Section 11 Other County Plans

Plans that provided important information to the TSP Update process

- Transportation Safety Action Plan (TSAP) 2012
- US 26 Mt Hood Rural Safety Audit 2009
- Holly Lane Safety Report 2012
- Beavercreek RSA Report 2012
- Clackamas County Traffic Calming Program (Urban Area Local Streets) 1997
- Intelligent Transportation System Plan(ITS) 2011
- Clackamas Count Vulnerable Population Transportation Study (H#S) 2012
- Clackamas Regional Center Pedestrian/Bicycle Plan (ZDO 238, 2012)
- Sunrise Project FEIS 2010
- Sunrise Project ROD 2011

Plans not being updated as Part of the TSP Update

Transportation

- Clackamas County Airport Plan (ZDO 178, 2001)
- Clackamas County Bicycle Master Plan (ZDO 198, 2003)
- Clackamas County Pedestrian Master Plan (ZDO 198, 2003)
- 172nd / 190th Corridor Management Plan (ZDO 232, 2012)

COMMUNITY AND DESIGN PLANS,

- Sunnyside Corridor Community Plan (ZDO 173, 2000)
- McLoughlin Corridor Design Plan (ZDO 173, 2000)
- Clackamas Regional Center Area Design Plan
- Phillips Creek Greenway Framework Plan
- Clackamas Regional Center Pedestrian/Bicycle Plan (ZDO 238, 2012)

CLACKAMAS COUNTY TRANSPORTATION SAFETY ACTION PLAN

Clackamas County, Oregon

June 2012

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

Clackamas County
Transportation Safety Action Plan

Clackamas County, Oregon

Prepared For:
Clackamas County
Department of Transportation and Development
150 Beavercreek Road
Oregon City, OR 97045
(503) 742-4705

Prepared By:
Kittelson & Associates, Inc.
610 SW Alder, Suite 700
Portland, OR 97205
(503) 228-5230

Project Manager: Nick Foster, A.I.C.P.
Project Principal: Brian Ray, P.E.

With:
Science Applications International Corporation
1001 4th Ave, Suite 2500
Seattle, WA 98154
(573) 356-7520

Project Manager: Brian Chandler, P.E., P.T.O.E.
Project Analysts: Christopher Armstrong, Jennifer Atkinson, P.E

Project No. 11235.0
June 2012

Contributors:

Joseph F. Marek, PE, PTOE
Director, Clackamas Safe Communities Program
503-742-4705
joem@clackamas.us

Patty McMillan
Safe Communities Coordinator
150 Beavercreek Road
Oregon City, OR 97045

All photos courtesy of Clackamas County staff, unless otherwise cited

TABLE OF CONTENTS

Executive Summary

EXECUTIVE SUMMARY

The Clackamas County Transportation Safety Action Plan (TSAP) is one of the first plans to be completed for an Oregon County. This plan outlines a strategy for the County to build and implement a County-wide Safety Culture. Its ultimate goal is to reduce transportation related fatalities and serious injuries by 50% over the next ten years. In order to create this culture and effectively meet the goal, the TSAP employs a 5E's approach, with action items related to engineering, education, enforcement, emergency medical services, and evaluation activities.

This TSAP is derived from larger national and state trends related to reducing fatal and serious injury crashes. Development of the TSAP has been based upon a collaborative effort across County departments including the Department of Transportation and Development, Clackamas County Safe Communities, Clackamas County Sheriff's Office, and the Clackamas County Health, Housing and Human Services Department. The Clackamas County Traffic Safety Commission (TSC), along with the Transportation Maintenance Division and the County Pedestrian and Bicycle Committee staff, supported the plan as an advisory committee. In addition, other key safety partners in the community have been engaged in the process through the Safe Communities Program.

Using a data driven approach based on a detailed review of County wide crash data, a number of emphasis areas have been identified with specific detail and actions for the top three focus areas. These three focus areas are Aggressive Driving, Young Drivers (ages 15-25), and Roadway Departure crashes. For each focus area, a description of the issue and countermeasures are discussed incorporating the 5E approach.

Looking towards the future, integration of the Highway Safety Manual is an important element of evolving safety technology for the County. The need for a robust roadway data inventory system and a data driven focus requiring integration and analysis of a variety of data sources is discussed. These data sources include crashes, emergency calls, patient transport data, patient outcome data, liquor sales, and citations, just to name a few.

Moving the plan forward includes a series of policy directions and action items focused on short term (1-2 years), mid-term (3-5 years) and long term (6+ years). These policies and action items will guide the County by laying the ground work for reducing fatality and serious injury crashes and building a County-wide Safety Culture.

Part 1: Overview and Background

PART 1: OVERVIEW AND BACKGROUND

Fatalities due to vehicle crashes in the United States dropped to 32,788 in 2010, the lowest rate since 1949. The steady decline in traffic fatalities can in part be attributed to include safer vehicles and national efforts to improve transportation safety, including the federal surface transportation authorization act, known as the Safe Accountable Flexible Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU). With SAFETEA-LU, safety was identified as a stand-alone program, with funding coming through the Highway Safety Improvement Program (HSIP). A critical aspect of the HSIP is the requirement that states draft a Strategic Highway Safety Plan (SHSP); thereby supporting the national directive emphasizing the importance of strategic planning in reducing the number of transportation-related fatalities. More recently, the Federal Highway Administration (FHWA) determined there should be a national strategy for reducing the number deaths on America's roads. This strategy is founded on the idea that even one death on the nation's roads is too many and is thus named *Toward Zero Deaths: A National Strategy on Highway Safety* (http://safety.fhwa.dot.gov/tzd/). National Cooperative Highway Research Program (NCHRP) Project 17-51 is developing this strategy, which is slated for completion later in 2012.

Oregon has long been a leader in transportation safety through the Oregon Department of Transportation (ODOT) Transportation Safety Division. ODOT has developed its own Transportation Safety Action Plan (TSAP) which satisfies the HSIP requirements for a SHSP. The Oregon TSAP encourages local agencies to integrate safety into their planning efforts and this is affirmed in Oregon Administrative Rule 660.012, the Transportation Planning Rule.

METRO, the Portland area regional government, is currently developing a Transportation Safety Action Plan in cooperation with ODOT and its regional partners with anticipated adoption in the summer of 2012. This plan will build upon the statewide plan, taking into account lands within the Urban Growth Boundary (UGB), and will identify general safety trends for local agencies to consider as they embark upon their own TSAP's.

Clackamas County has made a commitment to transportation safety for all modes of travel and this TSAP represents one of the key first steps towards that goal. This TSAP is derived from larger state and national trends and positions Clackamas County to be a leader in transportation safety. It is the product of a collaborative effort across County departments including the Department of Transportation and Development, Clackamas County Safe Communities, Clackamas County Transportation Maintenance Division, Clackamas County Sheriff's Office and the Clackamas County Health, Housing and Human

Services Department. The Clackamas County Traffic Safety Commission (TSC), supplemented by the Clackamas County Pedestrian and Bicycle Committee staff, supported the plan as a public advisory committee. Collectively, their insights and knowledge are supplemented by a survey of County staff and other key safety partners, as well as analysis results of crash and roadway data (see Appendix “B”).

INTRODUCTION

Clackamas County is one of the largest counties in the northwestern part of the State of Oregon containing 1,879 square miles in the northern Willamette Valley. A network of 1,400 miles of County maintained roads provides access for approximately 376,000 residents (Reference 1). Terrain in the southern part of the County is relatively flat with mountainous terrain and higher elevations in the far eastern portion. Traffic crashes are the number one cause of death in the county for individuals ages 5 to 34 (Reference 2). Clackamas County is working to improve the transportation system for the traveling public by implementing innovative strategies to reduce fatal and serious injury crashes and partnering with other agencies within the County and State.

Terrain and conditions vary widely across Clackamas County

Between 2005 and 2009, 160 people were killed in vehicular crashes in Clackamas County. These deaths were not from natural occurrences and, by and large, were potentially avoidable. As stewards of the transportation system, the County is making transportation safety a top priority.

The Clackamas County TSAP outlines a strategy for the County to build and implement a County-wide Safety Culture with the ultimate goal of reducing transportation related injuries and fatalities. Policy and action items set forth in the plan, when implemented, will achieve the desired goals; however, successful implementation depends upon a number of factors, including strong safety leadership at all levels, cohesive safety partnerships, funding, and working together toward a common goal. Success will result in reduced injuries and fatalities on roadways within the County.

TSAP DEVELOPMENT PROCESS

The County TSAP came about from a goal of the Safe Communities Program to reduce injuries and fatalities in Clackamas County and a grant funding opportunity from the Oregon Department of Transportation - Transportation Safety Division. County Engineering and Safe Communities staff were intrigued with the state TSAP and saw the opportunity to develop a similar plan at the county level. The County's Transportation System Plan (TSP) update was recently underway, so the timing was optimal to undertake a TSAP and adopt it into the TSP document. All of the work for the TSAP has been accomplished through a collaborative process with the support of the Safe Communities Advisory Board and the Traffic Safety Commission as the Public Advisory Committee. In addition, the diversity of the plan is the result of input from our safety partners, including the Clackamas County Sheriff's Office, Clackamas County Health, Housing and Human Services, Oregon Impact, American Medical Response, Clackamas County Fire District #1, Estacada Fire District #69, Alliance for Community Traffic Safety, Clackamas 9-1-1 and OHSU Think First. The state of the existing Safety Culture in the County was queried via a survey that was distributed to our safety partners (see Appendix "E").

GOAL AND OBJECTIVES

The County's primary goal for transportation safety is as follows:

> *As part of initiating a Safety Culture, the County will work collaboratively with state, regional, and local agencies and County residents to reduce the number of fatalities and serious injuries on roadways in Clackamas County by* ***one-half*** *in the next 10 years. Based on the 2005-2009 average number of fatalities and serious injuries due to crashes, this corresponds to saving 16 lives and preventing 125 serious injuries annually at the completion of the program.*

Fulfillment of this goal is illustrated in Figure 1 and shows the reduction in the rate of fatalities and serious injuries in the next ten years.

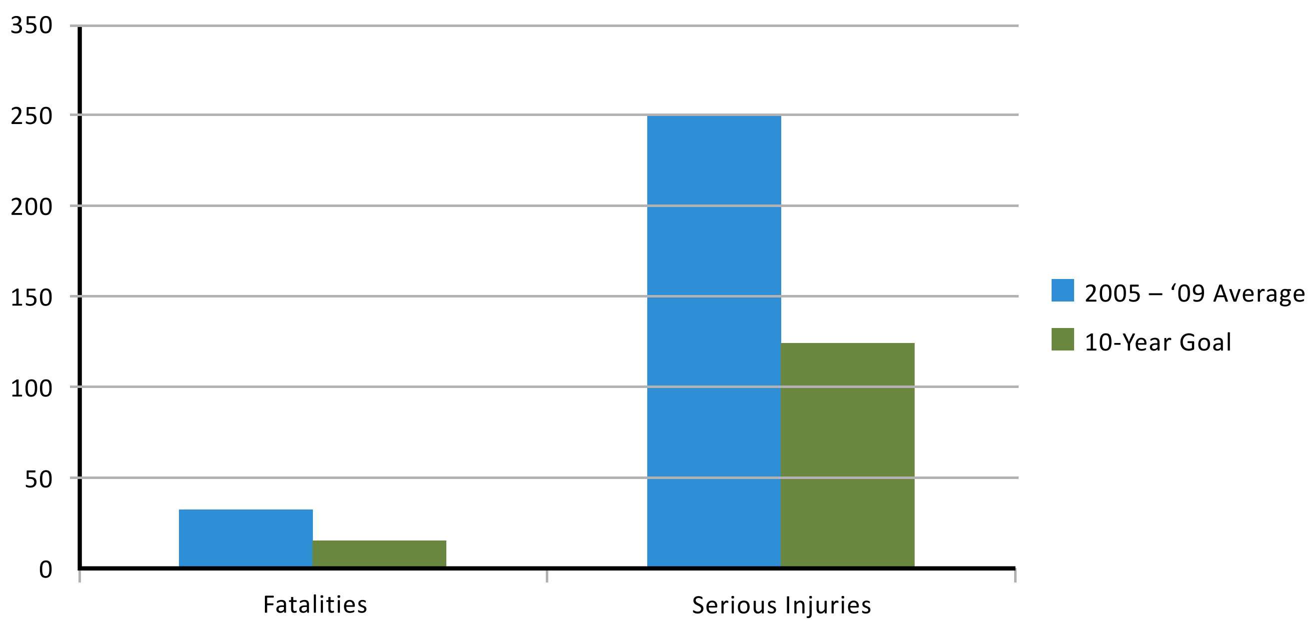
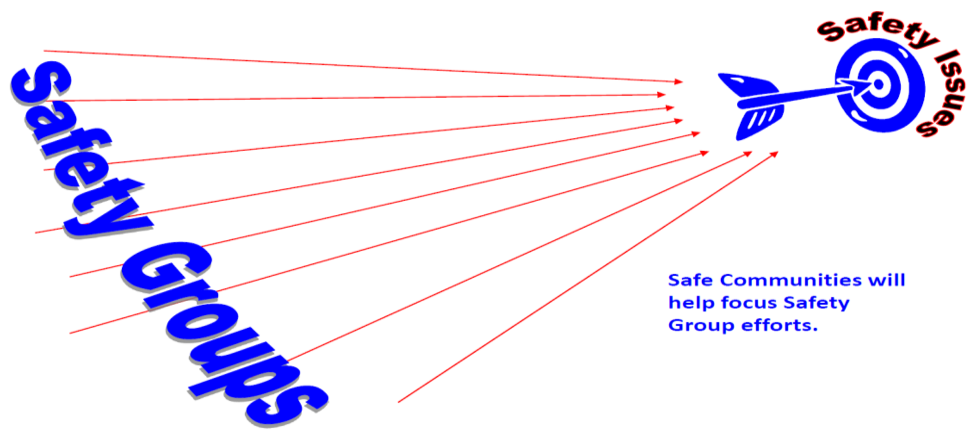


Figure 1 Impact of County's 10-Year Goal

THE COUNTY'S OVERALL OBJECTIVES FOR SAFETY ARE AS FOLLOWS:

1. **Setting the standard and foundation for developing a Safety Culture in Clackamas County.** Simply put, "Lead by Example!" To successfully build a Safety Culture within the County, staff and elected officials must lead the way through their actions, regulations, policies and practices at all levels. Recognizing that this is an iterative process accomplished through partnering and spreading the message, the County is ready to take up this task.

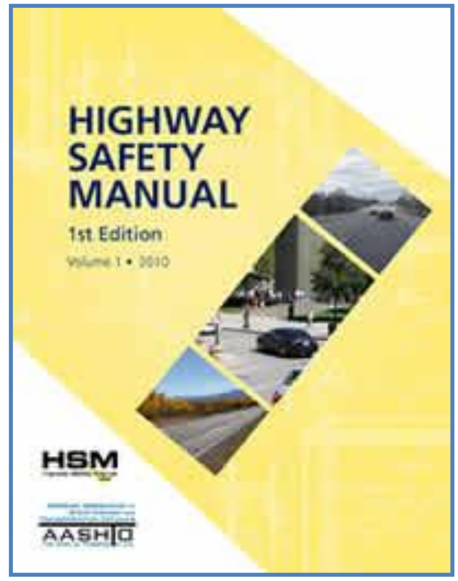
2. **Aligning County departments and external safety groups to work toward common state, regional, county, and city safety goals**. Using mutually beneficial partnerships, such as the work of the Safe Communities Program, over the past seven years, the safety community within the County has been able to better focus its efforts and better coordinate resources towards common goals. In other words, collective groups have become more aligned. This movement has been a grass roots effort percolating from the staff and community level and it has started to draw the attention of policy and decision makers. Continued growth depends on decision and policy makers elevating safety in their planning processes. The result will be increased coordination and partnerships coupled with policies, standards and directional focus strongly rooted around safety.



Safe Communities Helps Align Safety Related Groups

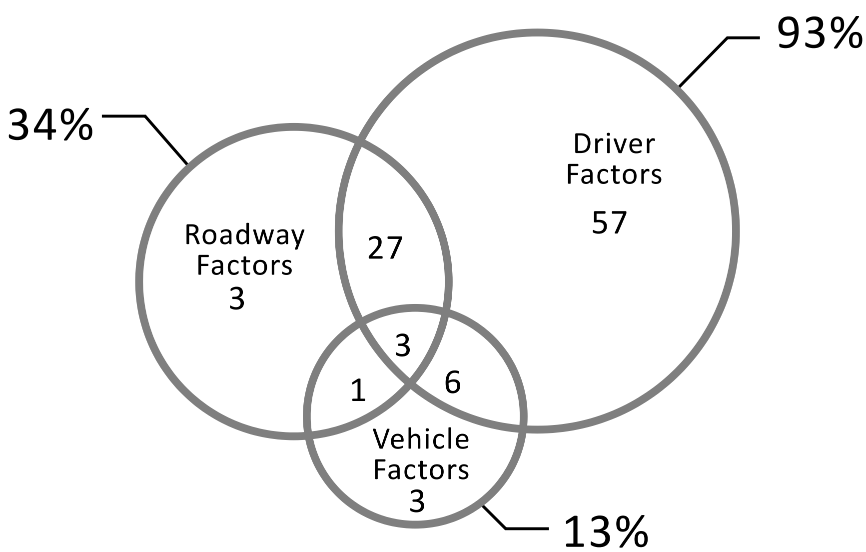
3. **Integrating roadway, safety, and traffic data management sources.** Success in building a Safety Culture and ultimately reducing fatal and injury crashes depends on a data driven approach to help us understand and diagnose the issues and potential solutions as well as to shape policy and justify expenditures. Data availability, integration, and mapping capabilities have changed exponentially over the past ten years. What was not possible just a few years ago is now easily accomplished. With these advances, our ability to tell the safety story has been greatly improved. Examples such as mapping multiple data fields such as crash types and cause factors allows decision makers and the public to understand and relate to the safety of the system which, correspondingly, helps them to understand and support various safety efforts.

4. **Integrating HSM principles.** The publication of the First Edition of the *Highway Safety Manual* (HSM) (Reference 3) set the stage for developing a robust and comprehensive safety assessment and mitigation process. As full implementation of the manual occurs over the next several years, safety will change from what has often been a subjective and reactive assessment to a more objective, quantitative, and proactive process. As the need for justification of investments increases, the HSM provides the tools to measure the success of our current investments and anticipate safety solutions needed in the future.



INTRODUCTION TO THE 5E APPROACH TO SAFETY

Motor vehicle crashes generally involve multiple contributing factors, which may be related to drivers, the roadway, or the vehicle, thus making transportation safety a multidisciplinary concern (Figure 2). The contributing factors that relate to roadway elements are about one third of those related to those of the driver. This means we cannot "engineer" our way to safety and education and enforcement must be integrated into a Safety Culture and strategy.



Source: Treat 1979

Figure 2 ***Contributing Factors to Crashes***

The County's goal cannot be achieved by one agency working alone. Accomplishing our safety goals requires a collaborative approach that draws from several key areas associated with traffic safety, which are shown in Figure 3 and listed here (in alphabetical order):

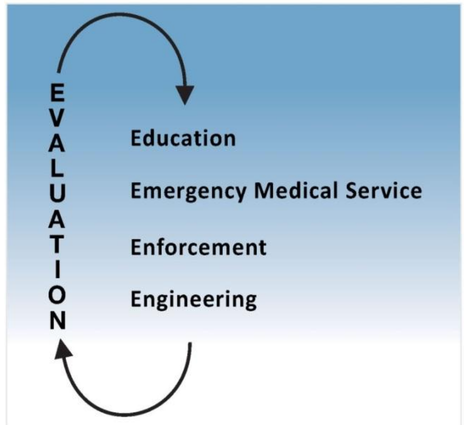


Figure 3 The 5E's

- **Education –** States and cities incorporating strong educational components report declines in fatality rates (Reference 4). Effective prevention education programs typically include some combination of knowledge content, social norming, personal commitment, and resistance skill strategies (Reference 5).
- **Emergency Medical Service (EMS) –** EMS provides the last opportunity to improve health outcomes from motor vehicle crashes and other medical emergencies. EMS data is highly reliable and valuable to crash analysis.
- **Enforcement –** Law enforcement affects behavior changes to transportation system users through enforcement, education, and incarceration.
- **Engineering –** Engineering includes designing, constructing, operating, and maintaining transportation facilities.
- **Evaluation –** This ties the other four elements together by measuring the success (effect in improving safety and cost effectiveness) of implemented solutions and deploying new solutions to address evolving needs.

The 5E's of safety are represented in the broad stakeholder groups who are responsible for making the roads safe for all users and will be covered in depth in Part II.

CURRENT SAFETY CULTURE

Policy documents, organizational relationships, and data management are all components of the County's current safety organization, and these individual components build upon each other to establish a Safety Culture.

PLANS AND POLICY DOCUMENTS

The County's current safety work is guided by a number of plans and policy documents. These documents and their relationship are discussed below.

COMPREHENSIVE PLAN

Clackamas County's Comprehensive Plan is the overarching planning policy document for the County. A proposed section on transportation safety is included herein as Appendix "A." This appendix also includes recommendations for refining safety related language in other sections of the comprehensive plan.

Transportation System Plan

The Transportation System Plan (TSP) is the County's long-range plan for its transportation system and makes up Chapter 5 of the Comprehensive Plan. At the writing of the TSAP, the 2000 TSP is being updated. The entirety of the TSAP will be incorporated into the TSP through reference and then specific components such as livability, health, and community will also be included. The TSAP will also be used to inform the TSP update.

Location-Specific Plans

Location-specific plans provide a detailed look at a specific area. These documents often include in-depth crash data review and specific improvement recommendations. The types of safety analyses performed for these plans are currently guided by existing practices. The TSAP concepts will inform and guide future studies, including improved analysis procedures and countermeasure recommendations.

Photo Courtesy of South Metro Area Regional Transit

County Code

Chapter 7.03 of the County Code addresses road use impediments and other activities within the County Road rights-of-way. This document provides enforcement authority to address a variety of safety issues within public rights-of-way, such as clear zone issues, fixed objects, vegetation and debris in the road.

SAFETY ORGANIZATIONS AND GROUPS

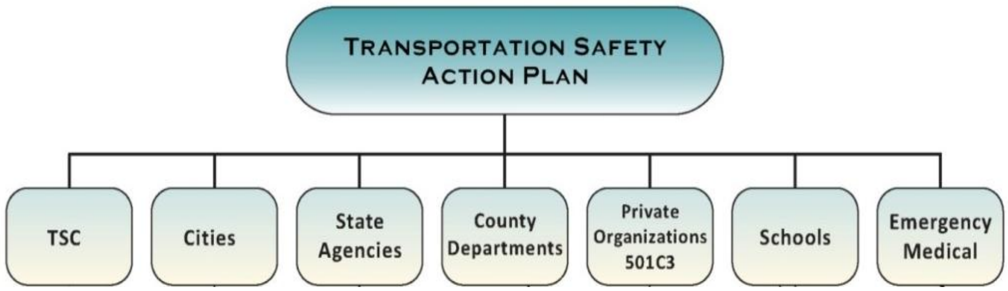


Figure 4 TSAP Implementation Groups

Improving transportation safety in Clackamas County requires the efforts of many County departments and multiple safety groups. These efforts include the work of elected officials, County departments, citizen groups, other public agencies, non-profit groups, and business partners. Organizations and groups referenced in this document currently provide support to the Safe Communities Program and do not represent every safety agency (Figure 4). As the Safety Culture grows, we anticipate more partnerships will be identified.

COUNTY DEPARTMENTS

Transportation Engineering Division (www.Clackamas.us/Transportation)

Clackamas County's Transportation Engineering Division is directly responsible for engineering related to the safety, design, operations, and maintenance of 1,400 miles of County owned roads and 5,900 intersections. Historically, the County has taken an adaptive approach to respond to crash locations. In the future, the County will be able to expand to proactive strategies and methodologies to reduce crash risk. Traffic engineering is currently undertaking the following activities to reduce crashes:

- *Safety Priority Index System (SPIS) List* – The County develops an annual list of priority high-crash roadway segments and intersections. SPIS is a composite formula of crash frequency (25%), crash rate (25%), and crash severity (50%).
- *Safety Corridor Program* – The County has a Safety Corridor program that targets up to two high crash or high severity corridors at any one time. The Traffic Safety Commission assists with

recommending Safety Corridors, and the Board of County Commissioners adopts the selected corridors. Road Safety Audits are conducted and recommendations are implemented.

- *Safety Projects* – County staff plan, design, and construct roadway projects in an effort to reduce crashes for the various users of the roadway system.
- *Service Requests* – The County responds to citizen comments by reviewing the area, analyzing the situation, and considering solutions.
- *Safety Reviews/Audits* –County staff conducts a field and crash data review of a specific roadway corridor and develops and implements safety improvements.
- *Incident Response Traffic Control* – County staff respond to traffic crashes and other on-road incidents by providing traffic control to allow emergency medical services and other first responder groups to work safely at the incident.
- *Intelligent Transportation Systems (ITS)* – This program focuses on the safety, operations, and management of the roadway system with a strong focus on traffic signal systems using sensors, communications, control, and electronics, and data management.
- *Development Review* – Development review encompasses the review and approval process for land development pursuant to the Clackamas County Zoning and Development Ordinance. Proposed land use actions are reviewed relative to safety criteria, and mitigation of safety issues are recommended by Staff.
- *Clackamas Safe Communities Program* – This program has a mission to ***"Reduce Injuries and Fatalities in Clackamas County."*** It strives to be the nexus that brings a diverse group of safety advocates together for a common mission. The program develops, oversees, and coordinates several educational efforts; obtains funding for special projects; and liaises with emergency medical service providers; thereby providing a critical link between engineering and the other E's. (http://clackamassafecommunities.org/index.cfm)
- *Clackamas County Traffic Safety Commission (TSC)* – The TSC was formed in 1980 and is one of the longest continuously operating traffic safety commissions in Oregon. The TSC gives the citizens of Clackamas County a forum to voice traffic safety concerns, evaluate related issues, interact with County agencies, and promote traffic safety. The TSC represents Clackamas County citizens on road safety topics to the County Traffic Engineering department. It also evaluates safety topics and works to educate County residents through its annual safety fair and other activities.

Low Cost Engineering Example

Canby-Marquam Highway and Barnards Road - This intersection was the #1 Safety Priority Index System (SPIS) site in the county. Converting the intersection from 2-way stop-control to all-way stop control cost approximately $1,500.

*In 2008, Canby Marquam Highway and Barnards Roads was the county's **#1** safety site. In 2009, after an engineering treatment costing less than $2,000, the site is no longer on the list!*

Transportation Maintenance Division (www.Clackamas.us/Roads)

Clackamas County's Transportation Maintenance Division is responsible for operating and maintaining the County's 1,400 mile transportation system. Their primary role is to ensure the safety of the system through:

- Traffic sign and pavement marking maintenance
- Traffic signal maintenance
- Guardrail installation and maintenance
- Vegetation management
- Roadway maintenance including surface, shoulders and drainage
- Roadway Data Management

Flood Damage Closes Lolo Pass Road

Road Safety Audit Example

Wilsonville Road Safety Assessment – County evaluated a 4.5 mile stretch of Wilsonville Road to examine ways to reduce run off the road incidents. County staff reviewed signing, pavement markings, guardrail, and vegetation and implemented a plan to improve the roadway visibility in a low cost manner.

Chevron Signs and Reflective Markings Improve Visibility on Wilsonville Road

Sheriff's Office - (www.clackamas.us/sheriff/)

The Sheriff's Office motto is ***"Working Together to Make a Difference."*** The department has demonstrated their commitment to traffic safety by:

Sheriff's Office Traffic Unit on Patrol

- Efficiently responding to and investigating crashes
- Deploying a highly functional traffic unit to address citizen complaints, work zone needs, and high crash locations
- Incorporating technology such as E-Ticketing to enhance data collection and staff efficiencies
- Partnering on enhanced enforcement details, such as alcohol compliance operations, impaired driving patrols, and seat belt compliance
- Participating in local community forums, safety fairs and school presentations
- Participating on the Safe Communities Advisory Board

Health, Housing and Human Services (H3S) – Prevention Coalition (www.clackamas.us/dhs/)

The mission of the Health, Housing and Human Services (H3S) Department is to ***"promote and assist individuals, families and communities to be safe, healthy and thrive."*** The department has demonstrated their commitment to traffic safety by:

- Working with youth about the consequences of alcohol and drug use
- Funding for Drug Recognition Expert (DRE) training for law enforcement personnel
- Funding enforcement and educational activities, such as Alcohol Compliance Details and Sticker Shock campaigns
- Supporting and funding publications targeting risks associated with distracted driving, speed, and impairment
- Participating in local community forums, safety fairs and after school programs
- Participating on the Safe Communities Advisory Board

"Sticker Shock" Window Cling

Clackamas County Communications (C-COM) - (http://clackamas911.org/)

C-COM provides 9-1-1 emergency and non-emergency call taking and dispatch service to the public. The department supports traffic safety by:

- Providing highly reliable crash and impaired driving data
- Educating citizens how to access emergency services via the 9-1-1 system
- Participating in local community forums, safety fairs and school programs

C-COM Educational Booth

EXTERNAL SAFETY ORGANIZATIONS

Emergency Service Providers (http://www.clackamas.us/community_health/)

Emergency Service providers include first responders from fire districts, the Life Flight network and transport agencies. Representatives from Clackamas Fire District #1, Estacada Fire District #69 and American Medical Response participate on the Safe Communities Advisory Board.

Clackamas Fire District #1 On-Scene at a Crash

These organizations have demonstrated their commitment to traffic safety by:

- Efficiently responding to crashes
- Providing transport data
- Participating in local community forums, safety fairs and school presentations

Crash Reenactment at a Local High School

Oregon Impact – (www.OregonImpact.org/)

Oregon Impact provides community education, prevention and awareness activities to stop individuals from driving under the influence of intoxicants or driving distracted. The 501C3 supports traffic safety by:

- Administrating impact panels for citizens remanded to the driving under the influence diversion program
- Providing educational activities such as the Every 15 Minutes program and guest speakers for school assemblies
- Supporting driver education programs locally and statewide
- Participating on the Safe Communities Advisory Board

Oregon Impact Trailer

Alliance for Community Traffic Safety (ACTS) Oregon - (www.actsoregon.org/)

ACTS Oregon's mission is **"to reduce fatalities, injuries and the severity of injuries resulting from vehicle crashes throughout Oregon."** The agency supports traffic safety by:

- Facilitating Building Safer Communities and Safe Routes to School mini grants
- Certifying child passenger safety technicians
- Supporting child passenger safety seat clinics, safety fairs and school programs
- Creating educational materials including a monthly newsletter focused on traffic safety best practices
- Participating on the Safe Communities Advisory Board

ThinkFirstOregon - (www.ohsu.edu/xd/outreach/programs/thinkfirst//)

- The mission of ThinkFirst is **"to reduce the incidence of brain, spinal cord, and other traumatic injuries and fatalities by providing education to youth, parents, and community members throughout Oregon."** The agency supports traffic safety by:
  - Selling helmets at a reduced cost for low income populations and ensuring all helmets are fitted properly
  - Organizing school activities focused on preventing traumatic injury
  - Targeting education to populations who are at risk for brain/spinal cord injury such as bicyclists, skateboarders, and skiers

The MAX Green Line opened in 2009 introducing light rail into Clackamas County - Photo courtesy of TriMet

COUNTY TRANSIT

Several bus transit systems provide local citizen transportation within the County in the form of bus, small transit vehicle, and light-rail. TriMet is the major transit provider; however, their service district does not include the entire County. For those areas not within TriMet's service district, smaller transit agencies provide service, including South Clackamas Transportation District between Molalla and Clackamas Community College; Canby Area Transit (CAT) connecting Canby to Oregon City; Sandy Area Metro (SAM) connecting Sandy to Gresham; and South Metro Area Regional Transit (SMART) serving the Wilsonville area. TriMet has a tri-county Safety Education Advisory Committee (SEAC) to help strengthen community presence and promotion of safety programs and services for pedestrians, bicyclists and motor vehicles around buses and trains.

Photo Courtesy of Sandy Area Metro (SAM)

Data Management

Successful implementation of the TSAP relies on a data-driven approach. Currently the County primarily utilizes crash data. Additional datasets are becoming available, but integration of the datasets has not yet occurred.

Current projects include designing a data integration platform to integrate existing and future datasets. An integrated platform would support the County's ability to more efficiently address transportation needs. Increasingly, this data is geocoded allowing easy map making to clearly display information. Geocoded data supports efficient geospatial analysis to monitor trends and system performance.

Current datasets available to support the TSAP include:

- Oregon Department of Transportation (ODOT) crash data
- 9-1-1 calls for service and response data
- American Medical Response transport data

This page is intentionally blank.

Part 2: Transportation Safety Action Plan

PART 2: TRANSPORTATION SAFETY ACTION PLAN

The Clackamas County Transportation Safety Action Plan (TSAP) proposes the framework for a County-wide Safety Culture through a close examination of the 5E approach to transportation safety, detailed crash data, and key emphases areas for crash reduction. The TSAP provides action items related to specific contributing factors identified from existing crash data and identifies programmatic measures and recommendations for moving the plan forward.

SAFETY DATA

Quality data and analysis techniques are fundamental to effectively identifying locations for potential improvements and countermeasures to reduce the frequency and severity of crashes. The TSAP is founded upon, and guided by, quantitative safety data obtained from crash reports and roadway information. For this first version of the TSAP, crash reports are the primary source of data due to their availability. Results of the safety data analysis will provide focus for current and future engineering, enforcement, emergency medical and education efforts while presenting opportunities to further integrate new data sources. In addition to near-term opportunities, the crash data helps identify near, mid, and long-term enhancements to the County's roadway safety management program efforts. Presently, the County uses crash data reactively; however, in the future as their roadway safety management approach evolves, the County will be able to apply proactive strategies, methods, and tools to reduce the future potential of crash risk.

ACCOUNTING FOR CRASH RANDOMNESS

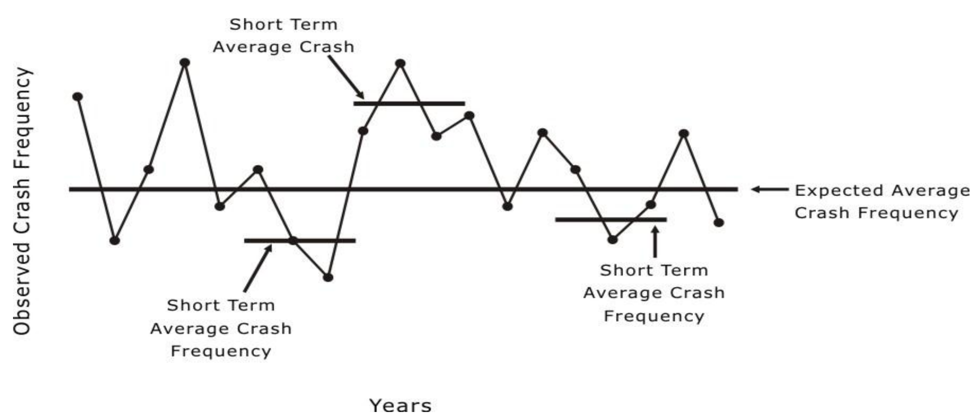
Clackamas County currently uses an adaptive approach to roadway safety assessments by reviewing past data and identifying strategies to counter documented incidents. This approach is based on information derived from the Safety Priority Index System (SPIS). SPIS uses multiple factors to prioritize crash locations; however, it does not adequately account for the randomness of crash locations. While certain physical conditions may make an intersection or road segment more prone to crashes (e.g., sharp curves, busy driveways, etc…), actual crash events are based largely on human factors, frequently combined with physical and vehicular conditions; thus, the location of crash events is largely random. The random nature of crashes can skew crash data (Figure 5) causing priority locations to vary widely from one year to the next. The SPIS analysis may identify locations where there is no physical deficiency because of a random one-time event (e.g., DUI crash involving multiple fatalities on a low-volume road would skew the crash rate and severity components of the SPIS). The SPIS does not account for crash randomness. The Highway Safety Manual (HSM) describes new tools and methods to consider and evaluate safety performance, accounting for the randomness, and helps an agency develop strategic and cost effective safety countermeasures.

CRASH DATA – LIMITATIONS AT THE COUNTY LEVEL

The TSAP is primarily focused on fatal and severe injury (i.e. Level A) crashes. While Clackamas County is one of the largest counties in northwest Oregon in geographic area and population, there is a limited amount of crash data from which to draw statistical conclusions. This is consistent in all but the largest counties in the country. It is not clear how Oregon's citizen crash reporting affects the crash data. These factors should be considered when drawing conclusions from the data.

The crash and roadway inventory databases are not linked together, which represents an opportunity to potentially link and correlate roadway, traffic, and crash data, as will be discussed later in this plan.

Figure 5 The random nature of crashes results in short-term spikes and valleys.



Source: Highway Safety Manual, 1st Edition

CRASH REPORTING IN OREGON

Oregon, unlike most other states, collects non-injury crash reports predominantly from citizens. This potentially affects the quantity of the crash reports compared with states that have only law enforcement reporting. Previous studies have indicated the number of non-injury crash reports in Oregon may be lower than would be expected in a state with similar transportation-related demographics (e.g., population, vehicles miles traveled (VMT), and severe roadway departure crashes) (Reference 4).

It is common to want to compare crash rates across counties around the nation. However, it is difficult to compare Clackamas County crash rates with data from other states because the rates in Clackamas County may be lower due to Oregon's reliance on citizen reporting. This could also affect the quality of reports and mask some crash patterns. It similarly affects severity percentage comparisons with other states (i.e., the number of fatalities and/or injuries per crash), making this value higher than most other jurisdictions around the country, because the value in the denominator (total crashes) does not capture all property damage only (PDO) crashes that occurred. This means comparisons to other states could potentially lead to over-focusing resources at unwarranted locations or crash types. These factors support Clackamas County using a county-specific, data driven safety evaluation process to guide safety decisions.

ROADWAY INVENTORY DATA

Clackamas County has an extensive roadway data inventory system. It is rare for a county-level data system to include the quantity and quality of roadway information found in Clackamas County's Roadway Infrastructure Management Systems (RIMS). The following features, among others, are available for Clackamas County-maintained roads:

- Number of Lanes
- Road History
- Shoulder Types
- Shoulder widths
- Surface Types
- Surface Widths
- Traffic Signs
- Average Daily Traffic (ADT) values
- Functional Class
- Guardrail
- Intersections
- Median Type and Widths

THE 5E APPROACH TO CRASH REDUCTION

Part 1 provided an introduction to the 5E approach for addressing transportation safety. This section will further explore the 5E approach and provide some examples of how it can be used to affect transportation safety.

Education – As was previously shown, human factors contribute to 93% of crashes. States and cities that conduct strong educational components report declines in fatality rates (Reference 5). Through education, users of the transportation system learn about traffic laws and become more aware of how their behavior contributes to safety. Effective prevention education programs typically include a combination of knowledge content, social norming, personal commitment, and resistance skill strategies. They may also include high intensity media campaigns combined with school education programs and/or other community level interventions (Reference 6). Repeated exposure to educational messages is critical. The National Cancer Institute suggests a minimum of five to eight exposures before individuals take action (Reference 7).

Examples of Safe Communities educational programs include:

- Young driver education presentations and contests serving hundreds of high school students each year
- Fleet vehicle wraps with safety messages
- Traffic signal cabinet safety message program
- Safety Street educational driving course serving thousands of children each year
- Coloring and activity books focused on pedestrian, bike and motor safety distributed at safety events and in local libraries at no charge
- Safety Fairs promoting safety through a number of informational booths, displays, and interactive activities

Vehicle Wraps on County Fleet Vehicles Turn Them into Portable Safety Announcements

Signal Cabinets Remind Drivers of Desirable Behaviors

Emergency Medical Service (EMS) - EMS provides the last opportunity to improve health outcomes from transportation related crashes and other medical emergencies. EMS is provided by a highly organized system that ensures prompt notification of the location and severity of the crash, timely dispatch of trained emergency care providers, use of evidence-based treatment protocols and triage to an appropriate health care facility. The overall risk of death is 25-percent lower when care is provided at a Level I Trauma Center than when it is provided at a non-trauma center. Counties with coordinated systems for trauma care have been shown to have crash fatality rates as much as 50% lower than counties without trauma systems. Supporting a well-functioning EMS system and engaging the State EMS Office are key strategies for reducing highway fatalities and serious injuries on all public roads (Reference 8). The Emergency Medical Services Council serves as an advisory committee for the Board of County Commissioners regarding EMS activities such as:

- System enhancement and protocol development
- EMS equipment and training recommendations
- 9-1-1 dispatch coordination
- System quality improvement

Enforcement - High-visibility enforcement can create a significant deterrent to violation of laws. Research shows even well-planned public awareness and education campaigns that promote traffic safety do not succeed without targeted enforcement. Likewise, without the community's support and a corresponding publicity component, law enforcement efforts tend to fall short. There must be a unified effort between traffic safety advocates and law enforcement agencies for any campaign to articulate its message effectively (Reference 9).

Outreach is One Way Enforcement Groups Seek to Improve Transportation Safety

Examples of enforcement activities include:

- Enhanced enforcement (e.g. impaired driving saturation patrols, safety corridors, speed complaints, and work zones)
- Alcohol sales compliance details which partner law enforcement personnel and Oregon Liquor Control Commission inspectors. These operations reduce youth access to alcohol by enforcing vendor compliance.
- Safety Fairs where law enforcement partners provide outreach and education to the community

"Wow, thanks for letting us have that radar sign for so long here on Burma Road. It truly made a difference." Debbie Thomas – 2009

Engineering – The role of engineering includes the designing, constructing, operating, and maintaining the transportation infrastructure system to meet the needs of citizens through capital improvement projects, development review, and administration of road statutes. Examples of efforts related to transportation safety include:

- Evaluating citizen issues related to safety
- Operating the 1,400 mile system, including traffic signals, signing, pavement markings, roadside shoulders, and pavement surface.
- Developing the transportation safety action plan
- Deploying radar reader signs that display speeds to drivers
- Conducting road safety audits and transportation safety assessments
- Evaluating road system evaluations and developing safety priority lists
- Managing the Safety Corridor Program
- **Evaluation –** Conducting assessments is an integral part of program implementation. Crash data serves as one evaluation tool. Safety professionals from education, enforcement, engineering, and emergency medical service program also provide assessments and evaluations. This feedback element helps assess if implemented solutions are providing the anticipated outcomes.

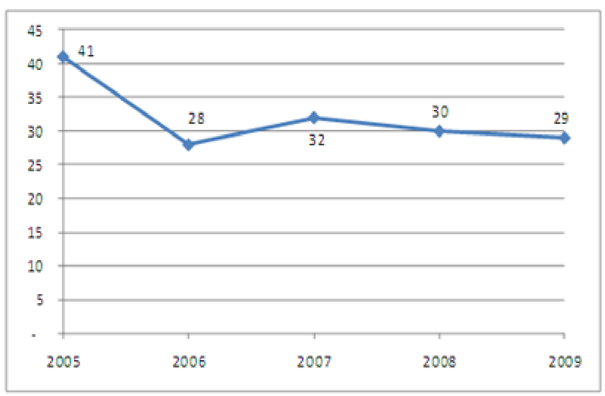
GENERAL COUNTY CRASH TRENDS

The average annual number of roadway crashes was approximately 3,900 on all roadways within the County from 2005 through 2009. Figure 6 shows the highest number of traffic fatalities in this period occurred in 2005 at 41, but leveled over the next four years to about 30 per year on all roads.

The crash data review focused on 2005-2009 annual crash data, the most recent five years of available data from ODOT at the time of this analysis. The review considered reported crashes on:

- All roadways within Clackamas County regardless of jurisdiction
- County maintained roadways and intersections
- Analyzing crashes on County maintained roadways and intersections helps identify areas the County might improve through a complete 5E approach, as it can implement engineering projects and enforcement on its roadways. Reviewing all crashes on all road types can help the County identify behavior modification activities, such as education outreach that affect drivers on all roads in the County. In addition, this approach helps direct where to look for opportunities to collaborate with other agencies (i.e. ODOT and cities) to reduce crashes in the County regardless of road ownership. A complete summary of the crash data analysis can be found in Appendix “B.”

Figure 6 Traffic Fatalities per Year on All Clackamas County Roads



SAFETY EMPHASIS AREAS & PROPOSED COUNTERMEASURES

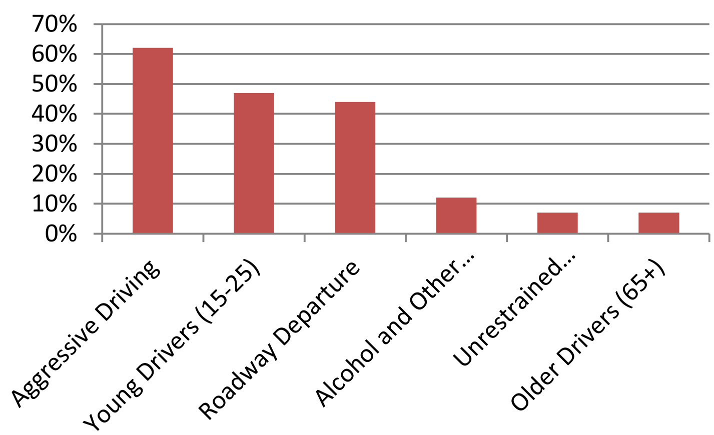
The most frequently occurring contributing circumstances by percentage to Clackamas County traffic crashes are:

- Aggressive driving
- Young drivers (ages 15-25)
- Roadway departure crashes, including horizontal curves, head-on collisions, run-off-road and fixed object crashes
- Older drivers (age 65 and up)
- Signalized and unsignalized intersections
- Inattentive driving
- Alcohol and other drugs
- Commercial motor vehicles
- Work zones
- Unlicensed drivers
- Unrestrained occupants
- Pedestrians
- Bicycles
- School buses or school zones

Top contributing circumstances for County maintained roads are illustrated in Figure 7 for the time period from 2005-2009[1].

The data reveals a distinct break after the three highest contributing circumstances. As a starting point for the TSAP, the top three areas were identified as emphasis areas for this plan.

Figure 7 Six Highest Contributing Circumstances to Fatal and Severe Crashes on County-maintained Roads, 2005-2009



AGGRESSIVE DRIVING

Aggressive driving is defined by the U.S. Department of Transportation as "driving actions that markedly exceed the norms of safe driving behavior and directly affect other road users by placing them in unnecessary danger" (Reference 10). Aggressive driving is defined for this analysis using the following contributing circumstances from the crash report forms:

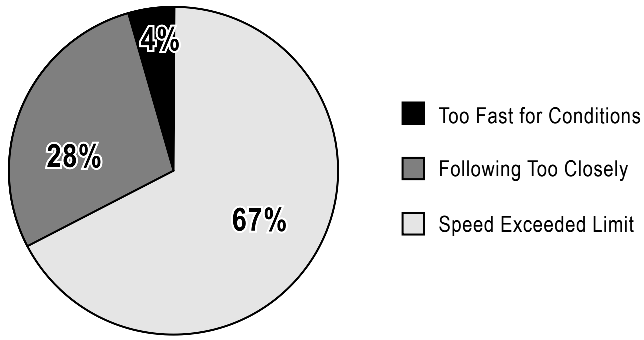
- Too fast for conditions
- Following too closely
- Driving in excess of posted speed

Aggressive driving is attributed to approximately 57-percent of all fatal or serious injury crashes on all roads in Clackamas County. The breakdown of contributing circumstances to aggressive driving crashes is shown in Figure 8.

---

[1] These categories are not mutually exclusive and there is overlap between them (e.g., young speeding drivers running off the road). For this reason, crash type percentages cannot be added cumulatively.

Figure 8 Contributing Circumstances to Aggressive Driving Crashes on all Roads in Clackamas County, 2005-2009



Of all crash types analyzed on County-maintained roads, aggressive driving crashes accounted for the highest percentage involving a fatality or serious injury at 62-percent. Specifically, speeding-related crashes are a higher percentage of crashes on Clackamas County-maintained roads (41-percent) than all routes in the county (31-percent).

Within the subset of fatal and serious aggressive driving crashes on all routes, the most common other circumstances are shown in Table 1.

Table 1 Other Circumstances Related to Aggressive Driving Crashes, All Roads in Clackamas County, 2005-2009

Circumstance	Location	Fatal/Severe Injury Crashes	Percentage of all Aggressive Driving Fatal/Severe Injury Crashes
Roadway Departure	Rural	176	72%
	Urban	76	21%
	All	252	42%
Young Driver (15-25) Involved	Rural	102	42%
	Urban	172	48%
	All	274	45%
Alcohol or Drug Impairment	Rural	42	17%
	Urban	26	7%
	All	68	11%

There is considerable overlap between aggressive driving crashes and roadway departures and young drivers, the other two primary emphasis areas. Roadway departure crashes and alcohol or drug related crashes are associated with aggressive driving most often in rural areas. While young drivers are involved in similar proportions of severe aggressive driving crashes in urban and rural areas, the number of severe young driver aggressive driving crashes is higher in urban areas.

COUNTERMEASURES

A number of countermeasures can be deployed to potentially reduce aggressive driving crashes. A list of possible countermeasures the County could implement is provided in Table 2. A more complete description of each countermeasure and its characteristics (i.e. where to use, cost, and effectiveness) is provided in Appendix "C."

Table 2 Possible Aggressive Driving Countermeasures

Countermeasure	5E Category
Public Education of Automated Enforcement Methods	Education
Establishing Appropriate Speed Limits	Engineering
Signal Retiming and Coordination	Engineering
Automated Speed Enforcement	Enforcement
Automated Red Light Enforcement	Enforcement
Targeted Corridor Speed Enforcement	Enforcement

In addition to these countermeasures, those listed in the following sections for Roadway Departure crashes and Young Drivers could potentially reduce the number and severity of crashes related to aggressive driving.

YOUNG DRIVERS

Young drivers, defined as those 15 to 25 years of age, are a vulnerable motorist group because of limited experience handling the tasks of operating a vehicle and applying newly-acquired driving skills, especially with the number of in-vehicle distractions (e.g., radio, GPS, cell phones, passengers) present on many trips. This age group is involved in approximately 44-percent of all fatal and serious injury crashes occurring on all roads in Clackamas County. On County-maintained roads, the number was even higher at about 47-percent. On all roadways in the county, the subset of fatal and serious young driver crashes includes the aggressive driving, roadway departure, and alcohol or drug impairment (see Table 3).

Table 3 Contributing Circumstances to Young Driver Crashes, 2005-2009

Contributing Circumstance	Location	Fatal/Severe Injury Crashes	Percentage of all Young Driver Fatal/Severe Injury Crashes
Aggressive Driving	Rural	102	64%
	Urban	172	60%
	All	274	61%
Roadway Departure	Rural	99	62%
	Urban	41	14%
	All	140	31%
Alcohol or Drug Impairment	Rural	26	16%
	Urban	19	7%
	All	45	10%

Young drivers in Clackamas County stand to benefit from roadway departure and aggressive driving countermeasures, with the former being more prevalent in rural areas, while the latter is more common in urban areas.

COUNTERMEASURES

A number of countermeasures can be deployed to potentially reduce young driver crashes, in addition to those previously listed for roadway departure and aggressive driving crashes. A listing of potential countermeasures is provided in Table 4. A more complete description of each countermeasure and its characteristics (i.e. where to use, cost, and effectiveness) is provided in Appendix "C."

Table 4 Possible Young Driver Crashes Countermeasures

Countermeasure	5E Category
Social Norming	Education
Driver's Education (see Figure 9)	Education
Stricter Enforcement of No Texting While Driving/Hands Free Law	Enforcement
Enforcing Primary Seatbelt Law	Enforcement
Enforcing Graduated Driver Licenses (GDL) and Zero Tolerance Laws	Enforcement
Warning Signing	Engineering

Figure 9 The 2012 Oregon Department of Transportation Parent Campaign "Why Drive with ED" focuses on parents with pre-licensed children to invoke parent engagement in the value of driver education.
http://www.whydrivewithed.com/

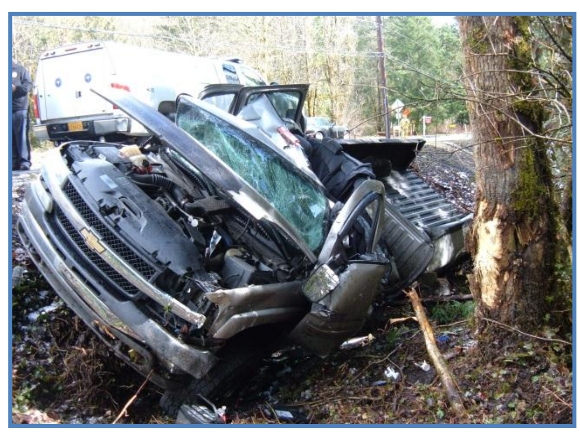
ROADWAY DEPARTURE CRASHES

Roadway departure crashes are defined by FHWA as non-intersection crashes that occur after a vehicle crosses an edge line or a center line, or otherwise leaves the traveled way. These crashes are extracted from the ODOT database using the following criteria:

- Single vehicle, non-pedestrian and non-bicycle crashes
- Head-on and sideswipe crashes where vehicles are traveling in the opposite direction (i.e., north vs. south or east vs. west)
- Crashes involving a fixed object and only one vehicle

Intersection, pedestrian, and bicycle crashes are not considered roadway departure crashes

Roadway departure crashes account for 34-percent of all fatal/serious injury crashes in Clackamas County. Percentages of this crash type are higher at 44-percent on County-maintained roads as is shown in Figure 8. Nearly 25-percent of roadway departure crashes on County roads that resulted in a fatality or severe injury were collisions with trees. Within the subset of roadway departure crashes on County-maintained roads, head-on and sideswipe meeting and fixed object collisions are associated with the highest number of traffic fatalities (see Table 5).



Roadway Departure Crash Involving a Tree

Table 5 Contributing Circumstances to Roadway Departure Fatalities, 2005-2009

Crash Type	Location	Percentage of Traffic Fatalities, 2005-2009		
		County-Maintained Roads	All Roads in County	National Average
Head-on + Sideswipe Meeting	Rural	25%	28%	12%[1]
	Urban	0%	10%	7%[1]
	All	21%	23%	10%[1]
Fixed Object	Rural	47%	37%	23%[2]
	Urban	63%	21%	22%[2]
	All	49%	33%	22%[2]

[1] Fatality Analysis Reporting System (FARS), 2005-2009
[2] Insurance Institute for Highway Safety. http://www.iihs.org/research/fatality_facts_2009/fixedObject.htm

Roadway departure crashes generally account for a higher percentage of traffic fatalities in Clackamas County than the national average, and are primarily focused on rural roads (Table 5). Head-on and Sideswipe Meeting fatalities in all locations are more than double the percentage of the total that is typically experienced around the country (about 10-percent). Due to the small sample size for data on County-maintained roads, this data may be less reliable than larger sample size evaluation results. Fixed Object crash percentages exceed the national average, especially on County-maintained roads in the urban portions of the county. On County-maintained roads in all areas, nearly half (49-percent) of traffic fatalities include the vehicle hitting a fixed object. This number increases to 63-percent in urban areas. Safety Performance Functions in Part C of the HSM indicate that run-off-the-road crashes are typically expected to contribute to a relatively high proportion of fatal and severe-injury crashes for rural two-lane highways and urban and suburban arterials. However, only detailed analysis of the individual roadways could determine if the proportions derived from the actual crash data are consistent with expected values from the HSM.

COUNTERMEASURES

A number of countermeasures can be deployed to potentially reduce roadway departure crashes. A listing of countermeasures the County could implement is provided in Table 6. A more complete description of each countermeasure and its characteristics (i.e. where to use, cost, and effectiveness) is provided in Appendix "C."

Table 6 Possible Roadway Departure Countermeasures

Countermeasure	5E Category
Advance Curve/Turn Warning Signs and Chevrons	Engineering
Flashing Beacons at Curves	Engineering
Centerline and Edgeline Pavement Markings	Engineering
Centerline and Edgeline Rumble Strips	Engineering
Alignment Delineation	Engineering
High Friction Surface Treatment	Engineering
Fixed Object Removal/Relocation/Modification	Engineering
Documentation of treatment benefits	Evaluation

Most of these countermeasures have been shown to reduce head-on + sideswipe meeting and fixed object crashes (Reference 11). Centerline pavement markings and rumble strips would be expected to have the most crash reduction benefit for head-on and sideswipe meeting crashes. Edgeline pavement markings and rumble strips and fixed object removal/relocation/modification would be expected to have the most crash reduction benefit for fixed object crashes.

INTERSECTION CRASHES

Clackamas County severe intersection crashes are lower than what is typically seen nationally. On County-maintained roads about 3-percent of fatal and severe crashes, which are likely not subject to the same underreporting as PDO crashes, have occurred at intersections. For all roads in the county, 4-percent have been at intersections. Nationally, approximately 20-percent of traffic fatalities occur at intersections (Reference 12).

While not a specific focus area, the County should review safety countermeasures as described in the National Cooperative Highway Research Program (NCHRP) Series 500 reports (Reference 11).

VULNERABLE USERS

Bicyclists, motorcyclists, and pedestrians are considered vulnerable users of the transportation system as they are more exposed in a crash than someone traveling in a car or truck. Table 7 compares the proportion of fatal and serious injury crashes these groups account for compared to their approximate mode share.

Table 7 Vulnerable User Fatal/Severe Injury Crash vs. Mode Split Comparison in Clackamas County

User Type	Percentage of all Fatal/Severe Injury Crashes	Percentage of all Trips to Work[1]
Bicyclists	2.5%	0.5%
Motorcyclists	10.7%	0.3%
Pedestrians	5.1%	2.8%

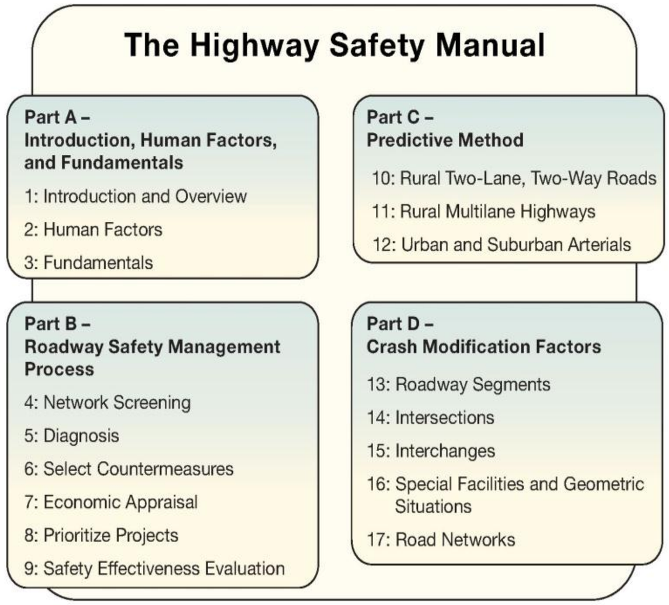
[1] 2005-09 American Community Survey, US Census Bureau

As Table 7 shows, each group accounts for a greater percentage of all fatal and severe injury crashes in Clackamas County than they do for trips to work. This indicates these user categories may be overrepresented in fatal and severe injury crashes, assuming that their respective share of commuter trips is representative of other trips. However, the table also shows each group accounts for a lower percentage of all fatal and severe injury crashes than the three emphasis areas previously identified. Organizations including the Bicycle Transportation Alliance (BTA), Team Oregon (motorcycle safety), and Oregon Department of Transportation – Transportation Safety Division Pedestrian Safety Program support safety initiatives for vulnerable users. The NCHRP Series 500 reports can provide countermeasure concepts for these users (Reference 11).

HIGHWAY SAFETY MANUAL INTEGRATION

Most typical roadway safety evaluation tools have included methods based on current and past data, typically centered on calculations dealing with crash rate, crash frequency and crash severity. There is now a more comprehensive method available for examining roadway safety. The First Edition of the Highway Safety Manual outlines methods and procedures to comprehensively manage roadway facilities and guide project decisions. The organization of the HSM is shown in Figure 10. HSM concepts employ an integrated approach to safety-based improvements applicable to all aspects of the County's project development process (planning through maintenance). The HSM concepts provide the means to incrementally improve current County activities from the planning documents noted in Part 1 to guiding funding toward programs that can measurably improve safety.

Figure 10 Highway Safety Manual Organization



DATA INTEGRATION WITH HSM

Successful implementation of the HSM relies on a robust database including crash and roadway data. While Oregon crash data is relatively thorough, roadway data may need some additional elements. In response to the release of the HSM, the Federal Highway Administration (FHWA) published a report titled: "MIRE – Model Inventory Roadway Elements" (Reference 13). Within this document, roadway elements necessary for full utilization of the HSM are described.

Integrating crash and roadway data would allow stronger analyses in line with recommendations from the HSM, including:

- *Section 2, Part C – Predictive Method* could be used to better understand the safety performance of Clackamas County's current roadway network. Because the County maintains such detailed roadway data, they could predict the likelihood of crashes using safety performance functions (SPFs) to identify opportunities for improving the network based on the HSM Excess Predicted Crashes method, which accounts for crash randomness.
- *Section 3* – Data Needs could be considered over the coming years as the County looks to improve roadway and crash data collection. The section describes and specifies the data needs required to perform the calculations and analysis presented in Section 2. For example, Clackamas County could collect horizontal curve data to better understand the safety performance of their rural two-lane, two-way roads. Data elements like curve length, radius, and superelevation are needed to apply the SPFs for these types of roadways. Predictive tools and SPFs could help identify systematic improvements or maintenance activities to reduce the potential for crashes.

- Roadway Information Management System (RIMS) data can be connected to other HSM-related tools (e.g., FHWA spreadsheets, HiSafe software) to support County staff-conducted data analysis at a potentially lower cost than more complex tools (e.g., SafetyAnalyst). Roadway, crash, and traffic data are used together to perform crash analyses. Currently each of these types of data is stored in an individual database not linked to the others. Although the extent of data collected in RIMS is impressive, it is an isolated database that cannot be easily connected to other systems, such as the Integrated Road Information System (IRIS) used by the Association of Oregon Counties and their many member counties. The current limitations of non-integrated databases reinforce an adaptive approach to roadway safety management where County actions and efforts focus on what has been reported. Enhanced data management tools will support future County efforts to proactively consider roadway safety management.

EXAMPLES OF HOW THE HSM CAN BE USED TO ANSWER TRANSPORTATION SAFETY QUESTIONS

By combining crash and roadway database information the following few example questions about the roadway departure emphasis area could be answered:

- Are there geometric cross section attributes that correlate to the roadway departure crash rate on rural 2-lane roads (such as lane width or shoulder width and type)?
- Does the age of pavement and associated friction values correspond to the safety performance of that roadway – particularly with regard to inclement weather related crashes?
- Is there a width or type of median particularly related to cross-median crashes?

Taking advantage of the County's robust data will allow both a higher level of querying and more meaningful data outcomes.

DEGREE OF CURVATURE OR CURVE RADIUS

Data on roadway degree of curvature or radius values for curves is currently not available in the county roadway information database. If this data becomes available, additional analysis could be performed to systematically implement curve treatments for addressing roadway departure crashes. Using curve type and degree of curvature or radius data could support greater capital cost efficiencies, allowing the County to prioritize curve treatments based on their geometric attributes. It could help the County best choose where to spend construction and maintenance funding by systematically identifying curve locations that need improvement. Most importantly, safety countermeasures applied using this information may effectively reduce the number and severity of curve-related crashes.

As an interim measure, a similar system-wide determination of curves can examine if all curves have been signed with advisory speed signs. Locations of curves with low advisory speeds could be identified because the county maintains sign placement records. These curves could then be treated with chevrons or other measures.

NETWORK SCREENING USING THE HSM

Network screening means reviewing a transportation network to identify and prioritize locations for potential safety improvements. It is the first step in the roadway safety management process as defined by the HSM. More information on network screening and performance measures contained in the HSM can be found in Appendix "D" of this plan.

As was previously discussed, the County currently screens its network through an annual ranking process using the ODOT SPIS methodology. Over time, and with enhanced access to and evaluation of roadway, traffic, and crash data, the County could incorporate safety performance measures that consider the randomness of crashes. These performance measures and screening methods of the HSM could help focus County funds more accurately on prioritized locations or crash types with the whole system in mind.

PERFORMANCE MEASURES

The most stable performance measures defined in the HSM need to be calibrated to local conditions using a locally developed calibration factor or a locally developed function. ODOT has developed local calibration factors for State highways and will make them available in mid-2012. Clackamas County has the opportunity to transition to using these calibration factors for applying the more stable performance measures on its roads. However, using these measures will be more data and time intensive than the current methods. Over time, and if the County integrates its roadway, traffic, and safety data, future safety analyses might be conducted in a more effective and efficient manner.

Interim steps could include using supplemental performance measures outlined in the HSM including: the method of moments, probability of specific crash types, excess proportion of specific crash types, or critical rate performance measures. The probability of specific crash types and excess proportion measures could be particularly valuable given the specific emphasis areas identified previously. For instance, either method could be run network-wide for a specific crash type (e.g. run off the road crashes) to develop a prioritized list of locations for that crash type. Similarly for young drivers or alcohol involved crashes either measure could be used to identify what locations are overrepresented, which could identify locations to increase enforcement.

NETWORK SCREENING TOOLS

The process of using more stable performance measures to screen the County's roadway network could potentially be simplified using network screening tools. There is an off-the-shelf tool that is available for this process or a tool could be custom-built for the County.

AASHTO's *SafetyAnalyst* is currently the only off-the-shelf tool implementing the Roadway Safety Management Process from Part B of the HSM. *SafetyAnalyst* applies the entire Part B process from network screening to evaluating the effectiveness of implemented treatments. Two limitations to the software are its intensive data requirements and cost. The program was developed for State DOTs and requires detailed roadway, crash, and traffic data. The most recent cost information posted on the program's website states that the program costs $15,000 per year for one workstation license or $25,000 for a site license. More information about *SafetyAnalyst* can be found at www.SafetyAnalyst.org.

An alternative to *SafetyAnalyst* would be a custom built tool that taps into the County's RIMS and crash databases and performs the network screening analysis.

QUANTITATIVE SAFETY ANALYSIS METHODS USING THE HSM

The HSM allows for quantitative safety analysis. Part C of the HSM covers the Predictive Method in detail. The Predictive Method allows analysts to predict the expected average crash frequency in terms of crashes per year for a road segment or intersection based on traffic volumes, geometric features, and a local calibration factor.

The Predictive Method can be used on existing facilities as well as planned improvements and new roadways. It can also be used to quantitatively compare alternative improvement options for a segment and/or intersection for an existing or new roadway. Alternatives can then be compared according to the differences in expected average crash frequency or by using a benefit-cost calculation to better compare projects of different cost magnitudes.

Using the Predictive Method requires more data than a traditional crash frequency, rate, or severity analysis. Fortunately, the County already collects much of the data required to implement the HSM. A full listing of additional data that would be needed in RIMS to automate analyses can be found in Appendix "D."

In addition to local roadway data, a locally developed calibration factor is required to adjust the results, which are based on national data, to local conditions. To begin implementing the Predictive Method in the near-term, the County could rely on these factors. In the longer-term, more accurate results could potentially be obtained by using calibration factors developed from county-level data. This is described in more detail in Appendix "D."

- Areas of the County's practices into which the Predictive Method could be incorporated include:
- Network screening/roadway system management
- Countermeasure identification and analysis
- Alternatives evaluation
- Improvement prioritization
- Safety analyses
- Traffic studies, including development review studies

The County has already taken steps to implementing the Predictive Method, including hiring an analyst responsible for safety analysis.

BROADER DATA ANALYSIS AND TRENDING

The County's safety analysis is currently based on crash data. However, the County has a stated desire to incorporate additional data to provide more comprehensive analyses and examine different aspects of safety and risk. The trends stemming from considering additional data sets could potentially be included in proactive strategies in engineering, education, emergency medical and enforcement activities. This additional data could include:

- Societal trends (demographics, technology changes, etc…)
- 9-1-1 data
- Hospital records
- School absenteeism trends
- Citizen complaints

Among other things, the use of this data has the potential to uncover issues not seen in crash data. For instance, a recent study by the Norwegian Institute of Science and Technology (Reference 14) used hospital data on slip-and-fall injuries to show wintertime maintenance of pedestrian facilities helps to prevent injuries in Norwegian cities. These types of injuries and trends would not otherwise be seen as there is no reporting mechanism. In Clackamas County, 9-1-1 calls could include reports of speeding and aggressive driving patterns, road racing, or underage drinking parties or gatherings. In the absence of reported crashes, this information could be the basis for special enforcement zones or education outreach to local high schools.

Collecting and analyzing additional data in a coordinated fashion will require a time investment. Ideally the data would be sent to a central location for processing and comprehensive analysis. The data could be used to identify locations for treatment, programmatic needs, and areas to target with educational outreach efforts. Building applications to merge, query, map and create tables/reports will become increasingly important as the Safety Culture grows and we partner with additional community stakeholders. Future plans need to include creation of the data infrastructure and sharing agreements to allow this data warehouse to grow and flourish. In addition, other regional partners and academia would likely have interest in this data.

DEVELOPMENT REVIEW

Traditionally, the focus of development review has been on the capacity impact of new development. Safety is considered but sometimes it is more difficult to define. Agencies have struggled to provide the same level of consideration to safety as capacity because there has not been a readily available way to quantitatively analyze safety. The Predictive Method can be used to identify the impacts of a development on crash frequency, and quantify the effect of alternative mitigation improvements on crash frequency.

Potential ways safety considerations could be incorporated into the development review process include:

- Requiring a Predictive Method analysis of impacted roadway facilities along with a capacity analysis as part of traffic impact studies (TIS).
- Allowing safety improvements in lieu of capacity improvements. To determine if a safety improvement provides an offsetting benefit compared to the disadvantage created by the increased congestion, the benefit of the safety improvement could be calculated in monetary terms using the reduction in expected average crash frequency, which could then be compared to the monetary value of the increase in congestion using the value of travel time. In some cases capacity improvements can decrease safety (i.e. as capacity is added on a segment or at an intersection, speeds may increase with improved flow). Less severe crashes could potentially be replaced with fewer but more significant serious crashes.
- Developing and implementing crash frequency standards, similar to the current use of mobility standards.
- Assess fees for the number of estimated trips through safety focus intersections and/or roadway segments. The fees would be used to implement safety improvements at those locations and/or implement enforcement or education programs to improve safety behaviors.

Implementing any of these ideas will require work to fit the concepts with existing codes and practices. Such changes will need to follow the County process of involving a broad range of stakeholders from policy makers to developers. For this reason, the County may want to test proposed ideas on select pilot development projects to determine whether implementation helps to accomplish the County's vision and whether the idea being tested can be practically implemented.

KEY OUTREACH ACTIVITIES AND SAFETY STAKEHOLDERS

There are a number of groups and individuals involved in promoting transportation safety in Clackamas County. Without their support and participation, many key activities would not be possible. These programs have been successful and should continue to be supported and potentially expanded as part of the TSAP.

SAFETY STREET

Safety Street is an interactive driving course for children and is the most popular activity operated through the Safe Communities Program. Thousands of children ride the course each year with the help of volunteers from local church groups, schools, private business, and citizens at large.

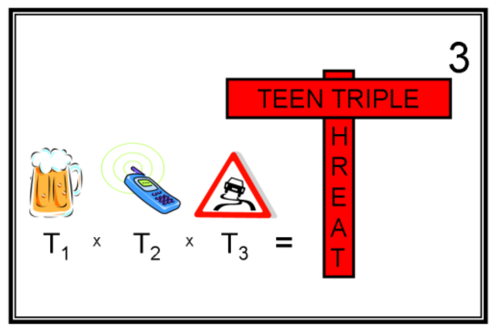
Safety Street

Roadway and Safety Fair

THE CLACKAMAS TOWN CENTER ROADWAY AND SAFETY FAIR

This annual fair takes place at the Clackamas Town Center under leadership from the Clackamas Traffic Safety Commission, Happy Valley Public Safety Commission, and Safe Communities Program. Collectively these groups manage safety stations from diverse partners, including Portland General Electric, TriMet, Clackamas Women's Services, Oregon Partnership, and Team Oregon.

TEEN TRIPLE THREAT



The Teen Triple Threat contest is held every other year and invites high school students to create safe driving messages based on speed, distracted driving and impaired driving. Since 2008, students have created safety videos, animated public safety announcements, and safe driving scripts that have been professionally produced. Partnerships with school organizations make the project possible. Private businesses, such as the Clackamas Review and State Farm Insurance, have supported the contest with contributions for prizes and media outreach. Winning videos are posted on the Clackamas Safe Communities Facebook page and You Tube site.

MIK AND NERO COMIC SERIES

The Clackamas County Sheriff's Office created the first of the Mik and Nero comic books about the dangers of methamphetamine use. Three comic and activity books were later created related to safe driving. The Safety Street Activity book is the most popular with over 10,000 distributed throughout the county at fairs, community events and schools. They are also distributed statewide through ODOT Transportation Safety Division and are available at county libraries at no charge. They can be downloaded at: www.clackamas.us/sheriff/kids/.

OTHER SAFETY STAKEHOLDERS

Clackamas County has worked to incorporate a broad range of safety partners to help create a 5E approach to safety. The addition of the Safe Communities Program, beginning in 2005, helped the building of partnerships considerably through its outreach and broad 5E focus. The list of partners continues to grow and expand.

In addition to those safety partners/organizations and groups mentioned in this report, the following ancillary groups should be recognized for their support and partnership. They contribute to Clackamas County's growing Safety Culture:

EDUCATION	**WEB SITE**
Bicycle Transportation Alliance	*btaoregon.org/*
Clackamas County Driver Education Program	*depts.clackamas.edu/driverEd/*
Clackamas County Fair Board	*www.clackamas.us/fair/*
North Clackamas School District and Transportation Office	www.nclack.k12.or.us
Northwest Family Services – Vibrant Futures Drug Free Youth Coalition	www.facebook.com/pages/Vibrant-Futures-of-Milwaukie
Operation Lifesaver – Rail Safety	www.oli.org/
Safe Kids Oregon	www.public.health.oregon.gov
EMERGENCY MEDICAL SERVICES	
Oregon Trauma System	www.public.health.oregon.gov
Providence Hospital	www.provhosp.org/
Sandy Fire District #72	www.sandyfire.com
ENFORCEMENT	
Clackamas County Sheriff's Office – Crime Prevention and PIO Unit	*www.clackamas.us/sheriff/neighborhoodwatch.jsp*
Clackamas County Justice Court	*www.clackamas.us/justice/*
Oregon Liquor Control Commission (OLCC)	www.oregon.gov/OLCC/index.shtml
Oregon State Police (OSP)	www.oregon.gov/OSP/
ENGINEERING	
Federal Highway Administration	www.fhwa.dot.gov/
METRO	www.oregonmetro.gov/
National Highway Traffic Safety Administration	www.nhtsa.gov/

ACTION ITEMS

The County has identified action items that will be undertaken over the next several years to potentially improve transportation safety in Clackamas County. These action items have been developed by the County working in consultation with its safety partners and the project team, and drawing on the analysis described previously. For organizational purposes, they are divided into six categories: county-wide action items and action items related to each of the 5E's. Within each category, items are grouped by a targeted timeframe that has been set by County staff: short-term (1-2 years), mid-term (3-5 years), and long-term (6+ years).

COUNTY-WIDE ACTION ITEMS

County-wide actions generally define broad, organizational activities meant to enable specific actions identified for the 5E's and promote an overall Safety Culture. These actions will generally be led by the County's traffic engineering division and the Safe Communities Program, with support from other County agencies.

	SHORT TERM
CW1	Creating a county-wide "Safety Culture" work group
CW2	Developing and implementing a financial sustainability model for the Safe Communities Program
CW3	Continuing to promote and support the efforts of the Clackamas County Traffic Safety Commission
CW4	Supporting internal agencies, such as the Department of Transportation and Development; the Sheriff's Office; and Health, Housing, and Human Services; and external organizations, such as Oregon Impact; Alliance for Community Traffic Safety; and Think First, in their transportation safety initiatives
CW5	Integrating this TSAP into County policy via the Comprehensive Plan through its inclusion in the TSP update and subsequent adoption into the Comprehensive Plan
	MID TERM
CW6	Supporting technology that improves efficiency and data sharing
CW7	Supporting legislation, ordinances, and policies that promote traffic safety and/or patient outcome (e.g. mandated driver's education) and likewise opposing legislation, ordinances, and policies that would detrimentally impact transportation safety and/or patient outcome
CW8	Expanding the Safe Communities Program into cities within the County
	LONG TERM
CW9	Updating the TSAP to ensure it remains current
CW10	Continuing to fund, support, promote and expand the Safe Communities Program
CW11	Developing and implementing a sustainability model for TSAP related initiatives

EDUCATION

Human factors are a primary contributing cause to transportation crashes. Educational efforts seek to create drivers who are informed about safe driving and promote an overall Safety Culture. These action items will be led by County agencies and external organizations and agencies.

	SHORT TERM
EDU1	Support partner safety programs from Oregon Impact, Clackamas County 9-1-1, and ACTS Oregon
EDU2	Use safety messaging strategies, including monitor/kiosk systems, public safety announcements, vehicle wraps, *Mik and Nero* comic series, and signal cabinets for broad outreach
EDU3	Support infant/child passenger safety with car/booster seat and seat belt education. If feasible, offer reduced priced seats for low income families
EDU4	Provide ongoing targeted safety education to: Young children (Kindergarten-3rd grade) and their parents emphasizing safe crossing practices, not playing behind vehicles or near streets, and the importance of adult supervision. Elementary school children (grades 4-6) emphasizing pedestrian safety, bicycle and skateboard safety, and school bus safety. Teens (grades 7-12) emphasizing distracted driving, impaired driving, graduated driving license compliance, aggressive driving, and speed.
EDU5	Use a variety of forums to educate county citizens including safety fairs, school presentations, town halls, and community events
EDU6	Increase the use of social media in education and outreach
	MID TERM
EDU7	Seek additional funding (grants/donations), utilize volunteers, and investigate other methods to keep the Safe Communities Program's operations cost effective
EDU8	Conduct internal and external training regarding the goals and mission of this TSAP
EDU9	Find methods to educate diverse populations of all income levels regarding safety
EDU10	Provide focused education on populations overrepresented in crash and citation data
EDU11	Educate citizens about traffic laws
EDU12	Incorporate safety education for multiple modes of travel including: pedestrian, bike, transit, train, motorcycle, school bus and personal motor vehicle as appropriate
EDU13	Develop a formal clearinghouse/forum for information sharing regarding safety-related activities
	LONG TERM
EDU14	Continue educational activities
EDU15	Support Safety Culture work group goals and objectives

ENFORCEMENT

Enforcement actions will be led by law enforcement agencies within the County, with support provided by the Safe Communities Program and other County agencies.

	SHORT TERM
ENF1	Enhance Driving Under the Influence (DUI) and impaired driving enforcement
ENF2	Continuation/expansion of the Minor Decoy Operations program
ENF3	Assign resources to address CCSO top ten crash locations in Clackamas County
ENF4	Assign one law enforcement representative on the Safe Communities Program Work Group
	MID TERM
ENF5	Enhance Driving Under the Influence (DUI) and impaired driving enforcement activities through: Data Driven Saturation Patrols Enhanced training including, Drug Recognition Training (DRE & K9), Standardized Field Sobriety Tests training, and wet labs A dedicated DUI enforcement unit
ENF6	Employ technology such as e-Citation & e-Crash to maximize efficiency and increase data sharing
ENF7	Enforce Graduated Driving License (GDL) compliance for youth drivers
ENF8	Increase Motor Carrier Safety Inspections and sanctions as needed
ENF9	Conduct work zone, chain enforcement, and other specialized details
ENF10	Continue to support and expand traffic unit
ENF11	Deploy resources based on safety assessments
ENF12	Target distracted driving in outreach and enforcement efforts
	LONG TERM
ENF13	Enhance Driving Under the Influence (DUI) and impaired driving enforcement activities by working with county officials to investigate repeat DUI driver offender programs
ENF14	Support Data-Driven Approaches to Crime and Traffic Safety

EMERGENCY MEDICAL SERVICES

Emergency Medical Services (EMS) actions will be led by EMS companies or County agencies.

	SHORT TERM
EMS1	Assign one EMS representative to the Safe Communities Program Work Group
EMS2	Work with the Emergency Medical Services Council to improve EMS reporting for the purposes of safety audits
EMS3	Work with stakeholders to sustain coordinated systems for Level 1 trauma centers
	MID TERM
EMS4	Work with Emergency Medical Service Council and other stakeholders to ensure maximum efficiency with urban and rural response times through techniques such as activation of Life Flight as requested by crews en route to crash scenes
EMS5	Work with stakeholders to identify equipment upgrades or enhancements that would improve patient outcome (e.g., Life Flight landing zone equipment)
EMS6	Support evidence-based EMS research and review opportunities to improve it
EMS7	Improve EMS data reliability with a goal to have an electronic patient care record that is complete for each incident from the initial contact to a public safety answering point (9-1-1), to the outcome, including hospital outcomes when appropriate
EMS8	Review patient transport time data and work with stakeholders to fill gaps through voluntary or contractual requirements
	LONG TERM
EMS9	Support quality assurance for medical delivery and review improvement opportunities

ENGINEERING

Engineering is primarily the responsibility of the Clackamas County Department of Transportation and Development. Action items in this category range from implementing specific countermeasures to improving data management.

	SHORT TERM
ENG1	Continue Safety Corridor Program
ENG2	Convene a group to investigate incorporating increased safety analysis requirements into development review as outlined in the TSAP
ENG3	Research the relationship between capacity and safety improvements
ENG4	Increase the focus on safety in development review by: Developing and implementing crash frequency standards Assessing impact fees for trips through Safety Focus roadways and intersections
ENG5	Collect data on at-risk indicators (e.g., 9-1-1 calls)
	MID TERM
ENG6	Develop a policy and practice for incorporating safety assessments into project development, design, and construction
ENG7	Work with Transportation Maintenance to develop internal policies for integrating HSM principles into maintenance practices
ENG8	Deploy safety countermeasures related to safety emphasis areas
ENG9	Integrate RIMS, crash, and traffic Databases
ENG10	Screen network for overrepresentation of emphasis area crashes
ENG11	Integrate the HSM predictive method into: Countermeasure identification & analysis Alternatives evaluation Safety analyses
ENG12	Develop a formal method for sharing safety data with partners (i.e. newsletter, website, presentation)
ENG13	Integrate Road Safety Audits (RSAs) into the project development process for new roads and intersections. Encourage RSAs on existing roads and intersections.
ENG14	Begin incorporating additional roadway information necessary for HSM Predictive Method analyses into roadway database for segments and intersections
ENG15	Automate network screening by creating a custom tool or purchase an off-the-shelf tool
ENG 16	Fully integrate HSM procedures into the Development Review Process
	LONG TERM
ENG17	Add curve data into roadway database
ENG18	Incorporate HSM Predictive Method analysis of roadways and intersections
ENG19	Implement network screening using a safety performance function (SPF) based performance measure from the HSM. Use the results to prioritize improvements in the CIP, TSP, and other planning documents

EVALUATION

Evaluation efforts area continuous process and will be primarily led by the traffic engineering division and the Safe Communities Program, with support from other departments in the County and external stakeholders.

	EVALUTION
EVAL1	Provide quarterly updates to the Board of County Commissioners on crash occurrence and Safe Communities Program activities.
EVAL2	Work with county departments to create and deploy a comprehensive survey covering transportation related attitudes, behaviors and projects
EVAL3	Evaluate the effectiveness of the Safety Culture work group by way of outcomes that are measurable and sustainable
EVAL4	Review crash and safety related data on an annual basis with respect to TSAP goals
EVAL5	Refine and review other datasets to determine if emphasis area crashes are being reduced and experiencing changing trends

MOVING THE PLAN FORWARD

The greatest challenge of most plans is implementation. Success of the TSAP requires strong commitments and dynamic partnerships. As stewards of the transportation system, the County will strive to fully implement this plan.

The action items described above are too broad for any single department or group to implement on its own. Implementation will need to be a well-coordinated effort. The Safe Communities Program is best positioned for being the lead in monitoring and championing implementation of this TSAP given its current coordination activities and contact network. The program will accomplish much of this work with the county-wide Safety Culture work group identified in the short-term county-wide action items as this group will include representatives from multiple departments within the County.

To maintain the TSAP as a relevant document it needs to be updated regularly. The TSAP could be updated in conjunction with efforts to update the County's TSP. Updating the TSAP in combination with the TSP will allow the TSAP to be seamlessly integrated with the County's overall transportation vision.

CONCLUSION

The success of this TSAP can ultimately be measured in the progress the County makes toward achieving the overall goal laid out in the beginning of this plan: *to reduce the number of fatalities and serious injuries due to crashes in the next 10 years*. Evaluation needs to be included as part of each activity so that actions, projects and partnerships can be modified as needed. The ability to adjust the plan will better help build a road to success and, ultimately, help the County achieve its goal of a 50-percent reduction of fatal and serious injury crashes by 2022.

REFERENCES

1. Clackamas County Department of Transportation and Development staff. November 2011.
2. Centers for Disease Control and Prevention. *Motor Vehicle Safety.* http://www.cdc.gov/motorvehiclesafety/. November 2011.
3. American Association of State Highway and Transportation Officials. *Highway Safety Manual,* 1st Edition. 2010.
4. Dixon, K.; Monsere, C.; Xie, F.; Gladhill, K. "Calibrating the Future Highway Safety Manual Predictive Methods for Oregon State Highways." ODOT Research. February 2012.
5. Federal Highway Administration. *Other Measures*. http://safety.fhwa.dot.gov/saferjourney/library/countermeasures/59.htm. November 2011.
6. Juarez, P; Schlundt, D.G.; Goldzweig, I; Stinson Jr, N. "A Conceptual Framework for Reducing Risky Teen Driving Behaviors Among Minority Youth." *Injury Prevention*. April 2006.
7. National Cancer Institute. *Pink Book – Making Health Communication Programs Work*. http://www.cancer.gov/cancertopics/cancerlibrary/pinkbook/page5. November 2011.
8. Federal Highway Administration. *Strategic Highway Safety Plans (SHSP) and Emergency Medical Services (EMS)*. http://safety.fhwa.dot.gov/hsip/shsp/ems/. November 2011.
9. Federal Highway Administration. *Recruiting Law Enforcement Participation*. http://safety.fhwa.dot.gov/intersection/redlight/outreach/program/coalition/recruitlaw.cfm. November 2011.
10. National Highway Traffic Safety Administration. *Aggressive Driving Enforcement: Strategies for Implementing Best Practices*. http://www.nhtsa.gov/people/injury/enforce/aggressdrivers/aggenforce/toc.html. October 2011.
11. National Cooperative Highway Research Program. *Guidance for Implementation of the AASHTO Strategic Highway Safety Plan,* Volumes 1-23. http://safety.transportation.org/guides.aspx. November 2011.
12. Federal Highway Administration. *Intersection Safety*. http://safety.fhwa.dot.gov/intersection/. October 2011.
13. Federal Highway Administration. *Model Inventory of Roadway Elements*. http://www.mireinfo.org/. April 2012.
14. Johannessen, Stein. *Quality Assessment of Winter Operations and Maintenance of Pedestrian Pavements and Other Walking Areas.* Presented October 2011 at the International Conference on Walking and Livable Communities, Vancouver, Canada.

Part 3: Appendices

PART 3: APPENDICES

Appendix A – Comprehensive Plan Language Memorandum

Appendix B – Data Analysis Summary Memorandum

Appendix C – Countermeasure Summary Sheets

Appendix D – Information on Additional Programmatic Areas

Appendix E – Survey Results

Appendix A
Comprehensive Plan Language Memorandum

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING / PLANNING
610 SW Alder Street, Suite 700, Portland, OR 97205 P 503.228.5230 F 503.273.8169

MEMORANDUM

Date:	June 19, 2012	Project #: 11235.0
To:	Joe Marek, PE, PTOE; Clackamas County	
CC:	Patty McMillan, Clackamas County	
From:	Brian Ray, PE; Nick Foster, and John Ringert, PE	
Project:	Clackamas County Transportation Safety Action Plan	
Subject:	Draft Comprehensive Plan Language	

Kittelson & Associates, Inc. (KAI) is assisting Clackamas County to prepare a county-wide transportation safety action plan (TSAP). This plan will ultimately become the action plan for the County's *Slow to Zero* campaign for improving transportation safety. To incorporate the TSAP into County policy, KAI drafted language to increase the emphasis the County's Comprehensive Plan places on transportation safety and clarify the manner in which it does so. Our text is meant to support ongoing interagency (e.g. Traffic Engineering, Sheriff's Office, Office for Children and Families, ODOT, Fire, Communications, school districts, and City agencies) and private sector participation (e.g. emergency response providers, youth and family advocates, grant and volunteer providers, etc…) in improving the safety culture of Clackamas County. This memorandum provides a draft version of this text for the Comprehensive Plan and describes the documents reviewed as part of this process. This draft text will evolve to include more specific measures once the data analysis portion of the project is complete.

DOCUMENT REVIEW

KAI staff reviewed County, Regional and State planning documents to consider their roles, relationships, and opportunities to coordinate with the County Comprehensive Plan. In summary, the documents provide useful guidance in helping the County coordinate its plan with other efforts. The following documents were reviewed in developing the draft Comprehensive Plan language:

- *Oregon Transportation Safety Action Plan* (TSAP, 2004) – This statewide plan is an element of the *Oregon Transportation Plan*. It contains a vision for improved transportation safety in Oregon, implemented through 69 actions, with 9 actions being considered key. A 2006 amendment identified priority emphasis areas to be addressed through engineering strategies in order to bring the TSAP into full compliance with the guidance provided by SAFETEA-LU federal authorization.
- *Oregon Transportation Plan* (2006) – This is the guiding document for statewide transportation policy and contains a safety goal (5) and supporting policies and strategies.

- *Metro Regional Transportation Plan* (2004) – Metro's plan contains policies for regional planning efforts, including a policy (20.3) stating that safety related projects should be given utmost priority.
- *Clackamas County Comprehensive Plan* (2008) – This is the County's guiding policy document for planning and includes a transportation chapter addressing the County's transportation needs.

DRAFT COMPREHENSIVE PLAN LANGUAGE

The draft language proposed for Clackamas County's Comprehensive Plan is separated into two subsections in this memo. The first is a draft new section on safety. Following this, draft language to be incorporated into existing sections of the comprehensive plan is provided. The following text stems from our review of the County, Regional, and State planning documents, what we understand to be County objectives in initiating a "culture of safety", and KAI project experience in implementing multimodal safety plans.

Safety Section

From 2005 to 2009, there were approximately 160 fatalities and 1,245 serious injuries in Clackamas County due to crashes. The County has a strong stated desire to improve the safety of its system for all users and reduce the number and severity of traffic crashes for future years. The County seeks to address existing known problems and proactively attempt to reduce serious crashes. Improving safety is a truly multimodal concern that affects each and every resident of the County. The County intends to be a leader in the state of Oregon in implementing innovative strategies for reducing fatal and serious injury crashes and working with other agencies in the state to improve safety across Oregon.

Goal:

- As part of initiating a Safety Culture, the County will work collaboratively with state, regional, and local agencies and County residents to reduce the number of fatalities and serious injuries on roadways in Clackamas County by one-half in the next 10 years. Based on the 2005-2009 average number of fatalities and serious injuries due to crashes, this corresponds to saving 16 lives and preventing 125 serious injuries annually at the completion of the program.

Objectives:

- **Setting the standard and foundation for developing a Safety Culture in Clackamas County.** Simply put, "Lead by Example!" To successfully build a Safety Culture within the County, staff and elected officials must lead the way through their actions, regulations, policies and practices at all levels. Recognizing that this is an iterative process accomplished through partnering and spreading the message, the County is ready to take up this task.

- **Aligning County departments and external safety groups to work toward common state, regional, county, and city safety goals**. Using mutually beneficial partnerships, such as the work of the Safe Communities Program, over the past seven years, the safety community within the County has been able to better focus its efforts and better coordinate resources towards common goals. In other words, collective groups have become more aligned. This movement has been a grass roots effort percolating from the staff and community level and it has started to draw the attention of policy and decision makers. Continued growth depends on decision and policy makers elevating safety in their planning processes. The result will be increased coordination and partnerships coupled with policies, standards and directional focus strongly rooted around safety.
- **Integrating roadway, safety, and traffic data management sources.** Success in building a Safety Culture and ultimately reducing fatal and injury crashes depends on a data driven approach to help us understand and diagnose the issues and potential solutions as well as to shape policy and justify expenditures. Data availability, integration, and mapping capabilities have changed exponentially over the past ten years. What was not possible just a few years ago is now easily accomplished. With these advances, our ability to tell the safety story has been greatly improved. Examples such as mapping multiple data fields such as crash types and cause factors allows decision makers and the public to understand and relate to the safety of the system which, correspondingly, helps them to understand and support various safety efforts.
- **Integrating HSM principles.** The publication of the First Edition of the *Highway Safety Manual* (HSM) (Reference 3) set the stage for developing a robust and comprehensive safety assessment and mitigation process. As full implementation of the manual occurs over the next several years, safety will change from what has often been a subjective and reactive assessment to a more objective, quantitative, and proactive process. As the need for justification of investments increases, the HSM provides the tools to measure the success of our current investments and anticipate safety solutions needed in the future.

<u>Action Items:</u>

The County has identified action items that will be undertaken over the next several years to potentially improve transportation safety in Clackamas County. These action items have been developed by the County working in consultation with its safety partners and the project team, and drawing on the analysis described previously. For organizational purposes, they are divided into six categories: county-wide action items and action items related to each of the 5E's. Within each category, items are grouped by a targeted timeframe that has been set by County staff: short-term (1-2 years), mid-term (3-5 years), and long-term (6+ years).

County-Wide Action Items

County-wide actions generally define broad, organizational activities meant to enable specific actions identified for the 5E's and promote an overall Safety Culture. These actions will generally be led by the County's traffic engineering division and the Safe Communities Program, with support from other County agencies.

	SHORT TERM
CW1	Creating a county-wide “Safety Culture” work group
CW2	Developing and implementing a financial sustainability model for the Safe Communities Program
CW3	Continuing to promote and support the efforts of the Clackamas County Traffic Safety Commission
CW4	Supporting internal agencies, such as the Department of Transportation and Development; the Sheriff’s Office; and Health, Housing, and Human Services; and external organizations, such as Oregon Impact; Alliance for Community Traffic Safety; and Think First, in their transportation safety initiatives
CW5	Integrating this TSAP into County policy via the Comprehensive Plan through its inclusion in the TSP update and subsequent adoption into the Comprehensive Plan
	MID TERM
CW6	Supporting technology that improves efficiency and data sharing
CW7	Supporting legislation, ordinances, and policies that promote traffic safety and/or patient outcome (e.g. mandated driver’s education) and likewise opposing legislation, ordinances, and policies that would detrimentally impact transportation safety and/or patient outcome
CW8	Expanding the Safe Communities Program into cities within the County
	LONG TERM
CW9	Updating the TSAP to ensure it remains current
CW10	Continuing to fund, support, promote and expand the Safe Communities Program
CW11	Developing and implementing a sustainability model for TSAP related initiatives

Education

Human factors are a primary contributing cause to transportation crashes. Educational efforts seek to create drivers who are informed about safe driving and promote an overall Safety Culture. These action items will be led by County agencies and external organizations and agencies.

	SHORT TERM
EDU1	Support partner safety programs from Oregon Impact, Clackamas County 9-1-1, and

	ACTS Oregon
EDU2	Use safety messaging strategies, including monitor/kiosk systems, public safety announcements, vehicle wraps, *Mik and Nero* comic series, and signal cabinets for broad outreach
EDU3	Support infant/child passenger safety with car/booster seat and seat belt education. If feasible, offer reduced priced seats for low income families
EDU4	Provide ongoing targeted safety education to: • Young children (Kindergarten-3rd grade) and their parents emphasizing safe crossing practices, not playing behind vehicles or near streets, and the importance of adult supervision. • Elementary school children (grades 4-6) emphasizing pedestrian safety, bicycle and skateboard safety, and school bus safety. • Teens (grades 7-12) emphasizing distracted driving, impaired driving, graduated driving license compliance, aggressive driving, and speed.
EDU5	Use a variety of forums to educate county citizens including safety fairs, school presentations, town halls, and community events
EDU6	Increase the use of social media in education and outreach
	MID TERM
EDU7	Seek additional funding (grants/donations), utilize volunteers, and investigate other methods to keep the Safe Communities Program's operations cost effective
EDU8	Conduct internal and external training regarding the goals and mission of this TSAP
EDU9	Find methods to educate diverse populations of all income levels regarding safety
EDU10	Provide focused education on populations overrepresented in crash and citation data
EDU11	Educate citizens about traffic laws
EDU12	Incorporate safety education for multiple modes of travel including: pedestrian, bike, transit, train, motorcycle, school bus and personal motor vehicle as appropriate
EDU13	Develop a formal clearinghouse/forum for information sharing regarding safety-related activities
	LONG TERM
EDU14	Continue educational activities
EDU15	Support Safety Culture work group goals and objectives

Enforcement

Enforcement actions will be led by law enforcement agencies within the County, with support provided by the Safe Communities Program and other County agencies.

	SHORT TERM
ENF1	Enhance Driving Under the Influence (DUI) and impaired driving enforcement
ENF2	Continuation/expansion of the Minor Decoy Operations program
ENF3	Assign resources to address CCSO top ten crash locations in Clackamas County
ENF4	Assign one law enforcement representative on the Safe Communities Program Work Group
	MID TERM
ENF5	Enhance Driving Under the Influence (DUI) and impaired driving enforcement activities through: • Data Driven Saturation Patrols • Enhanced training including, Drug Recognition Training (DRE & K9), Standardized Field Sobriety Tests training, and wet labs • A dedicated DUI enforcement unit
ENF6	Employ technology such as e-Citation & e-Crash to maximize efficiency and increase data sharing
ENF7	Enforce Graduated Driving License (GDL) compliance for youth drivers
ENF8	Increase Motor Carrier Safety Inspections and sanctions as needed
ENF9	Conduct work zone, chain enforcement, and other specialized details
ENF10	Continue to support and expand traffic unit
ENF11	Deploy resources based on safety assessments
ENF12	Target distracted driving in outreach and enforcement efforts
	LONG TERM
ENF13	Enhance Driving Under the Influence (DUI) and impaired driving enforcement activities by working with county officials to investigate repeat DUI driver offender programs
ENF14	Support Data-Driven Approaches to Crime and Traffic Safety

Emergency Medical Services

Emergency Medical Services (EMS) actions will be led by EMS companies or County agencies.

	SHORT TERM
EMS1	Assign one EMS representative to the Safe Communities Program Work Group
EMS2	Work with the Emergency Medical Services Council to improve EMS reporting for the purposes of safety audits
EMS3	Work with stakeholders to sustain coordinated systems for Level 1 trauma centers
	MID TERM
EMS4	Work with Emergency Medical Service Council and other stakeholders to ensure maximum efficiency with urban and rural response times through techniques such as activation of Life Flight as requested by crews en route to crash scenes
EMS5	Work with stakeholders to identify equipment upgrades or enhancements that would improve patient outcome (e.g., Life Flight landing zone equipment)
EMS6	Support evidence-based EMS research and review opportunities to improve it
EMS7	Improve EMS data reliability with a goal to have an electronic patient care record that is complete for each incident from the initial contact to a public safety answering point (9-1-1), to the outcome, including hospital outcomes when appropriate
EMS8	Review patient transport time data and work with stakeholders to fill gaps through voluntary or contractual requirements
	LONG TERM
EMS9	Support quality assurance for medical delivery and review improvement opportunities

Engineering

Engineering is primarily the responsibility of the Clackamas County Department of Transportation and Development. Action items in this category range from implementing specific countermeasures to improving data management.

	SHORT TERM
ENG1	Continue Safety Corridor Program
ENG2	Convene a group to investigate incorporating increased safety analysis requirements into development review as outlined in the TSAP
ENG3	Research the relationship between capacity and safety improvements
ENG4	Increase the focus on safety in development review by:

	• Developing and implementing crash frequency standards • Assessing impact fees for trips through Safety Focus roadways and intersections
ENG5	Collect data on at-risk indicators (e.g., 9-1-1 calls)
	MID TERM
ENG6	Develop a policy and practice for incorporating safety assessments into project development, design, and construction
ENG7	Work with Transportation Maintenance to develop internal policies for integrating HSM principles into maintenance practices
ENG8	Deploy safety countermeasures related to safety emphasis areas
ENG9	Integrate RIMS, crash, and traffic Databases
ENG10	Screen network for overrepresentation of emphasis area crashes
ENG11	Integrate the HSM predictive method into: • Countermeasure identification & analysis • Alternatives evaluation • Safety analyses
ENG12	Develop a formal method for sharing safety data with partners (i.e. newsletter, website, presentation)
ENG13	Integrate Road Safety Audits (RSAs) into the project development process for new roads and intersections. Encourage RSAs on existing roads and intersections.
ENG14	Begin incorporating additional roadway information necessary for HSM Predictive Method analyses into roadway database for segments and intersections
ENG15	Automate network screening by creating a custom tool or purchase an off-the-shelf tool
ENG 16	Fully integrate HSM procedures into the Development Review Process
	LONG TERM
ENG17	Add curve data into roadway database
ENG18	Incorporate HSM Predictive Method analysis of roadways and intersections
ENG19	Implement network screening using a safety performance function (SPF) based performance measure from the HSM. Use the results to prioritize improvements in the CIP, TSP, and other planning documents

Evaluation

Evaluation efforts area continuous process and will be primarily led by the traffic engineering division and the Safe Communities Program, with support from other departments in the County and external stakeholders.

	EVALUTION
EVAL1	Provide quarterly updates to the Board of County Commissioners on crash occurrence and Safe Communities Program activities.
EVAL2	Work with county departments to create and deploy a comprehensive survey covering transportation related attitudes, behaviors and projects
EVAL3	Evaluate the effectiveness of the Safety Culture work group by way of outcomes that are measurable and sustainable
EVAL4	Review crash and safety related data on an annual basis with respect to TSAP goals
EVAL5	Refine and review other datasets to determine if emphasis area crashes are being reduced and experiencing changing trends

Incorporating Safety into Existing Sections

The following provides suggested language that can be incorporated into existing sections of the Comprehensive Plan.

GENERAL TRANSPORTATION GOALS

Add the following goal:

- As part of initiating a Safety Culture, the County will work collaboratively with state, regional, and local agencies and County residents to reduce the number of fatalities and serious injuries on roadways in Clackamas County by one-half in the next 10 years. Based on the 2005-2009 average number of fatalities and serious injuries due to crashes, this corresponds to saving 16 lives and preventing 125 serious injuries annually at the completion of the program.

ROADWAYS

Add the following text to the following subsections:

Needed Roadway Improvements

Modify Policy 7.0 as follows (*modified text in italics*):

- Fund and build the roadway improvements needed to accommodate and appropriately manage future traffic demands for the next 20 years *and reduce fatality and serious injury crashes…*

Improvements to Serve Development

Modify Policies 15.0, 21.0, 22.0, 24.0, and 26.0 as follows (*modified text in italics*):

- 15.0 - …off-site improvements for new developments and land divisions necessary to *safely* handle expected traffic loads and travel by alternative modes.
- 21.0 - …improve circulation *and safety*…
- 22.0 - …decreases average trip length *and improves safety*.
- 24.0 - …and speeds *in order to improve roadway safety.*
- 26.0 - …connectivity. *The owner of private road should demonstrate that access to the private road would not significantly impact the safety of the County road it connects to.*

TRANSIT

Add the following text to the following subsections:

Goals

- Provide safe access to transit stops.

Policies

- Evaluate and improve the safety and comfort of access to transit stops when planning and designing roadway projects.
- Coordinate with TriMet to provide adequate security at light-rail stations and transit centers
- Educate transit riders on how to make themselves visible in the dark

PEDESTRIAN AND BICYCLE FACILITIES

Add the following text to the following subsections:

Policies

- Coordinate with area Safe Routes to School (SRTS) programs to implement improvements and outreach and educational campaigns that will increase the safety of children bicycling and walking
- Explicitly consider pedestrian and bicycle safety when planning and designing roadway improvements
- Work with driver's educational programs to ensure that cyclist and pedestrian awareness is taught to young drivers

Appendix B
Data Analysis Summary Memorandum

Technical Memorandum

To: Kittelson & Associates, Inc.

From: SAIC

Subject: Data Analysis Findings

Date: October 25, 2011

The purpose of this technical memorandum is to provide information gained during the data analysis that outlines trends and significant findings to define the direction for reducing traffic fatalities and serious injuries in Clackamas County. For the purposes of this project the research team analyzed traffic crashes from 2005 to 2009.

Overall Findings

From 2005 to 2009, roadway crashes averaged approximately 3,900 per year on all roadways within the County. As shown in Figure 1, the number of traffic fatalities spiked to a high of 41 in 2005, but leveled over the next 4 years to about 30 per year on all roads.

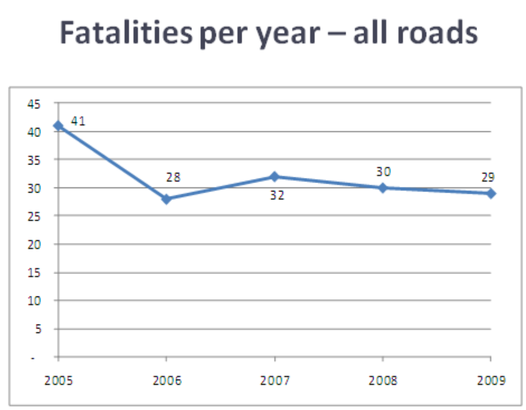


Figure 1. Traffic Fatalities in Clackamas County

County-maintained vs. All Roads. On the County-maintained system, we assumed that both infrastructure and behavioral modifications would be considered as potential treatments to improve safety. On other roadway types not maintained by the County (e.g., city streets, State routes, Interstates), the Transportation Safety Action Plan (TSAP) will include only human behavior-related strategies, as only through behavior modification efforts will the County influence non-county roads. Any infrastructure improvements on these routes would need to be addressed by other jurisdictions (e.g., cities, Oregon DOT).

The data revealed three distinct areas that could benefit from infrastructure and behavioral changes on County-maintained roads: roadway departure, young drivers and aggressive drivers.[1]

[1] Crashes may be attributed to multiple contributing circumstances and overlap into several categories. For this reason, crash type percentages cannot be added cumulatively.

Table 1. Contributing Circumstances to Severe Crashes, 2005-2009

Contributing Circumstances	Fatal/Severe Crashes	Percent of all Fatal/Severe Crashes
Aggressive Driving	221	62%
Young Drivers (15-25)	166	47%
Roadway Departure	157	44%

Intersection Crashes. Data analysis shows that Clackamas County severe intersection crashes were lower than what is typically seen nationally. On County-maintained roads about 3 percent of fatal and severe crashes occurred at intersections. For all roads in the County, 4 percent were at intersections. Nationally, this number is typically between 15 and 20 percent.[2]

Roadway Departure

Roadway departure crashes accounted for 34 percent of all crashes in Clackamas County where fatalities and serious injuries were involved. Roadway departure crashes meet the following criteria:

- Single vehicle non-pedestrian, non-bicycle crashes.
- Head-on crashes and sideswipe crashes where one vehicle was traveling east and one west, or one vehicle was traveling north and one south.
- All other multi-vehicle crashes where one of the first three identified crash events was a fixed object and none of the first three events involved another vehicle.
- Does not include intersection crashes.
- Does not include any other pedestrian or ped/cycle-related crashes.

On Clackamas County-maintained roads, roadway departure crashes were even more common, resulting in 44 percent of fatal and serious injury crashes. Nearly 25 percent of these roadway departure crashes on County roads were collisions with trees.

Within the subset of roadway departure crashes on County-maintained roads, the collision types in the figure below are associated with the highest number of traffic fatalities:

Head-on Crashes. "Head-on + Sideswipe Meeting" fatalities were more than double the percentage of the total that is typically experienced around the country (about 10 percent). This crash type accounted for 21 percent of traffic fatalities on County roads and 23 percent of fatalities on all roadways within the County.

Fixed Object Crashes. Fixed object crashes far exceeded the national average as well, especially on County-maintained roads. On these highways, nearly half (49 percent) of traffic fatalities included the vehicle hitting a fixed object.

[2] FHWA Office of Safety. http://safety.fhwa.dot.gov/intersection/

Table 2. Contributing Circumstances to Roadway Departure Fatalites, 2005-2009

Crash Type	Percentage of Traffic Fatalities, 2005-2009		
	County Maintained Roads	All Roads in County	National Average
Head-on + Sideswipe Meeting	21%	23%	10% [3]
Fixed Object	49%	33%	22% [4]

Aggressive Driving

Aggressive driving was attributed to 57 percent of all fatal or serious injury crashes on all roads in Clackamas County. The breakdown of contributing circumstances to aggressive driving crashes is shown in Figure 2.

On County-maintained roads, aggressive driving crashes were the most common contributing circumstance among crashes involving a fatality or serious injury at 62 percent. Specifically, speeding-related crashes were a significantly higher percentage of crashes on Clackamas County-maintained roads (41 percent) than all routes in the county (31 percent).

Within the subset of fatal and serious aggressive driving crashes on all routes, the most common other circumstances are shown in Table 3.

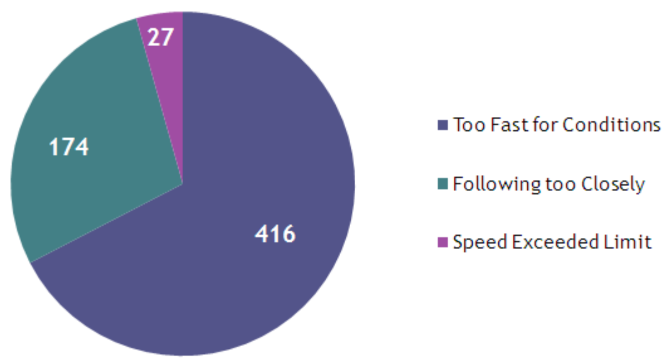


Figure 2. Contributing Circumstances to Aggressive Driving Crashes, 2005-2009

[3] Fatality Analysis Reporting System (FARS), 2005-2009

[4] Insurance Institute for Highway Safety. http://www.iihs.org/research/fatality_facts_2009/fixedObject.html

Table 3. Contributing Circumstances to Aggressive Driving Crashes, 2005-2009

Contributing Circumstance	Fatal/Severe Crashes	Percent of Aggressive Fatal/Severe Crashes
Roadway Departure	252	42%
Young Driver Involved (15-25)	274	45%
Alcohol or Drug Impairment	68	11%

Young Drivers (Ages 15-25)

Young drivers 15 to 25 years of age were involved in 44 percent of all fatal and serious injury crashes occurring on all roads in Clackamas County. On County-maintained roads, the number was even higher: 47 percent.

On all roadways in the county, the subset of fatal and serious young driver crashes included the following contributing circumstances, shown in Table 4.

Table 4. Contributing Circumstances to Young Driver Crashes, 2005-2009

Contributing Circumstance	Fatal/Severe Crashes	Percent of Young Driver Fatal/Severe Crashes
Aggressive Driving	274	61%
Roadway Departure	140	31%
Alcohol or Drug Impairment	45	10%

Appendix C
Countermeasure Summary Sheets

Aggressive Driving Crashes

Aggressive driving is defined by the U.S. Department of Transportation as driving actions that markedly exceed the norms of safe driving behavior and that directly affect other road users by placing them in unnecessary danger.[1] In the data analysis conducted for the Clackamas County TSAP, aggressive driving is defined using the following contributing circumstances from the crash report forms:

- Too fast for conditions
- Following too closely
- Driving in excess of posted speed

Aggressive driving was attributed to 57 percent of all fatal or serious injury crashes on all roads in Clackamas County. The following are recommended countermeasures to address aggressive driving crashes in Clackamas County.

