SCOG
Skagit Council of Governments

Rail Crossing Study

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prepared by:

Parametrix
ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

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EXECUTIVE SUMMARY

The rail system is an important piece of the overall transportation network in Skagit County. It keeps both people and goods moving. Not only will passenger rail movement continue to grow in the future with regional population and employment growth, but the mode of choice for goods movement will also continue to be freight rail. This will result in increased train traffic on the rail lines in Skagit County, which could affect transportation movement and operations at at-grade crossings in the county.

This report evaluates the impacts to local roads from increased future train traffic at all at-grade crossings in Skagit County. There are a total of 56 at-grade crossings in the County, with 26 on the North-South Mainline, 18 on the Burlington-Sumas Branch Line, and 14 on the Burlington-Anacortes Branch Line. On the North-South Mainline, train traffic is expected to grow by 2040 to between approximately 55 and 85 trains from the current 17 to 46 trains at crossings. On the Burlington-Anacortes Branch Line, it is expected that there will be approximately seven daily train crossings in 2040 compared to the existing four daily trains. Four additional trains are expected on the Burlington-Sumas Branch Line for a total of six daily trains by 2040.

With the predicted freight and passenger train volumes in 2040, daily gate-down time at at-grade crossings in Skagit County would increase by between approximately 12 minutes and 1 hour 45 minutes. Other impacts from future train traffic include safety impacts, delay in emergency response, and increased queuing at at-grade crossings.

Analysts identified 12 key crossings where impacts could be relatively high compared to other crossings in Skagit County. The key crossings included the following locations:

- Old 99/Blackburn Road near S 3rd Street ..... Mount Vernon
- SR 536/Kincaid near S 3rd Street ..... Mount Vernon
- Fir Street near 1st Street ..... Mount Vernon
- Riverside Drive near Alder Lane ..... Mount Vernon
- SR 538/College near Urban Avenue ..... Mount Vernon
- Hoag Road near Continental Pl ..... Mount Vernon
- Fairhaven near S Spruce St ..... Burlington
- SR 20/ Avon near S Spruce Street ..... Burlington
- Cook Road near Highway 99 ..... Skagit County
- Fairhaven/Cherry Street near Cascade Highway ..... Burlington
- State St near Cascade Highway ..... Sedro-Woolley
- SR 9 near Cascade Highway ..... Sedro-Woolley
- Ferry St near Cascade Highway ..... Sedro-Woolley
- SR 20/Burlington near E Orange Avenue ..... Burlington

Mitigation measures were identified for each of the key crossings. Suggested mitigation measures included grade separation, intelligent transportation systems (ITS) improvements, and signal timing. Of the 12 key crossing locations, three are considered a higher priority for mitigation:

- SR 538/College Way near Urban Ave and Hoag Rd near Continental Pl.....Mount Vernon
- Cook Road near Highway 99.....Skagit County
- SR 20/Avon near S Spruce St.....Burlington

These crossings were chosen as the highest priority crossings for mitigation because each had a low performance rating and are anticipated to have high traffic volumes in 2040.

The suggested mitigation measures include grade separation at SR 538/College Way, Cook Road, and SR 20/Avon. ITS improvements are proposed for Hoag Road. These mitigation measures would help to reduce transportation impacts from increased future train traffic.

INTRODUCTION

The rail system is an important piece of the overall transportation network in Skagit County. It keeps both people and goods moving. Not only will passenger rail movement continue to grow in the future with regional population and employment growth, but the mode of choice for goods movement will also continute to be freight rail. This will result in increased train traffic on the rail lines in Skagit County, which could affect transportation movement and operations at at-grade crossings in the county.

