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MEMO

DATE: June 14, 2012

TO: Planning Commissioners

FROM: Eric Engstrom

CC: Joe Zehnder, Susan Anderson, Jonna Papaefthimiou

SUBJECT: West Hayden Island Health Impacts Update

The goal of the WHI Health briefing is to share the health information BPS has collected as part of the West Hayden Island Planning Process. The local community on Hayden Island, specifically HiNoon, the neighborhood association and the Hayden Island Livability Project has requested that the city perform a Health Impact Assessment (HIA) prior to the beginning of the hearings process for this project.

Attached to this memo you will find 4 attachments, including:

A) Hayden Island Community Profile and associated census data
B) Consolidated health information from 3 technical studies produced for this project
C) Scope of work for baseline noise monitoring
D) Transportation Modeling Analysis, PBOT (2011)

The information attached offers some of the necessary building blocks to developing a formal Health Impact Assessment. BPS has been actively working with Multnomah County on a variety of projects to integrate health considerations into land use planning work, with the Portland Plan, and now in the Comprehensive Plan update.

With the West Hayden Island project, the call for a HIA has come through meetings with the local community and in the form of an EcoNorthwest recommendation. BPS staff supports this recommendation. Our existing technical studies do contain quite a bit of detailed health-related analysis, including an entire report describing local impacts of industrial development, a detailed narrative in the EcoNorthwest Cost/Benefit report, and information included in the City's Goal 5, Economic, Social, Environmental and Energy analysis, which was reviewed by Multnomah County Health Department.

The current BPS work plan is based on the City Council resolution from July of 2011 which directed BPS to develop a legislative proposal for annexation of West Hayden Island. The current budget for technical studies does not include funding for a full blown HIA prior to City Council consideration of annexation. However, we are working with the Port of Portland to obtain better baseline data on noise and air quality which would be beneficial to the project and a more detailed HIA. There has also been some discussion about the best timing for a HIA. Many of the specific impacts will not be know until there is a specific design, which will be the subject of a federal EIS process. BPS's staff recommendation at this time is that a HIA be completed prior to the anticipated EIS. BPS intends to outline more specific commitments as part of an intergovernmental agreement with the Port, which would be adopted with the annexation action.

What gaps in information do we feel exist that may be useful for a full blown HIA in the future?

- Cumulative impacts: There is more baseline information we could collect about existing conditions on the island and in the surrounding area given the close proximity to the region's transportation infrastructure, including rail and marine routes, highways, and the Portland Airport. These impacts relate to other on-going projects, such as construction impacts from the Columbia River Crossing.
- More detailed monetization of community impacts: MCHD indicated in their review of the ESEE that public health costs need to be better presented in order to clearly state the benefits of various decisions and impacts
- Collection of baseline noise and air quality data on the island: BPS has hired an acoustical engineering firm to collect baseline noise data. The ambient noise scope of work is attached as Attachment C. BPS is also in the process of reviewing the recent air quality study produced by DEQ for the Metro area and talking with Port and DEQ to determine if additional monitoring on island would be beneficial at this time.
- While rail yard noise impacts and best management practices to reduce those impacts have been researched, the community has expressed additional concern about air emissions from rail yard activity which has not been fully explored through our research.

EcoNorthwest, our consultant, who completed the Cost Benefit Analysis, provided these additional questions that could perhaps be answered by a HIA:

- To what extent would the distance and topography between the WHI port and residences in EHI provide an effective buffer that would mitigate noise effects from the operation of the facility or the rail traffic to and from the facility?
- To what extent would port-generated rail traffic on the elevated rail line that currently crosses WHI cause a noticeable increase in noise effects over current rail traffic? For example, the time of day, duration, or both of port-generated rail traffic may cause a noticeable increase in noise effects.
- To what extent would port-generated truck traffic on NHID cause a noticeable increase in noise effects over current or projected truck traffic? For example, the time of day of truck traffic may cause a noticeable increase in noise effects.
- If a HIA determines that port-generated traffic would cause a noticeable increase in noise effects, what types of measure could mitigate these effects?
- What is the geographic extent of the affected air shed and what populations, schools, employment centers, etc. are located in this air shed?
- How will port-related activities affect air quality in the affected air shed?
- What other sources of air pollution are present near the WHI port and what is their contributions to air pollution in the affected air shed?
- What is the current prevalence of asthma and other respiratory diseases, cardiovascular disease, cancer risk, low birth weight babies in the affected air shed?

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What are the next steps?

- Report back to PSC with updates on collection of baseline data and findings
- Work with Multnomah County Health Department to complete their review of this consolidated report to see if additional annexation-related recommendations can be made to support regional and local public health goals and further develop community mitigation measures.
- Integrate these lessons into a more refined HIA scope.

Attachment B contains excerpts of the health related sections from three reports referenced on page 1 of this memo. Below is a short description of each study's health-related information and the major findings.

Economic, Social, Environment and Energy (ESEE) Analysis (May, 2012): The purpose of this ESEE Analysis is to evaluate the economic, social, environmental, and energy trade-offs associated with managing significant natural resources in the West Hayden Island study area based primarily on a specific use scenario (based on City Council's resolution). The ESEE Analysis will inform upcoming Portland City Council decisions regarding natural resource management on WHI should it be annexed into Portland.

This analysis provides initial research to determine the positive, negative, mixed and neutral consequences of allowing, limiting, or prohibiting a mix of uses on WHI including industrial, recreation, and open space. Key takeaways from the social section of the report include:

- One of the important determining factors for public health is whether people have well-paying jobs that provide insurance. Traded-sector jobs are generally family-wage, union jobs that provide insurance. 300 acres at West Hayden Island, an estimate of 1,293 direct jobs, 1,767 induced jobs and 915 indirect jobs could be created.
- Communities like the manufactured home communities on Hayden Island may be consider "vulnerable" because of the higher percentage of seniors, person on fixed incomes and person with pre-existing medical conditions.
- Natural resource areas and open spaces create natural screens and buffers between incompatible land uses, separating them and reducing a broad array of impacts. For example, the US Department of Agriculture reports that a 100-foot wide and 45-foot tall patch of trees (approximately 1/10 an acre) can reduce noise levels by 50 percent.
- Natural resources contribute to livability by filtering the air and water, cooling the air, filtering noise and light from adjacent developed areas and providing opportunities for education, recreation and exercise. Development and industrial uses on West Hayden Island would remove some of the benefits provided by existing natural resources, but also offer the opportunity to protect 500 acres of open space, and enhance access to those natural resources.

WHI Cost/Benefit Analysis, EcoNorthwest (May, 2012)
The study considers the benefits and costs that may accrue over time if West Hayden Island is developed in accordance with the Concept Plan. This is compared with a baseline scenario, which would extend the current use of WHI over the same time frame as a mostly undeveloped island that houses a dredge deposit area, utility infrastructure, and remaining open space. Some of the key findings related to community effects include:

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- There is significant uncertainty regarding the potential Q of L effects, depending on the type of terminal, how effects are measured (traffic, noise, light pollution, and air quality), and mitigation actions taken to offset effects.
- The “worst case” scenario PBOT studied assumed 2 auto terminals and a bulk terminal. This worst case scenario generates up to 2,050 daily vehicle trips, including 516 trucks. PBOT report explained that 12% of the 2035 Hayden Island traffic would be attributable to the Port development. This number is the average Port impact on all the different links in the model that was studied on Hayden Island. This modeling number is useful only as a way to understand the total system-wide impact, but it is not a representation of the impact at any one location. The PBOT modeling suggests that in 2035 about 22% of the anticipated traffic in the vicinity of the manufactured home community would be port-generated.
- Potential sources of noise include train traffic on the main line, loading/unloading in the rail yard, and truck traffic. Distance reduces the train-specific effects. Unknowns regarding noise effects include the extent to which the distance and topography between the port site and residences will mitigate noise effects, and the extent to which port train and truck traffic would cause a noticeable increase in noise effects above current train and truck traffic.
- Noise effects of rail traffic on property values: research shows a 10% reduction in property values for homes within 100 meters of a rail line, a 4% reduction for homes within 200 meters, and no effect of noise on property values for residences greater than 275 meters from a rail line. Eight floating homes are within the 200-275 meters of the existing rail line.
- Light effects may be the most easily mitigated through shielding of lights and keeping them off in areas not used.
- Port activity could generate negative local air-quality effects but may have positive regional effects if it improves the overall efficiency of freight movement, or enables a mode shift from trucks to rail/ship. A HIA could help assess net local air quality effects.
- Some illustrative examples were given to show the local economic impact of these impacts. For example, air pollution costs associated with traffic may range from $.02 to $.04 per vehicle mile travelled. They estimated that the noise effects of Port-related rail traffic might have a one time impact on the property values for homes within 275 meters of the development. Given the number of homes in that zone, they quantified this impact as $33,440. They estimated the cost of traffic-congestion related impacts as $23,500 annually.
- The report cautioned that these are illustrative examples, and recommended additional work to evaluate health impacts via a Health impact Assessment framework.
- Development creates between $1.4 and $34.4 million in additional recreational benefits.

Local Impacts of Industrial Development Report (April 2010)
BPS conducted this research at the request of the project Advisory Committee during Phase 1 of this project which began in 2008. The committee had an interest in learning more about potential community impacts from industrial development and mitigation measures other communities have implemented. Since there is no specific development proposal, the potential impacts are not known. In order to determine focus areas for the report, City staff conducted interviews and met with residents living in the following neighborhoods: HiNoon, Hayden Island Manufactured Home Park, Bridgeton, St. Johns, Cathedral Park, East Columbia, Linnton, and the Pearl. City staff also conducted interviews with neighborhood groups that currently abut industrial areas to determine areas of concern for residents. This process helped define the focus areas of air quality (dust and diesel emissions), noise, light, and traffic. Key report findings/recommendations include:

- Existing industrial development abutting residential neighborhoods in Portland highlight light, train noise, and dust /diesel emissions as major concerns
- Good neighbor agreements and frequent meetings between residents and industrial neighbors are essential to monitor concerns and develop measures to eliminate or mitigate impacts

- Light: Humans can experience increased fatigue because of excess light shining into the home at night from the surrounding environment. In addition, frequent exposure to glare raises safety concerns for drivers or those with impaired vision. Recommendations: Implementing Model Lighting Ordinance created by International Dark Sky Association (IDA) and include BMPs using light shields and timers on light sources.
- Dust emissions: (such as grain) are labeled as “criteria pollutants” by DEQ and EPA and, if inhaled, may lead to health effects that generally aggravate cardiovascular and respiratory disease. Recommendations: installation of dust control systems; including enclosed silos and baghouses. Set up area air sampling monitors at the perimeter of the facility to monitor dust leaving the site.
- Diesel emissions: Diesel particulate matter is one of the top 10 toxins in Oregon which are associated with an increased risk of many health issues, including, heart and lung disease and respiratory aliments such as asthma. Recommendations: Improved efficiency of on site diesel engines and required use of low sulfur fuels, electrical hook up for berthed ships and direct to rail loading approaches.
- Noise: World Health Organization (WHO) describes excess noise as a nuisance and can impair a person’s ability to understand what someone is saying, but on a more extreme level the WHO has identified noise as a serious health hazard that can lead to high blood pressure and heart disease. WHO guidelines for community sound levels in 2009 were set at 40dBA as the target for nighttime outdoor noise. Typical residential construction provides approximately 25dB of noise reduction for exterior noise sources. Recommendations: mandated noise study with installation of sound level monitoring at marine terminal property lines for year round monitoring; at least 100 ft. of tree buffer between facility and residential development, and sound insulation on new home construction or extensive updates.
- Traffic recommendations: Review local street freight routing choices, and consider traffic calming devices. During construction suitable staging areas should be identified. If possible, complete rail connections first to allow for barge and rail system delivery of materials. Prior to construction of each marine terminal phase, evaluate construction management plans in collaboration with the City of Portland and HiNoon to address traffic, noise and vibration issues.

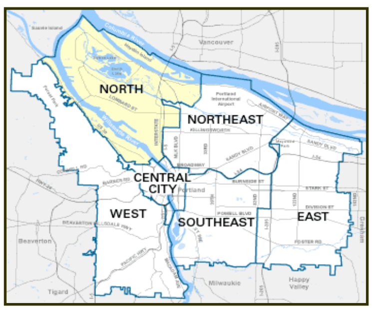
Attachment A

Demographic Profile of Hayden Island-Bridgeton Community

I. Introduction

The census geography that renders itself as a close proxy for the Hayden Island-Bridgeton community is **Census Tract (CT) 72.01**. So, the demographic and housing descriptions that follows is primarily based on Census data for the aforementioned CT. Also, to better understand the differences and similarities of this community, the following comparison geographies have been used:

- **North Portland:** This geography has been delineated for the purpose of district planning and is one of the six liaison districts of the City's Planning & Sustainability Bureau. The District is a peninsula formed by the confluence of the Willamette and Columbia Rivers. Interstate 5 generally forms the eastern boundary in addition to Piedmont, East Columbia, and Bridgeton neighborhoods. Hayden and Tomahawk Islands in the Columbia River form the northern boundary. Linnton and the Northwest Industrial neighborhoods are located along the west bank of the Willamette River and generally form the west boundary. The following map illustrates the North Portland area:



- **Portland-Vancouver-Hillsboro-OR-WA Metro:** This larger metro area is a census geography that covers a total of seven counties in the states of Oregon and Washington. Data for the metro area provides a good picture of the socio-economic connections that exist in a labor market that transcend county or state boundary lines.

II. Hayden Island-Bridgeton's Population Growth

During the 2000-2010 time period, Hayden Island-Bridgeton experienced a modest population growth. The most recent Census count provides the following population totals:

	Hayden Island-Bridgeton	North Portland	Portland Metro
Population 2010	2,270	63,561	2,226,009
Percent Change	6.6%	8.8%	15.5%
Absolute Population Gain	140	5,154	298,128

Source: Census 2000, 2010

Key Observation

- The current population of Hayden Island-Bridgeton is approximately 2,300 and the population growth rate for the 2000-2010 time period (6.6%) indicates that this area of the City grew more modestly than North Portland (8.8%). The larger Portland Metro area grew at a much more rapid pace (15%). To some extent, constraints imposed by growth in housing units impacts growth in population. Consequently, stability in housing stock in the Hayden Island community can explain the lagging population growth in this part of the City.

III. Hayden Island-Bridgeton's Age Distribution

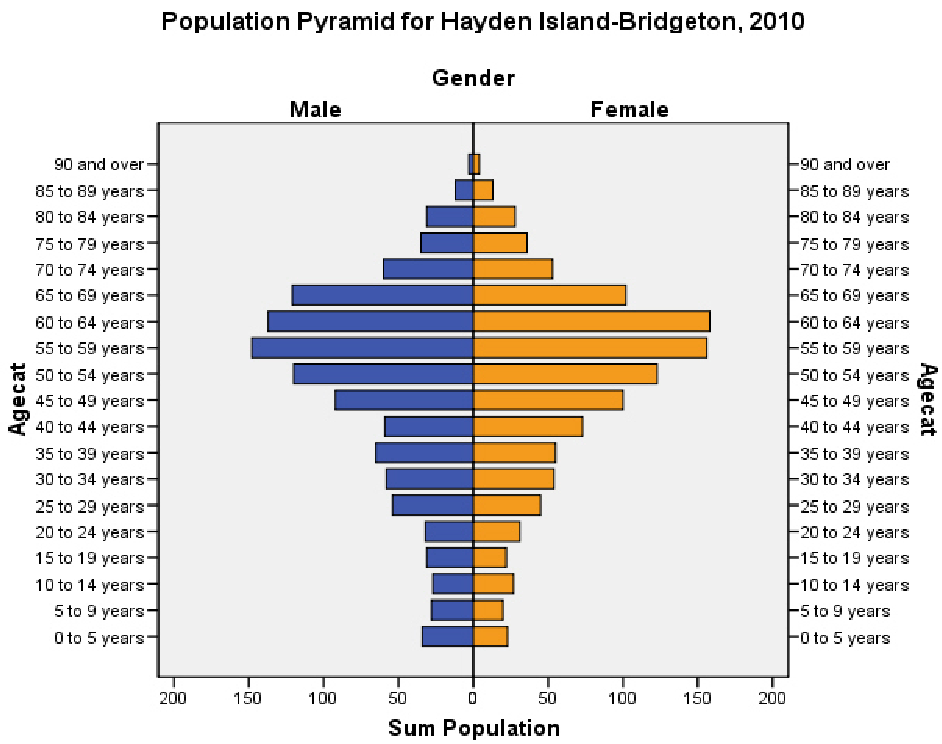
The age distribution in any given area provides great insights on the nature of the community. The following table provides detailed age distribution for the Hayden Island-Bridgeton Community:

	Number	Percent
Total population	2,270	100
Under 5 years	57	2.5
5 to 9 years	48	2.1
10 to 14 years	54	2.4
15 to 19 years	53	2.3
20 to 24 years	63	2.8
25 to 29 years	99	4.4
30 to 34 years	112	4.9
35 to 39 years	120	5.3
40 to 44 years	132	5.8
45 to 49 years	192	8.5
50 to 54 years	243	10.7

55 to 59 years	304	13.4
60 to 64 years	295	13
65 to 69 years	223	9.8
70 to 74 years	113	5
75 to 79 years	71	3.1
80 to 84 years	59	2.6
85 years and over	32	1.4
Median age (years)	**54.3**	**(X)**

Source: Census 2010

The following set of illustrations highlight the age distribution by sex for Hayden Island-Bridgeton, North Portland and the Portland Metro area:



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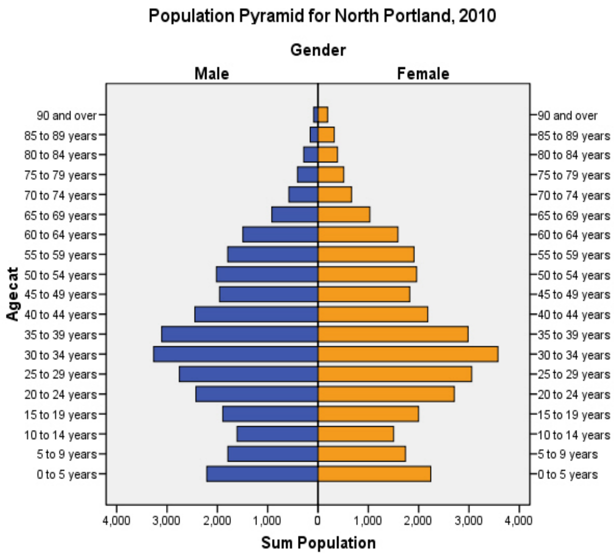
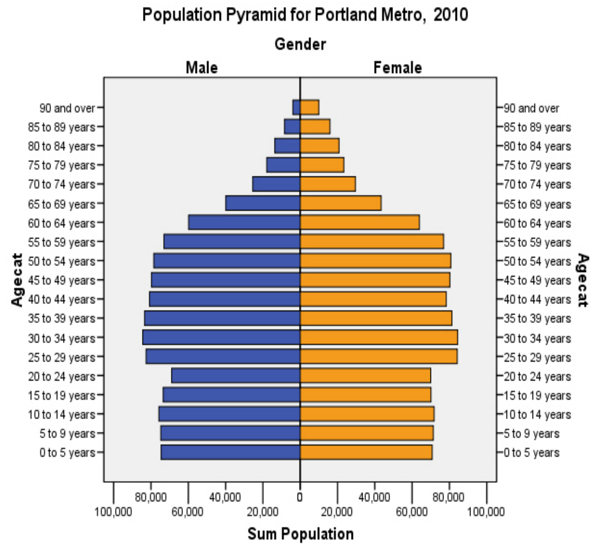




Key Observations

- Notably, the population in Hayden Island-Bridgeton is older than either North Portland or the Portland Metro region. The community's median age (54 years) is a clear indicator of this demographic trait. In comparison, North Portland and the Portland Metro area with median ages at 35 and 37 respectively, are younger.

- The proportion of older adults (55 yrs and above) constitute nearly half (48.3%) of the population totals.

- The nature of housing stock in any given area (Single-family/Multi-family/Floating-Homes/Mobile Homes) influences the type of households that reside there. Possibly, a significant presence of mobile homes (37%), a unit type that is affordable and/or preferred by older adults has influenced the concentration of this demographic group in the Hayden Island community.

IV. Hayden Island-Bridgeton's Racial and Ethnic Profile

The following table documents the racial and ethnic profile of the Hayden Island-Bridgeton community for the 2000-2010 time period:

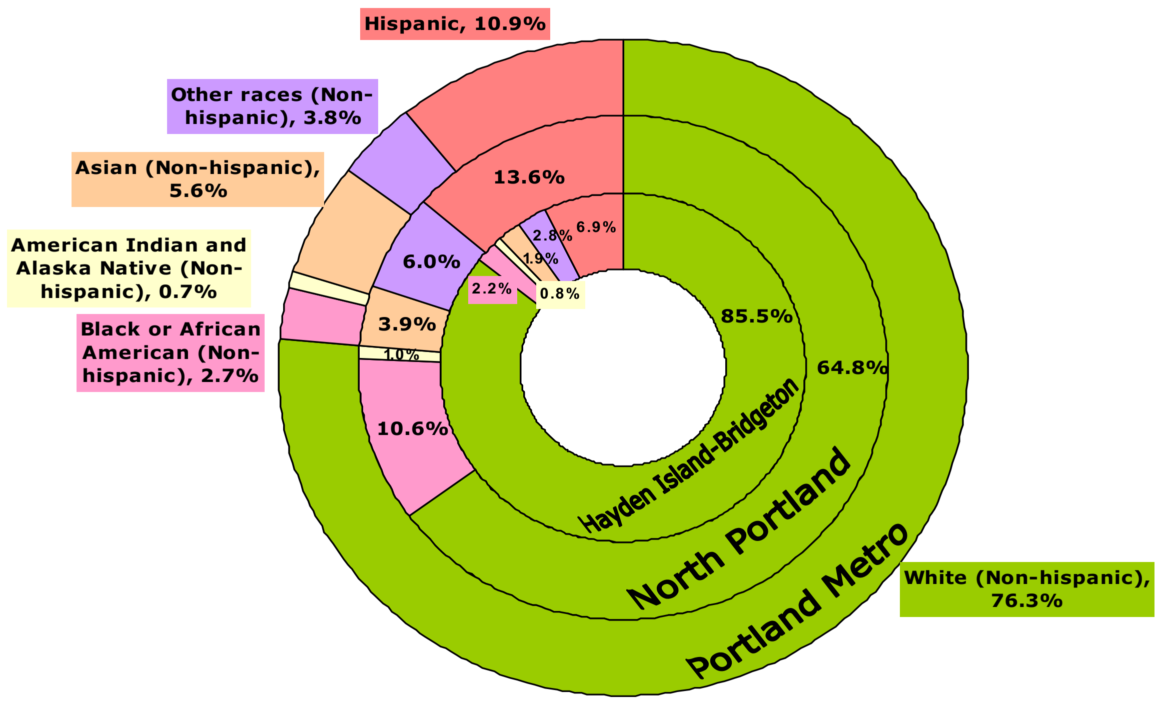
Year	Total population	White (Non-Hispanic)	Black or African American (Non-Hispanic)	Hispanic	Asian (Non-Hispanic)	American Indian & Alaskan Native (Non-Hispanic)	Other races (Non-Hispanic)
2000	2,130	1,971	37	46	23	27	26
	% Total	**92.5%**	**1.7%**	**2.2%**	**1.1%**	**1.3%**	**1.2%**
2010	2,270	1,940	49	157	43	18	63
	% Total	**85.5%**	**2.2%**	**6.9%**	**1.9%**	**0.8%**	**2.8%**

Source: Census 2000, 2010

Note: "Race" and "Ethnicity" are two distinct concepts defined and documented by the Census Bureau and the above table documents both racial and ethnic counts. Also, the category "Other races" includes groups such as the *Native Hawaiian* and *Some other race*. It is also important to note that historically, communities of color experience "undercounting" due to multiple reasons. A report titled *Communities of Color* released in 2009 documents population counts that are community verified for Multnomah County. In particular, the Native American Count is reported to be **37,745** for the County.

The following comparative illustration depicts the racial and ethnic make-up of the Hayden Island-Bridgeton community, North Portland and the Portland Metro area:

Racial and Ethnic Distribution for Hayden Island-Bridgeton, North Portland, Portland Metro, 2010



Source: Census 2010

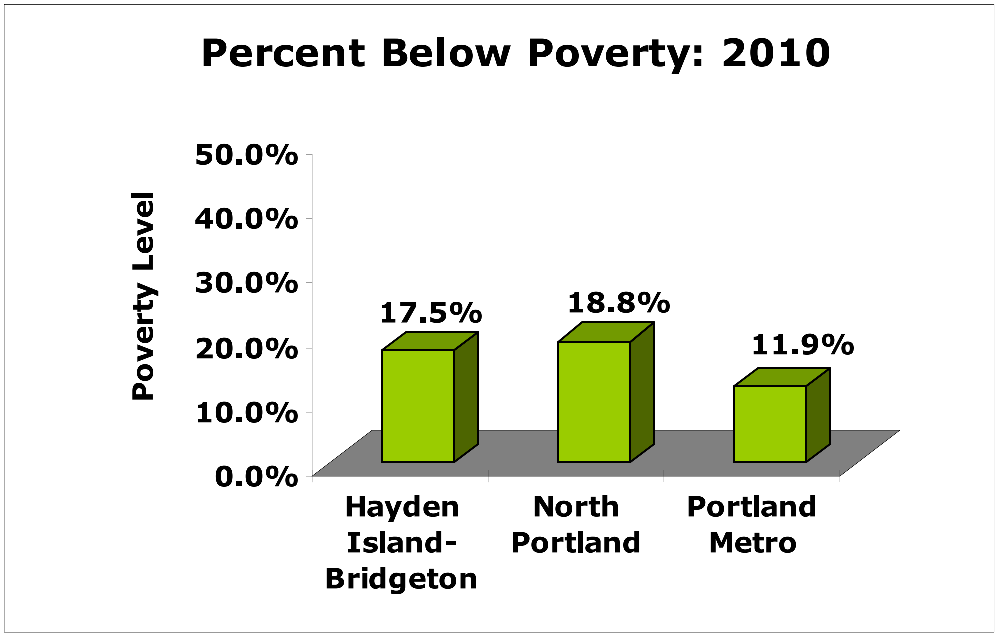
Key Observations

- Hayden Island-Bridgeton community is largely "white". This racial group makes up nearly 86% of the total population. However, like North Portland and the Portland Metro region, it has diversified in the last decade. Notably the Hispanic population in this area has grown nearly threefold (from 46 to 157) in the 2000-2010 time period.

- The racial make-up of the Hayden Island community is certainly different than the comparison geographies of North Portland and the Portland Metro. However, the ethnic composition of the community, including the growth in Hispanic population is quite similar to the comparison geographies.

V. Poverty Rates in Hayden Island-Bridgeton

The following chart provides a comparison of poverty rates in Hayden Island-Bridgeton, North Portland and the Portland Metro area:



Source: ACS 2006-2010

Key Observation

- The poverty rate for Hayden Island community is 17.5% that is just slightly less than North Portland at 18.8%. Notably, the larger metro area is experiencing significantly less poverty (12%).

VI. Housing Characteristics of Hayden Island- Bridgeton

The following set of tables provide details on housing unit counts, occupancy status and nature of housing stock in the Hayden Island community:

VIa. Housing Count and Occupancy Status

Year	2000		2010	
	Number	**Percent**	**Number**	**Percent**
Total:	**1,449**	**100%**	**1,539**	**100%**
Occupied	1,224	84.4%	1,280	83.2%
Vacant	225	15.6%	259	16.8%

Source: 2000, 2010

VIb. Housing tenure

Year	2000		2010	
	Number	**Percent**	**Number**	**Percent**
Total occupied units:	**1,224**	**100%**	**1,280**	**100%**
Owner occupied	1,012	82.7%	1,053	82.3%
Renter occupied	212	17.3%	227	17.7%

Source: 2000, 2010

VIc. Distribution of Housing Unit Types

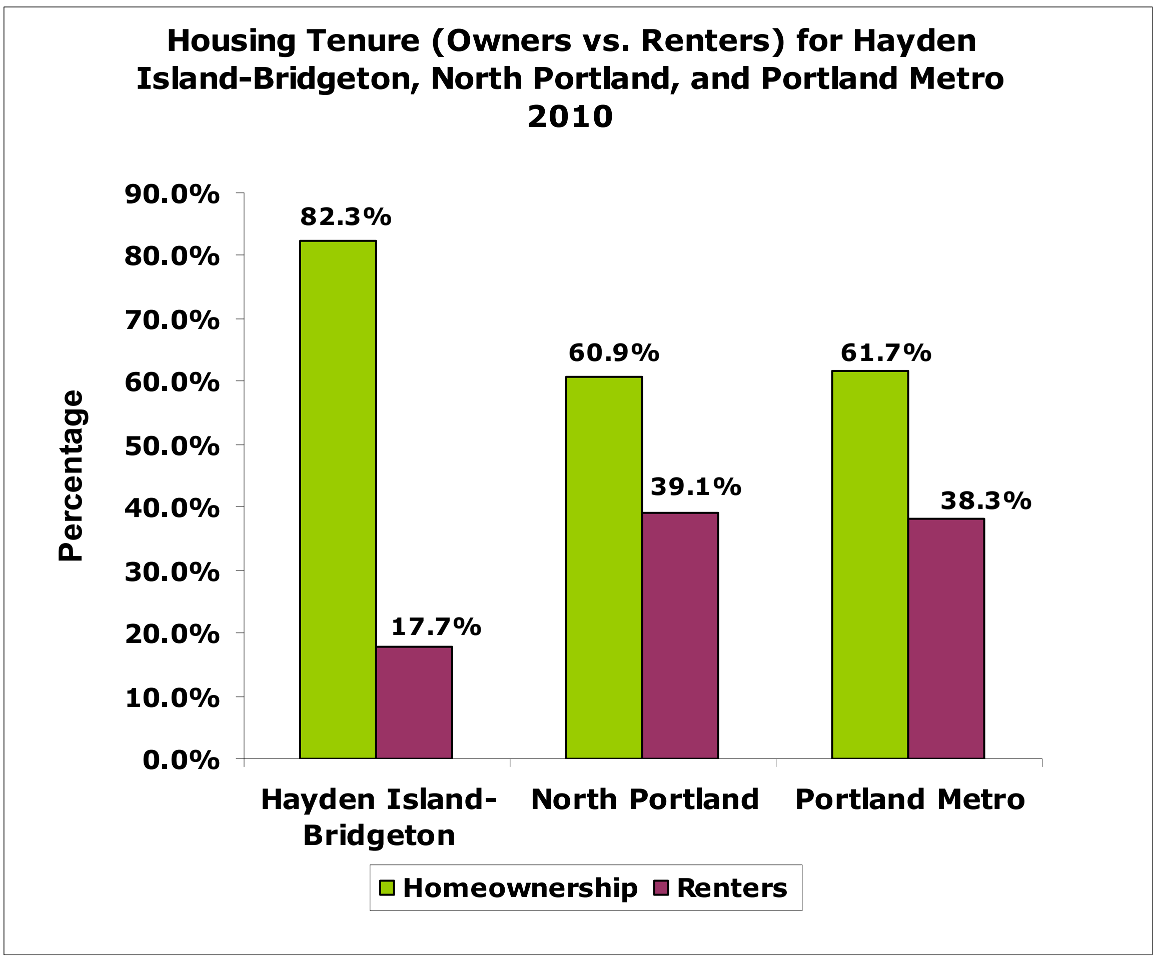
Total Units	**1230**
SF-detached	238
SF-attached	171

MF-2 units	0
MF-3 or 4 units	30
MF-5 or 9 units	120
MF-10 or 19 units	41
MF-20 or 49 units	29
MF-50 or More	47
Mobile home	454
Boat, RV, van,	100

Source: ACS 2006-2010

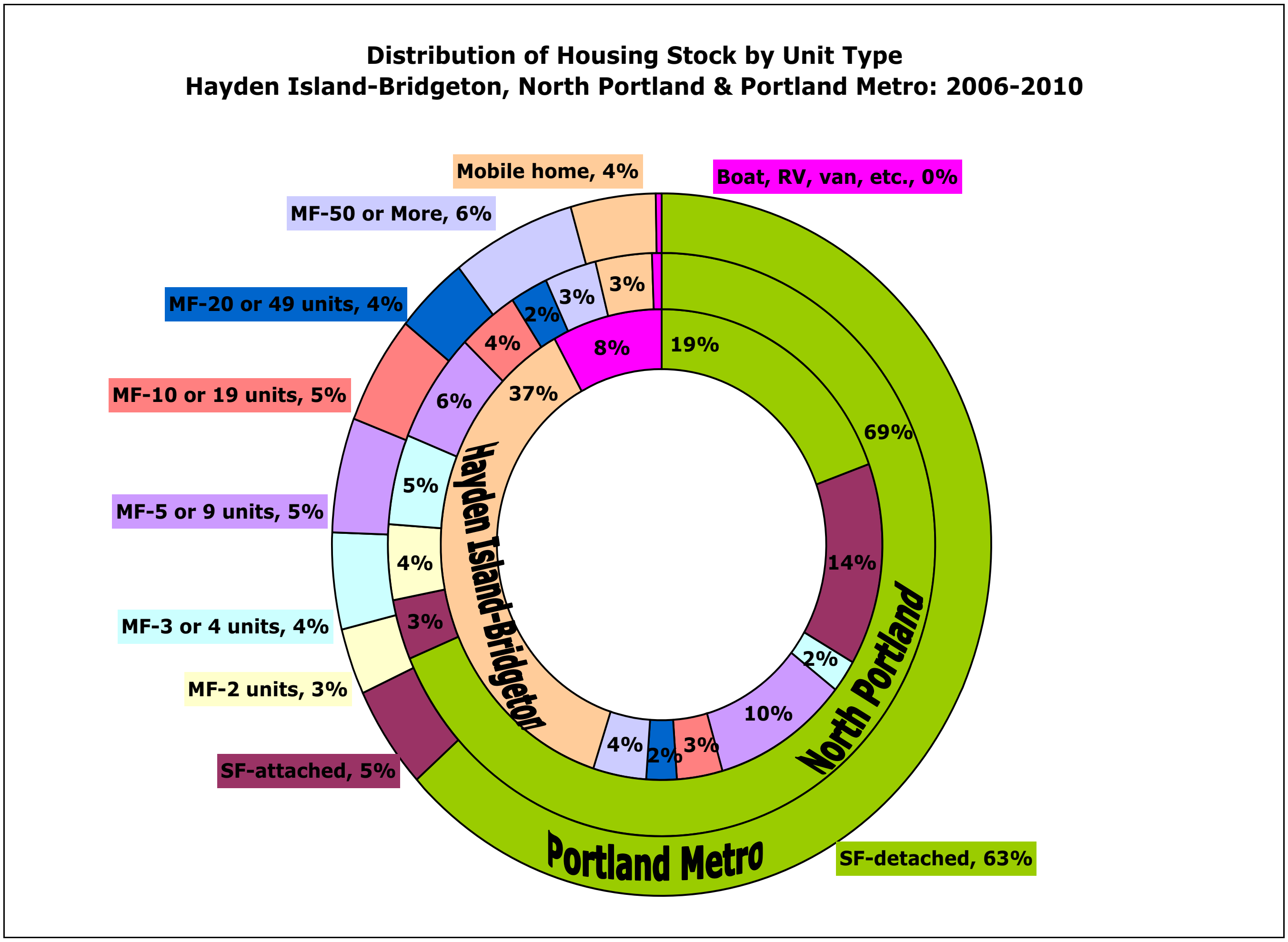
The following set of illustrations provide a comparison of the housing tenure and nature of housing stock in the Hayden Island community, North Portland and Portland Metro area:

Housing Tenure



Source: ACS 2006-2010

Distribution of Housing Types



Source: ACS 2006-2010

Key Observations

- The total housing stock in the Hayden Island-Bridgeton Community has remained fairly stable in the past decade with the addition of just 90 units. This 6% increase in housing stock is less than the production in North Portland and the Portland Metro area.

