Portland Marine Industrial Land Analysis:

An Assessment of the Marine-Dependent Industrial Economy in Portland Harbor

May 31, 2021

Prepared for: City of Portland Bureau of Planning and Sustainability

Final Report

ECONorthwest
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Executive Summary

To inform the City's update of its Economic Opportunities Analysis (EOA), in this report we offer an overview of factors impacting the market for marine-dependent industrial land in Portland Harbor. We define marine-dependent land as land accommodating marine terminal and marine/harbor-dependent production and service users. Marine/harbor-dependent users are those who require direct or indirect river access or those who are integrally reliant on location within the harbor (for example, container repair services). This report is organized into eight chapters and six stand-alone appendices covering a range of research topics impacting land need.

Report Chapters	Research Appendices
Introduction and Purpose	**Appendix A:** "Economic Shifts in the Portland Harbor: An Evaluation of Employment, Wages, and Investment"
Study Area and Data Sources	**Appendix B:** "The Impacts of Changes in Marine Terminal Design and Land Needs on Portland Harbor Competitiveness"
Report Organization	**Appendix C:** "An Assessment of Marine Industrial Competitiveness on the Lower Columbia River"
Summary of Stakeholder Engagement	**Appendix D:** "Analysis of the Portland Harbor Superfund Site Impact on Marine Industrial Land"
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Key Findings

- Total employment in Portland Harbor has been flat over the last 15 years, with declines in manufacturing and wholesaling offset by gains in other sectors like distribution and services. For example, over the last 15 years the transportation, warehousing, and utilities sector added 1,397 jobs. However, this has coincided with a five-year decline in marine cargo activity and loss in market share across several cargo types.

- Total employment losses do not tell the whole story. Within marine/harbor-dependent sectors, losses have been largely the result of several large employers. Most small and medium-sized firms have exhibited healthy expansion in the business cycle (prepandemic).

- Over the same period output, productivity and investment in equipment and capital have all expanded. At least 1.7 million square feet of development has occurred in the last five years. Firms in the harbor have also made significant marine cargo capital expenditures. Examples include:

- Capacity increases at Columbia Grain facility at Terminal 5
- A doubling of capacity at Canpotex/Portland Bulk Terminals dry bulk facility
- A roughly $50 million investment at Vigor to build the largest drydock in the United States
- New ship loading facilities at Kinder Morgan Bulk Terminal

- Susceptibility to natural disasters (hurricanes and earthquakes) and climate change generally has led to improvements to port infrastructure and operations. The Port of Portland has identified the infrastructure that would not withstand the Cascadia earthquake and continues to plan for emergency preparedness and the potential damage and disruption to port activities. Investments in sustainability and climate resilience have an ongoing impact on land need in the harbor. According to interviews with industry representees, risks presented by the Cascadia earthquake specifically impact costs of improving, repairing, and retrofitting liquid bulk storage capacity more than any other sector in the harbor.

- Emerging and maturing markets for sustainable energy products like wind and wave energy have the potential to increase land demand and diversify both production throughput sectors.

- Over a long-term horizon, climate change impacts on port activities may include the rerouting of trade routes, higher risk of port damage in the event of disaster, negative effects of climate volatility on productivity and operating costs, and a substitution of markets due to shifting agricultural habitats.

- From 2000 to 2018, Lower Columbia River cargo volume increased by 44 percent. Growth has been primarily driven by exports.

- The Portland Harbor continues to play a critical role in the facilitation of commerce throughout Oregon. As much as 30 percent of Oregon's economy is based on industries dependent on goods movement. Moreover, 89 percent of all exporters in Oregon are small businesses. Oregon's agriculture, forest and paper products, food manufacturing, and many other industries rely on the Portland Harbor for access to markets. A 2016 report from Tioga Group found that prior to the decline of container service in Portland, 25 different Oregon Counties exported containers through Portland's Terminal 6. On the import side, Oregon's manufacturing and construction sectors rely on import markets for critical supply chain inputs, including steel, cement, equipment, and fertilizers, among other products.

- Users in the harbor are generally optimistic about their business outlook. Their primary concerns include a growing proximity of nonindustrial uses and difficulties of doing business in Portland.

- The impacts of Trump-era trade policy coupled with the COVID-19 pandemic have negatively impacted cargo throughput in the short term. However, the market is expected to return to its long-run trend by 2025.

- Industry representatives interviewed for this project stated intentions to grow within their existing footprint through investment in capital, equipment, and densification.

- The Portland Harbor maintains a competitive advantage relative to other Lower Columbia industrial areas. Positive competitiveness factors include transportation linkages, workforce characteristics, and a well-established industrial cluster. Downside competitiveness factors include land availability, regulatory environment, and the Superfund Cleanup.

- Uncertainty caused by the Superfund Cleanup is considered the most significant impediment to new investment in the harbor. This condition is expected to continue until mechanisms to mitigate liability risk are available. The completion of remedial design is considered a critical threshold, but it remains at least three to five years away and many cost and liability uncertainties will remain beyond this milestone. Ongoing cleanup, stigma, and remaining unresolved factors will persist well into the planning period. Moreover, the EPA and the Oregon Department of Environmental Quality (DEQ) still have not fully defined roles for addressing upland and riverbank areas, resulting in uncertainty around the extent of liability for in-water contamination associated with upland properties.

- Longer unit trains and larger vessel sizes will have the greatest impact on terminal land need and cargo markets over the planning period. Collectively, these factors will require larger sites to accommodate modern terminal facilities. Internal rail upgrades, including longer sidings and railyard expansions over the long term, may be necessary to remain competitive.

- Harbor-related industries have been found to mitigate class and racial income disparities in the Portland region.[1] While BIPOC workers in the Portland MSA appear to be proportionately represented in the harbor relative to the share of BIPOC workers in all other industries outside the sector, we found that harbor-related industries offer greater upward mobility, housing stability, and achievable income compared to other sectors. Nearly all nonwhite racial and ethnic groups earn higher median incomes in the harbor sector than outside of it, constituting a large than expected share of income in the sector for BIPOC communities. Slower growth in the harbor sector would have inequitable impacts on the economic mobility of BIPOC workers throughout the region and residents without a college degree.

[1] See Appendix A for a discussion of marine/harbor-dependent industry sectors.

- Terminal capacity in the harbor has remained relatively flat in recent years. We documented three capacity changes at Canpotex (+1.25 million MT), Louis Dreyfus (-2.4 million MT), and Zenith (+0.25 million MT). With the exception of the Louis Dreyfus facility, this determination does not include idle capacity that could be reestablished quickly (for example, private capacity at EVRAZ).

- Portland Harbor industries have a positive economic impact on Portland and the Oregon economy. The Port of Portland's activities alone reportedly support over 7,100 jobs in the local economy. Private industry further spends six to seven billion dollars per year on goods and services, over 40 percent of which is reportedly retained locally. However, these impacts should be considered in the context of the potential externalities associated with industrial development, potential impacts on the environment, and public health and safety.

Marine Terminal Land Need

The volume of marine cargo through Portland terminals is expected to grow by 70 percent under the base case scenario. This rate of growth is not distributed proportionately across all cargo types. Relative to existing capacity, increases in grain and auto cargo types have the highest likelihood of supporting additional terminal development. We estimate that this growth has the potential to support between 80 and 140 acres of marine terminal development over the planning period. Under the most optimistic growth scenario, cargo demand for dry bulk commodities could trigger a need for an additional dry bulk terminal (80 to 100 acres) as well.

Marine-Dependent Production and Services Land Need

The future trajectory of marine-dependent production and services need in the harbor will be a function of structural economic trends, recent and planned investments, preferences and land needs of existing and potential users, the timing of resolving Superfund liability, and policy actions taken by the City. These factors collectively have a broad range of outcomes. Taken together, we estimate production and service land need to range between -160 acres and +600 acres over the 20-year forecast period.

1. Introduction and Project Purpose

The City is currently in the process of updating its periodic Economic Opportunities Analysis (EOA). The EOA is an analysis of 20-year supply and demand for employment development and land in the city. It is prepared according to State Administrative Rule OAR 660-09-0015. In the simplest terms, the EOA is a planning document that guides the City's land use policies relating to employment land over the planning period.

To inform this process, the Portland Bureau of Planning and Sustainability conducted a more detailed analysis of the Portland Harbor in the previous EOA cycle. This effort came out of the realization that typical methods for determining land demand—derived from employment forecasts—are not good indicators of economic performance and land need. On the terminal side, commodity flows can fluctuate broadly from year to year in the short term based on global demand factors, trade policy, or the decisions of a single firm or shipping line. Moreover, traditional methods do not adequately reflect the role that the marine and rail logistics systems play in facilitating commerce at the local, regional, or national level.

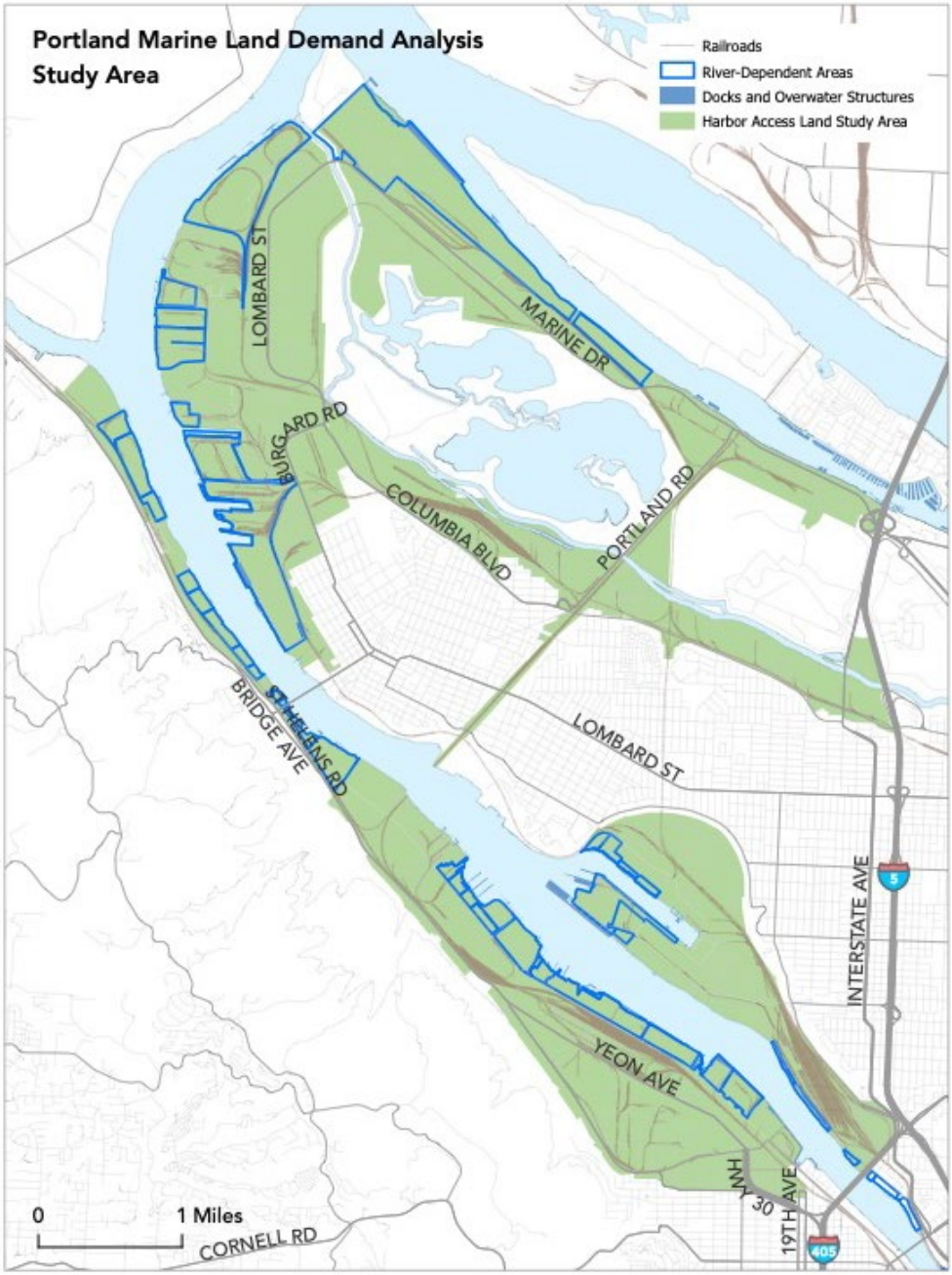
Unconstrained Demand: In practice, realized demand for land is in part a function of supply. More land, lower costs, and favorable characteristics equate to a more favorable location that can attract growth that otherwise would not be attainable. In this report, we address competitiveness factors. However, because policy decisions can remove constraints and/or impact the amount and quality of industrial land, we are primarily concerned with understanding potential unconstrained demand.

As in the last EOA cycle, we investigated the unique dynamics of the marine-industrial economy, its functional role in the local and regional context, and the factors that may influence land demand over the 20-year planning period. Findings of this report will include substantive analysis, empirical and anecdotal, to support estimates of unconstrained land demand. These estimates will be presented as a sensitivity analysis representing a range of potential outcomes. Drawing on analysis assessing the economic contribution of the harbor economy, these scenarios will be presented alongside the opportunity costs associated with growth alternatives. This context will assist the City in understanding the economic and social trade-offs associated with lower and higher growth scenarios.

