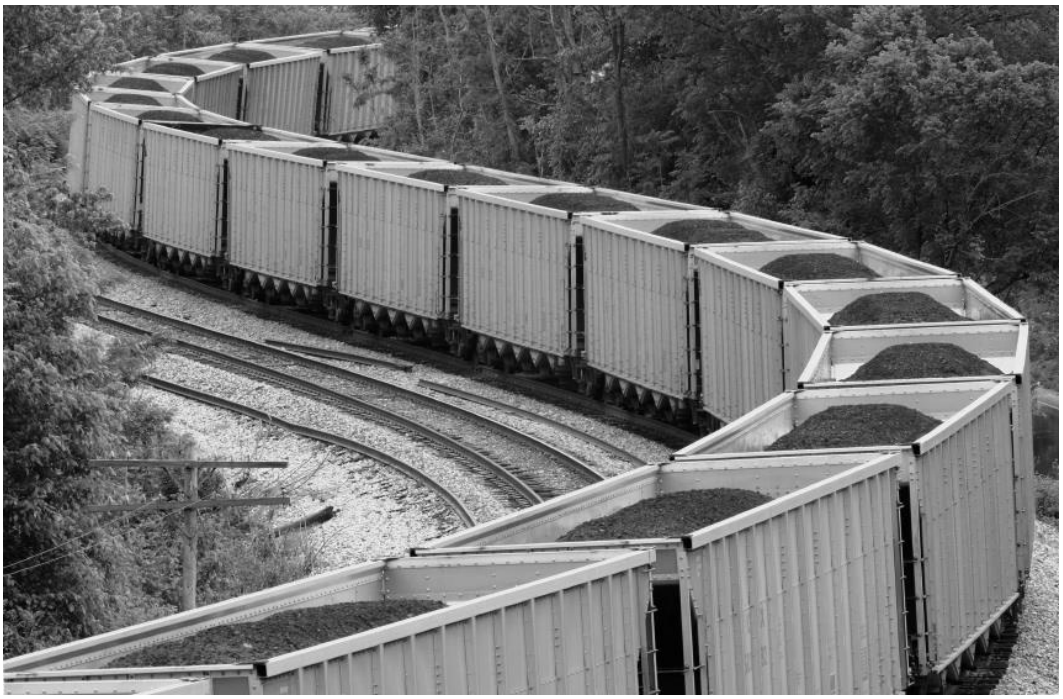
City of Seattle

Economic Analysis of Proposed Coal Train Operations



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PREFACE

Scientific evidence demonstrates that the burning of coal results in local air pollution and climate change worldwide through the effects of greenhouse gasses. Regardless of where coal burns, pollutants will be distributed globally through the atmosphere, including mercury, sulfur compounds, and smog-forming compounds. This pollution will burden public health and cost regional economies. Some regional economies will capitalize on economic opportunities to address environmental impacts, but on net the environmental and economic impacts of global warming will be dramatic if not curbed.

These important issues are not the subject or scope of this report, and therefore are not explored further. This study focuses on the potential economic impacts of coal train operations associated with the proposed Gateway Pacific Terminal in Whatcom County within Seattle. The study acknowledges regional and global considerations, including direct economic impacts and environmental and health externalities. Complete exploration of the externalities are beyond the scope of this study to quantify and express monetarily. Many direct impacts are the focus of rigorous quantitative and qualitative analysis on economic impacts for people, businesses and stakeholders within Seattle city limits.

The analysis demonstrates that the potential benefits are relatively few and low to Seattle, as would be expected given the pass-through nature of coal trains in Seattle. Some benefits are tangible and others are more speculative in nature. The direct costs of traffic impacts are tangible. The neighborhood level environmental and economic costs are also real and tangible, but more scientific work and economics studies are necessary to understand them better, and many of those may be speculative in nature, as well.

The cases to obstruct or accept coal trains passing through Seattle are not fully addressed in this report, either. Rather, this report provides an objective representation of stakeholders' perspectives, among those stakeholders scoped for interviews and research, and whose perspectives Seattle leaders requested to capture in this study. This includes local stakeholders leading efforts to build the coal terminal and facilitate transport of coal, as well as opposition leaders.

The result is much content for Seattle environmental and industrial leaders to consider, leverage or dispute, all designed to aid in an understanding of project related impacts in Seattle.

EXECUTIVE SUMMARY

Overview of Project

Once completed, the proposed Gateway Pacific Terminal in Whatcom County would be the final U.S. destination of coal mined from the Powder River Basin in northeastern Wyoming and southern Montana en route for consumption in China. **Exhibit 1** outlines the flow of coal train operations, from source to destination, with intermediary costs and benefits identified along the way.

The first phase of the project would allow for up to 25 metric tons (Mt) of coal, with capacity for an additional 23 Mt coal and 6 Mt of other dry bulk commodities as part of Phase II. Phase I was originally slated for completion in 2015, but more likely would be 2018 or later due to an extended review and permitting process.

With full build-out, up to 18 trains would travel to and from the Gateway Pacific Terminal (GPT) in Cherry Point each day (round trips of eight coal trains and one other dry bulk load). GPT-destined coal trains would be loaded in Wyoming, travel through Spokane, then head south through Pasco and along the Washington side of the Columbia River Gorge before heading north along the I-5 corridor, passing through Seattle. Empty cars heading back to the Powder River Basin or other eastern sites would either follow the same route, or head east at Everett and return by way of Stevens Pass.

Coal trains are expected to be 7,000 feet (about 1.3 miles) in length during Phase I of terminal operations. After completion of Phase II, the trains are anticipated to be 8,500 feet (1.6 miles) in length. There are eight at-grade crossings in Seattle that would be affected by more trains—Lander, Holgate, Horton, and Spokane in the SODO District, and Broad, Vine, Wall, and Clay in the North Waterfront.

Currently, approximately 30 freight trains travel each day to or through the North Waterfront district of Seattle and between 65 and 80 freight trains through the SODO district.

Some of these trains are long-haul trains 8,300 in feet length (about 150 cars), roughly equal in length to coal trains (Seattle Department of Transportation, 2012). At present, two or three coal trains per day (it varies by day) pass through Seattle heading north to the Westshore Terminal in Delta, BC.

Exhibit E-1. Coal Export Supply Chain Operations, with Intermediary Costs and Benefits

Supply Chain Activities	Geography of Impact(s)	Benefits L = Potential Large Impact M = Potential Medium Impact	Costs S = Potential Small Impact NC = Not Clear	Notes
Mining rights leased by federal government (Bureau of Land Management) to Peabody Energy	Powder River Basin	Lease revenues to federal government (M).	Use of natural resources, local environmental damages (NC).	Asset mining may occur regardless of this transaction.
Coal sold by Peabody and Cloud Peak to China	Coal company HQ and offices throughout the U.S; Wyoming mining areas.	Revenues to Peabody and Cloud Peak Energy (L); Mining and related jobs (M).		
BNSF ships coal to Cherry Point	Spread across BNSF corporation.	Revenues for rail industry (L).		EPA requesting coal transportation be included in Gateway Pacific Terminal EIS.
	Spokane		Traffic in Spokane (M-L); Coal dust (NC)	
Trains come through Seattle (some diverted)	Seattle		Congestion. Between $384,000 and $455,000 per year in travel cost burden. Fire Department mitigation strategies (M-L). Decline in property values along/near tracks due to noise, vibrations, and delays (M). Hospitality businesses near tracks see reduction in business (M-L). Coal dust (NC).	Capacity taken up on tracks. Some see this as helping to move forward capacity investments that are considered beneficial to the Port. Traffic impacts a concern and quantifiable. Insufficient information (for now) on extent of coal dust emissions and health impacts.
Gateway Pacific Terminal, owned by SSA	Seattle	Revenues to SSA. Some jobs and revenues in Seattle (S).		
	Whatcom County terminal site and regional economy.	Direct and multiplier impacts (e.g., jobs, revenues, labor income) (L).	Congestion, potential diverted investments (M).	
Coal used in Asia	China, World	Cheaper prices for Chinese energy users.	More coal burnt than otherwise, increase in GHG emissions (L).	Shippers' health important to Seattle Port

Stakeholder Concerns

The study included interviews of a broad range of stakeholders, including local businesses involved in the coal train planning, industrial businesses affected by increased train activity and local organizations opposing the coal trains. Many of these groups have funded or conducted their own studies of the anticipated impacts.

Potential benefits identified by this study include revenues and jobs created by increased train traffic and terminal operations by Seattle-based SSA Marine and local operations of BNSF Railroads. Port of Seattle and BNSF both speculate that the increased train demand could support improvements and expansion of local rail corridor infrastructure. The improvements were discussed by Port and BNSF representatives, and not drawn from funded plans or programs.

Concerns raised about the coal train's impacts to Seattle included the following perspectives:

- Coal, including concerns about the environmental impacts of mining, transporting, and burning coal
- Increased train traffic in Seattle, including impacts to roadway congestion due to traffic delays at at-grade intersections
- Capacity of railroad tracks and facilities in Seattle and throughout regional corridors
- Noise impacts on business
- The loss of parking along the North Waterfront due to seawall reconstruction and waterfront redesign, and
- The economic cost of these impacts on Seattle businesses and residents.

Additional perspectives germane to the analysis include opposite beliefs about the following two concerns:

- Whether the coal trains will travel through Seattle regardless of whether the Cherry Point facility is built
- Whether the project is of significant impact on global coal mining and demand for coal for energy.

Findings

The following sections list impacts identified due to an increase in coal trains, including benefits and costs. The anticipated benefits to Seattle consist of jobs at SSA Marine and increased revenues for BNSF. Indirect benefits include speculation that the increased train traffic and revenues could lead to

infrastructure improvements. Immediate, direct costs are primarily associated with more trains, which are longer and heavier than most trains passing through the city. These impacts include disruption to business activity, delay costs borne by drivers at surface crossing intersections, and associated mitigation.

Direct Benefits

- **Jobs and Revenues.** SSA Marine, the operator of the proposed Gateway Pacific Terminal, is an employer headquartered in Seattle, with approximately 400 FTEs in Seattle. SSA foresees growth in revenues, full time jobs, and expenditures captured within Seattle (both within SSA Marine and contracted companies) resulting from the project. SSA Marine anticipates the construction phase of the project would include up to $28 million in project expenditures on permitting, engineering, legal, and public relations-related activities, of which a large share would go to firms based in the Seattle metropolitan area. SSA Marine expects to hire 12 full-time employees (FTEs) to manage the project, with estimated total reimbursements of around $2.4 million per year. During construction, these FTEs would be in Seattle, though after construction seven positions would be relocated to Whatcom County.

- **Infrastructure improvements**. BNSF and the Port of Seattle officials suggest increased demand for the rail corridor could lead to investment in Seattle rail infrastructure. BNSF reports that they would make capital investments when the rail system nears full capacity. The Port of Seattle representatives report that such capacity investments ("triple-tracking" and additional sidings within Seattle) could make the Port more attractive and competitive. BNSF does not report displacement of transport of any other goods due to more coal cargo.

Direct Costs and Negative Impacts

- **Traffic interruptions and delays.** During Phase I of the build out, the Seattle Department of Transportation (2012) has estimated additional daily crossing gate down times of between 31 and 83 minutes. By 2026, daily crossing gate down times could increase to between 67 and 183 minutes, including a 39% to 108% increase at Broad Street (the most affected crossing).

  BNSF reports that 18 trains per day, train volumes would be only slightly above 2006 levels, and one possible scenario indicates as few as only 9 trains per day could pass through the city.

The quantifiable economic impact from anticipated congestion induced through more trains is between $384,000 and $455,000 per year (in 2013 dollars) borne by drivers and their employers. Delays in the North Waterfront aggravate tourism and recreation businesses, which rely on families and vehicle-based customers.

Congestion analyzed includes intersections affected by the proposed new sports arena; other studies underway will address the economic and transportation impacts of the arena.

- **Disruption of business**. Noise and vibrations from trains hurt many businesses, and the hospitality business in particular. Noise and vibrations are of greater magnitude with the coal trains because the coal trains are longer and heavier trains than most other trains. Hotel guests (individuals, families, and corporate clients) have reported to hotel management that they are bothered by train noise at night and the inconvenience of crossing delays, and have cited these issues as reasons for not returning.

- **Property values**. Recent estimates of property value diminutions from an increase in coal trains imply potential losses of between $270 and $475 million among commercial, residential, and industrial parcels within 600 feet of the BNSF mainline citywide. Potential losses in property value include up to $282.3 million in residential, $133 million in commercial, and $59.4 million in industrial properties. Demand would shift elsewhere within regional markets, theoretically increasing values elsewhere offsetting losses along the corridor.

Impacts to the City of Seattle

- The Seattle Fire Department may need to invest up to $150,000 in a new dispatching system to negotiate increased surface traffic. Other options include relocating the number 14 station in SODO to the west side of main line, or building an east-west bypass at Lander Street (projected to cost at least $100 million). A relocation of the number 14 station would cost approximately $9.5 million (plus the cost of land).

Environmental and Health Concerns

- **General impacts.** Environmental impacts associated with coal extraction and burning are recognized as an economic cost. Greenhouse gas emissions are known to affect the entire planet, regardless of the point of dissemination.

