Enforcement Integration of the Overheight Vehicle Detection System (OVDS)

Houston, Texas

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Enforcement Integration of the Overheight Vehicle Detection System (OVDS)

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DISCLAIMER

This research was performed in cooperation with the Texas Department of Transportation (TxDOT). The contents of this report reflect the views of the authors, who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official view or policies of the TxDOT. This report does not constitute a standard, specification or regulation. This report is not intended for construction, bidding or permits purposes. The engineer in charge of the project was Roma G. Stevens, P.E. #100354.

The State of Texas and TxDOT do not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to the object of this report.

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INTRODUCTION

TxDOT Houston District deployed an overheight vehicle detection system as a pilot demonstration at two locations in Houston, Texas in early 2015. The evaluation report for the pilot demonstration found system to be effective in diverting overheight to a route that avoids low clearance bridges in downtown Houston area and recommended deploying the system at additional locations. The evaluation report also recommended identifying impediments to integrating the OVDS with active enforcement in order to improve its effectiveness. Towards this end, TxDOT personnel collaborated with Houston Police Department's Truck Enforcement Unit (HPD TEU) to implement enforcement integration with OVDS as a three month pilot. This report documents the enforcement integration activities and findings from this effort.

Goals/Objectives

The goal of the TxDOT Houston District for the OVDS integrated enforcement was to:

1) Identify the impediments to active enforcement integration with the OVDS. Identifying and understanding the difficulties in integrating enforcement efforts will allow TxDOT Houston district to formulate a plan if active enforcement integrated with the OVDS is a required component for additional deployments of the system.
2) Evaluate the effectiveness of OVDS with active enforcement. This goal was selected to determine if integrated enforcement will improve the effectiveness of the system in diverting overheight vehicles and reducing bridge hits.
3) Validate the OVDS accuracy and accuracy reliability when detecting overheight vehicles.

Enforcement Integration Concept

For this pilot enforcement integration effort, TxDOT project manager coordinated with HPD TEU commander. At the beginning of the project following enforcement integration concept was envisioned for this pilot:

- Identify officers who will be participating in the enforcement effort. Configure OVDS server to send email alerts to enforcement officers participating in this effort.
- Provide email alert parameters that will allow participating officers to identify alerts that have a higher likelihood of being a violating vehicle, thus reducing efforts in trying to find vehicles that might divert to IH 610 and thus are not violators for overheight restrictions.
- Participating officers will not change their normal schedule to enforce vehicle height restrictions based on alerts from the OVDS system.

- At the time of receiving an overheight alert from the OVDS, if a participating officer is present along IH 10 inside the IH 610 loop., the officer will try to look for the violating vehicle, if identified pull over the vehicle at a safe location, perform a height inspection in addition to any other required inspections, and take an appropriate action as needed based on findings of the inspection. Maintain a log of any inspections made in response to alerts received from the OVDS and share these logs with TTI researchers and TxDOT personnel on a weekly or bimonthly basis as convenient for the officer.

Pilot Enforcement Schedule and Activities

TxDOT project manager and HPD TEU Commander agreed upon a trial three month enforcement period for this pilot effort starting with Feb 1st, 2016 thru April 30th, 2016. Following paragraphs document all activities that occurred during the pilot enforcement period.

A total of 12 officers were identified to participate in this pilot enforcement effort. On Jan 29th 2016, TxDOT Project Manager held a kick-off/briefing meeting at the HPD offices to explain the enforcement integration concept and provide documentation (See Appendix A) about the same to all the participating officers and to address any concerns/questions from the HPD officers. At this first meeting, TxDOT project manager also provided the contact information of TTI researchers so that participating officers could provide enforcement logs created during the enforcement period and get clarification on any questions/concerns that may arise during the pilot period. During the kick-off meeting, TxDOT project manager learned that HPD truck enforcement unit was somewhat unaware of the 13'6" height restriction for overheight permits inside the IH 610 Loop. A document showing this permit restriction was later provided to the HPD participating officers.

Despite repeated requests, during the month of February, TTI researchers didn't receive any enforcement logs from HPD officers. However, HPD truck enforcement unit commander did send an email raising concerns about the accuracy of the sensor and expressing her opinion about how inaccuracies in the system can affect an overall perception of the system among participating officers and dismiss a potential overheight vehicle as not being overheight. In response to HPD truck enforcement unit commander's email, both TxDOT project manager and TTI researchers assured her that the beams have been set at 14'0" and tested with a surveying rod; however lack of height measurements on actual vehicles traveling the corridor tends to raise concerns about the accuracy of the system. TxDOT project manager and TTI researchers also requested that having the enforcement officers measure the height of a violating vehicle (detected as overheight by OVDS) will provide a definitive measure to assess the accuracy of the OVDS.