2. Study Area and Data Sources:

In this analysis, we commonly refer to the study area as the "Portland Harbor." This area is defined as lands officially designated by the City as Harbor and Airport District (HAD) or Harbor Access Lands (HAL). Harbor and Airport District land is truncated to include only land west of Interstate-5. Exhibit 1 is a geographic representation of this area.

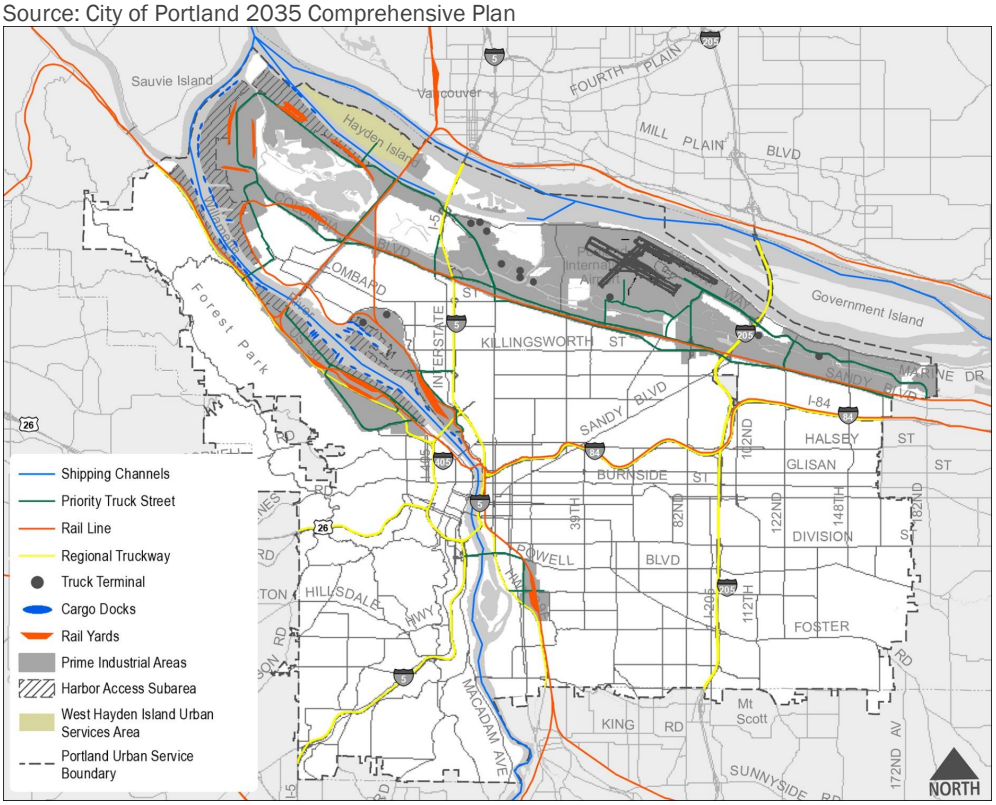
Exhibit 1: Portland Harbor Study Area Defined
Source: ECONorthwest



This geographic area has unique and defining characteristics that include:

- Over 70 identified areas with docks over-water suitable to accommodate marine-dependent industrial uses. These uses include Port-owned berths, private berths, brownfields, non/underutilized berths, and vacant sites with berths.
- An estimated 1,565 acres of designated river-dependent land. Almost 154 acres of industrial waterfront land is brownfields.[2]
- Four marine terminals owned and operated by the Port of Portland (Terminal 2 is currently nonoperational).
- Major industrial employers, including Vigor, Gunderson, EVRAZ, and Schnitzer.
- A unique confluence of regional transportation hubs that includes two Class I railways and railyards, access to regional truckways, and the Willamette and Columbia River shipping channels.

Exhibit 2: Regional Transportation Network
Source: City of Portland 2035 Comprehensive Plan



- In addition to this regional network, the Columbia/Snake River system includes a 400-mile-long barge navigation channel that extends to Lewiston, Idaho. This connection is essential to grain exporters and the regional barge industry.
- The mainline rail network is further supplemented by a regional short-line rail system.

[2] Governor's Natural Resource Office. "State of Oregon Perspectives: Portland Harbor Superfund Site." May 2017.

Data Sources

Throughout this report, we identify sources of information and assumptions used. Within the limitations imposed by general uncertainty and the resource allocation for this project, we have made efforts to check the reasonableness of primary and secondary data and to test the sensitivity of results to changes in key assumptions in association with the City and the project Technical Advisory Committee (TAC). Estimates of future economic activity are inherently uncertain and derived from the best available information at a given point in time.

To complete this analysis, we relied on three sources of information:

Existing Studies. Over the last decade, there has been extensive research conducted in the Portland Harbor and on marine-dependent industries. The primary studies informing this analysis include:

- Portland Economic Opportunities Analysis (Hovee, 2016)
- Portland Harbor Industrial Land Supply Analysis (ECONorthwest, 2012)
- Portland Marine Cargo Forecast (BST Associates, 2020)
- Metro Portland Regional Freight Strategy (Metro, 2018)
- Economic Impacts of the Port of Portland (Martin Associates, 2016)
- Oregon Trade and Logistics Analysis (Tioga Group, 2016)
- International Trade and the Portland Harbor's Impact (Portland Business Alliance, 2013)
- United Nations Conference on Trade and Development (United Nations, 2020)

Secondary Data Sources. Many secondary sources of data were utilized. While it is beyond the purview of this project to independently verify secondary data, we consider the sources used in this report to be from reputable institutions and private firms. Examples of secondary data sources include:

- Geographic Information Systems (GIS) layers from Metro's Regional Land Information Systems (RLIS)
- Real estate market and investment data from CoStar
- Quarterly Census of Employment and Wages (QCEW)
- WISERTrade commodity data
- Waterborne trade data from the US Army Corps of Engineers
- US Census Public Use Microdata Statistics (PUMS)

Interviews with industry representatives and agency officials. Many of the questions we set out to address in this research cannot be answered with empirical data analysis alone. The Portland region is blessed with a wealth of professionals in the public and private sectors with

knowledge of the subtleties of the harbor economy. This project assembled a Technical Advisory Committee (TAC) of public officials to review interim deliverables and reports, in addition to providing technical expertise. In addition to the TAC, we interviewed 29 industry representatives from the public and private sectors. The approach and outcomes of stakeholder engagement for the project are detailed in Chapter 4.

Referenced Geography

Throughout this report, we commonly reference specific geographic areas. In addition to the study area in Exhibit 1 above, the maps in Exhibits 3 and 4 depict other commonly referenced geographies as a guide.

Portland Harbor Superfund Site

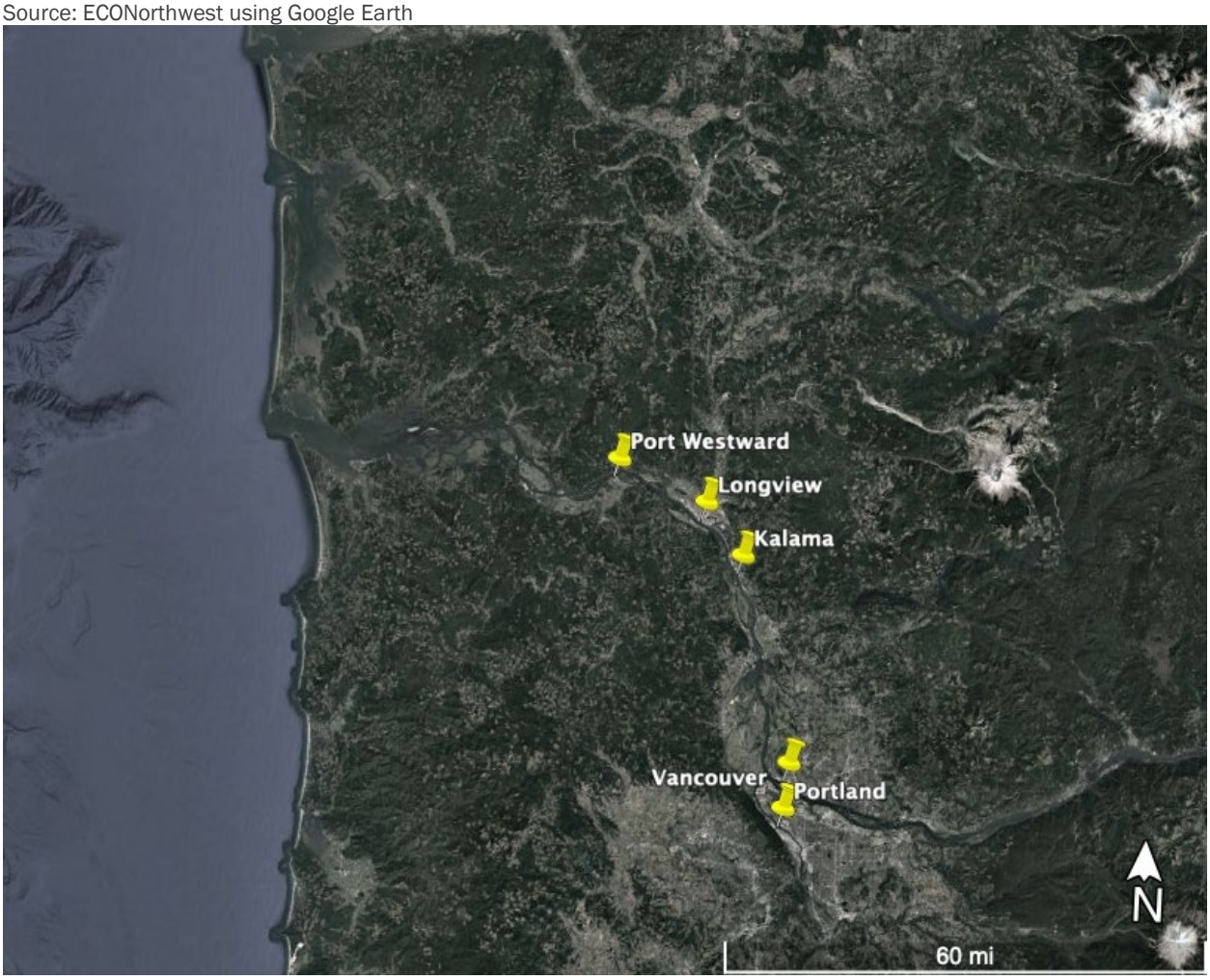
The Portland Harbor Superfund Site (PHSS), also commonly referred to as the "Harbor Cleanup Area," is the portion of the Willamette River from River Mile 1.9 to River Mile 11.8.

Exhibit 3: Portland Harbor Superfund Site
Source: City of Portland Bureau of Environmental Services

Lower Columbia

The term "Lower Columbia" is in reference to navigational portions of the Columbia River from the mouth of the Columbia River to Vancouver and from the mouth of the Willamette River south to the Steel Bridge. This geographic area includes five deepwater port areas at Ports of Westward, Longview, Kalama, Vancouver, and Portland.

Exhibit 4: Lower Columbia
Source: ECONorthwest using Google Earth



3. Report Organization

In the initial scoping for this project, the City and its partners identified questions, hypotheses, and research topics thought to be influential over the future outlook for the harbor. For example, What is the impact of the Harbor Superfund Cleanup on investment and competitiveness? Is the harbor economy more important to marginalized segments of the workforce? How are changes in technology and terminal operations impacting marine terminal land needs? In discussing these questions with the City, we determined that many of the topics impacting this project were highly complex and could have broader implications beyond our purposes. In our review of the scope of work and priorities outlined by the City, we identified six research topics for exploration. We organized these topics into stand-alone research papers. These research papers are organized as Appendices A through F. Chapter 5 of this report includes a summary of key findings from this body of work. The remainder of this report includes:

Chapter 4: A detailed summary of approach to industry outreach and key findings derived from interviews and technical input.

Chapter 5: A summary of highlights and key findings from stand-alone research papers.

Chapter 6: An evaluation of potential marine terminal land need.

Chapter 7: An evaluation of potential marine-dependent production and service-supported land need.

Chapter 8: An evaluation of the opportunity cost trade-offs of varying land need outcomes.

Appendices A-F: Stand-alone research papers covering topics pertinent to the function and competitiveness of the Portland Harbor.

Portland Marine Industrial Land Analysis: Research Reports

Appendix A: "Economic Shifts in the Portland Harbor: An Evaluation of Employment, Wages, and Investment"

Appendix B: "The Impacts of Changes in Marine Terminal Design and Land Needs on Portland Harbor Competitiveness"

Appendix C: "An Assessment of Marine Industrial Competitiveness on the Lower Columbia River"

Appendix D: "Analysis of the Portland Harbor Superfund Site Impact on Marine Industrial Land[3]"

Appendix E: "An Assessment of the Economic Function of the Marine Industry on the Regional Economy"

Appendix F: "Race and Educational Equity in Harbor-Dependent Sectors of the Portland Economy"

[3] This report was subcontracted in its entirety and completed by Maul Foster Alongi. Findings within are not representative of analysis conducted by or the expert opinion of ECONorthwest.

