroom facilities; interior and exterior intercom, security alarms, and extended engineering loads for roofs. Details about theses units, offered by B.I.G. Enterprises, Inc., are included in Appendix A.

FIGURE 2 - Station House Design Options

3.2 Mainline Sorting

Mainline sorting systems are intended for preclearing and automatically sorting vehicles based on weight of a truck, axle spacing, height, vehicle identification, credentials, and safety records. The processing steps include:

1. A truck travelling toward the truck inspection station is directed to use the right-hand lanes.

2. On the mainline, in advance of the inspection station, mainline sorting systems WIM scales weigh the truck, axle sensors determine axle spacing, overheight detectors determine height, and overhead automatic vehicle identification reader recognizes the unique identification signal from the truck's transponder.

3. A WIM computer processes this information to produce a vehicle record that can be checked with the credential database and transportation regulations.

4. Based on weight, credential information, and safety records, the computer makes a "sort" decision ("bypass" or "report").

5. The sort decision is transmitted via radio frequency to the in-cab transponder. The in-cab transponder will illuminate a red or green light according to the sort decision. A red light means the truck must report to the station. A green light means the truck proceed uninterrupted along the mainline without having to report to the station.

6. Trucks on both mainline and ramp are then tracked by in road sensors to verify correct lane use.

Examples of the benefits of mainline sorting include:

- Minimizes the volume of truck traffic reporting to the weigh station
- Improves productivity of the weigh station by performing automatic checks prior to the station and scales
- Accommodates increased truck traffic volumes while avoiding the greater costs of expanding an existing weigh station
- Increases enforcement capabilities by checking licenses, registration, permits, tax payments, and safety inspection records in less than one second.
- Automatically preclears those trucks registered and in compliance
- Saves time and operating expenses for transportation industry and public
- Improves safety (fewer trucks reporting results in fewer back-ups onto the mainline

- Provides accurate data collection for highway planning and maintenance
- Allows enforcement agency to maximize the efficiency of personnel

The basic configuration of a mainline sorting system is illustrated on Figure 3.

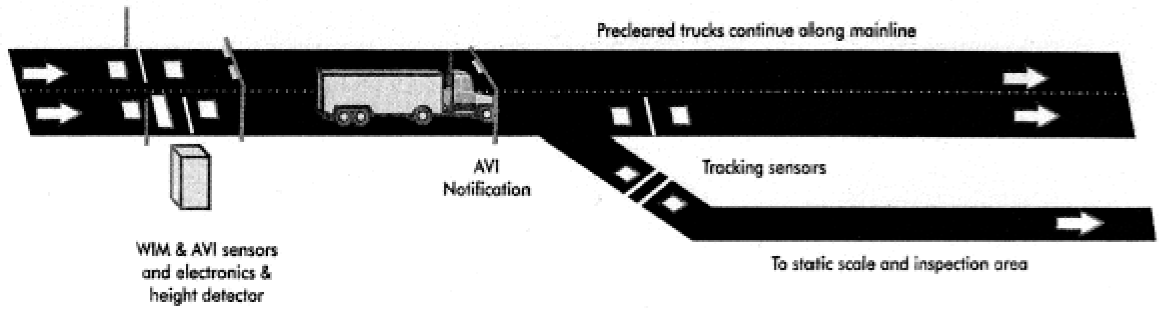


FIGURE 3 - Configuration of Mainline Sorting

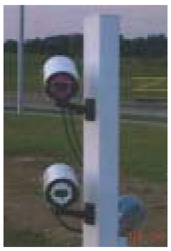
3.3 Integrated Safety and Security Enforcement System (ISSES)

The Integrated Safety and Security Enforcement System (ISSES) technology has many capabilities including radiation detection, thermal imaging, license plate recognition (LPR), USDOT image capture, and automatic vehicle identification (AVI). ISSES can be integrated to existing WIM systems. This system consists of several components that can be integrated into an existing WIM system to enhance detection operations. Components and capabilities include:

- Radiation Detection with Spectroscopy (HazMat Enforcement) - Radiological Sensors for bulk monitoring without slowing the pace of commerce.

