

Appendix F

Railway Infrastructure and Train Volume Analysis



Memorandum

To: Steven Gray, Moffatt & Nichol (M&N)
From: James Todd (M&N)
Date: April 22, 2016
Subject: Terminal 5 Railway Infrastructure and Train Volume Analysis
Project: Terminal 5 Cargo Wharf Rehabilitation, Berth Deepening and Improvements

1.0 INTRODUCTION

Moffatt & Nichol (M&N) has been retained by the Port of Seattle (Port) to provide design support services, including support for the State Environmental Policy Act (SEPA) review for the Terminal 5 (T5) Cargo Wharf Rehabilitation, Berth Deepening and Improvements Project (the Project). Part of this effort includes assessing the potential for project-related short-term and long-term effects relating to existing rail infrastructure.

This memorandum describes existing rail infrastructure and volume of train traffic in the study area, applicable regulations and management, and what potential changes in rail infrastructure and train volumes could occur. Measures to avoid, minimize, or compensate for potential adverse effects are identified and include two operational measures:

- Alternative 2 requires the use of additional storage tracks in the West Seattle Yard (WSY). This will allow the staging of additional loaded cuts¹ for removal from the Terminal.
- Alternative 3 requires additional shifts to support Terminal operations as well as the transfer of additional staging to the WSY. The addition of the on terminal air system will require qualified technicians on terminal to perform brake tests for staged cuts of cars. The closure of the T5 and Terminal 7 (T7) driveways will be required due to the impacts of switching movements.

Mitigation measures are not required or proposed for construction for any of the alternatives.

2.0 STUDY AREA

The study area for rail infrastructure is bounded to the east by the BNSF north/south mainline tracks on the east side of 2nd Ave S and UPRR Argo Yard. To the west, the study area terminates at the BNSF West Seattle Yard and the West Marginal Branch along the west side of the Duwamish waterway (Figure 6).

¹ A cut is a term for two or more cars that remain coupled together.



Figure 1: Port of Seattle Terminal 5

Source: Google Earth

2.1 Existing Rail Infrastructure

Two Class 1 railroads serve the Puget Sound region: the BNSF Railway (formerly Burlington Northern and Santa Fe Railroad) and the Union Pacific Railroad (UPRR). The BNSF and UPRR are the successor railroads to the first railroads to reach Seattle. The transcontinental Northern Pacific Railway line connected to Seattle shortly after 1883. In 1893, the Great Northern Railway reached Seattle. Over the course of the 20th century, these two railways became components of the BNSF and UPRR². Between them, these two railways provide three main connections between Seattle and the rest of North America (Figures 2 and 3). These rail connections were a cornerstone of the development of international trade at the Port of Seattle.

The UPRR mainline terminates at Argo Yard in the southeast portion of the Duwamish industrial area. The yard is made up of multiple storage and loading tracks. Trackage rights allow for UPRR operations over BNSF owned track connecting to the Port's T5 and Terminal 18 (T18). Previously, UPRR provided shipping service to T5 over the BNSF track, but switching and spotting the trains between the terminal and Argo was performed by BNSF. From Argo Yard, the UPRR railway extends south on single track to Tacoma. South of Tacoma, UPRR operates through trackage rights on BNSF track to Vancouver, WA. South of the Columbia River, the UPRR can continue south or turn east on its own trackage. The south main connects with markets through California and the rest of the south central US. Running east from Portland, the UPRR serves the central plains to connect with major Midwestern markets³.

The BNSF mainline runs north/south from California, through Seattle and terminates at Vancouver, BC. Through California, the BNSF connects with southern and plains areas of the US. From Seattle, three main east-west routes converge at Spokane, WA, and continue on to the mid-west. The three eastbound routes from the Seattle area are: Seattle-Vancouver-Kennewick-Spokane (Columbia River route), Seattle-Auburn-Kennewick-Spokane (Stampede Pass route), or Seattle-Everett-Spokane (Stevens Pass route) (Figure 4). Depending on rail traffic volumes, expedited traffic normally travels the Stevens Pass route, while bulk cargo uses the Columbia River route (Figure 5). The Stampede Pass route reopened in 1996, but sees only light traffic and the tunnel at the pass is too small to pass double stack container trains⁴.

In the Seattle Industrial District, the north-south BNSF track connects to the north end of Argo Yard at the Coach wye⁵. The west leg of the wye skirts the north end of Argo Yard and turns north into the Seattle International Gateway (SIG) Intermodal Facility. The SIG has multiple storage and loading tracks that serve off-terminal containerized train traffic from the Port and other local customers. The SIG terminates at its north end with a dead end tail track on the west side of Alaskan Way (Figure 6).

The West Seattle Lead (WSL, also referred to as the Spokane Street Lead by the Federal Railroad Administration [FRA]) originates at a wye on the BNSF line north of Argo and south of SIG. The track crosses and then interchanges with UPRR track running north-south between the UPRR Argo and Whatcom Yards. The WSL continues west and is joined by a single track from the north end of Argo Yard. The two tracks continue across the southern end of Harbor Island with three leads north onto the island and then continues as a single track across the lift-bridge on the Duwamish River West Waterway. Just west of the lift bridge, the track is joined by the West Marginal Branch (WMB) from along the west side of the West Waterway. The WMB runs north south originating at the Port's Terminal 115 and terminating at the junction with the WSL. From the junction with the WMB, the two tracks continue north and west to T5, the BNSF West Seattle Yard (WSY) and the Nucor Steel Plant. The single track WMB to the south serves multiple industries along the western waterfront of the Duwamish River.

² <http://www.seattle.gov/cityarchives/seattle-facts/brief-history-of-seattle>

³ http://www.up.com/aboutup/reference/maps/system_map/index.htm

⁴ <http://www.bnsf.com/customers/where-can-i-ship/>

⁵ "Wye" refers to a triangular junction where three legs of rail intersect. Two legs are normally the main tangent through track with two switches leading to the third diverging leg



