2017 Marine Cargo Forecast and Rail Capacity Analysis

Appendix A
Rail Capacity Analysis

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and

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Prepared by

BST Associates
PO Box 2224
Anacortes, WA 98221-8106

BST Associates
Market Research & Strategic Planning

with

MainLine Management, Inc.
The Beckett Group
IHS Markit

The Beckett Group

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Introduction and Background

MainLine Management Inc. (MLM) was retained by BST Associates (BST) to assist in the preparation of the 2017 Cargo Forecast Update and Rail Capacity Study for the Washington Public Ports Association (WPPA) and Freight Mobility Strategic Investment Board (FMSIB). MLM and BST previously teamed to perform similar studies in 2004, 2009 and 2011.

In previous studies, rail model simulation was not employed. Rather, the earlier capacity analyses involved the use of "Static Analysis" by line segment and corridor. Static Analysis is a non-simulation assessment of the capability of a line segment or corridor to efficiently handle rail demand based on projected train volumes on existing and/or potential infrastructure.

For this current analysis, it was decided to utilize rail model simulation for the greater rail network within Washington State, essentially the BNSF Railway (BNSF) network. The model simulation program used for this analysis was the Rail Traffic Controller (RTC) simulation suite, which is utilized by all Class I North American railroads and is accepted as the standard analysis program for analyzing rail operations and capacity under various operating protocols, train volumes and infrastructure design. A discussion of RTC, its requirements and capabilities is contained below in the section on Methodology and Analysis.

Initially, it was determined that five (5) different analyses for rail capacity consumption would be tested:

1. Base case of current operations and infrastructure.
2. Growth case of train volumes at 2020 with infrastructure and capacity improvements as identified.
3. Growth case of train volumes at 2025 with infrastructure and capacity improvements as identified.
4. Growth case of train volumes at 2030 with infrastructure and capacity improvements as identified.
5. Growth case of train volumes at 2035 with infrastructure and capacity improvements as identified.

For the above cases, model simulation was utilized for cases 1-4. Static Analysis was utilized for the 2035 case. In developing the work plan for the above analyses, it was first determined that for the simulation cases only critical line segments/corridors as identified would be simulated in cases 1-4; the balance of the BNSF network in the State would be analyzed utilizing Static Analysis. The line segments/corridors not analyzed with model simulation were the Stampede Pass route between Auburn and SP&S Junction near Pasco, and the Stevens Pass route between Everett and Spokane. For the 2035 growth case the entire network was analyzed with Static Analysis rather than model simulation.

Statistics for the growth cases were developed by BST and converted to train operating volumes by commodity and train type by MLM. BST has developed three different views of potential growth: low growth, medium growth and high growth. Due to time and funding constraints it was determined that performing 13 different rail capacity analyses (seven model simulation and six Static Analyses) was prohibitive. Consequently, it was agreed between MLM, BST, and the clients that MLM would perform one analysis for each of the five cases. The Base

Case of current operations was based on the best information that MLM could develop as discussed in the Methodology Section below. For the 2020 growth case it was agreed that the medium growth projections developed by BST would be utilized to develop revised train volumes and operating plans for simulation purposes. For the 2025, 2030 simulations and 2035 Static Analysis, BST's high growth projections were incorporated into the revised train volumes and operating plans.

The following sections discuss the methodologies and findings from each of the cases studied.

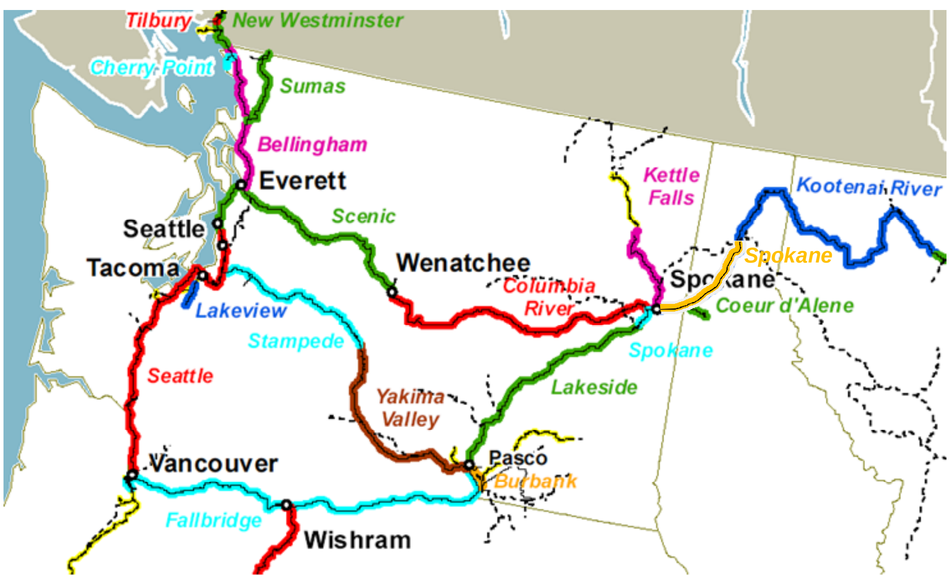
MLM does not represent that the capacity improvements and/or operational adjustments it introduced into the various simulation cases are requirements that BNSF would likely employ as growth in train volumes occurs. MLM introduced infrastructure and operational enhancements in a manner that it believes is reasonable given the significant growth in train volumes that were tested. The modifications were included to satisfy the ability of the model to successfully complete specific simulations with performance results that reasonably compared to previous case results.

MLM believes that BNSF, as it has done in the past, will invest in infrastructure improvements and make operational adjustments as demand requires and that best fits their strategies. The improvements that BNSF might make may be different than those MLM introduced into the model over the course of the simulation analyses. BNSF reviewed the draft analysis, and elected to not endorse or refute the results.

Model Network and Route Description

This section will provide a high level review of the entire track network used in the rail capacity analysis. Figure A-1 below displays BNSF's rail network in the Pacific Northwest, with the stations and the subdivision names shown on the map for reference.

Figure A-1: BNSF Pacific Northwest Mainline Rail Network



Sandpoint Junction to Spokane

The Montana Rail Link (MRL) main line connects to the BNSF main line at Sandpoint Junction in Sandpoint, ID. BNSF dispatches the route between Sandpoint and Spokane. This section of railroad is part of the Spokane Subdivision, which is a portion of BNSF's main corridor from the Pacific Northwest to Chicago. The line between Spokane and Sandpoint experiences high levels of traffic because it handles both Pacific Northwest to Chicago and Pacific Northwest to southeast trains. Domestic and international containers, manifest, grain, oil and autos are the primary commodities that move over the Northern Corridor route between Sandpoint and Minneapolis/Chicago. MRL traffic, including coal, grain and manifest moving between the southeast and the Pacific Northwest add to the northern tier traffic.

The segment between Sandpoint and Spokane is structured with large sections of multiple main tracks to accommodate the high volume of traffic. Where single track remains, sidings are closely spaced to facilitate train movements. There is a fueling and inspection yard at Hauser, ID; based upon the data that was used for this study, a high percentage of westbound freight trains and almost every eastbound freight train stops at Hauser to change crews, to be fueled or to be inspected. These stops can last from 10 minutes (crew change only) to up to three hours (fueling and inspection of trains with distributed power). Hauser is approximately 20 miles east of Spokane.

Spokane to Pasco

BNSF's tracks split just west of Spokane at Latah Junction. One route turns west towards Wenatchee, WA and the other route continues south towards Pasco, WA.

The route between Spokane and Pasco is BNSF's Lakeside Subdivision. The line is heavily utilized by manifest and Portland intermodal/container trains and hosts two Amtrak trains daily. Pasco is a major classification yard for BNSF manifest traffic.

Loaded unit trains moving to destinations between Vancouver, WA and Vancouver, BC also remain on the Lakeside Sub route towards Pasco. Grain, coal, and oil trains use this route because the grades are favorable as they do not exceed 1%. As will be described later, while the route to Wenatchee is actually shorter for trains moving to Seattle or north of Seattle, there is a section of 2.2% grade over the Cascade Mountains that restricts BNSF from using the route for loaded unit traffic.

The Lakeside Sub is a mix of single and multiple main tracks. Siding spacing in the single track portion is 5 to 9 miles between sidings. Existing siding lengths are 8,100 feet. The multiple main tracks are located on the section of the route where there are 1% grades to facilitate the continual movement of traffic in areas where heavy, loaded trains run slowly. BNSF invested multiple millions of dollars in 2014 and 2015 to construct additional second main tracks in locations that were determined to require additional main line capacity. All those improvements have been included in the simulation model based on information that was available to MLM and the public.

Pasco to Vancouver

At Pasco, the BNSF Fallbridge Subdivision turns west and follows the Columbia River to Vancouver, WA. The Fallbridge Sub is almost entirely single track; sidings are spaced 9 to 12 miles apart. The siding lengths alternate between 7,000 and 9,300 feet for the eastern half of the route, and are between 8,500 and 11,000 feet on the western half. There is approximately five miles of multiple main tracks just east of Vancouver; this section is used to stage trains that are arriving into the Vancouver/Portland area.

With the increase in unit traffic, BNSF has begun to institute an operating strategy that focuses westbound loaded unit trains on the Fallbridge Sub. The track is river grade between Pasco and Vancouver which is advantageous for heavy trains running over it. Eastbound traffic on the Fallbridge Sub consists of Portland intermodal trains, municipal waste trains operating to Roosevelt, some empty unit trains that originate between Vancouver and Centralia and manifest trains from

Seattle, Tacoma, Longview, and Portland/Vancouver that are destined to Pasco for classification. Westbound trains consist of loaded grain, coal and oil trains, empty municipal waste trains returning from Roosevelt, Portland intermodal trains, and manifest trains destined to Portland/Vancouver, Longview, Tacoma, Seattle and Everett. There is also a pair of Amtrak trains that run between Portland and Spokane that operate over the Fallbridge Sub.

Finally, all trains moving between the Pacific Northwest and California use the Fallbridge Sub to access Wishram, where the trains turn south and run towards California. Manifest, some unit trains, and empty intermodal trains are the most frequent users of the route to/from California from Wishram.

Vancouver to Seattle

At Vancouver, the BNSF Seattle Subdivision connects with the Fallbridge Sub and turns north towards Seattle, WA. From Vancouver to Tacoma, WA, BNSF shares the trackage with Union Pacific trains and multiple Amtrak movements; BNSF is the controlling operator. Between Tacoma and Seattle, UP exits the BNSF trackage and runs on its own route to Black River Junction, which is 10 miles south of Seattle. BNSF and UP share trackage between Black River and Argo, where UP exits to their own yard.

Between Tacoma and Seattle, BNSF also shares the tracks with Sound Transit's commuter rail operation.

The Seattle Sub is two or more main tracks for the entire distance between Vancouver and Seattle with the exception of a one mile section near Tacoma. The multiple main track configuration is required to accommodate the high volume of trains that utilize the route daily. There are crossovers between the main tracks every five to seven miles which provide the ability to move faster trains around slower trains.

Seattle to Everett

From Seattle to Everett, WA, BNSF's Scenic Subdivision runs along Puget Sound and is multiple main tracks with two very short single track sections. BNSF shares the tracks with multiple Amtrak trains and weekday Sound Transit commuter trains. Intermodal and container traffic from Seattle and Tacoma use this portion of the route to Everett where those trains turn east towards Wenatchee. Unit coal traffic continues north at Everett towards Roberts Bank, while unit oil trains move north towards Anacortes and Cherry Point.

Everett to Canadian Border

The Bellingham Subdivision between Everett and the Canadian Border is a single track railroad with sidings. The sidings on this line are spaced between 11 and 15 miles apart. Their lengths vary between 6,300 and 12,000 feet.

All unit trains to or from Canadian destinations use this line, as well as manifest trains that handle local Vancouver BC traffic and traffic being interchanged to/from Canadian National and Canadian Pacific Railways. Unit oil trains and manifest traffic destined to Cherry Point also utilize the Bellingham Sub to Custer, where they diverge to their destinations. There are also two pairs of round trip Amtrak trains that run between Seattle and Vancouver that use the line.

The Sumas Subdivision diverges from the Bellingham Sub at Burlington, WA. One train per day in both directions operates over the Sumas Sub between Burlington and Sumas. It handles local on line traffic and interchange from Canadian Pacific at Sumas.

Oil trains operating to or from Fidalgo/Anacortes diverge from or enter the Bellingham Sub at Burlington, as well.

Everett to Wenatchee, Wenatchee to Spokane

The Scenic Sub runs from Seattle through Everett and then turns east towards Wenatchee. At Wenatchee, the route turns into the Columbia River Subdivision which continues east to Latah Junction near Spokane. At Latah Junction, the line rejoins the Spokane Sub which continues east towards Sandpoint.

The Scenic Sub east of Everett is single track with sidings spaced between six and sixteen miles apart. This configuration continues on the Columbia River Sub, however there is a stretch of double main line tracks that is 20 miles long in the middle of that line segment. Like the route between Seattle and Everett, the Scenic and Columbia River Subs handle intermodal and container trains from Seattle and Tacoma, along with some vehicle trains and a manifest train that runs between Everett and Spokane. Amtrak's Empire Builder also uses this route.

The Scenic Sub features 2.2% grades on both sides of Stevens Pass, and an 8 mile tunnel at the summit. The heavy grades restrict the operation of loaded unit trains over the route. While it is not impossible to shove this type of heavy train over the summit, the amount of locomotives and the resulting slow speeds have discouraged BNSF from using the route for that type of traffic. Instead, BNSF leaves the route for faster, lighter intermodal trains that are usually more time sensitive than unit trains.

When traffic volumes allow, BNSF will run empty unit trains via the Scenic and Columbia River Subs back to Spokane and then east to their destinations. Unit empties from Canada and from oil facilities near Anacortes are candidates to operate via these line segments. However, it is a daily call that is made by management based on the volume of other high priority traffic on the two subdivisions.

Auburn to Ellensburg, Ellensburg to Pasco

The Stampede Sub and the Yakima Valley Sub run between Auburn, WA and SP&S Junction near Pasco. The Stampede Sub is a single track railroad with sidings spaced 20 to 25 miles apart. The sidings generally are not used because BNSF operates the Stampede (and Yakima Valley) Subs as a directional railroad. Trains depart Auburn for Pasco, but there are no through trains that run from Pasco to Auburn.

The Yakima Valley Sub is also a single track railway with sidings spaced 15 to 25 miles apart. Again, it is primarily operated in the eastbound direction for through trains. There are local road switchers that operate between Pasco and Yakima and Yakima and Ellensburg to serve local industries; these trains do require some traffic to use the sidings when they are out and operating.

The Stampede Sub features a 2.2% grade on both sides of Stampede Pass, and a two mile tunnel at the summit of the pass. The tunnel is not tall enough to allow double stacked containers and some freight cars through, so currently, the route is restricted to lower profile cars. Empty unit traffic from Seattle, Tacoma, north of Everett and occasionally Centralia, Longview, Kalama and Portland will operate on the Stampede Sub to access Pasco. This includes empty coal, grain and oil unit traffic. Some manifest trains from Everett to Pasco also use the route as long as there are no high profile cars on the train.

This route limits the number of empty trains that need to use the Fallbridge Sub in the eastbound direction, which improves the capacity of that subdivision. While local Everett, Seattle and Tacoma traffic use the Stampede Pass route on a daily basis, traffic from Centralia and stations south of Centralia only operates via Stampede when there are heavy volumes of westbound traffic on the Fallbridge line. Otherwise, it is shorter to send the trains via the Fallbridge route, and it is less costly because it reduces fuel requirements.

Methodology

Model Simulation

To meet the goals of the study, rail computer model simulation was utilized to determine the impact of existing and projected future rail operations within BNSF's Pacific Northwest (PNW) rail network. Model simulation is an important tool in providing data for analytical studies in complex rail environments. All simulations were performed with the Rail Traffic Controller (RTC) model. RTC is used by all Class 1 railways in North America and has been accepted as the primary tool utilized in rail simulation analysis.

The RTC model performs complex mathematical calculations that represent trains moving throughout a defined network of main lines, passing tracks, yards, turnouts and junctions. The model considers track speed, train length and weight, motive power, signals, bridges, train priorities and other information as trains are dispatched across the network. The dispatching algorithms are able to resolve conflicts at junctions, diamonds, yards, diverging routes, and on single track to reflect actual rail operations. A user can manually modify decisions the model makes based upon the user's knowledge of rail operations or desired outcomes for meets, overtakes or other operations.

The model creates output that can be formatted and analyzed to understand what is occurring across the entire network as trains are dispatched to and from designated destinations. Based on the technical capabilities of the model, train delay, train velocity, node occupancy and schedule adherence can all be analyzed.

The model requires the development of a network of main lines, passing tracks, yards, and junctions that accurately represent existing (and potential future) routes. For this study, the network is described in the Modeling Network Section of the report. It was created utilizing portions of networks that MLM had previously developed, and was filled in with the remaining sections of the network. Track charts, timetables and other data that MLM had from other studies were used to develop the sections of the network that had not been previously created. In areas that had been previously created, these same documents were used to update track information where it was necessary.

In addition, the model requires that train schedules are supplied that indicate the starting time, origin, destination, and dwell times of all trains and switch engines operating over the network. As discussed in a later section of the report, MLM developed train operating information from various sources. More detail of how the operating plan was developed is included in that section.

The size of the PNW network was such that the analysis required that a three day simulation be developed over seven days. Days 3, 4 and 5 are the three days that were analyzed in the simulation. Days 1 and 2 were "warm up" days, which were used to load the model with traffic prior to starting the analysis days. Days 6 and 7 were "cool down" days, which were required because the RTC model only records trains in the output file after they finish their runs. In other words, if the train does not arrive at the scheduled destination, the train is dropped from the output. With the network being as large as it is MLM needed two full cool down days to ensure that all trains from Day 5 completed their run so they would be included for analysis.

During a simulation, the model identifies every possible path for the route that each train is directed to, and then attempts to run the train over the path that creates the least "cost" for the network. Cost is defined by a number of factors including mileage, adherence to schedule (primarily for passenger trains) and train priority. When a conflict occurs between two trains, the model evaluates alternatives and attempts to find the alternative that creates the least cost to the network. This is repeated in the seven days of simulation until all trains are dispatched from their origin locations and they arrive at their destinations or until the simulation is terminated.

The model generates a large data base of information for each simulation scenario. For each simulation MLM breaks the data down into days and by segments to understand the operational impact as projected traffic and infrastructure changes are added in the later scenarios. The types of analysis that were performed are discussed in more detail below.

Analyses Performed

As mentioned, the model creates a large amount of data as it performs the simulations. This data is analyzed to determine where conflicts occur, or how operations change as infrastructure or rail traffic levels are modified.

Delay Analysis

MLM utilized the data to develop two major analysis applications involving delay. For RTC, delay is defined as time that a train must wait because the route it needs to take is unavailable. This could be because there is another train using the route, a drawbridge is open, a turnout is lined in the wrong direction or other scenarios. A train that accumulates delay is ready to move, but it cannot because of an obstruction. If the train is intentionally held to represent time for a crew change, an inspection or other operational functions, no delay is assigned during the period the train does not move.

The first analysis performed was to develop delay minutes for each 10 train miles operated (referred to as “D/10”) within the network segments. D/10 provides a measurement of how fluid the network is under specific operating conditions. D/10 consists of all delay to trains and engines moving in a section of the network divided by the number of miles those trains and engines operate. That result is multiplied by 10 so the number doesn't require precision behind the decimal point. The number indicates how many minutes of delay can be expected in the section of the network for every 10 miles a train or engine operates.

