CLACKAMAS COUNTY TRANSPORTATION SAFETY ACTION PLAN

Clackamas County, Oregon

July 2012

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

CLACKAMAS COUNTY

Clackamas County
Transportation Safety Action Plan

Clackamas County, Oregon

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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 groundwork 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 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 TSAPs.

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 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.

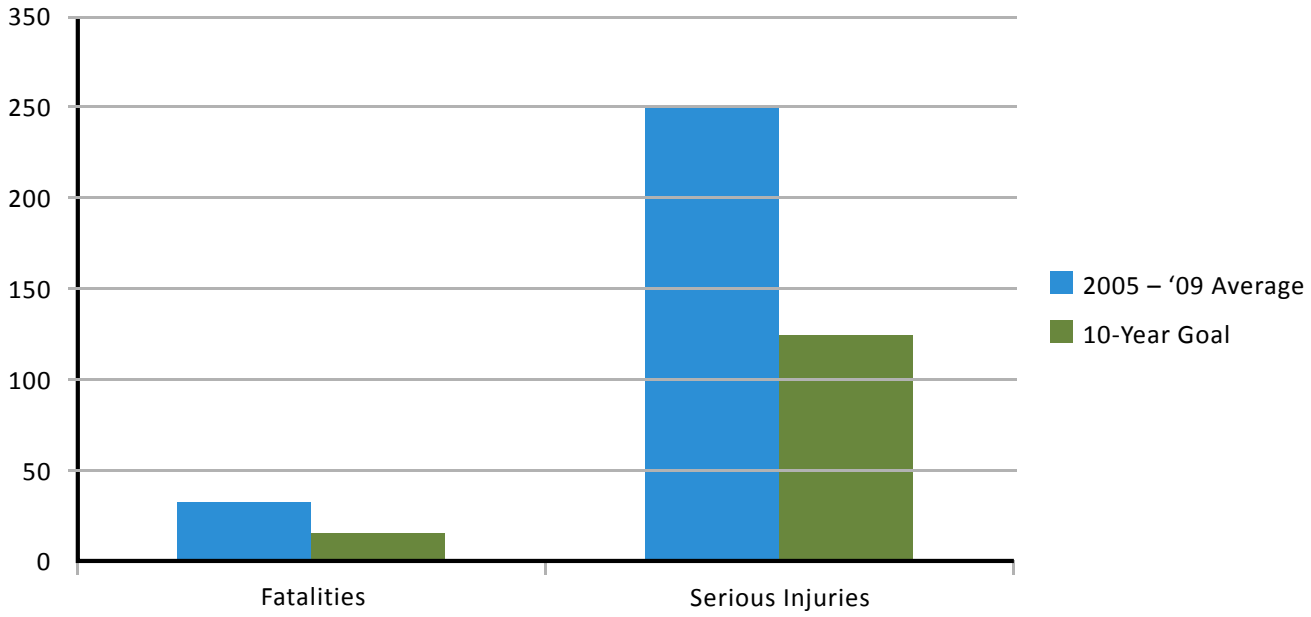
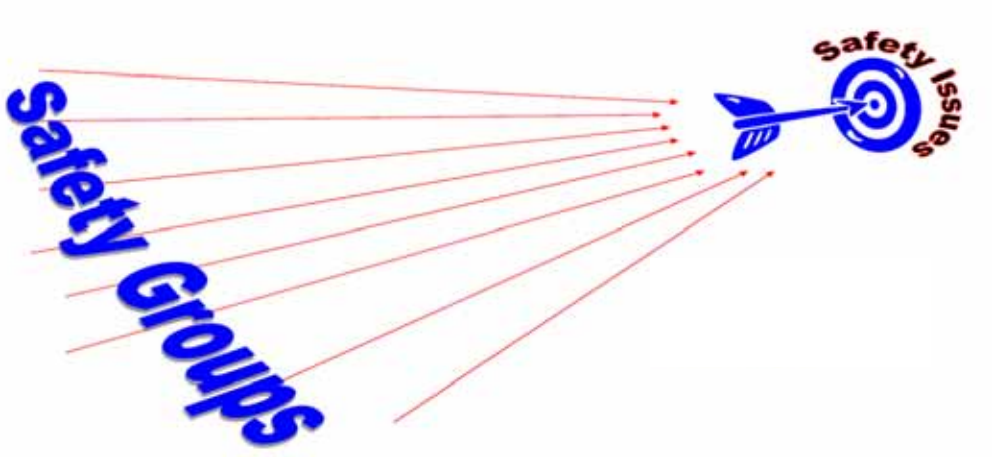


Figure 1 Impact of County's 10-Year Goal

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.