- **Coal dust**. No comprehensive report exists to demonstrate the extent of coal dust emissions along the proposed BNSF line. The EPA has not done a comprehensive analysis of the non-occupational health impacts of coal dust, but is calling for a review in the environmental impact study (EIS) for the proposed terminal in Cherry Point. Studies focus on coal dust emitted at and near the mines and at and near the terminal, as referenced in the body of this report. Research efforts during the course of this study found no scientific research on coal dust emissions during the middle segment of the transport phase between the mine and terminal. The EPA has requested such an analysis in the scoping comments for the Gateway Pacific Terminal environmental impact study.

  BNSF reports that they are committed to preventing coal dust emissions, and has already imposed strict rules to this end. BNSF reports a financial incentive to prevent coal dust emissions; dust can damage tracks and increase the risk of a derailment.

  BNSF charges a tariff to cover costs of treating coal dust with chemical sprays to mitigate dust. However, other industry stakeholders have challenged the tariffs, in part due to their skepticism of the efficacy of BNSF's efforts. The challenges also question the legitimacy of BNSF's stated goals for reducing coal dust. A recent lawsuit by the Sierra Club charging BNSF with dust emissions reflects growing concerns over coal dust.

- **Diesel exhaust.** The proposed coal trains, like all diesel locomotive trains, emit diesel exhaust, which has adverse health impacts for people exposed.

Impacts on operations and employment at the Port of Seattle

- The Port does not anticipate any direct increase in employment due to coal trains. Representatives of the Port expect that existing and soon-to-be-complete projects will mitigate the impacts of coal train-induced congestion on Port operations. The City of Seattle recently completed the South Street Spokane project, which includes a new connection to First Avenue South from the Spokane Street viaduct and Interstate 5, bypassing the BNSF mainline and providing direct access to Port areas from the freeway system. In addition, the Port contributed $300 million to the SR99 replacement project, which includes the construction of an overpass over the BNSF tail tracks near East Marginal Way South; this overpass is expected to be operational by the end of 2013.

- The largest segment of truck freight operates between port terminals and the two rail yards, to the west of the mainline. A smaller percentage services the Duwamish industrial region trans-loading operations, and thus could experience longer delays, but also has access to the Spokane Street Viaduct.

Additional Considerations

- Statewide, the project at Cherry Point could include 6 million metric tons per year of unspecified dry bulk commodity shipments and the use of cape-sized vessels. SSA Marine expects this capacity will reduce shipping costs for Washington-based dry bulk commodity shippers.

- Research on global demand for coal suggests the proposed increase in exporting capacity may help lower world prices for coal and thus delay China's transition away from this energy source, worsening pollution and associated impacts.

- Trains hauling empty cars from Cherry Point could potentially pass through either Stevens Pass or through Seattle, per interviews with the Washington State Department of Transportation, the Port of Seattle, BNSF, and two state reports on rail capacity.

- BNSF is ultimately the only party to have full knowledge of rail capacity along its rail lines, including through the Stevens Pass corridor.

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INTRODUCTION

Background and Purpose

The Gateway Pacific Terminal is a proposed coal export facility to be located at Cherry Point in Whatcom County. The coal shipped through the terminal will be mined from the Powder River Basin in Wyoming and Montana and hauled to Cherry Point by train, along BNSF rail lines. The Washington line of the proposed train route extends from Spokane, down the Columbia River Gorge, and along the Pacific Coast from Longview to Ferndale. The proposal calls for 10 daily trains in 2015, with up to 18 daily trains by 2026.

In support of Port of Seattle activities, port-related businesses, manufacturing and maritime businesses, and other Seattle businesses that may be impacted by increased coal train operations the Office of Economic Development issued an RFP seeking analysis of the potential economic impacts of the proposed coal train operations in the City of Seattle, with a particular focus on Seattle's North Waterfront and Duwamish Manufacturing and Industrial Center.

The findings of this economic impact analysis will inform City of Seattle policymakers, interested stakeholders, and the general public of the potential range and magnitude of economic impacts from the proposed coal terminal and associated train operations to Seattle. This report covers the following analysis:

- Impacts on operations, employment, and sales for business along the proposed coal train route, including the Duwamish industrial and North Waterfront districts and operations at the Port of Seattle;
- Assessment of what increased demand of Seattle's rail facilities means for remaining capacity; and
- Exploration of additional infrastructure improvements or policy measures required to support coal train operations and/or mitigate coal train impacts.

Methods

The approach to this work leveraged available quantitative sources and modeled estimates of traffic congestion induced by an increase in coal trains, combined with interviews with key stakeholders.

To estimate a range of impacts in dollars associated narrowly with congestion, the report utilized estimates of congestion modeled in a previous study commissioned by the City of Seattle for three crossings and select estimates for value of travel time (VOTT, discussed further below).

To better understand and assess the diverse range of possible impacts, a pool of stakeholders representing the Port of Seattle, City of Seattle Department of Transportation, City of Seattle Fire Department, BNSF, SSA Marine, and local businesses and associations in the two primary affected areas were interviewed. See **Appendix C** for the full list of stakeholders interviewed. Questions focused on the perceived/anticipated impact additional rail traffic and resulting crossing delays would have on retail vehicle and foot traffic, supply chains and distribution, employee commuting, and the expected benefits and costs associated with more coal trains passing through Seattle. See **Appendix D** for a list of sample interview questions.

The analysis also incorporated existing related transportation and economic analyses.

Outline of Report

The report is organized as follows:

- **Global Project Context.** Background on coal trains, supply chain economics including review of proposed new terminal at Cherry Point in Whatcom County, potential new train traffic, and economic participants and stakeholders.
- **Current Conditions in Seattle.** Current conditions, including literature review of impacts of congestion on economic development, increased train traffic through urban areas, and estimations of travel time value based on previous studies.
- **Proposed Project Activity.** Detailed description of coal train operations and their interaction with Seattle.
- **Regional Economic Impacts.** Conceptual discussion of economic impacts expected along the entire rail corridor.
- **Seattle Impacts.** Focused analysis on direct economic impacts expected for local residents, businesses and stakeholders.
- **Next Steps.** Additional context for future analysis.
- **Appendices.** Collection of supporting analysis and exhibits.

GLOBAL PROJECT CONTEXT

Asian Demand

Asia is the primary source of demand for coal shipped out of the Northwest, though estimates of future demand vary. A recent report commissioned by Peabody Energy estimates that global demand for coal will grow from 7.9 billion tons in 2012 to 8.9 billion tons in 2016, with most of this increase (700 million tons, or 70% of total demand increase) coming from China (Galuszka, 2012).

China has emerged as the world's largest producer and consumer of coal, accounting for more than 45% of both global totals. In 2011, China consumed 3.8 billion tons of coal, equivalent to 47% of global coal consumption. China's annual increase of 9% in 2011 constituted 87% of the 374 million ton global increase in coal use; between 2000 and 2011, China accounted for 82% of global coal demand growth (U.S. Energy Information Administration, 2013). In 2011, China imported 190 metric tons (Mt) of coal, of which 146 Mt was used for steam (i.e. power) generation, with another 38 Mt for coking (removing impurities from coal for a more potent fuel). China's overall 2011 coal production was 2,831 Mt for steam purposes, and 504 Mt for coking (World Coal Association, 2012).

Contributing factors to Asia's external demand for coal include China's rapid industrialization, a decline in U.S. demand for coal (due to a surge in natural gas and to a lesser extent growth in renewable alternatives)—resulting in cheaper prices—and a slowdown in demand for nuclear as an alternative fuel source following the Fukushima disaster in Japan. China's demand for coal is for thermal coal used in power plants and for coking coal as a heating source in blast furnaces (Galuszka, 2012).

The International Energy Agency's (IEA) base scenario projects China's coal consumption to account for more than 50% of global demand by 2014 and increase by 638 metric tons between 2011 and 2017, followed by India. Even with a likely economic slowdown (relative to annual real GDP growth of 10%), China is expected to continue to consume high levels of energy inputs—primarily coal—well into the future. In IEA's China slowdown scenario, China's demand would grow 2% per year through 2017 (International Energy Agency, 2012).

Analysis by Deutsch Bank is more pessimistic on future demand. The report projects thermal coal could be 18% lower than forecasted levels for 2015, factoring in China's continued efforts to reduce air pollution to safer levels. According to the report, even if China takes no action to curb air pollution, coal imports will still decline by 15 million tons between 2013 and 2015 (Bockmann, 2013).

Asian Demand for Powder River Basin Coal

A recent report by the non-profit organization Sightline Institute reflects concerns on future Powder River Basin coal demand. The report highlights potential uncertainties in Asian energy markets and competition from within the Pacific Rim to satisfy demand (primarily Indonesia and Australia, and to a lesser extent Russia and smaller players). For instance, Australia's export centers are "roughly a thousand nautical miles, or 20 percent, closer to China's big eastern ports—and they have an even greater location advantage for Indian markets" (de Place & Kriese, 2012, p. 3). The report cites evidence of a Chinese slowdown and economic rebalancing away from more energy-intensive manufacturing, along with the country's existing deep reserves of coal, as factors that may undermine future demand. If China continues to depend on coal at current levels, the government has the option of building plants closer to the mines and building out a sophisticated—and needed—comprehensive grid network to help mitigate the lack of sufficient infrastructure connecting coal deposits (mostly in the north and northwest) to demand centers along the coast.

Despite these concerns, some point to the inevitably of coal, at least in the short- and medium-term. SSA Marine and Ambre Energy (owner of the proposed Longview-based Millennium Bulk Terminal) both clearly believe in the strong future demand for PRB coal from China, as evidence by their willingness to invest in these new, costly facilities.

Power (2012) argues that Chinese coal demand is largely a function of price, and the increase in coal exports with the completion of the proposed terminals will be large enough to push down global prices, "[reducing] the incentives to retire older, inefficient, coal-using production processes [and reducing] justification for additional investments in the energy efficiency of new and existing coal-using enterprises" (p. 14). The author points to previous research showing China's coal consumption is relatively elastic (i.e., an increase in coal prices is offset by an equal or greater offsetting decrease in consumption), and that the proposed terminals will only further increase burning of coal in China with a far less offsetting decline in the U.S. and other OECD economies.

CURRENT CONDITIONS IN SEATTLE

Current Rail and Coal Train activity

In keeping with general railroad practice and federal prohibitions, BNSF Railway does not normally release train volume statistics for individual line segments. But the company has argued that number of freight trains running on main lines through Seattle is approximately 20 percent lower in 2013 than in 2006. According to BNSF, after the full build-out of the Gateway Pacific Project (assuming 9 loaded and 9 empty trains, with all of these trains passing through Seattle), train volumes through Seattle would be modestly above 2006 levels. BNSF emphasized that potential Seattle rail traffic estimates would be reduced further if some of the empty trains returned via the BNSF Stevens Pass route, avoiding Seattle on their way east, or if an operating Gateway Pacific export facility diverted some of the volume currently moving north to British Columbia.

BNSF emphasizes that the largest increase in Seattle train volume traffic over the last decade has come from the growth of passenger rail service. Currently between two and three fully loaded coal trains pass through Seattle each day en route to the Westshore Terminal in Delta, BC.

An important consideration in estimating the economic costs of an increase in coal trains is whether empty trains en route back east will travel through Seattle or over Stevens Pass. The answer to this question has important implications for estimates of train traffic-induced surface congestion, property values, and other impacts within the City. The Seattle Department of Transportation estimated additional delay times in its Coal Train Traffic Impact Study (2012). The report assumed that empty cars will return east via Seattle. Seattle cost burdens associated with delays calculated in this study are based on these prior delay estimates.

The extent that the eastbound route for empty rail cars returning from Cherry Point will pass through Seattle is inconclusive, due to the high level of uncertainty and unknowns. For instance, a 2006 Washington State Transportation Commission study of rail capacity found that the Stevens Pass rail corridor had already reached 123% of practical capacity[1] and projected overcapacity to persist through 2025 (Washington State Transportation Commission, 2006). However, a more recent report by the Washington State Department of Transportation (2009) estimated Stevens Pass to be at 70% of practical capacity. Moreover, estimates of future stress on the corridor are scenario-contingent, e.g., whether or

[1] According to the 2006 report, "practical capacity" is approximately one-half of theoretical capacity, which is subject to an array of human, infrastructure, and other factors. For a more detailed discussion of the report's definition, see (Washington State Transportation Commission, 2006).

not the tunnel height at Stampede Pass is expanded to allow for double-stacking of containers. Estimates between these reports may vary because different methodologies were employed for measuring practical capacity and forecast marine cargo flow. Differences may also be attributable to improvements made by BNSF since the 2006 report. Based on interviews with the Washington State Department of Transportation and the Port of Seattle, capacity improvements have included improved exhaust ventilation in the Cascade Tunnel, allowing for a reduction in the time intervals between trains passing through, and additional sidings along the corridor (Washington State Department of Transportation, 2013; Port of Seattle, 2013).

According to the Washington Public Ports Association's (2011) most recent marine cargo forecast, BNSF has indicated plans (at least as of 2011) to divert empty bulk trains through Stampede Pass. Trains directed through Stampede Pass would be those "generated on the BNSF system from Kalama north, thereby relieving the BNSF Columbia Gorge route of eastbound empty bulk trains, except for those originating in Portland and Vancouver" (p. 37). BNSF has stated in that the empty cars will most likely go over Stevens Pass.