On Feb 29th, 2016, HPD officers stopped a couple of overheight vehicles (vehicles that triggered the overheight sensor and activated the DMS) and measured their height. Both vehicles were found to be 14'1" high (see Figure 1 thru Figure 4), thereby assuring the project team and enforcement officers that OVDS was accurate in detecting overheight vehicles.

Figure 1. Vehicle 1 Measured for Overheight Status (Source: HPD TEU)

Figure 2. Vehicle 1 with Height Measurement Shown (Source: HPD TEU)

Figure 3. Vehicle 2 Measured for Overheight Status (Source: HPD TEU)

Figure 4. Vehicle 2 with Height Measurement Shown (Source: HPD TEU)

In order to understand any concerns/reasons for not sending an overheight enforcement logs, TxDOT project manager and TTI researchers met with HPD officers on March 2nd, 2016. At this meeting, participating officers were once again requested to actively participate in the enforcement effort and send any enforcement logs to TTI researchers. During this meeting, TxDOT project manager also asked the HPD officers to identify any challenges that might have been keeping them

from being more active with enforcement of overheight vehicles. A couple of concerns raised by HPD officers include

- Time lag between OVDS alert and email being sent to the officer from the HPD servers can be as high as 2 minute making it not worthwhile to try and find the violating vehicle. The only way for an officer to find a violating vehicle is to be stationed just downstream of the sensor and watch for the DMS to activate. This is not optimal arrangement considering that participating officers are not on an exclusive overheight enforcement task.
- Lack of shoulder space along IH 10 inside the IH 610 loop makes it difficult for HPD officers to pull over a vehicle for inspection, since they have to escort these vehicles off the freeway and through an intersection to a parking lot. Not knowing the height measurements on intervening structures such as traffic signal heads at the intersection can be a liability issue for HPD if the overheight vehicle damages such structures.

After the second meeting with HPD enforcement officers, TTI researchers didn't receive any additional height measurements and/or enforcement logs from HPD. At the end of March, TxDOT project manager asked HPD truck enforcement unit commander if there is any need to continue the pilot for another month, since there seems to be lack of interest in any active enforcement for overheight vehicles and requested her to send all logistical issues associated with integration of enforcement with OVDS as experienced by HPD. On receiving no response regarding the need for continuation for pilot, TxDOT project manager decided to end the pilot at the beginning of April 2016. On April 5th, 2016, HPD Truck Enforcement Unit commander sent a summary of all logistical issues that were identified as impediments to active enforcement of overheight vehicles during this integration effort. The email is included in the appendix and these issues have been summarized in evaluation results.

As an alternative to dedicated enforcement effort, TTI researchers recommended use of static signs advance of the OVDS location that will make drivers aware of the low clearance bridges, permit height restrictions, and possible enforcement of height restrictions inside the IH 610 Loop. A total of eight concept signs were developed. Two of these concepts are shown below in Figure 5 and Figure 6 and all of the eight concept signs are included in Appendix B.