Targeted Corridor Speed Enforcement

Identifying corridors with a history of speed related crashes supports a targeted enforcement and education campaign to reduce the number and severity of speeding crashes. Multiple strategies are available for developing successful targeted enforcement efforts. The National Highway Traffic Safety Administration (NHTSA) outlines planning and implementation of an aggressive driving campaign.[1]
http://www.nhtsa.gov/people/injury/enforce/aggressdrivers/aggenforce/toc.html

Crash type addressed

Aggressive driving crashes related to exceeding the posted speed limit, driving too fast for existing conditions, or driving considerably faster than prevailing travel speeds of other vehicles on the same roadway.

Where to use

Urban or rural corridors with a history of speed related crashes.

Why it works

Targeted enforcement campaigns can include an education component to share with the driving public where and when additional enforcement will be present, thereby changing driving behavior. Combining public education efforts with law enforcement campaigns has been shown to be more effective than individual efforts at improving traffic safety.

Approximate Cost

Enforcement costs vary based on the extent of use, and whether enforcement will consist of the daily activities of law enforcement personnel or used in primarily overtime situations. Grants are available through State's Highway Safety Improvement Programs (HSIP), Strategic Highway Safety Plans (SHSP) and NHTSA-administered funding sources.

Crash Modification Factor [2]

0.65-0.90 for speed related crashes.

---

[1] "Aggressive Driving Enforcement: Strategies for Implementing Best Practices," NHTSA.
http://www.nhtsa.gov/people/injury/enforce/aggressdrivers/aggenforce/toc.html

[2] "Countermeasures That Work: A Highway Safety Countermeasures Guide For State Highway Safety Offices", NHTSA, Sixth Edition, 2011.

Establishing Appropriate Speed Limits

Treatment includes establishing speed limits that are rational and meet driver expectations. Factors that can influence speed limits are:

- 85th percentile speed
- Crash history
- Number and type of ingress/egress points
- On-street parking
- Volume of pedestrians
- Roadway geometrics[3]

Crash type addressed

Aggressive driving crashes related to exceeding the posted speed limit, driving too fast for existing conditions, or driving considerably faster than the prevailing travel speeds of other vehicles on the same roadway.

Where to use

Speed limits are used on all roadways, whether by legislative action or administrative acts from a local agency. Establishing effective speed limits must include the consideration of broad public acceptance, roadway characteristics, active enforcement, and publicity.[4]

Agencies can first establish homogenous speed limits for all congruent sections of roadway, and then address sections with unique design characteristics or specific zoning and special-case issues.

Why it works

Setting speed limits that are in line with driver expectations and acceptance can lead to a change in driver behavior, especially when coupled with public education and enforcement.

Approximate Cost

Limited costs associated with new signage. Costs of enforcement can be applied in the overall estimate.

Crash Modification Factor

The CMF for posting an appropriate speed limit at a location is dependent on the speed limit, ingress/egress points, crash history and severity, and prevailing vehicle speeds before the change.

---

[3] Federal Highway Administration, Report No. FHWA/RD-85/096. July 1985.

[4] Transportation Research Board, 1998.

Signal Retiming and Coordination

Crash type addressed

Aggressive driving crashes attributed to motorists running through the red phase at traffic signals.

Where to use

At any signalized intersection, particularly where red-light running is frequent or the location has experienced a high number of angle crashes.

Why it works

Signal timing that follows ITE guidelines for clearance intervals and/or provides coordination of a signal system reduces the delay experienced by drivers. Reducing delay can lead to less aggressive motorist behavior at traffic signals.

Approximate Cost

Cost for traffic staff to develop and implement signal timing plans.

Crash Modification Factor [5]

0.92 for all crash types for using ITE clearance intervals

0.96 for angle crashes for using ITE clearance intervals

Automated Speed Enforcement

Due to the limitations of law enforcement agencies to be ever-present on a jurisdiction's roadways, technology options are available to support enforcement efforts to curb aggressive driving. One of these tools is the automated speed enforcement system, consisting of a speed collection device (e.g., radar or lidar), a camera to identify the vehicle (and in some cases, the driver), and computer equipment to collect the data and transmit it to the agency. In most cases a citation is sent to violators by mail.

Crash type addressed

Aggressive driving crashes related to exceeding the posted speed limit.

Where to use

Automated enforcement radar equipment is located in places of known speed limit disobedience or at locations where traditional speed enforcement approaches are not an option (e.g., lack of shoulder presence, limited access right of way, lack of ingress/egress locations).

Why it works

In locations known to drivers as having automated speed enforcement, drivers may reduce their speeds to reflect prevailing traffic speeds or speeds near the established speed limit.

Approximate Cost

Cost varies. Equipment can be purchased, leased or used from a contractor in exchange for a share of the revenues.[6]

Crash Modification Factor [7]

0.84 for speed-related crashes with the installation of speed enforcement cameras.

---

[5] http://www.cmfclearinghouse.org

[6] "Speed Enforcement Camera Systems and Operational Guidelines", NHTSA and FHWA, 2008.

[7] "Estimating the Longer Term Safety Effects of Speed Enforcement Cameras in Charlotte, NC", Moon and Hummer, Jan 2010.

Automated Red Light Enforcement

Crash type addressed

Aggressive driving crashes attributed to motorists running through red signal indications at traffic signals.

Where to use

Automated enforcement equipment can be used at intersections where red light running is a known problem or at locations where traditional enforcement approaches are difficult or risky (e.g., requiring an officer to run the red light himself/herself to catch a violator up ahead).

Why it works

In locations known to drivers as having automated red-light enforcement, drivers are more aware of the need to obey the signal indication. In some cases other non-automated signals have also experienced a reduction in red light running crashes.

Approximate Cost

Cost varies. Options for system operation and citation processing functions include agency owned/operated, contractor owned/operated or agency owned/contractor operated.[8]

Crash Modification Factor [9]

0.79 for angle crashes

1.18 for rear-end crashes. It is important to consider this trade off, as the total number of crashes at an intersection may increase. However, severe crashes are likely to decrease.

Public Education of Automated Enforcement Methods

Crash type addressed

All aggressive driving crashes that are speed and red light running related.

Where to use

County-wide.

Why it works

When tied to enforcement action, public information campaigns are shown increase compliance with existing speed limit and red light laws.

Approximate Cost

Varied based on the use of free public education advertisements or paid advertising campaigns

Crash Modification Factor [10]

0.90 for media coverage of installation of speed or red-light running enforcement cameras (can be applied in addition to the CMF for speed or red-light running enforcement cameras)

[8] "Red Light Camera Systems Operation Guidelines", NHTSA & FHWA, 2005.

[9] Table 14-28: Potential Crash Effects of Installing Red Light Cameras at Intersections, Highway Safety Manual, 2010.

[10] "Estimating the Longer Term Safety Effects of Speed Enforcement Cameras in Charlotte, NC", Moon and Hummer, Jan 2010.

Young Driver Crashes

Young drivers 15-25 years of age are a vulnerable motorist group, as they have relatively little experience with handling the tasks of operating a vehicle and applying newly-acquired driving skills, especially with the number of in-vehicle distractions (e.g., radio, GPS, cell phones, passengers) present on most trips. In Clackamas County, young drivers stand to benefit significantly from roadway departure and aggressive driving countermeasures, given that nearly 50 percent of both types of crashes involve young drivers. In addition, the following targeted safety strategies could provide an additional benefit to young driver safety in the county.

Enforcement of Graduated Driver Licenses (GDL) and Zero Tolerance Laws

Public education of the laws regarding GDL and Zero Tolerance – combined with education of law enforcement personnel and aggressive, targeted enforcement – have the potential to reduce young driver crashes associated with impaired driving, distracted driving, drowsy driving, and risky behaviors such as speeding and non-compliance with traffic control.

Crash type addressed

Impaired driving, distracted driving, drowsy driving, speed-related crashes and crashes associated with driver inexperience.

Where to use

Large scale deployment of this strategy throughout the county will provide the greatest benefit.

Why it works

Holding young drivers accountable for the responsibilities associated with possessing a driver's license has been documented to effectively lower young driver crashes.

Approximate Cost

Varied based on the use of free public service announcements or paid advertising campaigns. Enforcement of GDL and zero tolerance laws can be integrated into existing enforcement detail, therefore requiring little additional costs.

Crash Modification Factor

Studies have shown that enforced GDL restrictions effectively reduce crashes involving young drivers between 20-40 percent.[1]

---

[1] http://www.nsc.org/safety_road/TeenDriving/Documents/7-9500KeyGDLInfluences.pdf

The Role of Parents and Formal Driver Education

Parents:

Parents have an important role in youth driving. Each hour of instruction keeps teens more safe on the road, especially as they pass through the later stages of graduated licensing and leave parent supervision. Provisional license requirements include a minimum of 50 hours of supervised driving and approved traffic safety education course OR at least 100 hours of supervised driving. As well as supervising driving, parents should thoroughly understand Oregon's Graduated Driver Licensing (GDL) laws, establish family driving rules and limits, and set a good example for new drivers.

Driver Education:

A study completed in Oregon in 2005, reviewed teen driving records including 16, 17, 18, and 19-year old drivers and compared teens who took a formal driver education course to those who chose 100 hours of driving practice with their parents. Teens who took the formal driver course had a lower crash rate, lower traffic conviction rate, and lower driver suspension rate.[2]

In 2012, the Oregon Department of Transportation – Transportation Safety Division implemented the "Why Drive with Ed" campaign focused on parents with pre-licensed children to invoke parent engagement in the value of driver education. More information can be found at: www.whydrivewithed.com.

Crash type addressed

Distracted driving, driving under the influence, and most other crash types. Additionally, lower citation and suspension rates for youth drivers who complete a formal driver education course.

Where to use

Large scale deployment of this strategy throughout the county will provide the greatest benefit.

Why it works

Studies have shown students who take a formal driver education course experience a:

- reduced crash rate of 11-21%,
- reduced traffic conviction rate of 39-57%
- reduced driver license suspension rate of 51-53%[3]

Approximate Cost

Oregon's Approved Driver Education Program reimburses schools that meet approved program requirements (approved curriculum; trained, qualified teachers; etc.) up to $210 per student as a means to reduce the overall cost to parents. The tuition assistance for students who meet the following criteria:

- Obtain a current Oregon instruction permit by the first day of class.
- Complete the course before receiving their driver's license and before turning 18.
- Complete all course work within 90 days of starting the class.

[2] "The Oregon Parent Guide to Teen Driving." Oregon Department of Transportation.
[3] Ibid

Enforcement of Primary Seatbelt Law

Crash type addressed

The severity of all crash types is reduced by seatbelt use.

Where to use

Large scale deployment of this strategy throughout the county will provide the greatest benefit.

Why it works

Numerous studies show a reduction in the severity of injuries that drivers and passengers sustain when involved in crashes.

Approximate Cost

Enforcement of the primary seatbelt law can be integrated into existing enforcement detail, therefore requiring little additional costs.

Crash Modification Factor

When lap/shoulder safety belts are used properly, they reduce the risk of fatal injury to front-seat occupants riding in passenger vehicles by 45 percent and the risk of moderate-to-critical injury by 50 percent.[4]

Social Norming

Crash type addressed

Crashes involving high-risk behavioral choices made by drivers (e.g., driving while impaired and distracted driving).

Where to use

County-wide. Campaigns can be used in media or through school programs.

Why it works

Social norming campaigns are built on the premise that an individual's behavior is influenced by his or her perceptions of how most people behave. [5] By addressing issues that young drivers face with correct statistics, rather than myths, misperceptions, or facts that have been misconstrued, drivers are less likely to submit to the risky behavior involved in the campaign.

For example, surveys of young adults age 21 to 34 in Montana revealed that only 20 percent of respondents had driven in the previous month after consuming two or more alcoholic drinks, although more than 90 percent thought their peers had done so. Based on this finding, a paid media campaign was developed with the normative message, "Most Montana Young Adults (4 out of 5) Don't Drink and Drive." By the end of the campaign, there was a 13.7 percent decrease in young adults who reported driving after drinking.[4]

Approximate Cost

Varies based on the methods used to communicate the campaigns.

---

[4] http://www.nhtsa.gov/people/injury/airbags/occupantprotectionfacts/restraint.htm, NHTSA.
[5] "Countermeasures That Work: A Highway Safety Countermeasures Guide For State Highway Safety Offices", NHTSA, Sixth Edition, 2011.

Stricter Enforcement of No Texting While Driving/Hands Free Law

Oregon has banned the use of text messaging and handheld cell phones by all drivers, with hands-free attachments allowable only for those over 18 years of age. For drivers under the age of 18 with learner's permits or intermediate licenses, the ban applies to all cell phone use, regardless of whether a hands-free device is employed.

Crash type addressed

Crashes involving distracted driving.

Where to use

County-wide. Enforcement of this law can be incorporated into routine enforcement strategies.

Why it works

Strict enforcement of laws can reduce undesirable driver behavior. Reducing the number of distractions allows a driver to focus his or her attention on the operation of their vehicle and make timely adjustments to changing road conditions.

Approximate Cost

Enforcement of the hands free law can be integrated into existing enforcement detail, therefore requiring few additional costs.

Roadway Departure Crashes

Curves: Advanced Curve/Turn Warning Signs and Chevrons

Treatments include basic warning signs, chevron delineation signs, and advisory speed plaques. Additional elements, including doubled-up advanced warning signs and fluorescent sign sheeting, can enhance conspicuity of the curve/turn.

Crash type addressed

Roadway departure crashes attributed to motorists running off the road while attempting to negotiate a curve or turn in the roadway. In some situations, the driver was not aware they were approaching a curve or turn.[1]

Where to use

Any curve or turn with a history of roadway departure crashes, and curves or turns with risk factors (e.g., unusual geometry, superelevation concerns, sharp radius).

Addressing curves based on the advisory speed criterion, as a minimum, will be required to meet the the 2009 MUTCD. According to Table 2C-5, warning signs are required on curves or turns where the advisory speed is 10 mph less than the posted speed. Alignment delineation (chevrons) or a one direction large arrow sign is required on curves or turns where the advisory speed is 15 mph less than the posted speed limit.

Why it works

Installing warning signs and chevrons provides information to motorists before they enter the curve, giving them a chance to reduce their approach speed as they enter the new horizontal alignment. Advisory speed plaques provide additional information about the relative "sharpness" of the curve or turn.

Approximate Cost

$5,000 per curve

Crash Modification Factor[2]

0.70 for curve crashes

Curves: Flashing Beacons

A flashing beacon is typically placed above one or more advanced warning signs approaching a horizontal curve or turn.

Crash type addressed

Roadway departure crashes attributed to motorists running off the road while attempting to negotiate a curve or turn in the roadway. In some situations, the driver was not aware he or she was approaching a curve or turn.

Where to use

Any curve or turn with a very high number of roadway departure crashes, or a location that has not responded to basic and enhanced signing treatments.

Why it works

Flashing beacons can provide enhanced information to motorists before they enter the curve, giving them a chance to modify their approach speed as they enter the new horizontal alignment.

[1] Curve is typically defined as horizontal alignment measured above 30mph; a turn is typically defined as 30mph or below.
[2] Toolbox of Countermeasures and Their Potential Effectiveness for Roadway Departure Crashes," FHWA, 2008.

Approximate Cost

$7,000 per curve

Crash Modification Factor[3]

0.85 for curve crashes (can be applied in addition to the CMF for signing treatments)

Pavement Marking (Centerline and Edgeline)

Crash type addressed

Roadway departure crashes attributed to motorists running off the right side of the road, crossing the center line, or dropping off the roadway on an edge drop-off. Contributing circumstances include speed, inattention, and impairment.

Where to use

Any road is a candidate for this basic treatment – particular those with a history of run-off-road right, head-on, opposite-direction-sideswipe, or run-off-road-left crashes. Depending on the width of the roadway, various combinations of edge line and/or center line pavement markings may be the most appropriate.

Why it works

Pavement markings provide motorists important guidance information regarding the edge of the traveled way on the right and the location of the opposing lane on the left. When used around curves, pavement markings can serve as curve delineation.

Approximate Cost

$2,000/lane mile

Crash Modification Factor[4]

0.67 (all crashes) for centerline markings

0.56-0.62 (all crashes) for edgeline markings

Rumble Strips

Crash type addressed

Run-off-road-right, run-off road-left, and head-on crashes attributed to a vehicle leaving its lane of travel. Contributing circumstances include speeding, impaired driving, and inattention.

Where to use

Center line rumble strips/stripes can be used on virtually any roadway – especially those with a history of head-on crashes. Shoulder and edge line milled rumble strips/stripes should be used on roads with a history of roadway departure crashes.

In order to receive the full benefit, an agency should consider applying rumble strips/stripes systematically along an entire route instead of only at spot locations. For all rumble strips/stripes, pavement condition should be sufficient to accept milled rumble strips. For shoulder rumble strips, FHWA recommends a minimum 4 ft. shoulder. In situations

[3] Toolbox of Countermeasures and Their Potential Effectiveness for Roadway Departure Crashes," FHWA, 2008.
[4] "Toolbox of Countermeasures and Their Potential Effectiveness for Roadway Departure Crashes," FHWA, 2008.

where shoulder width is not sufficient, an agency should consider edgeline rumble stripes (or mini-rumble stripes of 4 to 6 inches in width).

Why it works

Rumble strips provide an auditory indication and tactile rumble when driven on, alerting drivers that they are drifting out of their travel lane, giving them time to recover before they depart the roadway or cross the center line.

Approximate Cost

Edge line: $6,000 per mile

Center line: $3,000 per mile

Crash Modification Factor[5]

Shoulder/Edge line: 0.71 for severe run-off-road crashes

Centerline: 0.54 for severe head-on crashes

Alignment Delineation

Alignment delineation refers to Raised Pavement Markers (RPMs), and delineators on roadside objects (e.g., guard rail, cable barrier, concrete barrier)

Crash type addressed

Roadway departure crashes attributed to a vehicle leaving the traveled way. Contributing circumstances include speeding, impaired driving, and inattention.

Where to use

RPMs and other methods to delineate the alignment of the roadway for night driving should be considered on all sections of highway, with a focus on those sections that have high incidences and proportions of crashes in dark conditions.

Why it works

Alignment delineation provides information about the alignment of the roadway and the location of the lane to motorists, allowing them to stay in their lane.

Approximate Cost

$5,000 per mile on average, but varies based on product used.

Crash Modification Factor[6]

0.75 - 0.96 for dark crashes, depending on the delineation used and the detailed crash history.

---

[5] NCHRP Report 641 - Guidance for the Design and Application of Shoulder and Centerline Rumble Strips

[6] Highway Safety Manual

High Friction Surface Treatment

High friction treatments include epoxy-based, microsurface, or chip seal overlays applied to the surface of the roadway.

Crash type addressed

Roadway departure crashes attributed to motorists sliding off the roadway. This treatment is most applicable in situations where the crashes have occurred on wet pavement.

Where to use

High friction treatments can address spot locations (e.g., a single curve, interchange ramp, bridge, or short roadway section). It should be used at locations with severe slick conditions that could benefit from increased friction. These locations can be identified by the history of wet pavement crashes and/or friction data collected on the roadway system.

Why it works

Vehicles often leave the road due to lack of friction – especially in wet conditions when water gets between the tires and pavement causing hydroplaning. The epoxy overlay can reduce the number of wet crashes by improving friction at specific locations of need.

Approximate Cost

$50,000 per location, but varies based on product used (e.g., epoxy, thin lift overlay)

Crash Modification Factor[7]

0.57 for wet pavement-related crashes

Fixed Objects (Trees, Utility Poles)

Crash type addressed

Roadway departure crashes attributed to vehicles striking a fixed object on the side of the roadway. Common examples include trees and utility poles.

Where to use

Depending on the situation, fixed objects on any roadway should be addressed in the following prioritized order:

1. Remove the obstacle.
2. Redesign the obstacle so it can be safely traversed.
3. Relocate the obstacle to a point where it is less likely to be struck.
4. Reduce impact severity by using an appropriate breakaway device.
5. Use impact attenuation devices to shield the obstacle, reducing crash severity.
6. Protect the driver through redirection of the errant vehicle.
7. Mark the object to provide motorist information.

Regarding trees and utility poles, locations for removal/relocation should be prioritized based on crash history and crash risk. In these cases, risk is typically defined as proximity to the roadway and exposure, with closer fixed objects and sections with high traffic volumes having a higher risk.

[7] Highway Safety Manual

Why it works

Removing, redesigning, marking, or relocating the fixed object reduces the likelihood of a crash. If a crash occurs, adding breakaway features, crash cushions, or redirection devices reduces crash severity.

Approximate Cost

$25,000/mile for tree or utility pole removal/relocation

Crash Modification Factor[8]

0.29 (run-off road crashes) for removing or relocating fixed objects outside the clear zone.

[8] Toolbox of Countermeasures and Their Potential Effectiveness for Roadway Departure Crashes," FHWA, 2008.

Intersections

Signing and Marking Improvements at Stop-controlled Intersections

Treatments include advanced warning signs for major and minor road motorists, double-up Stop signs on the minor approach, and intersection pavement marking to increase conspicuity.

Crash type addressed

Right-angle and rear-end crashes attributed to drivers unaware of the intersection.

Where to use

Unsignalized intersections not clearly visible to approaching motorists, especially approaching motorists on the major road. The strategy is particularly appropriate for intersections with patterns of rear-end, right-angle, or turning crashes related to lack of driver awareness of the presence of the intersection.

Why it works

Installation of signing in advance of and at intersections will provide approaching motorists with additional information at these locations. Drivers should be more aware that the intersection is coming up, and therefore make informed decisions as they approach the intersection.

Approximate Cost

$6,000 per intersection

Crash Modification Factor[9]

0.70 for all intersection-related crashes

Flashing Beacons at Stop-controlled Intersections

Flashing beacons are typically placed on top of the advanced warning signs and/or the Stop signs. In some cases they can be actuated to detect approaching vehicles.

Crash type addressed

Right-angle and rear-end crashes attributed to drivers unaware of the intersection or failing to stop at the Stop sign.

Where to use

Unsignalized intersections with patterns of right-angle crashes related to lack of driver awareness of the intersection on an uncontrolled approach and lack of driver awareness of the Stop sign on a stop-controlled approach.

Why it works

Flashing beacons indicate the presence of an intersection and can be effective in rural areas where there may be long stretches between intersections; they can also help at locations where nighttime visibility of intersections is an issue.

Approximate Cost

$15,000 per intersection

Crash Modification Factor[10]

0.91 for all intersection related crashes (can be applied in addition to the CMF for signing and marking improvements)

[9] Toolbox of Countermeasures and Their Potential Effectiveness for Roadway Departure Crashes," FHWA, 2008.
[10] Toolbox of Countermeasures and Their Potential Effectiveness for Roadway Departure Crashes," FHWA, 2008.

Basic Sign and Signal Improvements at Signalized Intersections

This treatment can consist of any or all of the following:

- Back plates for all signal heads (may be reflectorized).
- 12-inch LED lenses and at least one signal head per approach lane.
- Signal clearance timing in accordance with Institute of Transportation Engineers (ITE) clearance formula.
- Elimination of flashing operation during night conditions.

Crash type addressed

Signalized intersection crashes attributed to drivers unaware of the intersection or failing to stop at the traffic signal.

Where to use

Signalized intersections with patterns of right-angle or rear-end crashes or risk of this type of crash due to sight distance or other conspicuity issues.

Why it works

The combination of this set of low-cost countermeasures provides additional information to the driver that a signal is ahead, and provides adequate clearance time for a vehicle entering at the end of green to clear the intersection.

Approximate Cost

Up to $30,000 per intersection, depending on the number and type of treatments selected.

Crash Modification Factor[11]

0.70 for all intersection-related crashes

Change Permitted/Protected Left Turns to Protected Only

A permitted/protected left turn signal indication provides for a protected left arrow during part of the signal cycle, and a permitted signal (typically a green ball or flashing yellow arrow) during another part of the cycle. This treatment converts the permitted portion of the left turn phase to protected-only.

Crash type addressed

Left turn crashes attributed to a left-turning driver pulling out in front of a conflicting through movement.

Where to use

Any signalized intersection that has permitted/protected left turn signal phasing – particularly those with a history of left-turn crashes. An operational analysis may be needed to identify potential effects on vehicle delay.

Why it works

Turning left on a permitted green signal indication is a difficult maneuver that requires a driver to be watching multiple things at the same time (e.g., traffic signal indication, approaching vehicles, pedestrians in the crosswalk, vehicles in the desired lane). Providing a protected movement for the left-turning motorists reduces the complexity of this maneuver, and removes the need for depth perception of oncoming traffic.

[11] Toolbox of Countermeasures and Their Potential Effectiveness for Roadway Departure Crashes," FHWA, 2008.

Approximate Cost

$15,000 per intersection

Crash Modification Factor[12]

0.52 for multi-vehicle left turn crashes

Pedestrian Improvements

Pedestrian treatments at intersections can include the following:

- Pedestrian countdown signals.
- Crosswalks (if none exist) in some situations.[13]
- Warning signs for active pedestrian crossings.
- Potential elimination of the permissive portion of any protected/permissive turning operation phase that creates substantial conflicts with crossing pedestrians.

Crash type addressed

Pedestrian-related crashes at stop-controlled and signalized intersections.

Where to use

Intersections with a history of pedestrian crashes, known pedestrian activity, and/or other risks of pedestrian crashes.

Why it works

Crosswalks and warning signs provide conspicuity of pedestrians to motorists. Countdown signals give pedestrians more information about the safest times to cross. Protected-only left turns reduce the number of conflicts between pedestrians and vehicles.

Approximate Cost

Up to $30,000 per intersection, depending on the treatment chosen.

Crash Modification Factor[14]

0.60 for pedestrian-related crashes

Lighting Installation or Upgrade

Crash type addressed

Intersections crashes occurring in low-light or dark conditions.

Where to use

Unlit intersections with substantial patterns of nighttime crashes. In particular, patterns of rear-end, right-angle, or turning crashes on the major road approaches may indicate that approaching drivers are unaware of the presence of the intersection.

---

[12] Toolbox of Countermeasures and Their Potential Effectiveness for Roadway Departure Crashes," FHWA, 2008.

[13] Note that there are situations where crosswalks alone are not considered beneficial for safety (*Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations,* Zegeer, 2005)

[14] Toolbox of Countermeasures and Their Potential Effectiveness for Roadway Departure Crashes," FHWA, 2008.

Why it works

In many situations the only source of lighting for roadways is provided by vehicle headlights. Roadway lighting allows for greater visibility of the intersection which makes the intersection more conspicuous to motorists and provides aid in helping drivers determine their paths through the intersection by making signs and markings more visible.[15]

Approximate Cost

$15,000 per intersection

Crash Modification Factor[16]

0.50 for dark crashes

High Friction Surface Treatment at Intersections

High friction treatments include epoxy-based, microsurface, or chip seal overlays applied to the surface of the intersection approaches.

Crash type addressed

Intersection crashes attributed to motorists sliding on wet pavement.

Where to use

Epoxy-based, microsurface, or chip seal overlays can address intersection approaches. The treatment should be used at locations with severe slick conditions that could benefit from increased friction.[17]

Why it works

Vehicles often lose control of their vehicle or are unable to stop due to lack of friction – especially in wet conditions when water gets between the tires and pavement causing hydroplaning. The epoxy overlay can reduce the number of wet crashes by improving friction at specific locations of need.

Approximate Cost

Varies based on product (e.g., epoxy, thin lift overlay)

Crash Modification Factor[18]

0.50 for wet pavement-related intersection crashes

---

[15] Though not directly addressed, there is anecdotal evidence that installing lighting at intersections can also reduce daytime crashes, as the light poles themselves make the intersection more conspicuous from a distance.
[16] Toolbox of Countermeasures and Their Potential Effectiveness for Roadway Departure Crashes," FHWA, 2008.
[17] Rear-end crashes may not indicate a friction problem, but some other issue, including sight distance limitations or traffic signal clearance interval issues.
[18] Toolbox of Countermeasures and Their Potential Effectiveness for Roadway Departure Crashes," FHWA, 2008.

Appendix D
Information on Additional Programmatic Areas

APPENDIX D – NETWORK SCREENING

Network screening is discussed in Part B of the HSM and describes and applies Safety Performance Functions (SPFs) and Empirical Bayes (EB) methods to estimate expected crash frequency. The HSM also describes the concept of Regression to the Mean (RTM) in considering the random and varying nature of crash frequency over time. These terms are described briefly as follows:

- *Safety Performance Function*: A nonlinear regression equation that provides a base prediction of the number of crashes per year based on traffic volumes and basic roadway or intersection information (i.e. length of segment, number of travel lanes, median type, number of intersection legs, and type of intersection control).
- Empirical Bayes: A statistical method that ties the observed crash frequency history at a site to the predicted crash frequency; thereby accounting for RTM bias.
- Regression to the Mean: The tendency for extreme measures of crash frequency measures in one period to return toward an average condition in the next period. Failing to account for this is called "Regression to the Mean Bias." This concept is illustrated in Figure D-1.

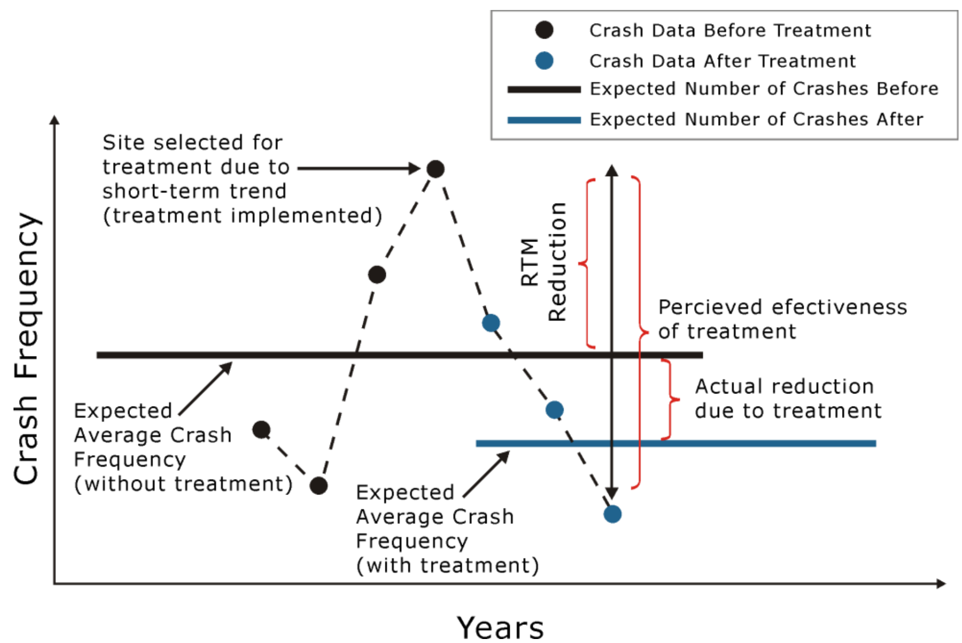


Figure D-1 - Accounting for RTM is important to accurately identify high crash locations and measure the benefit of implemented countermeasures.

Figure Source: Highway Safety Manual, 1st Edition

THE FIVE STEPS

Chapter 4 of the HSM describes the following five steps of network screening:

Step 1: Establish Focus – An agency establishes its goal in screening its network, whether it is to identify sites with the greatest potential for crash frequency or severity reduction or to identify sites with specific crash types or severity to address with a systematic treatment (e.g., run-off-the-road crashes for rumble strip installation).

Step 2: Identify Network & Establish Reference Population – Based on the purpose defined in the first step, the agency selects the roadway elements to be screened. Roadway elements covered by the HSM include intersections, segments, facilities (segments and intersections combined), ramps, ramp terminal intersections, and at-grade rail crossings). The study sites would be grouped into reference populations by defining attributes. This could be specific elements of a certain type or they could be defined by similar characteristics (e.g., traffic control, functional classification, cross-section, traffic volumes, etc…).

Step 3: Select Performance Measures – The measure, or measures, that would be used to evaluate the potential to reduce crash frequency or severity are selected. The HSM discusses thirteen performance measures that are summarized later in this section. Three key criteria to consider when selecting a performance measure are: 1) data requirements of the measure compared to available data, 2) stability of the results produced by the measure (i.e. the degree to which the measure accounts for Regression-to-the-Mean Bias), and 3) whether the measure provides a performance threshold to which the results can objectively be compared. The screening would likely be the most effective if readily available or collectable data allows the agency to use a stable measure (minimizing the effect of the randomness of crashes) that provides a performance threshold.

Step 4: Select Screening Method – The HSM recommends using either the sliding window or peak searching methods for screening roadway segments and the simple ranking method for screening intersections. A combination of methods should be used when examining a facility.

Step 5: Screen and Evaluate Results – Order the reference population being examined by the selected performance measure and identify sites for further study for countermeasure application.

PERFORMANCE MEASURES

The HSM contains thirteen performance measures that can be used for network screening. Table D-1 summarizes the measures in the general order of their statistical reliability and whether they provide a performance threshold. In the near term (0-5 years) the County could consider augmenting the SPIS information with another or other performance measures that use currently readily available information accessible by the County. Over time and as the County integrates or supplements its roadway, traffic, and safety data it could incorporate more robust performance measures. Considering the long term, the County could target its desired network screening performance measures and begin collecting roadway, traffic, and safety data that support the long term vision. More information on each measure, including specific strengths and weaknesses can be found in Chapter 4 of the HSM.

Table D-1 Network Screening Performance Measures

Performance Measure	Data Requirements	Accounts for RTM Bias	Provides a Performance Threshold	Potential County Application
Average Crash Frequency	• Crash Data • Basic Roadway Information to Develop Comparison Groups (e.g., type of intersection control)	No	Average Crash Frequency	Considered in the SPIS
Crash Rate	• Crash Data • Basic Roadway Information to Develop Comparison Groups (e.g., type of intersection control) • Traffic Volume	No	Crash Rate	Considered in the SPIS
Equivalent Property Damage Only (EPDO) Average Crash Frequency	• Crash Data • Basic Roadway Information to Develop Comparison Groups (e.g., type of intersection control)	No	Equivalent Property Damage Only (EPDO) Average Crash Frequency	Near term
Relative Severity Index	• Crash Data • Basic Roadway Information to Develop Comparison Groups (e.g., type of intersection control)	No	Relative Severity Index	Near term
Critical Rate	• Crash Data • Basic Roadway Information to Develop Comparison Groups (e.g., type of intersection control) • Traffic Volume	No, but accounts for some variance	Critical Rate	Near term
Excess Predicted Average Crash Frequency Using Method of Moments	• Crash Data • Basic Roadway Information to Develop Comparison Groups (e.g., type of intersection control) • Traffic Volume	No, but accounts for some variance	Excess Predicted Average Crash Frequency Using Method of Moments	Long term
Level of Service of Safety	• Crash Data • Specific Site Characteristics • Traffic Volume • Calibrated SPF and Over dispersion Parameters	No, but accounts for some variance	Level of Service of Safety	Long term
Excess Predicted Average Crash Frequency Using SPFs[1]	• Crash Data • Specific Site Characteristics • Traffic Volume • Calibrated SPF and Over dispersion Parameters	No	Excess Predicted Average Crash Frequency Using SPFs[1]	Long term
Probability of Specific Crash Types Exceeding Threshold	• Crash Data • Basic Roadway Information to Develop	Accounts for variance in data; Not	Probability of Specific Crash Types	Mid term

Performance Measure	Data Requirements	Accounts for RTM Bias	Provides a Performance Threshold	Potential County Application
Proportion	Comparison Groups (e.g., type of intersection control)	affected by RTM[3]	Exceeding Threshold Proportion	
Excess Proportion of Specific Crash Types	• Crash Data • Basic Roadway Information to Develop Comparison Groups (e.g., type of intersection control)	Accounts for variance in data; Not affected by RTM[3]	Excess Proportion of Specific Crash Types	Mid term
Expected Average Crash Frequency with EB[2] Adjustment	• Crash Data • Specific Site Characteristics • Traffic Volume • Calibrated SPF and Over dispersion Parameters	Yes	Expected Average Crash Frequency with EB[2] Adjustment	Long term
EPDO Average Crash Frequency with EB Adjustment	• Crash Data • Specific Site Characteristics • Traffic Volume • Calibrated SPF and Overdispersion Parameters	Yes	EPDO Average Crash Frequency with EB Adjustment	Long term
Excess Expected Average Crash Frequency with EB Adjustment	• Crash Data • Specific Site Characteristics • Traffic Volume • Calibrated SPF and Overdispersion Parameters	Yes	Excess Expected Average Crash Frequency with EB Adjustment	Long term

[1]SPF: Safety Performance Function
[2]EB: Empirical Bayes
[3]This method calculates the probability of a specific crash type being higher than its long-term expected value. It is essentially calculating the probability of that the over representation of a specific crash type is due to site characteristics and not RTM.

As Table D-1 shows, each measure requires at least crash data and some degree of roadway information. Other measures apply traffic volumes and/or SPFs calibrated to local conditions along with overdispersion parameters. Generally speaking, as data requirements intensify, the measures become more stable (i.e. less statistically biased). The table also provides a general sense of how these performance measures may be applicable to the County in the near, mid, and long term future.

The measures currently used in the SPIS (weighted crash frequency and rate) are found in the top part of Table D-1. They require limited data, but are susceptible to RTM bias and do not establish a performance threshold. Advancing the County's safety analysis practices would be based on moving beyond these current measures to more stable measures.

The most stable measures require SPFs calibrated to local conditions using a locally developed calibration factor or a locally developed SPF. ODOT has developed local calibration factors for State highways the County could use. Since the ODOT factors will be available shortly (currently anticipated to be early-mid 2012), the County has the opportunity to begin transitioning to using SPF-based measures. However, using these measures will be more data and time intensive than the current measures. Over time, and if the County integrates its roadway, traffic, and safety, data, future safety analyses might be conducted in an efficient and effective manner.

Interim steps could include using the method of moments, probability of specific crash types, excess proportion of specific crash types, or critical rate performance measures. The probability of specific crash types and excess proportion measures could be particularly valuable given the specific emphasis areas identified previously. For instance, either method could be run network-wide for a specific crash type (e.g. run off the road crashes) to develop a prioritized list of locations for that crash type. Similarly for young drivers or alcohol involved crashes either measure could be used to identify what locations are overrepresented, which could identify locations to increase enforcement.

QUANTITATIVE SAFETY ANALYSIS METHODS

The HSM allows for quantitative safety analysis. Part C of the HSM covers the Predictive Method in detail. Part C allows analysts to predict the expected average crash frequency in terms of crashes per year for a road segment or intersection based on traffic volumes, geometric features, and a local calibration factor. This is accomplished by using a SPF to provide a base estimate based on traffic volumes and road segment length or intersection control and number of legs; followed by applying crash modification factors (CMFs) to adjust the base prediction for site-specific characteristics (e.g., median width, presence of turn lanes); and then, since the models are based on national data, a local calibration factor would adjust the results to account for local conditions (e.g., weather, driver behavior. If the analysis is being performed on an existing roadway, historical crash data can then be used to further adjust the predicted crash frequency to arrive at the expected average crash frequency. This weighting methodology uses a statistical method called Empirical Bayes.

The HSM also contains a number of CMFs in Part D of the manual that can be used on their own to estimate the change in crash frequency that is expected to occur with implementation of an improvement (e.g. converting a signal to a roundabout has a CMF of 0.40 and a standard error of 0.1 for injury crashes, meaning that a roundabout would be expected to reduce injury crashes by approximately 20-60%). In addition to the CMFs found in the HSM, FHWA maintains a clearinghouse of CMFs that is updated regularly at www.cmfclearinghouse.org. Each CMF is given a quality rating based on a five-star scale with five-stars being the most reliable and statistically sound CMFs. ODOT has recommended using only CMFs of four stars or greater.

The Predictive Method can be used on existing facilities as well as planned improvements and new roadways. Crash randomness (RTM Bias) can be accounted for in an existing crash conditions analysis by using the Predictive Method in conjunction with local crash data as described in the HSM. This provides a more reliable way of determining whether or not location is experiencing more crashes than would be expected than a simple review of crash frequency, rate, or severity. As was mentioned in the section above, this method can also be used to identify high crash locations in a more reliable manner than a traditional "Black Spot" or SPIS analysis.

The Predictive Method can also be used to quantitatively compare alternative improvement options for a segment and/or intersection for an existing or new roadway. Alternatives can then be compared according to the differences in expected average crash frequency or by using a benefit-cost calculation to better compare projects of different cost magnitudes.

As was mentioned in the Network Screening section above, using the Predictive Method's SPFs requires more data than a traditional crash frequency, rate, or severity analysis. Fortunately, the County already collects much of the data required to implement the HSM. Additional data that would be needed in RIMS to automate analyses for roadway segments includes:

- Lane width (rural two-lane roads)
- Curve data (rural two-lane roads)
- Grade (rural two-lane roads)
- Presence of rumble strips (rural two-lane roads)
- Presence of a passing lane (rural two-lane roads)
- Two-way left-turn lane presence (rural two-lane roads and urban/suburban arterials)
- Roadside hazard rating (rural two-lane roads)
- Presence of automated speed enforcement (all roads)
- Presence of roadway lighting (all roads)
- Sideslope (rural multi-lane roads)
- Lane designations (urban/suburban arterials)
- Presence of a depressed median (urban/suburban arterials)
- On-street parking (urban/suburban arterials)
- Driveway type/size information (urban/suburban arterials)
- Roadside fixed object density and average offset (urban/suburban arterials)
- Speed (urban/suburban arterials)
- Additional data that would be needed in RIMS to automate analyses for intersections includes:
- Intersection control (all roads)
- Skew angle (all rural roads)
- Presence of turn lanes on free-flowing or signalized approaches (all roads)
- Presence of lighting (all roads)
- Pedestrian crossing distance (urban/suburban arterial signalized intersections)
- Approaches for which right-turns on red are prohibited (urban/suburban arterial signalized intersections)

Additional data that would be needed in RIMS to automate analyses for pedestrian-vehicle collisions at signalized urban/suburban signalized intersections only includes:

- Number of bus stops, schools, and alcohol sales establishments within 1,000 feet of the intersection
- Presence of red light cameras
- Approaches that right-turn on red is allowed

In addition to local roadway data, a locally developed calibration factor is required to adjust the results, which are based on national data, to local conditions. ODOT will likely continue developing these factors based on crash data from State roadways. To begin implementing the Predictive Method in the near-term, the County could rely on these factors. In the longer-term, more accurate results could potentially be obtained by using calibration factors, or even SPFs, developed from county-level data.

County-specific SPFs could provide more accurate results, but calibration factors would require less data. The HSM provides guidance for developing both of these. To develop county-specific SPFs or calibration factors, the County would need to work with other counties in the state to gather data from enough sites to develop reliable tools. This could potentially accomplished by using the Association of Oregon Counties (AOC) as a vehicle for coordination. The current County RIMS database might need to be modified to integrate with the AOC database to streamline this process.

Areas of the County's practices into which the Predictive Method could be incorporated include:

- Network screening/roadway system management (described above)
- Countermeasure identification and analysis
- Alternatives evaluation
- Improvement prioritization
- Safety analyses
- Traffic studies, including development review studies (discussed more in a later section)

The County has already taken steps to implementing the Predictive Method, including hiring an analyst responsible for safety analysis.

Appendix E
Safety Stakeholder Survey Results

Page 1, Q2. What efforts to improve transportation safety that your agency undertakes do you see as the most effective and why?		
1	Traffic enforcement, focused traffic details in areas designated as high crash areas, education	Jun 6, 2011 11:46 AM
2	1) Federally funded highway safety Grants 2) Education, especially prevention 3) High crash location analysis and solution devlopment	May 31, 2011 11:32 AM
3	Working to support local traffic safety committees and commissions with resources, mini-grant funding and networking. Child passenger safety training, education and public outreach through car seat check-up events.	May 31, 2011 8:45 AM
4	Gather input from community about safety issues in their area and try and address specific problems	May 31, 2011 7:41 AM
5	Road repair and improvements Safety Education Police Patrol and Traffic Enforcement	May 27, 2011 6:14 PM
6	Occupant Protection programs for children (child passenger safety) and teen driving programs.	May 27, 2011 6:01 PM
7	Continued education and emphasis on getting to scenes safely and how to manage traffic at emergency scenes. Required seat belt use prior to engagement of vehicle transmission by verbal confirmation of passengers.	May 27, 2011 2:45 PM
8	Fairly high patrol presence on the main roadways in Clackamas County. This seems to encourage citizens to slow down and drive responsibly.	May 25, 2011 9:23 AM
9	Public Education - It is what we have resoucres to do	May 20, 2011 10:19 AM
10	Participation with Safe Communities and Oregon Impact. These 2 groups probably have the most overall impact in coordianting and promoting traffic and transportation issues for high risk issues.	May 19, 2011 10:38 AM
11	Education and transportation improvements	May 19, 2011 9:37 AM
12	education, outreach, advocacy, lobbying, media relations	May 19, 2011 8:35 AM
13	Efforts to reduce drinking and driving are the most important actions we take to improve transportation safety. Those efforts include educational videos, public service announcements to minors and adults, training to servers and bartenders to recognize the signs of impairment so that people aren't overserved and so that someone can intervene before the person gets in a motor vehicle and the third effort is to contact businesses that are accused of serving alcohol to patrons who have been involved in a DUII. Not one practice could have an overarching effect, but many efforts combined can have a deeper effect on the population at large.	May 18, 2011 3:05 PM
14	From the Wellness/Safety perspective, we have just starting doing more newsletter awareness about causes of County vehicle accidents (distracted driving/backing/following too close). Not sure if its effective. Need to see long term County vehicle accident data.	May 18, 2011 2:46 PM
15	education	May 18, 2011 2:26 PM
16	Listening to the citizens concerns, complaints and take appropriate action as necessary	May 18, 2011 1:04 AM

Page 1, Q2. What efforts to improve transportation safety that your agency undertakes do you see as the most effective and why?		
17	Collective thought & input from TSC members and the ability to put programs into action, e.g., fatal DUII sims, safety fair.	May 17, 2011 3:34 PM
18	We work on youth drug and alcohol prevention. I think the most effective work we do is not really our own, but those activities that have been proven effective through research, such as partnering on the minor decoy operations with the CCSO, Safe Communities and OLCC. I think it is best to invest in those strategies that we know have been proven with years of research and multiple studies as effective. I also think that there is too much of an emphasis on programs and less focus on "environmental strategies," which target environments where problematic behaviors are occuring. I think it is also important to have comprehensive strategies to address transportation safety and prevention in general. It is not enough to provide information, although it is part of the puzzle, it typically doesn't change people's behaviors. You need to have incentives, disincentives, etc. to get at this piece.	May 17, 2011 12:57 PM
19	In-school education programs, safety fairs and outreach activites. I feel the in-school presentations are most effective because teens are over represented in crashes. safey fairs because they reach a broad audience and outreach because the word is reaching the community about safety programs.	May 17, 2011 12:06 PM

Page 1, Q3. Without any constraints or limitations, what would you like to do better, or more of, to improve transportation safety?		
1	More officers dedicated to traffic enforcement, DUII cars on during the evening, more education	Jun 6, 2011 11:46 AM
2	Put more funding into prevention of all types. Too much of our work is "after the fact."	May 31, 2011 11:32 AM
3	Provide mores support to communities to encourage local transportation safety action plans, networking between communities to share successes and challenges, promotion of best practices.	May 31, 2011 8:45 AM
4	Pipe drainage ditches and gravel over to eliminate roadside ditch, provide for water treatment for runoff, and add flashing lights to indicate stops at dangerous intersections. Provide gaurd rails where needed. Repair slide areas	May 31, 2011 7:41 AM
5	more community education and outreach	May 27, 2011 6:14 PM
6	Increase public education efforts, mandatory CPS training in hospitals so the day infants go home they are safely restrained. $$ for child safety seats for low income families. Big budget $$ for promotion of traffic safety messaging to the public on TV, etc.	May 27, 2011 6:01 PM
7	More training.	May 27, 2011 2:45 PM
8	It seems that too many citizens who have multiple DUIIs are still on our roads. Some have reinstated drivers licenses, others drive while suspended. If there were stiffer penalties, like the loss of a vehicle or jail time after the 3rd DUII, this might make more of an impact. Also, our motors team is currently not on the road, but should be coming back soon. Even with them at their full strength of 5 motors, this certainly could be increased to double the number for adequate coverage in our large county.	May 25, 2011 9:23 AM
9	More enforcement - but this is not our agency	May 20, 2011 10:19 AM
10	Do more focused public eduaction, awareness and media presentations to target high risk behaviors	May 19, 2011 10:38 AM
11	more roadway fixes i.e. better recovery areas, more guardrail, removal of hazards in the clear zone.	May 19, 2011 9:37 AM
12	Hire a huge staff to help in all of the efforts listed above!	May 19, 2011 8:35 AM
13	I would like to be able to make more videos targeted to specific audiences. I personally would also like to see our agency have more inspectors statewide so that we can do more proactive outreach to licensees.	May 18, 2011 3:05 PM
14	People - calm, not hurried, not distracted. Taking one's time to get there and being mindful. Environment - lots more sidewalks and bike lanes for safe ped/biking commute to work.	May 18, 2011 2:46 PM
15	make driver education required (all age groups)	May 18, 2011 2:26 PM
16	Be able to provide the necessary sidewalks, bath paths/lanes and keep current with road repair issues.	May 18, 2011 1:04 AM

Page 1, Q3. Without any constraints or limitations, what would you like to do better, or more of, to improve transportation safety?		
17	Make judges accountable for their actions and inactions. There are innumerable incidents here locally where a driver, having been convicted of multiple DUII offenses, is still out there driving until he kills someone.	May 17, 2011 3:34 PM
18	I think continuing to partner on ways we can prevent youth from getting involved in risky behaviors, including drugs and alcohol which impairs driving, nut not just limited to this.	May 17, 2011 12:57 PM
19	More media use. More road improvements. More enforcement activites (saturation patrols, targeted enforcement) More citizen outreach. More programs that have a comprehensive (5E) design.	May 17, 2011 12:06 PM

Page 1, Q4. What impediments or limitations have prevented your agency from considering or implementing other initiatives or programs?		
1	Money, people, and resources	Jun 6, 2011 11:46 AM
2	Federal and state rules and budgets are the main limitations. Public and media criticism are the next.	May 31, 2011 11:32 AM
3	Funding to increase staffing. The need for more planning to identify needs and services that would increase local community efforts to impact traffic safety.	May 31, 2011 8:45 AM
4	Financial limitations and staff limitations. The fact that we have 1800 miles of roads	May 31, 2011 7:41 AM
5	budget-manpower	May 27, 2011 6:14 PM
6	Funding	May 27, 2011 6:01 PM
7	Already increased requirements on other disiplines in both original certifications and recerts.	May 27, 2011 2:45 PM
8	Lack of funds.	May 25, 2011 9:23 AM
9	Funding	May 20, 2011 10:19 AM
10	Funding and personnel availability	May 19, 2011 10:38 AM
11	Money	May 19, 2011 9:37 AM
12	budget and staff constraints	May 19, 2011 8:35 AM
13	Much of what the agency does is outlined by state statutes and budgetary constraints.	May 18, 2011 3:05 PM
14	Time. Projects such as sidewalks/bike paths not in my area of work; our Dept of Transportation is doing good work in this area.	May 18, 2011 2:46 PM
15	probably cost	May 18, 2011 2:26 PM
16	MONEY!!!! Citizens would like to see more sidewalks, bike paths etc. but money is very tight and public works is out there monitoring the road conditions. Trying to balance what the citizens want to what we can seriously afford to pay for. Life threatening situations are taken care of immediately.	May 18, 2011 1:04 AM
17	Budget restraints	May 17, 2011 3:34 PM
18	I think staff time is a big one, especially now when we are having to do so much community mobilization just to keep ourselves affloat due to funding cuts. Many of us our facing significant cuts and it is critical for us to have partnerships in place so we can sustain prevention work in our community. I also think politics and turf issues - like who gets credit for what impacts our work greatly. I think that my parent agency sometimes doesn't understand the work we are doing and we don't get support at times in partnering. It takes a lot of effort and more support to get things done with so many "hoops" to jump through.	May 17, 2011 12:57 PM
19	Funding. Support at all levels. Laws that impede safety initiatives. Grant - limitations.	May 17, 2011 12:06 PM

Page 1, Q5. What type of assistance/collaboration could your agency use from other agencies/partners to promote transportation safety?		
1	Money, assistance in the way of bodies from other state and local LE to help promote safety and focus on high crash areas.	Jun 6, 2011 11:46 AM
2	Better state/local connections and possibly better volunteer development/training/rewards that keep good voulnteers in safety from year to year.	May 31, 2011 11:32 AM
3	Traffic safety committees and commissions in Clackamas County are built on the successful model used by the county which we share with other counties and cities. More commitment from agencies in Clackamas County to take a lead in collaborating regarding child passenger safety check-up events and car seat distribution.	May 31, 2011 8:45 AM
4	Finacial assistance and coordinated efforts to specifically identify and fund traffic safety issues	May 31, 2011 7:41 AM
5	joint safety education programs	May 27, 2011 6:14 PM
6	Collaborative staffing assistance at events, resources, etc.	May 27, 2011 6:01 PM
7	Outside instruction, simulators.	May 27, 2011 2:45 PM
8	Funding. Perhaps periodic updates on major crash sites would be good information for us to have.	May 25, 2011 9:23 AM
9	We should continue to collaborate with safe Communities and law enforcement	May 20, 2011 10:19 AM
10	Assistance with funding for community service related activities. I think we are fairly well connected for collaboration and partnerships.	May 19, 2011 10:38 AM
11	Always additional funding.	May 19, 2011 9:37 AM
12	being aware of and involved in transportation safety efforts when appropriate	May 19, 2011 8:35 AM
13	More partnerships and education on drinking and driving. Supporting and encouraging servers and bartenders to make the right decision of removing a drink, calling a cab, etc.	May 18, 2011 3:05 PM
14	Patty was great spending the day at the Wellness Fair educating about distracted driving.	May 18, 2011 2:46 PM
15	funds from ODOT	May 18, 2011 2:26 PM
16	Exchange of information with other agences/partners promotes good building practices and sharing our resources.	May 18, 2011 1:04 AM
17	The CCTSC is already lucky to have a great working relationship with ODOT, local law enforcement, Safe Comm., Kittleson, et al.	May 17, 2011 3:34 PM

Page 1, Q5. What type of assistance/collaboration could your agency use from other agencies/partners to promote transportation safety?		
18	I think Patty does a great job of partnering with our community coalitions to disseminate information and get activities done tha thelp to promote safe driving and reducing risky behaviors. I think continuing in this vein is good. I would like to have more planning up front though, because it is hard for me to drop everything in my schedule at the last minute to get things done. When I know ahead of time it makes it easier for me to create space in my calendar and I think might be the next step in strengthening or paretnerships. We all have different outcomes that we need to focus on and be responsible for acheiving and if we can spend more time planning up front I think that would help to share in each other's work. There have also been a lot of changes in my parent agency that make work a lot longer to get done and there are more restrictions on things now than previously, which is frustrating.	May 17, 2011 12:57 PM
19	More funding. More support/collaboration. Less constraints in grant funding. More partners and volunteers.	May 17, 2011 12:06 PM

Page 1, Q6. Does your agency have any planned new initiatives or programs aimed at promoting transportation safety that are planned to be implemented in the near future? If so, what are they?

1	Grants received from ODOT and OSSA to battle DUII's, Seat Belt compliance, Work Zones, Chain Enforcement during the winter, Motor Carrier Safety Inspections, and general money for Traffic Team OT	Jun 6, 2011 11:46 AM
2	State TSAP is our long range / new initiatives plan. Sadly, without new funding, I predicit there will be few "new" initiatives launched near future.	May 31, 2011 11:32 AM
3	Not at this time. The formation of an Advisory Committee for the Community Traffic Safety Program may result in additional ideas.	May 31, 2011 8:45 AM
4	We are considering funding tools	May 31, 2011 7:41 AM
5	not sure	May 27, 2011 6:14 PM
6	Yes, Safe Kids Countdown 2 Drive program- targeted at teen pre-drivers.	May 27, 2011 6:01 PM
7	No	May 27, 2011 2:45 PM
8	Unknown.	May 25, 2011 9:23 AM
9	None that I know of	May 20, 2011 10:19 AM
10	No	May 19, 2011 10:38 AM
11	unknown	May 19, 2011 9:37 AM
12	Continued involvement in driver safety issues, including teen driving, senior driving, distracted driving, preventing DUII, etc.	May 19, 2011 8:35 AM
13	Not directly. In Wellness, mindfulness is a growing area that can help us all slow down and enjoy the present.	May 18, 2011 2:46 PM
14	not that I know of at this time	May 18, 2011 2:26 PM
15	We have considered a "Street Utility fee" to help fund the necessary sidewalks, proper bike lanes but how n when n where the money will be allocated was somewhat confusing. Citizens want lot of high dollar upgrades.	May 18, 2011 1:04 AM
16	TSAP for Clacamas Co. & it is coming along very well.	May 17, 2011 3:34 PM
17	We have planned to meet with Safe Communities, and OLCC to do more frequent alcohol compliance stings. This is not really a new initiative, but this is something that we had planned previously and haven't done yet.	May 17, 2011 12:57 PM
18	The TSAP. We are just about to begin planning new initiatives for next grant cycle. DUI - impaired driving has been mentioned but no actions addressing that issue yet. Some of the new initiatives will be based on results of the data work with the TSAP.	May 17, 2011 12:06 PM

Transportation Safety Action Plan (TSAP) Survey

As it relates to your key safety issue, does your agency employ the use of the 4E's in their strategy? (select all that apply)		
Answer Options	**Response Percent**	**Response Count**
Engineering	50.0%	9
Education	88.9%	16
Enforcement	55.6%	10
Emergency Medical or Fire Services	55.6%	10
Other (please specify)	16.7%	3
	answered question	18
	skipped question	1

Number	Response Date	Other (please specify)	Categories
1	May 31, 2011 6:38 PM	Training, funding, legislation, standards	
2	May 31, 2011 3:49 PM	Encouragement	
3	May 18, 2011 9:31 PM	driver ed option for permit drivers	

Transportation Safety Action Plan (TSAP) Survey

What age group is your target audience? (mark all that apply)		
Answer Options	**Response Percent**	**Response Count**
Infant (0-5 years)	33.3%	6
Child (6-12 years)	61.1%	11
Teenagers (13-18)	88.9%	16
Young Adults (19-24 years)	77.8%	14
Adults (25-50 years)	72.2%	13
Seniors (50+ years)	55.6%	10
Other (please specify)	5.6%	1
	answered question	18
	skipped question	1

Number	Response Date	Other (please specify)	Categories
1	May 18, 2011 9:31 PM	any person w/o a driver's license (15 +)	

Transportation Safety Action Plan (TSAP) Survey

How do you reach your target audience?		
Answer Options	Response Percent	Response Count
Website	66.7%	12
Television/Radio	38.9%	7
Community Meetings	55.6%	10
You Tube	22.2%	4
Citizen Contacts	61.1%	11
One-on-one (meet with client)	22.2%	4
Safety Events/Fairs	66.7%	12
Newsletter	50.0%	9
Facebook	22.2%	4
Newspapers	38.9%	7
Other (please specify)	27.8%	5
	answered question	18
	skipped question	1

Number	Response Date	Other (please specify)	Categories
1	May 31, 2011 6:38 PM	Training, conferences, mailers, pul	
2	May 18, 2011 10:07 PM	Servers/Bartenders and liquor licei	
3	May 18, 2011 9:31 PM	school district/community college p	
4	May 17, 2011 10:39 PM	monthly meeting open to anyone	
5	May 17, 2011 7:10 PM	In class presentations	

Are the following issues a focus of your agency? Select all that apply.		
Answer Options	Response Percent	Response Count
Ped/Bike Safety	66.7%	12
Teen Drinking/Drug Use	77.8%	14
Texting - Cell Phones	72.2%	13
Passenger Safety	72.2%	13
Impaired Driving	77.8%	14
Speed	77.8%	14
Road Maintenance	27.8%	5
Agressive Driving	61.1%	11
Rail	11.1%	2
Tranportation of Children/disabled/elderly passengers	16.7%	3
Distracted Driving	61.1%	11
Other (please specify)	16.7%	3
	answered question	18
	skipped question	1

Number	Response Date	Other (please specify)	Categories
1	May 31, 2011 6:38 PM	Motorcycles, child safety seats, tru	
2	May 18, 2011 9:53 PM	These aren't exactly a focus; we ac	
3	May 17, 2011 8:02 PM	Preventing Youth Risky Behaviors	

Transportation Safety Action Plan (TSAP) Survey

What resources would assist your agency to fulfill your goals?		
Answer Options	**Response Percent**	**Response Count**
Volunteers	58.8%	10
Funding	100.0%	17
Staff	64.7%	11
Technical Support (grant writing etc)	58.8%	10
More Outreach Opportunities	41.2%	7
More Partners	58.8%	10
Training	47.1%	8
Reliable Data	41.2%	7
Other (please specify)	11.8%	2
	answered question	17
	skipped question	2

Number	Response Date	Other (please specify)	Categories
1	May 31, 2011 6:38 PM	Hard not to just check all of these	
2	May 27, 2011 9:50 PM	Oregon impact crash simulation	

Page 2, Q6. What (if any) emerging trends can you identify. Problems or solutions.		
1	Distracted Driving due to texting and cellualr phone use	Jun 6, 2011 11:48 AM
2	Problems: distracted drivers; GPS and related in car devices; elderly drivers; aggressive bikes and peds; poorly researched legislation	May 31, 2011 11:38 AM
3	Government funding is on the decrease which impacts our funding but also impacts the ability for counties and cities to maintain traffic safety committees and commissions and focus on local issues. The business sector may be seeing better times so we are needing to develop relationships with more businesses and other partners to be more efficient.	May 31, 2011 8:49 AM
4	Impaired driving and increase congestion	May 31, 2011 7:43 AM
5	Not sure	May 27, 2011 6:16 PM
6	inexperienced and distracted drivers,	May 27, 2011 2:50 PM
7	Now that using cell phones while driving is a traffic violation, many people elect to "hide" the fact that they are texting. This causes them to hold the cell phone low and out of site, which also causes them to avert their eyes away from the road.	May 25, 2011 9:29 AM
8	Texting as a inceasing risk to be an significant risk while driving.	May 19, 2011 10:41 AM
9	Senior driving safety will continue to be important as the number of older drivers grows. Also, distracted driving continues to be a major issue.	May 19, 2011 8:37 AM
10	Teens are drinking at an earlier age. We need to reach these students BEFORE they start drinking.	May 18, 2011 3:07 PM
11	Aging population. Better planning for new subdevelopments (sidewalks) More awareness of planning for walkers and bikes on roads. Still a hurried stressed culture that needs to slow down.	May 18, 2011 2:53 PM
12	any kind of distracted driving in addition to cell phones/texting which seem to be the focus. Eating, dogs jumping on driver's lap, etc.	May 18, 2011 2:31 PM
13	People continue to expect the moon and are madly disappointed where there's only a cow up there. Inother words, they want what they can't affors	May 18, 2011 1:09 AM
14	Too many drivers are ignoring the "hands free only" cell phone laws. Too many drivers are getting probation or just a week in jail for 2nd, 3rd, 4th, ad. inf., DUII convictions.	May 17, 2011 3:39 PM
15	Well, Clackamas is such a huge county with so many different cultures in our respective communities. It is hard to plan to meet the unique needs of each local area. I think that there is a concerning emergence of youth prescription drug use. While the data continues to show alcohol as our number one problem, it also points to more kids turning to prescription drugs. This has huge implications for drugged driving. I think more work in this area is needed and would truly reflect prevention. Solutions would involve continuing to work on changing social norms and perceptions about prescription drug safety, in conjunction with information dissemination, enforcement, and policy changes. Taken together, this would make quite a difference.	May 17, 2011 1:02 PM

Page 2, Q6. What (if any) emerging trends can you identify. Problems or solutions.		
16	Aging population as drivers. "Drugged" drivers. More bicyclists and peds in Clackamas.	May 17, 2011 12:10 PM

Transportation Safety Action Plan (TSAP) Survey

Thank you for your time. Please use the space below to share any further information.

	Response Count
	4
answered question	**4**
skipped question	**15**

Page 2, Q7. Thank you for your time. Please use the space below to share any further information.

1	Thanks for the invitation to comment - KC	May 31, 2011 11:38 AM
2	Thanks for your work!	May 18, 2011 2:53 PM
3	wish driver ed was a requirement for all drivers...	May 18, 2011 2:31 PM
4	I am a retired Oregon State Police Senior Trooper who used to patrol most all of Clackamas County and I could indicate on a traffic crash any factors that might have any safety concerns, line of sight, lack of lane markings etc" I took my job seriously and did my best to keep the public safe.	May 18, 2011 1:09 AM

Road Safety Audit

Mt. Hood Highway
Mile Post 47.0 – 54.3

Audit Date: June 16 – 18, 2009

OREGON DEPARTMENT OF TRANSPORTATION

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

Road Safety Audit (RSA)

Mt. Hood Highway, Mile Post 47.0 – 54.3

Clackamas County, Oregon

Prepared For:
Oregon Department of Transportation (ODOT)
123 NW Flanders Street
Portland OR 97209
(503) 731-3427

Prepared By:
Kittelson & Associates, Inc.
610 SW Alder Street, Suite 700
Portland, OR 97205
(503) 228-5230

Project Manager: Hermanus Steyn, Pr. Eng., P.E.
Project Principal: Jack Freeman, P.E., PTOE

Project No. 10261.0

September 2009

Mt. Hood Highway Road Safety Audit (RSA)
Mile Post (MP) 47.0 – 54.3

Project Title: Mt. Hood Highway Road Safety Audit

Date: Jun 16-18, 2009

RSA Team and Participants:

Carl Deaton, P.E. - Senior Roadway Designer, Oregon Department of Transportation (ODOT)
Hermanus Steyn, Pr.Eng., P.E. - Associate Engineer, Kittelson and Associates, Inc.
Jack Freeman, P.E., PTOE – Senior Principal, Kittelson & Associates, Inc.
Robert Tolman - Transportation Maintenance Manager (TMM), ODOT

Project Characteristics:

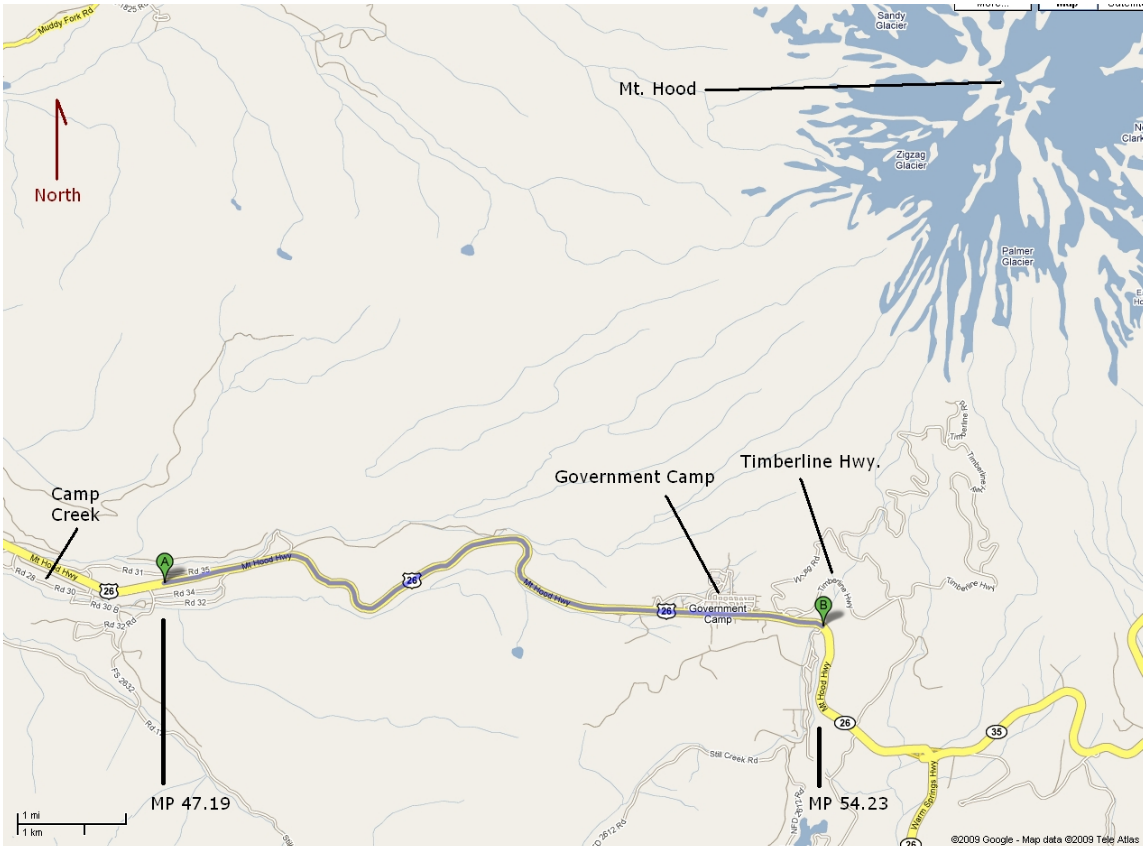
Audit Type: Planning Stage
Land Use Development Proposal: No
Units of Measure: US
Adjacent Land Use: Rural
Design Speed (US): 55 mph
Opposite Flow Separation: Undivided
Service Function:
    Highway Number: 26
    Route Number: US 26
    Functional Classification: Rural Principal Arterial, National Highway System (NHS) Route
    Oregon Highway Plan (OHP) Highway Designation: Statewide Highway
Terrain: Mountainous
Climatic Conditions - Temperature: Cold Winter (freezing, icing possible)
Climatic Conditions - Snow: Snow in Winter

Background:

This Road Safety Audit (RSA) is for Mt. Hood Highway (US 26) on the western slope between Portland and the Mt. Hood recreational ski areas. Oregon Department of Transportation (ODOT) has designated much of this corridor to be a "Highway Safety Corridor" meaning there is a focus on engineering, enforcement and education, and that violations will have double fines.

The specific limits of the RSA are from the vicinity of the entrance to Camp Creek Campground (vicinity of MP 47.0) to the intersection of Mt. Hood Highway and Timberline Highway (vicinity of MP 54.25). The RSA study area is totally within the Mt. Hood National Forest. The corridor is a designated truck route and moderate truck traffic was observed.

The corridor has two distinct sections. The western part from MP 47 to the western entrance to Ski Bowl (vicinity of MP 52.6) is a 55 mph posted speed mountain highway that is generally two lanes eastbound to provide a climbing lane and one lane westbound. There are very few access points for this section and most are trails into the National Forest. This is referred to as the *Mountain Highway Section*.



Project Vicinity Map

Between the western entrance to Ski Bowl and the Timberline Highway intersection the land use surrounding the roadway and its characteristics change. Located in this area is the community of Government Camp. This community has seen growth in recent years and continues to grow. The RSA Team observed two significant projects under construction that will add short stay rental property in the area. There are new residential developments under construction. The RSA Team was informed of two other developments in the planning stage that could bring an 1,000 to 1,200 additional units to the area. Both ODOT Maintenance staff and US Forest Service staff noted that local businesses want to increase the amount of Snow Park parking in the Government Camp area. Mt. Hood Highway is the major road serving this area and there are multiple intersections in this two-mile section. Clackamas County recently rebuilt the Multorpor Bridge to improve access to the south side of Mt. Hood Highway into Government Camp. The posted speed in this section remains 55 mph. This is referred to as the *Government Camp Summit Section*.

Occurring Developments

RSA Process:

The RSA Team initiated work on Monday, June 15, 2009 with a meeting at ODOT Region 1 in Portland, Oregon. Attending this meeting was Jason Tell, ODOT Region 1 Manager. Mr. Tell provided some thoughts regarding the safety issues on Mt Hood Highway, and they are summarized below:

- There are ongoing and future developments in the Government Camp area and concerns regarding access management.
- There is a great deal of safety data for the corridor available to the RSA Team.
- ODOT has some funding designated for the corridor and they want to know where they can get the most "bang for the buck." He suggested considering not only engineering solutions but also education and enforcement solutions for the corridor. He noted the Highway 26 Safety Corridor Citizens Advisory Committee (CAC) as a potential group to aid with educating the public. Staffing of law enforcement in the corridor has had some shortages in the past, but this may be improving.
- He asked the RSA Team to be creative in the thought process and to put all options on the table for potential consideration. ODOT needs a good plan for the corridor.
- ODOT is working with a group to consider multi-modal solutions for the corridor that will support ski operations. The lack of parking in the Government Camp area was noted.
- ODOT is planning some Intelligent Transportation System (ITS) improvements along the route that include the installation of Variable Message Signs (VMS) with temperature sensors.
- During the months of July and August, congestion is an issue.

Following Mr. Tell's comments, Jim McNamee, Transportation Maintenance Manager (TMM) for District 2C in Region 1 covered the RSA study area and his observations are summarized below:

- Information is currently provided to motorists by a VMS located at Rhododendron at about MP 43.76 regarding road conditions ahead and the need for chains or traction tires.
- Oregon laws regarding the use of traction tires and chains are complex with sign information needing to be regulatory (black lettering on white background). Traction tires are allowed between November 15th and April 1st for vehicles less than 10,000 GVW.
- The past two winters have had over 400 inches of snow at Government Camp. Snow can accumulate to 4 to 6 feet deep.
- ODOT has 24 hours to clear the road after the storm. They work 24 hours a day with three 8-hour shifts. He said that the road has never been closed due to snow since he has been the TMM. The snow plows often work with two to three plows in tandem covering the area from MP 42 to MP 62.
- Some ski areas like Meadows can handle over 20,000 skiers per day. The Timberline and Ski Bowl ski areas are limited in attendance due to parking restrictions. They would like more parking.
- Intersections become an issue during heavy snows. These include the Ski Bowl and Government Camp Loop accesses. He said that these intersections will have 10 feet of snow or more during the ski season.
- The chain-on/chain-off locations were described as "poor" with the best location at MP 48 where there is a dedicated lane in the eastbound direction.
- Trucks sometimes go past the chain-on location and then get stuck further up the hill blocking traffic.

- The following safety issues were noted:
  - Motorists drive too fast for conditions.
  - Motorists stop in the middle of the road to "chain-on".
  - Drivers park where they should not, especially at Mirror Lake Trailhead. Last year this snow park area was closed due to parking encroaching into the travel lane. In the summer, they have had as many as 14 illegally parked vehicles towed in a day. The westbound left-turn movement into the Mirror Lake parking area is an issue.
  - Rocks fall onto the pavement. This is principally a westbound roadway problem, primarily in the spring months. ODOT is considering some cut back of the rock face at the Mirror Lake curve. This area extends from this curve (MP 52) to MP 49.5.
  - The trees overhanging the roadway (west of MP 47.6) cause concern during heavy snowfall because chunks of snow from the overhanging branches come loose and fall into the travelway.

The RSA Team met on Tuesday morning, June 16, 2009 at the ODOT Maintenance Facility at Government Camp. This facility served the RSA Team as a base during the pre-audit meeting, field reviews and RSA analysis activities. The schedule for the RSA Team was as follows:

Tuesday, June 16th

8:30 am to 12 noon	Pre-audit meeting
1:00 pm to 5:00 pm	Field reviews – Government Camp area to Mirror Lake Curve (start on the east end)
9:30 pm to 11:00 pm	Night field review – entire corridor

Wednesday, June 17th

8:30 am to 12 noon	Field reviews – Camp Creek Campground to Mirror Lake Curve (start on the west end)
1:00 pm to 5 pm	RSA analysis – RSA Team discussion of issues/suggestions

Thursday, June 18th

8:30 am to 4:00 pm	RSA analysis – RSA Team discussion of issues/suggestions

Friday, June 19th

10:00 to 12 noon	Findings Presentation at ODOT Region 1 offices

During the pre-audit meeting, other individuals attended the discussions and provided input. Several of these individuals also participated in other aspects of the RSA. These individuals included:

Jim McNamee	TMM, ODOT Dist. 2C, Region 1
Jerry Sabel	Highway 26 Safety Corridor (CAC)
Sue D'Agnese	ODOT Region 1 Traffic Manager
Mike Reel	Oregon State Police
KC Humphery	ODOT Region 1 Transportation Safety Coordinator
Katherine Carlos	ODOT Engineering Intern

The pre-audit meeting further expanded the discussions of the day before. Mr. Freeman provided a presentation that explained the RSA process and followed with detailed crash data for concentrated crash locations from the year 2000 to 2008. The data was initially for the entire corridor and then focused on specific locations along the corridor. A copy of this presentation is attached (Appendix "A"). Some of the principal crash information is as follows:

- Crashes have decreased in recent years from the early 2000s. It was noted that the use of magnesium chloride as a deicer started in either 2004 or 2005 and combined with some roadway improvements it likely contributes to the reduction.
- The total number of crashes is likely under reported especially for Injury C and Property Damage Only (PDO) as there is no requirement for a police report for these crashes. Officer Reel feels the reporting for Fatal, Injury A, and Injury B type crashes to be accurate.
- The exact locations of crashes might be inaccurate, because it might be recorded to the closest MP location.
- The highest crash type is running off the road and hitting a fixed object, which is followed by rear-end crashes. Head-on and side-swipe crashes are also common types.
- Most crashes occur on Saturday or Sunday ***(approximately 50% of all crashes occur over weekends)***, and the highest months of crashes are January and December ***(approximately 40% during December/January)***. The month of January has more total crashes than the months of May through September even though these summer months are the five highest months of traffic volumes on Mt. Hood Highway
- The time of day with the highest number of crashes is 3 pm to 6 pm ***(approximately 25% of all crashes occur 3-6 pm)***. The RSA Team noted that the time period from 9 pm to midnight also had a high number of crashes, likely associated with night skiing.
- ***70% of all crashes occur with either ice or snow*** on the roadway. When considering wet pavement, this increases to 80%.

This information allowed the RSA Team to focus on the safety concerns for locations as the field reviews were conducted. During the discussions, Officer Reel noted that many of the crashes he has worked are speed related. He and Mr. Sabel discussed an educational brochure regarding speeding and the time saved versus the increased danger of a crash. This has been previously prepared but not funded for printing and distribution.

Many Crashes are Related to Speed

The report is organized to describe the safety issues starting with the entire corridor and then from west to east (increasing MPs).

Summary of High and Medium Safety Risk Locations:

As a result of the RSA analysis, the RSA Team found five (5) locations with safety issues to have a high safety risk. These issues are:

- Mountain Highway Corridor Section (MP 47.0 – 52.4) – Many speed related crashes in poor weather conditions
- Map Curve (Vicinity of MP 49.7) – Westbound crashes at Map Curve and on Top 15% SPIS
- Section between Map Curve (MP 49.7) and Mirror Lake Curve (MP 51.7) – Unacceptable configuration of existing westbound passing lane
- Mirror Lake Curve (Vicinity of MP 51.7) – Westbound crashes at Mirror Lake Curve
- Ski Bowl East Access (MP 52.85) – Unacceptable intersection spacing, skewed intersection angle, and highway turn lanes and on Top 10% SPIS

The RSA team also found eleven (11) locations with safety issues to have a medium safety risk. These issues are:

- Entire Corridor – Lack of inlaid pavement markers and delineators reflectivity
- Entire Corridor – Lack of sign consistency and retro-reflectivity
- Government Camp Summit Corridor Section (MP 52.4 – 54.3) – Challenging Accessibility to Growing Surrounding Land Uses
- Tree Cleared Area MP 47.6 – 48.8 – Lack of westbound passing lane
- Tree Cleared Area MP 47.6 – 48.8 – Lack of chain-on/chain-off areas
- Mirror Lake Curve (Vicinity of MP 51.7) – Undesirable location of chain-on area
- Ski Bowl West Access (MP 52.5) – Lack of intersection sight distance and highway turn lanes
- Western Government Camp Loop Road (MP 52.98) - Unacceptable intersection spacing, intersection sight distance, and highway turn lanes
- Multorpor Bridge (Vicinity of MP 53.5) – Limited westbound passing opportunity and on Top 25% SPIS
- Eastern Government Camp Loop Road (MP 54.0) - Unacceptable intersection traffic operations, intersection sight distance, and turn lanes
- Timberline highway (MP 54.3) - Unacceptable intersection angle, intersection sight distance, and turn lanes

RSA FINDINGS

Appendix “B” provides a summary of the issues identified during the RSA by location and suggestions to improve the issues.

LOCATION: ENTIRE CORRIDOR

Issue: Lack of In Pavement Reflectors and Delineators

Description of Safety Issue:
During the night field review, it was noticeable that the existing inlaid reflective pavement markers (RPM) and delineators have lost their reflectivity (see Figure 1). Certain sections of the road did not even have RPMs anymore and the delineator spacing was inconsistent (see Figure 2). Approximately 30% of all crashes occurred during dawn, dark, or dusk.

Figure 1

Figure 2

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

Suggestion:
Consider installing new inlaid RPMs and delineators. Consider delineator closer spacing at locations where the horizontal alignment entails to a design speed below 55 mph.

Issue: Lack of Sign Consistency and Retro-reflectivity

Description of Safety Issue:
The signs are of varying standards with spacing (see Figure 3), number, message (see Figure 4: rocks and slides), and retro-reflectivity issues.

Figure 3

Figure 4

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

Suggestion:
Consider conducting a sign study along the corridor to upgrade to current signing standards. Attention should be placed on sign spacing and retro-reflectivity. The RSA Team suggests that all signs in the corridor have high-intensity reflective sheeting.

Issue: Non-standard Guardrails

Description of Safety Issue:
The existing guardrails do not have reflective markers (see Figure 5) and some guardrail ends (see Figure 6) are non-standard.

Figure 5

Figure 6

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

Suggestion:
Consider investigating the existing guardrails along the corridor to upgrade to current guardrail standards, especially the guardrail ends. The addition of reflective markers will better delineate the roadway during times of low visibility and at night.

Issue: Limited Public Outreach

Description of Safety Issue:
The crash data shows a very high percentage of younger drivers, which are most likely linked to the recreational activities. Approximately 55% of drivers involved with crashes are younger than 35 years. Further, the number of available parking spots at the ski resorts and hiking trail access points is limited, leading to motorists to park in restricted areas.

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

Suggestion:
Consider targeting outreach advertising to the younger driver by communicating the limited time saved by reckless speed and describing the mortality difference between speed on the slopes and speed on the road. The OSP is already discussing opportunities to provide education brochures through its day-to-day enforcement activities. Additionally, the outreach should focus on providing information of alternative modes of transportation. This outreach should include working with winter recreational facilities and/or transit agencies to establish reliable public transit alternatives. The US Forest Services could consider providing kiosks at their snow parks with safety related brochures similar to safety messages that are provided at rest areas.

LOCATION: MOUNTAIN HIGHWAY CORRIDOR SECTION (MP 47.0 – 52.4)

Issue: Many Speed Related Crashes in Poor Weather Conditions

Description of Safety Issue:
As noted in the introduction section of the RSA, Mt. Hood Highway has two distinct sections within the overall project limits. The western part from MP 47 to the western entrance to Ski Bowl (vicinity of MP 52.6) is a 55 mph posted speed mountain highway that is generally two lanes eastbound, providing a climbing lane, and one lane westbound. The roadway has a number of horizontal curves and sections with longitudinal grades of more than 6%. There are very few access points for this section and most are trails into the National Forest. The roadway characteristics are very different in the summer and winter months due to the heavy snowfall in the winter. The speed designations for the roadway are typical for normal road conditions that do not apply during icy conditions. As mentioned by the OSP, the majority of the crashes along this corridor are speed related – motorists driving too fast for the conditions. In addition, approximately 70% of all crashes occur in the presence of ice and snow.

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

Suggestion:
Mt. Hood Highway is a 55 mph posted facility with advance curve-speed warning signs where appropriate. These warning signs should be revisited to determine the correct curve speed. Introducing a lower speed limit along this section of the corridor based on weather conditions with variable message signs could be operated from a remote location. Consideration should be given to apply photo speed enforcement only when the Variable Speed Limits (VSL) is used. Washington Department of Transportation (WashDOT) has been successful implementing VSLs along US 2 in Wenatchee, Washington (see Figures 7 and 8), but does not have automated speed enforcement. Washington Department of Transportation (WashDOT) uses a correlation between speed and road conditions such as:

- traction tires required – 40 mph;
- chains required – 30 mph; and
- emergency/accident – 25 mph.

Figure 7

Figure 8

LOCATION: GOVERNMENT CAMP SUMMIT CORRIDOR SECTION (MP 52.4 – 54.3)

Issue: Challenging Accessibility to Growing Surrounding Land Uses

Description of Safety Issue:
Mt. Hood Highway has two distinct sections within the overall project limits. The Government Camp Summit Corridor section stretches from the western entrance of Ski Bowl (vicinity of MP 52.6) to the Timberline Highway (vicinity of MP 54.3) intersection. The land uses surrounding the roadway and its characteristics have changed and are continuing to change. Mt. Hood Highway is the only road serving this area and there are multiple intersections in this two-mile section. The Ski Bowl West Access, the Ski Bowl East Access, and the 90-degree Western Government Camp Loop Road/Tyrolean Drive intersections are currently spaced approximately 1,700 feet and 600 feet, respectively (see Figure 9). Approximately one mile to the east, the Eastern Government Camp Loop Road intersection is approximately 1,300 feet from the Timberline Highway intersection (see Figure 9). The road section in the vicinity of the Ski Bowl East Access and Western Government Camp Loop Road/Tyrolean Drive intersections is on the Top 10% Safety Priority Index System (SPIS). This section experienced 49 crashes in 2000-2008 of which 13 were rear-ends and 8 were turning movements. The section in vicinity of the Eastern Government Camp Loop Road and Timberline Highway intersections experienced 50 crashes of which 15 were rear-ends and 14 were turning movements. Additionally, 30 of the 99 crashes occurred during dawn or night. Intersection spacing, turn lane parameters, intersection angles, traffic operations, and lack of lighting have likely all contributed to these crashes. Traffic volumes will continue to increase due to occurring and planned developments. In addition, there is a demand to increase the snow park areas.

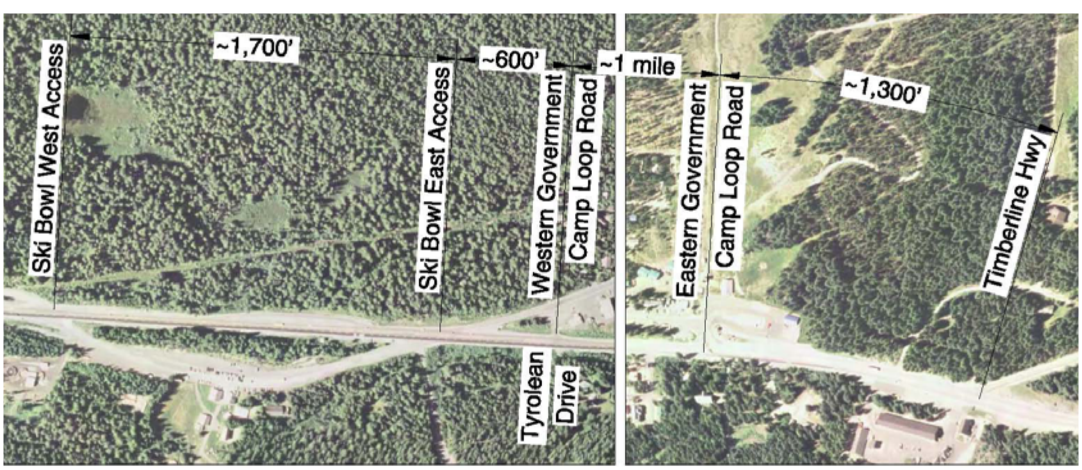


Figure 9

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

Suggestion:
The Government Camp Summit section should be considered as a unit, because the traffic operations at the one intersection likely impact the adjacent intersections. The surroundings along this corridor section are continuing to change and consideration should be given to lower the speed to 45 mph through Government Camp. The RSA Team recognizes that Mt. Hood Highway is a truck route, but felt this section of roadway is similar to reduced speed sections in Rhododendron and Zigzag. Additionally, consideration should be given to reconfigure the intersections to provide improved intersection angles and intersection spacing, especially the Ski Bowl accesses. In the near-future, traffic volumes will likely require the installation of either traffic signals or roundabouts at these intersections. Roundabouts would slow traffic down entering this road section. The geometric layout of roundabouts would be based on the design vehicle for the corridor. Encouraging slower speeds through this section could also include cross sectional elements such as introducing a raised landscaped median, curbed outside edges, narrower shoulders and/or lanes, etc. In addition, consideration should be given to provide street lighting along this road section with appropriate transition areas to/from the dark approaches.

LOCATION: TWO-LANE SECTION MP 47 - 48

Issue: Inappropriate Roadway Shoulder

Description of Safety Issue:
The existing paved shoulder from before the curve west of Camp Creek Campground entrance to just before MP 48 is typically 4-6 feet (see Figure 10). This area has trees very close to the travel lane and within the typical clear zone associated with a 55-mph facility. Due to the proximity of the trees, it is generally not comfortable for motorist to pull off on the shoulder if needed (see Figure 11). The narrow shoulder also restricts sight distance to the few access points. During the winter, the snow berms will further restrict the shoulder width and sight distances. The trees overhanging the roadway also cause concern during heavy snowfall, because chunks of snow from the overhanging branches come loose and fall into the travelway.

Figure 10

Figure 11

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

Suggestion:
Widen the paved shoulder to a minimum of 8 feet to meet ODOT standards. In addition, consideration should be given to remove trees closest to the road in the curve to improve sight distance and to provide reasonable roadside clearance.

LOCATION: CAMP CREEK CAMPGROUND (VICINITY OF MP 47)

Issue: Relative Sharp Curve West of Intersection

Description of Safety Issue:
West of the Camp Creek Campground entrance is a curve to the right in the westbound direction (see Figure 12). There are trees in the north side of the roadway approximately 10-12 feet from the edge of travel lane that are within the typical clear zone associated with a 55-mph facility. These trees restrict the sight distance through the curve and a westbound driver's ability to see and negotiate the curve. Also, sight distance is limited for a vehicle broken down in the curve, and for seeing eastbound vehicles on Mt Hood Highway approaching the intersection (see Figure 13). This location is west of the area that crash data was provided. The "Curve Ahead" sign is 48"X48".

Figure 12

Figure 13

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

Suggestion:
Consider cutting back trees to improve visibility of the curve and ability to negotiate the curve. This will also achieve decision sight distance for a broken-down vehicle in the curve and for intersection sight distance for a vehicle with a camper trailer making a left-turn from Camp Creek Campground Road. Additionally, consider increasing the size of the "Curve Ahead" to 60"x60" and use high intensity reflective sheeting to enhance retro-reflectivity. This will improve motorist awareness of the approaching curve.

LOCATION: TREE CLEARED AREA MP 47.6 - 48.8

Issue: Lack of Westbound Passing Lane

Description of Safety Issue:
Westbound traffic does not have many passing opportunities coming from the summit at Government Camp (MP 54.0) to this road section. Approximately 5.5 miles to the east of this location, there is a 3,000-foot three-lane cross section (two eastbound and one westbound)

between the Eastern and Western Government Camp Loop Road intersections that allows westbound traffic to pass by using one of the oncoming eastbound lanes. There is a 3,000-foot westbound passing lane approximately 2.5 miles to the east (MP 51.7 to MP 51.13) of this location. Crash data shows 15 crashes along this one-mile section (MP 47.6 to 48.8) with 11 occurring in the westbound direction of which, 3 involved eastbound traffic in 2000-2008. The road alignment has a winding up-and-down topography that does not provide passing opportunity, and motorists might become frustrated.

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

Suggestion:
The existing width between the cleared treelines is more than 95 feet over a length of approximately one mile and there is opportunity to provide a four-lane cross section (e.g., 8-foot shoulders, 12-foot lanes, and 2-foot median; total of 66 feet) from MP 47.9 to MP 48.7 (approximately 4,200 feet). Based on the RSA Team review, it is desirable to extend this proposed westbound lane as far as possible (approximately one mile) to provide ample opportunity for passing in a downhill section. In addition, advance signing communicating the location of the next passing lane should be placed immediately beyond the end of the previous westbound passing lane.

Issue: Lack of Clearly Defined Chain-on and Chain-off Areas

Description of Safety Issue:
There are no official chain-off areas in the westbound direction but instead wide open gravel areas (see Figure 14) and the eastbound slow-moving vehicle lane is currently used as a chain-on area during winter time (see Figure 15). Traffic traveling eastbound to the Mt. Hood area receives information regarding the use of chains at the VMS at Rhododendron (MP 43.76) and then ground mounted signs along this section for the mountain area. Currently these static signs are placed by ODOT maintenance when needed.

Figure 14

Figure 15

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

Suggestion:
The existing width between the treelines is more than 95 feet over a length of approximately one mile and there is opportunity to provide a four-lane cross section plus a 16-foot (minimum) wide chain-on/chain-off area replacing the shoulder (4 12-foot lanes, 2-foot median, and 2 16-foot chain-on/chain-off areas; total of 82 feet). A chain-off area of approximately 3,500 feet can be provided in the westbound direction, as well as a 3,500 feet chain-on area in the eastbound direction (in addition to the slow-moving vehicle lane). These chain-on/chain-off areas need to be clearly signed. The ground mounted regulatory signs for chain-on areas should be changed from manual installation to be automated. One RSA Team member reported that other locations have the “drum” type signs that roll the sign legend based upon the need. To further enhance motorist information regarding conditions on Mt. Hood and the need to chain-on, an overhead VMS for eastbound traffic should be considered at approximately MP 47.5. This sign can be used for providing information regarding mountain road conditions and the upcoming chain-on area. The VMS should also have a sign verification camera installed to the west of the sign. This sign would aid motorists to safely enter the chain-on area. A second camera in the chain-on area should be considered for the purpose of monitoring activities in the chain-on area. This camera could be remotely monitored (Portland) so that ODOT maintenance and Oregon State Patrol can be notified.

<u>Issue:</u> <u>Winding Horizontal Alignment with Roller Coaster Profile</u>

Description of Safety Issue:
There are 6 consecutive reversing curves with one travel lane in each direction and an eastbound slow-moving vehicle/climbing lane starting at MP 47.9 (see Figure 16). During winter the slow-moving vehicle lane becomes the chain-on area. The existing profile has a roller coaster (up-and-down) effect (see Figure 17) and together with the winding road places oncoming traffic (especially during night time) directly in front of them from a driver's perspective. Crash data shows 15 crashes along this section with 3 crashes in 2000-2008 between eastbound and westbound traveling vehicles.

Figure 16

Figure 17

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

Suggestion:
It is suggested to straighten this roadway section by providing a tangent section between approximately MP 47.7 and the existing curve at MP 48.8. The up-and-down topography will not be as critical since traveling traffic will continue along a straight line. However, motorists still need to negotiate decision sight distance over vertical crest curves for someone pulling out of a chain-up area. There might be opportunities to fill a few feet in the sag curves without extending the fill slopes beyond the existing tree lines.

LOCATION: MAP CURVE (VICINITY OF MP 49.7)

Issue: Westbound Crashes at Map Curve

Description of Safety Issue:
The crash history for this curve shows this location to be Top 15% SPIS (see Figure 18). There have been 23 crashes between 2000-2008 having no fatalities and 15 injuries. 18 of the 23 crashes were for westbound traffic; hit fixed object crashes (11) makes this the most prevalent type, with rear-end and head-on type crashes next with 4 crashes each. Crash data does show 7 crossover crashes (approximately 30%) at this location. The curve is after 1.5 miles of relatively straight road beyond the summit at Government Camp. The curve is posted for 40 mph with a "Curve Ahead" (36"x36") sign (see Figure 19).


Figure 18


Figure 19

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

Suggestion:
There are multiple options for improving this location. The first is to replace the existing "Curve Ahead" sign with a 60"x60" post mounted sign with high intensity sheeting. A 60"x60" sign should be considered for future improvement as an overhead sign with flashing beacons (bouncing ball over and under). In addition to improved signage at the curve, advance signage (Sharp Curve Ahead) communicating the location of the sharp curve could be placed half-a-mile in advance of Map Curve. There is a rock-fall project scheduled for 2011 that entails cutting back the rock face. Associated with this project, other options can be considered. The rock face would be cut back approximately 30-40 feet. This could allow the westbound lane to be pulled to the inside of the curve providing a median and minimum 10 feet paved outside shoulder for incident response purposes. Within the median a barrier treatment should be considered to reduce the crossover and head-on crashes. Several median treatments (e.g., cable barrier) were discussed by the RSA Team, but for maintenance and snow removal purposes, the concrete barrier appears to be the preferred option. The concrete barrier will also eliminate the possibility of a westbound vehicle making a left turn into the Map Curve viewpoint that may be causing some of the rear-end crashes. The concrete barrier design should address decision/stopping sight distance and will likely require a wider median along certain sections (especially the eastbound traffic on the outside of the curve). The barrier should be carried through the curve and safely terminated in a tangent section. Further, the barrier could have retro-reflective treatments installed on the top of the barrier to further delineate the curve in darkness.

<u>Issue:</u> <u>Undesirable Chain-On Area Location</u>

Description of Safety Issue:
There is an existing chain-on area for eastbound traffic in the sharp horizontal curve at Map Curve (see Figure 20). There is poor sight distance for uphill traffic to see eastbound vehicles rejoining the roadway around the curve. The curve does not have curve chevron signage for downhill traffic (see Figure 21) as the chain-on area is built on this curve, and a roadside barrier is placed on the top of the embankment at the outside edge of the chain-on area. 5 of the 23 crashes that were recorded at this location are for eastbound traffic, of which 4 occurred during snow/ice conditions.

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

Figure 20

Figure 21

Suggestion:
Considerations should be given to remove/close the existing chain-on area in the curve, bringing the concrete barrier to the shoulder location, and adding standard curve chevron signage for downhill traffic. Provide a new chain-up area (16-20 feet wide) to the east around the curve along the tangent section (see Figures 22 and 23). This area could be as long as 1500 feet (MP 49.85 to MP 50.13).

Figure 22

Figure 23

LOCATION: SECTION BETWEEN MAP CURVE (MP 49.7) AND MIRROR LAKE CURVE (MP 51.7)

<u>Issue:</u> <u>Inadequate Westbound Passing Lane</u>

Description of Safety Issue:
The westbound traffic has a passing lane starting (see Figure 24) in the Mirror Lake curve

extending down the mountain through S-curves (see Figure 25) for approximately 3,000 feet, terminating (see Figure 26) just beyond the second curve. The signs for the termination of the passing lane have both signs mixed with the chevron signage identifying the second curve and are difficult to see (see Figure 27). The RSA Team also observed westbound vehicles passing in the no passing areas approaching this curve, because west of the aforementioned passing lane the next opportunity to pass is approximately 5-6 miles. The crash data shows there have been 10 crashes in this section with two fatalities and 5 crashes between eastbound and westbound vehicles.

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

Figure 24

Figure 25

Figure 26

Figure 27

Suggestion:
The passing lane should to be lengthened. The issue for the Mirror Lake curve will be discussed in the next safety issue regarding extending the passing lane east to begin in the tangent section. The passing lane should also be extended to the west into the tangent section following the second curve. The signage for terminating the passing lane should be located in the tangent section beyond the curve chevron signs. The RSA Team suggests that the length of the passing lane be a minimum of one mile based on the westbound traffic volumes, downhill grade, and lack of passing opportunities. It is also suggested that signage (e.g., "Passing Lane - XX Mile Ahead") be place on the westbound lane immediately beyond the previous passing opportunity. Following this extended passing lane, a similar new sign should be installed identifying the distance to the next passing lane (potentially 2 to 2.5 miles ahead at MP 49). To address the crash issue between eastbound and westbound vehicles, the concrete barrier suggested for the Map Curve and Mirror Lake Curve should be extended through this section. (*The previously described issues for Map Curve and forthcoming issues for Mirror Lake Curve have suggested providing median barrier in both curves.*) This will eliminate two of the barrier wall termination sections to improve safety. Special attention needs to be given to the design of the termination sections, as

well as the median width to meet the appropriate decision and stopping sight distance (especially for motorist traveling along the outside of curves). To accommodate the concrete barrier, the roadway section should be widened to provide appropriate inside shoulders in each side of the barrier, as well as a 12-foot lane and a 10-foot paved outside shoulder where only one westbound lane exists. The wider outside shoulder would provide adequate width for traffic to pass in case of an incident.

LOCATION: MIRROR LAKE CURVE (VICINITY OF MP 51.8)

Issue: Sharp Curve at Mirror Lake

Description of Safety Issue:
This curve has a higher number of crashes (compared to Map Curve) and has a curve warning sign posted for 35 mph (see Figure 28). This sign actually describes an S-curve with a 35 mph supplemental sign. The crash data shows a total of 33 crashes between 2000 and 2008 resulting in 1 fatality and 12 injuries. The crash types had a uniform mix of head-on, side-swipe, fixed object and rear end. The reports show that there were 7-9 crossover crashes with the 1 fatality in the reporting period. Most crashes occurred during inclement conditions with 27 during snow/ice road conditions and an additional 5 in wet pavement conditions. There was a uniform distribution of eastbound and westbound crashes. The field observation shows that this is the first significant curve west of Ski Bowl (MP 52.6) and is on a significant downhill grade. Driving the curve westbound, the downhill grade contributes to difficulty in speed reduction through the curve. The current "Curve Ahead" sign is post mounted and appears to be 36"x36". The RSA Team also observed westbound traffic making left turns into the Mirror Lake Trailhead parking area. This can contribute to the reported rear-end crashes. Another issue observed by the RSA Team is that the passing lane is introduced in this curve (see Figure 29). It is not very visible to westbound traffic and is not signed.

Figure 28

Figure 29

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

Suggestion:
There are multiple suggestions for this curve area. The initial immediate improvement could be replacing the existing S-curve sign with a 60"x60" “Curve Ahead” sign having high intensity reflective sheeting and adding an additional “Curve Ahead” sign for the second curve (splitting the message of the existing S-curve sign). The supplemental speed advisory sign (based on actual curvature) should also be increased in size and have high intensity sheeting. In the future, consideration should be given to have the first sign mounted overhead with flashing beacons (bouncing ball) for Mirror Lake Curve. In addition to improved signage at the curve, advance signing (Sharp Curve Ahead) communicating the location of the sharp curve could be placed half-a-mile in advance of Mirror Lake Curve. As discussed for potential solutions at Map Curve to improve the crossover crash situation, consideration should be given to providing median

protection through the curve area as well. In discussion with ODOT maintenance staff, the concrete barrier appears to be the best option for snow removal and maintenance purposes. As discussed, consideration should be given to connecting the two proposed concrete barrier sections (i.e., Map Curve and Mirror Lake Curve) to provide a continuous section. The barrier will aid many of the crash types including the rear-end crashes for westbound left-turning vehicles into the parking area. The RSA Team also suggests moving the start of the passing lane further to the east, introducing it in the tangent section more visible to the driver, and having proper signing. This will require cutting the rock face back to provide room for both extending the passing lane and provide the concrete barrier. Consideration was given to eliminate the passing lane, but due to the limited passing opportunity for westbound traffic over an extensive road section, the RSA Team deemed this option infeasible.

Issue: Undesirable Mirror Lake Hiking Trail Parking Location

Description of Safety Issue:
A high-use parking area exists on the south side of the highway on the very tight Mirror Lake Curve (see Figure 30). There is limited sight distance for westbound left-turn vehicles crossing two eastbound travel lanes into this parking area (see Figure 31). Motorists leaving the parking area also need to turn left across the two eastbound lanes coming around the curve, as well as finding a gap in the westbound approaching downhill traffic. Entering traffic destined to the east is joining the eastbound traffic around the curve (out of sight) that would be unexpected for eastbound traveling traffic.

Figure 30

Figure 31

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

Suggestion:
Consider moving the trailhead to the vicinity of the Ski Bowl West access and extend/connect the existing trail (about 4000') to the new parking area. This parking area could be moved to the east and constructed on the straight section of the highway, or built in the vicinity of Ski Bowl and then given access via the Ski Bowl West access. The removal of the parking area would provide the opportunity to use the existing wide embankment near this curve to widen the shoulders and/or introduce a possible median.

LOCATION: SKI BOWL ACCESSES (MP 52.4 TO MP 53.1)

Issue: Undesirable Ski Bowl West Access Location and Configuration (MP 52.50)

Description of Safety Issue:
This intersection is approximately 1,700 feet from the Ski Bowl East Access. This intersection has a very skewed intersection angle of less than 40 degrees. There is no westbound left-turn lane

into Ski Bowl at this location (see Figure 32). The intersection sight distance, especially to the east, is limited due to the vertical crest curve to the east of this intersection (see Figure 33). There have been 9 crashes from 2000-2008 including 1 fatality. These crashes represent 3 fixed object, 3 rear-end, 1 turning, 1 side-swipe, and 1 head-on type crashes.

Figure 32

Figure 33

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

Suggestion:
The Ski Bowl West Access should be realigned to the east by approximately 350 feet to the top of the crest curve (see Figure 34). This location would provide the optimum intersection sight distance and provide the opportunity to provide a standard westbound left-turn lane. The left and right turners can be separated at this realigned conventional T-intersection. Providing a 90-degree conventional T-intersection with appropriate deceleration distance for turning movements along the highway could address the majority of the crashes at this intersection. The side-street movements (especially the left-turns) will experience long delays and as traffic increases in future, this movement would become more challenging. A future consideration at this intersection could be a signal or a modern roundabout.

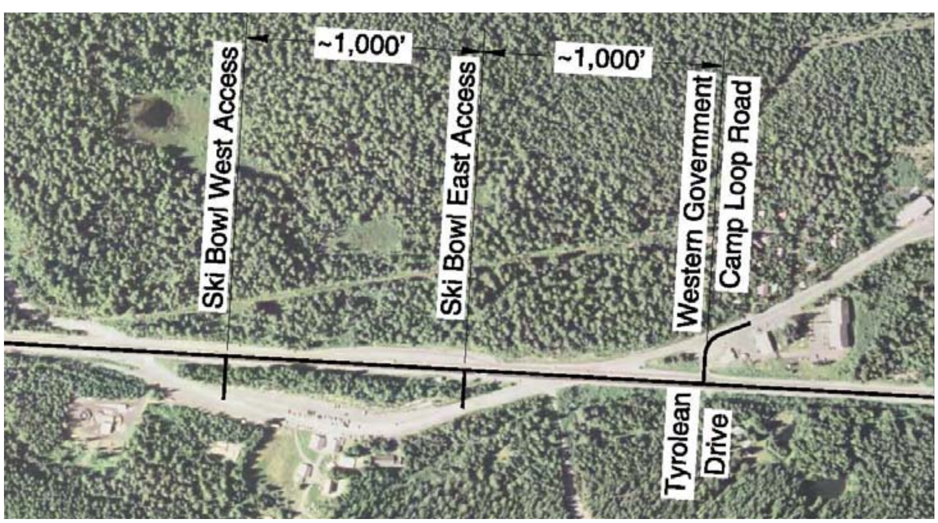


Figure 34

Issue: Undesirable Ski Bowl East Access Location and Configuration (MP 52.85)

Description of Safety Issue:
This intersection is approximately 1,700 feet from the Ski Bowl West Access and approximately 600 feet from the Tyrolean Drive intersection. Tyrolean Drive was recently added as a south leg to the 90-degree Western Government Camp Loop Road intersection. The 600-foot intersection spacing does not provide appropriate deceleration and/or storage lengths for back-to-back left-turns (see Figure 35). This intersection has a very skewed intersection angle of less than 30 degrees. The Ski Bowl West Access had 33 crashes of which 10 were rear-ends, 8 fixed objects, and 8 turning movements. The crash history for this intersection shows this location to be Top 10% SPIS. The skewed intersection angle results in a very wide open paved area (see Figure 36). It is also difficult to determine the correct in/out paths as the skewed intersection with long intersection crossing distances. This is further compounded by snow in the winter. This undesirable intersection configuration likely contributes to crashes at this location.


Figure 35


Figure 36

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

Suggestion:
As an immediate improvement, the Ski Bowl East Access southbound movement should be signed as a right-turn only allowing no through movement to Ski Bowl, all eastbound highway left-turns should occur at this intersection (none at the Tyrolean Drive intersection), and all southbound left-turns should be signed and directed to make a left at the Tyrolean Drive intersection. The objective of these alterations is to address the crashes in the north-south directions, as well as turning crashes at this intersection. A near-term solution for consideration is that the Western Government Camp Loop Road traffic should be redirected to the current 90-degree Tyrolean Drive intersection to the east, while the north leg at the Ski Bowl East intersection should be disconnected. The Ski Bowl East Access should be realigned to the west and provide an intersection spacing of approximately 1,000 feet (MP 52.79) from the realigned Ski Bowl West Access and approximately 1,000 feet from the Tyrolean Drive intersection (see Figure 34). This would provide sufficient distance to develop standard back-to-back left-turn lanes between this intersection and the Tyrolean Drive intersection. The left and right turners can be separated at this realigned conventional T-intersection. The side-street movements (especially the left-turns) would experience long delays and as traffic increases in the future, this movement would become more challenging. Providing a 90-degree conventional T-intersection with appropriate deceleration distance for turning movements along the highway would address the majority of the crashes at this intersection. A future consideration at this intersection could be a signal or a modern roundabout.

Issue: Undesirable Tyrolean Drive Intersection Location and Configuration (MP 52.98)

Description of Safety Issue:
This intersection is approximately 600 feet from the Ski Bowl East Access. A southern fourth leg (Tyrolean Drive) has recently been added making this a side-street stopped controlled intersection. The intersection experienced 16 crashes of which 6 were rear-ends, 3 fixed objects, and 7 other. There is no westbound left-turn lane (see Figure 37) and the eastbound left has non-standard deceleration and/or storage lengths (see Figure 38). The intersection radii are small and westbound right-turns almost have to come to a stop in the single westbound travel lane before making a turn. All the intersection parameters relate to a lot of friction at this node.


Figure 37


Figure 38

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

Suggestion:
As an immediate improvement, all southbound left-turns on Government Camp Loop Road should be signed and directed to make the left at this intersection and not at the skewed Ski Bowl East Access. The Ski Bowl East Access southbound movement should be signed as a right-turn only allowing no through movement to Ski Bowl. The objective of these alterations is to address rear-end and other crashes, as well as turning crashes at this intersection. Future improvements should consider realigning Western Government Camp Loop Road to this 90-degree Tyrolean Drive intersection (MP 52.98) and disconnect with the Ski Bowl East Access intersection. The north leg should better align with the south leg and consideration should be given to provide separate turn lanes. A westbound left-turn lane should be provided and the eastbound left-turn should be modified to provide sufficient deceleration distance. During snowy conditions the southbound left at the 90-degree access would have limited intersection sight distance to the east due to an approximately 10-foot snow wall. It should be considered to widen the shoulder or add a westbound right-turn lane to provide proper intersection sight distance. Adding a westbound right-turn lane would address right-turning vehicles decelerating in the only one westbound travel lane. The side-street movements (especially the left-turns) will experience long delays, and as traffic increases in the future, this movement will become more challenging. Providing a 90-degree conventional T-intersection with appropriate deceleration distance for turning movements along the highway would address the majority of the crashes at this intersection. A future consideration at this intersection could be a signal or a modern roundabout.

LOCATION: MULTORPOR BRIDGE (VICINITY OF MP 53.5)

Issue: Limited Westbound Passing Opportunity

Description of Safety Issue:
The crash history for this road section shows this location to be Top 25% SPIS. There have been 6 crashes from 2000-2008, including 3 injury crashes. There were 3 crashes between westbound and eastbound traffic. This is a three-lane cross section with one westbound and two eastbound lanes with supplemental non-standard signage (see Figure 39). The pavement marking allows westbound traffic to pass over a section of approximately 3,000 feet (see Figure 40). During the fieldwork, the RSA Team saw several undesirable westbound passing maneuvers.

Figure 39

Figure 40

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

Suggestion:
The proposed improvements at the Tyrolean Drive intersection include the provision of westbound left and right-turn lanes off the highway. In addition, one of the suggested improvements at the Eastern Government Camp Loop Road intersection is to move the intersection to the west. Both these intersection improvements will shorten the existing length for passing opportunity. Consideration should be given to eliminate passing opportunity for westbound traffic. This section of Mt. Hood Highway appears to have environmental sensitive areas along both sides of the road. Therefore, providing an additional westbound lane in the future will be challenging.