Duwamish MIC and North Waterfront Employment

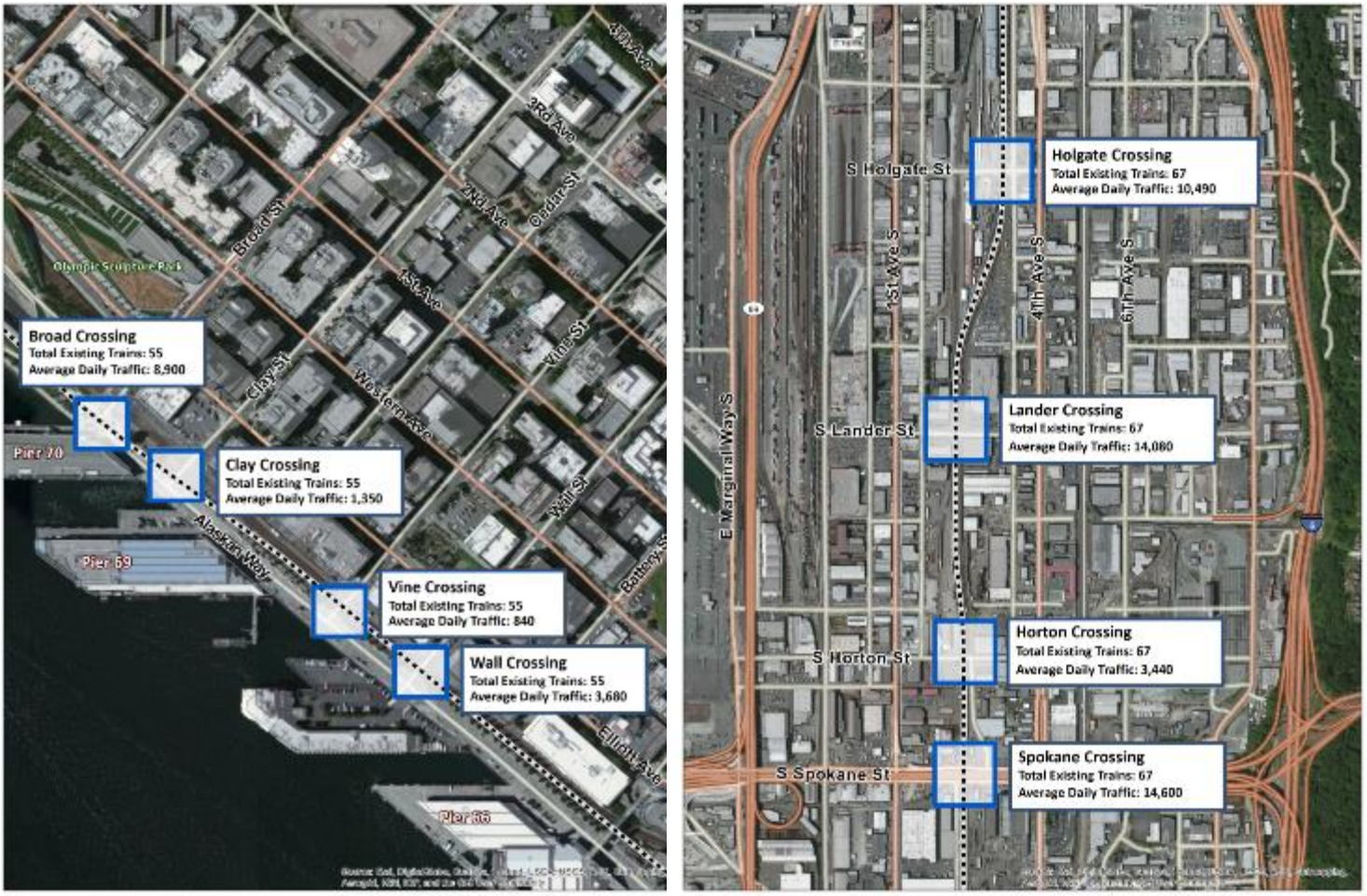
The two primary areas directly affected by increased congestion due to coal trains are the North Waterfront and Duwamish MIC, or SODO areas (SODO being a smaller area within the Duwamish MIC), each with four surface crossings. In the North Waterfront region, crossings are located at Wall Street, Broad Street, Clay Street, and Vine Street; in SODO, affected crossings are South Holgate Street, South Lander Street, South Horton Street, and South Spokane Street. **Exhibit 1** maps these intersections and current traffic flow estimates.

The SODO district, which includes census tracts 93 and 99, has a larger employment base than the North Waterfront area (census tracts 80.01 and 80.02), with nearly 44,000 covered workers in 2011 (compared to less than 17,000 in the North Waterfront). In 2011 SODO had a warehousing, transportation, and utilities employment base of almost 8,500 workers, owing to the large concentration of seaport terminals. The Port of Seattle's major intermodal container terminals are located in SODO (terminals 5, 18, 46, and to a lesser extent 30), along with BNSF's Seattle International Gateway rail yard and the Union Pacific Argo rail yard (at the far southern end). Between 2005 and 2011, the North Waterfront saw an increase in covered employment of 2,575, largely due to services, compared with a net decline of 1,977 in SODO (see **Exhibits 2 and 3**). In 2012, SODO was home to an estimated 254 street level businesses, including 86 retail businesses and 141 services establishments (Metropolitan Improvement District, 2012).

Exhibit 1. Affected Intersections in the North Waterfront and SODO

(a) North Waterfront

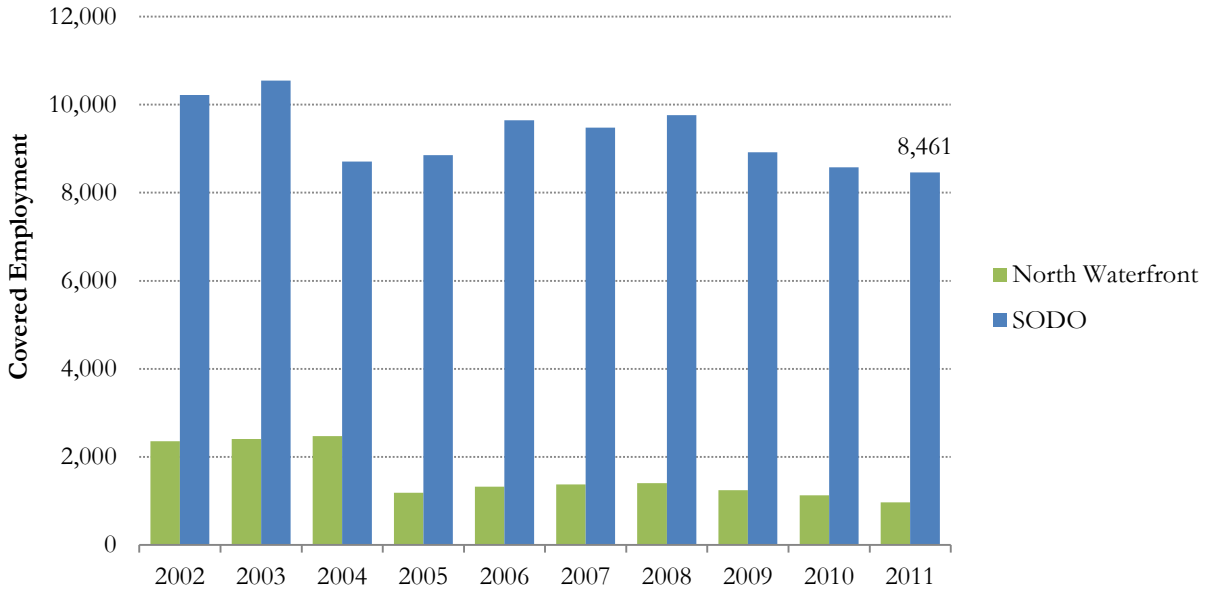
(b) SODO



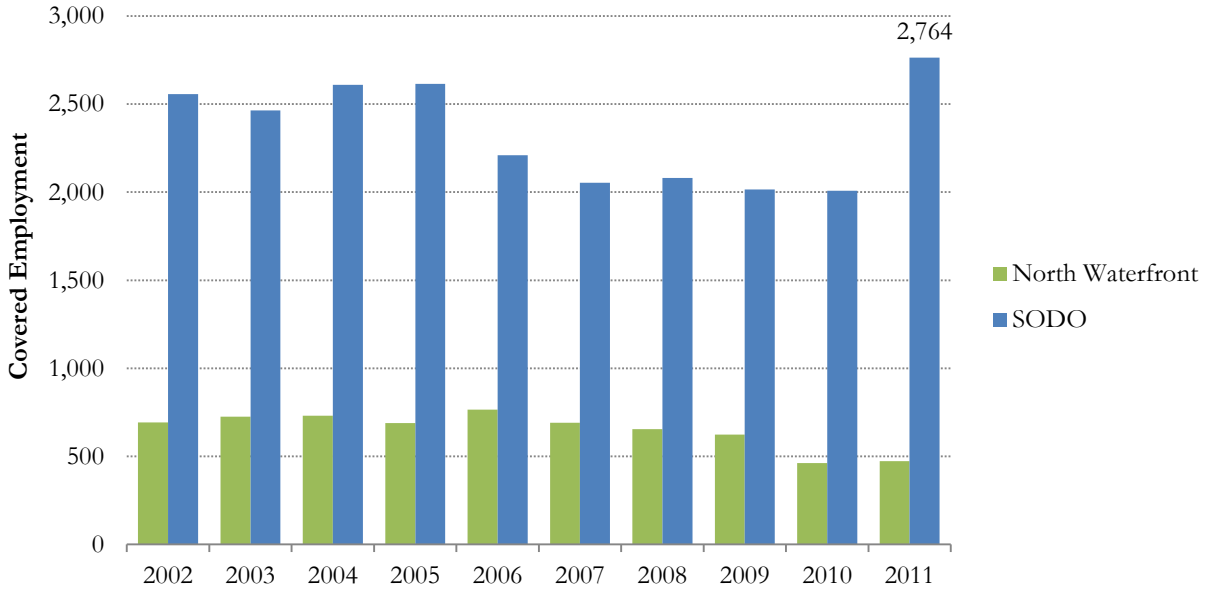
Source: Community Attributes Inc.; Seattle Department of Transportation (2012).

Exhibit 2. Employment in Affected Areas, 2002 - 2011

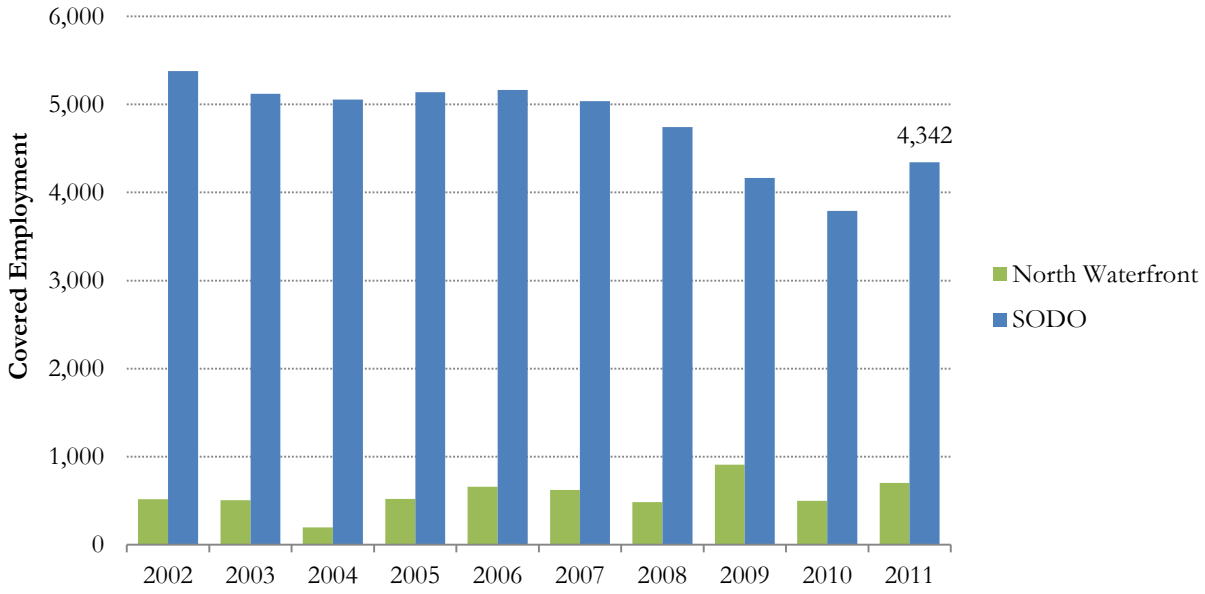
A. Warehousing, Transportation, and Utilities Profile
SODO and North Waterfront



B. Retail Profile
SODO and North Waterfront



C. Manufacturing Profile
SODO and North Waterfront



Source: Community Attributes Inc.; Puget Sound Regional Council (PSRC), based on the Quarterly Census of Employment and Wages, 2013.

Note: manufacturing data is not reported for the North Waterfront due to data suppression for various years for census tract 80.02.

Exhibit 3. Employment by Sector, North Waterfront and SODO Districts, 2011

	North Waterfront		SODO	
	Jobs, 2011	Change from 2005-2011	Jobs, 2011	Change from 2005-2011
Census Tracts	*80.01, 80.02*		*93, 99*	
Const/Res	28	(220)	2,869	154
FIRE	1,695	304	1,295	155
Manufacturing	703	181	4,342	(797)
Retail	472	(217)	2,764	149
Services	11,239	1,678	14,605	(1,145)
WTU	970	(213)	8,461	(392)
Government	1,088	285	8,874	57
Education	-	-	469	(155)
Total	**16,973**	**2,575**	**43,677**	**(1,977)**

Note: Manufacturing for North Waterfront is only for one census tract due to data suppression.

