Lake Oswego to Portland Transit Project: Health Impact Assessment

Program Partner

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Executive Summary

Health Impact Assessment (HIA) is an emerging practice that evaluates the impact of specific plans, policies, and projects on the health of individuals and population groups, and suggests ways to improve the health outcomes of the policy, plan, or project in question. HIA analyses can inform decision makers as they make choices that affect the communities in which they work. In winter, 2009, Oregon Public Health Institute (OPHI) received a grant from the National Network of Public Health Institutes and the US Centers for Disease Control and Prevention to conduct some HIAs in the Portland metro region. In spring, 2010, OPHI and Metro, the Portland area's tri-county regional government, agreed to partner on a pilot HIA focusing on the Lake Oswego to Portland Transit Project and the three transit alternatives—no-build, enhanced bus service, and streetcar—being considered in the Draft Environmental Impact Statement (DEIS) recently released by Metro.

As with many Environmental Impact Statements (EIS) prepared in conformity with the requirements of the National Environmental Protection Act (NEPA), the DEIS for this project contains substantial information useful for understanding how the different scenarios directly and indirectly impact the health of individuals and populations. However, the connections between the DEIS information and health outcomes are not always identified or fully assessed, particularly with respect to indirect impacts on health via direct impacts on health determinants. Health determinants refer to those features of the built, social, and natural environment that are known to impact the overall mental and physical health outcomes of a particular population, as well as influence the distribution of health outcomes within a population. The primary goal of this HIA is not to recommend the selection of a particular alternative, but to complement the DEIS information by more explicitly and more fully assessing the impacts of the different DEIS transit scenarios on known health determinants. In cases where adverse impacts are identified, this HIA will also offer recommendations for mitigating adverse impacts.

Based on the anticipated outcomes of the three transit scenarios being considered in the Transit Study, on available evidence in the DEIS and from other sources, and on input from the HIA Advisory Committee and Project Team, this HIA focused on assessing the study outcome's probable impacts on the following four health determinants:

- Opportunities for physical activity
- Air quality
- Access to health supportive resources
- Safety from traffic crashes

Below are the summary findings and recommendations for each of these four subjects. Lists of more detailed findings are provided in the assessment chapters of the main report.

Opportunities for Physical Activity

Physical activity levels are associated with multiple health outcomes, and an individual's physical activity level can be influenced by a wide number of personal, social, and environmental variables. There are three primary pathways through which the different transit scenarios are likely to variously impact opportunities for physical activity: by providing an incentive and destination for walking; by improving or impeding physical access to parks and trails in the study corridor; and by providing additional bicycle and pedestrian infrastructure.

Based on an assessment of the three scenarios' impacts on these pathways, this report finds that both of the build scenarios increase opportunities for physical activity when compared to the no-build scenario. When comparing the enhanced bus scenario to the streetcar scenario, the streetcar scenario would provide the greatest improvement in opportunities for physical activity because of its higher level of service, greater improvements in park and trail accessibility, and provision of greater amounts of bicycle and pedestrian infrastructure in the corridor.

Air Quality

The impact of air quality on multiple health outcomes is well-documented. Each of the build scenarios has the potential to impact the level of air pollutant-related health outcomes in the short-term and the long-term. In the short term, construction activities can produce substantial amounts of air pollutants that increase the health risks of construction workers and nearby area residents and users. In the long term, local and regional amounts of pollutant levels will likely be variously impacted by the different transit scenarios because of their potential to produce differing levels of passenger vehicle use and related emissions.

Based on an assessment of construction activities related to the two build scenarios, this report finds that, while both build scenarios would result in temporarily elevated levels of certain hazardous air pollutants, the streetcar scenario would produce the greatest temporary increases in air pollutants as a result of the relatively high magnitude of construction activities related to infrastructure construction. In addition, this assessment also found that the amount of air toxics produced during construction for either scenario can vary greatly depending on the age and condition of construction equipment used.

Based on an assessment of anticipated long-term changes in air quality, this report finds that the two build scenarios would produce modest improvements in future air quality as a result of decreased vehicle miles traveled. Because the streetcar would produce the greatest increase in transit use, it would also produce the greatest reductions in future air pollutant levels.

Recommendations for mitigating adverse impacts:

If either of the build scenarios is chosen, TriMet should:

- *Work with the State DEQ Clean Diesel program to develop more stringent emissions-based equipment fleet requirements or incentives for contractors and sub-contractors working on the project;*
- *Work with DEQ to identify and apply for grants to improve construction equipment emissions;*
- *Develop information and outreach programs to alert area residents and users of construction schedules and locations, and inform them of the potential health effects of being close to construction activities. Particular efforts should be made to reach the corridor's significant elderly population, as well as children, and the users of the corridor's parks since these groups are more likely to suffer adverse health impacts as a result of elevated pollutant concentration levels;*
- *Work with county health departments to educate area residents and users on how to avoid exposure to air toxics generated by construction; and*
- *Work with DEQ and OSHA to develop monitoring programs to better assess construction site concentrations of air toxics.*

Access to Health Supportive Resources

Good health requires access to resources such as healthy food retail, healthcare, employment, education, parks and recreation facilities, publicly accessible gathering spaces, and social services. Research has shown that a person's ability to access each of these resources can influence their health. While the three scenarios would not directly change what services and resources are easily accessible via transit, they would impact the level of transit service connecting people to these resources.

Based on an assessment of the relative levels of transit service provided by the three scenarios, this report finds that the enhanced bus and streetcar scenarios would provide improved access to health supportive resources relative to the no-build scenario. Since the streetcar scenario would provide the highest level of service, it would also provide the greatest improvement in access to health supportive resources.

Safety from Traffic Crashes

Traffic crashes are one of the leading causes of injury and death, both locally and nationally. There are a wide variety of conditions that have been identified as influencing motor vehicle-related crash rates. Two of these that would likely be impacted by the Transit Project are transit ridership rates and levels of bicycle and pedestrian activity. Transit ridership rates impact injury and death rates because transit is a much safer mode of transportation; as people switch to public transit, they lower their chances of getting injured. Bicycle and pedestrian rates influence crash rates because crash rates for these modes generally decrease as bicycle and pedestrian activity increases.

Based on an assessment of the relative levels of transit ridership and bicycle and pedestrian activity resulting from the different scenarios, this report finds that the two build scenarios would reduce exposure to traffic crash rates as a result of increased transit use and increased bicycle and pedestrian activity relative to the no-build scenario. Since the streetcar would generate the highest levels of transit ridership and bicycle and pedestrian activity, it would provide the greatest reduction in exposure to traffic crash rates.

Introduction and Overview

Over the past 10 years, the public health and planning communities in Oregon and nationwide have increasingly recognized the numerous direct and indirect impacts that the built environment has on people's health. This recognition has encouraged local and regional governments, including Metro, to begin considering how to better assess and articulate how, and to what extent, their plans and investments impact the health of the people they serve.

At Metro, this recognition has already led to the inclusion of health as a goal of the Regional Transportation Plan update and to the creation of the Active Transportation Partnership. However, in order for health considerations to be more effectively integrated into decision-making processes, Metro has recognized the need to develop stronger partnerships with public health experts and organizations who are working to develop datasets and analysis methods appropriate for assessing the various health outcomes of their plans and investments.

An increasingly common way for the inclusion of public health concerns in the consideration and design of planning-related policies and projects is through the preparation of Health Impact Assessments (HIAs), which provide qualitative and/or quantitative assessments of a policy's, plan's, or project's impacts on the health of the affected population. HIAs are currently being promoted and refined by public health agencies in a number of locations, and have proven useful for informing decision-makers in other fields such as planning.

Metro staff has recently expressed interest in partnering with the public health community to conduct an HIA on a Metro project in order to explore HIA methodology and its potential benefits and uses. Oregon Public Health Institute's (OPHI) HIA Initiative also recently received funding from the US Centers for Disease Control and Prevention (CDC) and the National Network of Public Health Institutes (NNPHI) to conduct HIAs on Portland-area projects, plans, and policies related to transportation strategies for mitigating climate change. After meeting with Metro staff to screen a variety of possible projects, Metro and OPHI agreed to pursue the development of an HIA on the three alternatives considered in the Draft Environmental Impact Assessment (DEIS) currently being prepared for the Lake Oswego to Portland Transit Project (the "Transit Project").

As with many Environmental Impact Statements (EIS) prepared in conformity with the requirements of the National Environmental Protection Act (NEPA), the DEIS for this project contains substantial information useful for understanding how the different scenarios directly and indirectly impact the health of individuals and populations. However, the connections between the DEIS information and health outcomes are not always identified or fully assessed, particularly with respect to indirect impacts on health via direct impacts on health determinants. Health determinants refer to those features of the built, social, and natural environment that are known to impact the overall mental and physical health outcomes of a particular population, as well as influence the distribution of health outcomes within a population. The primary goal of this HIA is not to recommend the selection of a particular alternative, but to complement the DEIS information by more explicitly and more fully assessing the impacts of the different DEIS transit scenarios on known health determinants. In cases where adverse impacts are identified, this HIA will also offer recommendations for mitigating adverse impacts.

Based on the anticipated outcomes of the three transit scenarios being considered in the Transit Study, on available evidence in the DEIS and from other sources, and on input from the HIA Advisory Committee and Project Team, this HIA will focus on assessing the study outcome's probable impacts on the following four health determinants:

- Opportunities for physical activity
- Air Quality
- Exposure to traffic crashes
- Access to health supportive resources

This report begins with a summary of HIA and overview of the HIA process, followed by a summary of the Transit Project. It will then describe the screening and scoping processes used to identify the transit project as the subject for this HIA, the four health determinants listed above, and how specific population impacts would be assessed. Subsequent chapters focus on assessment, and will consider each of the four determinants in order, providing information on existing conditions, summaries of the connections between the determinants and health outcomes, descriptions of the methodology used for assessing impacts, and assessment findings. Where adverse health outcomes are identified, recommendations for mitigating adverse effects will be identified.

A note on maps: The maps used in this report come from the DEIS. The Figure numbers above the maps are the ones referenced in the text of the HIA. The Figure numbers in the maps' legends are the DEIS Figure numbers and do not correspond to the HIA text.

The Health Impact Assessment Process

Health Impact Assessment (HIA) is an emerging practice that evaluates the impact of specific plans, policies and projects on the health of impacted individuals, and suggests ways to improve the health outcomes of the policy, plan, or project in question. HIA analyses are meant to inform decision makers as they make choices that affect the communities in which they work. HIA practice is relatively new in the United States, but has been effectively developed and employed in many countries to produce public policy and planning projects that more effectively promote health and thereby improve quality of life and reduce health inequities and healthcare costs.

The overarching goal of a Health Impact Assessment (HIA) is to make more explicit the health impacts of social decisions and help shape them to improve a population's health. HIA is based on a comprehensive approach to health which emphasizes that multiple physical and mental health outcomes are influenced by a broad range of factors from all aspects of the physical, social, and economic environment (see Table 1-1).

Table 1-1. Factors Responsible for Population Health

Fixed Individual Factors	Individual Health Behaviors	Public Services and Infrastructure	Environmental Conditions	Social, Economic, and Political Factors
Genetic Makeup Gender Age Existing Health Conditions and Disabilities	Diet Physical Activity Addictions Coping	Transportation Education Public Transportation Health Care Parks Community Centers Economic Development Housing Adequacy	Air, Soil & Water Quality Community Noise Disease vectors	Poverty Inequality Social Cohesion & Inclusion Political Participation

(Table developed by Human Impact Partners)

It considers a policy's, plan's, or project's direct impacts on health outcomes—for example via increased exposure to toxins or other environmental hazards—as well as its indirect impacts—for example, via making a neighborhood less supportive of healthy eating and active living. Consideration of such indirect impacts is particularly important for assessing proposed community plans because such planning decisions might have minimal direct health impacts, but still likely affect health indirectly through impacts on social or environmental conditions that are now known to impact a community's health. HIA also focuses on vulnerable populations and includes analysis of a proposal's potential impacts on health inequalities within the affected population. To assess health impacts, HIA relies upon a variety of sources of knowledge including lay and professional expertise and experience.

The HIA process typically includes five steps:

1. **Screening** is the process of deciding whether to conduct an HIA on a particular plan, project, or policy.
2. **Scoping** involves delineating the affected population, identifying which health determinants and outcomes to analyze, and determining which analytic methods will be employed in the analyses.
3. **Assessment** applies existing data and research, both qualitative and quantitative, to the identified determinants and outcomes in order to estimate the direction, magnitude, and distribution of potential health effects on the impacted population. It also involves the development of recommendations for improving the health and health equity outcomes of the project, policy or plan in question.
4. **Reporting** focuses on disseminating the results of the analysis in order to impact the decision and promote more healthful alternatives, if applicable. Reporting can be done in multiple forms including public testimony, a formal report, press releases, etc.
5. **Monitoring** focuses on assessing the effect of the HIA on the decision-making process and ultimate outcomes in of the policy, plan, or project in question.

The development of an HIA often relies on input from multiple groups, depending on its scope and subject matter. This HIA made use of two different advisory groups to help guide its content and direction. The HIA Advisory Committee (AC) had 10 members comprised of individuals from public health and transportation-related organizations and agencies, some of whom had prior experience in HIA. The AC met twice over the course of the project in order to provide input on scoping, assessment, and dissemination. The five member Project Team consisted of two staff from OPHI and three from Metro. The Project Team met regularly over the course of the project to provide input on all aspects of the HIA and to coordinate the sharing of draft DEIS materials.

Transit Project Summary

[This section is taken directly from the Summary chapter in the DEIS.]

Summary

This summary provides a brief description of the Lake Oswego to Portland Transit Project's Draft Environmental Impact Statement (DEIS). More detailed information can be found in the Lake Oswego to Portland Transit DEIS. There are also technical reports and documents that have been prepared to support the DEIS or that are referenced in the DEIS; see Appendix B for a complete listing and for instructions on how to obtain or view copies of the referenced and supporting documents. All data in this summary are for a projected average weekday in 2035, unless noted.

The Lake Oswego to Portland Transit Project

Local and regional transportation and land use plans call for Metro, TriMet and the cities of Portland and Lake Oswego to implement improved transit service connecting activity centers along Highway 43 in the Lake Oswego to Portland Transit Corridor. Those plans recommend using reserved transit right of way to improve transit service in the corridor and to be a catalyst for improved land use and increased economic development and redevelopment. The result is the proposed Lake Oswego to Portland Transit Project.

The Project Purpose

The Purpose of the Lake Oswego to Portland Transit Project is to optimize the regional transit system by improving transit within the Lake Oswego to Portland Transit Corridor, while being fiscally responsive and supporting regional and local land use goals. The project should maximize, to the extent possible, regional resources, economic development and garner broad public support. The project should build on previous corridor transit studies, analyses and conclusions and should be environmentally sensitive.

The Project Need

The Lake Oswego to Portland Transit Project is needed because of: 1) historic and projected increases in traffic congestion in the Lake Oswego to Portland corridor due to increases in regional and corridor population and employment; 2) lengthy and increasing transit travel times and deteriorating public transportation reliability in the corridor due to growing traffic congestion; 3) increasing operating expenses, combined with increasingly scarce operating resources, while demanding more efficient public transportation operations; 4) local and regional land use and development plans, goals and objectives that target the corridor for development to help accommodate regional population and employment growth; 5) previous corridor transit studies, analyses and conclusions; 6) the region's growing reliance on public transportation to meet future growth in travel demand in the corridor; 7) the topographic, geographic and built environment constraints within the corridor that limit the ability of the region to expand the highway and arterial infrastructure in the corridor; and 8) limited options for transportation improvements in the corridor caused by the identification and protection of important natural, built and socioeconomic environmental resources in the corridor.

Figure 1 Looking West onto the Lake Oswego to Portland Transit Corridor

Previous processes and conclusions

Three distinct but inter-related steps of alternative and design option development, evaluation and screening were taken by Metro and TriMet, leading to the current range of alternatives and options: 1) Consortium Formation and Right of Way Purchase in 1988, when a consortium of seven governments collectively purchased the Willamette Shore Line right of way to be preserved for future transit use; 2) Alternatives Analysis from 2004 to 2007, when Metro Council, in cooperation with local jurisdictions and the Oregon Department of Transportation, evaluated a wide range of alternatives, including river transit, light rail transit, bus, streetcar and roadway alternatives, and narrowed the range of alternatives to be studied in the DEIS to the No-Build, Enhanced Bus and Streetcar alternatives, based on various Purpose-and-Need-based screening criteria and measures; and 3) Scoping and Project Refinement Study in 2008 to 2009, when Metro Council and its partner jurisdictions and agencies narrowed the range of streetcar design options to be studied in the DEIS based screening criteria and measures, resulting in design options in the Johns Landing, Sellwood Bridge, Dunthorpe/Riverdale and Lake Oswego segments of the corridor (see Figures S-2 and S-3).

Alternatives evaluated in Detail in this DEIS

The DEIS examines three alternatives: the No-Build, Enhanced Bus and Streetcar alternatives. Table S-1 below summarizes key characteristics of the alternatives.

Table S-1. Summary Characteristics of the Alternatives

Attribute	No-Build	Enhanced Bus	Streetcar
Miles of New Streetcar Alignment	0	0	5.9 to 6
New One-Way Streetcar Track Miles	0	0	10.5 to 11.1
New Streetcar Stations	0	0	10
Line 35 Bus Stops North of Lake Oswego	26	13	0
Corridor Park-and-Ride Lots / Spaces	3/76	4/376	5/476
Streetcar Miles Traveled (systemwide)	2,180	2,180	3,200 or 3,230
Streetcar Revenue Hours (systemwide)	267	267	326 or 332
Bus Miles Traveled (systemwide)	76,560	77,560	75,520
Bus Revenue Hours (systemwide)	5,300	5,400	5,210
Systemwide Streetcars	22	22	33
Systemwide Buses	712	725	704

Source: Metro, TriMet; January 2010. Average weekday in 2035.

The **No-Build Alternative** includes the roadway capital improvements that are listed in the 20 year financially-constrained road network of the 2008 Regional Transportation Plan. The No-Build Alternative includes bus Line 35, which would operate every 15 minutes between Oregon City and downtown Portland via Lake Oswego, and service on Line 36, which currently operates between downtown Portland and Lake Oswego but would be extended to King City to improve connections to WES commuter rail from western Washington County.

The **Enhanced Bus Alternative** (see Figure S-2) would result in modifications to lines 35 and 36, including removal of half of the bus stops between Lake Oswego and downtown Portland, mostly along Highway 43. Line 36 would run between King City and Lake Oswego. The alternative would also include a new 300-space park-and-ride lot in downtown Lake Oswego.

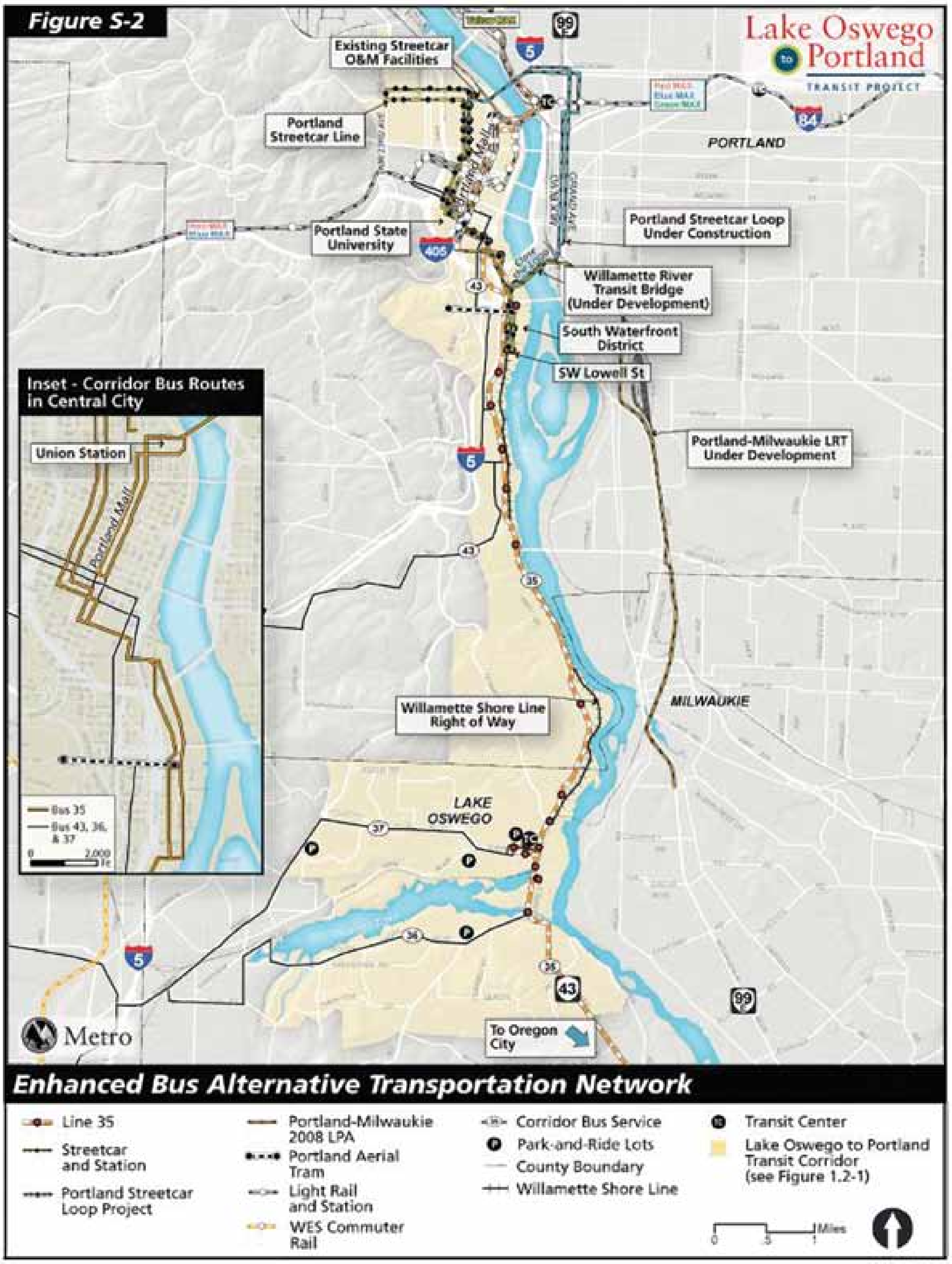



Figure S-3
Lake Oswego to Portland Transit Project
Existing Streetcar O&M Facilities
Portland Streetcar Line
PORTLAND
Portland State University
Portland Streetcar Loop Under Construction
Willamette River Transit Bridge (Under Development)
South Waterfront District
SW Lowell St
Inset - Corridor Bus Routes in Central City
Union Station
Portland Mall
Bus 35 & 43
Portland-Milwaukie LRT Under Development
MILWAUKIE
Willamette Shore Line Right of Way
LAKE OSWEGO
To Oregon City
Metro
Streetcar Alternative Transportation Network
Streetcar Alternative Extension
Streetcar Alternative Optional Stations
Line 35
Streetcar and Station
Portland Streetcar Loop Project
Portland-Milwaukie 2008 LPA
Portland Aerial Tram
Light Rail and Station
WES Commuter Rail
Corridor Bus Service
Park-and-Ride Lots
County Boundary
Willamette Shore Line
Transit Center
Lake Oswego to Portland Transit Corridor (see Figure 1.2-1)
Miles
12/15/2009


JOHNS LANDING
Willamette Shore Line Design Option
Macadam In-Street Design Option
SW Boundary St
Macadam Additional Lane Design Option
SW Carolina St
SW Nebraska St
1/8 mile
DUNTHORPE/RIVERDALE
Riverwood Design Option
Willamette Shore Line Design Option
SW Riverwood Rd
1/8 mile
LAKE OSWEGO
Briarwood Road
Union Pacific RR Right-of-Way Design Option
Foothills Design Option
E Avenue
B Avenue
park-and-ride lot 100 spaces
Lake Oswego Terminus park-and-ride lot 300 spaces
Line 35 bus to Oregon City
1/8 mile
Lake Oswego to Portland
TRANSIT PROJECT
Streetcar Alternative Design Option Details
Figure S-4
Johns Landing Design Options
- Willamette Shore Line
- Macadam In-Street
- Macadam Additional Lane
Dunthorpe/Riverdale Design Options
- Willamette Shore Line
- Riverwood
Lake Oswego Design Options
- UPRR Right-of-Way
- Foothills
Streetcar alignment common for all options
Streetcar design options
Streetcar station park and ride
Optional station
Transit Center
Map Index
JOHNS LANDING
DUNTHORPE/ RIVERDALE
LAKE OSWEGO

The **Streetcar Alternative** (see Figure S-3) would extend existing streetcar tracks and service between Southwest Bancroft Street and downtown Lake Oswego, generally parallel to Highway 43, adding about six miles of new streetcar track, with 10 new streetcar stations and two new park-and-ride lots (100 and 300 spaces), using 11 new streetcars. Line 35 and 36 service and bus stops would both cease operations north of downtown Lake Oswego.