LOCATION: EASTERN GOVERNMENT CAMP LOOP ROAD (VICINITY OF MP 54.0)

Issue: Undesirable Intersection Configuration

Description of Safety Issue:
This 90-degree intersection is approximately 1,300 feet from the Timberline Road intersection. It has an eastbound left-turn, as well as a westbound right-turn along Mt. Hood Highway. The westbound right-turn has to yield to the eastbound left-turn in the intersection throat. The north leg is very wide with very short exclusive southbound left and right-turn lanes in addition to the two inbound lanes (see Figure 41). The westbound right-turn lane from the highway is not visible for approaching motorists until breaking over the vertical curve (see Figure 42). This intersection had 22 crashes of which 9 were turning movements, 8 rear-ends, and 4 fixed objects. Observations indicate that westbound motorists were slowing excessively prior to reaching the right-turn lane in anticipation of turning at the intersection. There is another intersection less than

100 feet to the north from the highway providing access to the rest area and Government Camp Loop Road (see Figure 43), as well as a gas station with no defined access. There is a lot of open pavement which leads to driver confusion, especially when the pavement markings have faded and during snowy conditions. This intersection also has a flashing beacon and some lighting (see Figure 44). There is a vertical curve to the east that limits intersection sight distance. The left-turning vehicles block the sight distance of the right-turning vehicles. Additionally, the stop sign is far from the lanes and difficult to see, especially at night.

Figure 41

Figure 42

Figure 43

Figure 44

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

Suggestion:
Consideration should be given to extend the westbound right-turn lane over the vertical crest curve so that approaching vehicles can enter the turn lane and decelerate in the turn lane. This could address crashes related to traffic in the westbound direction. Consideration should also be given to better define the north leg of the intersection by clearly linking the intersection to the Government Camp Loop Road. The rest area and gas station would then access the Government Camp Loop Road. It is understood that during the winter, the rest area typically generates more traffic compared with the Government Camp Loop Road. From spring through fall, striping and signing should suffice, but during the winter season (snowy conditions) it would be challenging to clearly define who has right-of-way. Another consideration would be to realign Government Loop Road further to the west separating the gas station and rest area activities from the conventional T-intersection with Mt. Hood Highway (see Figure 45). A new intersection location would provide better intersection sight distance, as well as turn lanes with appropriate deceleration.

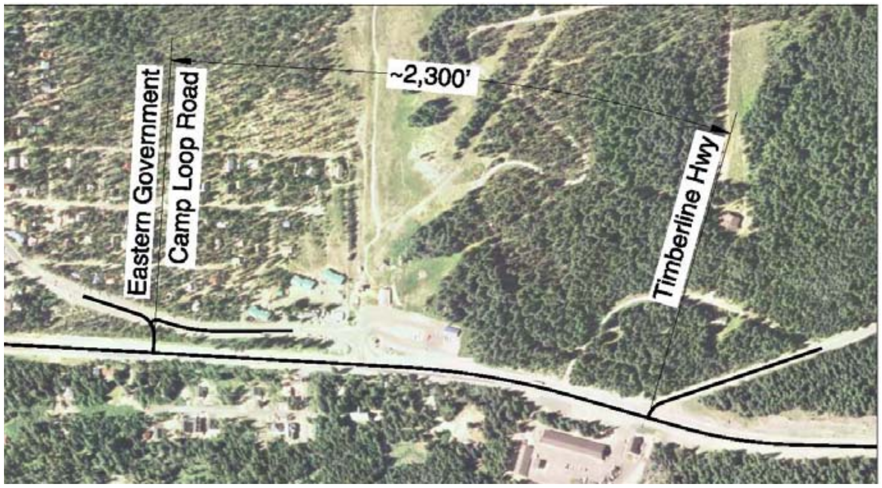


Figure 45

Issue: Poor Intersection Operations

Description of Safety Issue:
The 2009 traffic volumes indicate that some of the signal warrants might be met at this location. As developments continue to grow in Government Camp it would become more challenging for all users entering this intersection. As previously noted, this intersection had 22 crashes of which 9 were turning movements.

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

Suggestion:
There is a relatively high minor street left-turn movement at this intersection that will experience long delays (waiting to find a gap) as traffic continues to grow along the highway. The introduction of a signal or a roundabout would provide the necessary gaps and address the turning movement crashes. An intersection feasibility study should be completed to determine what traffic control device would be appropriate at this location (e.g., traffic signal or roundabout). There is currently some street lighting at this intersection. Illumination at this intersection should be evaluated and upgraded to meet appropriate intersection and transition requirements.

LOCATION: TIMBERLINE HIGHWAY (VICINITY OF MP 54.3)

Issue: Undesirable Intersection Configuration

Description of Safety Issue:
This intersection is approximately 1,300 feet from the Eastern Government Camp Loop Road intersection. This 40-degree intersection has an eastbound left-turn, as well as a westbound right-turn along Mt. Hood Highway. This intersection together with the Eastern Government Camp Loop Road intersection had a total of 50 crashes including 18 injury type crashes (see Figure 46). There were approximately 17 crashes at this intersection that included a wide spectrum of crash types, such as 5 turning/angle, 4 fixed objects, 3 sideswipes, 2 rear-ends, 1 head-on, 1 pedestrian, and 1 other. The north leg is very wide at the intersection where the right-turn is significantly flared (see Figure 47). The left-turning vehicles block the sight of the right-turning vehicles. The combination of the horizontal and vertical curves to the east limits intersection sight distance (see Figure 48). The westbound right-turn is signed and striped to yield to the eastbound

left-turn. There is a lot of open pavement that leads to driver confusion, especially when the pavement markings have faded and during snowy conditions. ODOT maintenance staff indicated that the several southbound right-turners from Timberline Highway use the flared right-turn and the wide shoulder as an unofficial add lane onto the highway (see Figure 49).

Figure 46

Figure 47

Figure 48

Figure 49

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

Suggestion:
Consideration should be given to clearly define this intersection, especially slowing the southbound right-turn, because it is currently used as an unofficial add lane onto the wide shoulder. Options for consideration might include: 1) Provide an approximately 100-foot southbound right-turn lane to avoid the left-turn queue blocking the high volume southbound right-turn. Eliminating the wide flared southbound right-turn provides the opportunity to realign the southbound right-turn lane more perpendicular to the highway. This modification would address the "merge" type crashes between westbound and southbound traffic. 2) Consideration was given to realign the bottom part of Timberline Road to "T" more perpendicular with the highway, but due to the longitudinal grade along Timberline Highway and current intersection angle, the RSA Team deemed this option infeasible. 3) A consideration might be to provide an acceleration lane for the southbound traffic onto the highway, but there is not sufficient distance to merge prior to the start of the westbound right-turn lane at the existing Eastern Government Camp Loop Road intersection. This can be treated as a westbound auxiliary lane between the two intersections, but it would introduce a weaving section, and it would be challenging to define the travel patterns during winter season. 4) However, if the Eastern Government Camp Loop Road is moved to the west (as suggested in previous sections), then there might be sufficient distance to provide an acceleration lane and an appropriate taper.

Issue: Poor Intersection Operations

Description of Safety Issue:
The 2009 traffic volumes indicate that the side-street traffic will have challenges in the future to find gaps. There is no street lighting at this intersection.

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

Suggestion:
An intersection feasibility study should be completed to determine what traffic control device would be appropriate at this location in the future (e.g., traffic signal or roundabout). Consideration should be given to provide street lighting at this intersection and along this road section with appropriate transition areas to/from the dark approaches.

Appendix “A”

Road Safety Audit Findings Presentation

ROAD SAFETY AUDIT
Mt. Hood Highway (Hwy. 26)

Camp Creek Campground to Timberline Road

(Mile Post 47.19 to 54.23)

For ODOT, Region 1
Clackamas County, Oregon

June 19, 2009

Presented by: John R. Freeman, P.E., PTOE

Kittelson & Associates, Inc.
Transportation Engineering/Planning

Presentation Outline

- Overview of Road Safety Audit (RSA) Process
- Review of Crash Data
- Overview of RSA Findings and Suggestions

Kittelson & Associates, Inc.
Transportation Engineering/Planning

RSA Team Leader – Jack Freeman, P.E., PTOE

- Co-author of FHWA's *Road Safety Audit Guidelines and Checklist*
- Lead over 20 RSA's in three states
- 37 years experience in design, traffic operations and safety
- Instructs FHWA's Designing and Operating Intersections for Safety Course, Road Safety Audits and Elder Road User
- 2003 ITE International President

Kittelson & Associates, Inc.
Transportation Engineering/Planning

Asst. Team Leader – Hermanus Steyn, Pr.Eng; P.E.

- Registered professional engineer in South Africa
- Worked as a roadway design engineer for a multi-discipline firm in South Africa (8 years)
  - Final design and on-site construction supervision of 13-km mountain pass
  - Evaluation and final design of rural highways
  - RSA was integral part of final design process
- Work at KAI since 2001
  - Develop road improvements based on anticipated traffic operations
  - Developing ways to incorporate upcoming HSM in day-to-day work
  - Actively participate in Geometric Design and Operational Effects of Geometric Design TRB Committees (and related subcommittees)

Kittelson & Associates, Inc.
Transportation Engineering/Planning

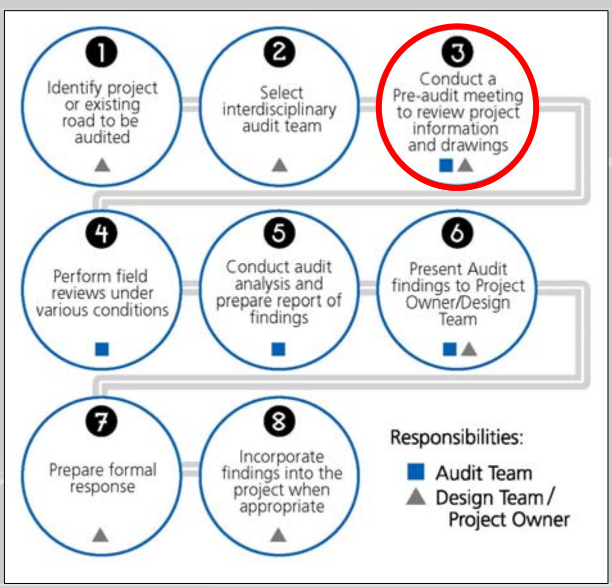
RSA Team Members

- Jack Freeman, P.E., PTOE – Team Leader
- Hermanus Steyn, Pr.Eng.; P.E., – Asst. Team Leader
- Carl Deaton, P.E. – Senior Roadway Designer, ODOT Region 2
- Robert Tolman – TMM, ODOT Region 5

- Team Resources
  - Jim McNamee – TMM, ODOT, Dist 2C, Region 1
  - Sue D'Agnese – ODOT Region 1 Traffic Manager
  - Jerry Sabel – Hwy 26 Safety Corridor CAC
  - Mike Reel – Oregon State Police

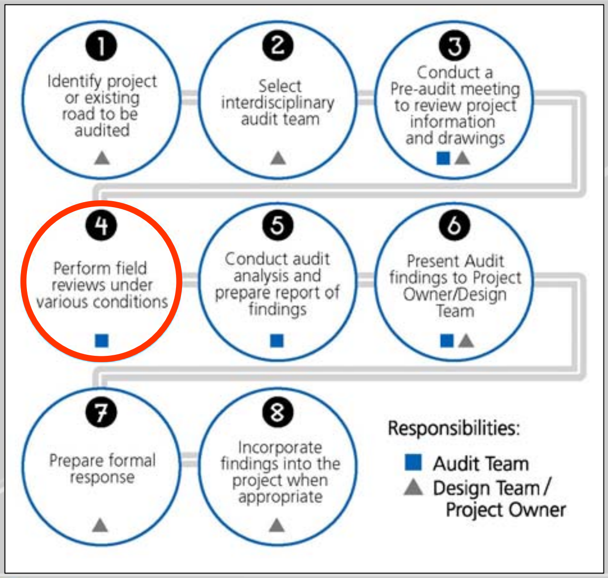
Kittelson & Associates, Inc.

RSA Process – Pre-audit Meeting



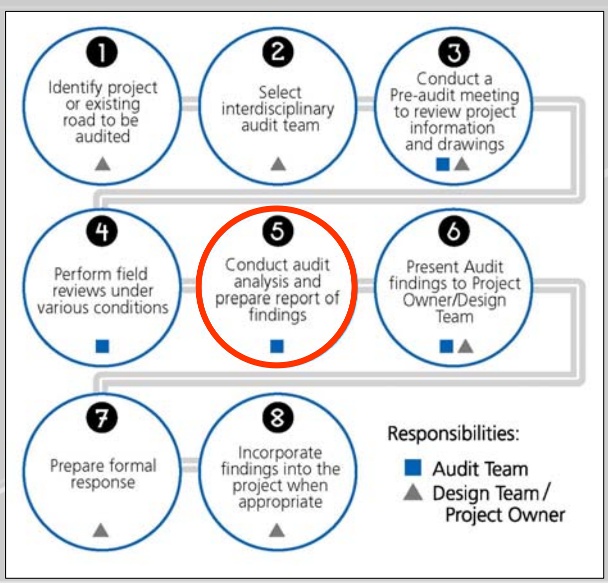
Kittelson & Associates, Inc.

RSA Process – Field Review



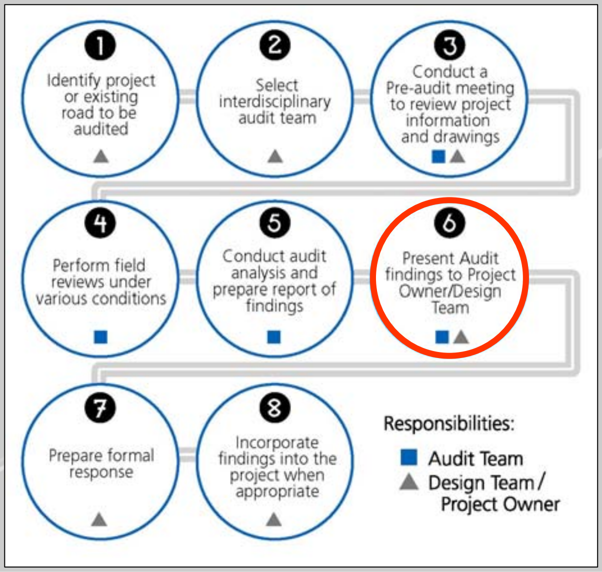
KITTELSON & ASSOCIATES, INC.

RSA Process – RSA Analysis

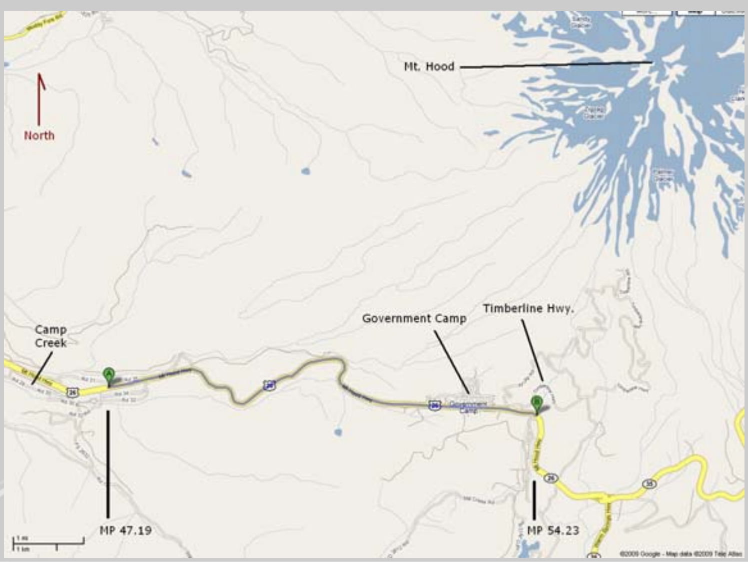


KITTELSON & ASSOCIATES, INC.

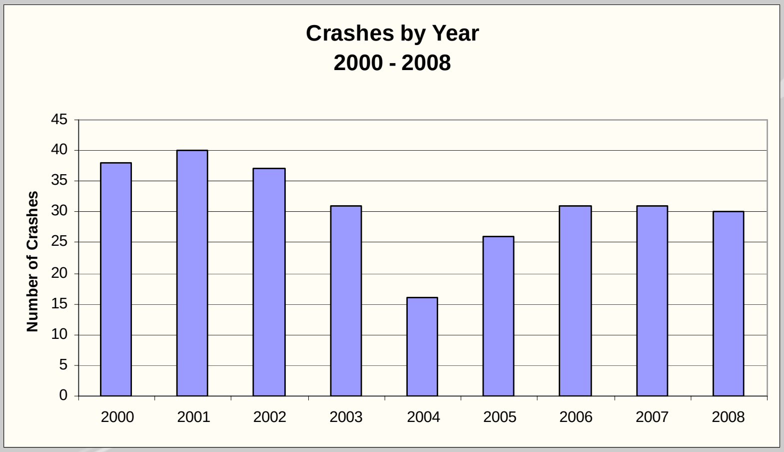
RSA Process – Presentation of Findings



Mt. Hood Highway RSA Segment (MP 47.19 to 54.23)



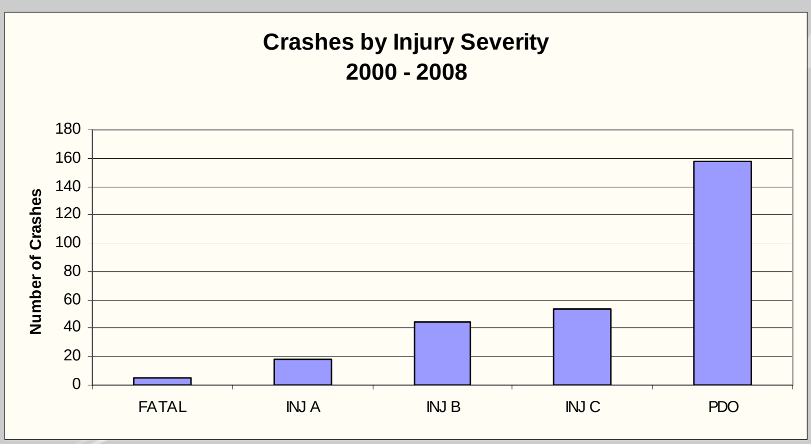
2000 – 2008 Crashes



Total Crashes = 280

KITTELSON & ASSOCIATES, INC.

Crashes by Injury Severity

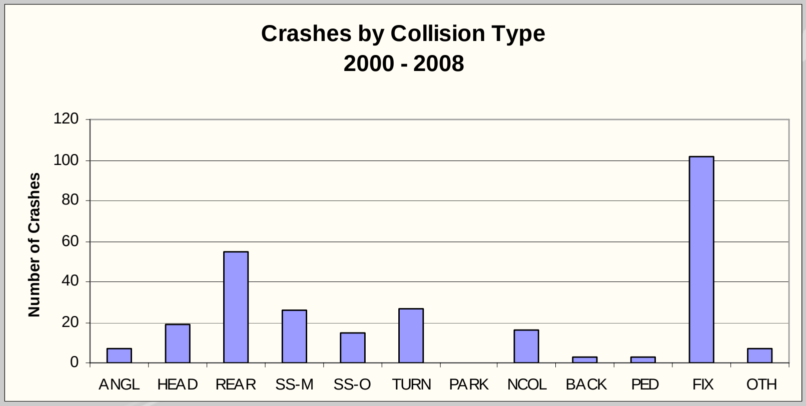


FATAL – Fatality; INJ A – Injury A; INJ B – Injury B; INJ C – Injury C; PDO – Property Damage Only

55% of all crashes are non-injury (PDO) crashes

KITTELSON & ASSOCIATES, INC.

Crashes by Collision Type

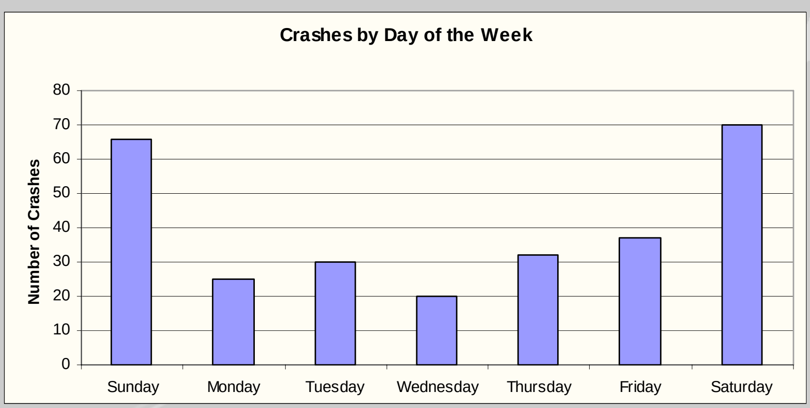


ANGL – Angle; HEAD – Head-On; REAR – Rear-End; SS-M – Sideswipe-meeting;
SS-O – Sideswipe-overtaking; TURN – Turning Movement; PARK – Parking Maneuver;
NCOL – Non-collision; BACK – Backing; PED – Pedestrian; FIX – Fixed/Other Object; OTH - Other

Crashes primarily fixed-object or rear-end crashes

Kittelson & Associates, Inc.
Transportation Engineering/Planning

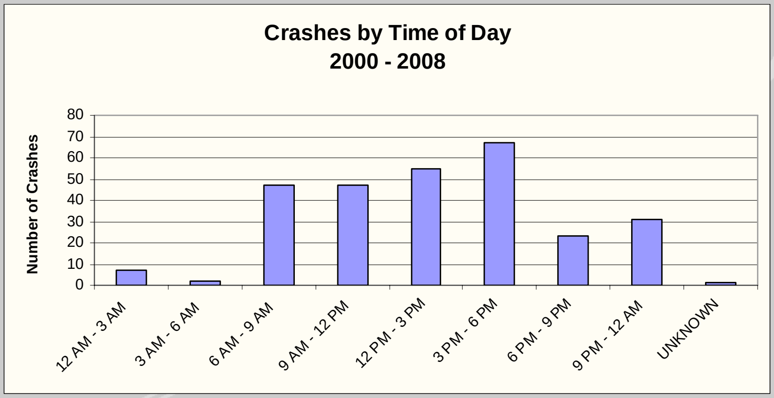
Crashes by Day of the Week



Crashes occur primarily during the weekends

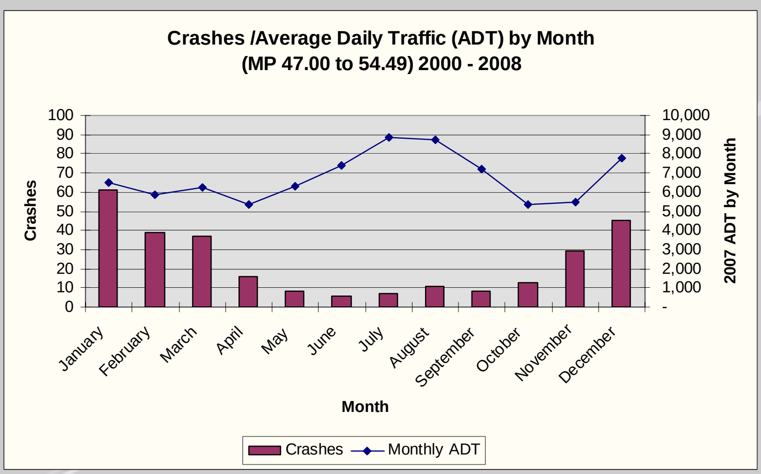
Kittelson & Associates, Inc.
Transportation Engineering/Planning

Crashes by Time of Day



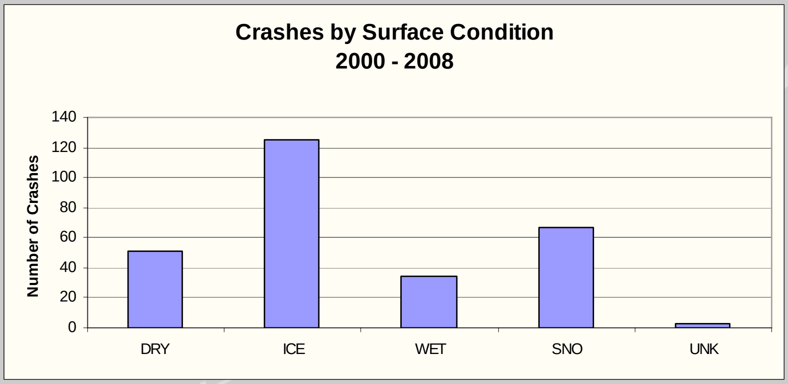
Crashes occur primarily during daylight hours

Crashes/ADT by Month



Crashes occur primarily during the winter months

Crashes by Surface Condition

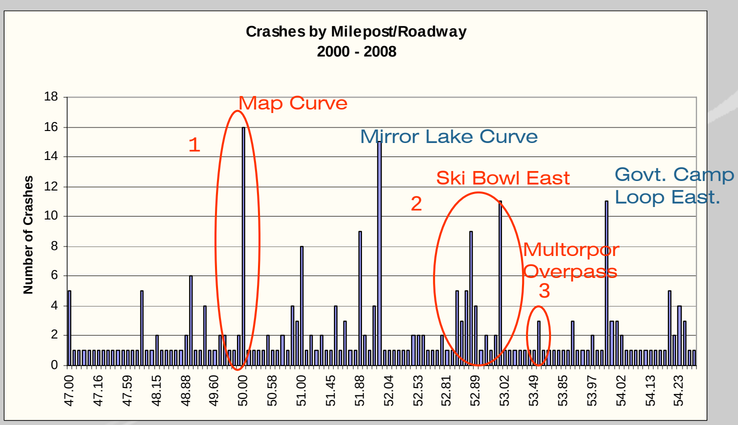


SNO – Snow; UNK – Unknown

Approximately 70% of crashes occur in the presence of ice and snow

KITTELSON & ASSOCIATES, INC.

Concentrated Crash Locations by Milepost



SPIS locations:

1. MP 49.91 – 50.09
2. MP 52.78 – 52.95
3. MP 53.45 – 53.59

KITTELSON & ASSOCIATES, INC.

Corridor Issues – Western Section – Camp Creek to Ski Bowl West

- Mountain Highway
  - 55 mph – speed is an issue
    - OSP Education
  - Minimum access
  - Curves
  - Chains on/off areas
  - WB passing areas
- Potential solutions
  - Variable Speed Limits (VSL) for poor roadway conditions
    - Consider photo speed enforcement – only when VSL is used
  - Better signs for curves; possible barrier separation
  - More Chain on/off areas
    - Electronic signs to inform public
  - More/longer WB passing areas
    - Improve signage

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

Crash Analysis: Camp Creek Entrance MP 47.0 – 47.3

Years 2000 - 2008

- Total Crashes: 12
- Fatalities/Injuries: 1 / 8
- Predominant Crash Types
  1. Fixed object (6)
  2. Rear-end (2)
- Predominant Road Conditions:
  1. Snow/Ice (5)
  2. Dry (5)
  3. Wet (2)
- Directional crash notes:
  - Both rear-end crashes occurred in the westbound direction
  - Fixed-object crashes occurred in varied directions

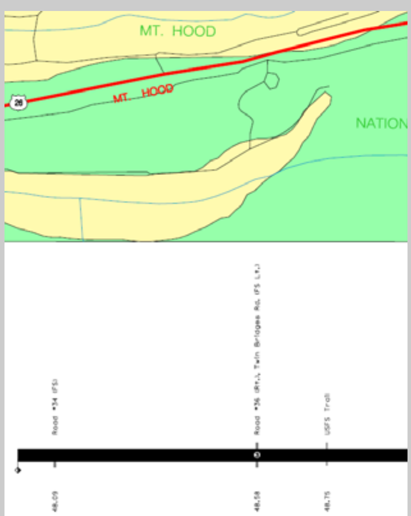
KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

Issues - Suggestions

- Improve decision sight distance thru curve
  - Trim back trees inside curve
- Improve visibility of curve
  - Increase size of “Curve Ahead” sign
- Improve paved shoulder width to 8’

KITTELSON & ASSOCIATES, INC.

Crash Analysis: MP 47.8 – 48.8 (Mt. Hood Hwy.)



Years 2000 - 2008

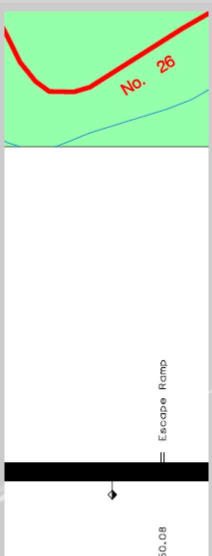
- Total Crashes: 15
- Fatalities/Injuries: 0 / 7
- Predominant Crash Types
  1. Fixed object (9)
  2. Side-swipe (4)
- Predominant Road Conditions:
  1. Snow/Ice (10)
  2. Wet (3)
  3. Head-On (3)
- Directional crash notes:
  - 10 crashes westbound (6 of these fixed-object)

KITTELSON & ASSOCIATES, INC.

Issues-Suggestions

- 1 mile cleared section
  - Approximately 95’ wide treeline to treeline
- Existing roadway – 3 lanes
  - Series of vertical and horizontal curves
- Improvements
  - Straighten road and improve vertical
  - 4 lanes – 2 each direction
  - 16’ Chain on/off outside shoulders
  - Electronic signs for chain areas, mountain road conditions and VSL (if applicable)

Crash Analysis: MP 49.91 – 50.09 (Map Curve)



Years 2000 - 2008

- Total Crashes: 23
- SPIS Top 15%
- Fatalities/Injuries: 0 / 15
- Predominant Crash Types
  1. Fixed object (11)
  2. Rear-end (4)
  3. Head-on (4)
- Predominant Road Conditions:
  1. Snow/Ice (14)
  2. Dry (5)
  3. Wet (4)
- Directional crash notes:
  - 18 of the 23 crashes occurred in the westbound direction
  - 7 cross over crashes

Issues-Suggestions

- Curve posted for 40 mph
- Contains winter chain on/off area and summer overlook
- Improvements
  - Enhance “Curve Ahead” signage
    - Replace existing with 60”x60” high intensity
    - Consider future overhead with flashing beacons
  - Improve curve
    - Cut back rock face
    - Shift WB lane to inside of curve w/wider shoulders
    - Add median barrier
  - Modify chain on area
    - Close existing location
    - Shift up grade beyond curve

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

Crash Analysis: MP 51.3 – 51.6 (bet. Map Curve & Mirror Lake)

Years 2000 - 2008

- Total Crashes: 10
- (non-SPIS)
- Fatalities/Injuries: 2 / 5
- Predominant Crash Types
  1. Fixed object (5)
  2. Head-on (2)
- Predominant Road Conditions:
  1. Snow/Ice (6)
  2. Wet (2)
  3. Dry (2)
- Directional crash notes:
  - 7 crashes WB (4 of these fixed-object)
  - 4 crashes between WB & EB vehicles

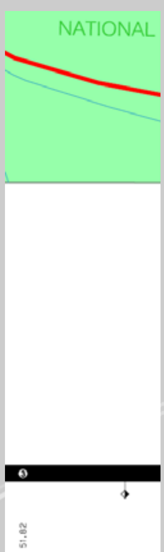
KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

Issues-Suggestions

- WB passing lane ends MP 51.6
  - Next passing lane 5 to 6 miles west
  - Passing lane termination signs mixed with chevron signs
- Improvements
  - Extend passing lane to be minimum of one mile long
  - Terminate in tangent and relocate signs into tangent
  - Consider barrier between Map Curve and Mirror Lake Curve
  - Add “Next Passing Lane – XX miles” sign

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

Crash Analysis: MP 51.88 – 52.04 (Mirror Lake Curve)



Years 2000 - 2008

- Total Crashes: 33
- Fatalities/Injuries: 1 / 12
- Predominant Crash Types
  - Uniform mix of head-on, side-swipe, fixed object, and rear-end crashes
- Predominant Road Conditions:
  1. Snow/Ice (27)
  2. Wet (5)
  3. Dry (1)
- Directional crash notes:
  - Uniform distribution of eastbound and westbound crashes (no north- or southbound crashes)

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

Issues-Suggestions

- Curve posted at 35 mph
- Mirror Lake Trailhead located in curve
- Improvements
  - Enhance “Curve Ahead” signage
    - Replace existing with 60”x60” high intensity
    - Consider future overhead with flashing beacons
  - Improve curve
    - Cut back rock face
    - Shift WB lane to inside of curve w/wider shouders
    - Add median barrier

KITTELSON & ASSOCIATES, INC.

Corridor Issues – Eastern Section – Ski Bowl West to Timberline

- Government Camp Summit Section
  - 55 mph
  - Increased access – more intersection crashes
    - Limited LT lanes
    - Skew angles
    - Some intersections lighted
  - Transitioning land uses
    - Development occurring/planned
    - Demand to increase snow park areas
- Potential solutions
  - Rework intersections
  - Change roadway character
    - Consider speed limit reduction to 45 mph
    - Consider roadway lighting

KITTELSON & ASSOCIATES, INC.

Crash Analysis: Ski Bowl West Entrance at MP 52.4 – 52.6

Years 2000 - 2008

- Total Crashes: 9
- Fatalities/Injuries: 1 / 1
- Predominant Crash Types
  1. Fixed object (3)
  2. Rear-end (3)
  3. Mix of turning (1), side-swipe (1), and head on (1)
- Predominant Road Conditions:
  1. Snow/Ice (7)
- Directional crash notes:
  – Even split EB and WB
  – No northbound crashes

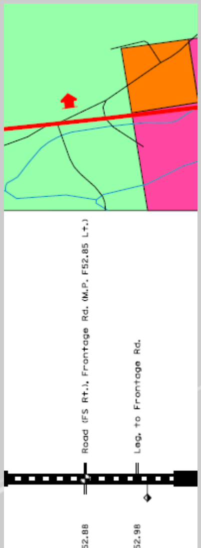
KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

Issues-Suggestions

- Existing intersection is on skew with minor road opposite
- No WB LT lane into Ski Bowl West
- Improvements
  – Shift intersection to east to become "T"
  – Locate at crest of vertical curve
  – Provide LT lane

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

SPIS Crashes: MP 52.78 – 52.95 (Ski Bowl East/Govt. Camp Loop)



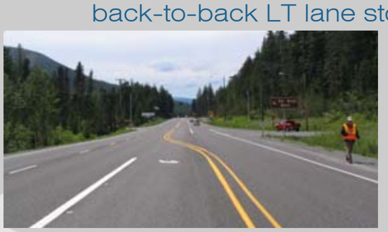
Years 2000 - 2008

- Total Crashes: 49
- SPIS Top 10%
- Fatalities/Injuries: 0 / 16
- Predominant Crash Types
  1. Fixed object (14)
  2. Rear-end (13)
  3. Turning (8)
- Predominant Road Conditions:
  1. Snow/Ice (33)
  2. Dry (12)
  3. Wet/Unknown (2/2)
- Directional crash notes:
  - Half rear-end crashes occurred north to south at "Y"
  - Fixed object and turning crashes were evenly split EB and WB

Kittelson & Associates, Inc.
Transportation Engineering/Planning

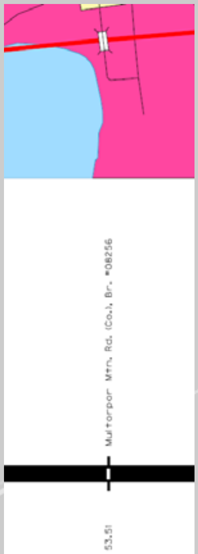
Issues-Suggestions

- Skewed intersection with multiple accesses
- Short LT lanes
- Has roadway lighting
- Improvements
  - Close skewed intersection to become 2 "T" intersections
    - Realign Ski Bowl East to be west of current location
    - Use existing full intersection at Tyrolean Drive for Government Camp Loop west access
    - Provide WB left to Tyrolean Drive
  - Provide adequate separation between intersections for back-to-back LT lane storage



Kittelson & Associates, Inc.
Transportation Engineering/Planning

Crash Analysis: MP 53.45 – 53.59 (Multorpor Overpass)



Years 2000 - 2008

- Total Crashes: 6
- SPIS Top 25%
- Fatalities/Injuries: 0 / 3
- Predominant Crash Types
  1. Sideswipe (3)
  2. Head-on/Fixed/Angle (1/1/1)
- Predominant Road Conditions:
  1. Snow/Ice (6)
- Directional crash notes:
  - 3 crashes were between EB and WB vehicles
  - 1 crash NB with EB
  - 1 crash WB with WB
  - 1 fixed object crash EB

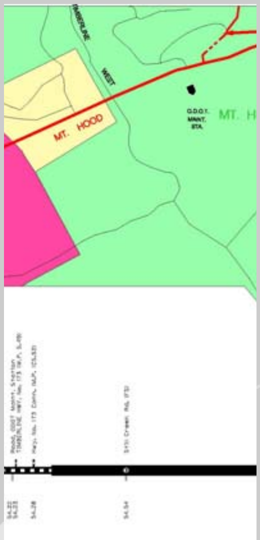
Kittelson & Associates, Inc.
Transportation Engineering/Planning

Issues-Suggestions

- Straight section with EB grade up to summit
- WB traffic able to pass with Yield
  - Anticipate to get more difficult with traffic increasing
- Improvement
  - Eliminate WB ability to pass
    - Needs passing lane improvements to west
  - Consider WB additional lane – environmental issues

Kittelson & Associates, Inc.
Transportation Engineering/Planning

Crash Analysis: MP 53.9 - 54.3 (Gov't Camp East to Timberline)

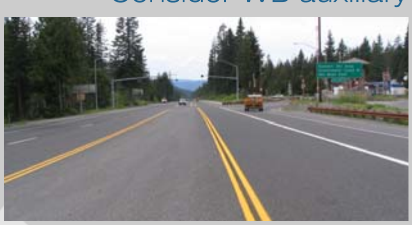


Years 2000 - 2008

- Total Crashes: 50
- Fatalities/Injuries: 0 / 18
- Predominant Crash Types
  1. Rear-end (15)
  2. Turning (14)
  3. Fixed object (9)
- Predominant Road Conditions:
  1. Snow/Ice (34)
  2. Dry (10)
- Directional crash notes:
  - Even directional split through segment (no pattern detected)

Issues-Suggestions

- High crashes and high volumes
- Rest area @ Gov't Camp Loop east
- Gov't Camp Loop may meet signal warrants
- LT and RT lanes provided at both intersections
- Improvements
  - Extend Gov't Camp Loop WB RT over the crest
  - Provide WB acceleration lane from Timberline
  - Consider WB auxiliary lane between intersections



Kittelson & Associates, Inc.

Next Steps

- Complete draft report by July 7th
- RSA team review (two weeks)
- Submit final report by July 28th

Kittelson & Associates, Inc.
Transportation Engineering/Planning

ROAD SAFETY AUDIT
Mt. Hood Highway (Hwy. 26)

Camp Creek Campground to Timberline Road

(Mile Post 47.19 to 54.23)

For ODOT, Region 1
Clackamas County, Oregon

June 19, 2009

Presented by: John R. Freeman, P.E., PTOE

Kittelson & Associates, Inc.
Transportation Engineering/Planning

Appendix “B”

Summary of Road Safety Audit (RSA) Findings

Appendix “B” – Summary of RSA Findings

The table below provides all the 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
Lack of In Pavement Reflectors and Delineators	*Entire Corridor*	• *Consider installing new inlaid RPMs and delineators.* • *Consider delineator closer spacing at locations where speeds are below 55 mph.*	
Lack of Sign Consistency and Retro-reflectivity	*Entire Corridor*	• *Consider conducting a sign study along the corridor to upgrade to current signing standards.*	
Non-standard Guardrails	Entire Corridor	• Consider investigating the existing guardrails along the corridor to upgrade to current guardrail standards, especially the guardrail ends.	
Limited Public Outreach • Approximately 55% of drivers involved with crashes are younger than 35 years.	Entire Corridor	• Consider targeting outreach advertising the younger driver. • Focus on providing information of alternative modes of transportation (establish reliable public transit alternatives). • The US Forest Services could consider providing kiosks at their snow parks with safety related brochures.	
Many Speed Related Crashes in Poor Weather Conditions • *Approximately 70% of all crashes occur in the presence of ice and snow.)*	*Mountain Highway Corridor Section (MP 47.0 – 52.4)*	• *Consideration should be given to apply photo speed enforcement only when the Variable Speed Limits (VSL) is used.*	
Challenging Accessibility to Growing Surrounding Land Uses • *This road section experienced 99 crashes in 2000-2008 of which 28 were rear-ends and 22 turning movements.*	*Government Camp Summit Corridor Section (MP 52.4 – 54.3)*	• *The surroundings along this corridor section are continuing to change and consideration should be given to lower the speed to 45 mph through the Government Camp.* • *Consideration should be given to reconfigure the intersections to provide improved intersection angles and intersection spacing. Encouraging slower speeds through this section could also include cross sectional elements.* • *Consideration should be given to provide street lighting along this road section with appropriate transition areas to/from the dark approaches.*	

Appendix “B” – Summary of RSA Findings

Issue	Location	Suggestion	Agency Response/Comment
Inappropriate Roadway Shoulder • The existing paved shoulder is typically 4-6 feet. • Trees are very close to the travel lane.	Two-Lane Section MP 47 – 48	• Widen the paved shoulder to a minimum of 8 feet to meet ODOT standards. • Consideration should be given to remove trees closest to the road to improve sight distance and provide reasonable roadside clearance.	
Relative Sharp Curve West of Intersection • Trees are approximately 10-12 feet from the edge of travel lane. These trees restrict the sight distance through the curve.	Camp Creek Campground (Vicinity of MP 47)	• Consider cutting back trees to improve visibility of the curve and ability to negotiate the curve. • Consider increasing the size of the "Curve Ahead" to 60"x60" and use high intensity reflective sheeting to enhance retro-reflectivity.	
Lack of Westbound Passing Lane • *The road alignment has a winding up-and-down topography that does not provide passing.*	*Tree Cleared Area MP 47.6 - 48.8*	• *The existing width between the cleared treelines provides the opportunity to provide a four-lane cross section.* • *Advance signing communicating the location of the next passing lane should be provided.*	
Lack of Clearly Defined Chain-on and Chain-off Areas • *There are no official chain-off areas in the westbound direction, but only wide open gravel areas.* • *The eastbound slow-moving vehicle lane is currently used as a chain-on area during winter time.*	*Tree Cleared Area MP 47.6 - 48.8*	• *The existing width between the cleared treelines provides the opportunity to provide a four-lane cross section plus a 16-foot (minimum) wide chain-on/chain-off area* • *These chain-on/chain-off areas need to be clearly signed, preferably with automated signage.* • *To further enhance motorist information regarding conditions on Mt. Hood and the need to chain-on, an overhead VMS for eastbound traffic should be considered.*	
Winding Horizontal Alignment with Roller Coaster Profile • *There are 6 consecutive reversing curves with one travel lane in each direction and an eastbound slow-moving vehicle/climbing lane.* • *The existing profile has an up-and-down effect and together with the winding road places oncoming traffic directly in front of them from a driver's perspective.*	*Tree Cleared Area MP 47.6 - 48.8*	• *It is suggested to straighten this roadway* • *The up-and-down topography will not be as critical since traveling traffic will continue along a straight line. There might be opportunities to fill a few feet in the sag curves without extending the fill slopes beyond the existing tree lines.*	

Appendix “B” – Summary of RSA Findings

Issue	Location	Suggestion	Agency Response/Comment
<u>*Westbound Crashes at Map Curve*</u> • *The crash history for this curve shows this location to be Top 15% SPIS.* • *Crash data does show 7 crossover crashes (approximately 30%) at this location.* • *The curve is after 1.5 miles of relatively straight road beyond the summit at Government Camp.*	*Map Curve (Vicinity of MP 49.7)*	First Option • *Replace the existing "Curve Ahead" sign with a 60"x60" post mounted sign with high intensity sheeting. A 60”x60” sign should be considered for future improvement as an overhead sign with flashing beacons (bouncing ball over and under).* • *To improved signage at the curve, advance signage (Sharp Curve Ahead) communicating the location of the sharp curve could be placed half-a-mile in advance of Map Curve.* Second Option • *The rock face would be cut back approximately 30-40 feet to allow the westbound lane to be pulled to the inside of the curve.* • *Within the median a barrier treatment should be considered to reduce the crossover and head-on crashes.*	
<u>*Undesirable Chain-On Area Location*</u> • *There is an existing chain-on area for eastbound traffic in the sharp horizontal curve at Map Curve.* • *There is poor sight distance for uphill traffic to see eastbound vehicles rejoining the roadway around the curve.*	*Map Curve (Vicinity of MP 49.7)*	• *Considerations should be given to remove/close the existing chain-on area in the curve, bringing the concrete barrier to the shoulder location, and add standard curve chevron signage for downhill traffic.* • *Provide a new chain-up area (16-20 feet wide) to the east around the curve along the tangent section.*	
<u>*Inadequate Westbound Passing Lane*</u> • *The westbound traffic has a passing lane starting in the Mirror Lake curve extending down the mountain through S-curves for approximately 3,000 feet terminating just beyond the second curve.* • *The crash data shows there have been ten crashes in this section with two fatalities and five crashes between eastbound and westbound vehicles.*	*Section Between Map Curve (MP 49.7) and Mirror Lake Curve (MP 51.7)*	• *The passing lane should to be lengthened by extending the passing lane east to begin in the tangent section. The passing lane should also be extended to the west into the tangent section following the second curve.* • *It is also suggested that signage (e.g., "Passing Lane - XX Mile Ahead") be place at strategic locations.* • *To address the crash issue between eastbound and westbound vehicles, the concrete barrier suggested for the Map Curve and Mirror Lake Curve should be extended through this section.*	

Issue	Location	Suggestion	Agency Response/Comment
<u>Sharp Curve at Mirror Lake</u> • *This curve has a higher number of crashes compared to Map Curve.* • *The accident reports show that there have been 7-9 crossover crashes with the one fatality in the reporting period.* • *The westbound passing lane is introduced in this curve and is not very visible to westbound traffic and is not signed.*	*Mirror Lake Curve (Vicinity Of MP 51.8)*	*Option One* • *Replace the existing S-curve sign with a 60"x60" “Curve Ahead” sign and add an additional “Curve Ahead” sign for the second curve.* *Option Two* • *Consideration should be given to have the first sign mounted overhead with flashing beacons (bouncing ball).* • *Advance signing (Sharp Curve Ahead) communicating the location of the sharp curve could be placed half-a-mile in advance of the curve.* *Option Three* • *Consideration should be given to providing median protection through the curve area.* • *Suggests moving the start of the passing lane further to the east introducing it in the tangent section more visible to the driver.*	
<u>Undesirable Mirror Lake Hiking Trail Parking Location</u> • A high-use parking area exists on the south side of the highway on the very tight Mirror Lake Curve. • There is limited sight distance for westbound left-turn vehicles into this parking area and motorists leaving the parking area that need to turn left.	Mirror Lake Curve (Vicinity Of MP 51.8)	• Consider moving the trailhead to the vicinity of the Ski Bowl West access and extend/connect to the existing trail (about 4000') to the new parking area. • The removal of the parking area would provide the opportunity to use the existing wide embankment near this curve to widen the shoulders and/or the introduction of a possible median.	
<u>Undesirable Ski Bowl West Access Location and Configuration (MP 52.50)</u> • *This intersection is approximately 1,700 feet from the Ski Bowl East Access.* • *It has a skewed intersection angle of less than 40 degrees.* • *There is no westbound left-turn lane into Ski Bowl at this location.*	*Ski Bowl Accesses (MP 52.4 - 53.1)*	• *The Ski Bowl West Access should be realigned to the east by approximately 350 feet to the top of the crest curve.* • *This location would provide the optimum intersection sight distance and the opportunity to provide a standard westbound left-turn lane.* • *Providing a 90-degree conventional T-intersection with appropriate deceleration distance for turning movements along the highway.*	

Issue	Location	Suggestion	Agency Response/Comment
• *The intersection sight distance especially to the east is limited due to the vertical crest curve to the east.* • *There have been 9 crashes from 2000-2008 including one fatality.*			
Undesirable Ski Bowl East Access Location and Configuration (MP 52.85) • *This intersection is approximately 1,700 feet from the Ski Bowl West Access and approximately 600 feet from the Tyrolean Drive intersection.* • *The 600-foot intersection spacing does not provide appropriate deceleration and/or storage lengths for back-to-back left-turns.* • *This intersection has a very skewed intersection angle of less than 30 degrees.* • *The Ski Bowl West Access had 33 crashes and the crash data shows this location to be Top 10% SPIS.*	*Ski Bowl Accesses (MP 52.4 - 53.1)*	*Option One* • *The Ski Bowl East Access southbound movement should be signed as a right-turn only allowing no through movement to Ski Bowl, all eastbound highway left-turns should occur at this intersection (none at the Tyrolean Drive intersection), and all southbound left-turns should be signed and directed to make a left at the Tyrolean Drive intersection.* • *Another near-term solution for consideration is, the Western Government Camp Loop Road traffic should be redirected to the current 90-degree Tyrolean Drive intersection to the east, while the north leg at the Ski Bowl East intersection should be disconnected.* *Option Two* • *The Ski Bowl East Access should be realigned to the west and provide an intersection spacing of approximately 1,000 feet (MP 52.79) from the realigned Ski Bowl West Access and approximately 1,000 feet from the Tyrolean Drive intersection.* • *This would provide sufficient distance to develop standard back-to-back left-turn lanes between this intersection and the Tyrolean Drive intersection.* • *Providing a 90-degree conventional T-intersection with appropriate deceleration distance for turning movements along the highway would address the majority of the crashes at this intersection.*	

Issue	Location	Suggestion	Agency Response/Comment
Undesirable Tyrolean Drive Intersection Location and Configuration (MP 52.98) • *The intersection experienced 16 crashes.* • *There is no westbound left-turn lane and the eastbound left has non-standard deceleration and/or storage lengths.*	*Ski Bowl Accesses (MP 52.4 - 53.1)*	*Option One* • *The Ski Bowl East Access southbound movement should be signed as a right-turn only allowing no through movement to Ski Bowl, all eastbound highway left-turns should occur at this intersection (none at the Tyrolean Drive intersection), and all southbound left-turns should be signed and directed to make a left at the Tyrolean Drive intersection.* • *Another near-term solution for consideration is, the Western Government Camp Loop Road traffic should be redirected to the current 90-degree Tyrolean Drive intersection to the east, while the north leg at the Ski Bowl East intersection should be disconnected.* *Option Two* • *The north leg should better align with the south leg and consideration should be given to provide separate turn lanes.* • *A westbound left-turn lane should be provided and the eastbound left-turn should be modified to provide sufficient deceleration distance.* • *During snowy conditions the southbound left at the 90-degree access would have limited intersection sight distance to the east due to an approximately 10-foot snow wall. It should be considered to widen the shoulder or add a westbound right-turn lane to provide proper intersection sight distance.* • *Providing a 90-degree conventional T-intersection with appropriate deceleration distance for turning movements along the highway would address the majority of the crashes at this intersection.*	

Appendix "B" – Summary of RSA Findings

Issue	Location	Suggestion	Agency Response/Comment
Limited Westbound Passing Opportunity • *The crash history for this road section shows this location to be Top 25% SPIS.* • *This is a three-lane cross section with one westbound and two eastbound lanes with supplemental non-standard signage.* • *The pavement marking allow westbound traffic to pass over a section of approximately 3,000 feet.*	*Multorpor Bridge (Vicinity of MP 53.5)*	• *Suggested intersection improvements at Tyrolean Drive and the Eastern Government Camp Loop Road will shorten the existing length for passing opportunity. Consideration should be given to eliminate passing opportunity for westbound traffic.* • *This section of Mt. Hood Highway appears to have environmental sensitive areas along both sides of the road. Therefore, providing an additional westbound lane in future will be challenging.*	
Undesirable Intersection Configuration • *This 90-degree intersection is approximately 1,300 feet from the Timberline Road intersection.* • *The north leg is very wide with very short exclusive southbound left and right-turn lanes in addition to the two inbound lanes.* • *The westbound right-turn lane from the highway is not visible for approaching motorists until breaking over the vertical curve.* • *This intersection had 22 crashes.*	*Eastern Government Camp Loop Road (Vicinity Of MP 54.0)*	• *Consideration should be given to extend the westbound right-turn lane over the vertical crest curve so that approaching vehicles can enter the turn lane and decelerate in the turn lane.* • *Consideration should also be given to better define the north leg of the intersection by clearly linking the intersection to the Government Camp Loop Road.* • *Another consideration would be to realign Government Loop Road further to the west separating the gas station and rest area activities from the conventional T-intersection with Mt. Hood Highway. A new intersection location would provide better intersection sight distance, as well as turn lanes with appropriate deceleration.*	
Poor intersection operations • *The 2009 traffic volumes indicate that some of the signal warrants might be met at this location.*	*Eastern Government Camp Loop Road (Vicinity Of MP 54.0)*	• *There is a relative high minor street left-turn movement at this intersection that will experience long delays (waiting to find a gap) as traffic continues to grow along the highway.* • *An intersection feasibility study should be completed to determine what traffic control device would be appropriate at this location (e.g., traffic signal or roundabout).*	

Appendix "B" – Summary of RSA Findings

Issue	Location	Suggestion	Agency Response/Comment
<u>Undesirable Intersection Configuration</u> • *This intersection is approximately 1,300 feet from the Eastern Government Camp Loop Road intersection.* • *This 40-degree intersection has an eastbound left-turn, as well as a westbound right-turn along Mt. Hood Highway.* • *There were approximately 17 crashes at this intersection that included a wide spectrum of crash types.* • *The north leg is very wide at the intersection where the right-turn is significantly flared.* • *The combination of the horizontal and vertical curves to the east limits intersection sight distance.*	*Timberline Highway (Vicinity Of MP 54.3)*	• *Consideration should be given to clearly define this intersection, especially slowing the southbound right-turn, because it is current used as an unofficial add lane onto the wide shoulder.* *Options for consideration might include:* • *Provide an approximately 100-foot southbound right-turn lane to avoid that the left-turn queue blocking the high volume southbound right-turn.* • *If the Eastern Government Camp Loop Road is moved to the west, then there might be sufficient distance to provide an acceleration lane and an appropriate taper for the southbound right-turn.*	
<u>Poor intersection operations</u> • *The 2009 traffic volumes indicate that the side-street traffic will have challenges in future to find gaps.* • *There is no street lighting at this intersection.*	*Timberline Highway (Vicinity Of MP 54.3)*	• *An intersection feasibility study should be completed to determine what traffic control device would be appropriate at this location in future (e.g., traffic signal or roundabout).* • *Consideration should be given to provide street lighting at this intersection and along this road section with appropriate transition areas to/from the dark approaches.*	

Holly Lane Safety Evaluation

Technical Report

February 8, 2012

Prepared by

Clackamas County Traffic Engineering
150 Beavercreek Road
Oregon City, OR 97045

Executive Summary

This project has been undertaken in response to citizen concerns regarding the safety of Holly Lane between Maplelane Road and Redland Road. Clackamas County has used a "Road Safety Audit" type approach in review of the safety of Holly Lane. The review included an analysis of crash history, historical traffic volumes, field observations, two public meetings to discuss the problems on Holly Lane, and several walkthroughs with members of the community.

This project evaluation did not find that Holly Lane is experiencing a significant or increasing safety or traffic volume issues compared with other rural roadways in Clackamas County. However, the project did indentify a number of improvements that would improve the safety and livability of the roadway.

Near term improvements recommended herein are low cost and can be implemented immediately. Intermediate improvements and long term improvements are larger projects and require Clackamas County to develop a "capital improvement project" and prioritize those projects along with other projects in the Clackamas County Transportation System Plan (TSP) and Capital Improvement Plan (CIP). It cannot currently be anticipated when the intermediate and long term improvements will be implemented.

Background & Process

Clackamas County has been contacted on several occasions over the past few years by the homeowners and residents along S. Holly Lane (hereafter referred to as "Holly") regarding safety and livability issues on Holly from S. Maplelane Road ("Maplelane") to S. Redland Road ("Redland"). It became clear that the nature, number and frequency of these contacts required special attention to the concerns on Holly. This safety evaluation's purpose and directive was as follows:

- Focus on safety issues on Holly Lane
- Offer input into the County Transportation System Plan (TSP) update for future improvements
- Consider the safety of all road users, not just motorized traffic
- Include staff not familiar with roadway for safety analysis
- Develop a "Road Safety Audit" style report recommending future improvements to the roadway
- Implement low cost short term improvements to improve safety
- Begin to prioritize and program intermediate and long term improvements

Resident concerns vary widely while there are shared concerns over the existing traffic volume, speed and safety issues. There is also great concern over future development within nearby Oregon City and within the Holly area itself. Nearby, several subdivisions have been constructed within the City of Oregon City and the approval and construction of these subdivisions have raised concern from some residents as traffic from the subdivisions will increase traffic volume on Holly.

Recently, with the creation of the Park Place Concept Plan (adopted by Oregon City in 2008), a planning effort led by Oregon City and Metro, a vision was developed for the future development of the area surrounding Holly. The resulting development would greatly change the landscape of the area. However, the purpose of this particular safety evaluation was not to evaluate the impacts of the Park Place Concept Plan or to address the impacts of other unconstructed developments.

On November 29, 2010, County staff hosted a public meeting attended by approximately 30 people to discuss the existing safety issues on the roadway. At that meeting, County staff invited those people to work with County staff to walk certain sections of the roadway to view reported safety issues in the field. Meeting notes and the presentation slides are provided in Appendix A.

On December 14, 2010, January 5, 2011, January 6, 2011, and January 10, 2011, County staff met with ten different homeowners and residents to view these safety issues in the field. Notes from these walkthroughs are provided in Appendix B.

County staff walked several portions of Holly Lane on five different occasions and drove the roadway several more times during varying roadway and weather conditions. Videologs of the roadway were taken both during daytime conditions and nighttime conditions and are available upon request.

County staff then conducted an evaluation of the crash history, traffic volumes, sight distance, geometry and other issues related to the safety and livability of Holly.

Again, on March 15, 2011, County staff hosted a public meeting to further discuss the existing safety issues and potential short, intermediate and long term solutions. Approximately 20 people attended that meeting. The slides presented at that meeting are provided in Appendix C.

We would like to acknowledge the assistance of these individuals in their help in their review of the roadway conditions:

Rod Moxley	Kristi Beyer	Cheryl Burks
Christine Kosinski	Cara Seifert	Les Fish
Chuck Hodson	Juanita Whitaker	
Jackie Hodson	Bob Nelson	

This report documents the process, problems and possible near term, intermediate, and long term improvements to Holly.

Impact of Park Place Concept Plan and other development

While the purpose of this safety evaluation was not to evaluate the Park Place Concept Plan, some important information about the plan is provided herein for those that may have an interest in learning the potential impacts to the area.

In 2002, 500 acres in the vicinity of Holly Lane were brought into Metro Urban Growth Boundary (UGB). The Park Place Concept Plan was developed to establish a plan for how the development of this 500 acres should occur. One aspect of the Concept Plan was to determine what roadway infrastructure would need to be in place to support the existing and proposed level of development. The plan concluded that two primary north-south connections between Redland and Holcomb Boulevard would be needed. Holly Lane and Swan Avenue would serve as these connections. A conceptual map of these connections are shown in Figures 1 and 2 below.

Due to funding restrictions, the Park Place Master Plan did not discuss to any level of detail traffic impacts or solutions to the portions of Holly outside of the UGB. This is a shortcoming in the Metro process related to assessment of urban reserve lands. County staff have discussed this concern with Metro staff, who have recognized this as an issue.

The purpose of this safety evaluation was also not to evaluate or discuss the impacts of the potential Rivers development that has been discussed near the Highway 213/Washington Street intersection or other potential development applications.

The purpose of the safety evaluation was to identify near, intermediate and long term improvements that would better the safety and livability of Holly Lane. However, many of the feelings and concerns about the future of Holly Lane hinge directly on the future of the Park Place planning area. For that reason, some attention is paid to the Park Place Planning project below. For further discussion of that planning process, interested parties should contact the City of Oregon City.

Figure 1. Park Place Concept Plan Roadway Network illustrating Holly Lane extension north to Holcomb and Swan Avenue extension south, paralleling Holly Lane

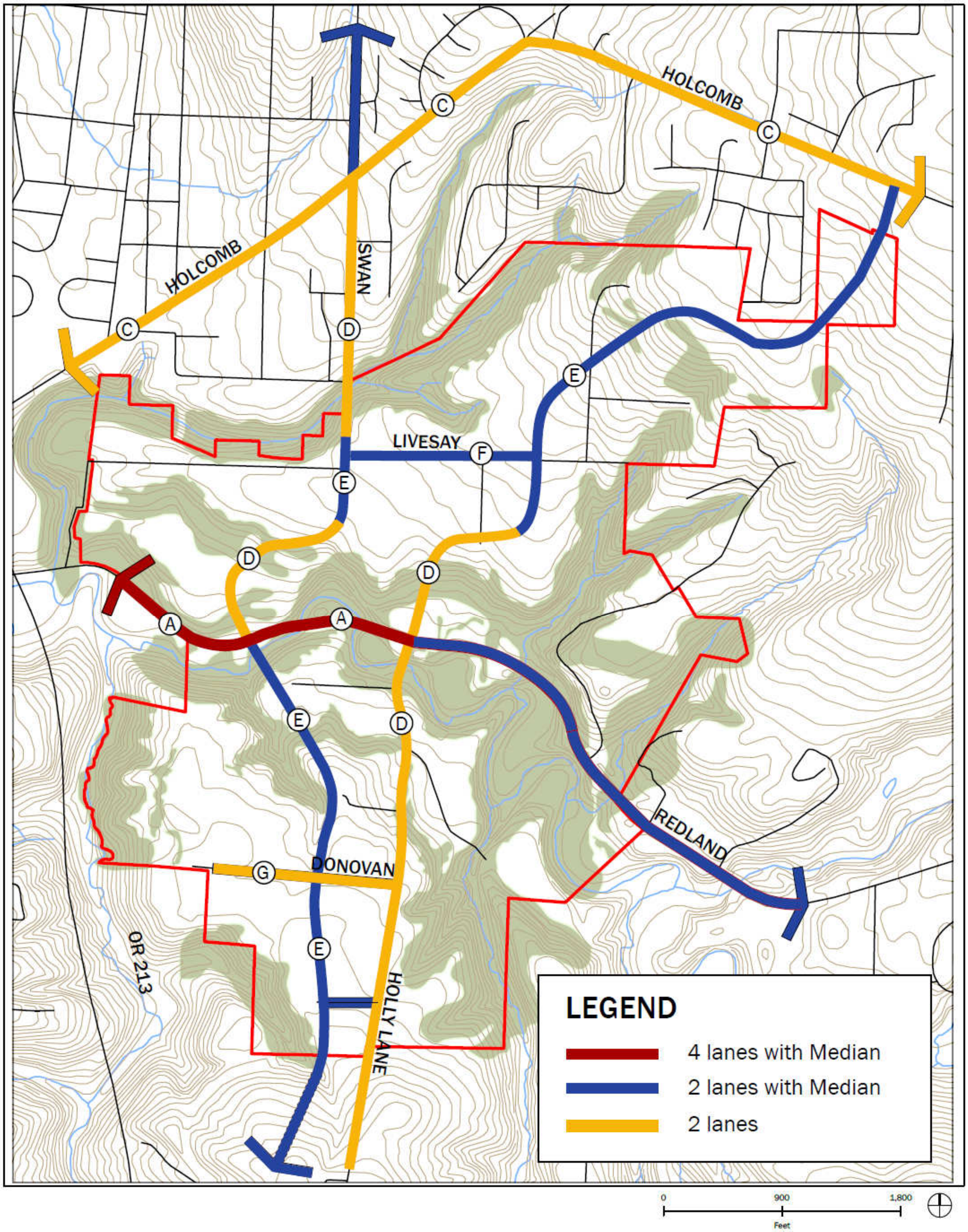
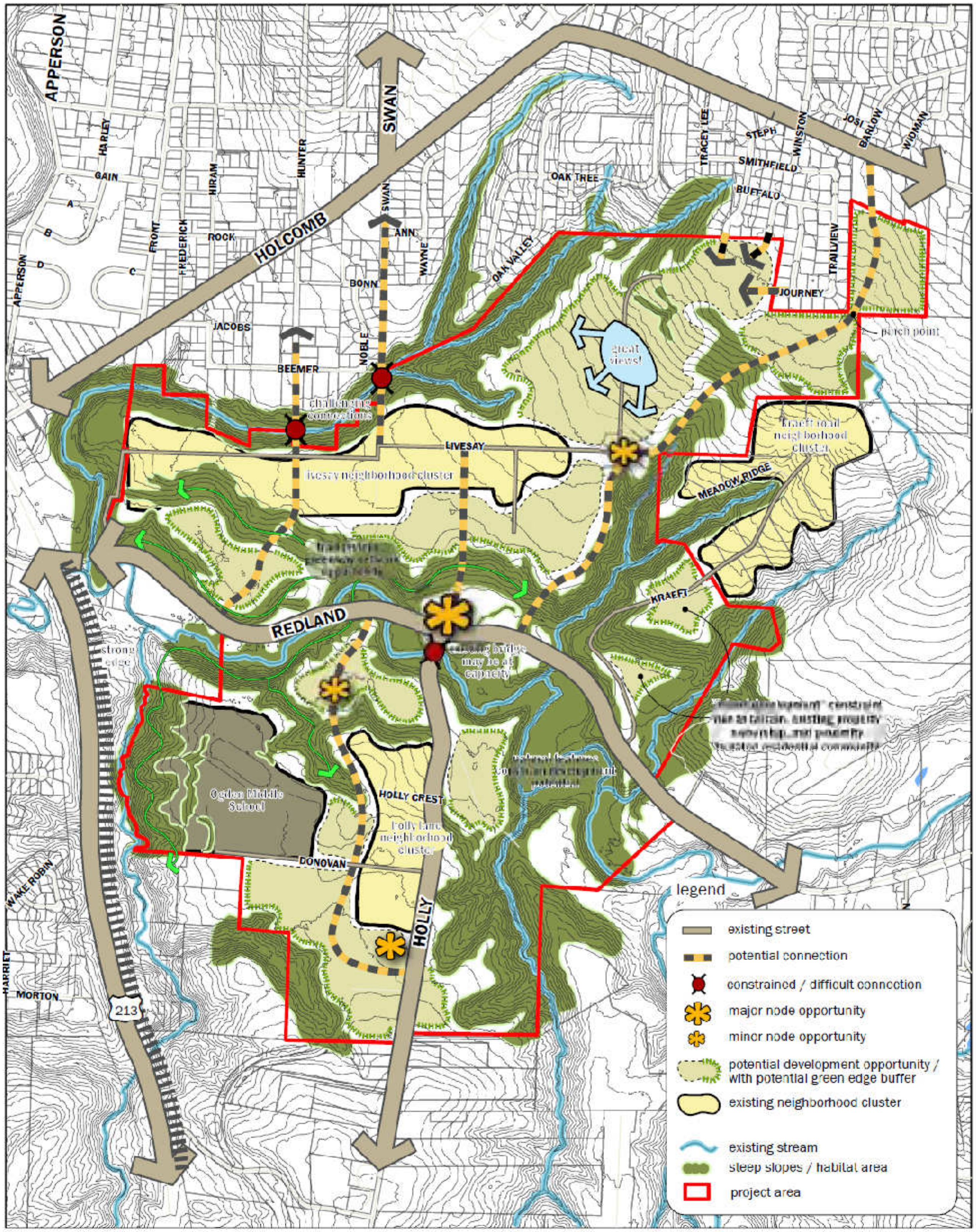


Figure 2. Park Place Concept Plan Roadway Network illustrating Holly Lane extension north to Livesay and new Swan Avenue from Redland to Holly



The Concept Plan's narrative indicated that Holly Lane would be "extended and improved" and will "experience significant increases in travel demand".

After the adoption of the Park Place Concept Plan, the City of Oregon City adopted new projects into their Transportation System Plan. These projects are shown below in Exhibit 1.

Exhibit 1. City of Oregon City Transportation System Plan

PARK PLACE CONCEPT PLAN

Table 5-1:

Summary of Estimated Needs for Transportation Improvements (for concept planning purposes only)

Roadway	No Build	Build	Total
HWY 213 Corridor Improvements (I-205 to Oregon City UGB)	75-125,000,000	0	75-125,000,000
Redland Road: Abernethy/Holcomb to Swan Ave		11,500,000	11,500,000
Holly Lane: Redland to Maplelane Road	3,000,000	0	3,000,000
Livesay Road: Swan Ext to Holly Ext		1,800,000	1,800,000
Donovan Road: Holly Lane to Ogden Middle School		1,200,000	1,200,000
Swan Ave Extension: Existing Swan Ave south to Holcomb Blvd		1,100,000	1,100,000
Swan Ave Extension: Livesay canyon to Redland Road		9,300,000	9,300,000
Swan Ave Extension: Redland Rd to Holly Ln		9,300,000	9,300,000
Holly Lane: Redland to Holcomb Blvd		17,400,000	17,400,000
Total	78-128,000,000	51,600,000	130-180,000,000

Intersections	No Build	Build	Total
Anchor Way/Redland	2,900,000		2,900,000
Holly Ln/Redland Rd	2,000,000		2,000,000
Holly Ln/Maplelane Rd	1,600,000		1,600,000
Swan Ave/Holcomb Blvd		300,000	300,000
Total Intersection Improvements	6,500,000	300,000	6,800,000
Grand Totals	85-135,000,000	51,900,000	137-187,000,000

The following are excerpts of the Park Place Concept Plan that further describe potential future impacts to Holly:

Exhibit 2. Excerpt 1 of Park Place Concept Plan

Holly Lane and Swan Avenue Extensions

Holly Lane serves a vital role in both the local and the regional context as the only continuous north/south travel corridor on the east side of HWY 213. Holly Lane connects the northern area of Oregon City to many key destinations in the hilltop area of the city, such as Berryhill Shopping Center, Clackamas Community College, Oregon City High School, City Hall, and many other retail and employment locations. As a result, this corridor is expected to see travel demands increase by nearly 13,000 vehicles per day to a total of more than 16,000 vehicles per day. Were this to occur, Holly Lane would need to provide five lanes near its intersection with Redland Road and three lanes for the remainder of its length. In addition, Redland Road would need to provide six lanes (unless a smaller cross section is proven adequate) near its intersection with Holly Lane and five lanes for the remainder of its length to Abernethy Road.

The cost and feasibility of these improvements is questionable. Much of the Holly Lane corridor has a very narrow right-of-way with many single-family residences that take direct access from Holly Lane. Climbing sections of Holly Lane will be very costly to reconstruct and face several engineering challenges. The existing two-lane bridge across Abernethy Creek would need to be demolished and replaced with at least a five-lane bridge. Finally, much of Redland Road is significantly constrained by topography on the north side and the Abernethy Creek on the south side.

Exhibit 2. Excerpt 2 of Park Place Concept Plan (Continued)

The Park Place Concept Plan provides for a parallel, collector-level corridor to Holly Lane, referred to as the Swan Avenue extension, as a solution to the issues described above. Establishing this corridor from Forsythe Road to points well south of Donovan Road ensures that the existing Holly Lane can remain a two-lane, collector-level facility, south of Redland Road. The Swan Avenue extension will include bridges across the Livesay Creek canyon and Abernethy Creek, creating much needed connections between adjacent neighborhoods and providing adequate capacity and system redundancy critically needed during times of emergency. In addition, Holly Lane would be extended north from Redland Road to connect with Holcomb Boulevard, providing good access, connectivity, and system redundancy to the area.

The Swan Avenue extension provides the opportunity for a continuous, north/south, collector-level facility that is fully equipped to serve all travel modes. The facility will include sidewalks and on-street striped bike lanes on both sides and accommodate future transit service. Equipped as such, Swan Avenue is anticipated to attract 10,000 to 12,000 vehicles a day, while Holly Lane is only required to serve 4,000 to 6,000 vehicles per day. This allows the existing Holly Lane to remain a two-lane road with improvements to address safety concerns and manage travel speeds.

The complete Park Place Concept Plan can be found at http://www.orcity.org/publicworks/park-place-concept-plan.

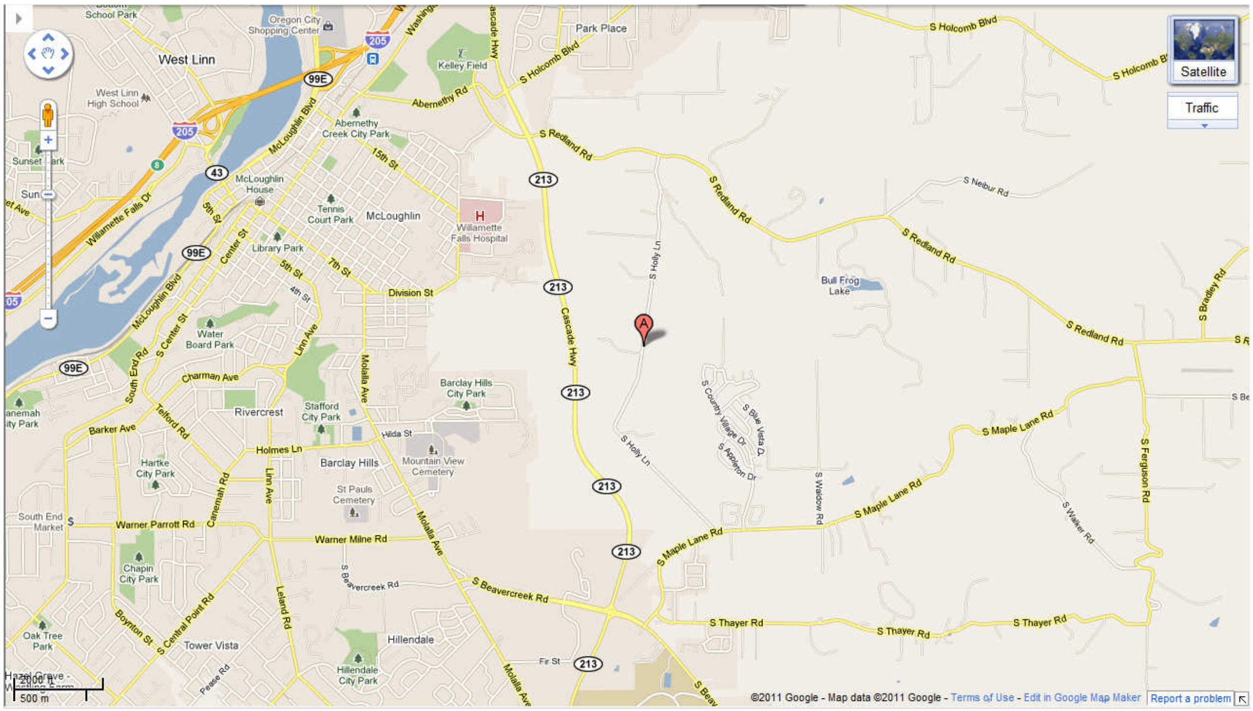
Holly Lane Key Information

Holly is classified as a minor arterial roadway (Clackamas Comprehensive Plan Map V-2a found at http://www.clackamas.us/docs/dtd/planning/map_v-2a.pdf). The posted speed of Holly is 45 MPH from Maplelane to the 90 degree curve (located at milepoint 1.23) and 40 MPH from the 90 degree curve to Redland. The Average Daily Traffic is approximately 3000 vehicles per day. Holly is approximately 1.83 miles long from Redland (MP 0.0) to Maplelane (MP 1.83).

The crash history of Holly has been fairly steady over the past ten years with no significant patterns trending toward a more unsafe roadway.

Holly Lane presents unique challenges including hilly terrain, a fairly narrow cross section, several homes close to the roadway, Ogden Middle School located off Holly Lane on Donovan Road, a large church located directly off Holly Lane on Donovan Road, and higher speeds that characterize typical rural roadway traffic operations.

Figure 3. Project vicinity map



Summarized Public Comments

Appendix D contains a list of public comments received and the resulting County responses. Many of the public comments have resulted in specific planned improvements to Holly. Others may receive further consideration as part of the signing and pavement marking plan that will be developed.

Ogden Middle School

Some concerns were raised about the impact of Ogden Middle School located on Donovan Road, both in terms of students walking to school and the impact of buses on livability and safety.

In our field review, staff noted several students walking to/from Ogden Middle School along Holly. In some places there are gravel shoulders for pedestrians to walk. In other locations, there are no shoulders. Bicyclists, while few were witnessed, must ride in the travel lanes of Holly. For inexperienced users or those less physically inclined, Holly is an extremely challenging environment. In terms of bicycle and pedestrian facilities for a rural roadway, this environment is not unique. However, Holly is adjacent to a burgeoning suburban area and experiences demands and uses in excess of that of a rural roadway.

A few concerns were raised about the number of school buses on Holly. There was some speculation that school buses use Holly Lane as a cut-through route from Redland Road to Maplelane Road. In email conversations with the school district, the school district indicated that there is not inappropriate use of

Holly Lane by school buses. While there are buses that utilize Holly Lane that do not serve Ogden Middle School, those buses are serving schools nearby.

Summarized Crash History

At the November 29, 2010 public meeting, a map was presented that indicated the locations of the reported crash history of Holly Lane from 1999 to 2009. Widespread comments from the public indicated substantial disagreement with the data of the map, mostly due to the number and location of crashes shown. The total number of crashes is likely underreported especially for Injury C (minor injury) and Property Damage Only (PDO) as there is no requirement for a sheriff's accident report for these crashes. While there are issues that many crashes occurring on the road are not reported, this is also true for other roadways. In terms of prioritization of projects and comparisons with other roadways, it is logical to conclude that other roadways also share the characteristic of underreported crashes. Additionally, the locations of crashes as reported can vary from the actual locations for several reasons including:

- Self reporting of crashes may be generally inaccurate or may be coded to the nearest milepoint or intersection
- Sheriff's Office reporting may be coded to the nearest milepoint or intersection

After further evaluating the Sheriff's Accident Reports, it is clear that there are accuracy issues with the coding of milepoints to tangent and curve sections in relation to the milepoints reports. Initial research indicated that there were no reported crashes in the 90 degree curve, which was of significant concern to those present at the public meeting. Later, after further research, it was determined and reported at the second public meeting that a substantial portion of crashes on Holly Lane do occur at or near the curve. The County undertook an effort to compare the different crash data available and determine the actual location of the crash.

The following observations were made in review of the crash history:

- Over the past 11 years, the number and severity of crashes along Holly Lane has been fairly steady.
- The severity and number of reported crashes are not trending upwards.

Figure 4, below, illustrates the crash history from 1999 to 2009 directly from the ODOT crash database.

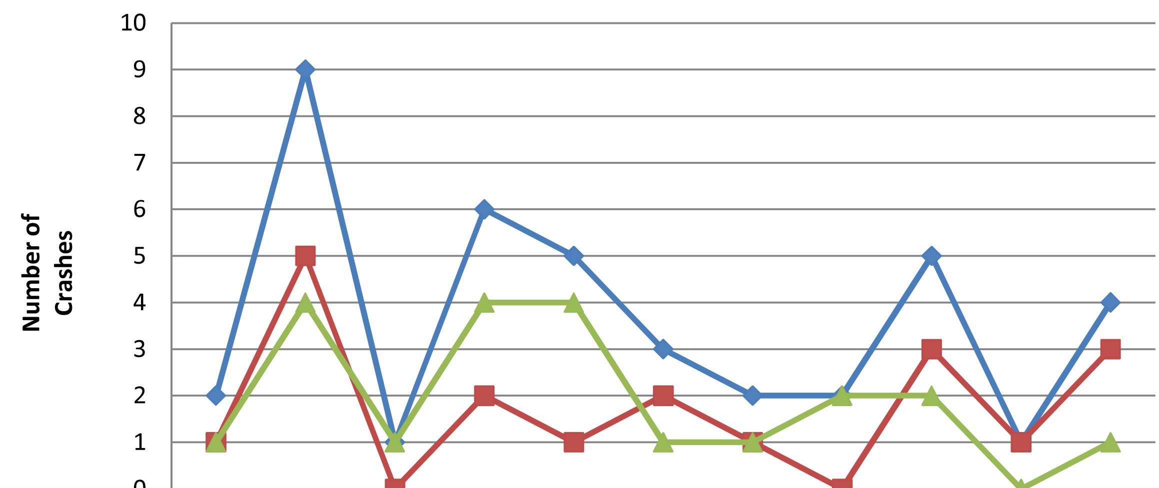
The crash history of Figure 4 is also shown graphically in Appendix F.

The milepoints of Holly Lane are shown below in Exhibit 2 and are critical to the review of the crash history.

Exhibit 2. Holly Lane Milepoints

No. 22060		S HOLLY LN
	MAP 64-33-NC	
0.000		BCM
0.000	CROSS	REDLAND RD (33034)
0.020	BRIDGE	#6217 - HOLLY LN BRIDGE
0.260	RIGHT	PVT HOLLY CREST LN
0.360	RIGHT	DONOVAN RD (22061)
0.860	RIGHT	MORTON RD (22059)
MP	*Placement*	*Description*
1.230	LEFT	PVT MORENCY LN
1.830	CROSS	MAPLELANE RD (32001)
1.830		ECM

Figure 4. Holly Lane Crash History 1999-2009 (Source: ODOT crash database)



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Total Crashes	2	9	1	6	5	3	2	2	5	1	4
Injury	1	5	0	2	1	2	1	0	3	1	3
Non Injury	1	4	1	4	4	1	1	2	2	0	1

Appendix E contains the crash history of Holly Lane from 1999 to 2009.

Table 1, below, utilizes the ODOT crash database to compare the length, average daily traffic (ADT), crash count, frequency and severity of crashes on Holly to other similar roadways in Clackamas County. As shown, Holly is not experiencing an unusual crash count, rate, or frequency when compared to other rural County roadways.

Table 1. 2007-2009 Crash Comparison of Holly Lane to Other Rural County Roadways (Source: ODOT crash database)

Roadway	Segment	Functional Classification	Length (mi)	ADT	Crash Count	Crash Rate	Crash Frequency
Holly Lane	***Redland to Maplelane***	***Rural Minor Arterial***	***1.83***	***3000***	***10***	***1.66***	***1.82***
Tillstrom Road	242nd to Foster	Rural Minor Arterial	3.60	1783	6	1.54	1.04
Compton Road	Orient to 352nd	Rural Collector	1.38	1675	4	1.58	0.97
282nd Avenue	Hwy 212 to Multnomah County	Rural Minor Arterial	2.00	5050	17	1.54	2.83
65th Avenue	Sagert to Stafford	Rural Collector	2.75	4000	10	0.83	1.21
Ek Road	Stafford to Borland	Rural Local	0.86	2100	6	3.03	2.33
232nd Drive	Hwy 224 to Hwy 212	Rural Minor Arterial	1.90	3550	4	0.54	0.70
Amisigger Road	Hwy 224 to Kelso	Rural Major Arterial	2.41	2850	10	1.33	1.38
362nd Drive	Hwy 211 to Dubarko	Rural Minor Arterial	1.50	3650	12	2.00	2.67
Firwood Road	Hwy 26 to Wildcat Mtn	Rural Minor Arterial	3.31	1633	17	2.87	1.71
Airport Road	Arndt to Miley	Rural Major Arterial	1.62	4500	15	1.88	3.09
Knights Bridge Road	Arndt to Canby Cotu	Rural Major Arterial	1.57	5750	15	1.52	3.18
Maplelane Road	Beavercreek to Ferguson	Rural Minor Arterial	2.67	5400	21	1.33	2.62
Hayden Road	Hwy 211 to Springwater	Rural Major Arterial	1.21	1950	3	1.16	0.83
Coupland Road	Currin to Estacada City	Rural Minor Arterial	1.38	2100	2	0.63	0.48
Lone Elder Road	Canby-Marquam to Hwy 99E	Rural Minor Arterial	3.31	2838	13	1.26	1.31
Union Mills Road	Hwy 213 to Hwy 211	Rural Minor Arterial	3.90	3725	30	1.89	2.56
Whiskey Hill Road	Barlow to Marion County	Rural Minor Arterial	1.74	1750	5	1.50	0.96
Roadway Average			**2.16**	**3184**	**11.1**	**1.56**	**1.76**

ADT = Average Daily Traffic

Crash Rate = Crashes per million vehicle miles travelled

Crash Frequency = Crashes per mile per year

Historical Traffic Volumes & Speed

Clackamas County has historically collected traffic volumes at various locations around the County over the past 15 years. Based upon Figure 5, it is clear that traffic volumes on Holly Lane are not trending upwards.

Table 2 provides additional details regarding directional traffic volume, speed and truck percentages.

Figure 5. Holly Lane Historical Daily Traffic Volume

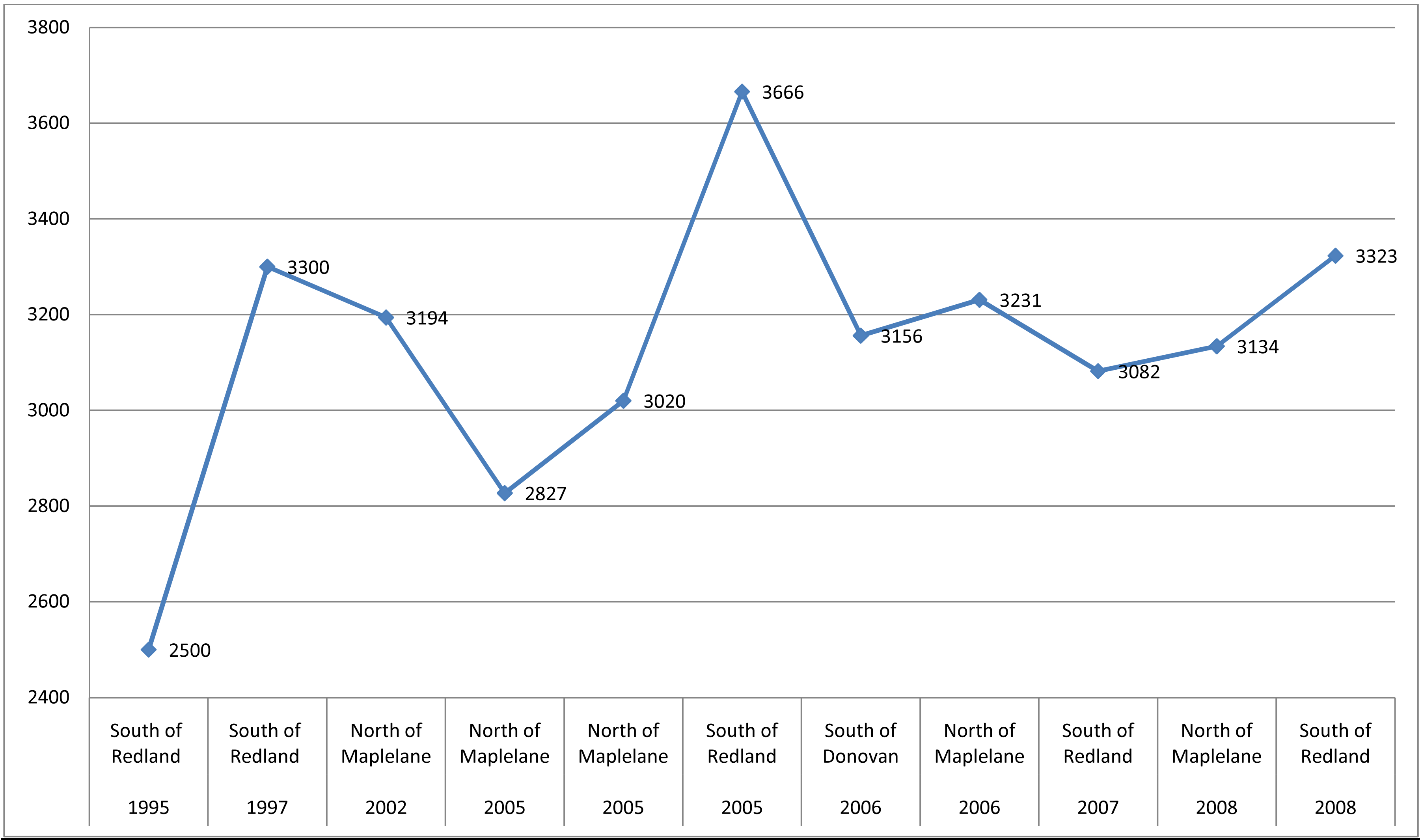


Table 2. Historical Holly Lane Traffic Counts

Year	Location	Average Daily Traffic (ADT) NB	SB	NB + SB	85th percentile speed	Truck %
1995	South of Redland	N/A	N/A	2500	N/A	N/A
1997	South of Redland	N/A	N/A	3300	N/A	N/A
2002	North of Maplelane	1412	1782	3194	52	8.3
2005	North of Maplelane	1116	1711	2827	34	8
2005	North of Maplelane	1660	1360	3020	52	10
2005	South of Redland	1654	2012	3666	36	9.4
2006	South of Donovan	1526	1630	3156	52	11.4
2006	North of Maplelane	1525	1706	3231	50	11.7
2007	South of Redland	1467	1615	3082	53	11.8
2008	North of Maplelane	1408	1726	3134	45	11.6
2008	South of Redland	1545	1778	3323	43	10.6
2010	North of Maplelane	1222	1422	2644	51	12.1
2010	South of Donovan	N/A	N/A	3002	52	8

NB = Northbound traffic
SB = Southbound traffic
85th percentile speed = Speed at which 85% of drivers travel at or below
N/A = No data available

Planned Transportation Improvements

The following improvement has been identified in the Clackamas County Capital Improvement Plan as a potential future construction project:

- Redland/Holly intersection signalization

Improvements planned by Oregon City were provided in Exhibit 1 of this report.

Large Curve approximately 0.6 miles north of Holly/Maplelane (MP 1.23)

Many of the concerns about Holly are focused on the 90 degree curve approximately 0.61 miles north of Maplelane and 0.3 miles south of Morton Road. The travel lanes are narrow through the curve at approximately 10.5 feet in width. The inside curve radius is approximately 115 feet and a centerline radius of approximately 120 feet. The curve is superelevated. The advisory curve speed posted in the northbound and southbound direction is 20 MPH.

There is a wide paved shoulder on the outside of the curve. There is a one to two foot shoulder on the inside of the curve.

Based upon turning movement evaluations, northbound school buses must cross the striped centerline or use the inside shoulder in order to navigate this curve. There was noted evidence that vehicles partially leave the roadway in this area as shown below in Figure 6. Additionally, staff and citizens have witnessed school buses crossing the striped centerline.

Figure 6. Inside corner of 90 degree curve

In addition to the issues with width and the tight radius, sight distance around this curve was somewhat limited by a holly tree located on the inside center of the curve. Recently, this tree was a removed by the property owner at the request of the County.

Public comments indicated that a large proportion of crashes along Holly Lane occur at or near this curve.

Currently, in the northbound direction, the signing is as follows as it approaches the curve:

- Slow sign
- Turn sign with advisory speed of 20 MPH
- School Bus Stop Ahead
- Large arrow board in curve

Currently, in the southbound direction, the signing is as follows as it approaches the curve:

- Slow sign
- Turn sign with advisory speed of 20 MPH

In the near term, there are a number of recommended improvements:

- Southbound arrow board or chevrons
- Enhance both northbound and southbound signage to emphasize the sharpness of corner
- Revised location curve warning signage
- Shoulder rock on inside of curve
- Investigate shoulder rock on outside of curve to reduce/remove ditches
- New delineators on outside of curve
- “SLOW” legend on pavement approaching curve

In the intermediate or long term, the following improvements should be considered as warranted:

- Reflective centerline buttons (raised pavement markers
- Pavement widening on inside of curve
- City TSP widening and potential realignment

Figure 7. Looking northbound at 90 degree curve

Figure 8. Looking southbound at 90 degree curve

Figure 9. Looking northbound at 90 degree curve

<u>Holly/Donovan Intersection</u>

Per the American Association of State and Highway Transportations Officials "A Policy on the Geometric Design of Highways and Streets" (hereafter referred to as AASHTO) and the “Clackamas County Roadway Standards”, intersection sight distance (ISD) is “inadequate” looking to north from Donovan. ISD is limited to approximately 335 feet to the north, while adequate ISD is 445 feet at a posted speed of 40 MPH. However, stopping sight distance (SSD) is adequate with 305 feet considered to be adequate. Sight distance to the south is adequate. At speeds of 45 MPH, stopping sight distance is not adequate.

Sight distance can be improved slightly with the removal of some vegetation on the northwest corner of the intersection, yet intersection sight distance will still not be adequate. Sight distance is limited by a horizontal curve and an embankment.

Inadequate intersection sight distance is not an unusual situation in any jurisdiction with roadways that were not necessarily designed to any standard, but came to be in their present condition over time.

There were some suggestions that the County should install an all-way stop at this intersection. The installation of road signs is guided by the Manual on Uniform Traffic Control Devices (MUTCD). The MUTCD provides guidance for the installation of all-way stop control. The MUTCD states that the decision to install an all-way stop should be based upon an engineering study. That study should consider the following factors:

- Where a traffic signal is warranted, all-way stop control can be considered as an interim measure.
- Five or more reported crashes in a year that would be corrected by all-way stop control.
- Minimum volume thresholds including 300 vehicles per hour on Holly Lane and 200 vehicles and/or bicycles/pedestrians per hour for a minimum of eight hours of the day.
- Other factors can be included in the study including lack of adequate visibility.

The County conducted an engineering study to evaluate the possibility of installing an all-way stop at this intersection and found that an all-way stop is not warranted at this time. None of the typical criteria was met. Although intersection sight distance is not available, stopping sight distance is available at the posted speed. Additionally, another consideration is the relative balance of traffic flows on each roadway. Holly Lane carries roughly 3000 vehicles per day, while Donovan carries roughly 1200 vehicles per day.

In the near term, there are a number of recommended improvements:

- Enhance southbound direction with Intersection Ahead and rider
- Enhance school guide signage
- Utilize larger street name signs
- Remove vegetation on the northwest corner of the intersection

In the intermediate or long term, the following improvements should be considered as warranted:

- Removing the necessary embankment to achieve adequate intersection sight distance
- Widening and realignment per City TSP
- Collision Countermeasure System (CCS) – a warning system that provides guidance to drivers on the main roadway or the side street about the presence of vehicles on the opposing roadway

Figure 10. Looking northbound from Donovan

Holly/Morton Intersection

Per AASHTO and the Clackamas County Roadway Standards, intersection sight distance (ISD), ISD is "inadequate" looking to north from Morton. ISD is limited to approximately 250 feet to the north, while adequate ISD is 445 feet at a posted speed of 40 MPH. Additionally, stopping sight distance (SSD) is inadequate with 305 feet considered to be adequate.

ISD is "inadequate" looking to south from Morton also. ISD is limited to approximately 410 feet to the south, while adequate ISD is 445 feet at a posted speed of 40 MPH. Stopping sight distance (SSD) is adequate with 305 feet considered to be adequate.

In looking both to the north and south, sight distance is limited by crest vertical curves fairly close to the Holly/Morton intersection. There are no vegetation issues present that hinder sight distance.

Inadequate intersection sight distance and stopping sight distance is not an unusual situation in any jurisdiction with roadways that were not necessarily designed to any standard, but came to be in their present condition over time.

As with the Holly/Donovan intersection, an all-way stop is not warranted at Holly/Morton. While no traffic count was conducted on Morton Road, it is known that traffic volumes are extremely low as Morton is a dead end street serving only a few residences.

Crashes at this intersection are rare, likely because of the low side street traffic volume.

The typical warning signage already exists with an "Intersection Ahead" and Morton Road rider currently installed.

In the near term, there are a number of recommended improvements:

- Enhance warning signage with recommended speed rider
- New bus stop ahead sign based on new standards, existing sign obscured by vegetation

In the intermediate or long term, the following improvements should be considered as warranted:

- Lowering the vertical curves of Holly Lane and/or raising Morton Road to improve sight distance
- Collision Countermeasure System

Figure 11. Looking northbound from Morton

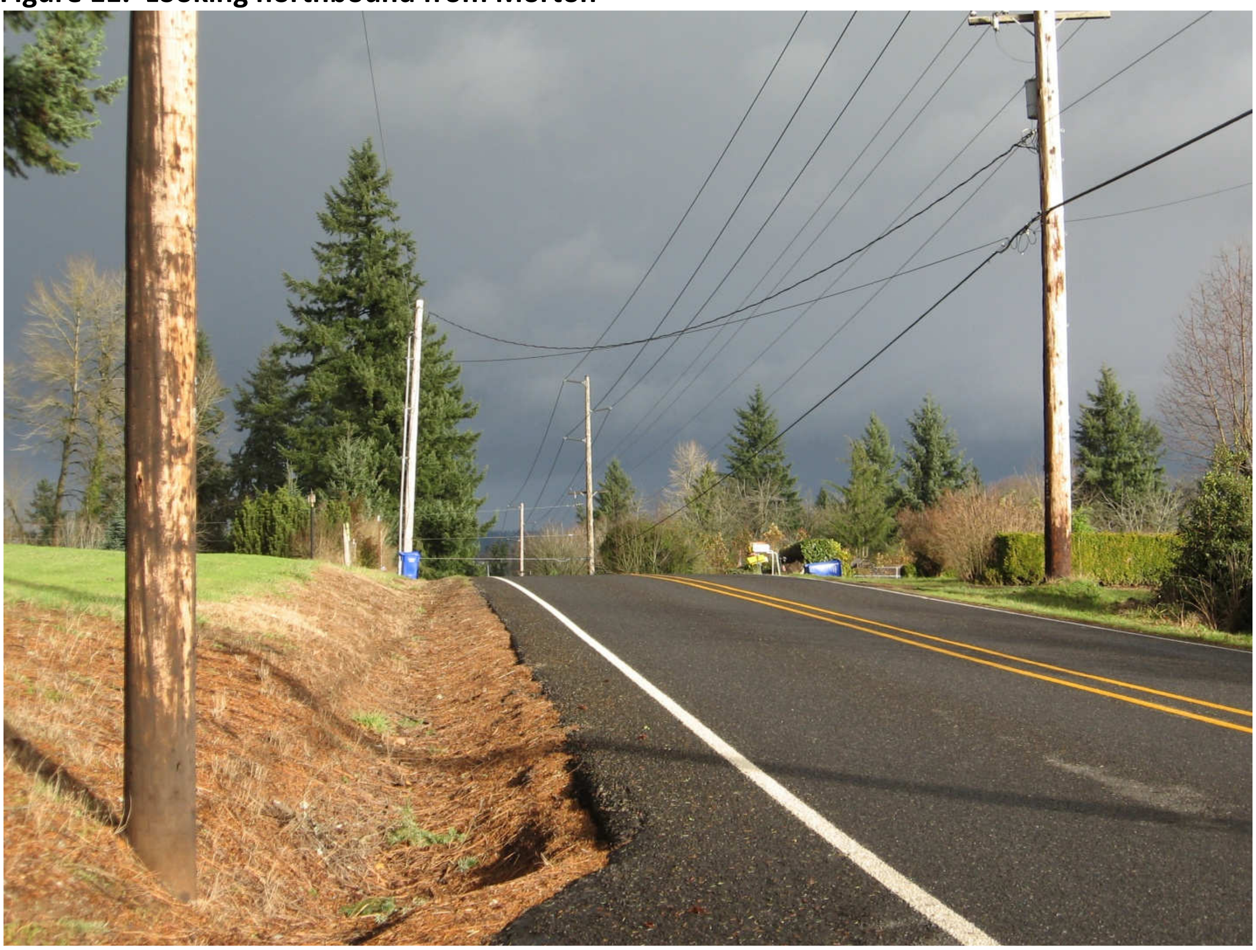


Figure 12. Looking southbound from Morton

<u>Speed</u>

Most comments received from the public were of the opinion that high speed detracts from the safety both of motorized users, but more susceptible users such as bicycles and pedestrians. Additionally, high speed also detracts from the livability along the roadway. It was also reported that high speed precludes some residents from utilizing the roadway for walking or other recreational opportunities.

Indeed, speed seems to be a contributing factor in a large portion of the crashes that have occurred on Holly Lane. High speed, combined with other factors included a narrow roadway with minimal shoulders and the use of alcohol creates a difficult situation.

Speed is an issue that is very difficult to control, especially in the absence of regular enforcement. For the past several years, the Clackamas County Sheriff's Office has not been able to fund a regular traffic enforcement unit. The lack of a separate traffic unit results in infrequent traffic patrols.

Over the past few years, Holly has had the benefit of Clackamas County's Radar Speed Sign Program, which installs radar speed signs on a temporary basis. These signs provide feedback to motorists regarding their current speed. Their speed flashes when exceeding the speed limit. Based upon feedback from Holly residents, the sign is effective. A survey of other County residents found the same. The signs are effective at slowing traffic while the sign is in place.

As previously mentioned, the posted speed of Holly is 45 MPH from Maplelane to the 90 degree curve and 40 MPH from the 90 degree curve to Redland. The County has agreed to investigate the possibility of reducing the speed on the section from Maplelane to the 90 degree curve from 45 MPH to 40 MPH. This would make it consistent with the other section.

In the near term, there are a number of recommended improvements:

- County will investigate 40 MPH on southern section
- Continued use of temporary radar speed sign program
- Evaluate additional speed signage
- Possibly radar speed signs paid for by residents based on further discussion with the neighborhood

In the intermediate or long term, the following improvements should be considered as warranted:

- County is working slowly on a traffic calming program update and will investigate rural options but effort may not result in benefits to Holly Lane
- Possibly radar speed signs paid for by residents based on further discussion with the neighborhood
- Urbanization generally results in lower speeds, but higher volumes, not necessarily a welcome trade-off – see City TSP. Urbanization, however, does result in improvements that are typically friendly to bicycles and pedestrians.

Redland/Holly Intersection

The intersection of Redland/Holly experiences congestion today, which will be worsened as traffic volumes increase. Capacity analysis to determine the existing or planned operations of this intersection was not a part of this project. However, Clackamas County does plan to eventually construct a traffic signal at the intersection. The City of Oregon City's TSP also includes improvements to this intersection.

At the time of construction, it will be important for the County to consider the ultimate improvement for the intersection, as Holly Lane bridge is narrow and unable to accommodate widening. Similarly, a creek crossing exists on Redland Road west of Holly Lane complicating the ability to install a westbound left turn lane at Redland/Holly. To date, these issues have not been evaluated.

As part of this project, a sight distance issue was identified. Looking west from Holly Lane, vegetation on the southwest corner of the intersection restricted sight distance. However, this vegetation has since been removed by the property owner at the request of the County.

In the near term, no improvements are recommended.

In the intermediate or long term, the following improvements should be considered as warranted:

- Construct County CIP or City TSP project

Ditches

It has been noted that there are wide, deep ditches in many locations along Holly Lane. Some residents have noted that the ditches seem to have gotten wider and deeper with the County's most recent maintenance activities. There are few inexpensive treatments to address this issue. Currently, there are fog lines and centerlines striped on the entirety of Holly lane. However, the roadway is narrow with little, if any, shoulders.

In the near term, there are a number of recommended improvements:

- Design a new signing and pavement marking plan for the entirety of Holly

In the intermediate or long term, the following improvements should be considered as warranted:

- Consider reflective centerline buttons (raised pavement markers) along the entirety of Holly
- Install shoulder rock at 90 degree curve (MP 1.23)
- Install spot location shoulder widening improvements

Bicycle/Pedestrian Issues

As previously stated, Holly can be a challenging environment for pedestrians. Most of the roadway lacks any shoulder at all. Where there is shoulder, it is typically very narrow and composed of gravel. Pedestrians and bicycles must exercise caution on the roadway both in avoiding motor vehicles but also

in the roadside terrain. Holly is a typical rural roadway not well designed for bicycles and pedestrians. However, it is on the suburban fringe, so experiences suburban type issues.
The County does not have a planned project to construct bicycle or pedestrian improvements on Holly Lane. The City of Oregon City's TSP does include those improvements. In the meantime, the following improvements are recommended to enhance the pedestrian and bicycle environment.

In the near term, there are a number of recommended improvements:

- Design a new signing and pavement marking plan for the entirety of Holly
- County will investigate 40 MPH on southern section
- Continued use of temporary radar speed sign program
- Evaluate additional speed signage
- Possibly radar speed signs paid for by residents based on further discussion with the neighborhood

In the intermediate or long term, the following improvements should be considered as warranted:

- Possibly radar speed signs paid for by residents based on further discussion with the neighborhood
- County is working slowly on a traffic calming program update and will investigate rural options but effort may not result in benefits to Holly Lane
- Urbanization generally results in lower speeds, but higher volumes, not necessarily a welcome trade-off – see City TSP. Urbanization, however, does result in improvements that are typically friendly to bicycles and pedestrians.
- Install shoulder rock at 90 degree curve (MP 1.23)
- Install spot location shoulder widening improvements

A full list of improvements suggested for Holly Lane are provided in Appendix G.

Road Safety Audit

S. Beavercreek Road (S. Timbersky Way to S. Ferguson Road)
S. Henrici Road (S. Beavercreek Road to S. Ferguson Road)
S. Ferguson Road (S. Henrici Road to S. Beavercreek Road)

Prepared for

CLACKAMAS COUNTY

Prepared by

DKS

Audit Dates: August 29-30, 2012

Road Safety Audit

S. Beavercreek Road (S. Timbersky Way to S. Ferguson Road)

S. Henrici Road (S. Beavercreek Road to S. Ferguson Road)

S. Ferguson Road (S. Henrici Road to S. Beavercreek Road)

Prepared For:
Clackamas County
Transportation Engineering Division
Development Services Building
150 Beavercreek Road
Oregon City, OR 97045

Prepared by:
DKS Associates
720 SW Washington Street, Suite 500
Portland, Oregon 97205

In cooperation with:
Clackamas County
150 Beavercreek Road
Oregon City, OR 97045

Clackamas County Project Manager: Joe Marek, P.E., PTOE
Consultant Project Manager: Scott Mansur, P.E., PTOE

October 2012

THIS DOCUMENT IS PROTECTED

UNDER THE PROVISIONS OF TITLE 23 UNITED STATES CODE SECTION 409 AS FOLLOWS:

Title 23 U.S.C. § 409

Discovery and admission as evidence of certain reports and surveys

Notwithstanding any other provision of law, reports, surveys, schedules, lists or data compiled or collected for the purpose of identifying, evaluating, or planning the safety enhancement of potential accident sites, hazardous roadway conditions, or railway-highway crossings, pursuant to sections 130, 144 and 148 of this title or for the purpose of developing any highway safety construction improvement project which may be implemented utilizing Federal-aid highway funds shall not be subject to discovery or admitted into evidence in a Federal or State court proceeding or considered for other purposes in any action for damages arising from any occurrence at a location mentioned or addressed in such reports, surveys, schedules, lists or data.

Road Safety Audit Summary

An interdisciplinary team formed by Clackamas County conducted a Road Safety Audit (RSA) along three rural corridors (listed below) and at nine intersections Clackamas County, Oregon. The RSA documents the safety performance evaluation of these roadways and intersections. The RSA team identified existing safety related issues through analysis of crash records and a field assessment.

- S. Beavercreek Road (M.P. 11.27-13.54) S. Timbersky Way to S. Ferguson Road
- S. Henrici Road (M.P. 1.04-1.99) – S. Beavercreek Road to S. Ferguson Road
- S. Ferguson Road (M.P. 0.5-1.99) – S. Henrici Road to S. Ferguson Road

The RSA team conducted the field assessment on the 29th and 30th of August 2012 and the findings are included in this report. The safety related issues were categorized based on a qualitative risk scale. The RSA team identified the following general issues with more specific issues identified in the report:

S. Beavercreek Road

- No provisions for pedestrians or bicyclists
- Narrow roadway shoulders
- Pavement drop off in focused locations
- Stopping sight distance restricted by vertical curves
- Intersection sight distance restricted by vegetation/vertical curves
- Signing blocked by vegetation
- Inconsistent roadway delineation
- Unprotected steep ditches along the roadside
- Objects located within the roadway clear zone

S. Henrici Road

- No provisions for pedestrians or bicyclists
- Narrow oadway shoulders
- Stopping sight distance restricted by vertical curves
- Intersection sight distance restricted by vegetation/vertical curves
- Signing blocked by vegetation
- Objects located within the roadway clear zone

S. Ferguson Road

- Narrow roadway shoulders
- Stopping sight distance restricted by vertical curves
- Intersection sight distance restricted by vegetation/vertical curves
- Posted speed may be high for roadway functional classification
- Objects located within the roadway clear zone

The RSA team identified several improvements to address these issues and improve the safety along the three roadways and at intersections. These improvements were categorized in terms of respective cost (low, medium, high) and are presented in this report.

RSA Process

RSAs are conducted by an independent multidisciplinary team to assess the safety performance of a roadway and/or intersection and suggest potential safety improvement options for all users (motor vehicle, bicyclists, and pedestrians). The goal of RSA's is to help improve roadway safety by identifying existing as well as potential future safety related issues, as well as promoting awareness of safe design, operational, and maintenance practices. The multidisciplinary team provides an unbiased view of safety issues and solution development. An RSA is a way to proactively address safety and identify low cost high value improvements by applying current safety evaluation techniques and engineering practices. The hope is to reduce the number and severity of all crash types.

Figure 1 shows the eight major steps for conducting an RSA consistent with Federal Highway Administration (FHWA) RSA Guidelines[1]. As shown in the figure the first two steps as well as the last two steps are conducted by the facility owner (Clackamas County). The RSA team is responsible for completing steps three through six. These steps are described in the following sections.

Figure 1: Road Safety Audit Process

[1] FHWA Road Safety Audit Guidelines, U.S. Department of Transportation Federal Highway Administration, Publication No. FHWA-SA-06-06.

Project Identification

The RSA involves assessing the safety performance of three rural roadway segments located just outside of the urban growth boundary within Clackamas County. These three corridors are listed below and are shown Figure 2.

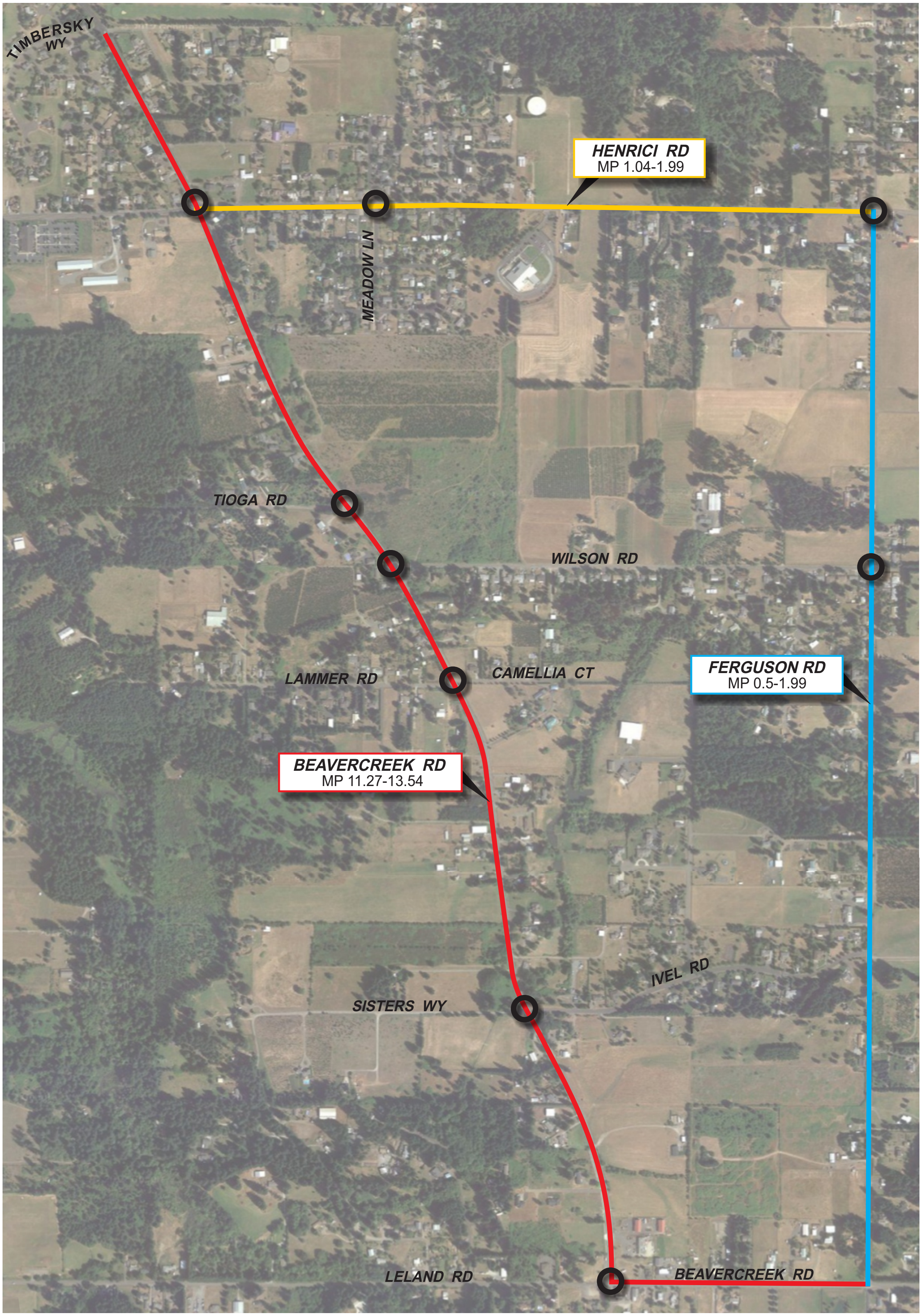
- S. Beavercreek Road (M.P. 11.27-13.54) S. Timbersky Way to S. Ferguson Road
- S. Henrici Road (M.P. 1.04-1.99) – S. Beavercreek Road to S. Ferguson Road
- S. Ferguson Road (M.P. 0.5-1.99) – S. Henrici Road to S. Ferguson Road

RSA Team

The RSA team members are listed in Table 1 along with their primary area of expertise. The goal is to have an independent, experienced, and multidisciplinary team.

