Audit Date: April 26 – 29, 2011

US30 Road Safety Audit
Berg Road to Millard Road

Mile Point 24.91 – 29.95

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

OREGON DEPARTMENT OF TRANSPORTATION

Road Safety Audit Report

US30
Road Safety Audit (RSA)

Berg Road to Millard Road
Mile Point (M.P.) 24.91 to 26.95

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April 26 – 29, 2011

Technical Summary

PROJECT TITLE:

US30 Road Safety Audit (RSA): Berg Road to Millard Road, Mile Point (M.P.) 24.91 to 26.95

DATE:

April 26 – 29, 2011

RSA TEAM AND PARTICIPANTS:

- Hermanus Steyn, Pr. Eng., P.E. - Associate Engineer, Kittelson and Associates, Inc. (KAI)
- Joel McCarroll, P.E., Region 4 Traffic Manager, Oregon Department of Transportation (ODOT)
- Kurt Mohs, Rail Crossing Compliance Specialist, ODOT
- Robert Doran, Region 2 Maintenance District 3 Manager, ODOT
- Amanda Westmoreland, Region 2 Traffic Investigator, ODOT
- Raymond Lapke, P.E., Region 3 Traffic Operations Engineer, ODOT

- Troy Johnson, Region 2 Roadway Designer, ODOT
- Lonny Welter, Columbia County Road Department
- Erin Ferguson, P.E., Engineer, KAI

RSA SUPPORT RESOURCES:

- Randy Fargher, Oregon State Police (OSP) Senior Troopers
- Mark Buffington, Claskanie Maintenance Section Manager ODOT
- Kate Freitag, Region 1 Traffic Operations Engineer, ODOT

PROJECT CHARACTERISTICS:

Description	Project Characteristic
Audit Type:	Planning Stage
Land Use Development Proposal:	No
Units of Measure:	U.S.
Adjacent Land Use:	Rural/Suburban
Design Speed (US in miles-per-hour [mph]):	70 mph[1] (Posted Speed 55, 50, and 45 mph)
Opposite Flow Separation:	Two-Way Center Turn Lane
Service Function: • Highway Number • Route Number • Functional Classification • Oregon Highway Plan (OHP) Highway Designation	 • 92 • US30 • Major Arterial, Freight & Truck Route • Statewide Highway
Terrain:	Level
Climatic Conditions - Temperature:	Wet and Cold Winter (rain with some freezing, icing possible), Warm Summer (sporadic hot days)
Climatic Conditions - Rain:	Rain with Occasional Snow in Winter

[1] - Historically all rural highways were designed to 70 mph and in urban areas 10 mph over the speed limit. Coordinating with ODOT staff and a review of geometric characteristics along this road section (e.g., degree of curves, spiral lengths, super-elevation, etc.), the original design speed would have likely been 70 mph.

BACKGROUND

The US30 RSA Team studied US30 from approximately M.P. 24.91 to 26.95, which corresponds to the portion of US30 extending from the Berg Road intersection in the south through the Millard Road intersection at the north end. The study corridor is located south of the City of St. Helens' city limits; however, the majority of the site is within the City of St. Helens' Urban Growth Boundary (UGB). Exhibit A (next page) illustrates the location and approximate extent of the site or study corridor.

The 2-mile section of US30 is part of a 5-mile Safety Corridor designated along US30 between Scappoose and St. Helens; ODOT implemented the safety corridor designation on March 4, 2011. The Bennett Road intersection and just north of Church Road intersection are both listed in the 2010 state SPIS report (Safety Priority Index System) as top 5% high crash locations. This section of US30 had 60 total reported crashes between 2005 through 2009 with 65% of those crashes resulting in one or more injuries and 5% resulting in a fatality.

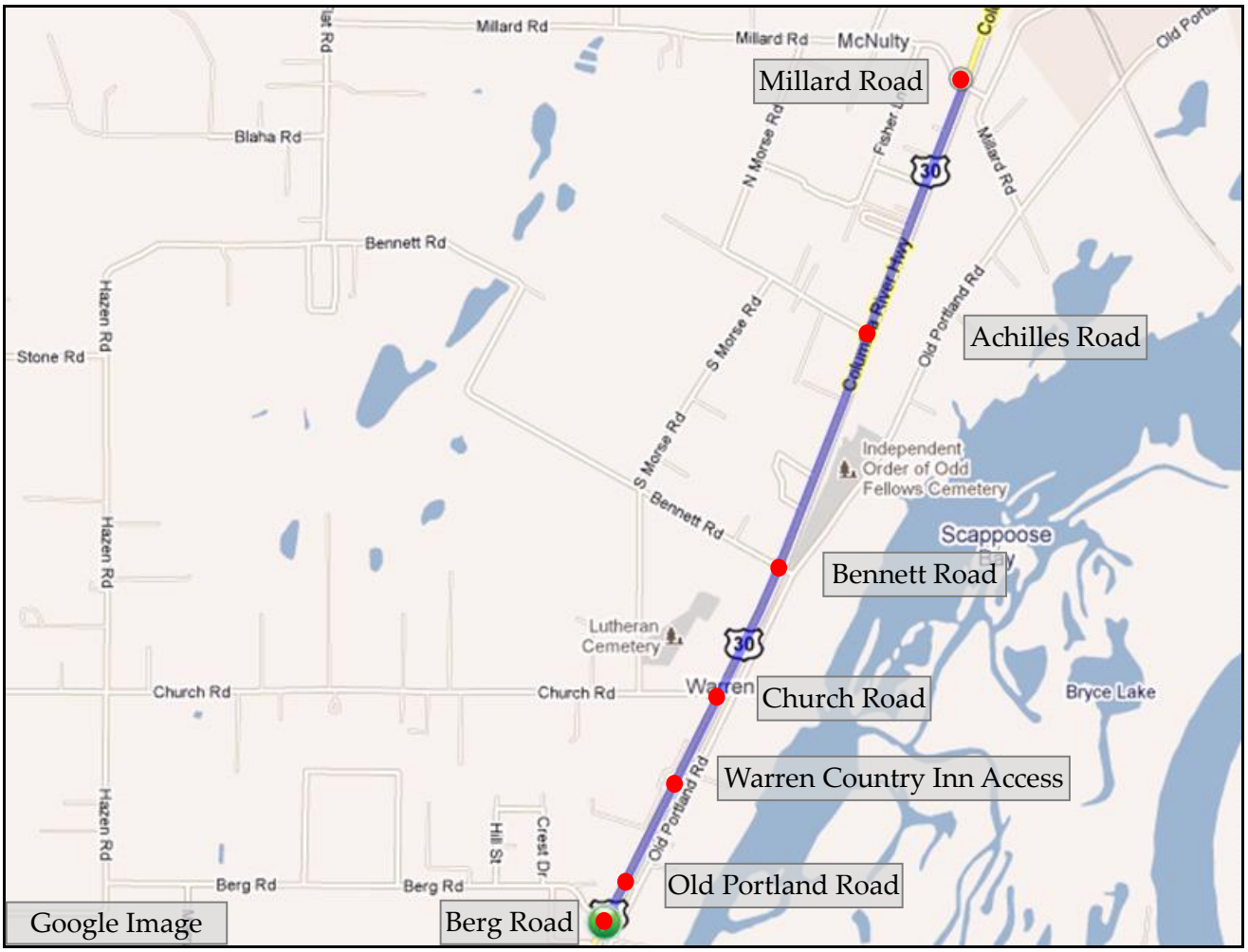


Exhibit A – Transportation Network Map (Key Intersections Highlighted on US30)

Within the study area, US30 has a five-lane cross-section: two travel lanes in each direction and a two-way center-turn lane. ODOT has designated US30 as a Statewide Highway, as well as a freight and truck route. In the City of St. Helens' UGB, US30 serves as a major arterial. The weekday morning peak hour in the southbound direction occurs from 6:15 am to 7:15 am and 7:00 am to 8:00 am in the northbound direction. The weekday evening peak hour occurs from 4:30 pm to 5:30 pm in both the north- and southbound directions. The primary intersecting roads/accesses along the corridor are listed from north to south and they are all unsignalized:

- Millard Road (adjacent to an at-grade railroad crossing with active warning signs and gates)
- Achilles Road
- Bennett Road-Old Portland Road (adjacent to an at-grade railroad crossing with active warning signs and gates)

- Church Road
- Warren Country Inn Access
- Old Portland Road (adjacent to an at-grade railroad crossing with passive warning signs)
- Berg Road

With regards to bicycle, pedestrian and transit service within the study corridor, there are formal bicycle lanes provided in the northern part of study section within the City's UGB and shoulders in the southern section. The shoulders in the southern section are approximately 10 feet wide. Sidewalks are present near and at the US30/Millard Road intersection on the west side of US30 up to Achilles Road in the south. There are no transit stops along the corridor; however, there are school pick-up and drop off locations along US30.

A unique attribute of this corridor is the presence of the Portland and Western Railroad (PNWR) that parallels US30 immediately to the east. The PNWR carries only freight (no passenger rail service). There are three at-grade railroad crossings in the study corridor:

- US30/Millard Road– Active at-grade crossing across Millard Road (eastern leg);
- US30/Bennett Road – Old Portland Road – Active at-grade crossing across Old Portland Road (eastern leg); and
- US30/ Old Portland Road – Passive at-grade crossing across Old Portland Road.

The PNWR also operates a rail yard north of Gable Road and east of US30. While the rail yard is north of the study corridor, the locally designated truck route along Millard Road provides a connection from US30 within the study corridor to the rail yard. Old Portland Road also provides a connection to Gable Road and the rail yard. Old Portland Road parallels and is approximately 150 feet east of US30 from Berg Road to Bennett Road.

In addition to the railroad and rail yard in the vicinity of the study corridor, there is an industrial site where log poles are treated for use as utility poles. This results in log trucks hauling up to 100-foot long log poles via the US30/Bennett Road-Old Portland Road intersection to access the industrial sites east of US30.

In approximately the last three years, there were two serious crashes involving log pole trucks turning right from US30 onto Old Portland Road at the US30/Bennett Road-Old Portland Road intersection. In 2008, a fatal crash occurred when a log pole truck turned right onto Old Portland Road, the ends of the logs on the truck trailer swung into the adjacent through lane on US30 striking a northbound vehicle and fatal injuring the passenger in the vehicle. A second similar type of crash occurred involving a log truck, but it did not result in a fatality. Due to those crashes, ODOT now requires rear pilot cars to accompany the log pole trucks. At the US30/Bennett Road-Old Portland Road intersection, the rear pilot cars block the through lanes on US 30 to prevent northbound vehicles from occupying those lanes while the log truck turns right onto Old Portland Road. Since implementing the rear pilot car requirements, there have not been crashes involving the log pole trucks. Additional information regarding the logistics and operations surrounding these trucks are discussed in more detail in the RSA findings section regarding the US30/Bennett Road-Old Portland Road intersection.

Log Pole Trucks with Pilot Car

There are also recreational uses accessed through the US30/Bennett Road-Old Portland Road and US30/Millard Road intersections the most popular of which appears to be the Bayport Marina. As a result, a relatively large proportion of the vehicles using the US30/Bennett Road-Old Portland Road and US30/Millard Road intersections are pick-up trucks and/or SUVs towing fishing boats and other recreational watercraft.

The posted speed along US30 changes along this section of the highway. Leaving St. Helens traveling south, the posted speed changes near the Achilles Road intersection from 45 mph to 50 mph and then to 55 mph just south of Berg Road (heading northbound, the posted speed decreases at the same locations).

RSA PROCESS

The purpose of the RSA is to identify potential issues contributing to crashes and suggest treatments for addressing those issues. The majority of the suggestions provided are engineering treatments; however, where appropriate, the RSA Team did identify opportunities for public education and enforcement campaigns, which tend to be more effective at influencing certain types of driver behavior (e.g., aggressive driving).

The RSA Team initiated work on Tuesday, April 26, 2011 with a kick-off meeting at ODOT Region 1 offices in Portland, Oregon. The meeting was attended by the RSA Audit Team, David Kim (ODOT Metro Area West Manager) and Sue D'Agnese (ODOT Region 1 Traffic Manager). The following observations and topics of discussion took place:

- David Kim provided the RSA Team with information as well as additional comments received from the US30 Safety Working Group, a group of active and concerned community members. They have gathered data, information, and public comments documenting their concerns and suggestions for the corridor with specific focus and attention given to the US30/Bennett Road-Old Portland Road intersection.
- The five-mile safety corridor designation including the two-mile study section was initiated on March 4, 2011.
- A grant was received for increased local law enforcement, which appears to be helping reduce vehicle speeds in the study area. Initial speed data indicated the 85th percentile speed south of Berg Road was approximately 66 mph (or 11mph over the posted speed which is 20%higher than posted speed). Speed data collected on US30 between Bennett Road and Achilles Road indicated the 85th Percentile speed was approximately 60 mph, which corresponds to 20% higher than the posted speed of 50 mph.

- Previous issues at the US30/Bennett Road-Old Portland Road intersection with trucks hauling the log poles were discussed.
- Observed and reported behavior of motorists using two-way center turn lane as an acceleration lane was discussed.
- School bus stops on US30 and corresponding influence on traffic and driver behavior was discussed.

The RSA Team reconvened after the kick-off meeting Tuesday afternoon, April 26, 2011 at a borrowed meeting space in the Avamere Retirement Community in St. Helens. This location served as a local base during field reviews and RSA analysis activities. The RSA Team schedule was as follows:

Tuesday, April 26th

8:30 am to 10:30 am	Pre-Audit Kick-Off Meeting with ODOT Region 1
10:30 am to 11:30 am	Travel to St. Helens
12:00 pm to 2:30 pm	RSA Panel Meeting/Training
2:30 pm to 3:30 pm	Break
3:30 pm to 7:30 pm	Field Reviews – Evening Peak Period
7:00 pm to 8:00 pm	Dinner Break
8:00 pm to 10:00 pm	Field Reviews - Nighttime Period

Wednesday, April 27th

6:00 am to 8:30 am	Field Reviews – Morning and School Peak Period
8:30 am to 9:00 am	Break
9:00 am to 11:00am	Review Field Notes and Technical Information
11:00 am to 12:30pm	Field Reviews – Midday Peak Period
12:30pm to 1:30 pm	Lunch Break
1:30pm to 4:30 pm	Field Reviews – Midday and Afternoon School Period
6:00 pm to 7:00 pm	Dinner Break
7:00 pm to 8:30 pm	Field Reviews as Needed/Team Field Notes and RSA Analysis

Thursday, April 28th

8:00 am to 12:00 pm	RSA Analysis and Report– RSA Team Discussion and Writing
10:00 am to 11:00 am	Field Review – Waste Removal pick-up
12:00 pm to 1:00 pm	Lunch Break
1:00 pm to 6:00 pm	RSA Analysis and Report– RSA Team Discussion and Writing
6:00 pm to 7:00 pm	Dinner Break
7:00 pm to 10:00 pm	RSA Preliminary Findings Preparation

Friday, April 29th

10:30 am to 12:00 pm Present Preliminary Findings at ODOT Region 1 Headquarters (See Appendix A for a copy of presentation.)

The RSA analysis included a detailed review of the crash data from the years 2005 through 2009. Some of the principle crash information included:

- 60 total crashes were reported for the study section (i.e., on US30 from M.P. 24.91 to 26.95).
- 17 crashes (28% of total crashes) were recorded between M.P. 25.80 and 25.89 which corresponds to the US30/Bennett Road-Old Portland Road intersection.
- 39 crashes (65% of total crashes) were injury and fatal crashes
- Turning movement and rear-end crashes were the most frequent crash type; 38% and 25%, respectively.
- The morning from 7:00 am to 9:00 am and afternoon from 1:00 pm to 3:00 pm were the most frequent time periods for crashes; 20% and 22%, respectively, of reported crashes occurred during those time periods.
- Monday and Friday were the most frequent days of the week during which crashes occurred. Twenty-five percent of crashes were recorded on a Monday and 25% were recorded on a Friday.
- 40 crashes (67% of total crashes) occurred under dry pavement conditions.
- 3 crashes (5% of total crashes) were fatal crashes:
    - 2005
        - Occurred at Berg Road (recorded as M.P. 24.91)
        - Angle crash; one vehicle failed to yield right-of-way to the other
        - Clear, Dry, September at about 7:00 p.m.
    - 2006
        - Occurred near M.P. 26.85 between Achilles and Millard Road
        - Pedestrian struck by vehicle and killed
        - Rainy, Wet, January at about 7:00 a.m.