Streetcar Alignment and Design Options

For the most part, the streetcar tracks would be extended into exclusive right of way purchased by the Willamette Shore Line Consortium in 1988. In many of the design options, streetcars would operate in current or new traffic lanes, just like the existing Portland streetcar that connects Northwest 23rd Avenue with South Waterfront. Stations would be placed at various intervals (typically at activity centers and primary cross streets), with shelters, information displays and accessible platforms. The stations would be similar to the existing streetcar stations in downtown Portland and the Pearl District.

There would also be a variety of changes to the streets that the streetcar would operate on (such as new or changed signals, lane striping changes, new sections of roadway), as well as new bicycle and pedestrian connections; see DEIS Section 2.2 and Appendix D for more detail. There are three design options for the Streetcar Alternative (see Figure S-4): the Willamette Shore Line, Macadam In-Street and Macadam Additional Lane options in Segment 3 – Johns Landing; the Willamette Shore Line and Riverwood options in Segment 5 – Dunthorpe/Riverdale; and the UPRR Right of Way and Foothills options in Segment 6 – Lake Oswego.

[End DEIS excerpt]

HIA Screening

This section describes the screening criteria and stakeholder input that resulted in the Lake Oswego to Portland Transit Corridor Study being selected for a HIA, and an overview of how Advisory Committee members and other stakeholders provided input into ongoing HIA activities.

Screening Criteria

In fall 2009, Oregon Public Health Institute (OPHI) received funding from the U.S. Centers for Disease Control and Prevention (CDC) and the National Network of Public Health Institutes (NNPHI) to conduct HIAs on Portland-area projects, plans, and policies related to transportation strategies for mitigating climate change. Metro, the Portland area's tri-county governing body whose duties include the coordination and development of regional transportation plans and projects, had been involved in previous conversations around HIA and expressed interest in partnering with OPHI to conduct an HIA on one of their projects. In winter 2010 OPHI and Metro agreed to partner together on a pilot HIA project.

In winter 2010, Metro staff began the screening process by asking various departments within the organization what project(s) had potential for an HIA and compiled a list of these potential projects. Once this list was developed, OPHI convened a group of local HIA experts and planning professionals to develop a set of screening criteria. These criteria were developed by reviewing national best practices as well as through discussions about regional and organizational capacity and needs. The following were selected as the criteria:

- **Topic Area.** The grant that funded this HIA focused on assessing the health impacts of transportation-related strategies for reducing greenhouse gas emissions.
- **Timeliness.** The HIA decision point should be made in or during the project period (Jan 2010-Dec 2010).
- **Policy Impact.** This HIA should have the ability to inform and/or influence current transportation and climate change advocacy efforts at local, state, and/or national levels.
- **Stakeholder Support.** Decision-makers for this project, policy, and/or program should support the HIA process and value its outcomes during the decision-making process.

- **Sustainability.** The HIA should be able to model how health can be integrated into transportation planning and policy after the HIA has ended and into the future.
- **Technical Capacity Building.** The HIA would have a research/technical component to test new assessment, modeling, or forecasting methods.
- **Replicability.** Lesson and techniques developed via this HIA should be replicable to communities throughout the region.
- **Community Engagement.** The project should include community engagement, either directly or through community based organizations.
- **Feasibility**. Resources should be available to conduct the HIA as well as offer support from both OPHI and Metro.

Metro and OPHI then convened a group of stakeholders from within and outside of Metro to review the potential projects per the criteria mentioned above. Within Metro, these stakeholders included staff that had attended HIA training, those that had shown interest in HIA as a tool, and the Climate Initiative Leadership Team, who offered oversight and final approval of the proposed projects. Additional participants included representatives from the Multnomah County Health Department, the Oregon Health Authority, Kaiser Permanente, and Upstream Public Health. Input was also gathered from the HIA Network, and group of public health practitioners, advocates, and academics in the Portland region working to develop support and capacity for HIA in the Portland metropolitan region.

Final Decision

While each project met some of the criteria to be considered for a HIA, some projects were more 'ripe' for a HIA than others. For these projects, short narratives were developed that explained the proposed project that the HIA would be done on and how the outcomes of the HIA would be used. There were also project write-ups that included an 'additional appeal' emphasizing additional benefits beyond the stated criteria for the HIA. OPHI met with all the project managers for each of the proposed projects in order to gain a greater perspective on the possibility and potential benefits of an HIA on the respective project and verify the written documentation.

In the end, the Lake Oswego to Portland Transit Corridor Study ("Transit Project") was selected because of how it met the stated criteria and offered additional benefits. One significant reason this project was selected was because a Draft Environmental Impact Statement was being developed, and offered a unique opportunity to pilot how HIA could be used in coordination with EIS processes. Table 1-1 below describes how the project aligned with the criteria and its additional benefits.

Table 1-1 Project Alignment with Screening Criteria

Criteria	Applicability to Lake Oswego Transit Corridor Study
Topic Area	The study is evaluating various transportation modes and how they could be used within a defined corridor. The various modes have the ability to impact climate change through mode shift and/or resulting land use changes.
Timeliness	The Draft Environmental Impact Statement (DEIS) comment period was scheduled to begin August 5, 2010, followed shortly by the selection of a locally preferred alternative.
Policy Impact	The HIA would focus on assessing the DEIS in order to influence the selection of a locally preferred alternative, and also to potentially lay the groundwork for more explicitly and thoroughly assessing health impacts in the Final Environmental Impact Statement.
Sustainability	The EIS process is a required task for any project that is deemed to have a significant environmental impact and that receives federal funding. Given that many of Metro's projects meet these criteria and Metro will be conducting EIS documents indefinitely, piloting a HIA that works within the EIS process can be continually adapted and used into the future.
Technical Capacity Building	The EIS has extensive technical information, modeling, and data collection about the transportation options and their resulting influence on ridership, air quality, and other environmental impacts. The HIA could use this information to predict health outcomes, which would build knowledge capacity at both OPHI and Metro.
Replicability	The EIS process in used extensively on the local, regional, statewide, and national scale, making the process of completing a HIA on an EIS replicable for a multitude of levels. In addition, transportation decisions that require modes to be compared will also continue to occur and offer additional opportunities for the HIA and its methodology.
Community Engagement	The EIS process requires extensive public outreach efforts. Any HIA outreach can take advantage of the Metro's required outreach strategy as well as add onto it as necessary.
Stakeholder Support	Previous to the partnership between Metro and OPHI, there was an internal study done at Metro to gauge the amount of support of the HIA process and how it should be completed. The study concluded that Metro staff and leadership were supportive of testing a HIA at a 'pilot' scale.

Table 1-1 (cont'd) Project Alignment with Screening Criteria

Criteria	Applicability to Lake Oswego Transit Corridor Study
Feasibility	OPHI received funding to complete this HIA. The Metro staff involved with this project have committed to allowing for time, meetings, and other resources that would be needed to assist with the HIA.
Additional Benefit: National Trends	The integration of HIAs into the National Environmental Policy Act (NEPA) documentation process (which includes completing a EIS) is beginning to receive attention and encouragement from federal agencies. This project would allow Metro to be at the forefront of and possibly contribute to this national discussion.

After the Transit Project was selected, OPHI assembled a 10-member advisory committee representing regional transportation, public health, and regional planning stakeholders. The advisory committee met twice over the period of the project. The first meeting focused on determining the scope of the project, including which health determinants should be addressed, and how the study area and affected population should be defined. The following section of this report provides more detail on the scoping process and outcomes. The second advisory committee meeting focused on reviewing a draft of the HIA. In between meetings, the advisory committee also provided written and verbal input on the various methodologies being developed for assessing impacts. A list of the advisory committee members can be found in Appendix C. To formalize the partnership on this pilot project, Metro and OPHI developed a Memorandum of Understanding that outlined expected outcomes and partner responsibilities. An important component of the MOU was also establishing protocol for information sharing between partner organizations throughout the project.

HIA Scoping

The scoping phase of an HIA is primarily concerned with defining the study area and affected population, identifying the health determinants that will likely be impacted by the project, and selecting which determinants and related health outcomes will be more fully assessed in the HIA. This section first describes process and criteria used for selecting which health determinants to include in the assessment component of this report, delineates the study area, and describes our approach to assessing impacts to specific populations within the study area.

Selecting Health Determinants to Assess

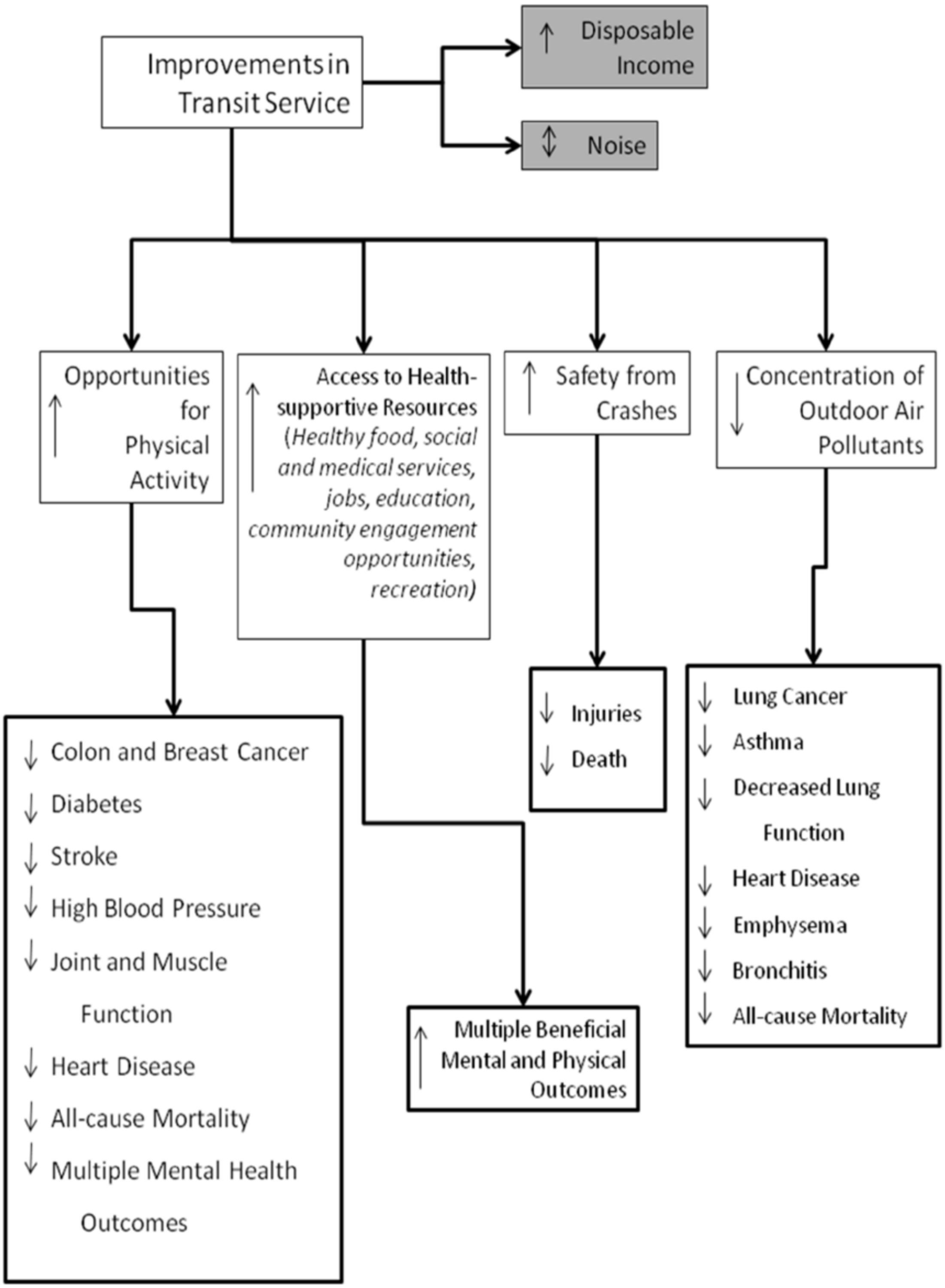
OPHI staff coordinated the scoping phase, gathering input from the HIA Advisory Committee and Project Team to help develop criteria for identifying determinants for further assessment, and then apply the criteria to the project. The selection criteria included consideration of:

- Existing research establishing connections between transit service and health determinants;
- Availability of data for assessing the relative impacts of the different scenarios on health determinants;
- The ability of additional assessment to complement and build upon assessment work already contained in the DEIS;
- The potential magnitude of impacts, positive or negative;
- The potential for adverse impacts for particular sub-populations, primarily elderly, disabled, and low-income individuals;
- Transportability of the analysis to other HIA's or transportation-related impact assessment work;
- Existing local and regional momentum around an issue;
- Likelihood of significant differences resulting from the three scenarios and various design options;
- Degree to which the issues has already been dealt with in the DEIS; and
- Available resources.

Researchers have identified a number of health determinants that can potentially be impacted by changes in transit service, the pathways of which are displayed in Figure 2-1. These include:

- **Opportunities for physical activity.** Transit users are more likely than others to achieve recommended levels of physical activity as a result of walking to and from transit. Investments in transit service can also include improvements to nearby bicycle and pedestrian infrastructure which can also encourage higher rates of walking and biking. Rail transit has also been shown to help increase the potential for the development of compact, mixed use neighborhoods which have been correlated with higher rates of walking [1-5].
- **Access to health-supportive resources.** Transit can improve people's access to a wide variety of health-supportive resources such as employment, medical and social services, education, public and private community gathering places, and parks and recreation facilities. This is particularly the case for transit-dependent populations such as youth, seniors, and low-income households [6].
- **Safety from traffic crashes**. Based on per-mile injury and death rates by mode, bus and rail public transit is much safer than automobiles [6, 7]. In addition, transit supports higher walking rates which are inversely related to pedestrian traffic crashes [8, 9].
- **Concentrations of outdoor hazardous air pollutants.** Transit service can lead to per capita reductions in vehicle use, which leads to lower per capita emission levels of hazardous air pollutants [3, 10].
- **Noise.** Transit service can either increase or decrease transportation-related noise levels depending on the location and type of transit service. While transit service can lead to reduced noise from reduced private automobile use, the operation of transit vehicles can also produce increased noise levels at station areas and along service lines [6].
- **Disposable income**. Public transit can reduce transportation costs, which leaves money to purchase housing, healthy food, medical care, and other health supportive goods and services [6].

Figure 2-1 Scoped Health Determinants and Pathways



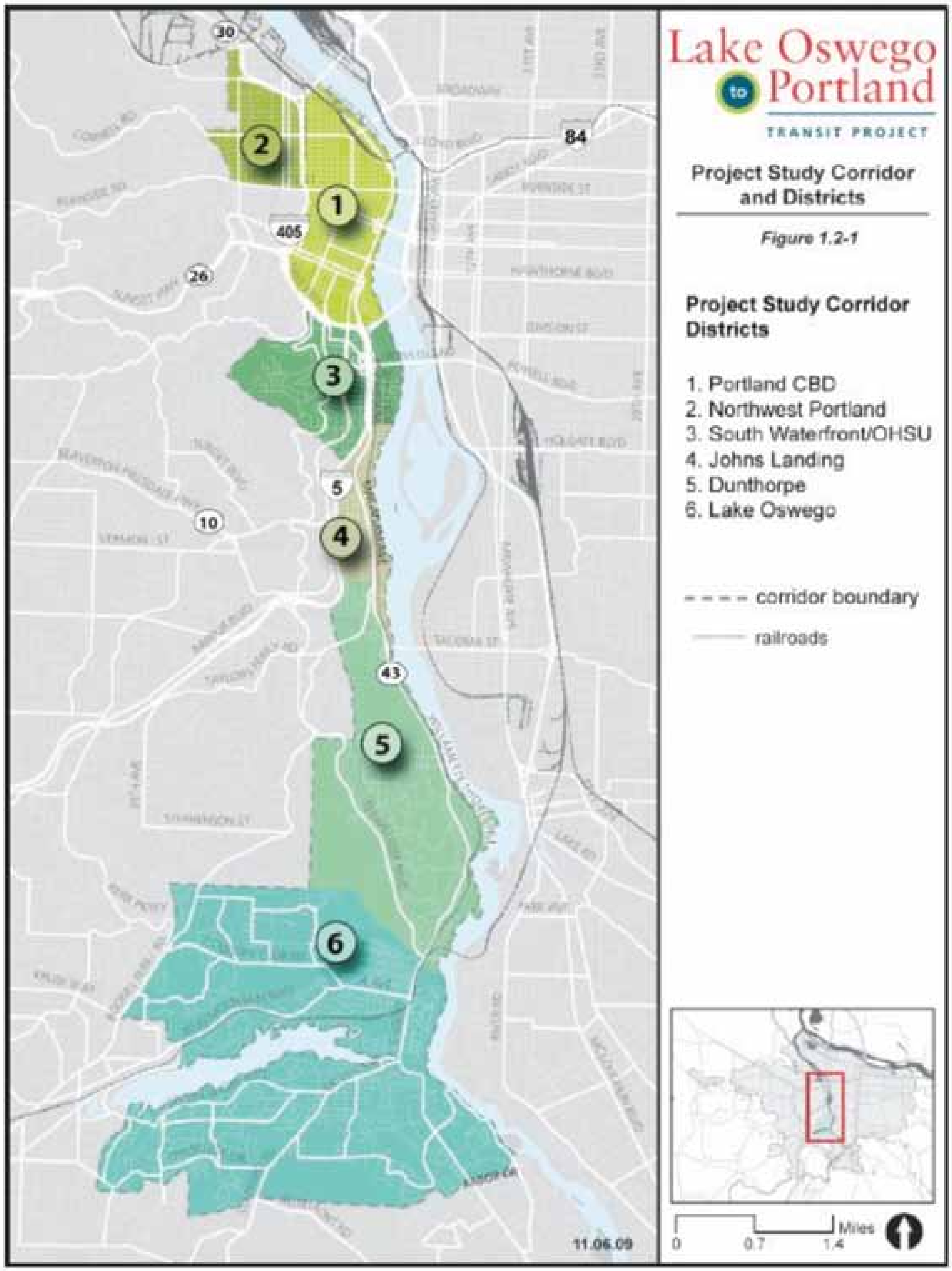
Based on the criteria listed above, the following four transit service-related health determinants were selected for further assessment in this report:

- Opportunities for physical activity
- Air Quality
- Exposure to traffic crashes
- Access to health supportive resources

Noise was not included because it is sufficiently addressed in the DEIS (see DEIS chapter 3.10), and provides mitigation strategies for minimizing identified problem areas. **Disposable Income** was not included primarily due to lack of resources and readily available data.