Data source: Puget Sound Regional Council, based on the Quarterly Census of Employment and Wages.

PROPOSED PROJECT AND ACTIVITY

The proposed terminal facility, the Gateway Pacific Terminal, is slated for construction at Cherry Point, just north of Bellingham in Whatcom County. The facility would include a 2,980 foot wharf with three berths. If built, the facility would be the largest of its kind in North America, capable of exporting 48 million dry metric tons of coal and an additional 6 million tons of other dry bulk commodities per year. SSA Marine identified four major reasons for its location decision: 1) the firm owns a large parcel of land on-site, of which roughly a third is slated for facility development; 2) the area was zoned as heavy industrial in the 1980s; 3) the presence of existing rail infrastructure; and 4) as a natural deep water port with no need for dredging, cape-sized vessels would be able to berth at the terminal.[2] For the latter reason, SSA expects greater economies of scale achieved through larger ships would help reduce transportation costs, often estimated to constitute up to 75% of total business costs for dry bulk shippers (Ritzman & Watters, 2013).

In February 2011, Peabody Energy—the world's largest private sector coal company—reached an agreement with SSA Marine to initially export up to 24 million metric tons of coal per year. Pacific International Terminals, a subsidiary of SSA Marine, is the developer proposing to build the facility.

Estimates vary as to the actual number of trains passing through Seattle. A report commissioned by the Seattle Department of Transportation (2012) released in the Fall of 2012 worked from the assumption that an average of 10 coal trains per day would pass through Seattle on their way to and from the Cherry Point terminal beginning in 2015, with up to eighteen trains passing through the city after full build-out of the proposed terminal.

However, it remains unclear how many trains would pass through the city, and when. In interviews, BNSF and SSA Marine report that, after full terminal build out an average of nine trains (eight coal trains and one dry bulk commodity load) would pass through Seattle heading north on a daily basis, with empty trains returning either east either through Seattle or via the faster (and steeper) Steven's Pass route (see above discussion).

[2] Cape-sized vessels are the largest class of vessels, able to carry between 180,000 and 240,000 metric tons of cargo. These vessels are too large to fit through the widened Panama Canal.

REGIONAL ECONOMIC IMPACTS

Economic Theory

Approximating the positive and negative impacts from coal shipments is not simple. The effects can manifest in a variety of ways; **Exhibit 4** helps illustrate some of these possible benefits and costs. The exhibit shows the types of impacts expected ranging from direct impacts (Tier 1, as shown), to more and more indirect impacts (Tiers 2 and 3). The increased capacity required to offload trains at the port of exit would require investments in construction and operations, the latter having a longer-term impact through greater economic activity and associated spillover effects (e.g., more jobs at a port, leading to greater spending in the regional income due to increased labor income).

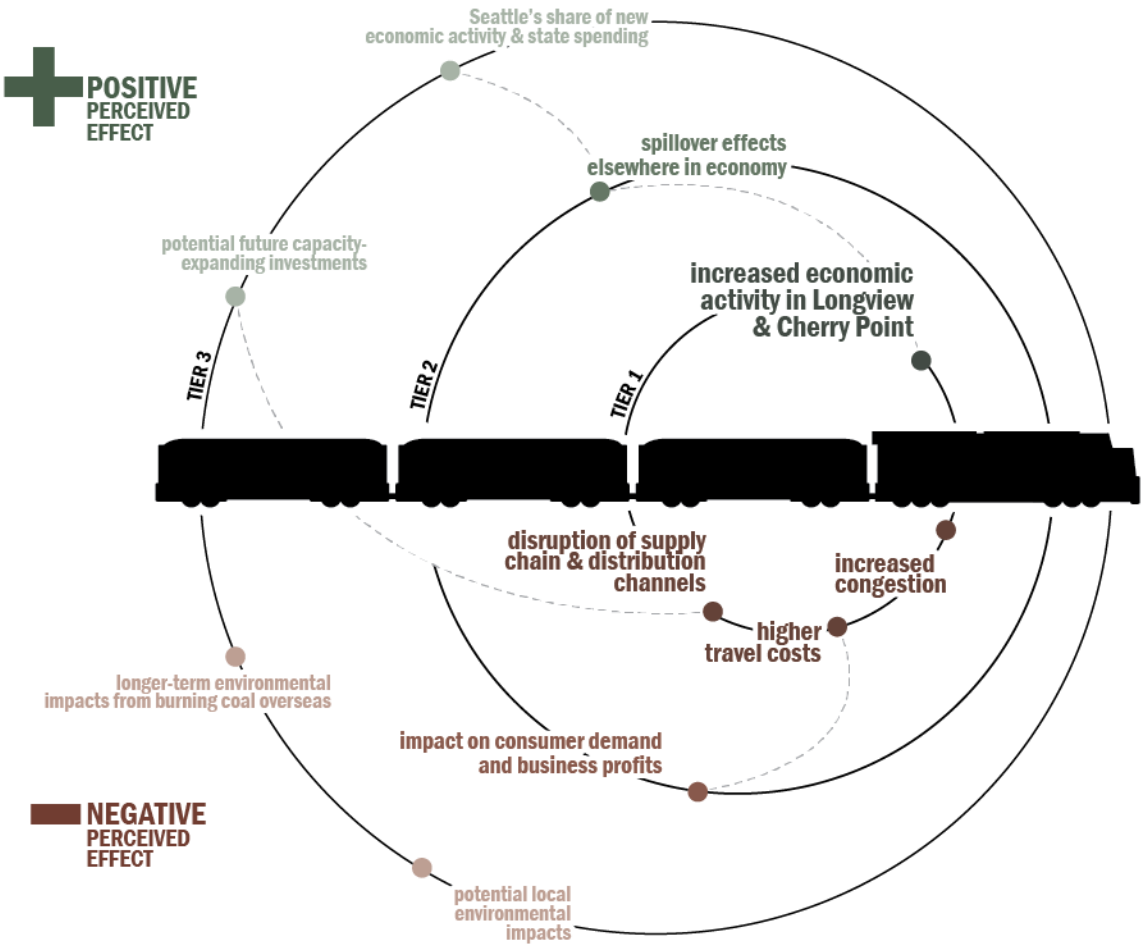
The two areas that would benefit most directly from this activity (gross benefits, not taking into account costs and impacts), under the current proposal are Cherry Point and Longview, though this increase in activity could spillover elsewhere in the state economy, including Seattle. For instance, since SSA Marine—the proposed operator at Cherry Point—is headquartered in Seattle, greater revenues earned through the Cherry Point operation could be transferred back to Seattle within the corporation, resulting in a possible increase in income spent within the city limits. Likewise, greater wealth accumulation at Cherry Point among newly hired workers could lead (through less observable channels) to some increase in spending in Seattle (either directly or indirectly). Part of the State's share of increased tax revenues (from direct, indirect, and induced impacts of the projects and operations) would likely be redistributed to Seattle, though costs due to congestion and other factors may offset these benefits.

In interviews, BNSF has indicated that if they determine that the increase in trains has the system nearing capacity, they may decide to invest in rail improvements, such as triple tracking. Such investments could in theory strengthen the competitiveness of the Port of Seattle as a whole, and would require collaboration with the City and the Port of Seattle. The public would be indirectly affected by these costs through tax revenues used to support these investments, for instance when necessary grade separations are needed to mitigate train-induced surface congestion or when capacity improvements along a privately held line are deemed necessary for regional competitiveness and in the public interest.

Trains, regardless of carrying load, can create congestion problems that erode business income and competitiveness, consumer spending through indirect "taxes" on travel, and quality of life attributes within the affected areas. For instance, a preliminary analysis commissioned by the City of Bellingham found

that an increase in trains would put pressure on an already stressed city rail crossing system; in some instances there may be insufficient time for queues to dissipate before the next train arrives (Gibson Traffic Consultants, Inc., 2012).

Exhibit 4. Hypothesized System Impacts of Additional Coal Trains



Source: Community Attributes Inc., 2013.

Congestion can disrupt supply chains and distribution systems, push up wages for commuting workers as compensation for additional commuting time, and make regions that depend on consumer traffic less attractive. Efforts to mitigate congestion can be expensive, especially if they include grade separation, though relatively sudden increases in congestion can expedite needed public investments. Increased capacity utilization can also rationalize intermodal investments, such as new rail lines and related infrastructure.

There are also clear environmental impacts, grouped into two kinds: 1) absent sufficient technology to fully contain coal dust, environmental degradation, and

other externalities resulting from spillage/emissions; and 2) the expected value of potential remediation fees associated with accidents, based on the probabilities of such an event. More broadly, coal burning in China and elsewhere contributes to GHGs and man-made global warming, and particulate matter from China can make its way back to Washington over months or years. Congestion induced by trains also leads to more idle automobiles, increasing carbon emissions.

Property values along or near affected areas may also be adversely affected due to train-related noise, vibrations, and congestion. For instance, Simons and El Jaouhari (2004) found that rail traffic affected the sale price of residential properties in Ohio in the 1990s. Using a hedonic regression model for the years 1996 and 1999, the authors found that an increase in rail traffic due to a routing reconfiguration resulted in decreases in residential property values that declined in magnitude as distance increased from the tracks.

More recently, a report commissioned by Climate Solutions estimated property values in areas north of Everett within 600 feet of the rail lines would decline 5 to 20%, depending on property type, due to the proposed train traffic increases. Similar properties in Seattle are forecast to decline by 3 to 5 percentage points less than the estimates for Everett (Climate Solutions, 2012).

However, these diminutions might be offset by an increase in values elsewhere within Seattle as property demand shifts to other areas, resulting in a transfer of wealth rather than an absolute decline.[3]

Negative impacts may primarily occur through increased congestion resulting in disruptions to supply chain and distribution channels, commuting times, and retail activities in the affected areas. Congestion can adversely impact businesses in the affected zones through a variety of channels, including the size of business markets, scheduling of business processes, deployment of personnel and vehicles, the dispersion of business locations, and use of intermodal connections. These impacts can "bear directly on either the competitive cost of doing business in a region or the ability to expand to expand business operations to meet the demands of a growing region" (Wiesbrod & Fitzroy, 2008, pp. 4-5).

Externalities associated with coal, such as remediation costs linked to spillage and coal dust in waterways over which coal trains travel also create economic impacts, sometimes indirectly. Absent additional capital expenditures to expand rail

[3] See, for instance, Zhang and Shing's (2006) analysis of London's congestion charge zone program, where the introduction of vehicle charge on congestion to enter a designated zone led to property values outside the zone increasing in value relative to the properties inside the zone.

capacity, an increase in train traffic may create costs for other shippers through the price mechanism of rail shipping rates.

Impacts also extend to community development, fiscal expenditures, and opportunity costs. A report by Public Finance Management (PFM) found that, when factoring other potential traffic mitigation costs and potential diversion of planned investments, the net economic impact to the city could actually be negligible or even negative. For instance, the report cited the risk to planned waterfront development in Bellingham from surface crossing delays as major concern. State and local agencies have committed more than $40 million for the project, which involves redevelopment of the former Georgia Pacific site in downtown Bellingham, but the project's feasibility may be compromised due to train noise and induced traffic. The Port of Bellingham projects that over a 25 to 30 year period, the project could result in $1 billion in investment and a net increase of 5,600 direct jobs (Public Financial Management, Inc., 2012).

Lastly, public sentiment about coal as a major contributor to greenhouse gases (GHGs) and congestion more generally may discourage both greater retail activities in affected areas—in this study, the SODO and North Waterfront districts—and prospective new investment or expansion by firms that rely on surface road systems. Congestion may in turn lead to a weakening of Seattle's competitiveness with other regions, particularly along the west coast, with sophisticated intermodal freight systems.

The following sections present the extent that these anticipated impacts may occur, their projected magnitude, as well as any positive benefits associated with more coal trains.

Major Economic Stakeholders

The shipment and selling of coal entails many stakeholders. These participants range from the owners of the land from which coal in mined (the U.S. Bureau of Land Management), the mining company that leases the land (Peabody Energy), the shipper (also Peabody Energy), the rail company (BNSF for coal shipments to Cherry Point), the terminal operator under the proposed plan (SSA Marine), the oceanic shipper, and market participants overseas (e.g., power plants and energy users in China and elsewhere).

Bureau of Land Management, Peabody Energy, and Cloud Peak Energy

The source of the coal, the Powder River Basin, is the single largest source of coal in the United States. In 2011, twelve active coal mines in the basin produced 423.2 million tons of coal, representing a 2.9% average annual increase since 1998. The largest producers were Peabody Energy (148.2 million tons), Arch

(115.0), and Cloud Peak Energy (76.6) (U.S. Bureau of Land Management, 2012). Peabody and Cloud Peak Energy are both entirely invested in coal. However, Cloud Peak Energy is entirely invested in Powder River Basin coal, whereas Peabody Energy has international assets.

Burlington-Northern Santa Fe (BNSF)

Burlington-Northern Santa Fe (BNSF) is the exclusive rail shipper for all coal heading north through Seattle. Currently between two and three BNSF coal trains pass daily through Seattle en route to the Westshore Terminal facility in Delta, British Columbia. BNSF has been operating in Washington for more than 100 years, and has exclusive rights to I-5 corridor rail mainline north of Tacoma (as well as other sectors of the state), though it also leases use for passenger rail.[4] BNSF currently employs roughly 3,500 workers within Washington. Since the start of the economic recovery, the company has added between 400 and 500 new workers in the state. The employment bases are not large within Seattle, but are typically industrial high-skill, high-paying jobs. Because of the training investments required, the company resorted to furloughs with retained benefits rather than layoffs during the economic downturn. The Seattle International Gateway (SIG) located in the SODO district of Seattle is a BNSF rail yard (Finn, 2013).