Table 1: Road Safety Audit Team

Name	Agency	Specialty
Scott Mansur, P.E., PTOE	DKS Associates	RSA Team Leader /Transportation Engineer
Michael Tomasini, P.E., PTOE	DKS Associates	Transportation Engineer
Jim Peters, P.E., PTOE	DKS Associates	Transportation Engineer
Steve Boice, E.I.T.	DKS Associates	Transportation Engineer
Christian Snuffin, P.E.	Clackamas County	Transportation Engineer
Rick Nys, P.E., PTOE	Clackamas County	Transportation Engineer
Nick Fortey, P.E.	Federal Highway Administration	RSA Experience
Elizabeth Graser Lindsey	Citizen/Hamlet of Beavercreek Member	Public Knowledge



LEGEND

- Study Intersection
- Study Corridor (as labeled/color coded)

MP 0.0-0.0 - Milepost Range

DKS

No Scale

Figure 2

STUDY AREA

RSA Startup Meeting

An RSA start-up meeting was held at Clackamas County offices on August 29th, 2012. The RSA Team was given a presentation to inform them of the existing site conditions including surrounding land uses, motor vehicle volumes, crash records, speed survey results, and previous intersection improvement efforts. Additional RSA training was also provided before heading out to the field to investigate the safety performance of the three study roadways. Training consisted of identifying key elements to look including roadway geometry, operations, road users, and environment. Each team member was provided an RSA checklist in which they could use to help facilitate the evaluation process and is included in the Appendix.

Preliminary review of crash records over the previous five years (2007-2011) revealed that there were several specific locations along each roadway where groups of crashes occurred. These locations were primarily within the vicinity of an existing intersection as listed below:

- S. Beavercreek Road/S. Henrici Road
- S. Beavercreek Road/S. Tioga Road
- S. Beavercreek Road/S. Wilson Road
- S. Beavercreek Road/S. Lammer Road-S. Camelia Court
- S. Beavercreek Road/S. Ivel Road
- S. Beavercreek Road/S. Leland Road-S. Kamrath Road
- S. Henrici Road/S. Meadow Lane
- S. Henrici Road/S. Ferguson Road
- S. Ferguson Road/S. Wilson Road

These intersections were the primary focus of the RSA team; however, a thorough review of all roadways and intersections was completed to address potential safety issues.

RSA Field Investigation

The RSA team observed and investigated the three roadway segments and intersections during peak and off-peak hours during the morning, afternoon, and evening on the 29th and 30th of August, 2012. Both of these days featured dry sunny weather. The RSA schedule is provided in Table 2. Observations focused on the roadway and roadside environment, existing roadway geometry, motor vehicle operations, and driver behaviors. During these field visits team members were responsible for identifying and documenting safety issues.

Table 2: Road Safety Audit Schedule

Wednesday August 29, 2012	
3:00 pm to 4:00 pm	RSA Team Presentation/Training
4:00 pm to 5:00 pm	Afternoon safety performance evaluation
5:00 pm to 6:00 pm	P.M. Peak hour safety performance evaluation
6:00 pm to 6:30 pm	Dinner and debrief
6:30 pm to 8:00 pm	Evening safety performance evaluation
Thursday August 30, 2012	
6:30 am to 9:00 am	Morning safety performance evaluation
9:30 am to 11:30 am	Analysis, improvement options, and findings

RSA Analysis

The RSA team identified and categorized observed safety performance issues based on a qualitative risk scale as shown in Table 3. This risk scale was based on the probability of a potential crash and its associated severity based on FHWA's crash prioritization methodology.

Crash Frequency: Indicates the potential for how often a crash could occur.

- **Frequent:** Five or more crashes per year
- **Occasional:** One to five crashes per year
- **Infrequent:** One crash every six years
- **Rare:** Less than one crash every six years

Crash Severity: Indicates the potential for the outcome of a crash.

- **High:** Fatality or debilitating injury crash
- **Medium:** Non-debilitating injury crash, but medical assistance is required
- **Low:** Non-debilitating injury crash without need for medical assistance
- **Negligible:** property damage only type crashes

Table 3: Crash Prioritization Matrix

FHWA Crash Prioritization Risk Category		**Severity**			
		Negligible	Low	Medium	High
Crash Frequency Category	Frequent	C	D	E	F
	Occasional	B	C	D	E
	Infrequent	A	B	C	D
	Rare	A	A	B	C

This table assigns a letter score between A and F based on the potential combinations of crash frequency and crash severity. A score of "F" indicates that there would be a high probability of frequent and severe crashes – a poor situation that should be addressed with highest priority. Conversely, a score of "A" indicates that the probability of a crash would be rare to infrequent and the severity of the crash would be negligible to low.

RSA Study Area

The RSA study area including existing roadway characteristics, surrounding land use, motor vehicle traffic volumes and crash history over the previous five years is discussed in the following sections.

Roadway Characteristics

All three roadways included in this RSA are rural roadways that have two travel lanes with either a narrow paved or gravel shoulder and a posted speed limit ranging from 35 to 45 miles-per-hour (mph). The Clackamas County roadway classification guidelines are included in the Appendix. All roadways feature a continuous double yellow line (no passing zones within study area segment). S. Beavercreek Road features several horizontal curves and rolling terrain. Both S. Henrici Road and S. Ferguson Road are straight roadway segments and also feature rolling terrain. All roadways feature numerous driveways on both sides of the roadway and none have sidewalks nor designated bike lanes with the exception of bike lanes on S. Beavercreek Road north of S. Henrici Road.

The existing roadway characteristics along with the measured 85th percentile speeds[2] are summarized in Figures 5, 6, and 7. The 85th percentile speed is 4 mph over the posted speed on S. Ferguson Road, whereas on S. Beavercreek Road and S. Henrici Road, it ranges from 4-12 mph over the posted speed.

Figure 3: Looking South on S. Beavercreek Rd near S. Henrici Rd

There is one traffic signal located at the intersection of S. Beavercreek Road/S. Henrici Road. At this location, both the S. Beavercreek Road and S. Henrici Road roadway segments widen for an additional turn lane as shown in Figure 3. All other intersections are unsignalized with the minor street being stop controlled.

Surrounding Land Use

Surrounding land uses within the study area include rural, unincorporated community residential and rural commercial as shown in Figure 4[3]. The majority of the study area is rural, with the community of Beavercreek centered on the intersection of S. Beavercreek Road/S. Leland Road-S. Kamrath Road.

There are several land uses within and around the study area which contribute to traffic flow patterns. The Trinity Lutheran Church & School is located on S. Henrici Road between S. Beavercreek Road and S. Ferguson Road. The Oregon City Golf Club is located on S. Beavercreek Road, about half a mile north of the intersection at S. Henrici Road. The Oregon City High School is located about a half a mile north of the Golf Club on S. Beavercreek Road. Additionally the close proximity of the City of Oregon City influences traffic patterns.

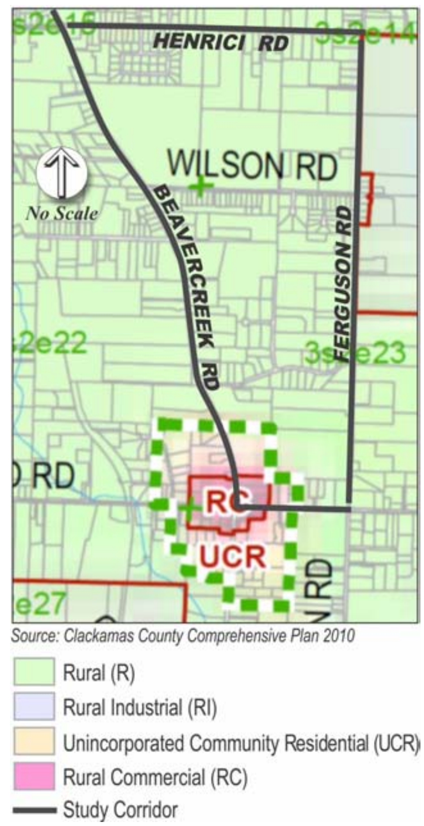


Figure 4: Surrounding Land Use

[2] Speed study conducted by Clackamas County on October 27th, 2011
[3] Clackamas County Comprehensive Plan. 2010.

CLACKAMAS COUNTY

Functional Classification	Rural Minor Arterial
ADT	6,190-9,320
Posted Speed	35-45 mph
85th Percentile Speed	47-50 mph
Number of Lanes	2
Paved Width (ft)	25-39
Shoulder Type/ Width (ft)	Pavement-Gravel/1’-15’
Terrain	Horizontal curves with rolling terrain
Turn Lanes	At S. Henrici Rd signal
Bike Lanes	North of S. Henrici Rd
Sidewalks	No

LEGEND

- Study Intersection
- Count Location
- Study Corridor

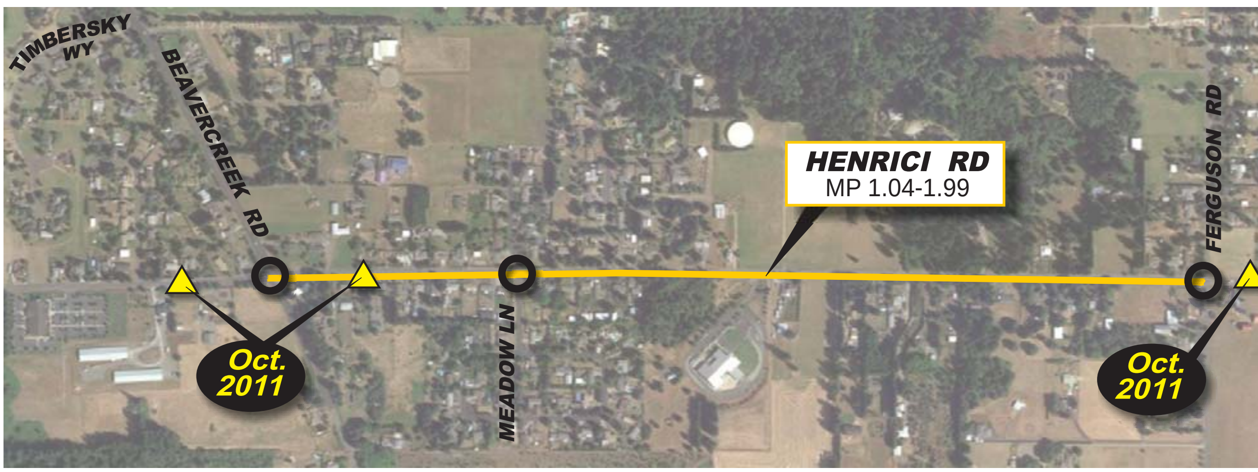
MP 0.0-0.0 - Milepost Range

DKS

No Scale

Figure 5

S. Beavercreek Road
(S. Timbersky Way to S. Ferguson Road)



Functional Classification	Rural Minor Arterial
ADT	2,270-3,645
Posted Speed	40 mph
85th Percentile Speed	44-52 mph
Number of Lanes	2
Paved Width (ft)	22-37
Shoulder Type/Width (ft)	Pavement-Gravel/0'-15'
Terrain	Straight segment with rolling terrain
Turn Lanes	At S. Beavercreek Rd signal
Bike Lanes	No
Sidewalks	No

LEGEND

- Study Intersection
- Count Location
- Study Corridor

MP 0.0-0.0 - Milepost Range

DKS

No Scale

Figure **6**

S. Henrici Road

(S. Beavercreek Road to S. Ferguson Road)

Functional Classification	Rural Local
ADT	680-700
Posted Speed	45 mph
85th Percentile Speed	44-49 mph
Number of Lanes	2
Paved Width (ft)	22
Shoulder Type/Width (ft)	Gravel/1’
Terrain	Straight segment with rolling terrain
Turn Lanes	No
Bike Lanes	No
Sidewalks	No

LEGEND

- Study Intersection
- Count Location
- Study Corridor

MP 0.0-0.0 - Milepost Range

DKS

No Scale

Figure 7

S. Ferguson Road

(S. Henrici Road to S. Beavercreek Road)

Motor Vehicle Traffic Volume

Hourly traffic patterns for the three study area roadways were examined via 24-hour tube counts[4]. The hourly volume profiles for each roadway are shown in Figure 8. As can be seen the hourly traffic patterns along S. Beavercreek Road and S. Henrici Road demonstrate the commuter nature of traffic in the area. Volumes peak in the morning commute period as well as in the afternoon/evening commuter period. Traffic volumes are highest along S. Beavercreek Road with approximately 6,190-9,320 average daily vehicles (ADT). S. Henrici Road carries approximately 2,270-3,645 vehicles per day while S. Ferguson Road carries approximately 680-700 vehicles.

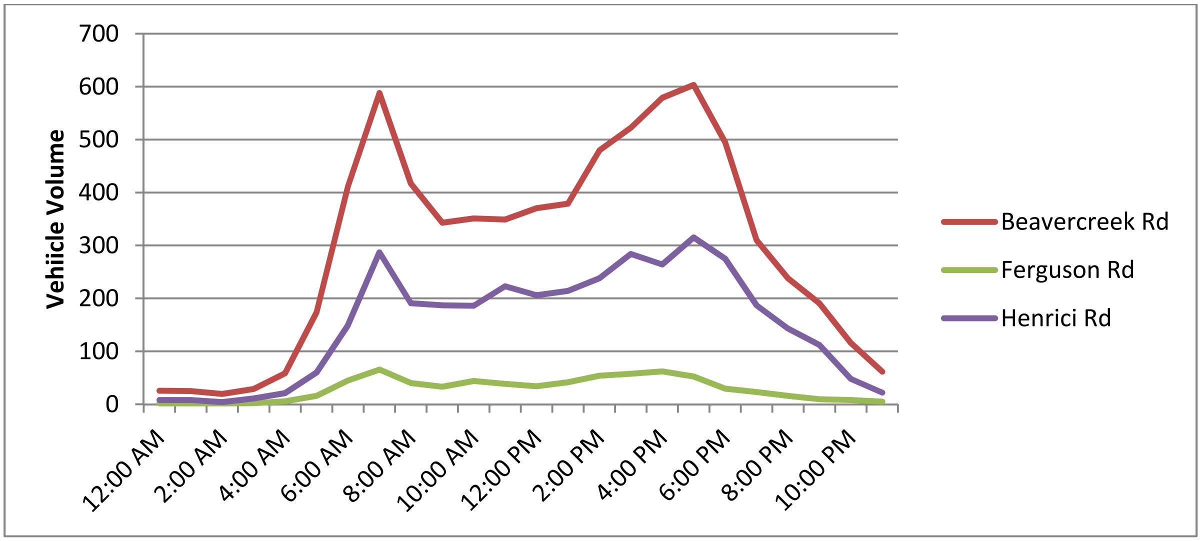


Figure 8: Hourly Traffic Patterns

Vehicle classifications over a 24-hour period are shown in Table 4 for all three roadway segments. Heavy vehicles (the sum of single unit truck, tractor/trailer, and tractor/multi-trailer categories) make up approximately 10-17 percent of the total vehicles. On S. Beavercreek Road approximately 11 percent of the vehicles are trucks (see Figure 9), S. Ferguson Road has approximately 17 percent, and S. Henrici Road has 10 percent. The largest truck measured within the study area was a tractor multi-trailer.

Figure 9: Heavy vehicle observed on S. Beavercreek Rd at S. Laland Rd-S. Kamrath Rd.

[4] Traffic counts conducted by Clackamas County conducted in October 2011 and January 2012.

Table 4: Daily Roadway Vehicle Classification

Roadway	Vehicle Classification				
	Passenger Car	Bike	Single Unit Truck	Tractor/Trailer	Tractor/Multi-Trailer
S. Beavercreek Rd	6308	48	689	103	4
S. Henrici Rd	565	19	108	5	0
S. Ferguson Rd	3276	9	315	37	0

Passenger Car = Vehicle class 1, 2, and 3
Single Unit Truck = Vehicle class 4, 5, 6, and 7
Tractor/Trailer = Vehicle class 8, 9, and 10
Tractor/Multi-Trailer = Vehicle class 11, 12, and 13

Figure 10: Bicyclist observed on S. Beavercreek Rd at S. Laland Rd-S. Kamrath Rd.

Approximately 50 bicyclists were counted along S. Beavercreek Road (see Figure 10), 20 along S. Henrici Road, and 10 along S. Ferguson Road. There are bike lanes on S. Beavercreek Road north of S. Henrici Road and no bike lanes on the other two roadways. The peak period for cyclists is between 2 -4 pm, with around 10 cyclists per hour (as shown in Figure 11). The bicycle activity during this time period could be due to the Oregon City High School. The highest cyclist activity occurs south of the high school along S. Beavercreek Road, in addition to, east of the high school along S. Henrici Road. The bicycle activity was low on Ferguson with less than 10 cyclists per day. Pedestrian activity within the study area is low and there are currently no sidewalks within the area except for a minor segment on S. Beavercreek Road near S. Leland Road-S. Kamrath Road.

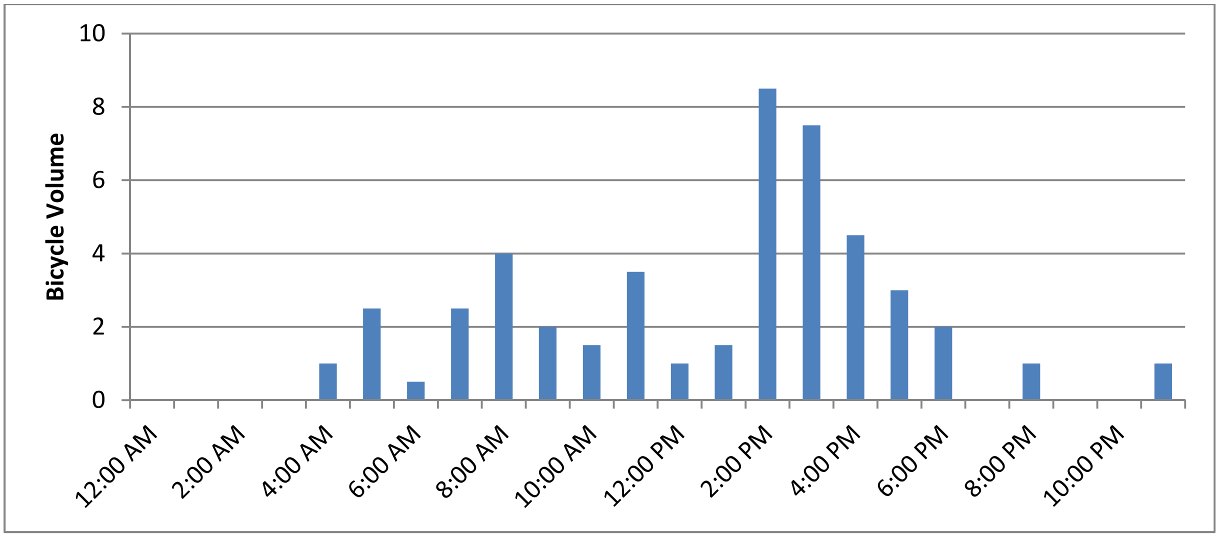


Figure 11: Hourly Bicycle Volumes along S. Beavercreek Rd

Crash History

The RSA team examined recorded crash records for the five year period from 2007 to 2011 along each roadway. There were a total of 58 crashes in the study area[5]. Figure 12 illustrates crash type by roadway, demonstrating that most of the crashes occurred on S. Beavercreek Road (roadway with the highest traffic volumes). Crashes that occurred at intersections involving more than one of the study corridors were included in both corridors' crash statistics. The majority of the crashes on S. Beavercreek Road were rear ends, whereas the majority of crashes on S. Henrici Road were turning or angle crashes. The following sections break down the crashes by roadway segment and at the intersection level.

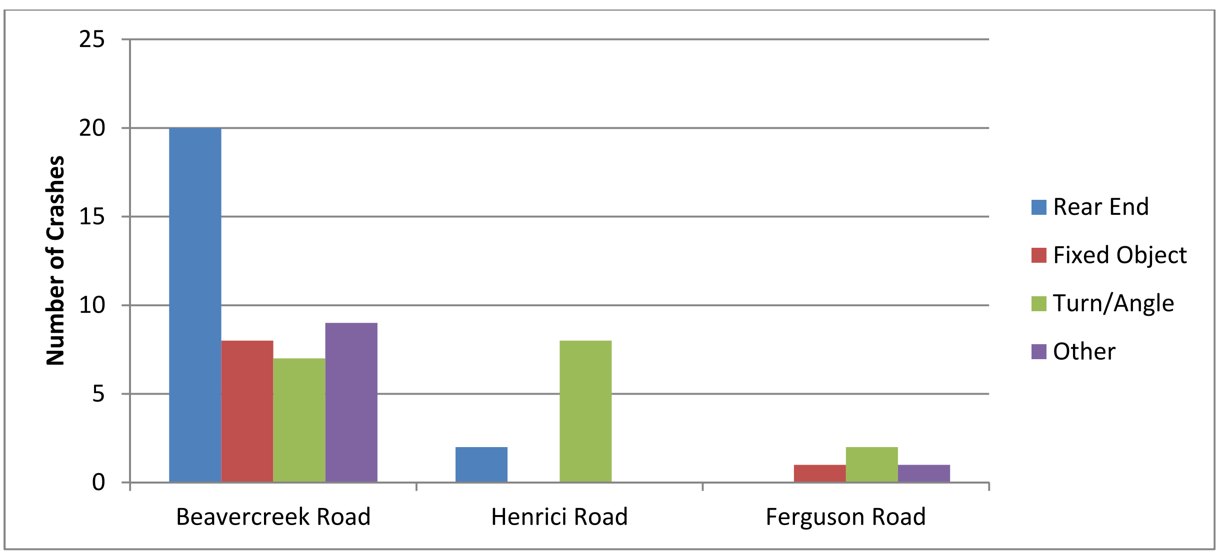


Figure 12: Crash Type by Roadway

[5] ODOT collision records, January 1, 2007 to December 31, 2011.

S. Beavercreek Road

There were 44 recorded crashes on S. Beavercreek Road. Some items of note include:

- The most common type of crash was rear end (45%)
- The second most common type of crash was fixed object (18%)
- One fatality occurred (motorcycle crash south of S. Ivel Road)
- Approximately 43% of the crashes resulted in property damage only
- Two-thirds of the crashes occurred during daylight conditions
- Approximately 38% of the crashes occurred between 4 -7 pm
- No crashes involved pedestrians or bicyclists
- Approximately 70% of the crashes occurred on dry pavement

For the crashes that were not intersection related, many were rear end or fixed object crashes that occurred along S. Beavercreek Road well-spaced from one another. S. Beavercreek Road has many driveways and features rolling terrain, which could be the cause for some of the rear end crashes. Generally the reported cause for the majority of crashes was either following too closely or driving too fast. A number of these crashes occurred at the intersection of S. Beavercreek Road/S. Leland Road-S. Kamrath Road (Figure 13).

Figure 13: S. Beavercreek Rd/S. Leland Rd-S. Kamrath Rd (looking south)

S. Henrici Road

A total of 10 crashes were reported along S. Henrici Road. Some items of note include:

- The most common type of crashes were turning & angle (combined 80%)
- No fatalities occurred
- The majority of the crashes resulted in injury (60%)
- One crash at the intersection of S. Ferguson Road involved a bicyclist
- One crash occurred during the evening
- Approximately 90% of the crashes occurred on dry pavement

Figure 14: S. Beavercreek Rd/S. Henrici Rd (looking south)

All of the crashes recorded along S. Henrici Road occurred at intersections, primarily the signalized intersection at S. Beavercreek Road/S. Henrici Road (Figure 14). The traffic signal is the primary causal factor for most of the turning and angle related crashes.

S. Ferguson Road

There were 4 recorded crashes on S. Ferguson Road. Some items of note include:

- Half of the crashes were turning or angle crashes
- Three of the four crashes involved injury
- No fatalities occurred
- One crash involved a backing vehicle
- One crash occurred during the evening
- Three of the four crashes occurred on dry pavement

Most of these crashes occurred near the intersection of S. Wilson Road (Figure 15).

Figure 15: S. Ferguson Rd/S. Wilson Rd (looking south)

Intersections

Ten intersections were analyzed by creating crash diagrams. The crash diagrams are included in the Appendix and show the crash type, severity, direction of travel, and crash identification number. This information is useful in identifying crash related trends. The collision records are included in the Appendix.

The study intersections are listed in Table 5 along with a summary of the crashes that occurred including the crash severity and type. The two intersections with the largest number of crashes are:

- S. Beavercreek Road/S. Henrici Road (12 crashes)
- S. Beavercreek Road/S. Leland Road-S. Kamrath Road (10 crashes)

The intersection of S. Beavercreek Rd/S. Henrici Road is a signalized intersection while the intersection of S. Beavercreek Rd/S. Leland Road/S. Kamrath Road is an unsignalized intersection with unfamiliar geometry. There was one fatality recorded at the intersection of S. Beavercreek Road/S. Ivel Road which involved a motorcycle.

Table 5: Intersection Crash Severity & Type

Intersection	Crash Severity			Crash Type				Total
	Fatal	Injury	PDO[a]	Rear	Fixed	Turn/Angle	Other	
S. Beavercreek Rd/S. Henrici Rd	0	2	10	4	1	4	3	**12**
S. Beavercreek Rd/S. Tioga Rd	0	4	1	3	2	0	0	**5**
S. Beavercreek Rd/S. Wilson Rd	0	3	1	3	0	0	1	**4**
S. Beavercreek Rd/S. Lammer Rd-S. Camellia Ct	0	1	2	1	2	0	0	**3**
S. Beavercreek Rd/S. Ivel Rd	1	1	0	0	0	0	2	**2**
S. Beavercreek Rd/S. Leland Rd-Kamrath Rd	0	4	6	4	0	2	1	**10**
S. Ferguson Rd/S. Beavercreek Rd	0	1	1	1	1	5	0	**2**
S. Ferguson Rd/S. Wilson Rd	0	2	1	1	1	1	0	**3**
S. Ferguson Rd/S. Henrici Rd	0	5	2	2	0	5	0	**7**
S. Henrici Rd/S Meadow Ln	0	1	1	1	0	1	0	**2**
Total	**1**	**24**	**25**	**20**	**8**	**12**	**7**	**50**

[a]PDO = Property damage only

Road Safety Audit Team Findings Summary

As previously mentioned the RSA team considered the following observation categories during the field reviews to determine safety related factors:

- Geometric Issues: horizontal curves, vertical curves, gradient, cross section, clearance, sight distance, clear zone obstructions
- Operational Issues: congestion, signing, striping, traffic control operations, speeding, queuing, turning movements
- Road User Observations: motorists, bicyclists, pedestrians, special need users
- Environmental Observations: weather, lighting conditions, surrounding land uses

All of these categories can play an important role in the safety performance of a roadway/intersection. The following sections provide a brief overview of these categories as observed by the RSA team with particular safety related issues presented the subsequent section.

Geometric Observations

All three roadways feature rolling terrain with vertical curves (see Figure 16), which restrict intersection sight distance and stopping sight distance at several locations. Other items noted during the field investigation included multiple objects such as utility poles, mailboxes, fences, and trees within the roadway clear zone. All roadways feature narrow shoulders and there is a moderate pavement drop off in some locations

Figure 16: Rolling terrain on S. Ferguson Road (looking south near S. Henrici Rd)

Operational Observations

Operational observations were made at nine intersections. The RSA team made several observations at the intersection of S. Beavercreek Road/S. Leland Road-S. Kamrath Road during the evening peak period. This intersection consists of the westbound to northbound and southbound to eastbound main movements along S. Beavercreek Road uncontrolled. The westbound through/left turn movement on S. Beavercreek Road is stop controlled (right turn permitted without stopping as shown in Figure 17) while S Leland Road and S. Kamrath Road are stop controlled. Observations at this intersection showed that the uncommon traffic control can lead to driver confusion at the intersection during peak periods.

Another item noted by the RSA team is that all roadways featured a continuous no passing zone within the study area.

Figure 17: Right Turn Permitted without Stopping Sign

Road User Observations

The majority of users observed were motor vehicles of various classifications as previously mentioned. Several bicyclists were observed along all roadways and pedestrian use is minimal; although there are signs of pedestrian usage within the study area. The team noted that all roadways featured no provisions for pedestrians or bicyclists with the exception of bike lanes on S. Beavercreek Road north of S. Henrici Road. Due to the rural location other users of the roadway include farm equipment and equestrian riders.

Figure 18: Pedestrian usage at S. Beavercreek Rd/S. Leland Rd-S. Kamrath Rd.

Environmental Observations

Field observations for all roadways took place during a dry, sunny, summer day in August. Sun glare in the morning and evening was visibly noticed by the team along S. Henrici Road (east-west roadway). The signalized intersection of S. Beavercreek Road/S. Henrici Road is the only study intersection that currently features street lighting. Night time observations indicate that the lighting provided at this intersection was adequate. Night time observations also indicated that both striping and signing produced acceptable visibility along all roadways (see Figure 19). The team identified a few signs where the retro-reflectivity was substandard. Traffic patterns along S. Beavercreek Road and S. Henrici Road resemble commuter patterns due to the surrounding rural residential land use.

Figure 19: Sign retro-reflectivity

RSA Issue and Suggestion Prioritization

This section summarizes the safety related issues identified by the RSA team along each roadway segment and nine study intersections. Each issue identified is categorized based on a qualitative risk scale previously discussed. Accompanying each identified issue is a recommended improvement option. Where possible, improvement options are associated with a crash modification factor (CMF), which is a multiplicative factor that can be used to aid with the estimation of the expected number of crashes after an improvement has been implemented. Respective CMF's were developed with the use of the Crash Modification Factors Clearinghouse[6]. The clearing house provides available research based CMF's, so there may not be an associated CMF for all improvement options. Finally, each improvement option is categorized as high cost, medium cost, or low cost. The low cost improvements are those that could be easily implemented on a short term basis. The medium cost improvements would cost more and could typically be implemented within five years. The long term improvements are identified as high cost and could be implemented within the next 20 years. These items could be adopted into the County's policy documents so that funding could be obtained.

The following pages summarize the RSA team's findings along each of the three corridors and at the nine study intersections.

[6] Crash Modification Factors Clearinghouse, U.S. Department of Transportation Federal Highway Administration, http://www.cmfclearinghouse.org/

Location: S. Beavercreek Road (S. Timbersky Way to S. Ferguson Road), Clackamas County	
Milepoint: 11.27-13.54	
Roadway Characteristics: Beavercreek Rd.	
Posted Speed (mph)	35-45
ADT	6,190-9,320
Classification	Rural Minor Arterial
Overall CMF:	TBD
Preliminary Cost Estimate:	TBD

Issue	Description	Severity	Frequency	Ranking	Improvement	CMF	Cost
A	Narrow gravel shoulder (currently ranges between 2-6 feet). This does not meet County standards for Minor Arterial.	Medium	Infrequent	C	Provide wider shoulder where shoulders are less than 6 feet. Shoulders should be built to County standard for the functional class.	0.52	$$
B	Obstructions located within clear zone (utility poles, mailboxes, trees)	High	Infrequent	D	Remove, protect, or delineate objects located within the roadway clear zone	0.62	$$
C	No provisions for pedestrians or bicyclists. This does not meet County standards for Minor Arterial.	High	Rare	C	Provide paved shoulder/bikeway for pedestrians and bicyclists consistent with County standards for Minor Arterial.	0.52	$$
D	Lack of visible residential address markers along roadway	Medium	Infrequent	C	Provide consistent address markers for residential land uses. This effort could be coordinated with the fire district. Address markers need to be installed in a safe location.		$
E	Vertical curves along roadway restrict stopping sight distance . The required stopping sight distance is 360 feet.	Medium	Infrequent	C	a) Provide "hill blocks view sign" (MUTCD W7-6) where stopping sight distance is restricted by vertical curves to less than the minimum required and install intersection warning signs where applicable. b) Evaluate the need for left turn lanes at intersections where vertical curve restricts stopping sight distance c) Flatten vertical curve	a)0.65 (Angle) b) 0.56 c) 0.80	$ $$ $$$

Issue	Description	Severity	Frequency	Ranking	Improvement	CMF	Cost
F	Pavement edge drop-off in focused locations	Medium	Infrequent	C	a) Install additional gravel in shoulder b) Install 45 degree pavement edge wedge		$ $$
G	Street name signs are not consistent	Negligible	Rare	A	Upgrade street name signs to County standard	0.85 (Injury) 0.93 (PDO)	$
H	Steep shoulder/ditch along both sides of Beavercreek Rd	High	Infrequent	D	Install pipe within ditch and fill in hole with gravel/rock	0.81	$$
I	Roadside vegetation blocks roadway signage	Medium	Rare	B	Trim vegetation clear of roadway signage		$
J	Storm water grates are hazardous for bicyclists	High	Rare	C	Replace existing storm water grates with bike safe grates		$
K	Roadway delineation is not consistent	Medium	Infrequent	C	Provide consistent delineation along roadway (chevron signs around horizontal curves, roadway pavement markers where warranted, edge of roadway delineators)	0.85 (Injury) 0.93 (PDO)	$
L	Inconsistent curve advisory speed signs	Medium	Infrequent	C	Verify appropriate speed designation of horizontal curves with ball bank indicator.	0.85 (Injury) 0.93 (PDO)	$

Existing Issues Photos


Reflective pavement markers are missing in newly paved sections


Lack of pedestrian and bike facilities

Existing Issues Photos (Continued)


Objects located within clear zone


Narrow shoulder


Pavement Drop off


Delineators broken, missing, or inconsistent


Storm water grates are hazardous for bicyclists


Unprotected ditches

Location: S. Ferguson Road (S. Henrici Road to S. Beavercreek Road), Clackamas County	
Milepoint: 0.50 – 1.99	
Roadway Characteristics: Ferguson Rd.	
Posted Speed (mph)	45
ADT	680-700
Classification	Rural Local
Overall CMF:	TBD
Preliminary Cost Estimate:	TBD

Issue	Description	Severity	Frequency	Ranking	Improvement	CMF	Cost
A	Posted speed (45 mph) may be high for roadway classification.	Medium	Infrequent	C	Review the functional classification of Ferguson Road and consider speed zone reduction	1.01	$
B	Double yellow centerline striping may be inappropriate for local roadway classification	Negligible	Rare	A	Review the functional classification of Ferguson Road. Evaluate possibility of removing centerline striping.		$
C	Vertical curves along roadway restrict stopping sight distance and intersection sight distance.	Medium	Rare	B	a) Provide "hill blocks view sign" (MUTCD W7-6) where stopping sight distance is restricted by vertical curves to less than the minimum required or install intersection warning signs where applicable. b) Evaluate the need for left turn lanes at intersections where vertical curve restricts stopping sight distance c) Flatten vertical curve	a)0.65 (angle) b) 0.56 c) 0.80	$ $$ $$$
D	Narrow or non existent shoulders (paved and gravel). This does not meet County standards for rural local roadway.	High	Infrequent	D	Provide gravel shoulders especially in locations with limited sight distance. Shoulders should be built to County standard for the functional class.	0.52	$$
E	Lack of visible residential address markers along roadway.	Low	Rare	A	Provide consistent address markers for residential land uses. This effort could be coordinated with the fire district. Address markers need to be installed in a safe location.		$
F	Obstructions located within clear zone (utility poles, mailboxes, trees)	High	Infrequent	D	Remove, protect, or delineate objects located within the roadway clear zone	0.62	$$

Existing Issues Photos

Possible high posted speed for local roadway classification

Double yellow centerline striping may be inappropriate for local roadway classification

Vertical curves along roadway restrict stopping sight distance and intersection sight distance

Narrow or non existent shoulders

Obstructions located within clear zone

DKS CLACKAMAS COUNTY

Location: S. Henrici Road (S. Beavercreek Road to S. Ferguson Road), Clackamas County	
Milepoint: 1.04 to 1.99	
Roadway Characteristics: Henrici Rd.	
Posted Speed (mph)	40
ADT	2,270-3,645
Classification	Rural Minor Arterial
Overall CMF:	TBD
Preliminary Cost Estimate:	TBD

Issue	Description	Severity	Frequency	Ranking	Improvement	CMF	Cost
A	Vertical curves along roadway restrict stopping sight distance (between Meadow Ln and Ferguson Rd)	Medium	Infrequent	C	a) Provide "hill blocks view sign" (MUTCD W7-6) where stopping sight distance is restricted by vertical curves or install intersection warning signs where applicable. b) Evaluate the need for left turn lanes at intersections where vertical curve restricts stopping sight distance c) Flatten vertical curve	a)0.65 (angle) b) 0.56 c) 0.80	$ $$ $$$
B	Narrow shoulders. This does not meet County standards for Rural Minor Arterial.	Medium	Rare	B	Widen shoulders to County standard for the functional class	0.81	$$
C	No provisions for pedestrians or bicyclists. This does not meet County standards for Rural Minor Arterial.	High	Infrequent	D	Widen shoulders to County standard for the functional class	0.81	$$
D	Obstructions located within clear zone (utility poles, mailboxes, trees)	High	Rare	C	Remove, protect, or delineate objects located within the roadway clear zone	0.62	$$
E	Lack of visible residential address markers along roadway. There is a high frequency of driveways	Low	Infrequent	B	Provide consistent address markers for residential land uses. This effort could be coordinated with the fire district. Address markers need to be installed in a safe location.		$

Existing Issues Photos

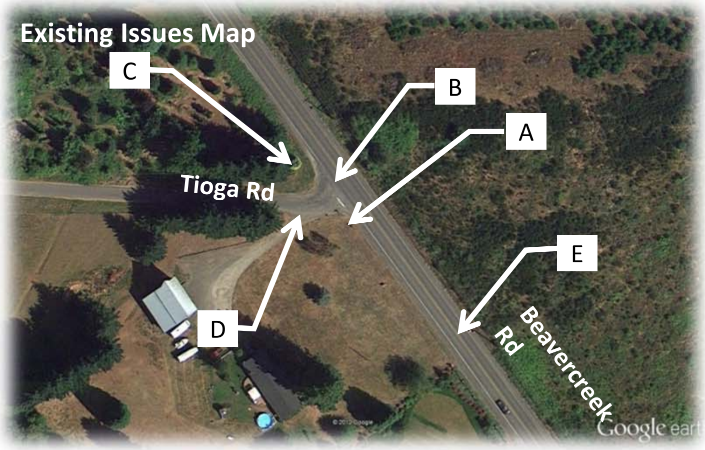
Vertical curve restricts stopping sight distance

Narrow shoulders

Obstructions located within clear zone

Lack of visible residential address markers along roadway

Location: S. Beavercreek Road at S. Tioga Road, Clackamas County		
Milepoint: 12.78		
Roadway Characteristics:		
	Beavercreek Rd.	Tioga Rd.
Posted Speed (mph)	45	Not posted
ADT	6,190-9,320	Unknown
Classification	Rural Minor Arterial	Rural Local
Overall CMF:		TBD
Preliminary Cost Estimate:		TBD

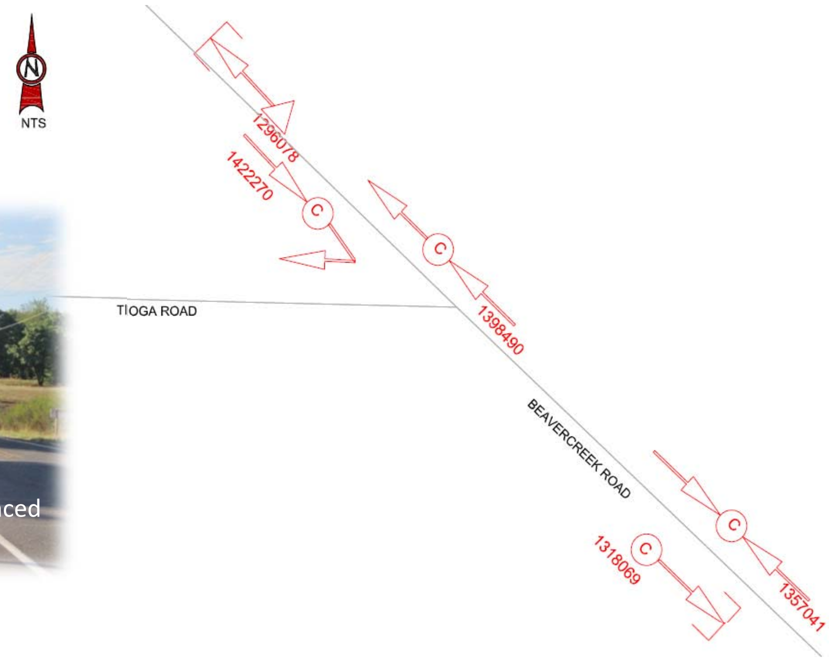


Issue	Description	Severity	Frequency	Ranking	Improvement	CMF	Cost
A	Street name sign for northbound Beavercreek Rd traffic is blocked by advanced intersection warning sign for Wilson Rd.	Negligible	Rare	A	a) Relocate existing intersection warning sign for Wilson Rd to the south or offset sign with respect to the Tioga Rd street name sign assembly.		$
B	Skewed intersection alignment causes undesired slowing and vehicle off tracking for turning vehicles on Tioga Rd.	Low	Occasional	C	a) Realign Tioga Road to intersect Beavercreek Road perpendicular and consider widening approach.		$$
C	Trees/vegetation restrict intersection sight distance to the north. The required intersection sight distance is 500 feet.	Medium	Rare	B	Trim existing tree/vegetation on the northwest corner of intersection.	0.53 (Injury) 0.89 (PDO) 0.44 (Fatal)	$
D	Driveway located in close proximity to intersection.	Negligible	Rare	A	Realign existing driveway to intersect Tioga Rd west of Beavercreek Rd.		$$
E	Vertical curve restricts intersection sight distance to the south. The required intersection sight distance is 500 feet.	Medium	Infrequent	C	a) Install hills blocks view sign and supplemental advisory speed sign. b) Evaluate need for northbound left turn lane c) Flatten roadway vertical curve.	a) 0.65 (Angle) b) 0.56 c) 0.80	$ $$$ $$$
F	No Advance intersection warning signs are provided along Beavercreek Road.	Low	Infrequent	B	Install advance intersection warning signs along Beavercreek Road in both travel directions.	0.65 (Angle)	$

DKS
CLACKAMAS COUNTY

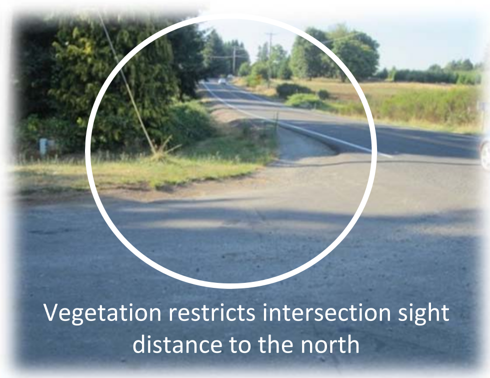
Collision Diagram (2007-2011)

Existing Issues Photos



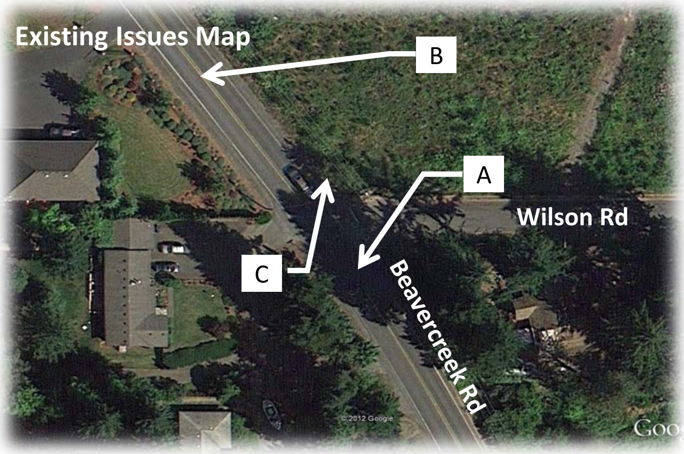

Street name sign blocked by advanced intersection warning sign


Skewed intersection alignment causes undesired slowing and vehicle off tracking


Vegetation restricts intersection sight distance to the north


Vertical curve restricts intersection sight distance to the south

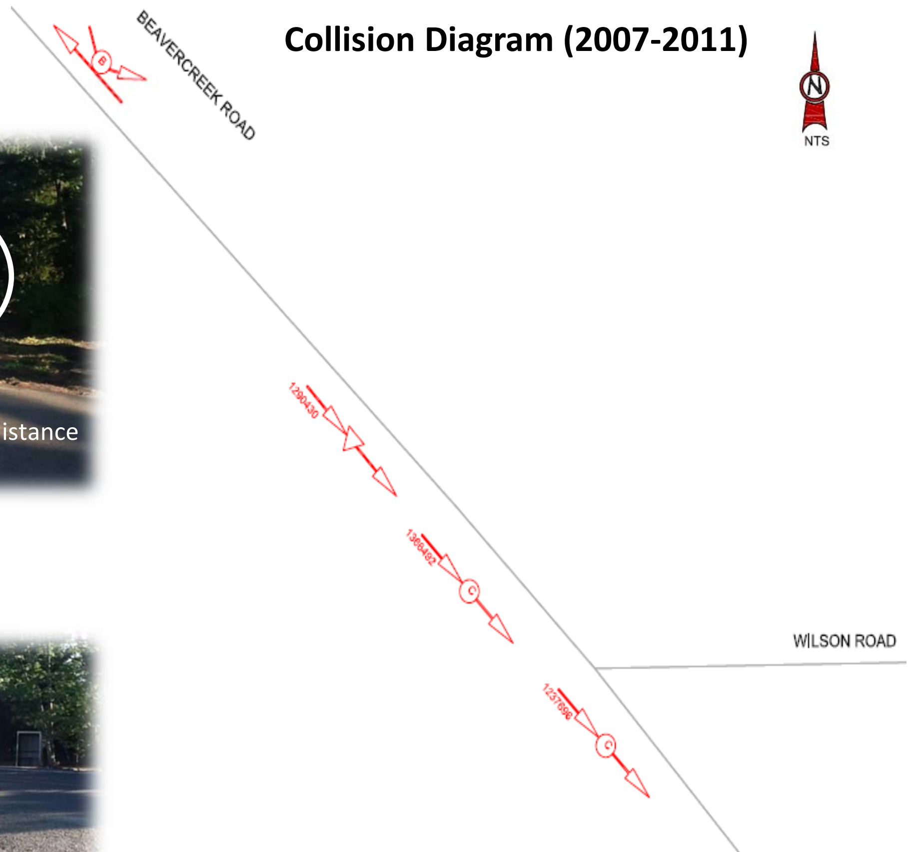
Location: S. Beavercreek Road at S. Wilson Road, Clackamas County		
Milepoint: 12.68		
Roadway Characteristics:		
	Beavercreek Rd.	Wilson Rd.
Posted Speed (mph)	45	25
ADT	6,190-9,320	Unknown
Classification	Rural Minor Arterial	Rural Local
Overall CMF:		TBD
Preliminary Cost Estimate:		TBD



Issue	Description	Severity	Frequency	Ranking	Improvement	CMF	Cost
A	Vegetation restricts intersection sight distance to the north and south (50 feet). The required intersection sight distance is 500 feet.	Medium	Rare	B	Trim existing vegetation located on the southwest, northeast , and southeast corners of the intersection.	0.53 (Injury) 0.89 (PDO) 0.44 (Fatal)	$
B	Vertical curve restricts intersection sight distance to the south. The required intersection sight distance is 500 feet.	Low	Infrequent	B	a) Install hills blocks view sign and supplemental advisory speed sign. b) Evaluate need for northbound left turn lane. c) Flatten roadway vertical curve.	a) 0.65 (Angle) b) 0.56 c) 0.80	$ $$$ $$$
C	Large pavement drop off in the northeast quadrant.	Negligible	Rare	A	a) Install additional gravel in shoulder. b) Install 45 degree pavement edge wedge.		$$ $$

Existing Issues Photos

Collision Diagram (2007-2011)



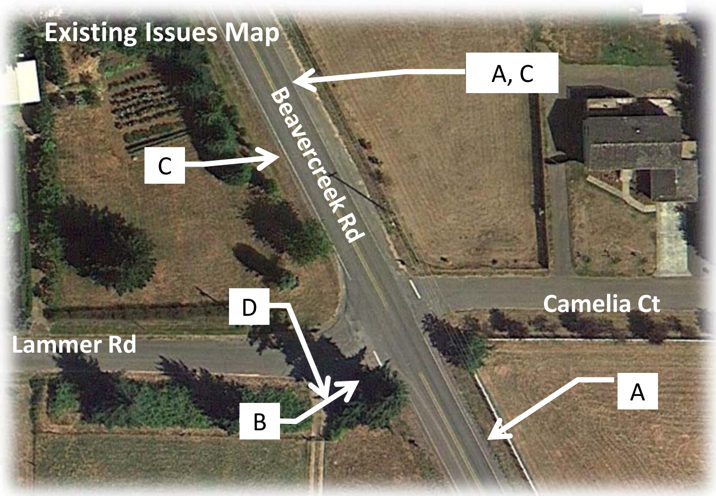

Vegetation restricts intersection sight distance to the north


Vegetation restricts intersection sight distance to the south


Vertical curve restricts intersection sight distance to the north

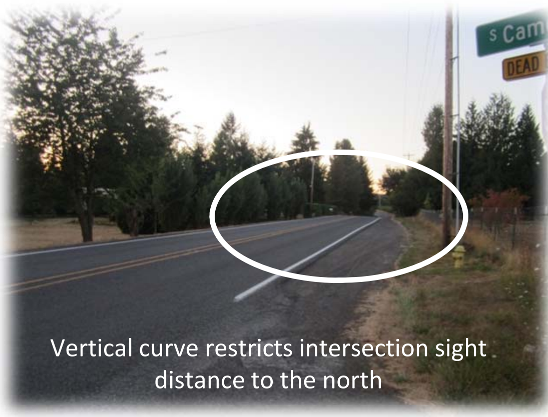

Pavement drop off

Location: S. Beavercreek Road at S. Lammer Road- S. Camelia Court, Clackamas County			
Milepoint: 12.50			
Roadway Characteristics:			
	Beavercreek Rd.	Lammer Rd.	Camelia Ct.
Posted Speed (mph)	45	25	25
ADT	6,190-9,320	Unknown	Unknown
Classification	Rural Minor Arterial	Rural Local	Rural Local
Overall CMF:		TBD	
Preliminary Cost Estimate:		TBD	

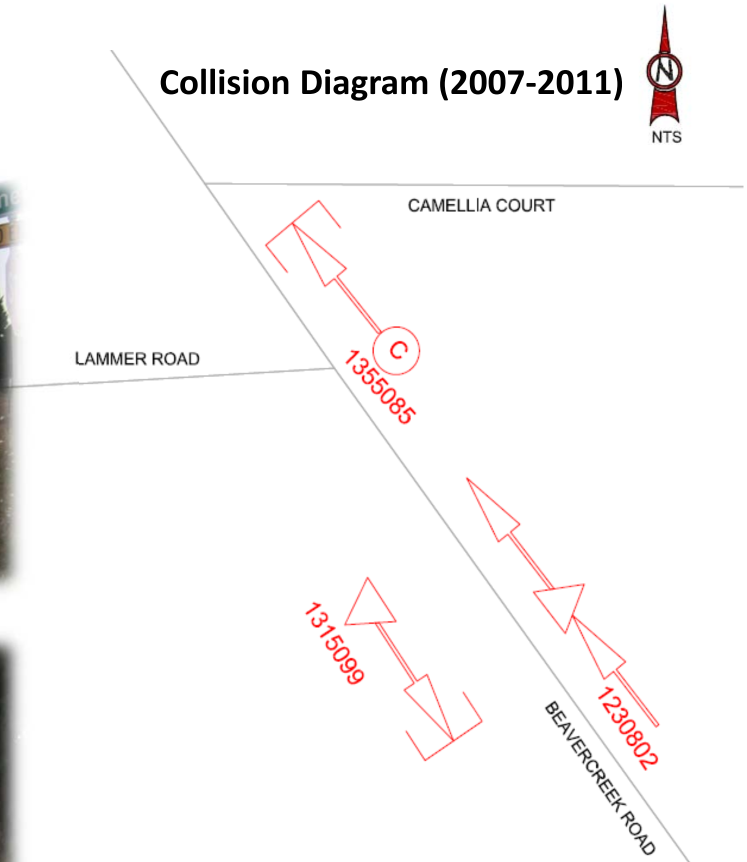


Issue	Description	Severity	Frequency	Ranking	Improvement	CMF	Cost
A	Vegetation restricts Intersection sight distance to the south (420 feet). The required intersection sight distance is 500 feet.	Medium	Rare	B	Trim existing vegetation located on the southwest corner of intersection	0.53 (Injury) 0.89 (PDO) 0.44 (Fatal)	$
B	Intersection street name sign on southwest corner is blocked by vegetation.	Negligible	Rare	A	Trim existing tree located on the southwest corner of intersection		$
C	Vertical curve restricts intersection sight distance to the north (520 feet). The required stopping sight distance is 500 feet.	Low	Infrequent	B	a) Install hills blocks view sign and supplemental advisory speed sign. b) Evaluate need for northbound left turn lane. c) Flatten roadway vertical curve.	a)0.65 (Angle) b) 0.56 c) 0.80	$ $$$ $$$
D	No Advance intersection warning signs are provided along Beavercreek Road.	Low	Infrequent	B	Install advance intersection warning signs along Beavercreek Road for in both travel directions.	0.65 (Angle)	$
E	Driveway located in close proximity to intersection	Negligible	Rare	A	Realign existing driveway to intersect Lammer Rd west of Beavercreek Rd		$

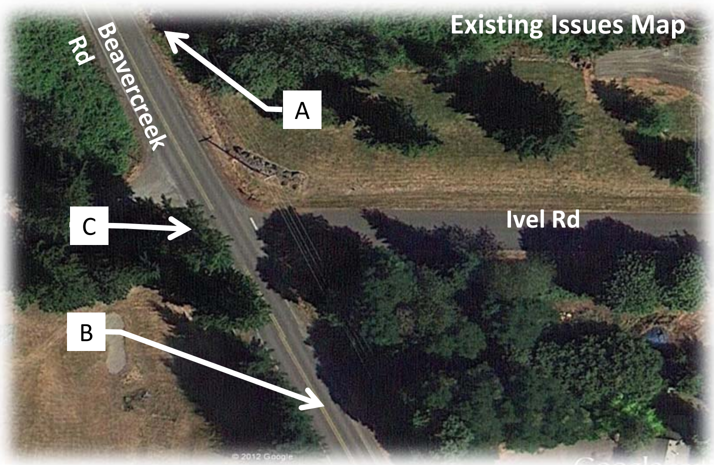
Existing Issues Photos



Collision Diagram (2007-2011)



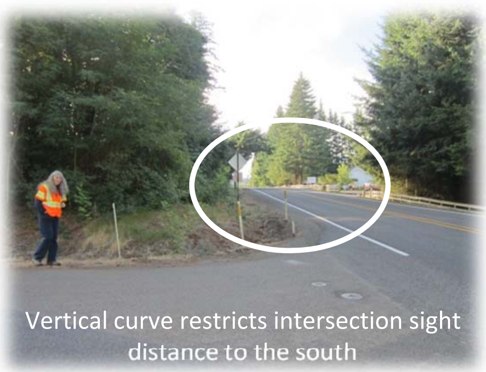
<table>
<tr><td colspan="3">Location: S. Beavercreek Road at S. Ivel Road, Clackamas County</td></tr>
<tr><td colspan="3">Milepoint: 12.02</td></tr>
<tr><td colspan="3">Roadway Characteristics:</td></tr>
<tr><td></td><td>Beavercreek Rd.</td><td>Ivel Rd.</td></tr>
<tr><td>Posted Speed (mph)</td><td>45</td><td>25</td></tr>
<tr><td>ADT</td><td>6,190-9,320</td><td>Unknown</td></tr>
<tr><td>Classification</td><td>Rural Minor Arterial</td><td>Rural Local</td></tr>
<tr><td colspan="2">Overall CMF:</td><td>TBD</td></tr>
<tr><td colspan="2">Preliminary Cost Estimate:</td><td>TBD</td></tr>
</table>



Issue	Description	Severity	Frequency	Ranking	Improvement	CMF	Cost
A	Vegetation restricts intersection sight distance to the north (400 feet). The required intersection sight distance is 500 feet.	Medium	Rare	B	Trim existing vegetation to the north along the inside of the horizontal curve	0.53 (Injury) 0.89 (PDO) 0.44 (Fatal)	$
B	Vertical curve restricts intersection sight distance to the south (475 feet). The required intersection sight distance is 500 feet.	Medium	Rare	B	a) Install hills blocks view sign and supplemental advisory speed sign. b) Flatten roadway vertical curve.	a) 0.65 (Angle) b) 0.80	$ $$$
C	Roadside obstructions within clear zone	High	Infrequent	D	a) Delineate obstructions within the clear zone by use of object markers b) Evaluate use of guardrail to protect obstructions within the clear zone c) Remove obstruction	0.62	$ $$ $$

Existing Issues Photos

Vegetation restricts intersection sight distance to the north

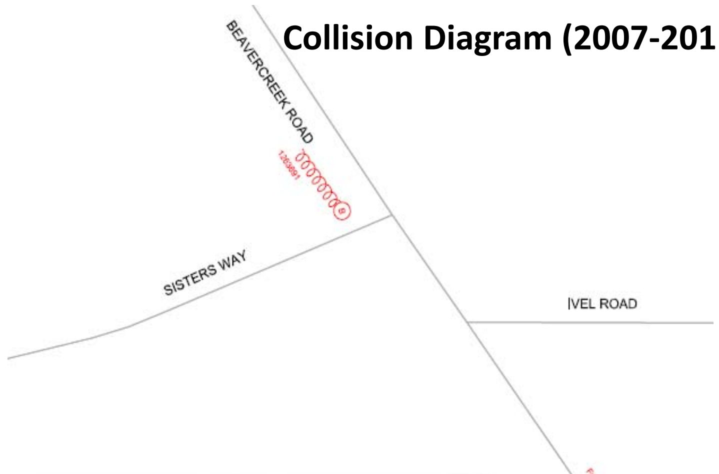

Vertical curve restricts intersection sight distance to the south


Steep ditch

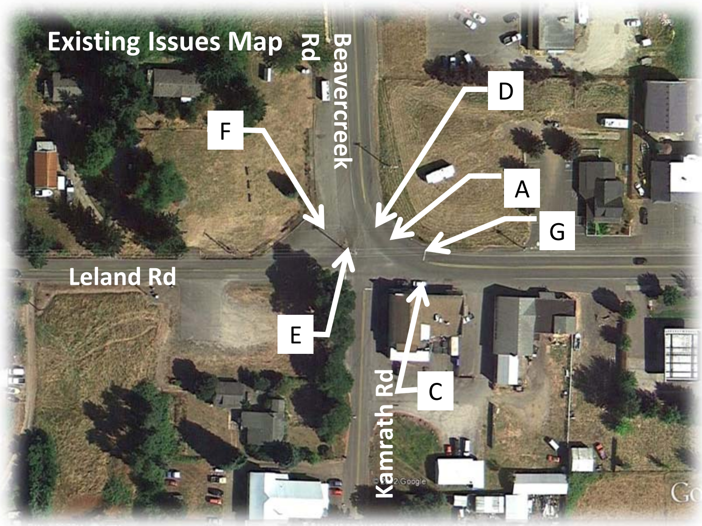

Steep ditch


Steep ditch

Collision Diagram (2007-2011)



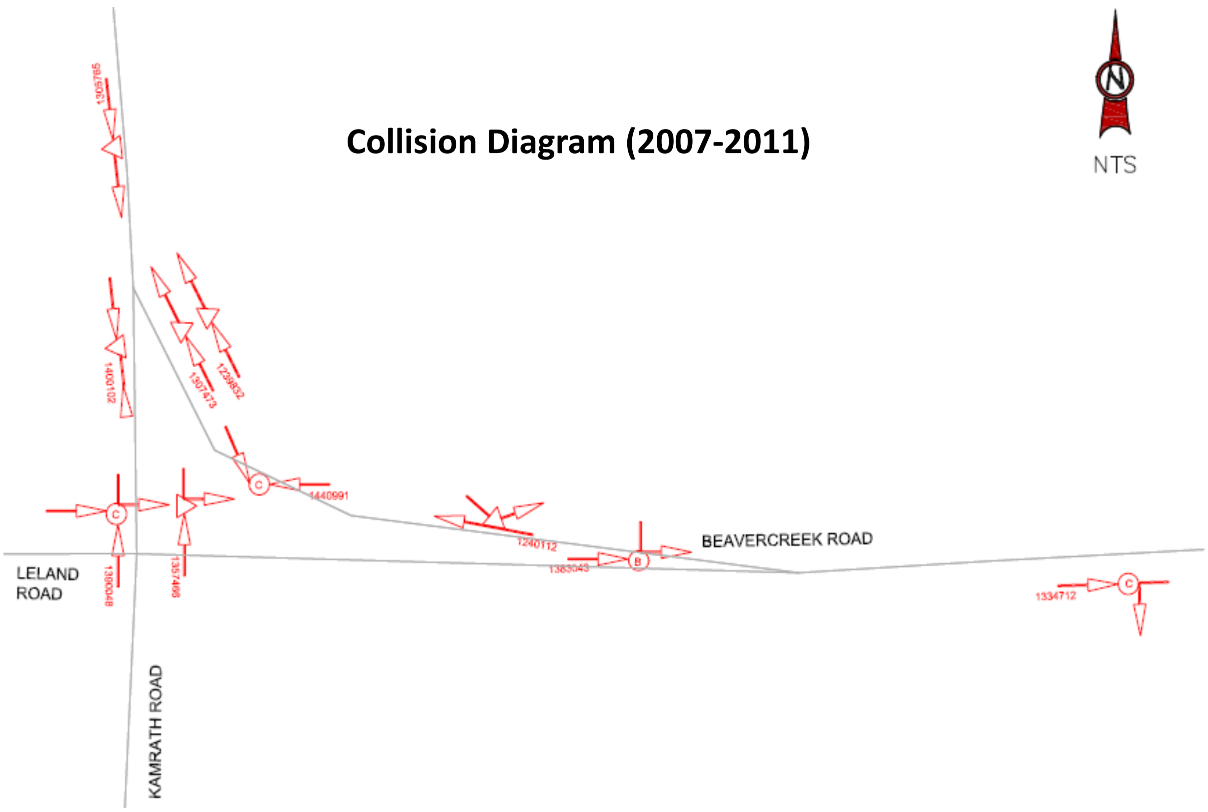
Location: S. Beavercreek Road at S. Leland Road- S. Kamrath Road, Clackamas County			
Milepoint: 11.62			
Roadway Characteristics:			
	Beavercreek Rd.	Leland Rd.	Kamrath Rd.
Posted Speed (mph)	45	45	45
ADT	6,190-9,320	1,540	1,230
Classification	Rural Minor Arterial	Rural Local	Rural Local
Overall CMF:		TBD	
Preliminary Cost Estimate:		TBD	



Issue	Description	Severity	Frequency	Ranking	Improvement	CMF	Cost
A	The superelevation for the horizontal curve along Beavercreek Road through the intersection causes vehicle off tracking. This off tracking has contributed to edge of pavement drop off and vehicles encroaching into the shoulder or oncoming traffic.	Low	Infrequent	B	Remove superelevation for the horizontal curve		$$
B	The grade differential between Beavercreek Road and Leland Road/Kamrath Road makes the intersection difficult to maneuver through from the minor streets.	Low	Infrequent	B	Modify intersection grade		$$
C	The permitted parking in front of the store located on the southeast corner restricts intersection sight distance at Kamrath Road. The existing stop bar along Kamrath Road is set too far back from the intersection.	Low	Infrequent	B	Restrict parking in front of store in order to improve intersection sight distance	0.80 (Injury) 0.73 (PDO)	$
D	There is no striping through the intersection (edge line, centerline). Additionally the stop bars for the eastbound and northbound stop bars are worn.	Low	Infrequent	B	Install 4” white/yellow dotted lines (WD/YD) for lane extensions along Beavercreek Road through the intersection (centerline, edge of pavement line). Install per TM500	0.76	$

Issue	Description	Severity	Frequency	Ranking	Improvement	CMF	Cost
E	Unprotected and nondelineated utility pole located on northwest corner causes difficult southbound right turn for larger vehicles and promotes the use of parking area on the right shoulder to execute the right turn maneuver.	Low	Rare	A	a) Relocate existing utility pole b) Install object marker on utility pole c) Provide southbound right turn lane from Beavercreek Road to Leland Road if utility pole is to be maintained to allow large vehicles to execute the right turn maneuver around the pole	a) 0.62	$$ $ $$
F	Congestion at the intersection in peak periods encourages the use of the parking lot for cut through/slip lane (southbound right turn and eastbound left turn)	Negligible	Rare	A	a) Enforce driver behavior during peak periods b) Provide striped parking spaces for the park located on the northwest corner of the intersection. Install curbing along the park property.		$ $$
G	Non-standard geometries (North/East legs being major movements) and traffic control ("Right Turn Permitted without Stopping" sign)	Medium	Occasional	D	a) Evaluate need for left turn lane for westbound Beavercreek Road at the intersection. Providing the left turn lane would separate turning traffic from through traffic. b) Modify intersection to modern roundabout. This would require significant R/W and have some design challenges.	a) 0.56	$$ $$$
H	Intersection street name signs are difficult to see and are older style	Low	Rare	A	Update street name to County standards and relocate signs so that they are visible	0.85 (Injury) 0.93 (PDO)	$
I	Lack of intersection illumination for non-standard traffic control. (The existing luminaires on wood utility poles are orientated towards the parking lot and not the roadway)	Low	Infrequent	B	Install new street lighting at intersection	0.62 (Injury)	$$
J	No intersection warning signs are provided along Beavercreek Road in advance of the intersection.	Low	Infrequent	B	Install advance intersection warning signs along Beavercreek Road in advance of intersection	0.65 (Angle)	$
K	Edge of roadway delineators along Beavercreek are worn/knocked down	Low	Rare	A	Replace roadway delineators		$

Collision Diagram (2007-2011)



Existing Issues Photos


There is no striping through the intersection


The grade differential makes the intersection difficult to maneuver through

Existing Issues Photos (Continued)

Parking in front of store restricts intersection sight distance

Unprotected and nondelineated utility pole

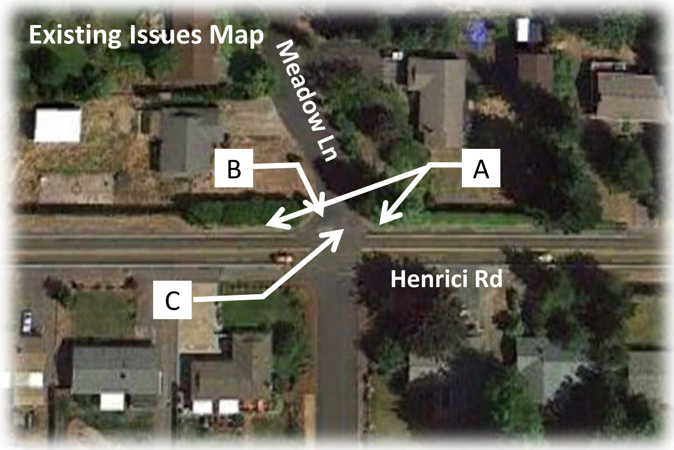
Vehicle offtracking

Delineators worn/knocked down

Parking lot used as cut through during peak periods

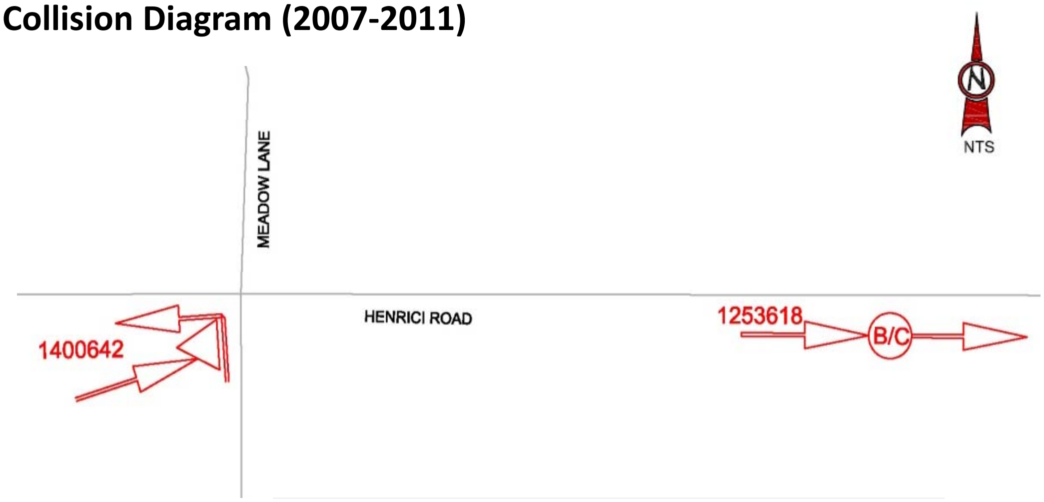
Utility pole makes right turn difficult for large vehicles

Location: S. Henrici Road at S. Meadow Lane, Clackamas County		
Milepoint: 1.29		
Roadway Characteristics:		
	Henrici Rd.	Meadow Ln.
Posted Speed (mph)	40	Not posted
ADT	2,270-3,645	Unknown
Classification	Rural Minor Arterial	Rural Local
Overall CMF:		TBD
Preliminary Cost Estimate:		TBD



Issue	Description	Severity	Frequency	Ranking	Improvement	CMF	Cost
A	Vegetation in NE and NW quadrants restrict intersection sight distance to the east and west	Medium	Rare	B	Trim existing vegetation in NE and NW quadrants of intersection	0.53 (Injury) 0.89 (PDO) 0.44 (Fatal)	$
B	Street name sign is blocked by vegetation – NW corner	Low	Rare	A	Trim vegetation to expose street name sign		$
C	Drivers cut corner from Henrici Rd to Meadow Ln. The intersection alignment allows higher speed through turn.	Negligible	Rare	A	Decrease width of road and radius at corner to lower speed		$
D	No advance intersection lane use signs on Henrici Rd	Low	Rare	A	Install advance intersection lane use signs on Henrici Rd in both travel directions.	0.65 (Angle)	$

Collision Diagram (2007-2011)



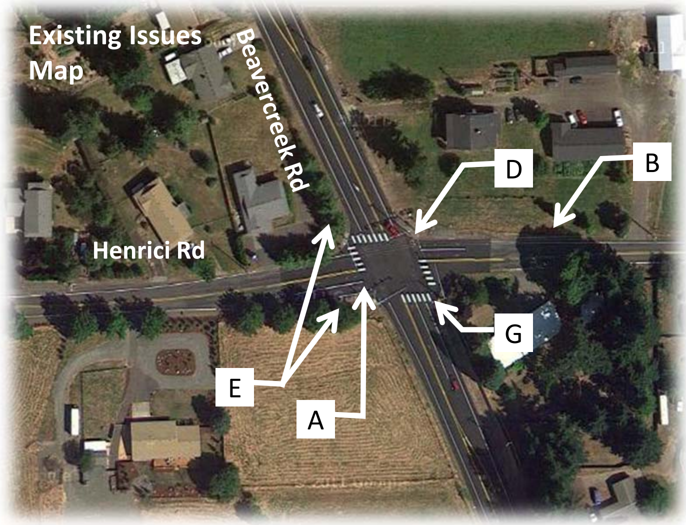
<u>Existing Issues Photos</u>

Vegetation restricts intersection sight distance to the west

Street name sign is blocked by vegetation – NW corner

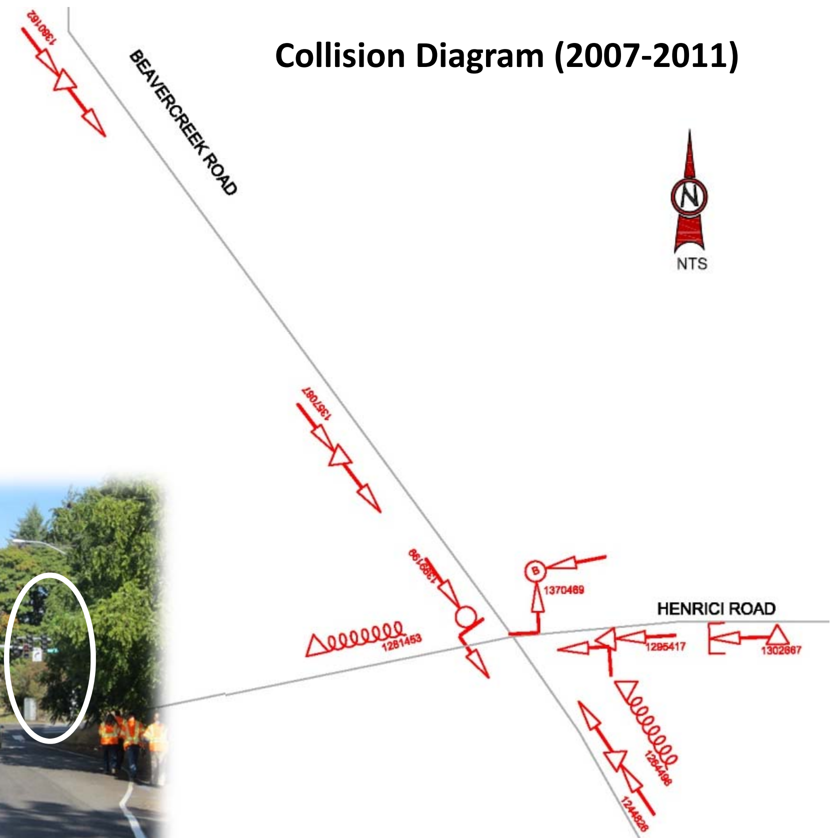
Drivers cut corner from Henrici Rd to Meadow Ln

Location: S. Beavercreek Road at S. Henrici Road, Clackamas County		
Milepoint: 13.25		
Roadway Characteristics:		
	Beavercreek Rd.	Henrici Rd.
Posted Speed (mph)	45	40
ADT	6,190-9,320	2,270-3,645
Classification	Rural Minor Arterial	Rural Minor Arterial
Overall CMF:		TBD
Preliminary Cost Estimate:		TBD



Issue	Description	Severity	Frequency	Ranking	Improvement	CMF	Cost
A	Storm water grates are unsafe for bikes.	High	Rare	C	Replace all storm grates with bicycle-safe storm grates		$
B	Advance intersection lane use sign is missing on westbound approach.	Low	Rare	A	Install advance intersection lane use sign on westbound approach.	0.65 (Angle)	$
C	Street name signs are too small and do not meet County standard.	Low	Rare	A	Upgrade street name signs to MUTCD and County standards on all mast arms.	0.85 (Injury) 0.93 (PDO)	$
D	Utility pole is located in pedestrian ramp - NE corner	Medium	Rare	B	Relocate utility pole	0.62	$$
E	Trees & vegetation in NW and SW quadrants encroach on roadway, block lane use sign and restrict intersection sight distance to the north. The required intersection sight distance is 500 feet.	Medium	Infrequent	C	Trim vegetation in NW and SW quadrants	0.53 (Injury) 0.89 (PDO) 0.44 (Fatal)	$
G	Crosswalk marking incomplete - SE corner	Low	Rare	A	Complete crosswalk marking on SE corner		$
H	Pedestrian ramps are not ADA compliant.	Low	Rare	A	Construct ADA compliant curb ramps and landings to provide access to pedestrian push buttons on all quadrants of intersection.		$$

Collision Diagram (2007-2011)



Existing Issues Photos


Trees and vegetation encroach in roadway


Street name signs are too small


Vegetation restricts intersection sight distance to the north

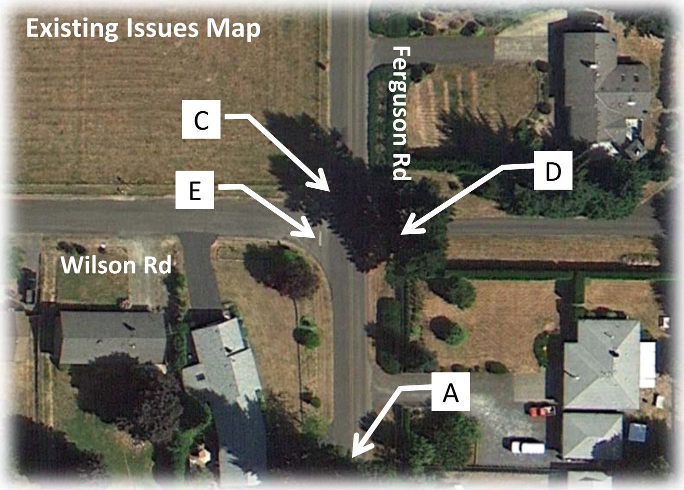
Existing Issues Photos (Continued)

Utility pole located in pedestrian ramp – NE corner

Pedestrian ramps are not ADA compliant

Storm water grates are unsafe for bikes

Location: S. Ferguson Road at S. Wilson Road, Clackamas County		
Milepoint: 1.49		
Roadway Characteristics:		
	Ferguson Rd.	Wilson Rd.
Posted Speed (mph)	45	25
ADT	680-700	Unknown
Classification	Rural Local	Rural Local
Overall CMF:		TBD
Preliminary Cost Estimate:		TBD



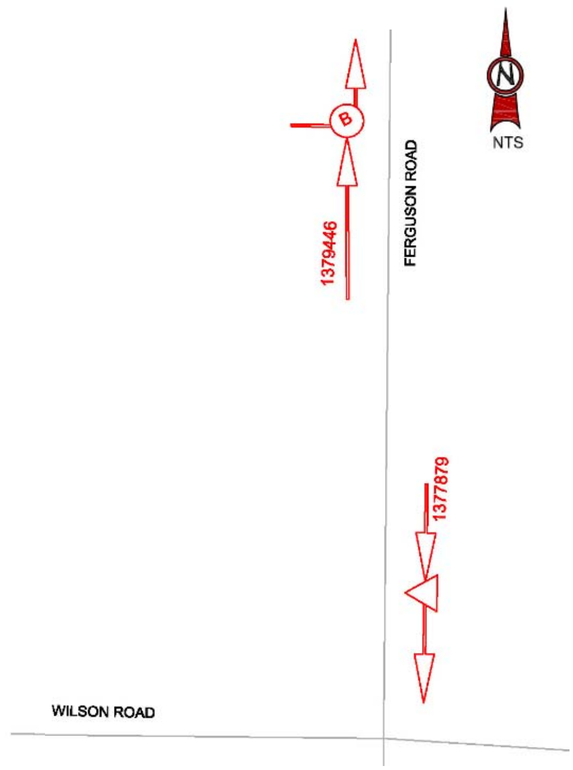
Issue	Description	Severity	Frequency	Ranking	Improvement	CMF	Cost
A	Vertical curve restricts intersection sight distance to the south. The required intersection sight distance is 445 feet.	Medium	Rare	B	a) Install hills blocks view sign and supplemental advisory speed sign. b) Evaluate need for norbound left turn lane. c) Flatten roadway vertical curve.	a)0.65 (angle) b) 0.56 c) 0.80	$ $$$ $$$
B	No advance intersection warning signs on Ferguson Rd.	Low	Infrequent	B	Install advance intersection warning signs on Ferguson Rd in both travel directions.	0.65 (Angle)	$
C	Large brick mailbox located within the clear zone – NW corner.	High	Rare	C	Replace brick mailbox structure with a breakaway mailbox support.	0.62	$
D	Street name signs are too small and do not meet County Standard. They are also located on the east side only.	Low	Infrequent	B	Upgrade street name signs on the east side to MUTCD and County standards. Install new street name signs on west side.	0.85 (Injury) 0.93 (PDO)	$
E	Stop bars on Wilson Road approaches are worn or missing.	Negligible	Rare	A	Install new stop bars on Wilson Road approaches.		$

Existing Issues Photos

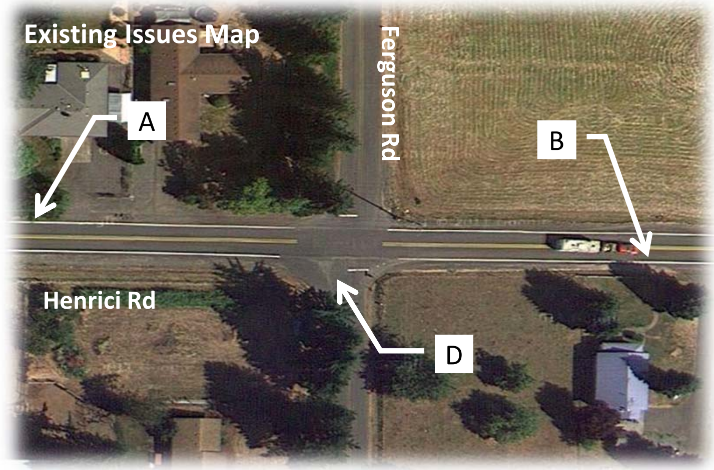
Vertical curve restricts intersection sight distance to the south

Street name signs are too small

Collision Diagram (2007-2011)



Location: S. Henrici Road at S. Ferguson Road, Clackamas County		
Milepoint: 1.99		
Roadway Characteristics:		
	Henrici Rd.	Ferguson Rd.
Posted Speed (mph)	40	45
ADT	2,270-3,645	680-700
Classification	Rural Minor Arterial	Rural Local
Overall CMF:		TBD
Preliminary Cost Estimate:		TBD



Issue	Description	Severity	Frequency	Ranking	Improvement	CMF	Cost
A	Vegetation restricts intersection sight distance to the west and blocks SPEED 40 sign. The required intersection sight distance is 445 feet.	Medium	Infrequent	C	Trim vegetation in northwest corner of intersection.	0.53 (Injury) 0.89 (PDO) 0.44 (Fatal)	$
B	Vertical curve restricts intersection sight distance to the east. The required intersection sight distance is 445 feet.	Medium	Infrequent	C	a) Install hills blocks view sign and supplemental advisory speed sign. b) Evaluate need for westbound left turn lane. c) Flatten roadway vertical curve.	a) 0.65 (Angle) b) 0.56 c) 0.80	$ $$$ $$$
C	No advance intersection warning signs on Henrici Rd	Medium	Infrequent	C	Install advance intersection warning signs on Henrici Rd in both travel directions.	0.65 (Angle)	$
D	Stop bar on northbound approach is worn.	Low	Rare	A	Replace stop bar on northbound approach.		$

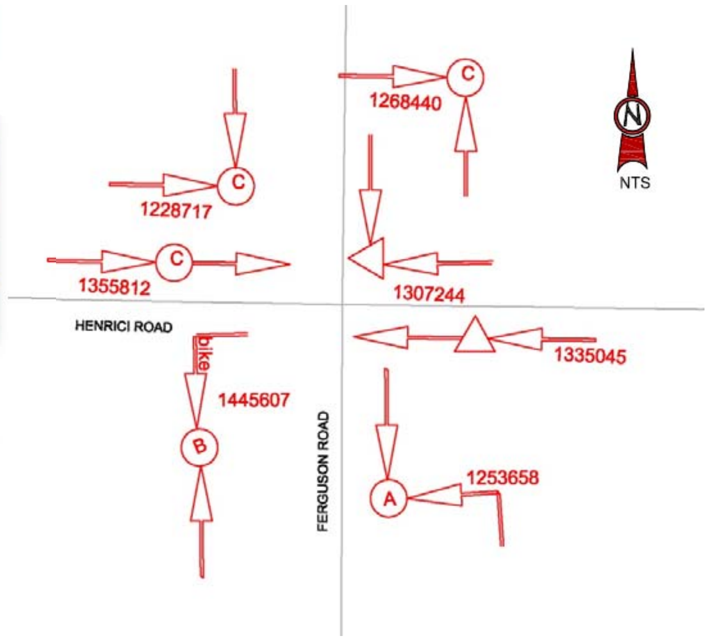
Existing Issues Photos

Vertical curve restricts intersection sight distance to the east

Vegetation restricts intersection sight distance to the west

Stop bar on northbound approach is worn

Collision Diagram (2007-2011)



Clackamas County Local Streets Traffic Calming and Skinny Streets Program

Prepared for:
Clackamas County

March 1997

Kimley-Horn and Associates, Inc.
Engineering, Planning, and Environmental Consultants

Clackamas County Local Streets Traffic Calming and Skinny Streets Program

Prepared for:
Clackamas County

March 1997

Kimley-Horn and Associates, Inc.
Engineering, Planning, and Environmental Consultants

COUNTY OF CLACKAMAS STATE OF OREGON

March 3, 1997

Clackamas County Local Streets Traffic Calming and Skinny Streets Program

Prepared for:

Clackamas County
902 Abernethy Road
Oregon City, Oregon 97045-1100
(503) 655-8521

Prepared by:

Kimley-Horn and Associates, Inc.
9320 SW Barbur Boulevard, Suite 130
Portland, Oregon 97219
(503) 977-2588

Kimley-Horn and Associates, Inc.

Project No. 093026.00

TABLE OF CONTENTS

INTRODUCTION

The Clackamas County Local Streets Traffic Calming and Skinny Streets Program was developed through a cooperative effort involving Clackamas County, the Oregon Department of Transportation (ODOT), a project Technical Advisory Committee, and the Clackamas County Transportation Advisory Committee. This program represents the commitment of Clackamas County Department of Transportation and Development, Board of County Commissioners, and the Traffic Engineering Section to the safety and livability of neighborhoods. Development of the program was funded through a Transportation Growth Management Grant sponsored by ODOT and the Department of Land Conservation and Development. The program provides a process for identifying, prioritizing, and mitigating problems related to traffic safety, traffic speeds, and volumes on local streets. Potential solutions to traffic problems include traffic calming measures, improvements to existing streets with retrofit local street standards, enforcement, and education. Attachments to this document describe various traffic calming measures and recommended local street standards for retrofit of existing streets.

PROGRAM OBJECTIVES

The primary goal of the Clackamas County Local Streets Traffic Calming and Skinny Streets Program is to improve the livability and environment on local residential streets. With that goal in mind, the County has identified the following program objectives:

a) Provide solutions that improve livability along local streets through the thoughtful implementation of a traffic management program, by properly controlling vehicular traffic and enhancing the safety and ability to walk and bicycle, while reducing accidents and maintaining emergency vehicle access;

b) Provide a means for neighbors to work together to seek solutions to local street traffic concerns;

c) Provide a wide range of solutions to address local street traffic management issues, including devices and street designs that accomplish the goals related to control of vehicular traffic, without creating adverse impacts to other key areas such as pedestrian and bicycle access, or service providers, or maintenance;

d) Provide an equitable and credible process to evaluate local street traffic calming requests;

e) Provide a process that incorporates the input of affected citizens, potentially affected citizens and service providers into the solution;

f) Provide the opportunity for cities within the County to participate in the development process so that the County can assist them or incorporate small city requests into this process;

g) Develop a means of providing street improvements for local existing streets or rights-of-way that take into account geographical and fiscal constraints as well as livability issues;

h) Develop a process based on engineering and factual information;

i) Develop local street management solutions that are maintainable after implementation;

j) Comply with Oregon Transportation Planning Rule 660-12-045 (7) and (3) regarding street design standards and features to provide safe and convenient bicycle and pedestrian access;

k) Minimize maintenance costs associated with traffic calming measures.

GUIDING PRINCIPLES

To ensure that traffic calming concerns are addressed in an equitable manner, several guiding principles were also identified:

- The purpose of local streets is to provide access to abutting properties and connect to higher order roads. New local streets should intersect collectors or, if necessary, minor arterials.

- Traffic volumes on local streets should be consistent with the density of residential development that is served by a particular street. According to data assembled by the Institute of Transportation Engineers, single family detached residences serve as origins or destinations for five to twenty trips on a typical work day. As a general guideline, traffic volumes on local streets should not exceed 2,000 vehicles per day or 200 vehicles per hour. Local streets with traffic volumes near or in excess of these guidelines may benefit from a study to develop, implement, and evaluate possible remedial actions.

- Vehicle speeds (85th percentile speeds established by radar or equivalent methods) on local streets generally should be within five miles per hour of the posted speed limit. Traffic speeds in excess of these guidelines normally indicate the need for increased police enforcement and/or a study to develop, implement and evaluate remedial actions.

- Neighborhoods, areas, or residences experiencing "detrimental" traffic conditions on a local street may benefit from a study to develop, implement and evaluate remedial actions. "Detrimental" traffic conditions are defined as (a) traffic using a local street as a shortcut or detour, (b) an excessive volume of traffic on a local street that should normally be served by an arterial roadway, or (c) traffic operating at excessive speeds.

- An influence area should be defined for each project location. The influence area should be determined on a case-by-case basis. As a general guideline, the area within a one-quarter mile radius of the project location and any adjacent or parallel local streets that may be affected by improvements at the project location should be included in the influence area. Residents within the influence area should be notified of the study and invited to participate in the process.

- Traffic calming measures should not be installed if they create severe adverse impacts in adjoining neighborhoods or to community service provider activities (i.e., school bus access, garbage collections activities, roadway maintenance, etc.).

STEP-BY-STEP PROCEDURES

The following procedures outline the Clackamas County Local Streets Traffic Calming and Skinny Streets Program. Procedures were adapted from jurisdictions in the Pacific Northwest with three key factors in mind. First, the traffic calming program will guide staff through a process to address traffic concerns in an efficient and equitable manner. Second, Clackamas County is rural in nature with a sparse network of roads; therefore, connectivity to collectors and arterials must be maintained. Third, public funds may or may not be available for implementation of devices or roadway improvements. Property owners may finance the installation of devices and associated maintenance costs or share the responsibility with the County. In order for an appropriate traffic calming strategy to be selected, the citizens must clearly understand the problem and potential solutions to that problem. Consequently, the step-by-step process outlined below requires a high level of citizen participation and education. The program outline is illustrated in **Figure 1**.

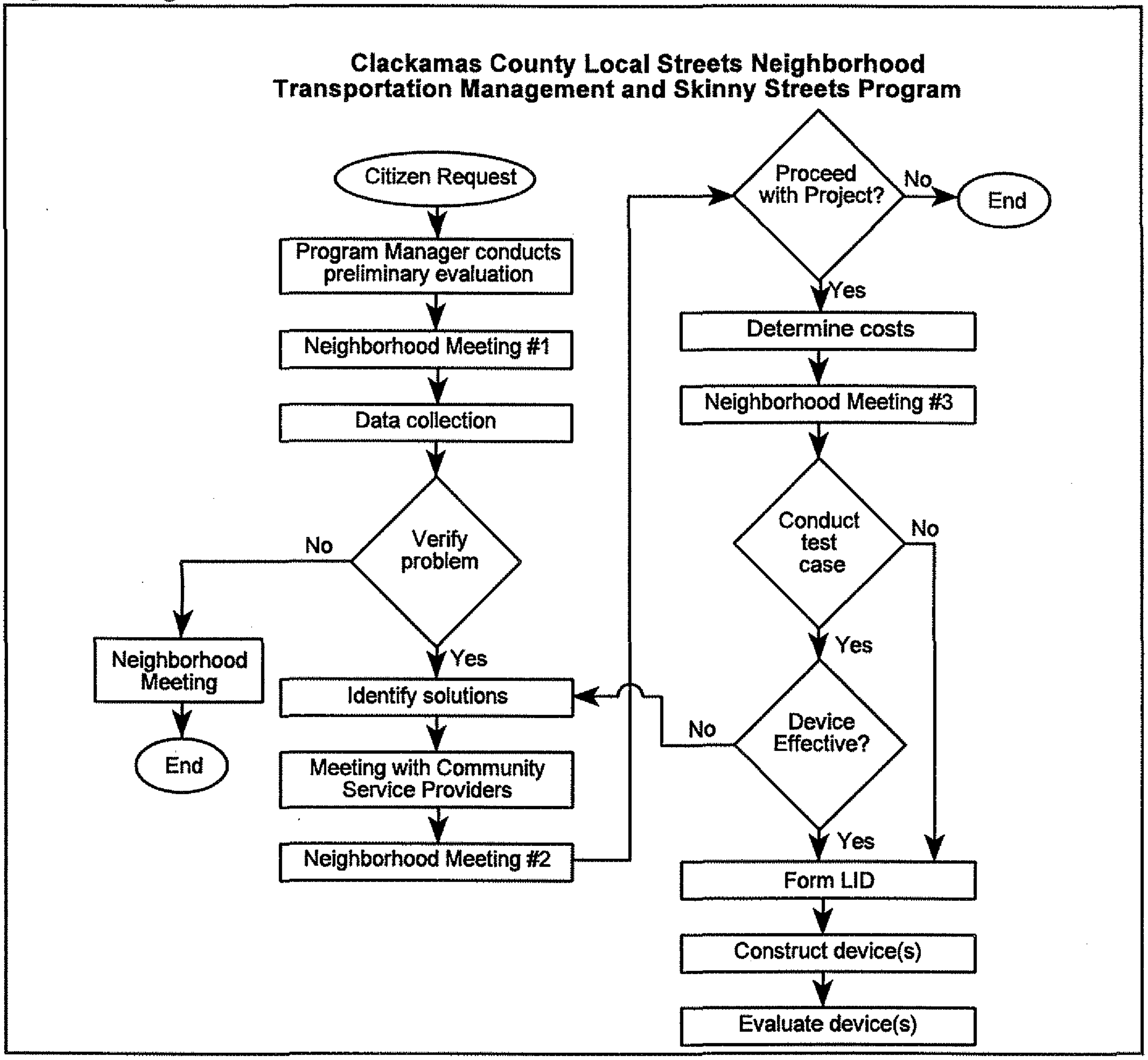
Step 1 Citizen Request: Neighborhood traffic calming projects can be requested in writing by a citizen. Citizen requests must be accompanied by a petition with signatures of at least 50% of the residents along the project street(s) or within 1000 feet of the project intersection(s). A sample petition is illustrated in **Attachment A**. The request should identify a contact person, the perceived problem, and the location(s). After the County receives a citizen request, the program manager should call the contact person and discuss a time frame for prelimary evaluation and first neighborhood meeting. The time frame will be based on the current number of citizen requests being evaluated by the program manager.

Step 2 Preliminary Evaluation: The Program Manager will examine the request and conduct a preliminary evaluation of the project site. On a case-by-case basis, the manager will determine an influence area for the project. The influence area should include all local streets that may be affected by the implementation of traffic calming devices or roadway improvements at the project location.

Step 3 Neighborhood Meeting #1: The program manager will identify a preliminary boundary for a potential Local Improvement District to implement recommended improvements. All property owners and residents within the boundary will be notified of the citizen request and invited to participate in the traffic calming program. The notice will identify the preliminary boundary of the Local Improvement District and describe how the boundary may change as the project evolves.

The manager will then organize a neighborhood meeting with the petitioners, property owners and residents within the influence area, and affected neighborhood organizations. Representatives from the community service providers will also be invited to attend the meeting.

Figure 1. Program Outline



Community service providers include the following: affected fire district, sheriff's office, school district, and garbage service. Affected Citizen Planning Organizations (CPO's) or Neighborhood Associations will also be invited to attend the meeting. In advance of the meeting, signs will be posted on the street and public notices will be published advertising the meeting. The program manager will conduct the meeting. The purpose of the meeting is to explain the traffic calming program process and identify local traffic concerns. The program manager will also explain the financial responsibilities associated with the installation of traffic calming measures.

Step 4 Data Collection: The program manager and county staff will collect data including roadway conditions, traffic volumes, speeds, physical characteristics of the subject street, accident rates, pedestrian facilities, schools within the influence area, and other pedestrian generators. Additional data may also be collected at the discretion of the program manager. Additional data may include items such as origin/destination surveys to determine cut-through traffic. The program manager will call the contact person and identify a time frame for the data collection effort.

Step 5 Evaluation of Data and Problem Verification: The program manager will evaluate the data collected to determine the type and severity of the problem. Projects will be scored to help set priorities for improvements and educate citizens. Scores will be based on the following criteria:

Traffic Volumes: Number of vehicles in a 24 hour period divided by 100. Maximum score of 30 points equates to 3,000 vehicles per day.

Speed: Using 85th percentile speed, assign 5 points for each MPH over 30 MPH for streets posted at 25 MPH. Using 85th percentile speed, assign 5 points for each MPH over 35 MPH for streets posted at 30 MPH. A 50 point maximum equates to 15 MPH over the posted speed limit.

Accidents: For a single intersection, assign 5 points for each correctable accident in a consecutive three year period. Maximum score of 30 points. For a street segment, assign 5 points for each correctable accident in a consecutive three year period at the worst intersection or link. Maximum of 30 points.

Schools: Assign 5 points for each public or private (K-12 school only) on the subject street.

Pedestrian Facilities: Assign five points for each public facility (parks, community centers, elderly housing, etc.) on the project street.

Streets Without Sidewalks: Assign 5 points if there is no continuous sidewalk or suitable pedestrian facility on at least one side of the project street.

The final project score will be ranked in order of points with projects in other neighborhoods. The program manager will also evaluate (but not score) physical characteristics of the site such as topography, bridges, horizontal and vertical curves, and adjacent land ~~uses~~ uses. The program manager may also examine congestion on streets in the vicinity of the project location to determine whether problems on local streets are resulting from inefficiencies on the collector and arterial system.

Projects must achieve a minimum score of 30 points to proceed to Step 6. If the project fails to score at least 30 points and the program manager determines that a problem does not exist, a meeting will be set up with the neighborhood property owners and residents to terminate the project. At the meeting, the program manager will explain the evaluation process and the results.

Step 6 Identify Solutions: Based on the evaluation results in Step 5, the program manager will identify potential solutions to address the traffic concerns. When considering potential solutions, consideration should be given to emergency vehicle access, connectivity to the transportation system, cost-effectiveness, maintenance impacts, and impacts to adjacent local streets. Solutions may include traffic calming measures as described in **Attachment B**. Solutions may also include roadway improvements to existing local street. Standards for upgrading existing local street are described in **Attachment C**. Traffic calming measures which include traffic control devices (e.g., stop signs) must conform to the requirements in the Manual on Uniform Traffic Control Devices and shall only be considered in keeping with sound engineering practices. Appropriate solutions must adhere to the following criteria:

- Reasonable automobile access should be maintained to the neighborhood.
- Solutions should encourage and enhance pedestrian, bicycle, and transit access to neighborhood destinations.
- Solutions should not significantly increase vehicle miles traveled (VMT) per capita as defined in the Statewide Land Use Planning Goal 12 Administrative Rule (OAR Chapter 600 Division 12).
- Traffic should not be rerouted from one local street to another if:
  a) A traffic calming measure which does not directly reroute traffic will alleviate the problem;
  b) The average daily weekday traffic (ADWT) on receiving streets with an ADWT of 400 or fewer vehicles per day would increase by 100 vehicles per day or more than 50%, whichever is less, as a result of rerouting;
  c) The ADWT on receiving streets with an ADWT of more than 400 vehicles per day would increase by more than 25% as a result of rerouting; or
  d) The ADWT on the receiving streets would exceed 2,000 per day on a local street.

Step 7 Service and Maintenance Providers Meeting: The program manager will meet with community service providers (as defined in Step 3) and County maintenance representatives to review the project evaluation and discuss the potential solutions. The purpose of the meeting is to gain consensus on which devices may be reasonably implemented without unduly increasing maintenance requirements or impeding service vehicle access or activities. The program manager will then request letters of approval for the recommended devices from the service providers and maintenance representatives.

Step 8 Neighborhood Meeting #2: The program manager will conduct a second meeting with the property owners and residents to present the results of the data collection and evaluation process. Community service providers, CPO's, and affected neighborhood associations will be invited to attend the meeting or send written comments. Based on the findings, the program manager will describe various solutions to address traffic issues in the neighborhood. Generic costs for each alternative should be discussed. Neighborhood residents will then decide which, if any, alternative they are willing to fund and implement.

Step 9 Determine Costs: The program manager will prepare a cost estimate for installation of the preferred alternative in the neighborhood. The cost estimate should include design, construction, and maintenance. In cooperation with the County's Assessor, the program manager should then verify boundaries of a local improvement district to fund implementation of the preferred alternative. Any potential County funding toward implementation of the alternative should also be identified. If available, the potential level of County funds should be identified on the basis of ranking (see Step 5), not first come/first serve. Information on the formation of a local improvement district should be mailed with a meeting notice to the neighborhood residents.

Step 10 Neighborhood Meeting #3: The program manager will conduct a third meeting with the property owners and residents to discuss the cost estimate for the preferred alternative. The program manager will explain the benefitted neighborhood's financial responsibilities associated with installation of the device. The program manager will also describe the County's financial participation, if any, project ranking, and timeline for obtaining County funds. The program manager will describe the process to form a Local Improvement District (see **Attachment D**) and the proposed boundaries of the district. If appropriate, the program manager will also discuss opportunities to install temporary devices.

Step 11 Test Case (Optional): Temporary devices such as traffic barrels or barricades may be installed to simulate the effects of permanent devices. If the program manager and the residents agree that installation of temporary devices is appropriate, a test case will be conducted. Traffic volumes and speeds will be measured one month after the temporary devices are installed. If the temporary devices are having the desired affect on traffic conditions, the program manager will initiate the LID process. If the test device is failing to address the problem, the program manager will return to Step 6 and identify other solutions.

Step 12 Local Improvement District Formation and Implementation of Device: Once an appropriate traffic calming measure has been selected, the program manager will work with a neighborhood representative to initiate the formation of a Local Improvement District. Formation of a LID will follow current procedures used in the Clackamas County Local Improvement District Program as described in **Attachment D**. It should be noted that there is some inherit duplication in the traffic calming program and the LID process. Coordination with the property owners and residents is necessary in the traffic calming program to ensure that the traffic issues are adequately addressed; likewise, coordination with property owners in the LID process is necessary to ensure that they are aware of the proposed financial obligations. In both cases, it is imperative that participants have an opportunity to endorse or oppose the recommendations.

The program manager or other County staff member will assist the representative in preparing a petition to form the LID. The petition will describe the boundaries of the LID, legal ownership and tax lot descriptions, and the proposed improvement. The petition will need to be signed by at least 60% of the property owners abutting the improvement. Once a signed petition is submitted to the County, the signatures will be verified and the County Treasurer will review property values and assessments to ensure the project is viable. Then the County will recommend to the Board of County Commissioners (the Board) that the LID be formed. Upon formation of the LID, the program manager will submit a Preliminary Feasibility Report documenting the scope of work, assessment district boundary, method of assessment, total estimated costs and estimated costs per benefited property owner. If the Board determines that the project will proceed, a letter will be mailed to the property owners indicating the total cost and their proposed share. Fifty percent or more of the property owners must object in writing within 20 days to stop the project. Otherwise, the project will proceed into final design. A design review meeting will be held with property owners. The completed design will then be put out to bid and awarded to the lowest responsible bidder. The recommended improvements will then be constructed by the contractor. Following implementation of the improvements, the final costs will be determined. A notice will be sent to property owners indicating their final assessment. A hearing before the Board will be held for any objections to the assessment. After the hearing, final assessments will be sent to the property owners.

Step 13 Evaluate Device: A minimum of 6 months after implementation, data should be collected to evaluate the impacts of the traffic calming device on drivers' habits. For comparison purposes, the data should be collected at approximately the same time of year as the original data collection effort in Step 4. For example, if data was collected in September of 1996 for Step 4 and the device was installed in January 1997, the data collection effort for Step 12 should occur in the fall of 1997. Residents should also be surveyed by mail to determine if they prefer traffic conditions with or without the device. The purpose of the evaluation is to determine the effectiveness of the device. This information will be used for citizen inquires about specific projects and evaluation of devices for future applications. Documentation of the testing results should be kept on file for ten years.

ATTACHMENT A
SAMPLE PETITION

The following is a sample petition to initiate the Neighborhood Transportation Management Program process.

Subject: Neighborhood Transportation Management Program
To: Clackamas County Program Manager

Contact Person: ______________________________

Address: ______________________________

____

Phone Number: ______________________________

Date: ________________

Location: ______________________________________

Problem Description: ______________________________________

____

____

____

____

____

We, the undersigned property owners and residents, request the initiation of a transportation management program for our neighborhood.

	NAME	ADDRESS	SIGNATURE	DATE
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				

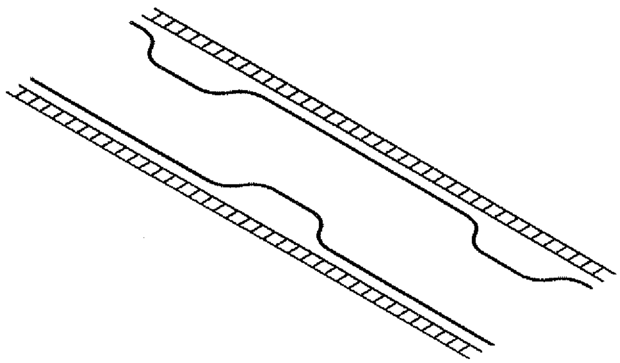
ATTACHMENT B
TRAFFIC CALMING DEVICES

This section provides a brief description of typical traffic calming measures. This list should be considered as a resource once the problem has been identified.

Summary of Traffic Calming Devices

Device	Impact					Approximate Unit Cost
	Safety	Speed Reduction	Traffic Diversion	Fuel Consumption, Pollution	Emergency Services	
Chicanes	Possible Improvement	Possible	Possible	Small Increase	Possible Problems	Varies
Curb Extensions	Improved Ped Crossing	Possible	No Effect	No Change	Possible Problems	$10-20K
Diverters	Possible Improvement	Mixed Results	Yes	No Change	Possible Problems	$10-40K
Entrance Treatments	Possible Improvement	Unlikely	Mixed Results	No Change	Possible Problems	$10K
Forced Turn Channelization	Possible Improvement	No	Yes	Small Increase	Possible Problems	$6-10K
Median Barriers	Possible Improvement	No	Possible	No Change	Possible Problems	$10-20K
Rumble Strips	Possible Improvement	Possible	No Effect	No Change	No Effect	$300-500
Speed Humps	Unknown	Yes	Possible	Small Increase	Possible Problems	$1.2-2K
Traffic Circles	Improved	Yes	Possible	No Change	Possible Problems	$10-20K

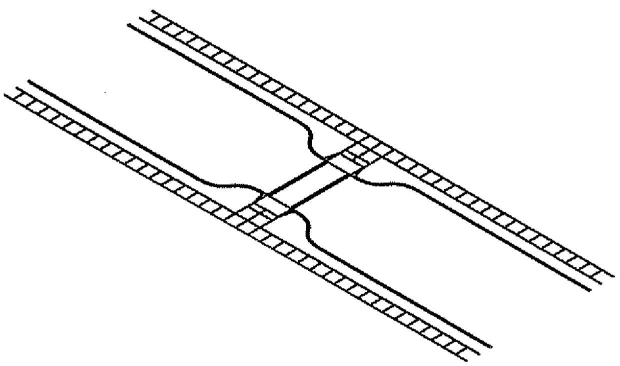
CHICANES



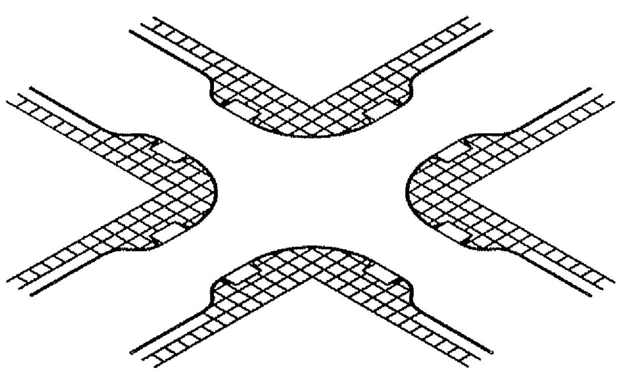
Chicanes are used to slow traffic by forcing vehicles to follow a meandering route. A typical chicane design consists of a series of curb extensions on alternating sides of the street. Chicanes narrow the street and travel lane width by widening the sidewalks or landscaped areas. When landscaped, chicanes create visual screens which give the appearance of discontinuity in the travel path.

Chicanes typically result in the loss of some on-street parking, increase maintenance costs and usually requires a relatively wide initial pavement and right-of-way width. Pedestrian and cyclist safety must be considered.

CURB EXTENSIONS



MID-BLOCK CURB EXTENSIONS

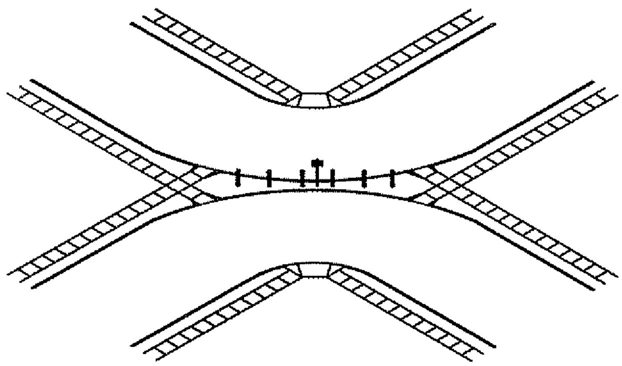


INTERSECTION CURB EXTENSIONS

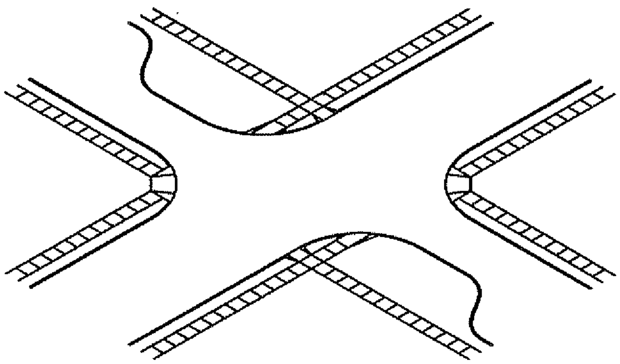
Curb extensions, also called chokers or bulb-outs, narrow the street by widening the sidewalks or landscaped parking strip. They are used to make pedestrian crossings shorter, and therefore easier and safer. They also narrow the area of pavement and travel lane widths providing a visual cue to drivers that caution is necessary. When curb extensions are constructed by widening the landscaped parking strip, they can have a positive effect on the visual appearance of a neighborhood.

Curb extensions can be used at intersections to create a street gateway or threshold effect, visually announcing an entrance to a residential neighborhood. At intersections, curb extensions are normally used in conjunction with a stop sign or traffic signal; in these locations when curb extensions are designed with raised crosswalks and/or a landscaped median, the effect on street appearance and vehicle turning speeds can be pronounced. Dimensions of curb extensions depend on a variety of factors including the desired design speed of the street and the turning radius required for service providers such as fire trucks and garbage trucks.