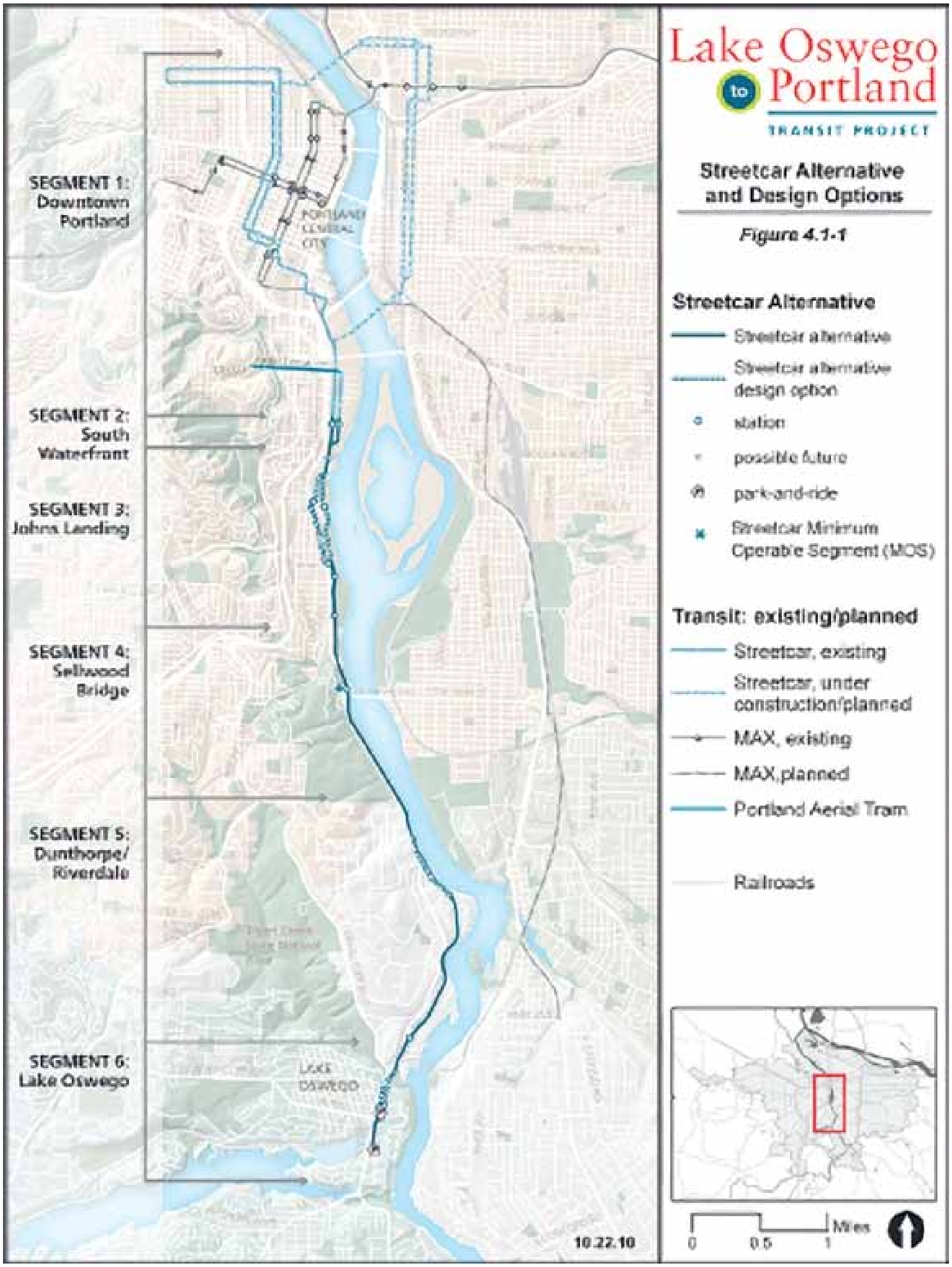
Defining the HIA Study Area

The Draft Environmental Impact Statement's definition of the corridor and corridor sub-sections varies somewhat throughout the document, depending on what is being assessed. Figure 2-2 displays the project study corridor and districts as defined in the DEIS summary chapter, which includes the Hwy 43 corridor between downtown Lake Oswego and downtown Portland, as well as downtown Portland itself and the portion of northwest Portland that is currently served by the Portland Streetcar.



Lake Oswego to Portland
TRANSIT PROJECT
Project Study Corridor and Districts
Figure 1.2-1
Project Study Corridor Districts
1. Portland CBD
2. Northwest Portland
3. South Waterfront/OHSU
4. Johns Landing
5. Dunthorpe
6. Lake Oswego
corridor boundary
railroads
Miles
0
0.7
1.4
11.06.09

Figure 2-3 Corridor Sections



Scoping Health Impacts to Vulnerable Populations

In addition to identifying how a policy, plan, or project might impact health, HIA is also used to gauge the *health equity* impacts of the policy, plan, or project by identifying how health impacts are distributed within the affected population. In particular, HIA seeks to determine whether vulnerable populations may be disproportionately impacted by proposed changes. Vulnerable populations include communities of color, immigrants, low-income communities, seniors, youth, people with disabilities, and any other identified group that is typically less able to participate in decisions affecting their environment, more likely to lack the resources to avoid, mitigate, or move away from unhealthy environmental features, or possessing pre-existing conditions that make them particularly vulnerable to the changes resulting from the proposed policy, plan, or project.

As a part of the screening process for this HIA, OPHI considered the potential of this project to disproportionally impact seniors, youth, low-income individuals, and people with disabilities both in the corridor and in the region in order to determine whether to conduct a more detailed assessment of the project's potential to disproportionally impact these groups. This consideration included a review of public comments made to Metro during previous public outreach stages of the project, a review of the DEIS material, including information on corridor and regional demographics and the potential for displacement of particular communities as a result of infrastructure construction, and a review of literature addressing the relationships between transit and vulnerable populations.

Study Area Population

The information in Tables 2-1 and 2-2 provides a brief sketch of the study area population in both the corridor and the tri-county region, including the proportions of vulnerable populations—elderly, disabled, below poverty, and minority—in the study area. The neighborhoods in these two tables correspond to those displayed in Figure 2-3 that overlap the HIA study area. In both tables, the numbers in bold indicate when the percentage in this area in this category is higher than the percentage for the tri-county region.

Figure 2-3 Corridor Neighborhoods

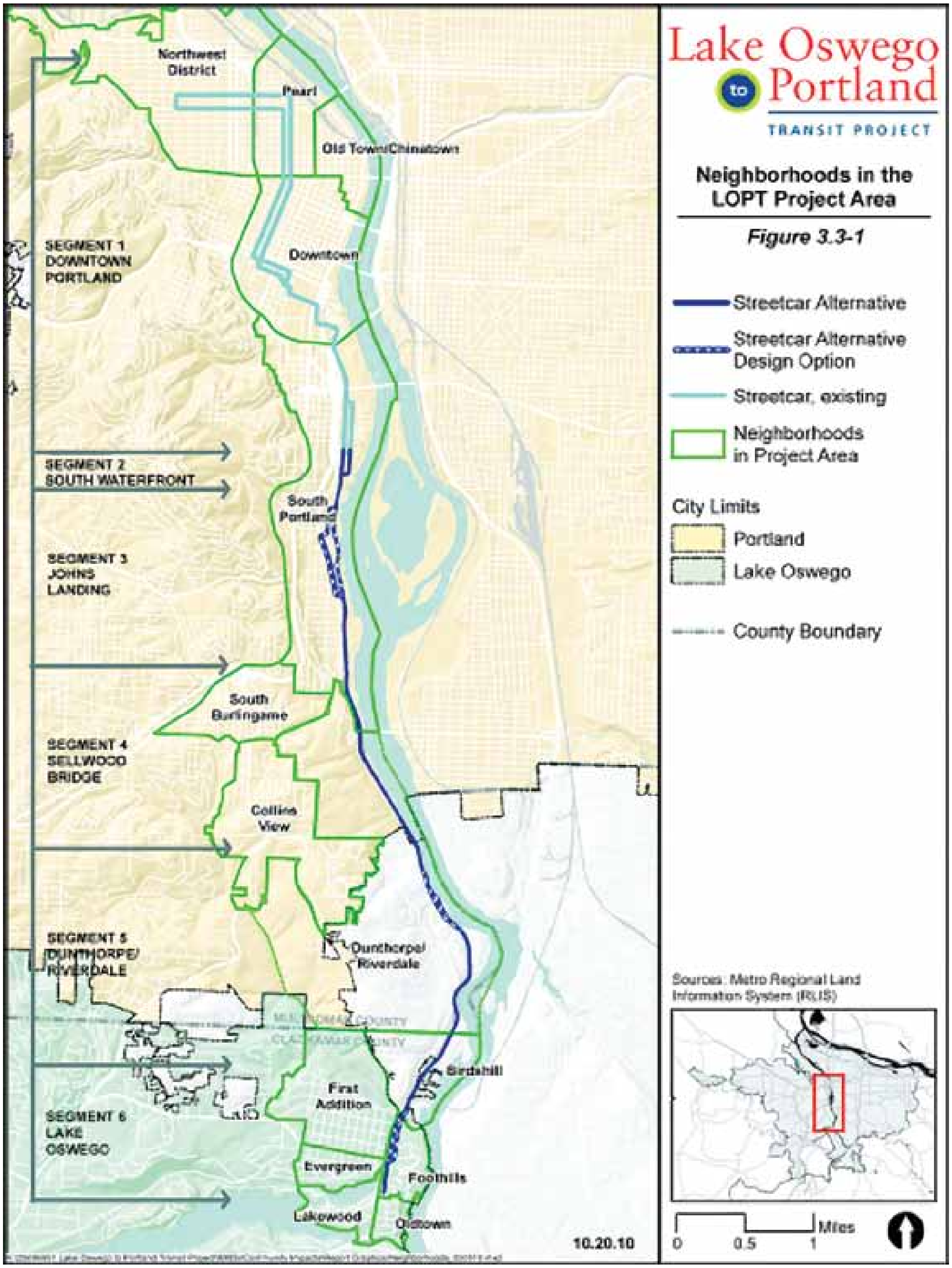


Table 2-1 Demographic Characteristics of Neighborhoods within in the City of Portland, Unincorporated Multnomah County and City of Lake Oswego (2000)

Neighborhood	Persons	Households	Residents 65 or older	Disabled	Below Poverty	Minority
South Portland	6,877	4,390	10%	13%	**31%**	**22%**
Dunthorpe/ Riverdale	1,025	592	**11%**	11%	8%	10%
Birds Hill	234	106	**11%**	14%	2%	11%
First Addition	2,879	1,004	10%	9%	6%	11%
Foothills	413	171	**11%**	10%	4%	9%
Old Town	186	76	**11%**	10%	4%	9%
Evergreen	795	357	7%	8%	**11%**	11%
Lakewood	424	174	**11%**	10%	4%	9%
CORRIDOR	12,833	6,870	10%	11%	**22%**	17%
Tri-County Region[1]	*1,444,219*	*569,461*	*10%*	*17%*	*10%*	*17%*

Source: LOPT DEIS Table 3.3-1

Note: Bold percentages indicate a percentage that is higher than the Tri-county region for that category

[1]The Tri-county region includes all of Multnomah, Clackamas, and Washington Counties.

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Table 2-2 Racial and Ethnic Composition by Neighborhood (2000)

Neighborhood	Persons	Black Alone	American Indian	Asian alone	Two or More Races	Hispanic (any race)
South Portland	6,877	**4%**	1%	**9%**	**4%**	5%
Dunthorpe/ Riverdale	1,025	1%	0%	3%	3%	4%
Birds Hill	234	1%	1%	4%	3%	2%
First Addition	2,879	1%	0%	3%	3%	2%
Foothills	413	1%	0%	4%	3%	2%
Old Town	186	1%	1%	3%	2%	2%
Evergreen	795	0%	0%	4%	3%	4%
Lakewood	424	1%	0%	4%	3%	2%
CORRIDOR	12,833	2%	1%	**6%**	3%	3%
Tri-County Region[1]	*1,444,219*	*3%*	*1%*	*5%*	*3%*	*8%*

Source: LOPT DEIS 3.3-2

Note: Bold percentages indicate a percentage that is higher than the Tri-county region for that category

[1]The Tri-county region includes all of Multnomah, Clackamas, and Washington Counties.

As Table 2-1 indicates, the only category in which the corridor percentage exceeds the regional percentage is households below the federal poverty level. However, as this Table also indicates, most of these households are located in the northern-most neighborhood, South Portland. With the exception of Evergreen in Lake Oswego, households in the rest of the corridor tend to fare better income-wise than the rest of the region. The percentage of elderly people in the corridor overall is about the same as the region. However, 5 of the 8 neighborhoods have elderly populations whose proportion is higher than that of the region. The disabled population throughout the corridor is lower than the regional proportion, and, with the exception of South Portland, the same holds true for the corridor's racial and ethnic minority population.
Table 2-2 displays the racial and ethnic composition of the corridor. South Portland is home to higher percentages than the region of minority and low-income residents.

After reviewing the demographic information in light of prior public comments, project details, and existing research on the relationships between transit and vulnerable populations, OPHI determined that there was no clear potential for any of the three scenarios to have an overall disproportionally positive or negative impact on the health of vulnerable populations within the corridor. None of the public comments raised particular concerns about disproportionate impacts on vulnerable groups, the DEIS demonstrates that no housing or services geared to vulnerable populations would be displaced, and existing research consistently identifies improved transit service as beneficial to vulnerable populations since they tend to be more transit dependent than the general population.

While this last fact indicates that the vulnerable populations in the corridor might stand to disproportionately benefit from improvements in transit service, particularly as a result of improved access to health supportive resources, it should be balanced by the fact that many of the impacts of transit service assessed in this study, particularly those stemming from improved traffic safety and opportunities for physical activity, accrue to the people who would begin using transit as a result of changes to the level of transit service. No data or research was found to indicate that vulnerable populations would be disproportionally represented in the group of new riders. Indeed, given their relative transit dependency, it is possible that they would be underrepresented in the group of new riders since they would be more likely to already be using transit. Finally, although youth and seniors would likely be more adversely impacted by degraded air quality during the construction of new transit facilities, they would also be more likely to benefit from the long-term improvements in air quality resulting from increased transit use, making it difficult to determine whether their overall health status as a group would be disproportionately impacted compared with the rest of the population.

At the regional level, some consideration was given to the potential for the two build scenarios to take transit investments away from other parts of the region that have higher proportions of vulnerable groups. However, without knowing how local funds for the two build scenarios would otherwise be spent, it was determined that there was no clear basis for determining whether vulnerable populations outside the corridor would be disproportionally impacted by the project.

Assessment: Opportunities for Physical Activity

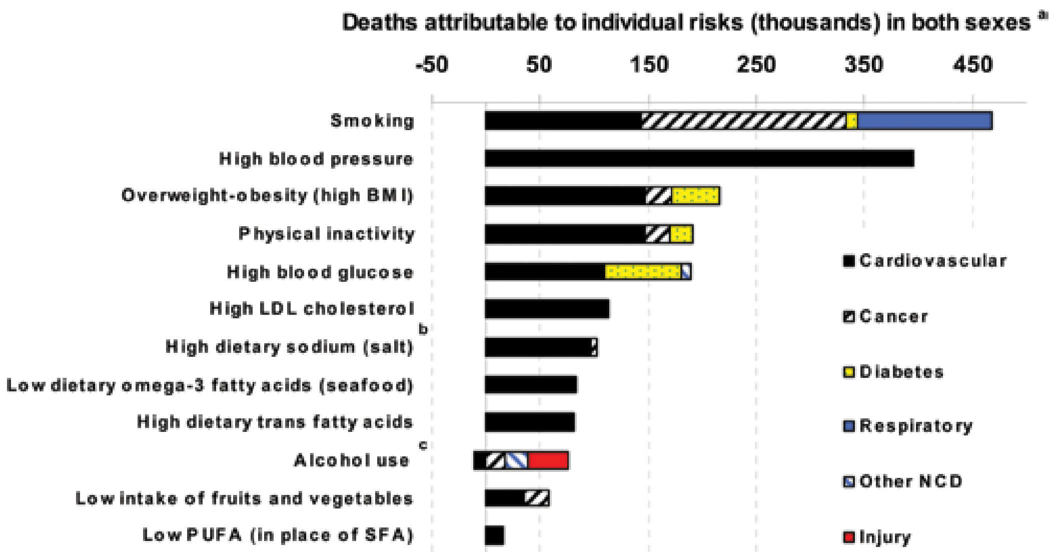
An individual's physical activity level can be influenced by a wide number of personal, social, and environmental variables. There are three primary pathways through which the different transit scenarios are likely to variously impact opportunities for physical activity:

1. **By providing an incentive and destination for walking.** In a 2004 study, Besser and Dannenberg found that 29% of transit users got all or their recommended daily physical activity solely from walking to and from transit, and that the median transit user walked 19 minutes each day solely as a result transit use[1], a significant increase from the overall American average of 6 minutes of walking per day[16]. Similarly, in a pre-post analysis of a Charlotte, NC neighborhood to which a light rail transit line was added, light rail users reported increased exercise levels equivalent to 1 additional hour of walking per weekday after the line was activated [5].
2. **By improving or impeding physical access to parks and trails in the study corridor.** The placement and design of supporting infrastructure such as rails, stations, and parking lots, can potentially hinder or improve both the development of, and access to, recreational, bike, and pedestrian facilities [17], all of which provide opportunities for physical activity.
3. **By providing additional bicycle and pedestrian infrastructure.** Large scale capital projects can also include improvements to nearby infrastructure, including the addition/modification of bike and pedestrian infrastructure. A number of studies have linked the availability of bicycle and pedestrian infrastructure with walking and biking rates.

Physical activity and health

Researchers' understanding of the relationships between physical activity and health has steadily improved since the early 1990s when they expanded the focus of their work from assessing the impacts of intensive vigorous exercise to include a wider range of low or moderate intensity physical activities. In 1996, the US Surgeon General released its first report on physical activity and health which concluded that moderate physical activity (defined as activities that use large muscle groups and are at least equivalent to brisk walking, such as swimming, cycling, dancing, gardening and yard work, and various domestic and occupational activities) can substantially reduce the risk of developing or dying from coronary heart disease, colon cancer, high blood pressure, and diabetes. In addition, physical activity has been demonstrated to improve mental health and, for people with joint or bone problems, improve muscle function, cardiovascular function, and physical performance [11, 12].

Figure 3-1. Deaths (thousands) attributable to total effects of individual Risk factors, by disease*



**Source: Danaei G, Ding EL, Mozaffarian D, Taylor B, Rehm J, et al. (2009) The Preventable Causes of Death in the United States: Comparative Risk Assessment of Dietary, Lifestyle, and Metabolic Risk Factors. PLoS Med 6(4): e1000058.*

Since the Surgeon General's report was issued, research has built on its conclusions and has also more conclusively demonstrated that for people who are inactive, even small increases in physical activity can yield numerous measurable health benefits. [12]. In addition, physical activity has been solidly linked to improved learning and educational attainment among adolescents [13]. Finally, types of physical activity that bring people into contact with each other, including walking about one's neighborhood and using parks and recreation facilities, have also been demonstrated to improve mental health and social cohesion. High levels of social cohesion can contribute to good health outcomes by enabling the dissemination of health-related information such as care options, and by establishing, maintaining, and promoting social norms and practices associated with healthful behaviors.

This improved understanding of physical activity's positive impact on health has also been accompanied by an increasing awareness of the magnitude of the impact of increasingly sedentary lifestyles on Americans' health. In a recent study that ranked the leading preventable causes of death in the United States[14], physical inactivity ranked 5th on the list, and was estimated to have been responsible for 191,000 premature deaths in 2005 (Figure 3-1).

Based on this research, the US Centers for Disease Control and Prevention (CDC) currently recommends that adults, including older adults (65+ years) should either engage in moderate exercise (e.g., walking at 3+mph, gardening, yoga, biking <10 mph) for at least 30 minutes 5 days a week, or in vigorous exercise (e.g., jogging, lap swimming, competitive team sports) for at least 20 minutes 3 days a week [12].

Existing Physical Activity Levels

Unfortunately, data for physical activity levels is not available at the neighborhood or even city level. The best available data for physical activity levels comes from the 2005 Oregon Behavioral Risk Factor Surveillance System (Oregon BRFSS) survey, which provides state- and some regional-level measures of physical activity levels for different socio-economic groups. According to the Oregon BRFSS, 43.6% of Oregon adults aren't meeting the CDC recommendations for physical activity. In the tri-county area that includes Portland, the number was about the same at 44.0%.

In Oregon, as elsewhere in the US, adults who are young, affluent, and/or well-educated were more likely to get recommended levels of physical activity than their counter-parts (see Tables in Appendix A). Of the different primary racial/ethnic groups American Indians (67.0%) were most likely to meet the CDC recommendations for adults, followed by African-Americans (63.9%), White (59.0%), and Asian/Pacific Islanders (54.6%). Latinos posted the lowest rates of attainment with only 42.1% meeting the recommended levels of physical activity [15].

Table 3-1 Extent of Physical Activity (PA) and Weight Status Among Oregon Adults with Selected Chronic Diseases, 2005

	Meets CDC PA Guidelines	Healthy Weight*	Doesn't Meet CDC PA Guidelines	Overweight/ Obese
Arthritis	50.00%	28.40%	50.00%	70.20%
Asthma	54.90%	38.80%	45.10%	59.60%
Heart Attack	41.20%	28.80%	58.80%	69.20%
Coronary Heart Disease	42.00%	28.80%	58.00%	69.30%
Stroke	46.60%	34.00%	53.40%	62.80%
Diabetes	38.20%	16.80%	61.80%	82.20%
All Adults	56.40%	38.80%	43.60%	59.70%

** Healthy Weight is defined by a body mass index between 18.5 and 25 kg/m2.*

Source: Oregon Behavioral Risk Factor Surveillance System

As Table 3-1 indicates, physical activity generally correlates with both weight status and a number of chronic disease conditions in Oregon, especially diabetes, cardiovascular health, and arthritis.

Transit Destinations for Increased Walking

Summary findings:

- The average amount of time transit users spend walking to and from transit each weekday is almost 24 minutes.
- About 23% of bus riders get all of their recommended physical activity solely from walking to and from transit.
- About 30% of street car riders get all of their recommended physical activity solely from walking to and from transit.
- The different build scenarios and design options have potential to directly impact physical activity levels by increasing transit use and increasing the distance that some people walk for transit.
- Compared with the no-build scenario, the **enhanced bus** scenario would result in:
    - 1,800 more people in the corridor and an additional 300 people in the region getting an average of 24 minutes of daily physical activity from transit use.
    - an additional 205 people in the corridor and 294 people in the region who would be getting all of their recommended physical activity solely from transit use.
- Compared with the no-build scenario, the **streetcar** scenario would result in:
    - 3,100-3,400 more people in the corridor and an additional 500-800 people in the region getting an average of 24 minutes of daily physical activity from transit use, depending on which alignment was chosen.
    - an additional 353-388 people in the corridor and 660-710 people in the region who would be getting all of their recommended physical activity solely from transit use, depending on which alignment was chosen.
- The Willamette Shore Line alignment for the streetcar option would produce the highest physical activity rates from walking to and from transit.

To determine the various impacts of the different scenarios and design options, this assessment will focus primarily on estimating the number of people who get the currently recommended levels of physical activity solely as a result of transit use. Although this metric does not capture those people who get their recommended amounts of physical activity as a result of engaging in other physical activities in addition to their transit use, it nonetheless provides a useful means for comparing the different scenarios, and for assessing transit's ability to contribute to helping individuals obtain the recommended levels of physical activity for helping maintain good health.

The current and projected transit ridership numbers for each of the scenarios and design options are contained in Table 3-2. In this table and throughout this report, two sets of numbers are given for the streetcar scenario, reflecting the fact that two of the design options in the John's Landing section. The "Macadam" design option reflects resulting performance and ridership outcomes if either of the "Macadam in-street" or "Macadam additional lane" options are chosen, and the Willamette Shore Line (WSL) option reflects the results of the WSL alignment being chosen. None of the design options south of John's Landing are anticipated to produce changes in performance and ridership. As this table indicates, the streetcar options are anticipated to generate the highest ridership levels at both the corridor and regional, system-wide scale, with the Willamette Shore Line design option providing slightly higher overall ridership than the Macadam option.