Figure 2 – BNSF National Network

Source: Wiki 2016

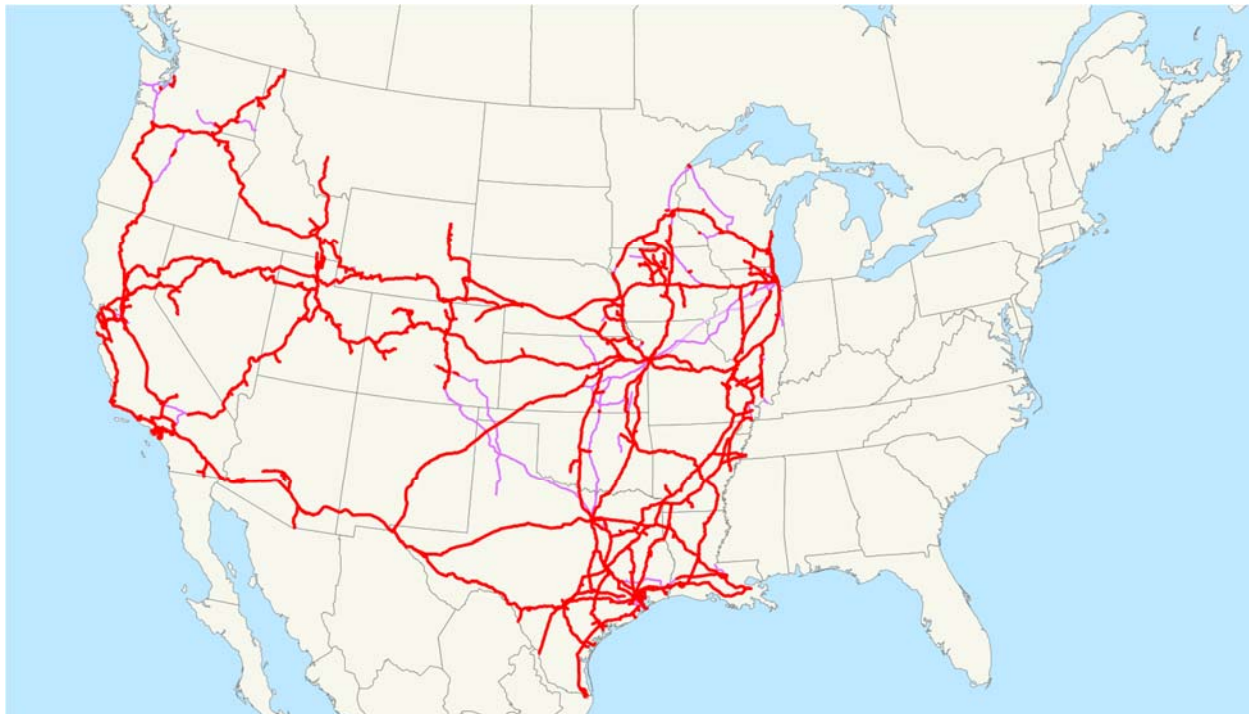


Figure 3 – UPRR National Network

Source: Wiki 2016



Figure 4 – Washington State Railways

Source: WSDOT 2013 Washington State Rail System



Figure 5 – Puget Sound Railways

Source: WSDOT 2013 Washington State Rail System

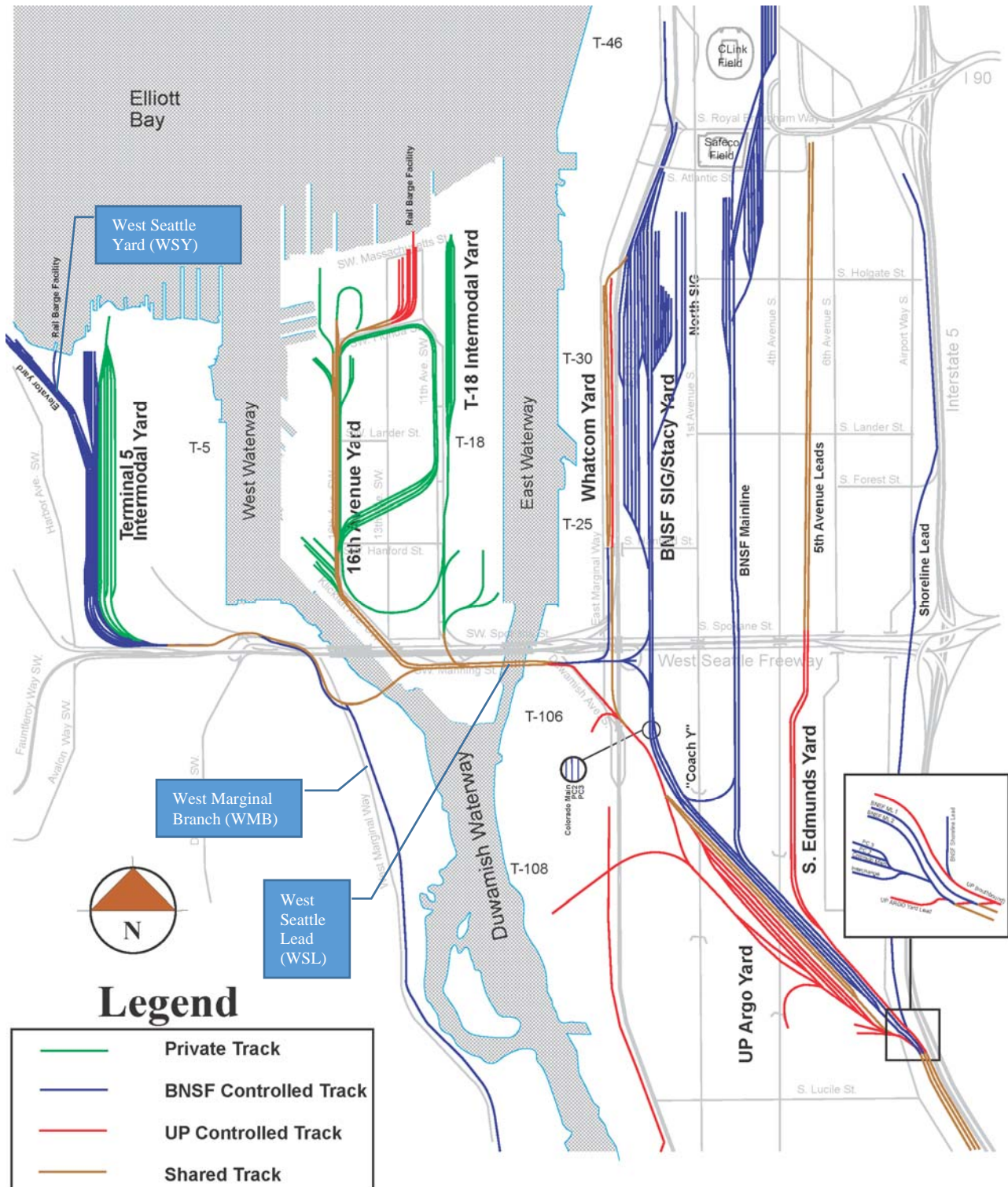


Figure 6 – Seattle Harbor Rail Network



2.2 Existing Freight Rail Traffic Volumes

The train counts in Table 1 represent traffic volumes on major segments of railway serving the Seattle area⁶. The current network is sufficient for existing freight rail volumes as indicated by the Daily Track Capacity in excess of the current Daily Train Volumes. Future demand will exceed track capacity through Stevens Pass and along the Columbia River Gorge.

Table 1: Freight Rail Traffic Volumes

Segment	Daily Track Capacity	Daily Train Volume (2010)
Seattle to Auburn	115 (BNSF) 48 (UPRR)	41 (BNSF) 10 (UPRR)
Seattle to Everett	81	33
Stampede Pass	39	6
Stevens Pass	28	16
Columbia River Gorge	40	28

The freight volumes forecasted by the Washington State Rail Plan anticipated increases in containerized, bulk and other commodities shipped throughout the State of Washington. The Plan also recognized that improvements to rail infrastructure are at the discretion and plans of the private railroads. Freight volumes can vary from year to year with commodity prices, demand and other factors. The current available capacity on each corridor is more than adequate to accommodate the peak 8 trains per day (4 each way) anticipated by the highest volume alternative (Alternative 3). Therefore no impact is anticipated to the rail network by the Project.

2.3 West Waterway Lift Bridge

The lift bridge over the West Waterway of the Duwamish River was originally constructed in 1928. The bridge is a single leaf bascule type with a single rail line. The bridge was improved coincident with the T5 redevelopment project completed in 1999. The improvements included renovations that support frequent and continuing intermodal train traffic. The bridge is normally kept open (raised) and lowered when needed for train movements. The bridge is owned and operated by BNSF.

2.4 Existing Infrastructure Constraints

The existing rail network between T5 and the UPRR/BNSF mainlines has several choke points. These existing nodes will constrict rail traffic in any of the proposed alternatives.