DIVERTERS



DIAGONAL DIVERTER



HALF DIVERTER

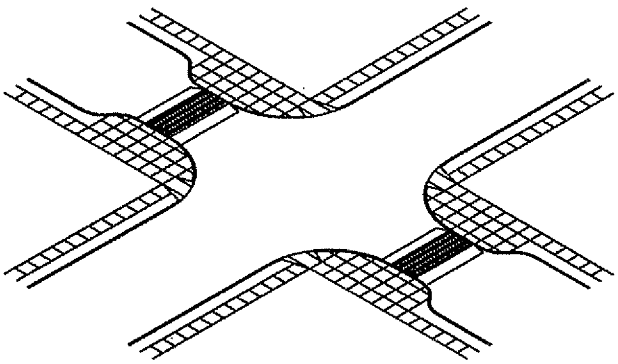
Traffic diverters come in two primary configurations: diagonal diverters and half-diverters. Traffic diversion devices are generally employed on existing streets to reduce traffic volumes within a limited area. Diverters discourage through trips on the street on which they are installed and divert those trips to other routes.

Diagonal Diverters: Diagonal diverters limit access to a street by placing a barrier diagonally across an intersection. The diverter allows for greater accessibility than full street closure but still limits undesirable through traffic movements.

Half-Diverters: Half-diverters limit access by blocking half the street. Like diagonal diverters, they are effective in reducing volume and allow more freedom of circulation within a neighborhood than street closures. Both diagonal diverters and half-diverters should be designed and installed to allow emergency vehicle access.

Wherever traffic diverters are employed, provisions should be made for continuation of pedestrian and bicycle routing around or through the diverter. Emergency vehicle access should also be considered before diverters are employed.

ENTRANCE TREATMENTS

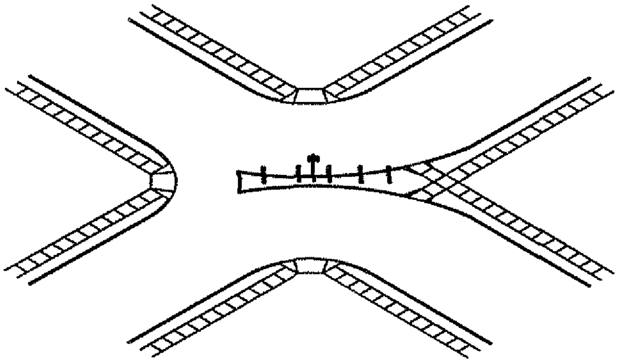


Entrance treatments consist of physical modifications at an intersection between a residential street and a higher order street. The purpose of an entrance treatment is to alert drivers that they are entering a residential area and are no longer on a major street. Common entrance treatments may consist of curb extensions, raised crosswalks, and textured pavements. These features are intended to identify a "threshold" or entry and exit point for a neighborhood and can be used to highlight the importance of a pedestrian or bicycle dominated intersection. Entrance treatments may also be used near schools where pedestrian and bicycle activity is high.

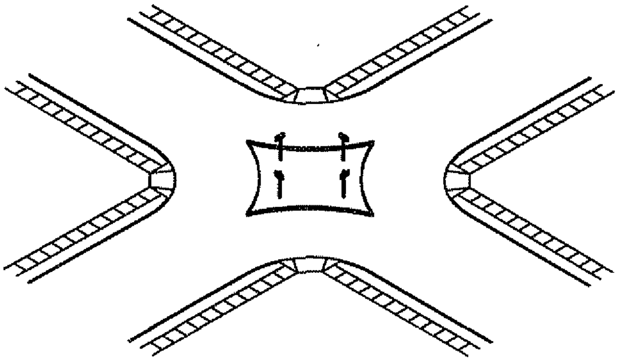
A raised crosswalk is designed to maintain the same grade as the approaching sidewalk. The width of the approaching sidewalk is also maintained (typically 5' to 6'). In retrofit situations, the slope and grade will vary depending on the existing conditions. A landscaped median or curb extension may also be used in combination with the raised crosswalk to further reduce vehicle speeds reductions. Raised crosswalks are generally used at locations with some form of intersection control such as a stop sign or traffic signal. The speed of vehicles leaving an intersection with a raised crosswalk is not affected due to the presence of the intersection control.

Not all pedestrians support the use of raised crosswalks. For visually impaired pedestrians, the grade transition between the sidewalk and street pavement indicates a crossing. The absence of a grade change reduces their ability to recognize a street crossing and increases the potential for a pedestrian-vehicle accident. If a raised crosswalk is used, there must be a detectable grade change between the sidewalk and the raised crosswalk. If this technique is utilized, applications need to be completely consistent throughout the County.

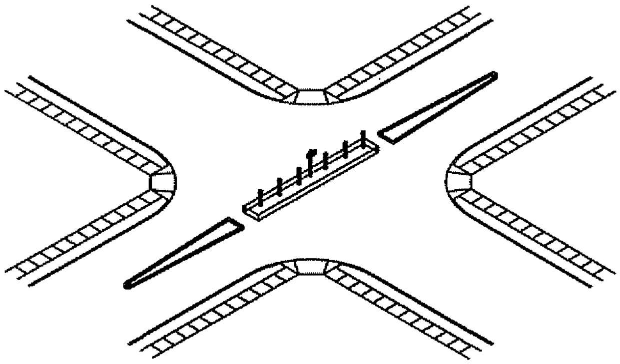
FORCED TURN CHANNELIZATION



Forced Turn Channelization consists of the use of striping, pavement markers, and/or raised islands to force drivers approaching an intersection to make a specific turn movement. This technique can allow traffic entering or exiting a neighborhood street to move in one direction only. Its purpose is essentially the same as a diagonal traffic diverter; it is used to discourage potential or existing through-traffic patterns and limits traffic movement choice but does not prevent it.

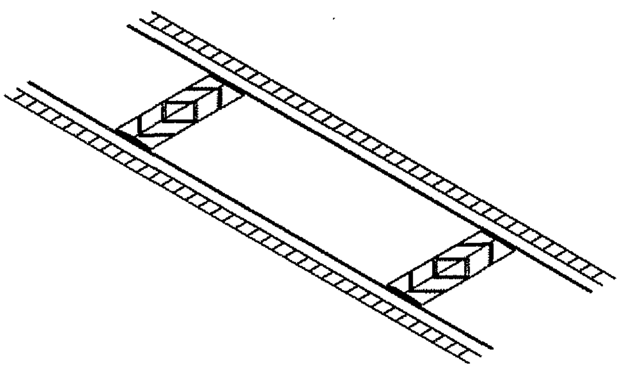


MEDIAN BARRIERS



This device is used on arterial streets to prevent cut-through traffic on local streets or to control turning direction into or out of a neighborhood. Medians may also be used within a residential neighborhood to prevent non-local through traffic movements. Typically, median barriers are used to control traffic volumes, rather than traffic speeds. Medians can be effectively used in combination with other techniques, such as forced turn channelization and turning prohibitions, to control traffic movements.

SPEED HUMPS

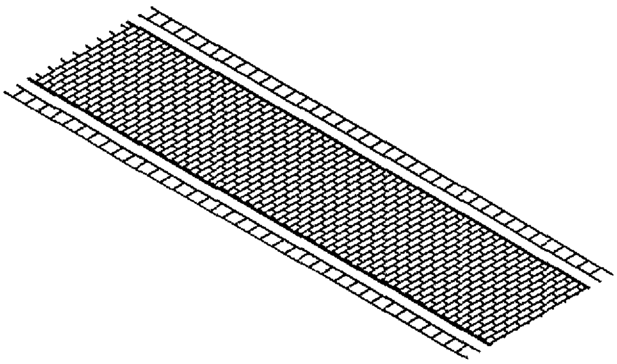


Speed humps (also called undulations) reduce speeds on residential streets by compelling motorists to slow to residential speed limits when approaching the hump. Speed humps are commonly 14' to 22' in length and are approximately 3" high. They are most effectively used in clusters of three to five, and are generally installed at intervals ranging from 200' to 500' apart. Speed humps are not to be confused with speed bumps. Speed bumps are much more abrupt, usually less than 3' in length, and are used in parking lots and private drives. Speed bumps are typically not used on public streets.

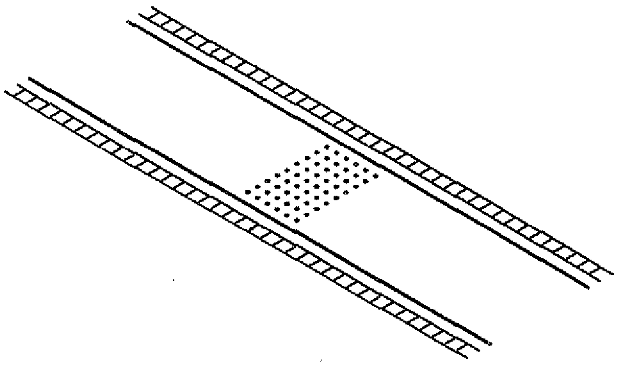
The 14' speed hump design, when used in a series, will reduce the average vehicle speed to approximately 25 mph. The 22' design will reduce the average speed to approximately 30 mph. This hump extends laterally over the width of the roadway sloping to the existing grade within a foot or two of the curb. This design allows bicyclists to weave around the hump near the curb to avoid having to cross the hump. Speed humps are generally not as effective at reducing speed when there are no curbs along the roadway. Motorists often weave around the speed humps unless a physical obstruction such as a curb, ditch or utility pole prevents evasive movements. Speed humps are inappropriate on steep grades. Speed humps should generally be implemented in relatively flat areas.

While primarily used for speed reductions, speed humps can reduce traffic volumes on streets by diverting traffic to other nearby streets as motorists choose alternative routes to avoid them. When installed on an existing street, speed humps may tend to increase the traffic noise level in the immediate vicinity.

TEXTURED PAVEMENTS



TEXTURED PAVEMENT

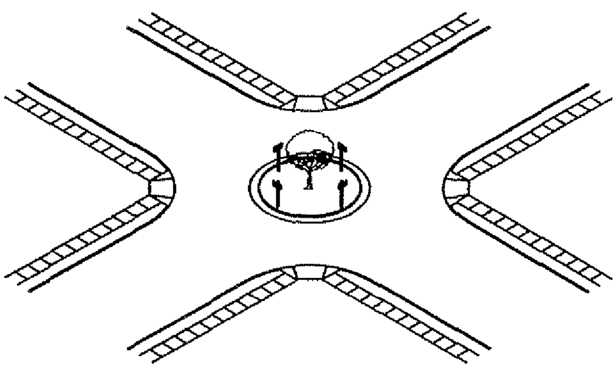


RUMBLE STRIP

A change in pavement texture can alert drivers to a change in conditions (e.g. entering a residential area). Textured pavements may slightly reduce speeds, but may create bicycle safety, maintenance, and noise concerns.

Rumble strips are a specific application of textured pavements. Rumble strips are areas where the pavement is modified (typically by placing raised buttons on the roadway) to create a physical warning to drivers. They are used to warn drivers of a hazard or to alert drivers of another traffic control device. Rumble strips may slightly reduce speeds at the point of installation, but create bicycle and motorcycle safety and maintenance concerns. Rumble strips also tend to increase street noise, creating another common concern.

TRAFFIC CIRCLES



Traffic circles are raised landscaped islands placed in the center of an intersection. Their primary purpose is to reduce speed and to separate intersection conflicts. Circles are especially effective in a series and may result in diversion of cut through-traffic to other streets. Traffic circles are typically used on relatively low-volume residential streets.

Traffic circles may either have a single vertical curb or two concentric circles with an outer mountable curb and an inner vertical curb. The mountable curb options creates an appearance of a narrower street for normal traffic operations while maintaining additional space for emergency vehicle access. The center on both designs may be paved or landscaped; landscaping is preferred for its aesthetic value but paved is generally easier to maintain. Traffic circle landscaping involves consideration of irrigation and long-term maintenance. These issues should be resolved before landscaping is chosen as the preferred option.

NEIGHBORHOOD TRAFFIIC CONTROL MEASURES

Technique	Some Appropriate Applications	Inappropriate Applications	Pros	Cons	*Legal Issues	Installation Issues	**Locations Implemented	Comments
One-Way Streets	- Reroute Cut-Thru Traffic to Non-Residential Roadways - Minimize Turn Conflicts - Reduce Side Friction - Improve Pedestrian Crossing Safety - Make Cut-Through More Circuitous - Make Room for On-Street Parking, Wider Sidewalks, and Other Amenities - Direct Traffic to Collectors - Increase Capacity	- Reduce Speeds - Reroute Cut-Thru Traffic to Other Residential Streets	- Can Improve Pedestrian Safety - Can Make Right of Way Available for Pedes-trian and/or Bicycle Enhancements - May Reduce Cut-Thru Traffic	- Causes Inconvenience to Some Residents - May Increase Response Time for Emergency Services - May Have to Reroute Bus Service (School and Public) and Garbage Collection - May Increase Volumes on Other Residential Streets - Initial Safety Issues as Drivers Adjust - Opportunity for Speeding May Be Enhanced		- Use in Conjunction with Turn Prohibition Signs - Thorough Advance Public Notification Necessary - May Need Origin/Destin-ation Study to Project Benefit of Technique	CA: Torrance FL: Orlando, Winter Park IL: Chicago, Decatur KY: Louisville LA: New Orleans MA: Cambridge MI: Kalamazoo MO: St. Louis, Kansas City NC: Rocky Mount NY: Rochester, Buffalo OH: Toledo, Cleveland, Dayton, Shaker Heights OK: Oklahoma City OR: Lake Oswego, Eugene PA: Philadelphia TN: Memphis UT: Salt Lake VA: Arlington Co., Hampton WA: Bellevue Washington, D.C. WI: Madison	- Paricularly Adaptable to Small Neighborhoods - Should Allow for Ample Public Input - Advance Warning Signs of "Upcoming Traffic Revision" Should Be Posted Prior to Installation
Diagonal Diverters	- Reroute Cut-Thru Traffic to Non-Residential Roadways - Make Cut-Thru More Circuitous - Reduce Speeds	- Reroute Cut-Thru Traffic to Other Residential Streets	- Effective for Rerouting Cut-Thru Traffic - If Properly Designed, Requires Little Enforcement - If Landscaped, Can Be Attractive - Can Reduce Speeds if Frequent Turns Required - Can Improve Pedestrian Safety	- Causes Inconvenience to Some Residents - May Increase Volumes on Other Residential Streets - May Require Additional Right of Way - Can Be Aesthetically Unattractive - May Increase Response Time for Emergency Services - May Have to Reroute Bus Service (School and Public) and Garbage Collection	- Not Addressed in MUTCD	- Temporary Installation and Monitoring Should Precede Permanent Installation - Thorough Advance Public Notification Necessary - May Need Origin/Destin-ation Study to Project Benefit of Technique - Consider Trucks and Buses In Design - Impact on Emergency Service Vehicles - Requires Advance Warn-ing Signs	AZ: Tucson CA: Pasadena, San Francisco Menlo Park, Oakland, Inglewood, Berkeley, Aurora, Santa Ana Sacramento, Davis Palo Alto FL: Gainesville IL: Chicago, Decatur, Joliet KS: Wichita KY: Louisville MD: Anne Arundel Co., Baltimore MI: Grand Rapids MN: Minneapolis, St. Paul MO: St. Louis OH: Dayton, Shaker Heights Toledo TN: Nashville OR: Portland, Lake Oswego Eugene TX: Dallas VA: Richmond WA: Seattle, Bellevue Washinton, D.C. WI: Madison Australia Canada Europe	- Should Allow for Ample Public Input - Can Be Paired with Other Techniques Like "Knuckles" - Advance Warning Signs of "Upcoming Traffic Revision" Should Be Posted Prior to Installation - If Landscaped, Residents May Agree to Maintain Landscaping

NEIGHBORHOOD TRAFFIIC CONTROL MEASURES								
Technique	Some Appropriate Applications	Inappropriate Applications	Pros	Cons	*Legal Issues	Installation Issues	**Locations Implemented	Comments
Partial Diverter	- Reroute Cut-Thru Traffic to Non-Residential Roadways	- Reroute Cut-Thru Traffic to Other Residential Streets - Reduce Speeds	- Effective at Rerouting Cut-Thru Traffic if Properly Designed and Enforced - Emergency Services Can Go Around Them If Necessary - If Landscaped, Can Be Attractive	- Causes Inconvenience to Some Residents - May Encourage Unsafe Vehicle Manuevers at Intersections - Requires Enforcement - May Have to Reroute Bus Service (School and Public) and Garbage Collection - May Increase Volumes on Other Residential Streets - Can Be Aesthetically Unattractive - Initial Safety Issues as Drivers Adjust - Thorough Advance Public Notification Necessary - Consider Trucks and Buses In Design	- Not Addressed in MUTCD	- Should Use in Conjunction With "DO NOT ENTER" and "TURN PROHIBITED" signs - "STOP AHEAD" Sign Should Be Considered - Striping Should Include: Stop Bar and Double Yellow Centerline - Temporary Installation and Studies Should Precede Permanent Devices - May Need Origin/Destination Study to Project Benefit of Technique - Impact on Emergency Service Vehicles	CA: Palo Alto, San Francisco, Oakland, Walnut Creek, San Mateo, Berkeley Pleasant Hill FL: Gainesville KS: Wichita MD: Anne Arundel Co., Baltimore MO: St. Louis OH: Shaker Heights, Toledo OR: Eugene, Portland, TX: Dallas VA: Arlington Co. WA: Bellevue, Seattle Australia Europe	- Should Be Used On a Neighborhood Street Which Intersects an Arterial - Should Allow for Ample Public Input - Advance Warning Signs of "Upcoming Traffic Revision" Should Be Posted Prior to Installation - If Landscaped, Residents May Agree to Maintain Landscaping
Traffic Circles	- Reduce Speeds at Intersection Approaches - May Reduce Accidents at Problem Intersections - Discourage Cut-Thru Traffic		- Traffic Circles Have Longer Speed Reduction Influence Zones Than Stop Signs - Does Not Restrict Movements, But Makes Them More Difficult - Can Be Landscaped for Aesthetics - May Discourage Cut-Thru Traffic	- May Require Additional Right of Way - Initial Safety Issues as Drivers Adjust - May Reduce Pedestrian and Bicycle Safety - May Increase Volumes on Other Residential Streets - Drivers May Speed Up Between Circles - May Increase Response Time for Emergency Services	- Not Addressed in MUTCD	- Install Reflectors on Circle Perimeter and Mounted on Markers Facing All Approaches - Improve Intersection Lighting - Temporary Installation and Studies Should Precede Permanent Devices - Perimeter Should Be a Mountable Curb - Bicycle/Pedestrian Movements Should Be Considered - Consider Trucks and Buses in Design - Impact on Emergency Service Vehicles - Thorough Advance Public Notification Necessary - Requires Advance Warning Signs	CA: San Francisco, Saratoga, Berkeley, San Mateo, Sacramento FL: Miami MD: Anne Arundel Co. OR: Eugene VA: Arlington Co. WA: Bellevue, Seattle WI: Madison Canada	- Not Appropriate if Heavy Left Turn Volume Exists at the Intersection - More Than One Circle Along a Section May Be Necessary - Residents May Agree to Maintain Landscaping of the Traffic Circles - Advance Warning Signs of "Upcoming Traffic Revision" Should Be Posted 30 Days Prior to Installation - Speed Impacts are Confined to Within 100 Feet of the Circle - Should Allow for Ample Public Input

NEIGHBORHOOD TRAFFIIC CONTROL MEASURES

Technique	Some Appropriate Applications	Inappropriate Applications	Pros	Cons	*Legal Issues	Installation Issues	**Locations Implemented	Comments
Cul de Sacs	- Reroute Cut-Thru Traffic to Non-Residential Roadways - Reduce Speeds	- Reroute Cut-Thru Traffic to Other Residential Streets	- Effective for Rerouting Cut-Thru Traffic - Requires Little Enforcement - If Landscaped, Can Be Attractive - Can Improve Pedestrian Safety	- Highly Restrictive - Can Be Aesthetically Unattractive - May Increase Response Time for Emergency Services - May Have to Reroute Bus Service (School and Public) and Garbage Collection - May Increase Volumes on Other Residential Streets - Causes Inconvenience to Some Residences		- Must Be a Local Street - Emergency Vehicle Access Should Be Considered - Temporary Installation and Studies Should Precede Permanent Devices - Should Be Designed to Accommodate Garbage Trucks and School Buses To Perform a U-Turn	AZ: Tucson Throughout California CO: Littleton CT: Hartford FL: Tampa IL: Chicago KS: Wichita MD: Baltimore MI: Grand Rapids MN: St. Paul MO: St. Louis NC: Rocky Mount NE: Omaha NJ: Metuchen OH: Toledo, Shaker Heights, Cleveland, Dayton OR: Eugene, Portland TX: Dallas, Houston VA: Arlington Co. WA: Seattle WI: Madison Australia Canada Europe Nova Scotia	- Should Allow for Ample Public Input - Advance Warning Signs of "Upcoming Traffic Revision" Should Be Posted Prior to Installation - If Landscaped, Residents May Agree to Maintain Landscaping
Speed Humps	- Reduce Speeds Along a Roadway Segment - Deter Truck Traffic - Reroute Cut-Thru Traffic to Non-Residential Roadway	- Reduce Speeds at Certain Points Along a Roadway Segment	- May Discourage Cut-Thru Traffic - Requires No Enforcement - Reduces Speeds in Area of Humps Without Increasing Accidents, If Properly Designed	- Can Be a Problem for Emergency and Transit Vehicles - Can Impact Drainage - Drivers May Speed Up Between Humps - May Increase Volumes on Other Residential Streets - Can Increase Noise, Air Pollution, and Vibrations	- Not Addressed in MUTCD	- Must Be a Local Street With a Speed Limit of 30 MPH or Less - Street Must Be No More Than Two Lanes Wide - Street Must Have Eight Percent Grade or Less - Requires Advance Warning Signs - Don't Install Adjacent to Intersections or Sharp Curves - Humps: 12' Long, 2" to 4" High, 160' to 400' Apart - Drainage Impacts Should Be Considered	CA: Torrance, San Francisco, Sacramento FL: Cities MA: Boston MO: St. Louis OK: Oklahoma City UT: Farmington WA: Seattle Australia Canada Great Britain Netherlands New Zealand	- Used Throughout the Country, Typically Without Incident

NEIGHBORHOOD TRAFFIIC CONTROL MEASURES								
Technique	Some Appropriate Applications	Inappropriate Applications	Pros	Cons	*Legal Issues	Installation Issues	**Locations Implemented	Comments
Knuckles (Curb Bulbs or Extentions)	- Protect Parked Cars - Improve Pedestrian Safety - Improve Aesthetics - Reduce Speeds at Intersection Approaches - Alert Driver to Change in Conditions	- Reduce Speeds Along a Roadway Segment	- May Provide Landscaping Opportunities - Does Not Restrict Movements - Can Improve Pedestrian Safety	- Initial Safety Issues as Drivers Adjust - Can Reduce Parking - Can Impact Drainage	- Not Addressed in MUTCD	- Consider On-Street Parking Demand and If It is Needed, Must Have Sufficient Right of Way to Accommodate Parking Lane and Provide an Adequate Turning Radius - Consider Trucks and Buses In Design	CA: San Francisco, Berkeley San Diego, Oakland, Visalia, LaFayette, Cupertino IL: Decatur MA: Boston, Springfield MO: St. Louis OH: Dayton, Shaker Heights OR: Portland, Eugene VA: Arlington Co., Hampton WA: Seattle WI: Madison	- Should Allow for Ample Public Input - If Landscaped, Residents May Agree to Maintain Landscaping

* Legal Issues are cited if they were addressed in the literature search or if the consultant had first-hand experience with the issue.
Some general legal issues are listed below and may be applicable to some or all of the techniques:

- Appropriate use of technique must be evaluated on a case-by-case basis using local engineering judgement in conformance with local regulations and ordinances.
- Techniques should consider coordination with emergency service providers, utilities, and other affected agencies.
- Need to adopt procedures for follow-up evaluations and removal, if necessary.
- May be necessary to show public purpose before reducing access opportunities.
- Proper driver warning of technique is necessary.
- Could be exposed to liability for injury and/or vehicle damage if it can be shown that the technique was designed or installed improperly.

** State Abbreviations:

AK Alaska	DE Delaware	IN Indiana	MI Michigan	NE Nebraska	OK Oklahoma	TX Texas	WY Wyoming
AL Alabama	FL Florida	KS Kansas	MN Minnesota	NH New Hampshire	OR Oregon	UT Utah	
AR Arkansas	GA Georgia	KY Kentucky	MO Missouri	NJ New Jersey	PA Pennsylvania	VT Vermont	
AZ Arizona	HI Hawaii	LA Louisiana	MS Mississippi	NM New Mexico	RI Rhode Island	VA Virginia	
CA California	IA Iowa	MA Massachusetts	MT Montana	NV Nevada	SC South Carolina	WA Washington	
CO Colorado	ID Idaho	MD Maryland	NC North Carolina	NY New York	SD South Dakota	WV West Virginia	
CT Conneticut	IL Illinois	ME Maine	ND North Dakota	OH Ohio	TN Tennessee	WI Wisconsin	

NEIGHBORHOOD TRAFFIC CONTROL MEASURES

Technique	Some Appropriate Applications	Inappropriate Applications	Pros	Cons	*Legal Issues	Installation Issues	**Locations Implemented	Comments
Psychological Techniques								
Change Street Surface (Brick)	- Alert Driver to Change in Conditions - Reduce Speed - Reduce Volumes		- May Improve Drainage - Does Not Restrict Movements - Requires No Enforcement - May Be an Aesthetic Improvement	- Increases Noise - May Be Uncomfortable for Bicyclists - Significant Disruption During Construction - Resurfacing Difficulties - If on Public ROW, Requires Ordinance Modifications			FL: Orlando	- Should Allow for Ample Public Input
Build Entryways to eighborhood	- Alert Driver to Change In Conditions - Improve Aesthetics		- May Be an Aesthetic Improvement				FL: Orlando MO: St. Louis London	- If Landscaped, Residents May Agree to Maintain Landscaping
Regulatory Techniques								
SIGNS:								
Speed Limit	- Indicate Speed Limit	- Impose Unrealistically Low Speed Limit	- Easy to Implement	- Usually Ineffective Without Enforcement		- Can Install Anywhere - Use in Conjunction with Enforcement - Use in Conjunction with Other Techniques	Everywhere	Typically, Drivers Will Travel at the Speed They Consider Safe
"SLOW"	- Provide Warning for Unexpected Condition		- Easy to Implement	- May Be Ineffective Without Enforcement	- Not Addressed in MUTCD	- Use in Conjunction with Other Techniques	CA: Torrance, Berkeley Claremont, Millbrae, Campbell, Saratoga, Walnut Creek, Aurora CO: Littleton FL: Jacksonville IL: Decatur, Stokie LA: Louisiana MI: Flint NC: Rocky Mount OH: Shaker Heights OK: Oklahoma City PA: Pittsburgh TN: Memphis, Nashville TX: Dallas UT: Farmington WA: Seattle Washington, D.C. WI: Madison Canada	

NEIGHBORHOOD TRAFFIIC CONTROL MEASURES

Technique	Some Appropriate Applications	Inappropriate Applications	Pros	Cons	* Legal Issues	Installation Issues	**Locations Implemented	Comments
SIGNS: (Continued)								
NO TRUCKS	- To Discourage Truck Traffic in Neighborhoods		- Easy to Implement	- Difficult to Enforce Because Some Trucks Must Be Allowed Into the Neighborhood for Deliveries		- Can Not Install On a Street That Provides the Only Access to a Destination of Trucks - Use in Conjunction with Other Techniques	CA: San Francisco, Claremont FL: Orlando MA: Cambridge, Boston, Concord OH: Toledo PA: Philadelphia VA: Norfolk	
4-Way Stop Stop Signs	- Assign Right of Way - Reduce Speeds at Inter-section Approaches	- Reduce Speeds Along a Roadway Segment - Reroute Cut-Thru Traffic	- Easy to Implement - May Reduce Right-Angle Collisions	- Mid-Block Speeds May Increase - May Increase Noise		- Must Be a Local Street	Most Communities	- High Incidence of Inten-tional Violation When Used for Speed Control or Nuisance Factor
Turn Prohibitions	- Reroute Cut-Thru Traffic to Non-Residential Roadways - Prohibit Signal By-Pass	- Reroute Cut-Thru Traffic to Other Residential Streets	- Proven to Be Effective When Reasonable Alter-natives Exist	- Requires On-Going Enforcement Within a Neighborhood		- Must Be a Local Street - Use on the Exterior of Neighborhood - Use in Conjunction with Enforcement	CA: San Francisco, Torrance, Aurora, LaFayette, Berkeley, Saratoga Santa Ana, Hawthorne FL: Miami LA: New Orleans MD: Rockville MI: Detroit, Kalamazoo NC: Charlotte, Rocky Mount NY: Buffalo OH: Cleveland, Toledo TX: Dallas, Houston VA: Norfolk Canada Nova Scotia Washington, D.C.	- Particularly Adaptable to Small Neighborhoods

* Legal Issues are cited if they were addressed in the literature search or if the consultant had first-hand experience with the issue.
Some general legal issues are listed below and may be applicable to some or all of the techniques:

- Appropriate use of technique must be evaluated on a case-by-case basis using local engineering judgement in conformance with local regulations and ordinances.
- Techniques should consider coordination with emergency service providers, utilities, and other affected agencies.
- Need to adopt procedures for follow-up evaluations and removal, if necessary.
- May be necessary to show public purpose before reducing access opportunities.
- Proper driver warning of technique is necessary.
- Could be exposed to liability for injury and/or vehicle damage if it can be shown that the technique was designed or installed improperly.

ATTACHMENT C
LOCAL STREET STANDARDS

This section describes local street standards for improvements to existing streets. These standards are not intended to be used for construction of new local streets.

OVERVIEW

The street standards element of the traffic calming program was developed in response to traffic calming issues on existing narrow streets in Clackamas County. Many property owners have indicated a desire to improve the local street abutting their property. However, property owners are unable or unwilling to widen the street to full County standard widths with setback sidewalks, and landscape strips. Not only is widening expensive, but adequate right-of-way may not be available and a widened pavement width may encourage higher speed on the local streets. Consequently, the property owners choose not to improve the street at all rather than widen to full County standards. Narrower local streets provide several benefits to the community as identified below:

- Narrow streets cost less to build and maintain. Less road base is needed and less surface is paved. This results in lower materials and labor costs.

- Narrow streets reduce the negative impacts of stormwater runoff. Paved streets are impervious surfaces which prevent the natural filtration of stormwater into the ground. Therefore, streets increase the volume of stormwater runoff, which can cause flooding, erosion, and habitat destruction, as well as reducing the supply of groundwater supply. Excess paving also causes increased pollution of surface waters as a result of contamination from the roadway surface entering their stormwater system. Minimizing the pavement width can help reduce these negative impacts.

- Narrow streets reduce the negative environmental impacts of street construction. A narrow street cross section will help minimize negative environmental impacts by requiring less land than a wider street. Narrow widths will also reduce the need to remove existing plants and trees.

- Narrow streets increase traffic safety. Narrow street designs will discourage the use of local streets by through traffic and help reduce traffic speeds. This helps to create quiet, safe residential streets with lower traffic volumes and speeds. According to Residential Streets, published in 1990 by the American Society of Civil Engineers, the National Association of Homebuilders, and the Urban Land Institute, "Excessive widths...encourage greater vehicle speeds." Lower vehicle speeds will also the reduce the severity of accidents, particularly accidents involving pedestrians. According to the

Center for Urban Transportation Research, approximately 55% of accidents are fatal to the pedestrian when vehicle speeds are 30 mph or lower, while only 5% are fatal when vehicle speeds are 20 mph or lower.

- Narrow streets improve neighborhood character. The positive environmental, land use and traffic safety benefits of narrow streets all work to improve the character and livability of residential neighborhoods. The 1980 Bucks County, Pennsylvania publication, Performance Streets, recognized that the purpose of local streets should be "not solely to move traffic safely and efficiently, but to see that the needs of people for a residential neighborhood that is quiet, safe, convenient, and sociable are met as well."

Although narrow street standards for existing local roadways offer many benefits, there is the potential for improperly designed local streets to hamper the operation of emergency service operations. It is possible that obstructions on narrow streets can increase response times and impede the ability of emergency service personnel to park and operate. Generally, a minimum width of 20 feet of clear area is required to allow safe and efficient operation of emergency services at a site.

Existing local street standards have been developed to create livable residential streets which are both safe and efficient. These standards provide several options for improvements on existing unimproved streets which may or may not have curb and gutter, storm drains, or sidewalks. Various street width and parking configurations allow for improvements to be made while minimizing the impact on adjacent properties. Improvement options for existing local streets are summarized in **Table C1** and illustrated in **Figures C1 through C3**.

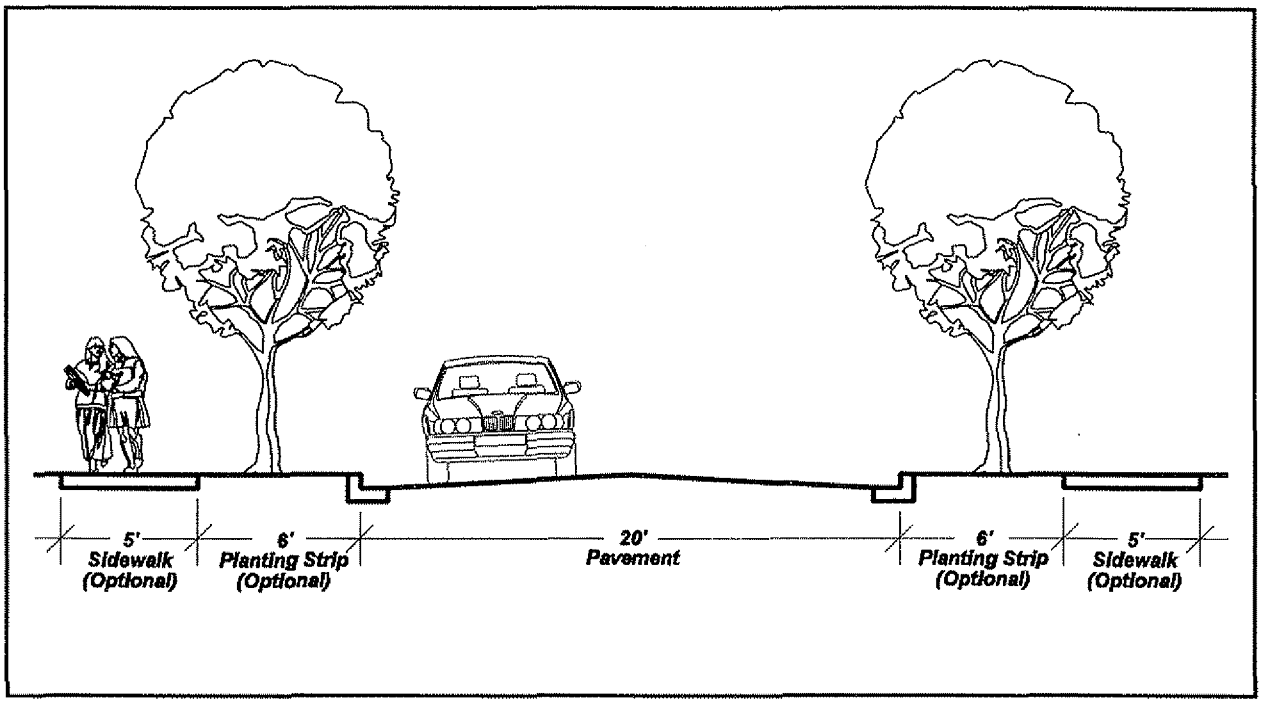
Table C1. Existing Unimproved Local Street Improvement Options

	Pavement Width			**Optional Improvements**			
				Sidewalks			
Roadway Type	Parking Both Sides	Parking One Side	No Parking	Curb-Side	Set-Back	Street Lights	Street Trees
Local	28'	24'*	20'	✓	✓	✓	✓
Local with Fire Route Designation	34'	28'	20'	✓	✓	✓	✓

*Note: Must be a through street.

As shown in **Table C1**, Local Streets have three on-street parking options: no parking, parking on one side, and parking on both sides. Streets with no parking have a 20 foot travel lane as illustrated in **Figure C1**. The 20 foot travel lane would maintain safe access for emergency vehicles. Sidewalks, street lights and street trees are optional.

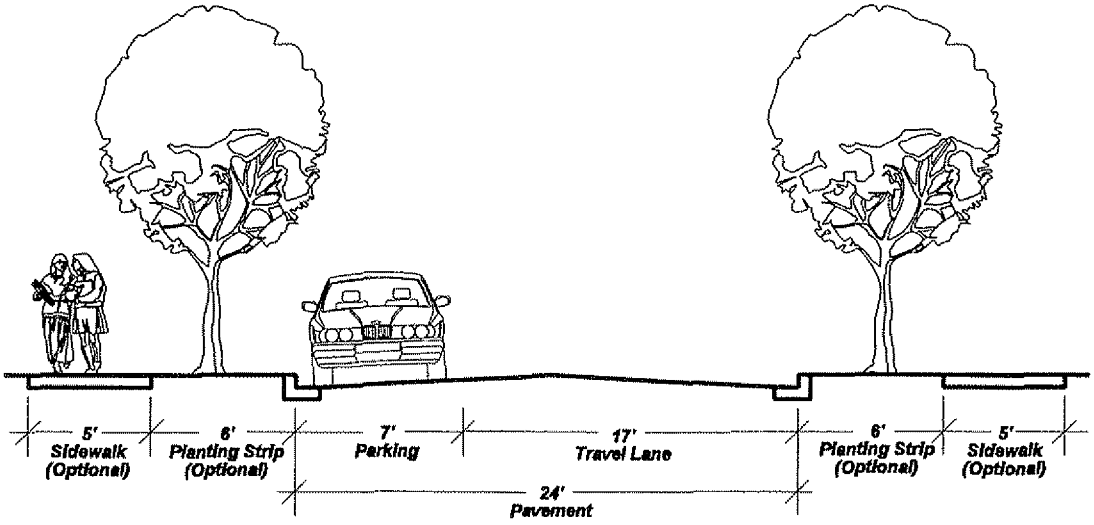
Figure C1. Typical Section of Existing Local Street - No Parking (With or Without Fire Route Designation)



Streets with parking on one side would have one 14 foot two-way travel lane and a 7 foot parking lane as illustrated in **Figure C2**. Therefore, the streets would operate as "queuing" streets: two vehicles travelling in opposite directions could not pass each other at a location where vehicles are parked. Since streets with parking on only one side often have all the available parking spaces filled, through access on the street must be maintained for emergency vehicles. This will ensure a secondary route is available in the event that a street is blocked. If the street is designated as a Fire Route, the travel lane must meet or exceed a minimum travel lane width of 20 feet. **Figure C2a** illustrates the typical section for local street with a Fire Route designation and parking on one side. Sidewalks, street lights and street trees are optional with or without the Fire Route designation.

Streets with parking on both sides would have one 14 foot two-way travel lane and two 7 foot parking lanes as illustrated in **Figure C3**. These streets may also operate as queuing streets when both parking lanes are full. Consequently, the travel lane must meet or exceed 20 feet when the street is designated as a Fire Route. **Figure C3a** illustrates the typical section for local streets with a Fire Route designation and parking on one side. Sidewalks, street lights and street trees are optional with or without the Fire Route designation.

Figure C2. Typical Section Existing Local Street - Parking on One Side



Note: Must be a through street. Not allowed on dead end streets or cul-de-sacs.

Figure C2a. Typical Section Existing Local Street - Parking on One Side (With Fire Route Designation)

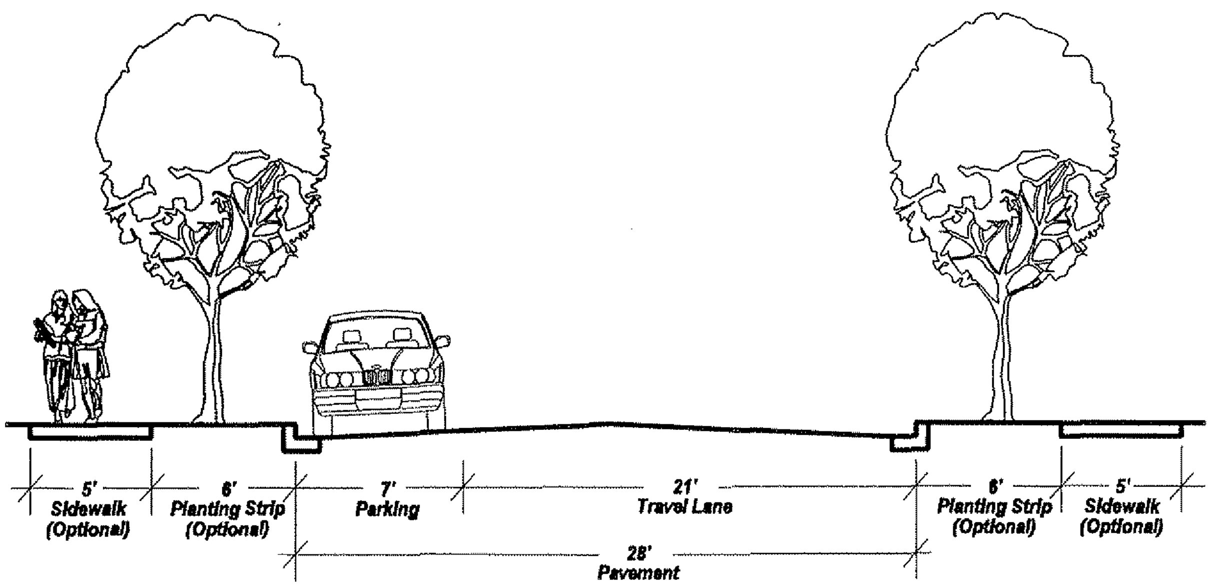


Figure C3. Typical Section Existing Local Street - Parking on Both Sides

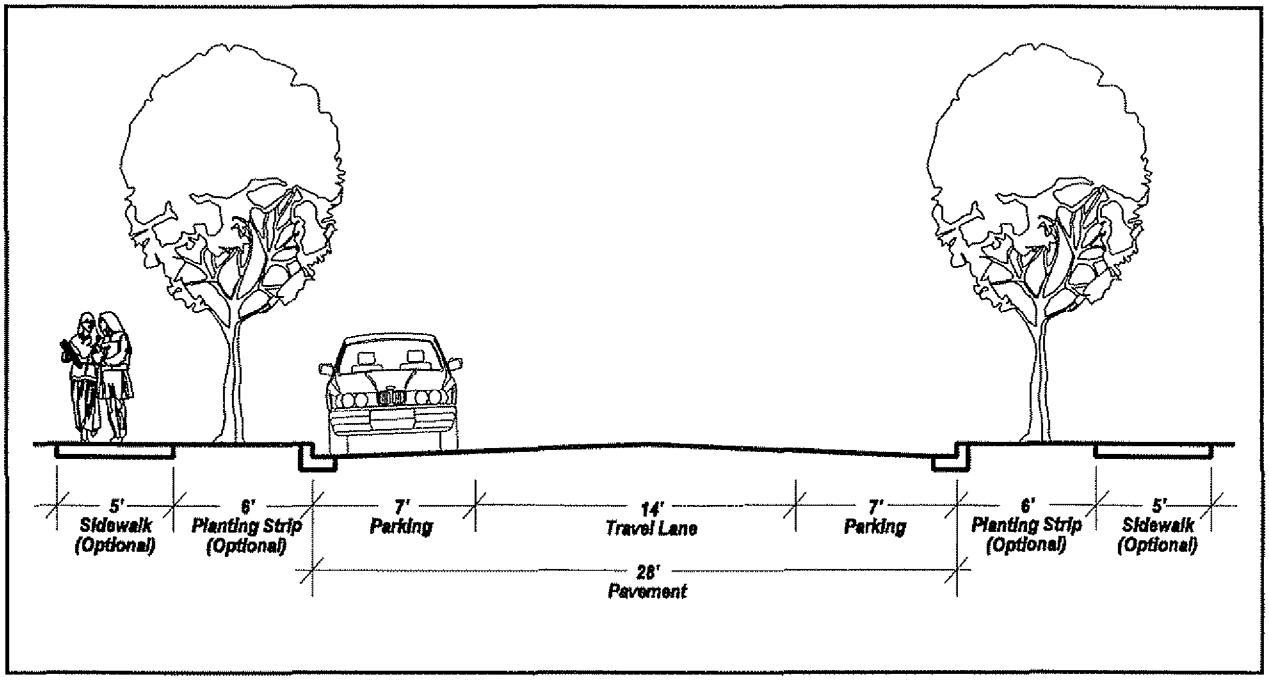
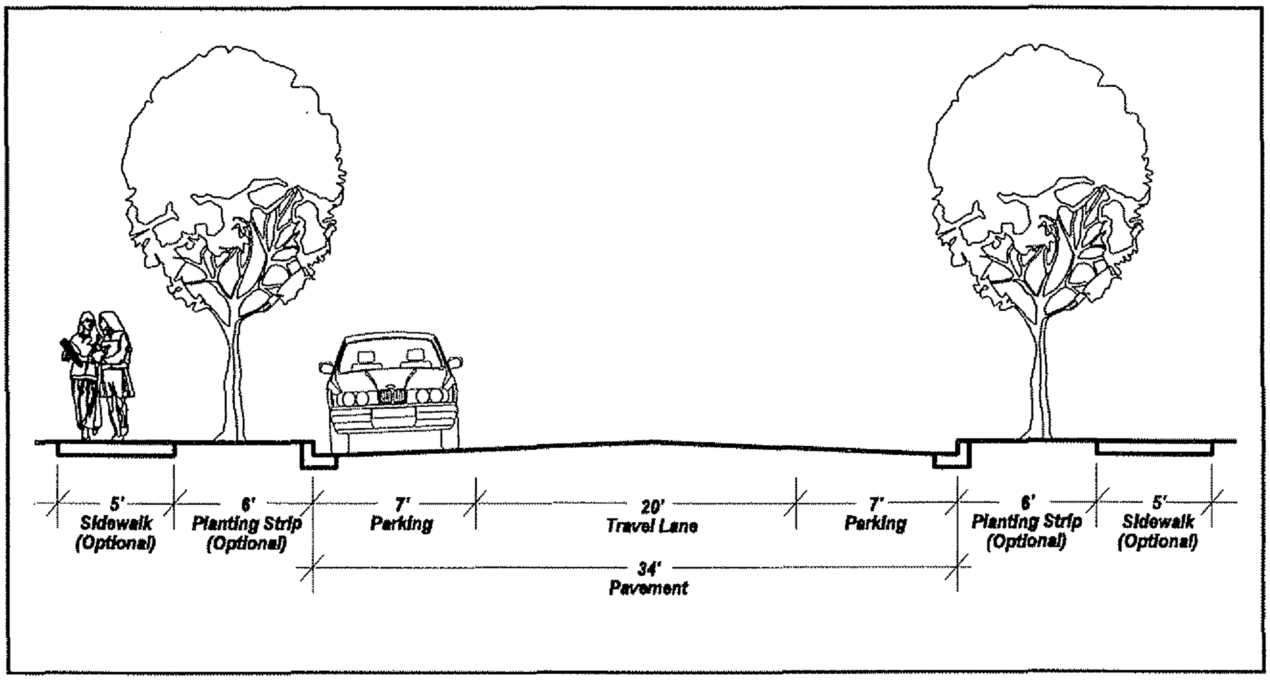


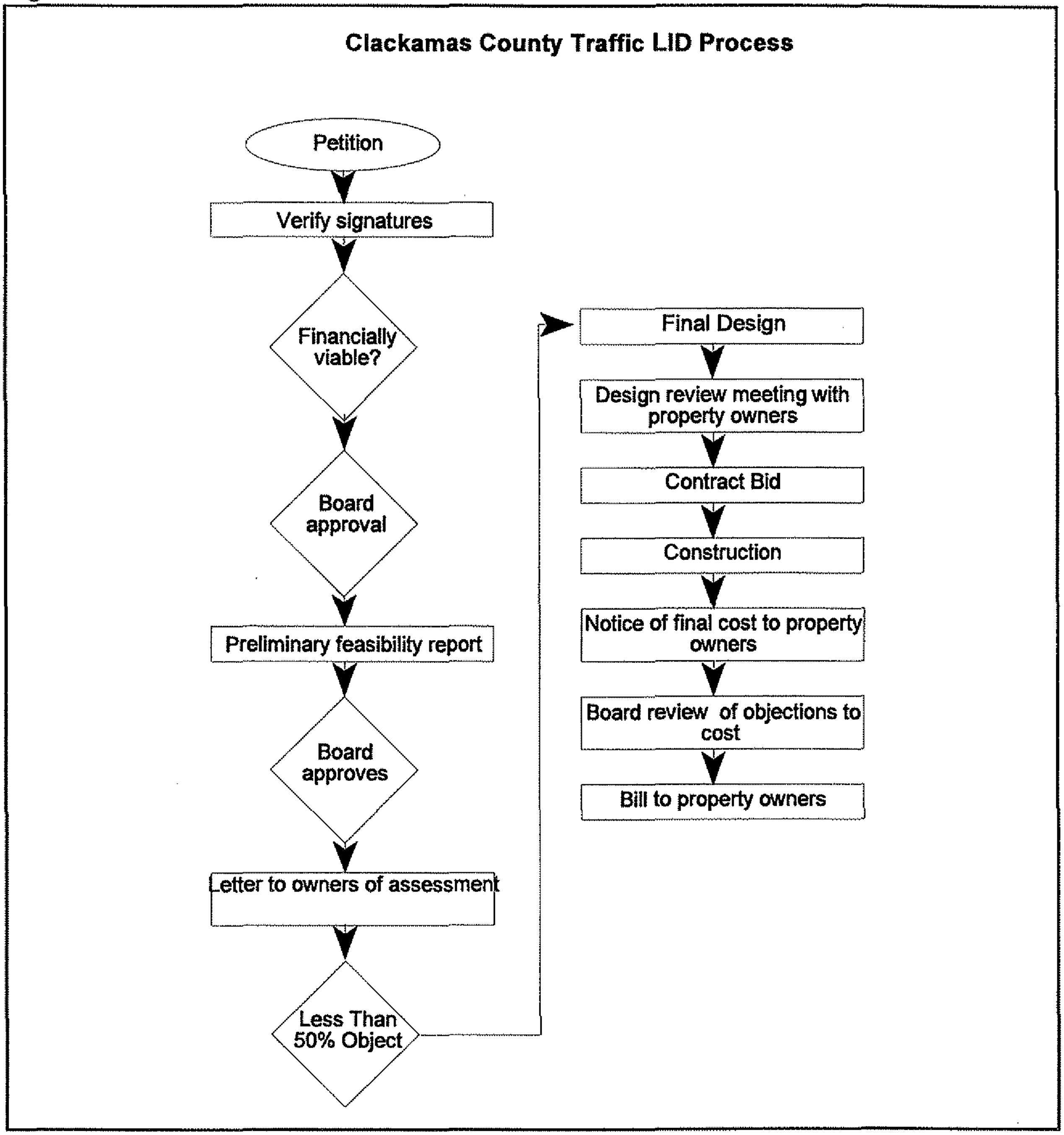
Figure C3a. Typical Section Existing Local Street - Parking on Both Sides (With Fire Route Designation)



ATTACHMENT D
LOCAL IMPROVEMENT DISTRICT

This section describes the process to form a Local Improvement District in Clackamas County. The process is illustrated in **Figure D1**.

Figure D1.



DEC 18 1996

THE LOCAL IMPROVEMENT DISTRICT PROGRAM

HOW IT WORKS FOR YOU

Thank you for expressing an interest in the Clackamas County Local Improvement District (LID) Program. This program is designed to assist county residents in improving their roadways, providing a safer, cleaner access to their homes.

Formation of an LID is a complex and often lengthy process. It is governed by a set of rules and regulations set forth in the Oregon Revised Statutes. We at the County would like to help make this process as easy for you as we can so that you can enjoy your new roadway as soon as possible. Following is a simplified description of the process to help you on your way.

The first step in forming an LID is the petition process. Upon request, the County will assist you in preparing a petition for your LID. We can help you define the boundary of your proposed LID, define the scope of work and determine the limits of roads to be improved. The petition must include all of this information. In addition we can help you by supplying the legal ownership and tax lot descriptions for all properties along the proposed improvement. These are the names of the individuals eligible to sign your petition. It is important that the petition be worded carefully to insure clarity, accuracy and compliance with legal issues.

Once the petition is properly prepared, it needs to be signed by at least 60% of the property owners along the proposed improvement, representing at least 60% of the land area abutting the improvement (area in square feet, acres, etc., and not lineal frontage in feet). We encourage you to contact all property owners in the district during your petition efforts, as this avoids problems later in the process from persons who were unaware of the proposed improvement. It is also desirable to obtain as many signatures as possible, as this is an indication of the strength of support for your project.

When the signed petition is returned to the County, we verify the signatures and, since the project will typically be funded by assessment bonding, the County Treasurer will review the value of the benefiting property and improvements compared to the proposed assessments to ensure that the project is financially viable.

Once the petition has been verified, and the project has been determined finacially viable, the County will recommend to the Board of County Commissioners (the Board) that the LID be formed.

Upon formation of the LID, the County will prepare a Preliminary Feasibility Report (Engineering Report) on the project. This report contains the scope of work for the improvement, the assessment district boundary, the method of assessment, total estimated costs and estimated cost per benefited property owner. During formation of the report, an informational meeting will be held to discuss these issues with the district participants. The Engineering Report will then be submitted to the Board, who will determine whether or not to proceed with the project.

Following acceptance of the report by the Board, each benefited property owner will receive a letter indicating the total estimated cost of the project and their proposed share. After receiving their letters with the proposed assessments, the property owners have 20 days from the mailing date of the notice to respond to the County in writing if they want to stop the project. If 50% or more of the benefited property owners, representing 50% or more of the total estimated assessment request in writing that the project be stopped, then the County will discontinue the process. Once a project has been discontinued, no petition to initiate a similar LID will be accepted by the County for a period of one year. If the decision is to continue the project at this time, the County will go to the Board for approval to proceed.

The County will select a Consulting Engineering Firm through a competitive process to prepare a final design, cost estimate, specifications and plans for construction of the proposed improvement. The consultant will make every effort to reduce project costs by considering the inclusion of existing road base and drainage facilities into the new design. The design of the project must conform to county design standards. A design review meeting will be held with the property owners to review the overall design, costs and schedule, and to review specific impacts on individual properties.

The completed design will be put out to bid by the County, and a contract will be awarded to the lowest responsible bidder. Soon after this, construction will begin. If this process occurs too late in the year, bidding and construction may be held over till the following spring and summer in order to avoid the extra cost and inconvenience of "wintering" the job.

Following completion of project construction, the final costs of the improvement will be determined, and a notice will be sent to all property owners indicating their proposed final assessment. The final costs are the actual cost incurred to construct the project. This includes County staff time, the consulting engineer's fee, the payments to the contractor and all other costs associated with the administration and financing of the project. A hearing before the Board will be held so that objections to the proposed assessments may be heard. After this hearing, final assessment billings will be sent to the property owners, along with their options for payment.

Many variables impact the schedule of the LID process. Each LID is unique and it is not unusual for the construction phase to begin a year or more after submittal of a signed petition. We appreciate your patience in working with us through the process.

If you wish to begin the petition process for an LID improvement, or if you have any questions regarding the process or procedures, please call the County's LID Office at 650-3304.

ATTACHMENT E
GLOSSARY

The following are brief descriptions of techniques and terms commonly used to describe and measure traffic conditions.

Accident History: Accident history is used to determine safety problems at a given location. Accidents, particularly at low volume intersections, are often random. Generally, only correctable accidents are considered in determined a hazardous location. Correctable accidents are those accidents that could have been prevented through geometric improvements to the roadway or intersection. An average of one or less correctable accidents per year usually does not indicate a safety hazard. An average of two or more correctable accidents per year can be significant, particularly if there is a pattern of several similar accidents having occurred. When a pattern is apparent, the problem can be identified and appropriate solutions developed.

Roadway Classifications: All roadways in Clackamas County are classified in the Transportation Chapter of the Clackamas County Comprehensive Plan. Those classifications designate a hierarchy of roadways to serve different kinds of trips.

- Local Streets: Local streets provide access to abutting properties and connections to higher order streets. Local streets should also serve bicycle and pedestrian needs. Local should serve traffic with an origin or destination within one neighborhood. **Note: Local streets are the only class of street to which the Clackamas County Local Streets Traffic Calming and Skinny Streets Program.**

- Collectors: Collectors are the principle carriers within neighborhoods or single land use areas. Collectors link neighborhoods with major activity centers and arterials. Generally, collectors are not intended for through traffic.

- Minor Arterials: Minor arterials provide connections to major arterials and freeways. Minor arterials are generally located on neighborhood boundaries. Major arterials may also bisect neighborhoods in areas of low density having insufficient collectors.

- Major Arterials: Major arterials carry local and through traffic to and from destinations outside the local community such as other cities and rural centers. Major arterials do not bisect neighborhoods, parks or commercial districts.

- Freeway/Expressway: Freeways and expressways serve interregional and intraregional trips. They are generally buffered for noise and pollution impacts. They do not bisect neighborhoods, parks or commercial districts.

Community Service Providers: Community service providers are those organizations which provide a service to all citizens within a community. Community service providers involved in the Neighborhood Transportation Management Program include the following: Clackamas County Fire District 1, Oak Lodge Fire District, Clackamas County Sheriff's Office, North Clackamas School District, and Oak Grove Disposal.

Detrimental Traffic Conditions: Detrimental traffic conditions occur on local streets when (a) drivers are using a local street as a shortcut or detour, (b) there is an excessive volume of traffic on the local street that should normally be served by an arterial roadway, or (c) traffic is operating at excessive speeds.

Speed: Speed may be the most often noted and discussed of neighborhood traffic problems. Speed is usually quantified in miles per hour (MPH). The 85th percentile speed is a statistical term indicating the speed below which 85 percent of the vehicles travel and above which 15 percent of the vehicles travel.

Traffic Calming Measures: Traffic calming measures are techniques employed to slow traffic and/or shift traffic to more appropriate routes. Techniques may include either traffic management devices or traffic control devices. Traffic management devices include traffic circles, speed humps, diverters, medians, and curb extensions. Traffic management devices do not include traffic control devices regulated by the Manual on Uniform Traffic Control Devices (MUTCD). Traffic control devices include stop signs, speed limit signs, one-way streets, and turn prohibitions.

Volume: Volume is another of the most commonly reported local traffic problems. Volume refers to the number of vehicles that cross a given section of roadway during a specified time period. Volumes are normally measured on mid-week days, on an hourly basis, for 24 hours. For streets near schools, volumes should be measured on mid-week days when school is in session.

ACTION PLAN

INTRODUCTION

This chapter presents the updated ITS action plan for Clackamas County. The plan includes a range of ITS projects that address the needs of the region. The action plan projects are grouped into the following categories:

- Traffic Management and Operations (TMO)
- Multimodal Operations (MMO)
- Traveler Information (TI)
- Data Collection and Management (DCM)
- Incident and Emergency Management (IM)
- Maintenance and Construction Management (MCM)

The following sections summarize the County's ITS vision and goals, and provides performance measures, a toolbox of ITS strategies, priority corridors, and the action plan projects.

CLACKAMAS COUNTY VISION AND GOALS

Currently, Clackamas County is updating their Transportation System Plan Policy. This policy update is outcome based and will be used to define the framework for the upcoming Clackamas County's Transportation System Plan. Key stakeholders, County staff, and the Board of County Commissioners (BCC) have been involved in the policy update. The policy update is scheduled to be completed and adopted in March 2011. The policy plan update will be used as guidance for the ITS action plan to ensure the projects selected are aligned with the County's vision and goals.[1]

Draft TSP Policy Vision

Building on the foundation of our existing assets, we envision a transportation system that provides mobility, accessibility and connectivity for people, goods and services; is tailored to our diverse geographies; and supports and sustains planned land uses.

The supporting goals for the TSP policy vision are grouped into six categories:

- Sustainable
- Livable and Local
- Local Business and Jobs
- Health and Safety
- Fiscally Responsible
- Equity

The following chart presents the Draft TSP policy goals and identifies ITS strategies that support each goal. Table 2 presents details for the types of projects that can be used within each ITS strategy.

[1] Clackamas County Transportation Framework Summary, DKS Associates in coordination with MIG, March 24, 2011.

Draft TSP Policy Goals

TSP Goal		Applicable ITS Strategies
Sustainable	*Work towards a transportation system that is environmentally, fiscally and socially sustainable by focusing on increasing energy security, decreasing greenhouse gas emissions, maximizing cost-effectiveness and providing equitable access for all.*	TMO MMO
Livable and Local	*Customize transportation solutions to suit the local context while providing a system that supports active transportation, promotes public health, facilitates access to daily needs and services, and creates successful and enduring communities. Where land use is evolving, fit the desired future, not the present.*	TMO MMO TI
Local Business and Jobs	*Support a prosperous, adaptable economy and the financial well-being of the county and its residents by preserving and enhancing business opportunities, and ensuring the efficient movement of people and goods.*	TMO MCM TI
Health and Safety	*Promote a transportation system that maintains and improves individual and community health, safety and security by maximizing active transportation options, public safety and service access, and safe and smooth connectivity.*	MMO IM MCM
Fiscally Responsible	*Use a fix-it-first approach to protect and improve existing roadways, paths, bridges and other transportation assets while cost-effectively enhancing the total system.*	TMO IM
Equity	*Provide a resilient transportation system that offers people choices, regardless of age, ability, income level and geographic location; and allows them to respond and adapt to changing conditions.*	MMO TI

Legend for ITS Strategies

- TMO: Traffic Management and Operations
- MMO: Multimodal Operations
- TI: Traveler Information
- DCM: Data Collection and Management
- IM: Incident and Emergency Management
- MCM: Maintenance and Construction Management

PERFORMANCE MEASURES

Performance measures will be used to evaluate transportation system performance and prioritize investments. Table 1 presents sample performance measures that could be used to monitor the effectiveness of projects and track ongoing transportation network performance.

Table 1: Sample Performance Measures for Goal Assessment

Candidate Performance Measures	Sample Measurement
Greenhouse gas emissions	Vehicle miles traveled Vehicle emissions- CO_2, CO, NOx, VOC Transit vehicle fuel efficiency
Travel time	Average travel time Average speed
Travel time reliability	90th or 95th Percentile Travel Time Frequency that congestion exceeds some expected threshold Travel time index Planning time index Buffer time index On-time transit performance
Modal Split	Percentage of travelers using personal vehicle, carpool, transit, bicycle, or walking
Recurring delay	Vehicle delay Person delay Freight delay
Non-recurring delay	Vehicle delay Person delay Freight delay
Throughput- vehicle	Vehicle volume per hour
Throughput- passenger	Passenger trips per vehicle revenue hour and mile Passenger load (ridership/capacity)
Hours of congestion	Duration of congestion
Customer satisfaction	Percent of population highly satisfied or satisfied with travel conditions Complaint/compliment rate Number/type of calls to 511 or transit advisory telephone Number/type of hits on traveler information website
Incident response	Number/type of incident responses Incident duration Incident response time Average incident clearance time
Collision rate	Rate/number of collisions Rate/number of fatalities Rate/number of injuries

TOOLBOX OF ITS STRATEGIES

Table 2.presents a toolbox of ITS strategies to help advance the regional ITS plan and address the identified issues and needs of Clackamas County The ITS strategies are provided for each of the previous six strategic plan categories.

The toolbox of potential ITS strategies do not represent specific recommendations. The strategies represent a range of alternatives for the region to consider when they elect to address a specific transportation system management need.

Table 2: Toolbox of ITS Strategies

ITS Strategy	Strategy Description	Expected Benefits	Specific Applications
Traffic Management & Operations – Supports the following Policy Goals: Sustainable, Livable and Local, Local Business and Jobs, and Fiscally Responsible			
Regional Multi-Agency Transportation Operations Center (TOC)	Develop a regional TOC to support traffic operations on City and County roadways and to interface with the ODOT Region 1 Traffic Operations Management Center (TMOC) and local 911 centers.	• Supports coordination and operation of the region's transportation systems • Collaboration between traffic and emergency agencies • Resource sharing	• Integrate Clackamas County TOC with ODOT TMOC
Traffic Management Software	Deploy traffic management software that supports incident management, dispatch, and logging for TOC response.	• Reduces incident response times	• ATMS system
Enhanced Traffic Signal Operations	Expand and improve existing traffic signals.	• Reduces travel times • Potential to improve travel time reliability • Reduces fuel consumption and vehicle emissions	• Expand signal system • Signal retiming & optimization • Adaptive signal timing • Central signal system upgrade • Flashing yellow arrow upgrades • Convert controllers from 170s to 2070s
Traffic Surveillance	Add monitoring cameras and detection equipment to observe key locations of the regional transportation network and assess real-time traffic flow conditions.	• Improves incident detection and verification • Provides real-time and historic system operations information • Supports the dissemination of real-time traveler information • Improved visual information for decision makers and travelers	• Arterial camera deployment • Vehicle detection equipment for volumes, speeds, classification and travel times (i.e. loops, video, microwave detectors, vehicle/cell phone probes)
Railroad Crossing Alert System	Deploy driving warning systems at select railroad at-grade crossings.	• Emergency response vehicles or travelers may choose alternative routes to avoid delay at the railroad crossing	• Variable message signs and an automatic train location system
Rural Safety Applications	Deploy warning and advisory systems at select high crash locations on rural highways to alert drivers of hazardous conditions or dangers.	• Reduced crashes and improved safety	• LED warning signs at high accident locations • Dynamic speed control

ITS Strategy	Strategy Description	Expected Benefits	Specific Applications
Multimodal Operations – Supports the following Policy Goals: Sustainable, Livable and Local, Health and Safety, and Equity			
Transit Signal Priority (TSP)	Extend the green phase at traffic signals for buses that are behind schedule to reduce the frequency of bus stops at traffic signals.	• Reduces delay at traffic signals • Reduces transit travel time • Improves travel time reliability • Increases passenger throughput • Reduces system operational costs if fleet can be reduced	• Traffic signal system and detector upgrades for TSP
Trail Crossing Improvements	Enhance trail crossings for all trail users including pedestrians and cyclists to allow safe interaction with motorized vehicles at intersections.	• Increases safety • Provides proper crossing amenities to all trail users	• ADA improvements • Restripe crosswalks • Pedestrian and bicycle detection
Pedestrian Enhancements	This strategy will deploy pedestrian crossing devices to improve safety at select pedestrian crossings.	• Reduces the number of vehicle-pedestrian crashes	• Pedestrian detection upgrades (pushbuttons with active feedback) • Countdown timers • School zone flasher update • In-road flashers • Passive pedestrian detection
Bicycle Enhancements	Improve bicycle travel at traffic signals to progress bicycles on major bicycle routes, or providing bicycle boxes at stop bars for increased bicycle visibility to motorists.	• Reduces bicycle stops and delay • Potential to improve bicycle travel time reliability • Increases safety	• Bicycle signal heads • Bicycle detection • Bicycle boxes
Alternative Transportation Options	Expand upon the existing regional public transportation services.	• Reduces congestion and emissions • Provides alternatives for disabled and elderly	• Rideshare • Carpool/vanpool • Dial-a-Ride

ITS Strategy	Strategy Description	Expected Benefits	Specific Applications
Traveler Information – Supports the following Policy Goals: Livable and Local, Local Business and Jobs, Equity			
Regional Traveler Information	Provide static and real-time traveler information (e.g. incidents, construction, transit arrivals) from all regional agencies from one central system.	• Reduces delay • Reduces the number of stops and vehicle emissions • Potential to improve travel time reliability • Reduces crashes • Provides information for travelers to make informed choices • Increases attractiveness of alternate modes • Increases traveler satisfaction with the transportation network	• TripCheck • TripCheck Traveler Information Portal (TTIP) • TripCheck Local Entry (TLE) • 511 • Highway advisory radio (HAR) • Travel time variable message signs on arterial roadways • Construction planning and scheduling updates to TLE
Predictive Traveler Information	Develop models/tools that can predict travel conditions.	• Provides information for travelers to make informed choices • Increases traveler satisfaction with the transportation network	• Arterial congestion maps • Arterial travel times
Community Outreach	Provide real-time and static traveler information to the community through multiple applications.	• Pre-trip planning capabilities that allow users to make informed travel decisions • Reduced congestion and delay	• Enhance County traveler information website • Social networking • County traveler information website enhancements
Data Management			
Regional Data Warehouse	Collect and store data from multiple agencies and systems in a single repository with consistent formats.	• Shares resources • Supports regional operations and planning efforts • Allows users to query basic data and run reports.	• Integrate County arterial data with PORTAL
Innovative Data Collection	Collect and store data at key intersections and roadways.	• Supports regional planning efforts • Cost-effective	• Automated turn movement counts and 24-hour counts

ITS Strategy	Strategy Description	Expected Benefits	Specific Applications
Incident and Emergency Management – Supports the following Policy Goals: Healthy and Safety, Fiscally Responsible			
Integrated Corridor Management (ICM)	ICM typically includes route/mode diversion, real-time information, and system adjustments.	• Reduces travel time and delay • Potential to improve travel time reliability • Supports alternate travel routing for incident management	• En-route electronic detour guidance • Variable message signs • Signal and ramp meter adjustments
Emergency and Traffic Management Integration	Enable traffic management and emergency management agencies to communicate with one another to support incident management.	• Reduces average incident duration by 25 to 70 percent • Reduces secondary crashes by 25 to 70 percent • Reduces delay due to quicker incident response • Potential to improve travel time reliability	• Integrate Computer Aided Dispatch (CAD) systems and traffic data between traffic agencies and emergency management
Maintenance & Construction Management – Supports the following Policy Goal: Local Business and Jobs			
Work Zone Management	Deploy variable message signs to display information or speed limits that change based on road, traffic, and weather conditions.	• Improves safety • Reduces speed variations • Reduces stop and go driving in congested areas • Reduces delay • Potential to improve travel time reliability	• Variable speed limits • Variable message signs
Road and Weather Management	Monitor and predict roadway conditions to mitigate impacts of adverse weather conditions.	• Reduces vehicle speeds • Potential to improve travel time reliability • Reduces crashes • Provides information for decision-makers and travelers • Improves maintenance resource allocation	• Road weather information systems (RWIS)
Flood/Slide Warning System	Monitor and predict river and stream water heights to mitigate impacts of adverse roadway conditions when water levels are high.	• Potential to improve travel time reliability • Improves safety by reducing crashes • Provides information for decision-makers and travelers • Improves maintenance resource allocation	• Warning lights • Alert flashers and signals • Roadway barriers

PRIORITY CORRIDORS

One of the important outcomes of the ITS Plan update is the list of planned ITS projects. The action plan assigns priority to the projects based on current needs, but priorities change over time and new funding opportunities emerge that may drive the selection of alternate strategies. To facilitate project selection from year to year, the project team has prioritized corridors as primary and secondary corridors to place emphasis on specific geographic locations that are more suitable to system management applications.

A primary corridor defines a segment of roadway that represents a greater need for action plan projects. That need is driven by whether there are a significant number of traffic signals, serves as an alternate route, transit route, freight route, is a high crash facility, and/or is affected by special events. A primary corridor designation does not automatically mean that all action plan projects would be implemented on the corridor.

A secondary corridor represents a segment of roadway that is a lesser priority for action plan projects. It typically represents a corridor with very few traffic signals, may be a transit or freight route but one and not both, low crash rate, and does not serve as an alternate route or special event roadway. Action plan projects would be provided on these routes only if it directly served another primary corridor or if primary corridors have been implemented to the fullest extent. The primary and secondary corridors in the region are identified in Figure 1.

ACTION PLAN PROJECTS

Clackamas County has implemented a significant number of ITS projects since the original ITS plan was completed in 2003. The list to right documents the completed projects from the original plan.

Completed ITS Projects (2003-2011)

1. Central Signal System and Clackamas County Traffic Operation Center
2. Traffic Signal Equipment Upgrades
3. Regional Arterial/Freeway Surveillance and Management at Sunnyside Road/I-205 Southbound Off-Ramp
4. Arterial Surveillance and Management – Phase 1, Phase 2, and Phase 3 on Sunnyside Road (from 82nd Avenue to 172nd Avenue) and 172nd Avenue (from Sunnyside Road to Hwy 212)
5. Harmony Road Arterial Surveillance and Management – Design Phase
6. Advanced Pedestrian Crossings
7. Traveler Information Website (http://www.clackamas.us/travel/)
8. Weather Information Stations at Johnson Creek Boulevard, Wally Road in Boring, Hwy 26 at Hoodland
9. Fiber Optic Cable Connection between ODOT and Clackamas County at Sunnybrook and Oregon City (I-205 to Red Soils Building)
10. Fiber Optic Cable Connection on Monterey Avenue from 82nd Avenue to Bob Schumacher Road
11. Connect City of Wilsonville to Regional Fiber Network via Wilsonville Road – 2011/2012 Broadband Innovation Initiative
12. Connect City of Milwaukie to Regional Fiber Network – 2011/2012 Broadband Innovation Initiative
13. Connect City of Oregon City to County Fiber Network
14. Traffic Responsive Implementation on Sunnyside Road (From 86th

The remaining projects were re-evaluated based on the County's needs, and new projects were identified to address the needs. Table 3 provides a complete list of the proposed action plan projects and supporting ITS projects are presented in Table 4. The supporting projects refer to projects that either support the deployment of ITS strategies such as communications infrastructure, or projects that would be led by another agency.

Figure 2 and Figure 3 illustrate the proposed equipment deployment locations for the ITS projects including communications, traffic signals and monitoring cameras.

Adaptive signal timing corridors, enhanced signal corridor operations, and integrated corridor management projects are shown on Figure 4, Figure 5, and Figure 6 respectively.

The project list is organized under the six functional categories. The project numbers are used for reference purposes only and do not solely indicate project priority. The following information is described for each action plan project:

- Strategy
- Project Number (for reference)
- Project Title
- Project Description
- Priority (High, Medium, or Low)
- Relativity to Other Planned Projects
- Project Dependencies
- Capital Costs/O&M Costs
- Expected Benefits
- Technical and Institutional Feasibility
- Status

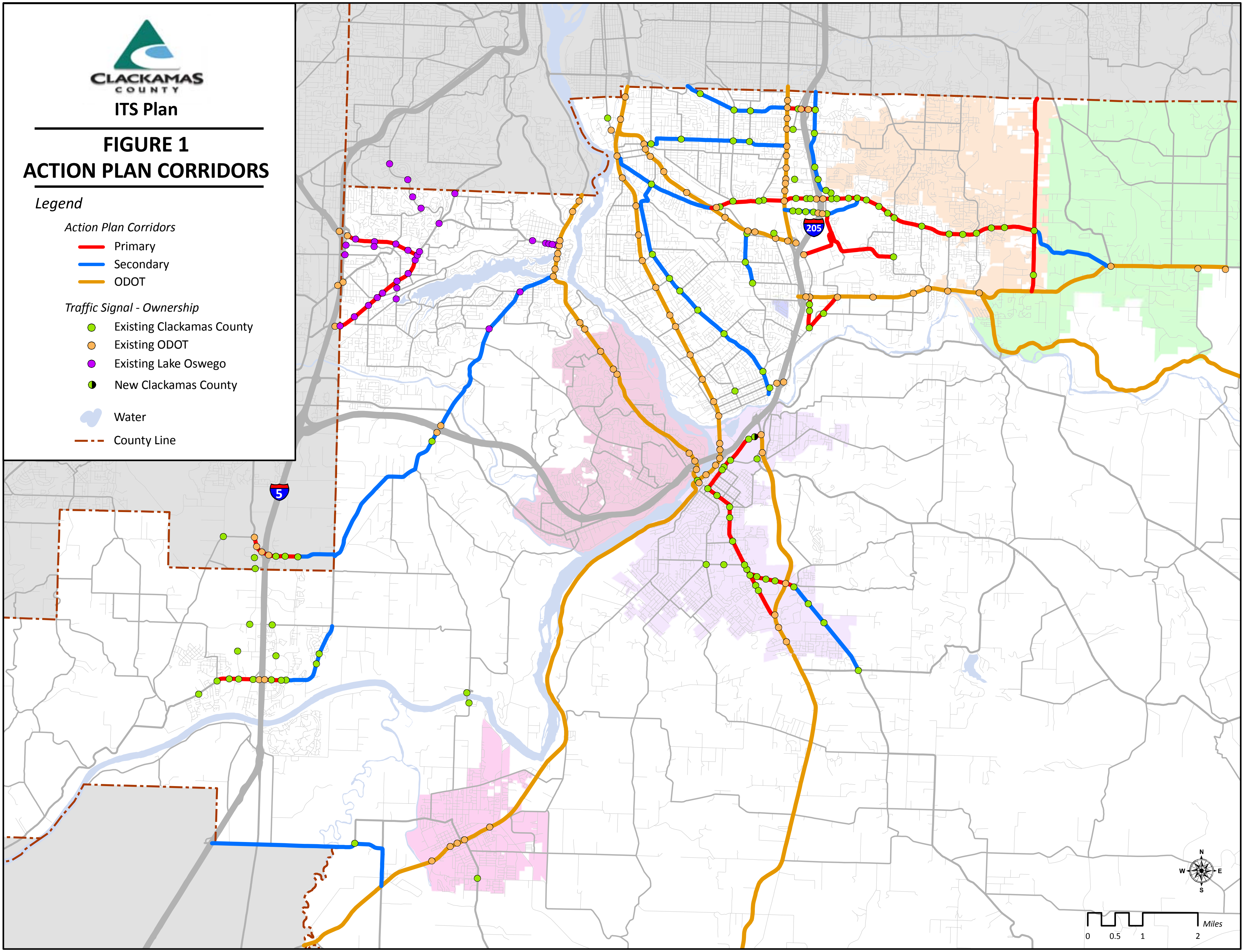
Priorities were assigned to each project based on input from the County, relativity to other planned projects, needs addressed, and equitable distribution of projects.

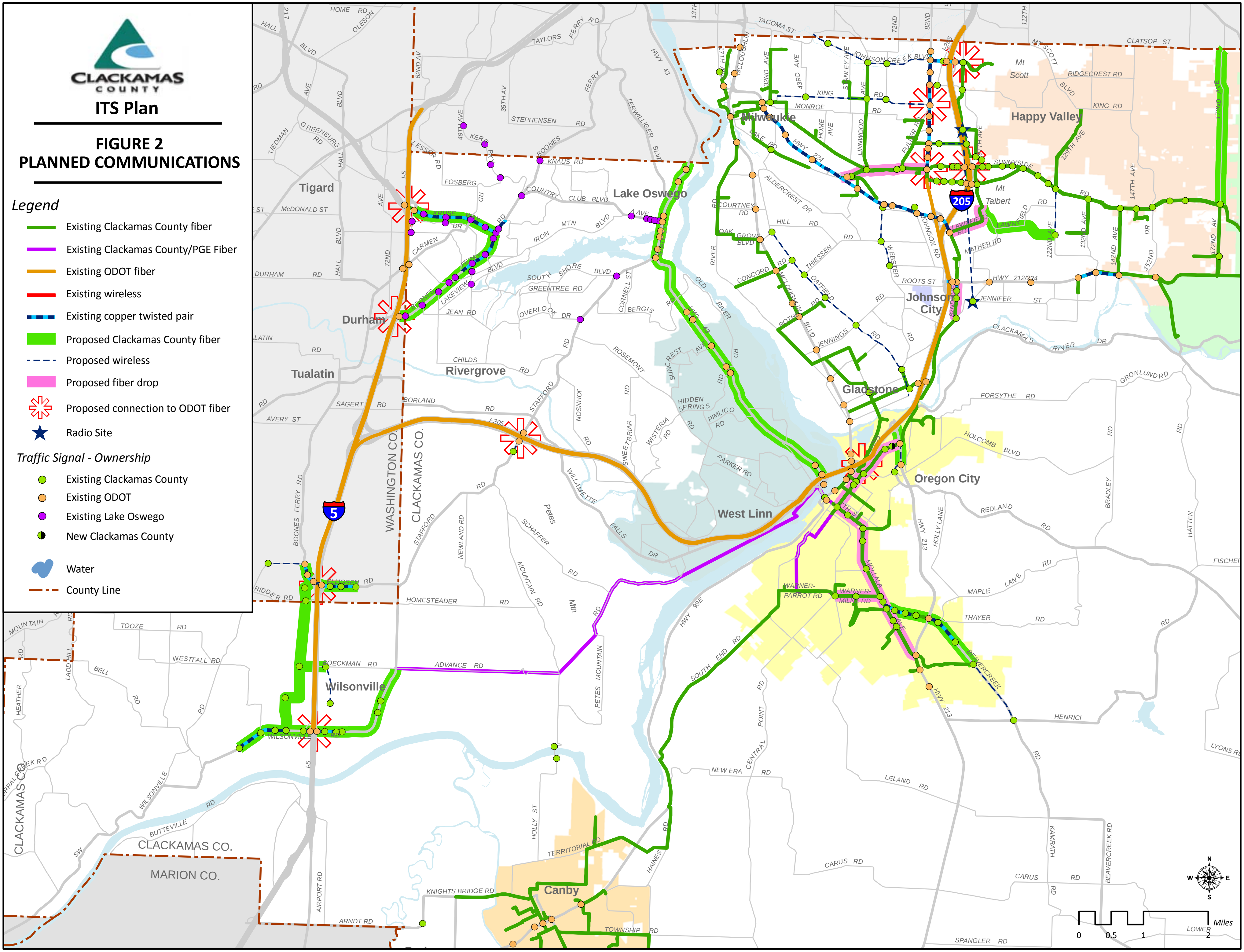
The cost estimates included with each project are based on past ITS project experience and costs found through various ITS studies that have been performed through the Federal Highway Administration (FHWA) and ITS America. The cost associated with each project includes a 20 percent mark-up for design.

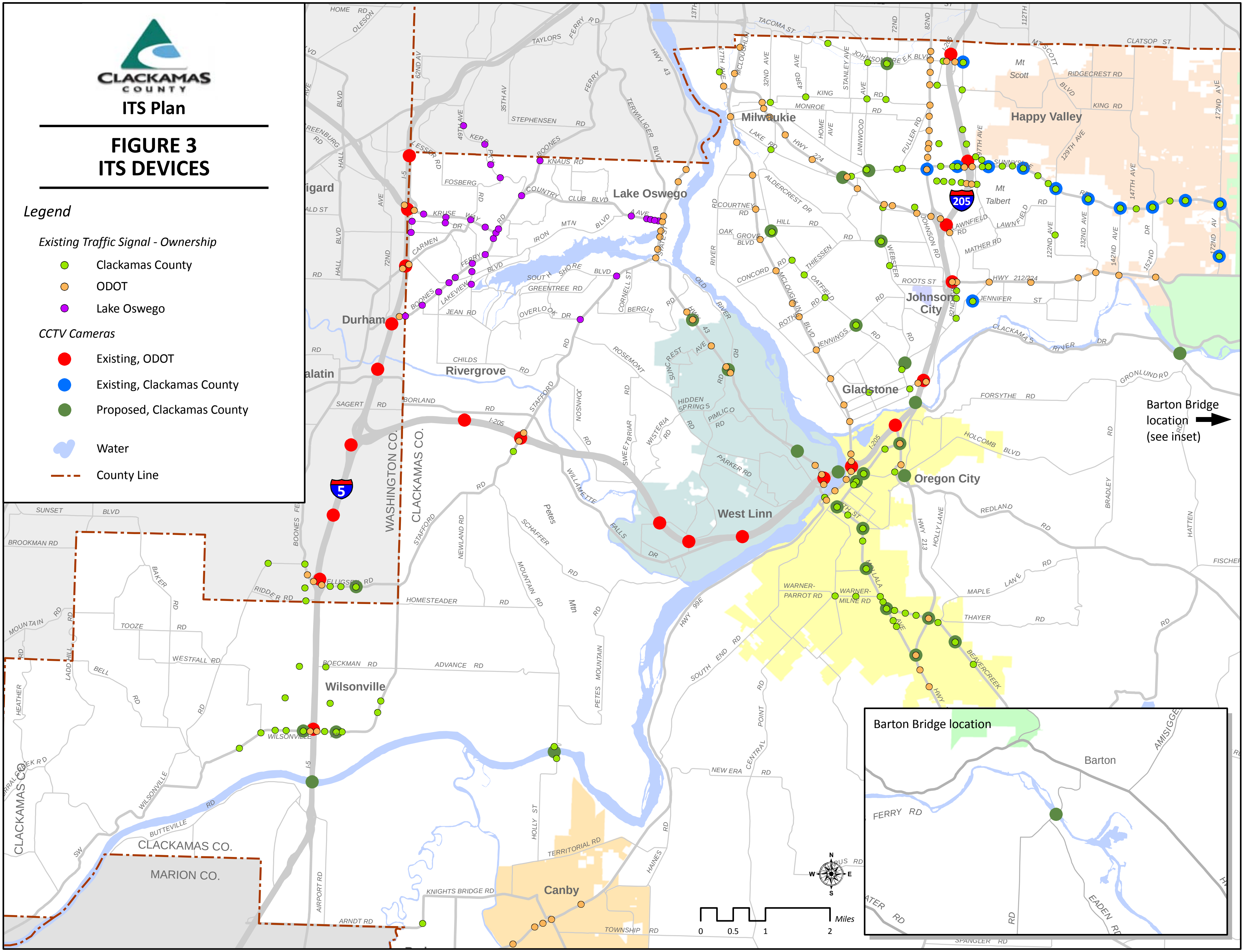
CLACKAMAS COUNTY

ITS Plan

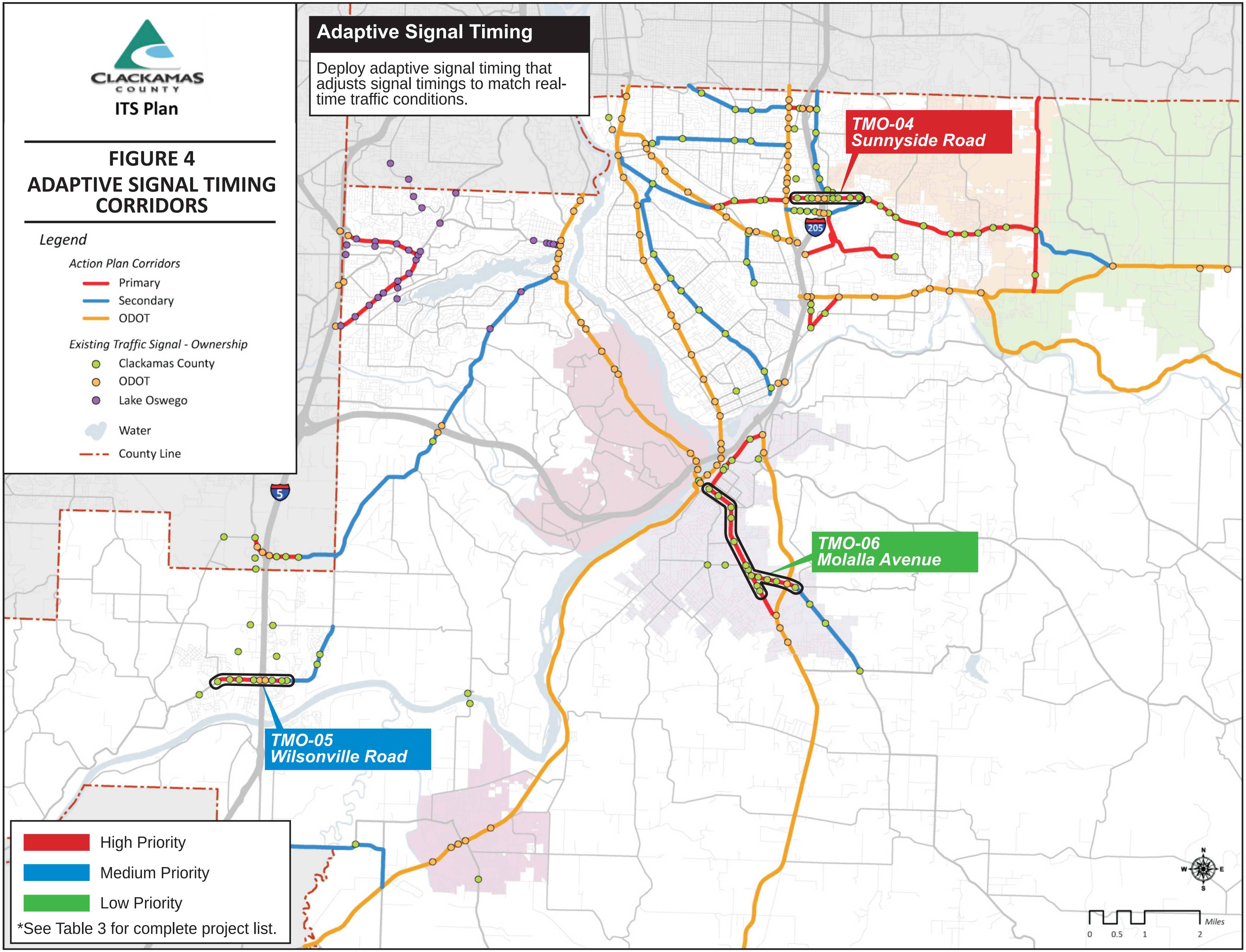
FIGURE 1 ACTION PLAN CORRIDORS




CLACKAMAS COUNTY
ITS Plan
FIGURE 2
PLANNED COMMUNICATIONS
Legend
Existing Clackamas County fiber
Existing Clackamas County/PGE Fiber
Existing ODOT fiber
Existing wireless
Existing copper twisted pair
Proposed Clackamas County fiber
Proposed wireless
Proposed fiber drop
Proposed connection to ODOT fiber
Radio Site
Traffic Signal - Ownership
Existing Clackamas County
Existing ODOT
Existing Lake Oswego
New Clackamas County
Water
County Line
Tigard
Durham
Tualatin
Rivergrove
Lake Oswego
Milwaukie
Happy Valley
Mt Scott
Mt Talbert
Johnson City
Gladstone
West Linn
Oregon City
Wilsonville
Canby
WASHINGTON CO.
CLACKAMAS CO.
MARION CO.
Miles
0
0.5
1
2

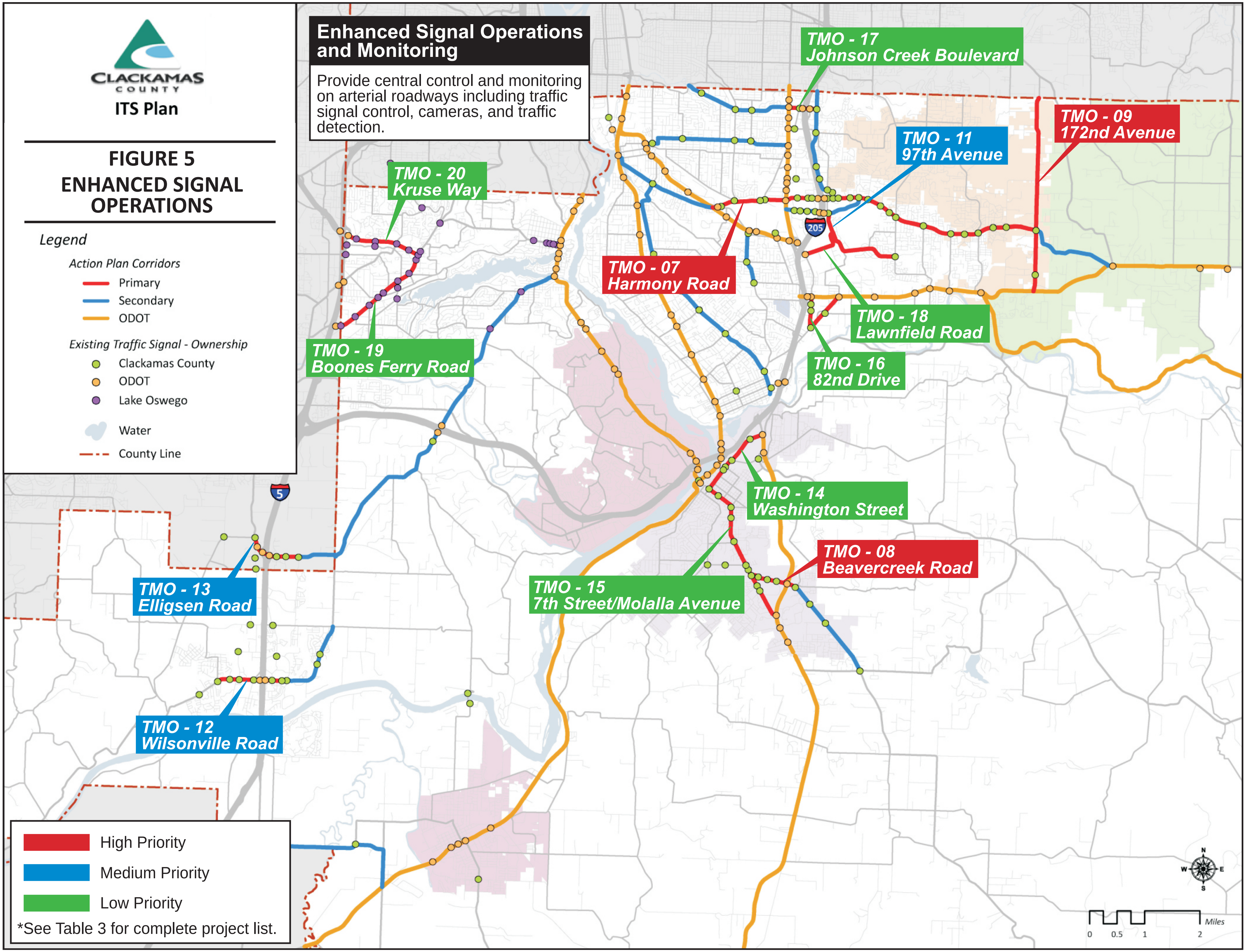


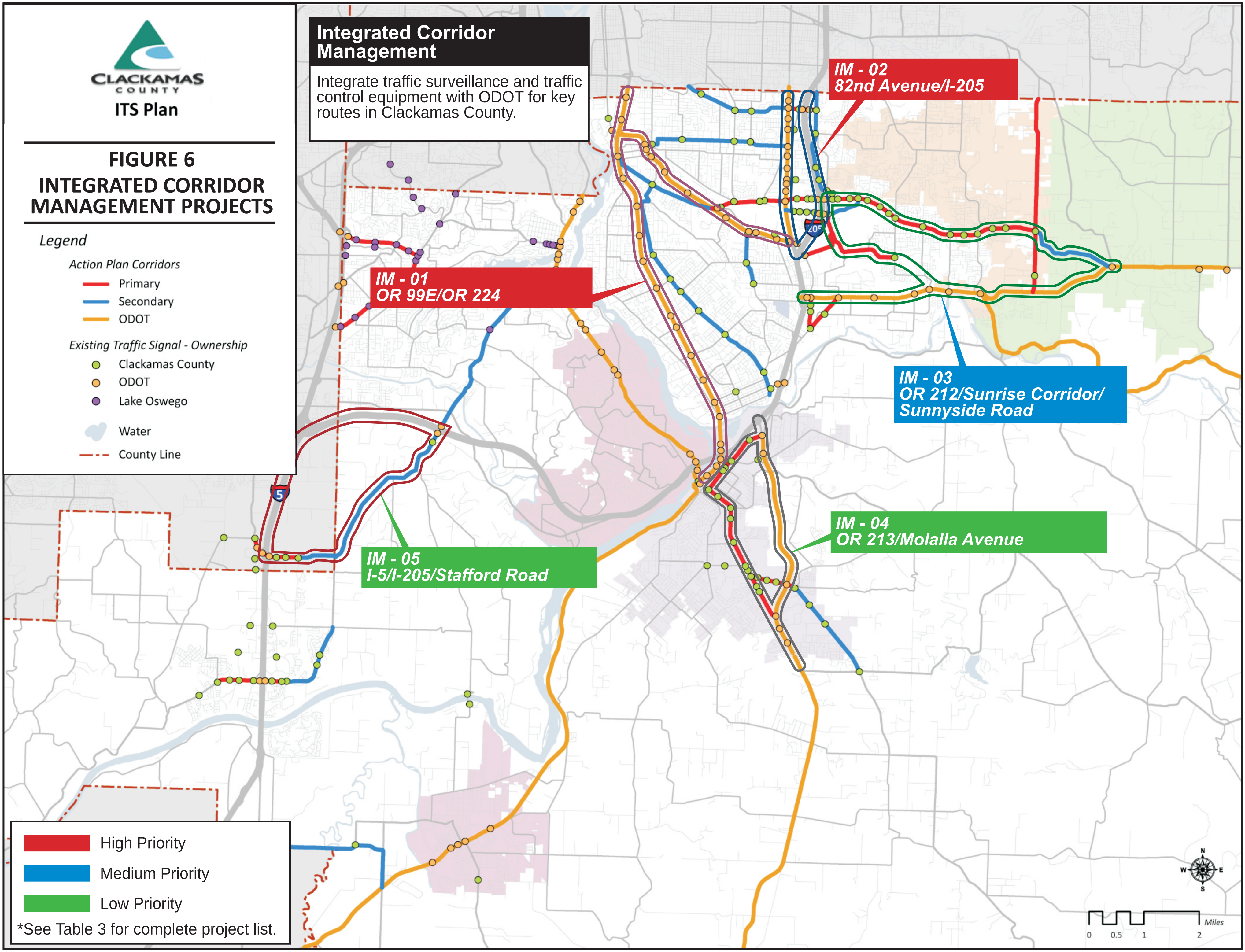
ITS Plan
FIGURE 3
ITS DEVICES
Legend
Existing Traffic Signal - Ownership
Clackamas County
ODOT
Lake Oswego
CCTV Cameras
Existing, ODOT
Existing, Clackamas County
Proposed, Clackamas County
Water
County Line
Milwaukie
Happy Valley
Lake Oswego
Mt Scott
Mt Talbert
Durham
Johnson City
Rivergrove
Gladstone
Oregon City
West Linn
Wilsonville
Canby
WASHINGTON CO.
CLACKAMAS CO.
MARION CO.
Barton Bridge location (see inset)
Barton Bridge location
Barton
Miles
0
0.5
1
2



CLACKAMAS COUNTY
ITS Plan
FIGURE 4
ADAPTIVE SIGNAL TIMING CORRIDORS
Legend
Action Plan Corridors
Primary
Secondary
ODOT
Existing Traffic Signal - Ownership
Clackamas County
ODOT
Lake Oswego
Water
County Line
Adaptive Signal Timing
Deploy adaptive signal timing that adjusts signal timings to match real-time traffic conditions.
TMO-04
Sunnyside Road
TMO-06
Molalla Avenue
TMO-05
Wilsonville Road
5
205
High Priority
Medium Priority
Low Priority
*See Table 3 for complete project list.
N
W
E
S
0
0.5
1
2
Miles

FIGURE 5 ENHANCED SIGNAL OPERATIONS





CLACKAMAS COUNTY
ITS Plan
FIGURE 6
INTEGRATED CORRIDOR MANAGEMENT PROJECTS
Legend
Action Plan Corridors
Primary
Secondary
ODOT
Existing Traffic Signal - Ownership
Clackamas County
ODOT
Lake Oswego
Water
County Line
Integrated Corridor Management
Integrate traffic surveillance and traffic control equipment with ODOT for key routes in Clackamas County.
IM - 01
OR 99E/OR 224
IM - 02
82nd Avenue/I-205
IM - 03
OR 212/Sunrise Corridor/ Sunnyside Road
IM - 04
OR 213/Molalla Avenue
IM - 05
I-5/I-205/Stafford Road
5
205
High Priority
Medium Priority
Low Priority
*See Table 3 for complete project list.
N
W
E
S
0
0.5
1
2
Miles

Table 3: Proposed Implementation Projects

Strategy	Project Number	Project Title	Project Description	Priority	Relativity to Planned Projects	Project Dependencies	Capital Costs/ O&M Costs[1]	Expected Benefits	Technical and Institutional Feasibility	Status
Traffic Management and Operations										
Regional Multi-Agency TOC	TMO-01	Integrate Clackamas County Traffic Operations Center (TOC) with ODOT Traffic Management Operations Center (TMOC)	Project provides an interface to the traffic operations center software used at the ODOT Region 1 Traffic Operations Center.	H	Project supports integrated corridor management functions.	Project requires upgrades to the ODOT traffic operations center software to support additional users.	$10,000/ $500	- Information sharing capabilities - Coordinated response to incidents and special events.	Feasible. The physical network infastructure is in place, but reqiures a software interface.	Partially Completed
Traffic Management Software	TMO-02	Develop Countywide Public Agency System Management Software	Provide real-time information on transportation network status and current emergencies within the County with an emergency management application. The system could include: * Emergency vehicle locations * Active incident locations * Active construction * Traffic incidents * Power outages * Maintenance vehicle locations Develop traffic management software to communicate with emergency management agencies. The software will also allow the County to log incidents and include data such as when the crash occurred, duration, number of lanes blocked, and signal timing adjustments.	H	Project facilitiates emergency response and management county-wide. This system enables real-time emergency and incident information sharing.	Requires commitment from other County users including strong involvement from information technology.	$900,000/ $1,000	- Provides real-time information at the TOC so traffic operations engineers can monitor the on-street conditions with the cameras, make signal timing adjustments and post messages on variable message signs. - Traffic engineers can also post incident information to the site to share it with other County emergency response personnel.	Requires information technology involvement and agreement with other agencies to securely provide system access to their data. The City of Salem recently implemented a similar system using a GIS platform called SAFE (Situational Awareness Framework for Events).	
Enhanced Traffic Signal Operations	TMO-03	Connect Traffic Signals to the Central Traffic Signal System	Upgrade traffic signal controllers and establishes communications to the intersections for central control and monitoring. The intersection upgrades also include video detection, transit priority ready Opticom detectors, detection upgrades, and communications network equipment.	H	Project relates to any new signal installations or modifications and arterial management projects.	None	$2,215,000/ $75,000	- Capability for advanced operations and more flexibility - Reduced vehicle delay - Provides technology needed for other ITS projects in this plan	Requires up-to-date inventory of existing traffic signal equipment.	Partially Completed
	TMO-04	Sunnyside Road Adaptive Signal Timing	Deploy adaptive signal timing that adjusts signal timings to match real-time traffic conditions.	H	Other arterial projects with communication cable to support communication to traffic signals in the region.	Requires a communications connection between the central signal system server and each traffic signal. In many cases, requires vehicle detection upgrades	$950,000/ $20,000	- Reduction in stops, fuel consumption, and vehicle delay - Improved travel time on major - arterials Ability to monitor and control traffic control systems in real-time from a remote location	Other agencies within the Portland metropolitan region have successfully implemented adaptive signal control.	
	TMO-05	Wilsonville Road Adaptive Signal Timing		M			$850,000/ $20,000			
	TMO-06	Molalla Avenue Adaptive Signal Timing		L			$1,430,000/ $20,000			
Traffic Surveillance	TMO-07	Harmony Road - OR224 to 82nd Avenue	Install video monitoring cameras and vehicle detection equipment to provide: * turn movement counts * hourly volumes * travel times * speed	H	Related to enhanced traffic signal operations projects	Requires fiber drops from exsiting fiber on Harmony Road. Connection to the Couty CCS requires an interface to Sunnyside Road fiber at 82nd Avenue.	$430,000/ $30,000	- Integration of multi-jurisdictional arterial systems - Improved safety and efficiency of arterial corridors, therefore reducing delay and emergency response times - More effective traffic management, incident management, and maintenance management - Timely and cost-effective complaint response - Increase in information available to travelers through VMS and the website - Availability of additional volume, speed, and occupancy data		
	TMO-08	Beavercreek Road - Molalla Avenue to Maple Lane		H		Project includes fiber optic cable from Beavercreek to the County center.	$560,000/ $18,000		Recent and upcoming improvements on Molalla Avenue will tie in well with this project.	Partially Completed
	TMO-09	172nd Avenue - OR212 to County Line		H		Requires a communications connection to Sunnyside Road. Communications to future traffic signals along 172nd should be included in the intersection construction.	$550,000/ $15,000			
	TMO-10	Sunrise Corridor - Interstate 205 to 122nd Avenue		H		New project. If project includes fiber optic cable it should interface to ODOT fiber on I-205.	$345,000/ $15,000			

Table 3: Proposed Implementation Projects

Strategy	Project Number	Project Title	Project Description	Priority	Relativity to Planned Projects	Project Dependencies	Capital Costs/ O&M Costs[1]	Expected Benefits	Technical and Institutional Feasibility	Status
Traffic Management and Operations (Cont.)										
Traffic Surveillance (Cont.)	TMO-11	97th Avenue/Mather Road - Sunnybrook Boulevard to 122nd Avenue	Install video monitoring cameras and vehicle detection equipment to provide: * turn movement counts * hourly volumes * travel times * speed	M	Related to enhanced traffic signal operations projects	Requires new communications along Mather Road and a connection to the existing CC fiber at Sunnybrook Boulevard.	$375,000/ $11,000	- Integration of multi-jurisdictional arterial systems - Improved safety and efficiency of arterial corridors, therefore reducing delay and emergency response times - More effective traffic management, incident management, and maintenance management - Timely and cost-effective complaint response - Increase in information available to travelers through VMS and the website - Availability of additional volume, speed, and occupancy data	Close proximity of ODOT fiber on I-5 provides easy link to field equipment.	
	TMO-12	Wilsonville Road - Brown Road to Town Center Loop East		M		Requires communication connection to ODOT's fiber at I-5. Assume communications to County CCS uses ODOT fiber on I-5 and I-205 and CC fiber on Molalla Avenue. Project will require patching fibers on existing ODOT fiber. Project assumes ODOT will allocate fibers for CC use.	$700,000/ $21,000			
	TMO-13	Elligsen Road - Day Road to Canyon Creek Road		M		Requires communication connection to ODOT's fiber at I-5. Assume communications to County CCS uses ODOT fiber on I-5 and I-205 and CC fiber on Molalla Avenue. Project will require patching fibers on existing ODOT fiber. Project assumes ODOT will allocate fibers for CC use.	$500,000/ $15,000		Strategies for ODOT corridors must be coordinated with ODOT.	
	TMO-14	Washington Street - 7th Street to OR213		L		Requires fiber drops from exsiting fiber on Washington Street.	$430,000/ $16,000			
	TMO-15	7th Street/Molalla Avenue - Washington Street to OR213		L		Requires fiber drops from exsiting fiber on 7th Street and Molalla Avenue.	$775,000/ $25,000		This project can be incorporated with planned capital improvements.	
	TMO-16	82nd Drive - OR224 to Jennifer Street		L		Requires fiber drops from exsiting fiber on 82nd Drive.	$385,000/ $14,000		Close proximity of ODOT fiber on I-5 provides easy link to field equipment.	
	TMO-17	Johnson Creek Boulevard - 82nd Avenue to 172nd Avenue		L		Project would install fiber to these traffic signals and connect to the existing fiber on 97th Avenue.	$500,000/ $19,000			
	TMO-18	Lawnfield Road - 82nd Drive to 97th Avenue		L		Communications to Lawnfield could interface to ODOT fiber on I-205 or CC fiber on Sunnybrook Boulevard. In either case, the connection distance to existing fiber is less than 1/4 mile.	$55,000/ $2,000			
	TMO-19	Boones Ferry Road - Interstate 5 to Kruse Way		L		Requires communicatoins connection to ODOT fiber at I-5. Assume communications to County CCS uses ODOT fiber on I-5 and I-205. Requires patching fibers on existing ODOT fiber. Project assumes ODOT will allocate fibers for CC use.	$900,000/ $25,000		Parts of this project can be incorporated with planned capital improvements, particularly on Boones Ferry Road.	
	TMO-20	Kruse Way - Interstate 5 to Boones Ferry Road		L		Requires communicatoins connection to ODOT fiber at I-5. Assume communications to County CCS uses ODOT fiber on I-5 and I-205. Requires patching fibers on existing ODOT fiber. Project assumes ODOT will allocate fibers for CC use.	$600,000/ $18,000			

Table 3: Proposed Implementation Projects

Strategy	Project Number	Project Title	Project Description	Priority	Relativity to Planned Projects	Project Dependencies	Capital Costs/ O&M Costs[1]	Expected Benefits	Technical and Institutional Feasibility	Status
Traffic Management and Operations (Cont.)										
Railroad Crossing Alert System	TMO-21	South Pacific RR crossings in Milwaukie and Oregon City	Detect an approaching train and provide advance information to emergency management personnel and travelers to allow them to make an informed decision about route choice.	M	None	None	$360,000/ $14,000	- Enhanced safety - Real-time railroad activity information - Alternate route information for travelers - More efficient allocation of emergency response vehicles - Reduced emergency response times - More efficient transit routing	May be difficult to coordinate with railroad companies for the deployment of detectors within railroad right-of-way. County may be able to place detectors outside of the railroad right-of-way if the railroad companies are not cooperative.	
	TMO-22	P&W RR crossings in Milwaukie and Wilsonville		M	None	None	$360,000/ $14,000			
	TMO-23	P&W RR crossings in Lake Oswego		L	None	None	$570,000/ $25,000			
Rural Safety Applications	TMO-24	Rural Highway Safety Improvements	Deploy LED warning signs at select locations on rural highways to alert drivers of hazardous conditions and dangers.	M, L	None	None	$125,000/ $5,000	- Reduced crashes	LED stop signs and curve warning signs are emerging. Technology is feasible.	
	TMO-25	Dynamic Speed Control	Deploy variable message signs to display a lower speed limit at specific times or to provide real-time speed feedback to travelers. Locations for dynamic speed control include select school crossings, construction zones, and severe weather locations.	M, L	None	None	$140,000/ $3,000	- Improved safety	Requires new electronic message signs and training maintenance staff.	
Multi-Modal Operations										
Transit Signal Priority	MMO-01	82nd Avenue (ORE 213), Sunnyside Road, McLoughlin Boulevard (ORE 99E), Molalla Avenue	Provide priority at traffic signals for buses behind schedule. This includes the use and deployment of Opticom detectors at traffic signals and emitters on buses.	H	TriMet's bus dispatch system upgrades and traffic signal equipment upgrades.	Requires upgrade to 700 series Opticom detectors and discriminators and 2070 controllers and HC11 processors if this has not already been done as part the traffic signal equipment upgrades project. SMART will need to install emitters on their transit fleet before transit signal priority may be implemented in the City of Wilsonville. (SMART has plans to do this in the future.)	$850,000/ $13,000	- Reduced transit delay - Schedule adherence and reliability - Reduced operational costs - Enhanced transit service - Increased ridership	TriMet and the City of Portland have successfully deployed the technology on several corridors in the City of Portland.	
	MMO-02	Milwaukie Expressway (ORE 224), State Street (ORE 43), King Road		M			$515,000/ $8,000			
	MMO-03	Kruse Way, Country Club Boulevard, Webster Road		L			$345,000/ $5,000			
Pedestrian and Trail Crossing Improvements	MMO-04	Advanced Pedestrian Crossings	Install active pedestrian crossing devices to improve safety at select pedestrian crossings. Equipment may include accessible pedestrian pushbuttons, pedestrian countdown timers, rectangular rapid flash beacons, or passive pedestrian detection.	H, M, L	This project may be coordinated with upgrade traffic signal equipment for crossings at traffic signals or with one of the traffic surveillance and management projects for crossings on major arterials.	None	$300,000/ $6,000	- Improved pedestrian safety - Pedestrian satisfaction	Other agencies within the Portland metropolitan region have successfully implemented advanced pedestrian crossings.	Partially Completed
Bicycle Enhancements	MMO-05	Bicycle Specific Signal Timing	Install bicycle detection and implement traffic signal timing to support bicycle movements on major bicycle routes. Traffic signal timings could include minimum greens long enough to support bicycle movements through the intersection and clearance times calculated for bicycle speeds.	H, M	This project may be coordinated with upgrade traffic signal equipment for crossings at traffic signals or with one of the traffic surveillance and management projects for crossings on major arterials.	None	$190,000/ $15,000	- Reduces bicycle stops and delay - Potential to improve bicycle travel time reliability - Increases safety	Other agencies within the Portland metropolitan region have successfully implemented bicycle specific traffic signals systems.	
Traveler Information										
Traveler Information and Community Outreach	TI-01	Traveler Information Website	Expand the existing Clackamas County traveler information website to include: * Additional video camera images * Traffic congestion information	H	Regional transportation website, regional arterial management and surveillance, and incident management	Depends on deployment of field equipment (vehicle detectors, video cameras, weather stations, etc...) to collect traveler information.	$95,000/ $20,000	- Real-time and static traveler information - Pre-trip planning capabilities that allow users to make informed travel decisions - Reduced congestion and delay - Customer satisfaction	Clackamas County has staff capable of maintaining the web site.	Partially Completed
Predictive Traveler Information	TI-02	Predictive Traveler Information	This project is a regional initiative that will develop models and tools that can predict travel conditions and provide regional predictive traveler information to the public.	L	Regional traveler information and the regional data warehouse	Depends on deployment of field equipment, communications to field devices, and arterial surveillance and management.	$300,000/ $68,000	- Increased traveler information - Support incident corridor management	This deployment may ultimately be a private sector initiative. Regional coordination on arterial and freeway operations is needed. WSDOT currently predicts travel times by time of day for major holidays.	