Table 3-2: Average weekday total system and corridor transit trips by transit type[1]

	2005	no build	enhanced bus	Streetcar: Macadam	Streetcar: WSL
Corridor	103,600	231,900	233,700	235,000	235,300
bus	103,600	231,900	233,700	222,216	221,745
streetcar[2]				11,170	11,930
System	267,300	583,800	585,900	587,400	587,700
bus[3]	171,790	375,200	376,550	369,200	368,943
lrt[3]	85,855	187,513	188,188	184,514	184,386
streetcar[3]	9,655	21,087	21,162	33,686	34,371

[1] Ridership is measured in person trips. Person trips are rides (i.e. one-way linked trips from an origin (e.g., home) to a destination (e.g., place of work or school), independent of whether the trip requires a transfer. A person traveling from home to work and back counts as two trips. Total corridor transit trips include all streetcar, bus, and light rail trips produced in or attracted to the Lake Oswego- Portland corridor. Excludes Intra-Portland Central Business District and intra-Northwest Portland trips and trips between the Portland Central Business District and Northwest Portland.

[2] These numbers are the sum of the projected streetcar boardings and deboardings for the corridor stops south of the South Waterfront segment (DEIS Table 4.2-7).

[3] The numbers for the Existing (2005), No Build, and Enhanced Bus trips are extrapolated from the current and projected system-wide trip counts (DEIS, Table 4.2.5), based on current transit mode splits (bus, light rail, streetcar)provided in DEIS section 4.1.1.3..

Calculation of the number of people getting ≥ 30 minutes/weekday of moderate-to-vigorous physical activity is based on Besser and Dannenberg's analysis of the 2001 National Household Travel Survey (NHTS). Their analysis employed bivariate and multivariate analyses of the results to identify predictors of achieving at least 30 minutes/weekday of physical activity by solely walking to and from transit[1]. Overall, this study found that 29% of all transit users (N=3,312) got ≥ 30 minutes/weekday of physical activity solely by walking to and from transit, and that the median amount of time for all transit users was 19 minutes. The average amount of time spent walking to and from transit each day was 24 minutes, regardless of what type of transit was being used. In addition, since the NHTS included both bus and rail users, the Besser and Dannenberg study allowed for assessment of the impact of transit type on physical activity amounts. According to the multivariate analysis which controlled for a wide variety of potentially confounding socio-demographic variables, rail users were 1.67 times more likely than bus riders to get ≥ 30 minutes/weekday of physical activity solely by walking to and from transit.

In order to facilitate comparison of different types of transit on physical activity, it is necessary to break these findings down by transit type. After taking into account the numbers of bus and rail riders in the survey results, the odds ratio of 1.67 would mean that 22.8% of bus riders and 38.1% of rail riders get the recommended levels of physical activity from walking to and from transit. However, since the type of rail used by virtually all (98%) of the NHTS respondents was high capacity service operating on dedicated rights of way (either commuter rail or subway/elevated rail [18]), it is likely that the percent for rail riders in the NHTS is higher than what we would expect from the streetcar since the streetcar operates in mixed traffic for much of its route and has lower carrying capacity.

To adjust the percentage of rail riders for streetcar riders, the two percentages calculated above were compared to Tri-Met rider survey data which provide information on the distances people are willing to walk to access different transit modes. For bus service, the distance is .2 miles, for streetcar .35 miles, and for light rail, .5 miles. Applying this distance ratio to the percentages of bus and light rail users who get ≥ 30 minutes/weekday of physical activity solely by walking to and from transit, the corresponding percentage for streetcar users is 30.4% (Table 3-3).

Table 3-3: Percentage of riders getting recommended physical activity solely from transit

Transit mode	Distance riders are willing to walk	% of riders getting recommended physical activity solely from transit
Bus	.2 miles	22.8%
Streetcar	.35 miles	30.4%
Light rail	.5 miles	38.1%

With these percentages, estimates of the number people who will get their recommended amount of physical activity solely from transit use can be made by multiplying the percentages by the projected ridership levels from Table 3-2. Since the ridership levels are calculated from one-way trips and the percentages are based on walking to and from transit, the ridership projections are first divided by 2 in order to convert them into round trips.

As the results in Table 3-4 demonstrate, both of the build alternatives result in more people getting their recommended levels of physical activity solely as a result of transit use, with the streetcar options supporting the greatest increase, in part because of the increased ridership, but also because people are willing to walk farther to access the improved service it provides.

Table 3-4. Number of people getting ≥ 30 minutes/weekday of physical activity solely by walking to and from transit

		2005	2035			
			no build	enhanced bus	Streetcar	
					Macadam	WSL
Corridor	*bus*	11,810	26,437	26,642	25,333	25,279
	streetcar				1,457	1,545
	TOTAL	11,810	26,437	26,642	26,790	26,824
Difference from no-build		**N/A**	**N/A**	**205**	**353**	**388**
% Difference from no-build		**N/A**	**N/A**	**0.78%**	**1.34%**	**1.47%**
Region	*bus*	19,584	42,773	42,927	42,089	42,060
	light rail	16,355	35,721	35,850	35,150	35,126
	streetcar	1,468	3,205	3,217	5,120	5,224
	TOTAL	37,407	81,699	81,993	82,359	82,409
Difference from no-build		**N/A**	**N/A**	**294**	**660**	**710**
% Difference from no-build		**N/A**	**N/A**	**0.36%**	**0.81%**	**0.87%**

Physical Access to Parks and Trails

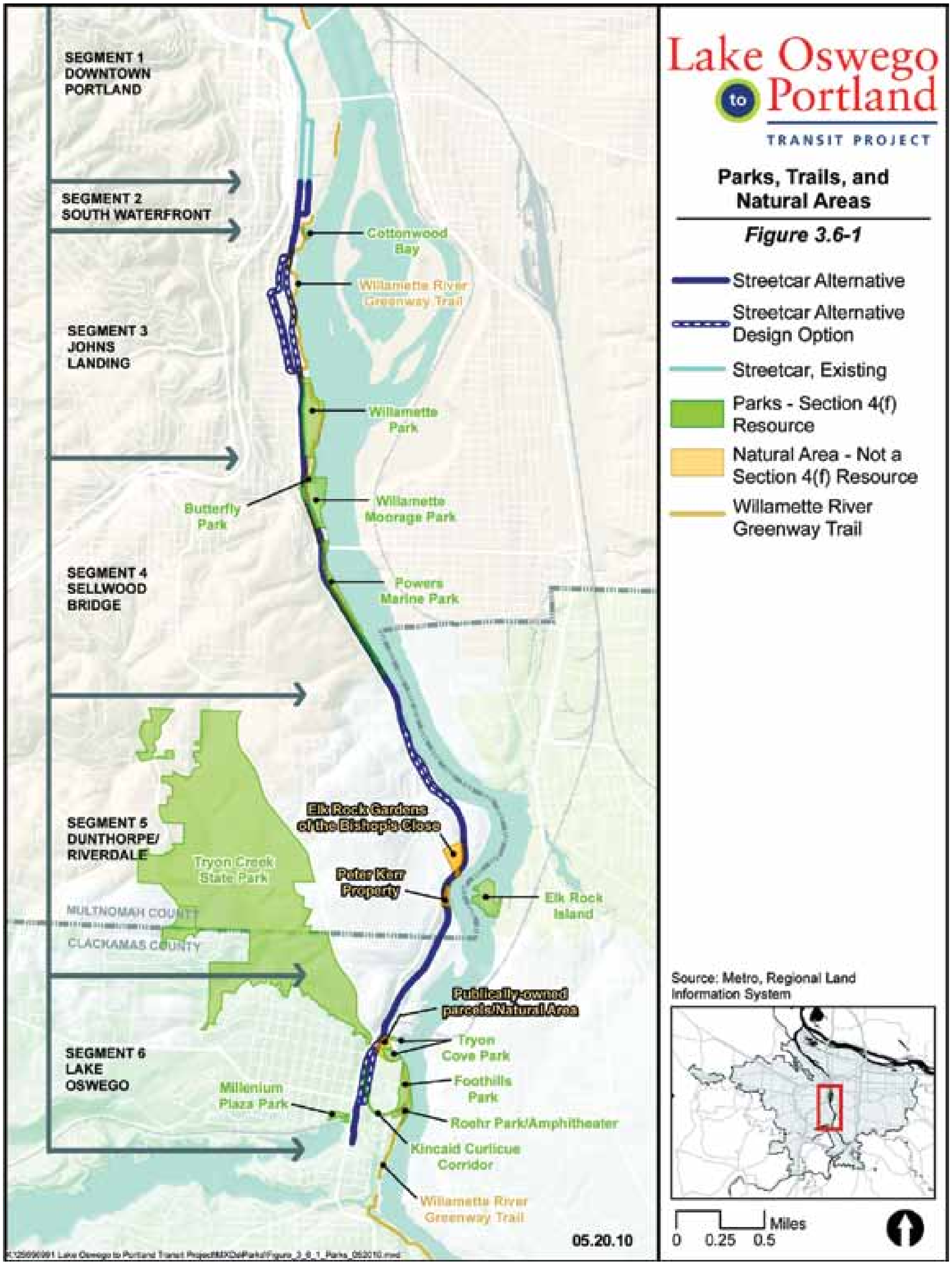
Summary findings:

- Parks and trails provide numerous opportunities for physical activity.
- The physical accessibility of parks and trails can influence their level of use.
- The two build scenarios have the potential to impact park and trail accessibility in two ways:
    - By changing the number and location of transit stations;
    - By changing park and trail access points and routes.
- The **enhanced bus** scenario would produce minimal overall changes in park and trail access. It would result in the loss to two transit stations that currently provide access to portions of the Willamette River Greenway Trail and Willamette Park. However it would also provide a park-and-ride access road which would also improve access to Foothills and Roehr Parks and the Kincaid Curlicue Trail in Lake Oswego.
- The **streetcar scenario** would improve overall access to parks and trails in the corridor as a result of many of the station's closer proximity to parks and trails, and of the accompanying construction or improvement of new formal access routes serving multiple parks, particularly in the Lake Oswego section.

The corridor's numerous parks and trails (see Figure 3-2) provide multiple opportunities for physical activity. Current research indicates that park and trail use and resulting physical activity levels in a community is influenced by a number of variables, including physical accessibility. While most of the research on the impact of physical proximity and park and trail use has focused on proximity to people's homes[19-22], it also suggests that a park or trail's proximity to transit stops would influence the likelihood that transit users would use the parks and trails for physical activity. The closer a transit stop is to a physical recreation facility, the more likely it is that people will use the facility. In comparison with the no-build scenario which would see only those changes in park accessibility resulting from other currently planned projects, the two build scenarios being considered in the DEIS have the potential to impact accessibility in two primary ways. First, changes in the number and location of transit stations will impact transit station proximity to park and trail access points.

Second, the two build scenarios would add or change existing infrastructure near the corridor's parks and trails which would produce changes in park and trail access points and routes, and thus likely impact people's use of some of the parks.

Figure 3-2: Corridor Parks, Trails, and Natural Areas



This section will consider the potential for the two build scenarios to contribute to physical activity levels by assessing their impacts on these two determinants of park accessibility in relation to each other and to the no-build scenario. In making a judgment about the relative impacts of the different scenarios on health, it will be assumed that relative improvements in accessibility will be accompanied be relative improvements in physical activity levels. No attempt will be made to quantify resulting levels of park and trail use and physical activity because the methodology for doing so based on available evidence has not yet been developed.

A. No-Build Scenario

Under the no-build scenario, changes in transit stop locations or access routes/points would result only from other planned projects and would be the same for all three scenarios. The only significant planned project that would alter transit station stop locations in the corridor is the Sellwood Bridge replacement project which would require the relocation of the transit stop at the intersection of the bridge and Hwy 43 from just south of the bridge head to just north of the bridge head.

The planned projects that would impact access routes/points for the corridor's parks and trails include:

- The City of Portland's **South Portal project** which includes the addition of bike lanes and sidewalks to connect the bike lanes and sidewalks on Moody and Bond Streets with the Willamette River greenway Trail;
- Multnomah County's **Sellwood Bridge Replacement** project includes bike and pedestrian facilities on the bridge as well as connections between the bridge facilities to the Willamette River Greenway Trail;
- Oregon Department of Transportation's **Hwy 43 Bike Connection** project which will add on-street bike facilities to Hwy 43 between Terwilliger Blvd in Portland and McVey Ave. in Lake Oswego;
- Metro's **Lake Oswego to Portland Trail project** which will create a regional multi-use trail running the length of the corridor, connecting existing trail, bike, and pedestrian networks.

B. Enhanced Bus Scenario

The enhanced bus scenario would result in the loss of half of the current Line 35 bus stops in the corridor. As a result, the number of transit-related access options serving two of the corridor's facilities, Willamette Park and the Willamette River Greenway Trail, would decrease, depending on what portion of these facilities was being sought out for use. This scenario also includes the construction of a park-and-ride facility in downtown Lake Oswego, which would include a roadway linking the facility to Hwy 43 (State St). This roadway would allow for greater bicycle and pedestrian access to Foothills and Roehr Parks, and to the Kincaid Curlicue Trail.

C. Streetcar Scenario

The streetcar scenario would have a variety of impacts on existing parks and trails in the corridor. Overall, it would provide improved access to parks and trails for streetcar riders, as compared to the no-build or enhanced bus options, both by placing some stations 200—400 feet closer to parks and trails and by adding infrastructure that improves access to some parks and trails. Although the streetcar line has the potential to create conflicts with park users as they cross the tracks while accessing the parks from Hwy 43, particularly in the John's Landing segment, the DEIS has identified these conflicts for mitigation through intersection signalization and design.

The Willamette Shore Line streetcar alignment offers some advantages compared to the Macadam alignment because of station proximity to Willamette Park and the Willamette River Greenway Trail in the John's Landing area. Two of the stations resulting from this alignment (the Nebraska Street and Nevada Street stops) would border the park. Access to Butterfly and Willamette Moorage Parks just north of the Sellwood Bridge would also benefit from the placement of the Sellwood Bridge station just south of Willamette Moorage Park. Access to Marine Powers Park south of the Sellwood Bridge would be maintained by a pedestrian overpass from Hwy 43 just south of the bridge head. However, since the streetcar would be traveling along the western edge of the park, it would eliminate a few informal access points and would require anyone accessing the park by foot from the south to walk an additional ½ mile to access the park via the new pedestrian overpass. Both streetcar options would also improve access to Elk Rock Gardens in the Dunthorpe neighborhood because the new Riverwood Road station would be about 800 feet from the entrance.

In addition, the streetcar scenario would be accompanied by the construction of a new bridge over Tryon Creek just north of downtown Lake Oswego, which would include a 14 foot wide bicycle and pedestrian path. This path would provide access to Tryon Cove Park and the Tryon Cove Park Annex just to the north of Tryon Creek, and would also facilitate bike and pedestrian access to Foothills Park, the Kincaid Curlicue, Roehr Park, and downtown Lake Oswego for the households on Stampher and Fielding Roads.

Currently, bicylists and pedestrians would have to use Hwy 43 to cross Tryon Creek which offers a paved shoulder, but no sidewalk or bike lane, and an indirect, circuitous route for anyone wanting to access the parks on either side of Tryon Creek. Finally, access to Millennium Park in downtown Lake Oswego would improve with the construction of an improved pedestrian crossing for Hwy 43 (State St) that would facilitate movement between the Millennium Park and the Avenue B and park-and-ride stations. The new crossing will also provide improved access from downtown Lake Oswego to Foothills Park.

Access to Bicycle and Pedestrian Infrastructure:

Summary findings:

- Improvements in bicycle and pedestrian infrastructure correlate with higher rates of physical activity via walking and biking.
- Relative to the no-build scenario, the **enhanced bus** scenario would add a small amount of bicycle and pedestrian infrastructure related to the construction of new park-and-ride facilities in Lake Oswego, including bike parking and a new access route between the park-and-ride and State Street.
- Relative to the no-build scenario, the **streetcar** scenario would add or improve bicycle and pedestrian facilities at numerous points along its route, and would result in the most improvements to bicycle and pedestrian infrastructure in the corridor.

Numerous studies have found that increases in the amount of pedestrian and bicycle infrastructure such as sidewalks, crosswalks, bike lanes, bike boulevards, and multi-use paths are correlated with increased rates of walking and bicycling [3, 8, 23, 24]. This section will consider the potential for the two build scenarios to contribute to physical activity levels by assessing their impacts on bicycle and pedestrian infrastructure in the corridor relative to the no-build scenario. In making a judgment about the relative impacts of the different scenarios on physical activity levels, it will be assumed that relative increases in the amount of bicycle and pedestrian infrastructure will be accompanied by relative improvements in physical activity levels. No attempt will be made to quantify resulting levels of bike and pedestrian activity because the methodology for doing so based on available evidence has not yet been developed.

A. No-build Scenario

The no-build scenario would not lead to any changes in bicycle and pedestrian infrastructure in the corridor other than those contained in other city and regional transportation plans. As noted above, these plans include:

- The City of Portland's **South Portal project** which includes the addition of bike lanes and sidewalks to connect the bike lanes and sidewalks on Moody and Bond Streets with the Willamette River greenway Trail;
- Multnomah County's **Sellwood Bridge Replacement** project includes bike and pedestrian facilities on the bridge as well as connections between the bridge facilities and the Willamette River Greenway Trail;
- Oregon Department of Transportation's **Hwy 43 Bike Connection** project which will add on-street bike facilities to Hwy 43 between Terwilliger Blvd in Portland and McVey Ave. in Lake Oswego;
- Metro's **Lake Oswego to Portland Trail** project which will create a regional multi-use trail running the length of the corridor, connecting existing trail, bike, and pedestrian networks.

B. Enhanced Bus Scenario

The enhanced bus scenario would include the construction of bike parking facilities at the park and ride station in downtown Lake Oswego. The park and ride access roadway from Hwy 43 (State Street) would also be designed to accommodate bikes and pedestrians.

C. Streetcar Scenario

The streetcar scenario would include a number of changes in, and additions to, the corridor's bicycle and pedestrian infrastructure. This section summarizes the primary changes and additions by segment. In addition to segment-specific improvements, streetcar construction would also include the addition of bicycle parking at all streetcar stations. A more detailed description of these alterations can be found in Chapter 4 of the DEIS. As with the no-build and enhanced bus scenarios, it is impossible to say at this point whether the enhanced bus scenario would enhance the possibility of the construction of a regional trail in the corridor.

- In the **South Waterfront** the existing multi-use path along the Willamette Shore Line right-of-way would be maintained or improved, depending on which design option was chosen.
- In **John's Landing**, the WSL design option would require changes in existing bike and pedestrian crossing points along the railway, but none of these crossing points would be eliminated. The WSL option would limit the planned regional trail design options, and could potentially produce a less desirable trail from the perspective of trail users, based on estimates of the resulting trail's impacts on trail user comfort, trail user conflicts, transportation system performance, recreation facility performance, and trail user aesthetics [25]. The Macadam design options would have to comply with state highway plans and regulations which require certain improvements to state highways to be accompanied by improvements for bicyclists if they don't currently exist. This could be accomplished through the addition of a bike lane, the addition of appropriate width for future bike facilities, or the provision of an alternate parallel facility. The DEIS does not specify which of these options would be chosen, leaving this decision for the final EIS, depending on which scenario is ultimately chosen.
- In the **Sellwood Bridge** section, streetcar construction would include the construction of a pedestrian over-pass over the rail line in Powers Marine Park just south of the bridge. As described in the park access section above, the streetcar scenario would also require the consolidation or elimination of informal access points in the park which would require people accessing the park by foot from the south to walk as much as an additional ½ mile to access the park.
- In the **Dunthorpe/Riverdale** section, streetcar construction would require improvements to existing private pedestrian track crossings, some of which would also be consolidated. If the Riverwood Drive alignment were chosen, the street would also receive sidewalk and bike boulevard improvements.
- In the **Lake Oswego** section, streetcar construction would be accompanied by a new bicycle and pedestrian connection under the existing Union Pacific Railroad freight tracks and a new bicycle and pedestrian bridge over Tryon Creek, which would create a new connection between the eastern portion of the Birdshill residential neighborhood and the Foothills and downtown areas. Streetcar construction would also include improvements to the Kincaid Curlicue trail in the Foothills area, and to the primary Hwy 43 (State St) pedestrian crossing that connects downtown Lake Oswego to the Foothills area.

Assessment: Air Quality

Each of the build scenarios has the potential to impact the level of air pollutant-related health outcomes in the short-term and the long-term. In the short term, construction activities can produce substantial amounts of pollutants that increase the health risks of construction workers and area residents and users. In the long term, local and regional amounts of pollutant levels will likely be variously impacted by the different transit scenarios because of their potential to produce differing levels of passenger vehicle use and related emissions. This assessment will focus on the potential impacts of the construction activities associated with the different build scenarios, and with their impacts on future air quality through changes in local and regional levels of VMT.

Construction activity related to the two build scenarios would produce elevated levels of air toxics in the short term and changes in personal vehicle use would impact air quality in the long term. As with the rest of this report, this section seeks to complement information already presented in the DEIS. The DEIS considers the impacts of the different scenarios on levels of criteria pollutants within the corridor and region and finds that levels of these pollutants will remain within acceptable limits, and would lower somewhat under the different build scenarios as a result of reductions in personal vehicle use. However, it does not consider impacts on levels of other air toxics, many of which currently exceed established health based benchmarks in the corridor. In order to complement the DEIS, this assessment will focus on assessing the Transit Project's impacts on levels of those non-criteria air toxics that are primarily attributable to combustion engines.

Air Pollutants and Health

There are many different types of outdoor hazardous air pollutants (HAPs) that are either known or strongly suspected to negatively impact human health. The health effects of HAPs can vary greatly depending on the specific toxic, concentration levels, duration of exposure, and an individual's pre-existing health status. In the case of the transit scenarios being considered in this study, the primary HAPs whose concentration and exposure levels will be impacted by the different scenarios are those related to the use of gasoline and diesel combustion engines. While engines produce hundreds of different potentially toxic substances, 12 of these substances have been identified by EPA as HAPs of primary concern related to gasoline and diesel engines because of their known health effects and their significant contributions to elevated ambient concentration levels.

Table 4-1 lists these pollutants and provides a brief description of their known health effects. In general, short-term exposure to high ambient concentrations of these toxics can cause immediate health problems including:

- Aggravated cardiovascular and respiratory illness
- Added stress to heart and lungs, which must work harder to supply oxygen;
- Damage to cells in the respiratory system.

Long-term exposure can also have permanent health effects, including

- Accelerated aging of the lungs and loss of lung capacity
- Decreased lung function
- Development of diseases such as asthma, bronchitis, emphysema, and possibly cancer
- Shortened life span.