    - 2008
        - Occurred at Bennett Road
        - Crash between right-turning vehicle and through vehicle
        - Clear, Dry, August at about 9:00 a.m.

This information allowed the RSA Team to pinpoint safety focus locations as the field reviews were conducted. The following sub-section summarizes the high, medium, and low safety risk features identified by the RSA Team. The remainder of the report presents the RSA findings.

SUMMARY OF HIGH, MEDIUM, AND LOW SAFETY RISK FEATURES:

As a result of the RSA analysis, the RSA Team found the following features with safety issues to have a **high safety risk**.

- Corridor Related
  - Inconsistency between roadway character and desired travel speeds
  - Intersection visibility
  - Minor-street left-turn finding a gap
- Intersection
  - US30/Bennett Road-Old Portland Road Intersection

The RSA Team found three features with **medium safety risks**:

- Corridor Related
  - Roadway departure crashes
  - Mainline lane visibility
  - Driveway accesses
  - Long-haul log pole trucks
  - Public education/clarification
- Intersections
  - US30/Millard Road Intersection
  - US30/Berg Road Intersection

The RSA Team also found three features with **low safety risks**:

- Corridor Related
  - Driver workload
  - Proximity of railroad tracks
  - Policy considerations

ROAD SAFETY AUDIT FINDINGS

The RSA findings are organized into two sections: 1) Corridor-Related Items and 2) Intersection Specific Items. Corridor-related items are applicable to the entire two-mile study section and/or multiple locations within the two-mile study section (e.g., multiple intersections). Corridor-related items may also be applicable to locations along US30 outside of the two-mile RSA study area. Intersection specific items are topics, issues or observations unique to the key intersections within two-mile study section. Appendix "B" provides a summary of the issues identified during the RSA assessment by location and suggested improvements.

1) CORRIDOR-RELATED ITEMS

ISSUE:
ROADWAY CHARACTER AND SPEED

Description of Safety Issue:

The physical roadway characteristics of US30 make it relatively comfortable for motorists to travel approximately 20% above the posted speeds, which corresponds to 10 to 11 mph above the posted speed, as demonstrated by 85th percentile speed data. The higher than desired speeds are contributing to crashes with approximately 20% of total crashes reported as speed related. Furthermore, vehicle travel speed can also contribute to turning movement crashes where vehicles fail to yield or give right-of-way when motorists misjudge gaps in fast moving traffic. Approximately 47% of reported crashes were turning movement-related and/or angled crashes.

Based on field observations, crash data, and speed data, the US30 roadway characteristics do not communicate the desired vehicle speeds. Given the surrounding land uses and accesses, the desired vehicle speeds along US30 are posted as 55 mph, 50 mph, or 45 mph respectively. Approaching from the south, the posted speed changes near the Berg Road intersection from 55 to 50 mph and then to 45 mph just north of Achilles Road (heading southbound, the posted speed increases at the same locations). While the posted speeds within the study area change, there are limited physical cues to indicate the need to slow down to motorists. There are no "Reduced Speed Limit Ahead" signs within the study area.[1] US30 within the study area is level with ample sight distance, limited horizontal and vertical curvature and has an open five-lane cross-section.

5-Lane Cross Section

Posted Speed

Posted Speed

[1] Per the Manual on Uniform Traffic Control Devices (MUTCD), "Reduced Speed Limit Ahead" signs are not required unless the change in posted speed is greater than 5 mph.

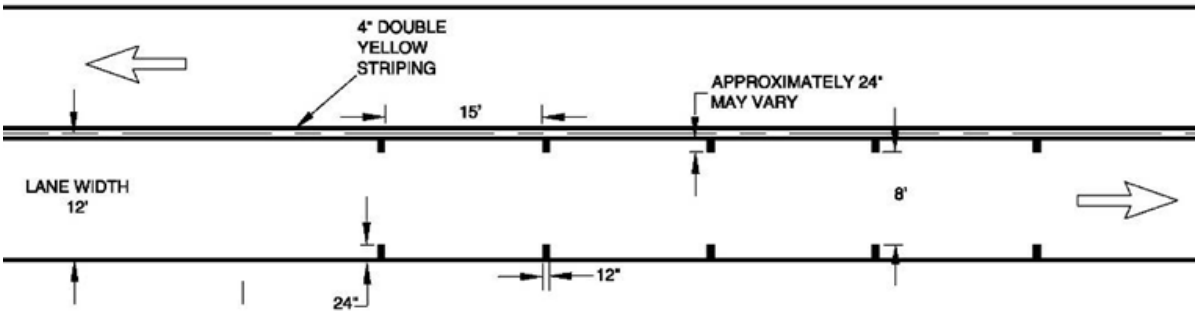
Safety Risk:

Exposure: High
Probability: High
Consequence: High
Resulting Road Safety Risk: High

Suggestions:

The RSA Team explored many types of treatments related to reducing vehicle speeds. There were a number of treatments considered but determined incongruent with the roadway character. These include reducing lane widths, installing a center median and reducing the number of through travel lanes. Due to the classification of US30 as a statewide highway, a freight route, and its predominantly rural environment, treatments such as those mentioned previously, are considered more likely to increase conflicts and/or the possibility of crashes. The following treatments were identified as potential measures for reducing speed and remaining consistent with the roadway's character and function. If the treatments below are applied, consideration should be given to where and how they are used so they communicate a consistent message to the driver reflecting the desired travel speed based.

- Install transverse pavement markings for approximately 200 feet upstream to the reduced posted speed signs and repeat at each sign approaching the City of St. Helens.



Excerpt from NCHRP Report 613

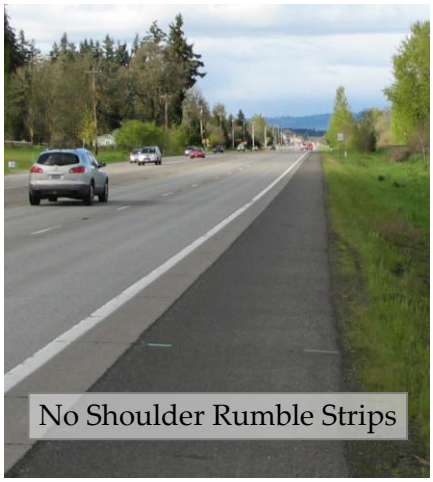
- Install roadside delineators at increased frequency as posted speed decreases.
- Install "speed-feedback" signs at the posted speed signs.
- Install flashing beacons at locations where the speed limit changes.
- Increase enforcement, consider photo radar enforcement, and/or automated speed enforcement.

Each suggested treatment above can be used in combination with each other to increase the likelihood of slowing vehicle speeds and reducing crashes.

ISSUE:
ROADWAY DEPARTURE CRASHES

Description of Safety Issue:

The crash data indicates there are approximately two (2) sideswipe-meeting, two (2) sideswipe-overtaking and eight (8) fixed or other object type crashes of the 60 total crashes along the two-mile corridor section. Each of these crash types are associated with vehicles departing from the roadway or their appropriate lane. In total, these types of crashes account for approximately 20% of total reported crashes.



No Shoulder Rumble Strips

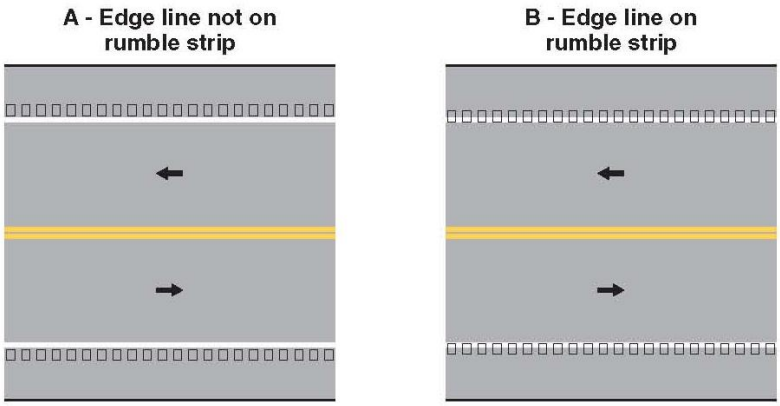
Safety Risk:

Exposure: High
Probability: Low
Consequence: Medium
Resulting Road Safety Risk: Medium

Suggestions:

The RSA Team identified the following suggestions as potential measures for reducing roadway departure crashes.

- Install shoulder rumble strips.
- Install rumble strips along double yellow pavement markings (i.e., in the median next to the striped left-turn lanes).
- Improve the visibility of pavement markings and markers (see Issue: Mainline Visibility below).



Excerpt from MUTCD Figure 3J-1

ISSUE:
MAINLINE LANE VISIBILITY

Description of Safety Issue:

The reduced and limited visibility of the mainline lanes is a concern with approximately 28% of reported crashes occurring during wet conditions and 35% occurring during dark, dawn, and/or dusk light conditions. Identifying the appropriate mainline lane for a minor street vehicle to turn into is challenging under lower light and inclement weather conditions, as well as if the mainline lanes are occupied and/or where gaps in the traffic stream exist.

Field observations indicated that during dry weather the striping along US30 is visible; however, during wet weather and at night the pavement markings have almost no reflectivity. Furthermore, US30 has recessed reflective pavement markers along the striped median (i.e., left-turn lanes and two-way center-turn lane) of which the majority are missing (i.e., removed by wear and tear of the roadway). There are no reflective pavement markers along the shoulder/bike lanes or the skip lane line. Additionally, when it rains the recessed pavement with the markers filled with water with limited to no reflectivity.

Limited Visibility of Approaching Lanes

Missing Recessed Pavement Markers

Safety Risk:

Exposure: High
Probability: Medium
Consequence: Medium
Resulting Road Safety Risk: Medium

Suggestions:

The RSA Team identified the following suggestions to improve mainline visibility and reduce the likelihood of the associated crashes.

- Provide yellow lane extension skip striping through intersections to guide minor-street left-turn movements into the appropriate lane on US30.
- Depending on the type of snowplow, install either recessed or raised reflective pavement markers along the striped median, shoulder/bike lanes, and the lane line striping.
- Increase the frequency (shorter spacing – typically 20 feet) of reflective pavement markers along the left-turn lane to better define the receiving lane for minor street left turns.
- Monitor the quality of the striping reflectivity and at a minimum refresh the median and shoulder/bike lane striping regularly.
- Consider installing inlaid "Methyl Methacrylate" type pavement markings over black tape especially along the concrete road segment. Inlaying the pavement markings will reduce abrasion due to snowplows.
- Provide illumination at intersections where appropriate. Street lights will better define the intersections. If illumination is provided, appropriate light transitions from dark-to-light and light-to-dark should be included in the illumination design.

- If roadway lighting is provided along US30 through the City of St. Helens in future, then extending roadway lighting to the south to provide appropriate transition from rural to urban conditions may be considered. The level of foot-candle lighting requirement could coincide with the posted speed signs to provide a consistent message for drivers entering the city.

ISSUE:
INTERSECTION VISIBILITY

Description of Safety Issue:

Almost 60% of the crashes occur at intersections and a lack of defining the intersections--especially along the highway--may contribute to these crashes. For motorists traveling on US30, there are limited clear visual cues indicating they are approaching, are at, or are traveling through an intersection. In most locations turn lanes for left-turns and right-turns are provided on the main line, but no other clear indications are evident for motorists on US30. The lack of obvious visual cues in advance of the intersection is particularly evident at night.

Crash data from 2005 through 2009 indicates 25% of all reported crashes along the study corridor occurred under darkness, dawn, or dusk conditions, and at or in the vicinity (within 0.05 miles or approximately 265 feet) of one of the primary intersections in the study area (i.e., Berg Road, Old Portland Road, Church Road, Bennett Road-Old Portland Road, Achilles Road, and Millard Road). Without advance knowledge and understanding of where the approaching intersection is located, motorists on US30 have no indication to slow down or be prepared for vehicles entering and/or crossing US30. This is likely a contributing factor to some of the turning movement and/or turning related crashes that have occurred in the study area.

Observations from the field indicate a few potential characteristics may be contributing to the lack of intersection visibility; these include inconsistent delineation, inconsistent signing (spacing and location), no illumination and limited to no visibility of lane markings at the intersection. For example, while the existing spacing between delineators along US30 is approximately 400 feet (consistent for the type of facility) there are sections of missing delineators. Delineators are also placed along the curb-returns at intersections, but not at all the key intersections; therefore, intersections are not consistently defined for motorists.

Sign Spacing and Location

Delineation

Safety Risk:

Exposure: High
Probability: Medium
Consequence: High
Resulting Road Safety Risk: High

Suggestions:

The RSA Team identified the following suggestions to improve the visibility of intersections and thereby reduce the associated crashes.

- Provide delineators (e.g., surface-mounted tubular markers) along the intersection curb-returns at approximately 20-foot spacing to better define the intersections. Install these delineators at the seven key intersections in the two-mile study section, as well as other key intersections outside the two-mile study section. Maintenance efforts and costs of the tubular markers will need to be considered, if this treatment is pursued.
- Install yellow lane extension skip pavement markings for minor street left-turn movements onto US30.
- Consistently sign for advancing intersections and intersection locations. The RSA Team considered advance intersection warning signs (i.e., W2-1, and W2-2) with street name riders, but the large intersection guide signs should suffice.
- Provide illumination at intersections where appropriate. Street lights will better define the intersections. If illumination is provided, appropriate light transitions from dark-to-light and light-to-dark should be included in the illumination design.
- The RSA Team considered raised median treatments at the key intersections along US30 to provide that intersection "presence" for approaching traffic. However, introducing a fixed object in the middle of the highway introduces other safety concerns that outweighed the potential benefit, especially in a high-speed environment.

ISSUE:
MINOR-STREET LEFT-TURN FINDING A GAP

Description of Safety Issue:

Forty-seven percent of reported crashes were turning movement and angled crashes with the majority of those crashes associated with the minor street left-turn movement onto US30. The 85th percentile speeds on US30 were recorded to be 20% higher than posted speeds (i.e., 10 to 11 mph above the posted speeds) indicating vehicles are generally traveling faster than desired. With multiple lanes of fast-moving traffic and a relatively large cross-section (five lane cross-section approximately 85 feet in width), it is difficult for motorists to identify adequate gaps in traffic. *(Potential related issues and suggested mitigations have already been discussed above, such as slowing vehicle speeds and improving mainline visibility. Additional potential mitigations are below.)*

Safety Risk:

Exposure: High
Probability: Medium
Consequence: High
Resulting Road Safety Risk: High

Suggestions:

The RSA Team identified the following suggestions to facilitate finding a gap in traffic and reducing crashes associated with incorrectly identifying a gap.