- Thermal Imaging - Thermal inspections for brakes, running gear, and other law enforcement application. This represents a key factor for pursuing the improvements due to the resulting effectiveness in safety enhancements on I-295.

- License Plate Recognition (LPR) - Pulsed infrared license place recognition system to identify vehicle registration and stolen vehicles.



- USDOT Image Capture - high speed, high resolution digital imaging for CMV enforcement and hazmat enforcement

- AVI (Automatic Vehicle Identification) - AVI is a surveillance method that uses optical character recognition on images to read the license plates on vehicles. This includes electronic identifiers such as transponders.

- DSRC (Dedicated Short-Range Communications) - This technology is a short- to medium-range wireless protocol specifically designed for automotive use. It offers communication between vehicles and roadside equipment.

- Vehicle Classification and Counter - This includes number of vehicles in each direction, vehicle speeds, axle counting, vehicle classification, and vehicle separation.

- Digital Video Capture - The video capture provides a digital image of the vehicle for record-keeping and further processing.

FIGURE 4 - Typical ISSES

3.4 Thermal Imaging Cameras

Thermal imaging cameras are compact and easy-to-use as a diagnostic tool and they quickly and accurately measure temperatures over large areas, allowing quick identification of hot spots. The primary purpose of such devices is early identification of malfunctioning brake which may pose a potential safety hazard. Applications include:

Electrical

- Most electrical problems exhibit a gradual rise in temperature prior to their failure
- Loose or over tight connections
- Shorted of overloaded circuits
- Load imbalances
- Components which have failed or are fatigued such as fuses

Mechanical

Excessive heating of mechanical devices can signify problems such as:

- Improper lubrication of bearings and motors
- Misalignments inn rotating equipment
- Improper tension in drive belts and pulleys

3.5 Detection of Special Nuclear Material (SNM)

The RadSentry family of portal monitors detect gamma and neutron radiation for the purpose of stopping elicit shipment of SNM and other radionuclides (see Figure 5). Cargo and box scanners can also be used with x-ray scanning and inspection systems. Radiation Sensor Panels (RSP) are supplied by North American Technical Services (NATS). This device uses RadSentry security portals for SNM and other radionuclides. A similar high-performance, hand-held spectrometer unit can be used to perform inspections of specific areas. Additional details are provided in Appendix D.

3.6 Laser-Induced Breakdown Spectroscopy (LIBS)

This technology is an emerging method that possesses many desirable attributes for a fast field-portable sensor system. Until recently, LIBS technology was able to monitor only a few elements at a time. However with the advent of new high-resolution broadband spectrometers, LIBS today is capable of monitoring all chemicals present in a sample at the same time with a single laser shot. This technology can identify virtually all hazardous materials. The key features of LIBS include:

1) Real-Time Analysis
2) High Sensitivity
3) No Sample Preparation
4) Ability to Detect all Elements (both Molecular and Biological)

3.7 Weigh Station Bypass Systems (PrePass and NORPASS)

PrePass is an automated vehicle identification (AVI) system that enables participating transponder-equipped commercial vehicles to be pre-scanned throughout the nation at designated weigh stations. Cleared vehicles are then able to “bypass” the facility while traveling at highway speed. Vehicles that participate in the program are pre-certified. Driver’s safety records and credentials are routinely given to state and federal agencies to ensure adherence to the safety and bypass criteria established by PrePass and member states. If an approaching vehicle’s weight and credentials are found to be satisfactory, a green light and audible signal from a windshield-mounted transponder advises the driver to bypass the weigh station. Otherwise a red light and audible signal advise the driver to pull into the weigh station for inspection. Figure 6 illustrates the three (3) PrePass processing steps.