People most susceptible to severe health problems from short term exposure to hazardous air pollutants include:

- Individuals with heart or lung disease
- Elderly Individuals
- Individuals with respiratory problems such as asthma or emphysema
- Pregnant women
- Outdoor workers
- Children under age 14 (their lungs are still developing)
- Athletes who exercise vigorously.

Although these effects are more likely to occur when ambient concentration levels are above established benchmarks, it is also possible that these effects can occur at lower levels. Air toxicologists have yet to establish a "no effects" threshold for any HAP, and benchmarks are based on scientific evidence combined with agreed upon acceptable risk levels.

Table 4-1 Health Effects of Vehicle-related Air Pollutants and Toxics*

Criteria Pollutants	Health Effects
Ozone (O_3)	Short term exposure can lead to irritation of the nose, throat, and lungs, and can cause increased airway resistance and decreased efficiency of the respiratory system. For individuals involved in strenuous physical activity and for people with pre-existing respiratory disease, ozone can cause sore throats, chest pains, coughing, and headaches. Long term exposure effects include significant breathing problems, such as loss of lung capacity and increased severity of both childhood and adult asthma.
Carbon Monoxide (CO)	High concentrations of CO strongly impair the functions of oxygen-dependent tissues, including brain, heart, and muscle. Prolonged exposure to low levels of CO aggravates existing conditions in people with heart disease or circulatory disorders. There is a correlation between CO exposure and increased hospitalization and death among such patients. Even in otherwise healthy adults, carbon monoxide has been linked to increased heart disease, decreased athletic performance, and diminished mental capacity. Carbon monoxide also affects newborn and unborn children. High CO levels have been associated with low birth weights and increased infant mortality.
Particulate Matter ($PM_{2.5}$ & PM_{10})	Relationships have been shown between exposure to high concentrations of particulate matter and increased hospital admissions for respiratory infections, heart disease, bronchitis, asthma, emphysema, and similar diseases. In addition, there may be several potential carcinogens present on particulate matter.
Nitrogen Dioxide (NO_2)	Nitrogen dioxide is a lung irritant and may be related to chronic pulmonary fibrosis. It is also important in the photochemical reactions leading to the formation of ozone.
Sulfur Dioxide (SO_2)	Sulfur dioxide is a lung and eye irritant. When SO_2 is inhaled, it causes bronchial constriction which results in breathing difficulty and increased pulse and respiratory rate. People with respiratory diseases like asthma, bronchitis, or emphysema are particularly susceptible to the effects of SO_2. Chronic exposure to SO_2 can lead to coughing, shortness of breath, fatigue, and bronchitis.

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Table 4-1 (cont'd) Health Effects of Vehicle-related Air Pollutants and Toxics*

Air Toxics:	Health Effects
Acetaldehyde	Short-term inhalation can lead to irritation of the eyes, skin, and respiratory tract, including decreased lung function. At high concentrations, irritation and pulmonary effects can occur, which could facilitate the uptake of other contaminants. EPA has also classified acetaldehyde as a probable human carcinogen.
Benzene	Long-term inhalation of benzene causes many disorders including anemia, excessive bleeding, damage to the immune system and genetic damage. On the job exposure to benzene has been shown to produce an increased incidence of leukemia. EPA has classified benzene as a known human carcinogen.
1, 3 Butadine	Studies have shown that long-term inhalation of 1,3-butadiene can result in an increased incidence of cardiovascular diseases, including rheumatic and atherosclerotic heart diseases (hardening of the arteries) and can cause blood disorders. EPA has classified 1,3-butadiene as a probable human carcinogen.
Diesel Particulate Matter (DPM)	The health impacts of diesel particulate matter include premature death, lung cancer, decreased lung function in children, and chronic bronchitis.
Formaldehyde	Chronic exposure to inhaled formaldehyde is associated with respiratory symptoms and eye, nose, and throat irritation. Increased incidences of menstrual disorders and pregnancy problems have been observed in women workers using urea-formaldehyde resins. Studies of workers have shown significant associations between exposure to formaldehyde and increased incidence of lung and nasal cancer. EPA considers formaldehyde to be a probable human carcinogen.
Acrolein	Short-term inhalation exposure may result in upper respiratory tract irritation and congestion. No information is available on its reproductive, developmental, or carcinogenic effects in humans, and the existing animal cancer data are considered inadequate to make a determination that acrolein is carcinogenic to humans.

** Sources: Oregon Department of Environmental Quality, 2009 "Air Quality Data Summaries" available on-line at: http://www.deq.state.or.us/aq/forms/2009AnnualReport.pdf; US EPA Technology Transfer Network Air Toxics Website: http://www.epa.gov/ttn/atw/ .*

Existing Conditions

Different HAPs are monitored in different ways, depending on their classification by EPA. The "criteria pollutants" listed in Table 4-1 make up five of the six criteria pollutants with which EPA is most concerned and over which it has the most regulatory authority. For each of these pollutants, EPA has established health-based benchmark ambient concentration levels which cities and regions must not exceed, as well as monitoring and reporting requirements to make sure that compliance is met. "Air toxics", including those listed in Table 4-1, comprise a long list (187) of other chemical substances that are known or strongly suspected to have adverse impacts on human health.

EPA has developed recommended health-based benchmark ambient concentration levels for most of these toxics, and has produced model-based national inventories of these substances. However, EPA does not directly regulate or closely monitor the ambient concentration levels of these toxics. Instead, EPA develops emissions standards for toxics emitting products which must be met by product manufacturers. In addition EPA also works with state, tribal, and local air quality monitoring agencies to monitor some of these substances and develop guidelines and programs for reducing their production.

[1] The term "ambient" refers to outdoor air to which the general public can be exposed, and does not include air in occupational settings such as construction sites to which the general public does not have access. The air quality in occupational settings, including outdoor settings, is regulated by the US

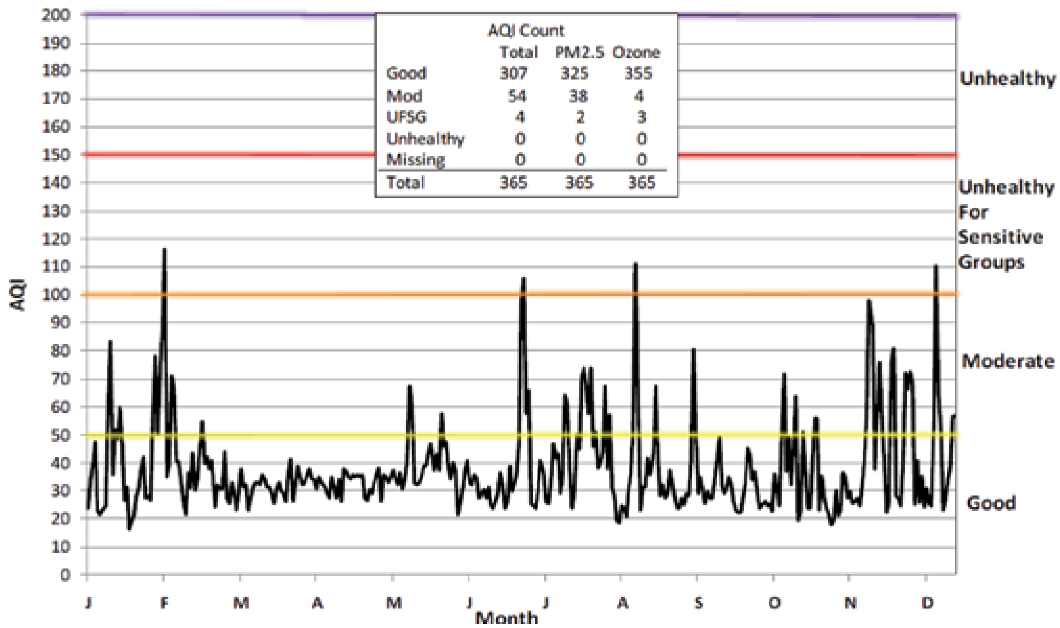
Table 4-2 Air Quality Index Health Category Descriptors

Air Quality	AQI	Health Advisory
Good	0-50	No health impacts expected.
Moderate	51-100	Unusually sensitive people should consider reducing prolonged or heavy outdoor exertion.
Unhealthy for Sensitive Groups	101-150	People with heart disease, respiratory disease (such as asthma), older adults, and children should reduce prolonged or heavy exertion. Active healthy adults should also limit prolong outdoor exertion.
Unhealthy	151-200	People with heart disease, respiratory disease (such as asthma), older adults, and children should avoid prolonged or heavy outdoor exertion. Everyone else should reduce prolonged or heavy outdoor exertion.
Very Unhealthy (Alert)	201-300	People with heart disease, respiratory disease (such as asthma), older adults, and children should avoid all physical activity outdoors. Everyone else should avoid prolonged or heavy exertion.

For the federally monitored and regulated criteria pollutants, the EPA requires DEQ to conduct continuous monitoring and reporting of each pollutant for each city in the state. The EPA then takes this information and calculates the Air Quality Index (AQI), a composite score ranging from 0 (good) — 300 (bad) which is designed to help people estimate the impact of air quality on health for any given day of the year (see Table 4-2). Figure 4-1 displays the daily AQI scores for Portland for 2009. The inset table in Figure 4-1 also displays information specific for PM2.5 and ozone concentrations since these two pollutants have been identified as the primary contributors to the city's AQI scores.

As this figure indicates, there were 54 days on which the AQI fell in the moderate range, indicating that particularly sensitive individuals with severe cardiac or respiratory problems should remain indoors. In addition, there were four days last year that Portland's air quality was compromised to the point of being unhealthy for vulnerable populations, including young and old people, and anyone with cardiac or respiratory conditions. Since the study area has high proportions of elderly residents relative to the rest of the city, it is likely that these conditions have a proportionally high impact on the study area population.

Figure 4-1 Daily AQI scores for Portland, 2009



For air toxics, EPA has worked with DEQ to develop an assessment program for the Portland metropolitan area focusing on 19 of the most prevalent and hazardous substances, including the six toxics listed above in Table 4-1. To assess the ambient concentrations of different pollutants, DEQ has developed a modeling approach that combines information about emission types and levels of different pollutant sources such as factories, cars, and dry cleaners, with information on known physical and atmospheric conditions known to influence the production and distribution of air toxics. The result of their models is census block-group level estimates of the annual ambient concentration levels of each of the 19 toxics.

Table 4-3 displays the ambient benchmark concentrations established by DEQ, measured in micrograms per cubic meter (µg/m3), for the primary combustion engine related air toxics of concern assessed by DEQ, as well as the range of concentrations of each of these air toxics for each of the study area's block groups. The benchmarks indicate the level at which a life-time of constant exposure is anticipated to produce elevated health risks. For carcinogens, an elevated health risk is defined as the level at which one additional person per million will likely contract cancer.

As Table 4-3 indicates, all of the toxics exceed the ambient benchmark concentrations in at least some of the study area block groups, in some cases by a large margin. In general the areas with the highest concentrations are in the northern portion of the corridor, are a result of proximity to I-5 and US 26.

Table 4-3: Modeled Concentrations and Benchmarks for Air Toxics from all sources in the Study Area Block Groups

Air Toxic	Ambient Benchmark Concentrations(µg/m3)	Average of Modeled Ambient Concentrations for Study Area Block Groups(µg/m3)	Magnitude of Difference Relative to Benchmark
Benzene	0.13	2.378	17.29
1, 3 Butadiene	0.03	0.136	3.52
Diesel Particulate Matter (DPM)	0.10	2.439	23.39
Formaldehyde	3.00	0.903	-0.7
Acetaldehyde	0.45	0.471	0.05
Acrolein	0.02	0.135	5.75

Construction Impacts

Summary findings:

- Ambient concentrations of multiple air toxics in the corridor, including those produced by construction equipment, are higher than established health-based benchmarks.
- Construction activities related to the two build scenarios will produce temporarily elevated concentration levels of multiple hazardous air pollutants in and around construction areas.
- The amount of hazardous air pollutants varies greatly depending on the age and condition of the equipment used.
- Predominant use of the newest (Tier 4) generation of equipment could lower construction activity emissions of some hazardous air pollutants by up to 80%.

Recommendations:

- If either of the build scenarios is chosen, Tri-Met should:
    - Work with the State DEQ Clean Diesel program to develop more stringent emissions-based equipment fleet requirements or incentives for contractors and sub-contractors working on the project.
    - Work with DEQ to identify and apply for grants to improve construction equipment emissions.
    - Develop information and outreach programs to alert area residents and users of construction schedules and locations, and inform them of the potential health effects of being close to construction activities. Particular efforts should be made to reach the corridor's significant elderly population, as well as children, and the users of the corridor's parks since these groups are more likely to suffer adverse health impacts as a result of elevated pollutant concentration levels.
    - Work with county health departments to educate people on how to avoid exposure to air toxics generated by construction.
    - Work with DEQ and OSHA to develop monitoring programs to better assess construction site concentrations of air toxics.

Construction on transportation infrastructure projects is accomplished primarily through the use of non-road diesel equipment. In addition to diesel exhaust, construction activities can produce significant amounts of particulate matter such as dust from grading and demolition activities, and from equipment wear-and-tear as wheels and other moving parts get worn down. However, assessment of the Transit Project's impacts on levels of non-emission particulate matter is beyond the resources of this study, which will instead focus on assessing the Transit Project's impacts on levels of four of the most toxic and prevalent air toxics created by the construction activities related to each scenario.

Assessment of the air-quality related health impacts on construction workers and nearby residents and area users of the construction activities related to the two build scenarios will be based on an estimation of a range of amounts of four of the more hazardous air toxics contained in diesel exhaust: diesel particulate matter, acetaldehyde, benzene, and formaldehyde. These toxics were chosen based on available recent research that measured these pollutants at a variety of construction sites. This range can then be compared to established benchmarks for these components in order to assess levels of increased health risks that the construction workers might face. A range is necessary because the composition of diesel exhaust is highly dependent on the manufacture year of the equipment being used, so could vary considerably depending on the contractors' fleet composition. This variation is due to the fact that the EPA regulates diesel emissions by imposing requirements on engine manufacturers. Emission reductions occur as fleets turn over and newer, less polluting engines replace older, more hazardous equipment. EPA began regulating diesel engines in the early 1990s with the establishment of Tier 1 standards for non-road equipment. More rigorous Tier 2 and Tier 3 standards have since been applied, and Tier 4 standards are currently being phased in. Therefore, construction workers using older equipment would be exposed to significantly higher concentrations of air toxics than construction workers using newer equipment.

Estimates of the higher end of the range of possible pollutant levels comes from a 2003 study conducted by Northeast States for Coordinated Air Use Management (NESCAUM) with support from the EPA [26]. For this study, researchers measured air pollutants for three days at five different work sites, placing monitors in cabs, around equipment and at the perimeters of the work sites. The manufacture date of the equipment used at these sites ranged from 1979 to 2002, with a median date of 1995. Although it is possible that construction workers starting work on this project in 2014 could be using an older fleet, the fleet mix measured in this study likely provides a good basis for estimating the higher end of the range of pollutant levels that workers might encounter.

Table 4-4 contains the average measured concentrations from the five NESCAUM study sites along with the ambient benchmark concentrations established by Oregon DEQ, and the 8-hour time weighted average (TWA) benchmarks established by the US Occupational Health and Safety Administration (OSHA) and the National Institute of Occupational Safety and Health (NIOSH). As these numbers indicate, construction workers would face highly elevated levels of both benzene and DPM, as well as moderately elevated levels of acetaldehyde and formaldehyde.

Table 4-4 Health-based Benchmarks and Measured Concentrations of Select Air Toxics at New England Construction Sites

Toxic	Average measured concentration (μg/m3)	DEQ Annual Ambient Benchmark Concentration (μg/m3)	OSHA 8-hour Time Weighted Average Benchmarks (μg/m3)	NIOSH 8-hour Time Weighted Average Benchmarks (μg/m3)
Acetaldehyde	1.38	0.45	360	NA
Formaldehyde	2.57	3.00	0.92	0.02
Benzene	6.60	0.13	31.9	0.319
Diesel Particulate Matter (DPM)	4.54	0.10	NA	NA

As Table 4-4 also indicates, there is a high degree of difference in these benchmarks, with OSHA's benchmarks being set significantly higher than the others. The exception is the benchmark for formaldehyde, for which the DEQ benchmark is much more liberal. This is because of differing interpretations of available scientific evidence regarding whether formaldehyde is a carcinogen. DEQ has classified formaldehyde as a non-carcinogen while OSHA and NIOSH consider it a probable carcinogen.

OSHA's relatively high benchmarks are primarily the result of two issues. First, since they are concerned with occupational exposure, the people they are hoping to protect are not continuously exposed to high levels of these toxics. When work period exposure to these toxics is averaged with non-work exposure to these toxics, the long-term average concentration levels to which workers are exposed, and which determine long-term health impacts, is much lower than the concentration levels to which they are exposed while at work.

Second, benchmarks always reflect a decided-upon acceptable level of risk. As stated earlier, air toxicologists have yet to establish a "no-effects" threshold for any air toxic, so there is always going to be the likelihood that exposure, even a very low levels, will produce adverse health effects in some individuals. While scientific evidence plays a role in the choice of benchmarks, so do numerous other considerations regarding other non-health related benefits of occupational practices. OSHA's benchmarks reflect these considerations, and are the result of their attempts to balance the trade-offs between health and non-health benefits.

NIOSH is the scientific research arm of OSHA, and is responsible for developing, among other things, the scientific evidence base and benchmark concentrations for informing OSHA's choice of benchmarks. As with OSHA regulations, NIOSH regulations are concerned with occupational exposure. As Table 4-4 indicates, the health-based benchmarks provided by NIOSH are significantly lower than the OSHA benchmarks, indicating that OSHA's benchmarks contain a higher level of acceptable risk when it comes to the respiratory health of workers. Without questioning OSHA's decisions, the NIOSH benchmarks suggest that even if OSHA benchmarks are achieved at a work site, significant cardio-respiratory health improvements can be gained by maintaining much lower levels of workplace concentration levels.

The estimate of the lower end of the range of possible pollutant concentration levels for acetaldehyde, formaldehyde, and benzene is based on EPAs assessment of non-road air toxics trends developed in support of the "Control of Hazardous Air Pollutants from Mobile Sources: Regulatory Impact Analysis" [27]. This study estimated reductions in individual air toxic between 2010 and 2030, based on current and anticipated fuel and equipment regulations, including the Tier 4 diesel equipment requirements for non-road engines.

As such, the projected decreases of emissions per gallon for 2030 detailed in this study provide an estimate of what could be achieved for the two build alternatives if most of the equipment being used was Tier 4 equipment. The anticipated reductions for the four air toxics being considered here are displayed in Table 4-5. As this table shows, predominant use of Tier 4 equipment would bring acetaldehyde and formaldehyde levels below current DEQ benchmarks. Benzene and DPM concentrations remain well above the benchmarks. However, they are significantly lower than the alternative and would likely be accompanied by significantly reduced health risks.

Table 4-5 Anticipated Reductions in Air Toxics Concentrations Resulting from Predominant Use of Tier 4 Equipment

Toxic	Potential average measured concentration (µg/m3)		% reduction resulting from use of new equipment	DEQ Annual Ambient Benchmark Concentration (µg/m3)	OSHA 8-hour Time Weighted Average Benchmarks (µg/m3)	NIOSH 8-hour Time Weighted Average Benchmarks (µg/m3)
	High	*Low*				
Acetaldehyde	1.38	0.37	73.5%	0.45	360	NA
Formaldehyde	2.57	0.57	77.7%	3	0.92	0.02
Benzene	6.6	3.02	54.3%	0.13	31.9	0.319
Diesel Particulate Matter (DPM)	4.54	0.90	80.1%	0.1	NA	NA

The estimate of the lower end of the range of possible pollutant concentration levels for acetaldehyde, formaldehyde, and benzene is based on EPAs assessment of non-road air toxics trends developed in support of the "Control of Hazardous Air Pollutants from Mobile Sources: Regulatory Impact Analysis" [27]. This study estimated reductions in individual air toxics between 2010 and 2030, based on current and anticipated fuel and equipment regulations, including the Tier 4 diesel equipment requirements for non-road engines. The estimate of the lower end of the range of possible pollutant concentration levels for DPM comes from the EPAs "Final Regulatory Analysis: Control of Emissions from Non-Road Diesel Engines" [28] which projects an 80.1% reduction in DPM between 2010 and 2030.

As such, the projected decreases of emissions per gallon for 2030 (based on a 1.8% annual increased in fuel consumption) provide an estimate of what could be achieved for the two build alternatives if most of the equipment being used was Tier 4 equipment. The anticipated reductions for the four air toxics being considered here are displayed in Table 6.3-2. As this table shows, predominant use of Tier 4 equipment would bring acetaldehyde and formaldehyde levels below current DEQ benchmarks. Benzene and DPM concentrations remain well above the benchmarks. However, they are significantly lower than the alternative and would likely be accompanied by significantly reduced health risks.

While these concentration ranges would apply to the construction activities of both the enhanced bus and the streetcar alternative, the streetcar alternative would result in greater numbers of workers being exposed to these concentrations because of the relative magnitude of the project. According to the DEIS estimates, streetcar construction would employ 1,430-1,530 workers over a three year period, and would consume 11.2 million gallons of fuel. Construction would take place all along the six-mile route, although the duration of construction activities on most sections would likely be much shorter than the project's overall three-year time frame. The enhanced bus alternative would employ 240 people over one year, and use 1.12 million gallons of fuel. It would be much more localized, taking place only in the Lake Oswego section where the park-and-ride facilities would be built.

Changes in Vehicle Miles Traveled (VMT)

Summary findings:

- On-road vehicles are one of the primary sources of hazardous air pollutants in both the corridor and region.
- Ambient concentrations of multiple air toxics in the corridor, including those produced by on-road vehicles, are higher than established health-based benchmarks.
- Despite anticipated increases in VMT between 2010 and 2035, total amounts of many air toxics in both the corridor and region being produced by on-road vehicles under the no-build scenario will be 23-30% lower as a result of recently enacted equipment and gasoline standards. However, the ambient concentrations of these air toxics will still exceed established health-based benchmarks.
- Annual VMT in the corridor for the **enhanced bus** scenario will be 1.5% lower than the no-build scenario which will result in 0.7-1.3% reductions in the amount of toxics produced in the corridor by on-road vehicles, depending on the toxic.
- Annual VMT in the corridor for the **streetcar** scenario will be 3.9-4.5% lower than the no-build scenario, depending on which alignment is chosen. This will result in 1.7-3.8% reductions in the amount of certain toxics produced in the corridor by on-road vehicles, depending on the toxic.
- Unless other sources of these air toxics are also addressed, the emissions reductions resulting from reduced VMT for both the enhanced bus and streetcar scenarios will still not be sufficient for lowering ambient concentration levels of most air toxics to benchmark levels.