The D/10 measurement allows comparison between cases that have differing number of trains and track configurations. When trains are added to a scenario (such as growth over time), more delay and more miles are accumulated in every section where the additional trains are included. If total delay were analyzed without considering miles operated, a scenario with a higher volume of trains would likely have higher delay totals. However, when delay totals are divided by train miles operated, a ratio is created that takes into account different train counts, operations and miles operated. Past studies have shown that analyzing D/10 creates a measurement that is easily understood when compared between scenarios.

As scenario modifications are made, if D/10 significantly increases, it is a clear indication that additional delays are occurring because of those modifications.

The second type of analysis performed was locating delays that occurred during each simulation that exceeded 30 minutes (referred to as “D>30”). Based upon MLM's experience with railroad operations, there are always going to be some delays in a railway network. There are many movements within a large network, and frequently, movements conflict with each other. Most of the delays arising from the conflicts are minor, and once they have occurred, trains resume their normal operation. However, some delays indicate problem areas, which is why D>30 delays are evaluated.

From past analysis experience, MLM has chosen 30 minutes as a minimum delay length that requires review. If a train is delayed for 30 minutes or more, there may be a serious network flaw or operational procedure that is creating that delay. If this delay occurs repetitively, MLM has found that it is worth exploring what is causing the delays and to determine if there is a modification that will reduce or minimize them. 30 minutes is strictly arbitrary; the threshold could just as easily be 15 minutes or 60 minutes. However, MLM believes that a delay of 30 minutes or more exceeds what would be considered normal, unavoidable delays and therefore requires review.

D>30 and D/10 are averaged over all three analysis days of the simulations. These values are then graphed or described for comparison with other scenarios.

With the data that RTC collects for each train movement, average velocity over a designated line segment can be calculated. This can be done for all freight operations on a line segment, or it can be broken down by train type. Individual average train velocities can also be developed, although detail to that level of specificity is rarely utilized.

Train Volumes

The model records every train that passes through every node of the network in the output files. MLM has developed an analysis that allows any specific node to be queried to find out all the trains that pass through the node, what time the train arrived and departed the node, and how fast the train was operating at the node.

This information was used to develop train volumes at locations through the PNW network. On many line segments, this involved analyzing multiple locations because of junctions or major industries, which alter the train counts from one location to the next. The train counts were recorded so volume changes could be compared with delay results.

Grade Crossing Analysis

MLM also developed an analysis that determined how often and for how long the grade crossings on the network were occupied by rail movements. To do this, nodes were included into the model network that represented the location of the various crossings being studied. The model records when the head end of a train enters each node and when the rear end of that train departs the node.

All nodes associated with the specified crossings were analyzed to develop this information for the simulations; in some cases, this meant two or more nodes had to be analyzed for a single crossing because multiple tracks ran through the crossing. In the Base Case analysis, there were approximately 190 nodes that were analyzed to include all the crossings that were provided for analysis.

The following data was provided for the grade crossing analysis for each analyzed day of each simulation. It was provided in a separate document so that it could be used for highway evaluation purposes as well as rail impacts on a community.

- Line segment abbreviation
- Crossing name
- Day of week

- Train ID
- Type of train
- Model node number for crossing
- Time head end enters crossing
- Time rear end clears crossing
- Dwell and delay - if delay occurs at the node, it was recorded
- Occupancy duration
- Length of train
- Count of occupancies at grade crossing
- Average occupancy duration
- Maximum duration

Analysis Segments

In this study, analysis was performed by subdivision. For each simulation, an analysis of delay and grade crossing occupancy was made for the following locations:

- Spokane Subdivision from Sandpoint to Irvin, including the Hauser Terminal*
- Spokane Terminal from Irvin to Lakeside Junction, including Latah Junction (east end of Columbia River Sub)
- Lakeside Subdivision from Lakeside Junction to SP&S Junction, including Pasco Terminal*
- Fallbridge Subdivision from SP&S Junction to Portland, including Vancouver (WA) Terminal
- Seattle Subdivision from Felida to Seattle MP 8, including the SeaTac Terminal
- Scenic West Subdivision from MP 8 to MP 28
- Bellingham Subdivision from MP 28 to the US Canadian Border, including Everett Terminal*
- Scenic Subdivision East* from Snohomish Junction to Wenatchee
- Columbia River Subdivision* from Wenatchee to Latah Junction
- Stampede Subdivision* from Auburn to Ellensburg
- Yakima Valley Subdivision* from Ellensburg to SP&S Junction

Subdivisions marked with an asterisk were simulated, however their operations were not developed to the level of detail other subdivisions were developed to per agreement with the clients. Terminals marked with an asterisk were also simulated, however only main line operations and the yarding or departure of trains was included. Some local industrial operations affecting the main line were included however detailed switching operations and locomotive movements were minimized.

Train counts and grade crossing occupancies within the subdivisions or terminal areas were recorded and MLM believes they are an accurate representation of the traffic in those areas. Delay analysis was performed, but the statistics developed only represent the simplified operations that were included.

Data Sources

BNSF Sources

Data from BNSF was not available for use in the rail simulation analysis, so MLM used other sources, including data from previous analyses, to create a rail operating plan for the current analysis.

One of the sources used to create the operating plan was 2012 data from BNSF's signal system provided to MLM for an earlier analysis. The data allowed MLM to identify train symbols that ran on both the Fallbridge and Seattle Subdivisions in the Portland/Vancouver area. These train symbols included UP traffic running between North Portland Junction and Tacoma (or vice versa) as well as BNSF traffic that originated, terminated or passed through Portland/Vancouver.

The second source that MLM utilized was a list of all active trains on BNSF's rail system for one day in November 2013 and then another list for one day in February 2016. MLM found one document on a train related web site and was provided the second by an employee. The lists included every active train symbol running on BNSF’s northern corridor on those days. MLM used its knowledge of BNSF and UP PNW operations along with these lists to create a sub-list of trains that originated or terminated in all terminals in the PNW.

Train origins and destinations identified in the list were Spokane, Pasco, Vancouver (WA), Portland, Tacoma, Seattle, Everett and New Westminster (British Columbia). Additional origins or destinations included Kalama, Longview, Grays Harbor, Fidalgo, Wenatchee, Hauser, ID, Roberts Bank, BC, and Vancouver BC. Trains originating in the PNW that were destined for Barstow, CA and other locations in California were also identified, as those trains utilized the Oregon Trunk Subdivision at Wishram, WA to move to or from California.

The frequency of the train symbols on these lists provided insight as to which trains ran daily and which trains ran less frequently. Since all active train symbols were listed, some trains running between the PNW and locations that took more than one day to reach had multiple listings, each with a different date. If the number of trains listed equaled the approximate running time in days between terminals, it indicated that the train was a daily train, or that multiple trains with that symbol ran each week. A train with only a single symbol for an operation that required multiple days to run from origin to destination was an indication that the train did not run daily.

The two lists provided a clear indication of how traffic had changed between 2013 and 2016. Many of the oil and coal trains running in 2013 were no longer shown in 2016, indicating a reduction of traffic. Some manifest and international container trains were also reduced in the 2016 lists, indicating trains that were daily trains in 2013 had been reduced in 2016 to four or five times per week trains.

Conversely, it appeared that grain operations slightly increased in the 2016 list. Trains to the various elevators in the PNW were proportioned from the 2016 list and assigned to elevators for the model simulation. MLM used its experience and best judgment to create the grain operating plan in the Base Case.

Another source that was used in a previous analysis and was also referred to in the current analysis was a monitoring website called ATCS Monitor. ATCS stands for Advanced Train Control System, which is a method used by railroads to dispatch and monitor their train operations.

ATCS Monitor was developed by radio enthusiasts who determined that the signals sent between dispatching centers and wayside signals could be captured and decoded to understand how a rail line was being dispatched. The developers of ATCS Monitor analyzed the digital dispatching signals and developed protocols to determine what aspect a signal was displaying at each control point that received those communications. Signals from locomotives were also captured and decoded.

Once the digital communications to the wayside signals were decoded, they were included into an application that replicated a dispatcher's display. A dispatcher's display shows all the tracks and signals that the dispatcher controls for the dispatching territory. A display is typically laid out to create a schematic representation of the line segment(s) that a dispatcher is responsible for. They include main tracks, sidings, signaled crossovers, yard leads, junctions and signaled bridges (or other structures that require train control).

In the previous analysis, ATCS Monitor was used to record all the train movements for a 5 day period on all BNSF subdivisions in the PNW. MLM made videos of the five days for each subdivision, and used those videos to determine train movements over line segments and in terminal areas. Train counts were taken from ATCS Monitor output, and then matched against the previously described lists of trains. ATCS Monitor does not show train symbol information; rather, it just shows how the trains run on each subdivision.

ATCS Monitor data was not available for the current study because of the time (and therefore, cost) to record each subdivision, as well as the time required to determine train counts over the subdivisions. However, the initial ATCS Monitor data was extremely helpful in determining timing of trains, as well as developing estimated schedules as described below.

Schedule Development

After the ATCS Monitor data had been recorded and analyzed, patterns were documented for traffic along line segments. For example, it was observed that a number of eastbound trains left Pasco Yard between midnight and 0800 each day during the videos. MLM used that information and the list of manifest trains leaving Pasco to assign train identities to eastbound trains observed in the ATCS Monitor data. Using a similar technique for multiple locations, MLM could fill in many of the train identities to the un-symboled ATCS Monitor trains.

Unit traffic, such as coal, grain or oil trains, tends to run in a more random manner. Therefore, after traffic such as intermodal, manifest or vehicle trains were assigned the remaining trains were assigned as unit trains. Destinations for many of these trains identified the actual type of train; for example, a train terminating at Kalama was assigned a grain symbol, while a train terminating at Centralia was assigned a coal symbol.

Also, most unit trains running to the PNW have Distributed Power Units (DPU), which are locomotives at the rear end of the train that are remotely operated. Many of the scheduled manifest or intermodal trains do not use DPU. Fueling operations at Hauser, ID, which was part of the Sandpoint to Spokane section of the network, were recorded by the ATCS Monitor videos. MLM could identify which trains fueled both the head end and rear end of the trains at Hauser by watching the progression of a train stopped there to fuel. When a DPU was fueled, it was likely a unit train and MLM assigned it as such.

MLM understands that the train identifications may not be exact; however they create a very good representation of the traffic that moves over each PNW line segment. Train counts were adhered to based on the February traffic lists, and if time patterns could be developed from ATCS Monitor, the traffic was assigned in the simulation in a similar manner. MLM is confident that while the data is not exact, it provides an excellent representation of actual traffic running on BNSF in the PNW and is a solid base of operations for future scenarios.

As discussed previously, the weekly number of many manifest or intermodal trains could be assigned by the number of trains listed on the BNSF active train lists. If the train appeared to be a daily train, it was shown to operate in all seven days of the simulation. If the train appeared to be a train that ran three days a week, it was assigned alternating days of the week. Trains that ran less frequently than alternating days were randomly assigned during the week.

Train departure times were estimated based on the BNSF documents from Portland/Vancouver, and observed ATCS Monitor departures from Seattle/Tacoma, Pasco and Spokane. Patterns for departures were established where available, and using that information, departure windows were estimated for most trains departing those terminals. After a window was established, a random number generator picked the times within those windows for each day of operation in the simulation. The trains were coded individually by departure time into the RTC model.

Once the manifest and intermodal trains had been assigned, the unit trains were added to the appropriate sections based on the operating plan. For example, a Roberts Bank coal train entered the network at Sandpoint from the MRL then ran via Spokane, Pasco, Vancouver and Everett north to Roberts Bank. The train entered Sandpoint at a random time, and stopped along the route for fueling at Hauser and crew changes at appropriate terminals. The rest of the dispatching was left to the RTC model to handle in conjunction with all other traffic running on those same routes.

Results and Analysis of Scenarios

The following sections of the report address the results and the capacity analysis of the simulations. Before discussing them individually, however, a brief explanation of rail capacity has been included to help define the implications of existing and proposed infrastructure and what additional trains will do to those networks.

Railroad Capacity

Railroad capacity can be defined in two categories, line and terminal. In the current study, the focus was placed on line capacity. Terminal capacity was considered; however, as discussed previously, the simulation limited terminal activity to arrivals and departures. Therefore, the terminal capacity that was considered is only a portion of the actual operations that occur that affect train movements through a terminal.

Line Capacity

Line capacity is simply the volume of trains a line can accommodate over time. There are two types of line capacity; theoretical and estimated sustainable. Theoretical capacity is the maximum number of trains a line can accommodate and continue to operate. For example, if all traffic moved in the same direction on one track, and trains could operate 15 minutes apart based on the signaling system, the line could theoretically accommodate 96 trains per day (4 trains/hour x 24 hours). Theoretical capacity ignores reality to some extent, as no terminal could produce that volume of freight trains at the exact time required to operate every 15 minutes. However, that capacity or even greater capacity is theoretically possible, as light rail transit systems demonstrate.

The second type of capacity, and generally the best measurement for whether a line is operating efficiently, is the estimated "sustainable capacity" of the line segment. Estimated sustainable capacity is a line, terminal or network configuration that will accommodate a number of trains that can operate over the configuration on a daily basis without creating excessive delays to other trains. Estimated sustainable capacity is a percentage of a network's theoretical capacity.

If a network is operating at or within estimated sustainable capacity, a delay that occurs to one train will not start a series of delays that affect many other trains. One or two trains may incur delay based on the first train's conflict, but those delays will be resolved relatively quickly and the system will return to normal operations.

Repetitive or long term congestion indicates that a railroad network is operating beyond estimated sustainable capacity. When a rail system is operating beyond estimated sustainable capacity, delays to one train begin to expand to trains operating in other portions of the network. Congested networks slow train velocities which lead to costlier operations and delays to customers. A network operating beyond estimated sustainable capacity cannot quickly recover from outages or unexpected events.

Line capacity is defined by various components; these include number of meeting points, meeting point spacing, speed of track, train mix and the number of trains running over the line segment. These components are the same for single or multiple track segments.

Single Track

A single track line segment creates an environment that features two capacity consuming operations, the "meet" and the "overtake". A meet is defined as two trains passing each other coming from opposite directions. An overtake occurs where a faster train will pass a slower train moving in the same direction. In both these situations on a single track segment, one train must occupy an alternate track while the second train proceeds past.

A meet on single track can be operationally described as follows: One train has to clear the main line at a multiple track meeting point, waiting in that location until the opposing train approaches it. On single track, a meeting point is generally referred to as a "siding". Once the opposing train is past, the waiting train can then proceed. If the stopped train has to meet more than one opposing train, it will remain in the siding until the route ahead is clear of opposing trains.

From this description, it is apparent that when a meet occurs, one train will be delayed for a length of time. The number of opposing trains that pass the waiting train, as well as the distance the opposing train is from the meeting location, determines the amount of delay experienced by the stopped train.

An overtake can be similarly described as follows: A slower train must clear into a siding prior to restricting the following faster train's progress. Once the faster train has passed, the train that was overtaken can only leave the siding after the faster train is far enough ahead to allow the signal system to protect both trains. Overtake delay is generally longer for a train than a single train meet delay, but can be shorter than multiple train meet delay.

A key component of single track line capacity is the running time between sidings. Running time between sidings is dependent on siding spacing, track speed, and average train speed. A basic single track line capacity rule is that on a single track line segment, the shorter the running time between sidings, the more capacity the line segment will have.

Closely spaced sidings generally reduce the running time between sidings. Therefore, a line with closely spaced sidings tends to have more line capacity than one with greater spacing between sidings.

Track speed is another component of running time between sidings. If the track speed of a line segment is restricted, line capacity will be affected even if the sidings are closely spaced. For example, mountainous rail territory, where track speeds are lower because of curves and grades, generally has less line capacity than level territory. At a maximum speed of 30 mph, sidings spaced 5 miles apart are equivalent to sidings spaced 10 miles apart where track speeds are 60 mph.

Average train speed is another important component of track capacity. A line with a large number of high speed trains will generally have more capacity than a line where most of the traffic are heavy, slow trains such as loaded unit trains. Faster trains can move from siding to siding in less time, thereby increasing the ability of the line to accommodate trains.

It is evident from the description of meets and overtakes that these operations create delay, which decreases the average speed of trains on a line segment. This effectively increases the average running time between meet locations, thereby reducing a line segment's capacity. Therefore, the number of meets or overtakes has an impact on line capacity.

The number of meets is a function of how many trains run in opposing directions. The more trains on a line segment that operate in both directions, the more meets will occur. If a line segment has traffic that runs predominately in one direction, that segment will have a greater capacity to accommodate trains than the same segment where the operating direction of trains is equally divided.

The number of overtakes that occur on a line segment is a function of the variance between speeds of the fastest and slowest trains running over a line segment. An example of this is a line segment where one train is running at a maximum speed of 70 mph. A freight (or passenger) train running at that speed will overtake freight trains running at slower speeds. If many of the slower freight trains operate at 45 mph, there will be more overtakes than if the slower freight trains operate at 60 mph.

The mix of train speeds is particularly significant on a line segment where there is a heavy volume of loaded unit trains such as coal, grain or oil trains. This is because most loaded unit trains are restricted to operate at a maximum speed of 45 mph. When the same line segment also hosts faster intermodal and/or passenger trains, there is likely to be a higher level of overtakes.

In summary, high train counts creating more meet or overtake delay and longer running times between sidings because of spacing or restricted track speed decrease the capacity of a line segment. Conversely, decreasing running time between sidings or minimizing meets through directional operations increases capacity.

Multiple Tracks

For the purposes of description, two parallel tracks (two main tracks) will be used to illustrate multiple track capacity. The logic applies whether there are two, three or four tracks; additional tracks just provide additional routes that are available at any given time.

In multiple track territories, each track tends to be operated in a regular direction much like a two lane highway; east trains tend to remain on one track while west trains remain on the other track. This makes each track essentially a directional single track; as was described previously, a single track that is running directionally has more capacity than a single track where there are opposing trains.

Multiple tracks also allow opposing trains to pass each other without meet delay. However, because different train types run at different speeds, multiple track segments continue to have overtakes. If there were no connections between the two tracks, slower trains would dictate how fast the fastest trains could move. However, in most modern two main track segments, there are connections between the two tracks. These connections are called crossovers, and are generally located between five and fifteen miles apart.

Crossovers make it possible for trains running in one direction to use either track. Crossovers allow trains to access yards or junctions that diverge from the opposite track they are running on. They also allow faster trains to overtake slower trains.

During an overtake on two main tracks, one train will crossover to the second track. While this occurs, the faster train will continue to gain on the slower train. Once the faster train is ahead of the slower train, the train that initially crossed over will cross over back to its original track. Based on crossover spacing, the difference in trains speeds and the level of opposing traffic, the slower train will likely incur some delay, but because it can run some distance on an adjacent track to the overtaking train, the delay will be minimized. If conditions are right, the slower train may not receive any delay.

If trains over a line segment have a wide variance in speed, such as areas where frequent passenger and heavy freight movements are intermingled, closely spaced crossovers are necessary to maintain capacity levels. However, when an overtake occurs on multiple main tracks, opposing trains are delayed until the overtake is completed and both trains are again running on their single track. Therefore, numerous overtakes create meet delay, even with two main tracks. So the more overtakes that are required, the more the line's capacity is reduced because of overtake and meet delays.