- The lift bridge over the West Waterway is a single track structure built in 1928. While fully operational at this time, increases in rail traffic will substantially increase the frequency of lifts.
- Rail traffic from Argo Yard must cross both WSL tracks to enter Harbor Island
- BNSF trains must cross a sharp reverse curve to enter the WSL from the south

⁶ Washington State Rail Plan, March 2014



- WSL trains departing to the north on BNSF must travel the reverse curve followed by back to back cross overs before entering the Coach wye.
- Trains must be broken into multiple cuts to spot in the Terminal. This requires off site power which can delay the moves as switching locomotives transit from the Industrial District to the Terminal. This can result in extended at grade street closures during switching.
- There is no on terminal air⁷. This lengthens the amount of time that a locomotive must idle to perform brake checks when picking up a cut of cars.

2.5 Existing System Improvements

Several improvements have been made to the roadway/railroad infrastructure in the project area since the original Terminal 5 EIS was prepared (1994).

- The Harbor Island roadway network was rebuilt as part of the Terminal 18 expansion in 1999. That project relocated the lead railroad tracks to Harbor Island and T18 under the SW Spokane Street Bridge (these trains previously crossed Spokane Street at grade near 11th Avenue SW). The T18 project also reconfigured SW Spokane Street to create the frontage road system, which simplified the intersection at 11th Avenue SW.
- In 2012 the Port and its partners completed the East Marginal Way grade separation project on Duwamish Avenue South. The overpass improves road and rail access to Port terminals, BNSF and UPRR intermodal rail yards and regional manufacturing and distribution facilities. It also benefits motorists and industrial vehicle traffic moving to and from West Seattle. The road now rises over railroad tracks which connect rail mainline with the on-dock rail at the port's T5 and T18. The grade separation is expected to reduce railroad crossing vehicle delay, which was estimated at more than 270 hours daily in 2010⁸.

3.0 RAILROAD OPERATIONS

Once reactivated, the tenant at T5 will have the option to select either BNSF or UPRR as their freight rail handler. While BNSF owns the track crossing the West Waterway, the UPRR has shared trackage rights leading to the Terminal. The prior tenant of T5 selected UPRR. In that scenario, UPRR landed the trains at T5 in two cuts onto the terminal storage tracks. BNSF was responsible for any switching or further building of the trains. UPRR then pulled the loaded trains from the storage tracks and out of Seattle to the South.

Rail operations at T5 are similar regardless of the carrier chosen by a tenant. UPRR and BNSF will use similar circulation and processes for trains serving the Terminal. Rail operations outside of the Terminal, mainly east of Harbor Island, do vary between the two carriers. Trains moved to the BNSF mainline must travel through difficult geometry at the east end of the WSL, but have additional options for leaving the Seattle area. UPRR has a more direct route from the Terminal, but their options for reaching inland markets are limited to the mainline south to Portland. Ultimately, it will be the decision of the tenant to negotiate rates and services with the rail carriers. The discussion below summarizes operations in the near Terminal area for both carriers.

⁷ On terminal air allows connection of cars to a site wide compressed air system that replicates the air supplied by a locomotive. This would allow brake testing of the cars prior to the arrival of the locomotives

⁸ <https://www.portseattle.org/Supporting-Our-Community/Regional-Transportation/Pages/East-Marginal-Way-Grade-Separation.aspx>



3.1 Train Operating Speeds

Train speeds in the study area are limited to 20 mph. However, switching movements are typically conducted at 5 mph and most freight trains in the area do not operate above 10 mph. Sharp curves, multiple crossings and crossovers, as well as the draw bridge over the Duwamish, all contribute to lower speeds. Limited accelerations of freight trains further reduce operating speeds. Amtrak passenger trains are the exception to this tendency. Amtrak operates north south on the BNSF main tracks. The passenger trains are lighter and their terminus is further north of the study area at King Station. This allows Amtrak trains to operate closer to the 20 mph speed limit on the BNSF mainline in the eastern limits of the study area.

Except for local movements to and from the Amtrak Yard near South Holgate Street, no passenger trains operate on tracks off the BNSF mainline in the study area.

3.2 BNSF Operations

This section describes BNSF operations between T5 and their north south mainline. Full trains are typically 7,500 feet (ft) long with locomotives (7,200 ft without power). The full train may be received in the storage tracks adjacent to the WSY in two cuts.

Inbound trains are brought through Seattle to the Coach Wye. The train travels through the wye and double crossovers onto the northbound track towards SIG. The trains then diverge west onto the WSL. This is a potentially problematic geometry (curve-crossover-crossover-curve-curve) with reversing lateral movements. The train travels across the southern end of Harbor Island, across the lift-bridge, and then past the switch to the Terminal working tracks and onto the storage tracks adjacent to the WSY. Because the storage tracks are not long enough to store a full train, the train cuts off approximately 4,500 ft on the storage track and the locomotive runs around to pull the rest of the train into the storage tracks.

There are many variables that can impact the amount of time that it takes to deliver a full train to the Terminal including throttle behavior, bridge operations and track availability at the WSY. However, the time span for arriving trains can be approximated as shown in Table 2.

Table 2: Train Arrival Sequencing

Sequence	Duration (minutes)
Full length train arrives, pull first cut past yard switch	14
Cut off trailing length	10
Pull leading cut clear of yard switch	-
Cut off locomotive	10
Run around to trailing cut	9
Connect to trailing cut	10
Pull trailing cut into storage	14
Total Duration	67



The times in Table 2 represent the dwell time once a train has crossed the Western Waterway. The trailing cut of cars will clear the bridge and allow raising the span during delivery operations.

Departing trains will be staged on the storage tracks in similar sized segments. The returning locomotive will attach to the shorter segment, pull through the terminal switch towards the lift bridge and then reverse to connect to the longer segment. Full brake tests are performed as the two segments of the train are connected. The sequence of steps taken for departing trains is approximated in Table 3.

Table 3: Train Departure Sequencing

Sequence	Duration (minutes)
Pull leading cut out past yard switch	14
Push back through yard switch to second cut	-
Connect trailing cut	10
Pull out trailing cut	14
Total Duration	34

Note that in the approximation of both the arriving and departing sequences the brake testing time is omitted. See section 3.2 for discussion of brake test classification and durations.

Between the delivery/return of full trains, smaller cuts of cars are shifted to and from the storage tracks into the Terminal working tracks. Typically three cuts of train segments are moved from the storage yard to the working tracks. These intermediate moves would require movement of sole locomotives to the Terminal for pulling and shifting cuts of cars from one track to the other. These moves are inefficient and can be minimized with careful management of on Terminal circulation and staging.

3.3 UPRR Operations

UPRR operations to T5 are similar to BNSF's except that all trains depart south through Argo Yard. This is a more direct departure that does not require the movement through the Coach and WSL wyes.

3.4 Near Dock Rail Operations

Near dock rail refers to the movement of containers by truck to railyards for loading onto trains. These movements serve two purposes: allows the inclusion of containers in mixed commodity trains to destinations that do not require full trains, and allows movement of containers to other carriers beyond the primary one serving the terminal. These movements do not require movement of trains to and from the Terminal, but the volume of near dock traffic must be accommodated in railyards in the Seattle area.

3.5 On Terminal Rail Operations

There will be intermittent movements of cars between the working tracks in the intermodal yard (IY) and the storage yard. These movements will consist of partial cuts of cars, typically around 1,200 or 1,500 ft long, and will be conducted by switching engines. The switch engines will attach to the south end of the cuts, pull the cars out past the first yard switch and then push the cars up in to the storage yard. The switch engines would typically bring cars back into the IY on the return trip.