On-road vehicles have long been identified as one of the primary sources of air pollutants in any community. These pollutants stem not only from tail-pipe emissions, but also from "hot soak"—evaporative emissions that occur after a car is turned off, and from road dust from brake linings, road dust and tire wear. Pollutants from tail-pipe emissions pose the most significant health concern, however, and will be the focus of this assessment.

The composition and amount of tail-pipe emissions are determined largely by fuel and vehicle standards, and by amount of vehicle use. Fuel and vehicle standards are set by the EPA with the intent of minimizing emissions of pollutants known to negatively impact human and environmental health. These standards have grown increasingly stringent in the past few years, and are likely to have significant impacts on tail-pipe emissions in the future. Vehicle use, or demand, is determined by a large variety of factors, one of which, transit level-of-service, will be variously impacted by the different scenarios. In general, as transit service improves, so does the proportion of people using it. As more people use transit, more cars are left at home, and the overall level of VMT begins to drop.

Predicting future changes in levels of pollutants produced by on-road vehicles as a result of the different transit scenarios, then, is largely a matter of assessing the impacts of regulations, as well as changes in VMT. Assessment of the impact of regulations on air toxics levels will be based on the Final Regulatory Impact Analysis (FRIA) that the EPA prepared in support of the most recent set of gasoline and on-road fuel regulations [27]. This assessment provided calculations of changes in the amounts of criteria pollutants and numerous air toxics between 1999 and 2030, based on projected increases in VMT and projected decreases in tail-pipe emissions, which would result from the most recent set of regulations enacted in 2007. These calculations also included estimates of pollutant levels for the years 2010 and 2020. In order to get the projections from this study to line up with the 2005-2035 timeframe of the DEIS, this assessment will rely on straight line projections based on numbers from the FRIA to determine pollutant levels for the years 2005 and 2035.

Since the EPAs assessment of the impact of their latest set of regulations is based on projected VMT, the additional impact of changes in VMT resulting from the different transit scenarios can be calculated by adjusting the VMT-based projections from the FRIA, in order to account for the relatively different changes in VMT for both the study corridor and the region, as supplied by the DEIS. This assessment will focus on detailing the anticipated changes in the five key toxics associated with gasoline-powered vehicles which comprise the vast majority of vehicles not being used as a result of transit use: acetaldehyde, 1, 3 butadiene, formaldehyde, benzene, and acrolein. The sixth toxic listed above in table 4-3, diesel particulate matter, was not assessed in the FRIA, so information is currently lacking for assessing how its concentration levels will change over time.

Table 4-6 contains the projected changes in VMT and air toxics amounts at the national level. Table 4-7 contains the DEIS projected changes in corridor and regional VMT for 2035. As these Tables indicate, increases in corridor and regional VMT are anticipated to be much more modest than national trends. Because the projected increases in regional and corridor VMT are lower than projected VMT changes at the national level, the 2035 air toxics amounts also had to be adjusted downwards in order to more accurately predict future ambient concentration levels in the study areas. This adjustment was based on the proportional differences between changes in national and local levels of VMT. Additional adjustments were also made to reflect the fact that the baseline ambient concentration data is from 2010 while the VMT base year is 2005.

Table 4-6 Projected changes in national VMT (billion miles) and key air toxics (tons), 1999-2035

	1999	**2005***	**2010**	**2020**	**2030**	**2035****	**% change, 2005-2035**	**% change, 2020-2035**
VMT	*2,666*	*3,011*	*3,299*	*4,031*	*4673*	*5,129*	*70.30%*	*27.2%*
1,3 butadiene	23,876	11,473	9,160	8,655	8,707	8,733	-23.9%	0.9%
acetaldehyde	29,821	17,169	13,970	13,222	13,677	13,905	-19.0%	5.2%
acrolein	3,485	1,824	1,458	1,382	1,434	1,460	-20.0%	5.6%
benzene	183,661	110,526	79,034	73,141	72,673	72,439	-34.5%	-1.0%
formaldehyde	80,458	38,885	31,475	29,877	31,196	31,856	-18.1%	6.6%

** based on a straight-line projection from 1999 to 2010*

*** based on a straight-line projection from 2020 to 2030*

Table 4-7 DEIS Projected Changes in Annual Corridor and Regional VMT, 2005-2035

	2005	2035			
		No-build	Enhanced Bus	Macadam	WSL
corridor	52,986,189*	79,151,600	78,756,600	78,144,100	77,979,600
change from 2005		*26,165,411*	*25,770,411*	*25,157,911*	*24,993,411*
% change from 2005		*49.4%*	*48.6%*	*47.5%*	*47.2%*
region	15,188,307,000	23,028,178,500	23,013,213,500	23,004,307,500	23,003,358,500
change from 2005		*7,839,871,500*	*7,824,906,500*	*7,816,000,500*	*7,815,051,500*
% change from 2005		*51.6%*	*51.5%*	*51.5%*	*51.5%*

** Extrapolated from daily VMT projections provided in DEIS Ch. 3, sections 12 and 13.*

Table 4-8 displays the percent by which we can expect that the levels of these key air toxics being emitted by on-road vehicles to decrease in the corridor by 2035 for each of the scenarios. The enhanced bus scenario would lower toxics produced by on-road sources by 0.7-1.3%, depending on the toxic. The streetcar scenario would lower toxics produced by on-road sources by 2.0-3.8%, depending on the toxic. Table 4-9 displays the amount by which the ambient concentration levels would decrease, assuming that levels of these toxics produced by other sources remain at current levels. As this table shows, with the exception of formaldehyde, the reductions in ambient concentrations of these toxics would still not be enough to lower them to benchmarks levels.

Table 4-8 Percent Decreases in Amounts of Key Air Toxics From On-Road Sources, 2010-2035

	No-build	Enhanced Bus	Macadam	WSL
1,3 butadiene	26.5%	26.8%	27.2%	27.3%
diff. from no-build		*1.0%*	*2.6%*	*3.0%*
acetaldehyde	23.6%	23.9%	24.3%	24.4%
diff. from no-build		*1.2%*	*3.1%*	*3.6%*
acrolein	23.8%	24.1%	24.5%	24.7%
diff. from no-build		*1.2%*	*3.0%*	*3.5%*
benzene	30.4%	30.6%	30.9%	31.0%
diff. from no-build		*0.7%*	*1.7%*	*2.0%*
formaldehyde	22.8%	23.1%	23.5%	23.7%
diff. from no-build		*1.3%*	*3.2%*	*3.8%*

Table 4-9 Projected Ambient Concentration Levels of Key Air Toxics From On-Road Sources, 2035

	Benchmarks	No-build	Enhanced Bus	Macadam	WSL
1,3 butadiene	0.03	0.15477	0.15469	0.15440	0.15422
acetaldehyde	0.03	0.53968	0.53935	0.53810	0.53729
acrolein	0.1	0.14115	0.14112	0.14101	0.14094
benzene	0.13	2.88919	2.88778	2.88253	2.87915
formaldehyde	3	1.01239	1.01183	1.00975	1.00841

Assessment: Safety from Motor Vehicle Crashes

According to CDC, motor vehicle-related injuries are the leading cause of death for people ages 1-34, and among the top leading causes of death for every age group. In 2007, there were over 41,000 people killed in roadways, the vast majority of whom were either in cars or struck by cars. That same year, over 2.5 million people were injured as a result of a crash involving motor vehicles [7]. Bicycle and pedestrian safety have also been a primary public health issue for many years, and also constitute one of the leading preventable causes of deaths in injuries in the United States, particularly for people under the age of 44. In the United States in 2008, 4,378 pedestrians died as a result of being struck while by a vehicle, and there were 69,000 reported pedestrian injuries that year. Also in 2008, 630 bicyclists were killed in traffic accidents, and another 51,000 were injured [29].

There are a wide variety of conditions that have been identified as influencing motor vehicle-related crash rates. Two of these that would likely be impacted by the Transit Project are transit ridership rates and levels of bicycle and pedestrian activity. Transit ridership rates impact injury and death rates because transit is a much safer mode of transportation than private vehicle use [6, 7]. As people switch to public transit, they lower their chances of getting hurt.

Bicycle and pedestrian rates influence crash rates because crash rates for these modes generally decrease as bicycle and pedestrian activity increases [9, 23]. This section will provide a qualitative assessment of the three scenarios based on potential to impact crash rates as a result their relative ability to shift people from automobile to transit use at both the corridor and regional scales, and to increase walking and biking rates in the corridor which have been inversely correlated with crash rates for these modes.

Existing Conditions

The best available data on traffic safety in the study areas comes from the City of Portland's Bureau of Transportation (PBOT). According to PBOT, traffic safety in the city has been improving over the past two decades. The number of fatalities from all traffic crashes has steadily decreased from 235 deaths between 1994 and 1998 to 151 deaths between 2004 and 2008. While the numbers of accidents involving bicyclists and pedestrians has fluctuated within the same range (see Figure 5-1 below) since 1996, the amount of bike and pedestrian traffic has steadily increased; indicating that crash rates for these modes has declined over this period.

Within the corridor, crash data was obtained for the City of Portland section, as well as for Hwy 43 south of the Portland city limits. According to PBOT crash maps for the period from 1995-2004 (See Appendix C), there were four crashes involving bicyclists that resulted in injuries, and eight crashes involving pedestrains that resulted in injuries. For both modes, only those crashes that involved injuries and required a police response are reported, so it is likely that there were other unreported crashes as well. There were also numerous vehicle-only crashes in the corridor, the vast majority of which took place on Macadam Blvd/Hwy 43. However, the volume of these crashes was not sufficient for the city to categorize it a "high crash corridor", a designation which would indicate that crash rates in the corridor were abnormally high compared with the rest of the city.

According to 2005-2009 Oregon Department of Transportation (ODOT) crash data for Hwy 43 from the Ross Island Bridge just north of the corridor to North Shore Rd in Downtown Lake Oswego, there were 474 total crashes resulting in 260 injuries and four deaths.[2] The average crash rate for the 17 sub-sections of Hwy 43 ODOT tracks in this corridor is 1.76 crashes per million vehicle miles traveled.

Data on crashes and crash rates for transit, both at the regional and corridor scale, were unavailable. According to national level data, there were 12.24 transit riders injured per 100 million passenger miles between 1995 and 2006, and 0.14 transit riders killed per 100 million passenger miles (see Table 5-1 below).

Safety Impacts from Increased Transit Use

Summary findings:

- People who use public transit experience much lower rates of injury and death resulting from crashes.
- Both the enhanced bus and streetcar scenarios will likely improve safety from crashes in the corridor as a result of increased transit use.
- The streetcar scenario would likely produce the greatest safety improvements because of its higher ridership rates.

[2]*Obtained by request from the ODOT Transportation Development Division, Crash Analysis and Reporting Unit.*

According to the US Bureau of Transportation Statistics, public transit, including both bus and rail transit, is four to five times safer than passenger vehicles when measured by injury and death rates per million passenger miles. As Table 5-1 indicates, between 1995 and 2006, the number of fatalities per 100 million passenger miles for transit was 0.14, while the fatality rate for automobiles was 0.79. Similarly, the injury rate per 100 million passenger miles for transit was 12.24, while the rate for automobiles was 53.6. These numbers indicate that automobile users are 4.4 times more likely to get injured than transit users, and 5.6 times more likely to die.

Table 5-1 Injuries and Fatalities per 100 million passenger miles by mode, 1995-2006

	Transit	Automobiles	Magnitude of difference
Injuries	12.24	53.6	4.4
Fatalities	0.14	0.79	5.6

Source: US Bureau of Transportation Statistics Annual Report, 2008. Available on-line at: http://www.bts.gov/publications/transportation_statistics_annual_report/2008/

As Table 5-2 indicates, both of the build scenarios are anticipated to attract more riders compared to the no-build scenario, both at the corridor and regional level. As people switch from automobile use to transit use, they are exchanging a less safe mode of travel for a safer mode. Because the streetcar scenario is anticipated to create the greatest shift in auto use to transit use, this scenario would produce the lowest overall rates of crash-related injuries and crashes.

Table 5-2 DEIS Projected Changes in Annual Corridor and Regional Annual VMT, 2035

	No-build	Enhanced Bus	Macadam	WSL
corridor	79,151,600	78,756,600	78,144,100	77,979,600
change from no-build	*NA*	*395,000*	*1,007,500*	*1,172,000*
%change from no-build	*NA*	*0.50%*	*1.27%*	*1.48%*
region	23,028,178,500	23,013,213,500	23,004,307,500	23,003,358,500
change from no-build	*NA*	*14,965,000*	*23,871,000*	*24,820,000*
%change from no-build	*NA*	*0.06%*	*0.10%*	*0.11%*

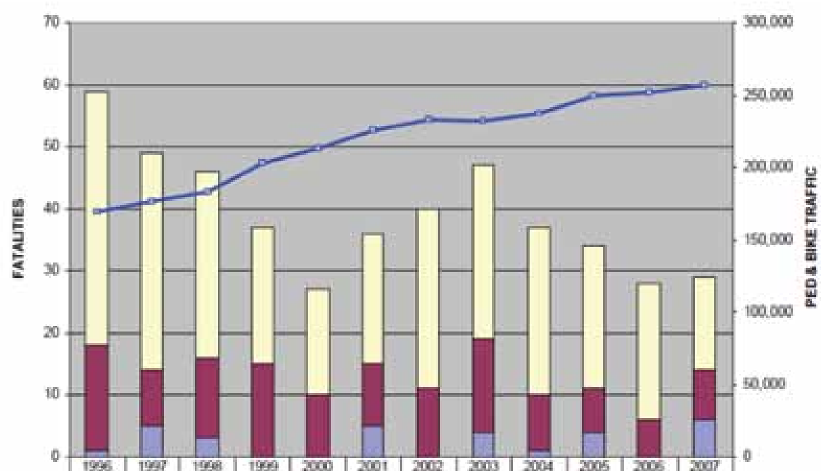
Safety Impacts from Increased Bicycle and Pedestrian Rates

Summary findings:

- Higher rates of walking and biking produce lower crash rates for these modes.
- Both the enhanced bus and streetcar scenarios will likely improve safety from crashes in the corridor as a result of increased pedestrian activity in the corridor.
- The streetcar scenario would likely produce the greatest safety improvements because of the additional amount of walking and biking activity in the corridor induce as a result of multiple improvements to the corridor's bicycle and pedestrian infrastructure.

Numerous studies, along with local data, have shown that increased numbers of cyclists and pedestrians actually produce lower rates of crashes with motor vehicles as cyclists, pedestrians, and drivers grow more accustomed to regularly interacting with each other in public rights-of-way [8, 9, 23, 30]. As Figures 5-1 and 5-2 indicate, local experience supports these research findings. While bicycle and pedestrian activity has steadily increased, the absolute numbers of cyclists and pedestrians being injured or killed by motor vehicles in Portland have remained within the same range for the past decade, producing increasingly lower injury and fatality rates for bicyclists and pedestrians.

Figure 5-1 Portland traffic fatalities compared to estimated growth in bicycle and pedestrian travel (1996-2007)

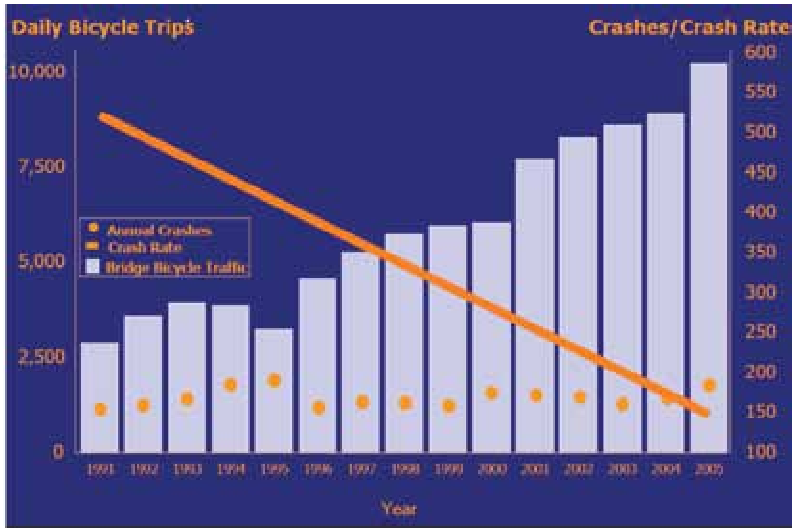


	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Motorist Fatal	41	35	30	22	17	21	29	28	27	23	22	15
Ped Fatal	17	9	13	15	10	10	11	15	9	7	6	8
Bike Fatal	1	5	3	0	0	5	0	4	1	4	0	6
Ped and Bike Traffic	169,030	176,725	183,090	202,810	213,420	225,224	232,850	232,263	237,175	249,392	252,146	256,663

* Bicycle and pedestrian traffic is estimated based on the best indicators available. For pedestrian use, average weekday originating transit boardings are represented. For bicycle use, annual bicycle counts on 4 downtown bridges are represented.

Source: City of Portland Bureau of Transportation

Figure 5-2 Change in Portland's Bicycle Crash Rate, 1991-2005



Source: City of Portland Bureau of Transportation

Based on this inverse relationship between walking and biking rates and crash rates, assessment of the three scenarios' impacts on bicycle and pedestrian crash rates will be based on a consideration of their relative impacts on walking and biking rates in the corridor. The transit scenarios' relative impacts on walking rates will be based on an assessment of the relative amounts of walking they induce as a result of 1) attracting transit riders, and 2) providing additional pedestrian infrastructure. The scenarios' relative impacts on biking rates will be based on their contribution to bike infrastructure in the corridor. Since the different scenario's impacts on bicycle and pedestrian infrastructure have already been detailed in the section on Physical Activity, this discussion will simply summarize these details here.

A. No-build scenario

Under the no-build scenario, transit ridership in the corridor would increase significantly between 2005 and 2035 as a result of continuing local and regional development and growth (Table 5-3). However, it would not directly lead to improvements in bicycle or pedestrian infrastructure.

B. Enhanced bus scenario

Compared to the no-build scenario, the enhanced bus scenario would attract about 200 more daily riders. As with the no-build scenario, it would not include improvements to pedestrian infrastructure in the area. It would, however, include the addition of bicycle parking facilities with the construction of the park-and-ride station in downtown Lake Oswego which could be expected to contribute to modest increases in biking rates in this area.

Table 5-3. Weekday ridership levels

	2005	2035			
				Streetcar	
		no build	enhanced bus	Macadam	WSL
bus	11,810	26,437	26,642	25,369	25,326
streetcar				1,421	1,498
Corridor Total	11,810	26,437	26,642	26,790	26,824

C. Streetcar scenario

The streetcar scenario is anticipated to produce the highest rates of transit use, and make the greatest contribution to bicycle and pedestrian infrastructure in the area, attracting 343-387 more daily riders than the no-build option and 148-182 more daily riders than the enhanced bus option, depending on the design option. In addition, streetcar construction would be accompanied by numerous bicycle and pedestrian infrastructure improvements (see the "Assessment: Opportunities for Physical Activity" section for a description of these improvements) that would likely encourage increased walking and biking rates in the corridor.

Assessment: Access to Resources

Summary findings:

- There are numerous health supportive resources either in the corridor or in the nearby central business district, including full-service grocery stores, medical and social services, parks and recreation facilities, community gathering spaces, and educational and employment opportunities.
- Both the enhanced bus and streetcar scenarios will likely improve access to health supportive resources as a result of their higher levels of transit service.
- The streetcar scenario would likely produce the greatest improvements in access because of its frequency, reliability, and speed relative to the bus scenarios.

Good health requires access to resources such as healthy food retail, healthcare, employment, education, parks and recreation facilities, publicly accessible gathering spaces, and social services. Research has shown that a person's ability to each of these resources can influence their health:

- Access to **healthy food** has been linked with rates of obesity and type-2 diabetes.
- **Clinical healthcare** access has been linked with a wide variety of health outcomes, and has been identified as a primary driver of health disparities between different socio-economic groups in America.
- **Employment** is the primary source of income for most people, and income levels are correlated with a wide variety of health outcomes, in large part because it determines a person's ability to access health-supportive resources. In addition, lower income levels contribute to higher levels of psychological stress that undermines physical health. Frequent or continuous exposure to stress can result in adverse effects on cardiovascular and immune systems leading to heart disease, diabetes, high blood pressure, strokes, depression, infections, and premature death. The stress and lack of opportunity associated with lower income levels also lead to the increased likelihood of engaging in unhealthful behaviors such as smoking, crime, substance abuse, and physical abuse.
- **Education** impacts health primarily through its influence on a person's income level. In addition, education can impact health by providing access to information and by allowing a person the opportunity to develop cognitive skills useful for identifying, avoiding and/or changing unhealthful or risky behaviors. Schools

also offer opportunities for social engagement. Social engagement influences social cohesion which can contribute to improved health outcomes by enabling the dissemination of health-related information about healthcare options and healthful behaviors, and by reinforcing social norms and practices associated with healthful behaviors

- **Parks, trails, and recreation facilities** offer opportunities for physical activity and social engagement with attendant health benefits. Access to greenspace has also been correlated with mental health benefits.
- Publicly accessible **gathering spaces**, including public spaces such as libraries, parks, plazas, schools, and community centers, as well as private spaces such as restaurants and neighborhood retail establishments that facilitate chance encounters with other community members, can increase social engagement and social cohesion.
- **Social services** encompass a broad set of services which directly and indirectly address numerous physical and mental health issues. Such services include those that help people cope with issues stemming from aging, disability, substance abuse, domestic violence, social isolation, poverty, and mental illness. These services can be provided by both public and private sector organizations.

A person's ability to access such resources is influenced by a variety of factors including a resource's location and cost, as well as the infrastructure and travel options that influence a person's ability to actually get to the needed resource. Transit can play an important role in peoples' ability to access resources, particularly for more transit-dependent populations such as low-income individuals, youth, seniors, and people with mobility constraints. The ability of transit to improve people's access to resources is based on the routes/locations that are served, and on the level of service that the transit route and system offer. In the case of the three transit scenarios being assessed here, the vast majority of the resources that are easily accessible by transit don't change between alternatives so there is very little difference in which resources can be accessed.

Rather, the main difference is between the scenarios' levels of service, particularly the level of service between the corridor and downtown Portland which contains most of the health supportive resources that could be easily accessed by transit. This section provides an overview of the health supportive services within the corridor and downtown Portland, and an assessment of the levels of transit service provided by the three different scenarios, as measured by commute times, frequency of service, and reliability. The DEIS provides information for each of these variables for each scenario, and this information will serve as the basis for comparing the different scenarios.