Crossovers are also necessary where other tracks diverge from the line segments. On both single and multiple track segments, trains will enter or diverge from the main route. This happens because of line segment junctions, yards, industry locations and stations. Diverging moves tend to be made at slower speeds than through movements because of the curvature and track structure of turnouts. A turnout is the track apparatus that allows trains to diverge from one track to another; they are also commonly called "switches".

When a train makes a diverging move, it can delay other trains in the area which effectively reduces capacity. When a train makes a diverging move in a multiple track configuration where some or all tracks are required for the move (such as crossing over from the north track to a diverging route off the south track), trains on all tracks involved are affected, reducing the capacity of each line. Crossovers around junctions or yards can be configured to create routes that allow other trains to get around trains that are entering or diverging from a main line. So in locations where there are frequent junctions or yards, crossovers may be spaced more closely to create flexibility for through trains.

Terminal Capacity

The second type of capacity that affects railroad operations is terminal capacity. This is simply stated as the ability to process trains through an area where they originate, terminate, change crews or are serviced. Terminals have two internal types of capacity; the capacity to arrive and depart trains and the capacity to process what has arrived. Arrival and departure capacity will be examined first.

The capacity to receive trains can be broken into two aspects; first, main line capacity to handle trains that will be moving through the terminal and second, yard track capacity to handle trains scheduled to stop for some sort of work or servicing. Both have approximately the same effect on operating capacity in a terminal area.

Trains that move through terminals frequently are required to stop to change operating crews. The impact these types of trains have on capacity is the simplest to understand; the main line through a terminal is the same as a line segment. If there is only one main and a train is stopped on it, all other trains needing that track must wait until the train departs. Therefore, a line segment that includes a terminal will have a greater capacity to accommodate a high volume of trains the faster those trains using the main line can stop, change crews and depart.

If there are two main tracks at a terminal, meets and overtakes can take place just like on a line segment. However, since trains have to stop to change crews, the operations take longer than through movements on multiple tracks outside of a terminal. Stopping a train increases the running time the train takes to clear a segment; as discussed previously, this reduces the capacity of the segment that includes the terminal.

Terminals that have a lot of trains that use the main line to stop and change crews often have multiple tracks on both sides of the crew change location. This allows following and opposing trains to queue up on one track while the train (or trains) is stopped in the crew change location, while leaving a second track to accommodate the trains that have finished changing crews and are departing.

The other type of terminal arrival capacity is the capacity of a yard within the terminal. For the current analysis, only arrival (and departure) capacity was simulated, so this discussion will be limited to that aspect of a terminal. It should be noted that there are additional terminal capacities that occur in actual operations, including the ability to store, sort and repair cars, as well as assembling outbound trains and moving locomotives around a yard facility. These were not considered in the current analysis.

If a train “works” at a yard, it generally has to enter the yard first. “Work” is a term that means the train is setting out or picking up cars, or the train will be switched and sorted at the terminal. For a train to be able to enter a yard there has to be one track that is clear of cars and long enough to accommodate the entire train, or two clear tracks that the train can be distributed into. Much like line capacity, the more yard tracks that are available the more capacity a yard has to receive a train.

In some locations, the train entering a yard or facility is not setting out or picking up cars, but instead it is being inspected or serviced. For example, in the PNW network, Hauser Yard east of Spokane is a fueling facility for locomotives. A majority of westbound freight trains and virtually all eastbound freight trains stop in Hauser to be fueled (Amtrak does not stop). For this to occur without delay to the train being fueled or to other trains attempting to pass or enter the facility, there have to be fueling tracks available when the trains arrive. When those tracks are filled with other trains, delays occur to trains on the main line waiting to get into one of the fueling tracks. These delays reduce the capacity of the line segments approaching the yard.

The final component to yard arrival capacity that will be discussed is the lead tracks into or from the yard. A lead track is the track that diverges from the main line and is connected to all the yard tracks. Generally, a yard will have at least one lead track on both ends of the yard.

Lead tracks act just like line segments. If there is a single track lead at one end of a yard, only one train can enter or exit the yard at a time over that track. If there are multiple lead tracks, and the main route past the yard consists of multiple tracks, a configuration can be developed that will allow two trains to enter or exit the yard simultaneously. In yards where there are a high number of trains entering or departing each day, this is an important feature that affects the ability of the yard to accommodate trains efficiently.

Measurement of Capacity

As mentioned previously, the best measurement for whether a line is operating efficiently is the estimated sustainable capacity of the line segment. To reiterate, estimated sustainable capacity is the number of trains that can operate over the line on a daily basis without creating excessive delays on the line.

A terminal has an estimated sustainable capacity as well. Similar to a line segment, once a terminal exceeds estimated sustainable capacity small delays can trigger chains of events that affect multiple operations around the terminal, rapidly decreasing the efficiency of all operations. Once at that level of capacity utilization, these types of delays can take many days from which to recover.

It should be noted that a network can operate above estimated sustainable capacity for short time periods without major impacts to network operations. However, these periods will generally be brief, and if the volumes continue for longer periods above sustainable levels, eventually the network will begin to experience widespread major congestion.

The RTC simulation model produces data that can be used to calculate the expected amount of delay minutes a train will experience for every 10 miles it operates (D/10). MLM uses these calculated figures to evaluate line and terminal capacity. To do this, the calculated statistics are compared against criteria that estimate sustainable capacity. From experience with many other simulations, MLM has found that line segments that operate with D/10 values between 10 and 15 minutes per 10 miles operated are approaching or at estimated sustainable capacity. Values under 10 minutes indicate the line segment is operating efficiently; the lower the number, the more efficient the network.

Similarly, terminals found to be operating between 25 and 30 minutes of delay per 10 miles are also approaching or at estimated sustainable capacity. Again, D/10 values below this range indicate the terminal is operating relatively efficiently and can accommodate the level of traffic being moved through the area.

In the current analyses, detailed yard operations were not included. Similarly, local switching of industry was only included at a high level. Both of these operations affect the capacities of terminals and lines. Therefore, to account for these operations that could not be included, MLM adjusted the evaluation criteria used to determine whether a line or terminal was below, approaching, at or above its estimated sustainable capacity.

MLM reduced all estimated D/10 evaluation criteria by 20% to account for the operations that could not be included. Therefore, for this analysis, MLM has assigned the following description of the line segments based on the operating statistics that were generated by the model:

- D/10 < 4.0 minutes of delay: Line is operating **"well below"** its estimated sustainable capacity.
- D/10 < 8.0 and D/10 > 4.0 minutes of delay: Line is operating **"within"** its estimated sustainable capacity.
- D/10 < 12.0 and D/10 > 8.0 minutes of delay: Line is operating **"approaching or at"** its estimated sustainable capacity.
- D/10 > 12.0 minutes of delay: Line is operating **"above"** its estimated sustainable capacity.
- The evaluation criteria utilized in the simulations for terminals were as follows:

- D/10 < 10.0 minutes of delay: Terminal is operating **"well below"** its estimated sustainable capacity.
- D/10 < 20.0 and D/10 > 10.0 minutes of delay: Terminal is operating **"within"** its estimated sustainable capacity.
- D/10 < 24.0 and D/10 > 20.0 minutes of delay: Terminal is operating **"approaching or at"** its estimated sustainable capacity.
- D/10 > 24.0 minutes of delay: Terminal is operating **"above"** its estimated sustainable capacity.
- This report includes D/10 delay minutes per 10 miles operated and velocity graphs for all the line segments and terminals in the study.

Train Volume Growth and Track Improvements

Train Volume Growth

This section reviews how growth was calculated for various commodities for the multiple simulations. Growth for international containers, domestic intermodal, vehicles, manifest, grain, oil, and coal were calculated using various methodologies that are described below.

For the simulations, most of the projected growth was developed using BST Associates' (BST) tonnage/ twenty foot equivalent (TEU) projections between 2015 and 2035. BST's projections included a "Low", "Reference" and "High" projection for tonnages and TEUs. MLM's projected Base plus 5 (Base P5) simulation analysis used the "Reference" column projections, which reflected a medium growth view. The Base plus 10 (Base P10) and Base plus 15 (Base P15) analyses utilized the "High" projections; the 2035 static analysis also utilized the "High" growth projections.

International Containers and Domestic Intermodal

BST supplied estimated growth for international container movements for the Ports of Tacoma and Seattle. Projected rail traffic growth for the simulations was calculated using the compounded annual growth rate (CAGR) between the projected years and the 2015 actual TEU data that were supplied.

Growth rates for both east and westbound flows were calculated from the data. Those rates were then applied to the number of container trains per week that operated in each direction respectively in the Base Case. This yielded the number of projected new trains per week, which were added to the train files for the growth simulations. Both BNSF and Union Pacific growth was included in the analysis, as both serve the two PNW container ports.

There was an imbalance between eastbound and westbound flows for international container trains, with more eastbound than westbound trains. Empty intermodal trains, generally referred to as "bare table" trains, were added in the westbound direction to rebalance the estimated car flows. Most of the bare table trains were assumed to come from the Los Angeles area, entering the simulation at Wishram and running to Seattle.

Domestic container/trailer growth was not provided as most of this traffic originates away from port facilities. MLM chose to grow domestic intermodal traffic at the same rate as international container traffic, which as mentioned previously, was provided. Domestic container trains had to be broken down between Seattle and Portland origins/destinations. As with the international container trains, east and westbound growth factors were applied and the traffic was divided between BNSF and UP based on the number of Base Case trains (UP was included in the Seattle estimates, but not in the Portland estimates). The calculated growth trains were added in the appropriate direction to/from each origin or destination in all future year simulations.

Vehicle

BST provided growth numbers for vehicles moved by trains for both import and export movements. These data were utilized for vehicle train growth. Again, a CAGR was calculated from the BST data, and then applied to the number of trains per week running to/from Tacoma, Grays Harbor, Vancouver and Portland in the Base Case. The calculated growth trains were added to the existing traffic for each future year simulation. The trains were again broken down between BNSF and UP where appropriate.

Manifest

BST provided growth estimates for break bulk marine commodities, however this was a very small percentage of manifest traffic that moved to or from the PNW. Therefore, MLM used a CAGR of 1.5% for manifest growth for the five year period between 2016 and 2020 (Base P5) (medium growth). For High growth, a CAGR of 1.7% was utilized. This range of CAGR has been vetted by FRA personnel during other projects and was generally considered to be an acceptable estimate of manifest growth.

As with the container and intermodal traffic, the CAGR was applied against the number of trains per week that were running in various corridors for BNSF and UP in the Base Case. Many of the BNSF trains originated east or west of Pasco, WA, and then terminated at that yard for classification. Other trains originated at Pasco and then ran east or west of the yard. Trains were broken into similar origin/destination groups and then the growth was calculated, so a proper number of trains in each corridor could be applied.

Grain

BST provided growth tonnage for various regions in the PNW. The regions were Oregon Columbia River (Portland), Washington Columbia River (Vancouver, Kalama, Longview), Puget Sound Regional Council (Tacoma, Seattle) and Puget Sound Excluding PSRC (Grays Harbor). MLM's grain flow in the Base Case had trains moving to/from each of these areas.

Grain growth calculations are difficult because grain does not move at the same traffic level throughout the year. Grain movements during peak periods are much higher than during non-peak periods, so calculating train movements from annual tonnage must utilize peaking assumptions. The assumptions include total trains per day during peak movements and the duration of the peak movements. They also include all non-peak movements and the duration time that those operations occur. MLM included estimated peak grain flows in the Base Case and all future year simulations.

MLM's assumption was that peak movements occurred for approximately three months per year. The other three quarters of the year were represented by fractions of peak movements. For this analysis, it was assumed that peak trains moved for three months, 60% of peak trains moved for three months, 40% of peak trains moved for three months, and 25% of peak trains moved for three months. When totaled together, this assumed breakdown equated to the actual tonnage that was moved to PNW ports in 2015, as shown in the BST data.

Grain train growth could be calculated by maintaining the assumed quarterly breakdown of the percentage of peak trains but modifying the annual tonnage using BST's projected 2020, 2025, 2030 or 2035 tonnage. Once the number of new grain trains per week was calculated, they were distributed to the four different regions based on BST's projections. In regions where there were multiple elevators, the trains were assigned to a destination based on MLM's understanding of elevator capacity. The growth trains were also split between BNSF and UP; for the analysis, BNSF operated approximately 70% of the grain trains and UP operated approximately 30% of the trains.

Coal

BST provided growth estimates for Dry Bulk goods through the PNW ports which included coal. Currently, most of the dry bulk traffic is non-coal traffic such as potash, soda ash or petroleum coke. The predominance of dry bulk is potash moving through the Port of Portland; however, most of that traffic comes via UP and is out of the scope of the project simulations. The remaining dry bulk was included in the simulations, however there is little growth forecasted for that traffic and MLM believes it will likely operate via manifest trains.

A major change in dry bulk traffic comes if the Millennium Bulk Terminal project at Longview is approved and begins exporting coal. The tonnage was reflected in BST's "High" growth projection category, and was captured in the 2025 (Base P10) and beyond simulations. Based on discussions with the client, MLM assumed that 25 million metric tons of coal would move to the Millennium Terminal in 2025, with an additional 19 million metric tons moving in 2030 (Base P15). There was to be no additional growth beyond those two future year simulations.

There are three other sources of coal demand that generate coal train movements on BNSF rails in Washington, however. The first was export coal to Roberts Bank, which is outside Vancouver, BC. This traffic was projected to increase based on an estimated CAGR up through the 2025 (Base P10) simulation. Based on discussions with the client, MLM assumed that an additional six million metric tons would move to Roberts Bank in 2030 (Base P15), in conjunction with Millennium Bulk Terminal reaching its maximum capacity.

The second demand source was coal to the Centralia, Washington power utility. Based on research through public websites, MLM believes that one of two boilers at the Centralia plant will be shut down prior to 2020. The second boiler will be shut down in 2025. The trains counts for the simulations reflected those decreases in coal demand. No coal operated to Centralia in the 2025 (Base P10) and 2030 (Base P15) simulations.

The final demand source was coal to the Boardman, Oregon power utility. Boardman trains operate on BNSF rails from the mine to Spokane. At Spokane, the train is interchanged to UP, which takes it to Oregon on its own rail line. Like Centralia, it is scheduled to be completely shut down by 2021. Therefore, coal movements to Boardman were included in the 2020 (Base P5) simulation, but were removed from the 2025 (Base P10) and 2030 (Base P15) simulations.

Unit Oil

BST supplied existing and projected tonnage for liquid bulk traffic to/from PNW ports, which included unit oil train traffic. A large percentage of the tonnage that was listed in the BST data came from unit oil train movements to Anacortes, Cherry Point and Tacoma.

The data indicated that liquid bulk movements were likely to drop by approximately 35% from 2016 to 2020. MLM used the amount of tonnage each oil train carried to calculate how many fewer trains would run in 2020 as compared to 2016 traffic. Trains were removed from Base Case traffic levels to reflect the reduction in oil traffic that is projected.

For the 2025 (Base P10) and 2030 (Base P15) simulations, oil trains to Tacoma, Anacortes and Cherry Point were increased based on BST's CAGR in the "High" category. However, in addition to this growth, the major increase in oil train movements to the PNW was associated with the Vancouver Energy (VE) project, in Vancouver, WA.

Like coal, oil projections experienced a sharp increase if the Vancouver Energy project proceeds. This expansion of oil train operations was reflected in the “High” growth column; based on discussions with the client, MLM assumed that the project would move forward, with associated trains included in the 2025 (Base P10) simulation. MLM was instructed to assume there would be no further growth of oil trains to the PNW beyond that projected growth, so the unit oil train volumes remained constant in the 2030 (Base P15) simulation and the 2035 static analysis.

Track Improvements by Simulation

There were track improvements in all the simulations based on areas of congestion that were observed after analyzing the simulation outputs. The following sections reflect the improvements that were made.

The improvements that MLM included in the analyses were based on simulation results and may not be the same as improvements that BNSF may make into the future. However, MLM is confident that the simulations do reveal potential areas of concern, and that BNSF will find similar results as their traffic actually increases. MLM believes that BNSF may approach mitigation of the areas of congestion in a different manner than were dealt with in the simulations, however, we are confident that BNSF will attempt to mitigate areas of concern if or when projected growth actually materializes.

Track Improvements, 2020 Base P5 Case

Track improvements that were included in the Base P5 Case were in addition to the track configuration used in the Base Case. These improvements consisted of the following:

- 7.84 miles DT East Ramsey to East Hauser, MP 36.69 to MP 44.53, absorbing Ramsey siding on the Spokane Sub.
- A second lead track on the east end of Hauser Fueling Facility from the main track to the fueling tracks.
- 3.26 miles of second main track between Glade and East Pasco, WA on the Lakeside Sub.
- 4.97 miles third main track within Pasco Terminal, MP 140.35 to MP 145.32, replacing crossover track at Husky with North/South yard connections. This track is the track that is used to spray coal trains with an agent to minimize coal dust.
- 15.67 miles of third main track, MP 95.30 to MP 110.97, between Ostrander and Kelso, WA on the Seattle Sub. This improvement was part of WSDOT Cascade improvements.
- Pt. Defiance Bypass passenger route, Nisqually Junction to TR Junction near Reservation (Tacoma).
- 6.13 miles third main track, MP 9.62 – MP 15.75 between Black River Junction and Kent, WA within the Seattle/Tacoma terminal.

MLM is aware that the spray track at Pasco and the third track at Kent are currently in service. The third track between Woodland and Kelso is currently being constructed, as is the Pt. Defiance cutoff.