- Install an Intelligent Transportation System (ITS) (e.g., Collision Avoidance System) for the side-street approaches that would feature flashing lights to inform drivers of approaching vehicles. The RSA Team had concerns about adding any specific message (such as "STOP FOR CROSS TRAFFIC WHEN FLASHING") due to potential liability associated with failure of the system, such as when power to the ITS sign is lost.
- An alternative (or supplemental) treatment to installing a Collision Avoidance System is adding yellow flashing beacons to the advance intersection signs on US30 and a red flashing beacon to the stop signs on the side-streets. The flashing beacons would raise awareness by flashing when a vehicle approaches on US30 and/or a vehicle is present on the side-street. Historically, ODOT has only considered adding flashing beacons to "Stop Ahead" signs, if there is a documented crash history resulting from motorists disregarding the stop signs. Using flashing beacons in the manner above may require modifying the manner and process ODOT has traditionally used to identify when, where, and how flashing beacons are installed.
- Improve the visibility of the mainline (see Issue: Mainline Visibility).
- Improve the visibility of the intersections (see Issue: Intersection Visibility).
- Educate motorists on how to identify gaps in oncoming traffic and how to appropriately use the two-way center turn-lane, or turn into the fast lane next to a formal left-turn lane when present.

ISSUE:
DRIVER WORKLOAD

Description of Safety Issue:

Motorists are provided with a relatively large amount of information in the form of various signs along US30. The priority of the information conveyed is unclear based on the locations of the signs relative to the right-of-way and relative to each other. There is a mixture of regulatory, warning, guide, and informational signs; plus advertisement signs relatively close to the right-of-way. Additionally, as noted above, intersection approaches are signed inconsistently. Signs also block sight distance at some intersections for motorists turning from minor streets onto US30.

Safety Risk:

Exposure: Low
Probability: Low
Consequence: Low
Resulting Road Safety Risk: Low

Suggestions:

The RSA Team identified the following suggestions to help manage driver workload, prioritize information provided to motorists, and provide clear information to motorists.

- Conduct sign inventory and evaluate sign spacing and offsets along the corridor to allow appropriate distance for motorists to make informed decisions and be warned about key road characteristics.
    - Specifically consider font size and legibility.
    - Increase visibility for all sign installations, by considering adding 3M yellow Brite Sticks on the sign posts, as well as Diamond Grade reflective sheeting to increase the retroreflectivity of the critical signs during both day and night conditions.
    - Remove unnecessary signs and move less important signs further from roadway.
    - Evaluate existing signs to ensure consistency and compliance with the 2009 MUTCD (e.g., using upper/lowercase lettering).
    - Provide a "NEXT LEFT" guide sign for the Achilles Road intersection, add directional guide sign at the intersection to better define the intersection and be consistent with other intersections.

- Evaluate the locations of the STOP signs relative to the approach vision for motorists. Concurrently investigate the appropriate location of the STOP BAR to locate the side-street vehicle in an appropriate location to identify a gap in oncoming traffic. It is desirable to have the minor street driver's eye approximately 14.5 feet from the edge of travel lane (AASHTO Greenbook)

- Remove or relocate signs and obstructions along US30 to provide appropriate sight distance from minor street (including driveways) approaches for motorists.

ISSUE:
DRIVEWAY ACCESSES

Description of Safety Issue:

US30 is a regional connection that mainly serves mobility, but as the highway approaches cities more accesses are provided (typical approach). South of the Church Road intersection, the intersection/driveway spacing is appropriate and consolidation of accesses has already occurred (i.e., Warren Country Inn Access). North of the Church Road intersection, there are accesses to single-family residential properties and highway commercial properties. Crash data indicates there were 10 crashes (approximately 15%) located between the Church Road and Bennett Road intersections. There were also 3 driveway-related crashes reported south of the Millard Road intersection in the vicinity of the commercial and residential properties' driveways.

Driveways North of Church Road

Driveways South of Millard Road

Safety Risk:

Exposure: Medium
Probability: Low
Consequence: High
Resulting Road Safety Risk: Medium

Suggestions:

The RSA Team provided the following suggestion to improve access management on US30 and reduce crashes associated with access driveways.

- In the long-term and as opportunities presents themselves, work to consolidate driveways by sharing accesses to the highway. This can result in minimized conflict points along the highway.

ISSUE:
LONG-HAUL LOG POLE TRUCKS

Description of Safety Issue:

The 2008 fatality crash involved a long-haul log pole truck where the end of the pole swung into the path of a vehicle in the adjacent travel lane, fatally injuring a passenger in that vehicle. There was another, similar crash, but fortunately there was no passenger in the car. The RSA Team was fortunate to observe three long-haul log pole trucks turning right at the US30/Bennett Road-Old Portland intersection. Based on the team's observations, the log pole trucks and accompanying rear pilot cars executed their turning movements acceptably without turning into opposing lanes on the side street. The RSA Team did observe impatient and improper driver behavior on the part of *other* motorists (i.e., the general traveling public) on US30. For example, a RSA team member observed the following while following a log pole truck with a rear pilot car:

> Traveling northbound the RSA team member stayed in the right lane some distance back to observe traffic behavior. For the most part, traffic behaved appropriately, until they approached the Bennett Road-Old Portland Road intersection. The rear pilot vehicle straddled the white skip lane line to prevent vehicles from occupying the northbound through lanes adjacent to the right-turning log pole truck. Then a sedan vehicle passed the RSA member in the left-hand northbound through lane on US30. The sedan vehicle had to slow down to avoid running into the rear pilot vehicle and tried to pass the pilot vehicle using the left-turn lane at the intersection. It was at that moment the logs swung out into the northbound through lanes on US30. Fortunately the sedan driver decided to stay behind the rear pilot vehicle, and the right-turning movement of the log pole truck was completed without incident.

Log Pole Truck with Pilot Vehicle

> Another RSA team member noted the logs swing into the adjacent lane northbound through lanes relatively abruptly as the rear axles pivot to turn right. If a vehicle were occupying one of the northbound through lanes, the driver would have limited time to react.

Ends of Log Poles Swinging into Adjacent Lane

Since the modifications to the rear pilot car operations were made by following the log pole truck and occupy the adjacent lane, no additional crashes have occurred.

Safety Risk:

Exposure: Medium
Probability: Low
Consequence: High
Resulting Road Safety Risk: Medium

Suggestions:

The RSA Team identified the following suggestions to improve the maneuvers associated with the log pole truck operations.

- Continue using rear pilot car operations with the log pole trucks.
- Consider adding "LED Word" signage on the back of the rear pilot vehicle to be *actuated only when the log pole truck is going to turn* (similar to changeable message signs). A potential wording may be, "DO NOT PASS / TRUCK USES ALL LANES".
- Consider educating commuting motorists about the log pole truck operations. Education in local newspapers, city/county website, government facilities (e.g., libraries, city/county buildings), and similar community resources would help inform local and commuting motorists of the need to give the trucks plenty of space to make their turn movements. The US30 Safety Working Group has already established a platform to distribute information, and similar outreach could be used.

ISSUE:
PROXIMITY OF RAILROAD TRACKS

Description of Safety Issue:

Throughout the corridor there is limited distance between the railroad tracks and the US30. At intersections where crossings are provided (i.e., Old Portland Road, Bennett Road – Old Portland Road, and Millard Road) vehicles with trailers were frequently observed overhanging the railroad tracks. The available distance between the Highway STOP Bar and the railroad tracks (with

appropriate clearance) is approximately 35 feet. Crash data from 2005 through 2009 does not include any vehicle-train collisions; however, given the potential severity of such collisions, the RSA Team identified some potential suggestions for reducing the likelihood of such a crash.

Pickup with Boat Trailer at Bennett Road

Safety Risk:

Exposure: Low
Probability: Low (Based on crash data from 2005 through 2009.)
Consequence: High
Resulting Road Safety Risk: Low

Suggestions:

The RSA Team identified the following suggestions to help decrease the likelihood of crashes related to the railroad.

- Provide driver education to inform drivers of the need for keeping the tracks clear.
- Install railroad regulatory and warning signs noting the distance between the railroad tracks and the STOP bar.

Suggested Signs from MUTCD

ISSUE:
PUBLIC EDUCATION/CLARIFICATION

Description of Safety Issue:

Site observations indicated drivers do not necessarily understand safe and legal side-street left-turn maneuvers. The OSP representatives stated they have seen and given citations for the illegal side-street left-turn movements (defined below). Of the total reported crashes in the study area, 38% are turning crashes of which the majority of crashes are related to side-street left-turns. Additional potential conflicts are created when motorists misuse a left-turn pocket by using it as a refuge or acceleration lane for making a two-stage left-turn. This behavior can also confuse other drivers.

Legal Two-Stage Side-Street Left-Turn

Illegal Side-Street Left-Turn

Safety Risk:

Exposure: Medium
Probability: Medium
Consequence: Medium
Resulting Road Safety Risk: Medium

Suggestions:

The RSA Team identified the following suggestions to help increase public education on key topics that appear to contribute to crashes on US30. The topics below could be incorporated into statewide education and enforcement programs as opportunities arise.

- Provide educational information to drivers to make appropriate and legal turning movements at unsignalized three-legged (i.e., T-intersections), unsignalized four-legged, and signalized intersections. The education information should convey:
    - At an unsignalized T-intersection, side-street left-turners are allowed to use the striped median (e.g., two-way center-turn lane) to complete a two-stage maneuver by crossing the nearside travel lanes and waiting in the striped median for a gap to enter into the far-side travel lanes. It is illegal to use the center two-way left-turn lane as an acceleration lane.
    - At an unsignalized four-legged intersection with striped left-turn lanes (double yellow striping); it is illegal to use the left-turn lane as a refuge for a two-stage maneuver, because of the conflict with the opposing traffic.
    - At a signalized intersection, drivers could have a phase to complete the left-turn movement without trying to judge an appropriate gap in highway traffic.
- Provide educational information to drivers regarding the need to stay off railroad tracks adjacent to the intersection. Field observations indicated drivers towing boats or other trailers frequently (and sometimes inadvertently) had part of the trailer on the railroad tracks.
- Provide educational information to drivers regarding the need to stop for school buses on US30 when the buses are stopped with red lights flashing. Field observations indicated some drivers traveling in the opposite direction of the school bus did not stop.

ISSUE:
POLICY CONSIDERATIONS

Description of Safety Issue:

There are numerous post boxes along US30. Waste Management services pickup garbage along US30 on Thursdays. School buses stop either on the shoulder and/or in the right lane that stops all traffic in both directions on US30. These service vehicles result in friction along the highway and may contribute to avoidance types crashes (e.g., rear-end, sideswipe crashes); however, crash data to-date does not include any crashes directly associated with these services.

Post Boxes

School Bus Stopping in Slow Lane

Safety Risk:

Exposure: Low
Probability: Low
Consequence: Low
Resulting Road Safety Risk: Low

Suggestions:

The RSA Team identified the following suggestions with regard to services providers:

- Provide consolidated areas for post boxes, waste material containers, and create the necessary pull out areas for vehicles, if possible.
- Move school pick-up locations for school buses to side streets away from intersections, if possible.
- Communicate specific services to road users along the corridor with potential permanent or temporary variable message signs (VMS). The VMS signs would warn road users of slow or stopped vehicles (such as school buses, garbage trucks, and postal delivery vehicles) during certain time periods. Use of this treatment should be consistent with ODOT's VMS policies and guidelines.

2) INTERSECTION SPECIFIC ITEMS

US30/MILLARD INTERSECTION

Basic Characteristics:

The following are the basic characteristics of the US30/Millard Road intersection.

- Posted speed through the intersection is 45 mph.
- Unsignalized four-legged intersection with stop signs on minor street (Millard Road) approach. Flashing beacons are present at the intersection.
- Exclusive left-turn and right-turn lanes are provided on US30.
- A signalized railroad crossing is located approximately 50 feet east of the intersection.

Flashing Beacon

- The eastbound approach (i.e., west leg) intersects on a downhill grade and at a slight skew.
- Currently there is no intersection illumination or crosswalks. However, there are ADA ramps and sidewalks on the west side of US30 at and in the vicinity of the intersection. There is also curb and gutter on the east side of US30 at and near the intersection.

Downhill Eastbound Approach

- There are multiple business accesses north and south of the intersection as well as residential accesses south of the intersection. All accesses are located on the west side of US30 with the railroad paralleling US30 to the east.
- The east leg of Millard Road leads to a local marina that serves recreational water sports and fishing resulting in relatively frequent use of the intersection by pickup trucks towing boats.
- The west leg of Millard leads to a residential area.
- In the northwest quadrant of the intersection there is a large parking lot serving a local restaurant. Field observations indicated approximately two-thirds of left turning vehicles cut through the parking lot to use the center left turn lane across from access driveway as to make a two-stage left turn.

Description of Safety Issues:

The US30/Millard Road intersection does not have as many acute safety issues (based on crash data) compared to other locations in the study area. However, increased traffic volumes due to future land use developments or changes to the US30/Bennett Road-Old Portland Road intersection would increase the potential for crashes at the intersection. Furthermore, there have been two reported pedestrian-vehicle crashes, as well as pedestrians observed using the intersection during the RSA during day and night.

Therefore, summarized below are the primary issues and concerns identified for the US30/Millard Road intersection, as well as suggestions for mitigating or reducing the likelihood of crashes.

The primary issues and concerns identified for the US30/Millard Road intersection include:

- Four driveway-related crashes south of the US30/Millard Road intersection in the vicinity of the commercial and residential access driveways.
- Two pedestrian-vehicle crashes under low light conditions. A pedestrian was struck while crossing the eastbound approach (Millard Road); the pedestrian was correctly using the sidewalks/ramps provided and was struck by a southbound right-turning vehicle. The other pedestrian crash occurred south of the intersection when a pedestrian crossing US30 was struck by a vehicle.

Driveways South of Millard Road

- Cut through traffic in the northwest quadrant of the intersection. Motorists are using a large paved parking lot in the northwest quadrant of the intersection to make left-turn movements onto US30 instead of using the US30/Millard Road intersection. Based on field observations, motorists appear to use the parking lot driveway instead of the intersection because they are able to use the two-way center turn lane across from the driveway to make a two-stage left-turn. At the US30/Millard Road intersection, a two-stage left-turn movement would be illegal, because it is a four-legged intersection with left-turn pockets provided on US30.

Motorist Entering Parking Area

Motorist Waiting to Make a Left

- Rolling stops observed on the eastbound approach to the intersection.
- Limited distance between the railroad tracks to the east and the intersection.
- Increasing potential for crashes if or when traffic volumes increase due to future development and/or treatments/changes to the US30/Bennett Road – Old Portland Road intersection.

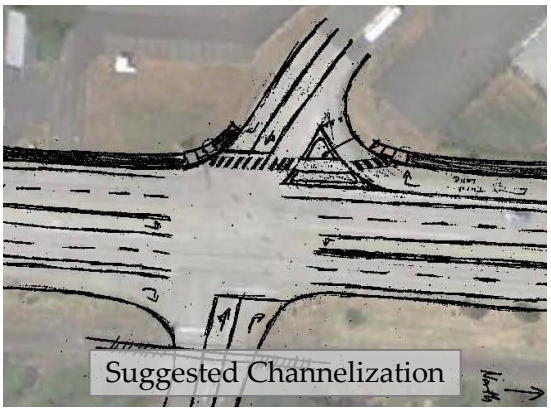
Safety Risk:

Exposure: Medium
Probability: Low (Based on crash history at intersection to-date.)
Consequence: High
Resulting Road Safety Risk: Medium

Suggestions:

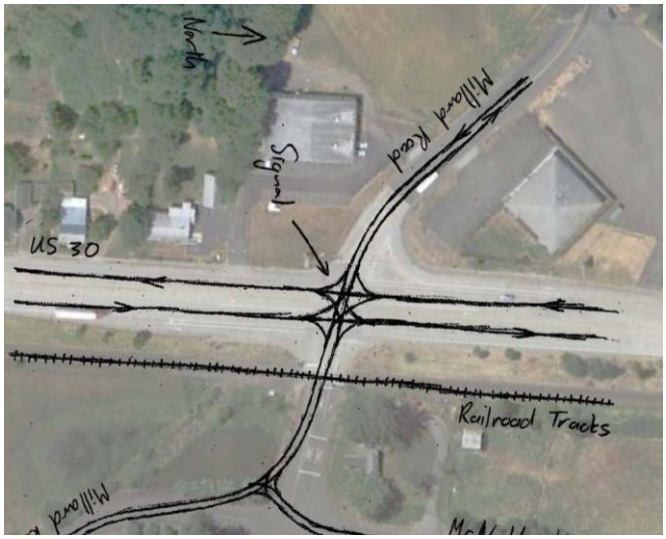
The RSA Team identified the following suggestions to address the concerns and issues above.

