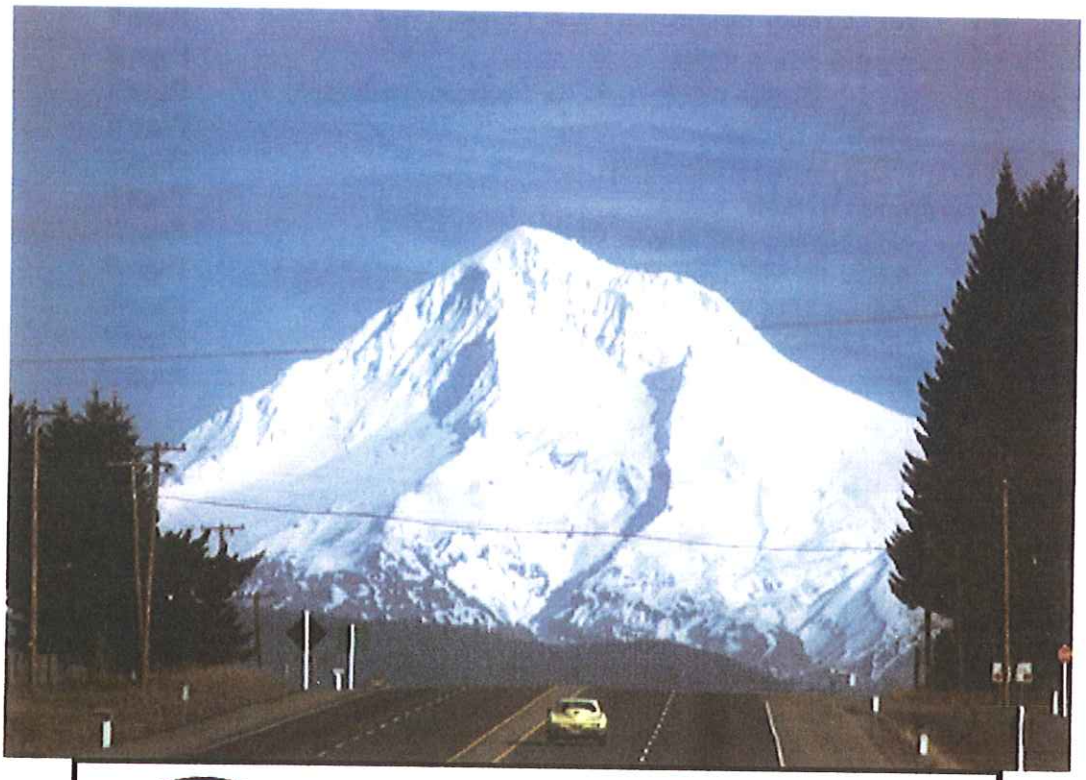
Year One Results:
Evaluation Study of the Mt. Hood Highway MP 30.56 to 32.32 Cable Barrier System



MT. HOOD Area Projects

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Appendices

1.0 Executive Summary

Overall, this first year report finds that the Mt. Hood cable barrier system has prevented crossover crashes and reduced the severity of crashes. The system has received positive feedback and operational costs are low.

The US 26 Highway (Mt. Hood Highway) from MP 25.20 to MP 57.45 was designated as a Safety Corridor in November 1996. Safety Corridors are defined by ODOT as, "stretches of state highway with an incidence of fatal and serious injury traffic crashes higher than the statewide average for a similar type of roadway."

In an attempt to reduce crossover crashes on Mt. Hood Highway, a cable median barrier system was installed from MP 30.56 to MP 31.31 and MP 31.55 to MP 32.32 in August 2007.

The purpose of this evaluation report is to assess the effectiveness of the cable barrier system in preventing crossover crashes. This evaluation report also looks to observe whether the system is creating any new safety or operational impacts on the system and road users. This evaluation report contains the first year results of the five year study.

The ODOT plan is to perform an annual review and perform a comprehensive study at the end of five years.

Scope of this evaluation includes:

- Maintenance feedback and repair logs
- Traffic engineering analysis including crash rates and a comparison study
- An operational review
- Interviews with first responders

Crash data has also been compiled and analyzed. It is important to note that only a year's worth of crash data is available for the first annual report and therefore, any finding may not be statistically significant.

Many different groups have contributed to this first year evaluation study. The maintenance section has recorded all hits on the cable barrier system and has provided feedback on the maintenance and operations of the cable barrier system.