Track Improvements, 2025 Base P10 Case

Track improvements that were included in the Base P10 Case were in addition to the track configuration used in the Base P5 Case. These improvements consisted of the following:

- A north leg of wye, Port of Vancouver to Seattle Sub so empty Port unit trains can move north towards Auburn, WA.
- A power switch at Centralia where the Puget Sound and Pacific connects to BNSF's Seattle Sub
- 3.22 miles of second main track at Cheney, MP 11.79 – MP 15.0 on the Lakeside Sub
- 2.7 miles of second main track at Fishtrap, MP 27.05 – MP 27.90 on the Lakeside Sub
- 2.1 miles of second main track at Keystone North, MP 48.8 – MP 50.9 on the Lakeside Sub
- 3.1 miles of second main track Lamphere to Sprague, MP 39.02 – MP 42.15 on the Lakeside Sub
- 2.33 miles of second main track Essig to Paha, MP 70.1 – MP 72.5 on the Lakeside Sub
- 6.47 miles of second main track Lind to Sand, MP 78.43 – MP 84.90 on the Lakeside Sub
- 3.3 miles of second main track Connell to Cactus, MP 109.9 – MP 113.3 on the Lakeside Sub
- 2.7 miles of second main track at Eltopa, MP 123.8 – MP 126.4 on the Lakeside Sub
- 4.34 miles of second main track Glade to Sagemore, MP 132.58 – MP 137.02 on the Lakeside Sub
- Extend Bay siding south 1.64 miles, MP 77.43 – MP 79.07
- 3.4 miles of second main track Camas to Washougal, MP 24.47 – MP27.79 on the Fallbridge Sub
- 1.84 miles of second main track through Wishram Yard, MP 105.90 – MP 107.81 on the Fallbridge Sub
- 10.76 miles of second main track Hover to Yellepit, MP 216.98 – MP 227.66 on the Fallbridge Sub
- Extend following sidings on the Fallbridge Sub to a minimum 8,800 feet in length:
    - Maryhill
    - Bates
    - Roosevelt
    - McCredie
    - Paterson
    - Berian
    - Wishram
- 2.3 miles of second main track Algoma to Cocolalla, MP 14.14 – MP 16.47 on the Spokane Sub
- 3.2 miles of second main track Athol to Ramsey, MP 33.5 – MP 36.7 on the Spokane Sub
- 4.1 miles of second main track Otis Orchards to Irving, MP 58.88 – MP 62.98 on the Spokane Sub

Track Improvements, 2030 Base P15 Case

Track improvements that were included in the Base P15 Case were in addition to the track configuration used in the Base P10 Case. These improvements consisted of the following:

- Crossover from UP Ayer Sub (Hinkle, OR to Spokane) near Mullinix Rd. in Cheney to BNSF at approximately MP 18 of Lakeside Sub. Modify operations such that northbound UP trains used crossover to enter two main track BNSF Lakeside Sub at MP 18 to eliminate crossover move at Lakeside Junction.
- Clear tunnels on Stampede Sub to accommodate domestic and international double stack trains. Modify operations for some manifest and intermodal trains to use the Stampede Sub to access Pasco or Spokane instead of using the Scenic and Columbia River Subs or the Seattle and Fallbridge Subs.
- Upgrade signal system on Stampede and Yakima Valley Subs to full CTC to facilitate additional capacity.
- Install power switches on Spokane Sub at Trentwood, Velox and Coeur d'Alene industrial spurs
- Complete second main track across Lakeside Sub between Lakeside Junction and Glade:
    - 6.53 miles second main track Bass to Fishtrap, MP 21.52 – MP 27.05
    - 5.71 miles second main track Keystone to Lamphere, MP 31.39 – MP37.10
    - 4.93 miles second main track Sprague to Keystone, MP 43.75 – MP 48.78
    - 5.0 miles second main track West Keystone to East Tokio, MP 52.77 – MP 57.77
    - 4.21 miles second main track West Paha to Lind, MP 74.22 – MP 78.73
    - 8.79 miles second main track Cunningham to Connell, MP 99.45 – MP 108.24
    - 5.00 miles second main track West Cactus to Eltopa, MP 118.80 – MP 12.80
    - 8.78 miles second main track Eltopa to Sagemoor, MP 132.58 – 123.80
- Extend third main track 3.04 miles, MP 137.24 – MP 140.28 at East Pasco to allow simultaneous staging of two loaded coal trains
- 2.63 miles second main track at Roosevelt, MP 144.43 – MP 147.06 on Fallbridge Sub
- 7.71 miles second main track Camas to McLoughlin, MP 7.71 – MP 27.05 on Fallbridge Sub
- Second Vancouver Bypass track for northbound crew changes in Vancouver Terminal
- Upgrade Bayside route in west Everett as follows:
    - Upgrade signal system to two main track CTC for 25 MPH operations
    - 5.72 miles of second main track Hawthorn Park to Delta Junction, MP 31.44 – MP 36.87
    - Modify operations to utilize Bayside route for north/south crew changes rather than using Delta Yard

Capacity Results, Analysis and Train Counts

Segment Results and Analysis

The following sections of the report will address the capacity findings from each of the simulations. A brief summary of the findings and MLM's conclusions starts each simulation's Results and Analysis section, followed by a description of the issues that were observed in each line segment or terminal.

Base Case Analysis Results

Base Conclusions

The Base Case conditions indicate that BNSF does not currently have capacity issues on most of their line segments in the PNW. Between terminals, trains ran efficiently for the most part. The largest group of delays on line segments occurred where there were many meets and passes on single track (with sidings), or where line segments transitioned into terminals. Access to some of the terminals did create queues of trains that impeded some operations.

The terminals in the PNW appear to be a larger concern for rail capacity in the PNW. Hauser, Pasco and Everett terminals experienced the greatest number of delays. Even with these delays, however, the terminals did operate to a level that allowed all trains to finish their operations throughout the network.

It should be noted that the scope of the project did not include detailed simulation of operations within the terminals, so delays that were found in the Base Case are likely an understatement of actual delays occurring at terminals in actual operations.

Train Volumes

Table A-1 shows the average number of trains per day that operated over the line segment during the three day simulation period. Multiple locations on some line segments were necessary as a result of junctions and/or major industrial destinations.

Table A-1: Three Day Average Train Volume Summary

Location	Subdivision	Milepost	Trains per Day Base Case
E. Spokane	Spokane	63	66
Lind	Lakeside	91	42
Plymouth	Fallbridge	190	38
McLoughlin	Fallbridge	14	42
Ridgefield	Seattle	122	59
Vader	Seattle	77	51
East Olympia	Seattle	35	46
SeaTac Terminal (Puyallup)		~32X	60
SeaTac Terminal (Spokane Street)		~2X	68
SeaTac Terminal (Broad Street)		~2	53
Mukilteo	Scenic	28	42
Marysville	Bellingham	38	26
Bow	Bellingham	79	20
Border	Bellingham	117	15
Monroe	Scenic	1770	23
Harrington	Columbia River	1527	24
Ravensdale	Stampede	91	6
Yakima	Yakima Valley	90	8

Source: Mainline Management

Grade Crossing Occupancy Analysis

As previously described, a grade crossing analysis was performed for each simulation case. The results from the analysis are included in a separate spreadsheet that accompanies this report. The grade crossings that were analyzed were provided to the Transpo Group personnel for a separate study of grade crossing conflicts. The number of occupancies over each track at the analyzed grade crossings was included along with the average and maximum time the crossings were occupied. The occupancy time did not include gate down time.

A list of all trains that operated through the crossings was also provided by line segment. The simulation day, train identification number, train length and train type were provided in the list, along with the entrance, clearing and total occupancy times.

Line Segment Capacity Observations

The following section of the memo briefly reviews the capacity observations by line segment (and by terminal where it is integral to the operation) for the Base Case. For each line segment, MLM has recorded its estimation of level of capacity utilization based on the Delay per 10 Miles operated statistic.

Table A-2 summarizes the criteria (described above) used to estimate the level of capacity consumption at which the line segments and terminals were operating:

Table A-2: Capacity Criteria Review

Description	Line Segment	Terminal
Well below	D/10 < 4 mins/10 miles	D/10 < 10 mins/10 miles
Within	4 < D/10 < 8 mins/10 miles	10 < D/10 < 20 mins/10 miles
Approaching or At	8 < D/10 < 12 mins/10 miles	20 < D/10 < 24 mins/10 miles
Above	D/10 > 12 mins/10 miles	D/10 > 24 mins/10 miles

Source: Mainline Management

Spokane Sub

The Spokane Sub (Sandpoint to Irvin) operated **well below** estimated sustainable capacity with a D/10 calculation of 1.6 minutes of delay per 10 miles operated. Hauser Terminal also operated **well below** estimated sustainable capacity at 6.2 minutes of delay per 10 miles. Hauser operations were simplified and likely do not represent the full range of potential delays that can occur in a major terminal.

Freight train velocity on the Spokane Sub was 32.3 miles per hour on average. The second main track that BNSF has included over large sections of the line segment allowed for efficient operations. Most delays that occurred were around Hauser Terminal; they consisted of trains waiting to access the terminal while other trains were departing on the single track eastern lead, or waiting until a fueling track was available.

Spokane Terminal and Lakeside Sub

Spokane Terminal (Irvin to Latah Junction, Latah Junction to Lakeside Junction, Lakeside Junction to Sunset Junction) operated **well below** estimated sustainable capacity at 4.3 minutes of delay per 10 miles operated. There are multiple junctions within the Spokane Terminal analysis segment, including Latah Junction (route to/from Wenatchee), Lakeside Junction (UP to/from Hinkle, Oregon), Sunset Junction (eastbound route from Pasco/Lakeside Junction joining westbound route to Pasco/Lakeside Junction), and Napa St. Junction (UP to/from Idaho/Canada). As would be expected with the many possible routes for trains passing through the city, trains experienced some delays waiting for the routes to be clear of other traffic so they could proceed.

The Lakeside Sub (Lakeside Junction to Glade) also operated **well below** estimated sustainable capacity with 2.5 minutes of delay per 10 miles operated. The new segments of second main track that BNSF installed in 2014/2015 alleviated locations that experienced notable delays in previous analyses. Extending a second track from Cheney towards Lakeside Junction eased many of the longer delays that had previously affected both BNSF and UP trains.

Average velocity for freight traffic on the route was 30.9 mph.

Pasco Terminal and Fallbridge Sub

Pasco Terminal (Glade to SP&S Junction) operated **within** estimated sustainable capacity, with 11.7 minutes of delay per 10 miles operated. Pasco is a major classification yard for BNSF, which means many trains terminate and originate at the terminal. At the same time, a very high percentage of empty unit trains and all loaded unit trains passed through the terminal.

The high volume of trains entering or leaving the yards combined with the high volume of trains passing through the terminal accounted for much of the delay that Pasco experienced. Pasco also has a single track bridge over the Columbia River on the west end of the terminal, which created congestion for all trains coming from or going west of Pasco. This configuration feature, along with the high train counts, facilitated the delays through the terminal.

The Fallbridge Sub (SP&S Junction to McLoughlin) operated **well below** estimated sustainable capacity with 3.9 minutes of delay per 10 miles operated. However, the subdivision had the highest number of delays exceeding 30 minutes (23.7/day). The Fallbridge Sub is almost exclusively single track with sidings (the exception being four miles of second track around Wishram), which led to the high number of longer delays.

Eastbound high priority trains such as Amtrak and high priority domestic intermodal trains from Portland were a major factor in the creation of the high number of extended delays. When those high priority eastbound trains operated over the Fallbridge Sub, the westbound unit and manifest trains had to wait in sidings to let the eastbound trains pass. Since the Fallbridge Sub runs higher volumes of westbound traffic than eastbound traffic (see operating description above), the westbound trains had to hold back in sidings that were located up to 50 miles from the opposing trains. This created long waits for multiple trains, leading to the high number of extended delays.

The high volume of trains and the length of the subdivision created a large number of miles operated for calculation of the D/10 statistic. It was this high number of miles that kept the D/10 at levels that showed the subdivision continued to operate well below estimated sustainable capacity even with the long delays experienced by trains waiting in sidings. Velocity also showed that the subdivision operated relatively efficiently, with freight traffic operating at an average of 30.3 mph.

Vancouver Terminal

In past analysis, Vancouver Terminal (McLoughlin to Portland, Columbia River Bridge to Felida) operated approaching or at estimated sustainable capacity. Trains moving from Seattle to Pasco (or vice versa) have to pass through Vancouver, and in past analyses, had to change crews on a single track connection between the Seattle Sub and the Fallbridge Sub. This choke point, which also featured a diverging route to the Port of Vancouver and yard switching leads, led to high levels of congestion through the terminal.

In this analysis, Vancouver Terminal operated **well below** estimated sustainable capacity with 9.3 minutes of delay per 10 miles operated. There were three major changes that facilitated this improvement.

The first was an “east bypass” route that allowed westbound trains to pass through the terminal on a newly constructed route away from the segment that caused a large portion of the congestion in previous analyses. Additionally, the single track that directly connected the Seattle and Fallbridge Subs was improved with a second track, allowing multiple trains to operate through the area at the same time.

Finally, a new connection to the Port of Vancouver was included that also took trains off of the connection between the Seattle and Fallbridge Subs. This new connection had an additional benefit of being grade separated from the Seattle Subdivision; the previous connection required trains moving to or from the Port to cross the Seattle Sub at grade.

The three improvements greatly enhanced movements through the terminal. While there were still some delays that occurred because of the volume of traffic that moves through Vancouver, the beneficial impact of the improvements was clearly evident in this analysis.

Seattle Sub

The Seattle Sub (Felida to Nelson Bennet) operated **well below** estimated sustainable capacity with 0.9 minutes of delay per 10 miles. The subdivision consists of two main tracks for the entire length, with the exception of a short stretch of single track around Nelson Bennett. The two main tracks have multiple crossovers that allow high speed passenger trains to overtake and run around slower freight traffic. BNSF and UP freight trains share the route from just south of the Columbia River Bridge near Vancouver to Reservation Junction in Tacoma.

Areas of minor congestion occurred around Kalama and Longview, where trains diverge to large industrial facilities. For the most part, these delays were quite minor in the Base Case analysis. Average freight train velocity for the subdivision was 32.2 mph, indicating the subdivision operated efficiently throughout the analysis.

Seattle Tacoma (SeaTac) Terminal

The SeaTac Terminal (Nelson Bennett to MP 8, Scenic Sub) operated **well below** estimated sustainable capacity with 5.3 minutes of delay per 10 miles operated. While the overall number is very good, there were times when the terminal became congested.

Sound Transit Commuter operations between Everett and King St. Station and King St. Station and Tacoma/Lakewood caused much of the congestion. During commute hours for the three weekdays that were analyzed, very few freight movements could operate along with the commuter trains. This is because the windows between the commuter trains were short and they operated in a bi-directional manner, meaning that both main lines were required to accommodate all the passenger trains. Freight traffic backed up in yards and on the outskirts of the SeaTac terminal during the commuter operations, and had to unwind after the commuter trains finished their operations.

Freight delays were experienced at Interbay Yard north of downtown Seattle, at Seattle International Gateway south of downtown and at Tacoma Yard. Additionally, a queue of trains formed south of Tacoma waiting for the commuter operations to conclude. Once the commuter trains completed their operation, the freight trains resumed operation and returned to relatively efficient operations.

Scenic Sub West

The Scenic Sub extends between Seattle (MP 0) and Wenatchee. However, for purposes of this analysis, it was divided into two segments, west and east. The Scenic Sub West extended from MP 8 to MP 28 (MP 8 to Mukilteo). It operated **well below** estimated sustainable capacity with 1.5 minutes of delay per 10 miles operated.

A portion of the Scenic Sub was included into the SeaTac Terminal analysis segment. Most of the freight trains that experienced delays because of Sound Transit commuter trains were delayed in the SeaTac portion of the subdivision. The 20 miles between Mukilteo and Everett ran efficiently throughout the analysis, with freight train velocity averaging 35.2 mph. There were some minor delays around short single track sections of the subdivision, but these delays did not last for an extended period and were resolved once opposing traffic moved through the gauntlets.

7.1.3.8 Bellingham Sub and Everett Terminal

Everett Terminal (MP 28 Scenic Sub to Bridge 38, Bridge 38 to PA Junction, Everett Junction to PA Junction) operated **within** estimated sustainable capacity at 19.3 minutes of delay per 10 miles operated. This number is very close to the boundary between **within** and **at or approaching** estimated sustainable capacity (>20 minutes of delay per 10 miles).

Passenger operations and a short single track segment were responsible for many of the delays that led to this D/10 statistic. Sound Transit's and Amtrak's shared station is located on a single track segment of the Scenic Sub between Everett Junction and PA Junction. When these trains were operating, freight trains could not leave Delta Yard without delaying the passenger trains. The model held the freight trains for the higher priority passenger trains. Since the commuter trains operated for approximately 1.5 hours in the morning and evening, some of the delays to freight trains exceeded 30 minutes which increased D/10 delay minutes.

In addition to the delays caused by passenger trains, restrictive capacity on the Bellingham Sub north of Everett also affected terminal operations. The nearest siding to Delta Yard on the Bellingham Sub is at English, which is approximately 10 miles north of the terminal tracks. The track speed is slow between English and Everett as the railroad passes through Marysville and across two bridges just north of the yard.

The running time to/from English affected the Bellingham Sub (Bridge 38 to US/Canada Border) as well. The Bellingham Sub operated **within** estimated sustainable capacity at 6.8 minutes of delay per 10 miles operated. This was the highest D/10 statistic for any of the line segments that were studied.

Trains waiting for tracks to clear at Everett were held in sidings north of Everett, leading to some of the delay. With slow running speeds between the yard and the siding, extended delays occurred regularly. Some southbound trains had to wait until other trains in Delta Yard departed Everett because of restricted yard capacity.

Additionally, Amtrak trains delayed trains along the Bellingham Sub. With restricted siding capacity, many times trains were observed holding in English or Stanwood to allow Amtrak to overtake or meet the freight trains. Because the sidings were occupied, trains attempting to leave Everett to head north could not advance. These trains were delayed within the yard at Everett, adding to the delay minutes that occurred in the Everett terminal.

Finally, there was also restricted siding capacity north of Bellingham between Ferndale and the border. Again, many freight trains were held within the existing sidings to allow Amtrak trains to pass. In some cases, trains had to wait for a southbound Amtrak train to move past then wait until a northbound Amtrak also passed because there were no sidings available to advance to. This led to long delays to some freight trains, which increased the subdivision’s D/10 statistic.

The average freight velocity on the Bellingham Sub was 20.7 mph. This is notably lower than previous subdivisions’ velocities. The slower velocity is an indication that there was additional delay on the subdivision, but it also increased running times between sidings which further aggravated the capacity issues.

Scenic Subdivision East and Columbia River Subdivision

The Scenic Subdivision East (PA Junction to Wenatchee) and the Columbia River Subdivision (Wenatchee to Latah Junction) were included in the analysis; however the simulation was not as detailed as other segments of the railroad (at the request of the clients).

In general, a simplified solution meant that the model operator did not spend a great deal of time working through inefficient meets that the model made. On occasion, the model makes decisions that would likely be different than those made by a real dispatcher. In those cases, the model operator can overrule the decision and modify it. Since MLM was instructed to simplify the Scenic and Columbia River Subs (as well as the Stampede and Yakima Valley Subs), these types of decisions were left in the final results.

The Scenic Sub East operated **within** estimated sustainable capacity at 6.4 minutes of delay per 10 miles operated, while the Columbia River Sub operated **well below** estimated sustainable capacity at 1.7 minutes of delay per 10 miles operated.

Most of the delay that was experienced on the Scenic Sub occurred between Skykomish and Winton. This section of the route has 2.2 % grades on each side of Stevens Pass, as well as curvature that limits the operating speeds to between 20 and 25 mph. Siding spacing is between 7 and 11 miles in this area, so there are long running times between sidings. Trains waiting for opposing traffic to pass waited for extended periods in these sidings, which led to the elevated D/10 statistic.

The Columbia River Sub experienced very few extended delays as well as a nominal number of short delays. The volume of traffic using the route minimized meets and overtakes, which allowed trains to run at consistent speeds across the subdivision.

Scenic Sub trains averaged a velocity of 20.5 mph, reflecting the slow track speed and delay issues. Columbia River Sub trains' average velocity was 36.5 mph, again reflecting how efficiently the subdivision operated under the traffic levels that were included in the analysis.

Stampede Sub and Yakima Valley Sub

The Stampede Sub (Auburn to Ellensburg) and the Yakima Valley Sub (Ellensburg to SP&S Junction) both operated **well below** estimated sustainable capacity at 1.0 minutes of delay per 10 miles operated. Similar to the Scenic (east) and Columbia River Subs, the Stampede and Yakima Valley Subs were not simulated with the same level of detail as other subdivisions. Again, this was done at clients' request to expedite the analyses.

The Stampede and Yakima Valley Subs operated most trains in an eastbound direction (see operating description above). The exception was two local trains that ran between SP&S Junction and Ellensburg that were responsible for switching local industry. These were the only trains that experienced delays on the route meeting trains in sidings.

The balance of the delays occurred around SP&S Junction to eastbound trains waiting for westbound trains to clear through Pasco Yard. The single track bridge over the Columbia River contributed to the delays to the trains coming from the Yakima Valley Sub at SP&S Junction.

There were only between six and eight trains per day that used the Stampede and Yakima Valley Subs. All the trains were empty unit trains returning from origins along the Seattle Sub or the Bellingham Sub. The average velocity of trains using these subdivisions was 30 mph.