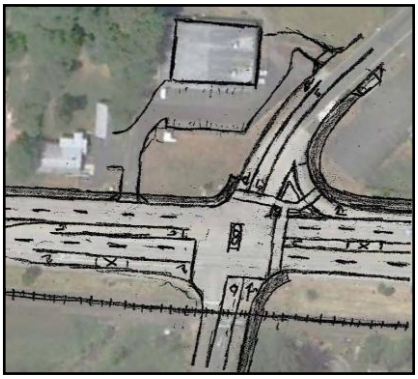
- Lower Cost Suggestions
  - Increase intensity of flashing beacons and realign beacon heads over through lane approaches. However, the effect of continuous flashing beacons has shown limited success, especially if in operation for some time.
  - Add marked crosswalks across west leg of intersection (Millard Road), and relocate northwest ADA ramp to the north for added visibility of pedestrians for southbound right turning traffic. Possibly install traversable right-turn channelization island for a pedestrian refuge and two stage crossing.



  - Add illumination in one or two quadrants at the intersection for increased pedestrian visibility and general visibility of the intersection during dark, dawn and dusk conditions.
  - Relocate signs to improve sight distance for minor street vehicles. Eastbound sight distance to the south partially obstructed/obscured by signs south of the intersection on west side of US30.
  - Investigate the appropriate location of the STOP sign for the eastbound downhill approach, as well as consider increasing the size of the sign.
  - Upgrade guide signs to standard letter sizes, locations and breakaway supports. Upgrade Stop Ahead signs to Stop Ahead symbol signs. Install larger intersection road name plaques under existing "Intersection Ahead" signs for improved legibility.
  - Add Rail Road Crossing Ahead legends to northbound right turn lane onto Millard Road, serving the railroad crossing on the east leg of Millard Road near the intersection.
- Higher Cost Considerations
  - Option 1: Near or at the time surrounding land uses develop; or modifications are made to US30/Bennett Road-Old Portland Road intersection; install a traffic signal, standard crosswalk lines, standard illumination, and upgraded ADA ramps. Install sidewalks on the east side of US30 near Millard Road to serve the crosswalks. Consolidate driveway accesses north and south of the intersection as part of signal

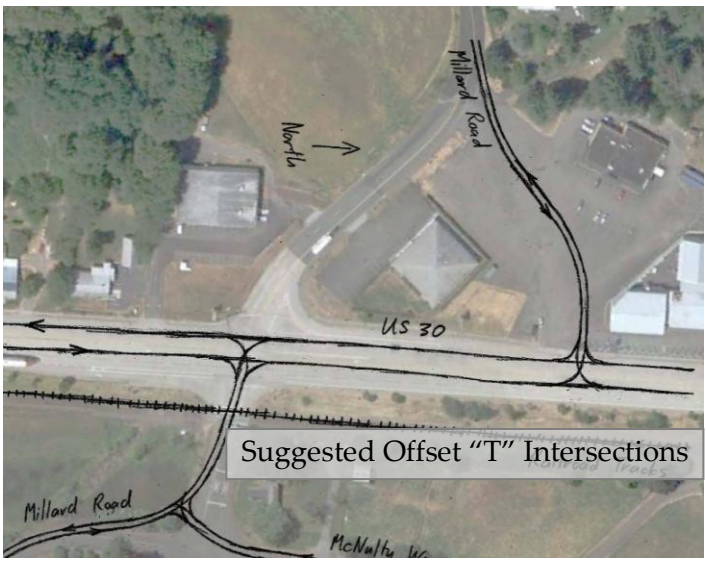
installation. Realign the west leg of Millard Road to provide better intersection sight distance and visibility. Install "Signal Ahead" sign with flashing beacon in the northbound direction. In addition, install concrete medians along US30 to manage driveways, slow vehicle speeds on approaches to the intersection, and alert motorists to the transition into an urban area.





Suggested Realignment and Signalization

- Option 2: Realign east and west legs of Millard Road to create two offset "T" intersections. This option allows the two-way center-turn lanes to serve two-stage left turn movements, creates better intersection visibility for both approaches and minimizes vehicle conflict points. Key considerations for this option include proportion of through movements at Millard Road (existing and potential future volumes) that would be redirected as a right- and left-turn movement within the offset "T" intersection option. In addition, storage associated with the back-to-back left-turns between the two intersections should be investigated in more detail. If the traffic operations analysis indicated insufficient storage, options include increasing the offset accordingly or providing side-by-side left-turn that would require widening along US30. This option would postpone the installation of a signal.



Suggested Offset "T" Intersections

US30/BENNETT ROAD-OLD PORTLAND ROAD INTERSECTION

Basic Characteristics:

The following are the basic characteristics of the US30/Bennett Road-Old Portland Road intersection.

- Posted speed through the intersection is 50 mph.
- Unsignalized four-legged intersection with stop signs on minor street (Bennett Road – Old Portland Road) approaches.
- Exclusive left-turn and right-turn lanes are provided on US30.
- A signalized railroad crossing is located approximately 50 feet east of the intersection across the Old Portland Road approach.

Train Crossing Old Portland Road

- The west leg intersects on a downhill grade.
- There is no intersection illumination, sidewalks or crosswalks. However, there is illumination at the railroad crossing across Old Portland Road.
- There are residential accesses south and north of the intersection on the west side of US30.
- The east leg of Old Portland Road leads to a local marina that serves recreational water sports and fishing, resulting in relatively frequent use of the intersection by trucks towing boats.

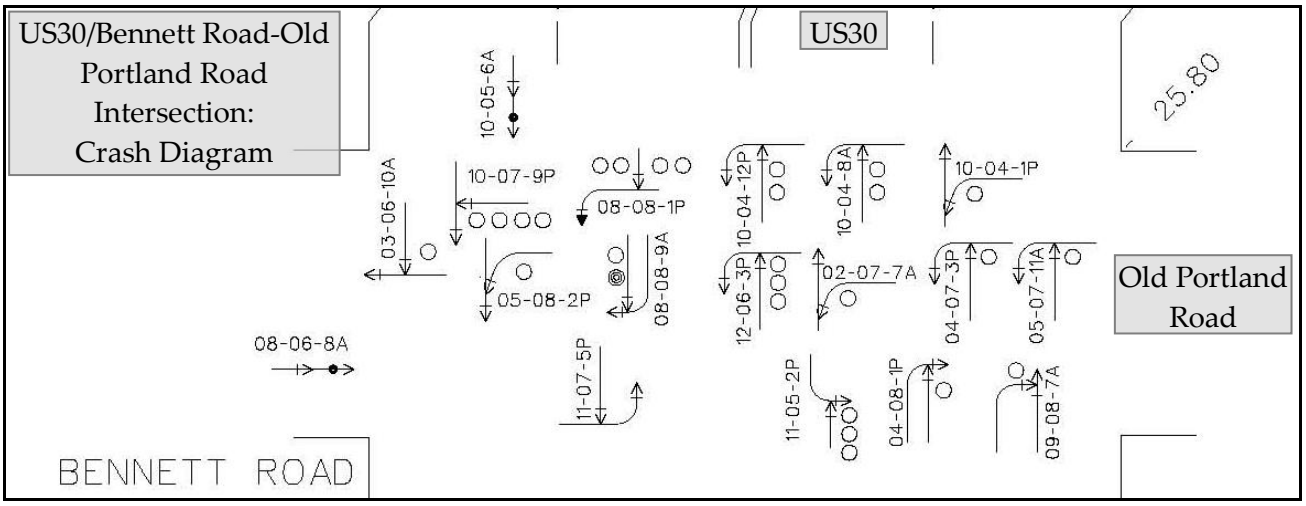
Parking Lot at Marina

- The east leg of Old Portland Road is also used by long-haul log pole trucks carrying logs of up to 100 feet in length. These log pole trucks are accompanied by rear pilot cars that follow the back end of the logs as the trucks make the northbound right-turn movement onto Old Portland Road from US30. The pilot car operations have been modified and required since two crashes occurred related to the back of logs swinging into adjacent northbound lanes when the trucks made the northbound right turn movement. Since the modifications to the pilot car operations were made, no additional crashes have occurred.
- The west leg of Bennett Road leads to farms and single-family residences. There is also farm land on the east side of the railroad tracks and farmers use this intersection to cross US30.

Farm Tractor

Description of Safety Issues:

The US30/Bennett Road-Old Portland Road intersection is the highest crash location (most frequent number of crashes) within the study area with approximately 18 of the 60 reported crashes occurring at this intersection. Approximately 80% of the crashes at the intersection were turning movement crashes with the majority of those crashes occurring when minor street vehicles attempted to turn left onto US30.



The issues presented below and corresponding suggestions for reducing crashes at this intersection focus on addressing the left-turn movements onto US30 at the US30/Bennett Road-Old Portland Road intersection.

- Crashes associated with the minor street left-turn movement onto US30. The westbound to southbound minor street left-turn movement accounts for 50% of the intersection crashes (9 of 18 reported crashes) at the US30/Bennett Road-Old Portland Road intersection. Field observations confirm it is difficult to identify gaps in traffic stream on US30 sufficient for left-turn movements. In addition to evidence that traffic volume and speed on US30 makes the minor street left-turn movement difficult, vehicles in the northbound right-turn lane also block visibility for westbound left-turning vehicles. Finally, some left-turning minor street vehicles inappropriately use the left-turn pockets on US30 as refuges to make a two-stage left-turn onto US30.

Vehicle in NB Right block Visibility

Visibility for WB lefts

- Northbound right-turn movements by trucks carrying log poles (up to 100 feet in length). The trucks carrying the log poles are not able to navigate the northbound right-turn movement without occupying both northbound lanes and the right-turn lane. As noted above, modifications and requirements to the accompanying rear pilot car operations appear to have mitigated the previous issues with the log pole trucks.

Log Pole Trucks with Pilot Car

- There is limited clearance distance between the railroad tracks and US30. The distance between railroad tracks and US30 STOP bar is approximately 50 feet. A pick-up truck towing a boat trailer has difficulty fitting between the Highway STOP bar and the railroad tracks.
- The pavement markings used to mark the edge of the outside travel lane are inconsistent with the stencils provided for the bicycle lane. In addition, a bike lane is striped between the through and the right-turn lanes in the southbound direction, but not in the northbound direction. If the shoulder is truly intended to be a bicycle lane (as indicated by the stencils), the pavement marking should be 8 inches in width instead of 4 inches in width.
- There is no intersection illumination and the only nearby lighting located at the railroad crossing may be removed since it is not the current standard to provide illumination at an active/signalized crossing.

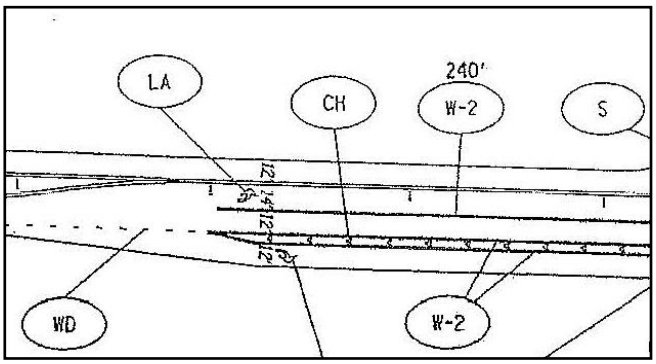
Safety Risk:

Exposure: High
Probability: High
Consequence: High
Resulting Road Safety Risk: High

Suggestions:

The RSA Team's suggestions for reducing crashes at the US30/Bennett Road-Old Portland intersection are discussed below. An important side note to consider is that installing a traffic signal at the US30/Millard Road intersection may help divert left-turning and through traffic volumes away from the US30/Bennett Road-Old Portland Road intersection.

- Lower Cost Suggestions
  - Add intersection warning beacons on the advance intersection/rail crossing signs.
  - Install cross-hatch pavement markings on the northbound approach between the through lane and the right-turn lane to increase sight distance for the westbound left-turn movement.



Cross-Hatch Pavement Markings

- Restripe bicycle lanes to follow the edge of pavement (not between through and right-turn lanes), especially since speeds are above 45 mph in the vicinity of the intersection.

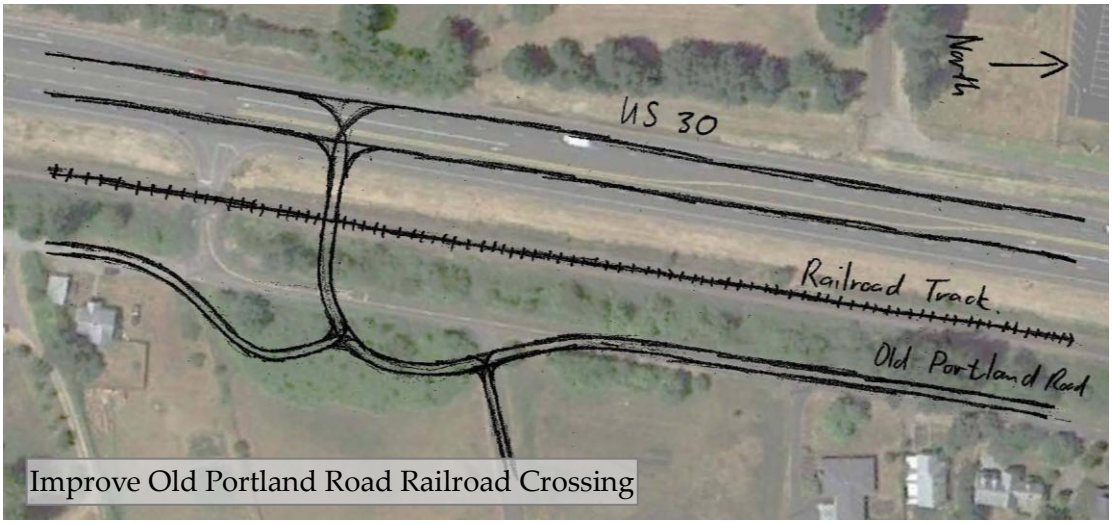
- Higher Cost Suggestions
  - Option 1: As suggested under the "MINOR-STREET LEFT-TURN FINDING A GAP" issue, install an Intelligent Transportation System (ITS) such as the Collision Avoidance System.
    - Installing the Collision Avoidance System or a similar type technology on US 30 would be one of the first installations on an undivided highway. Previous use of such systems has historically been applied to divided highways. A related concern noted by the RSA Team, is potential liability associated with the system if power to the Collision Avoidance System were to fail or be interrupted. A potential mitigation for such a situation is discussed below.
    - Supplemental use of yellow flashing beacons installed on the advance intersection signs on US30 and a red flashing beacon installed to the stop signs on the side-streets could be used to mitigate the risk of liability, if power to a higher tech system such as a Collision Avoidance System were to fail. The flashing beacons would raise awareness by flashing when a vehicle approaches on US30 and a vehicle is present on the side-street. Historically, ODOT has only considered adding flashing beacons to "Stop Ahead" signs, if there is a documented crash history resulting from motorists disregarding the STOP signs. Using flashing beacons in the manner above may require modifying the manner and process ODOT has traditionally used to identify when, where, and how flashing beacons are installed.
  - Option 2: Limit the intersection to Right-In/Right-Out/Left-In, eliminate Lefts-Out and cross traffic from the minor approaches, and install a J-Hook style U-Turn to the north. This will allow westbound left turns to turn right, travel north and then U-Turn. This will likely also divert traffic to both Millard Road to the north and Old Portland Road to the south.