Also, first responders from the Oregon State Police, ODOT Sandy Maintenance Section, Sandy Fire Department and Hoodland Fire Department were interviewed to help assess the effectiveness of the cable median barrier.

2.0 Evaluation Plan

Since this is the first time a median cable barrier has been installed on a non-freeway median, ODOT will evaluate its performance on an ongoing basis with a comprehensive assessment to be completed at the end of five years. This report is a preliminary report while the next report will be produced at the end of five years.

The primary goal of the evaluation is to determine if the cable barrier system reduces the number of crossover crashes. No barrier system, cable or concrete, will prevent all crossover crashes. The question is: Is the use of cable barrier in this location an effective part of an overall strategy to improve safety in the Mt. Hood Highway corridor?

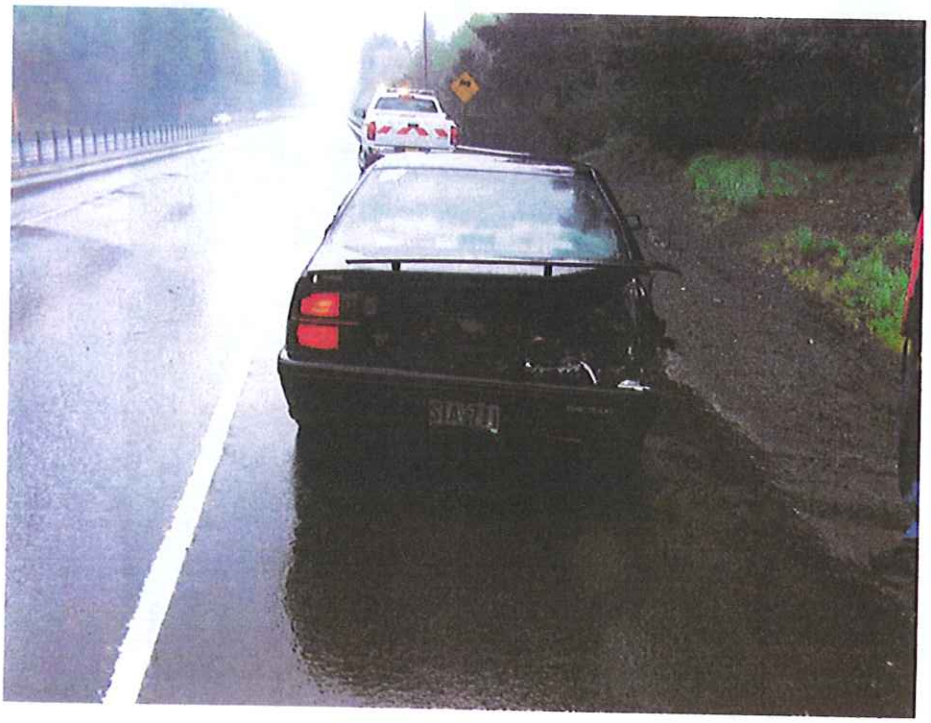
The evaluation plan will review maintenance crew logs in order to determine the number of automobiles that hit the cable barrier each year. The traffic unit will also track all crashes with the state crash database and analyze the data each year. Also, ODOT will investigate all work needed to maintain the cable barrier and ask for feedback from first responders and users.

3.0 Current Status

The ODOT Sandy Maintenance section has tracked all hits on the cable barrier system since installation and has provided a repair log. (Reference Appendix B) They have also provided any available pictures. The Maintenance Section has reported 10 hits on the CMB ranging from 1-53 posts replaced. The costs for these repairs range from $230-$4,644.