Base Case Plus 5 Years (Base P5) Analysis Results

Base P5 Conclusions

Based on the results of the simulations through Base P5, MLM believes BNSF has sufficient line segment capacity to accommodate the growth projected for five years. This projection excludes Millennium coal trains to Longview and Vancouver Energy trains to Vancouver.

It is MLM's opinion that the greatest concern to PNW capacity in this time frame is BNSF's terminals, in particular, Hauser, Pasco and Everett. Additionally, there are intermittent constraints in the Seattle/Tacoma terminal.

Recent website discussions indicate that Hauser is experiencing congestion issues under current traffic levels. Trains are backing up east and west of the terminal because all of the fueling racks are full servicing or holding trains. Trains from the east that are waiting must stop at Ramsey (approximately 7 miles east of East Hauser and capable of holding one train) or Athol and beyond (another 5 miles east of Ramsey, capable of holding multiple trains).

The Base P5 simulation attempted to address this issue. As was documented above, a second track between Rathdrum (current east end of two main tracks) and Ramsey was included along with a second lead track on the east end of the fueling facility. The extended second main track allowed multiple trains to advance and stop closer to the terminal entrance tracks. The second lead track allowed a train to enter the terminal while a train was departing. By allowing trains to queue up closer to the terminal, there was less time that a fueling track was unused waiting for a train to arrive.

It has been noted previously that detailed terminal operations were not within the scope of this study. MLM recognizes that the simulation did not entirely represent the fueling and crew changing process that occurs at Hauser, which led to the minimal delay figures that were developed in the simulation. This is a further concern regarding long term capacity that this study does not address.

Pasco also showed signs of potential congestion in the simulations. Again, the model did not represent all the movements within the terminal that affected the ability of the yard to receive and depart trains, and/or having many trains change crews on one of the main lines. Therefore, MLM again believes the delay statistics that were generated at Pasco likely understate actual conflicts that increase delay within the terminal.

A concern that the simulation did identify in the Base P5 simulation at Pasco was the single track bridge across the Columbia River at the west end of the terminal. In the Base P5 simulation, grain and some coal and oil train growth was included based on BST's projected volumes. These trains were in addition to the manifest and intermodal train growth that utilize the Fallbridge Sub to/from Port Terminals between Portland and Vancouver, BC, as well as trains moving to or from California between Pasco and Wishram. The sum of all the new traffic aggravated the congestion issue at West Pasco.

As mentioned previously, the Base P5 simulation did not include large unit train growth projects such as Millennium coal trains and Vancouver Energy oil trains. In the Base P10 and Base P15 simulations, these projects were included, and the results are noted in those simulations' outcomes.

Everett Terminal also has apparent capacity issues at its current and projected Base P5 traffic levels. Passenger operations between Seattle and Everett have a notable impact on Everett operations as observed in the simulations. It is not clear to MLM that there are additional track capacity solutions that would alleviate the impact of additional passenger trains, which is traditionally the way railways deal with requests to increase commuter or intercity passenger operations.

The reason that additional track capacity may not be an option is the fact that the Everett passenger station is located on a section of single track that is just east of a single track tunnel running under the city of Everett. Constructing a second track through this segment that would allow simultaneous freight and passenger operations will be very difficult and expensive. Therefore, conflicts between freight and passenger trains will likely continue into the future during periods of frequent passenger operations.

There were similar impacts between freight and passenger trains between Seattle and Tacoma. As described previously, passenger/commuter trains in that corridor operate in both directions simultaneously, thereby requiring two main tracks throughout a large portion of each morning and evening passenger operating window. The simultaneous operations restricted freight trains from using either of those tracks as the model dispatcher generally kept the tracks clear for the passenger trains to proceed with minimum interference.

The locations of the stations between Seattle and Tacoma compounded the conflict issue. Seattle's Sounder/Amtrak station is on the west side of the main lines, as are all stations for southbound trains through Puyallup. All northbound stations, including Tacoma's Sounder/Amtrak station, are on the east side of the freight main lines. This means that every passenger train must cross over the main lines to reach its terminus station; southbound trains crossover just north of Tacoma, and northbound trains cross over near King St. Station.

These crossover movements further restricted the use of either track by freight traffic. They also limited the effectiveness of the third track in the corridor during passenger operating windows, as each passenger train had to cross over all tracks in the corridor to access its terminus station.

MLM believes there is value in a third main track. However it will be limited during commuter operations. The value of a third track will be evident when commuter and Amtrak trains are not running. An additional track, such as the new third track between Black River and Kent, will allow more freight trains to operate simultaneously, which will be a benefit during non-passenger intensive periods. MLM believes this additional capacity will be necessary as more and more empty unit trains are rerouted to Auburn and the Stampede Pass route.

MLM believes BNSF and UP will have to carefully analyze any Amtrak or Sound Transit proposal that increases the number of passenger trains throughout the day between the three Puget Sound terminals. Any increase in service will further reduce time when freight operations can occur without being affected by higher priority passenger movements.

Base P5 Train Volumes

Table A-3 shows the average number of trains per day that operated over the line segment during the three day Base P5 simulation period. The Base Case volumes are also shown for comparison

Table A-3: Three Day Average Train Volume Summary, Through Base P5

			Trains per Day	
Location	Subdivision	Milepost	Base Case	Base P5
E. Spokane	Spokane	63	66	69
Lind	Lakeside	91	42	46
Plymouth	Fallbridge	190	38	38
McLoughlin	Fallbridge	14	42	42
Ridgefield	Seattle	122	59	64
Vader	Seattle	77	51	56
East Olympia	Seattle	35	46	52
SeaTac Terminal (Puyallup)		~32X	60	66
SeaTac Terminal (Spokane Street)		~2X	68	79
SeaTac Terminal (Broad Street)		~2	53	58
Mukilteo	Scenic	28	42	47
Marysville	Bellingham	38	26	25
Bow	Bellingham	79	20	20
Border	Bellingham	117	15	16
Monroe	Scenic	1770	23	23
Harrington	Columbia River	1527	24	23
Ravensdale	Stampede	91	6	9
Yakima	Yakima Valley	90	8	11

Source: Mainline Management

Base P5 Grade Crossing Occupancy Analysis

Additional grade crossing information related to the Base P5 simulation has been included in a separate spreadsheet. This is in addition to the Base Case spreadsheet that describes grade crossing occupancies for that simulation.

Base P5 Line Segment Capacity Observations

The following section of the memo briefly reviews the capacity observations by line segment (and by terminal where it is integral to the operation) for the Base P5 simulation. For each line segment, MLM has recorded its estimation of level of capacity utilization based on the Delay per 10 Miles operated statistic. The Delay Exceeding 30 minutes analysis was used to determine any repetitive causes that changed the lines' performance between simulations. Delay descriptions are the same as those used in the Base Case.

Spokane Sub

The Spokane Sub (Sandpoint, ID to Irvin, WA [east Spokane]) operated **well below** estimated sustainable capacity at 1.9 minutes of delay per 10 miles operated (1.6 minutes of delay in the Base Case). Hauser Terminal also operated **well below** estimated sustainable capacity at 4.4 minutes of delay per 10 miles (6.2 minutes of delay in the Base Case). As mentioned previously, Hauser operations were simplified and likely do not represent the full range of potential delays that can occur in a major terminal.

Freight train velocity on the Spokane Sub was 32.0 miles per hour on average (32.3 mph in Base Case). The inclusion of a six mile section of second main track from Rathdrum (near East Hauser) to Ramsey benefited trains on the subdivision while at the same time, a second lead track on the east end of Hauser Yard allowing simultaneous movements into and from the terminal was responsible for improving terminal operations. In combination, the two improvements kept the D/10 delay minutes almost constant as growth trains were added.

A major concern for Hauser that the model did not incorporate is the effect that crew changes have on the fueling tracks. Crews are changed at Hauser while the train is being fueled; in the model, 20 minutes is allowed for this procedure. However, in actual operations, if a crew is not available, or there is a delay associated with the crew change, the train can be parked on the fuel track for a much greater time than 20 minutes. This affects the following trains' ability to access that fueling track, and would also change the meet pass pattern on the line segment the outbound train uses. It is unlikely that this issue can be quantified in any analysis, as it is essentially a random function of available crews at a specific time and the number of trains arriving and needing those crews.

Spokane Terminal and Lakeside Sub

Spokane Terminal (Irvin to Latah Junction, Latah Junction to Lakeside Junction, Lakeside Junction to Sunset Junction) also operated **well below** estimated sustainable capacity at 3.8 minutes of delay per 10 miles operated (4.3 minutes in Base Case). Timing of trains through the terminal was responsible for the improvement in operations, as there were no infrastructure improvements included around the terminal. It is likely that the improvements at the east end of Hauser improved the flow through Spokane.

The Lakeside Sub (Lakeside Junction to Glade) also operated **well below** estimated sustainable capacity with 3.3 minutes of delay per 10 miles operated (2.5 minutes in Base Case). Four additional trains per day over the subdivision (Table A-3) was the cause of the increase in delay minutes, as there were more meets and passes because of the growth trains. There were no improvements included on this portion of the Lakeside Sub in the Base P5 simulation.

Average velocity for freight traffic on the route was 29.5 mph (30.9 mph in Base Case). The reduction in velocity reflects the impact of the additional traffic without including additional improvements.

Pasco Terminal and Fallbridge Sub

Pasco Terminal (Glade to SP&S Junction) operated **within** estimated sustainable capacity, with 14.8 minutes of delay per 10 miles operated (11.7 minutes in Base Case). As described previously, the high volume of trains entering or leaving the yards combined with the increased volume of trains passing through the terminal accounted for much of the delay that Pasco experienced. The second track between Glade and Pasco Yard helped mitigate some of the delay; however it was countered by having every loaded coal train stop on the new spraying track for approximately one hour to simulate the spraying cycle and a crew change.

Congestion around the single track Columbia River Bridge also impacted Pasco's delay minutes. Westbound trains were regularly held in the yard to allow eastbound trains from SP&S Junction or the Fallbridge Sub to enter the yard, which increased the delay totals. Other trains were held at SP&S Junction (from the Yakima Valley Sub) or at Hover or Yellepit sidings, again because of the conflicts at the Columbia River Bridge.

The Fallbridge Sub (SP&S Junction to McLoughlin) operated **well below** estimated sustainable capacity with 3.5 minutes of delay per 10 miles operated (3.9 minutes in the Base Case). The subdivision continued to have the highest number of delays exceeding 30 minutes (26.0/day compared to 23.7/day in Base Case). Most of these delays were associated with meets, where one train had to wait for three and sometimes four trains to pass before the model allowed the train in the siding to proceed.

The Fallbridge Sub saw no additional capacity improvements included in the model. However, the train counts remained virtually the same in the Base P5 case (Table A-3). A reduction in some unit traffic (coal and oil trains) and the rerouting of some empty unit trains to the Stampede Pass route was offset by an increase in grain traffic, which allowed Fallbridge Sub train counts to remain very similar between the two cases.

Velocity also showed that the subdivision operated relatively efficiently, with freight traffic operating at an average of 31.3 mph (30.3 mph in Base Case).

Vancouver Terminal

Vancouver Terminal operated **well below** estimated sustainable capacity with 7.5 minutes of delay per 10 miles operated (9.3 minutes in Base Case). The three major improvements included in the Base Case (east bypass, second track connecting Seattle and Fallbridge Subs, and the new grade separated Port of Vancouver lead) continued to positively impact the terminal. MLM believes that the new third track between Ostrander and Kelso also was responsible for the improvement in the D/10 minutes of delay because trains that were delayed in Vancouver in the Base Case could proceed without delay in the Base P5 case with the additional capacity north of the terminal.

Seattle Sub

The Seattle Sub (Felida to Nelson Bennett) operated **well below** estimated sustainable capacity with 1.5 minutes of delay per 10 miles (0.9 minutes in Base Case). The two main tracks over the entire length of the subdivision again minimized delays.

In the Base P5 case, there were multiple additional grain trains to Longview, Tacoma and Seattle which were responsible for the increased train volumes over the subdivision. Most of the delays exceeding 30 minutes continued to occur between Longview and Kalama, even with the additional third track. Northbound trains entering Longview Junction Yard had to cross over at least one main line to access the yard, which caused some of the delays. Trains departing the yard also could not get to the mainline without being delayed as well, which accounted for other delays.

One other location that experienced repetitive delay was at Nisqually Junction. This is where BNSF's Seattle Sub and the new Amtrak route between Tacoma and Nisqually converge. Freight traffic was occasionally delayed in this area by Amtrak trains entering or exiting the Seattle Sub.

Average freight train velocity for the subdivision was 32.2 mph (32.2 mph in Base Case), indicating the subdivision continued to operate efficiently.

Seattle Tacoma (SeaTac) Terminal

The SeaTac Terminal (Nelson Bennett to MP 8, Scenic Sub) operated **well below** estimated sustainable capacity with 6.7 minutes of delay per 10 miles operated (5.3 minutes in Base Case). Passenger operations were once again a contributor to the delays.

As discussed in the Base Case analysis, Sound Transit Commuter operations between Everett and King St. Station and King St. Station and Tacoma/Lakewood caused much of the congestion. This continued in the Base P5 analysis, even with the new third main track between Black River and Kent. While this allowed some trains to advance that were delayed in the previous analysis, the additional freight traffic (primarily grain empties and additional container/intermodal trains) countered the improvement. When there were few passenger trains running, the freight traffic had little problem proceeding without delay, however, when Sound Transit and Amtrak movements were occurring, many of the freight trains queued up south of Tacoma and north of King St. Station or in the various yards in the terminal. This led to the slight increase in delay as indicated by the D/10 statistics.

Scenic Sub West

The Scenic Sub West operated **well below** estimated sustainable capacity with 1.3 minutes of delay per 10 miles operated (1.5 minutes in Base Case). No improvements were included in the Base P5 case in this segment. The 20 miles between Mukilteo and North Seattle ran efficiently throughout the analysis, with freight train velocity averaging 36.1 mph (35.2 mph in Base Case). The only major delays that occurred on this segment were around a single track segment at Mukilteo. Other delays near this segment occurred within the SeaTac Terminal or the Everett Terminal.

Bellingham Sub and Everett Terminal

Everett Terminal operated **within** estimated sustainable capacity at 19.5 minutes of delay per 10 miles operated (19.3 minutes in Base Case). This number remained very close to the boundary between **within** and **at or approaching** estimated sustainable capacity (>20 minutes of delay per 10 miles).

As in the Base Case, passenger operations and a short single track segment were responsible for many of the delays that led to this D/10 statistic in the Base P5 analysis. As discussed previously, Sound Transit's and Amtrak's shared station on a single track segment of the Scenic Sub between Everett Junction and PA Junction caused delays to freight traffic entering and/or leaving the terminal. Additionally, the single track segment at Mukilteo also affected terminal operations as many southbound trains had to wait in the terminal until northbound trains cleared the single track following the commuter operations.

The Bellingham Sub operated **well below** estimated sustainable capacity at 3.8 minutes of delay per 10 miles operated (6.8 minutes in Base Case). This was a notable improvement in operations over the Bellingham Sub.

MLM believes there were multiple reasons for this improvement. The first was that the train mix was different in the 2020 simulation as compared to the Base Case. In the Base P5 case, there was a reduction of unit oil trains which were replaced by growth of coal and manifest trains to/from Canada. The oil trains experienced delays at Burlington trying to get back onto the main line; with a reduction in their count, some of that delay was removed from the model.

Additionally, with the increase in intermodal traffic from Seattle and Tacoma using the Scenic Sub, some of the eastbound empty coal and oil trains that used the Scenic Sub in the Base Case were rerouted to the Stampede Sub in the Base P5 case. These trains used a different route through Everett going towards Auburn and the Stampede Sub. This route, on the west side of the terminal, was less congested than going into Delta Yard on the east side of the terminal. This improved the trains' performance coming off the Bellingham Sub.

Finally, some manifest trains were directed into Delta Yard for furtherance towards Vancouver or Pasco. With the relocation of the empty unit trains away from the yard towards the west side of the terminal, there were additional yard tracks available to accommodate these arriving trains. That additional capacity improved Bellingham Sub operations as reflected by the reduced delay minutes.

The average freight velocity on the Bellingham Sub was 23.6 mph (20.7 mph in Base Case). This improvement reflects the reduction in D/10 minutes of delay experienced in the simulation.

Scenic Subdivision East and Columbia River Subdivision

The Scenic Subdivision East (PA Junction to Wenatchee) and the Columbia River Subdivision (Wenatchee to Latah Junction) were included in the analysis; as discussed in the Base Case analysis, the simulation was not as detailed as other segments of the railroad. The Scenic Sub East operated **within** estimated sustainable capacity at 4.3 minutes of delay per 10 miles operated (6.4 minutes in Base Case), while the Columbia River Sub operated **well below** estimated sustainable capacity at 1.6 minutes of delay per 10 miles operated (1.7 minutes in Base Case).

Most of the delay that was experienced on the Scenic Sub again occurred between Skykomish and Winton, which is the section of the route with high curvature and steep grades. As in the Base Case, these features slowed trains and caused long meets between traffic using the route. The Columbia River Sub experienced very few extended delays as well as a nominal number of short delays.

Scenic Sub trains averaged a velocity of 22.0 mph (20.5 mph in the Base Case), and the Columbia River Sub trains' average velocity was 36.7 mph (36.5 mph in Base Case).

Stampede Sub and Yakima Valley Sub

The Stampede Sub (Auburn to Ellensburg) and the Yakima Valley Sub (Ellensburg to SP&S Junction) both operated **well below** estimated sustainable capacity at 0.5 minutes of delay per 10 miles operated. Similar to the Scenic (east) and Columbia River Subs, the Stampede and Yakima Valley Subs were not simulated with the same level of detail as other subdivisions. The average velocity of trains using these subdivisions was 30.7 mph (30.0 mph in the Base Case).

As previously described, the Stampede and Yakima Valley Subs were operated in an eastbound directional manner with the exception of a local train working industries between SP&S Junction and Ellensburg. The trains continued to run without many delays in the Base P5 simulation, leading to the low D/10 statistics.

There were some additional empty unit trains over the route in the Base P5 simulation, as train counts increased by approximately three trains per day (Table A-3). The additional empty grain trains from Longview, Tacoma and Seattle all moved east via the Stampede/Yakima Valley Subs in the simulation, which accounted for the increased traffic levels. Additionally, some of the oil trains returning from Anacortes or Cherry Point (Bellingham Sub) also utilized the Stampede route in the Base P5 simulation whereas in the Base Case, those trains used the Scenic Sub. The intermodal growth traffic to/from Seattle and Tacoma required that some of the empty unit trains be relocated from the Scenic Sub to the Stampede Sub.

Base Case Plus 10 Years (Base P10) Analysis Results

Base P10 Conclusions

The Base P10 simulation showed that the projected growth trains over the 10 year time frame will create congestion if no line segment infrastructure improvements are constructed. However, with infrastructure improvements, such as those added in the simulation, each of the major line segments operated efficiently. MLM placed their improvements at locations where the simulation indicated they were needed; BNSF will likely perform their own analyses and may make improvements in locations that are different from MLM's. However, we are confident that BNSF will address the capacity issues as they arise when the traffic actually materializes.

MLM remains concerned with the PNW terminals. As has been discussed, the simulation simplifies many of the terminal operations to expedite the analyses. MLM believes this understates the issues that actually do or will occur in the terminals, as compared to the results from the simulations.