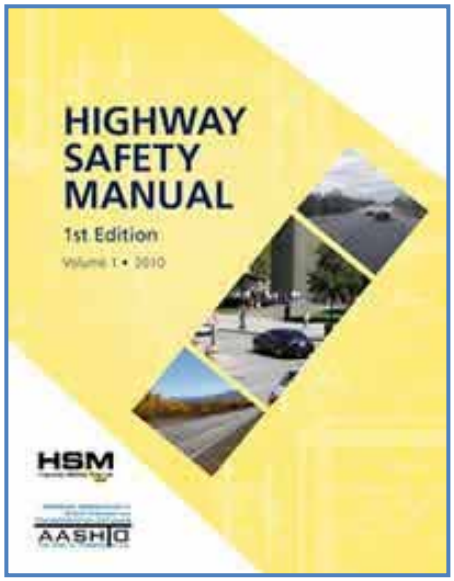
2. **Aligning County departments and external safety groups to work toward common state, regional, county, and city safety goals**. Using mutually beneficial partnerships, such as the work of the Safe Communities Program, over the past seven years, the safety community within the County has been able 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.



Collaborative Partnerships Help Focus on Common Safety Goals

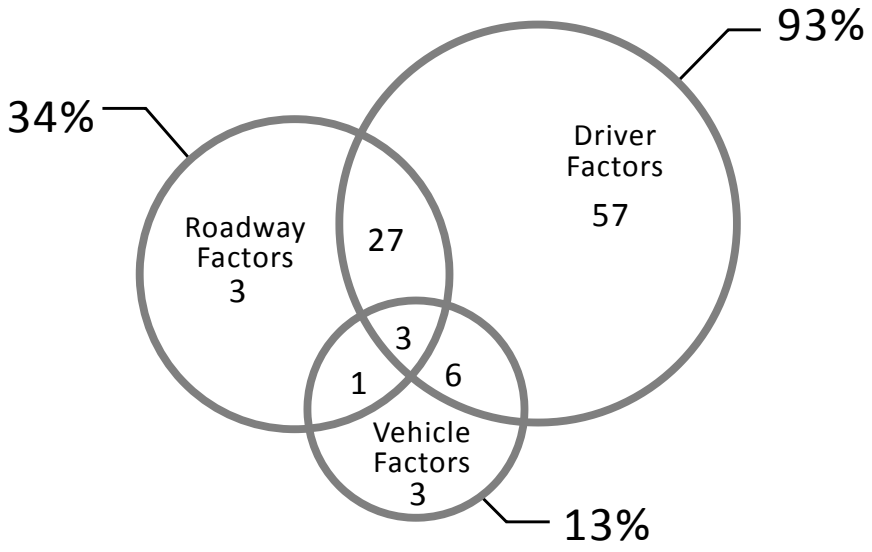
3. **Integrating roadway, safety, and traffic data management sources.** Success in building a Safety Culture and ultimately reducing fatal and injury crashes depends on a data-driven approach to help us understand and diagnose the issues and potential solutions as well as to shape policy and justify 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 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):

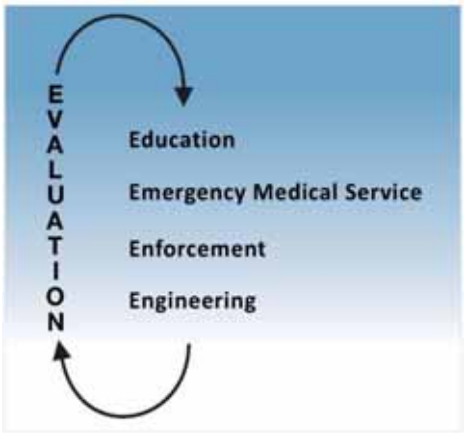


Figure 3 The 5E's

- **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, 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.