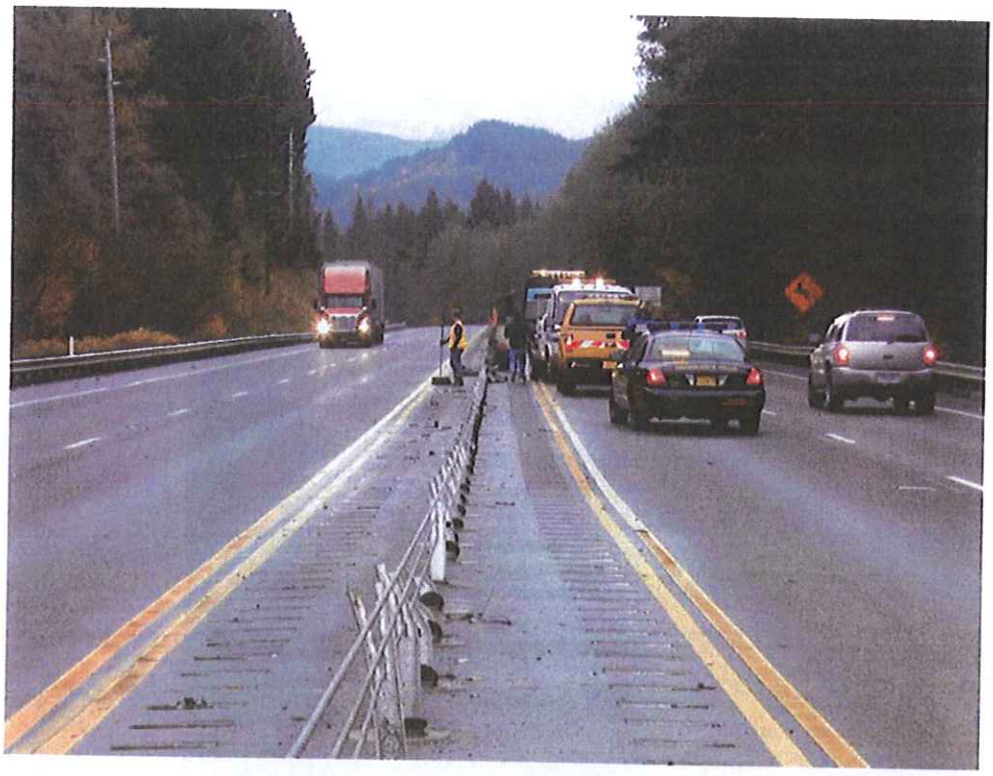
3.1 Sample Photographs of Crashes

Photograph #1, May 13, 2008 Crash (Sample Police Report # 1)

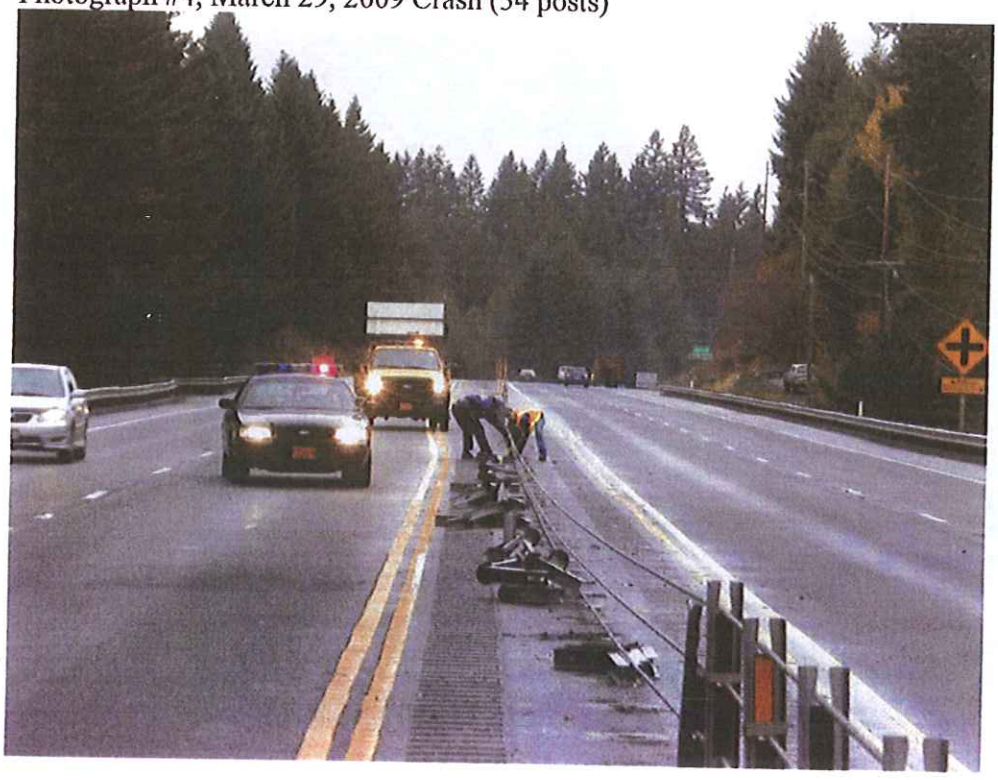


Photograph #2, June 7, 2008 Crash (37 posts)