One operation we believe has been understated is crew availability. The simulation includes a pre-determined hold on a train to simulate a crew change (usually 15 to 20 minutes). In actual operations, if no crew is available, that hold will be much longer. This understatement of the time a train is stopped on a terminal track affects terminal capacity that would not be available for a subsequent train entering the terminal. With the high level of growth that has been projected, particularly for 10 years and beyond, MLM believes that crew issues will likely be a major component of how efficiently trains move in the PNW.

Beyond the crew issue, other concerns remain such as the capacity of the fueling tracks at Hauser; arrival, departure and main line track capacity at Pasco; a single track bridge over the Columbia River at the west end of Pasco; and passenger/commuter train impacts at Tacoma, Seattle and Everett. MLM believes BNSF is or will become aware that these issues are real, particularly if the projected growth traffic materializes. However, there are major constraints to correcting some of these issues and MLM believes they could take many years to resolve. Therefore, BNSF should be made aware of the traffic projections and their impact as soon as possible so that they can begin their analyses (if not already being performed) and the process of mitigating the issues that have been identified in the simulation.

Base P10 Train Volumes

There was a notable increase in train volumes on certain line segments in the Base P10 simulation compared to the Base P5 simulation totals. These major increases represent the inclusion of growth as projected by BST's data as well as growth associated with large unit train projects such as Millennium Bulk Terminal coal trains and Vancouver Energy oil trains. For each loaded train that was added for those projects, there was a corresponding empty train that had to be added as well. Some of the line segments, such as the Lakeside and Spokane Subdivisions, experienced both the loaded and empty movements. Other line segments, such as the Fallbridge or Stampede/Yakima Valley Subs, only experienced either the loaded or the empty movement, but not both.

As was noted above, only 25 million metric ton of 45 million metric ton of Millennium coal was included in the Base P10 simulation. The remaining 19 million metric tons were included in the Base P15 simulation results which are included below. The 25 million metric ton represented five loaded unit trains per day (and five empties). Similarly, only three unit oil trains were added for the Vancouver Energy project at Vancouver in the Base P10 simulation; the remaining train was added in the Base P15 analysis.

Table A-4 shows the average number of trains per day that operated over the line segment during the three day Base P10 simulation period. The previous simulation volumes are also shown for comparison.

Table A-4: Three Day Average Train Volume Summary, Through Base P10

			Trains per Day		
Location	Subdivision	Milepost	Base Case	Base P5 (2020)	Base P10 (2025)
E. Spokane	Spokane	63	66	69	93
Lind	Lakeside	91	42	46	66
Plymouth	Fallbridge	190	38	38	47
McLoughlin	Fallbridge	14	42	42	52
Ridgefield	Seattle	122	59	64	79
Vader	Seattle	77	51	56	71
East Olympia	Seattle	35	46	52	66
SeaTac Terminal (Puyallup)		~32X	60	66	82
SeaTac Terminal (Spokane Street)		~2X	68	79	85
SeaTac Terminal (Broad Street)		~2	53	58	65
Mukilteo	Scenic	28	42	47	53
Marysville	Bellingham	38	26	25	28
Bow	Bellingham	79	20	20	22
Border	Bellingham	117	15	16	17
Monroe	Scenic	1770	23	23	28
Harrington	Columbia River	1527	24	23	28
Ravensdale	Stampede	91	6	9	20
Yakima	Yakima Valley	90	8	11	23

Source: Mainline Management

Additional grade crossing information related to the Base P10 simulation has been included in a separate spreadsheet. This is in addition to the previous simulations' spreadsheets that depict grade crossing occupancies for those simulations.

Base P10 Line Segment Capacity Observations

The following section of the memo briefly reviews the capacity observations by line segment (and by terminal where it is integral to the operation) for the Base P10 simulation. For each line segment, MLM has recorded its estimation of the level of capacity utilization based on the Delay per 10 Miles operated statistic. The Delay Exceeding 30 minutes analysis was used to determine any repetitive causes that changed the lines performance between simulations. Delay descriptions are the same as those used in the Base Case.

Spokane Sub

The Spokane Sub (Sandpoint, ID to Irvin, WA [east Spokane]) operated **well below** estimated sustainable capacity at 1.4 minutes of delay per 10 miles operated (1.6 in the Base Case, 1.9 in Base P5). Hauser Terminal also operated **well below** estimated sustainable capacity at 4.5 minutes of delay per 10 miles (6.2 in the Base Case, 4.4 in Base P5). As mentioned previously, Hauser operations were simplified and likely do not represent the full range of potential delays that can occur in a major terminal.

Freight train velocity on the Spokane Sub was 32.9 miles per hour on average (32.3 mph in Base Case, 32.0 in Base P5). Train volumes on this section of track increased by 24 trains per day (Table A-4) with the inclusion of a portion of the Millennium coal and Vancouver Energy oil trains. Even with this increase in train volumes, the subdivision performed well because of the additional track capacity that was added. As described in above, this included filling in the single track sections between Irvin and Hauser Junction, between Ramsey and Athol and between Cocolalla and Algoma with a second main track. Appropriate crossovers were also included as necessary.

The bridge over Lake Pend O'reille near Sandpoint was the only remaining single track in this segment. The additional second track was added to accommodate the growth volumes, as daily train counts exceeded 90 trains per day as reflected in Table A-4.

Spokane Terminal and Lakeside Sub

Spokane Terminal (Irvin to Latah Junction, Latah Junction to Lakeside Junction, Lakeside Junction to Sunset Junction) also operated **well below** estimated sustainable capacity at 5.2 minutes of delay per 10 miles operated (4.3 in Base Case, 3.8 in Base P5). The increase in delay minutes reflected the increase in train volumes through the terminal. There were no capacity improvements included through the Spokane Terminal in the Base P10 simulation; however, most growth trains that were added did not terminate or originate in Spokane. These trains generally passed through the terminal, which accounted for the relatively moderate increase in delay associated with the large increase in train volumes.

The Lakeside Sub (Lakeside Junction to Glade) also operated **well below** estimated sustainable capacity with 3.9 minutes of delay per 10 miles operated (2.5 in Base Case, 3.3 in Base P5). Train volumes over the Lakeside Sub also increased by 20 trains per day (Table A-4), reflecting the Millennium and Vancouver Energy growth, along with grain and manifest growth.

MLM had to add a large amount of second main track along the Lakeside Sub to allow trains to continue to operate at reasonable levels of delay. As discussed above, this included adding a second track (or extending sidings) between Lakeside Junction and Cheney, Babb and Fishtrap, Fishtrap and Sprague, Essig and Lind, Lind and Cunningham, Connell and Cactus, Cactus and Eltopia and Sagemoor and Glade. While the subdivision was not completely double tracked, a second track was added to a large portion to accommodate the 65+ trains per day, which ran bi-directionally over the Lakeside Sub.

Average velocity for freight traffic on the route was 28.1 mph (30.9 in Base Case, 29.5 in Base P5). The reduction in velocity reflects the impact of the additional traffic even with the inclusion of the additional improvements. The increase in train volumes in each direction increased the number of meets on the subdivision. While the additional second main track alleviated some of the delays associated with the increased meets, there were still a number of times when multiple trains running in the same direction had to wait at the end of a double track segment for a group of trains running in the opposite direction. These delays increased the D/10 minutes of delay while lowering the velocity of trains on the route.

Pasco Terminal and Fallbridge Sub

Pasco Terminal (Glade to SP&S Junction) operated **within** estimated sustainable capacity, with 16.4 minutes of delay per 10 miles operated (11.7 in Base Case, 14.8 in Base P5). Like Hauser and Spokane Terminal, Pasco also had to accommodate all the growth associated with Millennium and Vancouver Energy, as well as growth in grain and manifest traffic. The additional trains further congested the terminal. As previously described, the simulations are not capable of including all movements and/or operations within the terminal, so this measurement of delay is likely to be understated as compared with actual delay at these traffic levels.

The Columbia River Bridge at Pasco remained a concern in the Base P10 simulation. BNSF routing protocol will likely have all westbound loaded unit trains running from Pasco to Vancouver via the Fallbridge Sub, and most or all eastbound unit empties returning to Pasco via the Yakima

Valley Sub. These two subdivisions converge at SP&S Junction, which is just west of the Columbia River Bridge. Therefore, all projected unit train growth, whether it is coal, oil or grain, will cross this bridge twice; once when loaded, and then again when empty.

MLM estimates that, based on the traffic projections, 70 trains per day used the Columbia River Bridge at Pasco. That is 21 additional trains per day (combined Fallbridge and Yakima Valley Sub train counts, Table A-4) over the bridge as compared to the Base P5 case. Many of these new trains were loaded and empty coal and oil to/from Millennium or Vancouver. The balance of growth was increased by grain loads and empties, as well as some manifest and Portland intermodal growth.

The Fallbridge Sub (SP&S Junction to McLoughlin) operated **well below** estimated sustainable capacity with 3.7 minutes of delay per 10 miles operated (3.9 in the Base Case, 3.5 in Base P5). Train volumes over the subdivision increased by approximately 10 trains per day, reflecting Millennium and Vancouver Energy loads, as well as loaded grain growth. As described previously, empties for these trains were run via Stampede Pass, and are reflected in the train counts over that subdivision.

The increased train volumes again led to a high number of meets on a primarily single track railroad. Some capacity was added as noted above, including a second track between Hover and Yellepit, extending Washougal siding, and increasing all current 7,000 foot sidings to a minimum of 8,800 feet. These improvements allowed the growth trains to operate at reasonable levels of delay. Rerouting the empty unit traffic via the Stampede Pass also facilitated the fluidity of the subdivision.

The subdivision continued to have the highest number of delays exceeding 30 minutes with 28/day (23.7/day in Base Case, 26.0/day in Base P5). As has been observed in the previous simulation, most of these delays were associated with meets or overtakes. Amtrak trains, which had higher priority than all other trains on the route, created excessive delays as the model often had to hold trains six to eight sidings in advance because of the constant flow of westbound freight traffic.

A slight decrease in velocity also reflected the increased train movements, with freight traffic operating at an average of 30.6 mph (30.3 in Base Case, 31.3 in Base P5).

Vancouver Terminal

Vancouver Terminal operated **within** estimated sustainable capacity with 11.4 minutes of delay per 10 miles operated (9.3 in Base Case, 7.5 in Base P5). The increase in delay minutes reflects the impact of the Vancouver Energy trains on other Port traffic as they arrived and departed the Port of Vancouver. It also reflected the impact of the loaded Millennium and grain trains that had to move through the terminal between the Fallbridge and Seattle Subdivisions.

Seattle Sub

The Seattle Sub (Felida to Nelson Bennett) operated **well below** estimated sustainable capacity with 0.8 minutes of delay per 10 miles (0.9 in Base Case, 1.5 in Base P5). The two main tracks over the entire length of the subdivision again minimized delays.

Millennium, grain and growth UP and BNSF manifest and intermodal trains were responsible for the increase in train volumes in this corridor. Train counts increased by 15 trains per day over the corridor (Table A-4); in many cases, the growth was not the same trains at various locations. For example, at Ridgefield (MP 122), growth would have included BNSF/UP traffic, Millennium and grain loads. However, at Vader (MP 77), growth would have included BNSF/UP traffic, Millennium empties, grain loads to Tacoma or Seattle, and grain empties from Longview and

Kalama. The change in traffic type reflects the operating protocol that MLM believes BNSF will continue to utilize, which has unit empties from the Port destinations running north on the Seattle Sub to access the Stampede Pass at Auburn.

There were very few delays that exceeded 30 minutes on the Seattle Sub during the Base P10 simulation. Where they did occur was generally around the Kalama to Longview area, where trains were exiting or entering the Seattle Sub from elevators or destination facilities. Improvements to the track network at Longview to accommodate the Millennium coal traffic actually improved some main line performance in the area, as trains were able to clear the main tracks more quickly because of the improvements. This was partially responsible for the overall slight improvement in operating statistics for the Seattle Sub.

Average freight train velocity for the subdivision was 30.0 mph (32.2 in Base Case, 32.2 in Base P5). The decrease in velocity reflects the increased unit traffic that was added to the route, which generally runs at a reduced velocity compared to manifest or intermodal operations.

Seattle Tacoma (SeaTac) Terminal

The SeaTac Terminal (Nelson Bennett to MP 8, Scenic Sub) operated **well below** estimated sustainable capacity with 6.1 minutes of delay per 10 miles operated (5.3 in Base Case, 6.7 in Base P5). As has been observed in all the previous simulations, passenger operations were once again a major contributor to the delays.

As discussed in the previous analyses, Sound Transit Commuter operations between Everett and King St. Station and King St. Station and Tacoma/Lakewood caused much of the congestion. This continued in the Base P10 analysis. However, the new third main track between Black River and Kent facilitated freight operations when commuter trains were not operating, and this was largely responsible for the reduction in delay minutes during the entire simulation.

MLM believes the third main track will be heavily utilized over time as growth occurs. For example, in the Base P10 simulation, many of the empty unit trains from the Bellingham Sub (oil and coal trains) had to run to Auburn to access the Stampede Pass because much of the Scenic Sub capacity was taken by intermodal and container train growth. The third main track facilitated the movement of these trains in conjunction with the container and intermodal trains running between Seattle and Tacoma.

Scenic Sub West

The Scenic Sub West operated **well below** estimated sustainable capacity with 3.9 minutes of delay per 10 miles operated (1.5 in Base Case, 1.3 in Base P5). Increased growth train volumes accounted for the increase in the delay statistic; as previously noted, empty unit trains from the Bellingham Sub were rerouted from the Scenic Sub (east) to the Scenic Sub (west) for access to the Stampede Pass. Also, there was an increase in Seattle and Tacoma container trains in the Base P10 simulation; between these trains and the unit trains, the segment experienced an increase of six trains per day on average (Table A-4). Since no improvements were included in the Base P10 case, the extra traffic created conflicts that were reflected in the higher delay minutes.

Northbound (eastbound) trains experienced a number of delays exceeding 30 minutes at MP 27 in this segment. This is a short segment of single track near Mukilteo; in many cases, the model held northbound trains to allow southbound trains to leave the Everett Terminal. MLM believes the model did this to create track capacity in Everett for other train arrivals, both from the Bellingham Sub and from the Scenic Sub.

Bellingham Sub and Everett Terminal

Everett Terminal operated **within** estimated sustainable capacity at 15.4 minutes of delay per 10 miles operated (19.3 in Base Case, 19.5 in Base P5). This was a slight improvement over the past analyses.

MLM believes the improvement stems from the rerouting of many Bellingham Sub empty unit trains from the Scenic Sub to the Stampede Sub. As was seen in the Base P5 analysis, rerouting empty trains from the east side of Everett (Delta Yard) to the west side of Everett (Bayside) freed up tracks in Delta Yard for other traffic such as manifest trains moving to or from Canada. Also, as mentioned in the Scenic West analysis, the model chose to run southbound trains to free up track capacity around Everett. This also contributed to the reduced delay in the Everett Terminal.

The Bellingham Sub operated **within** estimated sustainable capacity at 4.6 minutes of delay per 10 miles operated (6.8 in Base Case, 3.8 in Base P5). There were two or three additional trains per day using the Bellingham Sub in the Base P10 analysis. Unit oil trains to Fidalgo or Cherry Point, coal trains to Canada and additional manifest trains to/from Canada were responsible for this growth.

The impact of the growth trains was significant enough that Bow Siding had to be extended towards Mt. Vernon in the Base P10 analysis. There is an 18 mile segment of single track between Bellingham and Bow that only has a short siding in the middle of it; that siding cannot hold a train over 5,000 feet in length so it is unusable by most trains in the simulation. The extended second track at Bow allowed two or more northbound trains to queue up at Bow, where they could wait for opposing traffic to clear the single track from Bellingham and then proceed as a fleet of trains to the north. While this helped keep traffic moving on the subdivision, it did add to delay minutes when the northbound trains were queued up and waiting for the opposing trains.

The average freight velocity on the Bellingham Sub was 23.1 mph (20.7 in Base Case, 23.6 in Base P5).

Scenic Subdivision East and Columbia River Subdivision

As noted in the previous analyses, the Scenic Subdivision East (PA Junction to Wenatchee) and the Columbia River Subdivision (Wenatchee to Latah Junction) were included in the analysis; however the simulation was not as detailed as other segments of the network. With this in mind, the Scenic Sub East operated **within** estimated sustainable capacity at 6.3 minutes of delay per 10 miles operated (6.4 in Base Case, 4.3 in Base P5), while the Columbia River Sub operated **well below** estimated sustainable capacity at 1.7 minutes of delay per 10 miles operated (1.7 in Base Case, 1.6 in Base P5).

Most of the delay that was experienced on the Scenic Sub again occurred between Skykomish and Winton, which is the section of the route with high curvature and steep grades. It should be noted that in the Base P10 analysis, an average of 28 trains per day ran over the mountain portion of the Scenic Sub. This approaches the estimated capacity of the route because of grades, curvature and slow speeds that create long meets in this section of the subdivision. MLM believes BNSF will not try to operate more than 28 or 29 trains per day over this route at any time in the future.

MLM will have to modify operations in the Base P15 simulation over this route to keep train volumes in the 28 trains per day range. As noted previously, many of the empty unit trains that had previously run back to Spokane via the Scenic Sub were rerouted in the Base P10 simulation to the Stampede Sub because of the limited capacity. In the next future simulation, MLM believes all empty unit trains as well as some intermodal trains will need to be rerouted as well. MLM will leave the highest priority domestic intermodal trains on the Scenic Sub because it is the shortest route to Spokane, however some container traffic from Seattle or Tacoma will likely need to be rerouted.

Scenic Sub trains averaged a velocity of 20.4 mph (20.5 in the Base Case, 22.0 in Base P5), and the Columbia River Sub trains' average velocity was 35.8 mph (36.5 in Base Case, 36.7 in Base P5).

Stampede Sub and Yakima Valley Sub

The Stampede Sub (Auburn to Ellensburg) and the Yakima Valley Sub (Ellensburg to SP&S Junction) both operated **well below** estimated sustainable capacity at 1.8 minutes of delay per 10 miles operated (1.0 in Base Case, 0.5 in Base P5). Similar to the Scenic (east) and Columbia River Subs, the Stampede and Yakima Valley Subs were not simulated with the same level of detail as other subdivisions. The average velocity of trains using these subdivisions was 28.7 mph (30.0 in the Base Case, 30.7 in Base P5).

As previously described, the Stampede and Yakima Valley Subs were operated in an eastbound directional manner with the exception of a local train working industries between SP&S Junction and Ellensburg. However, as Table A-4 shows, there were 11 to 12 more trains per day on the Stampede Sub in the Base P10 simulation compared to the Base P5 simulation. As has been mentioned in previous segments' analyses, these additional trains were rerouted from either the Fallbridge Sub or the Scenic Sub, or they were growth empties associated with Millennium or Vancouver Energy trains.

Since the trains mostly all run in the same direction, there are very few meet delays. Many of the remaining delays occurred at the south end of the Yakima Valley Sub near SP&S Junction, which is the connection to the Fallbridge Sub just west of Pasco. Delays in that area were caused by trains departing Pasco Yard, eastbound Fallbridge Sub trains coming from Vancouver or delays caused by the single track bridge over the Columbia River, which is immediately adjacent to SP&S Junction.

Base Case Plus 15 Years (Base P15) Analysis Results

Base P15 Conclusions

Growth associated with the Base P15 simulation was significant, as indicated on certain line segments in Table A-5. MLM was forced to include infrastructure and operating modifications in the PNW rail network to mitigate the congestion the new trains caused. As discussed above, there were major modifications on the Lakeside and Fallbridge Sub, as well as signal and tunnel modifications on the Stampede/Yakima Valley Subs. But beyond those improvements, there were operating changes that were required to maintain a fluid railroad network at the projected train volumes.