Canby-Marquam Highway and Barnards Road - This intersection was the #1 Safety Priority Index System (SPIS) site in the county. Converting the intersection from two-way stop-control to all-way stop control cost less than $2,000.

*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. Its 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

Wilsonville Road Safety Assessment – The 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 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 its 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 its 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 501(c)(3) 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
- Supporting local traffic safety commissions

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, its 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

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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 its 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

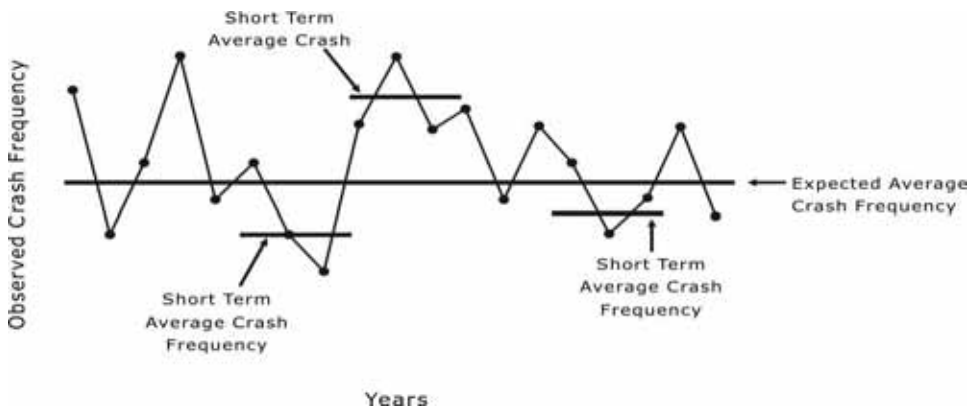
Clackamas County currently uses an adaptive approach to roadway safety assessments by reviewing past data and identifying strategies to counter documented incidents. This approach is based on information derived from the Safety Priority Index System (SPIS). SPIS uses multiple factors to prioritize crash 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., a 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.



Source: Highway Safety Manual, 1st Edition

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

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

Outreach is One Way Enforcement Groups Seek to Improve Transportation Safety

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).

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 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
- Performing 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 the 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 that the County might improve through a complete 5E approach. 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."

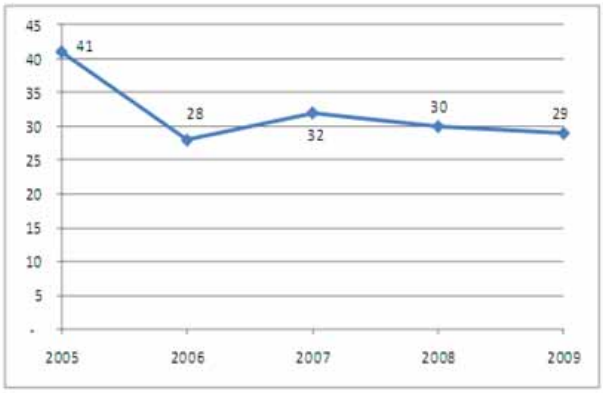


Figure 6 Traffic Fatalities per Year on All Clackamas County Roads

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 2005 to 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.

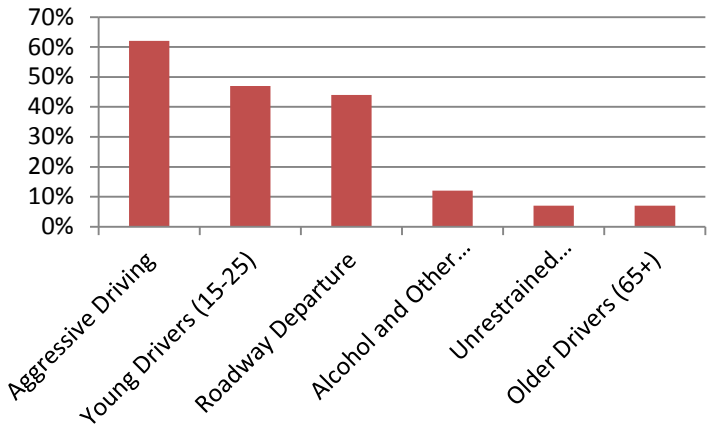


Figure 7 Six Highest Contributing Circumstances to Fatal and Severe Crashes on County-maintained Roads, 2005-2009

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.