Table 3: Proposed Implementation Projects

Strategy	Project Number	Project Title	Project Description	Priority	Relativity to Planned Projects	Project Dependencies	Capital Costs/ O&M Costs[1]	Expected Benefits	Technical and Institutional Feasibility	Status
Data Collection and Management										
Regional Data Warehouse	DCM-01	Integrate County Transportation Data with the PORTAL Regional Data Warehouse	Automate data transfer to the Portland area regional data warehouse at PSU.	H	Regional multi-agency TOC and traveler information	Requires enough traffic data to be collected spatially and temporally to be meaningful. Field devices should collect data that supports performance measures and takes advantage of the tools provided in PORTAL.	$380,000/ $20,000	- Improved resources for regional modeling, research, analysis, planning and design - Reduced cost of data collection	This project will make use of data already collected or planned from collection with the deployment of field devices.	
Innovative Data Collection	DCM-02	Automate Performance Measures	Collect and store data at key intersections and roadways. Field devices should be capable to collect travel times, travel time reliability, and other performance measures.	H	The traffic surveillance and enhanced traffic signal operatoins projects may install detection equipment to support this project.	Requires communication from the field devices to the Clackamas County TOC	$570,000/ $20,000	- More effective real-time traffic management - Traffic data available for performance monitoring	Project supports traffic congestion monitoring and traffic counting for planning purposes.	
Data Collection	DCM-03	Portable Data Analysis	Project will allow the County to temporarily set up portable data analysis equipment such as a camera/VCR or traffic count tubes to record data for analysis and development of traffic operations improvements. This will aid the County in monitoring high incident locations, collecting traffic count data, and investigating traffic issues.	M, L	None	Locations for portable data analysis will be based on System Priority Index System (SPIS) scores for high crash locations, traffic count data needs, or monitoring needs. Portable data analysis will not be required at sites where CCTV cameras are planned for installation.	$320,000/ $1,000	- Inexpensive data collection and monitoring capabilities - Data analysis tools that can be used to improve safety and efficiency	Maintenance staff have skills with video detection and County staff have expressed interest in using this equipment for traffic analysis.	
Incident and Emergency Management										
Integrated Corridor Management ICM	IM-01	OR 99E/Hwy 224 ICM	Integrate traffic surveillance and traffic control equipment with ODOT for key routes in Clackamas County.	H	Clackamas County traffic surveillance and traffic signal system projects. ODOT traffic management projects	Requires communications to field devices. Some field devices or communications equipment may be installed as part of other arterial surveillance and management projects.	$690,000/ 25,000	- Availability of real-time freeway and arterial corridor information during incidents - Increased capacity and throughput during incident conditions - Improved integration of regional freeway systems with local signal systems - Reduction in congestion and delay due to incidents - Reduced incident response times Improved safety and efficiency	Project needs to be coordinated with ODOT.	
	IM-02	82nd Avenue/I-205 ICM		H			$725,000/ 26,000			Partially Completed
	IM-03	Hwy 212/Sunrise Corridor/Sunnyside Road ICM		M			$350,000/ $15,000			Partially Completed
	IM-04	OR 213/Molalla Avenue ICM		L			$1,690,000/ $62,000			
	IM-05	I-5/I-205/Stafford Road ICM		L			$750,000/ $20,000			
Emergency and Traffic Management Integration	IM-06	Regional Emergency Operations Center (EOC) Integration	Install traffic information dissemination infrastructure at Emergency Operations Centers (EOC) to provide real-time information to emergency managers during disasters/major incidents.	M	Public safety integration and transportation system management software	The Clackamas County Emergency Operations Center (EOC) is located in the same building as C-COM, so once a communications connection has been established from the regional communications network to C-COM, it will only require a small amount of communications and equipment to link to the EOC.	$80,000/ $7,000	- Improved real-time traffic conditions information - Information sharing between agencies - More efficient allocation of emergency response resources - Reduced emergency response times	The Public Safety Integration project will provide the basis for the deployment of regional emergency operations center integration.	
	IM-07	Traffic Adaptive Emergency Response	Deploy an integrated emergency response system that provides for pre-trip planning, en-route guidance (static route plan), and dynamic route guidance (traffic-adaptive route plan) for emergency vehicles.	M	Public safety integration and emergency vehicle fleet management system	Depends on real-time traffic information availability and a communications connection between the regional communications network and the 911 centers. Automatic vehicle locators (AVL) are also required for dynamic route guidance.	$640,000/ $270,000	- Increased traveler information tailored to emergency management purposes - Reduced emergency response times	As 911 centers are connected to the regional communications network, real-time traffic information may be provided at the dispatcher's workstation.	

Table 3: Proposed Implementation Projects

Strategy	Project Number	Project Title	Project Description	Priority	Relativity to Planned Projects	Project Dependencies	Capital Costs/ O&M Costs[1]	Expected Benefits	Technical and Institutional Feasibility	Status
Maintenance and Construction Management										
Work Zone Management	MCM-01	Smart Work Zone Equipment	Provide a portable traffic management system including portable dynamic message signs, traffic sensors, video cameras and electronic driver feedback signs to notify motorists of their speed approaching work zones, travel times, and delays for County-constructed projects.	M, L	Dynamic speed control and predictive traveler information	None	$155,000/ $4,000	- Improved construction zone safety and efficiency - Heightened safety awareness through driver feedback	New equipment and training would be required for implementation of this project.	
Road and Weather Management	MCM-02	Mt. Scott, Ladd Hill, Warner Milne Rd/Linn Ave, ORE 213/Beavercreek RWIS	Install Road Weather Information Stations that provide temperature, road conditions, and a video image.	H	None	None	$390,000/ $16,000	- Real-time weather and pavement conditions - More efficient allocation of maintenance resources during inclement weather	Requires new technology for the County, but supports maintenance crew functions. ODOT has experience with weather stations and is a good resource.	Partially Completed
	MCM-03	Marmot, Lolo Pass RWIS		M			$200,000/ $8,000			
Flood/Slide Warning System	MCM-04	Flood Warning System	Link the Clackamas County Traffic Operations Center (TOC) to US Geological Survey (USGS) flood data to monitor potential flood locations and to provide related traveler information.	L	Could be a part of the Clackamas County Transportation System Management Software Project	In order to provide traveler information, variable message signs and/or the Clackamas County traveler information website would need to be in place.	$350,000/ $8,000	- More effective traffic management, incident management, and maintenance management - Improved safety and efficiency - Increase in traveler information	The USGS already collects real-time river and stream data in the region. Clackamas County would need to include this data as part of their monitoring duties at the Traffic Operations Center (TOC).	

[1] Costs include Engineering, Construction Management, and Construction.

Table 4: Supporting Projects

Project Title	Project Description	Priority	Relativity to Planned Projects	Project Dependencies	Capital Costs/ O&M Costs[1]	Expected Benefits	Technical and Institutional Feasibility	Status
Communications Network	Provide a communications network throughout Clackamas County to allow communications between regional agencies and between the Clackamas County Traffic Operations Center (TOC) and ITS devices in the field.	H, M, L	This project is relative to most of the projects included in this ITS Plan.	Each piece of the communications network is dependent on the pieces that link the communications line and field equipment back to the Clackamas County Traffic Operations Center (TOC) or ODOT.	$925,000/ $100,000 Does not include costs for communications infrastructure installed as part of other projects in this table.	- Connection between Clackamas - County and other regional agencies will allow for multi-jurisdictional control, management, coordination, and information sharing - Connection to ITS field devices allows for innovative strategies such as arterial management and incident management	Requires County to purchase fiber optic maintenance tools and train staff to maintain fiber.	Partially Completed
Connect City of Wilsonville to Regional Fiber Network	Install a fiber optic cable connection between ODOT's fiber on I-5 and the City of Wilsonville's engineering offices on Elligsen Road.	M	None		$650,000/ $18,000	- Connection between Clackamas - County and the City of Wilsonville will allow for multi-jurisdictional control, management, coordination, and information sharing	Other communications projects will include fiber optic maintenance tool purchases and staff training.	
Connect City of Milwaukie to Regional Fiber Network	Install a fiber optic cable connection between the Clackamas County offices on Sunnybrook Boulevard and the City of Milwaukie's engineering offices on Johnson Creek Boulevard.	M	None	Depends on fiber installation along 82nd Avenue.	$355,000/ $7,500	- Connection between Clackamas - County and the City of Milwaukie will allow for multi-jurisdictional control, management, coordination, and information sharing	Other communications projects will include fiber optic maintenance tool purchases and staff training.	
Emergency Vehicle Fleet Management System	Installation of automatic vehicle locators (AVL) on emergency vehicles and dissemination of real-time emergency vehicle locations to dispatchers at the 911 centers for resource allocation.	M	None	None	$700,000/ $30,000	- More efficient management of emergency vehicle fleet - Reduced emergency response times	TriMet currently uses automatic vehicle locators on its transit fleet and will be a valuable resource for project implementation.	
Maintenance Fleet Management System	Installation of automatic vehicle locators (AVL) on maintenance vehicles and dissemination of real-time maintenance vehicle locations to dispatchers at the 911 centers for resource allocation during incidents.	M	None	None	$470,000/ $20,000	- More efficient management of maintenance fleet - Reduced emergency response times when maintenance support is needed	TriMet currently uses automatic vehicle locators on its transit fleet and will be a valuable resource for project implementation.	
Advanced Commercial Vehicle Operator Tracking	Integration with the ODOT Green Light Program by applying detection technologies on roadways for long-range freight planning and commercial vehicle enforcement. This project will include deployment of portable and permanent transponder detection stations that communicate with the transponders carried in many heavy commercial vehicles.	M	ODOT Green Light Program (electronic screening and credentialing)	None	$530,000/ $30,000	- More effective commercial vehicle operations management - More effective commercial vehicle enforcement - Collection of information for use in planning	ODOT has experience with the technology relating to truck transponders. This project will require the County to purchase new equipment and training will be needed for Staff.	
Public Safety Integration	Integrate the three regional 911 centers in Clackamas County with the regional communications network. This project would provide the 911 centers with a direct link to regional traveler information: Clackamas County 911 (C-COM) Gladstone 911 Lake Oswego 911 (LOCOM)	H, M	Communications conduit installation projects.	Assumes Clackamas County will share fiber with ODOT and a communications path can be developed from ODOT's fiber on I-205. A software interface will be required at the 911 centers for access to the Clackamas County Traffic Operations Center (TOC) and the ODOT Traffic Management Operations Center (TMOC).	$200,000/ $15,000	- Improved real-time traffic conditions information - Information sharing between agencies - More efficient allocation of emergency response resources - Reduced emergency response times	ODOT and the Bureau of Emergency Communications (BOEC) are currently working on a proof-of-concept for 911 center integration. Evaluation of this proof-of-concept will help with 911 center integration in Clackamas County.	

[1] Costs include Engineering, Construction Management, and Construction.

IMPLEMENTATION SCHEDULE

The schedule below illustrates the implementation plan for the proposed projects, grouped by strategy. Since priorities and institutional objectives change over time, the implementation plan schedule should be re-evaluated from time to time.

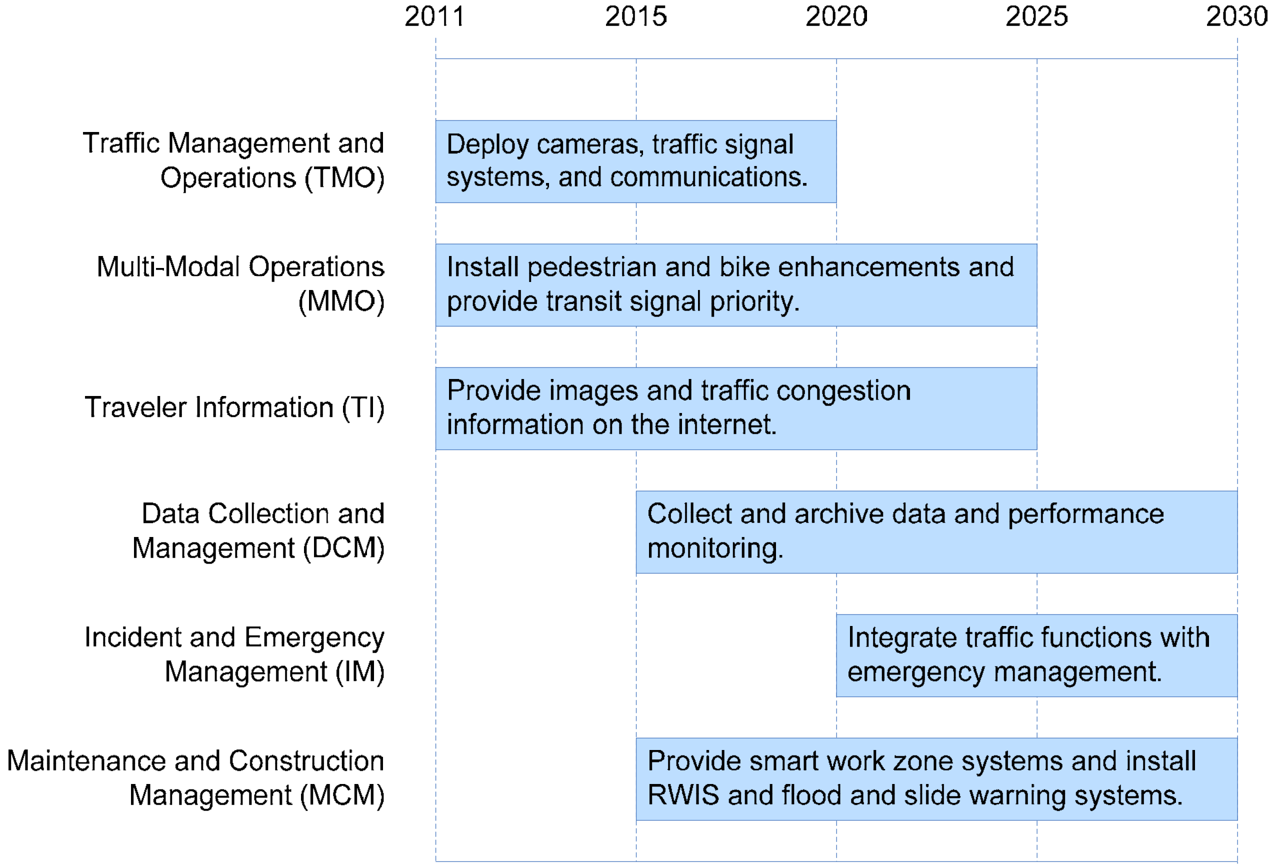


Figure 7: Implementation Schedule

HIGH PRIORITY PLAN PROJECTS

This section provides more detailed descriptions of high priority action plan projects. A total of 15 projects were identified by Clackamas County to explore in more depth. This section provides more details regarding each of these projects. A table describing each project includes the following information:

- Objective
- Description
- Stakeholders
- Communications Requirements
- Phased Plan
- Cost
- Operations and Maintenance
- Needs Addressed
- Benefits

Project TMO-01	Integrate Clackamas County Traffic Operations Center (TOC) with ODOT Traffic Management Operations Center (TMOC)

Objective	Provide access between the Clackamas County traffic management system and the ODOT traffic management system for interagency coordination and information sharing.
Description	With this project, Clackamas County will be able to monitor the functions being entered at the ODOT TMOC, view camera images, and view current messages posted on variable message signs (VMS) throughout the region. Similarly, ODOT will be able to monitor and view the functions at the Clackamas County TOC and view cameras and messages on variable message signs once Clackamas County deploys this equipment and connects it to the TOC. The link between the two traffic management centers opens the door for actively coordinating traffic management responses that involve both agencies 
Stakeholder(s)	Clackamas County – Traffic Management ODOT Region 1 – Traffic Management
Communications Requirements	Clackamas County and ODOT buildings are connected with fiber optic cable today. This project will require a software interface for interaction with ODOT's current TOC software.
Phased Plan	Complete project in the next 5 years
Cost	$10,000 for project deployment/$500 for annual O&M
Operations & Maintenance	Maintenance duties for this project will include upkeep of the fiber optic connection between Clackamas County and ODOT as well as preserving operable software at the Clackamas County TOC.
Needs Addressed	• Need access to information on desktops at the ODOT TMOC, including video feed of existing ODOT CCTV cameras and incident response activity • Need a back-up system in case of disaster
Benefits	• Information sharing between agencies • Monitoring capabilities that allow both Clackamas County and ODOT to make traffic management adjustments to their own facilities and systems based on congestion, incidents, or other activity on facilities owned and managed by the other agency • Back-up capabilities should the TOC or the TMOC become incapacitated • With the communications connection established to the ODOT TMOC, Clackamas County has the ability to share information with other regional agencies with connections to the ODOT TMOC including: City of Portland, WSDOT, City of Gresham, Multnomah County and TriMet

Project TMO-02	Develop Countywide Public Agency System Management Software

Objective	Provide real-time information on transportation network status and current emergencies within the County with public agency system application.
Description	The purpose of the public agency system management software is to provide real-time information about the status of public agency systems. The application could be designed to receive data from local fire, police, emergency agencies, power providers, County maintenance, current construction activity, weather, incidents and other information that would be useful for County personnel responsible for operating and managing the transportation network. This project will develop traffic management software to communicate with emergency management agencies. The software will also allow the County to log incidents and include data such as when the crash occurred, duration, number of lanes blocked, and signal timing adjustments. One example of an emergency management system is the City of Salem's Situational Awareness Framework for Events (SAFE) application developed using ArcGIS Server. SAFE was designed as a Common Operational Picture (COP) with the intent to collect data from multiple sources, automated in such a way that data is received by SAFE, requiring little or no interaction to consume multiple sources. It uses a web browser interface (as shown in the screen shot to the right)  and uses a flexible platform that allows the City of Salem to quickly add new data sources.
Stakeholder(s)	Clackamas County – Traffic Management Emergency Management – 911, Police, Fire
Communications Requirements	Communication will be required between each field device and the owning agency so that information from that device may be transmitted in real time. Existing network infrastructure can be used to provide access to the application.
Phased Plan	Complete project in the next 10 years
Cost	$900,000 for project deployment/$1,000 for annual O&M
Operations & Maintenance	Staffing hours needed to manage software. Maintenance includes keeping the software up to date, and upkeep of field devices and communications between field devices, transportation center and emergency agencies.
Needs Addressed	• Need to alleviate reoccurring traffic congestion from incidents • Need monitoring and incident detection capabilities
Benefits	• Reduce incident detection and response times • More efficient allocation and dispatch of incident responders

Project TMO-03	Connect Traffic Signals to the Central Traffic Signal System

Objective	Provide capability to monitor and manage traffic signals to support regional traffic management strategies.
Description	This project will upgrade traffic signal controllers and establish communications to the intersections for central control and monitoring. This will allow remote data collection, analysis, and real-time signal timing changes that respond to current traffic conditions. The remote access enables County signal operations engineers to efficiently make timing adjustments that reduce delays during incidents, unplanned events, and/or to respond to citizen comments. Plans may be implemented to respond to congested traffic conditions due to time of day, incidents, special events or adverse weather. The intersection upgrades will also include video detection, transit priority ready Opticom detectors, detection upgrades, and communications network equipment. 
Stakeholder(s)	Clackamas County – Traffic Management ODOT
Communications Requirements	Requires communications between the central signal system server and traffic signals.
Phased Plan	Complete project in the next 10 years
Cost	$2,215,000 for project deployment/$75,000 for annual O&M
Operations & Maintenance	Staffing hours needed to manage the Traffic Operations Center (TOC). Duties would include monitoring traffic signal performance and developing special signal plans in response to incidents and special events.
Needs Addressed	• Need to alleviate reoccurring traffic congestion from incidents • Need real-time traffic conditions information • Need communications connection from video detection, traffic signal controllers, and other equipment to County TOC
Benefits	• Capability for advanced operations and more flexibility • Reduced vehicle delay • Provides technology needed for other ITS projects in this plan

Project TMO-04 thru 06	Adaptive Signal Timing

Objective	Deploy adaptive signal timing that adjusts signal timings to match real-time traffic conditions.
Description	Adaptive signal control technologies receive and process traffic condition information from detectors to optimize signal timings. Adaptive signal systems automatically respond to measured traffic conditions and make continual adjustments to the cycle lengths, splits, and offsets to match the traffic needs. Adaptive signal control technologies have the most benefit on corridors with variable or unpredictable traffic demand. Three corridors where adaptive signal control appears appropriate include: • Sunnyside Road • Wilsonville Road • Molalla Avenue 
Stakeholder(s)	Clackamas County – Traffic Management ODOT
Communications Requirements	Requires a communications connection between the central signal system server and each traffic signal. In many cases, requires vehicle detection upgrades.
Phased Plan	Complete project in the next 10 years
Cost	Sunnyside Road: $950,000 for project deployment/$20,000 for annual O&M Wilsonville Road: $850,000 for project deployment/$20,000 for annual O&M Molalla Avenue: $1,430,000 for project deployment/$20,000 for annual O&M
Operations & Maintenance	Staffing hours needed to manage software. Maintenance includes keeping the software up to date, and upkeep of field devices and communications between field devices and transportation center.
Needs Addressed	• Need updated signal timing plans • Need to reduce traffic congestion and delay
Benefits	• Reduction in stops, fuel consumption, and vehicle delay • Improved travel time on major arterials • Ability to monitor and control traffic control systems in real-time from a remote location • Cost effective methods

Project TMO-07 thru 20	Arterial Traffic Surveillance

Objective	Develop and deploy a regional arterial surveillance and management system along several corridors within Clackamas County that provides for traffic-responsive corridor management and sharing of roadside subsystems at major decision points within the corridors.
Description 	This project will deploy additional traffic detection and closed-circuit television (CCTV) systems to provide supporting traffic flow data, incident detection data, and real-time traveler information along arterial roadways. The use of strategically placed system detectors will provide the County with the capability to collect and store traffic counts and to display congestion information on the County traveler information website. The historical count information may be used for planning or to adjust signal timings based on fluctuations in traffic. CCTV camera placement at key intersections provides agency staff with the ability to monitor the roadway for congestion, trouble spots, incidents, equipment failures, and then make real-time adjustments to traffic signal timings. Images from the cameras would be broadcast on the County traveler information website for public traveler information. This information helps improve the efficiency of traffic management, incident management, and operations and maintenance management, which effectively helps improve roadway safety and efficiency.
Stakeholder(s)	Clackamas County – Traffic Management ODOT
Communications Requirements	Varies by project, but all have some new fiber connection required. Some will use or connect to ODOT fiber.
Phased Plan	Complete project in the next 5 to 10 years
Cost	Varies by project: $55,000 to $900,000 for project deployment/$2,000 to 30,000 for annual O&M. Total for all projects: $7,100,000 for project deployment/ $230,000 for annual O&M. See Table 3 for project costs
Operations & Maintenance	County maintenance crews will be responsible for maintaining the new technology (cameras and fiber optic cable and components) deployed as part of this project. Some new maintenance equipment and staff training will be required (equipment to maintain fiber optic communications systems, skills needed to service fiber optic communications systems).
Needs Addressed	• Need remote video and traffic signal status/access to respond to complaints • Need video capabilities at key intersections on major arterials • Need traffic conditions information (i.e., congestion, hazards)
Benefits	• Integration of multi-jurisdictional arterial systems • Improved safety and efficiency of arterial corridors, therefore reducing delay and emergency response times • More effective traffic management, incident management, and maintenance management • Timely and cost-effective complaint response • Increase in information available to travelers through VMS and the website • Availability of additional volume, speed, and occupancy data

Project TMO-24	Rural Highway Safety Improvements

Objective	Two solutions are outlined to address rural highway safety; LED warning systems and dynamic speed control.
Description	Deploy LED warning signs at select locations on rural highways to alert drivers of hazardous conditions and dangers. A light-emitting diode (LED) blinker warning system will be deployed at rural intersections where sight restrictions due to vertical or horizontal curves exist and result in a high accident location.  Three locations were identified from the 2010 Clackamas County SPIS List: • Central Point Road and New Era Road • Amisigger Road and Jugg Road • Henrici Road and Redland Road The warning system will detect vehicles on all approaches and activate LED blinker warning signs for the conflicting movements. Approaching or stopped vehicles are detected and LED warning signs blink according to the received messages from the detectors. Issues that need to be addressed before implementing: • Need a fail-safe mode in case the vehicle detection equipment fails. • Address roll-through vehicles in a non-conflict situation (when a vehicle is not detected and the LED blinking warning signs are not activated).
Stakeholder(s)	Clackamas County – Traffic Management Clackamas County – Maintenance and Construction Management
Communications Requirements	Communication between the vehicle detectors and LED warning signs are transmitted wireless transceivers.
Phased Plan	Complete project in the next 5 years.
Cost	$42,000 each project deployment/$1,500 for annual O&M
Operations & Maintenance	Maintenance duties will include upkeep of vehicle detection and LED warning signs.
Needs Addressed	• Need low cost solutions for rural safety applications
Benefits	• Increases safety • Decreases speed and roll-throughs at the intersection in a conflict situation (when vehicles are detected and the LED blinking warning signs are activated) • This system is ideal for rural, low-volume intersections with sight restrictions caused by vertical or horizontal curves. • Low-cost, mobile warning system

Project TMO-25	Dynamic Speed Control

Objective	Deploy variable message signs to display a lower speed limit at specific times or to provide real-time speed feedback to travelers. Locations for dynamic speed control include select school crossings, construction zones, and severe weather or congested locations.
Description	Dynamic speed control systems may change the speed limits in real time based on traffic, adverse weather or road surface conditions. Part-time speed limit systems are also useful in school zones and construction work zones. Some components of a dynamic speed control system include: • Traffic and speed sensors • Environmental sensors • Variable message signs • Communications from equipment to controller   Examples of when to use dynamic speed control include stretches of congested roadways, weather-susceptible roadways, areas that experience highly variable, severe fog, and longer term construction work zones.
Stakeholder(s)	Clackamas County – Traffic Management
Communications Requirements	Communications is needed between variable message signs, field sensors and devices and controller.
Phased Plan	Complete project in the next 10 years
Cost	$140,000 for project deployment/$3,000 for annual O&M
Operations & Maintenance	Requires training maintenance staff to use new electronic message signs. Maintenance duties will include upkeep of field sensors and devices.
Needs Addressed	• Need low cost solutions for rural safety applications
Benefits	• Improves safety • Increases compliance of speed limits

Project MMO-01 thru 03	Transit Signal Priority

Objective	Provide priority at traffic signals for buses behind schedule to improve transit travel time reliability on corridors with traffic signals.
Description	This project includes the use and deployment of Opticom detectors at traffic signals and emitters on buses. The project will include the installation of transit signal priority (TSP) emitters on select buses and traffic signal controller software upgrades along the selected corridors to support transit signal priority. Corridors in the region will be selected based on levels of current traffic congestion and transit ridership. 
Stakeholder(s)	Clackamas County – Traffic Management TriMet City Traffic Signals ODOT Traffic Signals
Communications Requirements	A communications interface will be needed between each transit vehicle and each traffic signal along a transit priority corridor. Potential interfaces include preemption equipment used by emergency response, loops embedded in the pavement that detect bus presence, radio frequency tags and readers or a central management system that requests priority based on vehicle locations.
Phased Plan	Complete project in the next 15 years
Cost	MMO-01: \$850,000 for project deployment/\$13,000 for annual O&M MMO-02: \$515,000 for project deployment/\$8,000 for annual O&M MMO-03: \$345,000 for project deployment/\$5,000 for annual O&M
Operations & Maintenance	Maintenance includes keeping the software up to date, and upkeep of Opticom detectors and communications.
Needs Addressed	• Need reliable transit travel times to promote alternative modes of transportation
Benefits	• Reduced transit delay • Schedule adherence and reliability • Reduced operational costs • Enhanced transit service • Increased ridership

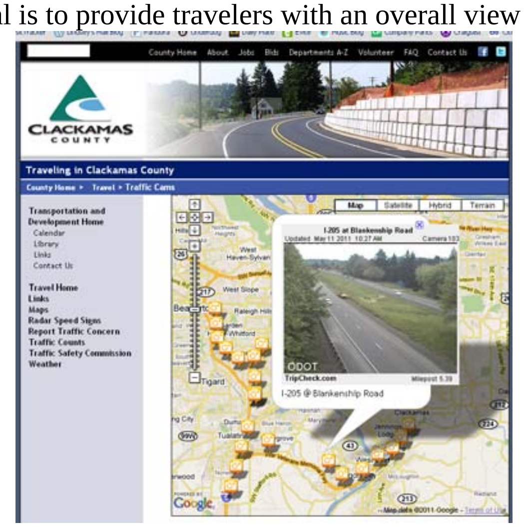
Project MMO-04	Advanced Pedestrian Crossings

Objective	Install active pedestrian crossing devices to improve safety at select pedestrian crossings.
Description	This project may include equipment such as accessible pedestrian pushbuttons, pedestrian countdown timers, rectangular rapid flash beacons, or passive pedestrian detection. A combination of treatments may be necessary to slow or stop vehicles to increase pedestrian visibility. Other treatments include signing and pavement markings, geometric improvements, and traffic calming applications. A system of components specific to a pedestrian crossing location could include ITS applications with a combination of these treatments. 
Stakeholder(s)	Clackamas County – Traffic Management
Communications Requirements	Communications from field devices to controller is needed.
Phased Plan	Complete project in the next 5 years
Cost	$300,000 for project deployment/$6,000 for annual O&M
Operations & Maintenance	Staffing hours needed initially to upgrade pedestrian crossing times and clearance intervals when countdown timers are installed. Maintenance of new field devices and communications is needed.
Needs Addressed	• Need to improve pedestrian safety • Need to improve pedestrian quality of service
Benefits	• Increases pedestrian safety • Improves pedestrian satisfaction

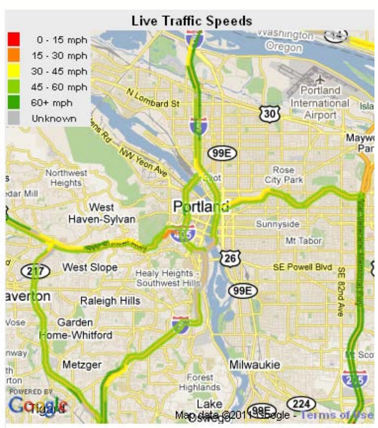
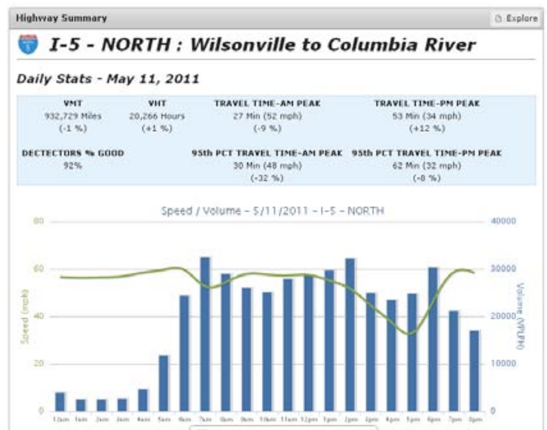
Project MMO-05	Bicycle Specific Signal Timing

Objective	Install bicycle detection and implement traffic signal timing to support bicycle movements on major bicycle routes.
Description	To provide safe and efficient bicycle movements at signalized intersections, traffic signal timings could include minimum greens long enough to support bicycle movements through the intersection and clearance times calculated for bicycle speeds. Bicycle detection may be deployed as part of this project as well. If high enough bicycle volumes, or safety issues from conflicting bicycle and vehicle movements are an issue, bicycle specific traffic signals may be installed. This project may be coordinated with upgrades to traffic signal equipment for crossings at traffic signals or with one of the traffic surveillance and management projects for crossings on major arterials. 
Stakeholder(s)	Clackamas County – Traffic Management
Communications Requirements	If bicycle detection is provided, communications between the detectors and controller will be needed.
Phased Plan	Complete project in the next 5 years
Cost	$190,000 for project deployment/$15,000 for annual O&M
Operations & Maintenance	Staffing hours are needed to develop bicycle specific signal timings. Maintenance of new field devices is needed.
Needs Addressed	• Need for safe and efficient bicycle crossings
Benefits	• Reduces bicycle stops and delay • Potential to improve bicycle travel time reliability • Increases safety

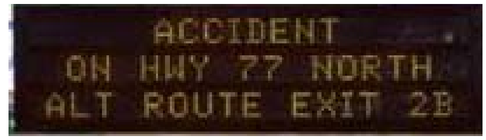
Project TI-01	Traveler Information Website

Objective	Expand the Clackamas County traveler information website with up-to-date traveler information to aid travelers with pre-trip planning.
Description	This project will expand upon the existing traveler information website for Clackamas County to include additional video camera images and traffic congestion information. The final goal is to provide travelers with an overall view of the system including information on real-time traffic conditions (camera views, travel times, etc…), incident locations and durations, construction activity, weather and road conditions, railroad activity, special events, trucking information and parking information. Transit information will be provided via links to the websites of TriMet, SMART, and Amtrak. Links will also be provided to other agencies, such as ODOT, with traveler information websites within or in the vicinity of Clackamas County.  Deployment of the website will occur in stages as the projects and technologies to collect the various types of information are implemented and data is collected.
Stakeholder(s)	Clackamas County – Traffic Management Clackamas County – Emergency Management Clackamas County – Maintenance and Construction Mgmt ODOT
Communications Requirements	Communications links from the Clackamas County Traffic Operations Center (TOC) to field devices for display on the website.
Phased Plan	Complete project in the next 5 years
Cost	$95,000 for project deployment/$20,000 for annual O&M
Operations & Maintenance	Operations and maintenance will play a key role in the successful implementation of this project since traveler information must continually be kept up-to-date in order to provide value to website users. The use of software will allow certain types of information to be automatically uploaded to the website while other information may need to be updated manually by key personnel. A quality assurance and quality control process should be used to evaluate the website on a periodic basis to ensure that information is correct and timely.
Needs Addressed	• Need real-time traffic condition information • Need camera images with clear descriptions
Benefits	• Real-time and static traveler information • Pre-trip planning capabilities • Reduced congestion and delay • Customer satisfaction

Project DCM-01	Integrate County Transportation Data with the PORTAL Regional Data Warehouse

Objective	Automate data transfer to the Portland area regional data warehouse at Portland State University.
Description	This project will develop a real-time data interface between Clackamas County and the PORTAL regional data archive hosted by Portland State University. PORTAL includes freeway data, transit data, freight data, incident data, traffic counts, parking data, weather information, and variable message sign data. This connection is a critical link between planning and operations, because it supports collection, storage, and analysis of transportation data. It also provides data and analytical capabilities that support the implementation of performance measures to evaluate whether the ITS strategies are meeting the vision and goals of the County's Transportation System Plan. As more data is archived in PORTAL, it may be possible to develop a tool that predicts travel conditions based on historic information. Public/private partnerships may also be explored because there are private companies (e.g. INRIX) that use available data to provide cutting edge traffic information.  
Stakeholder(s)	Clackamas County – Traffic Management Portland State University
Communications Requirements	PORTAL is a web-based interface. A communication connection would be needed to archive and access data.
Phased Plan	Complete project in the next 10-15 years
Cost	$380,000 for project deployment/$20,000 for annual O&M
Operations & Maintenance	Staffing hours needed to verify data fidelity and to develop useful performance reports from data archive.
Needs Addressed	• Need more archived transportation data • Need a cost-effective tool to analyze the data
Benefits	• Improved resources for regional modeling, research, analysis, planning and design • Reduced cost of data collection • Ability to identify effectiveness of investments • Supports regional planning efforts

Project IM-01 thru 05	Integrated Corridor Management

Objective	Integrate traffic surveillance and traffic control equipment with ODOT for key routes in Clackamas County to better manage traffic that diverts from area freeways due to major incidents on the freeways.
Description	This project will deploy traffic surveillance and control devices (system detectors, cameras, variable message signs, and changeable fixed message signs) on arterials to manage diverting traffic during a major incident.  The use of CCTV cameras will enable agency staff to monitor roadway operating conditions, identify and confirm incidents, and to monitor incident management progress. Images from the cameras will also be broadcast to the public on the County and ODOT traveler information websites. The deployment of variable message signs provides opportunities to display real-time information to motorists in advance of an incident to help them make an informed decision about their route choices. ODOT also has numerous variable message signs on their regional freeway network that will also be used to display information about the incident, its location and alternate route recommendations. Other strategies that will be implemented on arterials to better manage incident traffic includes advanced signal control (traffic responsive signal timing or adaptive signal timing), on-demand "green-wave" routing of emergency response vehicles, and transit signal priority.
Stakeholder(s)	Clackamas County – Traffic Management Clackamas County – Emergency Management Clackamas County – Maintenance and Construction Mgmt City of Milwaukie, Gladstone, and Oregon City – Traffic Management ODOT Region 1– Traffic Management
Communications Requirements	A connection is required between arterial traffic management equipment and the Clackamas County Traffic Operations Center (TOC) and the ODOT Traffic Management Operations Center (TMOC).
Phased Plan	Complete project in the next 15-20 years
Cost	Varies by project: $350,000 to $1,690,000 for project deployment/$15,000 to 62,000 for annual O&M. Total for all projects: $4,205,000 for project deployment/ $148,000 for annual O&M. See Table 3 for project costs
Operations & Maintenance	County and ODOT maintenance crews will be responsible for maintaining the new technology (cameras, variable message signs, fiber optic cable, and components).
Needs Addressed	• Need to better manage incidents and clear incidents faster • Need to plan alternate corridors for incident response to divert traffic • Need incident signal timing plans • Need variable message signs to provide traveler information
Benefits	• Improved real-time traffic conditions information and traveler information • Increased capacity and throughput during incidents • Reduction in congestion and delay due to incidents

Project IM-07	Traffic Adaptive Emergency Response

Objective	Deploy an integrated emergency response system that provides for pre-trip planning, en-route guidance (static route plan), and dynamic route guidance (traffic-adaptive route plan) for emergency vehicles.
Description	This project will use traffic information, road conditions, and suggested routing information to enhance emergency vehicle routing. Emergency vehicle preemption or other specific emergency traffic control strategies can be coordinated to improve the safety and travel times of responding vehicles. The 911 centers provide the routing for emergency vehicles based on real-time conditions. The emergency vehicles will be equipped with dedicated short range communications for local signal preemption and communication to surrounding emergency vehicles. This project depends on real-time traffic information availability and a communications connection between the regional communications network and the 911 centers. Automatic vehicle locators (AVL) are also required for dynamic route guidance. As 911 centers are connected to the regional communications network, real-time traffic information may be provided at the dispatcher's workstation.  
Stakeholder(s)	Clackamas County – Traffic Management Emergency Management – 911, Police, Fire
Communications Requirements	Requires wireless communications to response vehicles for vehicle location information and communications between the County's TOC and emergency management.
Phased Plan	Complete project in the next 15 years
Cost	$640,000 for project deployment/$270,000 for annual O&M
Operations & Maintenance	Staffing hours required for emergency traffic control and route requests.
Needs Addressed	• Need to better manage and quickly clear incidents • Need to link 911 dispatch centers within Clackamas County • Need real-time traffic conditions information for emergency management purposes
Benefits	• Increased traveler information tailored to emergency management purposes • Reduced emergency response times

Project MCM-01	Smart Work Zone Equipment

Objective	Provide a portable traffic management system to notify motorists of their speed approaching work zones, travel times, and delays for County-constructed projects.
Description	A smart work zone is a set of ITS strategies for addressing complex challenges within a roadway construction zone to ensure traveler safety and mobility. Smart work zones can be a standalone system or supplement an existing system. The system provides real-time traffic conditions to travelers via portable changeable message signs. Traffic conditions such as speeds, volume, and occupancy are measured continuously and are used to provide travelers real-time information such as estimated travel times, optimal merging locations and dynamic speed control. An example of a smart work zone system could include non-intrusive traffic sensors such as radar guns to collect vehicle speeds. Traffic conditions information could be supplemented and monitored by CCTV cameras and controlled using variable message signs. Traffic conditions information could be collected (e.g. travel times, delays, speeds) and displayed to travelers prior to the construction work zone. 
Stakeholder(s)	Clackamas County – Traffic Management Clackamas County – Maintenance and Construction Management
Communications Requirements	Communications is required between field devices such as traffic sensors, cameras, and variable message signs and back to the County's TOC.
Phased Plan	Complete project in the next 5-10 years
Cost	$155,000 for project deployment/$4,000 for annual O&M
Operations & Maintenance	Staffing hours required to develop and monitor traffic conditions within the work zone and messages displayed on the variable message signs. Maintenance of new field devices is required.
Needs Addressed	• Need for safe and efficient construction work zones for workers and travelers • Need for reliable travel times through construction work zones
Benefits	• Improved construction zone safety and efficiency • Heightened safety awareness through driver feedback • Reduced delay • Real-time information for travelers to make informed decisions

STAFFING REQUIREMENTS

An ongoing commitment to operations and maintenance of ITS equipment, software, and management techniques will be required to maximize the benefits of the Action Plan. The ITS elements themselves require consistent staffing for effective system operation, as well as requiring trained staff to do routine maintenance.

Problem

Clackamas County will require additional staffing to support the specialized and continuous operation of ITS systems. The potential for congestion is growing and the County will need new staff to maintain the additional equipment and projects identified in the ITS Plan. Existing staff struggles to maintain and manage the significant amount of existing transportation infrastructure.

Solution

Staffing solutions include the following:

- Fund adequate staffing levels to support the ITS Plan.
- Increase the level of staffing, in incremental steps, as system needs grow in the future.
- Seek and develop well trained and motivated professionals to support the ITS Plan.
- Identify opportunities to reduce maintenance needs when designing and specifying new equipment.

Description

Incremental increases in staffing levels to operate and maintain the ITS Plan will maximize benefits to transportation users. Efficient operation of the existing and future transportation systems will be necessary to retain the quality of life in the face of future projected growth in the region. Areas that will require specific attention include:

- Procurement procedures that ensure compatibility of equipment throughout the County.
- Equipment design standards that produce efficient results and low maintenance and support needs.
- Agreements between the Clackamas County regional agencies for consistent standards of equipment and software.
- Operations, maintenance, and ownership agreements between Clackamas County regional agencies.
- Technology transfer between other operating agencies.
- Repair, preventable maintenance, and activation of communications to field devices.
- Operations of the Transportation Operations Center.

Today, out of 8 full-time employees in transportation engineering and maintenance, approximately 2.5 full-time equivalent staff (FTE) operate and maintain existing ITS equipment and systems. An additional 2 FTE will be required for full implementation of the ITS Plan. Figure 8 illustrates the existing and future staffing levels within the Clackamas County Department of Transportation and Development that address both operations and maintenance of the ITS Plan. Table 5 includes a detailed breakdown of how the staffing hours are divided between operations and maintenance functions for today and the future.

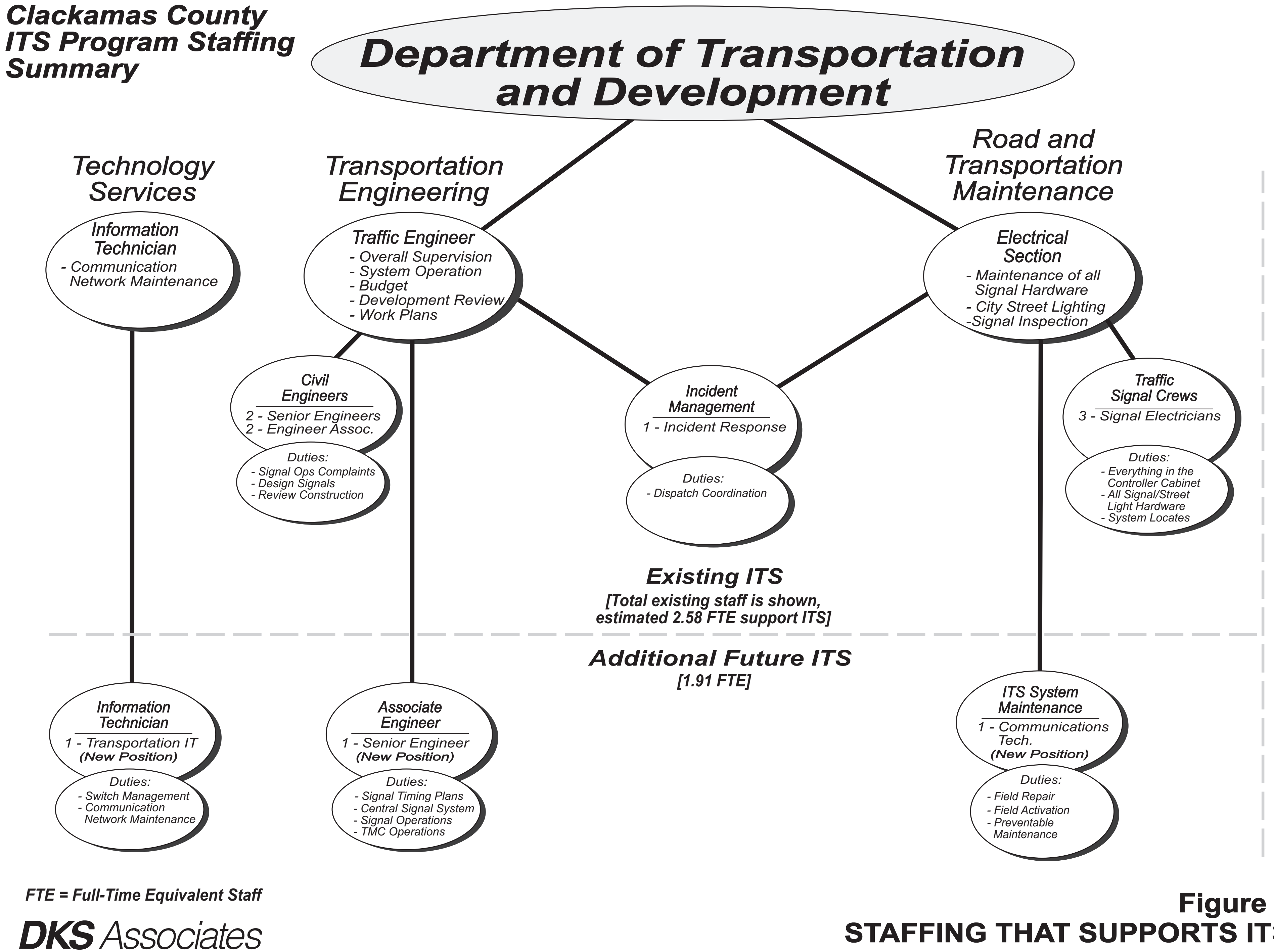


Figure 8
STAFFING THAT SUPPORTS ITS

Table 5. ITS Plan Staffing Needs

Existing Staffing	Existing Operations				Existing Maintenance		
	Design	Construct	Operate	Total Staff	Inspect	Repair	Total Staff
Travel and Traffic Management							
Signal Timing Plans	0.1			0.1			0
Vehicle Detection	0.1	0.1		0.2	0.05	0.05	0.1
Video Detection	0.1	0.1		0.2	0.05	0.05	0.1
Central Signal System	0.05		0.1	0.15			0
Signal Operations	0.1		0.1	0.2	0.05	0.05	0.1
CCTV Cameras	0.05		0.05	0.1	0.02	0.02	0.04
Data Integration	0.05		0.05	0.1			0
Incident Management							
Incident Management			0.5	0.5		0.05	0.05
Traveler Information							
Variable Message Signs				0			0
Traveler Information Dissemination			0.02	0.02			0
Communications							
Traffic Signals	0.1	0.1		0.2	0.1	0.1	0.2
Traffic Management Centers	0.05			0.05		0.05	0.05
Implementation Program							
Agreements/MOUs	0.02			0.02			0
Partnerships	0.02			0.02			0
Corridor Implementation	0.05	0.05		0.1			0
Total Staff Years:	**0.79**	**0.35**	**0.8**	**1.94**	**0.27**	**0.37**	**0.64**

Future Staffing (Full Build)	Existing + Future Operations				Existing + Future Maintenance		
	Design	Construct	Operate	Total Staff	Inspect	Repair	Total Staff
Travel and Traffic Management							
Signal Timing Plans	0.1		0.2	0.3			0
Vehicle Detection	0.1	0.1		0.2	0.05	0.05	0.1
Video Detection	0.1	0.1		0.2	0.05	0.05	0.1
Central Signal System			0.3	0.3			0
Signal Operations	0.1		0.2	0.3	0.1	0.1	0.2
CCTV Cameras	0.1	0.1	0.1	0.3	0.1	0.1	0.2
Data Integration	0.1		0.1	0.2			0
Incident Management							
Incident Management	0.1		0.7	0.8		0.05	0.05
Traveler Information							
Variable Message Signs	0.05		0.1	0.15	0.1	0.1	0.2
Traveler Information Dissemination			0.1	0.1			0
Communications							
Traffic Signals	0.1	0.1		0.2	0.1	0.2	0.3
Traffic Management Centers	0.1			0.1		0.1	0.1
Implementation Program							
Agreements/MOUs	0.02			0.02			0
Partnerships	0.02			0.02			0
Corridor Implementation	0.05	0.05	0.05	0.15			0
Total Staff Years:	**1.04**	**0.45**	**1.75**	**3.24**	**0.5**	**0.75**	**1.25**

Note: If the County chooses to staff an operations center in the future, this will require an additional staff person to operate the center.

Clackamas County

Transportation Options for Vulnerable Populations in Clackamas County

Department of Health, Housing and Human Services

H3S
11/27/2012

The completion of this study would not be possible without the assistance of contributors both within and outside of the Department of Health, Housing and Human Services.

H3S Project Workgroup

Richard Swift, Deputy Director, H3S

Teresa Christopherson, Social Services

Ben Visser, Social Services and Housing Authority

Lori Masterantonio-Moser, Department of Transportation and Development

Gretchen Landgraf and Matt Walker, Behavioral Health Division

Rodney Cook, Children, Youth and Families

Chuck Robbins, Community Development Division

Lori Mack and Tammie Merina, Community Solutions

Sunny Lee, Public Health

Mary-Rain O'Meara, Housing Authority

Galina Burley and Stefanie Reid, Social Services

Executive Summary

Purpose

The Divisions within the Department of Health, Housing and Human Services (H3S) provide some level of transportation-related assistance to their clients, ranging from contracting for taxi services to providing direct rides with county owned vehicles. H3S continues to identify accessible and reliable transportation as one of the most frequently listed barriers that prevent clients from accessing essential services. In 2011, staff began collecting and analyzing information from both internal sources and from external partners to better understand the transportation need, what resources are available and to strategize about how to better coordinate services and meet future demand.

Background:

Clackamas County is unique in Oregon for the variety of transportation options available throughout its diverse geographic area. The county has five separate public transportation systems. Tri-County Metropolitan Transportation District of Oregon (TriMet), the state's largest transit provider, serves the western, more urbanized part of the county. The county is also home to four rural transportation providers: South Clackamas Transportation District (SCTD) serving the Molalla area, Sandy Area Metro (SAM), Canby Area Transit (CAT) and Wilsonville's South Metro Area Transit (SMART). Clackamas County directly supports the Mountain Express service which provides public transit to the Hoodland area along the Highway 26 corridor east of Sandy. All of these services provide public transit as well as specialized services for seniors and persons with disabilities (paratransit) as mandated by the American with Disabilities Act.

The county is also home to a network of service providers who focus on the needs of seniors and persons with disabilities. Clackamas County Social Services, through a partnership called the Clackamas County Transportation Consortium, provides funding to nine senior and community centers in Welches, Sandy, Molalla, Canby, Oregon City, Milwaukie, Gladstone, Lake Oswego and Estacada. Each of the centers provides individual and group rides within and outside of their service district boundaries. The Social Services Division also has two internal programs- Transportation Reaching People (TRP) and Catch-a-Ride (CAR). TRP/CAR uses both paid drivers and volunteers to "fill in the gaps" in service for the center programs and helps seniors and persons with disabilities who live outside of a public transit or senior center service district get rides for medical appointments and other needed services. CAR is also a shuttle service that also provides rides to low-income households seeking employment and educational opportunities. Other H3S divisions contract with taxi companies to provide service to their clients or provide direct rides on a limited basis.

Clackamas County participates in the development and implementation of the Coordinated Human Services Transportation Plan which addresses the services available to vulnerable populations throughout the tri-county area. In that plan, needs, particularly of rural Clackamas County job seekers and residents, are identified as a priority for service development. The county maintains partnerships with both the public transit agencies and also with Ride Connection, a non-profit that provides coordination and other transportation- related services throughout the tri-county region. The county also addresses transportation needs through the Department of Transportation's work on the Clackamas County Transportation Service Plan (TSP). This planning process addresses the infrastructure needs, such as sidewalks, that make public transportation more accessible to vulnerable populations.

H3S provides services through the activities of its various divisions to a broad spectrum of community members throughout Clackamas County. The divisions are:

- Behavioral Health
- Business Services
- Children, Youth and Families
- Community Development
- Community Solutions
- Community Health
- Housing Authority
- Social Services

Each of these divisions focuses its efforts on particular populations based on the funding resources available. Coordination of services is essential to providing the most cost-effective mix of options to keep clients healthy and stable in their communities.

Mapping

Data about transit services, other transportation resources, and locations of certain services such as medical care are mapped in conjunction with client populations, including households in poverty, seniors and persons with disabilities and specific client groups. Client information is confidential and presented in a non-identifying manner.

Some of the key findings from the report

1. Transportation is reported, both anecdotally and in surveys, as a significant issue for many clients of H3S programs.
2. Most divisions in H3S that provide direct client services also assist their clients with transportation in some manner. Many of these resources are very limited, restricted or are at risk of future funding cuts.
3. Public transit coverage in Clackamas County is geographically broad but is very limited by the type of service it provides and the times and days of service provision.
4. Over 28% of all households in Clackamas County live more than ¾ of a mile from a fixed route bus or transit stop, reducing convenience and limiting the usefulness of the service.

5. Infrastructure such as sidewalks, benches, bus shelters, and safe road crossings can limit whether an individual can safely get to public transit services.
6. The cost of transportation can be prohibitive for a low income household. Public transportation is most cost effective, both from the consumer and the provider's perspective, but may not provide adequate service to meet the needs of someone seeking employment or needing other services. For more rural households, a car may be the only option, but the expenses associated with maintaining that car can be prohibitive.
7. Some communities in Clackamas County have no service or minimal transportation services available, creating barriers both to clients who wish to remain independent and living in their own communities and to others who may be seeking employment or educational opportunities but have limited mobility options.

Summary of Recommendations

H3S Divisions:

- Coordinate resources by activities such as developing department-wide contracts that both streamline procurement processes and reduce expenses by broadening the client pool. Consider the implementation of centrally coordinated programs such as a fare reduction or scholarship program that can be accessed by all divisions.
- Develop a quarterly transportation work group so all divisions are up to date on new developments and coordination around program and funding resources can be enhanced.

Short Term Recommendations

- Advocate for transportation funding, both at the program level and for continued funding for important transportation services, such as public transportation. The loss of Business Energy Tax Credits and increasing funding for transit operations, especially for seniors and person with disabilities, will be key issues in the upcoming legislative session.

- Explore strategies that address the "first and last mile" on accessing public transportation resources. Possible solutions include vehicle sharing with community based organizations, volunteer programs, car shares and locally based car pool and van pool programs.

- Provide services to vulnerable residents of the Boring area adversely affected by the TriMet withdrawal of transit and paratransit services. A pilot project has been established but will require long term funding and support.

- Reduce educational and financial barriers to public transportation use by fare scholarship programs and expand travel training to educate potential transit riders about their options.

- Develop programs to assist veterans' transportation needs, including a volunteer driver program.

- Promote access to medical services for high risk clients to limit emergency room use and promote preventative health care options by piloting programs around vanpool and volunteer driver vehicle placement and coordination of services with health care providers. For example, Social Services is currently working with Providence to pilot a project that will provide transportation to residents of low income housing that are regularly using emergency room services rather than preventative health care.

Long Term Recommendations

- Develop resources to address significant gaps in transportation services in Clackamas County, including Government Camp, Happy Valley, Damascus and Boring. Explore expansion of existing services, such as the Mountain Express bus going to Government Camp, or the development of community based resources such as shuttles, vanpools, and volunteer driver programs.

- Develop innovative programs, such as small vehicle repair loans, to assist clients who must depend on their cars for education and employment.

- Develop community-based shuttle services that enhance access to bus and rail stops in communities that have limited transit resources.

- Reduce barriers to accessing transit services due to inadequate infrastructure such as sidewalks and shelters by actively promoting projects that increase these amenities.

- Advocate on the local, state and federal for sustainable funding resources for transit, especially operating funds.

Transportation Access for Vulnerable Populations

Who are vulnerable populations and why is transportation important?

Transportation is an essential need in our society and allows individuals to remain in their own homes and communities while retaining access to essential services. Vulnerable populations experience unique barriers to meeting their transportation needs.

Vulnerable populations are individuals who have functional or access needs that may create a barrier to basic needs begin met. Basic needs that require transportation resources typically includes emergency services (police, fire, ambulance, etc.), public services and utilities, health care, food and clothing, education and employment and a certain amount of social and recreational activities. The concept of prioritizing transportation investments to provide access to those basic services for those with limited resources is referred to as transportation equity.

An individual who lives near transportation resources may still not be receiving adequate transportation access. If that person cannot drive a car and does not have alternate transportation available during the time of day or day of the week (bus service or other options) that he or she needs to get to the doctor or some other resource, the individual does not have adequate transportation available to have basic needs met.

Clackamas County and its residents

Clackamas County contains a mixture of both rural and urban land and is a large county encompassing 1,868 square miles. The county's population is estimated at 375,992 based on the 2010 US Census and has grown with an increase in population of 11.1% between 2000 and 2010. Approximately half o f the County's residents live in unincorporated areas, including rural areas. Clackamas County has a diverse population, with approximately 13% of the residents reporting as Hispanic/Latino in ethnicity. Residents aged 65+ number 51,231 (13% of total population). Persons with disabilities number 47,166 (13 %). The number of veterans residing in the county is estimated at 33,317.

Clackamas County and its Department of Health, Housing and Human Services are deeply committed to finding solutions that allow vulnerable residents of Clackamas County to remain in their own communities and homes and to remain independent, healthy and safe. The challenges presented by the rural/urban nature of our county make the need to coordinate services and finding cost-effective solutions even more important.

Clackamas County's Investment in Transportation

Clackamas County has long recognized the importance of providing for the transportation needs of all of its residents and has incorporated these priorities into its planning process. The Clackamas County Transportation System Plan, currently under revision, includes the vision:

Building on the foundation of our existing assets, we envision a well-maintained and designed transportation system that provides safety, flexibility, mobility, accessibility and connectivity for people, goods and services; is tailored to our diverse geographies; and supports future needs and land use plans.

In addition, the TSP includes goals that focus on issues of health and safety, as well as transportation equity. These goals prioritize a number of strategies that are important to vulnerable populations including roadway safety, pedestrian and bicycle access, use of public transit and facilitating access to daily needs and services regardless of race, age, ability, income level and geographic location.

Regional investments in transportation for vulnerable populations

Clackamas County is also a partner to many efforts on a regional level to increase transportation options for vulnerable populations. Clackamas County Social Services works closely with Ride Connection, a regional non-profit that focuses on transportation options for seniors and persons with disabilities. They contract with Ride Connection to receive certain types of funding and work with Ride Connection's programs to provide services such as driver training.

Clackamas County is also represented on the Special Transportation Fund Advisory Committee which produces the regional **Elderly and Disabled Transportation Plan (EDTP).** The EDTP, in combination with the regional Jobs Access plan which Clackamas County also participates in the development of, constitute the Coordinated Human Services Transportation Plan. This plan informs both planning efforts and funding decisions for services for vulnerable populations throughout Washington, Multnomah and Clackamas Counties and is a key element in providing a high level of coordination among a variety of service providers. TriMet, as the designated lead agency for the tri-county region, has been instrumental in obtaining resources to provide cost effective services for identified populations in both rural and urban areas.

Clackamas County also participates in regional coordinating efforts, such as the Regional Transportation Coordinating Committee that looks at strategies and best practices for service delivery for seniors and persons with disabilities. In addition, staff maintains connections with other projects and organizations, such as participating in the current study being conducted by the Oregon Department of Transportation and the Association of Oregon Counties on transportation coordination.

Current Conditions

H3S Divisions and Targeted Vulnerable Populations

The Department of Health, Housing and Human Services is focused on its mission of assisting vulnerable populations to remain safe, healthy and in their own communities. Transportation is an essential component of that process. While most H3S divisions do not directly provide transportation services (with the exception of Social Services), many of them either contract for services or provide referral and information to their clients. H3S divisions spend over $1.4 million toward transportation services for their clients in FY 11-12, including contracted services, bus tickets, and direct client transportation.

Some of the populations served by H3S divisions include:

- Seniors
- Persons with disabilities
- Low income households
- At-risk youth
- Homeless individuals and families
- Unemployed
- Individuals with substance abuse issues
- Uninsured or underinsured individuals and families needing primary health care
- Veterans

A detailed summary of the programs offered by H3S divisions, as well as survey and other information about transportation needs, can be found in Appendix C.

Unmet Needs

Many of the H3S programs do not directly collect information from their clients on a regular basis regarding transportation needs or barriers. However, some survey information is available and all divisions provided a rich source of anecdotal information about the struggles their clients experience in meeting their basic need for transportation.

Several common themes emerged regarding unmet needs for clients in Clackamas County:

1. Public transit is not available throughout Clackamas County.
2. Hours and locations of public transit make it less accessible for clients in need.
3. Other transportation resources that are no or low cost are very limited and only available to certain groups.
4. Programs such as the TRP program do not offer weekend or evening service.
5. Very few resources are available to assist clients to pay for transportation.
6. Very few resources are available to directly provide transportation.

Transportation Resources in Clackamas County

Clackamas County presents a unique challenge when examining its transportation availability. The western side of the county is congruent with the urbanized Portland metro area and has some access to the transit and other services available there, while the eastern parts of the county consist of rural or small rural communities with fewer resources. In spite of these challenges, the county has a broad array of services in both the public and private sectors. Each mode of transportation has its own advantages and challenges and may not be available to all residents depending on a variety of factors.

Unmet Needs/Challenges to Transportation Services

While a broad range of resources are available, it continues to be difficult for individuals to access a range of options based on their locations. Particularly in the case of low income clients, the only available resources may not be affordable. Funding is a primary concern for transportation providers, especially with the progressive elimination of the Business Energy Tax Credit program, which provided a source of income for many transit programs statewide, and program changes under MAP-21, the new Federal transportation reauthorization bill (see page 16 for additional detail).

Other themes and concerns that emerged include:

- Private vehicles remain the primary transportation mode for most households but the associated costs make it difficult for many individuals to safely and economically operate a vehicle.
- Public transportation is well connected but still does not fully meet all of the needs of the populations, especially in rural areas.
- Public transportation resources are contracting in several areas, primarily due to lack of funding. This also affects paratransit services for seniors and persons with disabilities.
- Existing community-based services only serve certain populations (primarily seniors and persons with disabilities) and are very limited due to lack of funding.
- Transferring between paratransit services is very difficult for frail or medically vulnerable clients. Direct services are either very expensive (taxi) or have limited resources available (Transportation Consortium providers).
- Gaps in service exist between many communities due to lack of public transportation service.
- The lack of sidewalks and other accessibility features, such as safe pedestrian crossings, also are barriers in many communities. Sidewalk and pedestrian enhancement mapping with a focus towards accessibility of public transit stops and access to essential services may help identify future projects for prioritization.

Available Modes of Transportation:

Privately Owned Vehicle

According to the American Community Survey conducted in 2005, only 5.3% of all occupied households in Clackamas County do not have at least one privately owned vehicle available to meet the needs of that household. However, 9% of the households in Clackamas County are in poverty.

Vehicle ownership can be prohibitively expensive for a low income household. The vehicle expenses, including fuel, insurance and repairs and maintenance, can consume a large portion of the household income. The AAA estimates the cost of vehicle ownership to be approximately $8,900 per year. For a household of four at the Federal poverty level, this is 38% of their gross income. However, in areas that are underserved by transit, having a vehicle may be essential for obtaining and maintaining employment, as well as accessing services

Taxi Services

Clackamas County is served by a variety of taxi companies that provide a fee based service to the general public. Taxis are not regulated directly by Clackamas County but many are licensed through the City of Portland's taxi program. Most taxis charge a flat base rate, then charge a per-mile fee, along with some additional surcharges, such as additional passengers, airport fees, and others.

Taxi services tend to be expensive. For example, using taxifarefinder.com, a cab ride from Oregon City to Oregon Health Sciences University is estimated to cost $57 one way. The same trip from Sandy is estimated to cost $80.

Some organizations, including Hoodland Senior Center and Community Health, have contracted with taxi companies to provide rides at a reduced rate. However, this rides are usually are a last resort when other resources are not available or appropriate.

Public Transit

Clackamas County has five separate but interconnected transit districts operating within its borders. Each transit district has a core area of service but also provides connectivity between other communities.

- Canby Area Transit (CAT) provides service in the city of Canby with connections to Oregon City and Woodburn.
- Sandy Area Metro (SAM) operates in the City of Sandy and connects to Estacada, Gresham and the Hoodland communities.
- South Clackamas Transit District (SCTD) is out of the Molalla area with connections to Canby and Oregon City.
- South Metro Area Regional Transit (SMART) is out of Wilsonville and provides service to Canby, Salem and Portland area locations.
- TriMet operates primarily in the urban west side of Clackamas County with one bus line to Estacada.

Clackamas County also provides service between Sandy and Rhododendron with the Mountain Express bus service.

More specific information about the public transit services can be found in Appendix D.

Paratransit Services

The Americans with Disabilities Act of 1990 requires that all public transit services provide "complementary paratransit" services within ¾ miles of a fixed route line. The intent of paratransit service is to provide individuals who are unable to successfully use the fixed route service due to a disabling condition equitable transportation services. To be eligible for paratransit, individuals must apply and be certified by a physician or a screening process that they are unable to use fixed route service.

None of the providers offer paratransit services outside of the required geographic boundaries, although certain programs such as SMART have obtained funding to provide expanded service directly to a destination point. For example, if an eligible person wants to travel from their home in Damascus to a doctor appointment in Portland, they will need to find transportation to the LIFT service boundary to board a LIFT vehicle. Transferring between services can be time consuming and is very difficult for frail, medically fragile clients.

For more specific information about the paratransit services available, please refer to Appendix D.

Medical Transportation Services

TriMet's Medical Transportation Program provides free rides to covered medical appointments for Oregon Health Plan Plus members. The service is provided Monday through Friday and is not available for emergency medical appointments. This service is available throughout Clackamas County, even in non-TriMet areas.

The Veterans' Administration also offers transportation programs to medical appointments. Rides are reimbursed based on mileage and a deductible is required before rides become eligible for reimbursement.

Clackamas County Transportation Consortium

Clackamas County Social Services partners with nine senior and community centers located in Welches, Sandy, Molalla, Canby, Oregon City, Milwaukie, Gladstone, Lake Oswego and Estacada. These locally based organizations provide transportation services to seniors and persons with disabilities primarily to activities within their service district, including congregate meals, medical appointments and shopping trips, as well as to services outside of their local area.

Other services

There are a variety of other types of group transportation services offered in Clackamas County. Some of these services include:

- School transportation (primarily contracted through one of several transportation providers)

- Vans and buses operated by church and non profit organizations
- Vans and buses operated by assisted living and other senior housing sites
- Private bus transportation that provides set rides to certain events or areas (charter services or the recreational rides offered to the ski resorts on Mt. Hood by Greasebus and Luxury Accommodations)

Opportunities for partnerships may exist for the future. For example, Ride Connection has had some success with partnering with local groups, such as churches, to use their vehicles during off-hours when their programs are not using them to facilitate weekend transportation. The opposite scenario, when used vehicles owned by private or nonprofit organizations are available for use during peak weekday times by transit or other organizations, does not appear to be a model that has been explored in our area.

Other Modes of Transportation

While the majority of transportation needs are met through some type of motorized vehicle, other methods of transportation are used to access services. For local needs, walking is a healthy option for those whose physical abilities allow them to do so. Walking can be a challenge in many locations in our communities. Not all streets have sidewalks with adequate and safe separation from motorized vehicles or have appropriate and accessible features such as curb cuts and appropriately marked crossings. In addition, sidewalk requirements are controlled by local code and enforcement may not be consistent from jurisdiction to jurisdiction. Communities that are walking-friendly are also accessible to individuals using mobility devices, allowing for a wide variety of options to get from place to place. Clackamas County does not currently have a complete sidewalk map, making it more difficult to identify future projects.

Bicycling is also a popular recreation activity as well as a means to access work and other services. Clackamas County has supported the development of several projects relating to active transportation modes and additional information can be found online at the Connecting Clackamas website.

Costs of Transportation Options:

Cost to client

Owning a vehicle can provide a vital link to community resources, particularly in more rural areas of the county, but it can also be prohibitively expensive. Every year for the last 62 years, the AAA (Automobile Association of America)has released a report that summarizes the cost of owning and operating a car. For an average sedan driven 15,000 per year, the total cost, including fuel, maintenance and insurance, is estimated at $8,946. For a household of four at the Federal poverty income level, currently at $23,050, this expense is 38% of their gross income. In an online report by CarMD (Vehicle Health Index, April 2012), Oregon ranked 15th in the nation for the cost of auto repairs, with an average cost of $346.17 for a typical repair (check engine light). Many low income households must operate their cars on less money, which can result in poor maintenance and lack of long term reliability.

The following table summarizes the cost to a rider for fixed, paratransit and TRP/Senior Center service, as well as an estimated average charge based on data collected from taxi companies operating in the metro area.

Name of service	Fare for 1 way trip	Monthly Pass	Senior/Honored Citizen	Paratransit
TriMet	$2.40 (2 hr pass)	$92	$1 trip/$26 mo.	$2.15 trip/$62 mo.
SAM	No fare	No fare	No fare	$.50
SCTD	$1 (commuter routes, intracity free)	N/A	N/A	N/A
SMART	$2.50 Salem, $1.25 other commuter, intracity free	$55 Salem, $30 other commuter, $80 all	$1.25 Salem, $.60 other commuter, intracity free, mo pass is half of regular	$2 trip, $40 mo. for other commuter routes, intracity free
Mountain Express	$2	N/A	N/A	$2
CAT	$1	$40	*Half price with proof of income eligibility	$1 (Dial-a-Ride service in Canby)
TRP/Senior Centers	Donation	N/A	N/A	*N/A*
Taxi service	** See below	N/A	N/A	

**Taxi service is based on the number of miles travelled and varies slightly from company to company. For example, a trip from Oregon City to Oregon Health Sciences University in Portland is estimated to cost $57, with additional charges if traffic is heavy or other conditions exist (see taxifarefinder.com) .

Cost to deliver services

The following table captures the cost to deliver services based on an average for the 12 month period ending June 30, 2012.

Service	Cost per ride (bus) (average)	Paratransit Cost per Ride (average)
TriMet	$2.67	$27.63
SAM	$3.65	$18.93
SCTD	$8.03	N/A (fixed route deviates)
SMART	$8.43	$25.58
Mountain Express	$6.74	N/A (fixed route deviates)
CAT	$6.84	$27.30
TRP/Senior Centers*	N/A	$9.08

*TRP/Senior Center Data is for FY10-11 and includes all funding sources. It is also not considered a paratransit service but is offered in a similar delivery model so it is classified that way.

Owning a car is important for many households but has a high cost associated with it, particularly for low income households. Public transit is low cost, although associated paratransit expenses are typical very high (4 to 10 times more than a public transit ride). Taxi services are high cost to the client. Community based services for seniors and person with disabilities are generally more expensive than public transit but less than paratransit services.

Current and upcoming challenges to transportation service:

Like all services, transportation resources change over time based on the availability of funding, demand for services and other factors. The following issues have been identified as highly pertinent to the delivery of transit and other publically funded transportation services over the next few years.

Funding:

Most of the transit and community based transportation providers receive both federal and state funding, along with local match dollars or other local funding. Federal transportation dollars have remained flat-funded at best and are constantly under threat, particularly as the Federal Highway Fund has been exhausted and requires additional input of tax dollars to provide basic funding to maintain roads, brides and existing services. The impact of MAP-21, the most recent reauthorization bill, is being evaluated and may result in an overall reduction of funding for Clackamas County transit programs, especially services funding with Jobs Access and Reverse Commute (JARC) program funds. These funds are being combined into rural transit dollars and will be redistributed based on a formula rather than a program, resulting in a net reduction.

Funding for public and Elderly & Disabled (E & D) transportation in Oregon has suffered from two large impacts over the last few years. Special Transportation Funding (STF) is primarily collected from cigarette tax revenue, along with some other minor sources of funding. Cigarette sales have been on the decline over the last 10 years which reduces the funding available for E & D services.

In addition, the State of Oregon has enacted new rules around the Business Energy Tax Credit (BETC) program. In the past, this program provided tax credits for projects, including public transportation, which provided energy savings. The existing program for public transportation is scheduled to sunset over the next five years. Public transportation programs throughout Oregon are reeling. For example, Canby has reduced its service substantially in anticipation of this loss of revenue and the Mountain Express service in the Hoodland area, which does not have a local revenue stream, will not continue once BETC program revenues drop below the amount needed to provide match for federal funds. The need for sustainable funding resources will be critical to both the largest and the smallest of the public and E & D transportation providers in Oregon over the next few years.

Boring:

The unincorporated community of Boring successfully petitioned TriMet for withdrawal from the TriMet service district. Line 84, which has provided service to this community as well as other areas of northwest Clackamas County has been eliminated as a result of this withdrawal and LIFT paratransit will no longer be available effective January 1, 2013. Boring is partially outside of the service area of the local senior centers and has very limited TRP service. This service change will leave about 30 individuals, including approximately 12 residents of developmentally disabled group homes, without paratransit services, as well as those in the general public that are dependent on public transportation.

Clackamas County Social Services is working with a regional non-profit, Ride Connection, as well as the Sandy Senior and Community Center, to obtain funding to provide enhanced services to this area to assist the residents in making this difficult transition. In addition, Social Services is working with the State of Oregon to obtain funding for the developmentally disabled clients to contract for transportation services.

Government Camp

Transportation to Government Camp and the ski resorts on Mt. Hood is dependent primarily on privately owned vehicles for residents, employees of local businesses and tourists/recreation seekers. Parking on Mt. Hood is limited and traffic conditions have led to increasing interest in providing alternate transportation options in this area. There are several private organizations, such as Greasebus, that offer transportation geared to recreational users and the ski resorts offer some limited transportation and shuttle services. However, there is still a gap to transporting employees and others to the area with connectivity to other transportation resources such as Sandy and TriMet services.

The US Forest Service has commissioned a study looking at transportation alternatives that will be completed in 2012. The Oregon Department of Transportation is also beginning work on a study on multi-modal transportation options for this area. There is a great deal of interest in exploring strategies such as increasing the use of Park and Rides with shuttle service or other public transportation options. The Mountain Express service is a logical candidate for expanded service in this area.

Coordinated Care Organizations (CCO)

The landscape of healthcare in Oregon is undergoing significant change with the federal changes to the provision of healthcare services and Oregon's initiatives regarding coordinated care organizations (CCO's). Beginning in late 2012, Medicaid/Oregon Heath Plan services will be delivered through one of two CCO's that have been established the tri-County area. The CCO's will be responsible for providing comprehensive health care services for eligible clients, including preventative care. The goal of these organizations will be to coordinate a variety of services, including transportation, to reduce the need for emergency health care.

The Medical Transportation Brokerages that currently provide coordinated, cost-effective medical transportation services on a regional level, will be impacted by this health care model, although the details have yet to emerge as the CCO's finalize their business models. There is a great deal of concern in the transit industry about the possibility of shifting costs and service delivery to public transit organizations which have historically kept their costs in control in part by the services offered by the medical transportation brokerages. The CCO's are currently mandated to begin providing transportation services in July, 2013.

Mapping Project

Maps cited in this section are located in Appendix B or are available by contacting Richard Swift, H3S Administration, or Teresa Christopherson, Social Services.

Identification of top gaps/deficiencies

Based on the mapping component of the project, the following gaps or deficiencies in service have been identified:

- Approximately 30% of households have no access to public transportation services. These households are car-dependent or must access other resources. Primary care clients in particular are broadly dispersed in areas that have limited or no transit options.
- Services for seniors and persons with disabilities living in rural areas is limited and primarily focuses on life-sustaining medical services.
- Overall, providers of essential services such as medical, education and grocery services are located within transportation-supported areas. This increases their accessibility to those who have access to transit options.
- As a caveat, the maps do not take into account frequency of services such as bus lines or accessibility, such as sidewalks in areas surrounding bus stops.
- The following areas have very limited or no transportation services available:
    1. Government Camp
    2. Happy Valley
    3. Damascus
    4. Boring (effective 1/1/13)
    5. Rural areas in central and southwestern Clackamas County
    6. Suburban areas between Lake Oswego and West Linn, as well as areas located south of Oregon City

Client Confidentiality:

H3S upholds the strictest guidelines of client confidentiality, including compliance with all applicable HIPAA rules and regulations. The information used to map the client populations is not identified by name, nor does it include any protected health information as part of the project. The mapped information has been plotted to indicated client populations concentrations within a certain distance in order to avoid identifying specific client addresses.

Populations:

Four primary populations were identified for inclusion in the mapping project based on the clientele served by the various divisions in H3S.

- Seniors (age 60 and over)
- Youth (under 18)
- Low income households (based on Federal poverty level)
- Actual client populations (Primary Care, Behavioral Health, Developmental Disabilities, Transportation Reaching People)

While there are other populations that are served by H3S, these populations represent a majority of the vulnerable citizens who are provided services in Clackamas County. The following data was used to map the information for the purposes of this study. All of the databases mentioned are either owned or purchased products used by Clackamas County programs.

Services Information:

To present meaningful analysis of the transportation needs it was important to develop information about both transportation services and the locations to which clients may need to travel. The recently completed Opportunity Mapping project conducted by the Housing Authority was a valuable resources to identify potential data and provide a framework for community and transit resources. A complete listing of the services, resources and origin of data used to generate the maps can be found in Appendix A.

Gaps and deficiencies in service

Future needs for service development or enhancement are identified through this project in terms of gaps and deficiencies. A gap is an area where no transportation service beyond privately owned vehicle and taxi cab services are available. A deficiency is where there is some level of service delivery, such as services for seniors or persons with disabilities but not for the general public, or there are general public services available but the frequency or other aspects of the service make it difficult to meet local need.

For the purposes of this report, the areas served only by the Transportation Reaching People program are considered to be service deficiencies for the primary population (seniors and persons with disabilities) and gaps for the general public and are identified as gaps in the map. The TRP program provides primarily life-sustaining medical services in many of the rural areas of Clackamas County and is unable to provide for a full array of basic service access. It does not offer public transportation services.

Proximity to Public Transportation

Proximity to public transportation is defined as living within ¾ mile of a bus stop, light rail or passenger rail stop or transit center. The review of Map 1 demonstrates that public transportation, while broadly dispersed throughout much of the county, does not fully meet the needs of all of the population. Analysis of the available data shows that 28.3% of Clackamas County households are further than ¾ mile away from pubic transit stops, although they may live within a transit district boundary. The following table summarizes the data regarding specific client populations:

Population	Within 3/4 Miles of a Bus or Transit Stop				
		Within ¾ miles		Outside ¾ mile	
	Total	Number	Percent	Number	Percent
All addresses (proxy for households)	153,495	110,063	71.70%	43,432	28.30%
Behavioral Health/Dev. Disabled clients	3,268	2,560	78.34%	708	21.66%
Primary Care clients	10,869	8,913	82.00%	1,956	18.00%
Transportation Reaching People Clients	6,124	4,687	76.53%	1,437	23.47%

This data does not address the impact of accessibility to the stops, such as sidewalks and pedestrian crossings, or the needs of individuals who cannot walk ¾ mile.

Proximity to Any/All Transportation Services

Map 2 shows transportation service levels throughout Clackamas County. These include high accessibility (within ¼ mile of a bus or transit stop), moderate/paratransit (within ¾ mile of a bus or other transit line), and low (within the service district of a senior center). Information about the Transportation Reaching People program is not included. This program provides county-wide coverage but is limited to seniors and persons with disabilities and service is limited to primarily life sustaining medical rides in many areas.

Southeastern Clackamas County has no service beyond the TRP services. However, this area is very rural in nature with low population density and also includes large tracts of forest land that is not used for residential sites. Northeastern Clackamas County, which includes the Mt. Hood area, has extensive coverage because of the senior center boundary but in practicality also has a very limited amount of service available. Much of the population in this area is concentrated in communities along Highway 26 from Sandy up through Government Camp. There is a clear gap in service between Rhododendron and Government Camp.

Other areas that have no access to any level of transportation service beyond TRP (gaps) include:

- Damascus/Boring
- Rural central Clackamas County between Oregon City and Estacada
- Suburban areas of northeastern Clackamas County that fall between senior center boundaries

Area and Population Analysis:

Maps in Appendix B also show more detailed regional analysis of populations, certain basic need resources and transportation options.

Northwest (Appendix B-3 maps):
Northwest Clackamas County, including the incorporated communities of Lake Oswego, West Linn, Oregon City, Gladstone, Milwaukie and Damascus, is the most densely served by transit and other resources. In reviewing maps in the Northwest section of Appendix B-5 which include information on populations and services, un-served or underserved areas include areas north of Happy Valley and more rural areas near Oregon City, Wilsonville and West Linn. The elder population in particular had concentrations of residents in these areas with few transit resources.

Northeast (Appendix B-4 maps):
Northeast Clackamas County, including Sandy, Estacada and the unincorporated community of Boring, show a more limited range of services. The City of Sandy and the City of Estacada overall have good coverage, although the frequency of TriMet service to Estacada is an issue. Boring and rural areas have limited senior center coverage. Youth also reside in areas not served by public transit. Several grocery stores are not accessible by transit services.

Southwest (Appendix B-5 maps):
Southwest Clackamas County, including Molalla, Canby and part of Wilsonville, is similar to the Northwest area in that transit services are very good in the incorporated cities but limited in more rural areas. South Clackamas Transit District has multiple rural stops that increase coverage along several routes in rural areas. Areas south of Canby and north of Molalla have less coverage for elderly residents, although senior center services are available. The outskirts of Canby and Molalla also have populations of low income households and youth that are underserved.

Southeast:
The southeast area of Clackamas County was not included in area analysis due to the low population base in primarily forest land areas.

Discussion of Limitations:

One area of concern to note for the maps that are based on census data is that the population density may not clearly show clusters of populations present in certain areas. The population density is based on the density per square mile but that population number comes from a census tract. In the more rural areas, census tracts are quite large so, even though there may be a dense population of seniors in a particular area, the overall density is diluted due to the size of the tract. The Hoodland Area near Welches is an excellent example of a location with a large number of seniors that does not even show up on the elderly population map.

Options for Transportation Services for the Future

Policy

Clackamas County, through its work on the Transportation System Plan and other opportunities, including the key work done on the formation of Coordinated Care Organizations, is in a unique position to influence decisions going forward that can have a positive impact on vulnerable populations having enhanced access to transportation services. Enhancing access to public and special needs transportation is in alignment with Clackamas County's sustainability goals and also aligns with the Department of Health, Housing and Human Services' mission to encourage individuals to remain independent and living in their own communities.

1. Clackamas County could explore accessibility to public transportation resources as part of its prioritization for future projects and growth. While 71% of the population lives within ¾ mile of a bus stop or other public transit service stop, infrastructure barriers exist. For example, areas may not have sidewalks or sidewalks may not be navigable for individuals with limited mobility. The county may want to consider a sidewalk mapping project, or, innovatively, an accessibility project that looks at access to public transit and essential services in a community or neighborhood that would look at not just sidewalks but also street crossings, terrain issues and resting stops, bus shelters and how to plan alternate routes to services for pedestrians and bikers.

2. Clackamas County could consider transportation as a key component for future development projects, including the sites of public housing and other community based projects. Housing Authority and Community Development are already mindful of transportation resources in project development.

3. Clackamas County should work proactively with state and federal partners to maintain existing funding for transportation services, especially public transit and E & D transportation services. Of particular concern in the short term is finding sustainable sources of revenue to replace decreasing revenue from Special Transportation Funds, Jobs Access and Reverse Commute program funds and Business Energy Tax Credit revenue.

4. Clackamas County could work actively with municipalities and other community partners to find strategies to maintain existing transit services as well as look for opportunities to increase connectivity between services and expand service areas. For example, the new light rail line coming into Milwaukie represents an opportunity for Clackamas County to partner with affected areas and TriMet to explore best practices for maximizing the use of this service while maintaining community safety.

5. Clackamas County could maintain its leadership role in supporting innovative, community based services that focus on the local need as well as regional connections and access. Transportation

resources are limited and already strained with flat or decreasing funding. Any project that shifts cost from one mode to another without addressing capacity and resources should be evaluated in light of long term sustainability. Coordination of resources is essential to maintaining existing services and managing future growth effectively.

Recommendations for service

This project has identified several key areas to maintain existing services and provide an adequate level of service to meet identified need for vulnerable populations. Future goals and projects are divided up into one of the following areas:

1. Maintain existing services
2. Provide services for vulnerable populations that are un-served or underserved
3. Provide services in areas that are un-served or underserved

Each of these strategies represents a significant investment on the part of a variety of agencies and organizations, including divisions of the Department of Health, Housing and Human Services. Some projects and goals revolve around enhanced efforts for coordination and others represent expansion of services, with funding resources to be identified in the future. Projects and goals that are low or no cost and present coordination or alignment activities are identified as such in the narrative.

Maintain Existing Services

1. Preserve the network of community based services by continued application for funding and applying for replacement equipment and other infrastructure needs as available. The Clackamas County Transportation Consortium is highly vulnerable to cuts in funding and has proven to be an excellent investment to assisting seniors and persons with disabilities remain in their communities.

2. Promote volunteerism to maintain and expand our existing pool of volunteers. Many of the community based programs are highly dependent on volunteers to provide transportation and other services. Social Services' Volunteer Connection is expanding its outreach capabilities for volunteer recruitment, including web based applications and using other country resources. Volunteer drivers are a highly cost effective means of providing service.

3. When applying for funding, identify transportation as a client need in order to preserve or increase resources for bus tickets, transit passes and volunteer mileage reimbursement.

4. Coordinate services with health care providers, such as dialysis treatment centers, so appointments are grouped and the number of individual rides can be minimized. Partner with

other health care providers, such as the primary care clinics, to group rides and explore other strategies to increase access and minimize the use of emergency services.

5. Provide training to both staff and clients on how to best use transportation resources. Social Services provides a travel training program for staff and group trainings for clients and also partners with Ride Connection to provide direct, one-on-one intense training for seniors or persons with disabilities who require additional assistance through their Ridewise program.

Provide Services for Populations that are Un-Served or Underserved

1. Expand Catch-a-Ride operations to include services to low income households in other areas. For example, shuttle services to bus stops or light rail stops could be scheduled for areas that have high concentrations of low income families.

2. Provide vans and train residents of public housing sites to safely operate them for the purpose of providing location-based vanpool services. Vans could be used to provide shopping and recreation trips, rides to doctor's appointments and connections to public transit services. With volunteer drivers and a local scheduling system, operating expenses would be minimal.

3. Implement car share programs. Some trips, due to the time of connections or lack of available public transit services, can only be provided by an automobile. Car share programs may provide a solution for occasional needs in certain areas. Flexcar and other commercial companies could potentially provide vehicles and the infrastructure to manage everything from insurance to making reservations. With partial support from grant or other funding resources, the service could provide a cost effective alternative to vehicle ownership for certain households.

4. Promote car pool and van pool options. Develop locally based and promoted options such as rider boards, links from local websites such as city sites, and other features that promote ride sharing strategies to the community.

5. Provide better transportation options for veterans to access basic needs, including employment. Ride Connection has experienced success particularly in Washington County with its Veterans Helping Veterans program, which recruits and trains volunteers to provide rides for veterans and their families. Work with the new formed Veterans Advisory Council to develop a comparable program in Clackamas County and seek funding resources to provide mileage reimbursement for non-medical rides.

6. Increase access to public transit with a fare scholarship program. For income eligible individuals, up to half of the cost of a bus pass could be paid for, with the balance coming from the individual's income. This pilot program could be easily administered for case-managed clients through H3S.

7. Establish a car repair short-term loan program. Car ownership, particularly in rural areas, continues to be a key to economic success and independence. Car repairs can be prohibitively expensive and can result in low income households incurring high interest debt situations, such as payday loans or credit cards. A revolving loan fund for vehicle repairs for case managed clients could provide a solution. Repaid loans can be re-lent out to the community and low interest rates can help cover administrative fees and provide a cushion for bad debt.

8. Advocate for the expansion of public transit services in areas of high need, both in terms of service area and in terms of days and times of service. Frequency has a great impact on how often public transportation resources are used.

9. Develop resources to address emergent medical transportation issues, particularly for households and individuals who are not able to readily access public transit. Transportation has been identified as a key factor in high emergency room utilization over comparatively lower cost urgent care or primary care services. Most scheduled services, such as Catch A Ride, are booked out weeks in advance and taxis may be prohibitively expensive. If a child becomes unexpectedly ill and no transportation is available, a trip to the emergency room may be the most convenient option. Some of this need could be met through a volunteer van pool program or a car share program. Contracts with cab companies or expansion of service through TRP could also be considered.

10. Explore partnerships with private and nonprofit groups around vehicle sharing and other options for assisting vulnerable populations in their communities. For example, churches often have vehicles that are infrequently used during the week but heavily used on the weekends. These vehicles could be used during the week to provide medical appointment and other rides with a vehicle sharing agreement. Partnerships with private industry, such as some of the nurseries that have vehicles they only use to transport employees on a seasonal basis, may also leverage underutilized vehicles.

11. Convene stakeholders to develop vehicle share programs, particularly in areas with limited existing resources. Include both service organization, such as churches and non-profits, and local businesses.

Provide Services in Areas that are Un-served or Underserved

1. Boring and Damascus: Develop long term strategies to maintain services for seniors and persons with disabilities in Boring. With the withdrawal of this area from the TriMet service district, vulnerable individuals will be left without paratransit service. A temporary grant to provide “lifeline” services (primarily life sustaining medical) will help fill the gap for 6 months after the withdrawal becomes effective on 1/1/13 but additional resources will be needed. In addition,

the City of Damascus is not served by any form of public transit, reducing their connections to the region. The feasibility of operating a shuttle service in the 212 corridor should be explored.

2. Mt Hood and Government Camp: Expand existing service or explore strategies for new services to the Government Camp area and the recreation and employment opportunities on Mt. Hood. The Forest Service and ODOT are currently working on short and long term planning for multi-modal transportation options in this area, including the Highway 26 corridor. Public transit could provide an ideal partnership to reduce traffic congestion on the mountain, promote employment opportunities and enhance accessibility.

3. Community Shuttles: For many individuals, the single biggest barrier to public transit use is the "first/last mile." An individual may be willing and able to use public transit but if they live a substantial distance from the closest bus stop or if physical barriers such as lack of sidewalks or other safe walking paths prevent access, they may never use the service. Community based shuttles have been a popular and successful means to bridge this gap in other communities, including the shuttles offered in Washington County by Ride Connection and the Dial a Ride services offered in Canby. In more urban and suburban areas of Clackamas County like Happy Valley that are underserved by TriMet, community shuttles may present a cost-effective solution. This type of shuttle service can also be operated in areas of high employment to increase access to these opportunities. The Swan Island shuttle is a good example of this type of employment related service.

Coordination of services within H3S

The Department of Health, Housing and Human Services, through its divisions, serves a variety of populations throughout Clackamas County. Because of the dedicated funding resources involved, it may not be possible for certain services to be combined. However, H3S is poised to look at recommendations that better coordinate services and enhance mobility both for their client populations and for vulnerable populations as a whole.

Many of the recommendations for service listed in this report are also applicable to H3S programs. Several areas for consideration to streamline and better coordinate services include:

- For contracted transportation services, such as taxi service, have an H3S wide contract to get favorable rates for services.
- Coordinate programs to target specific high-risk populations to increase transportation options. For example, Social Services is currently working with Providence to obtain an additional vehicle that will specifically focus on medical accessibility for low income clients who are using emergency rooms rather than preventative healthcare services. Similar services can be developed to target "hot spots" of vulnerable populations.

- Develop programs such as a fare scholarship program that can be accessed by case managers department wide to reduce the administrative burden on each individual division.
- Form a Transportation Workgroup that meets on a quarterly basis to get updates on projects, issues and changes to the current environment that can be shared throughout each respective division. The Social Services division has an internal workgroup that performs a similar function. By operating on a department level, the group can make recommendations and move forward proposals for projects that have value to multiple divisions.

Appendix A

Mapping Project:

Description of Map Layers and Data Sources:

Map Layers and Indicators Menu

Description of Map Layers:

Populations:

Seniors: Seniors are defined as individuals age 60 and over based on the criteria for eligibility for Older Americans Act services. Information was obtained from the results of the 2010 Census.

Youth: Youth are defined as individuals under the age of 18. Information was obtained from the 2010 Census.

Low Income Households: Low income households are defined as households at 100% or less of the Federal Poverty Level as of 2012. Information was obtained from the 2010 Census.

Actual Client Populations: Client level information was obtained for the following programs to map where clients live in proximity to essential services. Client data was obtained from the following information sources:

1. Primary Care- data obtained from Epic database and represents one year of clients treated by the primary care clinics.
2. Behavioral Health and Developmental Disabilities-data obtained from Anasazi database and represents one year of clients treated within these programs.
3. Transportation Reaching People- data obtained from TRP database and represents a point in time of May, 2011, of clients actively enrolled in the program. Data includes both the origin and destination of each scheduled ride.

Services and Resources:

Transportation: Based on data obtained by the various service provides, the transportation services mapped include fixed route (bus and light rail), transit stops/stations, the paratransit service area of ¾ miles around each fixed route service, and the transportation service areas of the senior centers providing rides to seniors and persons with disabilities. Transportation Reaching People provides limited services for seniors and persons with disabilities county-wide but is not included on the map.

Care Facilities: Data about the care facilities licensed by the State of Oregon, including assisted living, adult foster care, and nursing homes, was obtained from the local Oregon APD (Adults and Persons with Disabilities) branch office.

DD Licensed Care Facilities: Information about the licensed care facilities for developmentally disabled individuals, including foster and residential care settings, was obtained from the Social Services' Developmental Disabilities program, where it is tracked for service needs.

Primary Care and Health Care, Employment Opportunities, Full Service Grocery Stores, Adult Education Resources and Employment Agencies: Information was compiled from a variety of resources including the Equity Access-Business Analyst and from information previously compiled by Community Health.

TRP Destinations: Information about the destinations to which seniors and persons with disabilities are driven as part of the Transportation Reaching People program was obtained from the TRP database.

Other data available: Maps are available for Mobile Park Units, Affordable Housing Units, Public Housing Units and Free & Reduced Lunch, although those data points were not included as part of this analysis.