1. As a truck equipped with a transponder approaches the weigh station, an electronic reader on a boom over the road automatically scans the transponder.

2. A secure PrePass computer located inside the scale house accesses the vehicle information associated with the transponder, and validates it to ensure compliance with state requirements.

3. Finally, as the truck passes beneath a second boom, a signal indicating whether the vehicle may pass is transmitted back to the transponder which will indicate either a green or red light.

PrePass is currently operational at 280 sites in 28 states. In 2007, Georgia and South Carolina added PrePass to their WIM sites.

FIGURE 5 - SNM Detection

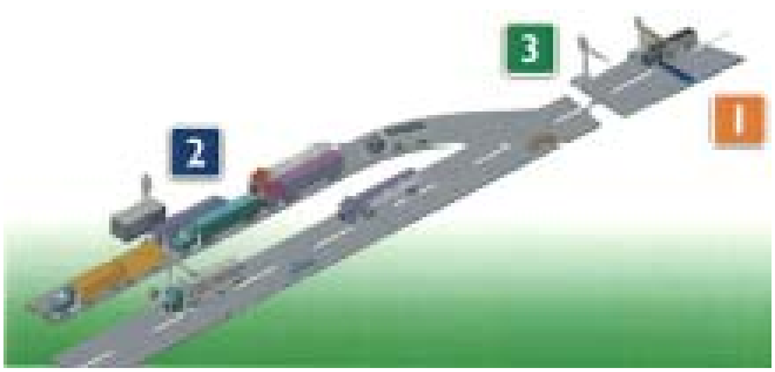


FIGURE 6 - PrePass Processing Steps

The **North American Preclearance and Safety System**, or **NORPASS**, is a partnership of state and provincial trucking industry representatives who are involved in promoting safe and efficient trucking throughout North America. The system is similar to PrePass and requires a transponder for communication purposes.

10. PRELIMINARY I-295 CONCEPT PLANS

As part of this study, Volkert conducted an evaluation of the existing sites (including a review of prior engineering work for I-295) to determine the feasibility of the planned improvements. Typical sections for the station sites are shown on Figure 7. The conceptual drawings developed for the two (2) station sites meet appropriate AASHTO design guidelines for deceleration and acceleration requirements for interstate highways (see AASHTO Exhibits for acceleration (Table 1) and deceleration (Table 2). Due to the proximity of the sites to the downstream Oxon Run Bridge (southbound I-295 site) and the Laboratory Road interchange, the scale house, inspection pit, and out-of-service truck storage space are placed as close to the roadway as possible to minimize the length of accel/decel lanes. The sites have sufficient space to accommodate installation of station houses, platform scales, inspection pit, two (2) truck storage spaces (i.e., for vehicles that are in violation), and between nine (9) and ten (10) parking spaces for enforcement vehicles. As shown on the concept plans, both sites necessitate retaining walls. The height of the walls will be determined during the next design phase of the project, however it is anticipated that the retaining walls will be 3 to 4 meters (10' to 13') in height. There is flexibility to expand the size of the scale house by reducing the number of parking spaces for the enforcement vehicles; this is another area to be evaluated during the design phase of this project.

The spacing requirements for the PrePass system, as described by the vendor are between one thousand and three thousand feet. Therefore, given the distances between the WIM load cells/OCR are approximately 460 meters (~1500'), it appears that sufficient space does exist for installation of this technology. License plate readers for enforcement can be placed on the overhead structures that will carry the PrePass detections systems. Please note that depending on the technology selected for the design, LPR may or may not be required to be overhead.

Both sites include an inspection pit. Sheds over the pits have been identified on Figure 7. The sheds over the inspection pits will require further investigation during the design phase. The sheds will provide for trucks inspections during inclement weather. The sites have existing nearby utilities including electrical, water, and sanitary sewer. A 6" water tap to existing WASA facilities can be provided. This water tap will be designed depending on specific requirements (e.g., the need for fire hydrant). Wireless technology exists and can be maintained for communication purposes. There also are existing Transportation Management System (TMS) conduits along I-295. Details of each site are provided below. The design elements for each site are illustrated in Table 3.