"J"-Hook U-Turn Option

The crossings at Old Portland will need to be improved from passive signs to active signs and crossing gates; Millard Road will need to be addressed to accommodate additional traffic as well as intersections along the new routes.

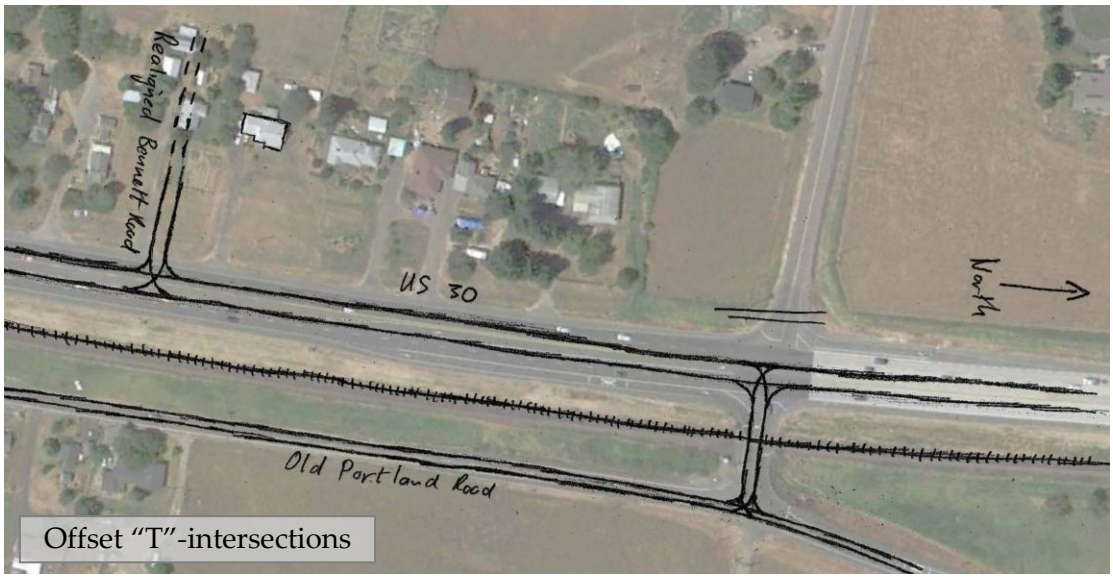
Traffic from the west side of Bennett will have to use other locals streets (e.g., Morse Road connects to Church Road and Achilles Road to the west of US30) to turn left because there is not enough room to provide a J-Hook between the highway and the railroad tracks south of the intersection. Also, an agricultural crossing will need to be developed as a local farmer farms fields on both sides of the highway and needs to move farm implements back and forth across the highway.

- Option 3: Close the railroad crossing at the Bennett Road-Old Portland Road completely. With this option, the RSA Team suggests improving the Old Portland Road crossing located approximately 0.8 miles to the south to a signalized gated rail crossing, re-grade and realign Old Portland Road, and improving Old Portland Road to accommodate additional traffic. Also an agricultural crossing will likely be required Bennett Road intersection.



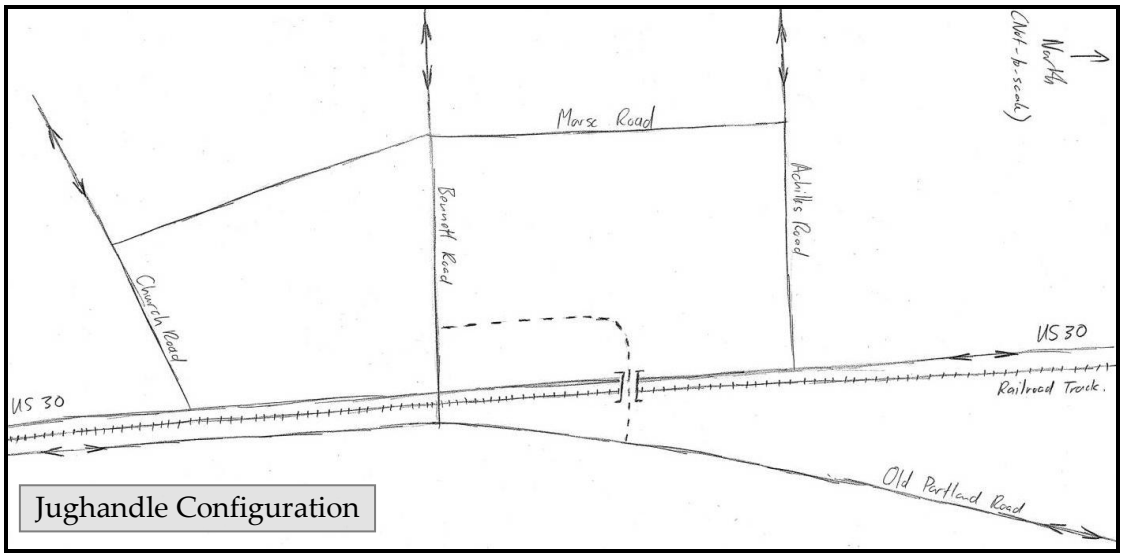
Improve Old Portland Road Railroad Crossing

- Option 4: Convert the intersection to two offset "T" intersections. The RSA Team considered realigning Old Portland Road (east leg) to the north, but the elevation difference between US30 and the railroad tracks becomes significant and would require re-grading either US30 and/or the railroad tracks. The other option is to realign Bennett Road (west leg) to the south to create the Offset "T" intersections, but has significant right-of-way impact. This Offset "T" intersections option will allow the side-street to complete the left-turns in two stages. Also an agricultural crossing will likely be required at the Bennett Road intersection. *The "Offset 'T' intersections" option appears infeasible, due to the constructability challenges when Old Portland Road (east leg) is realigned to the north, and to the home relocations when Bennett Road (west leg) is realigned to the south.*



Offset "T"-intersections

- Option 5: Install an overpass (over both railroad and US30) with jughandle style connections to allow right-in/right-out connections at the Bennett Road-Old Portland intersection to the highway. This option has significant right-of-way impacts on both sides of US30. *The "Jughandle Configuration" option would be infeasible, due to the required home relocations with the introduction of new roadway facilities and associated right-of-way.*



Jughandle Configuration

If there is a long-term vision for US30 to have limited access with a focus on mobility through the rural sections, then the "Jughandle Configuration" may become an option. Future long-term improvements would then allow the opportunity to convert the nearby intersections (i.e., Church Road, Bennett Road, and Achilles Road) to right-in/right-out and connect these roadways to the jughandle overpass to provide full access.

A traffic signal at the US30/Bennett Road-Old Portland intersection was considered by the RSA Team. However, the RSA Team determined a traffic signal would be inappropriate for the US30/Bennett Road-Old Portland Road intersection because the intersection is located in a rural area with high speed approaches. Historically, installing a traffic signal at similar locations results in high speed, high severity rear-end and/or angle crashes, which would not meet the primary objective of reducing crashes, injuries and fatalities at this location.

Travel distance from the Marina to Bennett Road was approximately 0.5 miles. If users decide to travel back to the Millard Road intersection, it would add approximately 1.5 miles to their trip. Therefore, any option considering turn movement restrictions at the Bennett Road-Old Portland Road intersection would likely necessitate modifications to Old Portland Road (including railroad crossing) to accommodate increased traffic volumes.

ISSUE:

US30/BERG ROAD INTERSECTION

Basic Characteristics:

The following are the basic characteristics of the US30/Berg Road intersection.

- Berg Road, a "T" intersection to the west is located approximately 0.1 mile south of the Old Portland Road intersection, a "T" intersection to the east. The "Offset 'T' intersections" configuration helps the two-stage left-turn maneuver for the minor-street left-turns.
- Posted speed through the intersection is 50 mph.
- Unsignalized three-legged intersection with stop sign on the minor street (Berg Road) approach.
- Exclusive left-turn and right-turn lanes are provided on US30.
- The eastbound approach (i.e., west leg) intersects on a downhill grade.
- An elementary school is located in the northwest quadrant of the intersection; school buses, as well as parents travelling to and from the school, use Berg Road to access the school parking lot.
- There is no intersection illumination, sidewalks or crosswalks at the intersection or along Berg Road or US30.
- Sight distance on Berg Road appears adequate.

- There are residential accesses south of the intersection on the west side of US30.
- In addition to providing access to the elementary school, Berg Road also leads to farms and single-family residences.

Description of Safety Issues:

Seven crashes were reported in the vicinity (within 0.05 miles or approximately 265 feet) of the US30/Berg Road intersection from 2005 through 2009. Five of the crashes were related to motorists turning left from Berg Road onto US30. Berg Road experiences relatively short periods of congestion relating to the arrival and departure times for the Warren Elementary School. At school drop-off and pick-up times there is a period of congestion as parents and buses arrive and depart. Four of the crashes appear to be related to school arrival and departure times and one crash involved a school bus.

The RSA Team observed one incidence of a specific issue involving a school bus. One bus in the afternoon turned left from Berg Road, traveled north on US30 for a short distance, and then turned right on Old Portland Road (passive railroad crossing). Because of the proximity of the two intersections the driver was unwilling to use the center two-way left turn lane. The bus driver had to wait approximately three and a half minutes to make the turn. There was a substantial queue built up behind the bus.

Safety Risk:

Exposure: Medium
Probability: Medium
Consequence: Medium
Resulting Road Safety Risk: Medium

Suggestions:

Suggestions for reducing left-turn crashes at the US30/Berg Road intersection are below.

Berg Road Approach

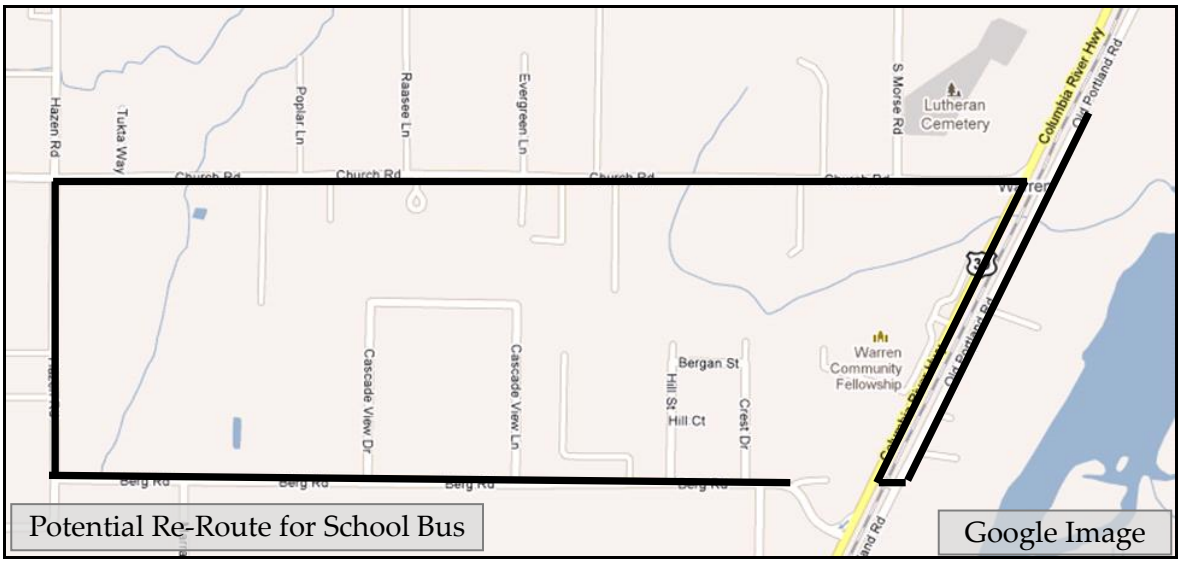
- Widen the Berg Road eastbound approach and increase vehicle storage. Currently a school bus or a couple of queued vehicles can prevent other vehicles from approaching the intersection. For instance when a school bus is waiting to turn left a vehicle does not have room to pull forward and turn right. Widening the approach will reduce delay for motorists and reduce the risk that they will take inappropriate gaps because they are impatient.

- Provide information to parents and bus drivers to help them understand how to make two-stage left turns correctly.

- Consider illuminating the intersection to improve visibility under lower light conditions and inclement weather. Two crashes reported to occur in the vicinity of the Berg Road intersection between 2005 through 2009 occurred under low light conditions (i.e., darkness, dawn or dusk). A parent of the school also commented to an RSA team member about how difficult it is to see at night and/or under rainy conditions; this parent also requested lighting be added to the intersection to make it easier to see under dark and/or rainy conditions.

- Evaluate signing. The Berg Road directional sign is in the southwest quadrant of the intersection, adjacent to an Adopt-A-Highway sign. The Adopt-A-Highway sign is closer to the shoulder than the directional sign. The Berg Road sign can be moved to the near side of the intersection and the Adopt-A-Highway sign can be moved south of the intersection.

- Consider rerouting school buses so that they do not have to turn left onto US30. Using Berg Road to Hazen Road to Church Road to return to US30 adds an additional six minutes to the trip, but avoids the minor street left-turn movement onto US30. The additional time to travel out of direction is slightly more than twice the time observed for the school bus to left onto US30.



Appendix A

US30 Road Safety Audit Findings Presentation

ROAD SAFETY AUDIT
US30: Berg Rd to Millard Rd

US30 RSA Preliminary Findings

Columbia County, Oregon

April 29, 2011

Presented by: **Hermanus Steyn, PE, Pr.Eng.**

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Presentation Outline

- RSA Team and Resources
- RSA Schedule
- RSA Study Area
- Review of Traffic Volumes and Crash Data
- Preliminary Findings
- Next Steps

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RSA Team

- **Hermanus Steyn, Pr.Eng., P.E.**
  - *KAI Associate Engineer*
- **Joel McCarroll, P.E.**
  - *ODOT Region 4 Traffic Manager*
- **Kurt Mohs**
  - *ODOT Rail Crossing Compliance Specialist*
- **Robert (Bob) Doran**
  - *ODOT Region 2 Maintenance District 3 Manager*
- **Amanda Westmorelane**
  - *ODOT Region 2 Traffic Investigator*
- **Raymond Lapke, P.E.**
  - *ODOT Region 3 Traffic Operations Engineer*
- **Lonny Welter**
  - *Columbia County Road Department*
- **Troy Johnson**
  - *ODOT Region 2 Roadway Designer*
- **Erin Ferguson**
  - *KAI Engineering Associate*

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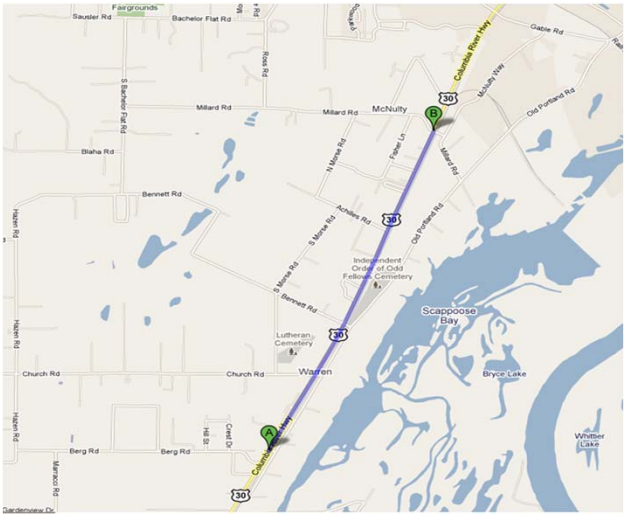
Resources to RSA Team

- **Randy Fargher**
  - *Oregon State Police (OSP) Senior Troopers*
- **Kate Freitag**
  - *ODOT Region 1 Traffic Operations Engineer*
- **Mark Buffington**
  - *ODOT Clatskanie Maintenance Section Manager*