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- The strikingly high vacancy rate of nearly 17% in the Hayden Island community that has lingered during the ten year time period of 2000-2010 is largely due to the following two reasons:
    - **Units, particularly mobile homes do not sell as quickly (In 2010, 113 units which is about 43.65 of total vacant stock was up for sale);**
    - **A significant portion of the housing stock is for seasonal, recreational or occasional use (In 2010, 93 units which about 37% of total vacant stock was up for sale).**

- A significant proportion of the housing stock in the (over 37%) is Mobile Homes. This is very different from the prevalent stock (Single-family detached) in both North Portland and in the Portland Metro area. This also explains the significantly high ownership rates (82%). Mobiles homes are much cheaper to purchase but pose the hardships of vulnerability to park closures and ability to sell, regardless of the prevailing state of real estate market.

Attachment B

ESEE Social Analysis (BPS, 2012)

This section examines the social consequences of allowing, limiting or prohibiting conflicting uses for the West Hayden Island study area. The social analysis focuses on the following topics:

- Human Health and Welfare
- Historic, Heritage and Cultural Values
- Regulatory Compliance Sections

(***the historic, heritage and cultural values and regulatory compliance sections have been removed for this consolidated health piece)***

Human Health and Welfare

Employment Opportunities

One of the most important factors in determining human health and welfare is household income, which is dependant on employment. Income can influence health by its direct effect on living standards (e.g., access to better quality food and housing, leisure-time activities, and health-care services). In the United States the risk for mortality, morbidity, unhealthy behaviors, reduced access to health care and poor quality of health care increases with decreasing socioeconomic circumstances (CDC, 2011).

Today, approximately 77 percent of Portland households earn enough income to be considered economically self-sufficient (City of Portland, 2012). This means more than 20 percent of Portlanders do not make enough money to cover their basic households needs (e.g. rent). The Self-Sufficiency Index measures whether an income is sufficient to meet the basic needs of most adults, including the cost of housing, childcare, food, health care and transportation. Unlike the federal poverty measure, this standard looks at "real world" household costs, not just the cost of food. The index reflects the variation in the cost of these items by geography and the effects of taxes and tax credits on household income.

An important factor in Portland's future economic prosperity, and addressing economic equity concerns, will be maintaining and growing "family-wage" jobs. Manufacturing and distribution jobs are typically an important part of any long-term economic development strategy because often wages in these sectors are significantly higher, and they are available to those with lower levels of education.

Martin and Associates produced a report called *The Local and Regional Economic Impacts* of the Portland Harbor in 2010. The study estimated that 17,512 resident jobs in Oregon and Washington were generated by cargo and vessel activity at the public and private marine terminals in the Portland Harbor. Of these, 7,011 were generated specifically by the movement of cargo over the docks (direct jobs). Average wages of the direct jobs provided at public marine terminals in the Portland harbor is $47,760. Another 6,668 jobs were created to serve those employed by the direct jobs (e.g. restaurants, retail) and 3,833 jobs were created by firms directly related to the shipping of the cargo (e.g. maintenance and repair). In addition, it was estimated that an additional 24,685 related jobs were with firms, farms and mines that ship and receive cargo via the terminals.

Based on a maximum terminal development of 300 acres at West Hayden Island, an estimate of 1,293 direct jobs, 1,767 induced jobs and 915 indirect jobs could be created. This includes jobs on and off site within the region. Extending the interpolation of other figures to WHI, marine terminal development could generate $295 million in personal income, $234 million in business revenue, and $30 million in state and local taxes.

Having a good job does more than supply the means to meet physical needs, it also provides opportunities to be creative, promotes self-esteem, and provides avenues for achievement and self-realization. Research has indicated that the effects of unemployment include impacts on psychological function, including anxiety and depression, and correlate with impacts on physical function as measured increased utilization of health services. (Linn, Sandifer, and Stein, 1985). Research also points to financial strain as strong mechanism through which unemployment contributes to ill health. In addition it has been found that unemployment "compounds the effects of unrelated (stressful) life events" (Kessler, Turner, and House, 1988).

A 2012 informational piece published by the American Psychological Association states that "the current state of the economy continues to be an enormous stressor for Americans…Unemployed workers are twice as likely as their employed counterparts to experience psychological problems such as depression, anxiety, psychosomatic symptoms, low subjective well-being, and poor self esteem (citing Paul and Moser, 2009). The piece continues, "Like unemployment, underemployment…is unequally distributed across the U.S. population, with women, younger workers, and African Americans reporting higher rates of involuntary part-time employment and low pay, as well as higher proportions of "discouraged" workers who have given up on searching for a job (McKee-Ryan et al, 2005). Additional documentation is provided addressing effects of unemployment and underemployment on families, communities, and different populations.

Access to Nature and Recreation

Access to natural areas and open spaces has an impact on human behavior and psyche. Access can mean a range of things from viewing vegetation to bird watching to hiking or boating. Dr. Roger Ulrich of Texan A&M's Center for Health Systems and Design found that passive scenic values, such as looking at trees, reduce stress, lower blood pressure and enhance medical recovery (Ulrich et al. 1991). The presence of trees and grass can lower the incidence of aggression and violent behavior (Kuo and Sullivan, 2001b). A study of residents in public housing in Chicago found that compared with apartment building that had little or no vegetation, buildings with high levels of greenery had 52% fewer total crimes, including 48% fewer property crimes and 56% fewer violent crimes (Kuo and Sullivan, 2001a). Common green areas in neighborhoods can also increase community ties and support networks. Studies have shown that exposure to natural environment enhances children's cognitive development by improving their awareness, attention, reasoning and observational skills (Louv, 2005).

In a 2004 City of Portland Parks and Recreation survey, park users identified a need for new natural wildlife areas for recreational purposes like bird watching and nature/wildlife observation (Godbe, 2004). Another study found that Portland homeowners would rather live near urban natural areas than other types of open space (Lutzenhiser, 2001).

In 2010, ENTRIX, a project consultant for the first phase of this West Hayden Island planning effort, completed a report which provided recreational context and identified recreational development opportunities on and around WHI. The report notes that currently, authorized recreation access on WHI itself is limited to the beaches. Land-based recreation activities in the vicinity are concentrated at other public recreation sites both on East Hayden Island and on the mainland. However, a number of water-based activities occur in the Columbia River surrounding WHI, including sailing, motorized boating, kayaking, canoeing, and fishing. Several marinas and other water access points exist on East Hayden Island (in private ownership), at other points along the Columbia River, and along the Willamette River in Portland.

Potential recreational activities that 1) would further the goals outlined in the City of Portland Parks and Recreation report, and 2) are compatible with trends in outdoor recreation and the vision for recreation established by Hayden Island residents, include: boat access, trails, picnic areas and other developed facilities, and natural areas. The location and size of potential recreation facilities would need to consider compatibility between recreational activities, between recreation and and potential industrial activities, and between recreation and wildlife and wildlife habitat conservation. Appropriate management, including physical separation with screening and buffering between potentially conflicting uses, could help improve compatibility between uses.

Currently, the only park on East Hayden Island is Lotus Isle Park, located at North Tomahawk Island Dr. The park includes a new play ground, paved paths, picnic tables and many large trees. Water access is not provided at the park. Based on Portland Parks and Recreation targets for park acreage per capita, Hayden Island is currently underserved with parks.

Recreation has multiple health benefits. Exercise improves overall health which reduces public and private health care costs, improves quality of life, and may help people live longer (Nieman, 1998). Activities such as walking in forested areas help boost the immune system (Sachs and Segal, 1994). In addition, the Centers for Disease Control strongly recommends improving access to places for physical activities such as biking or hiking trails to reduce the risk of cardiovascular disease, diabetes, obesity, selected cancers and musculoskeletal conditions.

Open spaces and natural areas in the West Hayden Island study area provide not only areas to recreate, but also an opportunity for Portlanders to learn about environmental science, natural history, and cultural history of the Columbia River, islands and the Pacific Northwest. Natural areas and open spaces provide "living laboratories" for active educational programs. Many schools use natural areas as a focal point of interdisciplinary studies. For example, Whitaker Ponds in the Columbia Slough Watershed is utilized by schools year-round as a living laboratory. This model of learning has been shown to improve critical thinking skills, achievement in standardized tests and improved student attitudes about learning and civility toward others (Leiberman and Hoody, 1998).

Vegetated landscapes, parks and scenic views each contribute a "sense of place" and personal attachment to particular locations. People are socially connected to the entirety of the built and natural environmental by walking, biking and driving through areas with street trees, gardens, parks and other open spaces. Natural resources and open spaces create a sense of identity and visual variety in the city. Trees, open spaces and water bodies help define the visual appeal the Portland area. People also identify with urban landscapes including river harbors and marinas, airports, new and old structures, workplaces, museum, restaurants and stores, parks and golf courses, and other gathering spaces. Portland is often identified by pictures of the cityscape, Mt. Hood and the Columbia and Willamette rivers.

In the West Hayden Island study area, views of local and regional features including the Columbia River, Mt. St. Helens and Mt. Hood, industrial areas, and bridges contribute to the scenic character of this area and of city as a whole.

In addition, West Hayden Island provides a visual amenity in itself. West Hayden Island is visible to travelers crossing the I-5 bridge and to boaters on the Columbia River. The beach, below ordinary high water, is open to the public and many residents walk the beach to view the scenery. Natural resources can soften or buffer the appearance, noise, and other impacts of urbanization.

Air Quality

The Department of Environmental Quality PATS 2017 Pollutant Modeling Summary projects that by 2017 eight of the modeled air pollutants will be above the benchmarks for public health; two will be below the benchmarks; and one has insufficient data to determine. Many of these pollutants are associated with movement of goods via truck, rail, ship or air plane. The proposed industrial zoning and marine terminal development could have negative impacts on air quality, depending on the type of terminal.

Dust Emissions

The main pollutant of concern in grain or dry bulk storage and handling is fine particulate matter, or dust. Particle size is important because finer particles, less than 2.5 micrometers in diameter can spread quite a distance and impact human health[1]. The EPA and DEQ label this fine particulate matter as "criteria pollutants" that, if inhaled, may lead to or aggravate cardiovascular and respiratory disease. Grain dust can occur at facilities during the loading, unloading, transfer and cleaning of the grain (DEQ, 2008).

A grain or dry bulk terminal must maintain a Standard Air Contaminant Discharge Permit from DEQ for their facility emissions if they have a throughput of 10 tons or more per year (Leppaluoto, March, 31, 2010). Grain terminals may be required to do extensive monitoring and upgrade dust collection equipment, resulting in modifications to their DEQ permits, if emission requirements are not being met. Three general types of measures are available to reduce emissions from grain handling and processing operations:

- modifications to facility design to prevent or inhibit emissions,
- capture/collection systems, and
- oil suppression systems that inhibit release of dust from the grain streams (USACE, 2000).

Best management practices can also be established. For example, the grain can be stored in fully enclosed silos using baghouses at emission points. There continue to be advancements in the technology for capturing dust particulate.

Diesel Particulate Emissions

Marine terminals, depending on the operation, can be a source for a significant amount of diesel particulates. This can be generated from berthed ships, truck loading and circulation, railroads and other diesel equipment located at the terminal. Diesel particulate matter is one of the top 10 toxins in Oregon which are associated with an increased risk of many health issues, including heart and lung disease and respiratory aliments such as asthma. There are strict state and federal regulations that govern allowable levels of diesel emissions. In 1996, refiners began to produce ultra-low sulfur diesel fuel, with sulfur levels at 15 ppm for use in heavy duty highway engines. Locomotives were required to meet low sulfur (500 ppm) in 2007 and will need to meet ultra low sulfur (15 ppm) requirements in 2012.Emission from large commercial marine vessels (e.g., container ships) are being phased in, starting in 2011. It is expected that by 2030 the engine fleet will be fully turned over and particulate matter will be reduced by 380,000 tons/year. (www.epa.gov/chleandiesel/reg-prog.htm)

A number of Ports across the US are implementing programs to reduce these emissions at their terminal facilities, such as:

- radio frequency identification system to reduce waiting times for trucks
- requiring berthed ships to plug into electric grid instead of using diesel engine
- creating an incentive program for off-site trucks that encourages "fleet modernization"
- providing lower emission diesel fuel or biofuel
- value-added approaches like on-dock rail loading to reduce cargo transfers and truck miles traveled

[1] In 1996, EPA made revisions to the primary and secondary NAAQS for PM (particulate matter) to provide increased protection of public health and welfare. With regard to primary standards for fine particles (generally referring to particles less than or equal to 2.5 micrometers ([micro]m) in diameter, $PM_{2.5}$).

Also of concern are carbon emissions and the associated greenhouse effects that increase air temperature. In addition, increased impervious area would likely result in higher ground level air temperatures at and near the development site. This could contribute cumulatively to urban heat island effect generated by the City of Portland and land in the vicinity of the Portland Harbor. Increased air temperatures, particularly in the summer, can exacerbate air quality problems and associated health impacts.

California Environmental Protection Agencies released a handbook about community health and air quality in 2005. The handbook is focused on placement of new sensitive land uses, like residential, away from sources of air pollution. It is recommended that sensitive land uses not be sited downwind from Ports, or not within 1,000 feet of a facility, and preferably one-half to one mile, from rail yards. Residential development exists on East Hayden Island and along the Oregon Slough with distances ranging from .41 to .47 miles (2,165 -2,482 feet) (See attached Map A).

Vegetation areas and water bodies that comprise natural resources identified in the inventory can help maintain air quality by filtering the air and maintaining air temperature and humidity. Eliminating or reducing the quantity or quality of these natural resources may affect air quality in the local area.

Water Quality and Quantity

Water quality and quantity is important for human health and safety. The Columbia River is currently water quality limited for multiple parameters. Impaired water quality can affect people recreating in the Columbia River (e.g. fishing, swimming).

Development can have a negative impact on both water quality and quantity. Point sources and non-point pollution are addressed through federal, state and local regulations and programs. Point source discharges of pollutants to rivers, streams and wetlands require permits and on-going monitoring. However, the cumulative affects of these discharges are not easily addressed through individual permits.

In Portland, non-point source pollutants are addressed through the Stormwater Management Manual (SMM). The SMM applies to new development and redevelopment involving at least 500 square feet of impervious surface (e.g., roads, parking lots and building rooftops). Runoff from the impervious surfaces must be managed for flow into pipes and streams, and treated to maintain water quality. Preference is given to treatment types that utilize natural systems such as bioswales. In the urban context, another source of non-point source pollution is erosion from construction activities, which are addressed in the City Code Title 10.

Roads and rail infrastructure and activities can negatively affect water quality; for example, hydrocarbons and heavy metals coming from break dust.

In order for development to occur West Hayden Island, significant fill to raise the current land elevation above the base flood elevation would have to occur. Filling in of the floodplain and the addition of impervious surfaces, changes the hydrologic regime on the island. Reduced flood storage capacity could potentially affect river hydraulics (e.g., deposition and scour) immediately up and downstream of the development area, potentially causing bank erosion. Mitigation actions, such as increasing flood capacity in some portions of WHI or off-site, could minimize the affects of flood plain fill associated with development.

Natural resources, such as vegetated riparian corridors and uplands, uncompacted soil, and wetlands help maintain and improve the quality of water through filtration, uptake and cycling, and providing microclimate and shade. These natural resources also help maintain a normal hydrologic cycle that contributes to groundwater recharge and stream flow maintenance. Wetlands and the active floodplain in particular provide temporary water storage, opportunity for pollutants to settle out of the water, uptake of certain pollutants by plants, and filtration of water through the soil.

Noise

Marine Terminals can be a source of noise, both from on-site loading operations, and from the associated rail and truck traffic generated by the cargo distribution. Neighborhoods in close proximity to West Hayden Island have raised noise pollution issues related to industrial uses. Noise pollution can have a number of negative consequences including reducing enjoyment of leisure activities; contributing to health effects such as hypertension, heart disease, sleep interruption, and hormonal changes; and affecting property values proximate to the noise source.

The nearest residential areas, including floating homes and other East Hayden Island neighborhoods, are located approximately 0.41 miles from the proposed marine terminal development on West Hayden Island. The land uses between the proposed development site and the residential areas are industrial (e.g. auto auction yard) and commercial. The nearest residential areas on the northern part of East Hayden Island are also located approximately 0.5 miles from the Port of Vancouver industrial uses.

The City of Portland defines permissible sound levels by land use in Title 18 of the City Code. The maximum permissible sound level for residential areas is 55dBA for day time, minus 5dBA for night time. Maximum levels for industrial areas is 65dBA daytime, minus 5 dBA for night time. There is no difference in noise levels allowed for industrial and residential uses. The City of Portland daytime permissible sound exposure level from industrial to residential is 65dBA and 60dBA at night. Nighttime hours are between 10 pm and 7 am.

The North Portland Noise Study, drafted by the City of Portland Bureau of Development Services in 2008, documented the main sources of noise and quantified specific levels of noise in North Portland Neighborhoods (Greenbusch Group, 2008). The main sources identified include:

- Portland International Raceway (PIR)
- Railways
- Arterial cargo truck noise in residential neighborhoods
- I-5 traffic
- Airplane activity at Portland International Airport (The Greenbusch Group, 2008).

<u>Railway Horn Noise</u>
Train horn noise at public grade crossings in many residential areas has been a source of frequent complaints to the City. Noise data collected for train horn noise in Kenton has exceeded 103 dBA. The North Portland Noise Study indicated that train horn noise would most likely result in levels as high as 70 dBA inside a residence with closed windows. Similar data for train horn noise in Cathedral Park revealed sound levels in the mid-60's dBA, in-residence with windows closed. Both of these noise level situations exceeded the 2009 WHO level of 40 dBA at which sleep disturbance can occur and the City of Portland permissible sound levels.

Starting in 2010 the Federal Railroad Administration (FRA) is implementing new regulations that establish minimum (96 dBA) and maximum (110 dBA) train horn levels. In addition, the FRA has established a new method for sounding train horns at public grade crossings to lessen the impact on surrounding communities. The City's Noise Control Office will be monitoring sound levels of train horns with the implementation of the new regulations to see if there are any noticeable changes in and around some of the affected communities.

At Terminal 5 on the Willamette River, loading and unloading potash into train cars created noise impacts from the train cars bumping into one another. Developing braking techniques that minimized car bumping helped mitigate this noise impact. Another mitigation measure is forming a sound barrier with empty rail cars that helps blocks the noise of loading other cars.

Cathedral Park Neighborhood Association and Toyota at Terminal 4 have been working together to try to resolve another noise issue that has been identified by the neighborhood. During the loading and unloading of vehicles on to train cars, a sharp banging noise results from the collision of steel bridge plats. The Toyota facility has worked with the Port, neighborhood groups and the City's Noise Control Office to search for ways to reduce this noise.

Kinder Morgan's Potash facility at Terminal 5 set up perimeter monitors throughout their facility and on Sauvie Island at property lines to determine the impact of their operations. The most impactful noise events were from air traffic, the grain elevator and train car movements to and from the grain elevators. The train car noise was primarily from the train cars bumping into one another during the loading and unloading process.

Light

The International Dark-Sky Association (IDA) defines light pollution as: "Any adverse effect of artificial light including sky glow, glare, light trespass, light clutter, decreased visibility at night, and energy waste (International Dark Sky Association)." Below is a brief description of the affect of light pollution:

- Humans can experience increased fatigue because of excess light shining into the home at night from the surrounding environment.
- Frequent exposure to glare raises safety concerns for drivers or those with impaired vision.
- The poor lighting design wastes energy and contributes to greenhouse gas emissions (Benya Lighting Design, 2010).
- Light clutter is excessive lighting potentially from a variety of sources that can cause distraction; such as poorly spaced street and building lighting.
- Sky glow is a combination of all of the above especially poorly directed lighting that limits sight of night stars.

A number of factors contribute to light pollution including 1) the type of light being used, 2) an inefficient fixture, 3) lack of understanding of how much light is needed, 4) incorrect installation of timers, or 5) lack of knowledge of how to direct or redirect lighting to meet lighting needs. Some of the biggest contributors of light pollution include:

- City street lights
- Signs (e.g. Times Square)
- Outdoor sales lighting (e.g gas stations, auto dealers)
- Industrial lighting

Marine Terminals have large exterior work and storage areas that are often illuminated for safety and security reasons, as well as to allow 24-hour operation. This light can affect adjacent properties as well as wildlife in adjacent natural areas.

Natural resource can reduce negative impacts associated with light by creating a buffer between sites or land uses. Other ways to control excess lighting include shielding lights, reducing light wattage, putting lights on timers, changing street light features and requiring light shields or redirection.

Light pollution also affects fish and wildlife; please refer to the environmental section (5.c) for additional information.

Traffic

Portland Bureau of Transportation noted in their WHI Transportation Modeling Analysis that with Port development and no WHI bridge traffic from the Port would account for 12 percent of the total volume on Hayden Island Streets (PBOT, 12/2011).

It is anticipated that most of additional port-related traffic would be automobiles driven by port employees rather than trucks. As described in the analysis, the makeup of the total daily traffic to and from the port would be 516 truck trips and 1,534 auto trips. Ports could help reduce traffic emissions by requiring that all trucks comply with specific air pollution standards. As part of the Columbia River Crossing project a light rail station is planned to be located on East Hayden Island. The Port could provide transit passes, van shuttles or a fleet of bikes for use to and from the station.

The EPA, through their Clean Diesel Programs, has been strengthening regulations to reduce particulate matter that has been linked to human health impacts for years. Cleaner technologies reducing diesel emissions and their impact on human health impacts have included retrofits for current truck fleets, new engines, full fleet replacement and cleaner fuels. Beginning June 1, 2006, refiners began producing ultra-low sulfur diesel fuel with sulfur levels at or below 15 parts per million (ppm) for use in heavy duty highway diesel engines.

In addition to reducing emissions from existing diesel fleets, these cleaner fuels enable the use of advanced after-treatment technologies on new engines. Technologies like particulate traps, capable of emission reductions of 90% and more, are required under new standards which began phasing in for the highway sector in 2007, and will begin taking effect in the nonroad sector in 2010.

These programs will yield enormous long-term benefits for public health and the environment. By 2030, when the engine fleet has been fully turned over, particulate matter (PM) and nitrous oxides (NOx) will be reduced by 380,000 tons/year and 7 million tons/year, respectively. This will result in annual benefits of over $290 billion, at a cost of approximately $15 billion. (EPA, Clean Diesel Home Page, 2012)

It is projected that the additional port traffic would not cause congestion or access problems for East Hayden Island drivers, in part due to the expected improvements that will be made to the street system and the Interstate 5 access as part of the Columbia River Crossing project and future street improvements as laid out in the Hayden Island plan, and in part due to the relatively small amount of additional traffic generated by the port in relationship to the future base traffic system's capacity.

Other uses allowed conditionally in heavy industrial zones (e.g., commercial parking, event facility) could generate considerable additional vehicular traffic and associated fuel consumption and air emissions, though no analysis has been conducted for these potential uses. Although these uses would not involve the energy consumption associated with cargo shipping and receiving, the additional vehicular traffic could be more likely to occur during PM peak traffic periods than the traffic associated with marine terminals. This could result in more substantial localized air quality impacts. The impact could be tempered if a new light rail station is built on East Hayden Island and by providing employee incentives to encourage use of public transit, such as transit passes.

Attachment B

Screening and Buffering

Natural resource areas and open spaces create natural screens and buffers between incompatible land uses, separating them and reducing a broad array of impacts. For example, the US Department of Agriculture reports that a 100-foot wide and 45-foot tall patch of trees (approximately 1/10 an acre) can reduce noise levels by 50 percent (1998). Trees can also reduce the off-site impacts of lighting or visual impacts from intensive development.

As noted above, noise and light are of significant concern among neighborhood residents living in close proximity to West Hayden Island. The waterways and riparian vegetation on the island can create a buffer between these uses. Trees and vegetated areas can also add soothing sounds of wind and bird song.

As a result of noise mitigation efforts at Terminal 4 on the Willamette River, a recommended vegetation buffer of at least 100 feet can reduce noise and light impacts between terminal operations and residential development. Management at other ports rely on buffers to help mitigate noise, light and other effects of port operations on adjacent neighborhoods. For example, the Port of Tacoma purchased 31 acres as a noise, visual and light buffer between the port and neighboring residential areas.

Vulnerable Communities

In considering the consequences of development in the study area it is important to address potential impacts on vulnerable communities who often disproportionately affected by impacts such as air quality, noise, light, and traffic.

The US Census information provides general data for baseline descriptors of the population. A single census tract covers all of Hayden Island, east and west. Hayden Island's population, persons 16 years or older, is 1,968. Unemployment on the island is slightly hirer than the metro region, 6.2% as compared to 5.8% city-wide. The median household income for Hayden Island is $46,000 which is also lower than the median household income for the region, $56,000.

The community located closets to the West Hayden Island potential development site is a 440 household manufactured home community. Because the manufactured home community is only a portion of the census track that covers all of Hayden Island, there are not detailed statists about the demographics in the community. In 2008, CASA of Oregon conducted an affordable housing survey and collected some information about the community. Approximately 800 people live in the community and that accounts for approximately 38% of the total population on East Hayden Island. The average home value within the manufactured home community is $13,900, making the homes much more affordable than the rest of East Hayden Island. The average home sale price for all of East Hayden Island combined in 2008 was approximately $230,000 to $350,000. Roughly 54% of the residents were 55 or older and 65% were on a fixed income. Most of the residents rent their home at an average of $562 per month.

Communities like the manufactured home communities may be consider "vulnerable" because of the higher percentage of seniors, person on fixed incomes and person with pre-existing medical conditions. Looking through an equity lens, vulnerable communities may be more susceptible to the impacts of development. The manufactured home community is located in close proximity to West Hayden Island and to the current Columbia River Crossing project.

It is difficult to determine the exact health implications of potential development on West Hayden Island without more detail about the types, location and extent of the terminals that would be present.

Attachment B

The ECONorthwest Cost/Benefit Analysis recommends a local Health Impact Assessment be completed. Please see the above sections for examples of best management practices.

Attachment B

EcoNorthwest: Excerpt from the WHI Cost/Benefit Analysis: Local Effects Section (2012)

I. Introduction

We studied the potential effects of the Development Scenario on the local community of East Hayden Island (EHI) for three reasons. First, residents of EHI have expressed concerns over how the Development Scenario could affect their island community and quality of life.[2] West Hayden Island (WHI) sits in close proximity to EHI, which means residents, workers and business owners in EHI will likely experience the bulk of any significant negative effects of the Development Scenario—to the extent that such effects occur. Second, the experiences of residents of other neighborhoods near port and industrial developments in the Portland area and elsewhere highlight the potential effects of a WHI port on the quality of life in adjacent neighborhoods. These experiences also shed light on measures that could mitigate potential negative effects. Third, the impacts of the Development Scenario on the quality of life in EHI is relevant to our description of the overall distribution of effects of the Development Scenario.

The Development Scenario is the latest in a series of changes that will or have affected life on EHI for residents and businesses. Through community groups such as the Hayden Island Neighborhood Network (HINooN) and the Hayden Island Livability Project (HILT), residents and business owners organize, become informed and express their concerns and comments on a range of developments such as the Columbia River Crossing (CRC) project, the proliferation of video-poker bars, the disposal of dredge material on WHI, and now the proposed port facility on WHI. The eastern edge of the WHI port would sit approximately one-half mile from the western edge of the nearest residential area in EHI.[3]

Residents' concerns focus on the close proximity of the development and the potential consequences on their quality of life caused by the construction and operation of a port facility that close to home. This portion of our analysis focuses on the effects of the Development Scenario on the quality of life (Q of L) in EHI. By quality of life we mean factors such as noise, light pollution, air quality, and traffic concerns. As we explain elsewhere, uncertainty exists regarding the types of development that will take place on WHI and when the development will occur. More information exists about some aspects of the Development Scenario, e.g., the configuration of the rail line, than about other aspects, e.g., what activities will take place on the land set aside for marine-industrial uses and how these activities would affect EHI. These data constraints and uncertainties surrounding the Development Scenario prevent us from quantifying and monetizing the effects on Q of L measures. Instead, we identify the major categories of quality of life concerns (e.g., noise effects), describe the potential effects as best the available information will allow, and, in some cases, summarize quantified measures of effects from other studies of similar port or industrial developments on local Q of L. We stress that these summaries are *illustrative* and we do not present them as measures for the WHI project.

This portion of our analysis has two parts. In the first part, which is Section II below, we describe the Baseline Scenario for EHI and current Q of L issues. By Baseline Scenario, we mean conditions that exist now and are projected to exist in the near future. This description includes information on trends and developments that will or could affect EHI, but which are unrelated to the WHI port. These developments include the CRC project, and proposed developments on EHI as outline in the Hayden Island Plan.

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[2] Oregon Consensus. 2008. *West Hayden Island Proposed Annexation and Rezoning Assessment Report*. Prepared by Oregon Consensus. November.

[3] As currently depicted by WorleyParsons and Anchor QEA in "Alternative A: West Hayden Island Concept," January 20, 2010.

In the second part, which we describe in Section III below, we describe the potential effects of the WHI port on Q of L under the Development Scenario. In some cases we draw on analyses conducted by City of Portland staff or other consultants specific to the WHI port, e.g., a study of how the Development Scenario could impact traffic on Hayden Island and in surrounding areas. In cases where WHI-specific information was not available, we reviewed the available literature and summarize the literature in the context of WHI. We also conducted a number of key-informant interviews of EHI residents to help us understand the potential effects of the WHI port on Q of L concerns.[4] Our analysis included how the proposed bridge that would connect WHI with Marine Drive could affect the extent to which the Development Scenario would affect the Q of L of EHI residents.

II. Baseline Scenario

Our analysis of the Baseline Scenario of Q of L for EHI has two parts. In the first part, we describe the current conditions in EHI and current Q of L concerns. In the second part, we describe projected future conditions in EHI as described in planning documents and other sources, but which are unrelated to the WHI port. We identify which current Q of L concerns may be mitigated by proposed or planned changes for EHI, which Q of L concerns likely will persist in spite of planned changes, and any new Q of L concerns that planned changes could cause. With this description as background, we describe the potential effects on Q of L specific to the Development Scenario in Section III.

As described in a recent report by the City of Portland, EHI is home to approximately 2,200 permanent residents living in 1,600 housing units that include a mix of single-family residences, condominiums, manufactured homes, floating homes, and boat "live aboards." EHI's population grows in summer when roughly 5,000 boat owners occupy the island's available moorage sites. Approximately 240 business operate on EHI and employ nearly 3,000 workers. Retail businesses range from small convenience shops to big-box retail outlets and includes restaurants, shops, bars, and marinas. EHI also includes a number of commercial and industrial operations.[5]

Land-use types are not uniformly distributed across EHI, and, as we describe in the next section, this fact influences the potential Q of L effects of the WHI port. The I-5 highway bisects EHI. To the east is a large number of floating homes, the largest system of boat moorages on the Columbia River, single-family homes and condominiums, and much of the small-scale retail and some of the commercial uses.[6] Because of the large number of boat moorages, floating homes and marine-related businesses, some residents who live on the east side of EHI describe the lifestyle as "resort-like" and "easy-going."[7] In general, compared with households west of I-5, households on the east side have higher household incomes (medium household incomes of $53,000 for east EHI vs. $37,000 for west EHI), a smaller percentage of households living in poverty (13% of households in east EHI vs. 22% for west EHI), and a

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4 The key-informant interviews of residents of EHI included: attending a meeting of the Hayden Island Livability Project during which participants raised questions and concerns about WHI, and interviews with Victor Viets, Ron Schmidt, Corky Koiler, Timme Helzer, Tom Dana, and Martin Slapikas. These interviews took place during January and February of 2012.

5 City of Portland, Bureau of Planning and Sustainability. 2009. *Hayden Island Plan*, August 19, p. 1-3.

6 Hayden Island Neighborhood Network, http://www.myhaydenisland.com/; City of Portland, Bureau of Planning and Sustainability. 2009. *Hayden Island Plan*, August 19; Google Maps of EHI.

7 Key informant interviews of EHI residents.

greater percentage of population with a post-secondary education (36% for east EHI vs. 17% for west EHI).[8]

To the west of I-5, land uses include commercial and manufacturing, the Jantzen Beach SuperCenter shopping mall and big-box retail businesses, office buildings, a manufactured-home park (the largest such park in Oregon), floating homes, a commercial marina, and over 190 acres of land zoned for industrial use on the western edge of EHI, which includes a large auto-auction yard that stretches the width of the island.[9] Residents of the manufactured-home park include low-income households, people with disabilities, and those living on fixed incomes.[10] Residential units in the manufactured-home parks and some floating homes are the homes closest to the WHI port. Many are adjacent to North Hayden Island Drive (NHID), which trucks and other traffic would use to travel between the WHI port and I-5 if the bridge connecting WHI and Marine Drive is not constructed.

I-5 provides the only (non-boat) access on or off EHI. The stretch of I-5 a few miles north and south of EHI is severely congested.[11] This creates problems for local residents, workers, and shoppers who can sit in rush-hour type delays at any time waiting to get off the island or on I-5 trying to access the island. Accidents, holidays, sporting events, bridge openings, etc. can compound congestion and delays. The CRC, which we describe in more detail in Section III, is designed to mitigate the I-5 bottleneck and improve access on and off EHI.

The concentration of 12 video-poker and lottery bars in two adjacent strip malls—which locals refer to as “casino row,” or “lottery row”—creates a casino-like atmosphere that concerns local residents. The close proximity to Vancouver, WA, and the fact that Washington does not permit video poker, attracts Washington residents to EHI.[12] These bars generated approximately $10 million in lottery commissions in 2010, which does not include food, alcohol, or tobacco sales.[13] Casino row also draws customers by offering low cost alcohol and cigarettes.[14] According to police and news reports, since casino row began operating, robberies, drug dealing in parking lots, and other crimes have increased significantly, which creates safety concerns for some residents.[15] In October of 2011, a Vancouver, WA man was injured in a suspected gang-related shooting on casino row.[16] The proposed CRC will physically displace

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8 U.S. Census. Census Bureau. 2010. American Community Survey 2006-2010. Block Group 1 and 2, Census Tract 72.01, Multnomah County, Oregon.

9 Hayden Island Neighborhood Network, http://www.myhaydenisland.com/; City of Portland, Bureau of Planning and Sustainability. 2009. *Hayden Island Plan*, August 19 (*Hayden Island Plan*, 2009); Google Maps of EHI.