Figure 7

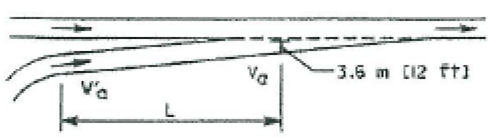
TABLE 1 - Minimum Acceleration Lengths for Entrance Terminals with Flat Grades of Two percent or Less

Metric									
		Acceleration length, L (m) for entrance curve design speed (km/h)							
Highway		Stop condition	20	30	40	50	60	70	80
Design speed, V (km/h)	Speed reached, V_a (km/h)	and initial speed, V'_a (km/h)							
		0	20	28	35	42	51	53	70
50	37	60	50	30	—	—	—	—	—
60	45	95	80	65	45	—	—	—	—
70	53	150	130	110	90	65	—	—	—
80	60	200	180	165	145	115	65	—	—
90	67	260	245	225	205	175	125	35	—
100	74	345	325	305	285	255	205	110	40
110	81	430	410	390	370	340	290	200	125
120	88	545	530	515	490	460	410	325	245

Note: Uniform 50:1 to 70:1 tapers are recommended where lengths of acceleration lanes exceed 400 m.

US Customary									
		Acceleration length, L (ft) for entrance curve design speed (mph)							
Highway		Stop condition	15	20	25	30	35	40	45	50
Design speed, V (mph)	Speed reached, V_a (mph)	and initial speed, V'_a (mph)								
		0	14	18	22	26	30	36	40	44
30	23	180	140	—	—	—	—	—	—	—
35	27	280	220	160	—	—	—	—	—	—
40	31	360	300	270	210	120	—	—	—	—
45	35	560	490	440	380	280	160	—	—	—
50	39	720	660	610	550	450	350	130	—	—
55	43	960	900	810	780	670	550	320	150	—
60	47	1200	1140	1100	1020	910	800	550	420	180
65	50	1410	1350	1310	1220	1120	1000	770	600	370
70	53	1620	1560	1520	1420	1350	1230	1000	820	580
75	55	1790	1730	1630	1580	1510	1420	1160	1040	780

Note: Uniform 50:1 to 70:1 tapers are recommended where lengths of acceleration lanes exceed 1,300 ft.



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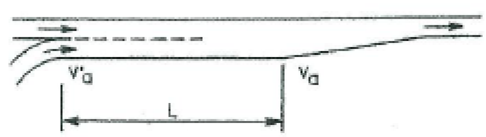


PARALLEL TYPE

Source: AASHTO

TABLE 2 - Minimum Deceleration Lengths for Exit Terminals with Flat Grades of Two percent or Less

Metric

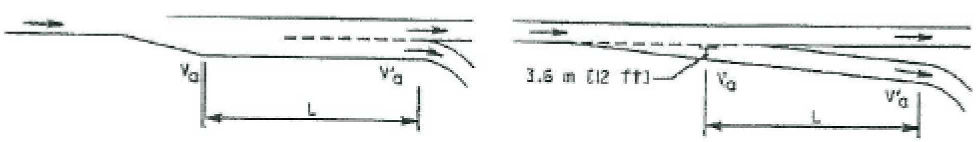
Highway design speed, V (km/h)	Speed reached, V_a (km/h)	Stop condition	20	30	40	50	60	70	80
		Deceleration length, L (m) for design speed of exit curve V'N (km/h)							
		For average running speed on exit curve V'_a (km/h): 0	20	28	35	42	51	63	70
50	47	75	70	60	45	—	—	—	—
60	55	95	90	80	65	55	—	—	—
70	63	110	105	95	85	70	55	—	—
80	70	130	125	115	100	90	80	55	—
90	77	145	140	135	120	110	100	75	60
100	85	170	165	155	145	135	120	100	85
110	91	180	180	170	160	150	140	120	105
120	98	200	195	185	175	170	155	140	120