Photograph #3, March 29, 2009 Crash (34 posts)



Photograph #4, March 29, 2009 Crash (34 posts)



4.0 Crash Analysis

Comparison Section

In order to analyze the cable barrier system and how it has impacted the safety performance of this section of highway, a comparison section was chosen. The selected comparison section has no median barrier, is adjacent to the cable barrier section and was chosen due to the similarity in crash types, length, and accesses. The Comparison Section is a section of Mt. Hood Highway that is located just west of the existing CMB section. The Comparison Section is 1.88 miles long while the CMB Section is 1.76 miles long and the Comparison Section is used as the control section in the following analyses. The time period for both sections is January 2001 through August 2008.

Crash List

The crash list used in the crash analysis is gathered from the State Highway Crash Database. Not all crashes are reported so for this part of the analysis, only driver-reported crashes were used in order to keep consistency in reporting.

All crashes were looked at but only crossover crashes and runoff road crashes were considered in the Traffic Analysis because these crashes are the most influenced by the existence of a cable barrier system. Crossovers are crashes that cross the median while runoff road crashes are crashes where the vehicle travels off the roadway.

4.1 Pre and Post-Installation Crash Findings

For the analysis of crash characteristics, the crashes occurring before the installation are compared to the crashes occurring after installation of the cable barrier. The two characteristics that are observed are severity and surface conditions. Only the crashes occurring in the cable barrier section are compared. Since the time period for the crashes before installation is longer (Jan 2001-July 2007) than the time period after installation (Aug 2007-Aug 2008), percentages were used in order to fairly compare the amount of crashes.

The first characteristic that was analyzed is severity. These crashes are separated into Fatal/Injury crashes and Property Damage Only (PDO) crashes. Before installation of the cable barrier system, 69% of crashes resulted in an injury while 31% were Property Damage Only. After installation of the cable barrier system, all crashes have resulted in Property Damage Only.

The second characteristic is surface conditions. These crashes are separated into the following conditions: Ice and Snow, Wet, and Dry. The results for before and after installation show the same conclusion: half of crashes occur during snowy or icy surface conditions.

4.2 Section Crash Rates

The crash rates of a section of highway allows for the comparison between different segments of highway by standardizing data. The section crash rate analysis standardizes the length of time being considered for crashes, the length in mileage and the volume of traffic for each section. Section crash rates are calculated as referred to .

In order to be able to compare the CMB section and Comparison section equally it was necessary to standardize the data. By comparing percent changes, this discounts the fact that the sections are different lengths and we can compare "apples to apples."

4.2.1 Section Crash Rates: Entire Section

The following table and figure show the crash rates and total percent change for all reported crashes for the entire sections; including the "gap" areas between cable barrier installations. This percent change is shown so that it is possible to see how the crash count has affected the section as a whole. As shown in the figure, the Comparison Section increased in total number of crashes by 7% whereas the CMB Section decreased by 19% in total number of crashes.

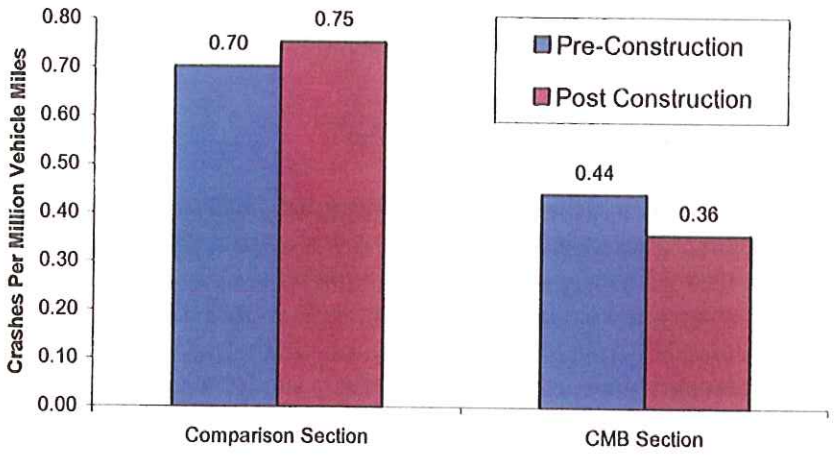


Figure 4.1. Section Crash Rates for Sections (with gaps).