10 Key informant interviews of EHI residents.

11 Rose, Joseph. 2010. “Daily Beast says Portland’s I-5 drivers have nation’s 16th worst commute,” *The Oregonian*. Thursday, January 21. http://blog.oregonlive.com/commuting//print.html.

12 Law, Steve. 2011. “State fumbles ‘Lottery Row’ fix,” *Portland Tribune*. November 17.

13 Manning, Jeff. 2011. “Problems with Oregon Lottery video poker at shopping center on Hayden Island prod consideration of new rule,” *The Oregonian*. November 11.

14 Law, Steve. 2011. “State fumbles ‘Lottery Row’ fix,” *Portland Tribune*. November 17.

15 Manning, Jeff. 2011. “Problems with Oregon Lottery video poker at shopping center on Hayden Island prod consideration of new rule,” *The Oregonian*. November 11; Law, Steve. 2010. “’Lottery row’ a magnet for crime,” *Portland Tribune*. December 16.

16 Reeden, Rim. 2011. “Man injured in Hayden Island shooting,” *Portland Tribune*. October 30; Thompson, Jeff. 2011. “Man hit in gang-related Haden Island shooting,” *KGW.com*. October 30.

the two strip malls that make up lottery row. Lottery officials say that changing regulations and required license renewals in 2015 will reduce the number of permitted video-poker and lottery bars that operate on EHI. Some residents, however, have concerns that business owners will find ways around the CRC displacement and any proposed licensing changes to maintain the revenues that these bars generate.[17]
EHI has little open space but residents regularly access the beaches on WHI. Lotus Isle Park, a 1.7 acre park sits on the southern shore of the island, east of 1-5.[18] The key informants we spoke with acknowledged that EHI lacks park space, but noted that EHI residents regularly walk along the beach below the high-water line into WHI. The beaches on WHI are also accessible by boat, which many EHI residents have.[19] According to the Hayden Island Plan, the single developed park in EHI is inadequate and the area is underserved by parks.[20]

Residents of EHI hear noise from planes, trains, and ships. EHI sits in one of the flight paths for Portland International Airport. This places EHI in the Portland International Airport Noise Impact Zone, which limits residential housing to areas that do not exceed a day-night average noise level (ldn) of 68.[21] Roughly the southern half of EHI has ldn measures of between 65 to 68 dB. The northern half of the island has ldn reading of 68 dB or above.[22] Given these noise levels, zoning restrictions prohibit new residential housing in areas that were not already zoned for housing before 1981.[23] According to the key informants we spoke with, residents of EHI can also hear horns from trains on the Washington side of the Columbia River, and horn blasts from ships in the River and in the Ports of Portland and Vancouver.[24]

Some EHI residents have concerns about the toxicity of dredge material deposited on WHI. The proposed site of the WHI port includes an area currently used as a disposal site for dredge material. This material comes primarily from dredging operations that maintain the ship canal and port areas on the Columbia and Willamette Rivers. Some EHI residents have concerns that the dredge materials contain toxic chemicals.[25] According to the Oregon Department of Environmental Quality (DEQ), however, the sediment does not pose a health hazard. DEQ analyzed the dredge material and concluded, "… that contaminant concentrations were at naturally occurring levels for metals or below screening values for people and animals and would not have an adverse impact."[26] Specific to residents

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17 Key informant interviews of EHI residents; Law, Steve. 2011. "State fumbles 'Lottery Row' fix," *Portland Tribune*. November 17.

18 *Hayden Island Plan*, 2009. Page 2.

19 Key informant interviews of EHI residents.

20 City of Portland, Bureau of Planning and Sustainability. 2009. *Hayden Island Plan*. September 18, 2009. Page 3.

21 Ldn values are decibel measures weighted by factors for annoyance, for example time of day or other considerations. Pilip-Florea, Shadrach, 20009. "Hayden Island: Strategic Resource for Sustainable Urban Future?" *Quarterly & Urban Development Journal*, 4th quarter. PSU Center for Real Estate. Page 22.

22 *Hayden Island Plan*, 2009. Page 8-9.

23 *Hayden Island Plan*, 2009. Page 3.

24 Key informant interviews of EHI residents.

25 Key informant interviews of EHI residents.

26 Oregon Department of Environmental Quality. *Beneficial Use of Solid Waste, Beneficial Use Determinations Port of Portland Post Office Bar, Questions and Answers*. www.dep.state.or.us. (DEQ Dredge Q and A)

of Hayden Island, DEQ concluded, "that there would not be an adverse impact to people or the environment, including concluding that there would be no impact to residents on West Hayden Island."[27]

We summarize the current Q of L concerns or issues of EHI residents and businesses as follows:

- I-5 is the single on-off access for the island. The frequent and extensive congestion on I-5 imposes hardships on residents, business owners and their customers as they travel to and from the island.
- Casino row, and the associated increase in crime, concerns residents because it reduces their sense of personal safety.
- EHI has little park or open space areas. Some residents say they access beaches on WHI by walking or boat. City planning documents list EHI as an area underserved by parks.
- EHI sits in the flights path of Portland International Airport and the associated Noise Impact Zone for the airport. Noise levels on the north side of EHI measure at the maximum limit permitted for residential areas. Noise levels on the south side are just below the maximum limit.
- Some EHI residents have concerns about the toxicity of dredge spoils deposited on WHI. DEQ concluded that the dredge materials on WHI pose no health concerns.

Factors unrelated to the Development Scenario will affect EHI in the future. Looking out 30 or 50 years no one can say today what all these factors will be, however we do have information today about two of the likely factors. The first, the Columbia River Crossing (CFC) project, aims to reduce congestion on I-5, improve vehicle access on and off Hayden Island, and bring light-rail to the island. The second, the Hayden Island Plan, describes planning goals and strategies to improve accessibility and livability on the island. Neither of these potential developments are without controversy. For the purposes of our analysis, we look to the CRC for information on the likely future traffic conditions on I-5 and EHI. We look to the Hayden Island Plan for the likely future growth and development of EHI.

As described in a preliminary report by the City of Portland's Bureau of Transportation, the CRC is projected to alleviate the current congestion on I-5 and associated back-ups on to EHI streets.[28] The City's transportation analysis took into account the housing and population increases projected in the Hayden Island Plan. According to the report, the CRC improvements and planned street upgrades on EHI are projected to alleviate congestion on I-5 and EHI through 2035. Press reports describe the CRC as a long, expensive process. Supporters and detractors alike agree that even though the process is moving forward, uncertainty exists as to the ultimate timing, cost or configuration of the final project.[29] Some critics of the project are concerned that projected population increases in the

27 DEQ Dredge Q and A.

28 Hillier Bob, N. Zhou, and J. Gillam. 2011. Memorandum: *DRAFT West Hayden Island Transportation Modeling Analysis: Phase I – Planning Level Network Analysis.* December 9.; Personal Communication with Bob Hillier, February 6 and 14.

29 Damewood, A. 2012, "White House sets aside $39 million for CRC work," *The Columbian*, www.columbian.com, February 14; Manning, J. 2012, "Columbia River Crossing officials suggest significant downsizing to trim $650 million from the controversial project," *The Oregonian*. January 19; Carinci, J. 2010. "Some fear bridge will lead to sprawl," *Daily Journal of Commerce*. February 22; Duin, S. 2011. "In the Columbia River Crossing bridge game, we're the dummies," *The Oregonian*. July 11; Manning, J. 2011. "Columbia River Crossing opponents lose first ruling on bridge project," *The Oregonian*. October 27; Manning, J. 2011. "Traffic estimates on Columbia River Crossing further muddy the financial picture," *The Oregonian*. July 19.

Portland-Vancouver area, and the associated increase in economic activity, will generate traffic that congests I-5 again in the not too distant future. According to these critics, the CRC may only temporarily address the area's traffic problems.[30]

According to the Final Environmental Impact Statement (FEIS), the CRC will displace 35 floating homes, 39 business that currently employ over 600 workers, and the bars on casino row.[31] Local residents express mixed feelings about the project. They welcome the relief from traffic congestion and improved accessibility, but have concerns about the five-year construction period and how the final configuration and operation of the project will affect their lifestyle.[32]

According to the CRC FEIS, "The traffic noise modeling in the Portland area indicates that there would be no traffic noise impacts to any of the noise-sensitive properties identified." The light rail would, however, cause "moderate" noise impacts for some floating homes near Jantzen Beach. Proposed mitigation measures include installing sound barriers, acoustical absorbent sound walls and increasing the height of traffic barriers to act as sound barriers as well.[33]

The City of Portland developed the Hayden Island Plan with input from island residents and business owners. The Hayden Island Plan includes planning goals and strategies to improve accessibility and livability on the island. Major components of the Hayden Island Plan include:[34]

- Maintaining current housing, including floating and manufactured homes, and adding up to 2,800 new dwelling units. The planned new developments include transit-oriented housing adjacent to the proposed light rail stop.

- Maintaining the industrial land uses on the western edge of EHI.

- Modernizing and improving the Jantzen Beach SuperCenter and incorporating mixed-use development on the site.

- Developing a park with beach access to the Columbia River.

- Improving accessibility to and from the island as part of the CRC. This includes a new interchange for I-5 at HI, new bridges across North Portland Harbor and the Columbia River, a light-rail stop on the island, and pedestrian and bike paths on the light-rail bridge.

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30 Letter from Lillian Shirley, Director, and Gary Oxman, Health Officer, Multnomah County Health Department to Doug Ficco and John Osborn, Co-Directors, Columbia River Crossing, June 9, 2008.

31 Oregon Department of Transportation, Washington Department of Transportation, U.S. Department of Transportation, et al. 2011. *Columbia River Crossing Final Environmental Impact Statement and Final Section 4(f) Evaluation*. September. Pages 3-88 and 3-94. Colombia River Crossing Final Environmental Impact Statement. 2011. Chapter 3: Existing Conditions and Environmental Consequences.; Manning, J. 2011. "At Hayden Island interchange, the Columbia River Crossing will cast a huge footprint." *The Oregonian*. September 24.

32 Manning, J. 2011. "At Hayden Island interchange, the Columbia River Crossing will cast a huge footprint.: *The Oregonian*. September 24; Key informant interviews of EHI residents.

33 CRC FEIS, 2011. Pages 3-297, 3-302, and 3-312.

34 City of Portland, Bureau of Planning and Sustainability. 2009. *Hayden Island Plan*. September 18, 2009. Page 6-7, 14-20.

- Improving and expanding the local street networks.

The Hayden Island Plan takes into account the new traffic generated by the projected increase in the island's population and visitors. According to past and current traffic modeling, the projected increase in traffic will not congest the Hayden Island I-5 interchange, assuming the current configuration of the CRC.[35]

Some residents of EHI expressed concerns that developments on the island will deviate from the details in the Hayden Island Plan in ways that do not take their concerns into account. They point to modifications of the CRC as one example of how actual developments may occur differently than planned.[36]

Based on the information available today, the CRC and Hayden Island Plan may affect Q of L concerns and issues for EHI. Below, we summarize the information on current Q of L concerns and information on how the CRC and Hayden Island Plan may influence these issues:

- The CRC and associated improvements to the local network of streets on EHI, are projected to alleviate congestion on I-5 and EHI. These developments would also improve accessibility to and from EHI by adding new vehicle bridge, a new light-rail stop, and pedestrian and bike paths on the light-rail bridge. This modeling takes into account the growth and development of EHI as described in the Hayden Island Plan, and the associated increase in on-island traffic generated by the projected growth. Some EHI residents have concerns over how the construction activities and the ultimate design and operation of the CRC will affect their Q of L.

- The CRC will displace the casino-row bars in EHI that make up casino row. Lottery officials state that new regulations, and required relicensing in 2015, will ultimately reduce the number and concentration of establishments with video poker and other lottery games. Some EHI residents are concerned that given the large revenues that the casino-row bars generate, the business owners will find ways around the new regulations.

- The Hayden Island Plan includes a new park with beach access to the Columbia River and open space areas that will help address what the City of Portland describes as a deficiency of parks on EHI. Some EHI residents note that they can access the shoreline on WHI by boat and walking from EHI below the high water mark.

- The CRC will generate moderate noise impacts from the light rail. The CRC FEIS describes measures that could mitigate these impacts. Residents of the manufactured home communities on EHI expressed concerns over noise and air-quality impacts from CRC construction actions.[37] This may exacerbate existing conditions, given that EHI sits in the Noise Impact Zone for Portland International Airport, which limits some development of residential areas.

III. Development Scenario

In this section, we describe the aspects of the proposed Development Scenario that may affect Q of L issues for EHI residents and businesses. In general, these concerns include the impacts of the WHI port

35 *Hayden Island Plan*, 2009. Page 7; Hillier Bob, N. Zhou, and J. Gillam. 2011. Memorandum: *DRAFT West Hayden Island Transportation Modeling Analysis: Phase I – Planning Level Network Analysis.* December 9; Personal Communication with Bob Hillier, February 6 and 14.

36 Key informant interviews of EHI residents.

37 CRC FEIS, 2011, Page 3-145.

on traffic congestion, noise, light pollution, and air quality. As described in Section I, the Development Scenario for WHI includes the following major factors that could affect the Q of L of EHI residents:

- Loading and moving unit trains that transport autos and bulk materials.
- Truck and auto traffic to and from the WHI port.
- Operating some parts of the WHI port 24-hours a day, which requires significant external lighting.
- Developing a new ramp for non-motorized boat access and new hiking trails.

In the following sections we describe our review of available information on the potential Q of L impacts from the WHI port. We base our analysis on information specific to the port, reports and other information from the Port of Portland, City of Portland, and the general literature on port operations. We begin with the potential traffic impacts of the WHI port.

A. Traffic Effects

The Development Scenario would result in increased truck and automobile traffic to and from the WHI port. Currently, the only route available for this traffic between the proposed facility and I-5 is North Hayden Island Drive (NHID). The Development Scenario includes a potential new bridge between WHI and Marine Drive, which, if built, traffic engineers predict would significantly reduce the volume of port traffic that uses NHID through EHI.

According to the City's analysis of the traffic impacts of a WHI port regional growth has a much greater impact on future traffic demand then the incremental increase from a Port development relative to the Baseline Scenario. Based on the transportation improvements and future land use assumptions identified in Metro's 2035 Financially Constrained Regional Transportation Plan, the City's traffic analysis shows that port-related traffic would not negatively impact roadway system capacity on the island, or on- or off-island access. Based on a reasonable "high impact" traffic generation scenario (two auto terminals and one bulk facility), port-generated traffic would be 1,534 auto trips and 516 truck trips per day, for a total of 2,050 daily trips. Based on the City's traffic model, about 12% of the PM peak hour traffic on Hayden Island's local streets are Port development generated traffic. As described in the City's traffic analysis, these results reflect the high end of the range of likely traffic impacts. That is, these effects describe a possible worst case scenario of traffic effects. The actual effects could be less.

According to the City's analysis, traffic related improvements included in the CRC and Hayden Island Plan will help mitigate negative impacts of the traffic effects from the port. The City's traffic analysts assumed that the CRC will happen as described at the time of their analysis (December 2011), and that EHI will grow and develop as described in the Hayden Island Plan. The traffic model predicted that growth on EHI unrelated to the WHI port will significantly increase traffic volumes on the island. The on-island road improvements in the CRC and Hayden Island Plan, however, would improve on-island roadways and access so that the projected traffic growth—natural growth from increased on-island development and growth from the port—would not overwhelm EHI roadways. The traffic model predicts no substantive traffic problems associated with the WHI port. This includes no substantive congestion on EHI and no substantive delays accessing or exiting the island from I-5 or the new auxiliary bridge that would be adjacent to I-5 through 2035.[38] Another reason for the limited impact of the WHI port on

[38] Hillier Bob, N. Zhou, and J. Gillam. 2011. Memorandum: *DRAFT West Hayden Island Transportation Modeling Analysis: Phase I – Planning Level Network Analysis.* December 9; Personal Communication with Bob Hillier, February 6 and 14.

accessing or exiting the island is that the late afternoon or early evening traffic flow ("PM peak traffic") for the port traffic would be opposite the direction of other on-island traffic at that time.[39] We understand that the City's traffic analysis of the WHI port is preliminary and meant to generally describe the amount and type of traffic the facility could generate. City traffic engineers have not yet conducted a detailed analysis of how port traffic could interact with other traffic on EHI at specific intersections. What seems more certain, however, is that to the extent that the on-island traffic improvements in the CRC and Hayden Island Plan do *not* happen as assumed in the City's analysis, it will increase the probability that port-related traffic would generate negative traffic impacts. These impacts could include increased congestion on EHI roadways, increased delays and travel times, and increased traffic accidents.

Public comments on the CRC included concerns that the project would prove only a temporary fix for traffic congestion on I-5 and EHI. According to these comments, projected population growth and associated increases in economic activities and roadway traffic could eventually increase congestion equal to or worse than current conditions.[40] Others believe that cost and funding issues will derail the CRC.

If developing the WHI port included a new bridge that connected WHI with Marine Drive, the City's traffic model predicts that 90 percent of the port traffic would use the bridge and connect to I-5 via Marine Drive.[41] This would significantly reduce port traffic and impacts of this traffic on EHI.

The City's traffic analysts also considered the possibility that some travelers would cut through EHI via the new bridge between WHI and Marine Drive to access I-5. According to model results, however, traveling this route takes 2 to 4 minutes longer than accessing I-5 via Marine Drive. Given these results, traffic analysts conclude that a new bridge between WHI and Marine Drive would not attract cut-through traffic between Marine Drive and I-5.[42] Recent news reports, however, describe potential changes to the CRC that may affect the results of the cut-through analysis. Officials with the CRC recently proposed eliminating most planned improvement to the Marine Drive interchange on I-5 as part of a cost-cutting measure.[43] To the extent that this development increases the travel time between the River Gate area and I-5 to the point that traveling this route takes longer than cutting through EHI, the bridge between WHI and Marine Drive could possibly attract cut-through traffic.

The City's traffic analysis predicted that some vehicles from EHI or WHI would travel through neighborhood streets in St. John's via a new bridge connecting WHI with Marine Drive. Results, however, indicate that traffic volumes on these streets would increase by 3 percent above projected baseline traffic counts, which, according to the traffic analysis, would not create congestion or require road improvements.[44]

As described in economics and transportation studies, increasing traffic on a given roadway imposes two types of costs on roadway users. The first is the cost of increased congestion. According to this literature, increased traffic generally increases travel times. Increased traffic also increases the probability of accidents between vehicles, bicyclists, and pedestrians. These costs include foregone

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39 Hillier, 2011. Page 14.

40 Letter from Lillian Shirley, Director, and Gary Oxman, Health Officer, Multnomah County Health Department to Doug Ficco and John Osborn, Co-Directors, Columbia River Crossing, June 9, 2008.

41 Hillier, 2011. Page 13.

42 Hillier, 2011. Page 12; Personal Communication with Bob Hillier, February 6 and 14.

43 Manning, J. 2012. "Columbia River Crossing officials suggest significant downsizing to trim $650 million from the controversial project." *The Oregonian*. January 19.

44 Hillier, 2011. Page 12.

work-related benefits and the costs of injury and damage to vehicles and other property.[45] For example, in one study traffic researchers calculated the congestion and accident costs for trucks traveling 9 to 15 mile segments of an industrial corridor in New Jersey. These researchers estimated a congestion cost, in 2011 dollars, of $0.84 per vehicle, per trip and an injury cost of $1.28 per vehicle, per trip.[46]

According to the City's traffic analysis, the Development Scenario will increase the number of vehicles traveling through EHI to I-5 on NHID. With increased traffic comes the possibility of increased congestion and traffic accidents, and the associated increased costs. Given, however, that the proposed port activities would not begin till approximately 2026, and given that other factors such as the final details of the CRC and future development of EHI neighborhoods that would affect traffic on EHI are unknown at this time, existing data do not allow us to calculate these projected costs.[47] We can, however, illustrate the potential magnitude of the cost of congestion. We do this by applying the costs of congestion reported in the literature to a number of vehicle-trips affected on NHID by the traffic to and from the WHI port. We calculate these illustrative costs for one year of port operations. We stress that the results of this illustrative calculation are not definitive for the WHI port. An analysis of the impacts of port traffic on travel times would require a more detailed traffic analysis.[48] We note that our illustrated cost calculation excludes the costs of traffic accidents associated with the port traffic because that is a more complex calculation that does not lend itself to a simple illustration.

According to the City's traffic analysis of the WHI port, without the bridge between WHI and Marine Drive, the Development Scenario would generate approximately 2,050 vehicle trips per day down NHID between the WHI port and I-5. With the bridge, this number drops to approximately 226. Given these results, we assume in our illustrative scenario that with the WHI bridge there would be no significant increase in travel time on EHI because of the traffic from the WHI port. Without the bridge, we assume that 500 vehicle trips per day on EHI roads are increased by an additional 30 seconds per trip because of the 2,050 additional port vehicles trips on NHID. We assume these 500 trips per day are generated by: workers and customers at the auto-auction yard and other commercial and industrial businesses on the west end of EHI; residents of the manufactured home communities; residents of the proposed residential developments on EHI; and shoppers at the renovated Jantzen Beach SuperCenter mall and other retail shops. As a point of reference we note that the traffic analysis of the CRC FEIS anticipates approximately 6,000 vehicle trips during the most traffic-intensive eight-hour segment of each day for the Hayden Island interchange on I-5.[49] Using these data and assumptions, we estimate the total increase in travel time is approximately 4.2 hours per day, or approximately 1,533 hours per year.[50]

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45 Ozbay, K. and B. Bartin. 2001. "Estimation and Evaluation of Full Marginal Costs of Highway Transportation in New Jersey." *Journal of Transportation and Statistics* 4(1): 81-104.; Small, K. 1992. *Urban Transport Economics.* Newark, NJ: Harwood Academic Publishers GmbH.; Vickrey, W. 1968. "Automobile Accidents, Tort Law, Externalities, and Insurance: An Economists Critique. *Law and Contemporary Problems* 33:464-87.

46 Ozbay. and Bartin. 2001. "Estimation and Evaluation of Full Marginal Costs of Highway Transportation in New Jersey." We have converted these figures from 2001 dollars to 2011 dollars using the Consumer Price Index (CPI).

47 Personal Communication with Bob Hillier, February 6 and 14.

48 Personal Communication with Bob Hillier, February 6 and 14.

49 CRC FEIS, 2011, Traffic Technical Appendix.

50 30 seconds/trip * 500 trips/day = 15,000 seconds, or 250 minutes, or 4.2 hours/day. 4.2 hours/day * 365 days/year = approximately 1,533 hours/year.

We then multiply this total increase in travel time by the estimated value of time for drivers and passengers. According to transportation planners,[51] at least some transportation analysts in the Portland area use statistics and data on travel time as reported in a study titled, *The Cost of Congestion to the Economy of the Portland Region*.[52] According to this report, the per person value of travel time is $30.73 for on-the-clock (working) drivers of passenger vehicles and trucks, $15.36 for commuters and recreational drivers, and $40.31 for on-the-clock freight truck drivers ($2011).[53] Assuming the data and conditions described above, and assuming all the drivers in our illustrative example are commuters and recreational drivers, the estimated cost of increased travel time for one year on EHI because of port traffic with no WHI bridge is approximately $23,500.[54]

B. Noise Effects

The Development Scenario could generate noise impacts from three sources. The first source is noise produced by unit trains as they travel the elevated railroad tracks that cross the island and as they travel through the new rail yard on WHI. The second source is noise caused by the loading of autos and bulk materials onto rail cars. The third source is noise made by trucks traveling on NHID between the WHI port and I-5. We describe these potential sources of noise impacts, summarize information on the economic costs of these impacts on affected populations, and describe potential mitigation measures. We begin by describing the problems associated with noise impacts and factors that can affect the severity of these impacts.

Noise pollution can have a number of negative consequences. Noise can cause undesired social outcomes by reducing enjoyment of leisure activities. It can contribute to health effects, including hypertension, heart disease, sleep interruption, and hormonal changes.[55] Noise can also negatively affect property values proximate to the noise source. As reported in recent studies, chronic noise has negative environmental impacts for a variety of terrestrial organisms, including changes in foraging behavior, reproductive success, and community structure.[56] Researchers report that because of the growth and close proximities of populations and rail and road transportation systems, noise annoyance is one of the most serious environmental pollutants in industrialized economies.

A number of sources describe permitted or recommended noise levels. The City of Portland’s daytime permissible level is 65 decibels (dB), and a nighttime permissible level of 60 dB. The Federal Highway Administration (FHWA) has guidelines that help engineers determine whether or not transportation

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51 Personal Communication with Bob Hillier, February 6 and 14; Personal Communication with Cindy Pederson, Principal Transportation Modeler, Portland Metro, February 16, 2012.

52 Economic Development Research Group. 2005. *The Cost of Congestion to the Economy of the Portland Region*. Prepared for the Portland Business Alliance, Portland Metro, and the Port of Portland. November 25.

53 Economic Development Research Group. 2005. “The Cost of Congestion to the Economy of the Portland Region: Appendix A.” Prepared for: Metro and Portland Business Alliance. November. We have converted these figures from 2005 dollars to 2011 dollars using the CPI.

54 1,533 hours * $15.36/hour = $23,547.

55 World Health Organization. 2011. “Burden of disease from environmental noise. Quantification of healthy life years lost in Europe.” Available online: http://www.euro.who.int/en/what-we-publish/abstracts/burden-of-disease-from-environmental-noise.-quantification-of-healthy-life-years-lost-in-europe.

56 Barber, J., K. Crooks, and K. Fristrup. 2009. “The costs of chronic noise exposure for terrestrial organisms.” *Trends in Ecology and Evolution* 25(3): 180-189.

projects generate sound effects that require mitigation. Engineers express these levels as Equivalent Sound Pressure Level (Leq), which describes levels for complex and fluctuating sounds. The FHWA interior measure is 52 Leq for residences, schools, hospitals, etc. and an exterior measure of 67 Leq. The U.S. Department of Housing and Urban Development (HUD) developed what they refer to as "acceptable" sound levels for residential developments. HUD considers sounds less than 65 dB "acceptable." Sounds between 65 to 75 are "normally unacceptable," and sounds greater than 75 dB are "unacceptable."[57] The World Health Organization (WHO) developed guidelines for community noise that focus on the human health impacts of noise at night. According to the WHO guidelines, interior nighttime sound levels above 45 dB can cause sleep disturbance if experienced 10-15 times during the night. The WHO target threshold for nighttime outdoor noise is 40 dB.[58]

The operations of the Toyota facility at Port of Portland Terminal 4 (T4) and the Kinder Morgan Potash facility at Terminal 5 (T5) provide insights into potential noise impacts of the WHI port, and also potential mitigation measures. The loading of vehicles onto train cars at T4 caused a sharp banging noise that impacted residents of the Cathedral Park neighborhood. Engineers tried mitigating the noise by modifying the train cars, but the modifications proved ineffective. Given that the noise complaints were primarily seasonal—increasing in winter when deciduous trees have no leaf cover—engineers recommended maintaining a vegetative buffer of at least 100 feet. Managers at other ports rely on buffers to help mitigate noise, light and other effects of port operations on adjacent neighborhoods. For example, the Port of Tacoma purchased 31 acres as a noise, visual, and light buffer between the port and neighboring residential areas. At T5, loading and unloading potash into train cars created noise impacts from the train cars bumping into one another. Developing braking techniques that minimized car bumping helped mitigation this noise impact. Another mitigation measure is forming a sound barrier with empty rail cars that helps blocks the noise of loading other cars.[59]

Truck traffic is another source of potential noise impacts from the Development Scenario. Research conducted as part of the North Portland Noise Study describe the noise impacts of trucks traveling freight corridors through neighborhoods. The Study focused on three freight corridors in North Portland: North Columbia Boulevard, North Lombard and North Going. Traffic noise along all three freight corridors exceeded the FHWA levels that would require noise abatement, and also exceed the HUD levels considered "acceptable" for residential areas.[60]

Noise walls 12 feet high or greater, are the typical engineering solution to traffic noise. Such barriers, however, would negatively affect views and the character of residential neighborhoods such as those in the North Portland Noise Study, and in EHI. The preferred mitigation measures described in the Noise Study were resurfacing freight corridors with quiet pavement and requiring sound insulation in new residential construction along the corridors.[61] Used more widely in Europe, quiet pavements cost approximately 10 to 25 percent more than traditional pavements.[62] Researchers in Washington state,

[57] City of Portland, Bureau of Planning and Sustainability. 2010. *West Hayden Island Planning Process Local Impacts of Industrial Development*. Prepared for the West Hayden Island Community Work Group. April. (City of Portland, *Local Impacts*, 2010) Pages 13, 28-29.

[58] City of Portland, *Local Impacts*, 2010. Pages 10-11.

[59] City of Portland, *Local Impacts*, 2010. Pages 10-14.

[60] North Portland Noise Study, 2010. Pages 12, 60-65.

[61] North Portland Noise Study, 2010. Page 67-68.

[62] U.S. Department of Transportation, Federal Highway Administration. 2005. "Quiet Pavements: Lessons Learned from Europe." FOCUS. April. Publication Number: FHWA-HRT-05-025

however, found quiet pavements degrade relatively quickly, and suggested the technology may not be compatible with the Northwest climate.[63] Other research also found that the pavement loses its noise-reducing benefits as it ages.[64]

A number of studies describe the costs of noise impacts on affected populations. Some studies describe costs in terms of the health-care effects and some use surveys to identify the amount that people would be willing to pay for less noise. Other studies describe the costs in terms of reduced values of properties in areas affected by noise or the cost of noise abatement.

In 2007, researchers published a handbook in which they describe their review and summary of current and past studies of the costs of noise and other environmental effects associated with traffic. Based on their review of several case studies of the economic costs of noise, they identified what they considered the most analytically reliable costs of noise impacts. Using data from these case studies they estimated the noise costs for road and rail traffic by type of vehicle and distance traveled. We list their results in Table 1 below.

Table 1. Noise Costs for Road and Rail Traffic in Suburban Neighborhood (per vehicle, per mile driven, $2011)

Vehicle	Time of Day	Cost (Low)	Cost (High)
Car	Day	$0.09	$0.26
	Night	$0.14	$0.40
Truck	Day	$0.70	$1.98
	Night	$1.30	$3.60
Freight Train	Day	$37.27	$72.20
	Night	$122.03	$122.03

Source: ECONorthwest staff estimates with data from Maibach, M., et al. 2007. *Handbook on Estimation of External Costs in the Transport Sector*. Internalisation Measures and Policies for All External Cost of Transport, Delft, CE, December 19. Table 111, Page 69.

Other researchers calculate a cost of noise as a function of decibels. One researcher calculated an annual willingness-to-pay to reduce noise of .09% to .11% of per capita income per dB.[65] Other studies describe analyses of property value depreciation due to noise. We present results from two of these studies in Table 2 below.

[63] Rosenthal, B. 2010. "A lot riding on 'quiet pavement' in Bellevue as testing continues." *The Seattle Times*. January 31.

[64] Rich, S. 2011. "'Quiet Pavement' Being Tested by More State DOTs." *Government Technology*. July 13.

[65] Maibach. 2011. *Handbook on Estimation of External Costs in the Transport Sector.*

Attachment B

• Table 2. Cost of Noise Annoyance from Railways ($2011)[1]

Decibel Level	Willingness To Pay Estimate	Impacts On Property Value
55-60 dB	$797	$68
60-65 dB	$955	274
65-70 dB	$645	$685
70-75 dB	$353	$1,367
75-80 dB	$163	$2,584[2]
>80 dB	$50	

Source: van Kempen, E.E.M.M. 2001. 2001. Een Schatting van de Baten van Geluidmaatregelen. RIVM rapport 715120004. quoted in Brons, M., P. Nijkamp, E. Pels, and P. Rietveld. 2003. "Railroad noise: economic valuation and policy." *Transportation Research Part D* 8:169-184.; and INFRAS/IWW. 2004. "External Cost of Transport: Update Study." Study for the International Union of Railways. Zurich.

Notes:

[1] We have converted the data from the original studies to 2011 dollars.

[2] This value represents >75 dB effect size estimation.

Researchers also developed the Proximity Depreciation Sensitivity Index (PDSI) to describe the relationship between distance from the sources of transportation-specific noise impacts and reductions in property values. As distance increases from a noise source, the noise impacts decline and so do the negative impacts of noise on property values. The results of one study found that for properties within 100 meters of a rail line, the noise impacts reduce property values by 10.4%, relative to comparable properties further from the rail line. For properties within 200 meters, the reduction in property value attributed to noise impacts was 4.0%.[66] Another researcher found that the discount on sale price attributed to noise impacts terminates approximately 275 meters from a railway.[67]

We expect that the WHI port would likely generate noise effects, however, data are not available at this time that would describe the type, severity or impact areas of those effects. This is especially relevant when calculating noise impacts because site-specific factors affect the severity of noise effects, including the distance from the noise source, topography, metrological conditions of air temperature, wind speed, and direction, and the location of sound blocking or reflection surfaces.

[66] Brons, M. et al. 2003. "Railroad noise: economic valuation and policy," *Transportation Research Part D 8*. Pages 169-184.

[67] Poon, L. 1978. "Railway Externalities and Residential Property Prices." *Land Economics* 54(2): 218-227.

Vehicle characteristics also affect the level of noise impacts including speed, frequency, types (rail, auto or truck), state of maintenance, and roadway- or rail-infrastructure characteristics.[68]

Researchers who study Q of L impacts of port facilities on adjacent neighborhoods recommend collecting this type of information as part of a Health Impact Assessment (HIA) of the proposed development.[69] As these researchers describe, a HIA could address a range of Q of L issues including noise, traffic, air quality, water quality, etc. Environmental Impact Statements (EIS) for projects that have a nexus with the Federal government also include sections on socioeconomic impacts of the projects. These impacts can include noise, traffic, air quality, etc. The range of possible Federal nexus include projects that receive Federal funding or projects that may affect Federally protected plant or animal species.

As we did with traffic-related costs, we calculate an illustrative cost of one of the potential noise impacts from WHI port operations—noise from rail traffic traveling the elevated rail line that currently crosses WHI. Again, we stress that these costs are illustrative and not definitive for the Development Scenario. Also, our illustrative cost calculation assumes no mitigation measures that could minimize noise effects from the rail traffic.

We used the PDSI to estimate the illustrative cost of noise effects from the unit trains as they travel the elevated rail line on EHI residents. As we described above, the literature on noise effects of rail traffic on property values includes research that found a 10% reduction in property values for homes within 100 meters of a rail line, a 4% reduction for homes within 200 meters, and no effect of noise on property values for residences greater than 275 meters from a rail line. We use these distances and percentage reductions in property values in our illustrative calculation. According to maps of EHI, no homes lie within 200 meters of the existing elevated rail line that crosses WHI, which would be closer to EHI homes than the loop track and other rail lines of the WHI port that would lie further west from the existing rail line. Approximately 8 floating homes with an estimated average value of $209,000[70] lie within the 200 to 275 meter zone. Based on results reported in the literature, the impacts on property values of noise at these distances would be between 4% and 0%. For the purposes of our analysis we assume a 2% reduction in value for these affected homes. Using these data and assumptions, we calculate an illustrative impact of the noise effects of the rail traffic associated with the Development Scenario of $33,440.[71] This is a one-time effect on property values from port-specific rail traffic that crosses the elevated rail line.