V = design speed of highway (km/h)
V_a = average running speed on highway (km/h)
V'N = design speed of exit curve (km/h)
V'_a = average running speed on exit curve (km/h)

US Customary

Highway design speed, V (mph)	Speed reached, V_a (mph)	Stop condition	15	20	25	30	35	40	45	50
		Deceleration length, L (ft) for design speed of exit curve, V'N (mph)								
		For average running speed on exit curve, V'_a (mph): 0	14	18	22	26	30	36	40	44
30	28	235	200	170	140	—	—	—	—	—
35	32	280	250	210	185	150	—	—	—	—
40	36	320	295	265	235	185	155	—	—	—
45	40	385	350	325	295	250	220	—	—	—
50	44	435	405	385	355	315	285	225	175	—
55	48	480	455	440	410	380	350	285	235	—
60	52	530	500	480	460	430	405	350	300	240
65	55	570	540	520	500	470	440	390	340	280
70	58	615	590	570	550	520	490	440	390	340
75	61	660	635	620	600	575	535	490	440	390

V = design speed of highway (mph)
V_a = average running speed on highway (mph)
V'N = design speed of exit curve (mph)
V'_a = average running speed on exit curve (mph)



PARALLEL TYPE TAPER TYPE

Source: AASHTO

Table 3 - I-295 WIM Sites - Design Elements

Existing	NB Site		SB Site	
	meters	Feet	meters	Feet
Deceleration Taper	--	--	80	262
Deceleration Lane	--	--	195	640
Acceleration Lane	--	--	155	508

Proposed	Relocated NB Site		Expanded SB Site	
	meters	Feet	meters	Feet
Deceleration Taper	75	246	90	295
Deceleration Lane	130	427	195	640
Platform Scale /Scalehouse/ Parking	75	246	75	246
Inspection Pit	30	98	30	98
Out-of-Service Truck Storage	40	131	40	131
Acceleration Lane	230	755	135	443
Acceleration Taper	90	295	90	295

4.1 Southbound WIM Site

The proposed concept plan would accommodate the additional uses (i.e., scale house, parking, platform scale, out-of-service vehicle storage, and inspection pit) while meeting AASHTO design guidelines for acceleration and deceleration lanes. This will require the use of approximately 0.6m (about 2’) of the left shoulder width, adjusting the mainline lanes, and using the right shoulder for acceleration. The resulting width of the left shoulder (i.e., 2.4m or 8’) would require a design exception.

The station site would require a retaining wall approximately 3 meters or 10’ in height. This concept would not have any adverse impact on the WASA property. The site would include parking space for two (2) trucks. Enforcement vehicles would have sufficient parking and be able to go around the scale house to return to I-295. Figures 8A and 8B provide plan and profile details of the concept plan. As shown on the plans, the concept includes placement of a new guardrail from station 106+97 to 107+67.

4.2 Northbound WIM Site

The proposed concept plan for this direction features a relocation (further south) of the existing site and WIM load cells. This relocated site also would accommodate the additional uses (i.e., scale house, parking, platform scale, out-of service vehicle storage, and inspection pit) while meeting AASHTO design guidelines for acceleration and deceleration lanes. The station site for this direction also would require a retaining wall. In addition, new guardrails are included from station 111+31 to 112+57 and station 115+12 to 117+69. Enforcement vehicles would have sufficient parking and be able to go around the scale house to return to I-295. The site offers trade-offs and flexibility with regards to use of the available area. The site would accommodate two (2) parking spaces for out-of-service trucks that are in violation (see Figures 9A through 9C for details).

As reflected on the drawings, Optical Character Readers are included for both directions at the existing and proposed locations of WIM load cells. It should be noted that there are existing utilities, including electrical, adjacent to both WIM sites. Provisions for lighting at the sites will be considered as part of the design process.