Existing Conditions

In order to identify existing health supportive resources in the corridor and downtown Portland, a variety of databases were used, including North American Industry Classification System (NAICS) codes for businesses and services, and other local datasets detailing the locations of parks and trails, schools, libraries, community gardens, food pantries, and farmers markets. To select resources from these datasets, a ¼ mile buffer was applied to the section of Hwy 43 between downtown Lake Oswego and downtown Portland, and to the Portland Central Business District. The following health supportive resources are found within this buffered area:

- **Healthy food** is provided by 5 full service groceries, 15 small grocery stores, 2 seasonal farmer's markets, 9 emergency food pantries, and 2 community gardens;
- **Clinical healthcare** is provided by 2 large hospitals, a county health clinic, and numerous private practices;
- **Employment** options are plentiful, including 22 major (+500 employees) employers;
- **Educational facilities** include 5 public schools, one of which is the state's largest university, 15 private and alternative schools, and over 20 day care centers.
- **Parks and trails** are primarily located in the corridor south of downtown and are detailed in the section on Physical Activity. There are no community centers.
- **Gathering spaces** are numerous. Along with the parks, trails, and schools identified above, there are dozens of restaurants, pubs, bakeries, and coffee shops, as well as theaters, and gyms, and the main branch of the Multnomah County Public Library.
- The area contains more than 200 **social service** providers ranging from private individual social worker practices to larger public and non-profit endeavors such as the Multnomah County Department of County Human Services, YWCA, the Salvation Army, and Goodwill which offer a variety of options for dealing with issues stemming from aging, disability, substance abuse, domestic violence, social isolation, poverty, mental illness, and more.

Transit service for the corridor is provided primarily by Tri-Met's Line 35 bus which provides service along Hwy 43 between downtown Lake Oswego and downtown Portland. According to the DEIS, the current (2005) total travel time for weekday PM peak-period travel between downtown Lake Oswego and downtown Portland (Portland State University) is 38 minutes. During this time period, buses run every 15 minutes. Since none of the route is on transit-dedicated rights-of-way, reliability is dependent on traffic conditions. Off-peak weekday frequency for Line 35 is 35 minutes.

Impacts of the Recommendations

Table 6-1 displays metrics for three measures of level of transit service for travel from downtown Portland to downtown Lake Oswego during the weekday PM peak period, as provided by the DEIS.

Table 6-1 Current (2005) and Future (2035) Level of Service Measures for Each Scenario

	2005		2035							
							Streetcar			
			no-build		Enhanced Bus		Macadam		WSL	
	PM peak	off-peak	PM peak	off-peak	PM peak	off-peak	PM peak	off-peak	PM peak	off-peak
Total Travel Time	38	NA	43	NA	39	NA	33	NA	29	NA
% difference from no-build					*-9%*		*-23%*		*-32%*	
Frequency (head-ways)	18	35	15	15	6	15	7.5	12	7.5	12
% difference from no-build					*-60%*		*-50%*		*-50%*	
Reliability (Miles of dedicated ROW)	0	0	0	0	0	0	4	4	4.8	4.8

A. No-Build Scenario

Under the no-build scenario, total travel time from downtown Portland to downtown Lake Oswego during the weekday PM peak period would increase five minutes, from 38 to 43 minutes. Frequency would improve slightly for peak period travel, dropping from 18 minutes between buses to 15 minutes. Frequency for off-peak travel would greatly improve, going from 35 minutes to 15 minute between buses. Service reliability would remain dependent on traffic conditions since the bus line would be operating entirely in mixed traffic.

B. Enhanced Bus Scenario

Compared to the no-build scenario, the enhanced bus scenario would improve peak period commute times 9%. Peak period frequency of service would improve 60% while off-peak frequency would be the same. As with the no-build scenario, service reliability would remain dependent on traffic conditions since the bus line would be operating entirely in mixed traffic.

C. Streetcar Scenario

Both of the design options for the streetcar scenario would offer greater improvements in travel time than the enhanced bus scenario. Compared to the no-build scenario, the Macadam in-street option would produce a peak period travel time of 33 minutes, 23% lower than the no-build option. The Willamette Shore Line option would produce a travel time of 29 minutes, 32% lower than the no-build option. Under both design options, streetcars would run twice as frequently during the peak period than buses in the no-build option, and 20% more frequently during off-peak periods. In addition, streetcar service would be more reliable than either of the bus scenarios because it would operate in a dedicated right of way for much of its route. Under the Macadam option, the streetcar would operate off-street for four miles. Under the Willamette Shore Line option, it would operate off-street for 4.8 miles.

Dissemination and Evaluation

During the development of the HIA, OPHI used a variety of dissemination strategies in order to get draft HIA materials into as many hands as possible and encourage stakeholders of the Transit Study to provide feedback. The following dissemination and outreach methods were used to disseminate the HIA during its development:

- **Brown Bags**. OPHI facilitated "brown bag" lunchtime discussions at Metro during multiple stages of the HIA's development. The goals of these discussions were to provide ongoing updates to Metro staff and stakeholders and for OPHI staff to receive feedback as activities progressed. The first "brown bag" was held in June 2010 and the final one will be held in January 2011 to discuss lessons learned. These brown bags were attended mostly by Metro staff, but also had representation from other interested stakeholders from the county health department, city planning agencies, and other health advocacy organizations.
- **Health Impact Assessment Network**. The HIA Network is a forum for more than 250 professionals from government agencies, nonprofit and advocacy groups, health care organizations, and private sector companies that are interested in incorporating health into decision making. The group meets quarterly to discuss current HIAs, offer information sharing, and conduct trainings. OPHI has presented three times at the HIA Network meetings about screening, assessment methodology, and HIA results.
- **Presentation to the Metro Council**. Kathryn Sofich, the lead Metro staff on this project, provided a detailed overview of the HIA project at a council work session to brief the councilors and get feedback.
- **Advisory Committee**. The HIA Advisory Committee for this project contained representatives from public health, planning, and advocacy organizations, and their participation in the project provided them and their organizations with the opportunity to stay informed about the project as it progressed.

Once the HIA is complete, the following avenues will be used to disseminate the HIA:

- **Metro Community and Stakeholder Outreach**. The National Environmental Policy Act (NEPA) requires various forms of public outreach around the DEIS. Metro has organized a thorough communication strategy that includes open houses, committee meetings, and presentations to elected officials and other concerned groups. OPHI provided materials on the HIA that will be available at each of these outreach events and a script about the HIA that Metro staff will read at any presentation. These outreach materials can be found in Appendix E. OPHI staff will also attend some events in order to serve as contact points and answer questions.
- **Advocate Email**. Emails will be sent to stakeholders that have expressed interest in this HIA, the Transit Project, or in HIA as a tool. The email will include final materials and instructions on how to comment on the DEIS using the HIA.
- **OPHI Website.** The HIA and information about how to comment on the DEIS using the HIA are posted on the OPHI website (www.orphi.org/healthy-community-planning/health-impact-assessments). The website address was integrated into all the communication materials that were distributed.

Evaluation

In 2011 OPHI will be completing a limited evaluation in order to look back at its work on the Lake Oswego Transit Corridor HIA. In researching frameworks for HIA evaluations, OPHI identified that there are few completed HIA evaluations. Therefore, OPHI staff completed a literature review of HIA toolkits and trainings in order to compile evaluation methods, questions, and formats. From this review, OPHI has decided to focus its HIA evaluation on meeting the following goals:

1. **Create a set of best practices and 'lessons learned' for future HIAs.** OPHI will use the evaluation of internal processes to create a set of best practices for future HIAs that will improve HIA reports, as well as lead to increased influence on the project, policy, or program that the HIA is done on.
2. **Document how the HIA influenced Lake Oswego Transit Corridor projects, policies, and/or programs.** The evaluation will look at how and why the HIA recommendations were and were not implemented into future planning efforts for the Lake Oswego Transit Corridor.

3. **Record the benefits of the HIA in increasing HIA literacy and capacity at Metro and in the region.** Given the 'new-ness' of HIAs in the Portland region, it was necessary to do a fair amount of internal and external education while completing the HIA, which created interest in HIAs throughout the region. The evaluation will detail how this HIA added health to more planning discussions, as well as document which individuals received information on HIA.
4. **Add to the literature on HIA evaluations.** In researching how to go about this evaluation, we found that there were very few examples of HIA evaluations. The reasons for this are unknown, although we presume that it is mostly due to lack of resources or the perception that the HIA is 'over' after the recommendations are made, among other reasons. We hope that this evaluation will be a useful addition to the currently limited HIA evaluations.

Evaluation Questions

In order to achieve these goals, OPHI will ask a series of questions to be answered by internal staff, Metro partners, members of the HIA steering committee, and other HIA and project stakeholders. These questions generally fall into two categories – process and impact evaluation – and were gathered through a literature of HIA toolkits.[3] Table 7-1 focuses on potential process evaluation questions, indicators, and methods while Table 7-2 focuses on the impact and outcome components.

[3]*These toolkits were developed by Human Impact Partners, University of New South Wales, North American HIA Practice Standards Working Group, and the UCLA HIA Clearinghouse Learning and Information Center (UCLA HIA-CLIC)*

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Table 7-1. Process evaluation questions, indicators, and methodology

Question to be answered	Indicator	Methodology
To what extent was the delivery of inputs consistent with what was originally planned? (EPHIA)	Consistency of outputs	Compare original HIA SOW with outputs
How much time was spent on HIA and by whom? (EPHIA)	Hours	Review of timesheets and time estimate requests to those involved with the HIA (e.g., project team, Advisory Team, etc.)
What were the associated financial costs (salaries, travel, expenses, etc.) (EPHIA)	Hours and budget	Costing out of hours and reviewing budget
Were vulnerable groups or their representatives involved in the HIA? (EPHIA)	vulnerable groups' involvement levels	Identify 'vulnerable' groups from the stakeholder list and identify the extent of their involvement
Was routine data on vulnerable groups readily available and accessible? (EPHIA)	N/A	N/A
Did the impacts identify the differential distribution across different population groups, not just impacts on vulnerable groups? (EPHIA)	Populations analyzed vs. populations that will be impacted	Review of population analysis
Did recommendations include actions to address any differential distribution of impacts? (EPHIA)	Geographical and population distribution in recommendations	Review of recommendations for distribution language and implications
What stages of HIA were used? (NSW)	HIA stages	Review of HIA process documentation

Table 7-1. (cont'd) Process evaluation questions, indicators, and methodology

Question to be answered	Indicator	Methodology
What evidence/ methodology was used and how did it inform development of the recommendations? (NSW)	Use of evidence in recommendations	HIA report scan to record types of methodology and impact on the recommendations
How were recommendations formulated and prioritized, what factors influenced this process, and who was involved? (NSW)	Input for recommendations, involved persons	Internal interviews
How were the decision makers involved and engaged in the process? What were their expectations and were they fulfilled with the limited resources available? (NSW)	Involvement by and satisfaction of decision makers	Internal interviews and interviews/ survey of involved decision makers
How and when were the recommendations delivered to the relevant decision makers? (NSW)	Reporting to decision makers	Review of reporting/ dissemination process and relation to decision makers

Table 7-2. Impact evaluation questions, indicators, and methodology

Question to be answered	Indicator	Methodology
Consensus and Partnership Building		
Did the HIA help to build consensus and buy-in for decisions and their implementation?	?	?
Has the HIA led to the development of new partnerships and coalitions focused on ensuring that health in considered in policy or decision-making processes? Are stakeholders who participated in the HIA continuing to work together on other health-related initiatives?	Change in incorporating health, new relationships	Online survey
Use of HIA		
Did stakeholders read it?	Number read	Online survey
Did stakeholders find the information useful? Well presented?	Satisfaction by stakeholders	Online survey
Was the HIA used to inform other comments on the DEIS?	References to HIA in DEIS comments	DEIS comment review
Increasing public knowledge		
Were discussions of connections between the decision and health evident in the media, statements by public officials or stakeholders, public testimony, public documents, or policy statements?	References to health/ HIA	Review of media, statements by public officials or stakeholders, public testimony, public documents, or policy statements for mentions of health/ HIA work.

Table 7-2. (cont'd) Impact evaluation questions, indicators, and methodology

Question to be answered	Indicator	Methodology
Did the HIA lead to interest from previously uninvolved groups (e.g., public health advocates), either in supporting or opposing the decision?	Involved and types of groups	Comparison of groups involved before the HIA began and after
Perceptions of Value		
Did the HIA prevent project delays by anticipating stakeholder concerns?	N/A	N/A
Were HIA findings and recommendations useful or influential to policy-makers?	Policymakers' opinions	Online survey/ interview
Implementation of recommendations		
Did the HIA aid in securing funds for project mitigations? (HIP)	N/A?	N/A
Did the final project, plan or policy decision change in a way that was consistent with the recommendations of the HIA? (HIP)	Changes to FEIS	Final EIS review for incorporation of HIA recommendations
For the recommendations that were accepted, when were they implemented and what factors contributed to this? (NSW)	Reasons for implementation	Review of accepted recommendations, interviews and/or on-line survey to decision-makers about why they were integrated
What are the likely reasons why recommendations were not implemented?	Reasons for not implementing	Review of non-accepted recommendations, interviews and/or on-line survey to decision-makers about why they were not integrated

Table 7-2. (cont'd) Impact evaluation questions, indicators, and methodology

Question to be answered	Indicator	Methodology
Capacity Building		
Did the HIA encourage public health agencies to participate in new roles in policy and planning efforts?	Before/after participation of public health	Online survey of public health agencies
Since the HIA was conducted, have there been requests for the study of health impacts on additional projects, plans, or policies in the same jurisdiction? Are there any new efforts to institutionalize HIA or other forms of health analysis of public policy?	Influence of LO Transit Corridor HIA on HIA community efforts	Tracking of new/on-going HIAs, HIA efforts, interview about relationship with the LO Transit Corridor HIA
Did the HIA lead to greater institutional support for consideration of health in formal decision-making processes?	Changes in formal decision-making processes	Review of updates to decision-making processes

Future Work

Contingent on the availability of resources, the HIA evaluation will be completed in 2011 and released as a separate report. Please check OPHI's website at www.orphi.org or email Steve White at steve@orphi.org for more information about the HIA evaluation.

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Appendix A: Description of Corridor Sections

The corridor centers on Hwy 43 and is narrowly bounded to the east by the Willamette River and to the west by the steep slopes of the Portland West Hills. Three of the 5 segments contain a mix of commercial and residential activity, and 2 are primarily residential.

- The **South Waterfront** segment contains a mix of commercial and residential uses, with commercial uses predominating on the east side of Hwy 43, and residential uses primarily located to the west. However, many of the Westside commercial uses are slated to convert to residential uses in the near future. This section is also where the Portland Streetcar line currently terminates. Interstate 5 runs just west of Hwy 43 in this section, posing a significant barrier to east-west movement in this area. Bicycle and pedestrian facilities include bike lanes on Moody and Bond Streets to the west of Hwy 43, and discontinuous portions of the Willamette River Greenway Trail.
- The **John's Landing** segment contains a wide mix of housing and commercial uses including single- and multi-family residences, and a variety of retail, office, and light industrial uses. It also contains numerous parks and recreation areas, including the Willamette River Greenway Trail which runs along the Willamette River shoreline for the length of the segment, as well as the northernmost portion of the Willamette Shore Line (WSL) railroad line which runs parallel to, and east of, Hwy 43 south to downtown Lake Oswego. I-5 runs parallel to Hwy 43 at the base of the West Hills, approximately ¼-1/3 mile, or 5-6 blocks, to the west. Development between Hwy 43 and I-5 to the west is laid out on a traditional grid pattern with sidewalks on all sides of the blocks. Development to the east between Hwy 43 and the Willamette River is primarily 1-3 story condominiums and office buildings served by private walkways, some of which also have public easements.
- The **Sellwood Bridge** segment is primarily open space, including the Willamette Riverview Cemetery extending up into the West Hills and parks between Hwy 43 and the Willamette River. There is also a small amount of commercial and residential uses along the River just north of the Bridge. Bike and pedestrian facilities in this area include the Willamette Greenway Trail and a 5 foot sidewalk on Hwy 43 to the north of the Bridge, and an informal dirt path leading through Powers Marine Park to the south of the Bridge. Given the lack of bicycle and pedestrian facilities south of the Bridge, it is effectively impossible to travel south of the Bridge by bike or by foot.

- The **Dunthorpe/Riverdale** segment is almost exclusively large-lot single-family residential and is in unincorporated Multnomah County territory. Hwy 43 contains no bike lanes or sidewalks in this section, and high traffic speeds and volumes make walking and biking along the edge too dangerous and uncomfortable for most people to attempt. The area's side streets only occasionally include sidewalks. However, traffic on the side streets is slow and sparse, making them an option for local bicycle and pedestrian use, although their connection to neighboring bike and pedestrian networks is very limited.
- The **Lake Oswego** segment includes a portion of unincorporated Clackamas County known as Birdshill that lies between Dunthorpe/Riverdale and northeast corner of the City of Lake Oswego. Like Dunthorpe, the Birdshill neighborhood is almost exclusively single-family residential. Hwy 43 contains no bike lanes or sidewalks in this section, and side streets only occasionally include sidewalks. Traffic volume on the side streets is slow and low, making them an option for local bicycle and pedestrian use. Connections to neighboring bike and pedestrian networks, however, are very limited. The City of Lake Oswego portion contains a mix of commercial and residential uses on both sides of Hwy 43, including a portion of the city's downtown core, and the Foothills neighborhood between Hwy 43 and the river, which is currently undergoing re-development. Development to the west of Hwy 43 is laid out on a traditional grid with sidewalks on all block fronts. Development to the east includes some condominiums and office space, as well as a couple of parks and recreation facilities and some industrial properties, the latter of which are slated for redevelopment. Hwy 43 is also named State Street in Lake Oswego.

Appendix B: Physical Activity Rates in Oregon

Table B-1 Extent of Physical Activity Among Adults, by Age Group, 2005

	Moderate (5x30 min.)	Vigorous (3x20 min.)	Meets CDC Recommendations	Insufficiently Active	No Leisure Time Activity	Doesn't Meet CDC Recommendations
18-24	50.50%	44.80%	**66.50%**	26.40%	7.10%	**33.50%**
25-34	45.60%	35.70%	**58.90%**	33.30%	7.80%	**41.10%**
35-44	44.10%	34.00%	**57.80%**	35.30%	6.80%	**42.10%**
45-54	43.40%	29.80%	**53.10%**	38.20%	8.70%	**46.90%**
55-64	45.20%	26.70%	**55.50%**	35.10%	9.40%	**44.50%**
65+ years	41.00%	19.60%	**48.80%**	33.70%	17.40%	**51.10%**
All Adults	44.70%	31.50%	**56.40%**	34.10%	9.50%	**43.60%**

**Percentages of those meeting guidelines for moderate and vigorous activity do not equal total meeting CDC recommendation because some persons meet guidelines for both.*
Source: Oregon Behavioral Risk Factor Surveillance System

Table B-2 Extent of Physical Activity Among Adults, by Level of Education, 2005

	Moderate (5x30 min.)	Vigorous (3x20 min.)	Meets CDC Recommendations	Insufficiently Active	No Leisure Time Activity	Doesn't Meet CDC Recommendation
Did not finish HS	38.10%	22.80%	**48.00%**	32.30%	19.60%	**51.90%**
HS graduate or GED	42.60%	27.90%	**52.70%**	33.90%	13.30%	**47.20%**
College, 1-3 years	45.70%	30.60%	**56.10%**	36.00%	7.90%	**43.90%**
College graduate	47.70%	38.20%	**62.60%**	33.00%	4.40%	**37.40%**
All Adults	44.70%	31.50%	**56.40%**	34.10%	9.50%	**43.60%**

**Percentages of those meeting guidelines for moderate and vigorous activity do not equal total meeting CDC recommendation because some persons meet guidelines for both.*
Source: Oregon Behavioral Risk Factor Surveillance System

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Table B-3 Extent of Physical Activity Among Adults, by Household Income, 2005

	Moderate (5x30 min.)	Vigorous (3x20 min.)	Meets CDC Recommendations	Insufficiently Active	No Leisure Time Activity	Doesn't Meet CDC Recommendation
Less than $15,000	37.80%	20.90%	**46.60%**	31.70%	21.70%	**53.40%**
$15,000-24,999	40.40%	24.80%	**50.00%**	35.90%	14.10%	**50.00%**
$25,000-49,999	46.60%	30.20%	**56.90%**	34.80%	8.30%	**43.10%**
$50,000 or more	47.80%	39.30%	**62.90%**	33.30%	3.80%	**37.10%**
All adults	44.70%	31.50%	**56.40%**	34.10%	9.50%	**43.60%**

**Percentages of those meeting guidelines for moderate and vigorous activity do not equal total meeting CDC recommendation because some persons meet guidelines for both.*

Source: Oregon Behavioral Risk Factor Surveillance System

Table B-4 Extent of Physical Activity Among Adults, by Race/Ethnicity[1], 2005

	Moderate (5x30 min.)	Vigorous (3x20 min.)	Meets CDC Recommendation*	Insufficiently Active	No Leisure Time Activity	Doesn't Meet CDC Recommendation*
White[2]	47.80%	33.00%	**59.00%**	33.90%	7.50%	**41.00%**
African-American[2]	47.60%	44.00%	**63.90%**	25.50%	12.10%	**36.10%**
Asian/ Pacific Islander[2]	41.70%	40.60%	**54.60%**	35.50%	8.60%	**45.40%**
American Indian[2]	60.00%	39.70%	**67.00%**	23.80%	7.90%	**33.00%**
Latino	31.40%	26.90%	**42.1%****	33.10%	22.70%	**57.90%**
All adults	44.70%	31.50%	**56.40%**	34.10%	9.50%	**43.60%**

**Percentages of those meeting guidelines for moderate and vigorous activity do not equal total meeting CDC recommendation because some persons meet guidelines for both. **Statistically significant difference, compared to White, Non-Latino*

[1] Age-adjusted [2] Non-Latino

Source: Oregon Behavioral Risk Factor Surveillance System

Appendix C: Advisory Committee and Project Team Members

Advisory Committee

Julie Early-Alberts, MPH
Program Manager
Health Assessment and Consultation
State of Oregon Public Health Division

Gerik Kransky
Advocacy Campaign Manager
Bicycle Transportation Alliance

Scott France, MS
Healthy Communities and
Tobacco Prevention
Clackamas County Community Health

John MacArthur
Sustainable Transportation
Program Manager
Oregon Transportation Research
and Education Consortium

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Co-Director
Upstream Public Health