Trains currently travel the elevated rail line across WHI. To the extent that the rail traffic associated with the WHI port has no noticeable increase in noise impacts, our illustrative calculation overstates the potential cost of the noise effects attributed to port-specific rail traffic.

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68 Brons, M. et al. 2003. "Railroad Noise: Economic Valuation and Policy," *Transportation Research Part D* 8: 169-184; Forkenbrock, D. 2001. "Comparison of External Costs of Rail and Truck Freight Transportation. *Transportation Research Part A* 35:321-337; Jarup, L. et al. 2008. "Hypertension and Exposure to Noise Near Airports: the HYENA Study," *Environmental Health Perspectives*. 116 (3): 329-333; Leon, B., et al. 2007. "Road Traffic Noise and Hypertension," *Occupational and Environmental Medicine* 64(2): 122-126.

69 Human Impact Partners. 2010. *Los Angeles and Long Beach Maritime Port HIA Scope Working Draft*. Prepared for the US Environmental Protection Agency. May 17.

70 Estimated property values from zillow.com, accessed February, 2012.

71 Estimate average property value for the affected floating homes = $209,000 * 8 affected homes * 2% = $33,440.

In addition to potential noise effects from rail traffic, port operations could potentially produce noise effects from truck traffic along NHID, and from port operations. Data exist on the value of noise effects from truck traffic, however, the environmental and socioeconomic conditions at the study sites for these effects differ substantially from conditions on EHI. For this reason we did not estimate an illustrative cost of noise effects from port-specific truck traffic. As results from the North Portland Noise Study show, however, trucks traveling other freight corridors in the Portland area generate noise effects that exceed FHWA and HUD levels.

According to researchers who developed the PDSI, the greater the noise effects on residential properties, the larger will be the negative impact on property values. Given these results and the proximity of homes to NHID, we assume that trucks traveling this route to I-5 would generate noise effects that negatively affect property values. Given the data constraints on the potential noise effects and that the available research results are not compatible with EHI conditions, we have not estimated an illustrative cost of this noise effect. We note, however, that given the location of the auto-auction yard on the west end of EHI, trucks of the type that would travel to and from the WHI port using NHID currently travel this route. Trucks transporting autos travel NHID between I-5 and the auto-auction yard. As with the noise effects from increased rail traffic across the elevated rail line, to the extent that port-specific truck traffic has no noticeable impact on noise effects, there would be no cost from these effects. Site-specific data collected as part of a HIA or EIS could help determine the marginal impact of port traffic on noise effects.

Regarding the potential noise effects of future port operations, perhaps the best indications may be the experiences with noise effects and mitigation results at T4 and T5. Activities at these terminals move the types of goods that may move through the WHI port—autos and bulk goods—and move these goods by rail and trucks, which would also transport goods from the WHI port. Based on this experience, mitigation worked better for some noise effects—filling and moving train cars—than for other noise effects—loading autos onto train cars. The distance between residential areas on EHI and the location of the WHI port will provide a buffer that will help mitigate noise and other effects from port operations. It is unknown at this time, however, the extent to which that buffer will sufficiently mitigate noise and other effects so that they have no impact on EHI residents and businesses. A HIA or EIS could help describe such effects.

Some of the specific questions that a HIA of the potential noise effects of the proposed WHI port could address include the following.[72]

- To what extent would the distance and topography between the WHI port and residences in EHI provide an effective buffer that would mitigate noise effects from the operation of the facility or the rail traffic to and from the facility?

- To what extent would port-generated rail traffic on the elevated rail line that currently crosses WHI cause a noticeable increase in noise effects over current rail traffic? For example, the time of day, duration, or both of port-generated rail traffic may cause a noticeable increase in noise effects.

- To what extent would port-generated truck traffic on NHID cause a noticeable increase in noise effects over current or projected truck traffic? For example, the time of day of truck traffic may cause a noticeable increase in noise effects.

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[72] For more details on specific questions that a HIA of noise effects could address see: Heller, J. et al. 2010. *Lost Angeles and Long Beach Maritime Port HIA Scope Working Draft*. Prepared by Human Impact Partners for the U.S. EPA. May 17; and, UC Berkeley Health Impact Group, 2010. *Health Impact Assessment of the Port of Oakland*. University of California, Berkeley, CA. March.

- If a HIA determines that port-generated traffic would cause a noticeable increase in noise effects, what types of measure could mitigate these effects?

C. Light Effects

The WHI port could generate light impacts due to the large expanse of work area outdoors and the possibility of loading and unloading operations continuing 24-hours a day. Worker safety regulations require a minimum amount of illumination. The experiences at the Port of Portland and other port facilities provide insights into potential light impacts from the WHI port, as well as mitigation measures that help reduce light impacts. We begin with a description of the problems associated with light impacts from industrial areas, and then summarize the experiences at the Port of Portland and other ports with light impacts and mitigating measures.

Researchers at the Lighting Research Center at Rensselaer Polytechnic Institute define light pollution as "an unwanted consequence of outdoor lighting [that] includes such effects as sky glow, light trespass, and glare."[73] Light pollution can affect humans by disturbing sleep patterns. Some researchers use the term "photopollution" to describe the adverse effects of artificial light on wildlife. Photopollution can interfere with feeding, biological growth processes, reproduction, and migration.[74] The light effects of T4 and T5 at the Port of Portland provides insights into the possible light effects of the WHI port. The Toyota facility at T4 offloads cars that are shipped throughout the region, and the Kinder Morgan Potash Facility at T5 loads potash onto ships. Both of these facilities are similar to those anticipated for WHI. After Toyota upgraded their facility in 2004, residents from the adjacent Cathedral Park neighborhood and the Linnton Community across the Willamette River complained of the light effects from the new development. Toyota managers responded by removing some lights, shielding others, redirecting lights down and away from residents, and turning off lights when not in use. Managers at the Kinder Morgan facility also received complaints about light effects from their operations and responded in ways similar to the Toyota managers.[75]

Increasingly, port managers across the country are taking steps to minimize light pollution from their operations. Light pollution is now among the list of light-related factors that port managers consider when selecting lighting products.[76] Other port facilities have addressed the light effects of their operations by developing lighting management plans or relying on buffers between the port and neighboring residential areas. The Canaveral Port Authority developed a light management plan to address the light effects of the port's operation on wildlife. The Authority developed the management plan in cooperation with the U.S. Fish and Wildlife Service. The plan relies on shielding and directing lights, installing timers, and using appropriate light levels for tasks at hand. The Port of Los Angeles will incorporate "Dark Sky" compliant lighting in their 30 acre public access buffer areas around the Port.[77]

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73 Simpson, S. 2007. *Willingness to Pay for A Clear Night Sky: Use of the Contingent Valuation Method.* Masters in Science, Technology, and Public Policy Thesis, Rochester Institute of Technology, Rochester, New York. October. Page 8.

74 Gallaway, T. 2010. "On Light Pollution, Passive Pleasures, and the Instrumental Value of Beauty." *Journal of Economic Issues* 44 (1): 71-88; Simpson, 2007; Kempenaers, B. et al. 2010. "Artificial Night Lighting Affects Dawn Song, Extra-Pair Siring Success and Lay Date in Songbirds." *Current Biology*, published on line September 16.

75 City of Portland, *Local Impacts*, 2010. Page 18-19.

76 Bensalhia, J. 2011. "Lighting the Way." *Portstrategy* Available Online: www.portstrategy.com. January 5.

77 City of Portland, *Local Impacts*, 2010. Appendix A Pages 5-6.

According to marine industry sources, the issue of light pollution is especially relevant in cases of existing ports expanding operations by adding new terminals.[78] In some cases, residents have sued ports that did not adequately address the light pollution from new facilities. For example, homeowners near the Port of Houston on Galveston Bay sued the Port after the Port expanded by developing a new terminal. Even though a half mile separated the new terminal from the residential area, homeowners complained that the bright lights from the terminal interfered with their right to enjoy their homes.[79] The experience at T4 and T5 at the Port of Portland, and at the Canaveral Port Authority and Port of Los Angeles, demonstrates that unmitigated light effects from port activities can negatively affect area residents. These experiences also demonstrate, however, that effective mitigation measures can help limit these negative effects. To the extent that the Port of Portland develops WHI without taking light effects into consideration, the resulting light pollution could negatively affect local residents. We found no studies of the economic costs of light pollution in situations comparable to the WHI port. We note, however, that among the potential negative impacts of port or industrial areas on Q of L of adjacent neighborhoods, light effects seem the easiest to mitigate.

D. Air Quality Effects

The Development Scenario could produce two sources of air-quality impacts. The first is particulate matter from diesel exhaust. Operations at port and rail facilities involve a number of diesel-powered engines including those on ships, trains, and heavy trucks that move cargo within the port and transport cargo on roadways throughout the region. The second potential source of air-quality impacts is dust from loading and unloading bulk materials such as potash or grain. We describe each of these sources and experiences with air impacts at the Port of Portland and other ports. We then summarize the literature on the economic costs of air-quality impacts from port operations. We begin by describing the problems associated with air-quality impacts from port and rail facilities.

Port activities, including construction, operations and transport, can emit harmful air pollutants including particulate matter (PM) and diesel exhaust. Oceangoing ships that call on ports can emit sulfur dioxide (SO_2) and nitrogen oxide (NO) and cargo-handling equipment like cranes and trucks are major sources of PM and NO_x. For example, researchers found that traffic generated by and activities in the ports of Los Angeles and Long Beach contribute to over 20% of all NO_x emissions in the Los Angeles area. [80]

Air pollutants emitted by port and rail operations can negatively impact human health by increasing the incidence of asthma, respiratory diseases, cardiovascular disease, lung cancer, pre-term and low-birth weights, and premature death. Researchers who conducted a 2007 study of the Port of Oakland concluded that the life expectancy of residents living near the port is more than ten years shorter than residents of other nearby areas.[81] In another study of the Port of Oakland, analysts with the American

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78 Maritime Journal. 2006. "Tackling Light Pollution in Ports," Maritime Journal. Available Online: www.maritimejournal.com. MJ Information No. 22412. November 1.

79 Pitman, D. 2010. "Homeowners Sue Port Authority Over Noise, Light Pollution," *KUHF Houston Public Radio*. March 23.

80 Moretti, E. and M. Neidell. 2009. "Pollution, Health, and Avoidance Behavior: Evidence from the Ports of Los Angeles." National Bureau of Economic Research. Working Paper 14939. May.

81 East Bay Alliance for a Sustainable Economy. 2007. "Taking the Low Road: How Independent Contracting at the Port of Oakland Endangers Public Health, Truck Drivers, and Economic Growth." Oakland, California.

Lung Association calculated that one in five children living near the port has asthma and the area has the highest asthma hospitalization rate in California.[82] Other researchers found that exposure to ozone near the ports of Los Angeles and Long Beach contributes to the ozone-related hospital costs of nearly $2 million per year.[83]

Staff from the California's South Coast Air Quality Management District found that residents of Los Angeles and Long Beach had one of the nation's highest lifetime risks of cancer from toxic air pollution. They attributed 84 percent of this high region-wide cancer risk to diesel exhaust emissions, 94 percent of which come from mobile sources, including port operations.[84] Diesel exhaust from port activity is of particular concern in the Portland airshed because diesel emissions are the number one source of toxic air pollution in the metropolitan area.[85]

We note that much of the literature on the impacts of port operations on air quality comes from research conducted in the Los Angeles area. This region has some of the worst air quality in the United States. While existing research support the conclusion that port operations contribute to air-quality impacts, ports are but one among other sources of pollution in this region. For this reason we must be careful when interpreting research results from the Los Angeles area for insights into air-quality impacts of ports elsewhere.

Dust from ports can be an annoyance and also pose serious health risks, including eye irritation and infection, digestive system diseases, and occasionally skin disease, bronchitis, tracheitis, and pneumonia.[86] Increases in ground-level ozone from seaports can affect respiratory morbidity by irritating lung airways, decreasing lung function, and exacerbates existing respiratory symptoms, such as asthma.

Regulatory officials expect that projected changes in air-quality regulations will reduce air-quality impacts from ports, rail yards and other industrial areas relative to current conditions. State and federal regulations already target harmful air pollutants from seaport operations, and regulatory staff predict that the continued phasing-in of air-quality standards will significantly reduce some air pollutants over the next 25 to 30 years. For example, phasing-in federal standards for diesel fuels and engines will continue reducing PM from diesel exhaust by up to 90% by 2030, relative to 2010.[87] EPA regulations specifically target the types of diesel engines and fuel used in port operations. According to the EPA:

- beginning in 2006, "…refiners began producing ultra-low sulfur diesel fuel … for use in heavy duty highway diesel engines. Nonroad diesel engines were required to use low sulfur … diesel fuel beginning in 2007 and ultra-low sulfur diesel fuel beginning in 2010."

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82 Cannon, J. 2009. "Container Ports and Air Pollution." Energy Futures, Inc.

83 Moretti, E. and M. Neidell. 2009. "Pollution, Health, and Avoidance Behavior: Evidence from the Ports of Los Angeles." National Bureau of Economic Research. Working Paper 14939. May.

84 South Coast Air Quality Management District. 1999. "Multiple Air Toxics Exposure Study II." November.

85 City of Portland. 2010. "Sustainable Procurement Evaluative Criteria Emissions Reduction and Construction Waste Recycling for Use in Construction Services." August.

86 Baltrénas, P., K.D. Fröhner, M. Pranskevičius. 2007. "Investigation of Seaport Air Dustiness and Dust Spread." *Journal of Environmental Engineering and Landscape Management* XV(1): 15-23; Clean Air Task Force. 2005. "An Analysis of Diesel Air Pollution and Public Health in America." Boston, MA. February.

87 CRC FEIS, 2011. Page 3-276; Environmental Protection Agency. 2011. "Regulations and Standards." Available Online: http://www.epa.gov/otaq/highway-diesel/regs.htm. June 29.

- "Locomotives and smaller marine engines required low sulfur diesel fuel beginning in 2007 and ultra-low sulfur diesel fuel beginning in 2012. In addition emission standard for large commercial marine diesel vessels like cruse and container ships will be phased in beginning in 2011."

- "In addition to reducing emissions from existing diesel fleets, these cleaner fuels enable the use of advanced after-treatment technologies on new engines. Technologies like particulate traps, capable of emission reductions of 90% and more, are required under new standards which began phasing in for the highway sector in 2007, and will begin taking effect in the nonroad sector in 2010."

- "These programs will yield enormous long-term benefits for public health and the environment."[88]

Actions taken by port managers also help mitigate air-quality effects of port operations. For example, all of the 10 largest U.S. container ports have environmental departments that ensure compliance with government regulations and create environmental protection strategies.[89] Most strategies focus primarily on reducing emissions from diesel by switching to cleaner diesel engines, installing pollution-control equipment, and switching to cleaner grades of diesel fuel that have lower sulfate contents. Many of these ports have a long-term plan to switch to alternative fuels, including natural gas, electric vehicles, and biodiesel. For example, the Port of Los Angeles debuted the first ever 100% electric vehicle deployed at a U.S. container port.[90]

Motivated by the fact that port operations contribute to air-quality effects, managers at the Ports of Seattle, Tacoma and Vancouver, BC (the Ports) partnered with regulatory agencies to identify and implement changes that would reduce air pollution from port operations. This partnership produced the Northwest Ports Clean Air Strategy (Strategy) in 2007. The Ports report annually on their progress toward achieving specific performance milestones for reducing "… port-related air quality impacts on human health, the environment, climate change, and the economy."[91] To reach these milestones, the Ports' staff developed performance measures for major operations including ocean going vessels, cargo handling equipment, trucks, rail, harbor vessels, and port administration. The Ports' staffs' first assessment of performance milestones in 2010 found progress in all operations, but not all the milestones were met. Staff will continue refining and improving their actions and report the next round of milestone results in 2012.[92]

The Port of Portland also has a program of environmental objectives and targets. Air-quality targets for fiscal year 2011-2012 include reducing diesel PM from Port-controlled operations by 25 percent below year 2000 levels by 2015, and reducing Port direct and indirect emissions of greenhouse gases 15 percent below year 1990 levels by 2020.[93]

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88 http://www.epa.gov/cleandiesel/reg-prog.htm

89 It is worth noting, however, that the largest contributors of particulate matter at these container ports may be large truck volumes. Other types of ports, for example the one proposed for the WHI port, may not have a similar impact.

90 Cannon. 2009. "Container Ports and Air Pollution."

91 Port of Seattle, Port of Tacoma, and Port of Metro Vancouver (The Ports). 2010. *Northwest Ports Clean Air Strategy 2010 Implementation Report*. Draft 1. April 8. Page, iv.

92 The Ports, 2010, Page v.

93 Port of Portland. *2011-2012 Environmental Objectives and Targets*. Available Online: www.portofportland.com.

The air-quality effects at Port of Portland T4 and T5 provide some insights into potential air-quality effects of the bulk terminal proposed for WHI. Kinder Morgan moves soda ash through T4 and Columbia Gran moves grain through T5, the bulk terminal currently anticipated for WHI could process either or both of these commodities. Kinder Morgan received complaints about dust produced from their operations at T4. Kinder Morgan responded by setting up air monitors at the perimeter of their facility to track dust movement and improved the efficiency of their bag house and dust collectors. Columbia Grain took actions to mitigate the air-quality impacts of their operations including hiring a consultant who provides ongoing monitoring at the facility, upgraded some of their bag houses, and began applying food-grade oil to grain to reduce dust produced with grain movement.[94]

At this time, no data exist on the magnitude or geographic extent of any potential air-quality effects of the WHI port. As we noted above in our discussion of potential noise impacts, researchers who study the impacts of ports on Q of L suggest developing a HIA, which could include air-quality effects. According to these researchers, the air-quality portion of a HIA for a port similar to the one proposed for WHI could address a number of questions associated with potential air-quality effects including the following.

- What is the geographic extent of the affected airshed and what populations, schools, employment centers, etc. are located in this airshed?
- How will port-related activities affect air quality in the affected airshed?
- What other sources of air pollution are present near the WHI port and what is their contributions to air pollution in the affected airshed?
- What is the current prevalence of asthma and other respiratory diseases, cardiovascular disease, cancer risk, low birth weight babies in the affected airshed?[95]

The economics and air-quality literature includes reports on the cost of the types of air pollutants produced by ports, railroads and other industrial areas. For example, in one study researchers estimated the per ton costs for the following pollutants: NO_2= \$10,248; PM_{10} = \$6,842; SO_2 = \$2,508; and CO = \$1,456.[96] The Oregon Department of Environmental Quality likewise estimates that each ton of diesel PM imposes \$395,425 in environmental damage and health costs to Oregonians.[97]

As we did with traffic- and noise-related costs, we calculate an illustrative cost of air pollution for one year of port operations using information from the literature on air-pollution costs and data specific to WHI. Again, we stress that these costs are illustrative and not definitive. Also, our illustrative cost calculation assumes no mitigating measures that could minimize air pollution effects from the WHI

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94 City of Portland. 2010. *Local Impacts*. Pages 6-9.

95 .For more details on specific questions that a HIA of air-quality effects could address see: Heller, J. et al. 2010. *Lost Angeles and Long Beach Maritime Port HIA Scope Working Draft*. Prepared by Human Impact Partners for the U.S. EPA. May 17; and, UC Berkeley Health Impact Group, 2010. *Health Impact Assessment of the Port of Oakland*. University of California, Berkeley, CA. March.

96 Nowak, D.J., D. Crane, and J. Stevens. 2006. "Air pollution removal by urban trees and shrubs in the United States." *Urban Forestry and Urban Greening* 4: 115-123. Converted from 1994 dollars to 2006 dollars using the CPI.

97 Oregon Department of Environmental Quality, Bureau of Planning and Sustainability. 2012. "Clean Diesel Efforts." Available Online: http://www.portlandonline.com/bps/index.cfm?a=247878&c=42402.

port. We factor in the phase-in of federal standards for diesel fuels and engines that analysts estimate will reduce PM emissions from diesel exhausts by 90%.

We can illustrate the cost of air pollution as a result of the additional traffic generated by the WHI port using a model developed by researchers from the Bureau of Transportation Statistics (BTS). Using results from the City's traffic analysis of WHI, our calculation assumes the port would generate 2,050 additional vehicle trips, of which 516 are trucks and 1,534 are cars. We assume 35 mpg for cars and 8 mpg for trucks. The BTS model includes the following costs per ton of pollutant type: VOC = $4,455, NO_x = $10,349, CO = $15.21, and PM_{10} = $132,616.[98]. The model also assumes the emission rates of each pollutant in (grams/gallon) are: 69.9 for CO, 13.6 for NO_x, 16.2 for VOC, and 0.0825 for PM_{10}.[99] Table 3 below illustrates the potential air pollution costs of truck and car traffic generated by the WHI port per vehicle mile traveled. Since we do not have information on how far each vehicle would travel, we cannot illustrate the total cost of the vehicle trips. We therefore calculated the costs of all 2,050 port-specific vehicles traveling one mile.

- **Table 3. Costs of Air Pollution Generated by Proposed Port Facility Traffic, per Vehicle Mile Traveled**

	Trucks	Cars	Total
Cost of air pollution, per vehicle	$0.04	$0.02	
Cost of air pollution, all port traffic	$18.69	$26.06	$45.61

Source: ECONorthwest staff estimates with data from Ozbay and Bartin. 2001.

Notes: While the fuel consumption of trucks (8 mpg) is higher than that of cars (35 mpg), the proposed port would generate significantly more car traffic and so the total cost of air pollution from cars is higher than that from trucks.

Not all air-quality effects of the WHI port would be negative. To the extent that the port improves the efficiency of ship, rail, and truck traffic, it would help reduce regional air-quality effects below what they would be in the Baseline Scenario. One impact of improved port and transportation efficiencies is moving comparable amounts of freight with lower emissions of carbon and other air pollutants.

E. WHI Bridge

The Concept Plan for the proposed annexation and development of WHI includes a bridge that connects WHI with Marine Drive (WHI bridge). Given the preliminary nature of the Concept Plan, no detailed engineering or cost studies of the bridge exist at this time. The Concept Plan includes a very preliminary cost estimate for the bridge of $50 million to $100 million.[100] According to the City's traffic analysis of the Development Scenario, the WHI bridge would significantly reduce the amount of port traffic that would travel through EHI to I-5. According to this study, with the bridge, approximately 226

[98] Based on the morbidity and morality cost per ton of each pollutant.

[99] These rates are based on expected emissions rates for passenger vehicles in New Jersey. Since we also include trucks in our analysis, which likely exhibit higher emissions rates, these values are likely an understatement. We also adjusted the estimates to account for the anticipated 90% reduction in PM_{10} emissions that likely will result from new federal regulations by 2030.

[100] WorleyParsons. 2012. Order of Magnitude Cost Estimate —Draft. Memo to Eric Engstron, City of Portland from Bill Dunlap, WorleyParsons. January 4. Table B Infrastructure Estimate Page 8.

vehicle trips per day, including trucks and cars, would travel NHID to and from I-5. Without the bridge, the daily number increases to 2,050 trips.[101] These results represent the high-end, or worst case estimate of the potential impact of port operation on traffic. The actual impacts may be less.
One of the benefits of the WHI bridge would be travel-time savings for the 89 percent of port traffic that would use the bridge. Based on the City's transportation study, and our interview with one of the City transportation engineers who worked on that study, we estimate that traveling over the WHI bridge and down Marine Drive to I-5 saves at least 2 minutes compared with traveling NHID between WHI and I-5. Assuming these conditions, we calculate the value of travel time saved because of the WHI bridge as follows. We begin with the City's traffic projections for the port traffic that would use the WHI bridge of 500 truck trips and 1,325 car trips per day, each trip saving 2 minutes. This equals approximately 16.7 hours of time savings per day for trucks and approximately 44.2 hours of time savings per day for cars.[102] Next, we multiply these time savings by the value of time as reported in the report on the cost of congestion in the Portland region.[103] We use time values per hour of $40.31 ($2011) for truck trips and $15.36 ($2011) per hour for car trips. We calculate the annual value of travel time saved by multiplying hours saved per day by 365, and multiplying the result by the value of time for trucks and cars.[104] Using this method, data and assumptions, we calculate that trucks and cars using the WHI bridge save travel time valued at $493,480 ($2011), for one year.

The WHI bridge would also benefit the Q of L of EHI residents by minimizing the amount of port-related traffic that travels through or near their neighborhoods, and by offering another route on or off the island when I-5 becomes congested. Minimal truck traffic on NHID would also be more compatible with the proposed growth and development of EHI as described in the Hayden Island Plan. According to the Hayden Island Plan, EHI will grow and develop over the next few decades. This growth is projected to include 2,800 new housing units, with part of this growth occuring in a new transit-oriented development adjacent to the new light rail stop. The Jantzen Beach SuperCenter will be redeveloped and modernized and include mixed-use developments. To the extent that NHID is the main access for the WHI port and industrial-type development on WHI, it may limit the interest of prospective developers to make the investments that would support the types of growth and development envisioned in the Hayden Island Plan. The risk is that because of the port traffic, EHI develops a feel and reputation of an industrial area, rather than residential or retail area. As a result, future types of development in EHI may not reflect those envisioned by the Hayden Island Plan, and would be less desirable and of lower valued.

The uncertainty regarding the types of goods or materials that could pass through the WHI port in the future, and possibly through their neighborhood, also concerns residents of EHI. As we describe in the section of this report on port effects, we cannot be certain today about the goods or materials that would pass through the WHI port 20 or 30 years from now. The best guess anyone has now about materials that could possibly pass through WHI and travel through EHI on NHID to I-5 is large trucks transporting autos to car dealers up and down I-5. The concerns of EHI residents is that if NHID is the only access to the WHI port from I-5, that at some point in the future more hazardous or traffic-intensive materials will travel this route, which would negatively affect their Q of L.

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[101] Hillier, 2011. Pages 7, 13.

[102] 500 truck trips * 2 minutes = 1,000 minutes/60 minutes per hour = approximately 16.7 hours. 1,325 car trips * 2 minutes = 2,650 minutes/60 minutes per hour = approximately 44.2 hours.

[103] Economic Development Research Group, 2005. Appendix C, Page 8.

[104] 16.7 hours/day saved for trucks * 365 days * $40.31 = $245,645; 44.2 hours/day saved for cars * 365 days * $15.36 = $247,836; total savings = $493,480.

Attachment B

Summary

Experiences at the Port of Portland and at ports elsewhere show that port operations can negatively affect the Q of L of those living in neighborhoods adjacent to ports. Negative Q of L effects include increased traffic, noise, light, and air pollution. Given these experiences, we expect that the Development Scenario would cause negative Q of L effects for those living in and traveling through EHI. Data do not exist, however, that would allow us to calculate the economic cost of these negative effects. Using data reported for Q of L effects at other ports we illustrate the potential magnitude of some of these effects.

Experiences at the Port of Portland and ports elsewhere also show the range of options that can help mitigate port-specific Q of L effects. Based on these experiences, mitigation works better for some effects than others. Light effects seem the easiest to mitigate. Changing work practices mitigated noise effects of loading rail cars with bulk materials. Likewise, improved filtration proved effective at mitigating air quality effects of transferring bulk materials. Loading autos onto rail cars, and the noise and air quality effects of truck and rail traffic to and from the port seem the effects most challenging to mitigate.

While the Development Scenario may generate negative local Q of L effects, there may be some positive effects at the regional level. To the extent that the WHI port improves the efficiency of ship, rail and truck traffic, it would help reduce negative air-quality effects below what they would be without it.

Some researchers suggest conducting a HIA as a means of identifying Q of L effects of the Development Scenario. In this case, a HIA could help characterize noise and air quality effects. Regarding noise effects, one of the unknowns is the extent to which the distance between the WHI port and residences on EHI—and the topography and other features of the landscape—will buffer potential noise effects of port operations. Another unknown is the extent to which port-specific rail and truck traffic will cause noticeable increases in noise effects over conditions in the Baseline Scenario. Specific to air quality, a HIA could help characterize marginal increases in air pollutants above baseline levels, and describe the relationship between increases in air pollutants and health effects on local populations. These measures could include, for example, the estimated number of missed days of school and work for residents and workers in the impacts area, or any increased incidence of asthma attaches and required medical treatments. If the port development includes a nexus to the Federal government, e.g., receives Federal funding, it could require an EIS, which could include an assessment of local Q of L effects similar to that of a HIA.

Attachment B

Local Impacts of Industrial Development (April 2010, BPS)

The West Hayden Island Community Working Group (CWG) and Neighborhood groups living on and around Hayden Island stressed the importance of researching the local impacts of industrial development on the neighborhood's quality of life. The following research looks specifically at air quality, noise, light, and traffic related impacts, all of which are often associated with industrial development and considers measures that can be taken to lessen those impacts. In order to determine these focus areas, City staff conducted interviews and met with residents living in the following neighborhoods and associations: HiNoon, Hayden Island Manufactured Home Park, Bridgeton, St. Johns, Cathedral Park, East Columbia, Linnton, and the Pearl[105]. Map 1 shows the general study area for this research, including the distances from residential neighborhoods to potential development on West Hayden Island.

The intended purpose of this piece is to 1) share a range of local impacts of industrial development and 2) explore approaches and measures that the CWG can consider to reduce the local impacts of potential industrial development.

This report also discusses recreational opportunities for the island since any future terminal development has the potential to integrate public access, recreational activities and preservation of wildlife corridors and natural areas. It is important to note that in the past couple of years other planning processes including the most recent East Hayden Island plan (2009) resulted in some useful information about what resident's value about living on the island. Some common values included:

- the river lifestyle,
- a close-knit community,
- access to the water for viewing, swimming and boating
- improved connectivity on the island for walking and biking, additional parks and trails
- Access to nature and wildlife
- protection of open space for wildlife , and
- improving riparian health of the Columbia River and North Portland Harbor

These resident values should be considered as part of any future discussion on natural resource protection and/or recreational activities for the island.

While this research does not look at the economic benefits associated with marine industrial development, it is important to note that there are positive impacts of potential marine terminal development. According to Martin Associates 2007 report, *Economic Impacts of the Port of Portland*, activity due to the movement of marine cargo, air passengers and cargo and real estate activity at the Port's industrial and business parks contributes to the local and regional economy by providing employment and income to individuals, taxes to state, county and local governments and revenue to local and national firms engaged in producing goods and services[106].

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[105] City staff will continue to schedule meetings with other surrounding neighborhood groups to discuss concerns and their ideas for potential improvements to the island.

[106] Martin Associates, Economic Impacts of the Port of Portland, Jan 2007

Attachment B

Air Quality

There are various sources that emit pollutants into the air. This section looks at two common emissions that occur at marine terminals; dust emissions that can come from grain terminals or other dry bulk terminals such as soda/potash terminals and diesel emissions from port operations. This summary provides more detail on dust emissions from grain terminals as that concern was specifically expressed by members of the HiNoon neighborhood group and the WHI Community Working Group.

Dust Emissions

The main pollutant of concern in grain or dry bulk storage and handling is fine particulate matter. Particle size is important because finer particles, less than 2.5 micrometers in diameter can spread quite a distance and according to DEQ cause the most concern for human health[107]. EPA and DEQ label this particulate matter as "criteria pollutants" and, if inhaled, may lead to health effects that generally aggravate cardiovascular and respiratory disease.

A grain or dry bulk terminal must maintain an air quality permit from DEQ for their facility emissions if they have a throughput of 10 tons or more per year[108]. A Standard Air Contaminant Discharge Permit through DEQ is good for five years[109]. Grain terminals may be required to do extensive monitoring and upgrade dust collection equipment, resulting in modifications to their DEQ permits, if emission requirements are not being met. Grain dust can occur at facilities during the loading, unloading, transfer and cleaning of the grain[110]. There are three general types of measures that are available to reduce emissions from grain handling and processing operations. These include modifications to facility design to prevent or inhibit emissions, capture/collection systems, and oil suppression systems that inhibit release of dust from the grain streams[111].

During the 1999 West Hayden Island planning process, a grain terminal was part of the potential development plan. At that time the proposal was to store the grain in fully enclosed silos using baghouses at emission points[112]. An 80% dust control efficiency was assumed of all the fugitive dust emissions from grain loading and unloading, and a 99% control was assumed for conveyors[113]. There continue to be advancements in the technology for capturing dust particulate.

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[107] In 1996, EPA made revisions to the primary and secondary NAAQS for PM (particulate matter) to provide increased protection of public health and welfare. With regard to primary standards for fine particles (generally referring to particles less than or equal to 2.5 micrometers ([micro]m) in diameter, $PM_{2.5}$).

[108] Grain and other dry bulk are very similar in the type of permits they have. The only difference would be the emission factors that are used to calculate emissions from the different products that are handled for their operations- personal communications with Tina Leppaluoto, DEQ, 3/31/10.

[109] Department of Environmental Quality ACDP permit guidlelines and requirements; http://www.deq.state.or.us/aq/permit/acdp/admin.htm

[110] Interview with Tina Leppaluoto, DEQ and fact sheet at http://www.deq.state.or.us/news/publicnotices/uploaded/081104_5322_26-2807-PNE-11052008-AQ.pdf

[111] US Army Corps of Engineers, Draft Environmental Impact Statement, Port of Portland Marine Cargo Facilities at West Hayden Island, page 3-22, November 2000.

[112] Baghouses are dust collection systems with large filter tubes. The larger system also includes ventilation hoods connected to a central duct system that capture dust. They can be designed to be placed anywhere that dust is emitted. Per interview with Jim Johnson, NW District Manager, Donaldson Torit , Industrial Air Filtration , 3/17/10.

[113] US Army Corps of Engineers, Draft Environmental Impact Statement, Port of Portland Marine Cargo Facilities at West Hayden Island, page 3-22, November 2000.

Best Practices for Reducing Dust Emissions

Portland Harbor grain terminals have updated many of their dust collection systems to reduce emissions by updating baghouses with better filtration systems. The new grain elevator in Longview plans to use some of the newest technological advances, including a system called Powercore which is much smaller than the traditional baghouse and captures much finer dust particles resulting in very low to zero emissions. The Port of Kalama is expanding their facility and updating their traditional baghouse system, but with a new lower emissions filter system[114].

Installing the most up to date baghouse systems can help lower emissions and save energy as many filter systems are becoming more efficient. Bag houses can be placed at any emissions point on the facility; however, controlling dust plumes during the ship loading process can be a challenge. Grain and dry bulk terminals around the US have experimented with different technologies to reduce the dust emissions during the loading process including:

- A bullet or adjustable gate at the end of the spouts that slows the grain and discharges it more slowly into a ship hold[115].
- Spraying grain with a food based oil product, or in the case of other dry bulk products there are similar de-dusting products that can be sprayed on the product.
- Using a large bag over the ship hold during loading
- Engineered industrial ventilation hoods and loading spouts that can be designed to limit this dust source.

The grain and dry bulk facilities are often required to hire a consultant to identify measures to mitigate for and correct dust emissions in excess of their permit [116]. Appendix A provides additional measures that US Ports are applying to reduce dust emissions at two Ports.