4.3 Severity Rating

For the last part of the traffic analysis, it was important to look at how the cable barrier system has impacted the severity of crashes. Since there is not straight formula for doing this, modified Severity Priority Indexing System formulations were used.

The severity rating quadrupled in the Comparison Section while the severity rating decreased in the CMB Section. As indicated by this modified analysis, it is probable that the severity in the CMB section has decreased since the installation of the cable barrier

system. Also, the sole Injury B & C crash in the Post CMB Section was in fact in the gap so one can expect an even greater decrease in crashes in the CMB Section if the gap was not included in this analysis.

4.4 Crash Analysis Summary

The overall section crash rate shows that the CMB Section may be decreasing in the number of crashes while the Comparison Section rate is increasing. The raw data also shows an apparent reduction in severity of crashes.

Although the data set is small, this does not mean that these findings are meaningless. If the numbers continue to decrease for the CMB Section over the next four years of the study period, then the analysis will be able to strongly conclude that the cable barrier system is reducing the amount and severity of crashes.

5.0 Operational Review

This section covers the operational aspects of the cable barrier system including maintenance and the perception of how the system is functioning as determined by community feedback. Also included is information on how the cable barrier system is repaired and how much repairs cost. Comments and opinions from a motorist, Oregon State Police (OSP), ODOT Sandy Maintenance Department, Sandy Fire Department and Hoodland Fire Department were collected as well.

First responders commented that their previous worries about response time are no longer worries and that they have not have had any problems with getting to crashes in an efficient manner. Police officers commented that the cable barrier has indeed reduced severity of crashes and that deflection of cables has not been a concern.

5.1 Maintenance and Repair Work

Due to the narrow median, the maintenance department must usually close down one lane in each direction in order to repair the barrier. Not only does this require labor and equipment, but time. Sometimes the maintenance crew can close down only one lane depending on how severe the damage is to the cable barrier.

Thus far, all repairs include only replacing damaged posts; no cable tensioning or cable replacement has been required. Replacing posts involves a couple of people; one who pulls out the damaged post and the other lifting the cable with an auto crane. Generally, more time is involved in setting up traffic control than in replacing the posts.

The following table shows the amount of repair work that has been performed on the Cable Median Barrier System since installation.

	Total	**Low Event**	***Average Event***	**High Event**
Events	**9**	1	*1*	1
Posts Hit	**127**	1	*14*	53
Hours	**28**	1	*3*	5
Cost	**$13,016**	$230	*$1,446*	$4,644

Table 5.1.1 Total Repair Work Completed.

5.2 Other Safety Improvements - Innovations

Last winter, the Maintenance Department installed snow poles on the barrier posts due to the difficulty of seeing the cable barrier during a heavy snow fall. These poles have reflective tape on them as do the cable barrier posts. The feedback received from motorists was unanimously positive so it was decided to leave the poles up all year long.

The Maintenance crew is commended for their innovativeness and for helping the CMB succeed. These poles also help drivers see the cable barrier when it is raining, overcast and/or at dusk.

5.5 Operational Review Summary

Overall, the operational review of the cable barrier system is satisfactory. The cable barrier is simple and low-cost to install and repair. There have been no problems with the cable barrier deflecting into oncoming lanes or with it slowing down response times for emergency vehicles. Also, plowing concerns from the maintenance section were addressed with snow poles, which also add visibility to the cable barrier.

6.0 Conclusion

This preliminary report finds that cable barrier system is successful in preventing crossover crashes and reducing the severity of crashes. The data set is small therefore statistical conclusions are not strong.

Maintenance is minimal and relatively easy and low in cost. The maintenance crew has a very positive attitude towards maintaining the cable barrier system and first responders gave positive feedback. Also, there have been no major issues with the operations of the cable barrier and ODOT will continue to monitor its operation and effectiveness.