Figure 5. Advance Static Sign - Concept 1

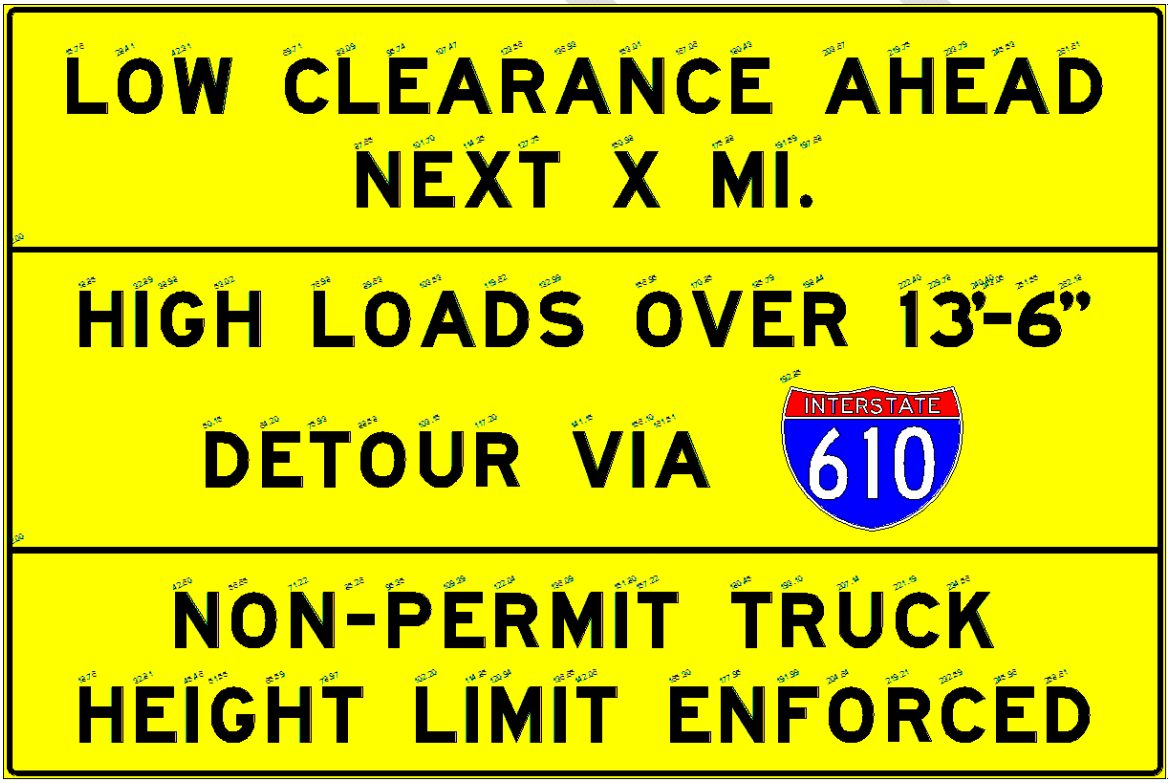

Figure 6. Advance Static Sign - Concept 2

EVALUATION RESULTS

Information provided by HPD Truck Enforcement Unit, number of alert emails received, and height measurements provided by HPD officers were analyzed and the results are presented in following sections for each of the goals/objectives identified for this evaluation.

1. Impediments to Integration of Enforcement with OVDS

Based on conversations with HPD officers, email communications from HPD TEU's commander (*1*), and observations regarding the alerts sent by OVDS, following impediments to integration of enforcement with OVDS were identified.

a) Delay in Receiving Alert Emails

Participating HPD officers found that there is a delay between activation of the OVDS system and the actual e-mail notification being received in their email inbox. This delay was reported to be at least 1 minute and up to as much as 3 to 4 minutes. This delay meant enforcement officer have to be stationed at a location 5 to 6 miles downstream of the sensor and in the correct direction of travel in order to identify the violating overheight vehicle from his/her alert email, merge behind this vehicle and pull over at a safe location in order to conduct the inspection. For this effort since the participating officers were not expected to change their normal job responsibilities, the delay in receiving email alerts was found to be an impediment for enforcement of overheight permit restrictions.

b) Non-dedicated Effort

The pilot integration was a non-dedicated effort, in fact the participating officers were asked not to change their normal job responsibilities. This meant that officers were not stationed at an optimal location that would facilitate finding the violating vehicle, may not be available to check the email alert as soon as the email alert was received, may be stationed in a location with less than ideal wireless signal thus spotty internet connection.

c) Safety versus Permit Inspections

HPD truck enforcement unit's main function as described in the Unit Commander's email is to find and inspect commercial motor vehicles with safety issues and prevent them from creating safety issues for the rest of the motoring public or cause traffic delays due to malfunctioning equipment or load securement. The unit commander further explained in her email that when trucks do hit a bridge without doing significant damage to the bridge itself, such as the car haulers that ultimately just damage the vehicles on the top, the truck enforcement unit is not notified unless the damage causes an accident scene or leave debris on the road making it a safety hazard. Thus based on her email it is clear that overheight status of vehicle is not considered a safety concern and as such enforcement of overheight vehicles was not considered a priority for this effort.

d) Lack of Driver Awareness of Vehicle Height and Unexpected Vehicle Types with Overheight Status

When looking at the type of overheight vehicles detected, researchers found that at one of the two OVDS sites about 24% of the overheight vehicles detected are closed cargo container type trucks that appear to be standard height to the naked eye and have raised concerns about the accuracy of the sensor. As described earlier, participating enforcement officers had similar concerns at the beginning of the pilot but eventually took measurements of two such vehicles and found the sensor to be accurate. However, it is possible that drivers of these overheight vehicles are unaware of the actual height of their vehicle and don't believe that are in violation since their vehicle appears to be of standard dimensions and thus is not the one that is triggering the sensor. Furthermore, since the sensor and integrated DMS are not capable of identifying and displaying the license plate information of the overheight vehicle, an overheight vehicle driver may not know that it was his vehicle that triggered the alert especially when other similar looking vehicles are traveling in the vicinity this violating vehicle.