The conceptual drawings include guardrails, concrete barriers, retaining walls, and bio-swales for each site. The approximate locations of these items are summarized in Table 4. In addition, the existing concrete barrier between stations 115+50 and 116+26 in the northbound direction will be removed as part of the improvements.

Table 4 - Conceptual Location of Guardrails, Barriers, Retaining Walls, and Bio-swales

	Relocated Northbound Site	Expanded Southbound Site
Guardrail	Station 111+21 to 112+57 Station 115+12 to 118+60	Station 106+97 to 107+67
Concrete Barrier	Station 112+79 to114+85	Station 107+74 to 109+06
Retaining Wall	Station 112+57 to 115+12	Station 107+67 to 110+03
Bio-Swale	Station 117+49 to 115+104 (outfalls to exist. SWM pond)	Station 107+63 to 106+53 (outfalls to exist. SWM pond) Station 109+98 to 110+94 (outfalls to exist. SW inlet)

4.3 Potential Traffic and Environmental Impacts

As part of this feasibility study, consideration was given to identifying any potential traffic or environmental impacts that may result from the site improvements. The implementation of an automated system to enable commercial vehicles to be pre-scanned and to "by-pass" a WIM facility while traveling at prevailing travel speeds would have beneficial impacts on traffic flow on I-295. The Federal Highway Administration (FHWA) estimates that roughly half of the traffic congestion experienced by Americans is caused by temporary disruptions that take away part of the roadway from use - or "nonrecurring" congestion, approximately twenty five percent (25%) of which is due to incidents ranging from a flat tire to an overturned hazardous material truck. Furthermore, AASHTO's Technology Implementation Group (TIG), in a presentation entitled "Virtual Weigh-in-Motion, A Wim-Win for Transportation Agencies," reports that such systems have a tendency to "ease traffic flow." Therefore, the planned improvements at the WIM station along I-295, including use of advanced detection technologies, are expected to have a beneficial impact on traffic flow while improving the overall safety of the area.

FIGURE 8A

FIGURE 8B

FIGURE 9A

FIGURE 9B

Figure 9C

The conceptual plans prepared as part of this feasibility study include bio-swales and use of existing storm water management ponds for drainage purposes. The improvements would be located within the existing rights-of-way without any adverse environmental impacts. Inasmuch as improvements in traffic congestion are expected on I-295, it is anticipated that improvements in air quality also can be achieved.

11. PRELIMINARY PLANNING COST ESTIMATE

Volkert staff contacted International Road Dynamics (IRD) and BIG enterprises to obtain preliminary estimates for various components. In addition, a preliminary cost estimate was developed for the roadway improvements. The total cost for the expansion of the existing southbound I-295 site and the relocation of the northbound I-295 site is estimated at approximately $6.9 million. Elements of the roadway improvements and associated costs are shown on Figure 10. For the purpose of clarity, the combined cost estimate for the scale house and related items is included on the figure as item number 10. It should be noted that the estimate is intended for planning purposes and basic system components. Inclusion of additional technologies such as thermal imaging can result in higher costs.

12. CONCLUSIONS

The preliminary review of both sites indicates that there is currently sufficient space available to accommodate a scale house while meeting AASHTO design guidelines (see Appendix H for calculation details) for the southbound I-295 site. The northbound I-295 site was relocated so as to not compromise traffic operations at the I-295 / Laboratory Road interchange. Research findings illustrate that new technologies are available for detection of various hazardous material including radiological, biological, and chemical. Considerations should be given to integration and implementation of such technologies, such as thermal imaging, as part of site improvements. Given the feasibility of the project, more detailed engineering design can be conducted to proceed with the upgrades. Additionally, the project team can be expanded to include representatives from vendors of the scale house and detection technologies. The next steps would consist of roadway improvement design, construction, system design, development, integration, and installation.

FIGURE 10