4. Summary of Industry and Government Agency Engagement

This report was informed through input by 35 industry and local agency leaders from the public and private sector. The project commenced by assembling a Technical Advisory Committee (TAC) comprised of public sector representatives. Over the course of the project, the TAC held five meetings to review project deliverables and provide technical input and feedback. Members of the TAC included:

Exhibit 5: Composition of the Technical Advisory Committee

Name	Position	Organization
Tom Armstrong	Supervising Planner	City of Portland
Steve Kountz	Senior Economic Planner	City of Portland
Tom Bouillion	Planning Manager	Port of Portland
Anne Debbaut	Metro Regional Solutions Team Representative	DLCD
Leigh McIvaine	Economic Development Specialist	DLCD
Stephanie Prybyl	Port Program Policy Coordinator	Business Oregon
Sallie Edmunds	Central City River and Environmental Planning Manager	City of Portland
Annie Von Burg	Environmental Policy Manager	City of Portland

Public Sector Outreach

In addition to the TAC, we interviewed 16 representatives from public sector institutions. These professionals represent local and state economic development in addition to port districts on the Lower Columbia. These participants were selected based on their knowledge related to brownfields, port competitiveness, commodity market trends, terminal operations, the Superfund Cleanup Project, and social equity. Participants are listed in Exhibit 6. No quotations or data points are directly attributed to individuals in this report. Rather, information has been summarized into key outcome themes presented below.

Exhibit 6: Public Sector Engagement

Name	Position	Organization
Mike Bomar	Director of Economic Development	Port of Vancouver
Jim Hagar	Economic Development Project Manager	Port of Vancouver
Alex Strogen	Chief Commercial Officer	Port of Vancouver
Kent Cash	Chief Operations Officer	Port of Vancouver
Erik Yakovich	Economic Development Manager	Port of Kalama
Mark Wilson	Executive Director	Port of Kalama
Matt Miller	Business Development Director	Port of Columbia Co.
Randy Fischer	Senior Analyst	Port of Portland
Tom Bouillion	Planning Manager	Port of Portland
Ken O'Hallaren	Marine Marketing Director	Port of Portland
Jessica Hamilton	General Manager of Portland Harbor Environmental	Port of Portland
Teresa Carr	Director of Business and Commercial Properties	Port of Portland
Dr. Steve Nakana	Social Equity Program Manager	Port of Portland
Emerald Bogue	Director of Regional Government and Community Affairs	Port of Portland

Jim Mckenna	Natural Resources Policy Analyst	State of Oregon
Karen Homolac	Brownfields Specialist	Business Oregon

Insights into Cargo Market Trends and Terminal Opportunities

- For future terminal development on the Lower Columbia, there are only six commodities that have demonstrated long-term demand growth, and site needs that align with available sites. These include:
  - Fertilizers
  - Cement
  - Mineral Bulk
  - Wood Pellets
  - Bulk Grain
  - Automobiles

- Grains and oilseeds will likely continue to have an ongoing regional advantage as an export commodity. The resiliency throughout the trade war/tariffs is a testament to market stability. Tariffs have had an impact but have not decimated the market.
- Over the long term, the Lower Columbia grain market may see increased competition from lower-cost export locations (i.e., South America).
- Conversely, the Pacific Northwest's position as a domestic grain exporter may improve as a result of climate change. Water resource constraints in the southern United States may push agricultural production north, making the Pacific Northwest an increasingly competitive gateway.
- Global demand growth among Pacific Rim trading partners will continue to raise the high-water mark for all Lower Columbia ports.
- We heard contrasting opinions on the long-term prospects for wind energy component imports. On the one hand, we heard bearish sentiment grounded in the industry's reliance on public subsidy for financial viability. The combination of lower-cost solar imports and expiring production tax credits was thought to depress wind energy development prospects over the intermediate term. Beyond five years, one port operator expects the market will be increasingly reliant on importing components for transfer to Canadian wind farm development where subsidy is likely to remain. However, the newly elected Biden administration may extend the duration of this market with further

Notes on Wind Energy Market Potential

Some members of our interview panel expressed bearish sentiment on the intermediate-term prospects for wind energy imports. However, other opinions on this topic are mixed. For example, the U.S. Department of Energy (DOE) foresees a ***doubling of wind energy capacity in the United States over the next ten years***.[4] Conversely, the Energy Information Administration (EIA) forecasts that "new wind capacity additions continue at much lower levels after production tax credits expire in the early 2020s."[5] Contrasting perspectives from federal agencies is a clear indication of broad uncertainty.

[4] U.S. Department of Energy. "Wind Vision: A new Era for Wind Power in the United States". Wind Energy Technologies Office. 2015.

[5] U.S. Energy Information Administration. "Annual Energy Outlook". 2019

subsidy, but the structural reliance on subsidy and cost disadvantage was expected to remain. On the other hand, one port operator is exploring opportunities to expand and penetrate the wind energy import market. Recent government research (see sidebar on page 9) coupled with the Biden administration's bullish tone toward wind energy indicates continued wind energy development growth. To capture this market, ports require both equipment and logistical expertise. In addition to large flat sites, specialized equipment may include large-capacity mobile harbor cranes, specialized expandable trailers, and stackers.

- Growing regulatory mandates in the United States to convert to fully electric automobiles may support new import markets for automobiles. California established a goal of fully electric vehicle sales by 2035. Other West Coast states may follow suit. China is expected to be the largest manufacturer of electric vehicles in the world. This creates long-term opportunity for auto import growth on the Lower Columbia.

Insights into Relative Port Competitiveness on the Lower Columbia

- Relative to Portland, most ports see availability of land as their primary competitive advantage, especially Vancouver.
- Portland's competitive advantages include labor access, established industries and employers, and a rail advantage that is distinct and considerable. Rail is the most important advantage over Vancouver.
- Portland also maintains an advantage of name recognition in addition to an agglomeration of a broader variety of uses in the harbor.
- Looking at all the available sites in the region, the Port of Vancouver may have the best opportunity at Terminal 5 to be immediately responsive to market opportunities. However, it's single-provider rail service continues to be a limiting disadvantage.
- Continued support to improve the Northern Rail Corridor will be essential in preserving cost-effective transportation and maintaining competitiveness for the Ports of Kalama and Longview. Lack of investment may result in a decline in regional advantage.
- Responses were mixed on whether there is an advantage to being downriver. Input was mixed on whether this translates into a measurable cost/time-saving advantage vis-à-vis other factors.
- The recent increase in market share captured by the Port of Kalama grain facilities has been a function of significant investments in state-of-the-art facilities that have increased loading speed and capacity. It has been operator driven in connection with the port's business friendly climate.
- Every port indicated that they feel they have a superior business and political climate compared to Portland. While most reported they have their own challenges, it was generally agreed that regulatory and permitting processes along with political factors in Portland are among its disadvantages.

- Ports are paying attention to potential increased capacity and competition from the Port of Woodland over the intermediate to long term. It is expected that Austin Point will develop at some point.
- Long-term terminal planning areas like Columbia Gateway and Barlow Point are still more than a decade off. In all likelihood, Barlow Point will be the first to come to market because master planning is already underway and it has better access to fill necessary to make the site suitable for development.
- Major development sites at Kalama, Port Westward, and Longview are being considered for uses that would not be viable in Portland Harbor (methanol production, coal export) even if there were a site large enough to accommodate them. However, these uses have to receive approved environmental permits that have been denied or appealed. Port officials say these projects remain a possibility (for example, the Jordan Cove project in Coos Bay, Oregon, has been in planning and litigating approval for over 15 years), but the future of these projects is uncertain.
- The urban terminal sites in Portland Harbor, like Terminal 2 and LD Commodities, are likely to continue to see increased pressure for conversion to other uses due to decreased competitiveness (i.e., draft depth) and proximity of noncomplementary uses. This pressure is also happening in Vancouver at Terminal 1.
- Maintaining and improving inland freight connections will be essential in preserving Lower Columbia cost competitiveness. As river ports are 60 to 100 miles upstream, additional costs are measurable from both a river pilot and time-cost perspective.
- Responses were mixed on whether there would be a potential substitution effect of liquid bulk terminal demand because of Portland's fossil fuel ordinance and other political influences. Most ports indicated they have their own regulatory challenges. Only the Port of Columbia County is likely to have a competitive advantage.
- Other Lower Columbia ports have not reported an increase in business leads or inquiries directly resulting from potentially negative competitiveness factors at Portland Harbor, specifically the Harbor Superfund Cleanup Project.
- Generally, port representatives reported that each port has developed a unique market niche specific to their own physical and operational factors. We heard consistently that Lower Columbia ports complement each other more than compete.
- Upriver expansions at the Port of Morrow have the ability to impact commodity flows in Portland. Morrow is expanding river barge service, and Portland has a competitive advantage in handling barge traffic. This should translate into an advantage for Portland in the grain market.

Insights on Superfund Cleanup and Brownfields

- Brownfields in Portland Harbor are hard to separate from the Superfund Cleanup project. Until the Superfund is addressed in terms of cleanup and liability, potential

tenants or buyers of potentially impacted properties are not going to be common. There needs to be a resolution in place for the market to function.

- The longer it takes for cleanup to be resolved, the greater the risk to losing marine-dependent industrial land. The longer sites are vacant and underutilized, the greater the risk of conversion to other uses and the deterioration of existing infrastructure. Reduced industrial activity starts to become the perceived status quo among the community, and it becomes politically difficult to reinstitute industrial and marine activity.
- In terms of growth, there are barriers to entry that are greater for new users than those already in the harbor. Those that are here will weigh investment decisions against their assumed liability. Users that are not already in the harbor have a very high threshold to cross to incent investment.
- Time Oil is a perfect example of a property that is generally ready to go but cannot attract investment due to unresolved liability risk.
- Total business investment is negatively impacted by the Superfund site status. The contributing factors include the extended cleanup horizon, uncertain liability, and additional due diligence costs.
- Potentially Responsible Parties (PRPs) are having trouble securing new tenants and in some cases are keeping land off the market.
- It will take a minimum of three to five years to complete remedial designs and move forward with remedial actions. It is expected that the settlement of remedial design will better support liability management and facilitate investment, but both liability and operational challenges will remain well into the planning period.
- The EPA and DEQ have not defined the jurisdiction between upland and in-water area, resulting in uncertainty around the extent of liability.
- In addition to liability, the uncertainty around implementation continued to also prohibit investment. The impact on marine-dependent operations and channel maintenance remains unclear.

Insights into Social Equity

- The consumption of fish is a primary risk pathway from contaminated media to the natural and human environment. Because the communities that rely more heavily on consumption of fish from the harbor are communities of color and populations with lower indices of socioeconomic status, the Superfund site has an important role in addressing environmental justice considerations.
- Harbor jobs have a low barrier to entry and are among the last low-barrier middle-income jobs in the city. This extends beyond the port itself and into the tenants in the harbor. Major employers like Vigor and Schnitzer have the greatest impact on providing jobs that offer mobility.

- There is a need to preserve industrial land for industrial jobs as much as possible. Loss of this land could limit access to these low-barrier high-mobility occupations. The City needs this opportunity for equitable economic growth.

Insights on Marine Terminal Operation and Land Needs

- Terminal capacity is a function of available land and capital equipment. This is a trade-off. Land increases storage capacity, and equipment increases the velocity of which product can flow. Higher capital utilization can allow a terminal to function with less land.
- Terminals do not operate at 100 percent capacity. Stabilized capacity is much lower. Markets start to consider adding capacity when operations get to 80 percent.
- The Port of Portland expects that most of future cargo demand will be accommodated on existing sites through densification and improvements in capital utilization. This is mostly out of necessity due to a general lack of viable sites for new terminals.
- Historically, it was important for terminals to be located near population centers. This is no longer the case. This is in part a function of the need for larger sites. Terminal facilities are getting larger on average. This is by and large driven by structural changes in rail operations that are resulting in longer unit trains.
- The trend toward larger ships will likely limit Portland's competitiveness in the container market over the long term. Portland will not be able to accommodate anything over a 7,000 TEU vessel.[6] This could result in a shift in the markets that Portland serves away from Pacific Rim markets and toward South American and European markets.
- Portland is expected to have excess capacity for containers over the planning period. There may be midterm to long-term opportunities to explore other commodity types at Terminal 6.
- Auto terminals are the most land consumptive. There are not cost-effective land/capacity solutions. Over the intermediate term, land constraints in California may push auto import/export activity into the Lower Columbia region.

Other Observations

- Portland's industrial lands and harbor activities meaningfully benefit the regional and state economy. Portland's policies for marine industrial land planning will impact businesses well beyond the Portland region.
- As the City moves forward with the EOA process, it should include a visioning process that prioritizes an equitable range of employment opportunities that harmonizes Portland's strategic advantages with other ports around the state.

[6] Container cargo is commonly measured by twenty-foot equivalent unit (TEU). This represents a shipping container whose internal dimensions measure 20 feet long, 8 feet wide, and 8 feet tall.

- As this Marine Industrial Lands Analysis informs the City's EOA process, it will be important for the City to balance the industry perspective with local stakeholders and be mindful of the downside economic and environmental risks associated with heavy industrial development.

Port of Portland Shared Prosperity Initiative

Over the course of this study, the Port of Portland announced its Shared Prosperity Initiative. This initiative reinforces its commitment to equitable economic development and prosperity in the harbor. Actions taken by the Port will certainly influence the economic trajectory in the Portland Harbor over the planning period. The Port provided the following description of this initiative as it relates to the City's Economic Opportunities Analysis Update.