Note that the partial cuts can vary depending on container handling in the IY. Inefficient staging and coordination in the yard could result in more frequent movements of smaller cuts of cars between the IY and the storage yard.

3.6 Brake Testing

Brake tests are a critical component of railroad safety. The testing is mandated by the FRA⁹ at five levels depending on the make-up and operation of a train.

Train brakes use air pressure generated either off train by a compressed air system (at terminals) or by the attached locomotive. The compressed air charges reservoirs on each car that then actuate the brakes. The trains are connected in sequence to form a single pressurized line. When pressure in the line drops (as when the engineer moves the locomotive into braking), the reservoirs discharge into the individual car brakes to slow the train. Leaks along the line can cause the brakes to accidentally engage. Leaks when the train is built can result in low reservoir pressure which undermines the braking capacity of the train. And, over time, wear on the individual cars can lead to failures of the individual cars' brakes.

The different levels of brake tests mandated by the FRA were established to identify failures in the brake lines. The classes range from the most involved (Class I) to the least (Transfer)¹⁰. Three of these tests are applicable to terminal operations: Class I, Class III and Transfer.

A Class I brake test will be required for most trains operating at T5 due to several conditions:

- Location where train originates operating in excess of 20 miles – trains departing T5 and traveling outside the Seattle area will exceed the 20 mile threshold
- Location where train consist¹¹ is changed – with limited exceptions, this applies to locations where trains are separated or cut into segments or assembled as long inter-modal trains
- Location where a train is off air for more than four hours – cars that are disconnected from a locomotive lose air and must be rechecked when reconnected to a locomotive

A Class III brake test must be performed in initial terminals whenever a locomotive is changed, a car or block of cars are removed (but the consist otherwise remains intact). This test will be applicable when cuts of cars are added or removed or when locomotives need to be changed out from an existing train.

Transfer brake tests will be required for trains that will travel less than 20 miles. This situation will arise if a partial consist is loaded and then moved off terminal for inclusion in other complete trains at SIG or Argo.

Part 232 of 49 CFR outlines 19 tasks that are required in various classes of brake test. The tasks are generally summarized as follows:

- Class I Brake Test – this test consists of three main steps: connect and pressurize the train; check pressure drop and airflow at the end of the train away from the locomotive or air source; walk the length of both sides of the train checking for kinks in the hoses, for engagement and release of the brakes and for piston travel in each brake; and provide documentation of the completed brake test to the engineer.

⁹ Brake tests per 49 CFR 232.607 - Inspection and testing requirements.

¹⁰ See extended text of CFR Part 232 for locations and conditions outside of terminals that require further brake testing. Off terminal brake checks are considered outside the limits of this project.

¹¹ A consist is a group of cars making up the train, or more commonly a group of locomotives connected together.



- Class III Brake Test – this test omits the check for release and piston travel, but keeps the other tasks from a Class I test. This test still requires an inspector walk both side of the train, but they are only checking for engagement and attachment.
- Transfer Brake Test – this is the simplest test. It requires a pressure check and a check that the brakes engage. Similar to the other classes, this test requires a walkdown of both sides of the train.

The exact times that each test requires can vary greatly depending on lighting, weather, and inspector's experience level. The simplest approximation is to take the length of the train, and assumed walking speed and an allowance of time per car for inspection depending on the class of test performed Table 4).

Table 4: Brake Check Times by Class

Brake Test Class	Length of Train ¹²	No. of Cars / Connections	Walking Time (2 mph)	Inspection Time	Total Brake Test Time
Class I	7,200 ft	94	81 minutes	94 minutes	3 hours
Class II				47 minutes	2 hours
Transfer Test				0 minutes	1.5 hours

The above tests are critical to ensuring safe operation of trains throughout the railroad networks. These are tests that are meticulously followed by all responsible railroad operators.

3.7 Railroad Locomotives

Current railroad operations are conducted primarily with six and four-axle diesel locomotives. The larger six axle locomotives are used for mainline and full train movements. The smaller four-axle locomotives are often used for shorter distances and lighter trains.

All locomotives in use in the Seattle area have diesel engines that drive generators feeding electric powered axles. Most of the locomotives in use have been upgraded to meet Tier 1, 2 or 3 air emissions targets as mandated by the Environmental Protection Agency (EPA)¹³. With limited exceptions, all locomotives constructed after 2015 are required to meet Tier 4 emissions standards¹⁴. The EPA tiered emissions requirements are applied by year of manufacture. All rebuilt locomotives are required to meet the emissions standards in effect at the time of their refurbishment (currently tier 4). Most locomotives are rebuilt on roughly 15 year intervals¹⁵.

There are also strong economic incentives for more efficient locomotives and more efficient operations. Both Class I Railroads have expanding programs including cylinder deactivation, alternative fuels and alternative drive systems¹⁶. These programs are not mandated, but they are pursued for both economic and stewardship principles.

¹² Typical trains are 7,200 ft long without power

¹³ 40 CFR part 1033 - Emission Standards and Certification Requirements, 40 CFR part 1068 - General Compliance Provisions, and CFR 1033.601 for instructions on applying the compliance provisions to locomotives. All available at <http://www3.epa.gov/otaq/locomotives.htm>

¹⁴ Discussion of EPA tiered regulations at <https://www.dieselnet.com/standards/us/loco.php>. Some of the excepted locomotives include historic steam-powered locomotives, all-electric locomotives, and some existing locomotives owned by small businesses.

¹⁵ EPA "Control of Emissions from Idling Locomotive" available at <http://www3.epa.gov/otaq/locomotives.htm>

¹⁶ <http://www.bnsf.com/communities/bnsfandtheenvironment> and <https://www.up.com/aboutup/environment/>



Rail road operators have the responsibility to determine where, and in what use, newer locomotives are deployed within their system. However, over time, the tier 4 compliant locomotives and switch engines will enter use in the Seattle operations of both railroads.

3.8 Rail-Street Crossings

The study area is located in a densely developed industrial district in south Elliot Bay, the Duwamish Industrial Area. Rail lines in this area cross multiple arterial surface streets and pass numerous commercial and industrial access points. There are also multiple private driveway crossings of the railways. All of these crossings expose trains to the danger of collision with vehicles that fail to yield right of way or have otherwise blocked the crossing. Trespassing is also a serious problem in any urban setting. There are opportunities for individuals to trespass on railroad right of way and be struck by trains.

The FRA retains accident data for all crossings in the US. For the 20 year period from 1995-2015, there were 29 accidents including 2 injuries involving freight trains in the study area¹⁷. There were no fatalities due to impacts with freight trains in the last 20 years. Table 5 summarizes the last 20 years of accident data for the study area:

Table 5: Accidents at Rail-Street Crossings Impacted by Terminal Rail Operations

Crossing No.	Name	No.	Injuries	Fatalities	Crossing Warning, Protection
933592P	Private - Yard	1	0	0	Stop signs
927504N	Private	1	0	0	Private crossing signs, crossbucks
096445R	E Marginal Way	13	2	0	Signs, signals, crossbucks
096442V	Spokane St.	1	0	0	Signs, signals, crossbucks, mast mounted lights
809548P	Colorado St.	2	0	0	Signs, signals, crossbucks
096202N	Chelan Ave. SW	2	0	0	Signs, signals, crossbucks, mast mounted lights
Total		20	2	0	

Note that of the 13 accidents at East Marginal Way, 12 occurred prior to the construction of the East Marginal Way Grade Separation. Since the construction of the overpass, there has only been one accident at the crossing.