SSA Marine

SSA Marine is the largest U.S. terminal operator and among the top ten globally. The firm was established in 1949 by Fred Smith in Bellingham, WA, originally as a stevedoring operation, and continues to be a privately held company under management by a third generation of the founding family. It later expanded its operations into terminal operations and relocated its headquarters to Seattle in the 1960s. Today, the company directly employs approximately 400 full-time equivalent (FTE) employees in Seattle, including 130 employed in Tideworks, a software company fully owned by SSA Marine that develops software-based terminal operations solutions; both headquarter operations are located on Harbor Island in Seattle. Globally, SSA Marine employs approximately 2,000 workers, as either direct FTEs or longshoremen, many of which are based in Seattle and earn on average between $90,000 and $100,000 annually. The company currently operates fifteen terminals worldwide, with long-term leases or ownerships in the U.S. (two in Seattle, two in Oakland, three in Long Beach), Mexico (1), Vietnam (2), Chile (2), Panama (1), and Colombia (2) (Ritzman & Watters, 2013).

[4] For more detail on rail lines in Washington, see Washington State Department of Transportation (2011).

Port of Seattle and logistics firms

According to a 2009 report commissioned by the Port of Seattle, rail operations at the Port accounted for approximately 1,621 direct jobs and over $1.5 billion in direct output in 2008. However, these counts include terminal and rail operations located on Port property. Within the two directly affected districts, warehousing, transportation, and utilities (WTU) employed more than 9,400 workers in 2011.

Local businesses

Contributors to this report included businesses representing the restaurant, hospitality, tourism, and hotel industries and associations representing diverse manufacturing and logistics interests (see **Appendix D** for a list of these interviewees).

Regional economies and communities

The short-term economic impacts to communities from the Cherry Point project can be negative or positive. Potential negative impacts to communities include job losses (for reasons discussed above), congestion, lost potential investments, as well as potential health and environmental hazards from coal trains and coal terminal operations.

Recent studies for other regions of Washington commissioned by proponents of coal terminals in Washington have focused on the positive impact of an increase in economic activity associated with the construction and operation of coal terminals, of which Seattle would not be a direct recipient. For instance, a report commissioned by Millennium Bulk Terminals, which would build and operate the proposed coal terminal at the Port of Longview, used the Washington State Input-Output model to show that the proposed $600 million, 100 acre multi-year investment would lead to a short-term impact (i.e., activities related to construction) of 1,350 temporary direct jobs, $70 million in direct wages, and $232 million in direct output. Indirect and induced impacts (i.e., the increased demand on suppliers and effects of new labor income spent elsewhere in the economy) resulting from construction would add another 1,300 jobs, $65.0 million in wages, and $203 million in output. The study estimated the long-term direct impacts from terminal operations (following a complete build-out) would be 135 workers, $16.0 million in labor income, and $49.0 million in output per year, with aggregate indirect and induced impacts of an additional 165 workers, $9.0 million in labor income, and $21.0 million in output elsewhere in the economy (Millennium Bulk Terminals Longview, 2012).

A similar analysis, employing a RIMS and proprietary input-output model, was commissioned by SSA Marine to assess the economic impacts of the proposed facility in Whatcom County. The analysis estimated a net impact (direct, indirect,

and induced) from operations of 863 annual full time equivalents (FTEs) for Phase I (25 million dry metric tons), and 1,229 annual FTEs after completion of Phase II (54 million dry metric tons), with $1.4 billion in business revenues and $11.2 million in state and local taxes for Phase II. The net construction impacts for both phase I and Phase II would include nearly 22 million hours of labor, $411 million in income, $665 million in business revenues, and $92.4 million in state and local taxes (John C. Martin Associates, LLC, 2011).

An alternative study by a team of local economists, using an IMPLAN model, found a direct impact from the proposed coal terminal when fully operational of 430 workers with aggregate labor income of $40.8 million. Factoring in indirect and induced effects the authors estimated an aggregate impact of 1,229 jobs, $126.3 million in income, more than $1.4 billion in output, and $11.2 in state and local taxes per year (based on taxable output associated with economy-wide increases activities derived from expanded port activities). The construction phase of the project, based on IMPLAN estimates, would directly employ 1,648 workers with a total impact of nearly 3,000 across the economy (Brewer, Hodges, & Nelson, 2011)

SEATTLE AREA IMPACTS

Benefits

SSA Marine

In interviews, SSA Marine presented potential direct positive impacts associated with the initial terminal build out and future operations of the facility. SSA Marine anticipates hiring up to 12 full-time equivalent employees based in Seattle to handle the day-to-day project management for the proposed new terminal; with an average fully loaded annual compensation of $200,000 (40% of which is benefits), equating to $2.4 million per year.

SSA Marine anticipates pre-operation gross expenditures of roughly $13 million on regulatory and permitting expenses, e.g., environmental impact study (EIS) contractor, environmental engineers, and commissioned studies as part of the EIS. SSA Marine would spend approximately $6 million in engineering design packages to contractors once permits are awarded. Engineering support is about $3 million before the permits are finished. Legal fees and public relations will likely total $5-6 million. The firm anticipates that the majority, if not all, of this work would likely be done by firms based in the Seattle and Bellevue. Once the terminal is completed and fully operational, seven of the twelve new hires at SSA Marine would be relocated to Cherry Point (Ritzman & Watters, 2013).

Burlington-Northern Santa Fe (BNSF)

BNSF does not anticipate a direct increase in employment in Seattle; the switching yards at SIG are purposed with loading, unloading, and building trains, and these activities for coal would take place at the originating mines. However, an increase in rail traffic could spur additional capital investments such as triple-tracking in Seattle, that would further the competitiveness of the Port of Seattle for intermodal cargo traffic. BNSF has a record of making capital investments necessary to reduce congestion and bottlenecks. The company recently invested in a third track and new sidings in Auburn that allow for more capacity; siding and storage capacity reduce delays and increase the number of trains that can operate along a given section of the mainline. Ideally, BNSF has stated they prefer a siding every five miles to pull a train off and let another pass by. Without these sidings BNSF would have to hold a train and send it up 20 miles or more, reducing mainline capacity (Finn, 2013).

BNSF has refuted several of claims regarding the impact of more coal trains. In a letter to then-Governor Chris Gregoire, the company stressed that there would be adequate capacity to "handle current and future freight and passenger volumes [and that increased volume] provides the necessary private capital to refresh BNSF's physical plan and expand capacity," largely echoing the Port of Seattle's view. In 2012 (time of writing), BNSF planned $106 million in investments across the state, largely to "enhance service for existing customers." In the letter, the company did not provide a clear estimate of the net impact in train traffic, but emphasized that the increase is small relative to the total volume of rail traffic in Washington State. In response to concerns that more rail traffic would disrupt Amtrak passenger service, BNSF highlighted that the success of the current system would not have been possible "but for the fact that BNSF accommodated its own growth in freight volumes through consistent and aggressive capital investment and operations efficiencies." In terms of environmental impacts, the letter emphasized BNSF's installation of green technology (e.g., wide-span electric cranes in Seattle and advanced locomotive fleet) and its request that coal customers treat coal carloads with a surface crusting agent to prevent dust emissions (BNSF, 2012).

In BNSF's estimation, the most likely scenario would be up to nine loaded trains heading north to Bellingham upon full build-out of the Cherry Point terminal. However, it is not yet clear whether this would include, or be in addition to, the two to three coal trains that currently pass through Seattle daily en route to Vancouver, B.C., thus absorbing terminal activity in the north, nor the route of empty cars heading back to the Powder River Basin (discussed above). For loaded cars, while the route from Spokane, down to Pasco, and along the Columbia

Gorge may be longer, the load weight and grades through Stevens Pass makes the flatter southern route more economical.

Economies of coal. In BNSF's view, current economies support coal shipment—demand continues to rise in Asia, mining is cheap, and no sufficiently scalable alternatives currently exist in China and India. Transportation of coal from the Powder River Basin to Asia constitutes roughly 75% of the total cost. The proposed terminal at Longview, a 43-foot dredge channel along the Columbia, would only be able to handle medium-sized ships; the Cherry Point facility, by comparison, is a deep water port able to handle large ships.

BNSF does not view increased coal traffic as an opportunity cost question, i.e., the increase in coal-bearing trains would not displace shipments of higher value-added goods. BNSF emphasized it would not lose capacity because this business allows for investment in the network. Passenger trains were the more recent example of these same opportunity cost worries. BNSF emphasized that adjustments were made to accommodate that increase, and is confident they would do so again.

Possible congestion impacts. BNSF does not believe the added trains would increase surface traffic, similar to the position of the Port of Seattle. Over the past decade, freight traffic has actually declined, offset by an increase in passenger rail. Over the past twenty-five years, two to three coal trains have passed through Seattle each day, and BNSF does not anticipate any strain on rail capacity from the planned increase.

To accommodate additional rail traffic, lighter trains can be rerouted over the mountains at Stevens Pass (bypassing Seattle), with heavier trains taking the longer, flatter route along the Columbia Gorge. Grain and other heavy commodities were previously shipped this way, with lighter intermodal cargo using the two alternative routes; more recently, BNSF found adding extra engines to these grain trains to get them through Stevens Pass relieved congestion on the southern track. Most Port of Seattle trains go north, not south. Double tracking to the north from Sounder has reduced congestion as well.

BNSF coordinates with Amtrak and Sound Transit, and over the last decade BNSF has seen a reduction in freight trains, offset by an increase in passenger trains. Freight trains were down from 54 trains per day to 41 or 42 per day, while passenger trains went from 10 to 26 during the same time.

BNSF emphasized that rail is a critical component of Seattle's global competitiveness. Seattle is a highly rail-dependent city, anchored by the Port of Seattle; roughly 65-70% of all traffic through the Port of Seattle travels via rail,

with cargo volumes far in excess of Seattle's local demand. Critical to Port operations is the rail mainline, allowing for shipments as far east as the Midwest, and use of rail is proven to be 3 to 4 times more energy efficient than trucking per ton of cargo.

Environmental impacts—coal dust. BNSF has a policy on coal dust emissions, which includes a tariff/rule imposed on shippers and miners (the responsible parties for coal loading) requiring the application of one of three types of topical agent or spray to contain dust. Stated company policy is to reduce incidence of coal dust near the mine by 85%. Loaded coal must also be wind profiled as part of this tariff to minimize the risk of wind-induced dust emissions.[5] BNSF reports it has a strong incentive to limit dust emissions—coal dust can damage rails, and when coal dust settled within the ballast rock under the rails mixes with rainwater a concrete-like consistency can form, raising the risks of a derailment (which has occurred in recent years due directly to these coal dust-induced hazards), imposing financial and operating costs on the company.

Potential benefits associated with more coal trains. According to BNSF and the Port of Seattle, an increase in rail traffic could spur additional capital investments, such as triple-tracking in Seattle, that would further the competitiveness of the Port for intermodal cargo traffic. BNSF has a record of making capital investments necessary to reduce congestion and bottlenecks. The company recently invested in a third track and new sidings in Auburn that allow for more capacity; siding and storage capacity help reduce delays and increase the number of trains that can operate along a given section of the mainline.

Economic Costs

Congestion impacts descriptions

A recent study commissioned by the Seattle Department of Transportation modeled the impact of additional coal trains on eight crossings in the North Waterfront and SODO districts (Seattle Department of Transportation, 2012). The study assessed the impact across four categories of disruption: crossing delays/gate down times; vehicle queues at railroad crossings; safety (i.e., risks of pedestrian, bicycle, and vehicle collisions with passing trains); and emergency vehicle access.

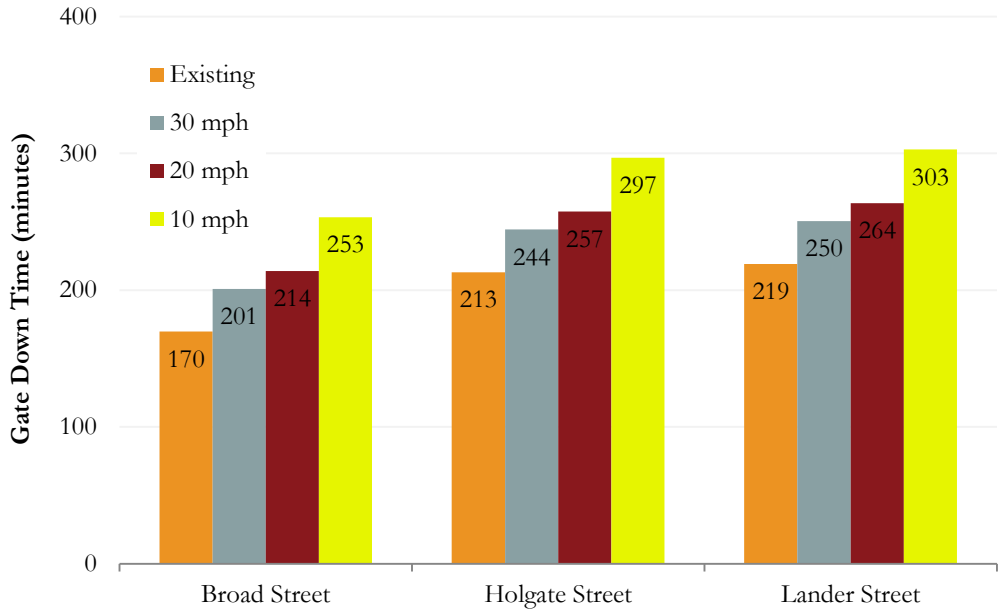
Currently, each day approximately 30 freight trains pass through the North Waterfront district, and 65-85 freight trains passing through SODO, including 1.6 mile-long long-haul trains. In addition, Sound Transit operates four Sounder trains north and nine trains south, and Amtrak operates 14 trains daily through

[5] Profiling usually takes the recognizable shape of a concave "bread loaf" in each loaded car.