The largest of these changes was rerouting trains to the Stampede/Yakima Valley Subs. In previous simulations, only empty unit trains used this route to return to Pasco and then east. In the Base P15 simulation, MLM had to assume manifest trains from Everett, Seattle and Tacoma that were destined to Pasco and Spokane used the route in addition to empty unit trains. Also, some intermodal trains from Portland and Tacoma were rerouted via the Stampede/Yakima Valley Subs to Pasco prior to proceeding east.

These trains were chosen to reduce eastbound volumes on both the Scenic Sub (Everett to Wenatchee) and the Fallbridge Sub (Vancouver to Pasco). With the growth in intermodal and container traffic associated with the Base P15 time frame, the Scenic Sub was found to be near or at capacity operating only passenger, intermodal or container/vehicle trains over the route. Therefore, empty unit trains, an eastbound manifest train and some Tacoma double stack container trains had to be reassigned to the Stampede Sub to leave enough room for the other high priority trains on the Scenic Sub.

Similarly, many of the Everett, Seattle and Tacoma manifest trains that previously had moved to Pasco via the Seattle and Fallbridge Subs (Seattle to Vancouver to Pasco) were reassigned to the Stampede Pass to minimize the amount of eastbound traffic using the Fallbridge route. As has been described, MLM believes BNSF will continue to utilize the water grade Fallbridge Sub for loaded westbound unit trains and manifest trains. Therefore, the remaining eastbound trains cause conflicts with the heavy westbound flow. The manifest trains actually reduced their mileage moving via Stampede, which would also benefit BNSF.

The Portland intermodal train that was rerouted was reassigned for the same reason; to reduce eastbound train flow on the Fallbridge Sub. That train would actually increase its mileage moving via Stampede, however we believe at the volumes that are projected in the Base P15 simulation, this would be an option BNSF might utilize. If there were capacity over the Scenic Sub on specific days, the train might be routed that way to Spokane rather than via Auburn and Pasco.

MLM believes that BNSF will have to make these appraisals on a daily basis during peak volume periods. The volume of trains moving to or from the Ports of Seattle and Tacoma will determine the available capacity of the Scenic Sub, and that in turn will determine which trains must be routed via the Stampede Sub. Similarly, the westbound flow of grain, oil and coal trains will likely determine the available capacity of the Fallbridge Sub, which will determine how many manifest or intermodal trains will be routed via the Stampede Sub to reduce the eastbound flow.

MLM made the assumption that should these volumes materialize, BNSF would increase the clearance on the Stampede Pass tunnels to allow international and domestic double stack trains to operate via that route. Clearance for that type of traffic would also allow manifest trains containing vehicle cars to operate via the route. Additionally, MLM assumed that the signal system for the Stampede and Yakima Valley Sub would be upgraded to allow more efficient dispatching of trains over the two segments. With the high volume of trains that potentially could use the route, MLM believes BNSF will utilize these options to increase PNW capacity as the traffic materializes.

With infrastructure improvements and the operational modifications, MLM believes BNSF will have enough line segment capacity to accommodate traffic into the 2030 time frame. As has been noted previously, MLM believes BNSF will perform its own analysis and may focus infrastructure in different locations from those that MLM has developed. They may also reroute a different group of trains to the Stampede Sub to facilitate capacity on the Fallbridge and Scenic Subs. However, the model does show that it is possible to develop a plan that will accommodate a heavy growth scenario.

The Base P15 simulation continues to support MLM's belief that the PNW terminals will ultimately determine the efficiency of BNSF's network in the PNW. Both Pasco and Everett were approaching or at capacity at the Base P15 train levels, while Hauser experienced a notable increase in delay as well. As has been stated previously, the RTC model does not account for all the delays that are likely to actually occur in actual terminal operations, so we believe that the effects observed in the Base P15 model understate the actual level of congestion within those terminals. This means there may be major problems at Pasco and Everett, as well as significant issues at Hauser.

Base P15 Train Volumes

Table A-5 shows the average number of trains per day that operated over the line segment during the three day Base P15 simulation period. The previous simulation volumes are also shown for comparison.

Table A-5: Three Day Average Train Volume Summary, Through Base P15

				Trains per Day		
Location	Subdivision	Milepost	Base Case	Base P5 (2020)	Base P10 (2025)	Base P15 (2030)
E. Spokane	Spokane	63	66	69	93	111
Lind	Lakeside	91	42	46	66	88
Plymouth	Fallbridge	190	38	38	47	51
McLoughlin	Fallbridge	14	42	42	52	58
Ridgefield	Seattle	122	59	64	79	93
Vader	Seattle	77	51	56	71	85
East Olympia	Seattle	35	46	52	66	81
SeaTac Terminal (Puyallup)		~32X	60	66	82	95
SeaTac Terminal (Spokane Street)		~2X	68	79	85	90
SeaTac Terminal (Broad Street)		~2	53	58	65	70
Mukilteo	Scenic	28	42	47	53	59
Marysville	Bellingham	38	26	25	28	31
Bow	Bellingham	79	20	20	22	25
Border	Bellingham	117	15	16	17	20
Monroe	Scenic	1770	23	23	28	26
Harrington	Columbia River	1527	24	23	28	25
Ravensdale	Stampede	91	6	9	20	40
Yakima	Yakima Valley	90	8	11	23	41

Source: Mainline Management

Table A-5 clearly shows the impact of major unit train projects such as Millennium Coal and Vancouver Energy. The growth over the segments that these trains use, either loaded or empty, in the Base P10 and Base P15 simulations far exceeds any growth observed in the Base P5 simulation, which excluded any major unit train projects. MLM remains certain that if large unit train projects like Millennium or Vancouver Energy are approved, BNSF will have to expedite modifications (whether infrastructure or operational) to accommodate the impact of the traffic growth that will be associated with those projects.

As described previously, the Base P15 simulation included the final 19 million metric tons of coal to Millennium Terminal, six million metric tons of coal to Roberts Bank and projected growth of grain, manifest and intermodal trains based on BST's analysis data. The growth by line segment in Table A-5 reflects all these additional trains, based on MLM's projected operating plan.

Base P15 Grade Crossing Occupancy Analysis

Additional grade crossing information related to the Base P15 simulation has been included in a separate spreadsheet. This is in addition to the previous simulations' spreadsheets that depict grade crossing occupancies for those simulations.

Base P15 Line Segment Capacity Observations

The following section of the memo briefly reviews the capacity observations by line segment and terminal for the Base P15 simulation. For each line segment, MLM has recorded its estimation of level of capacity utilization based on the Delay per 10 Miles operated statistic. The Delay Exceeding 30 minutes analysis was used to determine any repetitive causes that changed the lines performance between simulations. Delay descriptions are the same as those used in the Base Case

Spokane Sub

The Spokane Sub (Sandpoint, ID to Irvin, WA [east Spokane]) operated **well below** estimated sustainable capacity at 2.8 minutes of delay per 10 miles operated (1.6 BC, 1.9 P5, 1.4 P10). Hauser Terminal also operated **well below** estimated sustainable capacity at 7.5 minutes of delay per 10 miles (6.2 BC, 4.4 P5, 4.5 P10). As has been described previously, Hauser operations were simplified and likely do not represent the full range of potential delays that can occur in a major terminal.

Freight train velocity on the Spokane Sub was 29.8 miles per hour on average (32.3 mph BC, 32.0 P5, 32.9 P10). Train volumes on this section of track increased by another 18 trains per day (Table A-5) with the remaining 19 million metric tons of coal to Millennium, a six million metric tonne increase of coal to Roberts Bank, and annualized growth of grain, containers and manifest as projected by BST. No additional main tracks were added to the Spokane Sub in the Base P15 simulation; the only remaining section of single track along the subdivision was the mile long bridge over Lake Pend O'reille at Sandpoint, ID. Some switches at industrial locations were improved to power switches to facilitate the ability of local switching assignments to get off of or onto the subdivision more quickly.

The increase in train volumes did not significantly degrade the performance of the line segment or Hauser Terminal. There continued to be some delay around Hauser as trains stopped for fueling and crew changes. As has been noted, the simplified simulation of these operations likely understates the delay that would actually occur at this volume of trains per day.

While the bridge near Sandpoint remained single track, there was not a noticeable increase in delays to trains moving across the bridge. There were some queuing delays at each end, as a westbound fleet would wait for an eastbound fleet to pass (or vice versa). MLM believes this may understate the actual impact of the bridge on train flow, because the model network ends just east of Sandpoint Junction for the MRL route and just east of Boyer Siding for BNSF's Kootenai Sub.

With the network ending at those locations, the model has unlimited capacity to run trains off the network when necessary. In actual operations, there is a capacity associated with both the MRL and BNSF main lines as they head east; that capacity would likely affect traffic flow in a more noticeable manner than is represented by the model simulations.

Spokane Terminal and Lakeside Sub

Spokane Terminal (Irvin to Latah Junction, Latah Junction to Lakeside Junction, Lakeside Junction to Sunset Junction) also operated **well below** estimated sustainable capacity at 4.4 minutes of delay per 10 miles operated (4.3 BC, 3.8 P5, 5.2 P10). As described previously, most trains in the simulation do not stop in Spokane; rather, they utilize two main tracks to pass through the terminal to/from the various routes west of Spokane's Yardley Yard. However, with the various junctions described previously just west of Spokane, there are a number of movements that potentially can conflict with each other in the Spokane area.

One improvement that was made in this area was a modification to UP's connection to BNSF at Lakeside Junction. The improvement, which consisted of a crossover from UP's line to the BNSF two main tracks just south of Cheney, WA, allowed northbound UP trains from Hinkle, OR to enter BNSF's main lines near Cheney. Southbound UP trains continued to use the existing connection at Lakeside Junction. This operating change eliminated a UP crossover movement across BNSF's westbound route between Lakeside Junction and Marshall. By eliminating this crossover movement, it reduced conflicts with BNSF trains moving between Latah Junction and Lakeside Junction as well as reducing some delays that UP trains were experiencing because of the high volume of BNSF westbound unit trains.

The Lakeside Sub (Lakeside Junction to Glade) also operated **well below** estimated sustainable capacity with 0.4 minutes of delay per 10 miles operated (2.5 BC, 3.3 P5, 3.9 P10). Train volumes over the Lakeside Sub also increased by 22 trains per day (Table A-5), reflecting the Millennium and Roberts Bank growth along with other grain and manifest growth. Additionally, the volumes over the Lakeside Sub increased because of the need to reroute some container and manifest trains from the Scenic Sub to the Stampede Sub. Trains that previously had joined the Spokane Sub at Latah Junction now had to go through Pasco (from the Yakima Valley Sub) and then use the Lakeside Sub to get to Spokane.

The reason the delay figure dropped so significantly in the Base P15 simulation is because at an average of 88 trains per day (Table A-5), MLM believed a second main track was required across all the remaining single track segments of the subdivision, as discussed above. This eliminated most of the delay associated with trains being held for meets with opposing trains. Additionally, virtually all freight overtakes were eliminated because at the volume of trains in the model, all freight trains had to run at essentially the same speed. The only overtakes that continued to occur were passenger trains overtaking freight movements, which did lead to some delays. Some local train movements also experienced delays at their designated switching locations as it was difficult for those trains to reenter the nearly continuous flow of traffic.

Average velocity for freight traffic on the route was 36.1 mph (30.9 BC, 29.5 P5, 28.1 P10). The increase in average velocity reflects the reduction in delay that occurred along the subdivision with the inclusion of the sections of second main track.

Pasco Terminal and Fallbridge Sub

Pasco Terminal (Glade to SP&S Junction) operated **above** estimated sustainable capacity, with 26.2 minutes of delay per 10 miles operated (11.7 BC, 14.8 P5, 16.4 P10). This is a notable increase from the P10 delay statistics; MLM is concerned because at this level of delay, it is likely that the terminal would not be capable of operating for long periods without experiencing delays that potentially could affect all movements through Pasco.

MLM believes the level of delay experienced in the Base P15 simulation would make terminal operations unsustainable over long periods of time. While the terminal could operate for short periods, eventually an incident would occur that would delay a critical train, and that would set off a chain reaction of delays. MLM believes it could take days to recover from that sort of chain reaction, particularly at the train volumes associated with the Base P15 simulation. Review of the terminal shows there were three operations that caused the increase in delay minutes that were observed.

The first type of delay was to trains entering the arrival yard or leaving the departure yard. Trains trying to enter the arrival yard at one of the four locations within the Pasco terminal were frequently blocked by trains on an adjacent main track that were waiting for a crew change or for other traffic ahead. Trains attempting to depart the yard experienced the same type of delays; the routes were blocked by main line trains that were waiting in that location.

The second type of delay occurred to coal trains that were waiting for access to the spray shed. There were as many as 14 coal trains per day (nine to Millennium and five to Roberts Bank), each taking an hour for the spraying operation. With this many trains, there were multiple occasions when there were two or more coal trains waiting to use the sprayer route. MLM had to add an extended third main track to accommodate this queue of coal trains, otherwise they would have affected many of the other trains approaching the terminal because one main track would have been blocked for most of the simulation time. That would have prevented other train types from arriving and departing simultaneously, which would have led to further congestion and delays.

Coal trains waiting for the spray shed also were affected by arriving and departing trains to/from Pasco's yards. Some coal trains had to wait until the model dispatcher allowed manifest or other unit trains to enter or depart the yard before being allowed to proceed. This aggravated the delays the coal trains experienced, and created longer queues of coal trains.

Finally, the last location that experienced long and repetitive delays was the west end of the terminal. As has been described previously, the single track bridge over the Columbia River was the main contributor to these delays. With the full growth of coal trains associated with Millennium, the oil trains to Vancouver, and the other growth of grain and manifest trains, the bridge experienced train counts in the 90 trains per day range (Yakima Valley plus Fallbridge Sub counts, Table A-5). At that volume, it was not uncommon to see as many as six trains per hour passing over the bridge. Many times, the model had to fleet trains into or from the terminal. The delay occurred as the model held one group of trains to let the other group pass.

The Fallbridge Sub (SP&S Junction to McLoughlin) operated **well below** estimated sustainable capacity with 2.3 minutes of delay per 10 miles operated (3.9 BC, 3.5 P5, 3.7 P10). Train volumes over the subdivision increased by approximately four trains per day, which was less than either the Spokane or Lakeside Subs. The train count increase was less because even though there were additional westbound coal, grain and manifest trains on the route, some existing eastbound manifest and intermodal trains were removed from the route. Those trains were rerouted from Portland, Tacoma, Seattle and Everett to the Stampede Pass.

As has been documented in previous simulations, MLM believes BNSF will expand an operating concept they currently utilize that features westbound loaded unit trains via the Fallbridge Sub and eastbound empty unit trains via the Stampede/Yakima Valley Sub. At the growth volumes that have been projected in the Base P15 simulation, the quantity of westbound unit trains is so high that a single track railroad with sidings will likely not be able to accommodate even a moderate number of opposing eastbound trains.

Based on the observed delays caused by eastbound trains on the Fallbridge Sub, MLM chose to reroute manifest trains from Everett, Seattle and Tacoma and some intermodal trains from Portland to the Stampede Sub. This required assuming that the tunnels over Stampede Pass would be modified to allow double stack container trains and vehicle carrier rail cars. The rerouted trains reduced eastbound flow over the Fallbridge Sub, which improved operations and lowered train counts.

The relocation of many of the eastbound trains also improved the performance of the subdivision. While train counts went up, the delay minutes per 10 miles operated decreased. This reflected the reduction in meets associated with rerouting eastbound trains to the Stampede Sub. An additional 7.5 miles of second main track between Camas and Washougal also contributed to the reduction of delays, as this section of second main track allowed westbound trains to pass trains coming from Vancouver without delay.

In previous analyses, the Fallbridge Sub had the highest number of delays exceeding 30 minutes, with 26/day in the Base P5 case and 28/day in the Base P10 case. In the Base P15 case, the number of delays exceeding 30 minutes was reduced to 22/day, which was less than the average number from the Base Case. This reduction in major delays confirmed that rerouting eastbound trains away from the Fallbridge Sub made overall operations more efficient.

Creating a more uniform westbound flow on the subdivision also increased the average velocity of trains between Vancouver and Pasco. Freight traffic operated at an average of 33.2 mph (30.3 BC, 31.3 P5, 30.6 P10), which was notably higher than previous cases.

Vancouver Terminal

Vancouver Terminal operated **within** estimated sustainable capacity with 12.5 minutes of delay per 10 miles operated (9.3 BC, 7.5 P5, 11.4 P10). The increase in delay minutes reflects the impact of the additional loaded Millennium and grain trains that had to move through the terminal between the Fallbridge and Seattle Subdivisions. UP also had additional grain and intermodal trains that passed through the terminal.

Even with this growth, the terminal continued to operate relatively efficiently, which MLM believes is account of the second crew change track that was included in the Base P15 simulation as well as the infrastructure improvements that were included in all of the previous analyses.

Seattle Sub

The Seattle Sub (Felida to Nelson Bennett) operated **well below** estimated sustainable capacity with 1.1 minutes of delay per 10 miles (0.9 BC, 1.5 P5, 0.8 P10). The two main tracks over the entire length of the subdivision again minimized delays.

Another 14 trains per day were added to this corridor with the future growth of Millennium and Roberts Bank coal trains, along with grain growth to the ports of Kalama, Longview, Grays Harbor, Tacoma and Seattle. Additionally, one intermodal train from Portland was rerouted onto the Seattle Sub from the Fallbridge Sub.

At the same time, manifest trains from Everett, Seattle and Tacoma were removed from portions of the subdivision as they were rerouted from the Seattle/Fallbridge route to the Stampede route. Overall, while the numbers changed, the subdivision continued to operate relatively efficiently, even at train volumes approaching 95 trains/day.

Average freight train velocity for the subdivision was 27.7 mph (32.2 BC, 32.2 P5, 30.0 P10). The decrease in velocity reflects the increased unit traffic that was added to the route, which generally runs at a reduced velocity compared to manifest or intermodal operations.

Seattle Tacoma (SeaTac) Terminal

The SeaTac Terminal (Nelson Bennett to MP 8, Scenic Sub) operated **well below** estimated sustainable capacity with 7.9 minutes of delay per 10 miles operated (5.3 BC, 6.7 P5, 6.1 P10). As has been observed in all the previous simulations, passenger operations during commute hours continued to contribute to the delays. When passenger operations were reduced or non-existent, the terminal area operated efficiently.

Additional third main track between Kent and Auburn was partially responsible for the efficiency. The track created another route from King St. Station to Auburn that trains moving to the Stampede Pass could utilize, while through trains could utilize the remaining two main tracks.

As was described in the Base P10 analysis, this was evident during non-passenger hours, since passenger trains had to use the western and easternmost tracks to stop at their stations. The crossover movements near Tacoma and Seattle that the passenger trains had to make cut off the flow of the freight trains, which resulted in some of the delay that was observed in the simulations.

Scenic Sub West

The Scenic Sub West operated **well below** estimated sustainable capacity with 2.7 minutes of delay per 10 miles operated (1.5 BC, 1.3 P5, 3.9 P10). Most of the delays that occurred on this section of track occurred around the two short single track segments at MP 8 and MP 28. Northbound trains were held at MP 27 to allow southbound trains through that single track section, and some southbound trains were held at MP 8 to allow northbound trains through that section. MLM believes the model dispatched train in this manner to allow the terminal areas on both sides of the Scenic Sub West to clear out traffic to make room for arriving trains.