Port of Portland | Shared Prosperity Initiative

The Port of Portland (Port) owns multiple marine terminals and industrial business parks, in addition to Portland International Airport and general aviation airports in Hillsboro and Troutdale. Each of these facilities contributes to regional economic prosperity and a better quality of life by exporting materials from Oregon and throughout the Columbia River Basin, bringing in goods from around the state, nation, and world while supporting local manufacturing and retail.

The Port's mission is to enhance the region's economy and quality of life. The Port makes a big economic impact in the region. However, when looking at the Port's history, the Port recently acknowledged that while prosperity was created, it was not equitably shared. Historically, Black, Indigenous, people of color, people with disabilities, and low-income communities have been left behind in access to quality jobs, income equality, and wealth.

The Port, in responding to three events—a pandemic, economic recession, and movements for racial justice—is implementing a Port-wide business strategy called Shared Prosperity. There are three non-negotiable principles of Shared Prosperity at the Port: (1) maximize benefits to Black, Indigenous, people of color, low-income communities, and people with disabilities; (2) identify new opportunities for community engagement; and (3) create a financially sustainable path for the Port.

The intent of this strategy is to use Port resources to enable more people to share and drive the prosperity of the region. This means using resources such as workforce, business programs and services, and physical assets to create opportunities and reduce barriers, specifically for Black, Indigenous, people of color, low-income communities, and people with disabilities.

As part of the Shared Prosperity strategy, and concurrently with the City's Economic Opportunities Analysis, the Port is reviewing its assets to assess how marine terminals, industrial land, and airports can best contribute to shared prosperity. Outcomes of the Port's analysis are expected to play a role in policy discussions in the EOA process.

Private Sector Outreach

Building on public sector input, we also interviewed representatives from private firms in the Portland Harbor. Under direction of the TAC, we identified and contacted 14 firms across a range of sectors in the Portland Harbor for individual interviews. We also collaborated with the Working Waterfront Coalition to deliver awareness of the project to its constituents and to extend opportunities to inform this process. Given the somewhat contentious and unresolved nature of the Superfund Cleanup and other factors, many firms were reluctant to speak on this issue. Collectively, we interviewed 11 private sector leaders representing nine firms. Participants are listed in Exhibit 7. Summarized outcomes and themes follow. General comments are not directly attributed to induvial respondents, although comments on firm-specific investments or market trends reflect the firm involved. *The comments summarized here should be taken as the views and experiences of industry leaders representing a cross section of industries in the harbor.*

Targeted Sectors for Private Engagement

Manufacturing

Construction

Energy

Metals Recycling

Barge Lines

Railroads

Exhibit 7: Private Sector Interviews

Name	Position	Organization
Debbie Deetz Silva[7]	Environmental Specialist	EVRAZ
Alan Sprott	Vice President	Vigor
Jill Mackie	Vice President of Public Affairs	Vigor
Rob Rich	Vice President of Marine Services	Shaver
Heather Stebbings	Marine Services and Government Liaison	Shaver
Chris West	Senior Vice President	PacWest/Zenith
Jim Perris	Senior Vice President of Operations	Calbag
Aaron Hunt	Senior Director of Public Affairs	Union Pacific Railroad
Johan Hellman	Executive Director of Public Affairs	BNSF Railroad
Geoff Tichenor	Partner	Stoel Rives
Myron Burr	Director, EHS	Siltronic Corp.

Insights on Business Drivers and Market Factors

- While marine vessel repair makes up over 80 percent of business at the Portland Shipyard, leaders do not see a direct linkage between vessel calls in the harbor and shipyard business activity.
- The impact of large government contracts and required maintenance cycles limits the shipyard's exposure to business cycle fluctuations. Federal spending impacts this revenue stream in the long run, but these changes move slowly.
- The ship-repair industry has been going through significant consolidation over the last 15 years. Smaller operations have been closing down or have been acquired. There is a

[7] Interview was conducted via email correspondence.

general lack of drydock space on the West Coast. Given the assets available at the shipyard, this has resulted in market share gains.

- Commodity markets flowing by rail through Portland are seen as highly unpredictable and can change quickly with market conditions. This creates a need for the rail and freight systems to be resilient and adaptable. One rail representative noted that five years ago, oil was a major rail commodity. Now there is hardly any oil running on rail. This assertion is exemplified in marine export data that shows a dramatic decrease in crude oil export volume compared to five years ago.
- The rail network is seeing growth in domestic intermodal flows driven in part by e-commerce. COVID-19 created a situation where there was an influx in e-commerce demand coupled with a decline in freight trucking capacity. Rail quickly pivoted to meet this need. It remains to be seen if e-commerce commodity flows by rail will be "sticky" post pandemic.
- Over the long term, we heard that opportunities for rail commodity growth through Portland include heavy break bulk, specifically wind turbines and industrial break bulk.
- Over the near term, the commodity mix moving through Portland looks stable. There are market opportunities in some commodities that are not politically palatable for Portland, namely coal and petroleum products.
- Barge line and tug service in Portland Harbor is organized into two main categories. The first is ship assist work. This is directly related to marine vessel calls and activity at the Portland Shipyard. The second is upriver barging, which is predominately driven by the flow of grain from the upriver system.
- The Portland Harbor has historically had the largest share of barged grain activity on the Lower Columbia. This is in part a function of the two Willamette facilities (Temco and LD Commodities) that are not set up to handle unit trains.
- Business at the barge lines is influenced by vessel calls, not cargo volume. This brings exposure to shifts in international trade, both market and policy driven. Recent tariffs on soy and corn had a measurable negative effect on Lower Columbia calls. However, corn and soy only move by rail through Portland due to their source markets.
- In the intermediate to long term, nongrain-related market opportunities for the barge lines include barging of solid waste upriver and the transport of unrefined bulk petroleum. Also, because barging has a lower greenhouse impact than trucking, opportunities may exist for some substitution where barging can get cost competitive.
- Reduced activity at the Temco and LD Commodities facilities may negatively impact the barge lines because they were predominately barge houses.
- The move toward sustainable fuels is impacting the liquid bulk market in Portland Harbor and Oregon more broadly. Conversion to sustainable fuels is occurring in the Critical Energy Infrastructure Hub (CEI) as well as in Columbia County. We heard of the potential for this to accelerate as a result of the Port's sustainable fuels strategy.

- In the near term, the pandemic has had a negative impact on crude prices, which increased the need for storage markedly.
- The metals sector is cyclical in nature and subject to world market forces. It is heavily influenced by global trade and demand.
- In part the result of the pandemic, several major manufacturers in the Portland Harbor have laid off significant portions of their workforce or closed business lines. It was reported in the *Oregonian* in April 2020 that EVRAZ was closing its spiral mill. The company stated, "Crude oil prices and pipe product demand have dropped considerably, and pipeline construction projects have been delayed or slowed shrinking demand for spiral pipe products."[8] Railcar maker Greenbrier Gunderson also cut its North American workforce by 40 percent, including over 200 jobs in Portland.[9]
- The metals recycling sector is predominately tied to the local economy, and GDP is a fairly good indicator of market direction. The sector relies on manufacturing and construction activity in the local market for product to process and sell.
- An overall decline in manufacturing activity has a negative impact on metals recyclers. Lower local activity means they have to go out further to find product, which increases their transportation costs. When compounded with additional costs of getting containers to Tacoma, this has a depressing impact on business outlook.
- Gains in manufacturing and construction efficiency are reducing the amount of waste in production processes, compounding the supply crunch in the metals recycling sector.

Insights on Recent Investment Decisions

Below we identify examples of investments made by companies interviewed over the last business cycle. In most cases, firms say they are making investments in capital to intensify the use of their existing footprint. We did not find instances of existing firms acquiring new property for expansion.

Vigor

- Invested in the "Vigorous" drydock to address a market need to serve larger military ships. Vigorous is the largest drydock in the United States and opens up many new markets for the Portland Shipyard. An example is the opportunity for the shipyard to serve large cruise ships. Vigor's investment also serves as an example of a firm adding capacity through capital investment and not land consumption.
- Growing through acquisitions, which have not impacted Swan Island or the Portland Harbor.

[8] Rogoway, Mike. "Evraz will lay off 230 from Portland steel plant, citing coronavirus outbreak." *The Oregonian/OregonLive,* April 6, 2020.

[9] https://www.freightwaves.com/news/greenbrier-scales-down-and-loses-weight

- Other shipyard investments have included a new outside buildway and gantry crane and overhauled bays with new cranes that expanded capacity on the existing footprint. They also installed a new robotics welding center.

Shaver

- Over $50 million in tug and equipment purchases and upgrades since 2012.
- In the process of adding a new administrative building on their existing site.

Zenith

- A planned project to extend pipes from their facility to the terminal for chemicals exports has been indefinitely abandoned after public opposition.
- A planned $24 million rail upgrade project that will include a new offloading rack to handle plant-based fuels separately.
- A rail capacity investment in 2017 allowing an increase from 12 to 44 railcars.

Calbag

- Over the last three years they have made significant (in the millions of dollars) investments in equipment and facility upgrades. These investments will ensure their ability to maintain existing site utilization.

Insights on Land Needs

There was a general consensus from users that their long-term strategy is for the intensification of their existing sites to accommodate growth. This is in part a function of the supply issue as well as the lack of and/or cost of land adjacent to their existing facilities. For example, we asked interviewees the hypothetical question, If land became available near your site, would you acquire it and how much would you need? Those that answered this question indicated they would take on land, on a magnitude we calculate at 10 to 15 percent of their existing sites. Therefore, it would seem that the decision around capital intensification is derived at least in part from necessity not optimization.

This is reinforced by several observed expansion decisions. For example, Vigor reported that they recently acquired a significant amount of leased storage space on Swan Island because they didn't have capacity for it on their site. Vigor also recently acquired Kvicak Marine and chose to purchase the Christensen Facility in Vancouver to accommodate it.[10] The unresolved nature of the Superfund was commonly cited as a deterrent for future harbor investment. Shaver reported that to accommodate its new administrative building, it had to move storage capacity off-site to Rainer, creating additional operational burden.

In the CEI Hub, it was reported that there is significant "unconstrained" demand for new land. The diversification of the liquid bulk market into both fossil and non-fossil-based fuel was a

[10] Although Vigor did report that the timing of their needs would have prohibited a ground-up development in Portland even if they had land available.

driver of land need because the same storage tanks cannot be used for both sources. This is creating additional need for storage capacity without a proportional increase in product. However, the current regulatory environment limits expansion potential. While non-fossil tank expansion is allowed under the City's fossil fuel ordinance,[11] it was noted by several respondents as a presumed difficulty in getting new tank capacity permitted in the CEI. Because non-fossil tanks are allowed, this is clearly in reference to tank capacity in general. In this sense, we heard that the expansion of any one firm will come through the acquisition of existing capacity from other firms. Existing facilities are seen as far more valuable than land because of the permitting constraints for fossil-based tank capacity. The market has started to see collective efficiency gains through shared storage capacity. A secondary market for storage has emerged where firms are leasing storage capacity from each other.

On the terminal land side, representatives from both railroads echoed comments from the port districts. The adoption of a "precision scheduled railroading" operational model is influencing land need. This model emphasizes a focus on the movement of the railcar itself, regardless of commodity type. It has translated into longer unit trains and a need for longer sidings and expanded terminal rail capacity. Increasing the length of sidings through the rail network is a strategic priority for the railroads. As it relates to port and terminal infrastructure, "there is a need to take a look at port infrastructure and extending efficiency gains at terminals."

Insights on Portland's Competitiveness

Positive Competitiveness Factors

Multimodal Transportation. Portland's multimodal transportation linkages were seen as its principal competitive advantage. The combination of water, rail, and freight networks was cited as an advantage. Specifically, service by two Class I rail lines provides a competitive rate environment that is favorable to users. Sites with river access that can access the river for the manufacturing process were also highlighted.

> "Portland has it all! Access to the river as a resource in the manufacturing process. Rail and trucking access. Access to natural gas. Marine transportation infrastructure to receive raw materials and shipments. Synergies with other sectors and strong manufacturing base providing a shared labor pool."

Freight Mobility. We heard that as a planned industrial district, the road network is generally truck friendly and ongoing projects like the Rivergate Boulevard Crossing project are positives. However, these notions were prefaced with concerns over nonindustrial uses discussed below.

A Well-Rounded Cluster. The proximity of the harbor to the urban setting was seen as both an advantage and disadvantage. The positive impact is a function of access to labor. Workforce development assets like the Swan Island Trades Center were cited as advantages. It is also clear that the synergy associated with the diversity of Portland's industrial cluster, the presence of

[11] https://www.portland.gov/bps/fossil-fuel-zoning/about

major employers, and the institutional knowledge in the region that comes with this cluster were also an advantage.

Negative Competitiveness Factors

Inland Location. For some sectors, Portland's inland location relative to coastwise locations in California and Puget Sound was noted as a competitive disadvantage. This is partially offset by lower labor costs. However, Portland was reported to have higher environmental fee and enforcement impacts.