Local Improvements to Reduce Dust Emissions

Kinder Morgan has received complaints of dust from their soda ash facility at Terminal 4. The permitting of and ongoing monitoring of facilities such as this one are extensive. DEQ does permit facility operations and depending on product and dust collection efficiencies there may be situations where low levels of fugitive dust may travel beyond industry property lines. In response to dust concerns by Kinder Morgan's' industrial neighbor to the south Kinder Morgan proceeded in the following ways to address the issues:

- Area air sampling monitors were set up at the perimeter of the facility to monitor dust leaving the site.
- Bag house and /or dust collection efficiencies were improved

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[114] Per interview with Jim Johnson, NW District Manager, Donaldson Torit , Industrial Air Filtration , 3/17/10.

[115] Photo is from TEMCO Tacoma, provided by Bill Baxter Engineering Company

[116] Phone Conversation with Tina Leppaluoto, DEQ Permit Writer, 3/17/10

- Adjacent neighbor was invited to tour their facility and become familiar with the product and the operations[117]

Columbia Grain maintains a permit with DEQ and provides extensive, ongoing monitoring of their facility at Terminal 5, including the hiring of a consultant who provides ongoing opacity readings at the facility. Columbia Grain is allowed 20% emissions (not to be exceeded for three minutes per hour). Dust system upgrades the facility has implemented include:

- Upgrading 6 baghouses (of the 18 total at the facility), with more efficient filters, both for improved collection of dust emissions and also for their lower energy usage. With this upgrade, Columbia Grain has met Energytrust criteria and increased efficiency of their dust collection systems. The facility uses a local company to supply the new baghouse filters which can be laundered and reused.
- Applying a light application of food grade oil on the grain to reduce dust[118].

Diesel Particulate Emissions

Marine terminals, depending on the operation, can be a source for a significant amount of diesel particulates. This can be generated from berthed ships, truck loading and circulation, railroads and other diesel equipment located at the terminal. Diesel particulate matter is one of the top 10 toxins in Oregon which are associated with an increased risk of many health issues, including, heart and lung disease and respiratory aliments such as asthma. There are strict state and federal regulations that govern allowable levels of diesel emissions. A number of Ports across the US are implementing programs to reduce these emissions at their terminal facilities.

Case Studies from US Ports to Improve Diesel Emissions

Many ports around the world are implementing measures to address diesel emissions. Some ports, such as Tacoma, Seattle and Metro/Vancouver have collaborated with adjoining communities in communal goal setting for the health of their common airshed. Some ports have instituted air quality monitoring equipment to measure progress toward their diesel emissions goals.
The vast majority of emissions-reducing measures are either:

- management practices specific to a type of activity (e.g. radio frequency identification system to reduce waiting times for trucks, or requiring berthed ships to plug into electric grid instead of using diesel engine),
- programmatic (e.g. creating an incentive program for off-site trucks that encourages “fleet modernization”),
- general measures (e.g. providing lower emission diesel fuel or biofuel), and/or
- value-added approaches (e.g. on-dock rail loading to reduce cargo transfers, truck miles traveled – and associated emissions – to increase efficiency to the customer).

Appendix A contains some brief overviews of US and European ports and their approaches to improving air quality from diesel emissions.

Potential Approaches to Consider Moving Forward:

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[117] McMullin, Brent, Kinder Morgan, Personal communication with Rachael Hoy, BPS, 3/02/10. See Appendix B for neighborhood and industry summary discussions.

[118] Cartmill, Randy, Columbia Grain, personal communication with Rachael Hoy, BPS, 2/23/10

- Installation of better bag houses and other new technological advances in dust control systems
- Placement of spouts further in ship holds during loading of material or installation of apparatus to slow material during exit from the spout (eg. adjustable gates or bullets)
- Conveyors enclosed and baghouses put at different emission points to pass through
- Enclosures of all material transfer sites
- Area monitoring on a regular basis
- Food oil based spray on grain and other de-dusting sprays for non agricultural products to reduce dust
- Improved efficiency of on site diesel engines
- Provision of electrical hookup for berthed ships to allow them to shut down engines
- Consideration of 'direct to rail' loading approaches

Noise Pollution

Marine Terminals can be a source of noise pollution, both from on-site loading operations, and from the associated rail and truck traffic generated by the cargo distribution. This summary will focus on noise generated from railways and arterial cargo or truck freight movement since these are two noise sources that are often associated with industrial development. In addition, neighborhoods in close proximity to West Hayden Island have raised these as issues of concern through the current planning process.

North Portland Noise Study and WHO Noise Guidelines

The North Portland Noise Study, drafted in 2008, documented the main sources of sound and quantified specific levels of noise in North Portland Neighborhoods. The main sources identified include:

- Portland International Raceway (PIR)
- Railways
- Arterial cargo truck noise in residential neighborhoods
- I-5 traffic
- Airplane activity at Portland International Airport[119]

The study used a computer noise model to isolate individual noise sources because they found that the interaction of noises often made it difficult to study just one source at a time. The study also points out that wind and other atmospheric conditions can influence noise levels. Portland could be the first major US city to use noise maps to help direct future development decisions following in the footsteps of many European countries that have used this process in long range planning for years[120].

The World Health Organizations (WHO) developed guidelines in 1999 for community noise and updated these guidelines in 2009 specifically focusing on the human health impacts of noise at night[121]. Excess noise can be a nuisance and impair a person's ability to understand what someone is saying, but on a more extreme level the World Health Organization has identified noise as a serious health hazard that

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[119] City of Portland, North Portland Noise Study (Draft), June 2008, page 27, prepared by The Greenbusch Group, Inc. and Paul Van Orden, City of Portland.

[120] The North Portland Noise Study is in draft form and is in the process of being finalized pending additional funding, Paul Van Orden, personal communication, 3/26/10.

[121] World Health Organization, Night Noise Guidelines for Europe, WHO Regional Office for Europe, http://www.euro.who.int/Document/E92845.pdf

can lead to medical conditions such as high blood pressure and heart disease. They note that noise can also negatively affect a person's sleep, attentiveness, problem solving and memory[122] .

WHO guidelines for community sound levels in 1999 indicated that interior nighttime sound levels over 45dBA can cause sleep disturbance with more than 10-15 events during the nighttime period[123]. The updated report completed by WHO in 2009 has lowered the threshold to 40dBA as the target for nighttime outdoor noise. Typical residential construction provides approximately 25dB of noise reduction for exterior noise sources.

Results of North Portland Noise Study

The City of Portland defines permissible sound levels by land use zones in code section 18.10.010. The maximum daytime noise levels between industrial and residential zones are 65 dBA. Maximum levels are reduced 5 dbA to 60 dBA during nighttime hours between 10 pm and 7 am. The following present some of the findings of the North Portland Noise study for rail and vehicle traffic.

<u>Railway Horn Noise</u>

Train horn noise at public grade crossings in many residential areas has been a source of frequent complaints. Noise data collected for train horn noise in Kenton exceeded 103 dBA. The study indicated that this would most likely result in levels as high as 70 dBA inside a residence with closed windows. Similar results related to train horn noise in Cathedral Park revealed sound levels within mid 60's dBA in residence with windows closed. Both of these levels exceeded the 2009 WHO level of 40 dBA at which sleep disturbance can occur and the City of Portland permissible sound levels.

Starting in 2010 the Federal Railroad Administration (FRA) is implementing new regulations that establish minimum (96 dBA) and maximum (110 dBA) train horn levels. In addition, the FRA has established a new method for sounding train horns at public grade crossings to lessen the impact on surrounding communities. The City's Noise Control Office will be monitoring sound levels of train horns with the implementation of the new regulations to see if there are any noticeable changes in and around some of the affected communities[124].

<u>Vehicle Traffic Noise</u>

Vehicle traffic is also a major contributor to noise in North Portland neighborhoods. Normal traffic flow often includes a mix of freight vehicles, buses, and motorcycles which can raise the level of disturbance. The North Portland Noise Study specifically looked at the freight corridors of North Columbia Boulevard, North Lombard, and North Going Streets. Monitoring of sound levels for traffic noise along these streets in the surrounding communities found that many of the readings exceeded City regulations, especially in Cathedral Park and St. John's. There are federal EPA and state of Oregon Department of Environmental Quality (DEQ) guidelines for permissible levels for motor vehicles operating on public roadways. The City follows the EPA guidelines for freight transport vehicles of 10,000lbs Gross Combination Weight Rating (GCWR), and all other vehicles must comply with State DEQ levels[125] .

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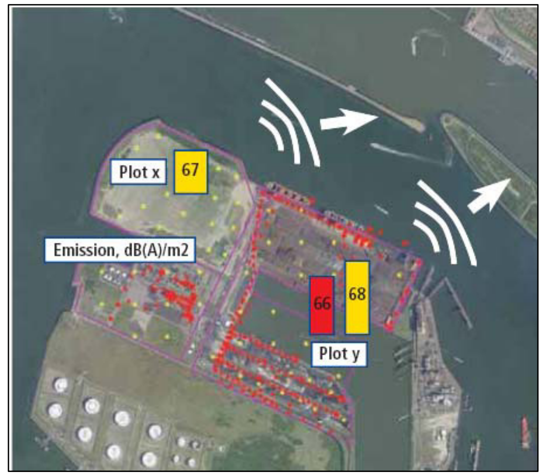
[122] World Health Organization, Website, http://www.who.int/mediacentre/factsheets/fs258/en/, accessed February 25, 2010.

[123] Decibel levels or "dB" are a measure of sound loudness presented in a logarithmic scale. More information on decibel levels, sound pressure levels and relative loudness of different activities can be found in the City of Portland, North Portland Noise Study (Draft), June 2008 page 15.

[124] City of Portland, North Portland Noise Study (Draft), June 2008, page 25, prepared by The Greenbusch Group, Inc. and Paul Van Orden, City of Portland.

[125] Ibid, page 27. EPA and DEQ maximum sound levels are provided by vehicle model year and minimum distance from road centerline.



The study found that St. John's and Cathedral Park Neighborhoods are impacted by regional and local truck traffic that use designated truck routes through the town center to get to the St John's Bridge; in addition, other streets that run through residential neighborhoods are also used. In 2000, the Portland Office of Transportation completed the St. John's Truck Strategy which provides recommendations for improvements to reduce freight movement conflicts in residential neighborhoods.

Local Case Studies Addressing Noise Impacts

Cathedral Park Neighborhood Association and Toyota at Terminal 4 have been working together to try to resolve another noise issue that has been identified by the neighborhood. During the loading and unloading of vehicles on to train cars, a sharp banging noise results from the collision of steel bridge plats. The Toyota facility has worked with the Port, neighborhood groups and the City's Noise Control Office to search for ways to reduce this noise. Toyota has researched different options for padding the bridge plats that resulted in the testing of two different products.

- A plastic material that acts as a buffer between the plats, and
- A rubber coating at the ends of the bridge plats

Unfortunately both of these test products quickly wore off of the steel bridge plats. Toyota continues to research possible solutions to reduce this noise. According to Toyota, this issue seems to be seasonal. When there is leaf cover on the trees the percentage of neighborhood complaints goes down[126]. The City's Noise Control Office has indicated that a vegetated tree buffer of at least 100 feet should be maintained to lessen the impact of noise[127].

Kinder Morgan's Potash facility at Terminal 5 set up perimeter monitors throughout their facility and on Sauvie Island at property lines to determine the impact of their operations. The most impactful noise events were from air traffic, the grain elevator and train car movements to and from the grain elevators. The train car noise was primarily from the train cars bumping into one another during the loading and unloading process. Kinder Morgan indicated that they have worked to address the train car noises in the following ways:

- Initiated training programs with the Longshoreman's association to show them how to brake more appropriately to prevent train cars from colliding during loading and unloading.
- Developed a new strategy for using stored rail cars on the outer loop to act as a barrier or buffer from the noise while rail cars on the interior train loop are being unloaded and moved through the dumping process[128] .

[126] Corbin, Ron, Toyota, personal communication with Rachael Hoy, March 11, 2010. See Appendix B for neighborhood and industry summary discussions.

[127] Van Orden, Paul, Bureau of Development Services, personal communication with Rachael Hoy, March 19, 2010

[128] McMullin, Brent, Kinder Morgan, personal communication with Rachael Hoy, March 2, 2010

Port Case Studies

The majority of ports that have addressed noise levels are those with very proximate urban interface. Several European ports have formed a collaboration to reduce noise, its associated annoyance, and health problems of people living around port industrial areas, through a GIS noise mapping and ongoing management system.

The Natural Resource Defence Council (NRDC) has conducted much research on sustainable port practices. Regarding port site planning and expansions, NRDC recommends: "*..at the very least new terminals should be located away from residential areas to protect communities from the pollution, noise, and other stressful effects of ports' heavy industrial activities.*"[129]

Port of Tacoma
The Port of Tacoma has addressed noise in its Environmental Impact Statement.[130] This analysis provides a quantitative estimate of traffic-related noise impacts (including vehicle and rail traffic) and a qualitative discussion of environmental (construction and operational) noise. To help mitigate for noise impacts, the Port of Tacoma has purchased 31 acres of a buffer area between the Port and neighbouring residential areas with a plan to expand acreage.

Port of Long Beach
The Port of Long Beach has addressed noise as part of its NEPA permitting. It relates mostly to traffic and construction noise, not ongoing port activities. To reduce noise, monitoring during construction and temporary mitigation measures such as barriers are implemented during construction. Additional information on how Ports around the world are addressing noise can be found in Appendix A.

North Portland Noise Study Recommendations

The North Portland Noise Study recommends the mitigation measures for noise noted below. This summary focuses specifically on train horn and freight corridor noise. In addition, these recommendations are followed by a list of potential approaches that could be considered as part of a future development agreement or Plan District provision.

Railroad: Train Horn Noise
The Federal Railroad administration published the Final Rule on the use of Locomotive Horns at Highway-Rail Grade Crossings in 2005. This rule allows public authorities the option to establish quiet zones provided certain safety measures are in place and the crossing accident rate meets FRA standards. According to the study two types of quiet zones could apply to North Portland:

- Full quiet zone with no horn noise 24 hours/day
- Partial quiet zone where a horn is silenced for a specified period, usually during nighttime hours
- In the event that a full quiet zone is not implemented, a wayside horn could be used to reduce the noise impact. The wayside horn is a stationary horn at the grade crossing which is sounded with the approach of a train. This replaces the train blowing its horn for ¼ mile prior to the crossing. The wayside horn is at the crossing, not on the train.

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129 NRDC Strategies to Clean Up U.S. Ports: http://www.nrdc.org/air/pollution/ports/ports2.pdf

130 Port of Tacoma: http://www.portoftacoma.com/feis

Other measures to consider include supplemental safety measures that include gate systems to provide closure at the crossing during a train or temporary closure of a crossing during nighttime hours to all vehicles.

Freight Corridors

- The traditional approach of noise walls are not recommended because they would disrupt view corridors on freight routes through some of the North Portland neighborhoods discussed above. The study recommends resurfacing these corridors with a quiet pavement to reduce noise.
- Adding building code requirements for residential structures built after January 2009 on North Columbia, North Lombard, and North Going.

Summary of Approaches to Considered Moving Forward:

- Mandated noise study that is coordinated by the City's Noise Control Office.
- Installation of sound level monitoring at marine terminal property lines. Coordinate with the City's Noise Control Office to implement a program to monitor throughout the year.
- Encourage sound insulation on new home construction or extensive updates
- Encourage use of sound barrier walls along railroad corridor where appropriate
- Provide a forested buffer between any future terminal and residential area
- If public grade crossings are part of any future development on WHI consideration of full or partial quiet zones should be implemented or at least require the use of a wayside horn.
- Longshoreman's association training to train on railcar braking techniques to avoid train car impacts.
- Restricting freight vehicles on local service streets and consider traffic calming devices such as turnabouts.

Light Pollution

Excess light can cause a number of issues in particular for plants and wildlife. The damages to animal and plant life cycles and the interference with animal migrations and breeding are well documented. In addition, the amount of energy wasted with poor lighting design has a huge impact on greenhouse gas emissions.[131] Humans can experience increased fatigue because of excess light shining into the home at night from the surrounding environment. In addition, frequent exposure to glare raises safety concerns for drivers or those with impaired vision.

Marine Terminals have large exterior work and storage areas that are often illuminated for safety and security reasons as well as to allow 24-hour operation. This light can affect adjacent properties as well as wildlife in adjacent natural areas. This section will discuss some of the causes and effects of light pollution and shares some ideas for reducing light pollution, including a review of other regulations and ordinances. This is followed by case studies of local and national port responses to light pollution issues. The report concludes with a summary list of potential approaches that could be considered to address the light pollution issues.

Forms of Light Pollution

The International Dark-Sky Association (IDA) defines light pollution as: "Any adverse effect of artificial light including sky glow, glare, light trespass, light clutter, decreased visibility at night, and energy

[131] Personal Communication with Jim Benya, Benya Lighting Design, March 30, 2010.

waste[132]. IDA identifies light pollution by categories including light trespass, over-illumination, glare, light clutter, and sky glow. Below is a brief description of each of these:

- Light trespassing is often used when referring to nuisance lighting and glare from one neighbor's yard to another.
- Over illumination is often seen in commercial and industrial areas as well as downtown street lights.
- Glare can come from a number of different types of lights such as vehicle lights from an on-coming car or light from a neighbor's front porch light.
- Light clutter is excessive lighting potentially from a variety of sources that can cause distraction; such as poorly spaced street and building lighting.
- Sky glow is a combination of all of the above especially poorly directed lighting that limits sight of night stars.

There can be a number of reasons for the light pollution noted above including 1) the type of light being used, 2) an inefficient fixture, 3) lack of understanding of how much light is needed, 4) incorrect installation of timers, or 5) lack of knowledge of how to direct or redirect lighting to meet lighting needs.

Some of the biggest offenders of light pollution include:

- City street lights
- Signs (e.g. Times Square)
- Outdoor sales lighting (e.g gas stations, auto dealers)
- Industrial lighting

Some ways to control excess lighting include shielding lights, reducing light wattage, putting lights on timers, changing street light features and requiring light shields or redirection.

The Model Ordinance and Federal & State Standards

The Oregon Department of Energy was directed under House Bill 2628 to review a model lighting ordinance, that was put together by the International Dark Sky Association (IDA) and the Illuminating Engineering Society of North America (IESNA). In addition this bill is reviewing current state statutes and provisions related to outdoor lighting and its impacts on energy efficiency and night brightness[133]. In general, there can be federal and state standards that enforce lighting requirements. Any local ordinances need to take these federal and state laws into account. However, there are currently very few provisions in Oregon that establish specific regulations on outdoor lighting. The Oregon Occupational Safety and Health Division (OAR, Chapter 437) has general lighting provisions, but it defers to American National Standard Practices for Industrial Lighting.

There are no provisions or regulations that regulate the lighting fixture type for general outdoor lighting. This could enable local city-level codes to establish regulations on fixture types to help

[132] International Dark Sky Association, web site, http://www.darksky.org/mc/page.do?sitePageId=55060&orgId=idsa

[133] Oregon Lighting Report, Oregon Dept. of Energy), September 2008, Nicholas Papke, page 3.

mitigate light pollution and light trespass to neighboring properties. In addition to fully shielding lights, another best practice is to develop a lighting plan, designed by a certified lighting specialists at the beginning of a project in coordination with facility and site planning experts[134].

The Model Lighting Ordinance discussed above is under public review at this time, but some of the components of the ordinance include:

- A description of lighting zones of different stringencies to address different uses.
- A system for regulating lighting installations using a rating system called BUG (Backlight-Uplight-Glare) that prevents excessive lighting.
- A computer analysis option for complex lighting installations[135]

Outdoor Lighting Regulations in Other States

There have been several programs recently implement in other states to address light pollution. These include:

- Missouri Night Sky Protection Act, House Bill, 457: This bill calls for the reduction of light emitted into the night sky to near natural levels for specified protected places including certain parks and historic sights that contain camping, wilderness areas, and riverways. The states Department of Natural Resources must develop voluntary guidelines to achieve specified reduction rates starting in 2025.
- Washington, House Bill 1069**:** This bill contains standards and specifications for requiring the best technology available in all exterior lighting in order to reduce energy consumption and reduce light pollution. All new public and private outdoor lighting installed after July 1, 2010, in Washington must conform to the requirements of the bill. Any new or replacement outdoor lighting fixture must be fully shielded if the rated output of the outdoor lighting fixture is greater than 1,800 lumens. Mercury vapor lamps must be removed by July 1, 2010.
- New Hampshire House Bill 0585**:** Any state funded out door lighting greater than 1,800 lumens must be fully shielded. The state produced a dark sky policy to encourage local adoption of outdoor lighting regulations. The Public Utilities commission adopted a part night or midnight rate for unmetered street and area lighting[136].

Local Ordinances in Oregon

In 2008, the City of Wilsonville used an earlier version of the Model Lighting Ordinance written by IDA and IESNA to update their lighting ordinance which applies to public, industrial, commercial and multi-family housing facilities. They have established five lighting zones and mapped boundaries of these zones as well as applied specific regulations within each zone including:

- maximum wattages allowed and specific lighting standards.
- light shielding types that can be used, and
- curfew times

[134] Personal Communication Jim Benya, Benya Lighting Design, March 30, 2010.

[135] Oregon Lighting Report, Oregon Dept. of Energy), September 2008, Nicholas Papke

[136] International Dark Sky Association's web site, www.darksky.org has a comprehensive list with links to state lighting ordinances around the US and Europe.

Attachment B

The Oregon Department of Energy, House Bill 2628 recommends the incorporation of many of the Wilsonville ordinance provision in local codes and they consider it to be a suitable example for regulating outdoor lighting under State building code; however, they note that the development of lighting zones needs to be further discussed at the level of the local municipality.

Eugene and Bend have both implemented ordinances that require new outdoor lighting installations to be shielded and that prohibit use of certain types of lighting. Some exemptions do apply depending on the type of businesses and federal lighting standards can override the local standards. Bend specifies a curfew for turning lights off and Eugene provides lighting standards for five specific land uses.

Currently the Portland zoning code has a glare standard under chapter 33.262 which states that glare may not directly or indirectly form reflection, cause illumination on other properties in excess of a measurement of 0.5 foot candles of light[137] and strobe lights visible from another property are not allowed. In addition, the city's environmental overlay zone restricts lights from shining into environmental resource areas.

Local Case Studies Addressing Light Pollution[138]

Toyota Facility at Terminal Four: Toyota installed new lights throughout the facility as part of a facility upgrade in 2004. They received complaints from the adjacent Cathedral Park neighborhood because some of the light poles were the same height as the bluff causing light to shine directly into their homes. There were also complaints from the Linnton Community across the Willamette River. In response to the complaints, Toyota removed some of the lights, shielded others and redirected the lights down and away from residences. Toyota's Facility Manager noted that Toyota operates 24 hours/day and they must maintain some lighting on the facility at all times for security purposes; however, they also have started to turn off all other lights when they are not in use[139].

Kinder Morgan Potash Facility at Terminal Five: Kinder Morgan has worked with Sauvie Island residents to address concerns related to lighting and noise. Mr. McMullin noted that there are lighting challenges at industrial facilities because they must comply with OSHA regulations and make sure there is sufficient light for the safety of those loading ships and working on the dock. Some of the changes that have been made in response to community concerns include:

- Adding hoods to lights and angling lights down to limit glare on neighboring communities
- Automating the timing of lights on the ship loading equipment[140]

Port Case Studies

The two US examples explored for this analysis were Port Canaveral Florida and the Port of Los Angeles. The Port of Canaveral's approach was developed to limit the Port's overall lighting impact on specific wildlife. The management plan sets standards for control of existing exterior lighting plus rules

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137 A foot-candle is how bright the light is one foot away from the source. A lumen is a unit of measurement of light. A lumen is equal to one foot-candle falling on one square foot of area.

138 See Appendix B for neighborhood and industry summary discussions.

139 Personal communication with Ron Corbin, Toyota, March 11, 2010.

140 Personal communicaton with Brent McMullin, Kinder Morgan, March 2, 2010.

for the design of new or replacement site lighting systems. Most of the mitigation measures are not port-specific, but could be general to any large facility. The measures include:

- redirecting and shielding lighting,
- using lower-light bulbs,
- varying lighting height and intensity to match the use, and
- using motion detectors and timers.

The Port of Los Angeles 30-acre Harry Bridges Buffer area between residential communities and the Port facilities will incorporate "Dark Sky" compliant lighting design.[141] More information about these two examples can be found in Appendix A.

Potential Approaches to Consider Moving Forward:

- Using the minimum wattage and warm white tones while still to meeting federal/state standards.
- Turning lights off when not in use or using a timer or sensor to turn off lights.
- Improving lighting fixtures by using shields or cut off type lights, and angling lights to where they are needed.
- Consulting with a qualified lighting designer to design lighting plans for any future facility.
- Creating buffer areas with limited lighting directed to to sensitive land uses
- Implementing Model Lighting Ordinance created by International Dark Sky Association (IDA) and the Illuminating Engineering Society of North America (IESNA)

Traffic Related Impacts

Traffic Analysis[142] ***(this traffic analysis was written in 2009 by David Evans and Associates, prior to the completion of PBOT's transportation modeling analysis. Also see PBOT's final report from 2012 in attachment D.***

The traffic analysis completed for the 2009 Hayden Island Plan assumed that West Hayden Island would develop at some point in the future, in addition to the proposed development pattern for East Hayden Island. Answering the question of whether or not West Hayden Island develops was not part of the Hayden Island Plan, but from a traffic analysis standpoint it was essential to understand the potential ramifications of that development on the proposed Hayden Island street system and the new I-5/Hayden Island interchange proposed as part of the Columbia River Crossing (CRC) project.

The traffic analysis for the Hayden Island Plan assumed build-out Option 2, under which West Hayden Island would develop as an automobile distribution facility, an intermodal rail yard, and a bulk terminal employing 45 people, both with and without a new auxiliary bridge. This analysis also assumed that improvements would be made to the I-5 interchanges on the island as the result of the CRC. The Level of Service calculations were based upon these improvements.

141 http://www.sasaki.com/what/portfolio.cgi?fid=437&page=6

142 The information that follows is an excerpt from the DEA memo unless otherwise noted.

TABLE 1
Trip Generation for West Hayden Island Marine Terminal Development

LAND USE	A.M. PEAK		MIDDAY PEAK		P.M. PEAK		DAILY
	IN	OUT	IN	OUT	IN	OUT	
Build-out Option I							
Container Terminal	186	122	256	220	70	158	4,010
Intermodal Rail Yard	25	26	48	48	21	24	840
Bulk Terminal (45 Employees)	25	5	25	5	25	5	260
Total All Vehicles	236	153	329	273	116	187	5,110
Trucks	175	118	225	192	69	132	2,970
Autos	61	35	87	81	47	55	2,140
Build-out Option 2							
Auto Distribution Facility	225	26	55	99	17	64	1,620
Intermodal Rail Yard	25	26	48	48	21	24	840
Bulk Terminal (45 employees)	25	5	25	5	25	5	260
Total All Vehicles	275	57	128	152	63	93	2,721
Trucks	30	25	49	41	21	20	740
Autos	245	32	79	111	42	73	1,980
Source: West Hayden Island Marine Terminal Development (Parametrix 1999).							

In summary, it is important to point out that the amount of traffic produced by a new terminal(s) and the impact on adjacent residential neighborhoods will vary depending on the type of terminal or combination of terminals being proposed and infrastructure needs. Also it is important to note that product delivered to a local market, within 500-800 miles from Portland, is often transported by truck[143].

The various build out options that were analyzed for the previous Hayden Island processes would seem to indicate that a Container Terminal will generate more truck traffic than the dry bulk facility which will primarily move product from barge to rail[144]. The Port of Portland collects vehicle trips

[143] Healy, Phillip, Port of Portland, personal communication, 4/2/10.

[144] According to the 1999 Army Corps of Engineers Draft EIS, about 60% of all containerized cargo arrives at the Portland shipping terminal by truck from locations within the region and all import general cargo arriving in Portland is also distributed outward by truck. Some agricultural bulk facilities also generate byproducts that are trucked from the

information from all of their terminals on a monthly basis. A current snapshot of vehicle trips at the Port of Portland terminals in 2009 shows us the following[145]:

- Terminal 6: approximately 2,400 vehicle trips/day are generated including Hyundai, Honda, the Container Terminal and the break bulk facility.
- Terminal 5: approximately 700 vehicle trips/day are generated including Columbia Grain and the Canpotex potash facility.
- Terminal 4: approximately 1,000 vehicle trips/day are generated including Toyota, Kinder Morgan soda ash facility, and IRM liquid bulk facility.

Terminal 6 generates the most vehicle trips per day and approximately 50 percent is truck traffic.

Transportation Impacts without an Auxiliary Bridge

Without a new auxiliary bridge, all traffic generated from developing West Hayden Island would use North Hayden Island Drive and the I-5/Hayden Island interchange. The Transportation Analysis for the Hayden Island Concept Plan (2008) found that all of the intersections on Hayden Island would operate acceptably in the year 2030 without an auxiliary bridge, provided the CRC were built . The poorest Level of Service (LOS) is predicted to be "C," which meets the City of Portland's operational standard of LOS "D." The volume-to-capacity (v/c) ratios of the ramp terminal intersections are better than ODOT's maximum allowable v/c ratio standard of 0.85 specified in the Oregon Highway Plan (OHP) for ramp terminals.

Transportation Impacts with a New Auxiliary Bridge

The traffic analysis for the Hayden Island Plan also assumed a scenario with an auxiliary bridge between Hayden Island and Portland. The southern connection would terminate at Marine Drive, an important freight route in Portland with nearby connections to I-5 and Port facilities. Marine Drive provides access to the Rivergate Industrial District west of I-5 and to the Columbia Corridor Industrial Area located on both the east and west sides of the highway. Marine Drive also provides access to OR 99E or NE Martin Luther King Jr. Boulevard, a freight route into Portland. The analysis focused on the P.M. peak period for the 2030 build-out period to assess the impact to the proposed Hayden Island street grid of diverting traffic from the Hayden Island interchange and the impact of that diversion to Marine Drive and to the Marine Drive interchange.[146]

The traffic analysis assumed that most of the traffic generated from the Port of Portland marine terminal on West Hayden Island would use the new bridge for access and egress, because the bridge would provide the fastest and most direct freight route. In addition, a small percentage of traffic on the island originating from or destined to the area west of the I-5 interchange would also use the bridge, based on vehicle-trip origin and destination patterns. Traffic east of I-5 was assumed to not use the bridge because of the additional travel time that would be incurred by drivers taking that route. The total amount of traffic using the bridge would be approximately 290 vehicles during the P.M. peak

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facility. For example, com or wheat screenings and dust from collection systems are compressed into animal feed pellets that are exported and are also sold locally. Local distribution is handled by truck.

[145] These vehicle counts were provided by Phillip Healy, Senior Transportation Planner with the Port of Portland and include employee vehicles and truck traffic.

[146] Using the P.M. peak for the traffic analysis gives the best indication of how the bridge would affect traffic along Marine Drive and the I-5/Marine Drive interchange, because the total amount of traffic is at it highest point of the day. While the A.M. and Midday peak traffic assumptions are slightly higher from West Hayden in Table 1, the total amount of traffic already on the road system during those periods is lower than during the PM peak hour. The slightly increased A.M. and midday traffic estimates from West Hayden Island would not likely have a greater impact than the P.M. peak, given the lower existing traffic.

hour, with a fairly even split between inbound and outbound vehicles. The net effect of the auxiliary bridge would be a minor reduction in traffic volumes at the I-5/Hayden Island interchange and would cause a corresponding marginal improvement in the level of service and the volume-to-capacity ratio at the interchange ramp terminals. In addition, there would be slightly less traffic on the local street network west of the I-5 interchange. However, there would be a very small increase in traffic volumes west along North Hayden Island Drive towards the auxiliary bridge and a very small increase in certain turning movements in the neighborhood. The slight increase in traffic volumes would occur along roads that carry little traffic and, therefore, would not have a significant effect on overall intersection performance on the island.

Traffic using the auxiliary bridge to access I-5 at Marine Drive to travel northbound on I-5 would increase overall traffic volume at the interchange by approximately 4 percent, slightly increasing delays at the ramp meter, extending the queue of vehicles on the on-ramp, and increasing the volume of traffic traveling east on Marine Drive to the interchange. Similar increases in volume would occur for other movements at the interchange. These increases would not significantly impact the traffic operations at the Marine Drive interchange because the increase in volume is quite small. If volumes were to grow to the point where there would be a larger increase in delay, it is likely that vehicles would divert back to using the Hayden Island interchange, until an equilibrium in travel time was reached between the two interchanges.

Economic Impacts/Benefits of a WHI bridge

The economic costs and benefits of the auxiliary bridge were not described separately from the economic costs and benefits of constructing the entire marine terminal. This study was done in 1999. Given the significant changes in the economy in the last ten years since the economic study was completed, the information provided in that 1990s analysis is likely very outdated. However, the construction of large infrastructure (such as bridges) provides construction-related employment, and local companies benefit from purchases of goods and services, thus benefiting the local economy. Additionally, given the large Portland metropolitan area, construction workers would most likely come from the area, and the additional income generated from the construction would be spent locally.

What role the new bridge would play in the economy of the area will likely depend on how West Hayden Island is developed and the rate at which traffic increases. If traffic increases dramatically, there is an economic benefit for the Port, because a new bridge will provide direct access to Marine Drive and the regional freight network rather than having to travel through the Hayden Island commercial area to reach I-5. A new bridge is also an economic benefit to East Hayden Island in that truck traffic is directed onto routes that are designed to handle it. If a bridge is not constructed and truck traffic uses the I-5/Hayden Island interchange, there could be some adverse economic impact to East Hayden Island. A concern for residents since the 1990s has been that adding truck trips onto East Hayden Island roads would make the area less desirable, particularly with the recent efforts to develop a neighborhood plan that does not support heavy truck use on East Hayden Island.

Livability Impacts/Benefits of a WHI bridge

The auxiliary bridge is only one component of a much larger project; issues of livability related to the bridge are directly related to how the bridge affects traffic on Hayden Island and Marine Drive and, indirectly, how that affects residential and commercial development in the vicinity of the existing I-5/Hayden Island interchange.

Attachment B

Without a Auxiliary Bridge to WHI

Without an auxiliary bridge, access to the proposed terminal site would be via a new road that would connect to North Hayden Island Drive at the point where the existing road crosses under the BNSF bridge. This extension of North Hayden Island Drive would be constructed to the City of Portland's industrial access road standards. All access to the terminal would be via North Hayden Island Drive and the I-5/Hayden Island interchange. During the West Hayden Island annexation discussions in the late 1990s, increased traffic, especially truck traffic, was the prime concern of local residents and members of the HiNoon Neighborhood Association. They described existing congestion on Hayden Island Drive and I-5 as a serious threat to the island's livability.

The amount of additional traffic generated from a marine terminal would be dependent on the type of facility that would be constructed on West Hayden Island. The Hayden Island Plan traffic analysis assumed an auto distribution facility for its analysis to compare the traffic impacts on the proposed Hayden Island road network as well as for potential locations for the new bridge. The analysis concluded that, with the bridge, the amount of additional traffic generated from the facility would not significantly increase trips along North Hayden Island Drive. In the event West Hayden Island is developed without an auxiliary bridge, truck traffic will increase on North Hayden Island Drive from the terminal to the I-5/Hayden Island interchange through what is envisioned to be mixed-use, transit-oriented community.