e) Potential Liability in Detouring Vehicles Due to Lack of Shoulder Space

The IH 10 segment inside the IH 610 Loop has little to no shoulder space making it difficult for enforcement officers to pull over a vehicle for inspection. As such in order to perform inspections, officers have to escort these vehicles off the freeway and through an intersection to a parking lot and officers are not always aware of the height measurements on intervening structures such as traffic signal heads at the intersection. This lack of shoulder space and lack of information about safe detour routes can pose a liability issue for enforcement officers if the overheight vehicle causes damage when off its scheduled route.

2. Effectiveness of OVDS with Integrated Enforcement

At the start of the pilot, in order to evaluate the effectiveness of OVDS with integrated enforcement, a before-after study was envisioned. However due to lack of any enforcement data, effectiveness of OVDS for the after period could not be determined. Practically the before for this study is the same as after- period from previous evaluation, however it was decided to refresh that data set with recent data to determine the long-term impact of OVDS on overheight vehicle routes. Figure 7 shows the percent of overheight vehicles exiting to IH-610 (an intended route for diverting overheight vehicles i.e. a higher percent existing demonstrate a positive outcome of OVDS) at Wirt Site and Figure 8 shows the percent of overheight vehicles exiting to IH-610 at Mercury Site.

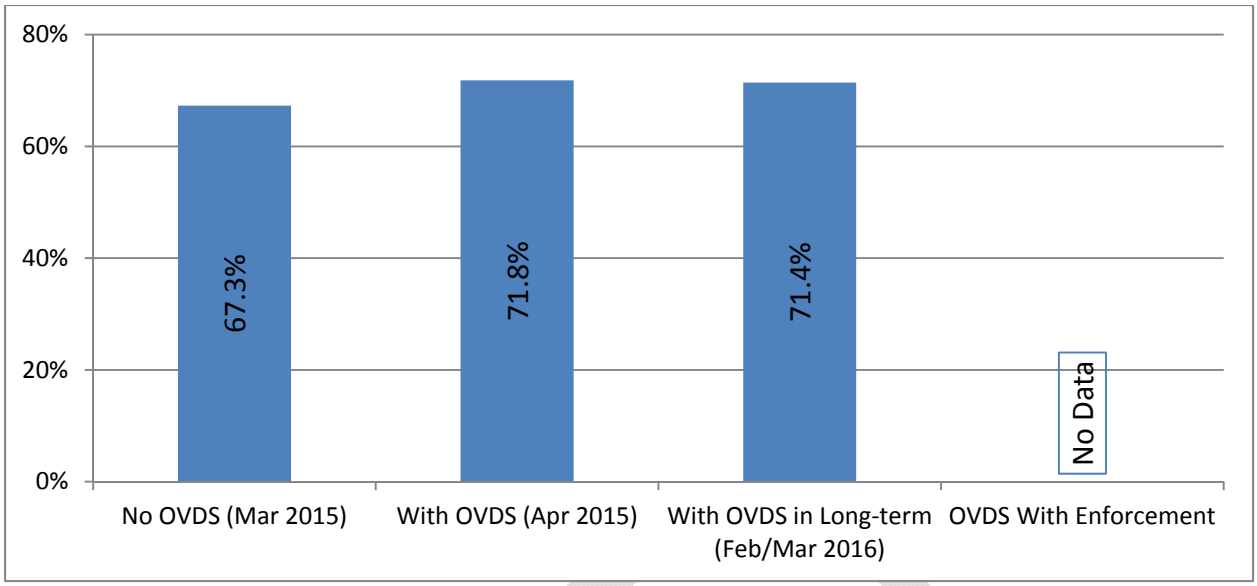

Figure 7. Percent of Overheight Vehicles Exiting to IH-610 at Wirt Site for Three Study Periods