Regulatory Context. Portland's fossil fuel ordinance was almost unanimously cited as an example of Portland's regulatory environment negatively impacting competitiveness. It places additional constraints on fossil-based tank capacity. Firms will innovate to improve throughput in other ways, but it will be costly and will not translate into significant need for additional land. We also heard concerns over mandates for open space, landscaping, and bike paths contributing to conflicting uses in industrial areas. The permitting process at the local and state/federal level was also referenced as overly burdensome. At the state/federal levels this was discussed in the context of the Superfund Cleanup Project.

Public Transit. Limited access to public transit in the context of a workforce that is increasingly originating from further out is a concern.

Investment and Land Availability. Several interviewees commented that Portland appears to be losing ground with respect to attracting investment. Respondents pointed to examples of investments elsewhere in the region, including terminal upgrades in Kalama and rail infrastructure projects in both Kalama and Vancouver. Land availability for nonterminal development was also a common concern. We heard that other port areas offered better opportunities for industrial development. However, these comments were prefaced with Portland offering a more robust industrial ecosystem.

Container Service. While not a disadvantage to other Lower Columbia markets that also do not have container service, the lack of container service was commonly referenced as a disadvantage relative to other West Coast areas and a significant cost burden on some sectors. However, Terminal 6 has added weekly trans-Pacific container service.

The Harbor Superfund Cleanup. The impacts of the Harbor Superfund Cleanup Project on competitiveness are discussed below.

Insights on Investments/Activities for the City to Improve Competitiveness

Interviewees identified a handful of projects that would benefit the Portland Harbor in the long term. We heard about the need for the City to be supportive of the I-5 Bridge replacement and the importance of maintaining freight mobility systems and shipping channels. However, a central theme of our interviews was that the Portland Harbor was not deficient in infrastructure

and that the best actions the City could take to improve competitiveness fell into three categories:

Protect industrial land from conversion and nonindustrial conflicts. This factor was unanimously cited as the most important issue for Portland Harbor. We heard examples from firms that have closed portions of their business or changed their operations as a direct result of conflict with adjacent uses. Intensifying residential uses in the Overlook neighborhood and the increasing risk of conflicts between neighbors and industrial areas were common concerns. On the west side of the Willamette River, the emergence of homeless populations in industrial areas in proximity to noise, machinery, and freight traffic was also cited as a safety issue. Protection of industrial land, specifically land with water access, was described as essential to the economic function of the region because it is finite in supply and cannot "outbid" other uses if forced to compete. Encroachment and loss of industrial land was listed as the number one downside risk to the long-term health of the harbor.

Improve the regulatory environment and business climate. There is a general perception among businesses in the harbor that the City is "at best neutral, and more likely anti-industry as it relates to the harbor." Interviewees commented that the City needs to be more mindful about policy proposals that "punish growth and investment." The City's fossil fuel ordinance, general time and difficulty in permitting processes, and landscaping requirements and setbacks in industrial areas were all cited examples. Interviewees are looking for the City to play a proactive role in facilitating a more certain regulatory environment.

> "The biggest thing the City needs to invest in is itself. They need to take apart and put back together the permitting process and make it easier to do business in Portland."

Support the resolution of the Harbor Superfund Cleanup. Interviewees indicated they would like to see the City be a better partner in developing solutions to the Superfund Cleanup at a reasonable cost. We heard a need for improved leadership in this area.

Insights on the Superfund Cleanup Project

- The Superfund Cleanup project results in everything taking longer and costing more. Vigor specifically discussed that their drydock took years longer to complete than it should have as a result of the complexities and agencies involved.
- Getting a resolution in place for Potentially Responsible Parties (PRP) is going to be critically important for Portland's future competitiveness. For PRPs, there is an ongoing administrative cost in addition to the uncertainty about potential liability. Companies cannot invest in their future in that situation. For potential new users, there are no mechanisms to protect them, so they can't choose the harbor for investments either.

Insights on Workforce and Social Equity

- Jobs in the harbor provide opportunities for people that do not have access to education. These are jobs that allow opportunities to earn a living wage and create upward mobility.

- Harbor jobs offer other benefits to underserved or marginalized segments of the workforce. For example, industry leaders report that many of the production and service users in the harbor are "felony friendly" and have an overrepresentation of workers that are non-native English speakers.
- Portland's workforce relative to other areas was highlighted as a key advantage. Expanding on this resource was cited as a key component to improving competitiveness. We heard a need for more assets like the Swan Island Trades Center.
- The lack of public transit in the Rivergate District was identified as a competitive disadvantage and an inequitable condition.[12]

[12] TriMet does serve the Rivergate District with bus service via Route 81.

5. Summary of Research Conclusions and Findings

In this section, we provide a brief abstract from each research topic evaluated in this project, highlighting findings that specifically impact our outlook for marine/harbor-dependent industrial land need in Portland Harbor. Detailed findings and supporting analyses are included in Appendices A through F.

Economic Shifts in the Portland Harbor: An Evaluation of Employment, Wages, and Investment

Using data from the Quarterly Census of Employment and Wages (QCEW) between 2003 and 2018, we document economic shifts in the Portland Harbor. Our approach begins with an evaluation of all users in the harbor, then takes a more granular look at firms in NAICS categories that are commonly associated with marine-dependent uses. Over the last 15 years, we have found that employment growth in Portland Harbor has been generally flat. Declines in production uses have been offset by increases in logistics, construction, and other nonindustrial sectors. However, this is not indicative of a stagnate marine-related economy. Overall, we found the negative employment impact to be largely isolated to a handful of large employers. Most of the firms in the harbor are growing. At the same time, output and investment are expanding. The harbor added over 1.7 million square feet of new space since 2014. Market values are increasing rapidly close-in and in the Rivergate District.

The harbor economy is not without downside risks. The metals and equipment sectors face structural market headwinds, the petroleum and chemicals sector continues to be limited by regulatory factors, and the impacts of the COVID-19 pandemic have been catastrophic. All factors considered, we find that employment-based indicators likely overstate downside risk to output, productivity, and land demand.

The Impacts of Changes in Marine Terminal Design and Land Need on Portland Harbor Competitiveness

Shifts in marine terminal design are the result of two basic factors. First, there is a growing need to accommodate heavier loads and to reduce the number of "actions" a railcar makes within terminals. On-dock rail systems are increasingly used to improve efficiency. Changes in rail operational models are driving a trend toward longer unit trains, longer sidings, and by extension larger terminal sites. Second, ocean-going vessels, specifically between Pacific Rim nations, are getting progressively larger. The limitation of Portland's channel depth will limit the size of ships that can call on the harbor indefinitely. This will play an increasingly limiting role on the Portland cargo market throughout the forecast period. This condition will impact the container market to the greatest degree. Changing rail needs will have an impact on terminal land need in the harbor. The sites that are likely to become available to accommodate future

terminal growth are on the cusp of what is sufficient to meet contemporary design needs. Innovative and creative rail solutions like infinity loops may be necessary to be competitive.

Case Study | G3 Grain Terminal, Vancouver, BC

The G3 terminal is a $500 million state-of-the-art grain terminal in Vancouver, BC. The project features a new innovative rail system called an infinity loop. This system allows a high-capacity grain terminal with the ability to accommodate two 135-car trains. This allows the terminal to be sited on a 60-acre site, whereas a traditional loop would require 80 to 100 acres for a similarly scaled project.

An Assessment of Marine Industrial Competitiveness on the Lower Columbia River

The Portland Harbor competes with other markets on the Lower Columbia for marine-dependent economic activity. This competitive landscape includes the market for marine terminals as well as production and service uses. In this report, we leverage a range of data sources, including cargo data from the US Army Corps of Engineers and WISERtrade, interviews with port operators, and primary research to compare and contrast Portland's competitiveness vis-à-vis alternative industrial areas with deepwater marine access on the Lower Columbia. Competitive markets include Vancouver, Kalama, Longview, and Port Westward in Columbia County. We find that Portland remains the market leader in terms of total cargo throughput, but it has been steadily losing market share in recent years. Domestic internal trade is more important to the Portland Harbor than any other port industrial area on the Lower Columbia.

Portland is perceived as having far superior transportation connectedness, specifically relating to rail. Cross competitiveness of two Class I rail lines presents a meaningful cost advantage over Vancouver. For nonterminal uses, Portland offers the most complete cluster of interrelated firms workforce assets, and access to production in puts on the Lower Columbia. We find that Portland's downside competitiveness factors include the unresolved nature of the Superfund Cleanup coupled with a lack of competitive land.

Analysis of the Portland Harbor Superfund Site Impact on Marine Industrial Land[13]

In this report, project partner Maul Foster Alongi (MFA) explores the impact of competitiveness and investment of the Harbor Superfund Cleanup.[14] Built upon interviews with local industry

[13] The findings in this report relating to the Portland Harbor Superfund Cleanup are the result of research, analysis, and interviews conducted by MFA. ECONorthwest summarized these findings in the context of the broader project.

[14] MFA is also contracted to conduct research and remedy design work related to the Superfund Cleanup.

leaders, the research finds that the Superfund Cleanup negatively impacts project feasibility through increased and uncertain costs, timelines, and environmental risk. Stigma and uncertain liability also contribute to a limited tenant pool that places further downward pressure of feasibility. Mechanisms to mitigate liability risk have not been deployed or have been largely unsuccessful at encouraging investment. This research appears to confirm the hypothesis that operational disruption and liability uncertainty associated with the Superfund Cleanup negatively impacts the competitive position of the Portland Harbor industrial lands and deters investment and reinvestment by property owners and users.

The report acknowledges that the tools available to Potentially Responsible Parties (PRPs) within the harbor to manage risk, liability, and cost are limited specifically by the nature of federal CERCLA laws, by the terms of the ROD, and the multiple layers of jurisdiction over the harbor.

In addition to potential tools, government and industry leaders interviewed voiced the opinion that government agencies are not prioritizing the PHSS as an issue of state and regional importance. The speculation is that this is due to the lack of demand from a major employer that the issues be resolved and/or provide a pathway to resolve liability to make investments and locate jobs in the harbor. It may also be due to a lack of awareness of the role that industry, and heavy manufacturing in particular, plays in providing living wage jobs for the region. This extends to overall competitiveness factors. Industry leaders are looking for the City to invest in improving the business climate, protecting encroachment from nonindustrial uses, mitigating "onerous stormwater and air quality regulations," and improving investment in public education and safety.

Summary of Potential Liability Mitigation Tools

Source: Maul Foster Alongi

DEQ can provide Prospective Purchaser Agreements (PPAs), which define and limit environmental liabilities on upland properties but cannot issue protection for in-water contamination. EPA has so far been reluctant or unwilling to issue PPAs, directing purchasers to rely instead on the liability protections of the Bona Fide Prospective Purchasers provision of the 2002 Brownfields Amendments to CERCLA. This has largely not been satisfactory for risk-averse purchasers. The only PPA issued by EPA to date has been for the Triangle site at the University of Portland. To date, EPA has emphasized the availability of "comfort letters" to PRPs once an agreement is negotiated. The value of such letters has not been tested on the market or in defense against a liability claim.

An Assessment of the Economic Function of the Marine Industry on the Regional Economy

This report builds off a body of research reports exploring the importance of harbor uses that extends almost a decade. The standard metrics of economic impact (employment, output, wages, etc.) are not complete measures of the importance of the marine-dependent industry on the regional economy. Many traded-sector industries rely on access to marine facilities to cost-effectively move cargo in and out of the region. This literature review, from a preselected set of reports, assesses the marine industry's role in facilitating trade and logistics in the regional economy. Maritime activities in Portland account for over 7,100 jobs and $629 million in income

through direct and secondary effects. Further, we find measurable negative impacts to Oregon's traded-sector exporters as a result of diminished container service at the Port of Portland.

Race and Educational Equity in Harbor-Dependent Sectors of the Portland Economy

In this report, we test the hypothesis that the harbor economy is overrepresented by black, Indigenous and people of color (BIPOC) workers. Using US Census Public Use Microdata Sample (PUMS) data, it is possible to tabulate the regional population by detailed person-level attributes, including race, ethnicity, education, and industry of employment. We found that BIPOC workers in the Portland MSA appear to be proportionately represented in harbor-dependent industries relative to the share of BIPOC workers in all other industries outside the sector. However, nearly all nonwhite racial and ethnic groups earn higher median incomes in harbor-dependent sectors than outside of it, constituting an "overrepresentation" of income in the sector for BIPOC communities. We found that the harbor-related industrial sector offers a sizeable benefit to the Portland region's different marginalized communities in the form of lower educational barriers to higher-than-average wages. Slower growth in harbor-related employment sectors may have a disproportionate impact on the wealth, and therefore the stability, of BIPOC workers and workers without higher educational attainment.

6. Land Need Forecast: Terminal Demand

Summary of Marine Cargo Demand Forecast

In May 2020, the Port of Portland with support from BST Associates completed its 2020 Marine Cargo Forecast. BST is a national leader in this type of work and also completed the previous marine cargo forecast. The 2020 report built upon forecast results and methodologies deployed in the 2017 Marine Cargo Forecast and Rail Capacity Analysis that was commissioned by the Washington Public Ports Association.