While the small increases in traffic volumes and congestion that would occur with the development of the terminal would not likely result in a significant increase in the number of accidents or accident rates on Hayden Island streets, the potential truck traffic that would result from development on West Hayden Island could adversely affect the livability of the area and adversely affect the recent efforts by the City of Portland and Hayden Island residents and businesses to increase residential densities and mixed-use development opportunities on East Hayden Island. This adverse effect could particularly impact nearby residences and bicyclists and pedestrians that would have to contend with trucks from West Hayden Island.

With an Auxiliary Bridge to WHI

Constructing an auxiliary bridge on West Hayden Island benefits East Hayden Island residents and businesses, because it would reduce the amount of through truck traffic from the terminal on West Hayden Island onto roads, such as Marine Drive, that are already dedicated to freight. For East Hayden Island residents, the auxiliary bridge also provides an alternative to the I-5/Hayden Island interchange. For these reasons, the auxiliary bridge maintains the livability of East Hayden Island as the Hayden Island Plan envisions.

However, a bridge across to Marine Drive, would allow a greater opportunity for termnal truck traffic to use North Portland Road to access routes into St. Johns and Cathedral Park neighborhoods. Residents of these neighborhoods have concerns about the amount of truck traffic that utilizes their streets to get from the industrial areas to the St. Johns Bridge. Portland Transportation is currently exploring ways to encourage trucks to use designated routes. Any future plans for West Hayden Island would have to include additional traffic analysis on these routes to determine the potential effect on St. Johns, Cathedral Park and other surrounding areas that a marine terminal may have on their traffic.

Port Case Studies

Many ports have addressed traffic issues including internal circulation, noise and air quality as well as external transportation volume, routes and infrastructure capacity.

When addressing external routes, ports tend to propose large-scale measures such as:

- port-specific tunnels, bridges and rail spurs, and/or
- increasing the area's capacity and efficiency by adding traffic lanes, grade-separated overpasses/underpasses/onramps, mandatory turn lanes, traffic signals and other standard measures.

Most ports researched address vehicle traffic by:

- prescribing truck routes to keep trucks off neighborhood streets,
- alter operating times to not be a noise nuisance to the community, and
- reduce truck idling at the perimeter access gates to reduce emissions.

Potential Approaches to Consider Moving Forward

The transportation analysis conducted during the 1999 West Hayden Island Planning process resulted in a number of traffic management strategies to reduce cut through traffic some of which are listed here and may continue to be relevant for the current planning process[147]:

To reduce project traffic:

- Develop design solutions that make the connecting route less attractive from a travel time perspective. This includes streets that are curvilinear rather than straight.
- Utilize traffic calming techniques on Hayden Island Drive and/or lowering the speed limit on the street.
- Through a future transportation agreement between the City and the Port of Portland set strict limits on Port of Portland traffic on Hayden Island Drive

To reduce construction traffic:

- The Port would identify and reserve a suitable construction staging area in North Rivergate that could be used for the proposed barge access during the first phase construction, A barge delivery site on the south shore of West Hayden Island would also be identified.
- The rail and bridge connections to West Hayden Island would be constructed as some of the first elements of the project, so that this mode could be used for the delivery of materials and equipment
- Contractors would be required to use the barge and/or rail systems for the delivery of materials where feasible and cost-effective,
- Prior to construction of each marine terminal phase, the Port would ensure that a construction management plan is developed in collaboration with the City of Portland and HiNoon to address traffic, noise and vibration issues.

[147] Some of the recommendations in the WHI Area Plan dealt with seeking funding immediately for a new bridge because the Port had a potential tenant during that planning process. These recommendations are not listed above as well a series of recommendations for I-5 interchange upgrades in the vicinity are not listed. These upgrades are being considered under the CRC project.

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Attachment C
West Hayden Island: Ambient Noise Baseline Data Collection

Scope of Work:

Introduction:

The City of Portland's Bureau of Planning and Sustainability (BPS) has been working on a planning project to determine the long term future of West Hayden Island. The Port of Portland is the landowner and they have an interest in future marine terminal development on the island. Although West Hayden Island is within Portland's Urban Services Area, it is actually part of Multnomah County and would need to be annexed to the city for any planning policies to take effect.

In July 2012 City Council directed BPS to develop a legislative proposal to annex West Hayden Island into the City, with the intent to protect at least 500 acres as open space, and 300 acres for future deep water marine terminal development. Council requested that the proposal should consider impacts from industrial development on adjacent communities on Hayden Island. These include: air quality (dust and emissions), noise, light and traffic impacts.

This Contract focuses on the collection and preliminary mapping of noise data collected on East Hayden Island between the I-5 corridor and the mainline railroad bridge to the west with some emphasis on noise data taken in the undeveloped area west of the mainline railroad. The main sources of noise that have been described by residential community members between the I-5 corridor and the mainline railroad includes truck traffic, passing trains on the mainline, aircraft traffic and ships on the Columbia River.

The Contractor shall:
Task 1) Identify several monitoring locations for long-term noise measurements north and south of Hayden Island Drive focusing generally on the area in and around the manufactured home communities. Conduct the 24-hour noise measurements focusing on the noise descriptors noted below in "Section 3" from at least 7, but preferably 8 to 10 representative measurement locations. Two of the locations should be interior measurement locations, if agreed to by a homeowner, where measurements are taken with the doors and windows closed.

Task 2) Collect baseline noise readings at monitoring locations on Hayden Island between Interstate 5 Bridge and the railroad bridge to the west and at monitoring locations west of the railroad bridge as described in "Section 2" below. Twenty-four hour noise measurements shall be made over seven (7) consecutive days at each monitoring location identified for long-term noise measurements. Monitoring at each long-term monitoring location does not have to occur during the same seven-day period. However, if long-term measurements are to occur over more than one seven-day period, measurements must be made at one of the long-term measurement locations during all measurement periods. That location shall be considered the "control" location for the study.

Take measurements that will provide data in terms of the following noise descriptors for the 7 days of measurements at each location: the hourly L_{01}, L_{10}, L_{50}, L_{90} and the hourly L_{eq}; the day- night average sound level (based on a 24-hour measurement period) commonly called the Ldn.

Task 3) The selected firm will supply the raw measurement data in an Excel format easily separated out by location and date. The data and any report from the consultant will be the property of the City of Portland and may be made available to the general public or to university students and Acoustical Ecologists for further analysis.

Task 4) The Acoustical Engineering firm selected shall generate graphs of the data measured at each of the long-term measurement locations. The graphs will show the hourly L_{10}, L_{50} and L_{90} noise levels as well as the 24-hour average sound level for each day (the Ldn level)of the 7-day period. A short report will accompany the graphs of data to explain baseline information collected and provide some source information based on the measurement period.

Time frame: Completed by September 30, 2012.

BES piece of Scope (not confirmed)

Two measurement locations will be chosen on West Hayden Island to help address the concern for future impact to wildlife. Those locations will be selected in consultation with the City of Portland's Noise Control Office, BES and the Portland Audubon Society. The Contractor shall prepare a monitoring proposal and share it with the City for approval prior to proceeding with the monitoring. Graphs of data and interpretation will be included in a short report .

Total: $3,000

Project Cost Estimate Summary Sheet

Project: 021121b

Client: Port of Portland

Title: West Hayden Island Ambient Noise Study

Task No. Task Description Cost Estimate

1 Select long-term sound measurements $700

2 Conduct long-term sound measurements $1,521

3 Download data and generate graphs $544

5 Generate report $235

Total $3,000

Port piece of Scope (not confirmed)

Supplemental short term monitoring and mapping:

A series of short-term measurements (clarify #/per week?) will be taken at specific locations within the study area to help identify noise levels caused by truck traffic on Hayden Island Drive, train traffic on the mainline railroad, aircraft traffic from PDX and ships on the Columbia River. That data will be used to assist in a contour mapping exercise which will highlight the long-term and short-term measurement data collected and show the contribution of noise from different sources and the combination of sources.

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Task No. Task Description Cost Estimate:

1 Select short term sound measurement sites

2 Conduct short term sound measurements

3 Download Data and Correlate with long term measurments

4Generate Contour maps (how many?)

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Total : $6,083

4 Conduct short-term measurements to determine contribution of various sources
$6,083

MEMORANDUM

Date: May 23, 2012

To: Rachel Hoy, Eric Engstrom, Phil Nameny - Portland Bureau of Planning & Sustainability

From: Bob Hillier, Ning Zhou, John Gillam - Portland Bureau of Transportation

Subject: **FINAL:West Hayden Island Transportation Modeling Analysis: Phase 1 - Planning Level Network Analysis**

Project: West Hayden Island Concept Plan

This memorandum describes the transportation modeling process and technical findings for the Phase 1 planning-level network analysis conducted by the Portland Bureau of Transportation (PBOT) for the West Hayden Island Concept Plan. The transportation analysis was conducted for what was determined to be a reasonable "high impact" traffic generation scenario for a 300-acre Port development site that includes two auto import terminals and one bulk marine facility on West Hayden Island. The results of the Phase 1 network analysis will be used as the basis for a more detailed Phase 2 operational level analysis at the intersection level for the selected future scenarios. A subsequent Phase 3 analysis will identify mitigating measures and state Transportation Planning Rule (TPR) findings for the preferred plan selected for the West Hayden Island Concept Plan.

1. Project Overview and Purpose

The Portland Bureau of Transportation has an interagency agreement with the Portland Bureau of Planning and Sustainability to provide transportation modeling and analysis services for the West Hayden Island Plan. This entails developing a transportation model of existing (2005) and future (2035) base conditions for West Hayden Island and its study area and conducting a "high impact" traffic generation scenario assessment both with and without a new West Hayden Island Bridge for a 300-acre Port terminal development.

The purpose for conducting transportation modeling analysis for West Hayden Island is to:

- Provide the basic assessment of traffic conditions on Hayden Island and the surrounding facilities with the combined effects from the following projects:
    - Columbia River Crossing (CRC)
    - New West Hayden Island Bridge
    - West Hayden Island Port Development Plan
    - Hayden Island Community Plan.
- Provide an analysis of the cut-through traffic impacts from a proposed West Hayden Island Port Development.
- Provide a tool to evaluate a "high impact" development scenario for a new West Hayden Island Port Development in respect to transportation system impacts within the study area.
- Provide the analytical basis for preparing state TPR findings on ODOT facilities.

2. Transportation Modeling Process and Network Area

Transportation Modeling Process:

A transportation model is a mathematical tool to simulate existing and forecast future traffic conditions within a designated geography. The input data of the model include: a) socioeconomic data such as population, employment and land use that is typically stored within a defined geographic area called a transportation analysis zone (TAZ), and b) transportation facility data such as street network (auto, truck and transit) normally coded at street links or bus lines. The model compiles all the data statistically to formulate the relations between the traffic demands and socioeconomic activities, the traffic condition and traveler's mode and route choices. All model parameters are calibrated against the survey data from current conditions, and are carried forward to a future year forecast. This process is traditionally prepared in four steps: a) trip generation (how many), b) trip distribution (to where), c) mode choice (auto, truck, transit), and d) traffic assignment (which route). The typical outputs of a transportation model are traffic volume, speed and congestion information, such as volume to capacity (v/c) ratio.

The 2035 Regional Transportation Plan (RTP) provides the framework for integrating the socioeconomic, land use and transportation network data built into the PBOT transportation model that was developed for this analysis. Consequently, the RTP framework establishes the background conditions necessary for conducting the transportation analysis in a consistent manner without injecting multiple variables for each scenario presented in this report.

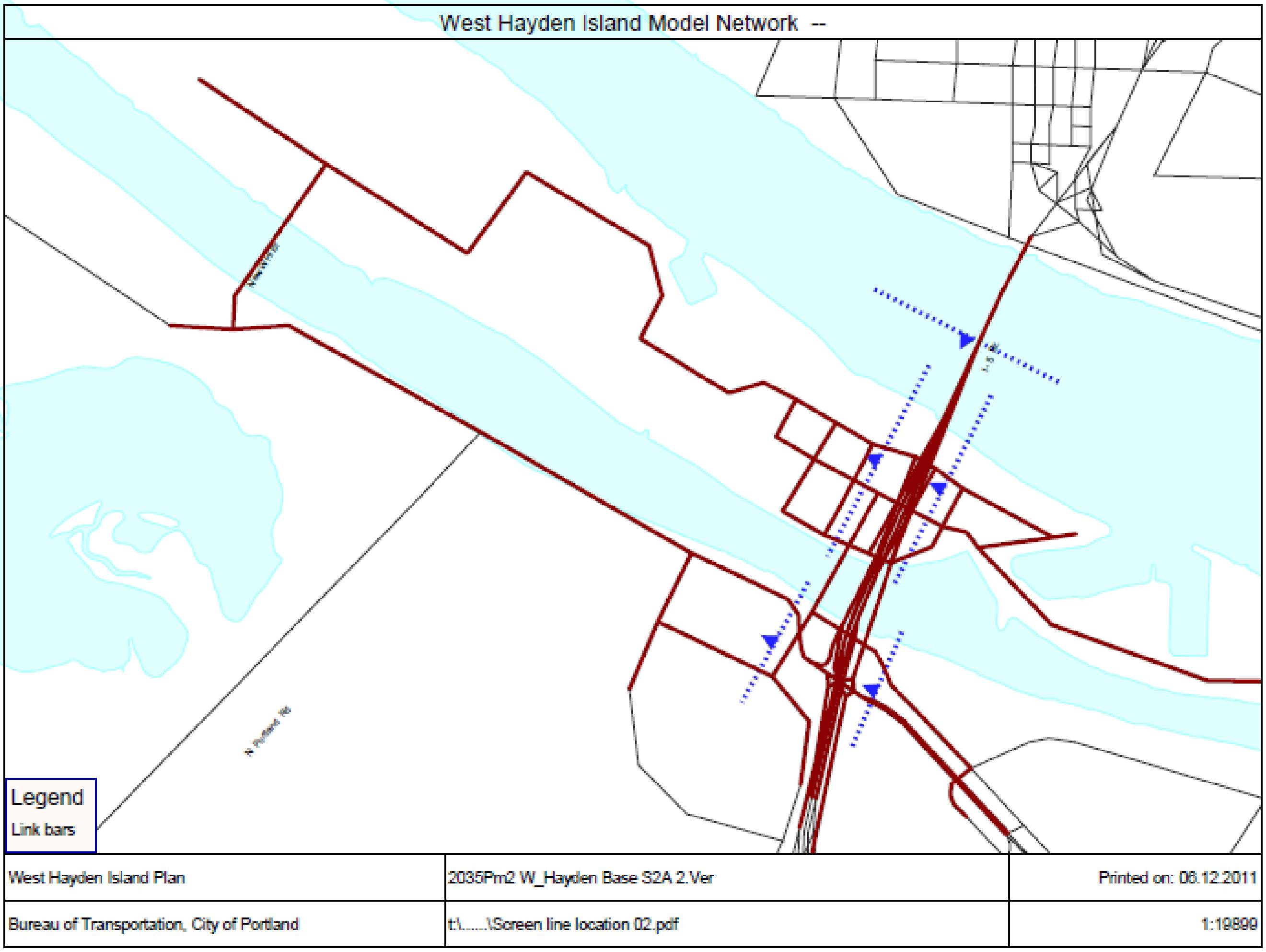
Modeling Network Area:

The modeling network area developed for the West Hayden Island transportation analysis includes the two Interstate bridges over the Columbia River (I-5 and I-205) and the two bridges over Willamette River (St. Johns Bridge and the I-405 Fremont Bridge). These four bridges form the loop for traffic assignment and provide a sufficient base for analyzing potential cut-through traffic. The modeling network area is illustrated in **Figure 1** below. Key analysis areas are also identified within the modeling network to provide a targeted look at potential transportation system impacts. These key analysis areas include: a) New West Hayden Island Bridge, b) Hayden Island community streets, c) CRC interchanges and Option D streets network which includes a new Hayden Island arterial bridge, d) MLK/99E and Marine Drive connections, and e) St. Johns Bridge connections.

Figure 1: West Hayden Island Traffic Model Network Area

For conducting the West Hayden Island transportation analysis, cutlines (imaginary lines) were placed in the model at specified locations to measure traffic demand on those links. **Figure 2** below shows the cutline locations (the blue dashed lines) and model links (solid red lines) selected for this analysis. These include the I-5 Bridge to capture northbound and southbound demands and across Hayden Island and the Marine Drive Interchanges to capture eastbound and westbound demands.

Figure 2: Cutline Locations for the West Hayden Island Traffic Model Network



3. Transportation Model Development and Network Assumptions

PBOT's model developed for the West Hayden Island transportation analysis is built on the base of Metro's RTP (Regional Transportation Plan) model, plus the more detailed local City street network. In developing the base model for this analysis, all future transportation network and land use inputs and assumptions were peer reviewed by Metro, ODOT and CRC modeling staff to validate the overall modeling approach and to ensure consistency with the currently adopted RTP. The following future transportation network and development assumptions are incorporated into the PBOT model:

- Metro 2035 Financially Constrained Regional Transportation Plan projects and land uses, which includes the Columbia River Crossing.

- Columbia River Crossing project with Option D street network (10 lane I-5 bridge with tolling, I-5/Hayden Island and I-5/Marine Drive Interchanges, local arterial bridge connecting Hayden Island with N. Marine Drive, new LRT service between Portland and downtown Vancouver).

- City of Portland 2009 Hayden Island Community Plan street network and land uses. The Hayden Island Community Plan would see a significant increase in the number of housing units, a 40 percent decrease in overall retail square footage, and little to no change in other land uses. The mall area near the future light rail station would transition over time from exclusively retail into mixed use with housing.

- Port of Portland 1999 West Hayden Island Port Terminal Option 2 Build-Out (auto distribution, intermodal rail yard and bulk terminal). A decision will be made as part of this process whether or not to include the Option 2 development assumption into the future year base model.

- New West Hayden Island Bridge west of the BNSF Railroad (based on the evaluation of four arterial bridge options conducted as part of the Port's 1999 West Hayden Island Plan). A decision will be made as part of this process whether or not to include a new West Hayden Island Bridge into the future year base model.

- New 8-10-space West Hayden Island Recreational Parking Lot. The parking lot will be coded to connect to the west end of Hayden Island Drive and all recreational trip will be added to the traffic demands from the Port's development plan scenario.

With the CRC project as identified in the adopted RTP, the West Hayden Island Port Development Plan and the adopted Hayden Island Community Plan, the future (2035) transportation model network is dramatically different from existing base model conditions. The major network changes assumed as part of this analysis include:

- On/Off Hayden Island Connections – Currently, the only vehicular access on and off the island is through the I-5/Hayden Island Interchange connecting ramps. Completion of the CRC project will not only increase this segment of I-5 from six to ten lanes, but will also change the way island traffic connects to the freeway and access on/off the island. Based on the current CRC design the I-5 ramps will only carry regional traffic for longer distance trips while another arterial bridge will be built adjacent to the west of I-5 to connect local traffic movements between the island and Marine Drive, Expo, MLK and the Bridgeton area. A new West Hayden Island Bridge (west of BNSF Railroad) is also assumed in several scenarios on the future network with the Port marine terminal development. This will provide another option for island traffic to connect to the Port terminals and the N Portland area. The location of a new West Hayden Island Bridge is based on the Port's 1999 West Hayden Island Study prepared by Parametrix. This analysis will include traffic impacts both with and without a new West Hayden Island Bridge.

- Local Street System and Connector Structure – Currently, most of the streets on Hayden Island are privately owned except a few that connect directly to the I-5 ramps or the I-5 ramp loop. With the single entry/exit ramp setting, the island network is very simple with only one street link in the model, and all four of the islands TAZ's traffic connecting to it. Based on proposed developments and roadway improvements, the future model network is coded more as a grid system. In order to keep consistent with the 2005 base network, the 2035 model doesn't sub-divide the four island TAZs but instead codes multi-connectors for each TAZ and use the specific demand share to simulate the detailed land use development plan and network system. Local street links are also coded with a 25 mph speed.

- I-5 / Marine Drive Interchange – The future model network incorporated the I-5 / Marine Drive Interchange design from the CRC project, which include local street system improvements in Expo and the Bridgeton area.

- New Light Rail Transit (LRT) Service – Currently, congestion on I-5 reduces bus travel speed and reliability between downtown Vancouver, Hayden Island and downtown Portland. A new LRT line will connecting Hayden Island to the existing MAX system and provide a non I-5 alternative transit route between Vancouver and downtown Portland not currently available.

- I-5 Bridge Tolling – The CRC assumes that a tolling scheme on the I-5 Bridge will be implemented as part of this project. To reflect this change on the future transportation network, a tolling penalty was coded on the I-5 Bridge link in the City's transportation model.

4. West Hayden Island Port Development High Impact Scenario

A reasonable "high impact" traffic generation scenario for this analysis was determined to be two auto import terminals with post processing facilities and one bulk marine facility located within the 300 acre West Hayden Island site. The estimated traffic generation rates were provided by the Port of Portland and developed based on actual count data collected from the Port's Terminal 4 Toyota facility from a year where 240,000 units were processed. This facility operates on two shifts so many of the trips are during the off-peak period. The estimated high traffic generation used for this scenario is based on the *total number of trips* which was determined to provide a more accurate representation of a proposed West Hayden Island Port terminal development rather then using a trip rate base on trips per acre or trips per employee.

Vehicles types were broken into three categories – *dual-unit trucks*, *other heavy vehicles and autos.* Dual unit trucks are the auto carriers that are distributing cars to local population centers. Most of these trips are going to and coming from the north on I-5. Other heavy vehicles are single-unit trucks supporting the processing center and other functions of the auto terminal. The distribution of dual-unit trucks are based on interviews with the logistics personnel at the Port's Toyota auto terminals. The distribution pattern for the remaining other heavy vehicles and autos is based on distributions identified in the 1999 Parametrix report for the Option 2 auto distribution and bulk terminal, with some minor adjustments to make up for some of the missing percentages in that report. For the purpose of the West Hayden Island modeling analysis, both duel-unit trucks and other heavy vehicles were combined into one truck category with the distributions allocated accordingly.

Tables 1-3 below summarizes the assumed auto/truck distribution patterns and vehicle volumes for the daily and 2-hour PM peak periods for a combined two auto import terminal and one bulk marine facility. This data was provided by the Port of Portland and converted into 2-hour peak volumes to be consistent with the City's Transportation System Plan criteria. **Table 4** shows the trip generation for the West Hayden Island Option 2 build-out from the 1999 Parametrix report.

Table 1: Combined Trip Distribution Pattern for Auto and Bulk Facility

Vehicle Type	North via I-5	South via I-5	North Portland and US 30	Columbia Corridor East of I-5	Columbia Corridor West of I-5 (Rivergate area)
Dual Unit Trucks	60%	16%	5%	14%	5%
Heavy Vehicles	20%	35%	5%	15%	25%
Autos	30%	35%	15%	15%	5%

Tables 1-3 Data Source: Port of Portland

Table 2: Two-hour PM Peak Vehicle Volumes and Distributions for Two Auto and One Bulk Facility

Vehicle Type	Total Two-Hour PM Peak Vehicles (in/out bound)	North via I-5	South via I-5	North Portland and US 30	Columbia Corridor East of I-5	Columbia Corridor West of I-5 (Rivergate area)
Dual Unit Trucks	33	20	5	2	4	2
Heavy Vehicles	38	8	13	2	6	9
Total Trucks	**71**	**28**	**18**	**4**	**10**	**11**
Auto	287	86	101	43	43	14
Total Vehicles	**358**	**114**	**119**	**47**	**53**	**25**

Table 3: Daily Vehicle Volumes and Distributions for Two Auto and One Bulk Facility

Vehicle Type	Total Daily vehicles (in/out bound)	North via I-5	South via I-5	North Portland and US 30	Columbia Corridor East of I-5	Columbia Corridor West of I-5 (Rivergate area)
Dual Unit Trucks	275	165	44	14	39	14
Heavy Vehicles	241	48	84	12	36	60
Total Trucks	**516**	**213**	**128**	**26**	**75**	**74**
Auto	1534	460	537	230	230	77
Total Vehicles	**2050**	**673**	**665**	**256**	**305**	**151**

Table 4: Trip Generation for 1999 West Hayden Island Marine Terminal Option 2 Build-Out

Land Use	**Units**	***AM Peak**		***Midday Peak**		***PM Peak**		**Daily**
		In	**Out**	**In**	**Out**	**In**	**Out**	
Build-out – Option 2:								
Auto Distribution Facility	270 ac.	225	26	55	99	17	64	1,620
Intermodal Rail Yard	Total	25	26	48	48	21	24	840
Bulk Terminal	45 employees	25	5	25	5	25	5	260
Total All Vehicles		275	57	128	152	63	93	2,721

Trucks		30	25	49	41	21	20	740
Autos		245	32	79	111	42	73	1,980

Source: West Hayden Island Marine Terminal Development (Parametrix 1999) * One hour Peak

5. Modeling Scenarios and Analysis Phases

Modeling Scenarios
A total of seven modeling scenarios were prepared for the West Hayden Island transportation analysis that include one existing 2005 base year and six future 2035 base/high impact scenarios. A brief description of each scenario and the primary differences between them (in **bold**) are as follows:

Scenario 1 - 2005 Base Year
Assumes the existing transportation network and land uses – no CRC project, no WHI Port development, existing Hayden Island transportation network and land uses. The existing base year is used to compare the overall changes in traffic volumes and congestion between each of the Future Year (2035) scenarios.

Scenario 2A - 2035 Future Base
Assumes **new WHI bridge**, 2035 RTP and land use, CRC, Hayden Island Plan, **Port Option 2 Build-Out**. The Future Base (2A and 2B) will be used to compare changes in traffic volumes and congestion between each of the Future Year High Impact Scenarios (3A, 3B, 3C and 3D).

Scenario 2B - 2035 Future Base
Assumes **no WHI bridge**, 2035 RTP and land use, CRC, Hayden Island Plan, **no Port Option 2 development**.

Scenario 3A - 2035 Future High Impact
Assumes **new WHI bridge**, 2035 RTP and land use, CRC, Hayden Island Plan, High Impact Port Development Plan. Each of the Future High Impact scenarios (3A, 3B, 3C and 3D) will include the same High Impact Port Development assumptions described above.

Scenario 3B - 2035 Future High Impact
Same as Scenario 3A but **no WHI bridge**.

Scenario 3C - 2035 Future High Impact
Same as Scenario 3A but **no street connection between the Port Development and East Hayden Island, except for emergency vehicles**.

Scenario 3D - 2035 Future High Impact/Preferred Plan with Mitigating Measures
To be determined.

Analysis Phases
The West Hayden Island transportation analysis will be conducted in three phases: *Phase 1* - planning level traffic network analysis at the link level (auto/truck volumes, volume to capacity ratio, cut-through traffic, green house gas), *Phase 2* – operational level analysis at the intersection level (delay and deficiencies identified) that will be based on the information and analysis from phase 1 planning, and *Phase 3* – mitigating measures for the preferred plan based on the outcome of the phase 2 operational analysis. The following table illustrates the analysis schemes for each of the seven modeling scenarios, the major network and development assumptions and the key decision points between the three phases:

Table 5: Summary of Modeling Scenarios and Analysis Schemes

Scenarios				Assumptions: network	Assumptions: developments	Analysis Schemes: Planning Level Network Traffic Assessment – WeekdayPM2 •link traffic •cut through	Analysis Schemes: Planning Level Network Traffic Assessment – Weekend Noon •link traffic	Analysis Schemes: Operational Traffic Analysis
1	Existing			Current, auto/transit	Exiting land uses	√		√
2A	Future	Base	with WHI Bridge	*2035 RTP Projects *WHI Bridge *CRC: I-5 *Marine interchange *Hayden Island street plan	*2035 RTP land use, *WHI Port's Option 2 build-out, * Hayden Island Plan	√		Select either 2A or 2B
2B	Future	Base	without WHI Bridge	* 2A minus WHI Bridge	*2A minus WHI Port option 2	√	√	
3A	Future	West H-Island Dev. (High Impacts)	with WHI Bridge	same as 2A	*2B *Port Dev. Plan *20 space recreational parking lot	√		
3B	Future	West H-Island Dev. (High Impacts)	without WHI Bridge	same as 2B	same as 3A	√	√	Select either 3A, 3B or 3C
3C	Future	West H-Island Dev. (High Impacts)	with WHI Bridge but no access to Hayden Island Drive	same as 3A but no access to Hayden Island Drive and make new bridge for WHI development use only	same as 3A	√		
3D	Future	West H-Island Dev. (High Impacts)	Preferred Plan	Mitigating measures	same as 3A	√	√	√

3 phases in future traffic analysis:

Phase 1 - focus on planning level analyses to assess the traffic condition at link level to against the project objectives, which is the mobility, accessibility and cut-through conditions.

---> Decision making process

Phase 2 – Based on the info from phase-1, analyze two scenarios at the intersection level to find if there is any deficiency

---> Planning / Design / Decision process

Phase 3 – Based on the outputs from phase-2, model mitigation measures and analyze the system with TPR findings.

Notes:

(1) Planning level traffic analysis based on traffic link data from travel demand model (Visum).

(2) Operational level traffic analysis applies Synchro/SimTraffic model at the intersection level.

(3) Weekend noon model would be converted from PM2 model with the relation defined by CRC study

6. Link-Level Traffic Network Analysis

This section summarizes the link-level network analysis from PBOT's traffic model and the key findings based on the assumptions and development scenarios described above. More detailed traffic volume output plots from the model are provided in the Technical Appendix.

<u>Link Analysis Traffic Conditions</u>
The traffic conditions in **Table 6** summarizes the total traffic demands and environmental measures that were modeled based on three link-level formats: 1) all project links, 2) Hayden Island links only, and 3) south of Columbia River/no freeway links. As illustrated, PM peak demand in 2035 is projected to increase for all project links both with and without a Port development. This is due to the overall increase in regional traffic demand which is projected to grow at a much greater level compared to the relatively small increase generated by a new Port development.

There is little variation in total PM peak traffic demand between each of the future year (2035) scenarios which also indicates that regional growth has a much greater impact on future network demand than the incremental increase from a Port development on West Hayden Island. Both congestion (v/c) and GHG emissions are expected to decrease for all project links by 2035 during the PM peak, primarily due to the planned I-5 improvements identified in the CRC project.

The increase in the v/c ratio on Hayden Island streets by 2035 is due to the increase in demand from the land use changes identified in the Hayden Island Community Plan which assumes a significant increase in housing units, a 40 percent decrease in retail square footage, and little to no change in other land uses. All of the v/c ratios measured under the three link-level formats operate at 0.88 or better for each of the future year scenarios either with or without the Port development or new West Hayden Island Bridge. Therefore, all of the project links in the study area will be operating at adequate levels of capacity by 2035.

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Table 6: Traffic Conditions

			2005 Base	2035PM2 Base		2035PM2 Alternatives				2035 Weekend Noon Alt.		
				2A	2B	3A	3B	3C	3D	2B	3B	3D
All Project Links	Demands	NB & SB Cutline[1] on I-5	20,700	27,400	27,300	27,500	27,500	27,500	0	18,900	18,900	0
		EB & WB Cutlines	9,200	17,000	16,900	17,000	17,400	17,100	0	16,200	16,400	0
		PK1-Hr Vol / link[2]	640	590	600	590	610	600	0	450	450	0
		Average Link V/C[3]	0.41	0.35	0.35	0.35	0.36	0.35	0.00	0.31	0.31	0.00
		Highest link V/C	1.23	0.88	0.88	0.88	0.88	0.88	0.00	0.88	0.86	0.00
		Congested street Links[4]	11	0	0	0	0	0	0	0	0	0
		% of total lane-miles	11%									
	Environmental Measures	Total VMT[5]	47,500	62,600	61,500	62,900	62,700	62,800	0	45,300	45,500	0
		Total GHG[6] (Ton)	178	47	47	47	48	48	0	13	14	0
Island Local Streets	demands	Cutlines[7]	4,800	9,900	9,800	9,800	10,300	9,800	0	11,700	11,900	0
		PK1-Hr Vol / link	180	360	360	350	390	360	0	400	410	0
		Average Link V/C	0.38	0.32	0.32	0.31	0.35	0.32	0.00	0.37	0.37	0.00
		Highest link V/C	0.71	0.86	0.86	0.75	0.87	0.87	0.00	0.88	0.86	0.00
		Congested street links	0	0	0	0	0	0	0	0	0	0
		% of total lane-miles	0%									
	Environmental Measures	Total VMT	3,800	11,600	11,000	11,200	11,900	11,400	0	11,100	11,200	0
		Total GHG (Ton)	3	6	6	5	7	6	0	7	7	0
S/ River No-FWY Links	demands	Cutlines[8]	4,500	7,100	7,000	7,200	7,100	7,300	0	4,500	4,500	0
		PK1-Hr Vol / link	390	620	610	630	620	640	0	390	390	0
		Average Link V/C	0.23	0.27	0.27	0.28	0.27	0.28	0.00	0.18	0.18	0.00
		Highest link V/C	0.84	0.82	0.82	0.81	0.83	0.84	0.00	0.43	0.44	0.00
		Congested street links	0	0	0	0	0	0	0	0	0	0
		% of total lane-miles	0%									
	Environmental Measures	Total VMT	6,200	12,100	11,800	12,300	11,900	12,500	0	7,700	7,800	0
		Total GHG (Ton)	3	5	5	5	5	6	0	2	2	0

1. Cutline is an imagined line crossing a collection of street to measure the traffic demands
2. PK I-Hour = Peak Hour, pm2 to pm1 = 0.52
3. V/C = ratio of Volume / Capacity
4. Congested streets: fwy: v/c >= 1.0, other v/c>= 0.9
5. VMT = Vehicle Mile Traveled
6. GHG = PM 2-hour Greenhouse Gas emission, calculated based on Synchro formula.
7. demand is 0.95 of the total traffic crossing the two cutlines
8. demand is 0.68 of the total traffic crossing the two cutlines

<u>Cut-Through Traffic Analysis</u>
The cut-through traffic analysis presented in **Table 7** identifies cut-through demand and system impacts from a Port development. As illustrated in 7a, a new West Hayden Island Bridge will not attract any cut-through traffic to or from Marine Drive between the Rivergate Industrial area and I-5 northbound or southbound. With the new CRC interchanges in place, the travel time to I-5 is at least 2 minutes shorter than taking the WHI bridge route. However, without the new Marine Drive and Hayden Island interchanges, it is estimated that one third of the east to northbound traffic (about 200 vehicles) will use the new WHI Bridge as a cut-through route due to projected congestion at the I-5/Marine Drive Interchange.

7b shows that almost 90 percent of Port development traffic in scenario 3A will use a new West Hayden Island Bridge with only 10 percent using the local Hayden Island street network during the two-hour PM peak period. Compared to the total per-link volume on the Hayden Island street network, Port development volumes will only account for 3 percent of the traffic with a new WHI Bridge. Under scenario 3B without a new WHI bridge, Port development traffic would account for 12 percent (90 vehicles) of the total per-link volumes on Hayden Island streets.