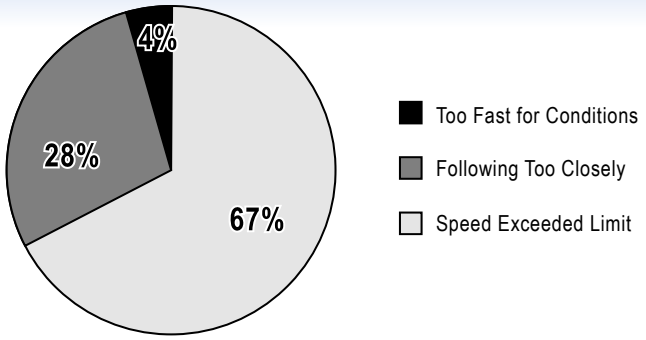


Figure 8 Contributing Circumstances to Aggressive Driving Crashes on all Roads in Clackamas County, 2005-2009

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 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. 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, it 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 its 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 its 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. An off-the-shelf tool 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 implement 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 because either the facilities do not yet exist or they have been utilized differently. 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 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.

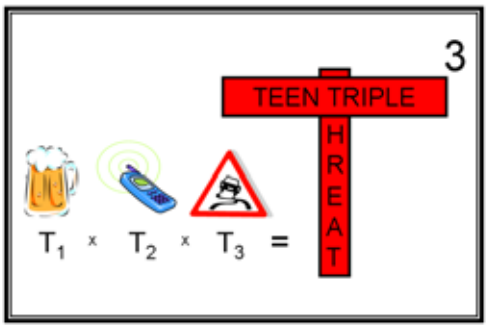
Safety Street

Roadway and Safety Fair

THE CLACKAMAS TOWN CENTER ROADWAY AND SAFETY FAIR

This annual fair takes place at Clackamas Town Center under the leadership of the Clackamas Traffic Safety Commission, Happy Valley Traffic & Public Safety Commission, and Safe Communities Program. 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 YouTube 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's

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 Transportation System Plan (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 Alliance for Community Traffic Safety (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 including safety fairs, school presentations, town halls, and community events to educate county citizens
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 Clackamas County Sheriff's Office (CCSO) top ten crash locations in Clackamas County
ENF4	Assign one law enforcement representative to the Safe Communities Program Work Group
	MID TERM
ENF5	Enhance 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 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 (DDACTS)

EMERGENCY MEDICAL SERVICES

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

	SHORT TERM
EMS1	Assign one Emergency Medical Services (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 Highway Safety Manual (HSM) principles into maintenance practices
ENG8	Deploy safety countermeasures related to safety emphasis areas
ENG9	Integrate Roadway Infrastructure Management Systems (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
ENG16	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 are a continuous process and will be primarily led by the traffic engineering division and the Safe Communities Program, with support from other County departments 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 County departments.

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 in 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.

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).

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	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
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Education

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EDU1	Support partner safety programs from Oregon Impact, Clackamas County 9-1-1, and Alliance for Community Traffic Safety (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 including safety fairs, school presentations, town halls, and community events to educate county citizens
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
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EDU13	Develop a formal clearinghouse/forum for information sharing regarding safety-related activities
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EDU14	Continue educational activities
EDU15	Support Safety Culture work group goals and objectives

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ENF1	Enhance Driving Under the Influence (DUI) and impaired driving enforcement
ENF2	Continuation/expansion of the Minor Decoy Operations program
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Emergency Medical Services

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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
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EMS9	Support quality assurance for medical delivery and review improvement opportunities

Engineering

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ENG2	Convene a group to investigate incorporating increased safety analysis requirements into development review as outlined in the TSAP
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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
ENG16	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.