Safety is a primary railroad concern in controlling train speeds. Switching at all yards is accomplished at speeds under five mph. Transfer movements on the BN from SIG/Stacy to the Ballmer Yard may reach 10 mph. Train crossings of surface streets result in street closures of 1 to 17 minutes in duration. Table 6 shows estimated street closure times in minutes associated with three train lengths.

Street closures by trains create traffic delays only to the extent that street traffic exists. Total traffic delays during a train crossing average half of the total street closure time. For example, in the affected line of delayed vehicles, the first car experiences full delay and the last car experiences zero.

¹⁷ Data gathered from FRA accident reports at <http://safetydata.fra.dot.gov>. Crossing analysis omits locations beyond T5 rail traffic and also omits accidents involving Amtrak and Sounder trains.



Table 6. Train Crossing Delays (minutes)¹⁸

Train Speed	Full Train ¹⁹	Half Train	Quarter Train
5 mph	17.4	9.2	5.1
10 mph	9.2	5.1	3.0
20 mph	5.1	3.0	2.0

3.9 CAPACITY

Previous Terminal 5 operations included up to two inter-modal trains in and out of the Terminal per day or 14 trains per week. Past operations also included switching moves between the Terminal 5 inter-modal rail facility and adjacent inter-modal storage tracks.

Prior operations at Terminal 5 relied on a 1:1 ratio of working to storage tracks at the Terminal. The balance of storage and working tracks is critical to the efficient conduct of on dock rail operations at container terminals. Deficient storage capacity requires additional moves on working tracks such as staging and swapping empty and loaded cuts of cars. During these moves on working tracks, loading and picking work must stop in the vicinity of the track where cars are being moved. Minimizing the number of times cars are moved to/from working tracks helps reduce interruptions to the marshaling operations.

4.0 PROJECT DESCRIPTION

In response to industry changes in marine cargo shipping practices, the Port is evaluating improvements to ensure that T5 will be capable of meeting industry needs. Three alternatives are being considered as part of the Project EIS and are described in brief detail below. Alternative 1, the No Action Alternative, provides a baseline of conditions for comparison when discussing the action alternatives.

The overall volume of train born traffic increases incrementally from each alternative to the next. However, the proportional share and distribution of rail traffic is the same for all three alternatives. It is forecast that 75% of the terminal container traffic will be carried by direct rail. That share is further divided such that 25% of the terminal traffic will be handled by near dock rail and 50% loaded to on dock rail. On dock rail includes use of the existing six track T5 inter-modal rail transshipment facility and use of the adjacent existing five track inter-modal storage yard. Near dock rail is loaded to truck chassis and then drayed to either the SIG (BNSF) or Argo (UPRR) for loading and incorporation into mixed use trains. These divisions are summarized in Table 7.

¹⁸ Closure times include 30 seconds closure before the arrival and 30 seconds after the passing of the train for the crossing to clear and gate arms to rise. Closures may be shorter at ungated/un-signalized crossings depending on driver behavior and failure to observe driving regulations.

¹⁹ Typical trains are 7,500 ft long with locomotives



Table 7: Rail Container Distribution

Mode	Percentage Share of Terminal Throughput
On Dock Rail	50%
Near Dock Rail	25%
Total Rail Share	75%
Truck Share	25%

Three alternatives are proposed for freight operations at Terminal 5:

4.1 Alternative 1 or No Action Alternative.

The No Action Alternative assumes that no improvements would be made to the existing site other than minor alterations, routine maintenance and repair work, none of which would impact throughput capacity.

In this alternative, on dock rail throughput will generate up to 9 full outbound trains per week during peak operations. Near dock rail will generate an additional average 5 trains per week during peak operations.^{20,21}

The reactivation of the terminal to the previous throughput does not require modification to the existing track.

4.2 Alternative 2: Wharf improvements, increased cargo-handling efficiency and volume.

Alternative 2 would rehabilitate the existing T5 container cargo pier and deepen the existing navigational vessel berth access. Upland improvements could also be constructed to support the above wharf upgrades.

With improvements to the terminal, T5 could generate up to 18 full on dock trains each way per week and an additional 9 near dock trains per week during peak operation.

No terminal rail modifications are required, but this alternative will require the expansion of storage into the WSY beyond the previously utilized storage tracks.

4.3 Alternative 3: Wharf improvements, relocate buildings, and densify rail yard, optimized cargo-handling efficiency and volume.

Alternative 3 would reconfigure and expand the on terminal storage track to accommodate further increases in cargo volume.

The reconfigured track and shifted operation would support up to 24 full on dock trains each way per week and an additional 12 near dock trains per week during peak operation.

This alternative would require the transition of additional train building operations to the WSY as well as the installation of on terminal air at the receiving and departing tracks to allow for more rapid turnaround of outbound trains. This alternative will require the addition of third shift train moves only during peak operations.

²⁰ M&N conceptual design and model

²¹ Alternative 1 represents no modification to the existing infrastructure of T5, but does represent a shift in inter-modal split from previous terminal operations. Previous operations did not reach the volume of rail traffic that is forecast in the reactivation. The historical 45% percentage share of truck volume is forecast to drop to 25%.



The distribution and share of containerized traffic is discussed above. The estimated terminal generated train traffic for the three alternatives are summarized in Table 8.

Table 8: Peak Weekly Terminal 5 Train Volume

Mode	No. of Trains per Week (each way)		
	Alternative 1	Alternative 2	Alternative 3
On Dock Rail	9	18	24
Near Dock Rail	5	9	12
Total Trains	14	27	36

4.3.1 On Terminal Air

On terminal air is required to support the number trains forecast as part of Alternative 3. The availability of on terminal compressed air can potentially decrease the amount of time that locomotives are on site and idling to provide air pressure during a brake test. While the necessity of the tests is unquestionable, it is worth noting that any class of brake test requires a substantial amount of time.

At terminals without a separate compressed air supply, arriving locomotives must attach to a cut of cars and then idle while the brake test is performed. In each brake test class, a person or persons must walk the entire length of both sides of the train. Depending on the class of test being performed, there are multiple features of each car that must be inspected. All this is performed while the locomotive engine is idling on site.

At terminals with a separate compressed air supply, the bulk of a Class I or Class II brake test can be performed prior to the arrival of the locomotive. The train is built and the brake system pressurized using the terminal air. The consist is inspected to the required class of test prior to the arrival of the locomotive. When the locomotive arrives, a valve in the lead car is closed to isolate the pressurized brake system and the terminal air is disconnected. The locomotive is connected and the end of train pressure and flow are checked. After this one Transfer test, the train may depart. In this operation the majority of the test is performed prior to the arrival of the locomotive and reduces idle times at the terminal.

The use of on terminal air to reduce turnaround times does require coordination between the terminal and railroad operators to ensure that the test is completed prior to the arrival of the locomotive. This also requires that a Qualified Mechanical Inspector (QMI) be on site to perform all tasks as part of Class I tests. Class III and Transfer tests may be performed by a Qualified Person (QP) or QMI. These persons are designated by the railroad as having demonstrated knowledge and ability to inspect the railroad cars.

5.0 RAIL AGENCIES REGULATIONS AND MANAGEMENT

This section describes the agencies, laws and regulations in place that helped to identify potential impacts to rail infrastructure and train traffic.

5.1 Laws and Regulations

Laws and regulations for determining potential impacts on rail traffic are summarized in Table 9. More information about laws and regulations is provided in Chapter 4, Environmental Health and Safety. The agencies and roles relative to the legislation are described in the following section.