7c and 7d shows the amount of cut-through traffic using St John's neighborhood streets for access to the St. Johns Bridge from both the Port development and Hayden Island street, respectively. On a per-link bases, the total traffic generated on Hayden Island only accounts for 3 percent of all traffic on the St Johns street network heading to/from the St. Johns Bridge, which is about 30-40 vehicles during the two-hour PM peak period. Only about 3 of those vehicles are from the Port development. Therefore, no additional link-level improvements on the S. Johns Street network are needed as a result of the Port development.

Table 7: Cut-through Traffic Analysis (2-hour PM Peak traffic for all vehicle types)		2005 Base	2035PM2 Base		2035PM2 Alternatives			
			2A	2B	Alt 3A	Alt 3B	Alt 3C	Alt 3D
a) Cut-Through traffic using new WHI Bridge:								
Marine Drive eastbound to I-5 northbound	total demand	n/a	550	n/a	550	n/a	n/a	0
	Cut-through using WHI Bridge		0	0	0	0	0	0
I-5 southbound to Marine Dr. westbound	Total demand	n/a	160	n/a	160	n/a	n/a	0
	Cut-through using WHI Bridge		0	0	0	0	0	0
b) Port development traffic using Hayden Island local streets:								
Port development demand:		n/a	350	n/a	420	420	420	0
	use new WHI Bridge		280		370	0	420	0
	%		81%		89%	0%	100%	0%
	use Hayden Island local streets		70		50	420	0	0
	%		19%		11%	100%	0%	0%
Volumes on Hayden Island local streets:								
	Hayden Island volumes per link		850		870	780	0	0
	Port development volumes per link		40		30	90	0	0
	% Port development volumes		4%		3%	12%	0%	0%
c) Port development cut-through traffic using St John's neighborhood streets to St. Johns Bridge:								
	Total St Johns neighborhood street volumes per link		1450		1350	1410	1380	0
	Port development volumes per link		3		3	3	3	0
	% cut-through volumes		0.2%		0.2%	0.2%	0.2%	0.0%
d) Hayden Island cut-through traffic using St John's neighborhood streets to St. Johns Bridge:								
	Total St Johns neighborhood street volumes per link	970	1160	1160	1160	1140	1190	0
	Hayden Island volume per link	10	30	30	40	30	40	0
	% cut-through volumes	1%	3%	3%	3%	3%	3%	0%

Key Traffic Analysis Findings

1. Total traffic growth on the Hayden Island project streets will grow at a higher rate than the City's average during the 2005-2035 planning period. Hayden Island's 2-hour PM peak traffic demands will grow by 100 percent from about 5,000 vehicles to 10,000 vehicles in 2035. Meanwhile, traffic demands on I-5 are expected to grow by less than 30 percent from about 21,000 to 27,000 vehicles during the same period.

2. Completing the CRC improvements are expected to improve roadway operating conditions in 2035 compared to the existing base year network. The highest future 2-hour PM peak link v/c ratio among all the project links will be less than 0.9, which is considered operating at an adequate level of capacity.

3. The Port's West Hayden Island Development will add 360 (in and outbound) vehicles to the island's 2035 2-hour PM peak traffic, about 70 of them (20%) are trucks. The 360 vehicles account for about 5% of the island's total 2-hour PM peak traffic. The peak direction of the Port's 2-hour PM peak traffic is opposite of the peak direction of the island traffic, which results in less impact in traffic operations.

4. There is little variation in total PM peak traffic demand between each of the future year (2035) scenarios which indicates that regional growth has a much greater impact on future demand than the incremental increase from a Port development. The average traffic conditions at the link-level on Hayden Island's local streets did not changes significantly among the scenarios.

5. Both congestion (volume to capacity) and GHG emissions are expected to decease for all project links by 2035 during the PM peak, which is primarily due to the planned I-5 improvements identified in the CRC project.

6. Only 11% (40 vehicles) of the Port's added 2035 2-hour PM peak traffic is projected to use local Hayden Island streets if a new West Hayden Island Bridge is built. If no new WHI bridge is built, the added Port traffic will use Hayden Island Drive to access the regional roadway system. However, total traffic on Hayden Island Drive is still less than 650 vehicles during the PM peak (per hours, per lane, per direction), which will not trigger any roadway design modifications at the link level. It should be noted that 17 dual-unit trucks are projected to need both inbound and outbound island access from the Port development during the 1-hour PM peak period, which equals to about one truck every three minutes.

7. Without a new WHI Bridge, the CRC Arterial Bridge that connects Hayden Island to N. Marine Drive is projected to carry 1,300 vehicles during the 2-hour PM peak. About 100 of those vehicles (8%) are associated with the Port development which include 17 trucks (8 dual-unit and 9 other heavy vehicles).

8. Hayden Island local streets are projected to experience the worse traffic conditions during the weekend noon period compared with the typical weekday PM peak period. This is due to the traffic associated with the commercial developments from the Janzen Beach Shopping Center. However, traffic generated from the WHI Port development during the weekend noon period will have little additional impact in the island's traffic since only 10% of the Port's auto and 5% of Port's truck traffic operate during the weekend.

9. Potential cut-through traffic on Hayden Island's local street network was analyzed with a new West Hayden Island Bridge. A select link analysis shows that a new WHI bridge will not attract

any cut-through traffic between the Rivergate Industrial area (T5, T6) and I-5 north. With the new CRC Marine Drive and Hayden Island interchanges in place, the travel time on Marine Drive to I-5 is at least 2 minutes shorter than taking the WHI bridge route to the I-5/Hayden Island interchange. If the new Marine Drive and Hayden Island interchanges are not built, one third of the east to northbound traffic (about 200 vehicles during the 2-hour PM peak) will use the new WHI Bridge as a cut-through route due to projected congestion at the I-5/Marine Drive Interchange.

10. It is projected that about seven vehicles generated from the Port development will use the local St Johns street network to access the St Johns Bridge during 2-hour PM peak hour period. As a comparison, about 140 (non Port generated) Hayden Island vehicles use the local St Johns street network to access the St Johns Bridge. On a per-street segment base, all Hayden Island generated traffic accounts for about 3% of total traffic on the local St Johns street network.

Technical Appendix

The Technical Appendix contains the model network output plots (pdf files attached) for the West Hayden Island transportation analysis prepared by PBOT.

Plot 1: All Project Links (for the link-level traffic conditions analysis):

S:\POLICY\West Hayden Island\Phase

Plot 2: Hayden Island Street Links (for link-level traffic conditions analysis):

S:\POLICY\West Hayden Island\Phase

Plot 3: South of Columbia River – No Freeway Links (for link-level traffic conditions analysis):

S:\POLICY\West Hayden Island\Phase

Plot 4: 2008 Two-Hour PM Peak Period (PM2) Traffic Volumes and Conditions:

S:\POLICY\West Hayden Island\Phase

Plot 5: 2035 PM2 Traffic Volumes and Conditions – Scenario 2B (without WHI Option 2 development and no WHI Bridge):

S:\POLICY\West Hayden Island\Phase

Plot 6: 2035 PM2 Traffic Volumes and Conditions – Scenario 3B (with Port development and no WHI Bridge):

S:\POLICY\West Hayden Island\Phase

Plot 7: 2035 PM2 Projected Traffic Growth - Scenario 3B (with Port development and no WHI Bridge):

S:\POLICY\West Hayden Island\Phase

Plot 8: 2035 PM2 Future Added Vehicle Traffic (auto equivalent) from Port Development (Scenario 3B):

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Plot 9: 2035 PM2 Future Added Truck Traffic from Port Development (Scenario 3B):

S:\POLICY\West Hayden Island\Phase

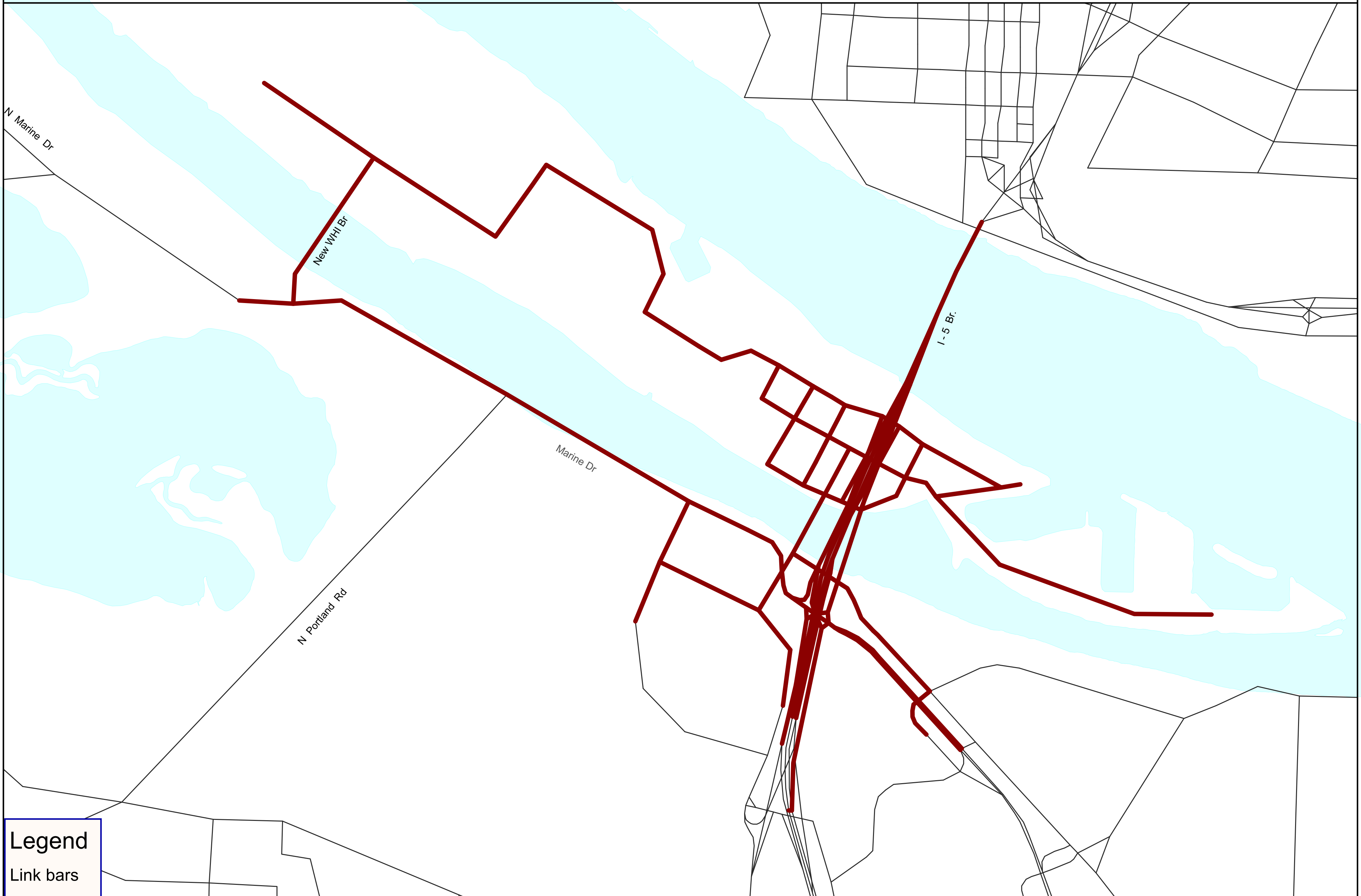
Plot 10: 2035 PM2 Traffic Changes resulting from Port Development (Scenario 3B minus Scenario 2B):

S:\POLICY\West Hayden Island\Phase

Plot 11: 2035 PM2 Traffic Flow and Travel Time Comparison between Rivergate Area and I-5 North (Scenario 2B):

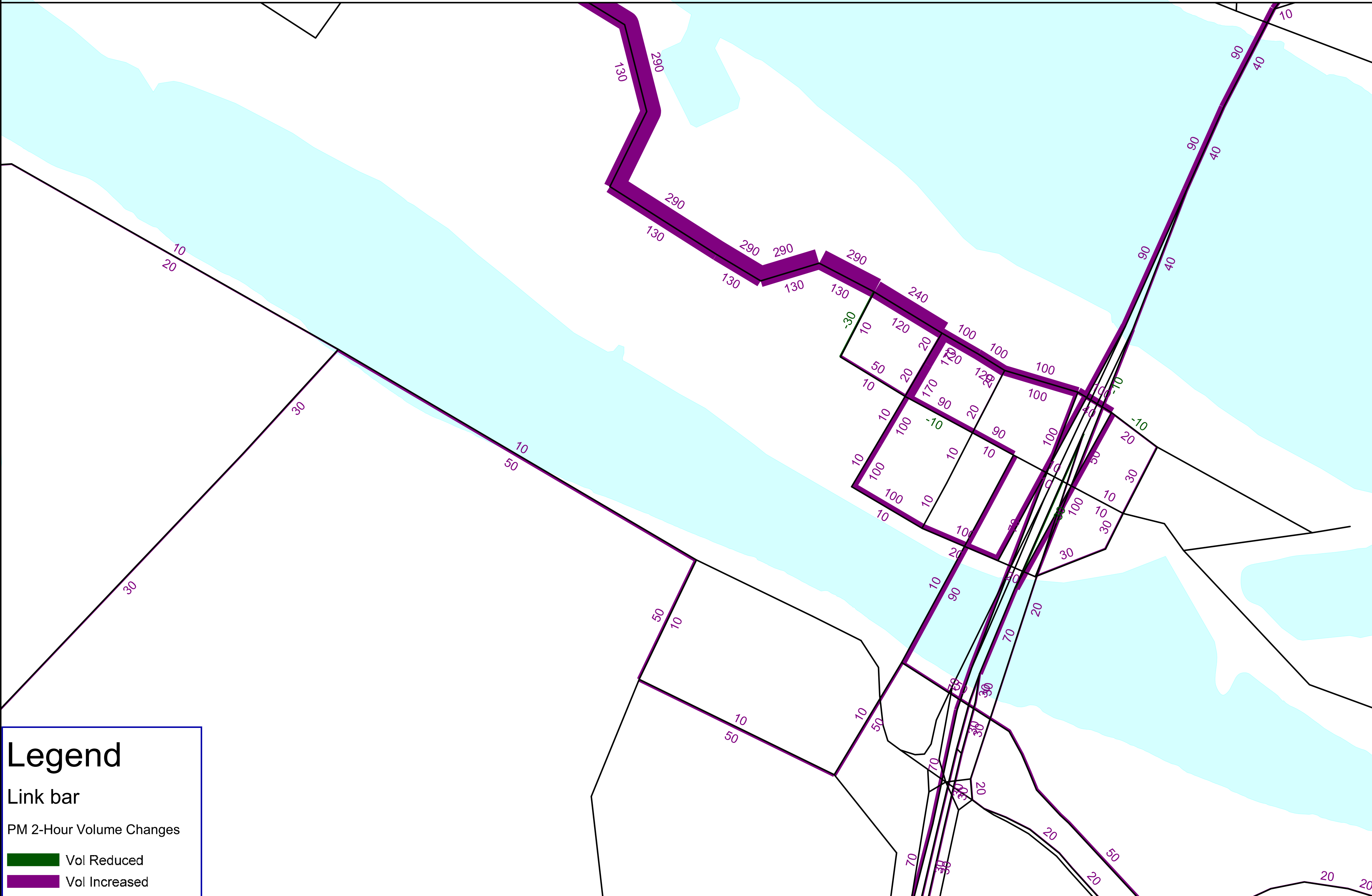
S:\POLICY\West Hayden Island\Phase

West Hayden Island Model Network --



West Hayden Island Plan	2035Pm2 W_Hayden Base S2A 2.Ver	Printed on: 06.12.2011
Bureau of Transportation, City of Portland	t:\......\Project links 01.pdf	1:24874

2035 PM2 Netwrok -- Volume Differences (Scen 3B - 2035 PM Base S2B)



Legend

Link bar

PM 2-Hour Volume Changes

Vol Reduced

Vol Increased

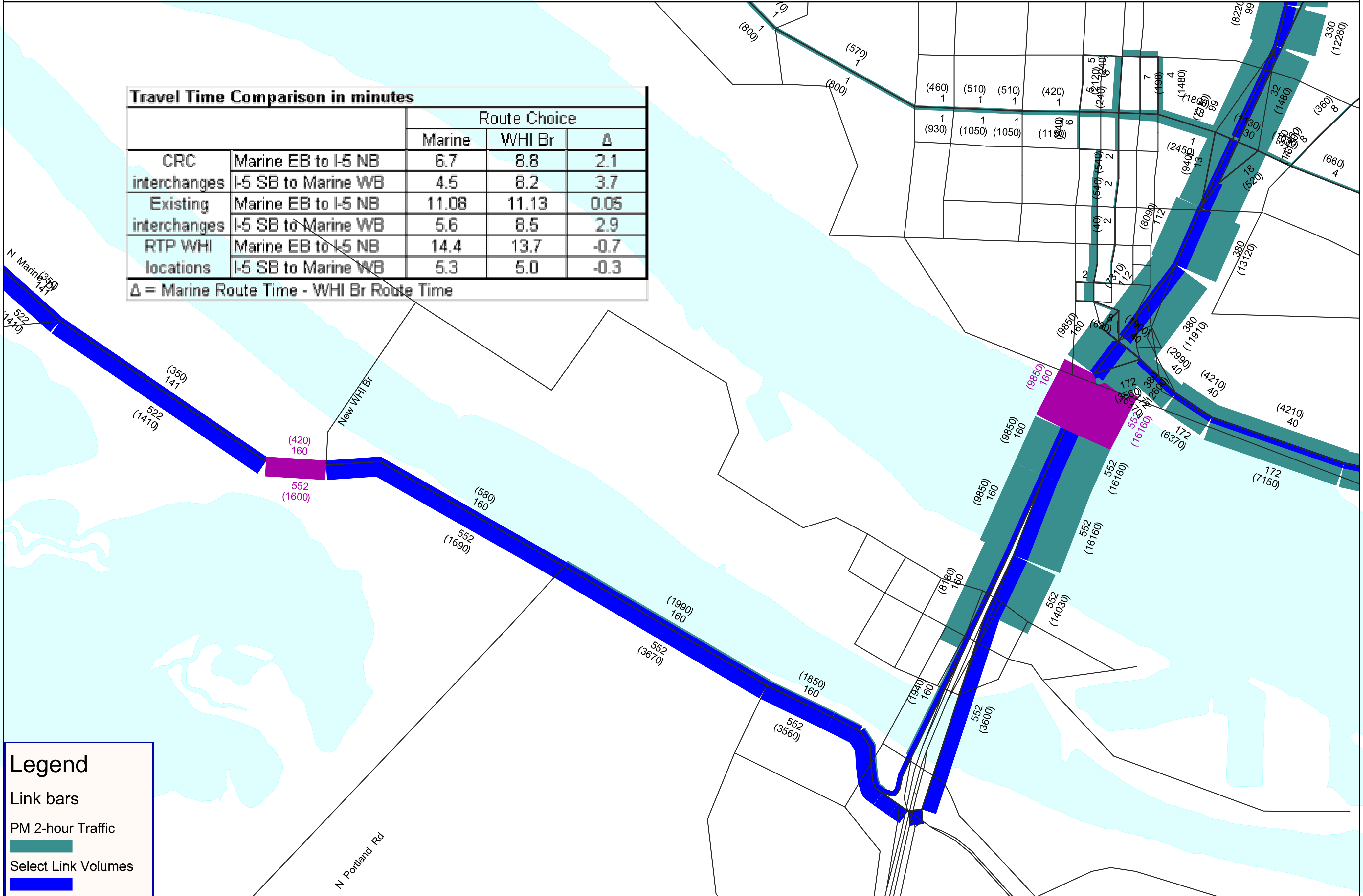
2035Pm2 W_Hayden Base S3B.Ver	- 2035PM2 W_Hayden Base S2B.ver	1"=0.2mile, 1:12580
West Hayden Island Development Study	t:\......\2035PM2 Vol Diff S3B-S2B 01.pdf	Printedd on: 07.12.2011, PBOT

West Hayden Island Model Network -- 2035 PM2 Flow Bundle Volumes (Future Base 2A)

Travel Time Comparison in minutes

		Route Choice		
		Marine	WHI Br	Δ
CRC interchanges	Marine EB to I-5 NB	6.7	8.8	2.1
	I-5 SB to Marine WB	4.5	8.2	3.7
Existing interchanges	Marine EB to I-5 NB	11.08	11.13	0.05
	I-5 SB to Marine WB	5.6	8.5	2.9
RTP WHI locations	Marine EB to I-5 NB	14.4	13.7	-0.7
	I-5 SB to Marine WB	5.3	5.0	-0.3

Δ = Marine Route Time - WHI Br Route Time



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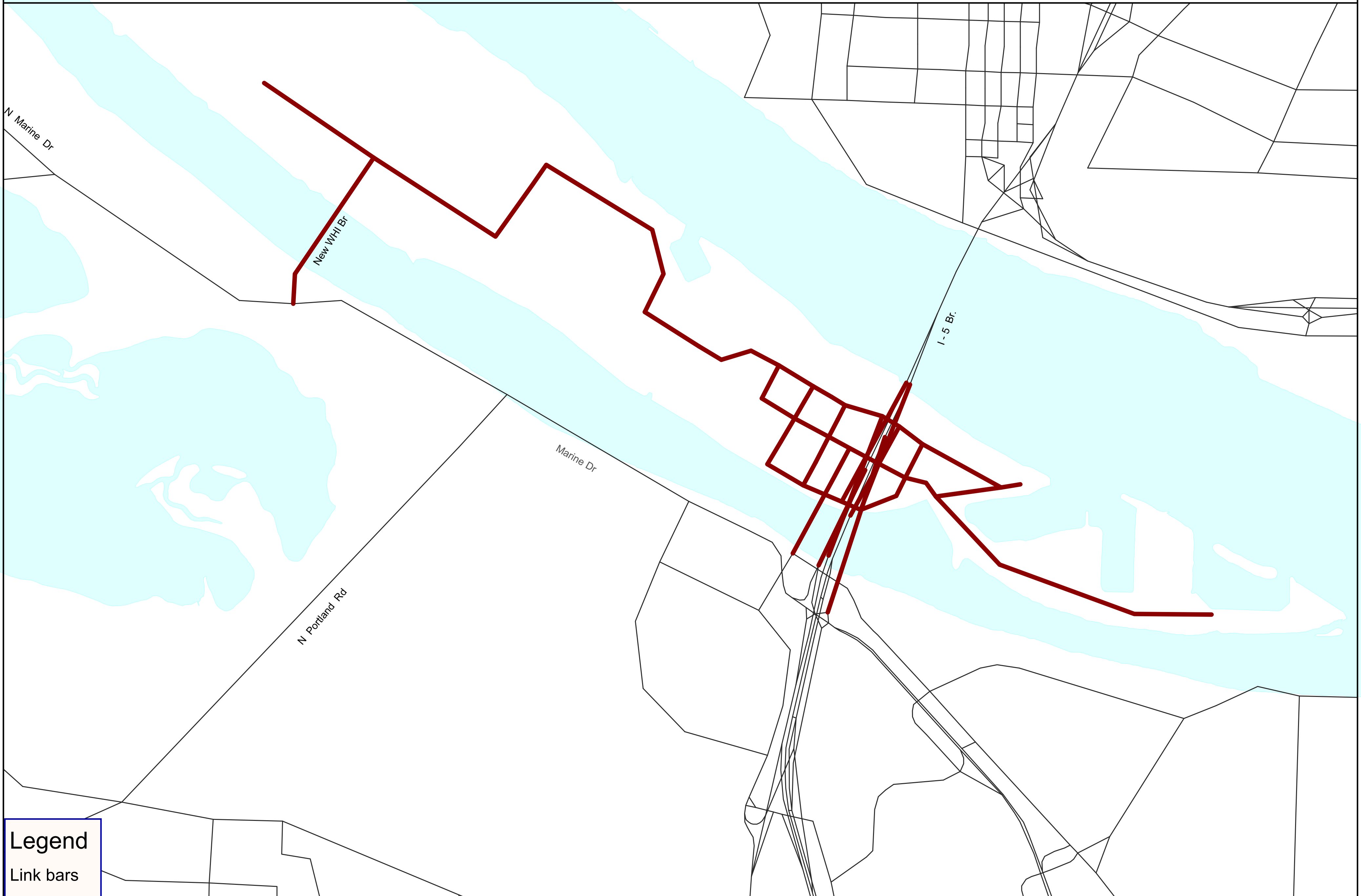
West Hayden Island Model Network --



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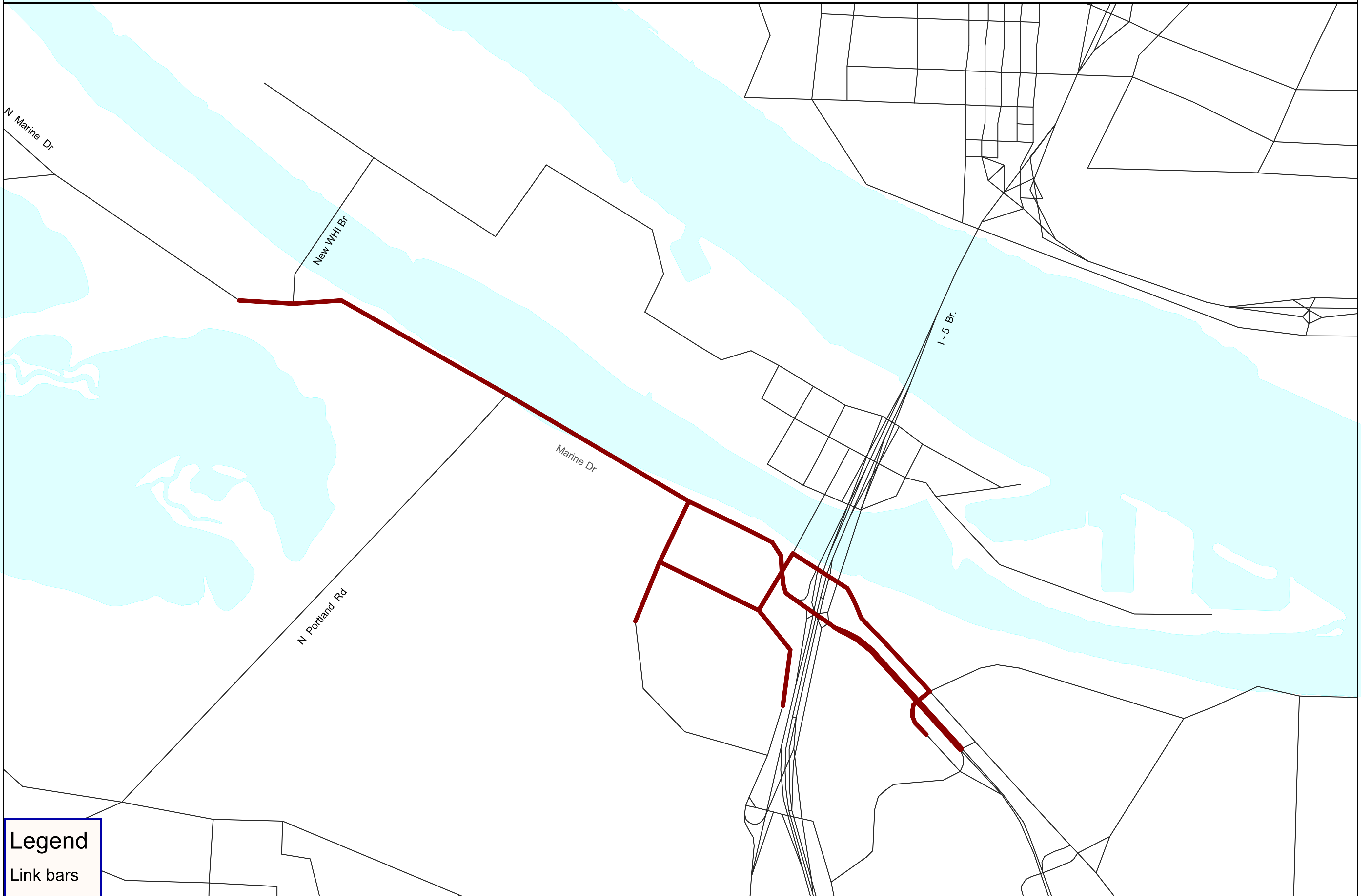
West Hayden Island Model Network --



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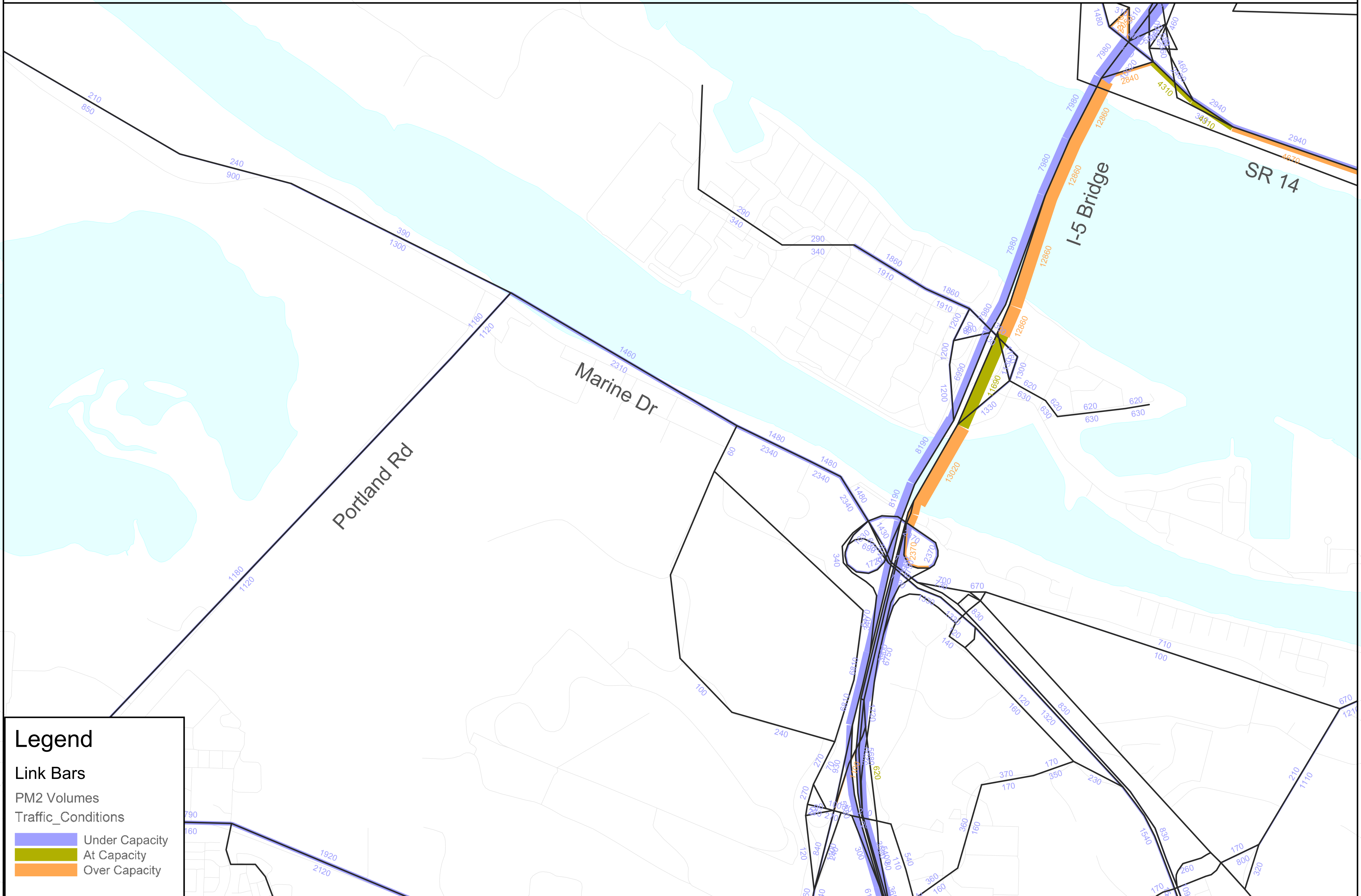
West Hayden Island Model Network -- 2008 PM2 Volumes



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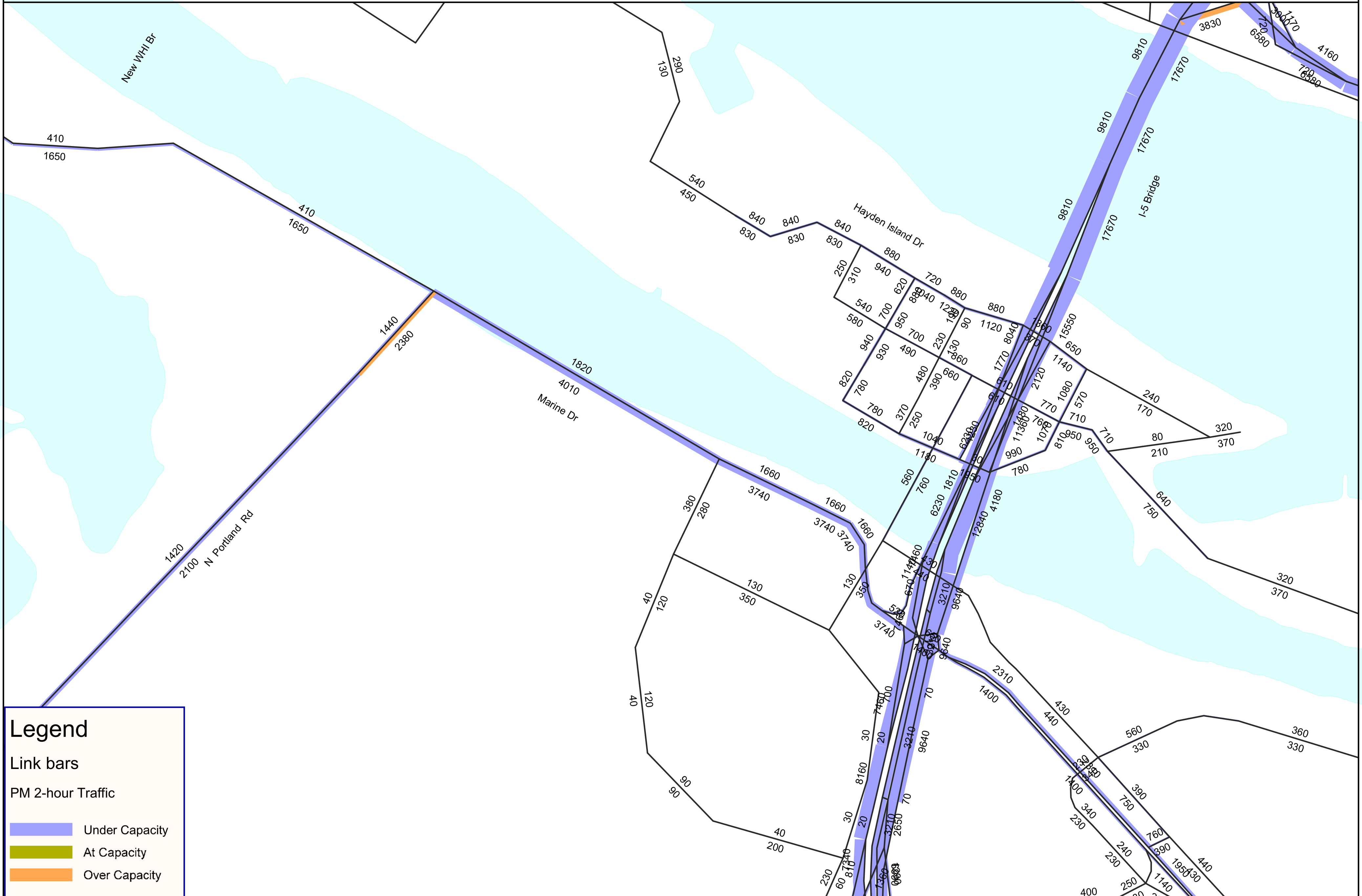
Bureau of Transportation, City of Portland	t:\......\2008PM2 Volumes 01.pdf	Printed on: 02.12.2011