Seattle. BNSF also operates rail tracks east of East Marginal Way South that serve its Seattle International Gateway intermodal terminal, with additional spur tracks off the BNSF mainline serving operations between I-5 and Fourth Avenue (Seattle Department of Transportation, 2012).

The SDOT study projects that in 2015, the estimated additional daily gate down time for coal trains could be 31 to 83 minutes, translating into an increase in daily gate down time of approximately 18% to 49% at Broad Street and 15% to 39% at both Holgate and Lander Street. By 2026, additional daily gate down time for coal trains could be approximately 67 to 183 minutes (representing an increase in daily gate down of approximately 39% to 108% at Broad Street and 31% to 86% at Holgate and Lander Streets). **Exhibit 5** summarizes these scenarios for different train speeds.

Exhibit 5. Estimated Daily Gate Down Times, by Train Speed Scenarios, 2015



Source: Seattle Department of Transportation, (2012).

Overall vehicle queue lengths at railroad crossings vary depending on when trains, including coal trains, arrive in relation to other trains and city traffic patterns. Freight trains longer than the proposed coal trains already operate today. The maximum number of vehicles queuing from a single train would not increase provided coal trains are operating at 20 mph or greater. Coal trains added to the current demand would increase the number and frequency of vehicles waiting in a queue.

The eight crossings adversely affected by the proposed increase in coal rail traffic are all within either the Northern Waterfront or Duwamish industrial zone

(SODO). If the terminal in Cherry Point is constructed and on schedule, in 2015 there would be ten 1.3 mile trains passing through Seattle; by 2026, this number may increase to 18 daily trains with an extended length of 1.6 miles. However, the current plan is for 8 coal trains plus one dry bulk commodity train, and it is possible that empty cars would be diverted over Steven's Pass rather than roundtrip through Seattle (this remains undecided).

Another limitation in estimating the congestion impacts of more trains is the lack of certainty and clarity on train schedules. While the Seattle Department of Transportation (2012) report modeled the impacts at three crossings at equally spaced time intervals throughout the day, in reality the schedule is far less certain, with the possibility of more trains passing through at specific intervals. This is due in part to the nature of mining extraction and off-loading port operations, but also uncertain weather conditions. For instance, landslides typically require 10 hours of rail segment closure for debris removal and slope stabilization, plus a 48 hour moratorium on passenger trains passing through the affected area. The advent of up to 18 additional coal trains would further aggravate these risks—potential delays not yet accounted for in the analysis.

Economic impacts associated with increased coal trains are not easy to quantify. To help illustrate these impacts, analysis was subdivided into four categories: 1) quantifiable estimates; 2) feedback from the business community and stakeholders in affected areas, primarily through interviews; 3) approximations of the costs for solutions intended to ameliorate congestion problems; and 4) impacts related to the Port of Seattle.

Congestion impacts quantified

Increased congestion can create a financial burden on vehicle travelers, as calculated by the loss in "value of travel time" (VOTT) associated with delayed travel, though these estimates do not factor in diversionary/adjustment behavior on the part of travelers along affected routes. The VOTT refers to the cost of time spent in travel—waiting as well as actual travel—including "costs to consumers of personal (unpaid) time spent on travel, and costs to businesses of paid employee time spent in travel" (Victoria Trasport Policy Institute, 2012, pp. 5.2-2).

This study employs a VOTT approach to estimate an annual dollar impact, though it should be noted that this approach is intended as an approximation and is subject to several important limitations. The VOTT estimates in this study vary based on estimation methodology and geographic scope and reflect revealed preferences of drivers based on tolls and traveling costs not directly associated with rail crossing delays. Estimates are made of the congestion impact under the

assumption that travelers, commercial drivers, and affected firms do not alter their traveling and economic behaviors to adapt to increased delays.

Importantly, calculations are based on estimated cumulative delay queues modeled by Seattle Department of Transportation (2012). These estimates were reported in physical length (as measured in feet) of queues at three of the eight affected crossings (Broad, Holgate, and Lander), but there is no available data on the traffic flows at these intersections disaggregated by vehicle type (e.g., two-axle passenger cars versus three or more axle trucks, and concomitant variation in vehicle length), nor purpose of travel (e.g., to a leisure destination, commuting, shipping, etc.). No information exists on the future costs of fuel and wages, which may impact VOTT estimates.

The traffic flow data was based on video recordings by the Seattle Department of Transportation (SDOT) for three of the eight identified affected crossings; because estimates here are based on the work previously done by SDOT (2012), direct travel cost estimates are made for these three crossings.

Travelers may assign a cost associated with the potential increase in traffic volatility, resulting in diverted trips or alternative routes that take longer on an average basis. Moreover, extended queues may, if long enough, occasionally impact the broader transportation network, adding to traffic congestions elsewhere. These impacts were not modeled, but should be mentioned as additional potential outcomes.

To calculate a dollar cost of delays due to a full schedule of 18 coal trains per day in 2026, the costs of delays with and without the additional trains were calculated to arrive at a difference. To do so, the number of uniform 25 foot long vehicles per minute at the three intersections was analyzed over a 24 hour period. Queue length estimates by the Seattle Department of Transportation (2012) are based on average traffic flows for a five-day work week. After arriving at the number of vehicles per minute at each crossing, the difference with and without the additional trains was subtracted to get an estimate of additional cars per minute in queue; this value was then multiplied by alternative estimates of VOTT divided by 60 (to get a summed total based on vehicles per minute). Calculations were varied based on the distribution of vehicles between passenger car and truck, adjusting estimated queue lengths to reflect these vehicle length differences (using a simplified approach, assigning a length of 25 feet to passenger vehicles and 60 feet to trucks, with space in between vehicles accounted for in length). **Appendix A** articulates these relationships.

The calculations suggest that an increase in the number and length of crossing queues would lead to annual dollar impact to drivers of between roughly $79,000

and $254,000 in current dollars, depending on the constitution of the fleet (with an estimate between 0% and 30% trucks), the speed of the train at Lander St. (between 10 mph and 20 mph), and the estimates of VOTT employed (**Exhibit 6a**). Though there are no estimates for the other five intersections, approximations can be made as to the total cost burden for travelers, assuming that queue length increases due to the additional trains at the other five crossings (Clay, Vine, Wall, Horton, and Spokane) are proportional to their traffic flows. For instance, Clay has weekday (Monday through Friday) traffic that is 15.1% of Broad levels, extrapolating a queue length increase (in feet-minutes) of about 727.8 feet per day; Broad can be used as the comparator crossing also for Vine and Wall, and Lander for Spokane and Horton. Assuming only up to 2% of the queue length for these intersections are trucks, analysis arrives at a total value of travel time cost burden for all intersections combined of between roughly $384,000 and $455,000 per year, based only on weekdays (**Exhibit 7b**).

Costs modeled here are isolated only for congestion in three crossings, and may actually understate the true economic impact on users of these roads. For instance, to what extent would shipping be disrupted by unpredictable, lengthy delays? Would landslides north of Seattle—already a major issue for passenger trains—and other disruptions push an already strained rail system beyond its functional capacity? How might congestion points affect the Port of Seattle's competitiveness, particularly given the already intense competition as a portal to Asia with other West Coast ports? These issues are explored below.

Exhibit 6a. Annual Value of Time Costs Due to Congestion, at Full Build-Out

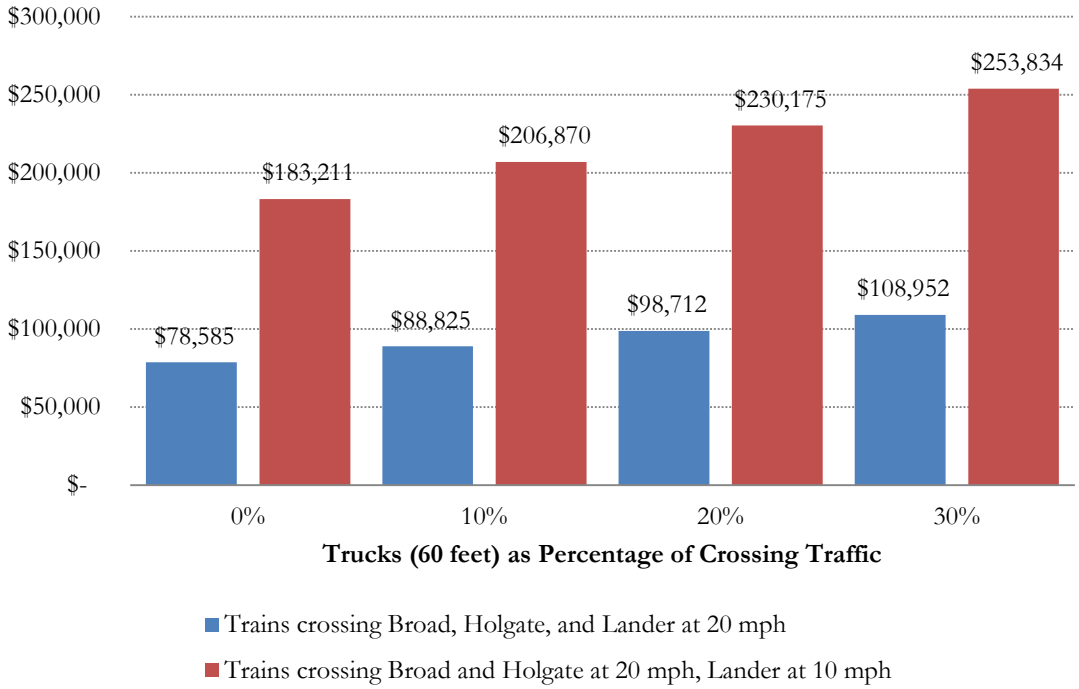
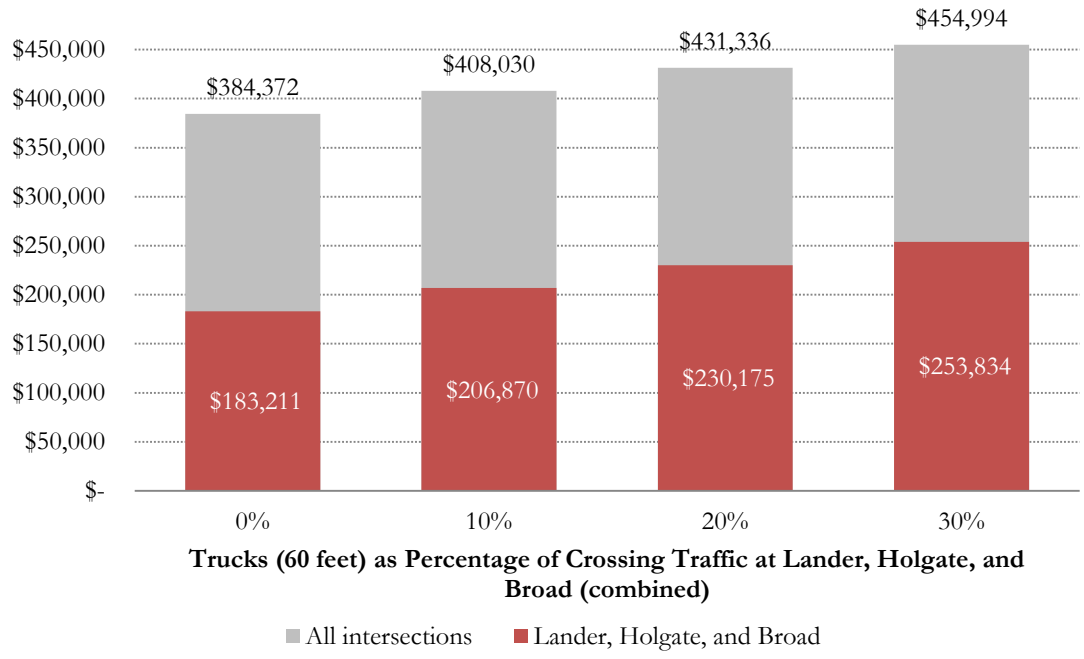


Exhibit 6b. Estimates of Annual Value of Time Costs for All Intersections, Assuming Trains Pass Lander at 10mph, at Full Build-Out



Note: based on $81.49 VOTT for trucks and $26.47 for cars, including inflation adjustments.

Anticipated public mitigation costs

The impacts of congestion can also affect health and safety, which includes associated economic costs. For instance, train-induced delays can impact aid car (e.g., ambulances, fire trucks, ladder trucks, police vehicles) access to the waterfront and the section of SODO west of the north-south tracks. Currently, the Seattle Fire Department Station 14 is to the east of the tracks, requiring crossing via Lander to provide emergency assistance to the western half of SODO. When a train delay occurs, responders must determine whether to wait out the length of delay or dispatch an aid car from another station. Because there is no certainty as to the schedule of coal trains passing through the city, no easily rendered predictive model exists for determining when congestion events might occur. A similar problem is presented at Fire Station 5. While the station is west of the tracks, and is purposed with waterfront fire and emergency response, larger incidents requiring assistance from downtown stations could be obstructed by a passing train, or delays induced by the increase in train traffic and backup either north or south.