RSA Schedule

- **Tuesday April 26th**
  - *Early Afternoon: Project Startup meeting*
    - Explain FHWA RSA process & Project data
  - *Afternoon & Evening: Field work*
    - Observe road user characteristics during evening commute and during night time
- **Wednesday April 27th**
  - *Morning & Midday: Field work*
    - Observe road user characteristics during morning commute and midday peak period
  - *Afternoon: RSA Analysis*
    - Identify, prioritize, and mitigate safety issues
- **Thursday April 28th**
  - *All day: RSA Analysis & Findings presentation*
    - Identify, prioritize, and mitigate safety issues
    - Document RSA in presentation format

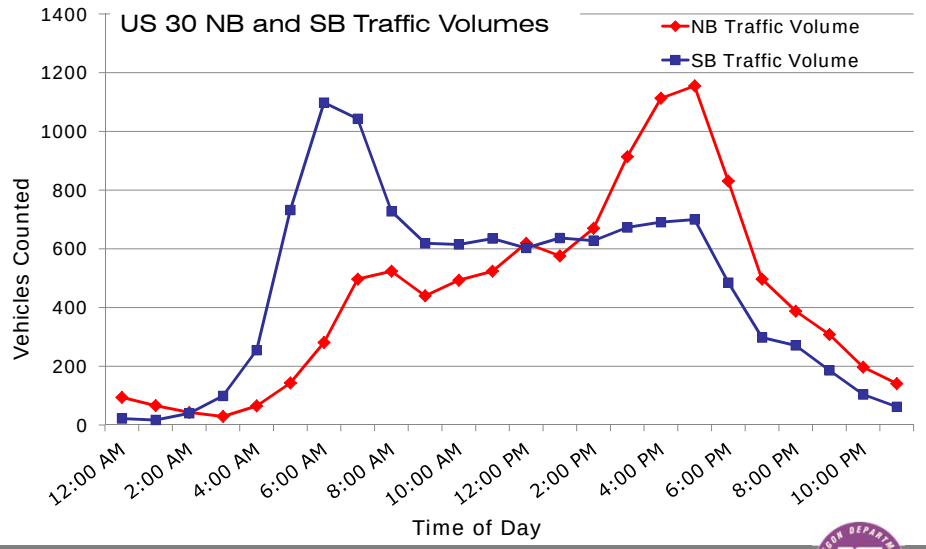
Scope of RSA



- 2-Mile Section
- Railroad to the east
- 7 Key Intersections
  - *Millard Road with railroad crossing*
  - *Achilles Road*
  - *Bennett Road with railroad crossing*
  - *Church Road*
  - *Warren Country Inn Access*
  - *Old Portland Road with railroad crossing*
  - *Berg Road*

Traffic Volumes – US 30 Near Millard Road

Count Date: June 3, 2008



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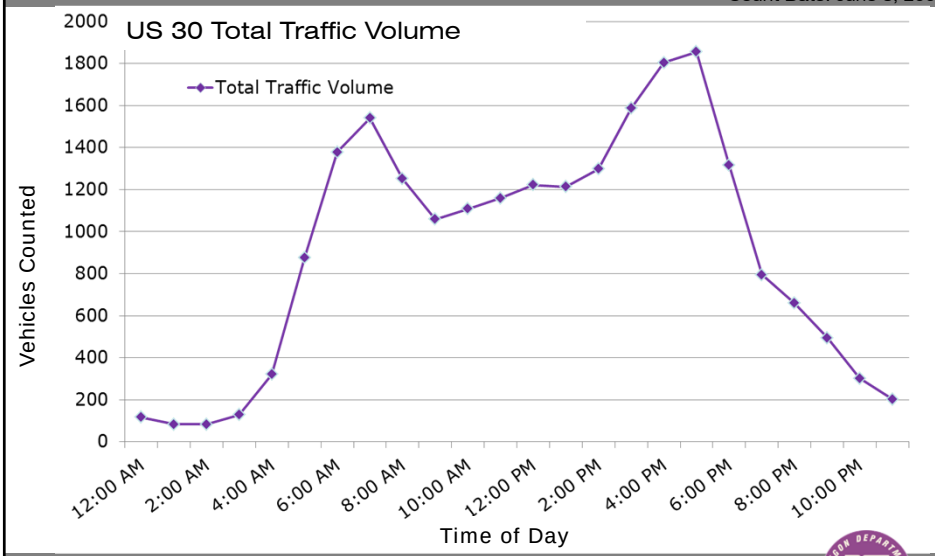
Traffic Volumes – US 30 Near Millard Road

Count Date: June 3, 2008



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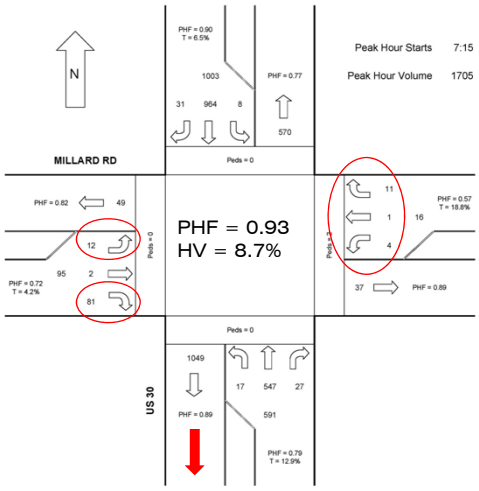
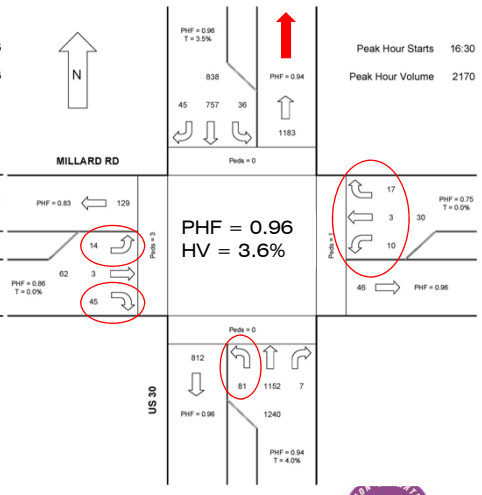
Traffic Volumes – US 30/Millard Road

Weekday AM Peak 7:15 – 8:15



Weekday PM Peak 4:30 – 5:30



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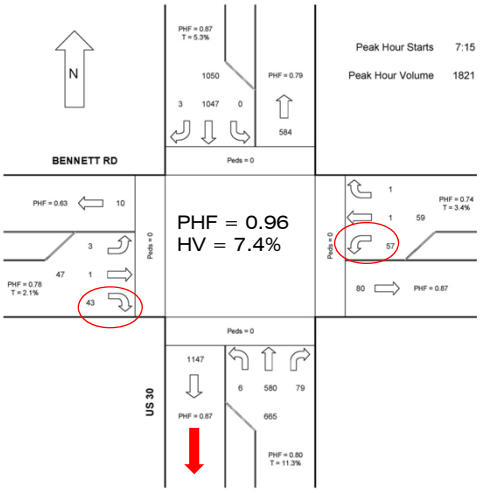
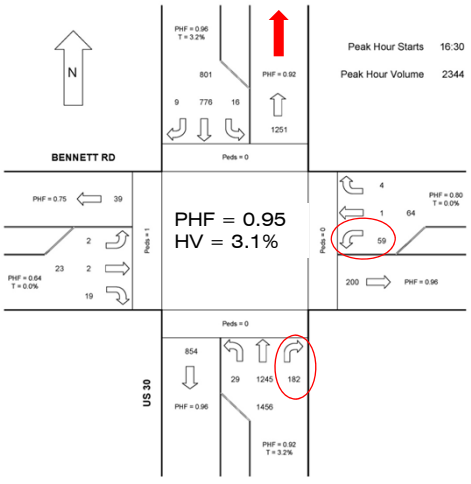
Traffic Volumes – US 30/Bennett Road

Weekday AM Peak 7:15 – 8:15



Weekday PM Peak 4:30 – 5:30



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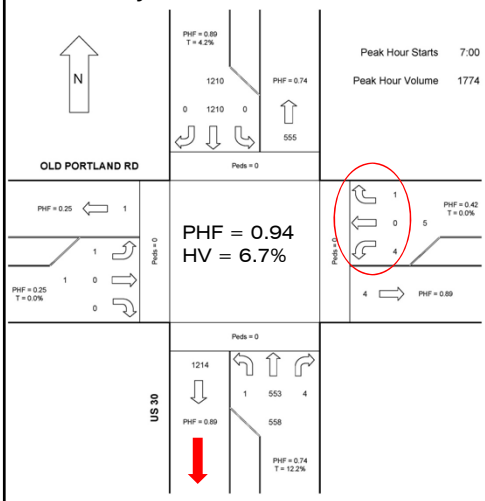
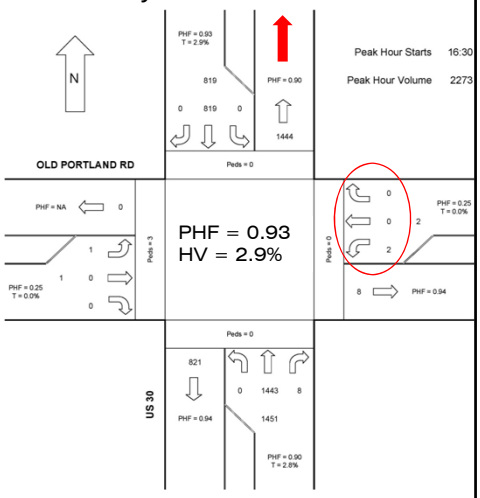
Traffic Volumes – US 30/Old Portland Road

Weekday AM Peak 7:00 – 8:00



Weekday PM Peak 4:30 – 5:30



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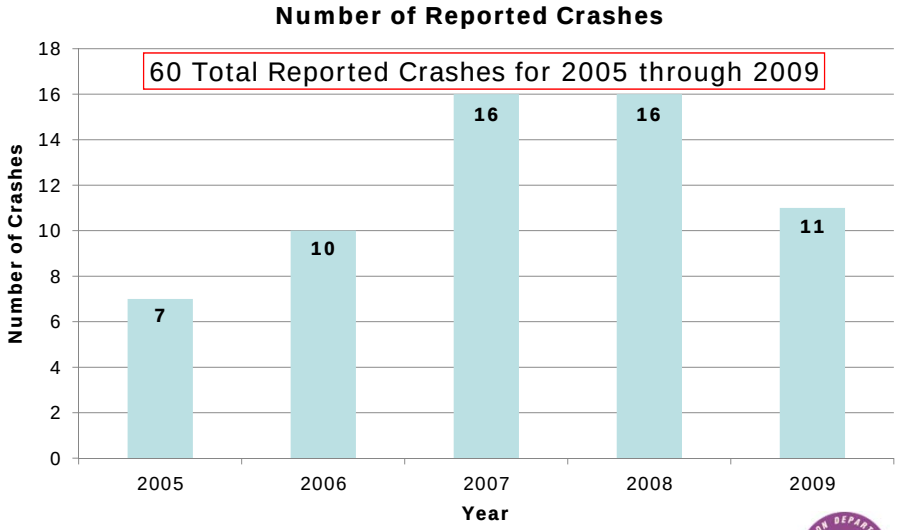
Crashes by Year



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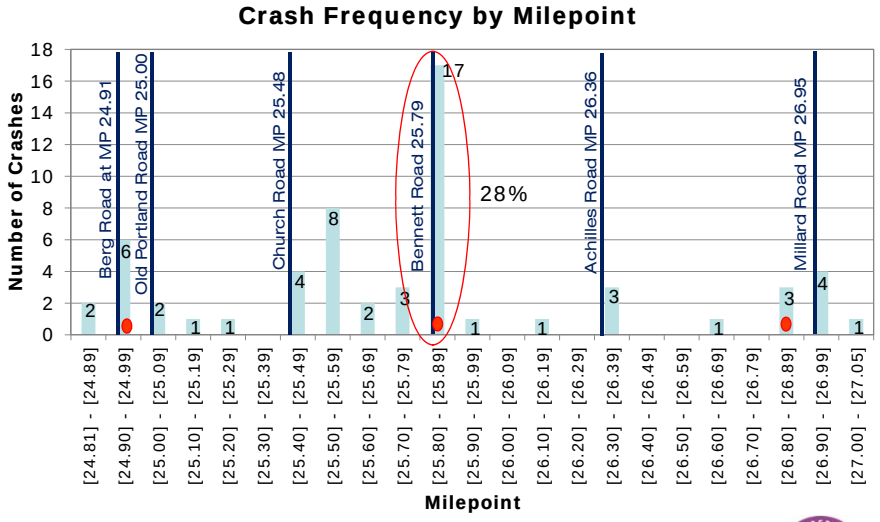
Crashes by Location
2005 through 2009



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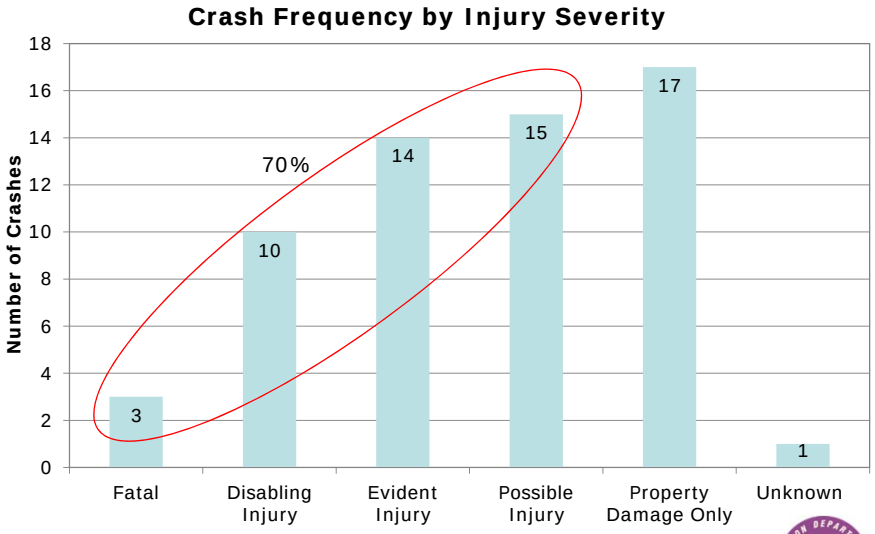
Crashes by Severity
2005 through 2009



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Crash Severity
2005 through 2009

- Three Fatal Crashes
  - *2005*
    - Occurred at Berg Road (recorded as MP 24.91)
    - Angle crash; one vehicle failed to yield right-of-way to the other
    - Clear, Dry, September at about 7:00 p.m.
  - *2006*
    - Occurred near MP 26.85 between Achilles and Millard Road
    - Pedestrian struck by vehicle and killed
    - Rainy, Wet, January at about 7:00 a.m.
  - *2008*
    - Occurred at Bennett Road
    - Crash between right-turning vehicle and through vehicle
    - Clear, Dry, August at about 9:00 a.m.