Bellingham Sub and Everett Terminal

Everett Terminal operated **approaching or at** estimated sustainable capacity at 22.0 minutes of delay per 10 miles operated (19.3 BC, 19.5 P5, 15.4 P10). This was an increase in delay minutes compared to past analyses. There were three locations that experienced repetitive delays that led to this increase.

The first location was Delta Yard, where many trains stopped for crew changes or car pick up and set outs. Once in the yard, there were repetitive delays to these trains when they tried to leave; in some cases, it was traffic on the Scenic Sub (including passenger traffic) or traffic on the Bellingham Sub. Slow speeds and a lack of siding capacity north of Everett created long delays that increased delay minute statistics.

The second location was in Lowell Siding which is at the east end of the terminal on the Scenic Sub. Eastbound trains were held in the siding for timing of trains moving over Stevens Pass, and westbound trains were held in the siding waiting for traffic to clear the single track between PA Junction and Everett Junction. Some of the traffic that the westbound trains had to wait for was passenger trains (Sound Transit and Amtrak) using the station between those two points.

The final location was along the western route past Everett, commonly referred to as the Bayside route. Most of the northbound loaded unit trains were directed to this route along with many of the empty unit trains that were routed to the Stampede Pass. To allow these additional trains to utilize the Bayside route, MLM added a second main line from near Everett Junction to Delta Junction. Additionally, the signal system was improved and the route's maximum speed was increased to 25 mph.

Most of the trains that were delayed on the Bayside route were northbound loaded unit trains. These delays were caused by the slow speed single track segment between Delta Junction and English, and the high volume of trains that were projected to operate over the Bellingham Sub in the Base P15 analysis.

The Bellingham Sub operated **within** estimated sustainable capacity at 5.6 minutes of delay per 10 miles operated (6.8 BC, 3.8 P5, 4.6 P10). The additional coal trains to/from Roberts Bank and some additional manifest traffic to/from Vancouver, BC added three trains per day to the route (Table A-5). No additional infrastructure was included on the Bellingham Sub in the Base P15 simulation, and MLM believes the additional meets that were caused by the increase in traffic contributed to the increase in delay minutes. Additionally, delays getting into Everett Terminal also had an impact on Bellingham Sub delay.

The average freight velocity on the Bellingham Sub was 22.4 mph (20.7 BC, 23.6 P5, 23.1 P10). The reduction in velocity is a symptom of the increase in delay minutes.

7.4.3.9 Scenic Subdivision East and Columbia River Subdivision

As noted in the previous analyses, the Scenic Subdivision East (PA Junction to Wenatchee) and the Columbia River Subdivision (Wenatchee to Latah Junction) were included in the analysis; however the simulation was not as detailed as other segments of the network. With this in mind, the Scenic Sub East operated **within** estimated sustainable capacity at 5.0 minutes of delay per 10 miles operated (6.4 BC, 4.3 P5, 6.3 P10), while the Columbia River Sub operated **well below** estimated sustainable capacity at 2.0 minutes of delay per 10 miles operated (1.7 BC, 1.6 P5, 1.7 P10).

Table A-5 shows there was a decrease in train volume from 28 to 26 trains per day on the Scenic Sub. This was solely a function of which trains MLM assigned to run via the Scenic Sub vs. trains assigned to run via the Stampede Sub. The model does not have the flexibility to determine how many trains would be routed one way versus the other; the model operator chose the types of trains to run on each route and let the model dispatch them as designated.

MLM believes in actual operations BNSF would fill the capacity of the Scenic Sub before routing intermodal trains from either Tacoma or Portland to the Stampede Sub. This would be particularly true for the higher priority intermodal train from Portland; it would likely use the Scenic Sub to move to Spokane if capacity were available. Under a scenario where additional trains were routed via the Scenic Sub to fill all available capacity, MLM would expect the delay statistics to closely match the statistics from the Base P10 simulation, where the Scenic Sub operated near capacity.

Scenic Sub trains averaged a velocity of 21.3 mph (20.5 BC, 22.0 P5, 20.4 P10), and the Columbia River Sub trains' average velocity was 35.6 mph (36.5 BC, 36.7 P5, 35.8 P10).

Stampede Sub and Yakima Valley Sub

The Stampede Sub (Auburn to Ellensburg) and the Yakima Valley Sub (Ellensburg to SP&S Junction) both operated **well below** estimated sustainable capacity at 1.8 minutes of delay per 10 miles operated (1.0 BC, 0.5 P5, 1.8 P10). Similar to the Scenic (east) and Columbia River Subs, the Stampede and Yakima Valley Subs were not simulated with the same level of detail as other subdivisions. The average velocity of trains using these subdivisions was 28.6 mph (30.0 BC, 30.7 P5, 28.7 P10).

As previously described, the increase in train volume (18 - 20 trains per day, Table A-5) occurred because of the increase in Millennium and Roberts Bank coal empties, empty grain train growth, and rerouting of manifest and some container traffic onto the subdivisions. These trains, like all through trains using the subdivisions, ran directionally from Auburn to Pasco. As has been previously noted, the only trains that run on the subdivision in a westbound direction are two local trains that work industry between SP&S Junction and Ellensburg.

Most of the delay on the route was caused by congestion near Kennewick and SP&S Junction as eastbound trains tried to enter the Fallbridge Sub and Pasco Terminal. The high volume of trains, in conjunction with the high volume of westbound trains leaving Pasco and the single track Columbia River Bridge, created queues of trains that the model fleeted into Pasco after letting a fleet of trains leave Pasco towards Vancouver. As the trains queued up, there was delay to multiple trains which was reflected in the delay minutes.

As was noted previously in this section, Pasco Terminal experienced high levels of delay from the westbound trains waiting until the trains from the Yakima Valley Sub cleared. MLM believes both line segments and the Pasco terminal were affected by the single track bridge.

Summary of Simulation Observations

Based on the results of the Base, Base P5, Base P10 and Base P15 simulations which utilized BST's projected growth to and from the PNW, MLM has summarized its observations in the following section. The summary is broken down in the order of operational, line segment and terminal observations.

General Operational Observations

MLM believes that BNSF will continue to utilize and ultimately expand the use of the Fallbridge Sub for primarily westbound loaded unit and other trains, while running empties and potentially other eastbound traffic through Pasco via the Stampede and Yakima Valley Subdivisions. This operating pattern will maximize capacity on routes that will be increasingly difficult on which to add capacity.

Based on MLM's beliefs regarding likely BNSF routing protocols, the Spokane and Lakeside Subdivisions will have to accommodate all loaded and a very high percentage of empty unit trains. Large unit train growth projects, such as Millennium Coal or Vancouver Energy, will increase traffic on these two subdivisions in sudden increments rather than at an expected linear growth rate. Linear grain growth projections for the PNW ports will also have a notable impact on traffic levels on these two subdivisions, particularly during peak shipping periods or when there are heavy overseas export programs.

The Fallbridge Subdivision will experience the growth of all loaded unit trains moving to PNW ports. The route's location along the Columbia River makes it difficult to construct a second track in certain areas. Therefore, MLM believes BNSF will reroute some of the current eastbound traffic to the Scenic and Stampede Subdivisions as the unit traffic continues to grow. This will keep train counts at levels that the Fallbridge Sub can accommodate, and will further reduce the number of meets that westbound trains will have to make.

The Scenic Sub has a limited sustainable capacity of approximately 28 trains per day because of long running times between sidings caused by grades and curvature. Since this is the shortest route between Seattle/Tacoma and Spokane, MLM believes the route will be utilized by BNSF's highest priority traffic. Once that traffic type grows to a level that approaches the route's capacity, MLM believes BNSF will likely reroute other traffic such as manifest and potentially some intermodal trains to the Stampede Pass route. These trains will be in addition to the empty unit trains that are already likely to use the Stampede Pass route to access Pasco.

Line Segment Observations

Based on the results of the simulations, MLM believes BNSF has sufficient line segment capacity to accommodate the growth projected for the next five years. This projection excludes the implementation of large unit train growth projects such as Millennium Coal or Vancouver Energy.

Beyond five years, growth will require BNSF to pursue capacity improvements to maintain efficient operations. MLM believes the Spokane and Lakeside Subdivisions will be the two most likely locations where additional capacity will be required.

MLM believes BNSF will have to construct a second main track across all the remaining single track sections of the Spokane Sub between Sandpoint and Spokane to accommodate the 2030+

projected volume of 110 or more trains per day. Even the 2025+ projected volume of more than 90 trains per day justifies adding a second main track to most if not all remaining single track segments between Sandpoint and Spokane.

The one exception may be the single track bridge just west of Sandpoint. While the model did not indicate that there were major delays around the bridge, the simulation did not account for the impacts of capacity issues east of Sandpoint Junction on the MRL or east of Sandpoint on BNSF's Kootenai Sub. If additional network was added east of the current network's endpoints, MLM believes that the capacity constraints associated with the extended segments would potentially influence the results of trains approaching and using the single track bridge.

MLM further believes that the Lakeside Subdivision between Lakeside Junction and Pasco will eventually have to have a continuous second main track if growth projections are realized. The subdivision could see train per day counts approaching 90 by 2030+, of which a high percentage will be loaded unit and manifest trains. These trains operate at slower speeds than other traffic types, particularly over the hills across the Lakeside Sub. MLM believes BNSF will incrementally construct the second track in strategic locations as traffic grows to allow the subdivision to continue to operate efficiently.

UP trains crossing over BNSF's Spokane Sub from Lakeside Junction to Scribner created recurrent conflicts as traffic was increased in the model. A new connection between the two railroads near Cheney would allow operations to be modified such that the crossover movement could be reduced or eliminated, which will benefit both railroads' operations.

The Fallbridge Sub will likely require some additional capacity in locations adjacent to terminals. This includes on the east end near Pasco, in the middle near Wishram and on the west end near Vancouver. There are areas where a second track can be constructed in these locations. Additionally, some sidings that are currently 7,000 feet in length will need to be lengthened to accommodate longer trains. The longer sidings will create additional meet/overtake locations, which should allow improved traffic flow over the subdivision.

The simulations indicated that the Seattle Subdivision will not require any major construction projects through 2030 beyond what is currently planned and approved. The Washington Department of Transportation (WSDOT) projects at Vancouver, between Woodland and Kelso, and between Nisqually and Tacoma will allow the projected PNW freight and passenger traffic growth to operate relatively efficiently through that time frame.

Under the growth projections that BST provided to MLM for modeling, it does not appear that there will be major capacity issues on the Scenic Subdivision between North Seattle and Everett through 2030. The current track structure was able to accommodate growth even while trains from the Bellingham Sub were rerouted towards Auburn and the Stampede Pass.

The Bellingham Sub experienced some congestion approaching Everett and between Burlington and Bellingham. MLM believes some additional siding capacity will be required to allow trains to be staged prior to accessing Everett Terminal; capacity will also be required to stage trains adjacent to the 25 mile section between Bow and Ferndale. As long as there are no major unit train growth projects that require operations over the Bellingham Sub, MLM believes these improvements will provide enough capacity to allow the subdivision to operate efficiently through 2030.

As mentioned previously, the Scenic Sub east of Everett has a limited sustainable capacity based on long running times between sidings. MLM does not believe there is a realistic solution to increase this capacity because of the geography of the route, and therefore BNSF will have to modify its operations in the PNW when traffic utilizing the route approaches the sustainable capacity.

The Stampede and Yakima Valley Subdivisions will play a major role in keeping PNW rail operations fluid. As has been described previously, MLM believes that as traffic grows, this route will become the major eastbound route between Seattle/Tacoma and Pasco for all empty unit trains and potentially other train types such as manifest and even intermodal trains. This will require improvements along the route, which MLM believes will include restructuring the tunnels to allow double stack rail cars and upgrading the signal system to improve train flow.

Terminal Observations

It is MLM's opinion that the greatest concern to PNW capacity in the simulations' time frames is BNSF's terminals. In particular, Hauser, Pasco and Everett showed signs of congestion at Base Case traffic levels. As growth was included, the delay levels also continued to increase even with infrastructure improvements and operational changes.

MLM believes Hauser Terminal is a concern today and will continue to be a concern as traffic levels increase. All projected growth traffic moving between eastern locations and the PNW will pass through Hauser Terminal. Infrastructure improvements in the terminal or operational changes are both likely to be required to keep traffic fluid through the area.

In addition to the infrastructure MLM included in the Base P5 simulation, we believe there will need to be additional fueling tracks to accommodate the potential growth volumes simulated in 2025 and 2030. Additional staging tracks that have access to or from the fueling tracks will also likely be needed, as delays associated with crew changes will have to be addressed by BNSF. Operational changes such as having certain trains bypassing fueling at Hauser may also be required.

These issues were not addressed in detail in the simulation as they were beyond the scope of the project. However, even with high level simulation, delays were evident which led to MLM's observations.

Pasco Terminal also currently has issues that will be aggravated with the projected increase in unit and manifest traffic. As described previously, all projected loaded and a very high percentage of empty unit trains will pass through Pasco, as well as all manifest traffic moving between eastern locations and the PNW. The simulations showed this will put a tremendous burden on Pasco to arrive and depart trains. MLM believes additional trackage on the east end of the terminal will be required for queuing of coal trains waiting to be sprayed to minimize coal dust. Other traffic waiting to get into the yard or waiting for crew changes will also benefit from additional trackage.

The single track bridge over the Columbia River is another concern for Pasco Terminal. All eastbound trains coming from the Yakima Valley and Fallbridge Subdivisions have to pass over the bridge, as well as westbound trains departing Pasco for Wishram or Vancouver and beyond. The simulation developed trains counts that exceeded 90 trains per day at the high growth level, which MLM believes will be very difficult to accommodate efficiently on a slow single track segment immediately adjacent to a major terminal.

Vancouver Terminal was shown to operate relatively efficiently through the projected 2030+ traffic levels. MLM believes the improvements made by WSDOT, BNSF and the Port of Vancouver have greatly improved the flow through the terminal, and they will continue to allow efficient operation into the future. Some additional staging capacity may be needed to facilitate crew changes; MLM believes there is sufficient room along the eastern bypass to construct that capacity.

The Seattle/Tacoma Terminals also operated relatively efficiently through 2030 when there was a minimum of passenger operations. The third track being constructed between Black River and Auburn allowed freight operations to remain fluid under all the growth projections. Passenger operations during commute hours continued to conflict with freight operations during those times in all growth scenarios. MLM believes BNSF and UP will have to carefully evaluate passenger growth proposals to understand their impact on freight operations.

Everett Terminal is likely to experience congestion issues as traffic increases. MLM believes that BNSF can mitigate some of these issues by upgrading the Bayside route, which will allow some unit trains to be rerouted away from Delta Yard. Passenger traffic in the terminal, again particularly during commute hours, will further aggravate capacity issues because of the location of the main passenger station which is on single track.

Base P20 (2035) Static Analysis

In addition to the four simulation analyses discussed above, MLM utilized the ‘High’ growth projection developed by BST to estimate train volumes in 2035 over the various segments of the network previously described. Since a model simulation analysis was not performed for the segments, MLM did not attempt to identify potential capacity improvements that might be necessary to accommodate train volume growth. As previously described, the model requires capacity and/or operational improvements as growth is introduced to ensure that the model can successfully complete the simulation run in a manner that would provide an acceptable level of operational performance.

Also, since a model simulation analysis was not performed for the P20 analysis, specific road/rail crossing conflict information was not developed and provided to the Transpo Group and the LTC, as was provided for in the Base, P5, P10 and P15 simulation cases.

As previously mentioned, MLM introduced capacity and operational improvements with the knowledge that BNSF would most likely introduce changes on their network as they determine which are best suited to meet growing train volumes as they occur. BNSF’s approach to maintaining a fluid network could very well be different from those utilized by MLM to ensure that the model was able to successfully complete each simulation under the assumptions utilized for train volume growth. MLM remains confident that BNSF will make those determinations as growth is identified and capacity demand requires improvements.

Although no attempt was made to identify specific changes in capacity or operations for the P20 Static Analysis, a few observations can be made. First, since the P15 (2030) analysis at the High growth projection required completion of a second main track across the Spokane and Lakeside subdivisions, there is little opportunity for constructing additional second main track on the routes between Sand Point and Pasco. If additional infrastructure is required, it would likely include a third main track in strategic locations over those subdivisions. The Scenic Subdivision and the Fallbridge Subdivision would likely remain configured as estimated above because of the issues and constraints previously described.

Second, the bridge over Lake Pend Oreille at Sand Point was left as single track in the P15 simulation case, but as mentioned above MLM was not able to determine the impact of westbound train staging on the BNSF Northern Corridor and the MRL east of Sand Point due to the scope of the analysis. If the growth projected materializes over time, a second track across the bridge may become necessary.

Third, the P20 train volume projections do not include any significant growth changes from the P15 analysis as it relates to unit coal and oil train volumes. With the volatility of changes in unit energy train demand, particularly over a 20 year horizon, a significant upturn in demand for unit energy trains into and through Washington could significantly alter the growth and capacity demand profiles that were assumed in these analyses.

Fourth, passenger train volumes and operations (Sound Transit and Amtrak Cascades) were held constant after the P5 simulation (2020). Any significant changes in passenger train volumes and operations could have a significant impact on the Portland/Seattle/Vancouver, BC corridor for freight operations.

Finally, and as discussed in above, MLM is concerned that the terminals within the State, particularly Hauser and Pasco, will continually be challenged by a growth in train volumes operating on the Spokane and Lakeside subdivision. The single track bridge over the Columbia River at Pasco will continue to impact efficient train operations at Pasco, the Fallbridge subdivision and the Yakima Valley subdivision. Vancouver, Tacoma and Seattle terminals would likely continue to operate relatively efficiently with the growth projected in the P20 Static Analysis. The Everett terminal would likely continue to experience congestion even with the improvements to the Bayside Route previously described.

As the matrix below indicates, the growth in train volumes from the P15 to the P20 static analysis through Everett is relatively modest as little growth is projected between Everett and the Canadian border. Any changes in the volumes of energy trains north of Everett or intermodal/manifest train volumes could amplify the congestion problems through the Everett terminal and between Everett and the Canadian border.

Table A-6: Three Day Average Train Volume Summary, Through Base P20

			Trains per Day				
Location	Subdivision	Milepost	Base Case	Base P5 (2020)	Base P10 (2025)	Base P15 (2030)	Base P20 (2035)
E. Spokane	Spokane	63	66	69	93	111	119
Lind	Lakeside	91	42	46	66	88	93
Plymouth	Fallbridge	190	38	38	47	51	54
McLoughlin	Fallbridge	14	42	42	52	58	61
Ridgefield	Seattle	122	59	64	79	93	100
Vader	Seattle	77	51	56	71	85	91
East Olympia	Seattle	35	46	52	66	81	87
SeaTac Terminal (Puyallup)		~32X	60	66	82	95	99
SeaTac Terminal (Spokane Street)		~2X	68	79	85	90	94
SeaTac Terminal (Broad Street)		~2	53	58	65	70	74
Mukilteo	Scenic	28	42	47	53	59	62
Marysville	Bellingham	38	26	25	28	31	31
Bow	Bellingham	79	20	20	22	25	25
Border	Bellingham	117	15	16	17	20	20
Monroe	Scenic	1770	23	23	28	26	28
Harrington	Columbia River	1527	24	23	28	25	27
Ravensdale	Stampede	91	6	9	20	40	42
Yakima	Yakima Valley	90	8	11	23	41	43

Source: Mainline Management