West Hayden Island Model Network -- 2035 PM2 Volumes (Future Base)

West Hayden Island Plan	2035Pm2 W_Hayden Base S2B.Ver	1:22390
Bureau of Transportation, City of Portland	t:\......\2035PM2 Volumes (Proj Base) 01.pdf	Printed on: 06.12.2011

West Hayden Island Model Network -- 2035 PM2 Volumes (Scenario 3B)

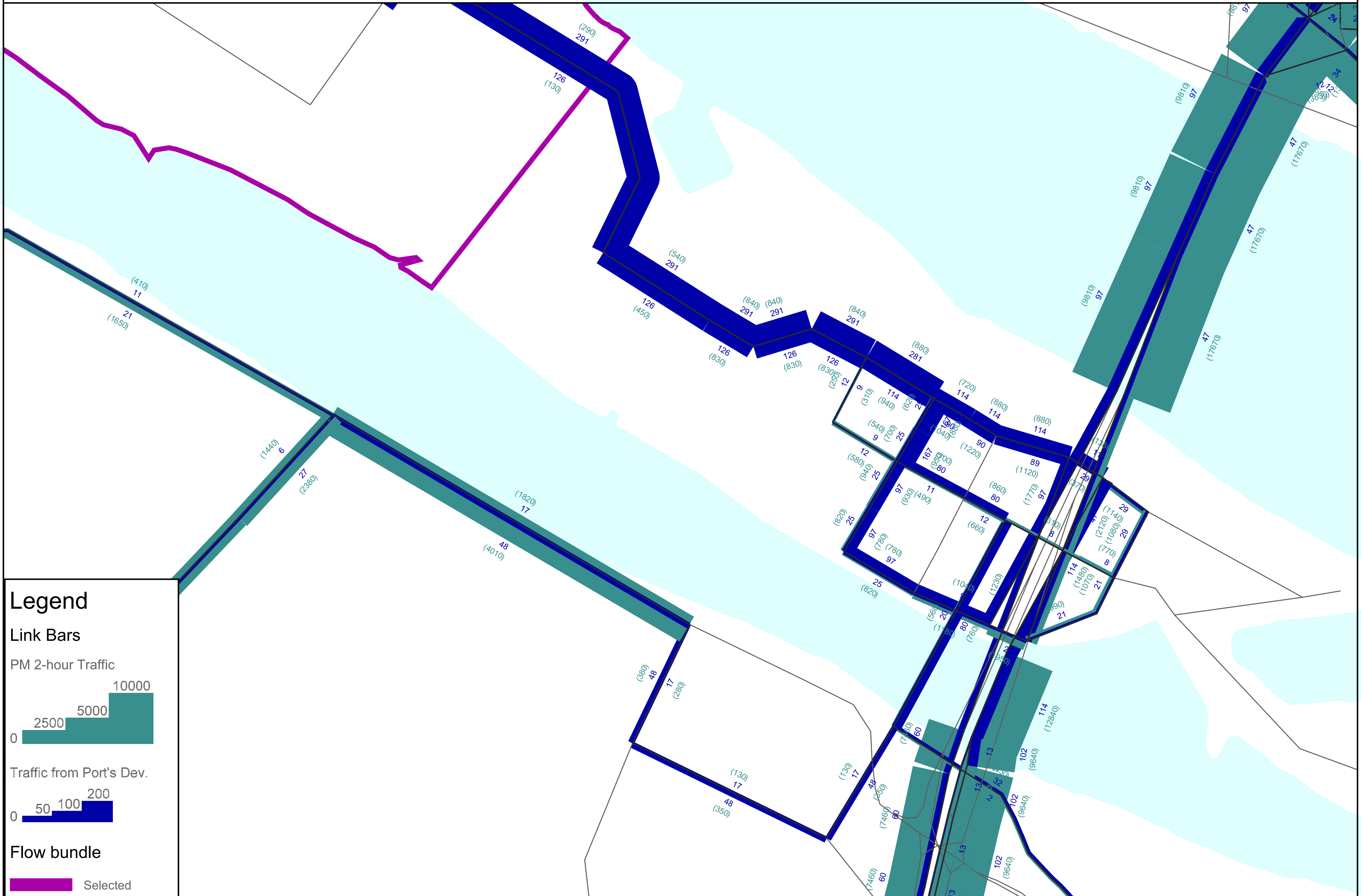


West Hayden Island Plan	2035Pm2 W_Hayden Base S3B.Ver	1"=0.25mile, 1:15840
Bureau of Transportation, City of Portland	t:\......\2035PM2 Volumes S3B 01.pdf	Printed on: 07.12.2011

2035 PM2 Netwrok -- Traffic Growth (Scen 3B - Existing)

2035Pm2 W_Hayden Base S3B.Ver	- 2008PM2 W_Hayden Base 111610.ver	1"=0.2mile, 1:12672
West Hayden Island Development Study	t:\......\PM2 traffic growth S3B-S1 01.pdf	Printedd on: 07.12.2011, PBOT

West Hayden Island Model Network -- 2035 PM2 Flow Bundle Volumes (Scen. S3B)



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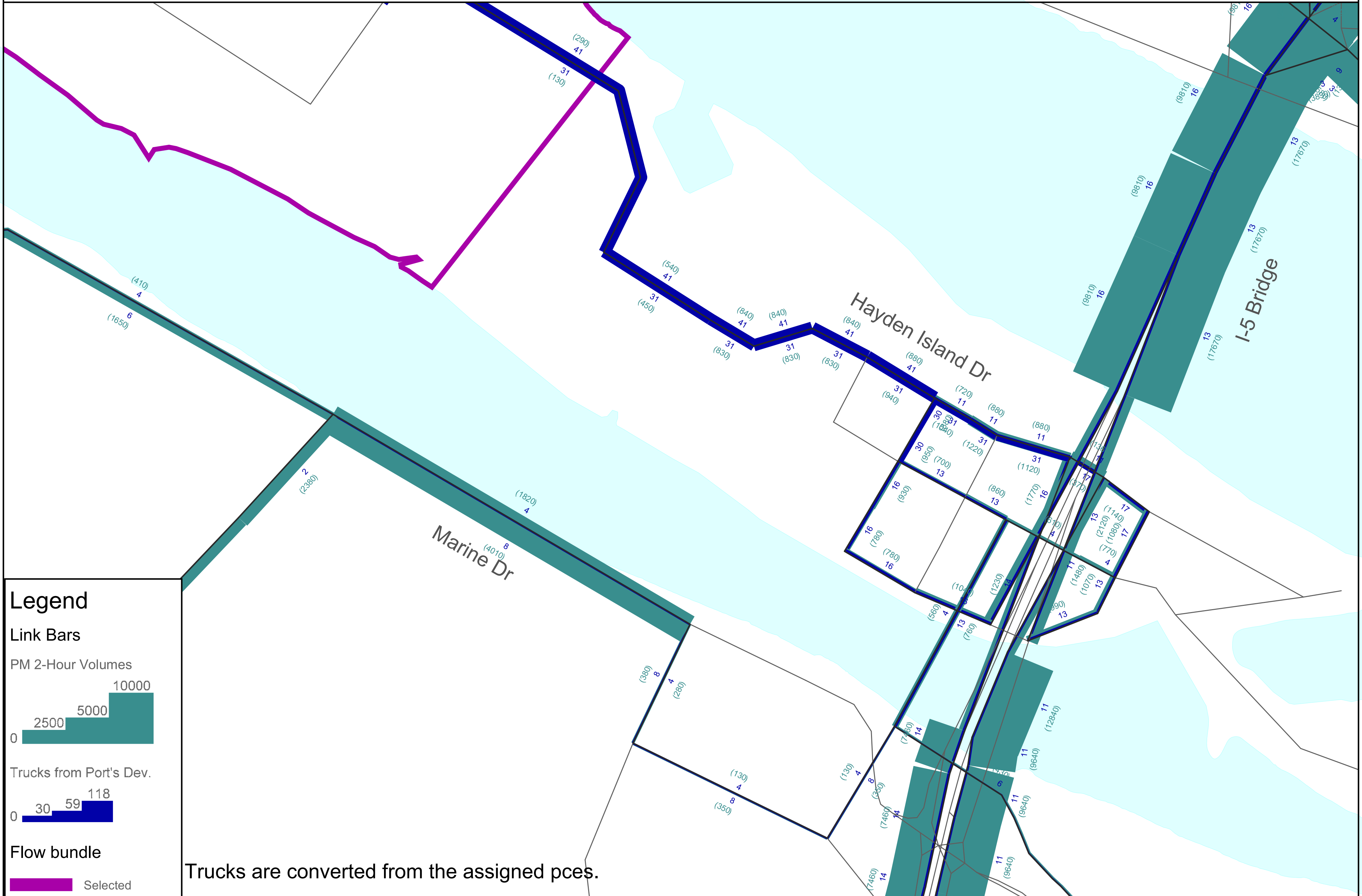
Bureau of Transportation, City of Portland	t:\......\2035 PM2 S3B FB WHI Traffic 12.pdf	Printed on: 07.12.2011

West Hayden Island Model Network -- 2035 PM2 Flow Bundle Volumes (Scen. S3B, Port's Trucks)



Trucks are converted from the assigned pces.

West Hayden Island Transportation Study	2035Pm2 W_Hayden Base S3B.Ver	1"=0.2mile, 1:12672
Bureau of Transportation, City of Portland	t:\......\2035 PM2 S3B FB WHI Traffic 13.pdf	Printed on: 07.12.2011

MEMORANDUM

Date: May 23, 2012

To: Rachel Hoy, Eric Engstrom, Phil Nameny - Portland Bureau of Planning & Sustainability

From: Bob Hillier, Ning Zhou, John Gillam - Portland Bureau of Transportation

Subject: **Final: West Hayden Island Traffic Analysis: Phase 2 – Intersection Operational Analysis**

Project: West Hayden Island Concept Plan

This memorandum describes the technical findings for the Phase 2 intersection operational analysis conducted by the Portland Bureau of Transportation (PBOT) for the West Hayden Island Concept Plan. Also included are the identified transportation deficiencies and potential mitigation measures from the Phase 1 and Phase 2 transportation analysis. The West Hayden Island transportation analysis is being conducted in three phases: *Phase 1* - planning level traffic network analysis at the link level (auto/truck volumes, volume to capacity ratio, cut-through traffic, green house gas), *Phase 2* – operational level analysis at the intersection level (delay and deficiencies identified) that will be based on the information and analysis from phase 1 planning, and *Phase 3* – mitigating measures and state Transportation Planning Rule (TPR) findings for the preferred plan based on the outcome of the Phase 2 operational analysis.

Phase 1 Findings and Recommendations

The "high impact" traffic generation scenario developed for this analysis was determined to be two auto import terminals with post processing facilities and one bulk marine facility located within the 300 acre West Hayden Island site. The estimated 2-hour PM peak volumes are 358 total vehicles (287 autos, 71 trucks), and 2,050 total daily vehicles (1,534 autos, 516 trucks) for the high impact scenario.

Based on the Phase 1 analysis, all of the link-level v/c ratios operate at 0.88 or better for each of the future year scenarios either with or without a high impact Port development or new West Hayden Island Bridge. Consequently, all project links within the modeling study area are projected to operate at adequate levels of capacity by 2035.

The following two future year 2035 scenarios were recommended to move forward into the Phase 2 traffic operational analysis:

- Scenario 2B - 2035 Future Base (2-HourWeekday PM Peak Period) - Assumes no new WHI bridge, 2035 RTP and land use, CRC, Hayden Island Plan, no Port Option 2 development.
- Scenario 3B - 2035 Future High Impact (2-Hour Weekday PM Peak Period - Assumes no new WHI bridge, 2035 RTP and land use, CRC, Hayden Island Plan, High Impact Port Development Plan (two auto terminals and one bulk terminal).

Note: All of the transportation network improvements, signalization and intersection layouts identified in the CRC FEIS, are also assumed in the future base year and future high impact scenarios in Phase 2.

Intersections Analyzed

A total of 14 intersections were analyzed as part of the Phase 2 operational analysis that includes intersections located on both City and ODOT facilities (see **Figure 1**). The settings of the traffic control type (i.e., signalized or stop controlled) at each of the intersections is consistent with the CRC FEIS analysis. While the adopted Hayden Island Plan identified four additional signalized intersections on the Hayden Island street network (3 on Main Street and 1 on the local CRC Arterial Bridge @ Tomahawk), they were determined not to be warranted in the CRC FEIS analysis.

Turning Volumes Analyzed

The future (2035) transportation network is dramatically different from existing conditions and all but two of the intersection in the Phase 2 analysis (#12 N. Portland Rd @ Marine Drive and #13 N. Force Ave @ Marine Drive), are new. Consequently, existing turning count data would not provide a viable basis for projecting future turning movement volumes on the future street network. As a result, most of the projected turning volumes used for this analysis were derived directly from the travel demand model with some minor adjustments for link volume balance due to the central connector[1] coding in the model.

Intersection Operations Analysis and Key Findings

The traffic operational conditions for the two future year scenarios (Scenario 2B and 3B) were evaluated using Synchro/SimTraffic modeling software. The software uses traffic volumes, lane configuration, controller types, and signal timing to asses traffic operations and provide *key performance indicators* including delay time in seconds, level of service (LOS), volume-to-capacity (V/C) ratios, and the amount of queuing (Q) at intersections.

Table 1 below shows the capacity standards used for both City and ODOT facilities by intersection type which provides the basis for evaluating intersection performance for the two future year scenarios.

Table 1. City and ODOT Capacity Standards

	Signalized	Stop controlled intersections	
	LOS & V/C	all-way-stop	2-way-stop
		LOS / intersection	LOS / movement
City	D	E	E
ODOT	0.99		

The results of the traffic operational analysis based on the *key performance indicators* referenced above are illustrated in **Table 2**. For *signalized* and *all-way-stop* intersections, the LOS and V/C are from the weighted average of all legs of the intersection, while for the *two-way-stop* intersections, the data are from the worst reading of individual movement among all legs. All

[1] Central Connector – a special coding used in demand model for starting and ending traffic to/from a TAZ (transportation analysis zone), which will cause unrealistic concentration of traffic movements at detailed scale.

signalized intersections are evaluated with optimized signal timing plan. For intersections on ODOT facilities, the signal cycle lengths are set as 90-120 seconds. The queuing length data are from the average of five runs of the SimTraffic simulations.

All intersections, except for one, are projected to operate at the level meeting both City and ODOT mobility standards in the year 2035 with the LOS “E” or better, and the V/C ratio at 0.96 or lower, in the future base scenario (Scenario 2B). Although it is projected that intersections that had met City and ODOT mobility standards in the future base scenario will still meet the standards in the Future High Impact development Scenario (Scenario 3B), several of the local intersections are operated at the level that is very close to their capacities.

The following describes those intersections that do not meet future mobility standards, or they meet mobility standards but will be close to their capacity with a high impact development scenario:

N. Marine Dr/N. Portland Rd intersection (#12) - Based on its current geometric design, this intersection is projected to operate at LOS “F” in the 2035 future base scenario (Scenario 2B). The overall V/C ratio for this intersection is projected at 1.15 for the weekday PM peak hour. The traffic demand model shows high traffic growth at this intersection in the future year due to the CRC improvements at the N Marine Dr/I-5 interchange, especially for the northbound right turns onto N. Marine Drive from N. Portland Rd. The Port high impact development scenario (Scenario 3B) will have little additional impact on the overall operating conditions at this intersection. It is projected the high impact development scenario will add 25 vehicles to the intersection during PM peak hour, which will push its already congested V/C readings 0.01 point higher from 1.15 to 1.16. *Potential mitigation*: Add northbound slip lane on N. Portland Road (see **Figure 2**).

N. Hayden Island Dr @ N. Main St (#7) - This intersection is an off-set configuration with two-way-stop signs. The intersection’s operational conditions are projected to move from LOS “D” to “E” with a V/C ratio from 0.36 to 0.85 with the Port high impact development scenario. The longest observed queue length of the five simulation runs of the northbound approach is recorded at 536 feet, occupying the whole length of the street segment. The northbound left movement is important path for all Port traffic connecting southbound I-5 traffic from north and the new local arterial bridge. Without a new local circulation network to the west, any additional traffic from the WHI Port development in excess of the high impact development scenario will cause the operation of this intersection to fail. *Potential mitigation*: There are three possible mitigation measures for this intersection: 1) signalization with the existing off-set intersection, 2) signalization with a re-aligned intersection (see **Figure 3**), and 3) extend the local street network toward the west to relieve the northbound left turning Port traffic at this intersection.

New Local Arterial Bridge @ Tomahawk Dr (#5) - This intersection is currently designed as 2-way stop controlled and is projected to operate at LOS “E” under the high impact development scenario. The high impact scenario has pushed the delay per vehicle for northbound movements from 27.5 seconds to 41 seconds, which leaves little room for additional traffic growth. *Potential mitigation:* Signalize intersection.

Tomahawk Island Dr @ Main (#8) – This intersection is currently designed as 4-way stop controlled. Under the high impact development scenario, the operation of this intersection will be pushed from LOS “C” to “E” which reduces capacity for additional traffic growth. *Potential mitigation:* Signalize intersection.

Tomahawk Is Dr. @ Sunrise (#9) - This intersection is currently designed as 2-way stop controlled. Under the high impact development scenario, the operation of this intersection will be pushed from LOS “D” to “E” which reduces capacity for additional traffic growth. *Potential mitigation:* Signalize intersection.

Jantzen Dr @ Sunrise (#10) - This intersection is currently designed as 2-way stop controlled. Under the high impact development scenario, the operation of this intersection will be pushed from LOS “D” to “E” which reduces capacity for additional traffic growth. *Potential mitigation:* Signalize intersection.

Figure 1. Intersection Analyzed and the Assumed Controller Types

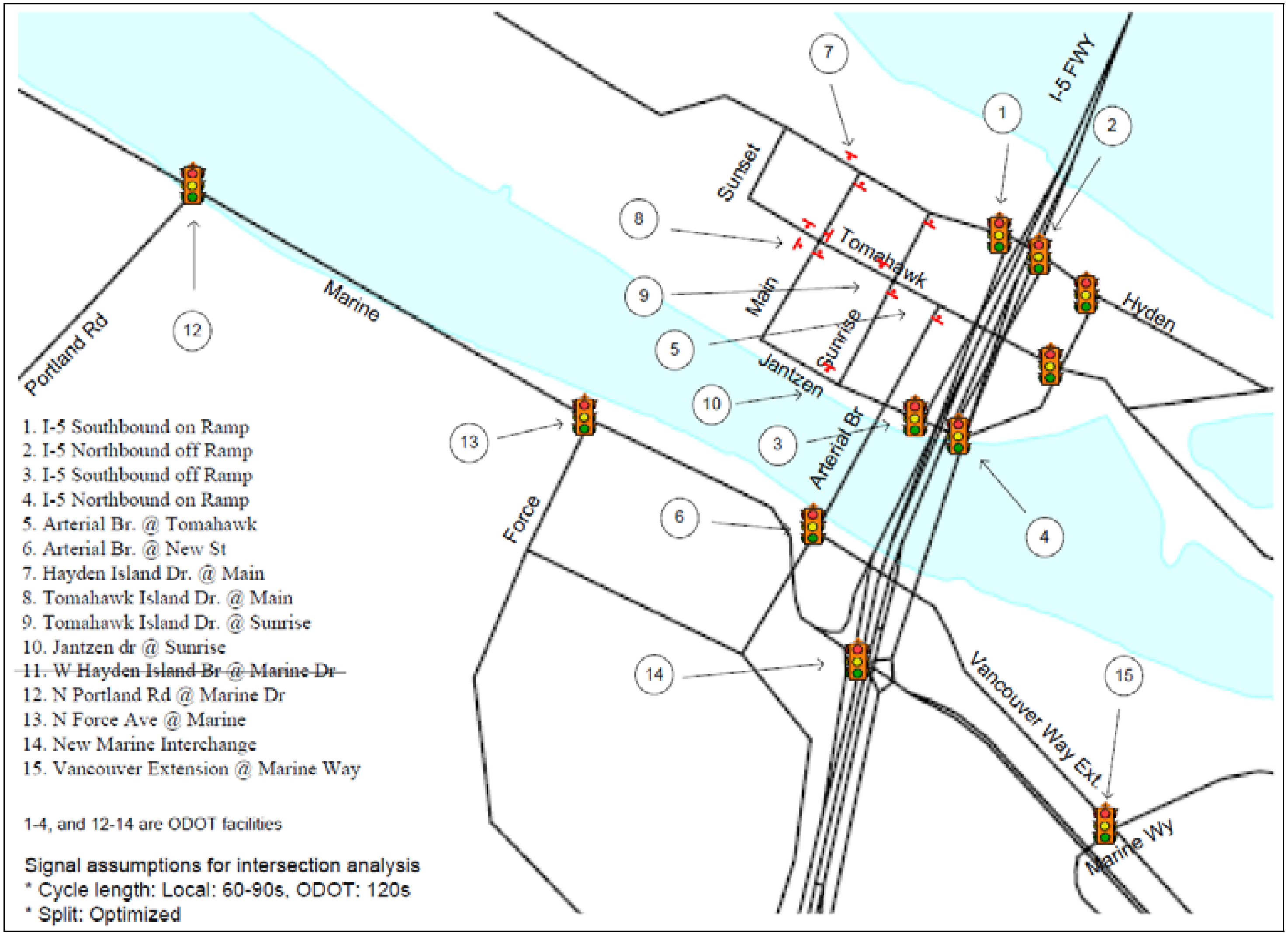


Table 2. 2035 Weekday PM Peak Hour Traffic Operation Result Summary

(Map ID #) Intersections	Controller Type	Scenario 2B				Scenario 3B			
		Delay (s)	LOS	V/C	Max Q. Len. (ft)	Delay (s)	LOS	V/C	Max Q. Len. (ft)
(#1) I-5 SB On Ramp @ Hayden Is Dr.	signal	7.8	A	0.37	156 / eb	10.1	B	0.43	188 / eb
(#2) I-5 NB Off Ramp @ Hayden Is Dr.	signal	17.1	B	0.32	321 / nb	16.1	B	0.37	318 / nb
(#3) I-5 SB Off Ramp @ Jantzen Ave.	signal	18.4	B	0.48	735 / sb	18.4	B	0.48	386 / sb
(#4) I-5 NB On Ramp @ Jantzen Ave.	signal	0.9	A	0.34	282 / ebl	0.9	A	0.35	265 / eb
(#5) Arterial Br. @ Tomahawk Is Dr.	2W-Stop	27.5 NB	D	0.72	60 / nb	41.0 NB	E	0.85	220 / nb
(#6) Arterial Br. @ Vancouver Way Ext.	signal	10.5	B	0.34	100 / sb	10.7	B	0.36	100 / sb
(#7) Hayden Is. Dr. @ Main	2W-Stop	33.4 NBL	D	0.36	161 / nb	41.0 NBL	E	0.85	371 / nb
(#8) Tomahawk Is Dr @ Main	4W-Stop	23.5	C	0.55	285 / nb	36	E	0.6	391 / nb
(#9) Tomahawk Is Dr. @ Sunrise	2W-Stop	33.5 NBL	D	0.34	156 / nb	38.2 NBL	E	0.38	136 / nb
(#10) Jantzen Dr @ Sunrise	2W-Stop	33.8	D	0.65	180 / sb	42.2 SB	E	0.72	158 / sb
(#12) Marine Dr. @ Portland Rd	signal	75.3	**F**	1.15	1418 / nb	81	**F**	1.16	1426 / nb
(#13) Marine Dr @ Force	signal	25.5	C	0.96	501 / eb	27.5	C	0.97	514 / eb
(#14) New Marine Dr Interchange	signal	22.2	C	0.76	208 / sb	22.2	C	0.76	182 / sb
(#15) Vancouver Way Ext. @ Marine Way	signal	16.8	B	0.44	167 / sb	16.7	B	0.44	173 / eb

Scenario 2B: No new WHI Bridge and no Port Option 2 development
Scenario 2B: High Impact Port development and no WHI Bridge
ODOT facilities are in **bold**.
Note: The West Hayden Island Bridge @ Marine Drive Intersection (#11) was not recommended to move forward into Phase 2 analysis.

Figure 2. Potential Mitigation for N. Portland Rd @ Marine Dr Intersection (#12)

Preliminary mitigation measure is to add a northbound to eastbound slip lane at the intersection. The improvement can reduce the intersection V/C ratio from 1.16 to 0.8 with LOS C.

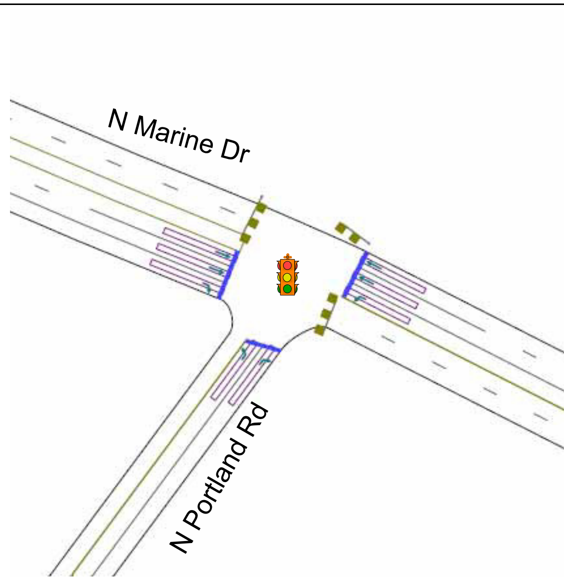
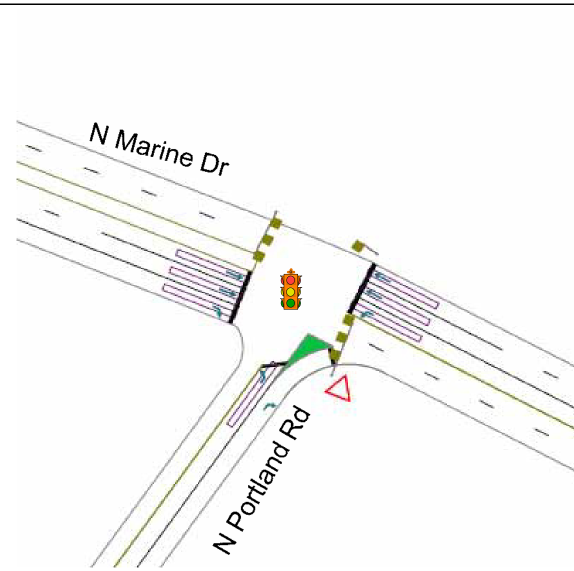
Existing configuration	Preliminary mitigation (draft)
	
LOS = F V/C = 1.16 Delay (s) = 81	LOS = C V/C = 0.85 Delay (s) = 21.6

Figure 3. Potential Mitigation for N. Hayden Island Drive @ Main Intersection (#7)

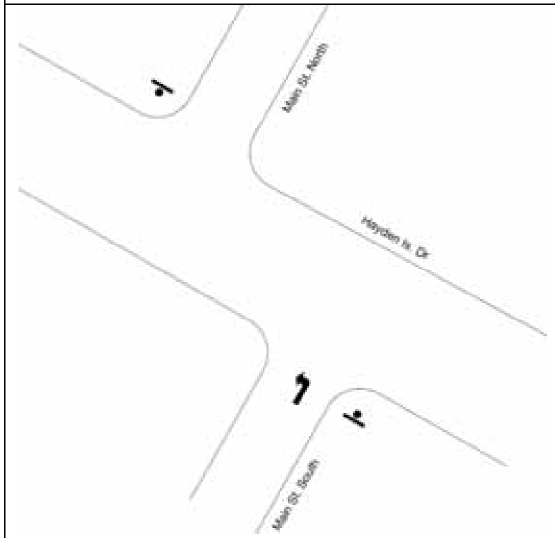
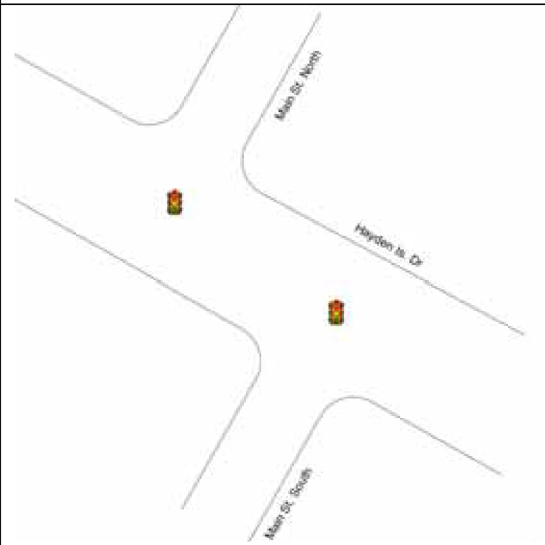
Existing Configuration	Signal w/ existing layout	Signal w/ re-alignment
		
LOS = E V/C = 0.85 Delay = 41.0	LOS = D /C (East/West) V/C = 0.7 / 0.44 Delay (s) = 37.1 / 32.2	LOS = C V/C = 0.66 Delay (s) = 20.2

Table 3: Identified Transportation System Improvements

Transportation Facility	Impacts and Improvement Needs	Potential Mitigation	Estimated Mitigation Costs
North Hayden Island Drive (Main Street to BNSF Railroad: approx 5,000 feet). *Existing public right-of-way ranges between 55-70 feet.	Infrastructure and lifecycle improvement needs caused by heavy truck traffic on a City street that is not classified or designed to accommodate heavy industrial truck traffic. Community impacts from increased industrial traffic.	Roadbed/curb-to-curb - Rebuild roadbed to meet City street design standard and 20-year life cycle to accommodate increased heavy truck traffic based on the following conceptual cross-section dimensions: • Two 12-foot travel lanes. • One 12-foot center left turn lane that allows landscape median treatments were turn lanes are not provided. • Two 6-foot bicycle lanes. **Total estimated curb-to-curb width: 48 feet.** Buffer/edge treatments – Include buffer treatments to mitigate impacts on the surrounding residents and commercial business operations, based on the following conceptual cross section dimensions: • South side: 8 foot sidewalk and 6-foot furnishing zone. • North side: 8-foot swale and 12-foot multi-use path. **Total estimated buffer width: 34 feet** **Total estimated ROW width: 82 feet** Estimated right-of-way needs – For the purpose of estimating ROW costs, it was assumed that an additional 27 feet of ROW will be needed along Hayden Island Drive to accommodate an estimated total RW width of 82 feet (82 total – 55 exiting =27 feet). **Estimated additional ROW (5000 x 27): 135,000 sq. ft.**	Cost factors • Roadbed/curb-to-curb (48 foot width) : $2,300 per linear foot • Buffer/edge treatment (34 foot width): $1,800 per linear foot • Shopping Center ROW costs: $27.50 per square foot • Business Park ROW costs: $12.50 per square foot • Storage/Mobile Homes ROW costs: $6.00 per square foot Estimated Mitigation Costs • Roadbed/curb-to-curb costs: $2,300 LF x 5,000 = $11.5 million • Buffer/edge treatment costs: $1,800 LF x 5,000 feet) = $9 million • Estimated build cost (less additional ROW) = **$20.5 million** • Range of additional ROW costs: 135,000 sq ft x (shopping, business, mobile home) = $0.8 - $3.7 million. • Range of Total Estimated Mitigation Costs: **$21.3 - $24.2 million**
Jantzen Drive Extension (N. Hayden Island Dr to Main Street: approx 2,100 feet) *Private street, with no existing public ROW.	Network improvement needs caused by Hayden Island Drive serving as the primary access route for I-5 truck traffic. May cause heavy trucks to use Main Street and/or Sunset Ave as a cut-through route to the I-5 northbound on-ramp.	Construct new Jantzen Drive Extension between Hayden Island Drive and Main St. via Sunset Ave and Jantzen Ave. An alternative roadway link would provide travel demand relief along the segment of N. Hayden Island Drive east of Sunset Ave while also improving the performance of the Hayden Island Dr/Main Street intersection and providing an alternative route for northbound I-5 truck traffic. Roadbed design standards need to account for heavy truck traffic. For the purposes of estimating ROW and construction costs, a Jantzen Drive Extension should be based on the following conceptual cross-section dimensions: Roadbed/curb-to-curb • Two 12-foot travel lanes. • One 12-foot center left turn lane. • Two 6-foot bicycle lanes. **Total estimated curb-to-curb width: 48 feet.** Buffer/edge treatments • Two 13 foot sidewalk corridors with furnishing zones **Total estimated buffer width: 26 feet** **Total estimated ROW width: 74 feet** Estimated right-of-way needs – For the purpose of estimating ROW costs, it was assumed no existing public ROW. **Estimated additional ROW (2100 x 74): 155,400 sq. ft.**	Cost factors • Roadbed/curb-to-curb (48 foot width) : $2,200 per linear foot • Buffer/edge treatment (26 foot width): $1,500 per linear foot • Shopping Center ROW costs: $27.50 per square foot • Business Park ROW costs: $12.50 per square foot • Storage/Mobile Homes ROW costs: $6.00 per square foot Estimated Mitigation Costs • Roadbed/curb-to-curb costs: $2,200 LF x 2100 = $4.6 million • Buffer/edge treatment costs: $1,500 LF x 2100 feet) = $3.2 million • Estimated build cost (less additional ROW) = **$7.8 million** • Range of additional ROW costs: 155,400 sq ft x (shopping, business, mobile home) = $0.9 - $4.3 million. • Range of Total Estimated Mitigation Costs: **$8.7 - $12.1 million**
N. Portland Rd @ N. Marine Dr Intersection	Traffic capacity (LOS F)	Add a northbound slip lane on N. Portland Road for eastbound Marine Drive traffic (see **Figure 2**).	TBD
N. Hayden Island Dr @ N. Main Street Intersection	Traffic capacity (LOS E) at the intersection of two collector streets. Safety issues with turning vehicles and other modes at the off-set intersection.	The CRC FEIS assumed signal control at the intersections of Avenue B (Main Street) at Hayden Island Dr and at Jantzen Ave. A signal warrant analysis was conducted in January 2011 at the request of ODOT and concluded that 2030 traffic volumes would not warrant traffic signals at either location. For a WHI development, reevaluate signal, stop-control and realignment warrants (See **Fig. 3**).	Estimated signal cost (not including ROW): $250,000 per signal