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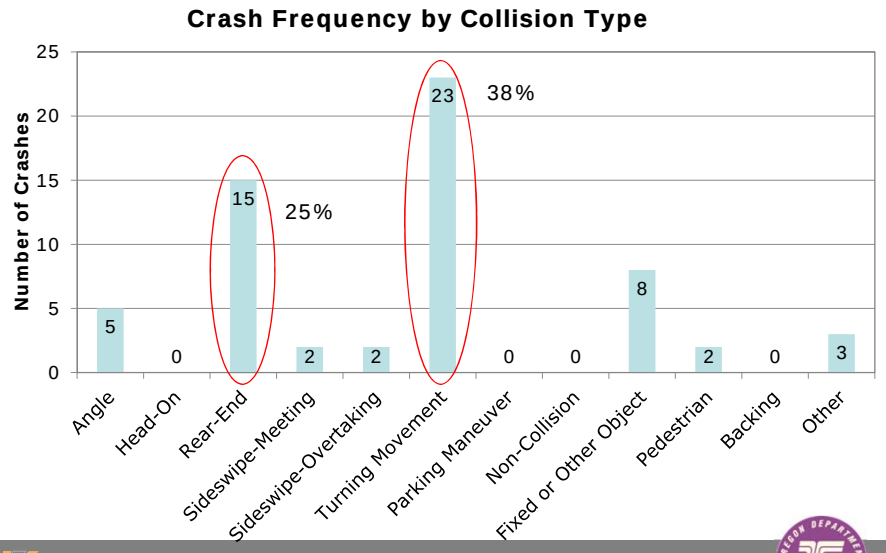
Crashes by Type
2005 through 2009



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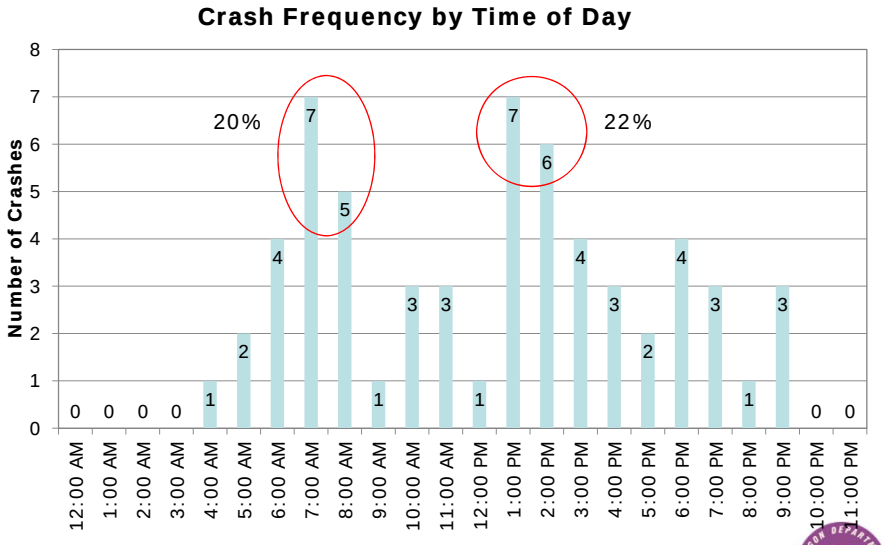
Crashes by Time of Day
2005 through 2009



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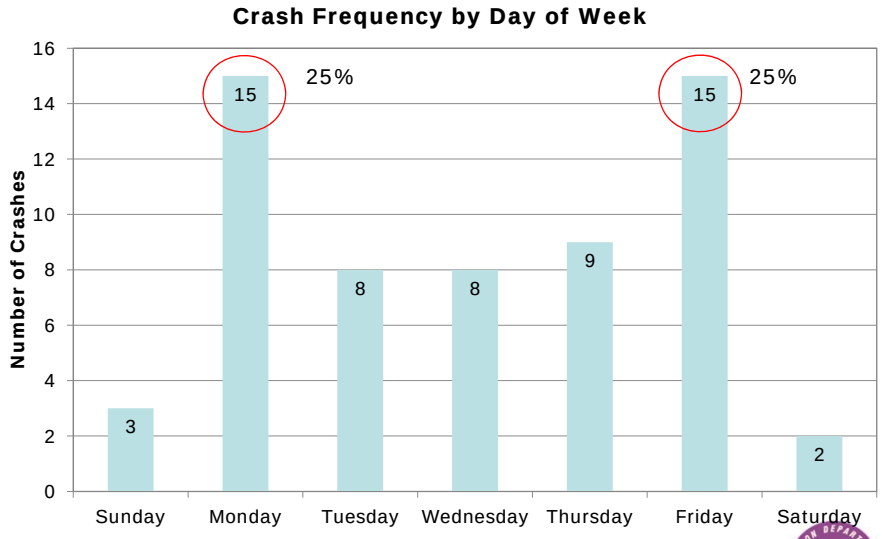
Crashes by Day of Week
2005 through 2009



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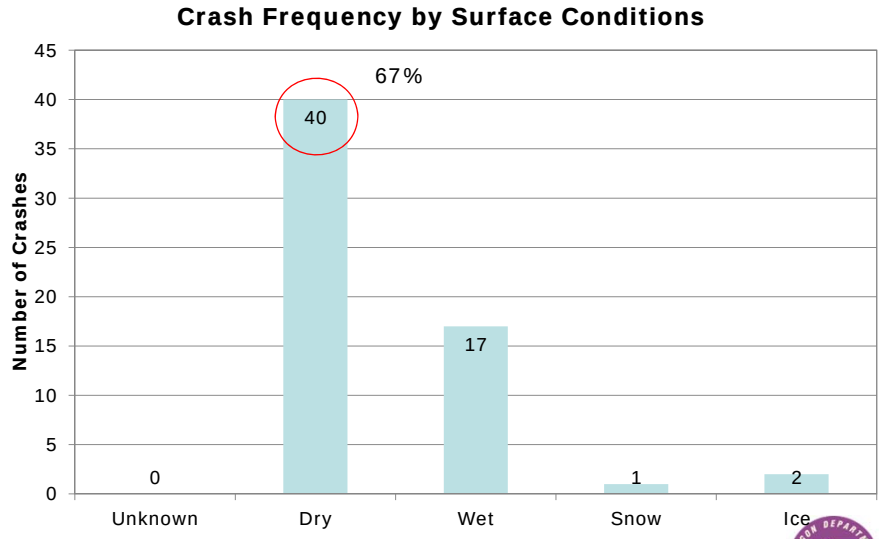
Crashes by Surface Condition 2005 through 2009



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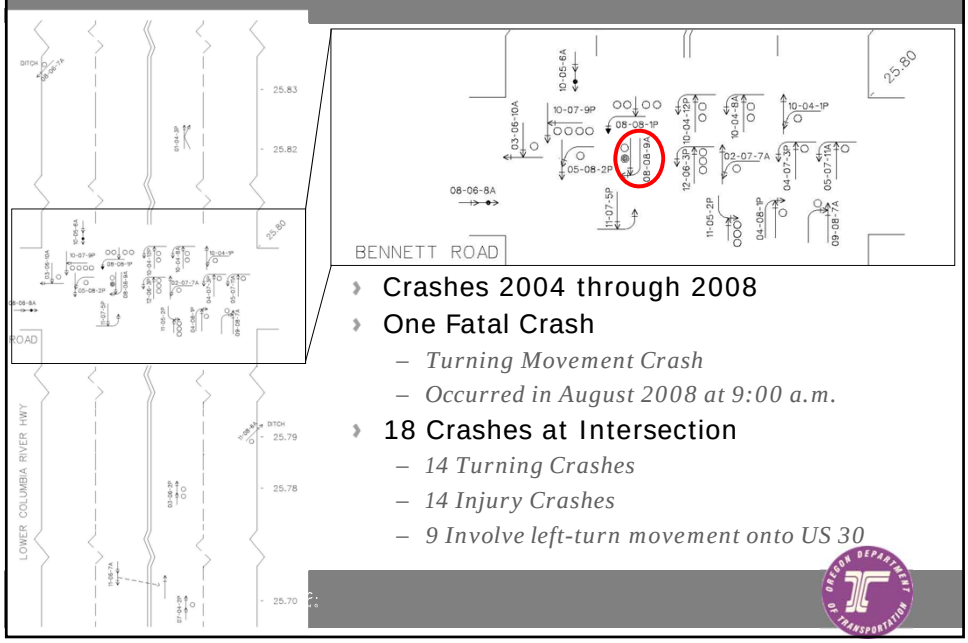
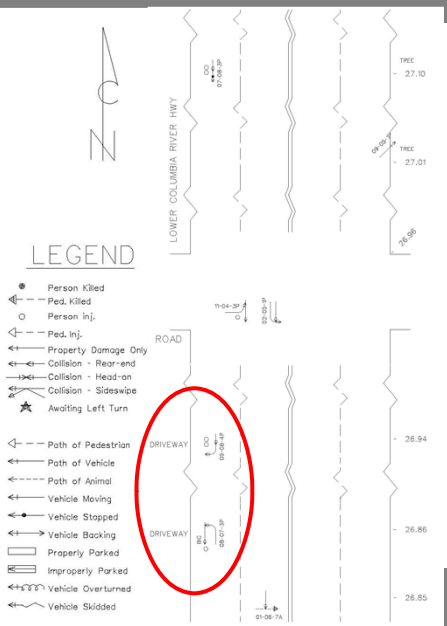
Collision Diagram – US 30/Bennett Road



- Crashes 2004 through 2008
- One Fatal Crash
  - *Turning Movement Crash*
  - *Occurred in August 2008 at 9:00 a.m.*
- 18 Crashes at Intersection
  - *14 Turning Crashes*
  - *14 Injury Crashes*
  - *9 Involve left-turn movement onto US 30*

Collision Diagram - US 30/Millard Road



- Crashes 2004 through 2008
  - *6 Reported Crashes in Vicinity of Intersection*
  - *2 Crashes at Intersection*
  - *2 Crashes at Adjacent Driveways*
  - *1 Fixed Object Crash*
  - *1 Rear-End Crash*

Preliminary Findings

Safety Issues and Associated Suggestions can be divided into Two Categories

- Corridor Related
  - *Issues may be similar along other sections along US30*
  - *Suggestions may be applicable to other US30 segments*
- Intersection Related
  - *Each intersection has unique characteristics*

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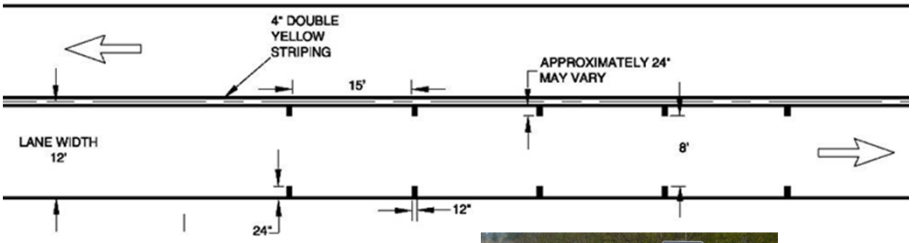
Corridor Issue: Roadway Character & Speed

- Roadway characteristics do not communicate desired vehicle speeds given surrounding land uses and accesses
  - *Results in higher speeds than desired*
  - *Exacerbates challenge of identifying gaps in traffic*
  - *Contributes to frequency and severity of turning movement crashes*

Suggestions for Reducing Vehicle Speeds

- Install Transverse markings at posted speed signs



- Install roadside delineators along roadside at increased frequency as posted speed decreases

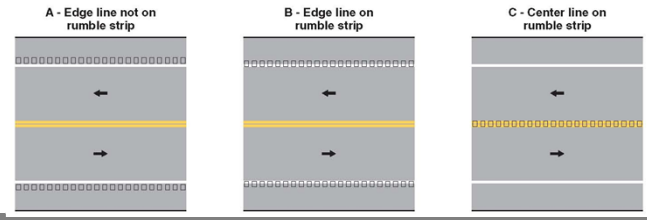
Suggestions for Reducing Vehicle Speeds

- Install feedback signs (with flashing beacon)
- Increase enforcement of speed zones
  - *Monday and Fridays*
- Photo radar for speed enforcement (long-term legislative effort)

Corridor Issue & Suggestions: Departure Crashes

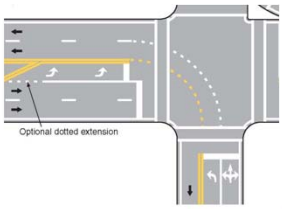
- Observations & Concerns:
  - *2 sideswipe-meeting, 2 sideswipe-overtaking, and 8 fixed or other object type crashes*
  - *Use of left-turn pocket for two-stage left-turns*
- Suggestions:
  - *Shoulder rumble strips*
  - *Rumble strips in the median next to striped left-turn lanes*
  - *Improved pavement markings and markers*

Figure 3J-1. Examples of Longitudinal Rumble Strip Markings



Corridor Issue & Suggestions: Mainline Lane Visibility

- Observations & Concerns:
  - *Lack of pavement marking (striping) reflectivity*
  - *Missing recessed pavement markers*
  - *Challenging to judge in which lane approaching vehicle is*
  - *Challenging to aim for appropriate receiving lane*
- Suggestions
  - *Improved pavement markings and markers (includes lane extension markings)*
  - *Illumination at intersections where appropriate*



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Corridor Issue & Suggestions: Intersection Visibility

- Observations & Concerns
  - *38% turning movement and majority related to side-street lefts*
  - *Unexpected entering vehicles for mainline traffic*
  - *Challenging to locate intersection*
  - *Number of signs and location (offsets)*
- Suggestions:
  - *Delineation of intersection edges (e.g., tubular markers)*
  - *Thoughtful signing*
  - *Illumination at intersections where appropriate*
  - *Lane extension pavement markings*

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Corridor Issue & Suggestions: Finding a Gap

- Observations & Concerns
  - *38% turning movement and majority related to side-street lefts*
  - *Two-stage minor street left versus finding a gap in both directions*
- Suggestions
  - *ITS Detection at Bennett Road*
  - *Proximity of Upstream Signals would create gaps and platoons*

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Corridor Issue & Suggestions: Driver Workload

- Driver Overload and Unclear Information
  - *Signing Inventory*
  - *Remove unnecessary signing*
  - *Relocate lower priority signs*
  - *Ensure driver sight distance unobstructed*
  - *Driver education*
    - Two-stage left turns
    - 4-legged intersections with striped left-turns
      - Illegal two-stage left-turn

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Corridor Issue & Suggestion: Driveway Accesses

- Observations & Concerns
  - *Key Areas in Corridor with recorded crashes*
    - North of Church Road
    - South of Millard Road
- Suggestion for Access Management
  - *Explore access management opportunities as land uses redevelop or other opportunities arise.*

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Corridor Issue & Suggestions: Railroad Tracks

- Observations & Concerns
  - *Vehicles with trailers that stands on tracks*
  - *Limited space available between STOP bar and tracks*
- Suggestions
  - *Driver Education*
    - Keep tracks clear
  - *Install railroad warning signs noting distance between STOP bar and tracks*
    - MUTCD: W10-11a sign

R8-8

W10-11a

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US 30/Millard Road: Observations & Concerns

- Cut through traffic in northwest quadrant
  - *Use parking lot driveway to make two-stage left-turn movement onto US30*
  - *Increased risk to pedestrians and business patrons*

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US 30/Millard Road: Observations & Concerns

- Rolling stops observed on EB approach
- 4 driveway related crashes to the south
- Distance between rail tracks and US30
- Higher potential for crashes as/if volumes increase with future development
- Relationship to potential changes at Bennett Road

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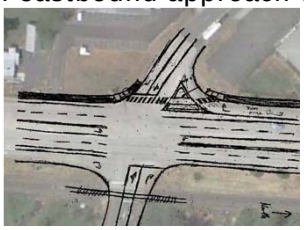
US 30/Millard Road: Suggestions

- Increase intensity of flashing beacons and align over through lanes

- Adjust ADA ramp location, add marked crosswalk and traversable channelized right-turn island on eastbound approach (Millard Road)



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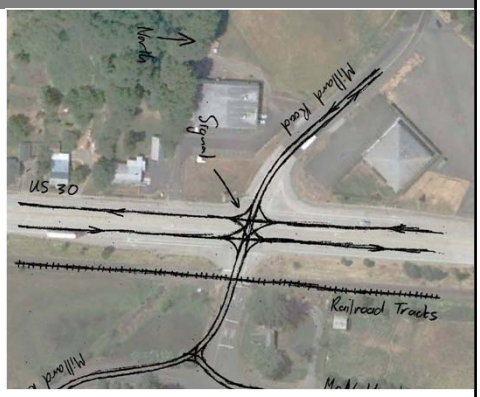
US 30/Millard Road: Suggestions