Appendix A: Maintenance Repair Log

Date	Time	E/W	MP	Temp.	Road Condition	Vehicle Type**	Severity	Repair Date	Posts Re-placed*	Time for Repair	Cost of Repair	Police Report
11/26/2007	Unk.	W	31.5	Unk.	Clear	Unk.	PDO	11.26.07	1	3 hours	$650	No
1/27/2008	Unk.	W	31	Unk.	Snowy/Slush	Unk.	PDO	02.20.08	1	1 hour	$230	No
3/28/2008	Unk.	W	31	Unk.	Snowy/Slush	Unk.	PDO	Unknown	2	3 hours	$300	No
4/14/2008	5:00pm	W	31	Unk.	Heavy Rain/Hail	SUV	PDO	04.30.08	3	3 hours	$650	Yes
5/13/2008	3:00pm	W	32	50	Heavy Rain	Car	PDO	5/21/2008	6	4 hours	$993.37	Yes
6/2/2008	Unk.	E	31	60	Dry	Unk.	PDO	6/4/2008	1	2 hours	$300	No
6/7/2008	6:00am	W	32	55	Rain	Pick-up	PDO	6/7/2008	37	3 hours	$3,215	Yes
6/22/2008	1:50pm	W	31.5	75	Sunny/Clear	Pick-up	PDO	6/23/2008	23	5 hours	$2,034	Yes
11/1/2008	8:30am	E	30.5	58	Rain	Pick-up	PDO	11/3/2008	53	5 hours	$4,644	Yes
3/29/2009	Unk.	W	32			SUV	PDO					

Maintenance Repair Log.

* The Maintenance Department noted that hits where only 1-2 posts were replaced could have been hit and runs, contractor errors, or posts that were barely hit before the driver was able to recover. Some of these events are not expected to exist in the ODOT crash database.

** Note that no truck-trailers or motorcycles have hit the cable barrier system. It is unknown the damage that would be caused from these types of collisions.

Appendix B. Crash Diary

MP	Date	Severity	Notes:	Police Report*	Maint. Report	Crash Database	Photos
31.5	11/26/2007	PDO	Unknown vehicle traveling westbound, hit 1 post. SPEED and ICE		X		
31.97	1/27/2008	PDO	Passenger car traveling eastbound, icy conditions. Speeding too fast for conditions, failed to maintain lane and hit CMB. *(Discrepancies between milepoints are expected because of approximation)* SPEED and ICE			X	
31			Unknown vehicle traveling westbound, hit one post. Snowy/slushy conditions. SNOW		X		
32.00	3/26/2008	PDO	Passenger car traveling eastbound, icy conditions. Speeding too fast for conditions, failed to maintain lane and hit CMB. Second car hit guardrail.			X	
31	3/28/2008	PDO	Unknown vehicle traveling westbound, hit 2 posts *(It is believed that this was the repair for the crash of 3/26/2008)* SNOW		X		
31	4/14/2008	PDO	SUV traveling westbound, hit 3 posts. Traveling too fast for conditions and stopped in ditch. SPEED and SNOW	2/3	X		1
32	5/13/2008	PDO	Passenger car traveling westbound, hit 6 posts. The vehicle was traveling too fast for conditions when it hit standing water and hydroplaned. The front left tire made contact with the CMB and then spun around and made contact with the right side. The vehicle came to a stop facing east in the westbound lane, then drove onto the shoulder. SPEED and HEAVY RAIN	3/3	X		3
32.00		PDO	Passenger car traveling too fast for conditions going westbound. Rainy and wet conditions. Driver hit high water and failed to maintain lane and hit the CMB. Also ran off road. SPEED and DRY			X	
31	6/2/2008	PDO	Unknown vehicle traveling eastbound, hit 2 posts.		X		
32	6/7/2008	PDO	Pick-up traveling westbound, hit 37 posts. Rain. Damage on left side of vehicle and stopped alongside CMB. RAIN	1/3	X		many
32.25			Passenger vehicle traveling westbound. Inattention caused the vehicle to lose control and hit raised median and guardrail. Cause of crash was due to carelessness and conditions were rainy/wet. INATTENTION and RAIN			X	
31.5	6/22/2008	PDO	Pick-up pulling fifth wheeler traveling westbound, hit 23 posts. Cited for failing to maintain lane.	1/3	X		3
30.5	11/1/2008	PDO	Pick-up traveling eastbound, hit 53 posts. Hit front of pick-up on CMB and cited for careless driving. RAIN	1/3	X		
32	3/29/2009	PDO	SUV traveling westbound, hit left side of car on CMB. Hit 34 posts.	1/3	X		

*Police Reports: 1/3 means one out of the three existing pages of the police report was obtained.