Map Layers/Indicators Menu

- Primary Resources
    - Full Service Grocery Stores (Equity Atlas – Business Analyst)
    - Family Practice Doctors (Equity Atlas – Business Analyst)
        - Accepting OHP – (Self compiled from FamilyCare and CareOregon lists)
    - Adult Education Resources (Self compiled)
    - Employment Agencies (Self compiled)
    - Primary Care Clinics (GIS/Community Health, 2010)
- County Clients
    - TRP Origins (Social Services)
    - TRP Destinations (Social Services)
    - County Primary Care Clients (Epic)
    - County Behavioral Health and Developmentally Disabled Clients (Anasazi)
- Care Facilities
    - Adult Care Facilities (Social Services)
    - DD Foster Providers (Social Services)
    - DD Residential Providers (Social Services)
- Other Places
    - Mobile Park Units
    - Affordable Housing Units (HACC)
    - Public Housing Units (HACC)
    - Free & Reduced Lunch
- Overlays
    - Employment Opportunities - Over 2000 Employees per sqare mile (based on ES-202)
        - This can be defined differently using ES-202 Firm data
    - Transportation Service Level (Self-compiled)

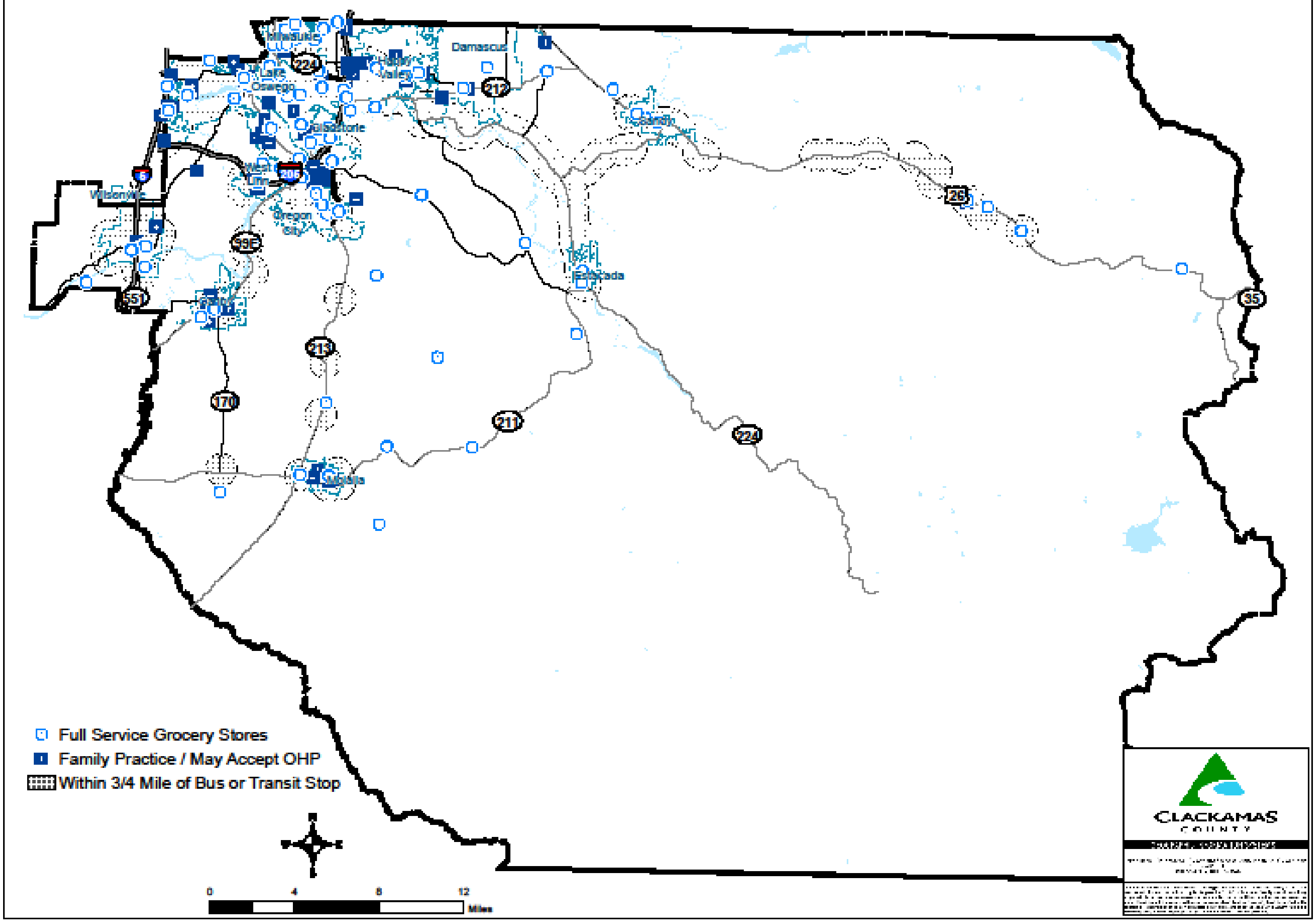
        - Levels are ¼ mile from stop, ¾ mile paratransit boundary, senior center coverage)
    - Census Data
        - 60 and Over (SF1)
        - Under 18 (SF1)
        - Below 100% of Poverty Level (ACS)
- Opportunity Maps layers (not currently in the map template, but can be added)

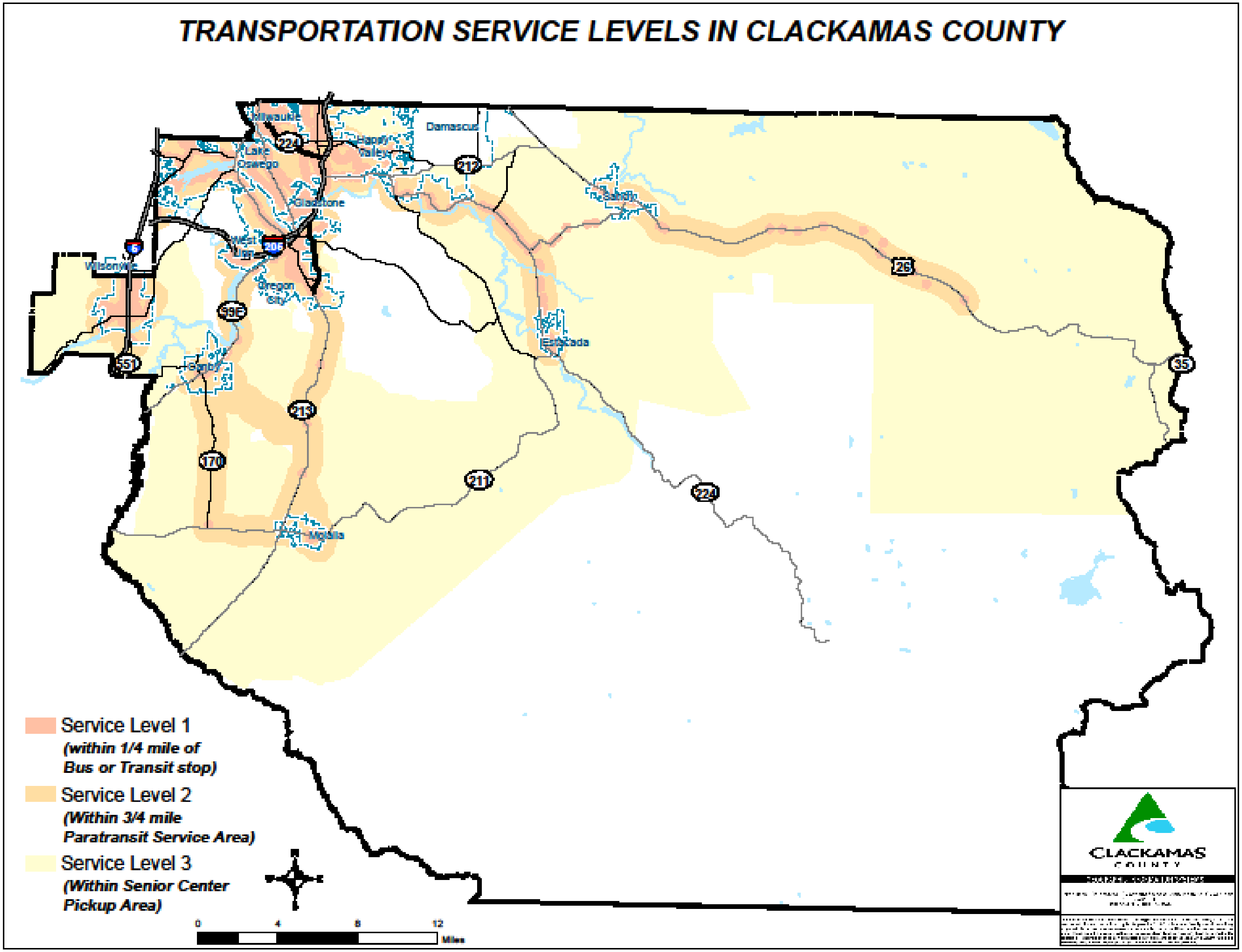
Appendix B

Mapping Project:

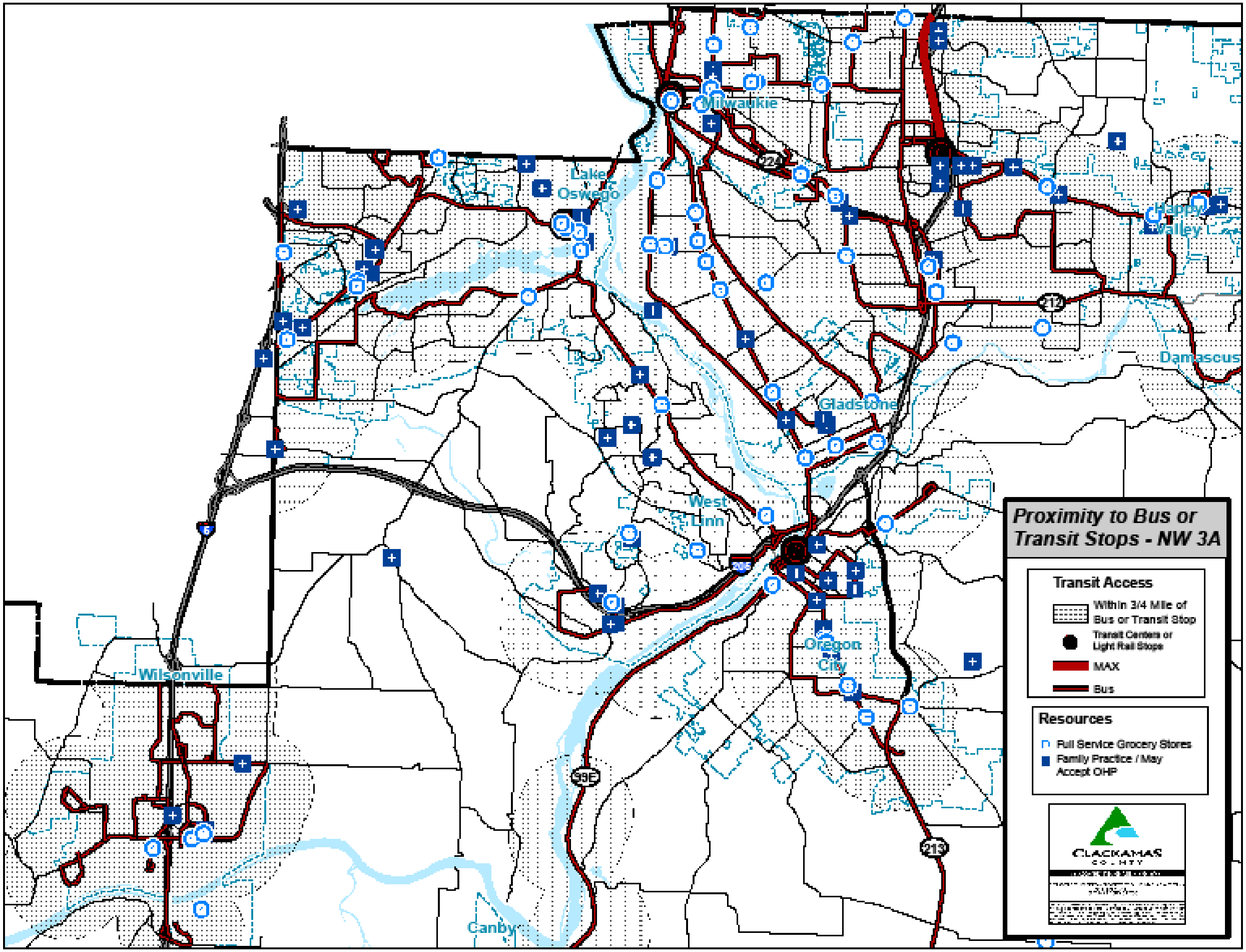
County Maps

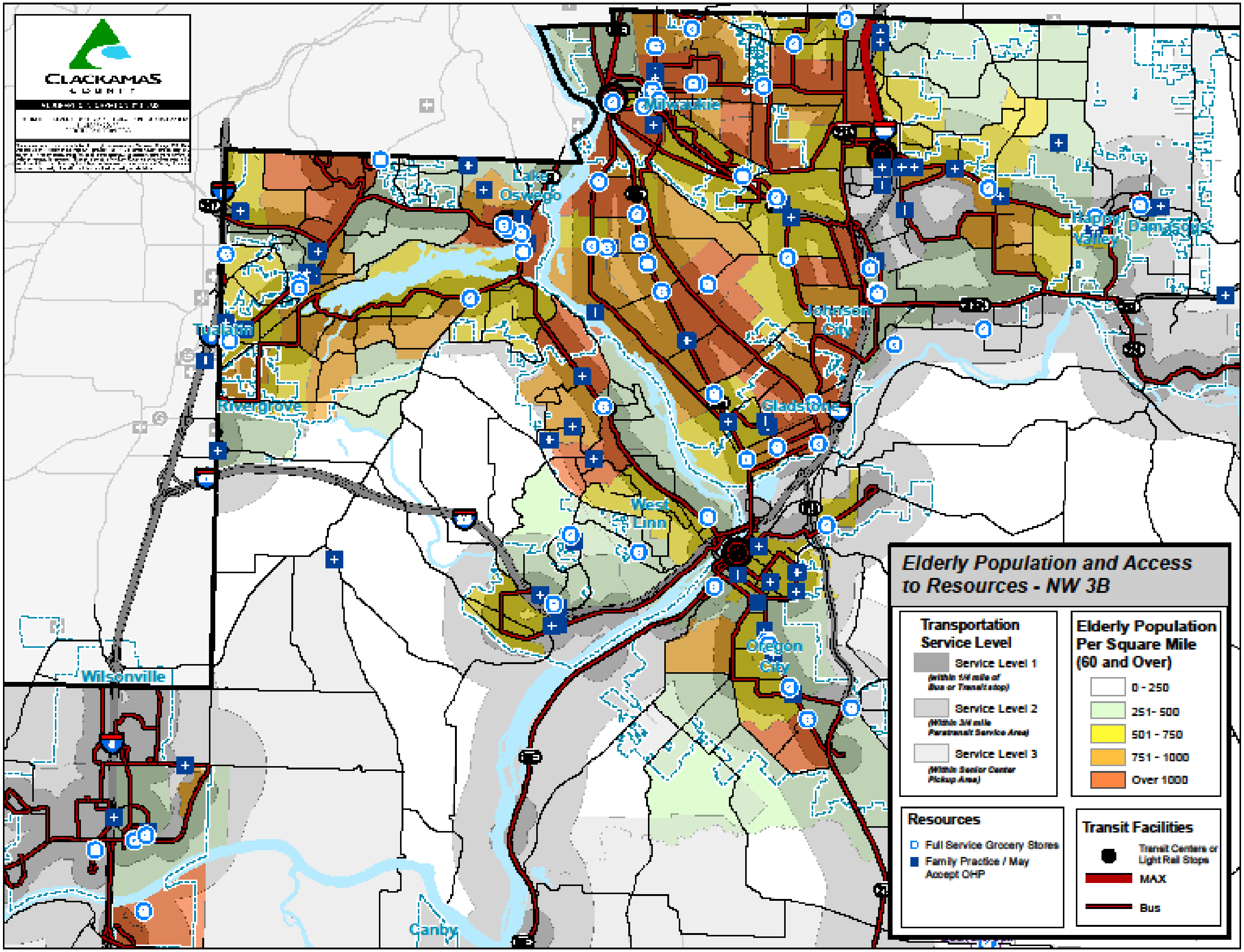
PROXIMITY TO BUS OR TRANSIT STOPS IN CLACKAMAS COUNTY

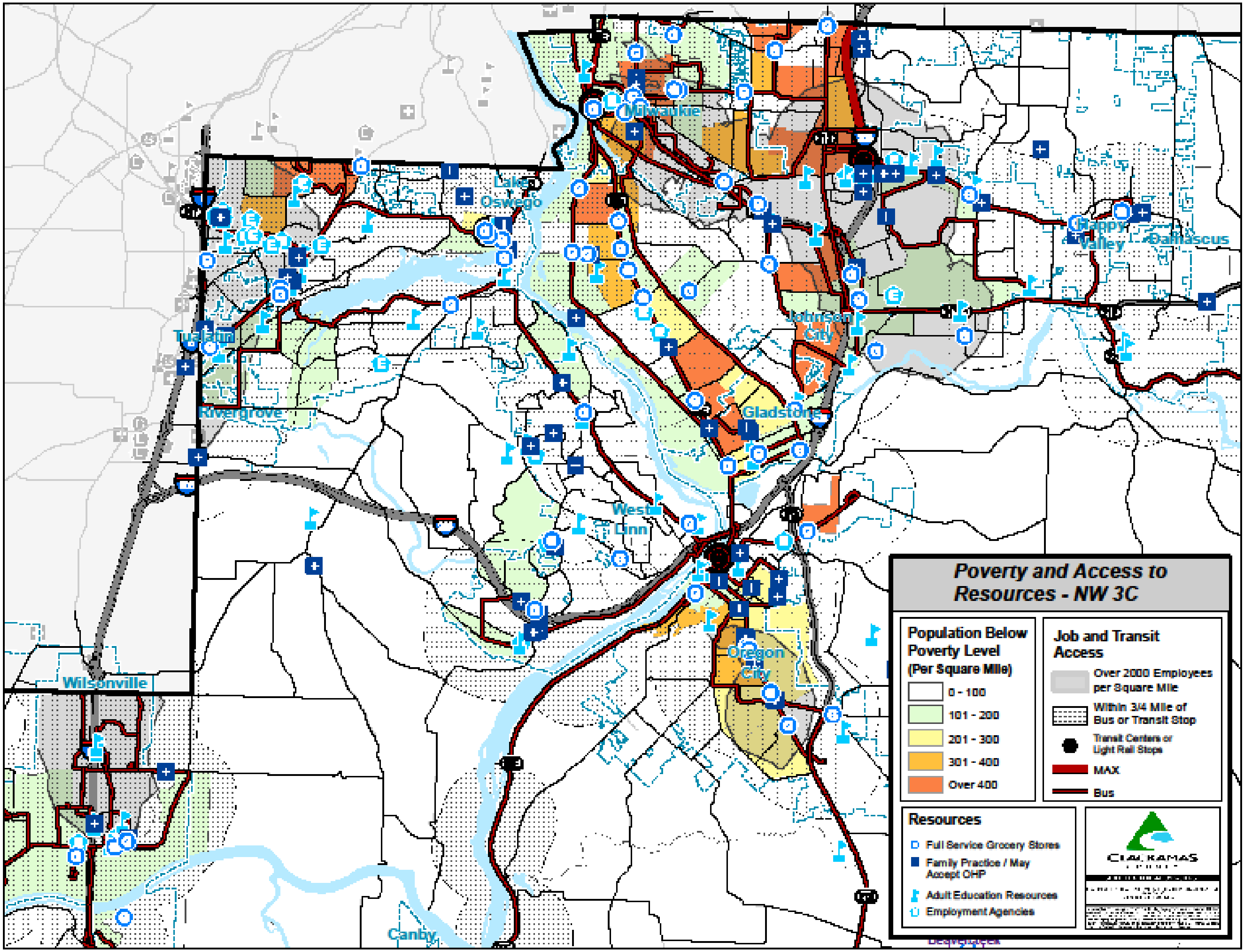


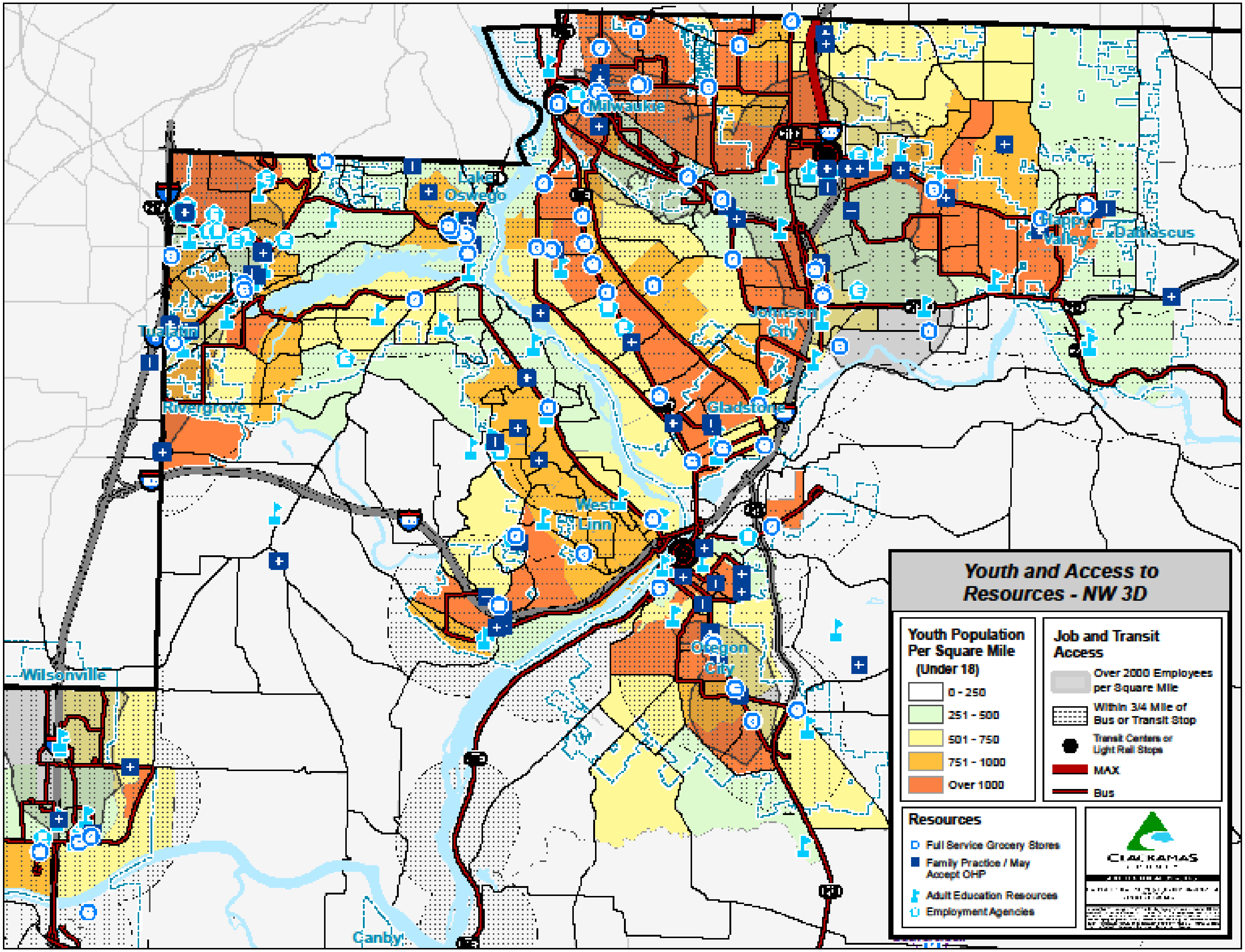

TRANSPORTATION SERVICE LEVELS IN CLACKAMAS COUNTY
Milwaukie
224
Lake Oswego
Happy Valley
Damascus
212
Gladstone
West Linn
5
205
Wilsonville
Oregon City
99E
551
Canby
Sandy
26
Estacada
35
213
170
211
224
Molalla
Service Level 1
(within 1/4 mile of Bus or Transit stop)
Service Level 2
(Within 3/4 mile Paratransit Service Area)
Service Level 3
(Within Senior Center Pickup Area)
0
4
8
12
Miles
CLACKAMAS COUNTY

Appendix B-3: Northwest Area Maps

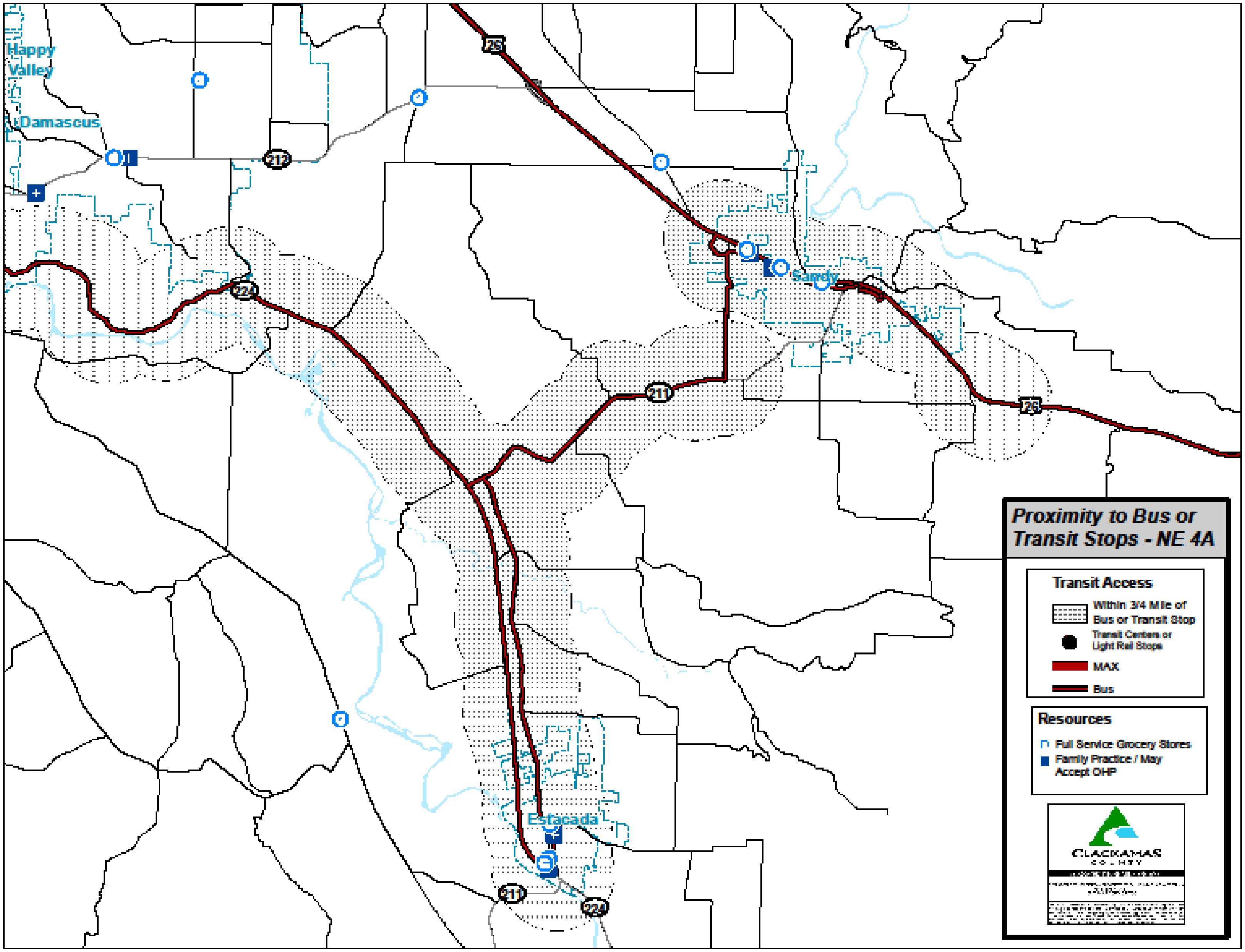


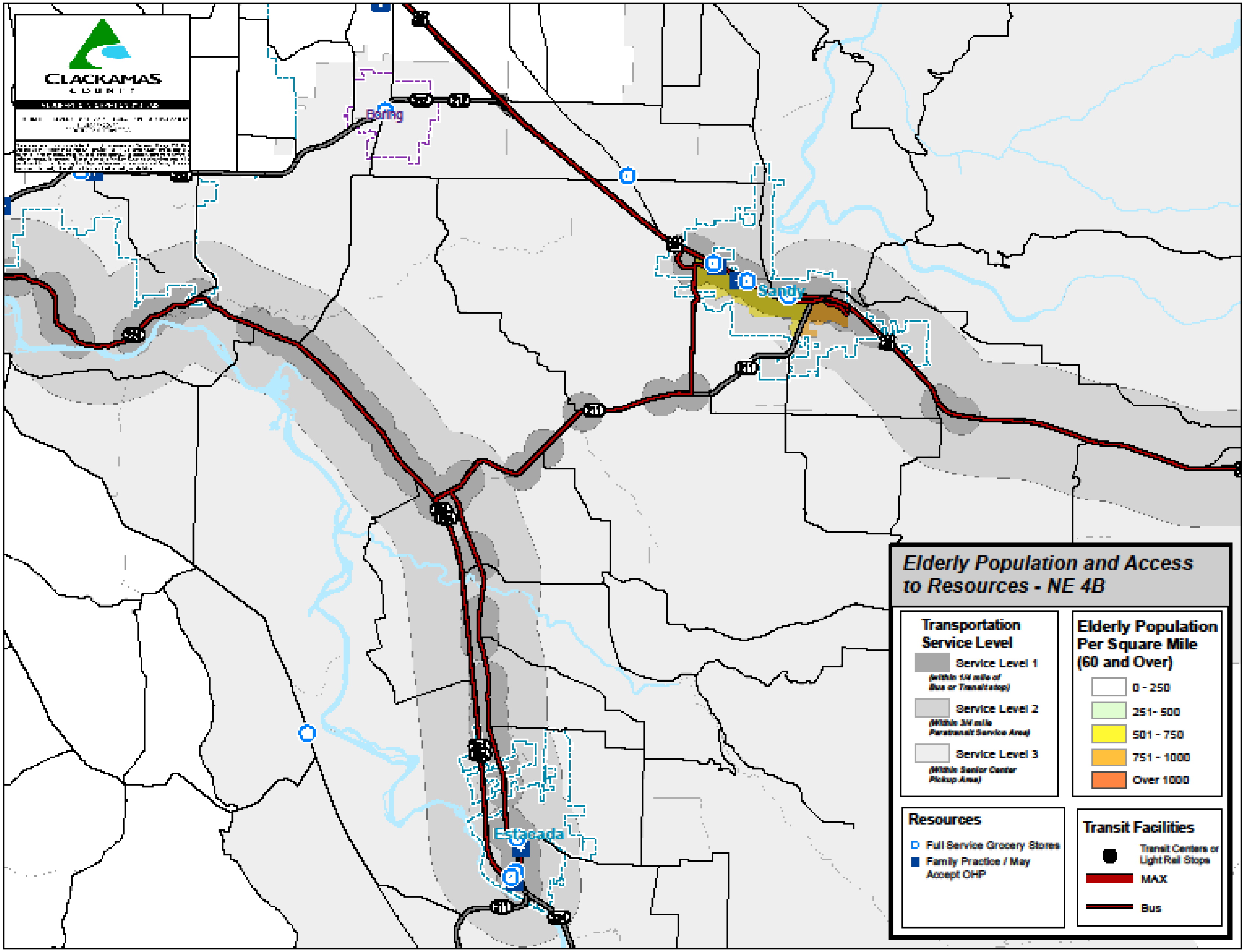

CLACKAMAS
COUNTY
Milwaukie
Lake
Oswego
Tualatin
Rivergrove
Johnson
City
Happy
Valley
Damascus
Gladstone
West
Linn
Oregon
City
Wilsonville
Canby
Elderly Population and Access to Resources - NW 3B
Transportation Service Level
Service Level 1
Service Level 2
Service Level 3
Elderly Population Per Square Mile (60 and Over)
0 - 250
251 - 500
501 - 750
751 - 1000
Over 1000
Resources
Full Service Grocery Stores
Family Practice / May Accept OHP
Transit Facilities
Transit Centers or Light Rail Stops
MAX
Bus


Poverty and Access to Resources - NW 3C
Population Below Poverty Level (Per Square Mile)
0 - 100
101 - 200
201 - 300
301 - 400
Over 400
Job and Transit Access
Over 2000 Employees per Square Mile
Within 3/4 Mile of Bus or Transit Stop
Transit Centers or Light Rail Stops
MAX
Bus
Resources
Full Service Grocery Stores
Family Practice / May Accept OHP
Adult Education Resources
Employment Agencies
Milwaukie
Lake Oswego
Happy Valley
Damascus
Johnson City
Tualatin
Rivergrove
Gladstone
West Linn
Oregon City
Wilsonville
Canby

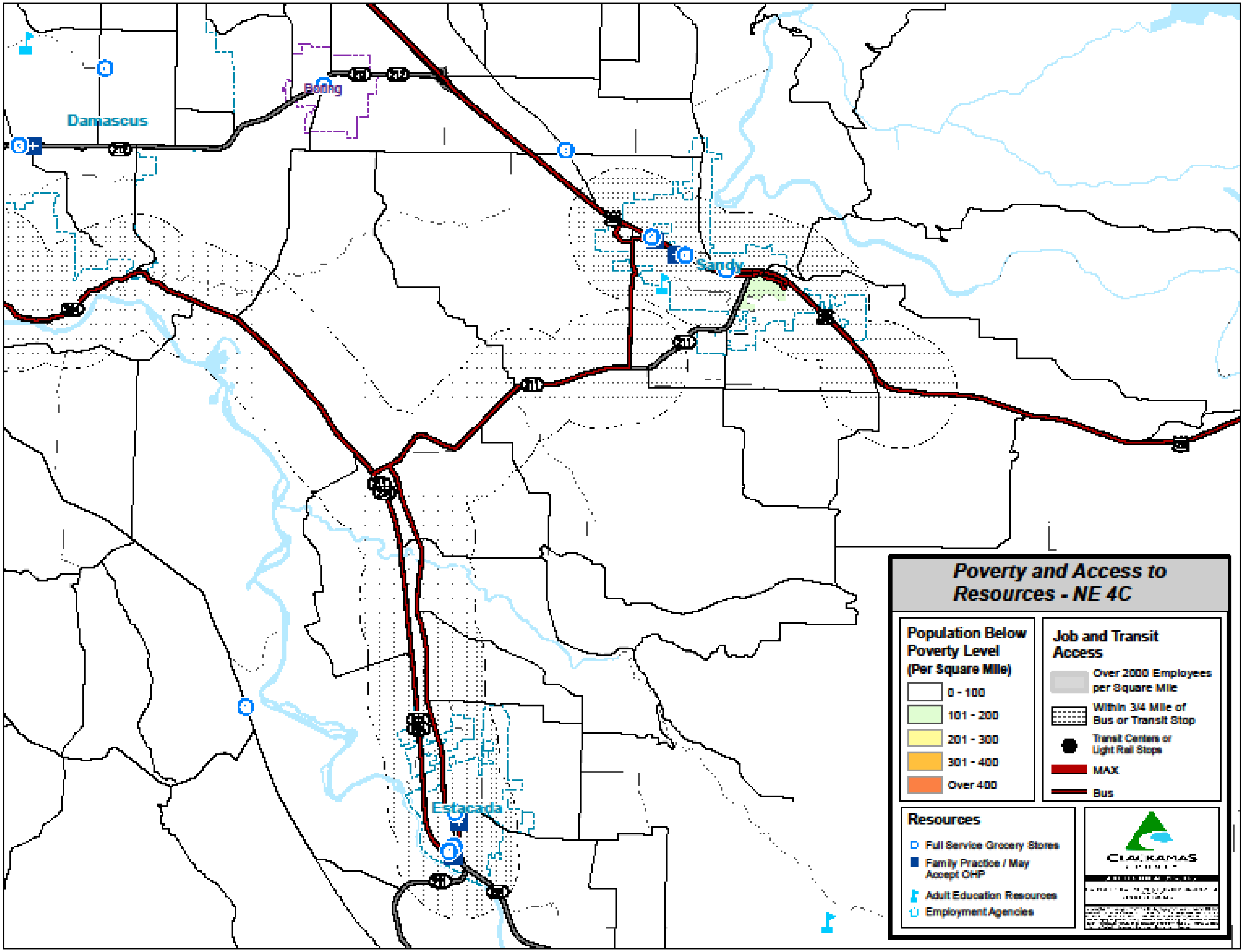

Milwaukie
Lake Oswego
Happy Valley
Damascus
Tualatin
Johnson City
Rivergrove
Gladstone
West Linn
Oregon City
Wilsonville
Canby
Youth and Access to Resources - NW 3D
Youth Population Per Square Mile (Under 18)
0 - 250
251 - 500
501 - 750
751 - 1000
Over 1000
Job and Transit Access
Over 2000 Employees per Square Mile
Within 3/4 Mile of Bus or Transit Stop
Transit Centers or Light Rail Stops
MAX
Bus
Resources
Full Service Grocery Stores
Family Practice / May Accept OHP
Adult Education Resources
Employment Agencies

Appendix B-4: Northeast Area Maps

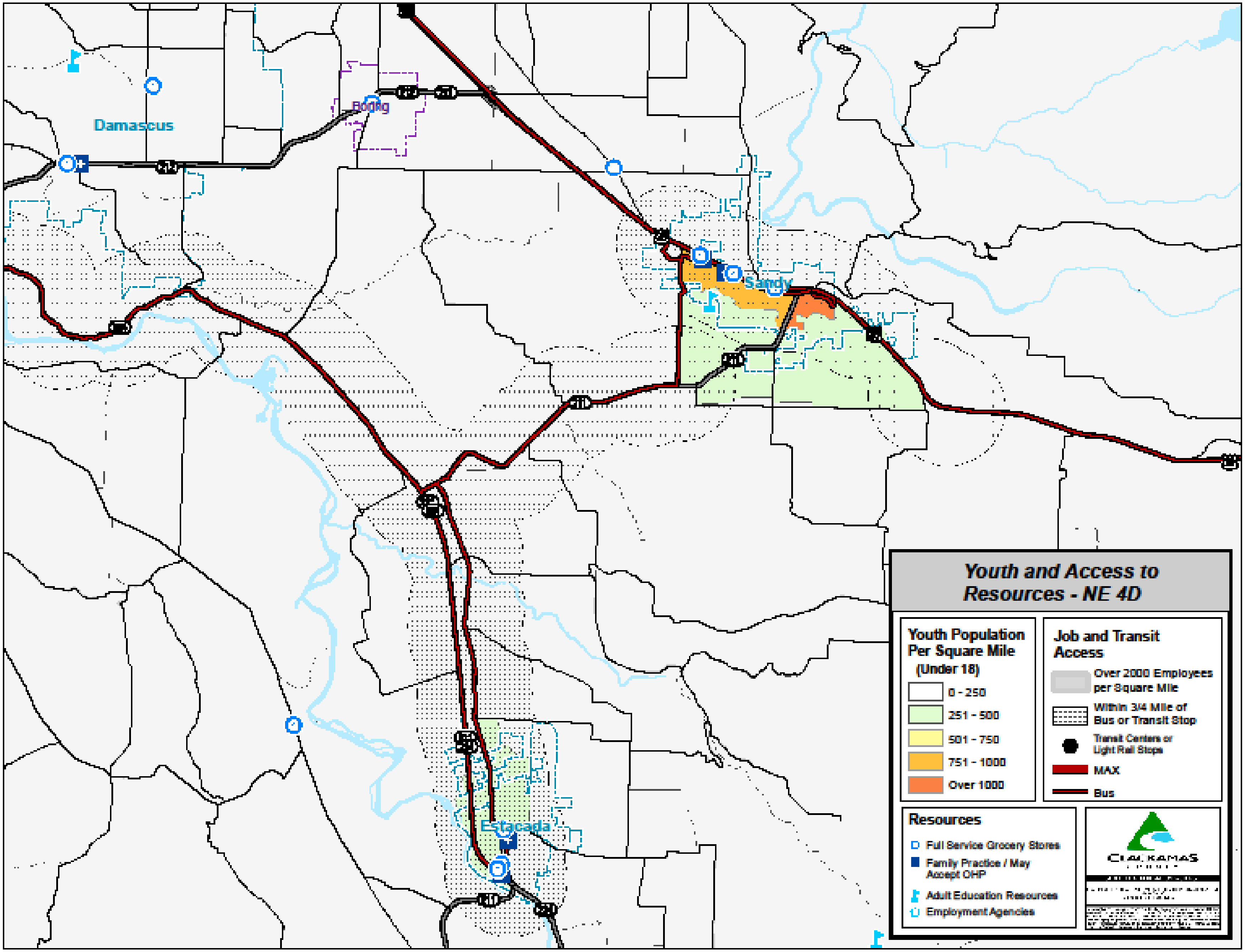




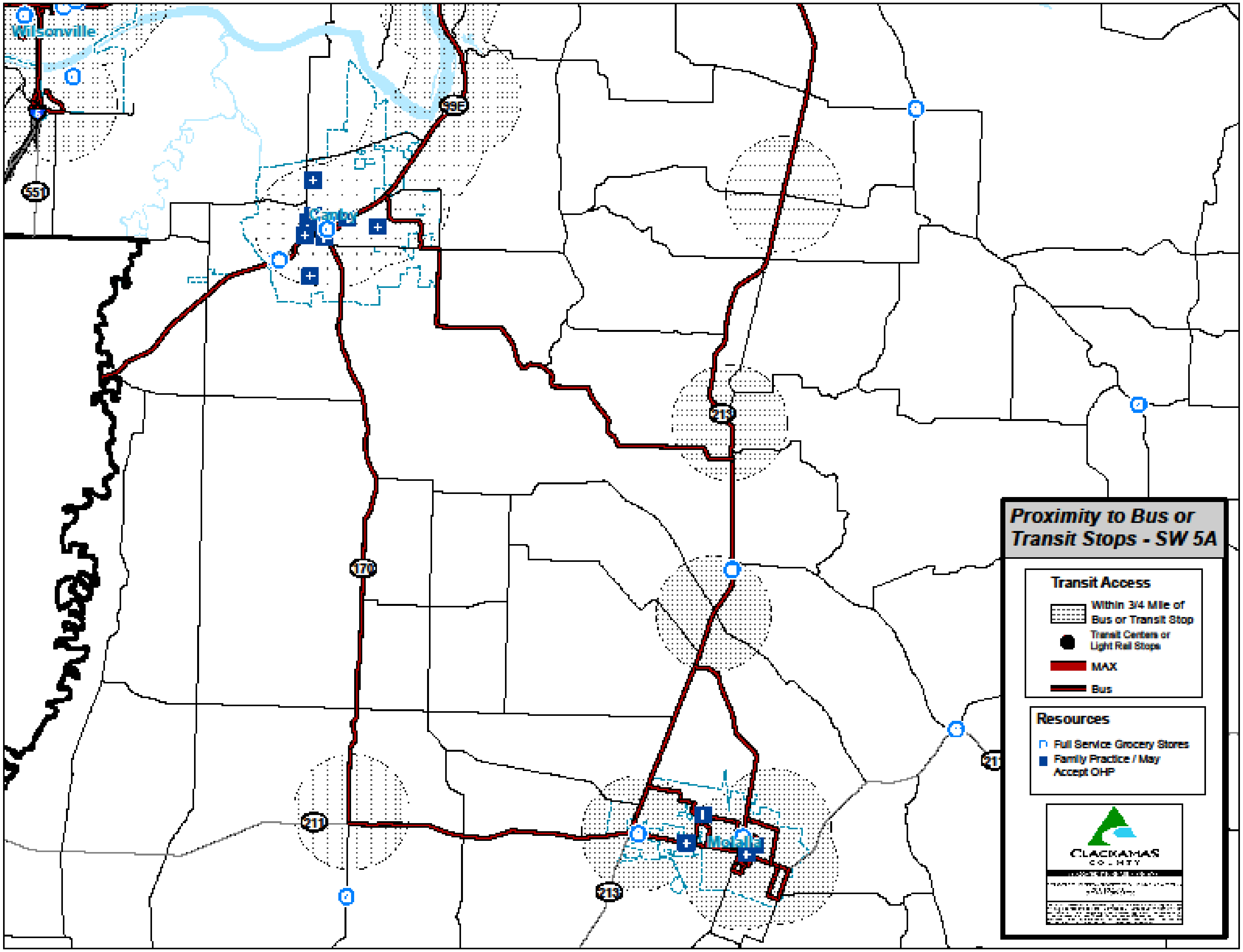
CLACKAMAS
COUNTY
Boring
Sandy
Estacada
Elderly Population and Access to Resources - NE 4B
Transportation Service Level
Service Level 1
Service Level 2
Service Level 3
Elderly Population Per Square Mile (60 and Over)
0 - 250
251- 500
501 - 750
751 - 1000
Over 1000
Resources
Full Service Grocery Stores
Family Practice / May Accept OHP
Transit Facilities
Transit Centers or Light Rail Stops
MAX
Bus

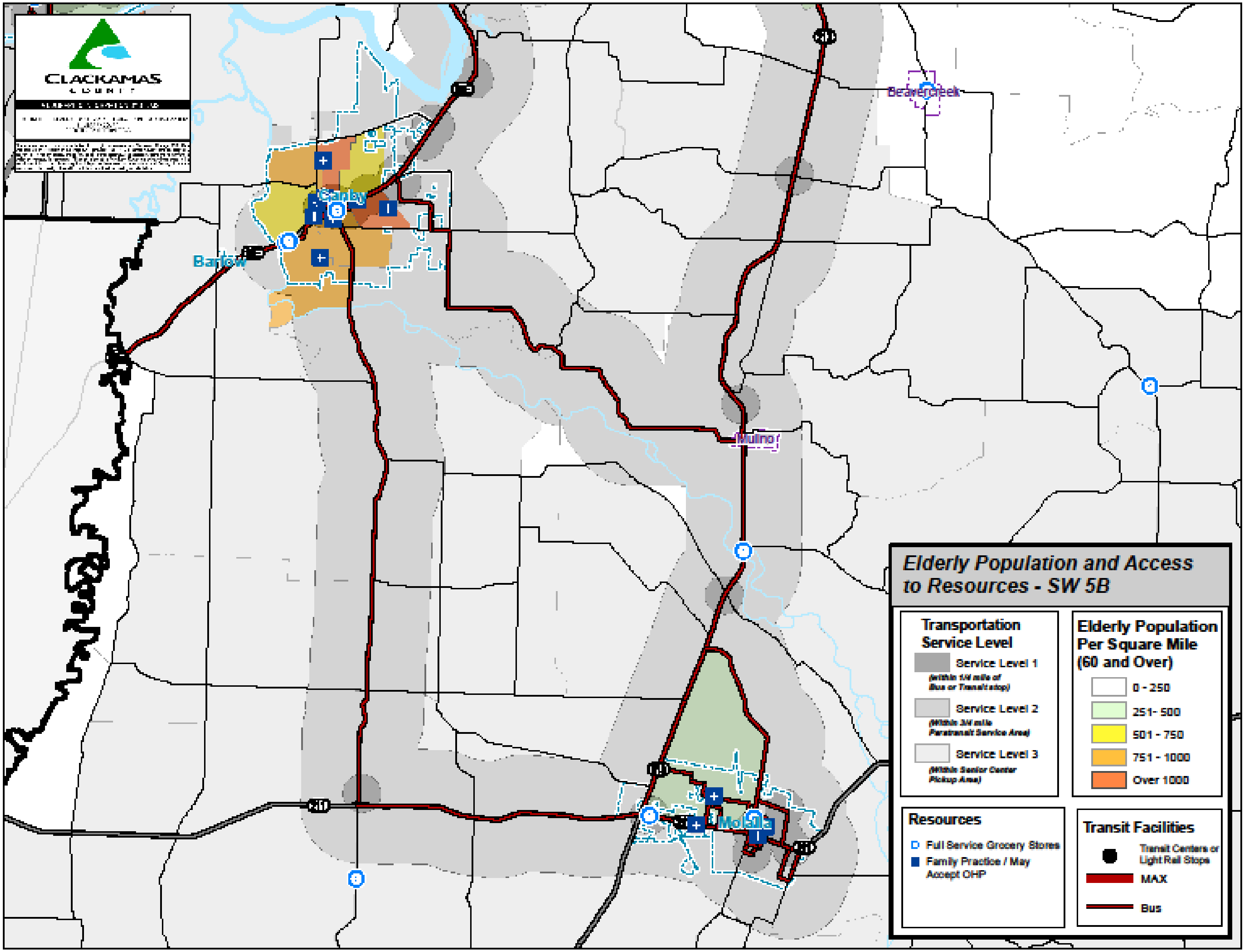


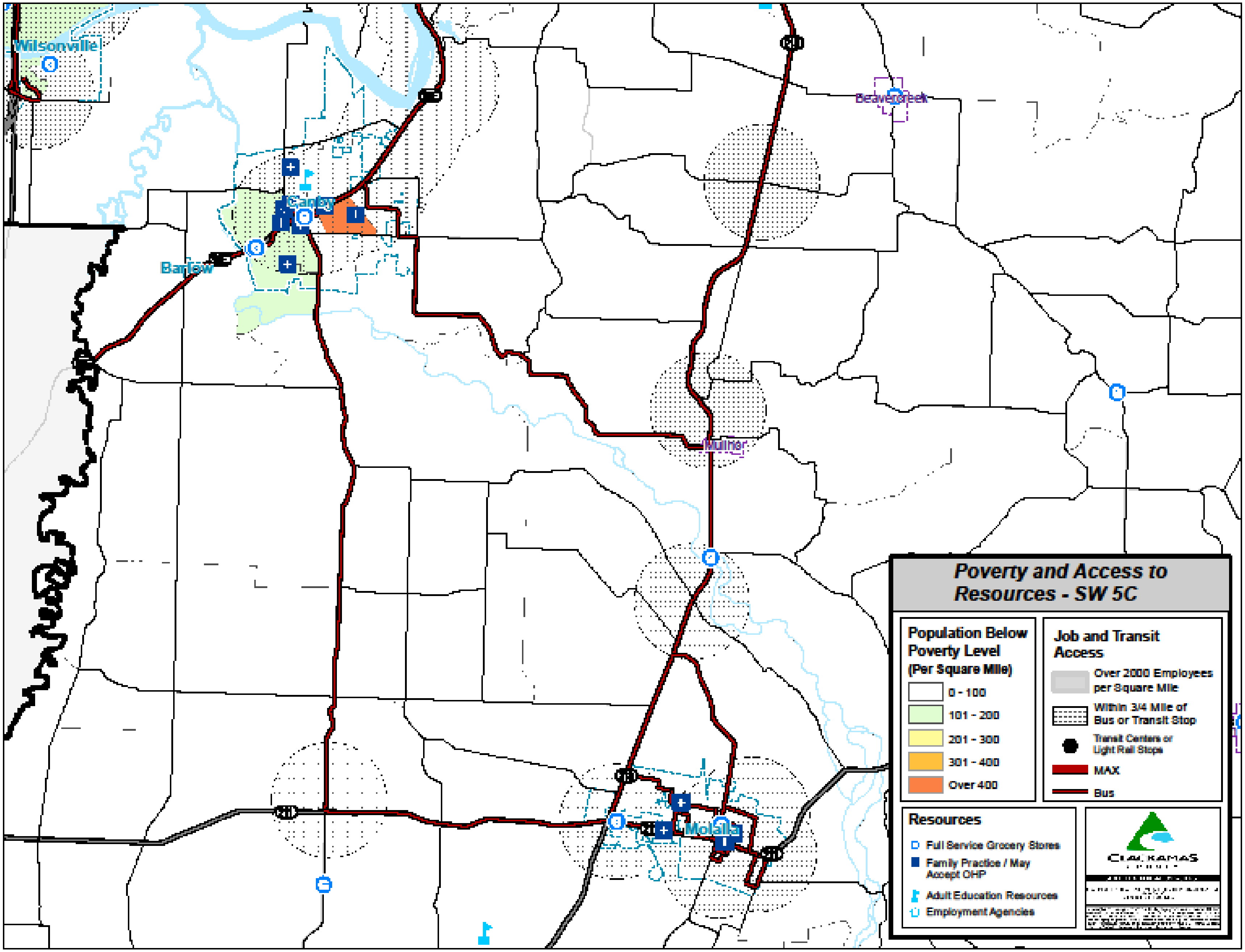
Poverty and Access to Resources - NE 4C
Damascus
Boring
Sandy
Estacada
Population Below Poverty Level (Per Square Mile)
0 - 100
101 - 200
201 - 300
301 - 400
Over 400
Job and Transit Access
Over 2000 Employees per Square Mile
Within 3/4 Mile of Bus or Transit Stop
Transit Centers or Light Rail Stops
MAX
Bus
Resources
Full Service Grocery Stores
Family Practice / May Accept OHP
Adult Education Resources
Employment Agencies

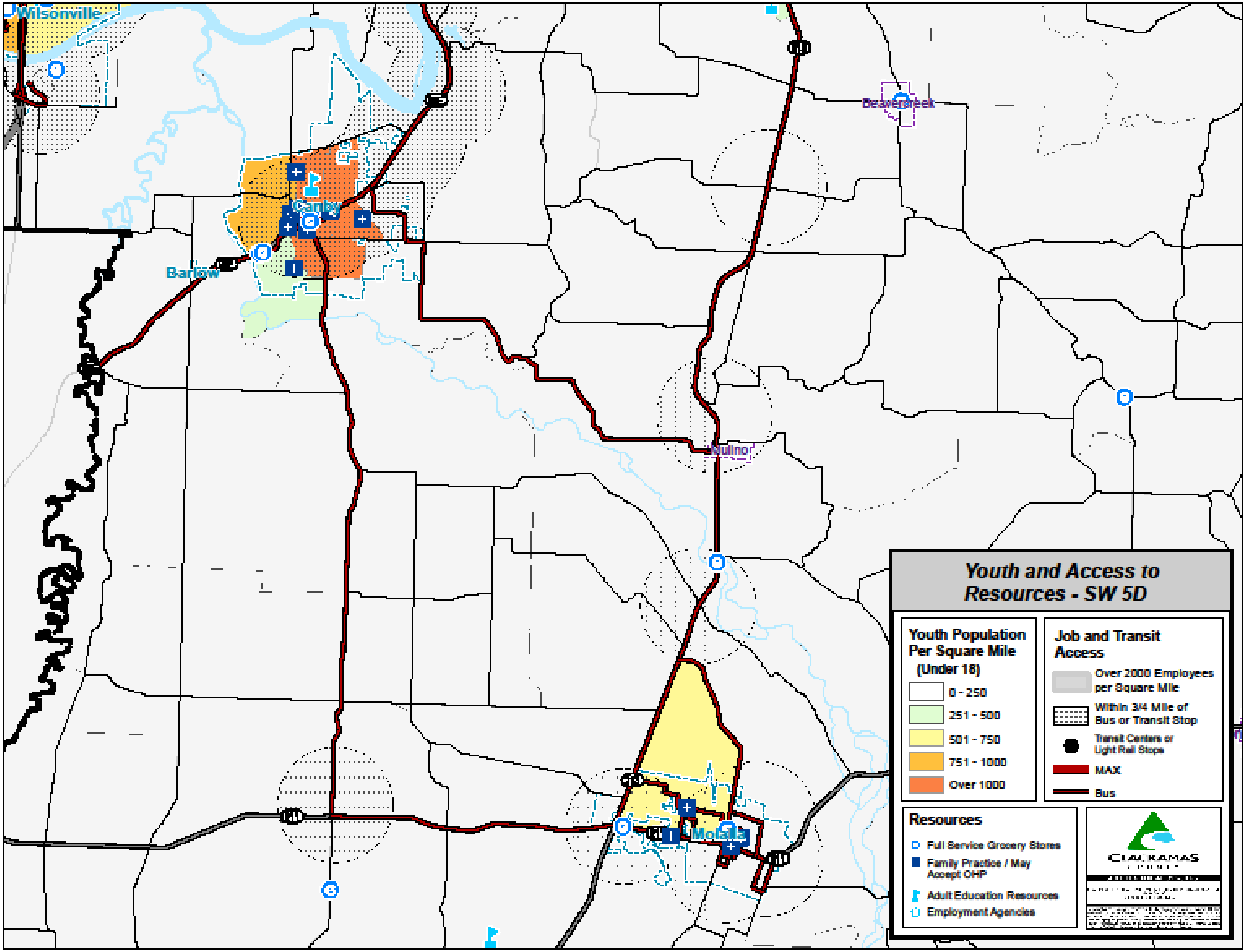

Damascus
Boring
Sandy
Estacada
Youth and Access to Resources - NE 4D
Youth Population Per Square Mile (Under 18)
0 - 250
251 - 500
501 - 750
751 - 1000
Over 1000
Job and Transit Access
Over 2000 Employees per Square Mile
Within 3/4 Mile of Bus or Transit Stop
Transit Centers or Light Rail Stops
MAX
Bus
Resources
Full Service Grocery Stores
Family Practice / May Accept OHP
Adult Education Resources
Employment Agencies

Appendix B-5: Southwest Area Maps




CLACKAMAS
COUNTY
Canby
Barlow
Beavercreek
Mulino
Molalla
Elderly Population and Access to Resources - SW 5B
Transportation Service Level
Service Level 1
(Within 1/4 mile of Bus or Transit stop)
Service Level 2
(Within 3/4 mile Paratransit Service Area)
Service Level 3
(Within Senior Center Pickup Area)
Elderly Population Per Square Mile (60 and Over)
0 - 250
251- 500
501 - 750
751 - 1000
Over 1000
Resources
Full Service Grocery Stores
Family Practice / May Accept OHP
Transit Facilities
Transit Centers or Light Rail Stops
MAX
Bus


Wilsonville
Canby
Barlow
Beavercreek
Mulino
Molalla
Poverty and Access to Resources - SW 5C
Population Below Poverty Level (Per Square Mile)
0 - 100
101 - 200
201 - 300
301 - 400
Over 400
Job and Transit Access
Over 2000 Employees per Square Mile
Within 3/4 Mile of Bus or Transit Stop
Transit Centers or Light Rail Stops
MAX
Bus
Resources
Full Service Grocery Stores
Family Practice / May Accept OHP
Adult Education Resources
Employment Agencies


Youth and Access to Resources - SW 5D
Youth Population Per Square Mile (Under 18)
0 - 250
251 - 500
501 - 750
751 - 1000
Over 1000
Job and Transit Access
Over 2000 Employees per Square Mile
Within 3/4 Mile of Bus or Transit Stop
Transit Centers or Light Rail Stops
MAX
Bus
Resources
Full Service Grocery Stores
Family Practice / May Accept OHP
Adult Education Resources
Employment Agencies
Wilsonville
Canby
Barlow
Beavercreek
Mulino
Molalla

Appendix C

H3S Programs

Housing Authority

The Housing Authority of Clackamas County (HACC) provides a variety of housing assistance programs for low income household, including special needs populations such as individuals with developmental disabilities or mental health issues. HACC provides public housing in several locations throughout the county, affordable housing, special needs housing and a housing voucher program. Residents need transportation to access a variety of basic needs, including education, Headstart programs, grocery stores, medical appointments and other services.

HACC does not provide direct transportation services or fund any purchased services. Through their client services coordinators, they work directly with local transit partners such as TriMet and the Social Services' transportation programs to assist clients in identifying transportation options. Many of their clients identify "the last mile" as being a barrier to service, with the timing of public transit service a barrier to access as well. For example, in Clackamas Heights located in Oregon City, bus service is available Monday through Friday with a total of 5 stops primarily in the morning and evening commuter hours. There is no weekend service. For many of the residents of Clackamas Heights, this service is not adequate to meet their needs and many residents are reliant on other means of transportation.

HACC conducted a survey of residents of Clackamas Heights in 2010 and found that 70% of residents own their own vehicle, which is a huge financial burden for many of these families. The survey comments identify several barriers to use of public transportation including concerns about safety and the timing of connections.

Anecdotally, residents also report the lack of public transportation options as a barrier to youth, particularly middle and high school students, in being able to participate in activities after school.

Community Solutions

The Community Solutions Division (CS) assists individuals to find training and employment opportunities. Many of their programs are based on contracts with partner agencies and focus on specific populations, such as low income households or food stamp recipients. Their Workforce Annex program is available to any job seeker regardless of income and provides computers and staff to assist with job search activities. Transportation is not specifically called out as part of their intake process but is part of the work they do with clients to assist them in identifying employment opportunities

CS has very limited discretionary funds available through some of their programs to assist with transportation needs. These funds are used to buy gas cards and bus tickets for the various public transit programs. In Fiscal Year 10-11, 406 clients received transportation assistance in the form of bus passes or tickets.

Clients report that the availability of public transportation limits their employment options. For example, Wilsonville has had multiple employment opportunities that clients feel they can't apply for because the bus schedule does not accommodate a swing shift position. Getting to and from other more rural locations such as Canby and Estacada is also very difficult because service doesn't operate on weekends or has very limited hours of service.

These barriers also impact the ability of clients to get education and assistance with job seeking activities. Clients who are required to do job searches or participate in job search classes report difficulties in getting to these needed services.

Community Development

The Community Development (CD) Division provides housing rehabilitation programs for households whose income is 80% or less of the median county income. They also fund projects that have indirect benefits such as street improvement or community facility updates or construction. Their HOME program funds the development of affordable housing, including transit oriented development. For example, they recently completed two Clackamas Town Center area projects that are both near light rail. When the project was planned, they anticipated that 25% of residents would not have a privately owned vehicle. In reality, closer to 50% of residents are transit dependent, illustrating the need for transit oriented development.

While CD does not directly fund any transportation services for their program participants, they may have discretion in the future to use certain funds to purchase vehicles or build bus shelters for facilities such as senior centers that serve low income residents.

Children, Youth and Families

The Children, Youth and Families (CYF) Division primarily serves children from birth to age 18 by providing prevention services focused around issues such as child abuse, domestic violence, juvenile delinquency and early childhood intervention. Most programs are available to the general public but certain programs, such as Healthy Start, are needs-based with poverty as one of the indicators. CYF services are mainly contracted with community partners and focus on increasing positive outcomes such as school graduation attainment.

Since their service model is primarily contracted, CYF does not provide direct transportation services. Some of the funds they contract out can be used to provide transportation supports. For example, Northwest Family Services provides bus passes and also some limited group transportation to students participating in their programs. It allows their participants to both attend programs that they might not otherwise be able to access and also participate in programs such as enrichment field trips. Occasionally, they are able to access federal funds to purchase vehicles on behalf of their programs. Some of the parent groups also receive gas cards or stipends to allow them to participate and some volunteers receive mileage reimbursement.

The lack of transportation in some of the more rural communities in Clackamas County has led to programs being delivered in the local community rather than in a more centralized location. Groups frequently meet in schools, libraries or fire departments to minimize the barriers associated with transportation. Since many of their programs are after school, busing can be an essential feature of access.

Public and Environmental Health

The Public and Environmental Health programs that are part of the Community Health Division, provides services to both specific populations as well as the general public. The WIC program provides nutrition and other services for women who are pregnant or have small children. The Maternal Child Health program provides direct client services for pregnant women. Other programs, such as Environmental Health and Communicable Diseases, provide general public services such as health inspections and vaccinations that benefit the population as a whole. In addition, they provide preventative services such as health education and tobacco cessation. None of their programs provide or pay for transportation services.

Because of public health's role in tracking health indicators, they have some data from programs regarding transportation needs. A dental services survey conducted in four Housing Authority public housing sites (Clackamas Heights, Oregon City View Manor, Hillside Park and Hillside Manor) showed between 29% and 17% of respondents indicating that they did not have reliable transportation. Another review by community health nurses of clients visited in January, 2011, shows that as many as 50% of their clients reported transportation issues as being a barrier to accessing health and dental services.

Community Health- Primary Care

The Primary Care program of Community Health provides medical, dental and mental health services at three clinics located in Oregon City, Clackamas and Gladstone. They also offer school based health services, including medical and preventative care, to youth and adolescents in the Oregon City High School and the Canby High School. Services can be paid for by traditional health insurance plans, including Oregon Health Plan, or, if no insurance is available, for low fees based on income.

Primary care does not currently provide or pay for transportation services. Clients who are eligible, such as individuals on Medicaid or Medicare or individuals who are eligible for paratransit services, may use these services to attend appointments. Other clients may experience barriers to accessing services via public transportation. While all three primary care sites have public transit access, frequency and availability of connections, particularly for residents of more rural areas, can limit access. A 2010 client survey conducted at the Beavercreek site showed that 58% of clients drove, 19% used public transit or medical transportation, 18% were drive by a friend or family member and 3% walked.

Behavioral Health/MHO

The Behavioral Health (BH) Division serves youth and adults with mental and emotional disturbances, youth and adults in need of alcohol and drug abuse treatment, individuals diagnosed with severe and persistent mental illnesses and those in need of 24-hour mental health crises services. BH operates clinics with outpatient services in Oregon City and Sandy and has also recently opened Centerstone in Happy Valley, which provides outpatient as well as crises services. All of the clinics are accessible by public transportation through TriMet or SAM (Sandy Transit).

BH directly provides some transportation services and also purchases or contracts for other services for their clients. BH clients use a variety of transportation options to meet their needs, including public transportation, paratransit programs such as TriMet's LIFT, Medicaid Medical Transportation, and local transportation options such as the senior center network or Social Services' transportation programs. Many clients get rides from family and friends as well. Case managers provide transportation services for clients on a limited basis using county vehicles. In the past, BH has had a part time temporary staff person to give clients rides to medical appointments and group meetings but that was discontinued due to funding reductions. Some clients who do not have Medicaid or are indigent are provided bus passes for TriMet or other public transit services.

BH also contracts with Broadway Cab to provide non-routine rides to clients who are in crises or in an emergency situation to get them to the hospital, hotel or another safe location. The Villebois program in Wilsonville, which provides case management services to chronically mentally ill clients living in supportive housing, contracts with SMART (Wilsonville Transit agency) to transport residents to predetermined locations. In addition, BH contracts with Thora Enterprises (dba Mountain Transportation) to provide secure transportation of clients between facilities.

Many clients continue to have unmet transportation needs, especially with respect to vocational rehabilitation, employment, shopping and medical appointments. Transportation is typically most difficult to arrange in more rural communities due to limited public transit services.

The Clackamas Mental Health Organization (MHO) is a program within the Behavioral Health Division of H3S. The MHO manages the mental health benefit for Clackamas County residents on the Oregon Health Plan (OHP). Services provided included authorization and payment of claims, intensive case management and service facilitation for adults in the Adult Mental Health Initiative and children in the Intensive Services Array, exceptional needs care coordination, management of inpatient psychiatric hospitalizations, and phone screening and referral services. The MHO contracts with a network of approximately 20 organizations throughout the Tri-county region to provide mental health services to over 4,000 OHP members each year. As with many other programs, the MHO serves individuals with limited resources in all parts of the county. Access to clinic-based mental health services is one of the greatest barriers faced by OHP members. Clinics are largely centralized in the northwest urban corner of the county, and the low population density in rural areas makes locating additional sites in these communities cost-prohibitive. A lack of transportation leads to missed appointments, which negatively impacts both the effectiveness of services for the consumer and the operational capacity of the provider.

Social Services

The Social Services Division (SSD) offers a variety of programs to assist seniors, persons with disabilities and low income households, including those who are homeless or at risk of homeless. The programs focus on increasing self sufficiency and providing supports to allow vulnerable individuals to remain safe in their own homes and communities. Examples of programs range from Energy Assistance for low income household that are struggling with their energy bills to the Money Management program, which provides assistance to individuals who are not able to independently manage their financial affairs.

Social Services directly provides transportation services and contracts with other organization to provide locally based transportation services. Through a partnership called the Clackamas County Transportation Consortium, SSD provides funding to nine senior and community centers in Welches, Sandy, Molalla, Canby, Oregon City, Milwaukie, Gladstone, Lake Oswego and Estacada. The centers, with both paid and volunteer drivers, provide rides to seniors and persons with disabilities to essential services such as medical appointments, congregate meals and grocery shopping.

Social Services operates three direct transportation services. The Transportation Reaching People (TRP) and the Catch-a-Ride (CAR) programs provide transportation using both paid drivers driving lift-equipped vans and buses and using volunteers using their own privately-owned vehicles to “fill the gaps” in service for the center programs and help seniors and persons with disabilities who live outside of a public transit service area or a senior center service district get rides, primarily for medical services. CAR also has a shuttle service that provides rides to low income residents who are seeking employment and educational opportunities but don’t have access to public transit. TRP provides rides under contract to TriMet for Medicaid Waivered Non-Medical rides for eligible clients. The final direct program is the Mountain Express which provides point-deviated fixed route service in the Hoodland area on the Highway 26 corridor between Sandy and Rhododendron.

The Developmental Disabilities program uses DD53 funds from the State of Oregon to purchase bus or LIFT passes for eligible clients or, for those who are unable to use public transit or are outside of a transit district, contracts with providers for transportation services.

The Veterans Services Office connects eligible veterans to service through the Veterans Administration programs and through service organizations. Transportation has been identified as a need for veterans in our communities, not just for medical treatment but also to access other services and to find employment.

Several housing programs operated by SSD have limited discretionary funds and are able to provide their clients with bus passes. SSD also partners with a non-profit organization, Social Services of Clackamas County, to provide a limited number of bus passes or gas cards for clients who do not have access to other funding resources and are in crises. These funds are very limited and typically only available to a client once per year.

Appendix D

Transit Resources

Public Transit Services

TriMet (Tri County Metropolitan Transit District)

TriMet, Oregon's largest transit entity, operates in Washington, Multnomah and Clackamas Counties. MAX, the region's light rail network, provides service into the Clackamas area while a future light rail extension into the Milwaukie area is in development. TriMet provides bus service in the urbanized western areas of the county, including Lake Oswego, Oregon City, Milwaukie, Gladstone, Clackamas, Happy Valley, and Estacada. TriMet will be providing bus service to the Boring area until December 31, 2011, at which time the Boring area will withdraw from the TriMet service district and be without fixed route service. TriMet also offers LIFT paratransit service and Medical Transportation Brokerage services for eligible clients (discussed under the "Paratransit Services" and "Medical Transportation" sections).

With the exception of the Green Line MAX service and WES service to Wilsonville, Clackamas County has been impacted by service cuts from TriMet over the last few years. As TriMet has struggled with diminishing returns from its payroll-based tax revenue and reductions to federal and state funding, bus services regionally have been reduced or eliminated. For example, service to South End Loop Road in Oregon City was completely eliminated as a cost-savings measure. Other bus lines have suffered from reductions in the frequency of service. While these impacts have been felt throughout the TriMet service area, Clackamas County has been particularly hard hit.

Sandy Area Metro (SAM)

In 2001, the City of Sandy withdrew from the TriMet service district and established its own transit program, Sandy Area Metro (SAM). SAM offers fixed route bus service Monday through Saturday in Sandy and to the TriMet Gresham Transit Center. Service is available approximately every 30 minutes from 5:30am to 9pm on weekdays and every hour from 9:30am to 10:30pm on Saturdays It also offers STAR, a demand-response (dial-a-ride) service within the city limits with reservations accepted at least 24 hours in advance. The ride destination must be within Sandy, but rides to the regular fixed route service with destinations outside of Sandy are available. SAM also provides bus service Monday through Friday to Estacada five times per day from 7am to 7pm. There is no fare for the fixed route service. The STAR service is $.50 per one way trip with seniors and children riding free.

Mountain Express

Clackamas County Social Services has partnered with the Villages at Mt. Hood and the City of Sandy to provide deviated fixed route bus service to the communities east of Sandy on Highway 26 to Rhododendron. The service runs six times per day Monday to Friday from 5:30am to 7pm and has four runs on Saturdays. The service is coordinated with the Estacada bus service and also provides access to the fixed route service between Sandy and Gresham. The fare is $2 per one way trip with discounted books of tickets available.

SMART (South Metro Area Regional Transit- Wilsonville)

Since 1989, SMART has been providing transit services to the Wilsonville area. SMART operates most services Monday through Friday from 5:30am to 8:30pm with Saturday service offered on the bus lines going to the Barbur Transit Center connecting to TriMet services and on Route 4 though Wilsonville. Wilsonville is also served by WES (Westside Express Service), an express commuter rail service operated by TriMet that starts at the Beaverton Transit Center, stops at several locations in Tigard and Tualatin and terminates at the Wilsonville Transit Center. SMART also offers bus service to the Salem Transit Center during commuter hours in the morning and afternoon Monday through Friday and also provides bus service to the Canby Transit Center weekdays during commuter hours. Bus service within the city of Wilsonville is free of charge. Fares to Canby, Salem and Portland range from $1.25 to $2 with weekly and monthly passes available.

SMART offers several services targeted toward seniors and persons with disabilities. Its dial-a-ride service is a door to door paratransit service. It provides prescheduled door-to-door rides to Wilsonville's Community Center for senior meals and other activities. It provides a Thursday Shopping Shuttle for senior and supported housing residents. It also provides medical appointment rides into the Portland area for seniors and persons with disabilities.

SCTD (South Clackamas Transit District- Molalla)

SCTD provides bus service both within the city of Molalla and by routes that go to Canby and to Clackamas Community College in Oregon City. SCTD is a point deviated fixed route service, with calls requesting pickup within 3/4 mile of the fixed route scheduled at least 24 hours in advance and subject to availability. The intra-city route operates from 7:30am until 6:30pm Monday to Saturday. Bus service is available to Clackamas Community College Monday through Friday from 5am to 8pm and on Saturdays from 7am to 5pm. Service to Canby is available from 7:30am to 5:30pm during weekdays. The intra-city route is free. Routes to Canby or Oregon City are $1 per one way trip.

CAT (Canby Area Transit)

CAT provides bus service to Canby with connections to Woodburn and Oregon City. Within the urban growth boundary of Canby, CAT provides a general public dial-a-ride service for locations within the boundary from 6am to 8pm on weekdays. Shuttle service is also offered at various stops within the city. The Orange Line fixed route service provides rides from the Canby Transit Center to Woodburn and to Oregon City Transit Center Monday through Friday from 5:30am to 8:30pm. A fare will be implemented in the fall of 2012. It has been tentatively set at $1 per ride with discounts available to seniors.

Paratransit Services

Paratransit services can follow several service models and each transit system meets these requirements as follows:

- TriMet- provides services through its LIFT program which provides origin to destination service within TriMet's district using a fleet of small, fully accessible buses. Services are generally offered 22 hours per day for 7 days per week. Beginning in September, LIFT services will more closely parallel fixed route service offerings so, for example, LIFT will not be available on weekends for areas that only have weekday fixed route service.

- Canby Area Transit- services are provided as a 'dial-a-ride' within the city boundaries. Rides with destinations outside of the city boundaries are available on a limited basis. The routes to Woodburn and to Oregon City are considered commuter routes with no stops so paratransit services are not available on these routes.

- South Clackamas Transit District (Molalla)- provides paratransit service within ¾ miles of its fixed route services with calls for scheduling placed at least 24 hours in advance. The service is provided using a "point deviated" model with the regular fixed route bus actually going off of its regular route to pick up eligible customers.

- South Metro Area Regional Transit (Wilsonville) - provides full paratransit services within ¾ miles of its fixed route services with the exception of the commuter lines to Salem and to Portland.

- Sandy Area Transit – provides full paratransit services using the SAM shuttle within the city boundaries. The services to Estacada and to Gresham are commuter services.

- Mountain Express- provides paratransit services within ¾ miles of its fixed route services with scheduling in advance for pickup. This service is also a point deviated service, with the regular fixed route bus deviating from the regular route.

Clackamas Regional Center Pedestrian/Bicycle Plan

Table of Contents

Clackamas Regional Center

Pedestrian and Bicycle Connection Project

Project Overview

INTRODUCTION

The purpose of the Clackamas Regional Center (CRC) Area Pedestrian and Bicycle Connection project is to create safe pedestrian and bicycle connections between the Clackamas Regional Center Max Green Line station and major area employers and services. This is done by working with the community to identify and prioritize safe pedestrian and bicycle connections in the study area. The major destinations or routes were identified and the bicycle and pedestrian system gaps and deficiencies for those routes and recommendations on way-finding signage were completed. This information provides a framework for the recommended system improvements associated with pedestrian and bicycle facilities within the project area.

The study area includes the CRC area from Causey Avenue west to Fuller Road, south to below Harmony Road and east to include the area just south of Sunnybrook Boulevard, east of the freeway, past SE 97th Avenue and up to Sunnyside Road back to Causey Avenue.

SUMMARY OF ROUTES AND DESTINATIONS

Seven routes leading to seven major destinations in the CRC study area were examined for system gaps, deficiencies and obstacles. (See Clackamas Regional Center Pedestrian/Bicycle Connection Project Routes and Projects Map). All of the routes have various needs regarding street access, sidewalk/walkway and bike lane gaps and deficiencies. In some cases there are obstacles that are in the way of connecting sidewalks and/or access to bike lanes and the I-205 multi-use path.

The seven destinations include Kaiser Permanente Sunnyside Hospital, Stevens Road Commercial Area/Eagle Landing Mixed Use Development, Mixed Housing North of Clackamas Town Center, 82nd Avenue Development/Housing, Clackamas Promenade Shopping Center, Clackamas Community College Harmony Campus/OIT/Aquatic Center and Clackamas Town Center. The routes leading to these destinations and the various pedestrian and bicycle system gaps, deficiencies and obstacles between the Clackamas Town Center Transit Centers and Max Green Line are described in this report.

DESTINATIONS

There are seven primary destinations within the study area including the CTC. Since all seven routes pass through or near the Town Center it is not distinguished with a separate route but is listed as a destination.

The seven destinations, listed in the table below, have been identified as the employers, services and areas with the CRC that would benefit most from improved pedestrian and bicycle facilities. The seven routes within the CRC have been defined as from the TriMet Max Green Line/Transit Center to the destinations listed below and are shown on the Clackamas Regional Center Pedestrian/Bicycle Connection Project Routes and Projects Map.

Routes	Destinations
	Clackamas Town Center
1	Kaiser Permanente Sunnyside Hospital
2	Stevens Rd. Commercial Area / Eagle Landing Mixed Use Development
3	Mixed Housing North of Clackamas Town Center
4	82nd Avenue Development / Housing
5	Clackamas Promenade Shopping Center
6	Clackamas Community College Harmony Campus/OIT/Aquatic Center

System Gaps and Deficiencies

The system gaps and deficiencies were identified using information gathered from the Technical Advisory Committee's[1] study area field visit and the Project Advisory Committee's[2] study area field visit.

Gaps are defined as missing pieces in the system in contrast to system deficiencies. A system deficiency is where the standard is not met. For example, 8-foot wide sidewalks are the standard for 82nd Avenue within the study area (outside of the gateway intersections) whereas, the majority of sidewalks along 82nd Avenue are less than 8 feet in width and in some cases there are obstacles in the sidewalk in the form of signal and utility poles creating multiple types of deficiencies. Deficiencies can also include hazards such as a buckling or raised sidewalk.

The seven routes in order of priority as determined by the Project Advisory Committee include the following:

1. Kaiser Permanente Sunnyside Hospital (Route 1)
2. Clackamas Community College/Oregon Institute of Technology/Aquatic Center (Route 6)
3. CCC Harmony Campus Connection to Kaiser Hospital. (Route 7)
4. Mixed Housing North of Clackamas Town Center Shopping Center (Route 3)
5. 82nd Avenue Development/Housing (Route 4)
6. Clackamas Promenade Shopping Center (Route 5)
7. Eagle Landing Mixed Use Development/Stevens Road Commercial Area (Route 2)

---

1 The Technical Advisory Committee for this project includes representatives from the Oregon Department of Transportation, the Clackamas County Pedestrian/Bikeway Advisory Committee, TriMet and County staff.

2 The Project Advisory Committee includes representatives from the Town Center, Kaiser, Clackamas Community College Harmony Campus, Oregon Department of Transportation, the Clackamas County Pedestrian/Bikeway Advisory Committee, TriMet, Community Planning Organizations and County staff.

The system gaps, deficiencies and obstacles by route for each of the destinations are described in a separate document and attached. They are colored coded and match the colors illustrated on the Clackamas Regional Center Pedestrian/Bicycle Connection Project Routes and Projects Map.

Project Rating and Evaluation System

The pedestrian and bicycle improvement projects were rated against criteria in order to evaluate and prioritize the projects. Examples of the criteria utilized included connectivity, safety, route completion cost and proximity to pedestrian generator. A detailed description of the rating system is attached.

Sign Plan

An important element to improve the walking and cycling experience in the Town Center Area is wayfinding signage for both pedestrians and bicyclists, especially between the TriMet Max Green Line and area major employers and services. The goal of the Pedestrian and Bicycle Sign Plan (Sign Plan) for the CRC Area Pedestrian / Bicycle Connection Project is to provide a comprehensive wayfinding system for both walkers and bikers within the Study Area.

This Sign Plan includes information on sign placement; sign content (general destinations) and sign type. The plan recommends installation of 21 new pedestrian signs (five map-based signs and 15 pole signs) and 16 bicycle wayfinding signs along bikeways within the Study Area. Detailed maps showing recommended sign locations are attached to the Sign Plan as Map 1: Pedestrian Sign Locations and Map 2: Bicycle Sign Locations.

	Priority Pedestrian/Bicycle Projects						
	Projects	Evaluation Criteria					
		Connectivity	Safety	Route Completion or Pedestrian Volume	Cost: Low, Med, High	Proximity to [illegible]	Total Score
	ROUTE 1: KAISER PERMANENTE SUNNYSIDE HOSPITAL						
1C	Construct walkway from Max Green Line platform directly south through existing fence along north and eastern edges of the Clackamas Town Center southeast parking lot to the I-205 multi-use path via stairway and/or to Sunnyside Road.(Needs Report 1.a.)	3	3	2	3	3	14
4L	Travelling south on the I-205 multi-use path install a pedestrian signal to cross the I-205 northbound/Sunnyside intersection across the right turn lane.(needs report 1.k.)	0	4	0	4	5	13
3A/3B	Widen I-205 overpass on Sunnyside Road for bicyclists/pedestrians.(Needs Report 1.b.) Or, construct separate bicycle/pedestrian bridge over I-205.(Needs Report 1.b.)	3	3	3	1	3	13
1D	Construct sidewalk extension/bulb to accommodate pedestrians and cyclists around signal pole at the Sunnyside Road/I-205 northbound interchange.(Needs Report 1.j.)	2.5	3	3	3	3	14.5
2A	Install "green" transition bike lane from where bike lane ends on Sunnyside Road travelling west to the I-205 overpass.(Needs Report 1.c.)	3	3	3	3	2.5	14.5
2B	Widen Sunnyside Road to the north for a bike lane on Sunnyside Road from the I-205 northbound/Sunnyside intersection to approximately 200 feet to the east.(Needs Report 1.c.)	3	3	3	2	2.5	13.5
	ROUTE TOTAL:						**82.5**
	AVERAGE ROUTE SCORE:						**13.75**

	Projects	Evaluation Criteria					
		Connectivity	Safety	Route Completion or Pedestrian Volume	Cost; Low, Med, High	Proximity to Pedestrian Generators	Total Score
ROUTE 2: EAGLE LANDING MIXED-USE DEVELOPMENT/STEVENS ROAD COMMERCIAL AREA							
1L	Construct contiguous walkway from Max Green Line station north to strip mall/Clackamas Corner Library.(Needs Report 3.d.)	2.5	2	1.5	3	2	**11**
1K	Construct a pedestrian stairway with bike grooves for cyclists from the intersection of Monterey Avenue/90th Avenue to the Clackamas Town Center parking lot.(Needs Report 3.c.)	3	3	3	3	2	**14**
6D	Install bicycle signs on Monterey Avenue directing cyclists to I-205 multi-use path and/or median refuge/crossing treatment.(Needs Report 3.e)	0	0	2	5	3	**10**
7D	Install parabolic mirror and/or signage to resolve limited sight distance issue at the intersection of the I-205 multi-use and the path extension at Monterey Avenue.(Needs Report 3.m)	0	0	3	3	3	**9**
1I	Analyze feasibility of constructing multi-use path from I-205 northbound/Sunnyside Road intersection north to Bob Schumacher Road.(Needs Report 2.c.)	2	3	2	1	1	**9**
1E	Construct walkway from Max Green Line transit station north to Monterey Avenue/90th Avenue through Clackamas Town Center parking lot.(Needs Report 2.a.)	2	2	2	3	2.5	**11.5**
ROUTE TOTAL:							**64.5**
AVERAGE ROUTE SCORE:							**10.75**

	Projects	Evaluation Criteria					
		Connectivity	Safety	Route Completion or Pedestrian Volume	Cost; Low, Med, High	Proximity to Pedestrian Generators	Total Score
ROUTE 3: MIXED HOUSING NORTH OF CLACKAMAS TOWN CENTER SHOPPING CENTER							
4D	Install crosswalk(s) where needed at Town Center access drive off of Monterey Avenue leading to the Mall Transit Center.(Needs Report 3.n.)	0	4	0	5	4	13
1J	Remove trees and construct separated sidewalk with landscape strip or curb tight sidewalk along part of 85th Avenue between Causey Avenue and Monterey Avenue.(Needs Report 3.a.)	3	2.5	3	2	2.5	13
6F	Remove "End Bike Route" sign at the end of the Causey Avenue cul-de-sac at the I-205 multi-use path.(Needs Report 3.s.)	0	0	2	5	3	10
2D	Install bike boulevard on Causey Avenue between 82nd Avenue east to the I-205 multi-use path. The bike boulevard should include consideration of the following: left turn lane removal, curb extensions, raised crosswalks for traffic calming and bike sharrows.(Needs Report 3.b.)	3	3	3	2	2.5	13.5
1M	Repair heaving sidewalks along Causey Avenue between 82nd Avenue and 90th Avenue.(Needs Report 3.g.)	3	1.5	1.5	2	2.5	10.5
7C	At the intersection of 82nd Avenue/Causey Avenue (SE and SW corners) install sidewalk ADA ramps.(Needs Report 3.h.)	0	0	3	4	4	11
7E	82nd Avenue/Causey Transit Stop: install pedestrian amenities, e.g. covered shelter.(Needs Report 3.v.)	0	0	4	3	3	10
1R	Replace/repair sidewalks on Causey Avenue west of 82nd Avenue to standard requirement.(Needs Report 4.o.)	2.5	1.5	1.5	3	2.5	11
2F	Install bike lanes on Causey Avenue between Fuller Road and 82nd Avenue.(Needs Report	3	2	3	3	2.5	13.5
	ROUTE TOTAL:						**105.5**
	AVERAGE ROUTE SCORE:						**11.7**

	Projects	Evaluation Criteria					
		Connectivity	Safety	Route Completion or Pedestrian Volume	Cost; Low, Med, High	Proximity to Pedestrian Generators	Total Score
ROUTE 4: 82ND AVE. DEVELOPMENT/HOUSING							
4F	Install pedestrian safety devices (e.g. pedestrian signal, signage) for the crosswalk at the Max Green Line Park and Ride to JC Penney.(Needs Report 3.p.)	0	5	0	5	5	**15**
4G	Install pedestrian safety devices (e.g. pedestrian signal, signage) for the crosswalks leading to the Transit Center on the north side of the mall.(Needs Report 3.r.)	0	4	0	5	4.5	**13.5**
7B	Upgrade sidewalks and crosswalks on the north side of the mall to ADA standards.(Needs Report 3.f.)	0	0	2	3	2	**7**
1N	Construct a pedestrian connection through the north Clackamas Town Center parking area west to 82nd Avenue. Construct sidewalk between 82nd Avenue access driveway and the Transit Center north of the cinema.(Needs Report 4.a.)	3	3	2.5	2	3	**13.5**
2H	Install bike lane on Town Center driveway (northernmost access) from 82nd Avenue to the CTC North Mall Transit Center.(Needs Report 4.g.)	1	1.5	1	2	2.5	**8**
1P	Construct east/west connector street with sidewalk/bike boulevard treatment between 82nd Avenue and Fuller Road.(Needs Report 4.c.1)	3	2	3	1	2	**11**
4H	Increase walk time at crosswalks along 82nd Avenue within project area.(Needs Report 4.k.)	0	3	0	5	4.5	**12.5**
1O	Construct sidewalk/landscape strip along both sides of 82nd Avenue from Sunnyside Road north to Causey Avenue as per boulevard standard.(Needs Report 4.b.)	3	3	3	1	3	**13**
7G	Install transit amenities along 82nd Avenue within project area.(Needs Report 4.i)	0	0	4	3	4	**11**
2G	Install bike lanes on 82nd Avenue within the project area, if adequate right of way exists. If not, acquire right-of-way for bike lanes along 82nd Avenue.(Needs Report 4.d.)	3	3	3	1	3	**13**
7H	Analyze feasibility of decreasing number of driveways and implementing 82nd Avenue Access	0	0	4	3	4	**11**
ROUTE TOTAL:							**128.5**
AVERAGE ROUTE SCORE:							**11.6**

	Projects	Evaluation Criteria					
		Connectivity	Safety	Route Completion or Pedestrian Volume	Cost; Low, Med, High	Proximity to Pedestrian Generators	Total Score
ROUTE 5: CLACKAMAS PROMENADE SHOPPING CENTER							
1T	Construct pedestrian connection along access drive within the Promenade from the crosswalk on Sunnyside Road at about the 9000 block (Petco).(Needs Report 5.b.)	2.5	2.5	2	3	2.5	**12.5**
1S	Analyze feasibility of strategically locating and constructing walkways within Clackamas Promenade parking lot.(Needs Report 5.a.)	3	2	2	1	2.5	**10.5**
1U	Construct walkway(s) from the second driveway heading south through the Promenade Shopping Center parking lot.(Needs Report 5.c.)	3	2	2	1	2.5	**10.5**
1V	Construct an east/west connector walkway west of 93rd Avenue along the north side of the Target store.(Needs Report 5.d.)	2.5	2.5	2.5	1	2.5	**11**
2I	Install bike lanes along 93rd Avenue.(Needs Report 5.f.)	3	3	3	3	3	**15**
1X	Construct sidewalks along the west side of 84th Avenue. (Sidewalks exist along east side of 84th Avenue.)(Needs Report 5.h.)	1.5	1.5	2.5	1	1.5	**8**
2J	Install bike lanes along 84th Avenue.(Needs Report 5.i.)	2	1.5	1.5	3	1.5	**9.5**
ROUTE TOTAL:							**77**
AVERAGE ROUTE SCORE:							**11**

	Projects	Evaluation Criteria					
		Connectivity	Safety	Route Completion or Pedestrian Volume	Cost, Low, Med, High	Proximity to Pedestrian Generators	Total Score
ROUTE 6: CLACKAMAS COMMUNITY COLLEGE (CCC) / OREGON INSTITUTE OF TECHNOLOGY / AQUATIC CENTER							
1B	Construct walkway along existing north/south street in the Clackamas Town Center southeast parking lot to Sunnyside Road.(Needs Report 1.a.)	3	3	2	3	3	**14**
7F	Prepare traffic study to analyze feasibility of reducing travel lanes or other modifications to add pedestrian/bike improvements including landscaping on Sunnyside Road between 82nd Avenue I-205.(Needs Report 4.f.)	0	0	5	5	5	**15**
1W	Repair heaving sidewalks (as per the Sunnyside Road design in Figure X-CRC-3) along south side of Sunnyside Road adjacent to Promenade and on south side of Sunnyside Road between 82nd and I-205.(Needs Report 5.g.)	3	3	3	2	3	**14**
4J	Analyze need for additional crosswalks across Sunnyside Road between 82nd Avenue and the I-205 overpass. If needed, provide additional crosswalk(s)/pedestrian refuge areas.(Needs Report 6.k)	0	4	0	4	3.5	**11.5**
7K	Add and paint bike stencils along Harmony Road.(Needs Report 6.e.)	0	0	4	5	4	**13**
5C	Install lighting along Harmony Road west of Sunnyside Road.(Needs Report 6.f.)	0	5	0	2	3.5	**10.5**
4K	Analyze need for additional crosswalks across Harmony Road west of 82nd Avenue at the CCC Harmony campus area. If needed, provide additional crosswalk(s).(Needs Report 6.l.)	0	4	0	5	4	**13**
2K	Provide safer left turn movement for cyclists from Harmony Road to the CCC Harmony Campus.(Needs Report 6.j.)	2	3	2	3	3	**13**
4I	Paint crosswalk at intersection of Harmony Road and Fuller Road.(Needs Report 6.g.)	0	3	0	5	3.5	**11.5**
7J	Analyze ingress/egress to CCC Harmony Campus west of 82nd Avenue. Consider requiring vehicles to use entrance further west at signalized intersection if traffic issue exists or require modifications to existing accessways to increase safety for pedestrians and bicyclists.(Needs Report 6.d.)	0	0	5	5	5	**15**
1AA	Construct/replace sidewalks along Harmony Road, west of 82nd to Fuller Road as per the Harmony Road Regional Boulevard design in Figure X-CRC-4.(Needs Report 6.i.)	3	2	2	2	3	**12**
1BB	Extend Sunnyside Road multi-use path to the intersection of 82nd Avenue/ Harmony Road.	3	3	3	3	3	**15**
ROUTE TOTAL:							**157.5**
AVERAGE ROUTE SCORE:							**13.13**

	Projects	Evaluation Criteria					
		Connectivity	Safety	Route Completion or Pedestrian Volume	Cost, Low, Med, High	Proximity to Pedestrian Generators	Total Score
ROUTE 7: CLACKAMAS COMMUNITY COLLEGE HARMONY CAMPUST TO KAISER PERMANENTE HOSPITAL							
1Z	Construct bikeway from existing aquatic center multi-use path east to 82nd Avenue/ Sunnybrook Boulevard.	3	3	3	1	3	13
	ROUTE TOTAL:						13
	AVERAGE ROUTE SCORE:						13

DESCRIPTION OF PROJECT RATING AND EVALUATION SYSTEM

To evaluate the bicycle and pedestrian projects recommended and developed by the Project Advisory Committee evaluation criteria were developed. Five evaluation criteria as shown below were established for the Sidewalks/Walkways/Paths/Bicycle Lanes/Sharrows/Parking/I-205 Overpass projects. Four evaluation criteria were established for the Crosswalks/Lighting projects. And three evaluation criteria were established for the Signage/Other projects. The rating system was designed so that the maximum number of points for each project did not exceed 15 points to ensure parity among the project categories. A summary of each of the categories with the corresponding rating system, evaluation criteria and descriptions is offered below.

SIDEWALKS/WALKWAYS/PATHS/BICYCLE LANES/SHARROWS/PARKING/I-205 OVERPASS

Rating System

3	Alternative meets evaluation Criterion	2.5	Alternative mostly meets evaluation criterion	2	Alternative somewhat meets evaluation criterion	1.5	Alternative barely meets evaluation criterion	1	Alternative does not meet evaluation criterion

Evaluation Criteria (5)

Connectivity	Safety	Route completion	Cost; Low, Med, High	Proximity to Pedestrian Generators

For this group of projects five criteria were scored on a rating system from 1 to 3. The maximum score for each project does not exceed 15 points to ensure more parity among the various project categories, therefore projects were assigned 3, 2.5, 2, 1.5 or 1 point(s).

CROSSWALKS/LIGHTING

Rating System

5	Alternative meets evaluation Criterion	4	Alternative mostly meets evaluation criterion	3	Alternative somewhat meets evaluation criterion	2	Alternative barely meets evaluation criterion	1	Alternative does not meet evaluation criterion

Evaluation Criteria (4)

Safety	Pedestrian Volume	Cost; Low, Med, High	Proximity to Pedestrian Generators

For this group of projects four criteria were scored on a rating system from 1-5 points. The Pedestrian Volume and Proximity to Pedestrian Generators criteria were averaged to ensure a score of no greater than 15 points.

SIGNAGE/OTHER

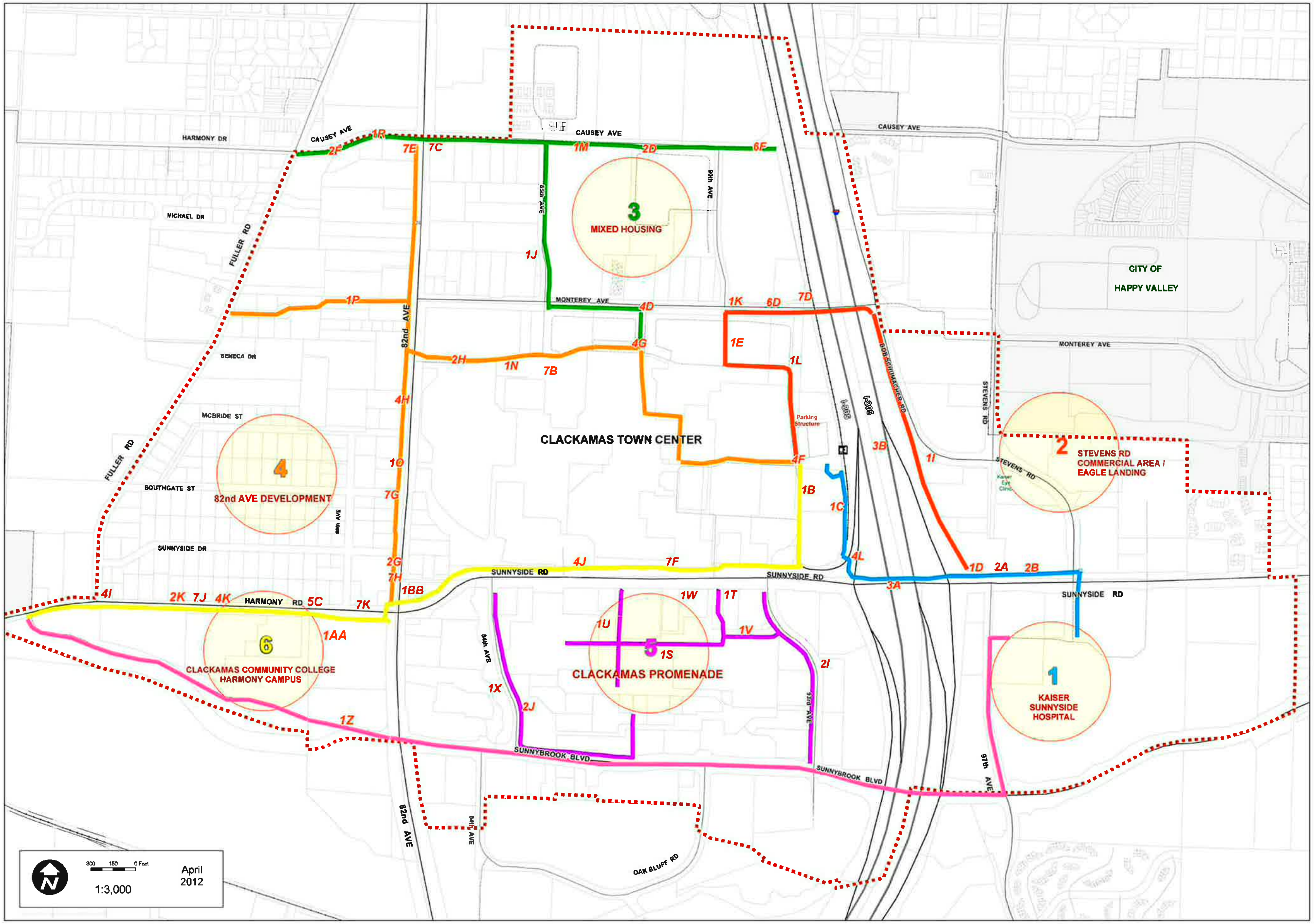
Rating System

5	Alternative meets evaluation Criterion	4	Alternative mostly meets evaluation criterion	3	Alternative somewhat meets evaluation criterion	2	Alternative barely meets evaluation criterion	1	Alternative does not meet evaluation criterion

Evaluation Criteria (3)

Pedestrian Volume	Cost; Low, Med, High	Proximity to Pedestrian Generators

For this group of projects three criteria were scored on a rating system from 1-5 points. The total score will be no greater than 15 points.



Clackamas Regional Center
Pedestrian / Bicycle Connection Project
ROUTES AND PROJECTS

PROJECT STUDY AREA

DESTINATION

Recommended Projects → *1A, 2B, etc*

Routes To Destinations

1 Kaiser Hospital
2 Eagle Landing Mixed-Use Development
3 Mixed Housing North of Town Center
4 SE 82 Ave Development
5 Clackamas Promenade
6 Clackamas Community College/OIT/Aquatic Center
7 CCC Harmony Campus Connection to Kaiser Hospital

PEDESTRIAN & BICYCLE SIGN PLAN

1. Introduction

The purpose of Clackamas Regional Center (CRC) Area Pedestrian / Bicycle Connection Project is to create a plan for safe pedestrian and bicycle connections within the Study Area. An important element to improve the walking and cycling experience in the Town Center Area is wayfinding signage for both pedestrians and bicyclists, especially between the TriMet Max Green Line and area major employers and services. The goal of the Pedestrian and Bicycle Sign Plan (Sign Plan) for the CRC Area Pedestrian / Bicycle Connection Project is to provide a comprehensive wayfinding system for both walkers and bikers within the Study Area. The Study Area includes the CRC area from Causey Avenue west to Fuller Road, south to below Harmony Road and east to include the area just south of Sunnybrook Boulevard, east of the freeway, past SE 97th Avenue and up to Sunnyside Road back to Causey Avenue.

This Sign Plan includes information on sign placement; sign content (general destinations) and sign type. The plan recommends installation of 21 new pedestrian signs (five map-based signs and 15 pole signs) and 16 bicycle wayfinding signs along bikeways within the Study Area. Detailed maps showing recommended sign locations are attached as Map 1: Pedestrian Sign Locations and Map 2: Bicycle Sign Locations.

2. Clackamas County Bike Wayfinding Sign Program

Clackamas County is currently developing a network of wayfinding signage to direct bicyclists to various destinations. The bicycle wayfinding signs include approximate ride time and distance to destinations in the urban portion of Clackamas County and selected areas in rural County. A typical bicycle wayfinding sign is shown in Figure 1 on page 3. Currently, wayfinding signs have been installed in the urban portion of Clackamas County on River Road, Webster Road and Oatfield Road. Bicycle sign placement within the Town Center Area should tie into the existing network of wayfinding signage to insure a cohesive network of bicycle signs.

3. Destinations

The Sign Plan will direct travelers to various destinations in the CRC Pedestrian / Bicycle Connection Project area. Some of the destinations to be signed include the Town Center, public transit, parks, Kaiser Permanente Hospital, Clackamas Community College Harmony Campus, Aquatic Center and other major destinations. A complete list of destinations is shown in Table 1. Destinations located outside of the Study Area (Mt. Talbert, for example) may be included on the wayfinding signs. With the assistance of the Project Management Team, staff developed the destination list shown on Table 1 below.

TABLE 1: DESTINATIONS		
#	NAME	SIGNED AS
1	Sunnyside Kaiser Permanente Hospital	Hospital
2	Clackamas Community College Harmony Campus	CCC Harmony Campus
3	Mt. Talbert Nature Preserve	Mt. Talbert
4	MAX Green Line	Max Green Line
5	TriMet Bus Stop on north side of Town Center	Transit Station
6	Clackamas Promenade Shopping Center	Clackamas Promenade
7	Eagle Landing Neighborhood	Eagle Landing
8	I-205 Multi-use Path	I-205 Path
9	Clackamas Town Center Shopping Mall	Clackamas Town Center (or "Shopping Center")
10	82nd Avenue Commercial Area	82nd Ave.
11	Clackamas Aquatic Center	Aquatic Center
12	Sunnybrook Boulevard	Sunnybrook Blvd.

4. Bike Sign Design

The CRC Sign Plan recommends wayfinding signage for both pedestrians and bicyclists. Different types of signs are proposed for the different travel modes. The type of bicycle signage proposed for the CRC Area Pedestrian / Bicycle Connection Project is the design shown in Figure 1. Installation of this sign will insure consistency with the existing County Sign Plan and adjacent jurisdictions including the Cities of Milwaukie and Portland. The ODOT approved sign is green and measures 24" x 30". The bicycle wayfinding signs are typically placed in the public right-of-way.

4.1: Bike Design Protocol:

- Each sign can hold one to three destinations but a given sign may have fewer destinations.
- Destinations should be named so as to be consistent with adjacent jurisdictions (e.g. the Milwaukie plan uses Dntwn. Milwaukie; Max Green Line, this project should sign similarly.)
- The straight ahead destination shall be listed on top, the left destination in the middle and the right destination on the bottom.
- For a destination with a straight arrow, the arrow shall be placed to the left of the destination; for a destination with a left arrow, the arrow shall be placed to the left of the destination and the right arrow to the right of a destination.

Figure 1: Bicycle Wayfinding Sign

5. Pedestrian Sign Design

Pedestrian signage should be located primarily in the Town Center and Promenade shopping center complexes and the multi-use paths in the area. Two types of pedestrian signs are recommended: map-based signs and pole signs. A description and examples of the two types of pedestrian signs are shown on pages 5-7 of this report. The sign examples shown on pages 5-7 are for illustrative purposes only; final sign design will be considered during the Sign Plan implementation stage. The two types of signs should work together to create a comprehensive wayfinding system.

The Town Center is planning to install a monument welcoming sign at the southeast corner of the Town Center property near the I-205 exit ramp at Sunnyside Road. Figure 2 shows a version of the proposed monument sign. A pedestrian sign design using a similar color scheme and/or graphics to the signs planned for the Town Center should be considered during the Sign Plan implementation stage. Wayfinding signage at the Town Center proposed under this Sign Plan should be consistent in design with the existing signage and new sign placement shall coordinate with existing directional signage on the Town Center property. In addition, new signs (content, design, location, etc.) proposed in conjunction with this Sign Plan will be coordinated with the Clackamas Town Center and Clackamas Promenade management. Color, content, placement and theme synchronization would create a consistent and recognizable network of signs for the Town Center area.

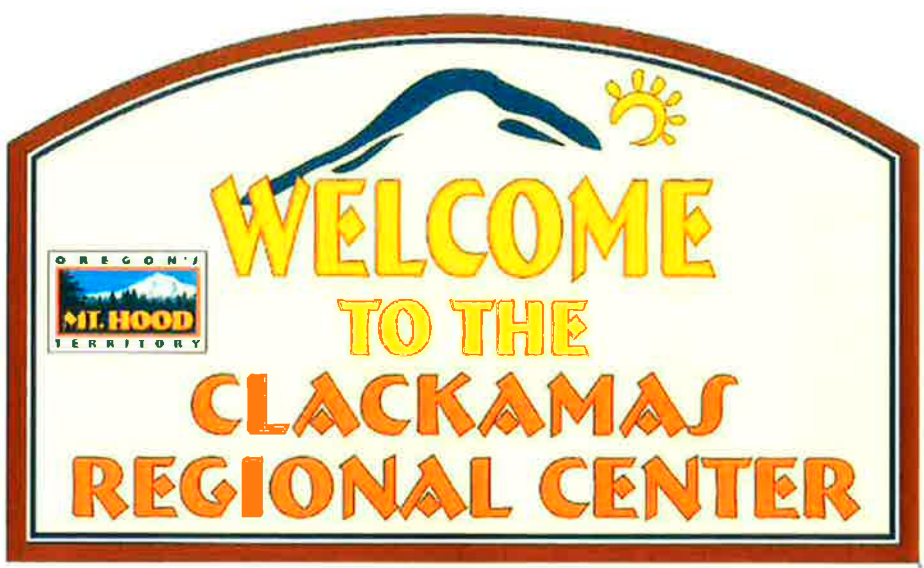


Figure 2: Monument Sign

A) Map-Based Signs

As shown in Figures 3 and 4, the map-based signs would include a simple map of the Study Area as well as directional arrows to destinations. These types of signs would help visitors navigate the Study Area. Staff suggests a limited number (five) of the map-based signs. The final design, specific placement and dimensions of the map-based signs will be considered during the Sign Plan implementation stage.

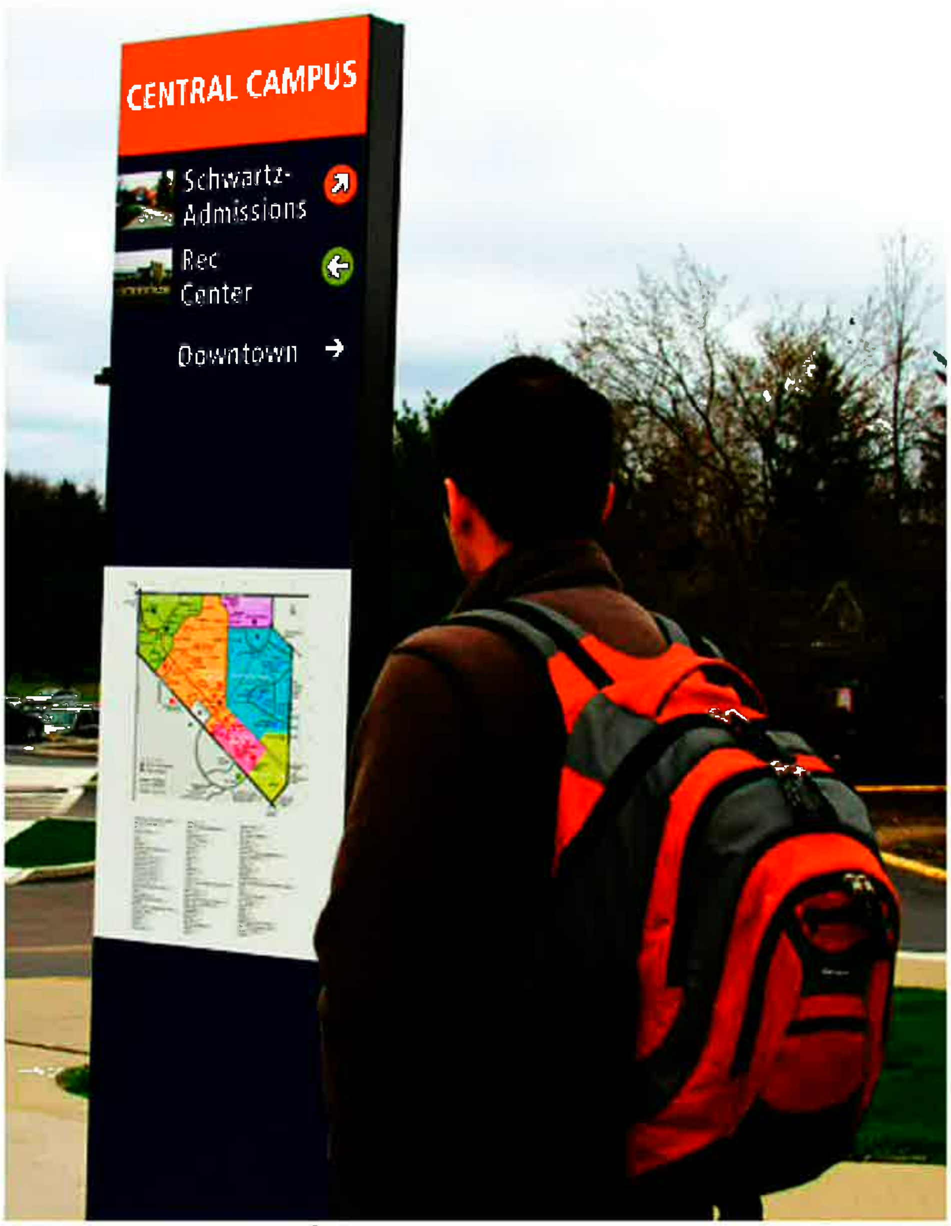


Figure 3: Map-Based Sign Example.

Figure 4: Map-Based Sign Example.

B) Pole Signs

As shown in Figure 5, the pole signs include destination and directional arrows. Distance could also be placed on these signs. Pole signs can be “collocated” with other road signs located in the public right-of-way.

Figure 5: Pole Sign Example

6. Pedestrian and Bicycle Sign Locations

The bicycle wayfinding signs should be located along existing bikeway facilities. Pedestrian wayfinding signs should be located in areas with significant pedestrian traffic. In order to limit clutter, streets with extremely low volume pedestrian or bicycle traffic should not be signed. For example, the local east-west streets between Fuller Road and 82nd Ave. (Southgate Street; Sunnyside Drive, etc.) and north-south streets between Sunnybrook and Sunnyside (84th Avenue and 93rd Avenue) should not be signed for pedestrians. With the assistance of the Project Management Team, staff developed a list of locations appropriate for wayfinding signage. Sign locations include streets such as Monterey Avenue as well as general areas such as the Town Center and Clackamas Promenade. General locations suitable for sign placement are shown in Table 2 which will be further refined when the Sign Plan is implemented. Installation of the signs indicated on Map 1: Proposed Pedestrian Sign Locations and on Map 2: Proposed Bike Sign Locations shall be in coordination with the underlying property owners (Clackamas Town Center management; Clackamas Promenade management; Clackamas Community College/OIT and the Clackamas County Traffic Engineering Division, as appropriate) and may change during implementation.

6.1 Bike Wayfinding Sign Locations

Bike wayfinding signs should be located on roads within the CRC Pedestrian / Bicycle Connection Project area with existing bike facilities, i.e. streets with bike lanes and multi-use paths. Placement should be coordinated with the broader County Bike Sign Plan in order to achieve adequate sign coverage.

6.2 Pedestrian Wayfinding Sign Locations

Pedestrian signs should be located in high traffic pedestrian areas. For example, at the end of the Max Green Line and the Tri-Met Transit Station located on the north side of the Town Center shopping mall. Areas with a low volume of pedestrian traffic such as Sunnybrook Boulevard should not be signed for pedestrians.

TABLE 2: PEDESTRIAN AND BICYCLE SIGN LOCATIONS

LOCATION	PEDS	BIKES
Monterey Avenue	Yes	Yes
Sunnyside Road Multi-Use Path	Yes	Yes
Harmony Road	No	Yes
I-205 Multi-Use Path	Yes	Yes
Town Center	Yes	No
Promenade	Yes	No
Sunnybrook Blvd.	No	Yes
Stevens Road/Schumacher	No	Yes
“Costco Path”	Yes	Yes
Clackamas Community College Harmony Campus	Yes	No

7. Sign Placement: Bike Wayfinding Signs

Bicycle wayfinding signs should be installed along streets within the Study Area that have bike lanes. Sign placement (the specific site of the sign) typically occurs at the intersection of all established bikeways and anywhere else a cyclist faces a decision point. The existing bikeways in the Study Area include Fuller Road, Sunnybrook Boulevard, Monterey Avenue, Causey Avenue, 84th Avenue and Harmony Road.

This Sign Plan recommends installation of 16 bicycle wayfinding signs along bikeways within the Study Area. The 16 signs are listed in Table 3, which provides sign placement and content (e.g. destinations and directional arrows). A map of the Study Area showing proposed bicycle sign placement is attached as Map 2.

7.1: Sign Placement Protocol

- Placement along streets with bike lanes only.
- Signs should be placed at major intersections, high bicycle traffic areas and at important wayfinding decision points / directional changes in route.
- Distance from intersection: signs shall be placed at a distance to allow adequate notification of left or right turns.
- Frequency: sign spacing and overall quantity is critical. Signs should be frequent enough so cyclists can find destinations but not too numerous that they clutter the urban environment. Periodic signs at regular, predictable intervals are recommended. A Primary Destination that is signed at a distance of 5-6 miles might have 2-3 wayfinding signs along a given route. (Note: urban areas typically need more signs per mile than rural areas because of more route intersections and more decision points).
- Destinations will be signed from multiple directions.

TABLE 3: BICYCLE SIGN PLACEMENT		
#	PLACEMENT	CONTENT
1	East end of Causey Avenue @ the cul-de-sac, near the I-205 bike path.	Left Arrow: I-205 Path North Bound Right Arrow: I-205 Path South Bound
2	85th Avenue southbound @ SE Monterey Avenue	Left Arrow: Mt. Scott Left Arrow: Eagle Landing Straight Arrow: Clackamas Town Center
3	Causey Avenue eastbound @ 85th Avenue	Straight Arrow: I-205 Path Right Arrow: Clackamas Town Center Right Arrow: Mt. Scott
4	Causey Avenue west bound @ 82nd Avenue	Straight Arrow: Downtown Milwaukie Straight Arrow: Aquatic Center Straight Arrow: OIT
5	Causey Avenue eastbound @ 82nd Avenue	Straight Arrow: I-205 Path Straight Arrow: Max Green Line Straight Arrow: Mt. Scott
6	Fuller Road northbound @ Causey Avenue	Left Arrow: Springwater Trail Left Arrow: Downtown Milwaukie Right Arrow: I-205 Path
7	Causey Avenue west bound @ Fuller Road.	Straight Arrow: Downtown Milwaukie Left Arrow: CCC Harmony Campus/Aquatic Center/OIT
8	Fuller Road southbound @ Causey Avenue	Straight Arrow: CCC Harmony Campus/Aquatic Center/OIT Right Arrow: Downtown Milwaukie Left Arrow: I-205 Path
9	Harmony Drive eastbound @ Fuller Road	Straight Arrow: I-205 Path Straight Arrow: Clackamas Town Center Right Arrow: CCC Harmony Campus/Aquatic
10	Fuller Road southbound @ Harmony Road	Straight Arrow: CCC Harmony Campus/Aquatic Center Left Arrow: Clackamas Town Center
11	Harmony Road westbound @ Fuller Road	Straight Arrow: N. Clackamas Park Right Arrow: Springwater Trail
12	Harmony Road eastbound @ 82nd Avenue	Right Arrow: I-205 Path/Max Green Line Right Arrow: Mt. Talbert
13	82nd Ave. southbound @ Sunnybrook Blvd.	Left Arrow: Max Green Line Left Arrow: I-205 Path Left Arrow: Mt. Talbert Park
14	Sunnybrook Boulevard eastbound @ the I-205 bike path.	Straight Arrow: Mt. Talbert Park Left Arrow: I-205 Path North Bound Right Arrow: I-205 Path South Bound
15	SE Monterey Avenue eastbound @ SE Bob Schumacher Boulevard.	Left Arrow: Mt. Scott Right Arrow: Eagle Landing Right Arrow: Mt. Talbert Park
16	SE Monterey Avenue eastbound @ 9100 block.	Left Arrow: I-205 Path Straight Arrow: Mt. Scott / Eagle Landing Straight Arrow: Mt. Talbert Park

8. Sign Placement: Pedestrian Wayfinding Signs

Pedestrian wayfinding signs should be installed in areas with high amounts of pedestrian traffic. For example, at the end of the Max Green Line and the Tri-met Transit station at the north side of the Town Center. Pedestrian wayfinding sign placements are described in Table 4 which can be further refined when the Sign Plan is implemented.

8.1: Sign Placement Protocol

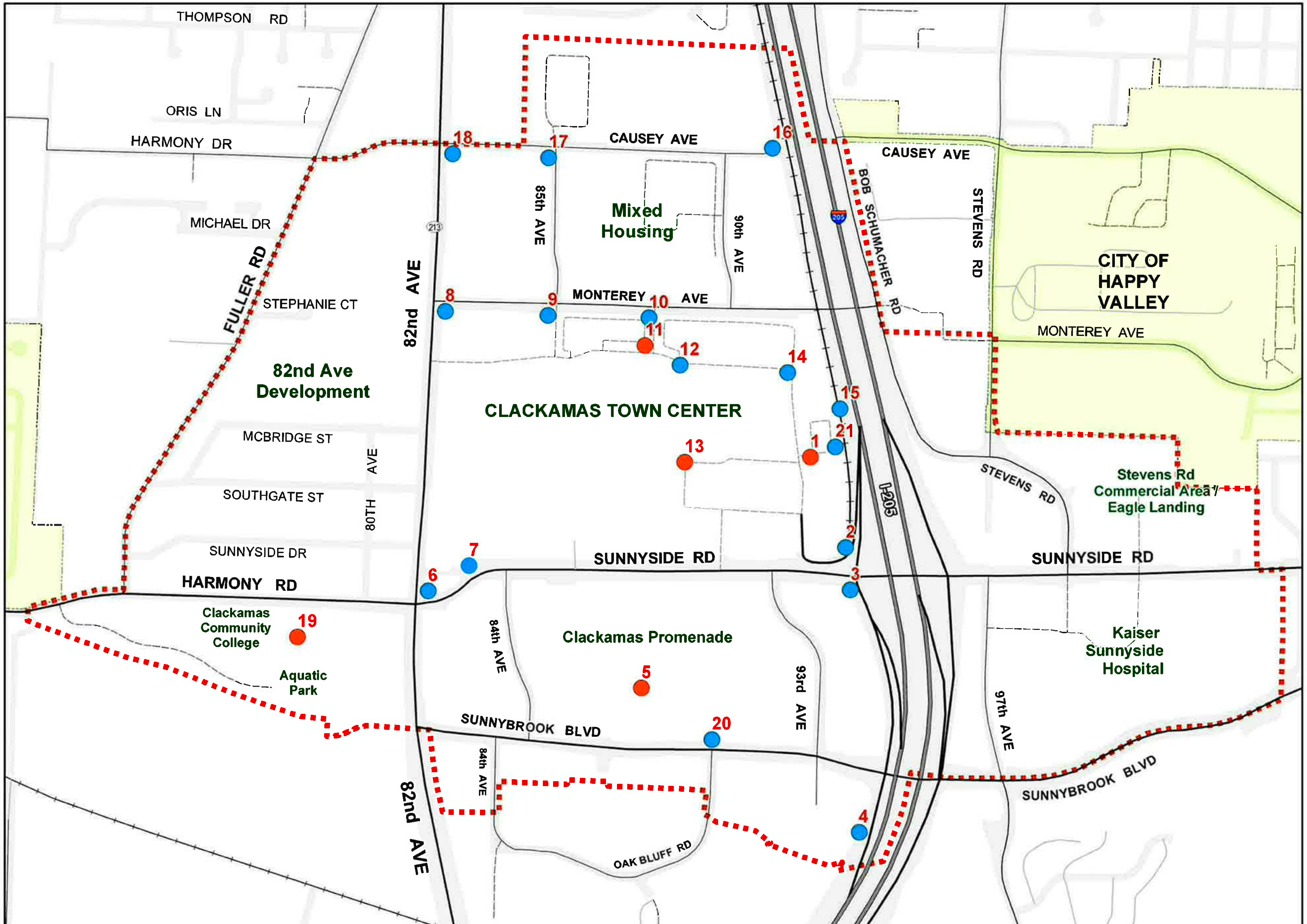
- Signs should be placed in high pedestrian traffic areas.
- A combination of map-based wayfinding signage and pole-based signs is recommended.
- Signs should be placed along the “walking routes” identified in Table 2.
- The map-based signs should be placed at key “origin/destination points” such as the Max Green Line and the transit station on the north side of the Town Center.
- To enhance the sense of place and provide navigational assistance, pole signs should be placed at points between the map-based signs.

TABLE 4: PEDESTRIAN SIGN PLACEMENT			
#	PLACEMENT	TYPE	CONTENT
1	SE corner of Max Green Line Park N Ride	Map Sign	Map of CRC area with destinations labeled.
2	SE corner of Town Center property at the intersection of the I-205 & Sunnybrook multi-use paths.	Pole Sign	East Bound: Mt. Talbert, Hospital, I-205 path West Bound: CCC Harmony Campus, Aquatic Center, OIT
3	Northbound I-205 path and Sunnyside Road	Pole Sign	North bound: Max Green Line East bound: Hospital; Mt. Talbert West bound: OIT, Aquatic Center
4	"Costco Path" and I-205 path intersection.	Pole Sign	Oregon City, Portland
5	Walkway in central portion of Promenade	Map Sign	Map of CRC area with destinations labeled.
6	NE Corner of 82^{nd} Avenue and Sunnyside Road	Pole Sign	CCC Harmony Campus, Aquatic Center, OIT
7	Beginning of Sunnyside Multi-use path – west end.	Pole Sign	East Bound: Mt. Talbert, Hospital, I-205 path West Bound: CCC Harmony Campus, Aquatic Center, OIT
8	SE corner of 82^{nd} Ave. and Monterey Ave.	Pole Sign	CCC Harmony Campus, Aquatic Center, OIT
9	1st access driveway to Town Center Mall east of 82^{nd} Ave.	Pole Sign	East Bound: I-205 path West Bound: CCC Harmony Campus, Aquatic Center, OIT
10	2^{nd} access driveway to Town Center Mall east of 82^{nd} Ave.	Pole Sign	East Bound: I-205 path West Bound: CCC Harmony Campus, Aquatic Center, OIT
11	Mall Transit Stop (north side of mall).	Map Sign	Map of CRC area with destinations labeled.
12	Walkway on the north side of the Town Center Mall.	Pole Sign	Max Green Line
13	SE Town Center Mall Plaza north of REI	Map Sign	Map of CRC area with destinations labeled.
14	Northeast corner of Town Center Mall.	Pole Sign	Max Green Line
15	Intersection of I-205 path and pathway leading to Max Green Line platform.	Pole Sign	Max Green Line

16	Intersection of Causey Avenue and the I-205 path.	Pole Sign	North Bound: Portland South Bound: Gladstone
17	Intersection of Causey Avenue and 85th Avenue	Pole Sign	South Bound: Clackamas Town Center West Bound: CCC Harmony Campus, Aquatic Center, OIT
18	Intersection of Causey Avenue and 82nd Avenue	Pole Sign	South Bound: CCC Harmony Campus, Aquatic Center, OIT.
19	CCC Harmony Campus/Aquatic Center	Map Sign	Map of CRC Area with destinations labeled.
20	Intersection of Sunnybrook Boulevard and Oak Bluff Road	Pole Sign	Clackamas Town Center; Clackamas Promenade; CCC Harmony Campus, Aquatic Center, OIT;
21	Max Green Line Platform	Pole Sign	Directional signage to the I-205 Multi-use path and bike parking.

9. Implementation

In order to implement a Sign Plan funding needs to be addressed. Sign production, funding and installation can be one of the recommended projects for the CRC Area Pedestrian / Bicycle Connection Project. Implementation should include further refinement of specific sign placements, sign content, and design (including color and logo).