Table 9: Laws and Regulations

Laws and Regulations	Description
Federal	
Interstate Commerce Commission Termination Act (49 U.S.C. 101)	Re-establishes the Surface Transportation Board and upholds the common carrier obligations of railroads; requires railroads to provide service upon reasonable request.
Federal Railroad Administration Regulations (49 CFR 200–299)	Establishes railroad regulations, including safety requirements related to track, operations, and cars.
State	
Title 81, Transportation – Railroads, Crossings (RCW 81.53)	Establishes requirements and process for railroad construction and extensions that would cross any existing railroad or highway at grade. Includes approval from the commission.
WSDOT Local Agency Guidelines M 36-63.28, June 2015, Chapter 32, Railroad/Highway Crossing Program	Focuses on adding protection that improves safety and efficiency of railroad/highway crossings. Provides a process for investigating alternatives for improving grade-crossing safety. Alternatives include closure, consolidation, and installation of warning devices
WSDOT Design Manual M 22.01.10, July 2013, Chapter 1350, Railroad Grade Crossings	Provides specific guidance for the design of at-grade railroad crossings.
Rail Companies - Operation (WAC 480-62)	Establishes operating procedures for railroad companies operating in Washington State. Includes general and procedural rules, safety rules, reporting requirement rules, and the establishment and distribution of a grade-crossing protective fund.

U.S.C. = United States Code, CFR = Code of Federal Regulations, RCW = Revised Code of Washington

5.2 Federal Rail Agencies

The Federal government controls interstate commerce to the exclusion of State and Local entities. Interstate rail system and railroad operators are primarily overseen by two federal agencies: the Federal Railroad Administration (FRA) as part of the US Department of Transportation, and the Surface Transportation Board (STB) as successor to the Interstate Commerce Commission (ICC). The Federal Transit Administration (FTA) has oversight of passenger transit systems that do not connect to the national freight rail network. Therefore, the FTA does not have jurisdictional oversight in this project.

In addition to the primary oversight of the FRA and STB, other Federal agencies have jurisdictional oversight of portions of railroads' operations as well as direct involvement with corollary State and Local agencies. These Federal roles are summarized in Table 10.



Table 10: Federal Agencies

Agency	Scope of Activity	Authorities/Responsibilities
Federal Railroad Administration (FRA)	Train/Track Safety	<ul style="list-style-type: none">• Develops and enforces basic operating rules for train safety, tank car safety, railroad industrial hygiene, rail equipment safety, and grade crossing safety and trespass prevention.• Oversees employee hours of service regulations and signal and train control regulations.• Inspects and audits railroad track.• Tracks rail movement of spent nuclear fuel and radioactive waste.• Manages the Rail Safety Improvement Act of 2008 (RSIA).
	Rail Funding/Financing	<ul style="list-style-type: none">• Oversees Railroad Rehabilitation and Improvement Financing program (RRIF).• Manages American Recovery and Reinvestment Act (ARRA) as it relates to freight railroads.• Administers rail grants through various programs.
	Guidance	<ul style="list-style-type: none">• Provides guidance and analysis of rail services.• Produces the National Rail Plan, outlining national priorities for freight and passenger rail networks, incorporating input from state rail plans.
Surface Transportation Board (STB)	Administrative Authority	<ul style="list-style-type: none">• Settles railroad rate and service disputes.• Reviews proposed railroad mergers, acquisitions, abandonments and new line construction.
Pipeline and Hazardous Material Safety Administration (PHMSA)	Hazardous Materials Safety	<ul style="list-style-type: none">• Regulates and enacts rules that ensure safe movement of hazardous materials.• Tracks data on hazardous materials.• Permits, inspects and enforces safety of hazardous materials.
Department of Homeland Security (DHS)	Security	<ul style="list-style-type: none">• Establishes requirements for national rail security strategy and risk assessment.• Tracks hazmat shipments.• Creates railroad requirements for developing institutional risk assessments.• Conducts programs for rail security training.• Conducts rail security research and development (R&D).
DHS: U.S. Coast Guard	Construction Permitting and Funding	<ul style="list-style-type: none">• Manages permitting for structures crossing navigable waterways.• Administers Truman-Hobbs Act, which funds bridge projects over navigable waterways.
Environmental Protection Agency (EPA)	Environmental Regulation	<ul style="list-style-type: none">• Regulates and establishes locomotive emission standards.• Enforces the National Environmental Policy Act (NEPA) that requires environmental review for proposed rail projects.
U.S. Army Corps of Engineers	Construction Permitting	<ul style="list-style-type: none">• Manages permitting for construction on waterways and wetlands.

Source: Washington State Rail Plan, Integrated Freight and Passenger Rail Plan 2013-2035



5.3 State and Regional Agencies

Non-Federal oversight of freight rail is limited by the federal preemption for interstate commerce. Outside of economic and safety oversight, nonfederal agencies are engaged in many other aspects of the rail industry, particularly in the realm of planning, coordination, investment, and, to some degree, safety. The key nonfederal agencies involved in these topics are described in Table 11.

Table 11: State and Local Agencies

Agency	Scope of Activity	Authorities/Responsibilities
Washington State Department of Transportation (WSDOT)	Rail Funding/Financing	<ul style="list-style-type: none">• Manage and direct the state's rail programs (both freight and passenger; and both capital and operating).• Oversees the state's freight grants and loans programs, and developing the State Rail Plan.• Prepare and administer the State Rail Plan.• Develop the State Freight Mobility Plan in cooperation with the Freight Mobility Strategic Investment Board (FMSIB).
Freight Mobility Strategic Investment Board (FMSIB)	Rail Planning and Financing	<ul style="list-style-type: none">• Designate strategic freight corridors with WSDOT research.• Develop criteria for projects.• Administer project grants.
Washington State Utilities and Transportation Commission (UTC)	Train/Track Safety	<ul style="list-style-type: none">• Monitor railroad operations, crossing signals and track.• Inspect crossings and evaluate company-filed petitions for crossing changes and close clearances.• Regulate movement of hazardous materials.• Provide education and outreach as part of the Operation Lifesaver program.• Investigate accidents and complaints from the public.
City of Seattle Department of Transportation (SDOT)	Rail Planning	<ul style="list-style-type: none">• Prepare and administer the SDOT Freight Mobility Plan.• Maintain and improve roadway approaches to at-grade crossings.

Source: Washington State Rail Plan, Integrated Freight and Passenger Rail Plan 2013-2035

5.4 Other Organizations

Non-governmental organizations that weigh significantly in the railroad industry are listed in Table 12. While these two do not have specific statutory authority, their standards and guidelines are enforceable as cited by multiple railroads, agencies and organizations.



Table 12: Other Organizations

Organization	Scope of Activity	Authorities/Responsibilities
American Railway Engineering and Maintenance-of-Way Association (AREMA)	Rail design, safety, operation and maintenance	<ul style="list-style-type: none">• Develop and advance the technical and practical knowledge and recommended practices for the design, construction and maintenance of railway infrastructure• By citation, complete standards for construction of track, roadway, structures and other ancillary railway improvements
Association of American Railroads (AAR)	Rail Planning and Financing	<ul style="list-style-type: none">• Advance public policy that supports the interests of the freight rail industry• Establish safety, security, and operating standards• Prepares comprehensive statistical records• Support research, development and testing through the Transportation Technology Center Inc. (TTCI), Railinc, and the Railroad Research Foundation.