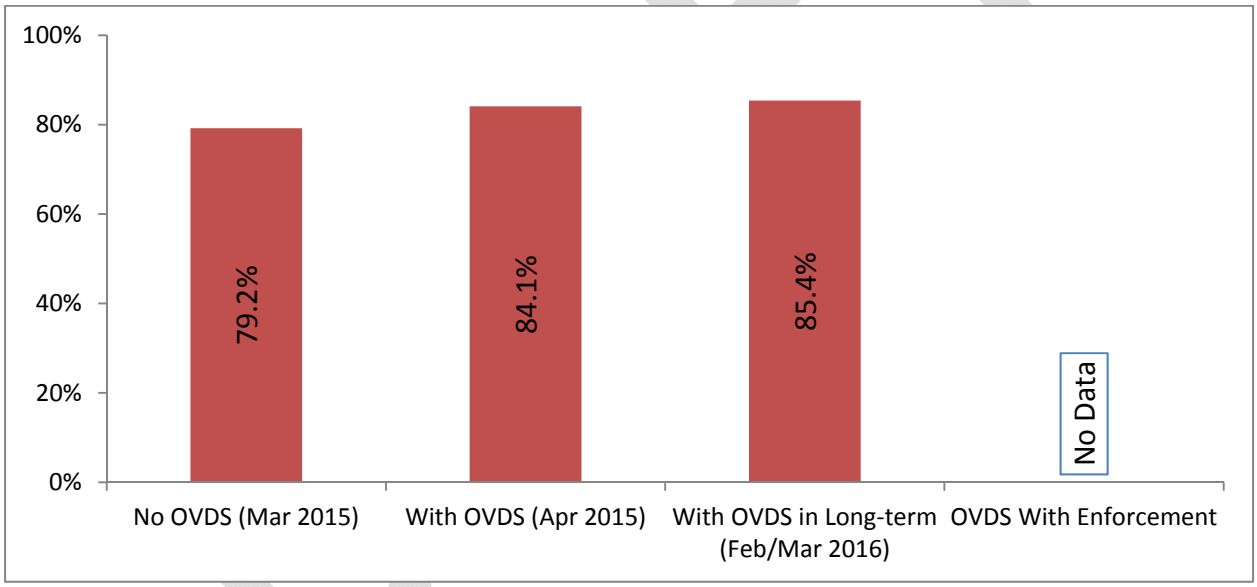

Figure 8. Percent of Overheight Vehicles Exiting to IH-610 at Mercury Site for Three Study Periods

From Figure 7 and Figure 8, it can be seen that the percent of overheight vehicles exiting to IH 610 is approximately 4% to 6% higher with the OVDS than it was without the OVDS system. Furthermore comparison of recent data with data from previous report shows that OVDS has maintained its effectiveness in diverting overheight vehicles to the intended route in the long-term.

Table 1 shows the total number of alerts analyzed for each study period and at each site.

Table 1. Number of Overheight Alerts Analyzed for Each Study Period

Study Period	Wirt Site			Mercury Site		
	Exiting to IH 610	Staying on IH 10	Total Alerts	Exiting to IH 610	Staying on IH 10	Total Alerts
No OVDS (Mar 2015)	284	138	422	316	83	399
With OVDS (Apr 2015)	314	122	436	275	52	327
With OVDS in Long-term (Feb/Mar 2015)	105	42	147	76	13	89

3. OVDS Accuracy and Accuracy Reliability

This goal was specifically selected to answer questions about the validity of overheight status of vehicles being detected at one of the pilot sites.

At Wirt site the proportion of closed cargo container type trucks (to the naked eye closed cargo container trucks appear to be of standard height) is about 24% whereas at the Mercury location this proportion is only 9% of all overheight vehicles detected. The two height measurements collected by HPD TEU officers helped in verifying the OVDS accuracy, however having only two measurements for two different vehicle types did not provide sufficient sample size to verify the accuracy reliability of OVDS with any level of confidence. Figure 1 shows one such truck that was measured by HPD TEU officers and was found to be 14'1", one inch above the sensor threshold height for triggering the alarm.

Since August 2015, Wirt site OVDS has experienced a high variability in the number of alerts being sent daily, and the variation can be as much as about 54 alerts per weekday (average) to as about 400 alerts per day. Furthermore, the spikes in number of daily alerts tend to happen for one to two week long time periods and then the alert rate reverts close to the average number for no apparent reason. The project team was unable to relate these spikes to weather impacts, variations in wireless signal, possible power issues, and seasonal variations in traffic volumes along the corridor. The fact that only one site (Wirt) experiences these variations in alert rates while both sites have same type of system, are located along the same freeway, and experience the same type of weather makes it more difficult to attribute the variations to a specific source. The manufacturer of the system was also unable to help understand any possible reasons for these spikes in alert rates. At the time of writing this report, this seems to be a random phenomenon.