TownCenter_PedSigns.MXD

Clackamas Regional Center Pedestrian/Bicycle Connection Project

MAP 1

PROPOSED PEDESTRIAN SIGN LOCATIONS

Legend

- Map-Based Sign
- Pole Sign
- Project Study Area
- Incorporated City

1:7,750

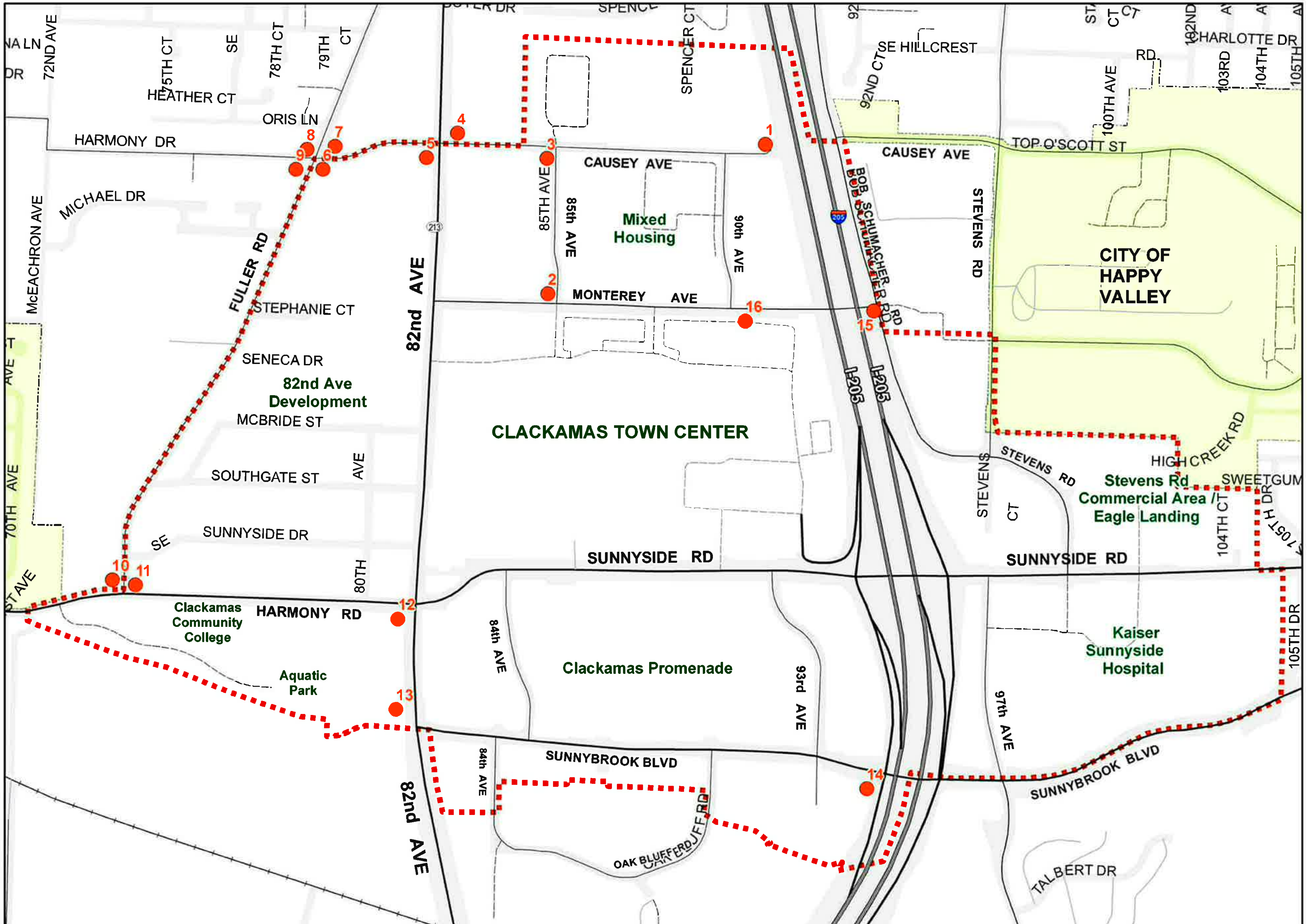
500 250 0 Feet

CLACKAMAS COUNTY

Clackamas Regional Center Pedestrian/Bicycle Connection Project

MAP 2

PROPOSED BIKE SIGN LOCATIONS



Legend

- BIKE SIGNS
- Project Study Area
- Incorporated City

1:7,750

500 250 0 Feet

CLACKAMAS COUNTY

U.S. Department of Transportation
Federal Highway Administration

Oregon Department of Transportation

Sunrise Project
I-205 to Rock Creek Junction
Clackamas County, Oregon
ODOT Key # 12454, Federal Aid # C005(046)

U.S. Department of Transportation, Federal Highway Administration
and
Oregon Department of Transportation

February 2011

A. DECISION

This Record of Decision (ROD) describes the Federal Highway Administration's (FHWA's) decision related to the Sunrise Project. The Sunrise Project is an approximately five-mile, east-west oriented limited-access highway from Interstate 205 (I–205) to the Rock Creek Junction in Clackamas County, Oregon. The basis for this decision is provided in the Sunrise Project Draft, Supplemental Environmental Impact Statement and Final Environmental Impact Statement.

The FHWA has determined that the requirements of the National Environmental Policy Act of 1969 have been satisfied for the Sunrise Project. FHWA approved the FEIS on December 16, 2010. The US Environmental Protection Agency published the Notice of Availability in the Federal Register on December 23, 2010 (Volume 75, Number 246, Page 80808). The 1993 Draft Environmental Impact Statement (DEIS), the 2008 Supplemental Draft Environmental Impact Statement (SDEIS), and the 2010 Final Environmental Impact Statement (FEIS) discuss the development of alternatives for the project; narrow the choice of alternatives for environmental evaluation; assess impacts of the alternatives advanced for environmental evaluation; and identify a preferred alternative for the project. These documents, which are incorporated herein by reference, can be viewed and downloaded from: http://www.sunrise-project.org.

After considering each proposed alternative's impacts to the human environment using the social and natural sciences to evaluate the impacts and input received from stakeholders, the FHWA selects the "Preferred Alternative" for implementation. The Project Advisory Committee (PAC) and the Policy Review Committee (PRC) for the project, support the selection of the Preferred Alternative.

The following sections contain a description of the preferred alternative, other alternatives considered, and decision criteria. Other sections of this ROD discuss the Section 4(f) finding, measures to minimize harm, and the monitoring of mitigation and conservation measures. Appendix A includes comments received on the FEIS and includes responses to those comments.

DESCRIPTION OF THE SELECTED ALTERNATIVE (PREFERRED ALTERNATIVE)

Chapter 2 of the FEIS provides a complete description of the Preferred Alternative. Two public hearings were held in November 2008 following publication of the DEIS. After public and agency comments were evaluated and considered, FHWA selects the Preferred Alternative, composed of elements of Alternative 2 with Design Options A-2, C-2, and D-3.

Preferred Alternative Evaluated in this FEIS

The Preferred Alternative is Alternative 2 as studied in the SDEIS with Design Options C-2 and D-3 and the Tolbert overcrossing portion of Design Option A-2. The Preferred Alternative also includes several modifications based on stakeholder input and additional design refinements related to analysis of traffic performance and avoidance of environmental resources. The following paragraphs describe the Preferred Alternative from west to east. Figures PA-1 through PA-5 in the FEIS depict the Preferred Alternative alignment.

I–205 Interchange Area

In the I–205 Interchange area, the Preferred Alternative consists of Alternative 2 with the addition of the Tolbert overcrossing from Design Option A-2. This section includes connecting the existing north and south sections of the I–205 multi-use path, adding a third westbound lane on OR 212/224 from I–205 to SE 98th Court, and closing SE Lake Road with a cul-de-sac at SE Johnson Road.

After the publication of the SDEIS, the following modifications were made to the Preferred Alternative in the I–205 Interchange area, based on stakeholder input and refinements based on traffic and environmental analysis:

- The Sunrise Project western transition to the Milwaukie Expressway will be widened to three westbound lanes within the existing right-of-way for OR 224 and will be extended to the west through SE Webster Road.
- The North Lawnfield Extension will be shifted to the east to avoid impacts to the KEX site historic resource (copper ground wire mat) and other cultural and natural resources in the area between the existing SE Lawnfield Road and SE 97th Avenue.
- OR 212/224 will be widened in the westbound direction from SE 98th Avenue to I-205, from existing two lanes to three lanes. A dedicated right-turn lane will be added on westbound OR 212/224 to northbound 82nd Drive.
- A dedicated southbound right-turn lane will be added on 82nd Drive to westbound OR 212/224.
- SE 82nd Drive and its intersection with OR 212/224 will be expanded to improve overall mobility by:
    - Restricting all left turns at this intersection and adding a raised median both north and south of the existing intersection on 82nd Dr.
    - Widening SE 82nd Drive and creating a new signalized intersection at SE 82nd Drive and SE Clackamas Road to accommodate U-turns, including trucks.

- Widening and reconfiguring the existing signalized intersection at SE 82nd Drive and the northern Fred Meyer access point to accommodate U-turns, including trucks.

Midpoint Area

In the Midpoint area, the Preferred Alternative consists of Alternative 2, the tight diamond interchange with a connection to OR 212/224 at SE 122nd Avenue, and Design Option C-2, the southernmost alignment between the Midpoint and Rock Creek interchanges. In response to stakeholder and agency input, the multi-use path will be extended along OR 212/224, from SE 122nd Avenue to the Rock Creek Junction area.

Rock Creek Junction Area

In the Rock Creek Junction area, the Preferred Alternative consists of Design Option D-3, a Single Point Urban Interchange (SPUI). Design Option D-3 includes the following features, as analyzed in the SDEIS:

- The eastern leg of the SE Goosehollow Drive/OR 224 intersection will be closed.
- Existing OR 212 will become a cul-de-sac just east of SE 162nd Avenue. SE 162nd Avenue will be connected to OR 212 on the north side.
- The Sunrise Project eastern transition will reconnect with OR 212 east of the SE 172nd Avenue intersection with OR 212.
- The Sunrise Project southern transition will reconnect with OR 224 at SE Eckert Lane.

Based on stakeholder input and traffic refinements, the following additions to the Preferred Alternative were made in the Rock Creek Junction area to provide for reasonable community access:

- A right-out-only access at the end of SE Orchard View Lane to northbound OR 224 will be created. Alternative 2 retained existing north Orchard View Lane as a cul-de-sac, with no access to/from OR 224.
- A connection between SE 162nd Avenue and SE Goosehollow Drive south of OR 212 will be created at the northeast corner of the Orchard Lake neighborhood.

Transit, Bikeway, and Pedestrian Improvements

Current regional plans identify SE Sunnyside Road as the primary east-west transit route within the Sunrise Project area. The Preferred Alternative will provide opportunity for initiation of new local transit service by the regional transit agency (Tri-Met) on the new Sunrise Expressway, from Happy Valley to the Springwater area. This new transit service will include more frequent service between Damascus and Gresham; and, new express bus service along the Sunrise Project between the Clackamas Transit Center and Damascus Town Center.

The Preferred Alternative will provide better accommodations for bicycles and pedestrians by filling in gaps in the system, such as on the I-205 multi-use path between SE 82nd Drive and SE Roots Road. A new multi-use path will parallel the Sunrise Project from I-205 on the north side until SE 122nd Avenue, where it will cross under and follow the existing OR 212/224 to SE 152nd Avenue. A separate path will also connect the cul-de-sac of OR 212, just east of SE 162nd Avenue to SE 172nd Avenue.

Cost

The estimated cost to construct the Preferred Alternative is $1,493 million (2013 dollars). These construction costs include approximately $216 million for right-of-way.

B. ALTERNATIVES and DESIGN OPTIONS CONSIDERED

In the SDEIS and the FEIS, a No Build Alternative and two Build Alternatives were evaluated, along with six design options to those alternatives, leading to the selection of the Preferred Alternative. These alternatives and design options, as well as other alternatives considered and dismissed from further evaluation, are discussed in Chapter 2 of the FEIS and incorporated into this section of the ROD by reference.

Selection of the Preferred Alternative and Identification of the Environmentally Preferred Alternative

The Preferred Alternative was selected through a collaborative process based on the project Purpose and Need, and identified Goals and Objectives. These broad criteria were refined with the development of screening and evaluation criteria to assess project alternatives. While selection of the Preferred Alternative was driven by the need to provide a safe and efficient transportation system to address a major transportation problem along this corridor (Goal 1), other critical values and goals were applied to the selection of alternatives and design options, to ensure selection of the preferred alternative that causes the least damage to the biological and physical environment. These other goals and values assessed within the study area include: maintaining the industrial and commercial viability of the Clackamas Industrial Area (Goal 2); maintaining the community livability of area neighborhoods (Goal 3); and preserving natural and cultural resources within the corridor (Goal 4).

These values and goals were balanced in their application to specific alternatives, design options, corridor segments, and resources in the selection of the environmentally preferred alternative. As such, the Preferred Alternative selected is also the environmentally preferred alternative. A comparative assessment of the reasons for the selection of the Preferred Alternative follows:

The Preferred Alternative is Alternative 2 as studied in the SDEIS with Design Options C-2 and D-3 and the Tolbert overcrossing portion of Design Option A-2. Figures PA-1 through PA-5 in the FEIS Executive Summary show the Preferred Alternative as a whole and in specific areas.

The only difference between Alternative 2 and Alternative 3 is the midpoint interchange. Goal 1 of the project is to provide a highway that meets existing and future safety, connectivity, and capacity needs. Alternative 2/Preferred Alternative has slightly better volume-to-capacity ratios during peak hours and slightly fewer congested lane miles than Alternative 3. Therefore, Alternative 2/Preferred Alternative does slightly better than Alternative 3 in two out of four evaluation measures of Goal 1, Objective 1 of the screening criteria; the other two evaluation measures have equivalent benefits for Alternatives 2 and 3. The Preferred Alternative's project refinements result in reduced volume on I-205 of more than 1,000 vehicles compared to Alternative 3 (Objective 3 of Goal 1).

Alternative 2/Preferred Alternative supports faster travel times (2 to 3 minutes) and more trips to and from the Clackamas Industrial Areas near SE 122nd Avenue compared to Alternative 3, which reflects improved accessibility for businesses, patrons and employees. Therefore, Alternative 2/Preferred Alternative best meets Goal 2 of the project, which is to support the viability of the Clackamas area for industrial uses.

The midpoint interchange also provides desired redundant emergency access, so Alternative 2/Preferred Alternative also meets Objective 7 and Objective 9 (serving freight travel safely and efficiently) of Goal 1 better than Alternative 3.

Objectives 1 and 3 of Goal 2 call for providing local circulation and access for industrial users and minimizing business displacements and acquisition of industrial land. Alternative 2 and the Preferred Alternative displace more industrial land (133 and 156 acres) than Alternative 3 (117 acres). Alternatives 2 and 3 displace a similar number of displaced jobs (60), which is 20 fewer jobs than the Preferred Alternative will displace. Additional displacements under the Preferred Alternative are primarily caused by the mitigation measures at SE 82nd Drive to alleviate circulation impacts from Alternative 2 (after adopted as the Preferred Alternative).

The Preferred Alternative better meets the objectives of Goal 3, community livability, in generating fewer noise impacts; less impacts to affordable housing; and, less residential displacement (Objectives 2, 3, 4, and 7). The Preferred Alternative also better meets the objectives of Goal 4, natural and cultural resources, by creating less wetland and wildlife corridor impacts than Alternative 2 or 3, and the Build Alternatives with design options (Objectives 1, 2, and 3).

Although the Preferred Alternative will create 127.2 acres of new impervious surface, about 4 acres more than Alternative 2 and about 16 acres more than Alternative 3, all alternatives support Objective 7 of Goal 4 because all alternatives need to meet the same water quality standards. Analysis for the Preferred Alternative has demonstrated (see Figures PA-26 through PA-45 in FEIS Chapter 3) that water quality treatment can be accommodated.

The Tolbert overcrossing (Design Option A-2) was included in the SDEIS as a way to provide access and mobility to the industrial area without building the North Lawnfield Extension, which as evaluated in the SDEIS, had impacts on the KEX radio transmission facility, a Section 4(f) resource, as well as wetland impacts.

Since publication of the SDEIS, the North Lawnfield Extension was modified to avoid any impacts to the historic KEX facility and the copper mats which could affect its radio signal. The modification of the alignment of the North Lawnfield Extension also reduces wetland impacts. The Preferred Alternative incorporates aspects of Design Option A-2, the Tolbert overcrossing, that enhance access to I-205 and Clackamas, as well as the North Lawnfield Extension for truck traffic, without the impacts to the KEX facility Section 4(f) resource, and adjacent wetlands, of that extension.

Public support for Alternative 2 combined with the benefits of redundant access, mobility within and through the industrial areas and shorter travel times to the core of the Clackamas Industrial Area contributed to the development of the Preferred Alternative.

Design Option B-2 was not incorporated into the Preferred Alternative because it tended to have the highest impacts in almost every category of environmental impact and was also the highest cost. For example, the split-diamond interchange requires more right-of-way and displaces more residential and industrial uses compared to the diamond interchange under Alternative 2. The larger size of the Design Option B-2 interchange creates the most impervious surface of all alternatives, and indirectly affects two additional historic and Section 4(f) resources (Frank A. Haberlach House and Silverthread Kraut and Pickle Works Building). It further constrains the wildlife corridor as compared to Alternative 2.

In short, Design Option B-2 was not recommended as part of the Preferred Alternative, because the split-diamond interchange design has no measurable traffic benefit compared to the Alternative 2 diamond interchange, and Design Option B-2 costs more and has a greater impact on environmental and community resources.

Because there is no difference in traffic mobility benefits among Alternative 2, Design Option C-2, and Design Option C-3, the selection focused on balancing other trade-offs. The alignment of Design Option C-2 avoids the residential displacements that occur under Alternative 2, but Design Option C-2 displaces more businesses. Design Option C-3 was not chosen because while it avoids the business displacements of Design Option C-2, it displaces a similar number of residences as Alternative 2 and has the highest impact on the wildlife corridor. Alternative 2 has a greater noise impact than the Design Options C-2 and C-3. Design Option C-3, on average, is worst for environmental resources because of its highest impacts on the wildlife corridor, the forested slope, and noise impacts on the bluff. Design Option C-2 is the best at reducing environmental and community impacts, because it travels in the straightest line with the least amount of impervious surface.

Design Option C-2 is incorporated into the Preferred Alternative, because on average Design Option C-2 has the fewest residential impacts, has the least amount of impervious surface, is the best option for preserving the wildlife corridor, and has the least impact on wetlands.

Design Option D-2 has a more southerly alignment than Alternative 2, thereby reducing impacts on a wildlife corridor and leaving more land to the north available for future development. Design Option D-3 reduces land use impacts on a proposed medical care center to the north even more than the other alignments, and the interchange design reduces impervious surface and right-of-way needs compared to Design Option D-2 and Alternative 2.

Alternative 2 and Design Option D-2 have the same traffic impacts; Design Option D-3 is not able to serve the same traffic volumes as the other options, but operates similarly under the predicted 2030 demand. Alternative 2, in this area, has the greatest impact on wildlife passage; requires the most right-of-way; and, impacts the most local driveways. Design Option D-3 has fewer noise impacts on residences south of the corridor. Residential and other environmental impacts are similar under all alignments. In response to public comments requesting an extension of the multi-use path beyond SE 122nd Avenue to the Rock Creek interchange, this extension has been included in the Preferred Alternative.

The Preferred Alternative replaces the Alternative 2 alignment and design with Design Option D-3, the single-point Rock Creek Interchange, because of the smaller footprint and southerly alignment, which create fewer impacts on the wildlife corridor and on the industrial property to the north.

C. SECTION 4(F) FINDING

The Sunrise project will use 0.18 acres, or 7,924 sqaure feet (4 percent) of one Section 4(f) property, the Clackamas Elementary School recreation field. The FHWA made a Section 4(f) *de minimis* finding on September 1, 2010, that includes these mitigation measures:

- Construct a noise abatement wall between I-205 and the school, that will reduce noise levels below noise levels present on the recreation field.
- Move the jogging trail to the east.
- Move the softball backstop playing area to the east.

D. MEASURES TO MINIMIZE HARM

This section and Table 1 below present mitigation measures for the project as described in the FEIS and the Biological Opinion. Measures listed in ODOT's *Standard Specifications for Construction* (ODOT, 2008) are incorporated by reference. All practicable measures to minimize harm have been incorporated into the Preferred Alternative for implementation. Measures are grouped by subject area. The Preferred Alternative includes all conservation measures from the Biological Opinion, as shown in Table 1 below.

Unavoidable Noise Impacts

Due to the topography of the mid-section of the Sunrise Project study area, and the physics of sound dispersion, up to 113 single-family and multi-family residences near SE Bluff Drive, between approximately SE 117th Avenue and SE 135th Avenue, will be adversely impacted by traffic noise increases from construction of the Preferred Alternative. The front-line of residences of this neighborhood, located along a tall bluff overlooking the proposed alignment of the Preferred Alternative, are predicted to experience "substantial" (10+ dB increase above existing noise levels, and/or total dBA levels around 70 dBA) increases in noise from the Sunrise Project.

Federal funds may be used for noise abatement measures when: an impact has been identified; the measures would substantially reduce the noise impact (feasibility criteria); and, the overall benefits from abatement outweigh other potential adverse effects and the cost of abatement (reasonableness criteria). "Feasible" mitigation is that which is constructible, and effectively abates noise by at least 5 dBA. "Reasonable" mitigation is that which is cost effective. ODOT considers noise mitigation up to $35,000 per household "cost effective". ODOT's *Noise Manual* has procedures and guidelines for whether abatement meets the criteria for feasibility and reasonableness, including the following criteria considered in recommending mitigation:

- Noise mitigation must provide a 5 dBA reduction in noise levels with a typical goal of 7 to 8 dBA, or higher, at first row receivers.
- Cost of abatement is typically capped at $25,000 per benefited residence. Costs up to $35,000 can be considered under specific circumstances.
- Opinions of impacted residents (property owners).
- Absolute noise levels of 60 dBA L_{eq} or higher.
- Residences constructed after 1996 generally not offered mitigation unless there is an increase of 5 dBA or more.

- Other environmental impacts from mitigation need to be considered, such as impacts on visual, cultural or wildlife resources.
- Other sources of noise.

Standard mitigation measures for abating noise impacts to sensitive receptors usually entails the construction of sound walls. However, due to the nature of the topography of the front line residences of the Bluff neighborhood in relation to the proposed alignment of the Sunrise Expressway, utilization of this common mitigation measure was determined to be neither "feasible" nor "reasonable". Extensive evaluation of a wider range of potential mitigation measures was pursued. Fourteen (14) additional mitigation options were evaluated for the Bluff area based on variations of noise wall designs, adjustments to the location or operating characteristics of the highway, roadway surface treatments and compensation. A brief description of these additional mitigation options considered is presented below. A comparison table, with the reasons for rejection as mitigation measures is included in Table D-2, "Evaluation of Noise Impact Mitigation Measures along Bluff" in FEIS Appendix D.

Noise Walls

Option 1: Wall at north edge of proposed Sunrise Project (35 to 60 feet high)

Option 2: Wall in center median (30 to 60 feet high) combined with a north-edge wall (Option 1) which would allow lower height of north-edge wall)

Option 3: Partially cover the proposed Sunrise Project highway (open structure on south side)

Option 4: Construct Concrete Wall at top edge of bluff (12 to 16 feet high)

Option 5: Construct Transparent Acrylic Wall at top edge of bluff (minimum 16 feet high)

Highway Alignment Adjustments

Option 6: Move new Sunrise Project alignment close to existing OR 212/224

Option 7: Build Sunrise Project on top of existing OR 212/224

Option 10: Lower grade of Sunrise Project through bluff area

Limitations of Highway Speeds/Traffic Volumes

Option 8: Reduce speed limit on Sunrise Project

Option 9: Reduce traffic volumes/number of travel lanes

Other Options

Option 11: Apply quiet pavement

Option 12: Purchase homes along the bluff

Option 13: Offer financial compensation to affected property owners

Option 14: Quiet pavement, reduced speed, and reduced traffic volumes

None of the additional options evaluated meet the ODOT noise abatement criteria. All potential mitigation measures studied for the Bluff neighborhood, including the wall at the top of the bluff, were expected to have very high costs, with preliminary estimates in the range of $100,000 to $1,000,000 per residence for the 113 predicted homes that are expected to exceed the noise abatement criteria. None of the sound walls considered would provide effective mitigation without excessive heights. The need for additional height and/or right-of-way area would have other potential environmental impacts and add to the costs of these measures.

No other options were identified that would effectively reduce potential noise impacts while also preventing additional project-related impacts, and meeting cost requirements for mitigation under ODOT policy for reasonable mitigation costs. Therefore, it was concluded that no feasible and reasonable methods of noise reduction are available for potential impacts to the Bluff neighborhood north of the proposed project alignment. The results are summarized in the 2010 Sunrise Project FEIS *Noise Technical Report*.

FEIS Mitigation Measures

Table 1 Mitigation Commitments for the Sunrise Project

Transportation

Measures to address potential local access and circulation impacts from the **Preferred Alternative** include the following design refinements:

- SE 162nd Avenue will be extended south of OR 212 to connect with Goosehollow Drive to mitigate the closure of Goosehollow Drive at OR 212.
- A right-out (northbound) only exit from the Orchard Lake neighborhood on Orchard View Lane adds another access point to mitigate the closure of Goosehollow Drive at OR 212.
- To avoid lengthy queues of westbound traffic on the Sunrise Project/OR 212 between the I-205 interchange and Webster Road, a third westbound lane will be added.
- The intersection of SE Johnson Road and Deer Creek Lane will be revised by maintaining the existing intersection location and roadway alignments to minimize impacts to local businesses.
- New frontage roads with driveways will be built for local businesses along OR 212 (south of Rock Creek Junction), near 125th Court, and near SE 82nd Drive. The frontage roads mitigate for closures or turning movement restrictions that will occur at those locations.
- Bike and pedestrian access will be built between SE Adams and SE 82nd Drive to better accommodate the high demand of bicyclists and pedestrians accessing the post office from SE 82nd Drive.
- A connection between SE Ambler Road and SE Jasmine Lane will be built on a structure over the rail corridor to improve circulation for businesses in that area. This allows for the businesses west of I-205 and east of SE 82nd Avenue to have access to their properties. Building the connection on a structure avoids impacting the rail corridor.
- Construction of cul-de-sacs at several locations near Hubbard Road, SE 142nd Avenue, SE 162nd Avenue, and SE 82nd Drive will be provided as parts of new access roads and will mitigate either closure of existing accesses, or provide turn-around points due to closure of existing intersections or roadways.
- A local circulation road will be constructed between SE Adams and SE St. Helens along SE 82nd Drive to mitigate for turning movement restrictions or closures of some driveways and intersections on SE 82nd Drive.
- Prior to construction, traffic analysis will be conducted to determine if signal warrants will be met at SE 82nd Drive at SE Jannsen Road.

Land Use

Direct property acquisition and relocation impacts will be mitigated through financial compensation regulated in accordance with the federal Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended (Uniform Act) 42 U.S.C. 4601 et. seq., 49 CFR Part 24, Oregon Revised Statutes, Oregon Department of Transportation guidance, and Federal Highway Administration Federal Aid Policy Guide. Tax lots that become land-locked as a result of the project removing the existing driveway will either receive a new driveway or will be acquired outright.

Table 1 Mitigation Commitments for the Sunrise Project

Parks and Recreation

Three mitigation measures will minimize the impacts on the Clackamas Elementary School recreation field, as follows: (1) move the softball backstop playing area to the east, (2) move the jogging trail to the east, and (3) build a sound wall to buffer the site from the noise of I-205. The combined effect of these measures will minimize the impacts to the school recreation field and improve the quality of the recreational experience overall.

Businesses and Communities

ODOT and KEX/Clear Channel jointly acknowledge existing technology does not allow for the forecasting/modeling of potential future impacts to the radio station signals from construction of elements of the Sunrise Project before construction. Therefore, the mitigation measures reflect commitments to pursue an agreed-upon strategy for assessing potential impacts to Clear Channel radio station signal viability from construction of the Sunrise Project.

Prior to FHWA authorization of construction of major structures near the KEX/Clear Channel transmission site:

- ODOT will retain a radio expert to assess impacts to transmission signal attributable to the construction of the Sunrise Project.
- If adverse impacts on radio transmission signal strength and coverage are realized from project construction, on-site mitigation efforts to address these impacts will be pursued first. On-site mitigation efforts are estimated to cost approximately $3.5 million to $7.0 million, and are included in the total project cost estimate.
- If such on-site mitigation efforts do not prove feasible, appropriate off-site mitigation efforts will be pursued. Off-site mitigation efforts are estimated to cost approximately $15 million to $25 million, and are included in total project cost estimate.

Temporary Construction Impacts

A construction management plan will be developed that supports the continued operation of business districts and the livability of neighborhoods.

Relocation

Mitigation will be provided to individual businesses and residents by purchase and relocation. This purchase and relocation must follow the requirements of the Uniform Act. The Uniform Act provides protections and assistance for people affected by the acquisition, rehabilitation, or demolition of real property for federal or federally-funded projects. The law helps ensure that people whose real property is acquired, or who move as a direct result of projects receiving federal funds, are treated fairly and equitably, and receive assistance in moving from the property they occupy. Federal law also addresses partial takes of property, addressing how payment and assistance to reconfigure the business and residence must take place.

Business and Neighborhood Access

Multiple mitigation measures related to access have been incorporated into the project as described under Transportation, above.

Community Cohesion

The change in access to Sunnyside Community Church will be mitigated by installing two directional signs on OR 212/224.

Environmental Justice

No mitigation measures suggested beyond the assistance already provided under federal law and mitigation measures suggested for relocation under Land Use and Businesses and Communities and for noise impacts under Noise. All households will be provided relocation assistance if they are renters; and purchase and relocation assistance if they are owners. Sound walls E205N-3 and E205S-5 proposed for the east side of I-205 (see Noise section) will reduce the noise levels in the neighborhood below their current levels after the Sunrise Project is completed. These block groups have higher than state average levels of poverty.

Visual Character and Resources

I-205 Interchange Area

Mitigation Location A (Figure PA-17): Because a noise wall is planned in this location, no mitigation measures are proposed for visual impacts.

Midpoint Area

Mitigation Locations D and E (Figure PA-18): In these locations, vegetation will be planted to screen residential viewers from direct vehicle light and glare. The planting will be done in an appropriate manner consistent with ODOT's Roadside Development Design Manual (ODOT 2006).

Rock Creek Junction Area

Mitigation Location F (Figure PA-18): No noise wall is planned in this location. Thus, as much as possible existing vegetation will be retained in order to maintain the vegetative screen between viewers and the new interchange.

Mitigation Location G (Figure PA-18): In this location, vegetation will be planted to screen residential viewers from direct vehicle light and glare. The planting will be done in an appropriate manner consistent with ODOT's Roadside Development Manual (ODOT 2006) and bridge design will be consistent with ODOT's Bridge Design and Drafting Manual (ODOT 2004).

Table 1 Mitigation Commitments for the Sunrise Project

Mitigation Locations H and J (Figure PA-18): In these locations, vegetation will be planted to screen residential viewers from direct vehicle light and glare. The planting will be done in an appropriate manner consistent with ODOT's Roadside Development Manual (ODOT 2006).

There are no mitigation measures proposed for locations B, C, and I. See Visual Character and Resources section in FEIS Chapter 3 for visual conditions at those locations.

Noise

The project will comply with the construction noise abatement measures contained in ODOT's Standard Specifications, Section 00290.32.

Permanent noise impacts will be mitigated through construction of noise walls where they meet ODOT's reasonable and feasible criteria. Based on existing modeling and current design for the **Preferred Alternative**, the following noise walls are proposed (as shown in Figures PA-19 through PA-20, FEIS):

- Noise Wall W-2
- Noise Wall J-1
- Noise Wall J-2
- Noise Wall E205N-3
- Noise Wall W205S-4
- Noise Wall E205S-5
- Noise Wall ZM-6

If during final design conditions have substantially changed, noise abatement may not be necessary. The final decision of the noise abatement will be made upon: completion of the project design, which occurs following the ROD; and the completion of the public involvement processes as outlined in ODOT's Noise Manual.

Air Quality

No long-term mitigation is required or included. Construction contractors are required to comply with Division 208 of OAR 340 which addresses visible emissions and nuisance requirements and with ODOT standard specifications, Section 290.30 (c) for air emissions during construction, including new 2008 controls on diesel-powered vehicles.

Greenhouse Gas

No long- or short-term mitigation is required or included.

Energy

No long- or short-term mitigation is required or included.

Biology

Wildlife

To minimize long-term wildlife access impacts and reduce animal-vehicle collisions:

a. Where 'full wildlife access' (meaning access to all species, regardless of size) is specified in the bulleted lists below and on Figures PA-2 through PA-5, it will have a minimum 10-foot-wide horizontal and vertical clearance (or greater, with some bridges), with adjacent exclusionary fencing (either along the highway and/or connected to wing walls of crossings) that will 'direct' wildlife away from the highway and towards crossings.

b. Where culverts to allow for 'medium wildlife (e.g., smaller than deer) passage' are specified in the bulleted lists below and on Figures PA-2 through PA-5, they will be culverts with a dry bench (earthen, concrete, or metal grate; above two-year flood elevation) at least three feet wide and tall, or an adjacent dry culvert at least three feet in diameter. They will include a 'ramp' sufficient for access onto the bench or into the dry culvert.

See Figures PA-2 and PA-3 for locations of exclusionary fencing and wildlife passage locations in the I-205 area.

SE 82nd Avenue (OR 213)/Mount Scott Creek and Railroad Bridge

- Exclusionary fencing along SE 82nd Avenue and the freeway will be installed.

SE 82nd/Ambler Road/Dean Creek Culverts

- New culverts (including replacement or extended culverts) will allow for medium wildlife passage.
- New culverts longer than 80 feet will have roadbed grates for natural light and ventilation.
- Exclusionary fencing along SE 82nd Avenue and the freeway will be installed.

I-205/Dean Creek Crossing

- The crossing will provide for full wildlife access.

Table 1 Mitigation Commitments for the Sunrise Project

I–205/Mount Scott Culvert and Vicinity

- The interior of the existing culvert will be modified to include a bench (concrete or metal grate) that allows medium wildlife passage through the culvert above the two-year flood elevation, including a sufficient 'ramp' for access onto the bench.
- Existing right-of-way fencing along the south side of I–205 between Dean and Mount Scott Creeks will be removed and new right-of-way fencing will allow for full wildlife access.

See Figures PA-4 and PA-5 for exclusionary fencing and wildlife passage in the Midpoint and Rock Creek Junction areas.

Clackamas Bluffs (Camp Withycombe to Rock Creek)

- Maintain full wildlife access, along the northern right-of-way of the new highway.
- Avoid right-of-way fencing along the northern right-of-way boundary to maintain connectivity with existing forested habitat.
- Direct highway lighting away from the forested bluffs.

Culverts at Sieben, Graham, and Trillium Creeks

- New culverts (including any replacements for existing culverts) shall be designed to allow for medium wildlife passage.
- New culverts longer than 80 feet will have roadbed grates for natural light and ventilation.

Rock Creek Bridge

- The bridge and embankments underneath the bridge will be designed to span the existing terraced landscape along west side of the stream.
- Full wildlife passage will be ensured through the two bridged crossings in the Rock Creek area (OR 212/224 and OR 224) by one or more of the following measures: minor hand-grading to create a path (where geologically stable and where does not require tree removal), clearing invasive weeds, revegetation with native plants or shrubs to help prevent re-growth of weeds.

Plants

Because there are no sensitive plant impacts, no mitigation measures related to sensitive plants are proposed.

To address noxious weeds, as part of construction and post-construction landscaping, the contractor will be required to remove invasive weeds and landscape with natives to discourage infestation of weeds.

Fish Habitat

Project will comply with all terms and conditions of the NMFS Biological Opinion as detailed below.

Water Quality

Best management practices in accordance with ODOT Standard Specifications (in Sections 280 and 290) will be used to control or prevent the movement of sediments.

The project will treat runoff from 247 acres of impervious surface (all but 16 acres of total 263 acres) within the project area including existing and new as well as contributing areas. The project will compensate for 16 acres of untreated on-site stormwater runoff by treating stormwater runoff from equal areas of impervious surface at off-site locations. These off-site locations are two existing segments of I-205 located immediately north of the project area and south of the project area, from which stormwater is not currently collected and treated (see Figures PA-45A through PA-45C).

Endangered Species NMFS Biological Opinion Terms and Conditions/Fish Habitat

The project will implement all terms and conditions from the NMFS Biological Opinion as follows.

1. To implement draft conservation measure #1 (general construction, riparian disturbance, and in-water work), the FHWA shall ensure that:

a. Timing of In-water Work. Work within the active channel of the Trillium Creek will be completed during the period of July 15 – August 31. Work within the active channel of the Phillips Creek will be completed during the period of July 15 – September 30. All in-water work must be completed within these dates unless otherwise approved in writing by NMFS. Work done outside of this period must be fully isolated and contained.

b. Minimize Impact Area. Confine construction impacts to the minimum area necessary to achieve project goals.

c. Cessation of Work. Operations will cease under high flow conditions that may result in inundation of the project area, except for efforts to avoid or minimize resource damage.

d. Pollution and Erosion Control Plan. A pollution and erosion control plan will be prepared and carried out to prevent pollution related to construction operations. The plan must be available for inspection on request by FHWA or NMFS, contain the pertinent elements listed below, and meet requirements of all applicable laws and regulations:

    i. Practices to prevent erosion and sedimentation associated with access roads, stream crossings, construction sites, borrow pit operations, haul roads, equipment and material storage sites, fueling operations and staging areas.

Table 1 Mitigation Commitments for the Sunrise Project

ii. A description of any hazardous products or materials that will be used, including procedures for inventory, storage, handling and monitoring.

iii. A spill containment and control plan with notification procedures, specific clean up and disposal instructions for different products, quick response containment and clean up measures that will be available on the site, proposed methods for disposal of spilled materials, and employee training for spill containment.

iv. Practices to prevent construction debris from dropping into any stream or waterbody and to remove any material that does drop with a minimum disturbance to the streambed and water quality.

v. Turbidity monitoring shall be conducted and recorded as described below. Monitoring shall occur each day during daylight hours when in-water work is being conducted. An appropriately and regularly calibrated turbidimeter is recommended, however, visual gauging is acceptable. Turbidity that is visible over background is considered an exceedance of the standard.

(1) Representative Background Point: a sample or observation must be taken every two hours at a relatively undisturbed area approximately 100 feet upcurrent from in-water disturbance to establish background turbidity levels for each monitoring cycle. Background turbidity, location, date, and time must be recorded prior to monitoring downcurrent.

(2) Compliance Point: Monitoring shall occur every two hours approximately 100 feet downcurrent from the disturbance and be compared against the background measurement or observation. The turbidity, location, date and time must be recorded for each sample.

vi. Turbidity compliance: Results from the compliance points should be compared to the background levels taken during each monitoring interval. Exceedances are allowed as follows:

MONITORING WITH A TURBIDIMETER

ALLOWABLE EXCEEDANCE TURBIDITY LEVEL	ACTION REQUIRED AT 1ST MONITORING INTERVAL	ACTION REQUIRED AT 2ND MONITORING INTERVAL
0 to 5 NTU above background	Continue to monitor every 2 hours	Continue to monitor every 2 hours
5 to 29 NTU above background	Modify BMPs & continue to monitor every 2 hours	Stop work after 4 hours at 5-29 NTU above background
30 to 49 NTU above background	Modify BMPs & continue to monitor every 2 hours	Stop work after 2 hours at 30-49 NTU above background
50 NTU or more above background	Stop work	Stop work

If an exceedance occurs at: 50 NTU or more over background; 30 NTU over background for 2 hours; or 5-29 NTU over background for 8 hours, the activity must stop immediately for the remainder of the 24-hour period.

VISUAL MONITORING

ALLOWABLE EXCEEDANCE TURBIDITY LEVEL	ACTION REQUIRED AT 1ST MONITORING INTERVAL	ACTION REQUIRED AT 2ND MONITORING INTERVAL
No plume observed	Continue to monitor every 2 hours	Continue to monitor every 2 hours
Plume observed	Modify BMPs & continue to monitor every 4 hours	Stop work after 4 hours with an observed plume

a. Inspection of Erosion Controls. During construction, all erosion controls must be inspected daily during the rainy season and weekly during the dry season to ensure they are working adequately.[1]
   i. If inspection shows that the erosion controls are ineffective, work crews must be mobilized immediately to make repairs, install replacements or install additional controls as necessary.
   ii. Sediment must be removed from erosion controls once it has reached 1/3 of the exposed height of the control.

b. Construction Discharge Water. All discharge water created by construction (e.g., concrete washout, pumping for work area isolation, vehicle wash water) will be treated as follows:
   i. Water quality treatment. Design, build and maintain facilities to collect and treat all construction discharge water, using the best available technology applicable to site conditions, to remove debris, nutrients, sediment, petroleum products, metals and other pollutants likely to be present.
   ii. Return flow. If construction discharge water is released using an outfall or diffuser port, velocities may not exceed four feet per second, and the maximum size of any aperture may not exceed one inch.
   iii. Pollutants. Do not allow pollutants such as green concrete, contaminated water, silt, welding slag, sandblasting abrasive, or grout cured less than 24 hours to contact any waterbody, wetland or stream channel below OHWL.

[1] 'Working adequately' means no turbidity plumes are evident during any part of the year.

Table 1 Mitigation Commitments for the Sunrise Project

c. Pre-construction Activity. Before significant[2] alteration of the project area, the following actions are completed:
   i. Marking. Flag the boundaries of clearing limits associated with site access and construction to prevent ground disturbance of riparian vegetation, wetlands and other sensitive sites beyond the flagged boundary.
   ii. Emergency erosion controls. Ensure that the following materials for emergency erosion control are onsite.
      a. A supply of sediment control materials (e.g., silt fence, straw bales[3]).
      b. An oil-absorbing floating boom whenever surface water is present.
   i. Erosion controls. Erosion controls must be in place and appropriately installed downslope of riparian areas to be disturbed until site restoration is complete.
d. Select Heavy Equipment with Care. Use of heavy equipment will be restricted as follows:
   a. Choice of equipment. When heavy equipment must be used, the equipment selected must have the least adverse effects on the environment (e.g., minimally-sized, rubber-tired).
   b. Vehicle staging. Vehicles must be fueled, operated, maintained, and stored as follows:
      i. Vehicle staging, cleaning, maintenance, refueling, and fuel storage must take place in a vehicle staging area 150 feet or more away from any stream, waterbody or wetland. All vehicles operated within 150 feet of any stream, waterbody or wetland must be inspected daily for fluid leaks before leaving the vehicle staging area. Any leaks detected must be repaired in the vehicle staging area before the vehicle resumes operation. Inspections must be documented in a record that is available for review on request by FHWA or NMFS.
      ii. All equipment operated instream must be cleaned before beginning operations below the bankfull elevation to remove all external oil, grease, dirt and mud.
   c. Stationary power equipment. Stationary power equipment (e.g., generators, cranes) operated within 150 feet of any stream, waterbody or wetland must be diapered to prevent leaks, unless otherwise approved in writing by NMFS.
e. Site Preparation. Native materials will be conserved for site restoration.
   a. If possible, native material must be left where they are found.
   b. Materials that are removed, damaged, or destroyed must be replaced with a functional equivalent during site restoration.
   c. Any large wood,[4] native vegetation, weed-free topsoil and native channel material displaced by construction must be stockpiled for use during site restoration.

2. To implement draft conservation measure #2 (work area isolation and fish salvage), the FHWA shall ensure that:
   a. Isolation of In-water Work Area. The work area will be well isolated from the active flowing stream using inflatable bags, sandbags, sheet pilings or similar materials.
      i. After completion of the project, the existing isolation area should be re-watered in a way that will not degrade water quality or cause fish stranding.
      ii. An ODOT or ODFW biologist shall be on site to monitor for fish stranding during this process.
      iii. The existing flow downstream from the action area will be maintained throughout the construction.
      iv. Turbidity monitoring shall be conducted and recorded as described below. Monitoring shall occur each day during daylight hours when in-water work is being conducted. An appropriately and regularly calibrated turbidimeter is recommended, however, visual gauging is acceptable. Turbidity that is visible over background is considered an exceedance of the standard.
   b. Capture and Release. Fish will be captured and released from the isolated area using trapping, seining, electrofishing or other methods as are prudent to minimize risk of injury.
      i. A fishery biologist experienced with work area isolation and competent to ensure the safe handling of all ESA-listed fish must conduct or supervise the entire capture and release operation.
      ii. If electrofishing equipment is used to capture fish, the capture team must comply with NMFS' electrofishing guidelines.[5]
      iii. The capture team must handle ESA-listed fish with extreme care, keeping fish in water to the maximum extent possible during seining and transfer procedures to prevent the added stress of

[2] 'Significant' means an effect can be meaningfully measured, detected or evaluated.
[3] When available, certified weed-free straw or hay bales must be used to prevent introduction of noxious weeds.
[4] For purposes of this Opinion only, 'large wood' means a tree, log, or rootwad big enough to dissipate stream energy associated with high flows, capture bedload, stabilize streambanks, influence channel characteristics, and other support aquatic habitat function, given the slope and bankfull width of the stream in which the wood occurs. See, Oregon Department of Forestry and Oregon Department of Fish and Wildlife, *A Guide to Placing Large Wood in Streams*, May 1995 (www.odf.state.or.us/FP/RefLibrary/LargeWoodPlacemntGuide5-95.doc).
[5] National Marine Fisheries Service, *Backpack Electrofishing Guidelines* (NMFS 2000) (http://www.nwr.noaa.gov/1salmon/salmesa/pubs/electrog.pdf).

out-of-water handling.

vi. Captured fish must be released as near as possible to capture sites.

vii. ESA-listed fish may not be transferred to anyone except NMFS personnel, unless otherwise approved in writing by NMFS.

viii. Other Federal, state, and local permits necessary to conduct the capture and release activity must be obtained.

ix. The NMFS or its designated representative must be allowed to accompany the capture team during the capture and release activity, and must be allowed to inspect the team's capture and release records and facilities.

3. To implement draft conservation measure #3 (monitoring), the FHWA shall ensure that FHWA and ODOT shall provide a report to NMFS with the results of the hydroacoustic monitoring program.

a. Prepare a Project Completion Report. Prepare and submit a project completion report to NMFS describing the FHWA's success in meeting the terms and conditions contained in this Opinion. The content of the project completion report will include:

i. Project identification.

(1) Project name.

(2) Type of activity.

(3) Project location by 6th field United States Geological Survey (USGS) HUC and by latitude and longitude as determined from the appropriate 7-minute USGS quadrangle map.

(4) FHWA contact person(s).

(5) Starting and ending dates for work completed.

ii. Photo documentation. Photos of habitat conditions at the project site before, during and after project completion.[6]

(1) Include general views and close-ups showing details of the project and project area, including pre- and post-construction.

(2) Label each photo with date, time, project name, photographer's name and the subject.

iii. Other data. Include the following specific project data in the project completion report:

(1) A summary of pollution and erosion control inspection results, including a description of any erosion control failure, contaminant release, and efforts to correct such incidences.

(2) Dates work ceased due to high flows.

(3) Total cleared area (riparian and upland).

(4) Isolation of in-water work area and fish capture and release.

(5) Supervisory fish biologist – name and contact information.

(6) Methods of work area isolation and take minimization.

(7) Stream conditions before, during, and within one week after completion of work area isolation.

(8) Means of fish capture.

(9) Number of LCR Chinook salmon, LCR steelhead, and LCR coho salmon captured.

(10) Location and condition of LCR Chinook salmon, LCR steelhead, and LCR coho salmon released.

(11) Any incidence of observed injury or mortality.

(12) A summary of the hydroacoustic monitoring results.

b. Site Restoration.

i. Finished grade slopes and elevations.

ii. Planting composition and density.

c. Monitoring for Extent of Take. Complete riparian removal monitoring as follows: The extent of take is covered for up to 3.4 riparian acres removed on the projects streams with ESA-listed species.

d. Reporting. Prepare and submit a summary of the turbidity monitoring, including a photograph of the baseline and compliance sites; a copy of turbidity measurements or observations with the date and time that each was taken; other relevant sampling conditions; and description of any sediment control failure, sediment release, and correction efforts. Copies of daily logs for turbidity monitoring shall be available to DEQ, USACE, NMFS, USFWS, and ODFW upon request. The log must include: background NTUs or observation, compliance point NTUs or observation, comparison of the points in NTUs or narrative, and location, date, time, and tidal stage (if applicable) for each reading. Additionally, a narrative must be

[6] Relevant habitat conditions may include characteristics of stream channels, eroding and stable streambanks in the project area, riparian vegetation, water quality, flows at base, bankfull and over-bankfull stages, and other visually-discernable environmental conditions at the project area, and upstream and downstream from the project.

Table 1 Mitigation Commitments for the Sunrise Project

prepared discussing all exceedances with subsequent monitoring, actions taken, and the effectiveness of the actions.

e. Submit Reports. To submit the project completion monitoring report, or to reinitiate consultation, contact:

Oregon State Habitat Office
National Marine Fisheries Service
Attn: 2010/01606
1201 NE Lloyd Blvd., Ste. 1100
Portland, Oregon 97232-1274

f. NOTICE. If a sick, injured or dead specimen of a threatened or endangered species is found in the project area, the finder must notify NMFS through the contact person identified in the transmittal letter for this Opinion, or through NMFS Office of Law Enforcement at 1-800-853-1964, and follow any instructions. If the proposed action may worsen the fish's condition before NMFS can be contacted, the finder should attempt to move the fish to a suitable location near the capture site while keeping the fish in the water and reducing its stress as much as possible. Do not disturb the fish after it has been moved. If the fish is dead, or dies while being captured or moved, report the following information: (1) The NMFS consultation number (found on the top left of the transmittal letter for this Opinion), (2) the date, time, and location of discovery, (3) a brief description of circumstances and any information that may show the cause of death, and (4) photographs of the fish and where it was found. The NMFS also suggests that the finder coordinate with local biologists to recover any tags or other relevant research information. If the specimen is not needed by local biologists for tag recovery or by NMFS for analysis, the specimen should be returned to the water in which it was found, or otherwise discarded.

Wetlands

Wetland impacts will be mitigated through the purchase of 22.9 credits at an approved wetland mitigation bank. The project area lies entirely within the service area of the Foster Creek Mitigation Bank. The mitigation bank currently has sufficient credits to cover the needs of the project. If available credits from the Foster Creek wetland mitigation bank are insufficient to mitigate all impacts when the project goes to construction, ODOT will identify a site where an ODOT-developed wetland mitigation site will be provided to accommodate mitigation for the Sunrise Project.

Geology and Soils

Groundwater

Where present, impacts to shallow groundwater will be mitigated with dewatering. Dewatering will either be temporary, to accommodate temporary excavations, or permanent with the installation of drainage, in areas where the natural drainage paths are blocked by the addition of embankment fill. Details of any permanent drainage improvements/modifications will be developed during final design with input from the civil engineer.

Erodible Soils

Erosion will be mitigated during construction by compliance with ODOT's Standard Specifications, Section 280 and Clackamas County erosion protections/control requirements.

Stability of Cut Slopes and Excavation

Avoid impact to the toe of the existing slopes at landslide areas (i.e., the Camp Withycombe and Eastern landslides) and local slopes located between Camp Withycombe and SE 135th Avenue (See Figure PA-47). Filling along the toe of the slope may be possible provided further evaluation of the mapped landslides and steep slopes indicates that doing so will improve stability.
If grading along the slopes cannot be avoided, slope drainage (dewatering) will be installed, excavation (cut) will be limited to short segments, and temporary and permanent retaining structures, or rock buttresses will be installed. Such measures will require further detailed evaluation of the mapped landslides and steep slopes and development of appropriate mitigation recommendations during preliminary engineering design.

Embankment Fill and Settlement

A site-specific geotechnical investigation will be performed to estimate the potential damage and required mitigation resulting from embankment dead loads.

Soft, compressible soils will be removed or replaced and ground/soil improved with either deep soil mixing or installation of displacement piles or reamed aggregate piers.

Seismically-Induced Liquefaction

Liquefaction settlement, where present, will be mitigated under embankment fills with ground improvement methods such as installation of rammed stone piers, stone columns, and removal and replacement of soft and potentially liquefiable soils. Bridge foundations will be supported on pile foundations bearing on dense gravels that are present beneath potentially liquefiable deposits, as appropriate.

Cultural Resources: Archaeological Resources

Table 1 Mitigation Commitments for the Sunrise Project
The following measures were approved as part of SHPO concurrence (letter dated June 1, 2010) with an evaluation of archaeological site 35CL330. A copy of the documentation for the site is included in Appendix B of the FEIS. To minimize impacts to site 35CL330, ODOT adjusted the design of the flyover structure to relocate the concrete footings (piers) outside of the portion of the site that is recommended eligible for listing in the National Register of Historic Places. Two pier locations were moved to the southwest to avoid the significant portion of 35CL330. The piers will be constructed by first drilling deep shafts measuring 1.2 to 1.8-meters (4 to 6-feet) in diameter, which anchor the concrete piers in the ground. The depth of the drilled shafts will depend upon the results of the geotechnical borings. Spoils from the drilling will be placed outside of the eligible portion of site 35CL330, and all equipment necessary for drilling the shafts and constructing the piers will be directed to stay outside of the eligible portion of site 35CL330. Geotechnical borings will be used to test the soil at site 35CL330 for suitability for construction. The methods of constructing the scaffolding and falsework within the eligible portion of site 35CL330 will depend upon the suitability of the soil. ODOT will direct contractors to develop a falsework plan that does not extend below the ground surface within the eligible portion of site 35CL330. Based on the results of the geotechnical borings, if it is determined that the soil is suitable for being built upon, then one or more of the following options will be used for construction of the falsework: • Geotextile fabric and a layer of crushed rock could be placed over the eligible portion of site 35CL330 for construction of the falsework. The layer of rock will be later removed. • An above-ground cribbing plan could be developed to support the falsework. If soil is not suitable for construction, then the following options will be possible: • A falsework construction plan, supported by beams that span the site • An alternative structure span, possibly steel, to span the eligible portion of site 35CL330 During construction, the following measures will be implemented for site 35CL330: • Archaeological monitoring of construction activities; ODOT will notify the Confederated Tribes of the Grande Ronde prior to construction activities so they may elect to have a tribal representative present on-site during any ground disturbing fieldwork by project consultant archaeologists • Fencing will be placed outside of the significant portion of the site and will include a 5-meter (16-foot) buffer wherever possible. • Where vehicles and equipment will travel over the eligible portion of site 35CL330, construction mats and/or geotextile cloth and/or layers of crushed gravel or fill dirt will be installed. • Development of a vegetation management plan, in consultation with the Confederated Tribes of the Grand Ronde Community of Oregon, to prevent future disturbance and looting of site 35CL330. Mature plant roots should not extend below a depth of 30 centimeters (12 inches) below the ground surface, which is the depth to which the site has been previously disturbed. Placement of a layer of shallow fill may be another option to allow for deeper plantings. Surveys on seven privately-owned parcels were not completed. Right-of-Entry to six of these parcels was denied by the property-owner. They are located near SE 142nd Avenue , SE Morning Way, OR 212, and near or abutting OR 212/224 (west of 152nd Avenue and north of the highway, and west of 122nd Avenue south of the highway). If the parcels are acquired by local or state agencies, a State of Oregon Archaeological Permit, issued by the State Historic Preservation Office, will be necessary to conduct exploratory excavations to determine if buried archaeological deposits are present on public land. A Memorandum of Agreement (MOA) has been prepared to address an identified archaeological site on one property where survey work was not completed. A copy of the MOA is provided in Appendix B of the FEIS. No previously-recorded resources are on the unsurveyed parcels. No mitigation measures are required for the proposed project related to historic resources because no adverse impacts are anticipated to historic resources located on tax lots in or adjacent to the Preferred Alternative (see Appendix B of the FEIS for a copy of the letter of concurrence from SHPO, dated July 26, 2010).
Hazardous Materials
Plans and surveys will be developed to mitigate exposure to potential hazardous materials issues during construction, in accordance with ODOT's Standard Specifications, Section 00280 - Erosion and Sediment Control, and Section 00290 - Environmental Protection. ODOT will prepare site-specific Hazardous Material Assessments (Phase I Environmental Site Assessments) prior to the purchase of private and public land for new right-of-way. The preparation of Hazardous Material Assessments will assist in the identification of environmental liabilities associated with a particular parcel. Additionally, Hazardous Material Assessments are required prior to the purchase of new right-of-way when federal funding is involved and by ODOT internal policy. ODOT will prepare a Phase II Environmental Site Assessment (Phase II ESA) for all properties requiring one, as determined during the Hazardous Materials Assessment site reconnaissance. Camp Withycombe Contaminated Media Management Plan

Table 1 Mitigation Commitments for the Sunrise Project

Although lead-containing soils have been remediated at Camp Withycombe, the cleanup criterion was 400 mg/kg. It is possible that areas planned for the Preferred Alternative construction will involve the disturbance of soil that can contain up to 400 mg/kg lead. Therefore, a Contaminated Media Management Plan that addresses the procedures for proper soil management and proper worker health and safety training with regard to lead-containing soil will be prepared for the construction activities.

Pedestrian access to surface soils will be limited (e.g., covering surface with clean fill, installing fencing) where trails cross the areas of lead-containing soils.

<u>Consent Decree and Easement and Equitable Servitude for the Northwest Pipe & Casing Site.</u>

The Preferred Alternative crosses a National Priority List facility, Northwest Pipe & Casing, which is currently under a Consent Decree between ODOT and the United States of America. The Consent Decree has established ongoing obligations for the long-term management of this property that include institutional controls, not interfering with the remedy at the site, and retaining the integrity of the remedy at the site. The Easement and Equitable Servitudes agreement was recorded with Clackamas County (Clackamas County Official Records, 2009) and establishes legal requirements for ODOT in relation to the Northwest Pipe & Casing property. In particular, the document references the "Sunrise Corridor Project" where ODOT "shall integrate the Sunrise Corridor Project with investigative and remedial activities initiated or planned by ODEQ or EPA to the maximum extent feasible, as required by Section 6 of the Consent Decree." The reader should refer to the Easement and Equitable Servitudes and the Consent Decree documents attached in Appendix D of the FEIS for details.

In summary, the restrictions on the site are:

- Groundwater use restrictions (does not apply to dewatering activities related to construction, development, or the installation of sewer or utilities at the site).
- Maintaining the functional integrity of the soil cap on Parcel B (map is attached to the Consent Decree, attached in Appendix D of the FEIS).
- Access restrictions (security of groundwater treatment system from damage by third parties).
- Land use restrictions that prohibit residential and agricultural uses.
- New construction and the evaluation of whether vapor intrusion controls must be implemented to prevent migration of site contaminants into on-site buildings.
- Notice of transfer of the site to other parties.
- Development (such as the Sunrise Corridor Project) and written approval after plan and activity review by ODEQ.
- Zoning changes.
- Partition.

Utilities

No short- or long-term mitigation is required or proposed.

Monitoring of Mitigation and Conservation Measures

In addition, to complying with the Biological Opinion, FHWA and ODOT will prepare a project completion report. The report will include project identification; photo documentation before, during, and after completion; data results from monitoring stream conditions and fish capture and release activities; site restoration; and results of monitoring the extent of the fish take as well as turbidity monitoring. All mitigation measures from the FEIS and the Biological Opinion have been entered into the ODOT Environmental Commitment Tracking System.

E. RECORD OF DECISION APPROVAL

Based on the systematic, interdisciplinary analysis contained in the Sunrise Project SDEIS and FEIS; careful consideration of the social, economic, and environmental factors; and input received from other agencies, organizations, and the public; FHWA has approved selection of the Preferred Alternative as the Selected Alternative for the Sunrise Project.

F. COMMENTS ON THE FEIS

Two comment letters were received on the FEIS, one from the City of Damascus and another from the US Environmental Protection Agency. The letter from the City of Damascus is supportive of the project and requires no response. Appendix A contains copies of each comment letter and responses to the comments submitted by the US Environmental Protection Agency.

REFERENCES

Federal Highway Administration (FHWA), Oregon Department of Transportation (ODOT), and Clackamas County. 1993. *Sunrise Project, I-205 to Rock Creek Junction, Draft Environmental Impact Statement and Draft Section 4(f) Evaluation.*

Federal Highway Administration (FHWA), Oregon Department of Transportation (ODOT), and Clackamas County. 2008. *Sunrise Project, I-205 to Rock Creek Junction, Supplemental Draft Environmental Impact Statement and Draft Section 4(f) Evaluation.*

Federal Highway Administration (FHWA), Oregon Department of Transportation (ODOT), and Clackamas County. 2010. *Sunrise Project, I-205 to Rock Creek Junction, Final Environmental Impact Statement.*

National Marine Fisheries Service. December 17, 2010. *Biological Opinion.*

Oregon Department of Transportation (ODOT). 2008. *Oregon Standard Specifications for Construction.*

Phillip A. Ditzler
FHWA Oregon Division Administrator

2/22/2011
Date

APPENDIX A

Mayor Steve Spinnett
City of Damascus
Damascus City Hall
19920 SE Highway 212
Damascus, Oregon 97089
(503) 312-3450
stevespinnett@gmail.com

January 7, 2011

Governor John Kitzhaber
Portland State Office Building
800 NE Oregon Street
Portland, OR 97232
Email: [Through website:] www.governor.state.or.us

Re: Sunrise Project, I-205 to Rock Creek Junction
Final Environmental Impact Statement, Dated December 2010

Dear Governor Kitzhaber:

On January 3, 2011, I took office as the newly elected Mayor of the City of Damascus, Clackamas County, Oregon. During my campaign for Mayor, I met and spoke with many citizens of Damascus. I believe that I am familiar with the concerns of my fellow citizens. I write you today to address the Sunrise corridor road construction project and its affect on my fellow citizens of Damascus.

In December of 2010, the Sunrise Project, I-205 to Rock Creek Junction Final Environmental Impact Statement was published. On page 1 of that document states, in part:

> "The Oregon Department of Transportation (ODOT) and Clackamas County plan to build a new, east-west oriented, limited-access highway -- called the Sunrise Project -- from Interstate 205 (10205) to the Rock Creek Junction in Clackamas County, Oregon. ...
>
> "The Sunrise Project **Preferred Alternative** will be part of the state highway network (as defined in the Oregon Highway Plan), connecting I-205, the Milwaukie Expressway, and OR 212/224. The highway will have six through-lanes plus two auxiliary lanes. The Sunrise Project will become the designated OR 212/224, with the existing OR 212/224 becoming a county arterial.
>
> "Major benefits from the project are significantly slowing the growth of traffic congestion and improving safety on I-205 and OR 212/224.

Building the project will support planned growth in the northwest area of Clackamas County. . . .

"Construction is planned to begin in 2012 and total project costs (consisting of right-of-way acquisition and construction costs) are estimated to be $1.49 billion (in 2013 dollars). Project construction is likely to be phased."

The Sunrise Project has been discussed and planned for far too long. It is time for construction to begin. The citizens of Damascus and, indeed, our neighbors in this area of Clackamas County, needed this road years ago. Construction of this road will not only relieve traffic congestion, but will promote economic growth in this area. Oregon needs jobs, Clackamas County needs jobs, and Damascus needs jobs. Beginning the Sunrise Project now will have an immediate effect of creating jobs now and in the future.

If I can answer any questions or be of any assistance, please do not hesitate to contact me.

Sincerely,

Steve Spinnett, Mayor
City of Damascus

Cc: See Below

Director Matthew Garrett
Oregon Department of Transportation
1158 Chemeketa St., NE
Salem, OR 97301
Email: matthew.l.garrett@odot.state.or.us

Manager Jason A. Tell
Region 1, Oregon Department of Transportation
123 NW Flanders Street
Portland, OR 97209
Email: jason.a.tell@odot.state.or.us

Chair Lynn Peterson
Clackamas County Board of Commissioners
2051 Kaen Road
Oregon City, OR 97045
Email: lynnpet@co.clackamas.or.us

Commissioner Jim Bernard
Clackamas County Board of Commissioners
2051 Kaen Road
Oregon City, OR 97045
Email: bcc@co.clackamas.or.us

2011 JAN 10 PM 12:22

Commissioner Ann Lininger
Clackamas County Board of Commissioners
2051 Kaen Road
Oregon City, OR 97045
Email: bcc@co.clackamas.or.us

Commissioner Charlotte Lehan
Clackamas County Board of Commissioners
2051 Kaen Road
Oregon City, OR 97045
Email: bcc@co.clackamas.or.us

Commissioner Paul Savas
Clackamas County Board of Commissioners
2051 Kaen Road
Oregon City, OR 97045
Email: bcc@co.clackamas.or.us

Eraut —

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue, Suite 900
Seattle, WA 98101-3140

OFFICE OF
ECOSYSTEMS, TRIBAL AND
PUBLIC AFFAIRS

RECEIVED
JAN 27 2011
FHWA
OREGON DIVISION

January 24, 2011

Ms. Michelle Eraut
Federal Highway Administration
Oregon Division Office
530 Center Street N.E., Suite 100
Salem, Oregon 97301

Mr. Thomas Picco
Oregon Department of Transportation, Region 1
123 NW Flanders Street
Portland, Oregon 97209-4012

Re: Sunrise Project, I-205 to Rock Creek Junction
EPA Region 10 Project Number 93-038-FHW

Dear Ms. Eraut and Mr. Picco:

The U.S. Environmental Protection Agency has reviewed the Sunrise Project, I-205 to Rock Creek Junction Final Environmental Impact Statement (FEIS). We are submitting comments in accordance with our responsibilities under the National Environmental Policy Act (NEPA) and Section 309 of the Clean Air Act. Thank you for the opportunity to offer comment.

The FEIS identifies a Preferred Alternative that is a modification of Alternative 2 from the Supplemental Draft EIS. This Preferred Alternative is to construct a new limited access highway with six through-lanes plus two auxiliary lanes with a midpoint interchange coupled with Design Options C-2, D-3, and a portion of Design Option A-2 (Tolbert overcrossing that links Lawnfield area and SE 82nd Drive businesses). The Preferred Alternative also includes an array of local access roads, additional transition lanes, and other refinements to increase capacity, enhance mobility, and where feasible, reduce impacts.

We appreciate the efforts made to respond to our comments and recommendations on the Supplemental Draft EIS. While the existing wildlife corridor in the project area would be narrowed by the proposed project, we are grateful that it would be conserved as much as possible and that a number of crossing structures and needed fencing would be provided. We are also pleased that the bicycle/pedestrian path would be extended approximately two miles east to Rock Creek Junction. Wetland impacts, while still substantial, have been reduced to 22.9 acres. The extent to which these losses can be adequately mitigated via the Foster Creek Mitigation Bank is not yet known, but a contingency plan is being developed.

In general, we remain concerned about the size of the project. Several changes made since the Supplemental Draft EIS would expand rather than contract the roadway footprint resulting in additional impacts, including losses of upland and riparian habitats. We are concerned about the magnitude of the project's potential effects to local ecosystems and communities and that the proposed mitigation would not sufficiently address these impacts. We offer the following specific comments and recommendations below.

Aquatic Resources

Stormwater management. While there are plans to treat and manage stormwater from project and non-project areas, we are concerned that, as stated in the FEIS (p. 183-188), the Preferred Alternative would create a net increase of 113.3 acres of new impervious surface that would potentially affect seven major drainages, all included on ODEQ's 303(d) list of waters not meeting standards, with increased runoff and pollutant loadings. The FEIS does not quantify the residual (post-treatment) pollutant loadings nor calculate/estimate effects on water quality, including for storm events that exceed the capacity of the treatment and detention systems. Projections should also consider how the number and severity of such events may increase with changing climate.

The most significant impacts from runoff would be to Cow Creek Basin, particularly the more intact reaches downstream of the project. This is because the percent of impervious area would increase from 10% to 26% in the Cow Creek basin, thereby crossing the general threshold for significant basin degradation (p. 185).

Recommendations: We encourage more and continued efforts to reduce project impacts from runoff and pollution and to retain or restore ecological functions within the project area. Efforts could include:

- incorporating a diversity of additional project and non-project related low impact development features, such as pervious pavements, rain gardens, eco-roofs, and pocket parks;
- increasing the number of acres for removal of existing impervious surfaces;
- expanding/restoring diminished riparian areas;
- restoring stream channels and floodways where ditches currently exist; and
- ensuring that the large patch of contiguous habitat/wetland complex, for which Design Option C-2 avoids and minimizes impacts (p. 182), is protected from future development.

We would encourage you to explore implementing activities in partnership with Clackamas County to improve livability within the project area.

Groundwater. The information contained in the Geology and Soils Technical Report is helpful, but does not go far enough to characterize the project area groundwater resources, to provide understanding of the ecological functions supported by these groundwater supplies, and to convey the vulnerabilities to potential project impacts. We continue to believe this information is necessary for NEPA disclosure and avoidance/minimization of impacts. For example, the Technical Report indicates that underlying gravels contain groundwater at levels that fluctuate with Clackamas River levels and rainfall. This may indicate the presence of a hyporheic zone associated with the Clackamas River, which could provide an array of ecological functions that should be disclosed and protected to the extent possible. Because the Clackamas River serves as the area drinking water supply, its connection to groundwater is relevant to drinking water quality and quantity as well as to the support of aquatic organisms, and other ecosystem functions.

The FEIS and Technical Report provide no discussion of groundwater quality, quantity, flow rates and direction, recharge areas, aquatic connectivity and ecological function, or how the project would affect these features. Dewatering is anticipated (Appendix A, p. 20) where trenches or below-grade cut slopes occur in areas of shallow groundwater, but there is no information regarding the estimated volume and/or duration of dewatering or discussion of construction/building design that could reduce or avoid the need for dewatering.

Recommendation: Provide supplemental information as described above to improve characterization of groundwater resources, ecological functions, vulnerabilities, and potential project impacts. Commit to appropriate measures in the Record of Decision (ROD) that would avoid, minimize, or otherwise mitigate direct and indirect project impacts.

Air Quality

We appreciate that the FEIS includes discussion of air toxics and the Portland Air Toxics Assessment. However, the FEIS does not apply what is known about these pollutants to the proposed project. There is no assessment of the existing localized air quality conditions in the project area that includes air toxics, and no quantitative estimate of how conditions would be changed with the Sunrise project. Consequently, the conclusion in the FEIS (Table 12, p. 25) that no air quality impacts would occur because the Preferred Alternative would not cause exceedance of the NAAQS is misleading since impacts may manifest as local effects. There is still need to identify sensitive receptors that may be affected by localized emissions hotspots and/or near roadway effects.

Recommendation: Provide the information as described above, and propose any feasible mitigation where needed to minimize emissions and exposure to elevated levels of MSATs during construction and operation of the proposed project.

We appreciate that construction contractors would be required to comply with Division 208 of OAR 340 and ODOT Section 290.30 (c) for air emissions during construction (p. 171-172). An additional measure to address preventative maintenance of construction equipment could further strengthen these standard specifications.

Recommendation: Consider adding a specification for construction contractors to incorporate preventative maintenance on construction equipment and vehicles.

Environmental Justice, Health and Safety of Children

The FEIS states that there are high concentrations of children, the elderly, and the disabled surrounding the Sunrise project area (p. 114). These are vulnerable populations that should be considered in the analysis and disclosure of and mitigation for project impacts.

Executive Order 13045 on Protection of Children from Environmental Health Risks and Safety Risks directs that FHWA make it a high priority to identify, assess, and address environmental health risks and safety risks from the proposed action that may disproportionately affect children. Similarly, elevated risks to the elderly and disabled should be identified, assessed, and addressed to mitigate impacts as directed by the CEQ NEPA implementing regulations at Section 1502.14(f).

As stated in our comments on the SDEIS, there is an array of potential impacts associated with project construction and operation that could affect populations in close proximity to the proposed project. The FEIS focuses heavily upon displacement in answering the five questions on page 120. In particular, we believe the response to Question c should be addressed more broadly to consider that vulnerable populations, such as low income, elderly, disabled, and children, could potentially suffer project related adverse impacts more severely or to a greater magnitude than less vulnerable populations.

Recommendation: Take a closer look at how project impacts (e.g. air pollution; noise and vibration; construction and operation safety risks from traffic and machinery; and access to schools, work, community activities, and businesses) may affect these vulnerable populations. Include any health related information that would characterize existing vulnerabilities among these populations, such as incidence of asthma or other respiratory ailments. Commit to appropriate mitigation.

We appreciate the efforts to produce this FEIS, and thank you for the helpful features it incorporates. There are many useful figures and tables to illustrate affected resources and impacts, and the use of green font for the new text additions in the FEIS is an especially helpful practice. We hope it will be continued in future NEPA documents.

Thank you for the opportunity to participate in the Sunrise Project. If you have questions or would like to discuss these comments, please contact Elaine Somers of my staff at (206) 553-2966, or by electronic mail at somers.elaine@epa.gov.

Sincerely,

Christine B. Reichgott

Christine B. Reichgott, Manager
Environmental Review and Sediment Management Unit

Sunrise Project – Responses to EPA Comments

Aquatic Resources – Stormwater Management

We are concerned that, as stated in the FEIS (p. 183-188), the Preferred Alternative would create a net increase of 113.3 acres of new impervious surface that would potentially affect seven major drainages, all included on ODEQ's 303(d) list of waters not meeting standards, with increased runoff and pollutant loadings.

Stormwater treatment and mitigation analysis for water quality and quantity issues was conducted for the Preferred Alternative. A series of stormwater treatment/detention ponds and LID treatment options have been proposed, from contributing surfaces as well as new impervious surfaces, consistent with Best Management Practices identified collaboratively by ODOT, FHWA, and natural resource agencies (NMFS, DEQ, USFWS, EPA, ODFW), as provided in ODOT *Geo-Environmental Stormwater Management Guidelines (GE09-02[B]*; January 27, 2009. A copy of these guidelines is provided as an attachment.

On-site water quality and quantity mitigation of impervious surface created by the project, or contributing to the project from adjacent county and state roadways, is included within the project footprint, except for 16 acres that is treated off-site. Runoff is not expected to affect any of the creeks morphology or water quality (*Sunrise Project Water Quality Technical Report,* p. ii and p. 93). For the 16 acres that will be mitigated off-site, the project will treat stormwater runoff from equal areas of impervious surface. Specifically, ODOT identified additional locations where 24 acres of currently untreated impervious surface on the much more heavily-traveled I-205 can be treated for water quality as part of the Sunrise Project (*Final EIS, p.194).*

The FEIS does not quantify the residual (post-treatment) pollutant loadings nor calculate/estimate effects on water quality, including for storm events that exceed the capacity of the treatment and detention systems.

The annual Minimum and Maximum pollutant loadings, and once-in-three-year exceedance concentrations were calculated for the Preferred Alternative, with water quality and quantity control mitigation measures using the FHWA-RD-88-006 methodology, based on post-project conditions on local streams. The results of this analysis are presented for the lowest impact scenario (Minimum) and the highest impact scenario (Maximum). Tables 76 – 88 of the *Sunrise Project Water Quality Technical Report* (p. 100) provide the change in annual loadings between Baseline conditions and Preferred Alternative, with mitigation.

Treatment and detention options were designed using Clackamas County standards, which in this case were more conservative than ODOT design standards. Clackamas County requires two-thirds of the 2-year storm to be used for water quality, and the 25-year post developed runoff rate be reduced to the 2-year pre development rate. ODOT requires one-half of the 2-year storm for water quality, and detention of 42% of the 2-

year storm through the 10-year storm for water quantity. In all cases, the water quality and quantity volumes were calculated separately, and added together. The project team then increased these calculations by 10% in order to establish even more conservative treatment and detention targets. This volume was then used to size the proposed treatment options.

The *Sunrise Project Water Quality Technical Report* provides the results of the pollutant loading analysis in several tables (Table 79 to Table 87) for the Preferred Alternative, with mitigation. The results show that the Clackamas River will have the largest increase in annual pollutant loading, followed, in descending order, by Dean Creek, Phillips Creek, Mount Scott Creek, Kellogg Creek, and Cow Creek. The proposed treatment options, as identified in the *Sunrise Project Final EIS*, will help ensure that the Preferred Alternative will not have adverse effects downstream on either water quality or quantity issues, such as channel morphology or ecology, and effects on stream riparian zones and wetlands will be minimal. As indicated above, the proposed treatment and detention systems would be designed to meet the appropriate standards as required by Clackamas County and increased by approximately 10%. It is expected that this increase in volume would help address some storm events beyond the County standards, however, it is not possible to design for every event.

Projections should also consider how the number and severity of such events may increase with changing climate.

NEPA requires analysis of the effects of a proposed action that are "reasonably foreseeable" (40 CFR 1508.8). Given the current lack of consensus on accepted methodologies for calculating the affects of climate change, it is considered too speculative, at this time, to reasonably foresee the number and severity of future storms.

The *Sunrise Project Final EIS*, Appendix D does include information on ODOT's efforts to address climate change. Internally, ODOT has a Climate Change Executive Group and a Climate Change Technical Advisory Committee both of which are analyzing interrelationships between greenhouse gas production, climate change, and transportation systems. Externally, ODOT provides financial and technical support to Metropolitan Planning Organizations engaged in efforts to reduce reliance upon Single Occupant Vehicles, a contributor to greenhouse gas emissions. ODOT is also a key participant in the Oregon Modeling Steering Committee promoting state-of-the-art modeling to analyze land use and transportation relationships to support land use-transportation modeling by federal, state, regional, and local agencies.

Additionally through Senate Bill 1059, ODOT is working with the Oregon Department of Land Conservation and Development to develop a framework for analyzing climate change and transportation to reduce greenhouse gas emissions. ODOT is also looking forward to the findings of the *Pacific Northwest Climate Change Collaboration* among federal agencies to further define efforts to understand impacts associated with climate change. Thus, while clear direction on the appropriate methods for addressing climate change are not yet available for the Sunrise Project, ODOT is actively engaged in developing programmatic guidelines for assessing future transportation project impacts. Insights and strategies developed from these guidelines may provide opportunities to reduce potential impacts associated with changes to the climate that could appear in the future.

The most significant impacts from runoff would be to Cow Creek Basin, particularly the more intact reaches downstream of the project. This is because the percent of impervious area would increase from 10% to 26% in the Cow Creek basin, thereby crossing the general threshold for significant basin degradation (p. 185).

The Cow Creek Basin presents particularly difficult conditions, as it drains the most heavily developed portion of the Sunrise Project area. Of its 781 acre drainage basin, ALL is under private ownership, and 97% of the basis is already "developed" or planned for future development (353 acres zoned industrial; 329 acres residential; 69 acres commercial; 7 acres office). As noted in Table 57 (p. 81) of the *Sunrise Project Water Quality Technical Report* Cow Creek Basin will experience a relatively minor increase (13%) in pollutant loadings. (26.4 lbs/yr baseline/pre-project vs. 29.9 lbs/yr Preferred Alternative) This basin is already greatly affected by development and has no natural component remaining, except within the lower reach. Therefore, the least relative change in condition caused by runoff from the Preferred Alternative would be in the Cow Creek Basin (see *Sunrise Project Water Quality Technical Report*, p. 78).

Recommendations: We encourage more and continued efforts to reduce project impacts from runoff and pollution and to retain or restore ecological functions within the project area. Efforts could include:

- *incorporating a diversity of additional project and non-project related low impact development features, such as pervious pavements, rain gardens, eco-roofs, and pocket parks;*
- *increasing the number of acres for removal of existing impervious surfaces;*
- *expanding/restoring diminished riparian areas;*
- *restoring stream channels and floodways where ditches currently exist; and*
- *ensuring that the large patch of contiguous habitat/wetland complex, for which Design Option C-2 avoids and minimizes impacts (p. 182), is protected from future development.*

We would encourage you to explore implementing activities in partnership with Clackamas County to improve livability within the project area.

While many of these recommendations would be beneficial enhancements to addressing the management of stormwater runoff in the project area, they often exceed the authority of ODOT to achieve with this specific transportation project. ODOT has worked with other agencies to identify stormwater Best Management Practices, that may help reduce potential stormwater impacts. See ODOT Technical Bulletin on Stormwater Management Guidelines (GE09-02B), attached. ODOT will continue to partner with Clackamas County, where appropriate, to implement these activities.

- Consideration of the use of pervious pavement, where appropriate, is currently being studied. In February 2011, the ODOT GeoEnvironmental unit began assembling a comprehensive, multi-disciplinary committee to develop statewide guidance on the use of pervious pavements. Decisions resulting from the committee's work will be discussed and documented through ODOT's Technical Bulletin process. Trial use of pervious pavement on inside shoulders of recent projects on I-5, Tualatin River to Willamette River, and US 26, Cornell Road to SW 185th Ave., will be evaluated for its effectiveness, durability, and maintenance/life-cycle costs, and may be a part of this larger study effort.
- Net calculations in the FEIS of total impervious surface under Preferred Alternative (new impervious surfaces less removal of existing impervious surfaces) reflect identified removal of all existing impervious surfaces not needed as a part of project. Consideration will be given for increasing the number of acres for removal of existing impervious surfaces when those are identified and found to be practical.
- All impacts to riparian areas from the Preferred Alternative have been mitigated. Consideration will be given to expanding/restoring diminished riparian areas, in conjunction with Clackamas County and regional agencies, where appropriate.
- The stormwater design work for the Preferred Alternative includes consideration of stream channel, ditch and floodway restoration and the Final EIS contains mitigation commitments to address stormwater impacts. Additional consideration will be given to restoring stream channels and floodways where ditches currently exist, and where appropriate and practical.
- Consideration may be given to ensuring that, where possible, contiguous habitat/wetland complexes (e.g., wetlands complex in Design Option C-2) are protected from future development, by retention within project public right-of-way. There are limitations, however, on the use of project funds for property acquisition not required for construction of the Preferred Alternative transportation facility.

Aquatic Resources – Groundwater

The information contained in the Geology and Soils Technical Report is helpful, but does not go far enough to characterize the project area groundwater resources, to provide understanding of the ecological functions supported by these groundwater supplies, and to convey the vulnerabilities to potential project impacts. We continue to believe this information is necessary for NEPA disclosure and avoidance/minimization of impacts.

Preparation of the Sunrise Project EIS included considerable coordination with resource agencies through the CETAS process. The *Sunrise Project Final EIS* includes analysis of all relevant issues related to water resources identified by participating agencies including EPA, NMFS, USFW, ODFW, DEQ, and DSL. Additionally, the Final EIS provides responses to comments on the Supplemental Draft EIS received from the resource agencies. Considerable attention has been given to environmental concerns raised by the agencies related to water resources, and plant and animal species, in the project area. Impacts on sensitive plant and animal species that could be affected by changes in water quality have been addressed.

Insofar as there are *no* identified critical groundwater areas or groundwater limited areas within the project area, nor any critical recharge areas (per information from Oregon Water Resources Department), a more extensive groundwater characterization was not initiated in the Final EIS. No other regulatory agencies identified the need to have conducted this analysis. The Final EIS analysis of water resources in the project area was sufficient, to adequately assess the impacts of stormwater runoff of new impervious surfaces. This information also contributed to analysis of project impacts to water quality, wetlands, and fish and wildlife habitat, to identify appropriate avoidance, minimization, and mitigation strategies.

Because the Clackamas River serves as the area drinking water supply, its connection to groundwater is relevant to drinking water quality and quantity as well as to the support of aquatic organisms, and other ecosystem functions.

The Clackamas River is the primary source of public drinking water supplies in the Sunrise Project area (Clackamas Water District and Sunrise Water Authority). It is the sole source of drinking water supplies for all residences and businesses between SE Webster Rd. and SE 152nd Avenue (Clackamas Water District). That portion of the project area to the east of SE 152nd Avenue relies primarily on the Clackamas River for drinking water supplies, with occasional use of groundwater well supplies depending on need (Sunrise Water Authority). In addition to the information presented in the above response, it should be noted that much of the project area is industrial in character and highly developed. It is acknowledged that the Preferred Alternative would contribute to on-going development in the project area, including additional impervious surface area. The Preferred Alternative's contribution to these changes, however, is not expected to result in substantial differences in water supply to the Clackamas River. Clackamas County was an integral member of the project development team, attending project meetings on at least a monthly basis since the project's inception. Clackamas County has not raised concerns with the SDEIS or FEIS impact analysis for resources, including the drinking water supply.

The FEIS and Technical Report provide no discussion of groundwater quality, quantity, flow rates and direction, recharge areas, aquatic connectivity and ecological function, or how the project would affect these features.

See previous response, a full groundwater characterization was not prepared on the project for the reasons noted above. Depths to groundwater are highly variable along the Preferred Alternative alignment, although it is anticipated to generally occur at relatively shallow depths along the project area. Estimated groundwater depths range from approximately 5 – 30 feet below the ground surface, except in designated wetland areas. The depth to the groundwater is generally shallower at the western portion of the project area than at the eastern portion. Shallow groundwater and groundwater seeps are present along slopes north of the alignment.

The Biological Opinion (BiOp) issued by National Marine Fisheries Service (NMFS, December 15, 2010; available in the Sunrise Project Final EIS, Appendix D) also addresses water quality and quantity issues in the project's Construction Impact Area. The BiOp addresses floodplain storage and connectivity, fluvial changes, riparian vegetation and other characteristics relevant to in-stream and streamside water availability.

The BiOp notes the developed nature of the project area, and in examining cumulative impacts, assumes that future private and public actions will continue and increase as the population density of the project area increases. The BiOp concludes that "NMFS is not aware of any specific future activities that would cause greater effects to a listed species or a designated critical habitat than presently occurs (p. 30)." The BiOp further concludes that because the functional floodplain would be fully spanned by proposed bridges and culverts, effects to critical species and habitats "would not substantially reduce the conservation value of existing critical habitat," And "this project should have no effect on floodplain connectivity (p. 29)." These conclusions provide additional examples of consideration of ecological functions and values during the project's environmental review process.

The BiOp's conclusions also include statements that "water quantity and quality will be improved over pre-project conditions," "stormwater treatment will improve water quality," and "natural cover will be restored with native vegetation at a greater density" than existing conditions (pp. 30-31). These conclusions provide additional support to the Final EIS analysis that indicates the proposed project would not substantially impair surface or groundwater conditions in the project area, or the plant and animal species dependent upon them.

Dewatering is anticipated (Appendix A, p. 20) where trenches or below-grade cut slopes occur in areas of shallow groundwater, but there is no information regarding the estimated volume and/or duration of dewatering or discussion of construction/building design that could reduce or avoid the need for dewatering.

Runoff from the project will be collected, treated, and routed to natural surface drainages – not infiltrated back into the groundwater. Where present, impacts to shallow groundwater will be mitigated with dewatering. Dewatering will either be temporary, to accommodate temporary excavations, or permanent with the installation of drainage, in areas where the natural drainage paths are blocked by the addition of embankment fill. Details of any permanent drainage improvements/modifications will be developed during final design with input from civil engineers. Additional exploration will be necessary to determine groundwater depths to support the design and construction of structures, such as bridge foundations, culverts, luminaries, retaining walls, embankment fills, and earthwork activities. Use of a permanent de-watering system is not presently anticipated. It is too early to determine at this time, given the approximately 5% level of preliminary engineering conducted in the Final EIS, whether permanent de-watering is expected to necessitate a pumped, de-watering system. If future explorations identify potential negative impacts to groundwater, additional mitigation measures will be proposed to address such impacts.

Recommendation: Provide supplemental information as described above to improve characterization of groundwater resources, ecological functions, vulnerabilities, and potential project impacts. Commit to appropriate measures in the Record of Decision (ROD) that would avoid, minimize, or otherwise mitigate direct and indirect project impacts.

See previous response, above. The *Sunrise Project Final EIS* complies with Council on Environmental Quality (CEQ) *Regulations for Implementing NEPA* (40 CFR 1502) and FHWA's *Environmental Impact and Related Procedures* (23 CFR 771). All appropriate mitigation measures have been described in the Final EIS.

Air Quality

We appreciate that the FEIS includes discussion of air toxics and the Portland Air Toxics Assessment. However, the FEIS does not apply what is known about these pollutants to the proposed project. There is no assessment of the existing localized air quality conditions in the project area that includes air toxics, and no quantitative estimate of how conditions would be changed with the Sunrise project. Consequently, the conclusion in the FEIS (Table 12, p. 25) that no air quality impacts would occur because the Preferred Alternative would not cause exceedance of the NAAQS is misleading since impacts may manifest as local effects. There is still need to identify sensitive receptors that may be affected by localized emissions hotspots and/or near roadway effects.

Modeling for the Sunrise Project included overall travel demand modeling, air quality conformity modeling and Mobile 6 hot spot modeling. This modeling is consistent with the approved air quality model for the project region. The Preferred Alternative has been determined to not cause an exceedance of the NAAQS for the Portland metro area. The project will not delay timely implementation of Transportation Control Measures (TCMs) included in the Portland CO Maintenance Plan.

The Sunrise Project Socioeconomics Technical Report sections on Community Cohesion and Environmental Justice Effects identify sensitive receptors within the project area, including parks, schools, religious or fraternal organizations, or service centers for low-income, elderly, or disabled populations. No identified air quality impacts from the Preferred Alternative would cause a high adverse effect on the community at large or on sensitive populations. (p.vi)

A CO hot spot analysis was conducted for the Sunrise Project. This analysis included evaluation of localized impacts at the three worst performing intersections affected by the project alternatives (*Air Quality Technical Report* [December 2010], p. 46). These intersections include: OR 224 (Milwaukie Expressway) x SE Webster Rd., SE 82nd Dr. x SE Evelyn (Jennifer) St., and OR 212/224 x SE 135th Ave. The EPA dispersion model CAL3QHC was used to estimate CO concentrations near selected intersections. None of the three intersections demonstrated an exceedance of CO. Tables 7a and 8a (p.67) of the Air Quality Technical Report provide a comparison of CO concentrations (ppm) for each of the three intersections to established NAAQS standards, for 1-hr and 8-hr periods. NAAQS standard for 1-hr concentrations are 35 ppm, and for 8-hr concentrations are 9 ppm. CO concentrations for each hot spot for a 1-hr period ranged from 4.3 to 5.4 ppm (2012), and from 4.1 to 4.7 ppm (2030). CO concentrations for each hot spot for an 8-hr period ranged from 3.7 to 4.4 ppm (2012), and from 2.6 to 4.1 ppm (2030).

The air toxics analysis required and conducted for this project was a qualitative analysis, as outlined in the *Interim Guidance on Air Toxic Analysis in NEPA Documents* (September 2009) from FHWA. The *Sunrise Project Air Quality Technical Report* indicates that "Overall, future MSAT emissions are predicted to be lower than existing emissions due to vehicle emission controls that will come into effect over the next 25 years (p. 63)." No adverse impacts for MSAT emissions are expected to result from the Preferred Alternative. The project will follow Oregon Administrative Rules (OAR) 340 regulations, and ODOT standard specifications, Section 290.30(c) to address air quality impacts during construction.

Recommendation: Provide the information as described above, and propose any feasible mitigation where needed to minimize emissions and exposure to elevated levels of MSATs during construction and operation of the proposed project.

See previous response, above. No impacts were noted in the hot spot analysis for the Preferred Alternative and no additional mitigation measures, beyond those already included in the Final EIS, related to air quality are proposed.

We appreciate that construction contractors would be required to comply with Division 208 of OAR 340 and ODOT Section 290.30 (c) for air emissions during construction (p. 171-172). An additional measure to address preventative maintenance of construction equipment could further strengthen these standard specifications.

Recommendation: Consider adding a specification for construction contractors to incorporate preventative maintenance on construction equipment and vehicles.

ODOT standard specifications (Section 290.30 Pollution Control) do include a measure to address appropriate operational conditions (preventative maintenance) for contractor vehicles and equipment as follows:

"290.30 (a) 3. Equipment Fueling, Repair and Maintenance:

- Promptly correct or repair operational procedures, leaks, or equipment problems that may cause pollution at the Project Site. If soils or other media become contaminated as a result of operational procedures or equipment problems, remove and dispose of them according to applicable Laws and 00290.20(g).

- Locate areas for parking, refueling and servicing mobile equipment and vehicles at least 150 feet away from any waters of the State and U.S. or storm inlet, unless otherwise approved by the Engineer.

- For large equipment that is not easily moved, prevent fuel and operating fluids from reaching any waters of the State and U.S. or storm inlet by, at a minimum, using spill containment systems designed to completely contain potential spills during all refueling and equipment repair operations." (*Standard Specifications for Construction, Volume 2* (ODOT, 2008)

Environmental Justice, Health and Safety of Children, Elderly, and Disabled

The FEIS states that there are high concentrations of children, the elderly, and the disabled surrounding the Sunrise project area (p. 114). These are vulnerable populations that should be considered in the analysis and disclosure of and mitigation for project impacts.

The *Sunrise Project Final EIS* identifies potential impacts to minority and low-income environmental justice groups consistent with Executive Order 12898 providing direction to consider environmental justice analyses prepared under NEPA regulations. Because the Preferred Alternative would not have direct impacts on other vulnerable population groups in the general area, the Final EIS does not explicitly discuss those groups. However, in recognition of these vulnerable populations, additional information is provided for children, elderly and disabled groups identified closest to the Preferred Alternative alignment. Indirect effects on environmental justice communities addressed in the analysis include changes to view, additional noise levels, increased stormwater runoff, and potential exposure to air emissions and hazardous materials (Final EIS, p. 122). This analysis did not result in identifying substantial adverse impacts from these potential indirect effects.

Specific public outreach efforts conducted for the Sunrise Project are noted in the *Sunrise Project Socioeconomics Technical Report* (p. 164+), and include the following efforts:

- Met with or offered to meet with manufactured home park managers during stakeholder interviews, and at selected decision points during the EIS process. Some residents of these home parks are elderly or disabled. Issues and concerns raised by three managers about possible impacts on their residents were conveyed to project team.
- Distributed project flyers and meeting invitations door-to-door within manufactured home parks.
- Presented project information at a Clackamas County Community Action Board meeting. (County agency involved with low-income housing assistance, elderly care, disabled care).
- A project citizen advisory committee (Project Advisory Committee) position was specifically designated to be filled from a member of EJ protected population (low-income and disabled) to help the project consider EJ issues and concerns.

Executive Order 13045 on Protection of Children from Environmental Health Risks and Safety Risks directs that FHWA make it a high priority to identify, assess, and address *environmental health risks and safety risks from the proposed action that may disproportionately affect children. Similarly, elevated risks to the elderly and disabled should be identified, assessed, and addressed to mitigate impacts as directed by the CEQ NEPA implementing regulations at Section 1502.14(f).*

Executive Order 13045 applies only to rulemaking actions. The NEPA/EIS process is not a rulemaking action. However, in recognition of these vulnerable populations, additional information is provided below for children, elderly and disabled groups within the project area identified closest to the Preferred Alternative alignment.

We believe the response to Question c should be addressed more broadly to consider that vulnerable populations, such as low income, elderly, disabled, and children, could potentially suffer project related adverse impacts more severely or to a greater magnitude than less vulnerable populations.

Throughout the project area there are pockets of sensitive populations, including children, the elderly, and disabled. While there will be impacts of the Preferred Alternative on all population groups in the project area, these impacts are not expected to be appreciably more severe or greater in magnitude than those suffered by non-sensitive populations. EIS analysis of impacts of specific environmental elements on sensitive populations, include the following:

- Air quality/health: no identified air quality impacts from the Preferred Alternative would have an adverse impact on community at large or sensitive populations. The Preferred Alternative will not cause exceedance of NAAQS standards within project area.
- Noise: Under the Preferred Alternative with mitigation (noise walls) sensitive populations along the east side of I-205 will experience noise levels 8 – 10 dBA lower than existing or future No Build conditions.
- Visual: visual impacts occur along the entire project alignment and are not expected to disproportionately impact sensitive populations. The largest decline in view quality would occur on the eastern end of the project, where few sensitive populations have been identified near the project alignment.
- Community resources: there are no religious or fraternal organizations, service centers for low income populations, assisted-living facilities, nursing homes, retirement centers, or residential care facilities within the project area.
- Traffic/congestion/access: there would not be disproportionate impacts to sensitive populations with regard to traffic and congestion. Under the Preferred Alternative delay in the OR 212/224 corridor would be reduced, therefore improving congestion and safety for all area populations.

Additional information, from the *Sunrise Project Socioeconomics Technical Report*, follows on the vulnerable populations of children, elderly, and disabled,

Children: One Census Tract/Block Group (CT 221.03/BG 3) exceeds the County-wide average of 26%, with a population proportion of 31%. However, this CT/BG, while located within the Sunrise Project Land Use Study Area, is located to the south of the Preferred Alternative, and is not directly impacted by the Preferred Alternative. There are only three (3) schools within the project area (Clackamas Elementary – 92nd Ave. x Church St.; Alder Creek Middle School – OR 224 x Webster Rd., and Sabin-Schellenberg Skills Center – OR 224 x Johnson Rd.). Only one of these (Clackamas Elementary) is directly impacted by the Preferred Alternative. Mitigation has been provided for all impacts to Clackamas Elementary School identified in the Final EIS.

Elderly: Two Census Tracts/Block Groups contain concentrations of elderly that exceed the County-wide average of 6%: CT 215/BG 1 with an elderly population proportion of 8% is located at the far western edge of the Preferred Alternative, and outside of the Sunrise Project Land Use Study Area, and the location of two retirement facilities. This population is not directly impacted by the Preferred Alternative. CT 221/BG 3 is located to the south of OR 212/224, and south of the Preferred Alternative. The land-use in this area is predominately industrial and commercial. The location in this CT/BG of a manufactured home park (Shadow Brook) that accepts only residents 55+, combined with the overall low population in the area, results in an elderly concentration of 17%. Shadow Brook Mobile Home Park is located approximately 600' east of the intersection of SE 135th Ave. x OR 212/224, and is not directly impacted by the Preferred Alternative. There are no retirement centers, senior centers, residential care facilities, assisted-living facilities, or nursing homes in the project area.

Disabled: Two Census Tracts/Block Groups contain concentrations of disabled that exceed the County-wide average of 14%: CT 221.04/BG 3 is located to the south of OR 212/224, and south of the Preferred Alternative, and is the location of five manufactured home parks, including Shadow Brook Mobile Home Park (residents 55+ only). CT 221.04/BG 2 is located in the midst of the Preferred Alternative, and is impacted by the Preferred Alternative. However, a number of mitigation measures, such as sound walls, have been identified to reduce the impacts of the Preferred Alternative on the existing residential areas. These residential areas are the remnants of an existing residential area that existed before I-205 was constructed. The residential area contains at least one small special needs housing project (SE 90th between Janssen St. and Tolbert St.), and several scattered housing authority units.

Recommendation: Take a closer look at how project impacts (e.g. air pollution; noise and vibration; construction and operation safety risks from traffic and machinery; and access to schools, work, community activities, and businesses) may affect these vulnerable populations.

- Air pollution: no identified air quality impacts from the Preferred Alternative would have an adverse impact on community at large or sensitive populations. The Preferred Alternative will not cause exceedance of NAAQS standards within project area. Clackamas Elementary School is located adjacent to I-205. Construction of the Sunrise project will not result in significant changes in traffic levels along I-205. Construction of the Sunrise project is not expected to cause detrimental impacts to air quality or any resultant health issues, anywhere along the project, or specifically at Clackamas Elementary School.

- Noise and vibration: Under the Preferred Alternative with mitigation (noise walls) sensitive populations along the east side of I-205 will experience noise levels 8 – 10 dBA lower than existing or future No Build conditions.
- Construction and safety risks: Construction impacts would be temporary and borne equally throughout the project alignment, with no disproportionate impacts to sensitive populations. Under the Preferred Alternative delay in the OR 212/224 corridor would be reduced, therefore improving congestion and safety for all area populations.
- Access to schools, work, and community activities: All of the residences, facilities, and services utilized by children, elderly, and disabled facilities within the project area are already established and located on existing transportation facilities. There are few service facilities for the elderly and disabled within the project area. Insofar as the Sunrise Project is a *new* highway alignment, that largely avoids direct impacts to these population groups, there should be limited conflict with existing area roadways and bike/pedestrian facilities during construction, except for possible delay at some intersections at certain times of the day.

  Currently transit service within the project area is provided by three Tri-Met bus lines (line #30 to Estacada via 82nd Ave./I-205/OR 212/224/ and OR 224; line #79 to Oregon City, via 82nd Ave. and 82nd Dr.; and line #156 Mather Road, via Sunnyside Rd./ SE 97th Avenue/ Mather Rd./SE 122nd Avenue/OR 212/224/ and SE 152nd Avenue). Access/service to these bus lines by sensitive population groups within the project area, should experience minimal adverse impacts on access or service due to construction or operation of the Sunrise project. New express bus service will be initiated on the Sunrise Expressway upon its completion, which should provide enhanced transit service to all population groups in the project area. Transit agencies have been facing declining revenues, and may independently institute service cuts with no relation to construction or operation the Sunrise project.

Increased traffic and congestion, and access and safety issues, are discussed in the travel patterns and accessibility section of the Environmental Justice chapter, and in the Transportation section of the Final EIS.

Include any health related information that would characterize existing vulnerabilities among these populations, such as incidence of asthma or other respiratory ailments. Commit to appropriate mitigation.

Asthma is a common chronic inflammatory disease of the airways characterized by variable and recurring symptoms, reversible airflow obstruction, and bronchospasm. Symptoms include wheezing, coughing, chest tightness, and shortness of breath.

Data on asthma rates for adults and children by County (2002 – 2005) and by State of Oregon indicate no significant disproportional differences between residents of Clackamas County and state-wide.

Location	Children (8th Grade)	Children (11th Grade)	Adults
Clackamas County	9.7%	10.9%	9.6%
State of Oregon	10.2%	10.4%	9.3%

Source: *The Burden of Asthma*, Oregon Department of Human Services, Public Health Division, February 2009.

The analysis for this project did not identify any new asthma impacts and additional mitigation is not proposed. Additional related information is provided in the response to air quality comments.

OREGON DEPARTMENT OF TRANSPORTATION TECHNICAL SERVICES Geo-Environmental BULLETIN				
SUBJECT Stormwater Management Program	FINAL NUMBER GE09-02(B)	EFFECTIVE DATE 01/27/2009	VALIDATION DATE 00/00/0000	SUPERSEDES GE07-02(B)
	WEB LINK(S) http://www.oregon.gov/ODOT/HWY/TECHSERV/technicalguidance.shtml			
TOPIC/PROGRAM Hydraulics, Environmental	APPROVED SIGNATURE Original signed by H.A. (Hal) Gard, RPA Geo-Environmental Manager			

PURPOSE

The purpose of this technical bulletin is to provide stormwater water quality and flow control guidance for Oregon Department of Transportation (ODOT) projects.

GUIDANCE

ODOT manages its stormwater discharges to:

- Protect water quality by reducing pollutant loads and concentrations.
- Prevent or reduce peak runoff rate increases caused by urban development.
- Address downstream drainage capacity problems.
- Meet Endangered Species Act (ESA) requirements related to duration and frequency of discharges to streams.

Project teams are required to follow this guidance for any project that will

i. Produce new impervious surface,
ii. Result in a change in the total contributing impervious area (CIA),
iii. Result in a change to the stormwater conveyance (e.g., type, location, direction, distance, or endpoint) in the project limits,
iv. Replace or widen stream crossing structures, or
v. A project requiring a Clean Water Act (CWA) 404 permit affects impervious surface that drains untreated to waters, wetlands, or groundwater.

This guidance provides the implementation strategy of stormwater management and guidelines for water quality and flow control facilities. This guidance addresses the natural resource concerns of regulatory and resource agencies (see *Background/Reference* section below).

Design Strategy

The implementation strategy of stormwater management is outlined in the following steps:

Step 1:	Prior to the Design Acceptance Phase (DAP) of Statewide Transportation Improvement Program (STIP) projects or during design of Maintenance projects, evaluate the feasibility of hydrologic attenuation and low impact development (LID) best management practices (BMPs), such as minimizing and disconnecting impervious cover, conserving or restoring natural areas, or mimicking natural drainage patterns (e.g., using sheet flow, dispersion or infiltration techniques, and retrofitting existing open channels). This may eliminate the need for or reduce the size of an engineered stormwater treatment facility.
Step 2:	Incorporate sufficient LID BMPs into the stormwater management plan to meet the project's stormwater management goals, such that an engineered treatment method and quantity control are not needed. Go to Step 3 if this is not the situation.
Step 3:	Use a combination of LID BMPs, an engineered treatment method, other BMPs, and quantity control to meet stormwater management goals. The stormwater management practices discussed in Attachment 1: Water Quality Guidance and the Storage Facilities Chapter (ODOT's Hydraulics Manual) are applicable to transportation projects.

Low Impact Development Best Management Practices

LID BMPs are innovative stormwater management approaches that utilize vegetation and infiltration to reduce the rate and volume of runoff, filter out pollutants, and facilitate infiltration and evapotranspiration of stormwater. LID BMPs help to improve the quality of receiving waters and stabilize the flow rates of nearby streams. In many cases LID BMPs are less expensive to construct and maintain than other stormwater treatment facilities.

LID BMPs are not a significant departure from the current rural road design practices in which curbing and gutter systems are not typically used. The major difference is that LID BMPs are specifically designed not to concentrate flows or transport flows for long distances.

The use of LID BMPs should be evaluated for feasibility on all transportation projects early in project development as additional right of way may be needed. The use of LID BMPs may influence the water quality and flow control treatment chosen and reduce the size of any additional stormwater management facilities needed. The feasibility of LID BMPs depends on the physical characteristics of the site, the adjacent development, and the availability and cost of additional right-of-way, when applicable. Note that use of LID BMPs will not be feasible on all projects. Utilize LID BMPs discussed in the following publication:

Evaluation of Best Management Practices for Highway Runoff Control (NCHRP 2006) http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_565.pdf. (Also follow the link "Report Web Page" to access the User's Guide and LID BMP Manual.)

The benefits of using LID BMPs:

- Supports streamlined permitting,
- Can eliminate the need for engineered treatment facilities on many projects,
- Can reduce the size of storm drain systems and engineered treatment, facilities on many projects, and
- Can frequently reduce maintenance and construction costs compared to engineered facilities.

Water Quality

ODOT's water quality goals:

1. Stormwater runoff from a project shall not cause violations of water quality standards in the receiving water.
2. Provide water quality treatment for the total CIA using the most effective techniques practicable for the site.

   The water quality design storm is 50 percent of the cumulative rainfall from the 2-year, 24-hour storm for the project site, except as follows:

   i. Climate Zone 4: 67 percent
   ii. Climate Zone 5: 75 percent
   iii. Climate Zone 9: 67 percent

Further information is available in Attachment 1: Water Quality Guidance Document and Appendices. Refer to Attachment 2: Water Quality Design Storm Factor – Climate Regions for the climate zone map and *Water Quality Design Storm Technical Guidance* for background technical information. This document is provided on the ODOT Stormwater Management Program website.
http://www.oregon.gov/ODOT/HWY/GEOENVIRONMENTAL/Storm_Management_Program.shtml

Flow Control (Water Quantity)

Flow Control for the Protection of Channel Processes

ODOT is responsible for managing stormwater runoff to avoid an increase in sediment transporting flows from pre-project to post-project (i.e., match the existing hydrology) between:

i. The lower endpoint of 42 percent of the 2-year flow event (annual series) in western Oregon and 50 percent of the 2-year flow event (annual series) in Eastern Oregon; and
ii. The upper limit of the channel over-topping event for streams with an entrenchment ratio that is greater than or equal to 2.2 (i.e., slightly incised) or the 10-year flow event (annual series) for streams with an entrenchment ratio that is less than 2.2 (i.e., moderately to severely incised).

Certain projects are excluded from application of the flow control (water quantity) performance standard as follows:

i. Projects that discharge into major water bodies, such as large mainstem rivers (e.g., Columbia, Willamette, Umpqua) and large lakes and reservoirs;
ii. When the uncontrolled peak post-construction runoff rate from the new impervious surface area increases by less than 0.5 cubic feet per second during the 10-year, 24-hour storm event from the total proposed contributing area.

Projects are expected to follow the local jurisdiction's regulations if their requirements are stricter than those given above.

Refer to *Flow Control (Water Quantity) Technical Guidance* for the background technical information. This document is provided on the Stormwater Management Program website.

Flood Flow Control

Projects are expected to comply with local flood control regulations and guidance provided in ODOT's Hydraulics Manual.

<u>Water Quality and Flow Control Treatment Best Management Practices (BMPs)</u>

Project teams should use LID BMPs, when feasible, to reduce the volume of stormwater runoff produced from roads and bridges and use BMPs categorized as "preferred" (many of which are LID BMPs), when feasible, to treat the remaining stormwater. Use of the LID BMPs and "preferred" BMPs on a project will result in streamlined review and rapid approval by the natural resource agencies.

If project-specific conditions preclude the use of "preferred" BMPs, then other BMPs are to be used and combined in a treatment train to achieve comparable pollutant removal effectiveness. Refer to the BMP Selection Tool and User's Guide for guidance on BMP selection if "preferred" BMPs cannot be used. This document is provided on the ODOT Stormwater Management Program website.

The "preferred" stormwater treatment BMPs are:
- Infiltration facilities,
- Bioretention,
- Bioslope,
- Grass swale with soil amendment.
- Filter strip with soil amendment, and
- Constructed wetlands.

Use of the BMP Selection Tool and proper documentation will facilitate regulatory review of projects where "preferred" BMPs cannot be employed by providing the rationale for BMP selection decisions, demonstration that the most effective BMPs suitable for the project have been chosen, and evaluation of the expected effectiveness. The Stormwater Treatment Decision Document is provided on the ODOT Stormwater

Management Program website. This document can be provided to the natural resource agencies upon request and can aid in preparation of other required environmental documents (e.g., Biological Assessment, Stormwater Management Plan).

Operation and Maintenance (O&M) Manuals

Operation and Maintenance Manuals provide maintenance guidance, the recommended facility inspection schedule, the location of the facility, and a general overview of how the facility functions.

Development of O&M Manuals is critical to ensure that stormwater treatment facilities are maintained in such a way that they function as designed and to meet the intent for which they are designed. These manuals link the transfer of structures completed by ODOT Project Teams to that of ODOT Maintenance.

All facilities must have an O&M Manual prepared and a copy must be distributed to the appropriate district maintenance office and the ODOT Geo-Environmental Senior Hydraulics Engineer.

Manual preparation guidance is provided in Attachment 1: Water Quality Guidance.

Stormwater Management Plan

Projects requiring a CWA Section 404 Permit or that are subject to the ESA may require a formal Stormwater Management Plan (SWMP). The SWMP should be formatted using the most current submittal checklist from DEQ for CWA Section 401 Water Quality Certifications, and should be reviewed by ODOT using the most current ODOT SWMP Quality Control (QC) Checklist before submittal to the resource and regulatory agencies.

The DEQ submittal checklist is available from DEQ. The ODOT SWMP QC Checklist is available on the ODOT Stormwater Management Program website.

DEFINITIONS

Best Management Practices (BMPs) – BMPs are physical, structural, and/or operational practices employed to reduce or eliminate the pollutant load carried by highway runoff. Within ODOT, BMPs refer to both engineered and non-engineered facilities that are known to have a water quality and/or flow control benefit.

Contributing Impervious Area (CIA) - The project's contributing impervious area consists of all impervious surface within the strict project limits plus impervious surface owned or operated by ODOT outside the project limits that drains to the project via direct flow or discrete conveyance. Design guidance is provided in Attachment 1: Water Quality Guidance.

Engineered Treatment Facilities – A treatment facility that requires engineering analysis to determine the hydrology, hydraulics, and design of the structure. Engineered treatment facilities include features such as dry and wet detention basins, engineered water quality swales (bioswales), treatment wetlands, and proprietary systems.

Low Impact Development (LID) - The concept of designing projects to minimize the effect on natural hydrology and water quality. This is primarily accomplished by minimizing impervious surface area and applying LID BMPs which provide opportunities for infiltration of stormwater into vegetated soil. For highway projects, LID BMPs refer to the treatment of highway runoff within the linear highway right of way using techniques and facilities that generally require minimal hydraulic engineering.

New Impervious Surface – Includes new impervious surfaces plus impervious surfaces that originally were bordered by and drained to vegetated ditches or slopes and are boarded by curbs after construction.

Net New Impervious Surface – Includes new impervious surface minus old impervious surfaces that are removed.

Stormwater Runoff – The precipitation that runs off the surface of a drainage area after accounting for all abstractions. The portion of precipitation that appears as flow in streams; total volume of flow of a stream during a specified time.

BACKGROUND/REFERENCE

Stormwater management has increased in complexity and importance for ODOT, the Federal Highway Administration (FHWA), and the natural resource agencies. These agencies agree that stormwater runoff is a major factor in the degradation of the waters of the United States and of Oregon, and that highway runoff is an important contributor to reduced water quality. As a consequence, regulatory scrutiny of and expectations for transportation projects have increased. ODOT, FHWA, and the natural resource agencies embarked on a collaborative venture to promote improved management of stormwater, ensure that all parties are in alignment on permitting requirements and enhance streamlined permitting. The natural resource agencies involved were the National Marine Fisheries Service (NMFS), Oregon Department of Environmental Quality (DEQ), the U.S. Fish and Wildlife Service (USFWS), the U.S. Environmental Protection Agency (EPA), and the Oregon Department of Fish and Wildlife (ODFW).

A comprehensive literature review was used to inform and direct the development of the technical guidance. Discipline experts were also consulted during the development of the design storm definitions. The final selections of the design storms and elements of the BMP Selection Tool and Summary Reports were consensus decisions by ODOT, FHWA, and the natural resource agencies.

RESPONSIBILITIES

Refer to Attachment 3: Process Diagram for Addressing Stormwater Runoff during Project Development.

SPECIAL INSTRUCTIONS
Highway Division Project Delivery Leadership Team Operational Notice PD-05 sets forth ODOT's goals for highway runoff water quality, with direction on determining the requirements for treatment facilities.

PD-05 can be viewed and downloaded from the Stormwater Management Program web site.

CONTACT INFORMATION
Stormwater treatment guidance questions should be directed to:

Title:	Water Quality/Resources Program Coordinator
Section:	Geo-Environmental Section
Phone:	(503) 986-3509
E-mail:	william.fletcher@odot.state.or.us

Design of stormwater treatment facilities should be directed to:

Title:	Senior Hydraulics Engineer
Section:	Geo-Environmental Section
Phone:	(503) 986-3365
E-mail:	alvin.shoblom@odot.state.or.us