- Option 1: Install Signal (includes illumination)
  - *Contingent upon increased volumes (due to development or potential changes at Bennett Road)*
  - *Improve alignment of side streets*
  - *Install advanced warning signs/beacons on northbound approach (mitigate potential for rear-end crashes)*
  - *Improve access management on approach to intersection; work with property owners to eliminate cut through traffic*



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US 30/Millard Road: Suggestions

- Option 2: Convert to two Offset "T"-Intersections
  - *Confirm limited through movement volumes to occur in future*
  - *Check storage for back to back left-turn movements*

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US 30/Bennett Road: Observations & Concerns

- Turning Crashes
  - *Westbound Left-turn Movement*
  - *Accommodating Pole Trucks Northbound Right-Turn Movement*

- Farm Crossing

- Distance between rail tracks and US30
- Vehicles in Right-Turn Lane slightly Obstruct Westbound Left-Turn Movement

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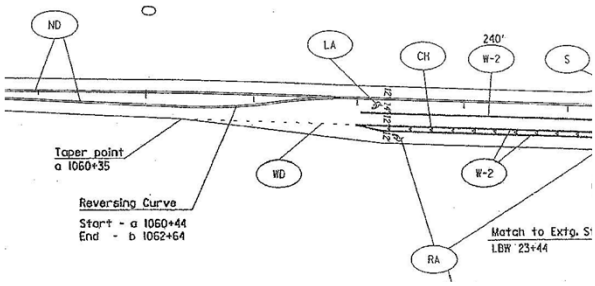
US 30/Bennett Road: Suggestions

- Install cross hatch pavement markings between through and right-turn lane to increase sight distance for westbound left-turn movement



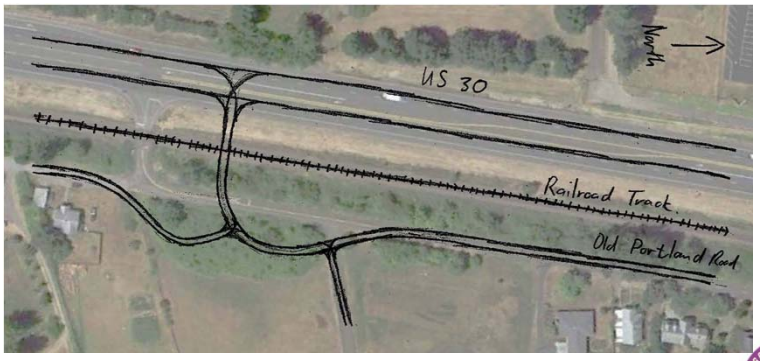
- Option 1: Install Collision Avoidance System
  - *An ITS treatment that assists minor street movements in identifying gaps in traffic*
  - *Applied in Wisconsin and Minnesota*

US 30/Bennett Road: Suggestions

- Option 2: Limit Movements to Right-In/Right-Out/Left-In with "J"-Hook Style U-Turn to the North
  - *No opportunity to introduce "J"-Hook in the southbound direction; however motorists may use:*
    - Old Portland Road to the south
    - Morse Road to connect with Church Road or Achilles Road

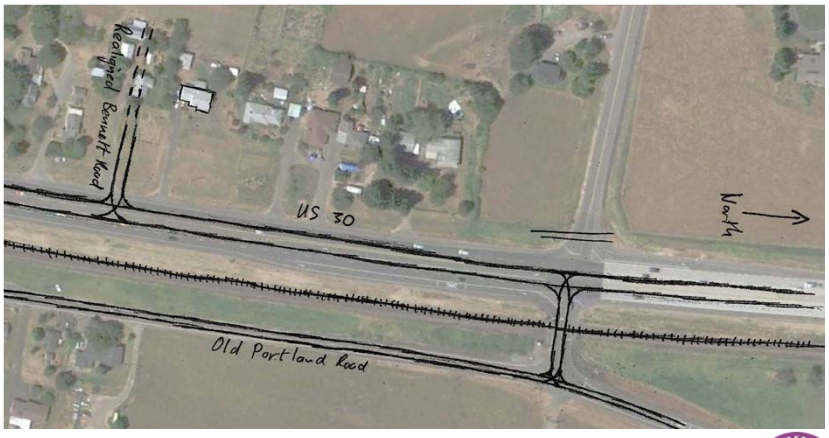
US 30/Bennett Road: Suggestions

- Option 3: Close Railroad Crossing Completely
  - *Improve Old Portland Road railroad crossing*
    - Gated at-grade crossing
    - Re-grade and realign approach to acceptable guidelines
  - *Improve Old Portland Road to accommodate additional traffic*



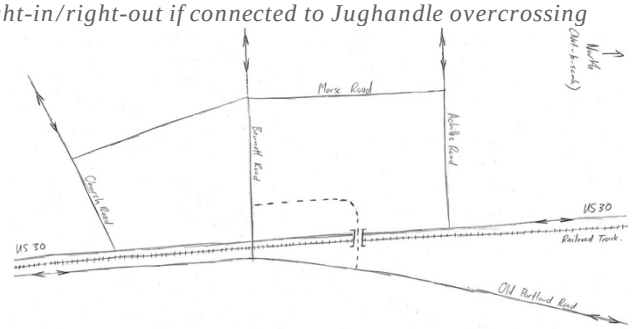
US 30/Bennett Road: Suggestions

- Option 4: Convert to two Offset "T"-Intersections
  - *Two "T"-intersections would allow two-stage side-street left-turns*



US 30/Bennett Road: Suggestions

- Option 5: Jughandle Style Overcrossing with Right-In/Right-Out Movements on US30
  - *In future Church Road and Achilles Road could also be converted to right-in/right-out if connected to Jughandle overcrossing*



*** Options with Turn Movement Restrictions require Modifications to Old Portland Road (including Railroad Crossing) to Accommodate Increased Traffic. ***

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US 30/Berg Road: Observations & Concerns

- Left-Turn Crashes from Berg Road onto US 30
  - *Finding a gap*

- Long Delays for School Buses

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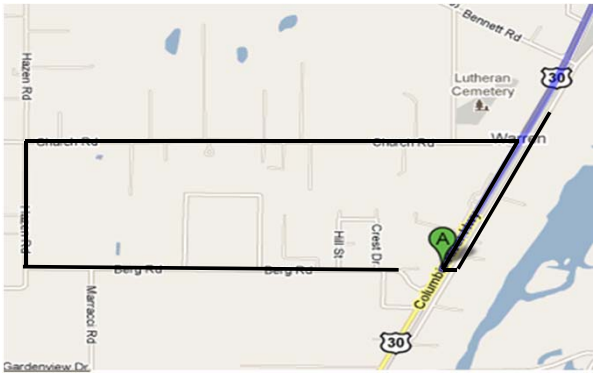
OREGON DEPARTMENT OF TRANSPORTATION

US 30/Berg Road: Suggestions

- Widen Berg Road to Provide Space for Left-Turning and Right-Turning Vehicles at Stop Bar
- Education for Parents and School Bus Drivers regarding Two-Stage Left-Turn Movements

US 30/Berg Road: Suggestions

- Consider Illumination Consider Rerouting School Buses to Avoid Left-turn onto US30
- Evaluate signing and relocate signs to improve visibility of vehicles on US30



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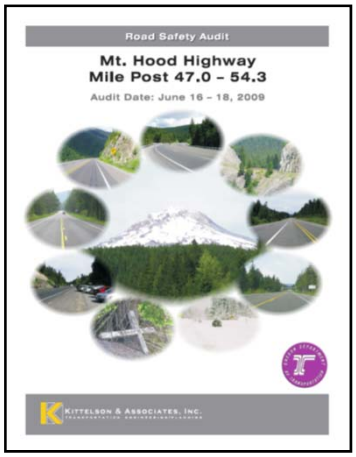
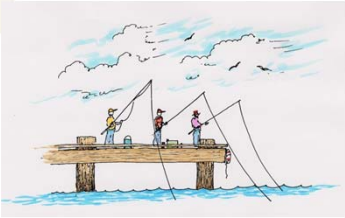
Next Steps

- Complete draft report by week of May 18th
- ODOT Region 1 review (~two weeks)
- Submit final report by mid June
- Feedback to US30 Safety Working Group



Questions/Comments?



Appendix B

Summary of Road Safety Audit (RSA) Findings

The table below indexes all issues identified during the RSA. Those shown in italic are high and medium risk safety issues. This table is formatted to allow ODOT to provide a response to each safety issue. The first three columns of this table are consistent with the RSA Report.

Issue	Location	Suggestion	Agency Response/Comment
Inconsistency between Roadway Character and Speed	*Two-Mile Study Section*	• *Install transverse pavement markings for approximately 200 feet upstream of the reduced posted speed signs. Repeat at each sign approaching the City of St. Helens.* • *Install roadside delineators at increased frequency as posted speed decreases.* • *Install "speed-feedback" signs at the posted speed signs.* • *Install flashing beacons at locations where the speed limit changes.* • *Increase enforcement, consider photo radar enforcement, and/or automated speed enforcement.*	
Roadway Departure Crashes	*Two-Mile Study Section*	• *Install shoulder rumble strips.* • *Install rumble strips along double yellow pavement markings (i.e., in the median next to the striped left-turn lanes).* • *Improve the visibility of the pavement markings (see Issue: Mainline Visibility).*	
Mainline Visibility	*Two-Mile Study Section*	• *Provide yellow lane extension skip striping through intersections to guide minor street left-turn movements.* • *Install recessed or raised pavement reflective pavement markers along the striped median, shoulder/bike lanes, and the lane line striping.* • *Increase the frequency of reflective pavement markers along the left-turn lane to better define the receiving lane for minor street left turns.*	

Issue	Location	Suggestion	Agency Response/Comment
		• *Monitor the quality of the striping reflectivity and at a minimum refresh the median and shoulder/bike lane striping regularly.* • *Consider installing inlaid "Methyl Methacrylate" type pavement markings over black tape.* • *Provide illumination at intersections, where appropriate. Consideration should be given to light transition from dark to light and light to dark.* • *If roadway lighting provided, extend roadway lighting to the south to provide transition from rural to urban conditions.*	
Intersection Visibility	*Intersections within Two-Mile Study Section*	• *Provide delineators (e.g., surface mounted tubular markers) along the intersection curb-returns at approximately 20-foot spacing.* • *Install yellow lane extension skip pavement markings for minor street left-turn movements onto US30.* • *Consistently sign for advancing intersections and intersection locations.* • *Provide illumination at intersections where appropriate. Consideration should be given to light transition from dark to light and light to dark.*	
Minor Street Left-Turn Finding a Gap	*Intersections within Two-Mile Study Section*	• *Install an ITS treatment (e.g., Collision Avoidance System) to help side-street approaches identify gaps.* • *Install yellow flashing beacons to the advanced intersection signs on US30 and red flashing beacons on the minor street stop signs – flashing beacons would activate when vehicles are present.*	

Issue	Location	Suggestion	Agency Response/Comment
		• *Improve visibility of the mainline (see Issue: Mainline Visibility).* • *Improve visibility of the intersections (see Issue: Intersection Visibility).* • *Educate motorists on how to identify gaps in oncoming traffic and how to appropriately use the two-way center turn lane.*	
Driver Workload	Two-Mile Study Section	• Conduct sign inventory and evaluate sign spacing and offsets along the corridor. • Ensure driver sight distance from minor street (including driveways) approaches is not obstructed by signs.	
Driveway Accesses	*Two-Mile Study Section*	• *In the long-term and as opportunities arise; work to consolidate driveways by sharing accesses to the highway.*	
Long-Haul Log- Pole Trucks	*US30/Bennett Road-Old Portland Road Intersection*	• *Continue using rear pilot car operations with the log pole trucks.* • *Consider adding an LED word sign to the back of the rear pilot car to be actuated only when the log pole truck is going to turn. Potential wording for the sign may be, "DO NOT PASS/TRUCK USES ALL LANES".* • *Conduct driver education program targeting local drivers and commuting traffic.*	
Proximity of Railroad Tracks to US30	Two-Mile Study Section	• Provide driver education to inform motorists of the need to keep clear of the railroad tracks. • Install railroad regulatory and warning signs noting the distance between the railroad tracks and the STOP bar.	

Issue	Location	Suggestion	Agency Response/Comment
Public Education/Clarification	*Two-Mile Study Section*	• *Provide educational information to motorists to help them make appropriate and legal turning movements at unsignalized and signalized intersections.* • *Provide education information to motorists regarding the need to stay off of the railroad tracks adjacent to the intersections.* • *Provide educational information to drivers regarding the need to stop for school buses on US30 when the buses are stopped with red lights flashing.*	
Policy Considerations	Two-Mile Study Section	• Provide consolidated areas for mailboxes, waste material containers, and create the necessary pull out areas for vehicles, if possible. • Move school pick-up locations to side streets away from intersections, if possible. • Communicate specific services to road users along the corridor with potential permanent or temporary variable message signs (VMS).	
US30/Millard Road		*Lower Cost Suggestions* • *Increase intensity of flashing beacons and realign beacon heads over through lane approaches.* • *Add marked crosswalks across west leg of the intersection and relocate ADA ramp to the north. Possibly install traversable right-turn channelization island for pedestrian refuge and two-stage crossing.* • *Add illumination for increased pedestrian visibility.* • *Relocate signs on south leg (i.e., northbound approach) to improve sight distance.* • *Investigate appropriate location of eastbound STOP sign; consider increasing the size of the sign.*	

Issue	Location	Suggestion	Agency Response/Comment
		• *Upgrade guide signs to standard letter sizes, locations, and breakaway supports. Upgrade Stop Ahead signs to Stop Ahead symbol signs. Install larger intersection road name plaques under existing "Intersection Ahead" signs.* • *Add Railroad Crossing Ahead legends to northbound right turn lane onto Millard Road, serving the railroad crossing on the east leg of Millard Road near the intersection.* *Higher Cost Suggestions* • *Option 1: Install a traffic signal (when traffic volume warrants are met), standard crosswalk lines, illumination, and upgraded ADA ramps. Realign west leg of intersection to provide better intersection sight distance and visibility. Install "Signal Ahead" signs with flashing beacon in the northbound direction. Install concrete medians along US30.* • *Option 2: Realign east and west legs of Millard Road to create two offset "T" intersections. This option would postpone installing a signal.*	
US30/Bennett Road-Old Portland Road Intersection		*Lower Cost Suggestions* • *Add intersection warning beacons on the advance intersection/rail crossings signs.* • *Install cross-hatch pavement markings on the northbound approach between the through lane and the right-turn lane to increase sight-distance for the westbound left-turn movement.* • *Restripe bicycle lanes to follow the edge of pavement.* *Higher Cost Suggestions* • *Option 1: Install an ITS treatment such as the Collision Avoidance System to help minor street movements find gaps in traffic on US30.*	

Issue	Location	Suggestion	Agency Response/Comment
		• *Option 2: Restrict turn movements at the intersection to Right-In/Right-Out/Left-In and install a J-Hook Style U-turn north of the intersection to serve restricted movements.* • *Option 3: Close the westbound approach (and railroad crossing). Improve Old Portland Road Railroad Crossing further south to serve affected movements.* • *Option 4: Covert the intersection to two offset "T" intersections.* • *Option 5: Install an overpass with jug-handle style connections to allow right-in/right-out connections at Bennett Road-Old Portland Road intersection to US30.*	
US30/Berg Road Intersection		• *Widen Berg Road eastbound approach and increase vehicle storage.* • *Provide information to parents and bus drivers associated with the Warren Elementary School to help them understand how to make a two-stage left turns correctly.* • *Consider illuminating the intersection to improve visibility under lower light and/or inclement weather conditions.* • *Evaluate size and location of signing in the southwest quadrant of the intersection.* • *Consider rerouting school buses to avoid having them turn left onto US30.*	