The results in the 2020 forecast are "unconstrainted" in the sense that they assume that investments in infrastructure necessary to handle forecasted volumes will be made commensurate with demand growth. The report utilizes a top-down allocation methodology, where regional demand for the Pacific Northwest is forecasted based on broad economic trends and trade data, then allocated to subregions and ultimately to terminals in the Portland Harbor. Forecast results are presented with a range of outcomes to reflect shifts in market share as a result of potential projects in the planning and permitting phase. For example, the high forecast scenario for regional liquid bulk volume reflects planned new terminal development at Port Westward and Kalama to handle methanol exports. The future of these projects coming to market have become increasingly less likely over the last year, with each failing to obtain environmental permits. However, if approved over the planning period, these projects would be market making in the sense that they would increase the overall volume of cargo on the Lower Columbia considerably; however, they are less likely to impact volumes in Portland.

This report will serve as the basis for our conversion of cargo demand to land need.

Recent Cargo Trends: Key Observations

- Long-term growth in cargo volume on the Lower Columbia has been facilitated by investments in facilities and river maintenance. Over the last decade, port development has focused on investments in existing facilities and planning for new development.
- The impacts of trade policy and the COVID-19 pandemic will negatively impact cargo throughput in the short term. The market is expected to return to its long-run trend by 2025.
- From 2000 to 2018, Lower Columbia River cargo volume increased by 44 percent. Growth has been primarily driven by exports.
- Strong export growth from 2015 to 2018 offset a decline in imports, resulting in a 10-million-metric-ton increase in cargo volume (+24 percent) over the three-year period.

Cargo Growth Trend: 2010 to 2018

- Cargo volume growth on the Lower Columbia has been driven by a significant increase in grain exports (+11.09 million metric tons, +54 percent), auto exports (+120,000 units, +40 percent), and other dry bulk exports (+2.61 million metric tons, +28 percent).
- Lower Columbia breakbulk volume fell measurably (-0.47 million metric tons, -28 percent) with liquid bulks falling only slightly (-0.08 million metric tons, -2.7 percent).
- In the Portland Harbor, volume in other dry bulks (+.243 million metric tons, +37 percent) and autos (+60,000 units, +24 percent) increased but was offset by losses in all other commodity types.
- While the regional market for grain exports grew, Portland lost market share as a result of capacity investments in Longview and Kalama and the closure of the LD commodities storage and moving facility in Portland. Portland's grain export volume fell measurably (-2.26 million metric tons, -37 percent).
- Similarly, Portland's breakbulk market has almost disappeared (-0.96 million metric tons, -98 percent). The majority of this market has been historically derived from two major steel import customers. Both customers left Portland for facilities in other markets.
- The majority of fuels transported to Portland arrive by the Olympic Pipeline from Puget Sound refineries, while external trade accounts for roughly two-thirds of liquid bulk throughput. The expectation is for crude oil and petroleum product export growth to remain especially subdued as a result of the downward trend in consumption.
- Perhaps the most noteworthy change in Portland Harbor's market has been the decline in ocean trade container volume, which completely disappeared in 2017 but has seen some recent growth from 2018 with a restoration of weekly container service. In 2010, Portland handled 181,000 TEU. Some of the decline has been offset by an increase in intermodal container service (+63,500 TEU).

Cargo Forecast Summary

In the tables below, we summarize Portland's forecast by commodity type and report on the major factors influencing market growth and Portland's market capture. Data in the forecast range are from the 2020 Portland Marine Cargo Forecast.[15]

[15] BST Associates (2020)

Grain

Lower Columbia Commodities Traded: Wheat, Corn, Other Coarse Grains, Soybeans

Market Growth (HIGH): The market for grain exports is expected to remain strong, driven by demand growth in China and other Pacific Rim nations. The market is competitive, with the West Coast facing increasing competition from Canada, Australia, and Brazil.

Lower Columbia Competitors:	Factors Influencing Market Share:	Forecast Range ('20-'40):
▪ Vancouver ▪ Longview ▪ Kalama	▪ Likelihood that Portland's two smaller grain terminals cease operations. ▪ Increasing capacity at other Lower Columbia ports. ▪ Shifting product mix away from wheat, and Portland's shift to regional commodity shares. ▪ Containerized grain shipping. ▪ Impact of Snake River Dam on barging.	*million metric tons, (%AAGR)* Low: +3.04 (+4.3%) Base: +4.58 (+5.7%) High: +8.86 (+8.3%) **Base Case Market Share:** 20%

Other Dry Bulks

Lower Columbia Commodities Traded: Gypsum, Limestone, Cement, Soda Ash, Potash, Scrap Metal

Market Growth (MODERATE-LOW): Import market growth is driven by construction demand and is expected to grow in line with the overall economy. Exports of soda ash and potash will be driven by global demand. Export growth on the Lower Columbia will likely remain positive but slow considerably over the forecast period.

Lower Columbia Competitors:	Factors Influencing Market Share:	Forecast Range ('20-'40):
▪ Longview ▪ Vancouver	▪ Portland will continue to draw a similar market share for imports due to proximity to construction concentrations. ▪ American Natural Soda Ash Corporation (ANSAC) composition. One of the producers may leave the consortium and seek a terminal elsewhere, potentially in Longview. ▪ If the Millennium Bulk Terminal in Vancouver begins exporting coal, Portland will see a sharp decline in other dry bulk market share, even in light of growth in throughput.	*million metric tons, (%AAGR)* Low: -2.31 (-1.7%) Base: +3.36 (+1.8%) High: +5.83 (+2.4%) **Base Case Market Share:** 74%

Autos

Lower Columbia Commodities Traded: Automobile Imports and Exports. Honda, Ford, Toyota, Fiat/Chrysler

Market Growth (MIXED): Imports are expected to grow slowly, with light vehicle sales growth in the United States generally flat. Exports will grow at a faster pace, with growing global demand and a shifting of market share to the Lower Columbia region.

Lower Columbia Competitors:	Factors Influencing Market Share:	Forecast Range ('20-'40):
▪ Vancouver	▪ Import growth on the West Coast is impacted by a shift of imports for waterborne to overland moves. ▪ The extent that Portland remains the only auto exporter on the Lower Columbia ▪ Fiat/Chrysler shifting its exports to Portland from out of the region.	*Units, (%AAGR)* Low: +130,000 (+1.9%) Base: +220,000 (+2.8%) High: +270,000 (+3.1%) **Base Case Market Share:** 70%

Breakbulk

Lower Columbia Commodities Traded: Forest Products (Pulp, Paper, Lumber), Machinery/Equipment, Iron & Steel (Coils, Bars, Pipe, Rail)

Market Growth (LOW): The macroeconomic outlook for demand for commodities traded on the Lower Columbia is generally low. However, in recent years the Lower Columbia has seen a deterioration in West Coast market share. Opportunities exist to recapture some of this market.

Lower Columbia Competitors:	Factors Influencing Market Share:	Forecast Range ('20-'40):
▪ Vancouver ▪ Longview	▪ A shifting of railroad steel imports out of the region. This is likely to remain. ▪ The extent that EVRAZ's steel imports remain in Vancouver or shift back to Portland. ▪ The extent that the Port of Portland is successful in repositioning Terminal 6 to accommodate new/expanded breakbulk commodities, including wind energy equipment, project cargo, and transportation equipment.	*million metric tons, (%AAGR)* Low: +0.04 (+4.3%) Base: +0.42 (+14.5%) High: +0.87 (+18.5%) **Base Case Market Share:** 27%

Liquid Bulks

Lower Columbia Commodities Traded: Refined Petroleum, Crude Oil, Other Liquid Bulks (Animal Fats, Chemicals, Fertilizers), Sodium Hydroxide, Toluene, Ethanol

Market Growth (MIXED): The flow of liquid bulks through the Lower Columbia are driven by both external and internal trade. External trade accounts for two-thirds of liquid bulk throughput. While growth in crude oil and petroleum products is likely to remain structurally low, consistent with declining consumption, the outlook for the market of other liquid bulk products has a wide range of outcomes depending on planned investments in the region.

Lower Columbia Competitors:	Factors Influencing Market Share:	Forecast Range ('20-'40):
▪ Vancouver ▪ Longview ▪ Port Westward ▪ Kalama	▪ Price competition from pipelines serving Eastern Washington market. ▪ Policy impacts on crude oil shipping and storage. ▪ Impact of the Port's sustainable aviation fuels strategy on biodiesel sourcing. ▪ Two potential methanol plants on the Lower Columbia would reduce Portland's *market share* of liquid bulks but not impact overall throughput.	*million metric tons, (%AAGR)* Low: +0.34 (+0.7%) Base: +0.63 (+1.1%) High: +0.91 (+1.6%) **Base Case Market Share:** 66%

Containers

Lower Columbia Commodities Traded: Varying Containerized Products

Market Growth (UNCERTAIN): International container traffic moving through the Pacific Northwest is driven by trade with Asia, specifically China.

Lower Columbia Competitors:	Factors Influencing Market Share:	Forecast Range ('20-'40):
Competition on the Lower Columbia is limited. Portland competes more directly with other West Coast locations.	▪ The extent that British Columbia continues to capture market share from the Pacific NW ports. ▪ Longevity of the SM Lines/Swire Shipping services. ▪ Ongoing trend in design and vessel size shifting calls away from the Lower Columbia. ▪ Business case for container service at T6 vis-à-vis alternative commodity types. ▪ Resolution and long-term stability of labor constraints.	*TEUs, (%AAGR)* Low: -22,500 (-100%) Base: +35,900 (+4.9%) High: +44,600 (+5.6%) **Base Case Market Share:** N/A

Estimate of Existing Capacity

To estimate the impact of marine cargo demand growth on land need in the harbor, we start with an understanding of existing terminal capacity. Terminal capacity is impacted by many factors that vary broadly by commodity type. Throughput is generally a function of storage and speed, which at its core is derived from a mix of land and capital equipment. For most commodities, these inputs are a trade-off. For example, capital improvements that increase the speed at which cargo can move reduce the need for land/storage. The ratio of land to capital varies by commodity type. For example, equipment can be used to stack containers and fit more on a given footprint. This is more difficult for automobiles.

Due to the complexity of the inputs involved and the ability of operators, it is inherently difficult to arrive at a complete picture of harbor wide capacity. This is compounded by Portland's large number of private terminals where data on capital investments and throughput is proprietary. Given the information available, to develop a baseline estimate of capacity, we deployed a simple methodology. We began with capacity estimates by commodity type identified in Portland's 2016 EOA. We then considered the potential impact of terminal investments (or disinvestments) identified in Appendix C. Many of these investments were already considered in the 2016 EOA capacity estimates. Reconciling previously identified investments with our research, we identified three impacts on capacity.

1) Canpotex expansion estimate. The 2016 EOA calculated the Canpotex expansion that was ongoing at the time at 2,250,000 MT of additional capacity. Upon completion of the project in 2018, Canpotex announced the capacity increase totaled 3,500,000 MT.[16] The additional capacity was included in our estimates.
2) Since the 2016 EOA, the Louis Dreyfus grain terminal on the Willamette River has ceased operations. We heard from multiple sources that the long-term prospects of the LD facility operating as a grain terminal are uncertain. This sentiment was also expressed in the Port's 2020 Marine Cargo Forecast. Capacity at the LD facility was not included in any forecasted demand scenario. The Port of Portland estimated annual throughput capacity of this facility at 2.4 million MT.
3) Zenith Terminal. Recent capacity increase at Zenith for liquid bulks.

As a final check, we also considered the trend in commodity flows in Portland Harbor over the last decade. We calculated the "high-water-mark" of cargo volume by cargo type over the last decade. For automobiles and containers, we obtained recent data that also includes automobile units and container twenty-foot equivalent unit (TEU). This data was not included in the 2016 EOA, but we have included it in our 10-year high-water-mark estimate for reference.

[16] https://www.canpotex.com/news/canpotex-announces-completion-portland-bulk-terminals-expansion

Exhibit 8: Estimate of Terminal Capacity, Portland Harbor (2020)
Source: ECONorthwest Research, BST Marine Cargo Forecast, 2016 Portland EOA, WISERTrade Data

Cargo Type	2016 Capacity Estimate	Estimated Capacity Change	Estimated 2020 Capacity	2010 Cargo Volume (from EOA)	10-Year High-Water-Mark	Ratio: Peak Volume to Capacity
Autos (MT)	1,007,800	0	1,007,800	376,000	654,000	65%
Autos (units)	n/a	n/a	n/a	n/a	325,000	n/a
Containers (MT)	3,990,000	0	3,990,000	1,129,000	1,129,000	28%
Containers (TEU)	n/a	n/a	n/a	n/a	181,100	n/a
Breakbulk (MT)	2,350,000	[17]	2,350,000	966,000	1,110,000	47%
Grain (MT)	9,750,000	-2,400,000	7,350,000	6,113,000	6,700,000	91%
Dry Bulk (MT)	15,450,000	1,250,000	16,700,000	6,193,000	11,740,000	70%
Liquid Bulk (MT)	8,280,000	250,000	8,530,000	5,948,000	4,140,000	48%
TOTAL	40,827,800	-900,000	39,927,800	20,725,000	25,473,000	64%

Factors Influencing Land Need

From our analysis of trends in marine terminal design, we expect that terminal land need per "x" unit of cargo to be higher than in the past. This is largely a function of the need to accommodate longer unit trains. Our analysis in Appendix B resulted in a matrix of expected terminal land need by cargo type, which is referenced again below:

Exhibit 9. Design Characteristics of Selected Commodity Types
Source: ECONorthwest from interviews with port operators.