According to the Seattle Fire Department, its Fire Alarm Center needs up-to-date and accurate information about any road closures to determine which companies to dispatch that will arrive at an emergency in the shortest amount of time. A doubling of the number of trains and blockages in the SODO/North Waterfront complicates this task. The trains would essentially double the amount of time that eight east-west crossings are blocked. In a worst case scenario it may take 10 to 12 minutes to reach areas west of a long coal train moving through those intersections. The Fire Department's response times to those areas now averages 4 minutes.

The Department is working with SDOT on getting real-time traffic condition information fed into the computer assisted dispatching (CAD) system. Traffic conditions could include the movement of coal trains and crossing closings and openings. With this real time information the CAD system can dynamically select the closest companies that will arrive at an emergency scene in the shortest amount of time. Response times would still be greater than when all of the crossings are open but the Department will be able to make the optimal dispatching decision.

Range of costs for these changes. The Fire Department has just started to work with SDOT on the traffic condition interface. Very preliminary information on the traffic condition interface suggests it will be under $150,000 to implement.

Other infrastructure improvements in SODO and/or the North Waterfront. The Fire Department agrees with the grade separations and traffic re-

configurations options in SODO and the North Waterfront areas discussed in the Seattle DOT (2012) study, but these solutions would be expensive (Nelsen, 2013). If Station 14 needed to be relocated, it would cost an estimates $9.5 million, plus the costs of land.

According to the Seattle Department of Transportation, with the advent of up to 18 coal trains a day, there are two capital-intensive infrastructure solutions, both of which would present costs to the city and taxpayers. The first option would entail construction of a new fire station to the west of the tracks, circumventing train-induced delays. The second option would be the construction of a grade separation (i.e., bridge overpass) over the tracks at Lander Street; because separation over rail lines must be at least nearly 24 feet, and the complications associated with such a project, Seattle Department of Transportation anticipates such a project would cost at least $100 million (Eaves, 2013).

Coal dust health impacts

Estimating the economic costs from adverse health outcomes is difficult within a reasonable range. There exists a large body of literature on the health impacts of coal dust at the place of extraction (i.e. at the mine), but only sparse reports on the impacts of non-occupational health hazards. For instance, a literature review by the Environment Canterbury Regional Council of New Zealand (2009) states that there are "few studies in the literature of respirable dust concentrations and/or health outcomes for non-occupational exposure to coal dust" (p. 6). While there may be risks associated with coal train dust emissions, there is insufficient updated and scientifically conducted analysis to allow for an economic impact assessment at this time. For instance, the last time the EPA published a report on the effects of transporting coal was in 1978 (U.S. Environmental Protection Agency, 1978).

Based on the above, the EPA and others have called for an examination of coal dust to be included in the environmental impact study (EIS) for the proposed terminal. The EPA's scoping comments for the EIS, the agency calls for an evaluation to include "potential increases in fugitive coal dust and diesel emissions that would accompany rail traffic to the proposed new terminal, and the potential related human health impacts to communities along the proposed routes" (U.S. Environmental Protection Agency, 2013).

Impacts on businesses in crossing areas

Several landowners, businesses, and organizations in the SODO and North Waterfront areas were interviewed, representing manufacturers, transportation and logistics firms, food and retail, and recreational activities (see **Appendix B** for list of interviewed stakeholders).

Among interviewees, most saw the coal train traffic within the larger context of disruptions brought on by seawall construction, viaduct replacement activities, and even the prospect of a new arena in SODO. Within this context, interviewees largely saw the coal trains as having only a limited impact. For instance, the North Waterfront area depends on visitor traffic. In the summer, roughly one third of total visitors are from within King County, while in the winter (largely due to less tourist traffic) about 70% come from within the county. Roughly 3.5 million people visit the waterfront each year, including 800,000 visitors to the Seattle Aquarium—more than the combined visitors to Mariner and Seahawk games. After the waterfront redevelopment is complete, this number is expected to double to 7 million visitors.

However, the Edgewater Hotel's major concerns deal directly with train noise and train-induced traffic delays. The hotel, opened during the World's Fair in Seattle 50 years ago, has 240 full-time employees and has $25 million in annual revenues. The hotel has an annual occupancy rate of about 80%, though this includes seasonal variations (winter occupancy rates are usually closer to 70%). The hotel attributes loss of business in recent years largely to disruptive train noise, which primarily affects the 50% of hotel rooms facing the city (the hotel provides complimentary earplugs for city-side rooms).

The hotel's competitiveness is also hampered by traffic, which can be an acute issue for visitors trying to get to the airport or a downtown meeting but are stuck on Alaskan Way waiting at a crossing gate. Trains crossing over Broad Street typically travel closer to 10 miles per hour, and crossing gate queue times can last as long as 25 minutes at the current train volume. The Edgewater depends heavily on car-based visitors—roughly 60% of non-corporate customers are from within the Northwest and thus come by way of automobile. Corporate clients, which used to constitute roughly 35% of total business, have since dropped to 22%, and feedback from clients indicated the noise and train traffic were major inconveniences. Reviews on TripAdvisor.com have highlighted these disruptions, further hurting business. Local businesses, including software and media firms, have since relocated to other parts of downtown and South Lake Union. The hotel recently replaced all of its windows, but due to the age of the building it cannot be retrofitted to be more soundproof. The hotel is unable to predict what the future impact of more trains would be on its business, other than to say it may need to reduce employment to offset continued declines in business (Cocks, 2013).

Other waterfront businesses, while acknowledging adverse traffic impacts due to the trains, view by many more orders of magnitude inadequate traffic and parking management during construction and limited mass transit service; an increase in

trains simply further aggravates an on-going set of problems. When traffic delays occur, these inconveniences discourage customers from visiting more frequently, hurting tourism- and recreational-based businesses in the area. Ferry traffic during construction can also be very disruptive, leading to long traffic queues on Friday nights, from Pier 52 to as far north as Pier 69.

The pending seawall construction (set to begin Fall 2013 and continuing into 2016) may further aggravate traffic delays and business operations in the area. For instance, the sidewalk in front of the Seattle Aquarium will be closed off, shortly followed by viaduct-related construction (Plunkett, 2013). These backups are also of concern because Alaskan Way is the primary route for overweight trucks carrying cargo and hazardous materials heading to Ballard.

Based on survey data collected by Ivar's Acres of Clams, Pier 57, the Seattle Aquarium, and Argosy Tours over the past sixteen years, roughly 65% of visitors to the waterfront travel by car and as family groups, typically with a local resident (from either Seattle or the surrounding suburbs) taking visitors/family members from out of town to the waterfront for dinner, a cruise, or other recreational activities. There has been a reduction in metered parking under the viaduct, which will continue following construction.

Feedback from Pier 57 helps illustrate some of these anticipated problems. Pier 57 is a family owner-operator business along the waterfront; the business owns the building and street-side land, but leases the last portion of the pier, which extends into the tidelands, from the Washington State Department of Natural Resources. Griffith family owns all businesses operating on the pier, including two large restaurants—the Fisherman and the Crab Pot, the latter one of Seattle's highest-volume restaurants—a creamery, bakery, food court, and the recent addition of the Great Wheel. Approximately 750 staff are employed at the pier during the summer months (with less during the slower off-peak season). The pier was first purchased by the family in the 1960s and converted the structure from warehouse space into recreational usage.

Business at the pier has historically been driven by outside visitors, though a large percentage of the roughly 1 million customers who have ridden the Great Wheel since it opened six months ago are from Seattle. Since the wheel opened, the pier has also seen more off-season visitor traffic (especially among locals during the Christmas season). As is with other waterfront business, most visitors come via automobile, typically as a group, with plans to visit several establishments in the area. Many such groups include the elderly and very young, thus requiring sufficient parking near the sites to reduce walking distance and steep sidewalks. As such, the pier stated they are very concerned with the loss of parking, lane

reductions, and street closures due to seawall construction. They have been working with the Seattle Department of Transportation to coordinate construction schedules to minimize disruptions, concentrating most of the heavy work during the slower off-season months.[6] However, the Pier owners expressed concern over the design of the waterfront after the viaduct is torn down (Griffith, 2013).[7]

Interviewees also expressed concerns over mass transit. The current single bus line only travels southbound on Alaskan Way, following a circuitous route that goes through the International District before heading north on First Avenue—an inconvenience for visitors whose primary purpose is recreational along the waterfront.

SODO interviewees also did not foresee any significant impacts associated with more coal trains. Again, their greater concerns were with potential impacts associated with a new arena. The SODO region has almost twice as many covered employees in warehouse, transportation, and utilities than manufacturing (8,461 versus 4,342 in 2011).

Port of Seattle

Based on interviews with the Port of Seattle, there are no plans for expansion of Port facilities to accommodate coal trains, either terminal operations or other facilities related to rail movement. The Port believes recent and on-going infrastructure projects will sufficiently mitigate traffic induced by an increase in trains.

Potential negative impacts. Two important surface separation projects currently underway are anticipated to mitigate increased rail traffic, irrespective of coal trains or other freight. The City of Seattle recently completed the South Street Spokane project, which includes a new connection to First Avenue South from the Spokane Street viaduct and Interstate 5, bypassing the BNSF mainline and providing direct access to Port areas from the freeway system. In addition, the Port contributed $300 million to the SR99 replacement project, which includes the construction of an overpass over the BNSF tail tracks near East Marginal Way South; this overpass is expected to be operational by the end of 2013. Both projects are intended to ease movement of truck freight into and out

[6] The seawall reconstruction will occur over three phases/zones, with most of the uprooting of road and sidewalk and replacement occurring during the off-season months. Each phase is assigned to a separate zone of the region, so that the entire project will be complete within three years.

[7] The plan would replace the existing space with about 40 parallel, metered parking spots along the new Alaskan Way.

of port terminals, and should sufficiently mitigate the risks of train crossing delays for freight truck.

Most trucks that leave the Port follow 599 south along the Duwamish, with the remainder heading north or east; the latter would take the Atlantic Street overpass to get on either I-5 or I-90. Overall the Port has made $1.5 billion (including the $300M for SR99) in local infrastructure improvements over the past 13 years. In the Port of Seattle's estimation, the increase in rail should not be a major concern for truck freight due to these infrastructure improvements (Styrk, 2013).

Context of freight movement at the Port. The majority of cargo entering and leaving the Port comes via rail directly to the terminal; this is especially the case at terminal 86, which primarily handles grain from the Midwest, and for intermodal (container) cargo handled at terminals 46, 18, and 5, and 30 (the latter more often used for overflow).[8] Many container shipments through the Port are loaded/offloaded between rail and ship, either directly at the terminal or drayed (i.e. trucked) between the terminals and the SIG and ARGO rail yards. Of the remainder, the majority are shipped via truck onto I-90 and I-5, unimpeded by rail crossings once the little H Atlantic Street bypass is completed in 2014, with the benefit of the SR519 and Spokane Street Viaduct. Another segment of truck freight going to trans-loading centers in the Kent Valley may possibly be affected by more rail traffic (though they would likely use the Spokane Street viaduct) to the extent it uses surface streets. This leaves containers destined to or from freight facilities in the Duwamish (estimated at about 20% of the Port's traffic) to use existing grade separations or travel east/west on surface streets. **Exhibit 7** helps illustrate these patterns for intermodal cargo (gross flows—imports and exports) While coal trains may cause some additional congestion, these delays are not expected to overflow into the primary freight truck arteries (Marginal Way, 519, and the Spokane Street Viaduct) (see **Appendix D** for primary trucking routes).