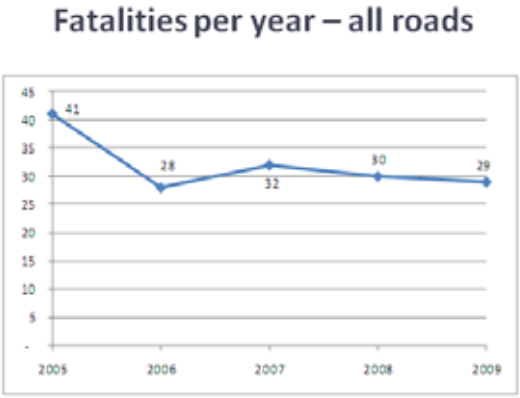

Figure 1. Traffic Fatalities in Clackamas County

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.

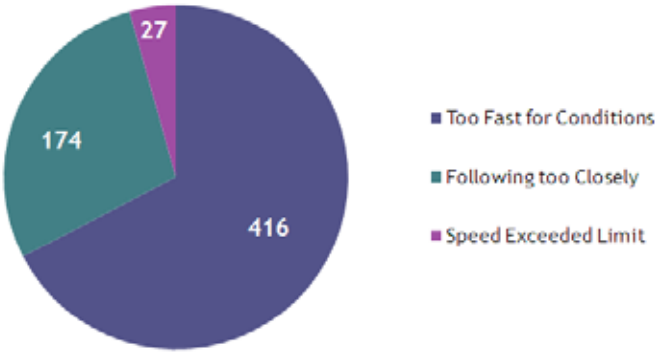

Figure 2. Contributing Circumstances to Aggressive Driving Crashes, 2005-2009

[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.

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[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.

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[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.

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[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)

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[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.

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[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.

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[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.

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[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.

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[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

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[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.

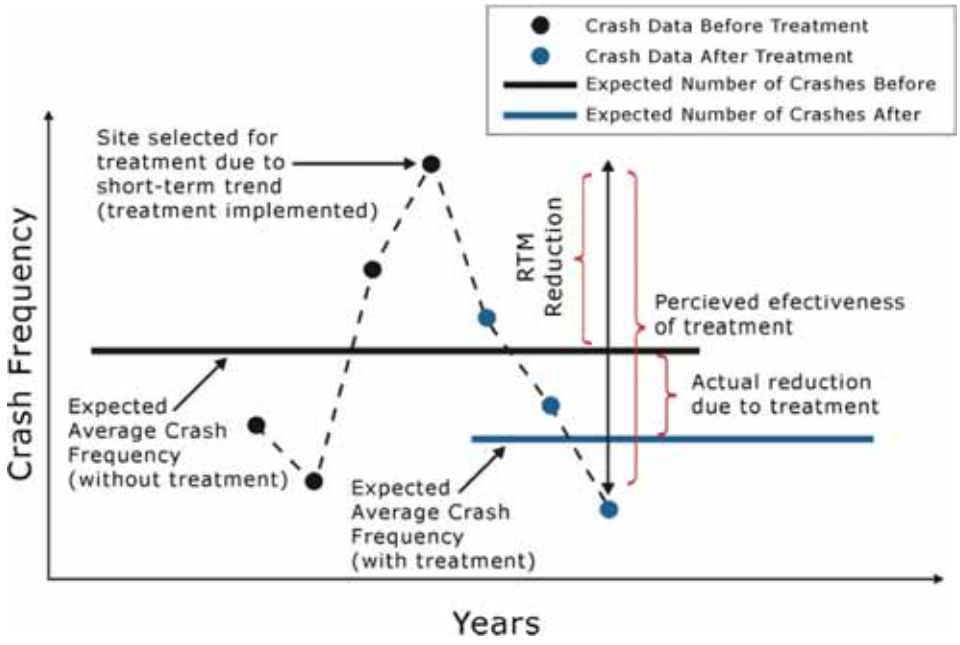

Figure D-1 - Accounting for RTM is important to accurately identify high crash locations and measure the benefit of implemented countermeasures.

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 lice	
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 a	
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