Commodity (Example)	Terminal Size	Vessel Size Draft Depth Typical Load	Storage Type Load Method Delivery Method
Dry Bulk (Potash)	40 acres 80–100 with unit train	Panamax 39–40 ft. 50–60,000 MT	Covered Conveyor Rail, unit trains
Dry Bulk (Urea)	40 acres (terminal only) 100 acres (with plant)	Handymax 33–36 ft. 40–55,000 MT	Covered Conveyor Rail, unit trains
Other Dry Bulk Import (Cement, Limestone)	20–30 acres (standard) 5–15 acres (infill)	Panamax or Barge Depth varies Load varies	Open/other Conveyor Rail and barge
Autos (RORO)	100–150 acres (large) 50–80 acres (typical) 20–30 acres (expansions)	Car Carrier 32 ft. 6–6,500 units	Open RORO Rail and truck
Breakbulk/Neo Bulk (General)	20 acres	Handymax 33–36 ft. 40–55,000 MT	Open, paved Mobile Harbor Crane Rail and truck
Breakbulk (Scrap Metal)	20–35 acres	Handymax 33–36 ft. 40–55,000 MT	Open Crane Rail or truck
Breakbulk (Wind/Large Machinery)	20–40 acres (standard)	Panamax 39–40 ft. 50–60,000 MT	Open Mobile Harbor Crane (x2) Rail and truck

[17] The Port of Portland has been marketing portions of Terminal 6 for breakbulk commodities as a result of lower container volume. In this analysis, capacity is still listed under container capacity. Permanent shifts at Terminal 6 would result in immediate capacity increases for breakbulk but declines in container capacity.

Liquid Bulk (Biodiesel)	20 or more acres	Panamax 39–40 ft. 50 – 60,000 MT	Storage tanks Pipeline Pipeline and rail
Dry Bulk (Grain)	40–60 acres	Panamax 39–40 ft. 50–60,000 MT	Silo storage Conveyor Rail and barge

Estimate of Future Terminal Land Need

It is important to recognize that terminal capacity supply is inherently a step function. Marginal growth in demand is accommodated by partial terminal development. Terminal development can cost tens to hundreds of millions of dollars. These investment decisions are not taken lightly, and certainty around the stability of future demand must be high for investors to commit. When coupled with long permitting and development periods, it should be no surprise that terminals rarely operate near full capacity. One finding we learned from interviews with port operators is that "stabilized capacity" is roughly 80-90 percent. Once this threshold is approached, market pressure for new terminal development (or expansion) begins to form.

In Exhibit 10 below, we present updated capacity estimates alongside low, medium, and high cargo forecasts.

Exhibit 10: Estimated Capacity and Forecast Range
Source: ECONorthwest, Forecast data from Portland Marine Cargo Forecast

Cargo Type	Estimated Capacity	2020 Cargo Volume Est.	2040 Forecast Range		
			Low	Base	High
Autos (units)	501,000	300,000	410,000	520,000	590,000
Containers (TEU)	640,000	22,500	0	58,400	67,100
Breakbulk	2,350,000	30,000	70,000	450,000	900,000
Grain	7,350,000	2,280,000	5,320,000	6,860,000	11,140,000
Dry Bulk (import)	16,700,000	1,600,000	1,690,000	2,080,000	2,310,000
Dry Bulk (export)		6,480,000	5,810,000	9,350,000	12,960,000
Liquid Bulk	8,530,000	2,460,000	2,760,000	3,090,000	3,420,000

- Under the base case scenario, total cargo volume in Portland is expected to increase by 70 percent compared to estimated volumes from 2020.

- Compared to existing capacity, forecasted cargo volume is expected to exceed 80 percent of existing capacity for automobiles in every scenario. This would be indicative of a high likelihood of supported demand for new terminal development over the forecast period.

- Forecast data would suggest that volumes for containers, breakbulk, and liquid bulk cargo are not expected to support additional development for those cargo types over the forecast period. However, we note that the majority of fuels handled at Portland's fuel terminals arrive by the Olympic Pipeline from Puget Sound refineries. The cargo forecast for Liquid Bulk in Exhibit 10 only includes a portion of total liquid bulk throughput. On net, both container and breakbulk cargo volumes are expected to remain well below existing capacity. These cargo types have the benefit of shared utilization at

Terminal 6. If opportunities for container volumes remain measured, Terminal 6 would be well positioned to handle more breakbulk capacity. This would include opportunities for wind energy import to the extent that wind energy development growth continues beyond the near to intermediate term.

- There is a reasonable likelihood that sufficient demand to support an additional grain terminal in Portland over the forecast period exists. Under the high growth scenario, this need remains even if the Louis Dreyfus terminal returns to operation. The market for additional grain terminals was anecdotally supported in our interviews with Business Oregon, who reported that they have had recent inquiries for sites suitable for grain terminal development on the Lower Columbia.

- Under the high forecast only, dry bulk cargo demand is forecasted to reach a threshold that would support additional terminal development. According to the Port's forecast report, this scenario would be most likely if Portland is able to retain exports for American Natural Soda Ash Corporation (ANSAC) members and the market for soda ash and potash accelerate favorably due to global demand.

Exhibit 11: Forecasted Capacity Shortfall
Source: ECONorthwest

Cargo Type	Capacity % Range	Terminal Need Likelihood	Terminal Land Need Range	Estimated Land Need
Autos	82% to 118%	High	30 to 50 acres	50 acres
Containers	0% to 10%	Very Low	N/A	0 acres
Breakbulk	3% to 38%	Very Low	20 to 30 acres	0 acres
Grain	72% to 152%	Moderate	40 to 60 acres	50 acres
Dry Bulk	35% to 91%	Moderate	40-100 acres	0 acres
Liquid Bulk	32% to 40%	Low	20 acres	0 acres

Our analysis found reasonable unconstrained demand to support two additional terminals (or expansions) over the next 20 years. We would expect the automobile and grain markets to drive new demand. Ultimately, land need is in part a function of the ability to accommodate demand through expansion of existing terminals or through entirely new terminal development. For example, Portland could potentially accommodate a portion of identified demand through a combination of storage capacity and throughput efficiency. By contrast, new terminals require inherently more land.

For the purposes of this analysis, we "bookend" estimates by assuming a low range where expansions can accommodate a portion of demand and a high range that assumes entirely new development at typical size thresholds. Considering terminal site requirements, land need would range from 80 to 140 acres to support this growth.

Additional High Growth Need (Dry Bulk Export)

Under the 2020 Marine Cargo Forecast's most optimistic growth scenario, the threshold to support an additional dry bulk terminal would also be approached by the end of the forecast

period. A new dry bulk terminal with a unit train configuration could result in additional need of up to 80 to 100 acres.

7. Land Need Forecast: Marine-Dependent Production and Services Demand

Where marine terminal land need is calculated as a product of cargo growth and terminal land needs, estimating land demand for production and service industrial uses is more challenging. In our analysis of harbor trends in Appendix A, we noted the difficulty in simply defining what a marine-dependent use is. For example, Portland has users with direct river access that do not necessarily require it. It also has users on nonaccess sites that simply need proximity and/or rail connectivity, not direct river access. How we distinguish marine-dependent uses from other industrial uses influences the magnitude of impacts estimated in this project and how they are incorporated into other long-range planning efforts.

This report began by establishing a baseline evaluation geography in Chapter 1 that includes land designated by Portland as "Harbor Access Lands" (HAL) and "Harbor and Airport District" (HAD) land west of Interstate-5. HAL sites have a reasonably high likelihood of accommodating marine-dependent uses, while HAD sites have a more diverse mix of uses that include nonindustrial users. Excluding in-water areas, we calculated HAL and HAD designations to include roughly 2,400 acres and 4,800 acres of gross land area, respectively. QCEW data suggests that within these areas there are 28,700 workers employed. Nearly three-quarters of these employees are in traditional "industrial" sectors.[18] We further identified six subsector categories comprised of three and five-digit NAICS categories known to be concentrated in marine activities. We cross-referenced these sectors with an inventory of firms we know to be marine dependent. Taken together, our marine-dependent subsectors accounted for 30 percent of all employment in the harbor. Individually identified firms accounted for nearly 6,000 workers in 2018. Based on our evaluation of QCEW data, we consider our identified subsectors to be an incomplete but reasonable cross-section of the marine-dependent economy in the harbor.

In the analysis below, we present three "forecast" scenarios estimating future demand levels for marine production and service land need in the harbor. These scenarios are forecasts in the sense that they make estimates about future economic activity. However, we would better characterize these scenarios as a sensitivity analysis representing a range of potential outcomes influenced by exogenous market conditions, local policy direction, or the outcome of a single event. Given that harbor economies are generally anchored by large users, a single event could drastically impact land need in the harbor as a result of emerging or deteriorating market conditions. On the one hand, the unexpected shuttering of any one of the harbors large users would create additional underutilized land capacity. Conversely, emerging market opportunities such as Vigor's pursuit of wave energy contracts would drastically impact land and labor need.

[18] Construction, manufacturing, wholesaling, and transportation and warehousing.

We acknowledge that any forecast into the future is inherently uncertain. The analysis below depends upon estimates of current variables that are uncertain and future conditions that are even more uncertain and have a wide range of outcomes. Like any analysis of future conditions, this section is built upon many layers of assumptions. Each assumption expands the range of potential outcomes, and each layer of assumptions compounds on the previous layer to provide an even greater range of potential results. The intent of this exercise is to use the information available within the resources of the project to assign an order of magnitude impact associated assumed future conditions. While actual results will vary, this exercise should prove useful in informing public policy and understanding the relative trade-offs of varying outcomes.

Factors Influencing Scenario Alternatives

In our research, we identified six factors that are likely to have the greatest insight into future conditions. There are likely others, but these factors are those with reasonable influence over our understanding of the trajectory of the harbor economy and have meaningful and accessible information.

Exhibited trends among harbor employers. In Appendix A, we presented an analysis of recent employment trends in the harbor. We observed relatively flat growth in the harbor as a whole. Production and wholesaling uses have been contributing negatively to employment, offset by gains in other sectors. A recent analysis by the City arrived at a similar conclusion, reporting negative employment growth on Harbor Access Lands since 2008.[19] Large employers have had an outmeasured impact on declines, with smaller firms posting stable growth trajectories. This condition softens the trend impacts on land need, as large employers are not likely to make significant changes to land utilization based on cyclical shifts in labor utilization. However, structural shifts in labor utilization or permanent reductions in operations increase the likelihood of disinvestment.

Trends and magnitude of investments. While the employment trajectory in the harbor has been in decline, manufacturing GDP is growing considerably and private investment has expanded in some areas. This reflects an ongoing trend of higher productivity and lower labor utilization. In recent years, the harbor has seen the development of over 1.6 million square feet of new space and the redevelopment/expansion of an additional 97,000 square feet. Major projects have been concentrated in distribution uses, with Amazon and FedEx both completing major hubs over the last five years. Interviews with local businesses and the Port indicated broad investment in capital and equipment. Geographically, increases in district valuation have been concentrated in close-in waterfront properties and in the Rivergate District around Terminals 4 and 5.

Structural industry trends/outlook. The general economic outlook for the Portland economy is healthy. The Oregon Employment Department's 10-year employment (2019-2029) forecast for

[19] Working analysis of 2008-2019 QCEW data as a part of the EOA update provided by the City of Portland Bureau of Planning and Sustainability.

the Tri-County area projects 1.1 percent average annual private-sector employment growth and the addition of over 100,000 jobs.[20] The manufacturing sector is expected to grow at a more measured 0.5 percent rate while adding 5,900 jobs. Our assessment of the subsectors in the harbor that utilize marine functions found stable future economic conditions in most cases. For example, production of paper products is expected to benefit from growth in packaging demand created by e-commerce growth, and industry groups cite that the near-term outlook for the metals recycling sector is exceptionally strong. Portland's base cargo forecast estimated a 70 percent expansion in cargo volume over the next 20 years, with 230 percent growth under the high forecast. If realized, this will positively impact the harbor's transportation support services, wholesaling and storage, and other downstream users secondarily connected to commodity logistics. Conversely, we heard of growing downside risks to transportation equipment, metals, and machinery producers. These sectors exhibit long-term employment declines, recent layoffs, and the closing of complete operational lines at several firms. While not imminent, the risk of complete disinvestment by a large employer has rarely been higher.

Needs and industry insights from interviewees. Private firms we interviewed were generally optimistic about their economic outlook. Activity at the Portland Shipyard and associated firms in the supply chain should expand over the forecast period. As discussed above, the majority of cargo shipped from Portland terminals arrives by rail. If cargo volumes expand at a rate projected in the base forecast or better, rail capacity upgrades will be a necessity. This would include internal upgrades such as longer sidings at existing terminals and new railyard capacity. The State has invested in an intermodal terminal in Millersburg, Oregon, that has alleviated some of this pressure according to rail representatives interviewed. There is a long-term downside risk to barge lines in Portland if the market for wheat arriving by barge shifts to other Lower Columbia markets. Downside risks to the metals recycling sector are supply-related. Recycled metals that ship in containers have seen additional risk in Portland as a result of changes in container service. Portland recyclers are having to ship product to Tacoma at additional cost.

With respect to land need, all the firms we interviewed indicated that their long-term intention is to accommodate growth through their existing land footprint, citing investments in capital and equipment to increase productivity and lower or maintain labor utilization. However, all firms also stated that if cost-competitive land adjacent to their existing facilities were available, they would take it down. We also identified examples of recent investments by firms in other markets that could have located in Portland. These factors indicate that stated intentions of growing on existing sites are possibly a function of supply constraints and not optimized preferences.