6.0 POTENTIAL IMPACTS TO RAIL INFRASTRUCTURE AND RAIL TRAFFIC

6.1 Construction

Construction at Terminal 5 will incur minimal impacts to the railroad infrastructure. The track reconfiguration in Alternative 3 would require slight modifications to the track interchange at the south end of the terminal. This connecting track work will be performed during scheduled windows.

6.2 Operations

6.2.1 Alternative 1 or No Action Alternative

There would be no impact to capacity or operations under Alternative 1. This alternative represents the resumption of terminal operations that are nearly identical to the prior function of the Terminal.

6.2.2 Alternative 2: Wharf improvements, increased cargo-handling efficiency and volume

There would be no impact to the capacity or operations under Alternative 2. The additional utilization of storage track in the WSY will support the programmed rail traffic volume over the existing system.

6.2.3 Alternative 3: Wharf improvements, relocate buildings, and densify rail yard, optimized cargo-handling efficiency and volume.

There would be impacts to the capacity and operations under Alternative 3. Additional train building operations will have to be transferred to the WSY. The storage tracks will have to be upgraded with on terminal air. Additional shifts will be necessary to allow movement of trains from the Terminal to the WSY without interruptions to the on terminal loading.



6.3 Potential Mitigation Measures for Impacts to Rail Infrastructure and Rail Traffic

6.3.1 During Construction

No mitigation measures are required during construction of the three alternatives.

6.3.2 Operations

Alternative 1 requires no operational mitigation.

Alternative 2 requires the use of additional storage tracks in the WSY. This will allow the staging of additional loaded cuts for removal from the terminal.

Alternative 3 requires additional shifts to support terminal operations as well as the transfer of additional staging to the WSY. The addition of the on terminal air system will require qualified technicians on terminal to perform brake tests for staged cuts of cars.

6.4 Significant Unavoidable Adverse Impacts

No significant impacts to rail infrastructure and train traffic would be anticipated from any of the Alternatives.

7.0 POTENTIAL MITIGATION MEASURES FOR IMPACTS TO NOISE, AIR QUALITY AND VEHICULAR TRAFFIC

The following potential mitigation measures are provided for information and are not required mitigation for impacts to Rail Infrastructure and Capacity. These measures may or may not be deemed necessary mitigation for other impacts in the project area.

7.1 Near Terminal Driveway Impacts

Increasing rail volumes moving to and from Terminal 5 will result in additional closure times of near terminal driveways and at grade crossings (Figure 7). The additional closures do not require mitigation for impacts to rail infrastructure and capacity. However, the driveways may have to be closed due to impacts to truck and vehicular traffic in the alternatives.

Arriving and departing trains have an additional impact on near terminal crossings beyond the simple transit time for a train to move through the crossing. These impacts are compounded by the switching movements between the Intermodal Yard of the Terminal and the adjacent storage yard. The arrival-departure of full 7,500 ft trains will impact all five of the crossings west of the West Waterway, but the switching movements will only impact the two western crossings: the T5 and T7 entrances.

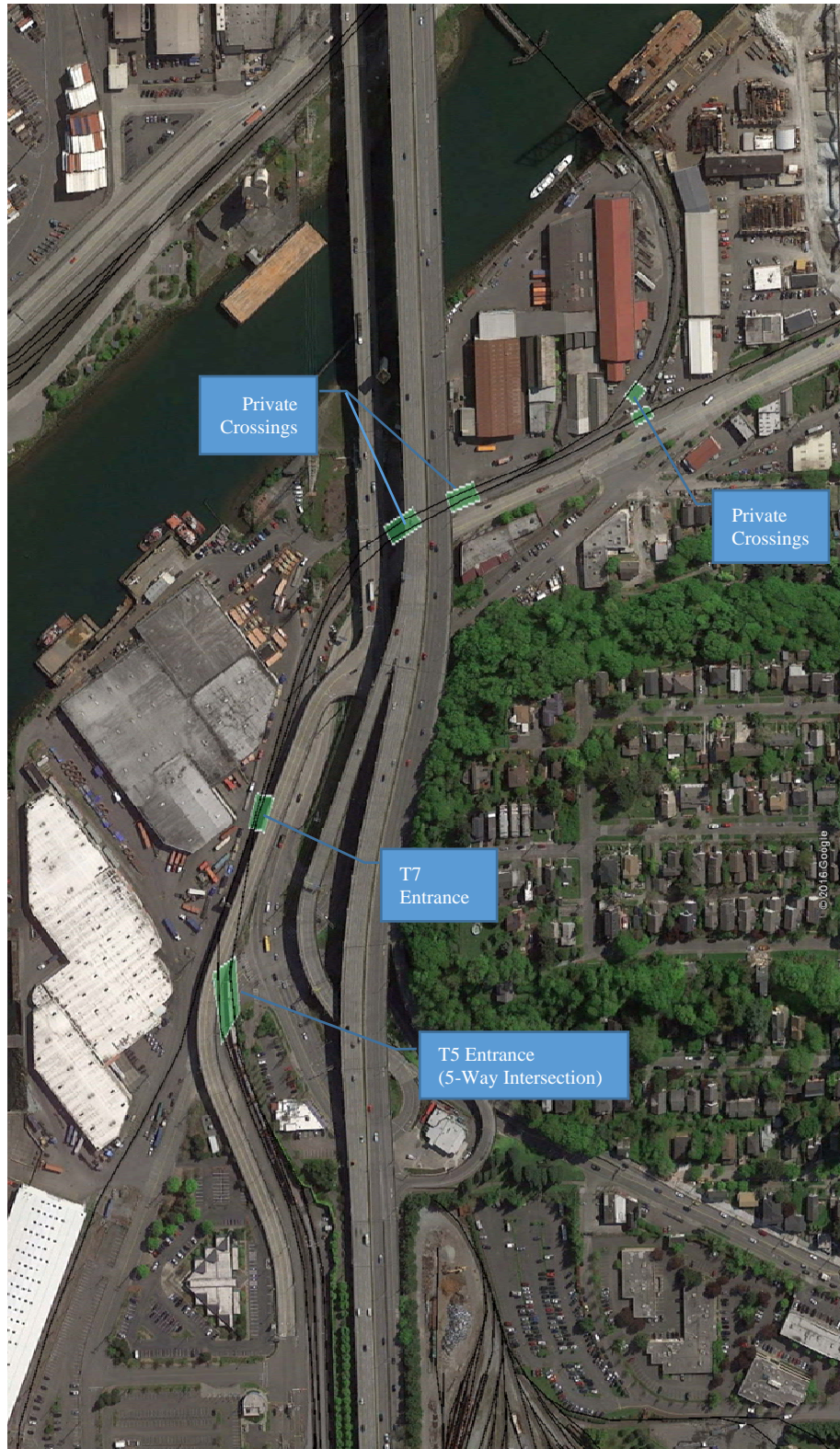


Figure 7 – Near Terminal Crossings

Source: Google Earth



Once across the West Waterway Bridge, arriving trains must stop and split out cuts of cars for staging on the Terminal storage tracks. Similarly, departing trains must be assembled and brake tests performed which can impact the crossings. These times are broken down in Section 3.2 above. At the proposed level of operations at T5, the delays at the five near terminal crossings can be considered cumulative during peak 24 hr periods as summarized in Table 13:

Table 13. Near Terminal Crossing Impacts – Train Arrival/Departure

Activity	Alternative 1	Alternative 2	Alternative 3
Trains/Week	9	18	24
Trains/Day	2	3	4
Inbound Closures (67 min/train)	134 min	201 min	268 min
Outbound Closures (34 min/train)	68 min	102 min	136 min
Total Closure Time per Day	202 min (3 hr 22 min)	303 min (5 hr 3 min)	404 min (6 hr 44 min)

In addition to the arrival/departure of complete trains, there are intervening switching movements between the IY and storage tracks that cause additional closures of the two crossings nearest the Terminal: the T5 and T7 drive entrances. Cuts of either 1,200 ft or 1,500 ft are moved between the two yards. Generally it takes at minimum three – 1,500 ft and 2 – 1,200 ft cuts to make a complete trains. The closure impacts due to switching movements are summarized in Table 14.