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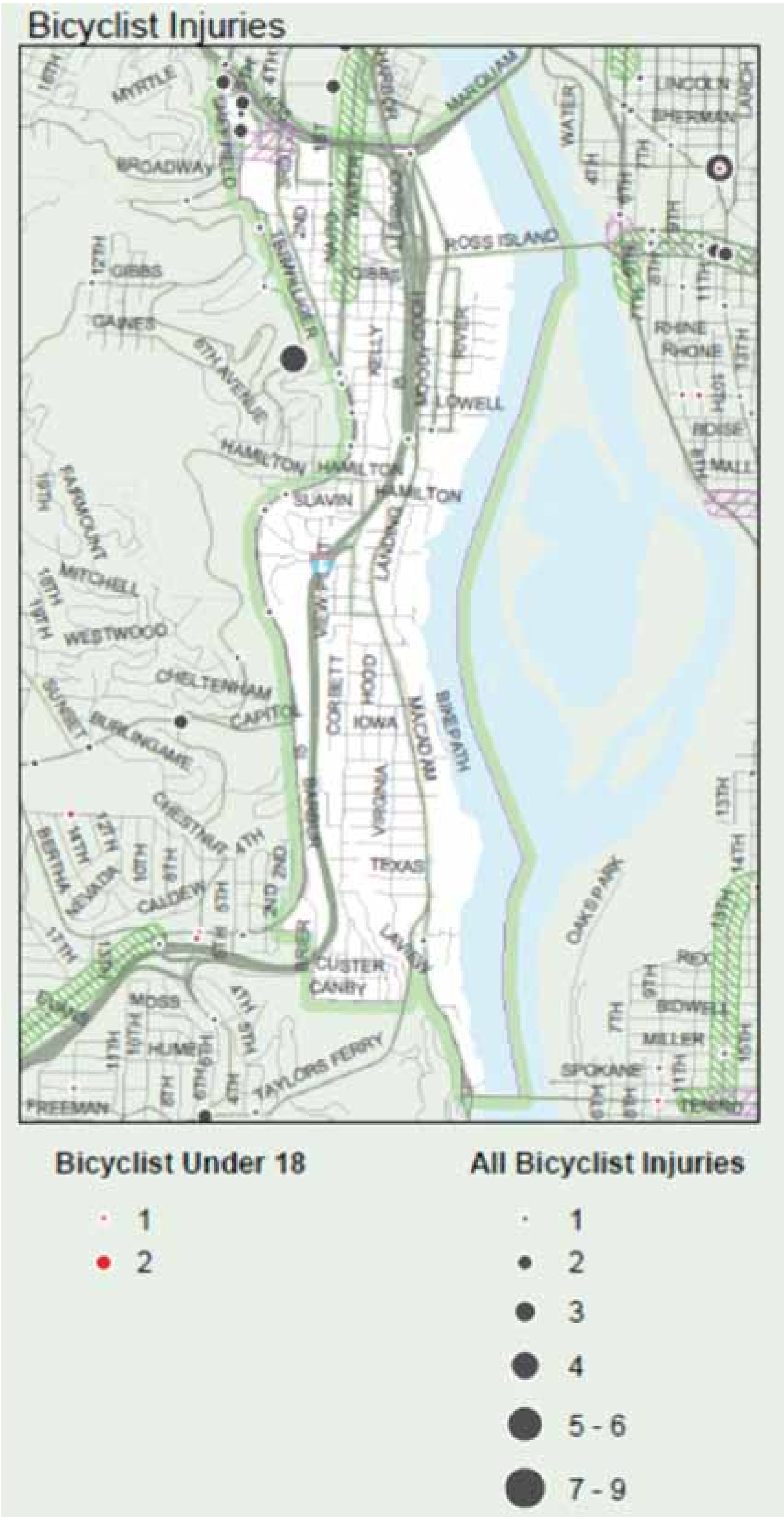
Principal Planner
Metro

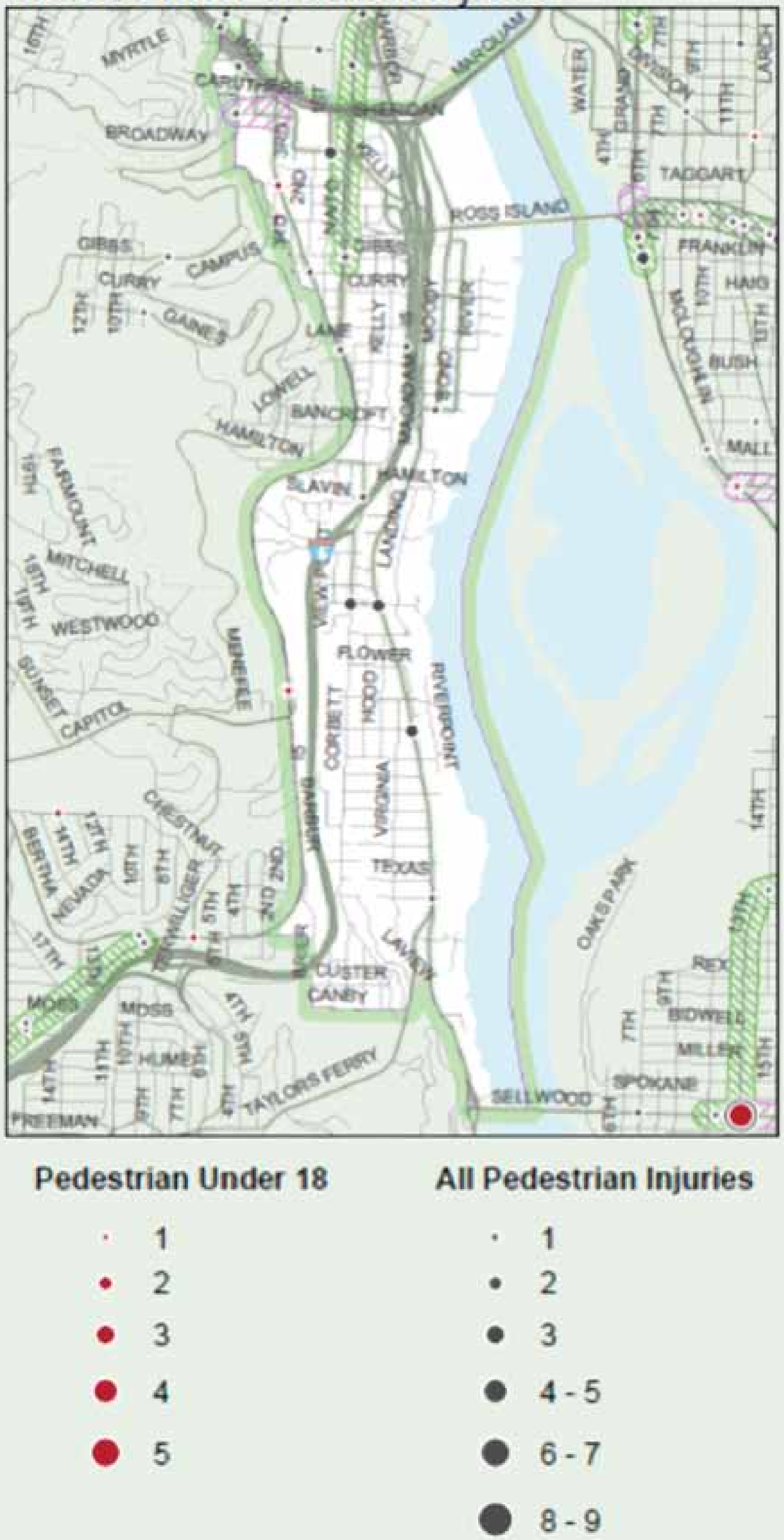
Cliff Higgins
Communications
Metro

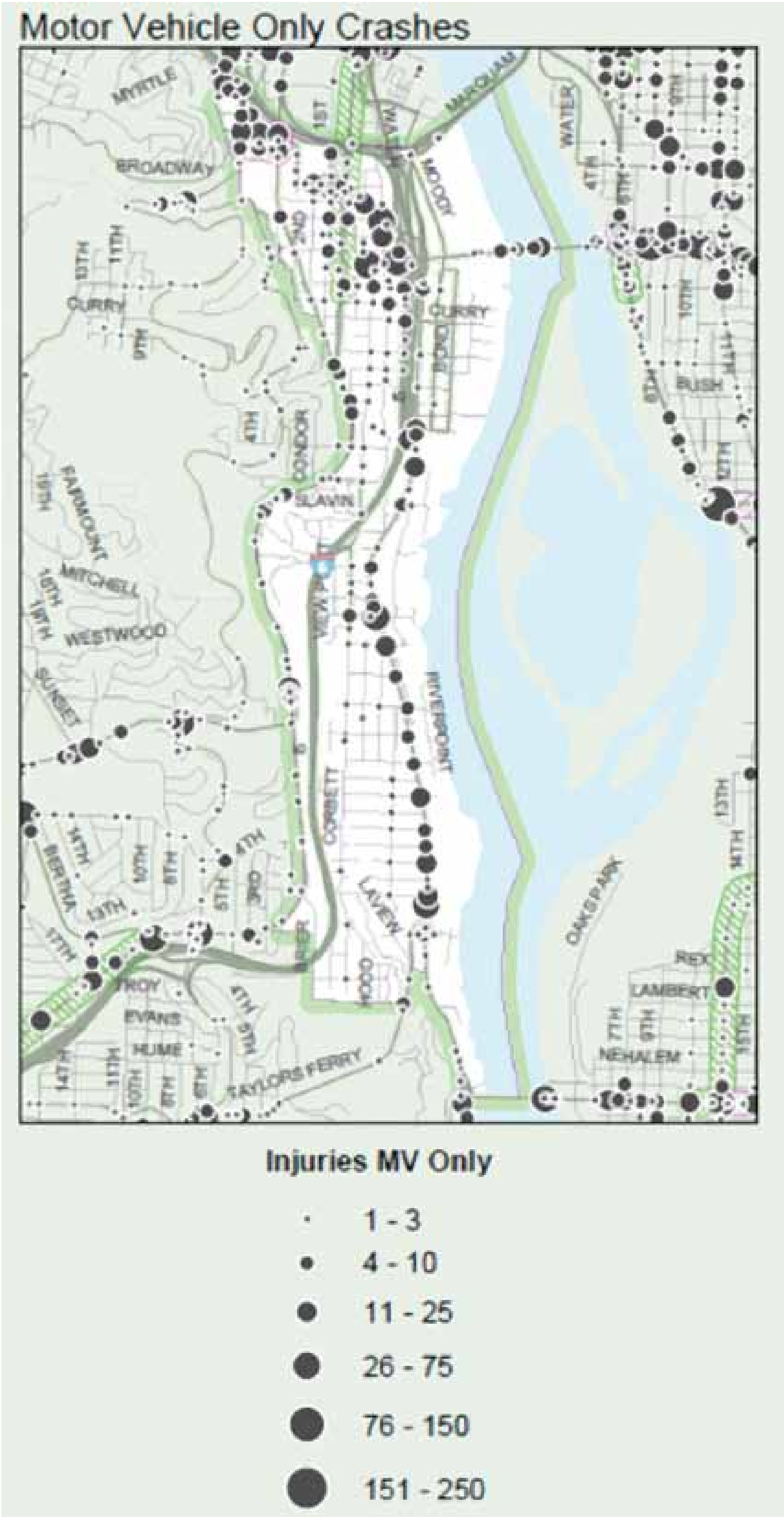
Brian Monberg
Senior Planner
Metro

Appendix D: Portland Bureau of Transportation Crash Maps for the Corbett/Terwilliger/Lair Hill Neighborhood (Original maps provided on request)



Crashes with Pedestrian Injuries




Motor Vehicle Only Crashes
MYRTLE
BROADWAY
1ST
MARQUAM
WATER
MOODY
4TH
6TH
12TH
11TH
CURRY
9TH
10TH
CURRY
BOND
RUSH
11TH
8TH
4TH
CONDOR
12TH
19TH
FARMOUNT
SLAVIN
MITCHELL
18TH
19TH
WESTWOOD
SUNSET
RIVERPOINT
CORBETT
13TH
14TH
BERTHA
10TH
8TH
5TH
4TH
3RD
13TH
LAVIEW
OAKS PARK
17TH
TROY
REX
LAMBERT
EVANS
HUME
NEHALEM
TAYLORS FERRY
Injuries MV Only
1 - 3
4 - 10
11 - 25
26 - 75
76 - 150
151 - 250

Appendix E: Outreach Materials

Script – Lake Oswego Transit Corridor HIA

As we have been discussing, the DEIS assesses the environmental impacts of the transit alternatives for the Lake Oswego to Portland Transit Corridor. These environmental impacts include those related to the natural environment as well as the human environment. Recently, Metro has become interested in furthering their knowledge on the human impacts of projects such as the LO to Portland Transit Corridor, particularly in respect to human health.

Health Impact Assessment (HIA) is a tool that can be used to assess how projects, policies or plans may impact human health. HIAs often go beyond what might seem like the obvious factors that influence health, such as availability of doctors, and look at 'social determinants of health.' These 'social determinants of health' are things like employment, education, food access, etc. that have been shown to influence health outcomes that may change as a result of a newly developed transit corridor.

Metro has partnered with Oregon Public Health Institute (OPHI) to conduct a 'pilot' HIA on the LO to Portland Transit Corridor DEIS to evaluate how the proposed alternatives may influence health outcomes. OPHI used information from the DEIS to draw conclusions about and make recommendations to improve health outcomes, as well as completing independent evaluation. OPHI hopes this HIA process will serve as a complement to the DEIS process and that together, the two documents can provide an in depth overview of both the environmental and human health impacts of the proposed corridors.

In your information packets, there is a cover letter from OPHI, a project summary, and a Q&A about HIAs. We hope that you will read through these materials to become more familiar with this specific HIA and how HIA can be used as a tool. In the handouts there is a web address that will take you to the full HIA document. We encourage you to read it for your own knowledge and potentially use it to inform your comments on the DEIS. If you do use information from the HIA in your comments, it would be helpful if you blatantly reference it, so we can evaluate the usefulness of the HIA in this DEIS comment period.

For clarification, although the HIA was done in partnership with Metro, the document was produced by OPHI and any comments on the HIA should be directed to Steve White, HIA project manager at OPHI. His email and phone number are on the enclosed documents. Any comments on the DEIS that reference the HIA should still be sent to Metro as any other comment would be.

(If OPHI staff is present) If you have any further questions about the HIA, Steve/ Noelle is here and would be happy to answer any questions you may have about the process or the document after we wrap up.

Lake Oswego to Portland Transit Project Health Impact Assessment

In Fall 2009, Oregon Public Health Institute (OPHI) received funding from the U.S. Centers for Disease Control and Prevention (CDC) and the National Network of Public Health Institutes (NNPHI) to conduct Health Impact Assessments (HIA) on Portland-area projects, plans, and policies related to transportation strategies for mitigating climate change. OPHI, Metro and other stakeholders screened a variety of potential projects for their HIA potential, and chose to pursue the development of an HIA on the three alternatives considered in the Draft Environmental Impact Statement (DEIS) for the Lake Oswego to Portland Transit Project.

HIA is an emerging practice that evaluates the impact of specific plans, policies, and projects on the health of impacted individuals, and suggests ways to improve the health outcomes of the policy, plan, or project in question. Although the DEIS for this project contains substantial information useful for understanding how the different scenarios directly and indirectly impact the health of impacted populations, the connections between the scenarios and health outcomes are not always identified or fully assessed. This HIA is meant to complement the DEIS by more explicitly and more fully assessing the health impacts of the different transit scenarios as described in the DEIS. In addition, it offers recommendations for improving the project's health outcomes.

This HIA is a pilot project for both OPHI and Metro and therefore it serves a variety of purposes. These purposes include educating Metro staff and regional partners on the use of HIAs, informing decision-makers on potential health outcomes of transit projects, and increasing HIA capacity in the region. In addition, we hope that the HIA will be used as a resource for those who wish to include concerns about impacts to human health in their comments on the DEIS. The completed HIA is posted on OPHI's website at: http://www.orphi.org/healthy-community-planning/health-impact-assessments.

While this HIA is focused on the DEIS and was produced with involvement from Metro, it is important to note that the HIA was produced by OPHI and is separate from the DEIS. If you wish to comment on the DEIS and the choice of a preferred alternative, you should direct your correspondence to Metro, even if the comment is based on the HIA. If your comment on the DEIS is based on the HIA, we encourage you to reference the HIA in your remarks. **Comments on the DEIS can be submitted in several ways:**

- Email to trans@oregonmetro.gov.
- Submit online at www.oregonmetro.gov/lakeoswego, available Dec. 3.
- Mail to Lake Oswego to Portland Transit Project, 600 NE Grand Ave., Portland, OR 97232.
- Testify at the public hearing or fill out a comment card at an open house (Information on the dates, times, and locations of the public hearing and open houses can be found at www.oregonmetro.gov/index.cfm/go/by.web/id=35271).

Comments on the HIA that are not meant to address the DEIS or the choice of a preferred transit alternative should be directed to OPHI. Since this HIA is serving to increase HIA capacity within the Metro Region and especially at OPHI, we encourage and welcome your comments on the scope, usefulness, and overall quality of this HIA. These comments should be sent to Steve White, OPHI's HIA Project Coordinator at:

- steve@orphi.org
- 315 SW 5th Ave, Suite 202, Portland, OR 97204

Q&A: Health Impact Assessments

What is a Health Impact Assessment (HIA)?

A Health Impact Assessments (HIA) is an emerging practice that evaluates the impact of specific plans, policies and projects on the health of impacted individuals and suggests ways to improve the health outcomes of the policy, plan, or project in question. HIA is based on a comprehensive and prospective view of health, which emphasizes that physical and mental health is influenced by a broad range of environmental factors - physical, social, and economic. As such, it is often focused on how a policy, plan, or project impacts "health determinants". Health determinants are the 'causes of causes' of health and include numerous features of the built, natural, and social environment known to impact human health.

HIAs aren't required by law. Why would you conduct a HIA?

There is no legal requirement to review plans, project, or policies to determine how they might impact human health. HIAs are a tool to complete this analysis in a relatively flexible manner, and since there are no legal requirements, the format of the HIA can be catered to the appropriate issues. In addition, HIAs focus on the health of vulnerable populations and typically includes an analysis of a proposal's potential impacts on health disparities. This 'Health Equity Lens' is another area that is rarely covered in required planning processes.

How does a HIA get used in an Environmental Impact Statement process?

While there are many different ways a HIA can be used within an Environmental Impact Statement (EIS) process, the Lake Oswego to Portland Transit Project HIA serves to compliment the analysis already done in the Draft EIS. The EIS includes detailed analysis on the three alternatives, and often, directly and/or indirectly, describes how its alternatives may impact human health. The HIA serves to compliment the evaluation already completed in the EIS by drawing out important analysis and/or completing additional analysis in order to better represent how the three alternatives may impact health determinants.

What are the steps of a HIA?

The following are the typical steps of a HIA:

1. **Screening** - Identifies project or policy for which an HIA would be useful
2. **Scoping** - Identifies which health effects to consider
3. **Assessing** - Identifies populations that may be affected and how they may be affected
4. **Recommendations & Reporting** - Provides results to decision makers and stakeholders
5. **Evaluating** - Determines the affect of the HIA on the decision-making process

How do the recommendations of a HIA get used?

Recommendations of a HIA can be used in a variety of ways. Ideally, recommendations are integrated into the plan, program or policy that the assessment is done on. Yet, recommendations can also be used to facilitate new discussions, increase organizational capacity about integrating health into planning, and/or be used in future projects.

Where can I find more information about HIAs?

There are many high-quality and comprehensive HIA resources available on-line. Oregon Public Health Institute recommends the following:

- **Oregon's HIA Initiative** - http://www.oregon.gov/DHS/ph/hia/index.shtml
- **UCLA HIA Clearinghouse Learning and Information Center** - http://www.hiaguide.org/
- **Human Impact Partners** - http://www.humanimpact.org/

Overview of Lake Oswego to Portland Transit Project

Health Impact Assessment Pilot Project

HIA Overview

To assess the health impacts of the Transit Project, the HIA focused on assessing how the different transit scenarios being considered in the DEIS would impact the following known determinants of health:

- Opportunities for physical activity
- Air quality
- Access to health supportive resources
- Safety from traffic crashes

Based on this assessment, this study found that both of the build scenarios would positively impact health determinants in both the corridor and region. Because the streetcar scenario would provide the highest level of transit service, the most improvements bicycle and pedestrian infrastructure and park and trail access, and the most improvements in park and trail access, it would produce more positive impacts on health determinants than the enhanced bus scenario. The only identified adverse impacts associated with the Transit Project are those stemming from temporary impacts on air quality resulting from construction activities related to the two build alternatives. Recommendations for mitigating these impacts are provided in the full report.

Why do an HIA on this project?

Over the past 10 years, the public health and planning communities in Oregon and nationwide have increasingly recognized the numerous direct and indirect impacts that the built environment has on people's health. This recognition has encouraged local and regional governments, including Metro, to begin considering how to better assess and articulate how, and to what extent, their plans and investments impact the health of the people they serve.

At Metro, this recognition has already led to the inclusion of health as a goal of the Regional Transportation Plan update and to the creation of the Active Transportation Partnership. However, in order for health considerations to be more adequately integrated into decision-making processes, Metro will need to develop stronger partnerships with public health experts and organizations who are working to develop datasets and analysis methods appropriate for assessing the various health outcomes of their plans and investments. The Lake Oswego to Portland Transit Project HIA Pilot Project offers the unique and educational opportunity for Metro to partner with public health stakeholders as well as understand how a specific project may impact its region's residents.

HIA Pilot Project

Because this is the first HIA done on a Metro project, this HIA was initiated as a pilot project. The HIA project team, consisting of both Metro and OPHI staff, has met on a regular basis to check in on the progress of the HIA.

The following are the goals of this project:

- to provide the project's steering committee and other interested stakeholders with information about the health impacts of the project's proposed alternatives, so that they can more effectively consider health outcomes when selecting their preferred alternative and providing public comment,
- to provide Metro with an example of an HIA that will inform their consideration of its utility in aiding decision-making for future plans, policies, and projects,
- to help OPHI develop the capacity to conduct HIAs,
- And to better understand how HIA process can be best integrated into projects that require an EIS.

In an effort to not only evaluate the product as well as the process, project staff has compiled a list of expected lessons learned that will be reviewed at the completion of this project. Some examples of expected lessons learn are:

- understanding what data and indicators are needed to complete an HIA,
- understanding the steps of an HIA and how Metro staff, OPHI, and other public health expertise is best utilized,
- how a HIA can be integrated with and completed during a EIS process,
- and understanding the resources needed by public agencies and nonprofit organizations to complete an HIA.

While the findings from the HIA are important, the learning opportunity for both OPHI and Metro is equally important. Valuable lessons will be learned through this process that will help both Metro and OPHI learn how to use HIAs as a tool.

For more information on the Lake Oswego Transit Corridor HIA, please contact Steve White at Oregon Public Health Institute at steve@orphi.org or 503.227.5502 x.228.