Range of policy actions by the City/State. Actions taken by the City to improve the competitiveness and business climate in Portland Harbor. Potential actions could include supporting the return of sites to productive industrial uses through economic development

[20] Oregon Employment Department. 2019-2029 Industry Employment Forecast for the Portland Tri-County Region. October 2020.

incentives or direct investment, policies to preserve industrial land from encroaching uses, or efforts to ease regulatory barriers for potential users.

Range of outcomes associated with the Superfund Cleanup. The Superfund Cleanup is perhaps the limiter on investment activity in the harbor today. We heard from PRPs that are withholding investment decisions due to uncertain liability. We heard that firms are investing in capital and equipment, not land and facilities. We heard that until liability certainty is resolved or there are mechanisms in place to mitigate liability risk, investment from new users is not likely to occur. The stigma associated with the project is limiting competitiveness, and projects that are occurring take longer and are more costly than they should be. In Appendix D, our team details a path forward for a return of investment in the harbor that includes 1) the completion of remedial design, 2) establishing the limits of liability for PRPs, and 3) deploying mechanisms like Prospective Purchaser Agreements to mitigate risk and facilitate investment. Unfortunately, the Superfund cleanup that has the greatest impact on the trajectory of the harbor also has the broadest range of outcomes. Even when liability is resolved, the project itself may impact operations in the harbor in unforeseen ways through the forecast period.

> "EPA has so far been reluctant or unwilling to issue PPAs, directing purchasers to rely instead on the liability protections of the Bone Fide Prospective Purchasers provision of the 2002 Brownfields Amendments to CERCLA. This has not been satisfactory for risk-averse purchasers."

Land Need Scenarios

Scenario 1: A Declining Industrial Harbor

This scenario reflects the observed trend of declining production employment in the harbor. Manufacturing employment in the harbor has declined by 7 percent over the last 15 years. Large-scale layoffs and recent closures/reductions among major employers are indicative of further downside risks. We assume one or more large employers cease operations in the harbor. This scenario also represents a condition where the City does not take proactive measures to preserve industrial land, resulting in conversion to other uses where that can outbid traditional industrial users for land—including Terminal 2 and the LD commodities site. Complications and uncertainty around the Superfund Cleanup persist and extend well into the forecast period—further disincentivizing investment beyond the intermediate term. Marine service users are more connected to cargo volumes and are likely to be more stable. This scenario results in a net reduction of marine-dependent industrial land need in the study area totaling 100 to 160 acres.

Scenario 2: Moderate Growth with Industrial Protection

This scenario reflects a condition where the structural factors currently negatively impacting the harbor's competitiveness are reconciled. The City proactively invests in policies that protect and maximize the utilization of industrial land. Existing production uses expand at a rate consistent with regional manufacturing forecasts. Large employers may have reductions in employment, but their business models remain sound and they continue to function on their existing sites

through investment in capital and densification. The Superfund Cleanup liability issues are improved within five years as remedial design is completed, bringing more certainty than exists today. In the latter half of the planning period, previously underutilized sites and brownfields become more marketable. This scenario results in a 10 to 15 percent increase in marine industrial land need consistent with rates of regional manufacturing growth and rates of "hypothetical need" reported by industry leaders. We calculate that this would equate to 215 to 325 acres of land to accommodate marine-dependent industrial users.

Scenario 3: A Revived Working Waterfront

This scenario reflects the most optimistic outlook for marine-dependent uses in the harbor. It assumes that cargo volumes exceed the base case forecast, resulting in positive influence over directly related production and service uses. Similarly, growth in manufacturing sectors exceed expectations. Local and state leaders are proactive in establishing mechanisms to overcome liability issues relating to the Superfund Cleanup earlier in the planning cycle. This results in a release of pent-up investment from new and existing firms. The City is aggressive in preserving and expanding industrial land supply in the harbor, including programs to incent brownfield remediation or other investments to improve the marketability of currently underutilized sites. The Port of Portland is successful in redeveloping the former Cargill property at Terminal 4, further contributing to the competitive supply of water-access sites. This scenario results in a 30 percent increase in marine-dependent industrial land need over current levels. This equates to roughly 650 acres of land demand.

Considerations for Rail

An additional land component to consider is the need to accommodate additional rail infrastructure. In Section 4 above and in Appendix B, we detail how a shift in railroad programming and operations is driving a need to accommodate longer unit trains and, by extension, longer sidings. Additional land need supported by demand for rail infrastructure can be organized into two areas: railyard expansion and on-site sidings/capacity.

Railyard Expansion

A railyard is a group of rail tracks used for storing, sorting, and repairing railcars and rail equipment. Examples in Portland include BNSF's Willbridge Yard and Union Pacific's Albina Yard. Railyards serve an essential function in facilitating throughput. The 2016 EOA identified a 200-acre potential increase in railyard demand systemwide. It did not specify where in the system railyard expansion would be appropriate. Estimates in the EOA were derived from projections of cargo tonnage growth at the time.

For this analysis, we are not estimating railyard expansion in Portland Harbor. Factors influencing this determination include:

Lower volume baseline. As reported in Section 6 and Appendix C, marine cargo volumes have fallen measurably over the last 10 years. This results in excess capacity relative to the baseline used in the previous EOA.

Interviews with railroads. In our interviews with representatives from BNSF and Union Pacific, we specifically asked if the railroads had major investments planned for expansion in Portland Harbor. Neither confirmed new railyard developments for Portland Harbor.

Recent investments elsewhere. It was also reported by one railroad representative that recent investments in the Millersburg railyard facility have alleviated some pressure in Portland Harbor.

On-Site Expansion

A rail siding functions to facilitate storing, loading, unloading, or allowing of other trains to pass. As previously noted, longer trains are putting pressure on existing infrastructure where sidings do not have enough capacity for some train lengths that run today. This dynamic will put pressure on sites that utilize rail infrastructure to improve, enhance, or expand. Rail infrastructure is inherently land consumptive, leading to a need to expand footprints or further densify uses on existing sites. The calculated land need to expand on-site rail is highly variable and dependent on a range of factors that include:

- Existing length/capacity
- Required capacity gain
- Use
- Topography
- Site orientation
- Number of turnouts
- Crossings
- Other factors

It would be beyond the scope of this analysis to make a reasonable estimate of future land need that varies on such a case-by-case basis. We highlight this source of potential land need here to demonstrate that nongrowth factors can have a meaningful impact on overall land need.

8. Opportunity Costs of Land Need Outcomes

Economic Impacts

As discussed above, the ultimate economic trajectory of the Portland Harbor economy will be, at least in part, a function of local and state policy. As the City plans on how it intends to accommodate economic pressure in the harbor, it should do so in the context of the trade-offs associated with different outcomes. In "An Assessment of the Economic Function of the Marine Industry on the Regional Economy," we document existing research exploring the importance of the harbor economy. In this report, we organize the harbor economy into two interrelated divisions. The first is marine cargo handling/terminals; the movement of goods by a marine vessel for external trade (import or export) or internal transport. The second is production and services.

Marine Cargo Terminal Impacts

Relative to the size of the total production impact of a commodity, the locally captured share of economic activity at an originating or terminating port is comparatively small. For exports, the impacts associated with the purchase and operation of equipment, labor, processing, and transport of a commodity to Portland are realized outside of the region. The productive value of the good is also captured elsewhere. Import impacts can be more pronounced to the extent that imported goods are used in local production functions (steel, construction materials, equipment). While small as a percentage of total impact, locally retained impacts are not trivial. The local maritime industry employs thousands of workers directly and includes facilities and equipment valued in the hundreds of millions of dollars. A 2016 study by Martin Associates found that the total economic impact of the Port of Portland's maritime activities alone had a multiplier effect of 1.6, meaning for every job, an additional 1.6 jobs are created elsewhere in the economy. The Port's activity accounts for 7,133 local jobs and $629 million in personal income.

Production and Service

In addition to local labor utilization, production and service uses can have much higher multipliers and economic impacts to the extent that production inputs are locally sourced. A 2013 study by the Portland Business Alliance found that marine industrial businesses in Portland spend between $6 and $7 billion annually. The same study found the total economic impact from all marine industrial users in Portland to be between 14,000 and 18,000 jobs.

Opportunity Cost

To the extent that a decline in industrial activity is replaced by other high-intensity uses, the "foregone" direct economic impacts of lower industrial land utilization may be mitigated to some degree. However, unrealized marine industrial demand has a true economic opportunity cost. It is difficult to quantity the magnitude of this impact. Reconciling site-specific QCEW data with known user sites, we observed a high degree of variance in employment density. This data will not accurately capture labor that is "recorded" off-site that includes rail workers, longshoreman, boat pilots, and truck drivers. Assuming a *very* conservative five employees per gross acre, the direct opportunity cost of the moderate growth scenario would be between 1,075 and 1,625 jobs.

The harbor further plays a vital economic development role that extends well beyond the city. Regional traded-sector firms rely on efficient and cost-competitive options for the receipt of inputs in their supply chains and delivery of their products to customers. An erosion of this function reduces Portland's attractiveness to traded-sector users that, in turn, further deteriorates economic productivity in the harbor and elsewhere in the region. This risk appeared in our analysis of the literature and in our interviews. The risk is considerable. Traded-sector industries account for 25 percent of regional Gross Domestic Product (GDP).

Regional Substitution

Our analysis of competitive marine industrial areas along the Lower Columbia took inventory of land assets available to accommodate future demand. We found alternative areas have both short and long-term assets to respond to regional market demand. While it is beyond the scope of this project to estimate existing excess capacity at competing port areas, we can assume that some share of unmet demand locally for grain and auto commodities could be met by existing excess capacity in competing markets. All Lower Columbia ports with the exception of Port Westward have existing grain facilities where marginal increases in capacity (or filling of excess capacity) could continue to capture market share. However, these ports have historically been less competitive in barged wheat that Portland specializes in. In the auto market, Kalama and Port Westward are not likely to be players anytime soon. Kalama lacks land and Port Westward lacks suitable rail infrastructure. Vancouver would be most likely to accommodate Portland's unmet need.

Over the second half of the planning cycle (10 to 20 years out), the collective Lower Columbia region will become increasingly competitive from a land perspective with Longview's Barlow Point, Vancouver's Columbia Gateway, Columbia County's Port Westward, and potentially Woodland's Austin Point coming closer to reality. However, land availability is not the only factor in location decisions. The extent to which unmet demand in Portland remains in the regional economy will vary broadly by industry and/or commodity type. For example, alternative locations are well positioned to respond to market changes in the grain market but not the container market. This has already been observed in a shift in grain export market share

away from Portland, but no other port has planned to accommodate container flows. Vancouver's Terminal 5 and Kalama's North Port have the best ability to accommodate unmet dry bulk or breakbulk demand.[21,22] Exhibit 12 presents Portland's estimated cargo market share over the planning period alongside our assessment of port areas best positioned to capture unmet demand by cargo type.

Exhibit 12: Portland Market Share and Potential for other Markets to Meet Demand
Source: ECONorthwest, Market Share from BST Associates

Commodity Type	Portland Market Share[A]	Potential to Meet Demand			
		Vancouver	Longview	Kalama	Port West.
Autos	70%	X			
Containers	N/A				
Breakbulk	27	X	X		
Grain	20%	X	X	X	
Dry Bulk	74%	X	X		
Liquid Bulk	66%	X	X	X	X
A = Base case forecast scenario from 2020 Marine Cargo Forecast					

We foresee less substitutability for nonterminal production and service uses. These industries have a greater reliance on other factors such as a skilled-labor pool, agglomeration of related firms, and reliance on key anchors. For example, firms downstream from activity at the Portland Shipyard want to be in proximity to the Portland Shipyard. To some extent, Vancouver would have the ability to accept some of Portland's unmet demand and still draw from local assets. We saw this in Vigor's purchase of the Christensen Facility. However, in most instances, the decision is Portland or elsewhere. This was reflected in our interviews with Lower Columbia port districts that stated that they have generally not seen firms cross-shopping between them or Portland.

Social Impacts

Acceptance of lower industrial activity in the harbor may also have broader social equity trade-offs. In "Race and Educational Equity in Harbor-Dependent Sectors of the Portland Economy," we found that, on average, industries in Portland Harbor serve to moderate racial income disparities by providing lower-educated and BIPOC workers greater upward mobility, housing stability, and achievable income than other sectors of the economy.[23] Our research in Appendix F found that nonwhite racial and ethnic groups comprise 22.5 percent of the workforce in harbor-related sectors. Calculating labor utilization across land demand scenarios,[24] the differential between the low and high land need scenario could cost access to 725 to 910 high-mobility jobs for nonwhite workers.

[21] North Port is currently being planned for a methanol production and export facility. It was denied environmental approval in January 2021. For more on this property and potential alternatives, see Appendix C.

[22] Marine Cargo forecasts are not currently estimating excess demand for these commodities.

[23] This analysis relied on data where some sample sizes may be small and lead to large statistical margins of error. The technical analysis in Appendix F documents this methodology and estimated margins of error for reported findings.

[24] Calculation assumes an average marine-dependent industrial employment density of four to five employees per gross acre.

Appendices