Table 14. Near Terminal Crossing Impacts – Switching

Activity	Alternative 1	Alternative 2	Alternative 3
Trains/Week	9	18	24
Trains/Day	2	3	4
Closure for 1,500 Ft Switches/day (3 per train, 17 min per switch)	102 min	153 min	205 min
Closure for 1,200 Ft Switches/day (2 per train, 14 min per switch)	55 min	82 min	109 min
Total Closure Time per Day	623 min (10 hr 23 min)	934 min (15 hr 34 min)	1,246 min (20 hr 46 min)

Note that the switching impacts only occur at the T5 and T7 gates. Furthermore, the full closure times only occur at the T5 gate. The T7 gate is further east and only experiences approximately 1/3 the time of closure as the cuts pull out and reverse direction to move through the yard switch.

The *Transportation Technical Report for the Terminal 5 Improvement Project*²² has recommended that the surface access to Terminal 5 be closed to improve operations at the five-legged intersection at SW Spokane Street/West Marginal Way SW/SW Chelan Avenue. The surface access is the north leg of this

²² Heffron Transportation, Inc.



intersection. Closing this access allows the intersection to operate with more conventional signal phasing, and would eliminate the railroad pre-emption phase that goes into effect whenever a train crosses that leg. Given the potential increase in rail closure times of that intersection with Alternative 2 or 3, the north leg would effectively be blocked for much of the day. The vehicular traffic analysis determined that the overpass which connects from SW Spokane Street to Terminal 5 as well as the private properties north of the tracks (Terminals 7A, 7B and 7C) has adequate capacity to accommodate all of the truck traffic generated by the terminal and those businesses.

7.2 Railway Safety

The increase in the number of trains crossing the West Waterway will increase the opportunities for vehicles and pedestrians to interfere with the safe operation of the railway. The existing crossings near the Terminal are provided with minimal crossing protection measures. Figure 7 shows the locations of the near Terminal crossings west of the West Waterway.

Only the driveway to Terminal 5 has lighted signals (flashers) at the crossing. The other driveways only have signs indicating the potential passage of trains. Furthermore, the corridor is open to sidewalks and adjacent parking. There are abundant opportunities for pedestrians and vehicles to impinge on the railway and expose themselves to serious injury, damage and even death.

There are two measures that can help increase safety on the rail corridor: crossing safety equipment and fencing the rail corridor.

The addition of gates and flashing signals would help reduce opportunities for vehicles to collide with trains. Due to the varied approaches and striping at driveway entrances, quad gates might be necessary to prevent runaround movements.

Fencing the rail corridor would help reduce two current conflicts: trespassing and parking. The open corridor provides multiple locations where parked vehicles and equipment can intrude on the railway operating envelope. Pedestrians have no barriers to trespassing between the sidewalks and track. Chain link fencing would help to seal off the railway and reduce such conflicts.

7.3 Quiet Zones

If noise from increased rail operations is deemed adverse, a new quiet zone could be implemented to mitigate for this impact. Quiet zones are not required as mitigation for impacts to rail infrastructure and capacity under any of the alternatives.

Quiet zones are sections of track where trains are, in certain conditions, prohibited from sounding horns. Trains use horns in a number of circumstances and are considered a vital element of the safe operation of trains. The horn is typically sounded in switching operations when the train begins to move. The horn is sounded continuously when persons or vehicles are sighted in the way of the train. Horns are also sounded at the approach to all at grade crossings with roadways. Quiet zones are implemented in segments of track to reduce the use of the horns in the last situation, at approaches to roadways. The trains will still sound their horns for trespassing pedestrians and blocking vehicles, even in quiet zones.

The FRA provides guidance on the establishment of quiet zones. The steps in part include²³:

1. Identify the crossings in the intended quiet zone. The new quiet zone must be at least ½ mile in length along the railroad tracks.

²³ Part III of FRA “Guidance on the Quiet Zone Creation Process”



2. A new quiet zone must have, at a minimum, flashing lights and gates in place at each public crossing. These must be equipped with constant warning time devices where reasonably practical, and power out indicators.
3. Private crossings that allow access to the public or provide access to active industrial or commercial sites, must conduct a diagnostic team review of those crossings. The recommendations of the team's review must be implemented.
4. Using the FRA's Quiet Zone Calculator, compare the Quiet Zone Risk Index (QZRI) to the Nationwide Significant Risk Threshold (NSRT). If the QZRI is less than or equal to the NSRT, the Quiet Zone may be designated through public authority²⁴.

The steps described above involve qualifying a quiet zone without implementing any Supplementary Safety Measures (SSMs) or Alternative Safety Measures (ASMs). If the calculator indicates that the proposed quiet zone will not qualify, necessary measures must be implemented. Public Authority Designation requires the implementation of SSMs, grade separations, crossing closures, or wayside horns.

If every public crossing in the proposed Quiet Zone is equipped with one or more SSMs and the QZRI falls below the Risk Index with Horns (RIWH), the Quiet Zone may then be designated through public authority.

To meet the minimum ½ mile length, the quiet zone could be developed between the T5 entrance at the five-way intersection and the lift-bridge over the West Waterway. The zone would exclude the track south along the WMB. The quiet zone would include the one public crossing at the entrance to T5 and 4 private crossings: the entrance to Terminal 7, access to the parcel between the high and low bridges, entrance to the north side of Riverside Mill, and the double crossing on the south side of the Mill (Figure 7). The public crossing to T5 has flashers. The private crossings only have signs. Also, most of the length of the track in this area is unfenced and allows unimpeded access to pedestrians trespassing on the railroad right of way.

Subject to a detailed technical assessment, the implementation of a quiet zone in this area would, at a minimum, require substantial upgrades at all five crossings (crossings arms, flashing lights and associated track circuitry). The quiet zone would also require securing the right of way with chain link fence to reduce the ease of trespassing on the right of way. These measures would mitigate for the loss of protection afforded by the audible warnings of an approaching train. In principle, the mitigating measures for a quiet zone outweigh the loss of the train horns and result in a net increase in crossing protection. In the case of the near terminal driveways, the installation of physical barriers to trespassing pedestrians and impinging vehicles would provide a substantial net improvement in safety.

It is standard practice for the crossing authority to maintain the added crossing equipment not the railroad. Agreements would have to be introduced for SDOT to maintain the crossing protection equipment.

The costs and footprint required to upgrade additional crossings east of the West Waterway makes an eastward extended quiet zone infeasible. There is not enough space available to install the gates and other equipment necessary to upgrade all of the crossings on Harbor Island.

7.4 On Terminal Air

As discussed in Section 6, the addition of an on terminal air system will result in substantial reductions in idle times for locomotives assembling departing trains. The air system is necessary to mitigate for impacts to Rail infrastructure in Alternative 3, but might be warranted in other alternatives as a mitigation to air quality impacts. See EIS section on air quality impacts for discussion of potential mitigation measures.

²⁴ Quiet Zones established by comparison to the NSRT are subject to annual FRA review (rule section 222.51).