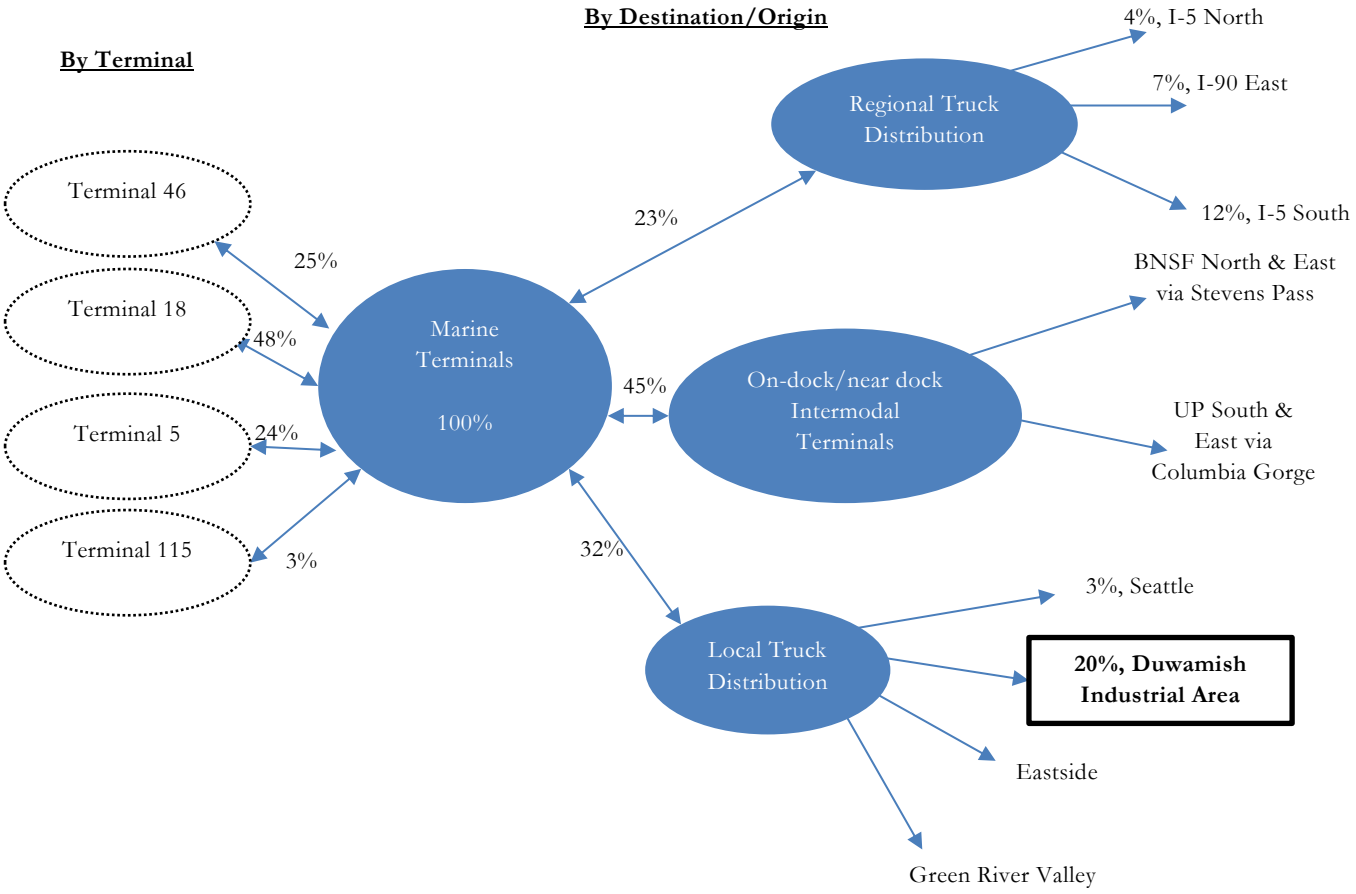
Environmental concerns. In interviews, the expressed minimal concerns about an increase in environmental risks associated with more coal trains. The majority of known dust emissions occur within 50 to 100 miles from the mining facility, and BNSF has required mining companies to use one of the three prescribed techniques for controlling coal dust (e.g., the use of a spray).

Potential benefits. The Port sees more upside to additional trains. The increase in traffic could prompt BNSF to make new rail investments, in particular "triple

[8] Terminal 91 is usually for one-time cargo shipments. The exception is for shipments of boring equipment used for the Alaskan Way tunnel, which are offloaded at T46.

tracking" to provide more capacity—more trains could mean more investment. Adding a new track would also allow for separation of freight and passenger rail—because freight trains give right of way for passenger trains, this would further mitigate rail traffic buildup. The Port also does not see more rail traffic displacing the shipment of products with greater direct benefit/return to Washington.

Exhibit 7. Projected Distribution of Intermodal Freight Volume, 2015



Source: Port of Seattle **(2003)**, based on Figure 14.

Property Value Impacts

Regional economics and property value impacts

Property value impacts are typically excluded from economic impact analyses, because of the transferrable nature of some of these impacts. In other words, while increased train traffic may make some specific parcels less desirable, and therefore be reflected in the market value of those parcels, the demand will often shift to other parcels in the market area and thereby increase their value, resulting in no net impact market-wide.

For instance, as an analogue, Zhang and Shing (2006), in their analysis of London's congestion charge zone program, found that the introduction of a vehicle charge on congestion to enter a designated zone led to property values outside the zone increasing in value relative to the properties inside the zone. This theoretical understanding may be of no consequence to property owners who are on the losing end of this impact, however. With these caveats in mind, this reports assessed the implications of coal trains for properties in close proximity to the mainline using a third party analysis.

Property value impact analysis

Analysis of property value impacts require property appraisals of those specific parcels affected, which this study is not. Climate Solutions (2012) commissioned an independent appraiser to estimate the extent to which the advent of more trains would lead to property value diminutions. The appraiser estimated diminutions of between 5-15% for Seattle properties, with the largest relative losses projected for single-family homes (ranging between 5 and 15%), but with a minimum diminution threshold of 5% across all land uses. The report considered train noise, vibrations, pollution (both real and perceived), and public stigma and perceptions as factors influencing property values.

The following findings of property along the affected corridor are intended to inform an understanding of property value impacts, rather than provide a net property values impact across the city. The analysis applied the estimated impacts from Climate Solutions report to existing King County Assessor values for total property value (land value plus improvement value) across the city within the identified rail buffer. The buffer included all parcels within 600 feet of BNSF mainline within Seattle, excluding parcels above the downtown mainline tunnel.

Across the entire city, 3,570 parcels (of all use types) reside within 600 feet of the BNSF mainline, excluding land above the downtown rail tunnel. Approximately 35% of all land area (measured in acres) within the buffer is classified as

residential, with a total assessed value (land plus improvement value) of $2.4 billion—roughly 30% of all assessed value within the 600 foot rail buffer.

Industrial land constitutes 25% of all land within the buffer, with an assessed land value of $1.2 billion, of which 53% is for warehousing. Importantly, industrial land does not include port terminal activities, which are classified as "Government and Services" and constitute 10.4% of all land (by acreage) within the buffer and with a total assessed value of $829.5 million.[9]

The analysis found that residential properties along the rail corridor would lose between $117.5 and $282.3 million (**Exhibit 8**). As explained in the previous section, it is possible that these losses might result in commensurate gains spread elsewhere across the regional housing market. Based on these estimates, Commercial land would stand to lose between $95.0 and $133.0 million in value, again expected to diffused as gains elsewhere in the office and retail markets.[10]

Exhibit 8. Implied Property Value Losses

Land Use	Number of Parcels[11]	Total Value ($mils)	Total Area (acres)	Estimated Losses ($mils)	
				Lower	Upper
Commercial	464	1900.6	452	95.0	133.0
Industrial*	443	1187.0	706	59.4	59.4
Single-family	1709	946.0	807	47.3	141.9
Multi-family	442	1404.0	188	70.2	140.4

**In both scenarios (high and low estimates), industrial lands were assigned a 5% depreciation.*

Source: Community Attributes Inc., 2013.

The Climate Solutions report found value declines among industrial lands as well, 5% depreciation. A 5% decline in industrial values would equate to $59.4 million in losses along the corridor.

[9] Data source: King County Property Assessment Data (2013).
[10] The Climate Solutions study did not separate out office space from other commercial space, though assessment data does differentiate between the two. In our application of the study we considered office space to be commercial space.
[11] Includes occupied and vacant parcels.

NEXT STEPS AND ADDITIONAL CONSIDERATIONS

The Puget Sound Regional Council plans to independently assess the economic benefits and consequences of the coal train activity for the broader central Puget Sound region in 2013. The findings in this report, while specific to the City of Seattle, may have broader regional dimensions, such as the traffic outcomes for manufacturers in the Kent Valley. A regional analysis could consider impacts on trade and economic development and the changes in property values and the distribution of these changes.

Interviewees expressed concerns that the seawall reconstruction, viaduct tear down, a possible arena in SODO, and long-term growth in Seattle's resident population will create additional stresses on the city's infrastructure and transportation system, including in the Duwamish and waterfront regions. Grade separations at South Lander and Broad Street should be considered.

While this report was focused precisely on the impacts of train volumes on the city economy, climate change is a serious issue and its impacts on Seattle should be better understood.

APPENDICES

Appendix A. Estimating the costs of congestion using a value of travel time approach

Assume a simple model in which vehicles are either 25 foot-long passenger cars or 60 foot-long commercial trucks. Take the estimates for minute-by-minute queue length for the three crossings modeled in the Seattle Department of Transportation study (2012): Broad, Holgate, and Lander (the latter two in the SODO district). To get an estimate of total queue length for all three intersections, simply sum the queue lengths for all three crossings over a 24 hour period. Then multiply this by the percentage of modeled traffic flow that are trucks and subtract the remainder (since there cannot have less than a full truck in queue). Since there are no data on the percentage of traffic flow by crossing that is truck versus car as measured in queue length, nor data on the timing of coal trains (the SDOT study modeled equally spaced intervals, while trains can pass through the city at random intervals), apply a percentage across the entire sum of queue lengths. To get the number of cars for all minutes of queue, subtract from the total queue the number of trucks multiplied by 60 feet (to remove the entire, summed length of all trucks in queue), and then divide by 25 feet, again removing the remainder (since we cannot have less than 25 feet of car).

Once the total number of cars and trucks in queue for a given percentage of trucks in the total queue length has been calculated, multiply the number of cars by the value of travel time (VOTT) for cars, divided by 60 minutes, plus the product of the number of trucks in queue and the VOTT for trucks divided by 60—the sum of these values is the estimated cost of delay in period 1. Because the data estimates for queue length are reported by the minute (for a total 1,440 minutes over a full day), the number of cars and trucks can be interpreted as car-minutes and truck-minutes in queue.

The VOTT estimates used come from two sources. The Washington State Department of Transportation publishes value of travel estimates of $76 for trucks and $16 for passenger vehicles (Washington State Department of Transportation, 2009), whereas the Puget Sound Regional Council has published estimates based on analysis in Puget Sound of $45 for medium trucks, $17.65 for home-based work single-occupant low-medium income vehicles, and $26.09 for home-based work single-occupant high-medium income vehicles (Outwater & Kitchen, 2008); the PSRC published additional estimates, but we only selected these estimates due to lack of additional information about traveler purpose (we averaged single-occupant estimates). Both sets of VOTT estimates were adjusted for inflation, using actual and forecasted for 2013 published by the U.S. Bureau of Labor Statistics (U.S. Bureau of Labor Statistics, 2013).

The equations below articulate these relationships.

Let $Q_{i,0}$ = total queue length for crossing i in the original period 0 and X = the percentage of traffic in crossing i that are trucks (of length 60 feet). Then,

Number of truck-minutes in queue before more coal trains = T_0

$= \sum_{i=1}^{3} Q_{i,0} * X_i$ / 60 feet - Remainder

And number of car-minutes in queue before more coal trains = C_0

$= (\sum_{i=1}^{3} Q_{i,0} - T_0 * 60)$ / 25 feet – Remainder

Costs of congestion before advent of more coal trains = $COST_{Before}$

$$= \frac{(T_0 * VOTT_{Trucks} + C_0 * VOTT_{Cars})}{60\ minutes} * (5 \text{ weekdays} * 52 \text{ weeks})$$

To get the net cost, the the above calculations were repeated using the estimated queue lengths with the advent of an additional 18 coal trains per day passing through Seattle. This would give new estimates of number of trucks in cars, T_1 and C_1, and total queue times of = $\sum_{i=1}^{3} Q_{i,1}$, allowing calculation of a net cost, which equals:

$$\frac{(T_1 - T_0) * VOTT_{Trucks} + (C_1 - C_0) * VOTT_{Cars}}{60\ minutes} * 5 \text{ weekdays} * 52 \text{ weeks}$$

To extrapolate for other intersections not modeled by the SDOT study, apply the projected percentage increase in queue length (in feet-minutes) for Broad Street to other North Waterfront crossings, and the Lander increase for Horton and Spokane. Then use the daily counts of trucks per intersection to calculate VOTT.

Appendix B. Interviewed Stakeholders

Representatives from the following organizations graciously contributed their expertise to the development of this report, directly through project interviews:

- American Life Inc.
- Argosy Cruises
- Burlington Northern Santa Fe Railroad (BNSF)
- Center for Advanced Manufacturing Puget Sound
- Climate Solutions
- Edgewater Hotel
- Great Wheel
- Ivar's Acres of Clams
- Manufacturing Industrial Council
- McMillan-Piper
- Port of Seattle
- Seattle Aquarium
- Seattle Department of Transportation
- Seattle Fire Department
- Sightline Institute
- SSA Marine
- Victoria Clipper
- Washington State Department of Transportation

Appendix C. Sample Interview Questions

Your Business & Clientele

1) What is the principal nature of your business?

2) How reliant are you on importing and exporting?

3) To what extent do you rely on rail for your business? What about on truck freight?

4) To what extent do you rely on the port for your business? Is your location in SODO (or North Waterfront) due in part to proximity to the port?

Impacts of Coal Trains

5) Are congestion and delays due to rail traffic already a concern/issue for your business? If yes, how so?

6) What factors helped drive your business to locate where it is? Will increased congestion from coal trains affect the advantages of your location? If so, please explain.

7) A recent study commissioned by the City of Seattle Department of Transportation estimated crossing gate delays at Holgate and Lander streets due to an additional 10 coal trains passing through Seattle in 2015 and up to 18 by 2026. Barring infrastructure investments to mitigate bottlenecks and further congestion, how might these further crossing delays impact your operations, employment, and sales?

8) If you (or your tenant businesses) use rail and/or truck freight, do you foresee an increase in train traffic and delays impacting shipping rates?

9) To what extent will congestion impact commute times for your employees?

10) If you are a property owner, do your anticipate any impacts on the value of your property? Please explain.

11) Are there ways you can adjust your business operations to mitigate these impacts? If so, please explain.

12) Do you foresee any positive benefits to more coal trains passing through Seattle? Please explain.

13) If these additional trains do begin to pass through Seattle, what do you think the city should do to resolve these issues?

14) Other concerns you would like to share.

Appendix D. Port of Seattle Truck Freight Flows in SODO Area

Sources: Port of Seattle (2012, p. 18); Community Attributes Inc.

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