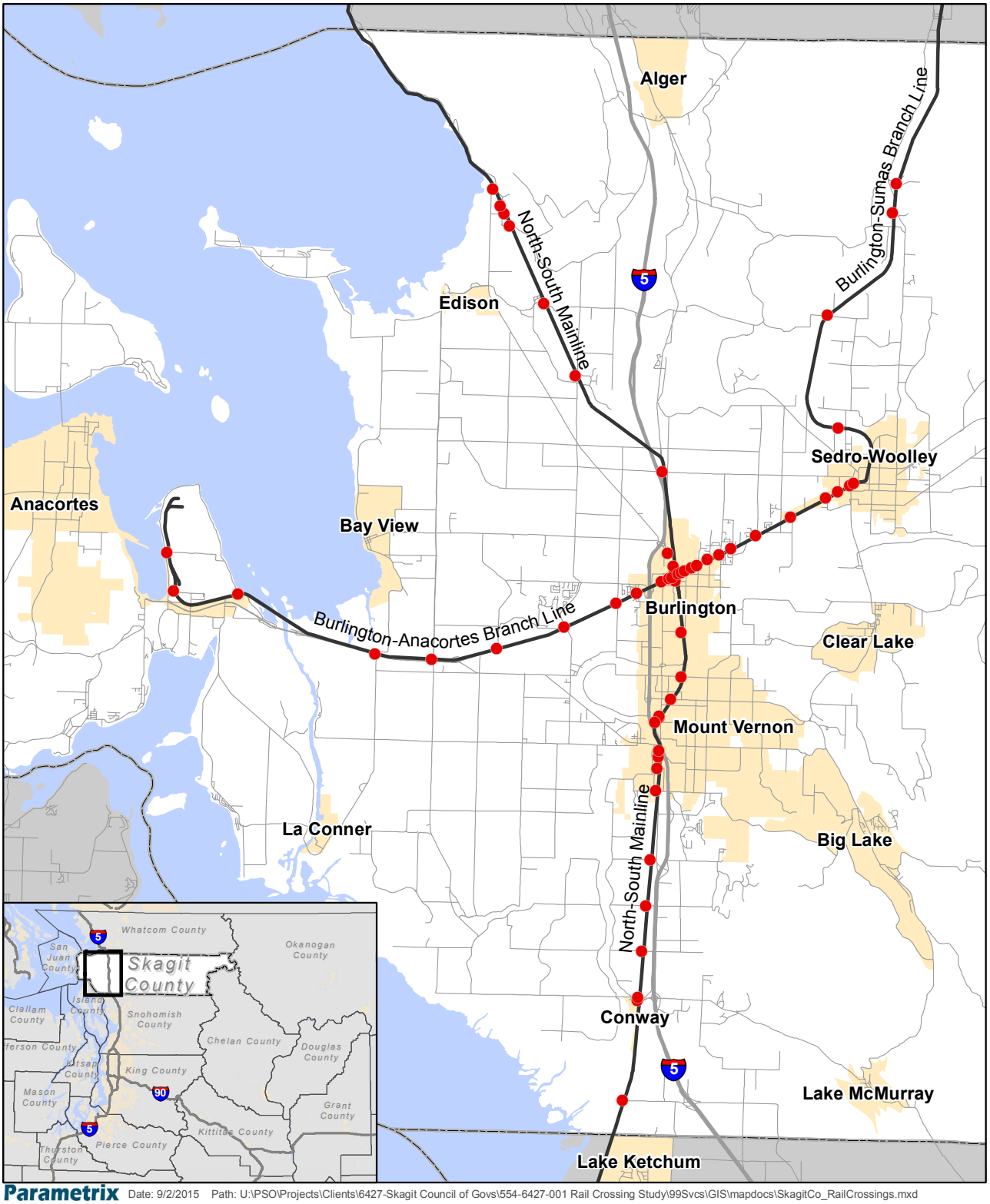
Study Purpose

The purpose of this study is to evaluate the impacts to local roads from increased future train traffic at all at-grade crossings in Skagit County. There are a total of 56 at-grade crossings in the County, with 26 on the North-South Maiuline, 18 on the Burlington-Sumas Branch Line, and 14 on the Burlington-Anacortes Branch Line.

Findings from this transportation study will inform the Skagit Council of Governments, local municipalities, interested stakeholders, and the general public of the potential range and magnitude of impacts that additional future train traffic could have on travel patterns and existing transportation infrastructure.

This study also identifies mitigation measures to reduce impacts from train traffic at key at-grade crossings. Key at-grade crossings include locations where impacts to transportation from additional train traffic would be relatively high compared to other crossings in the county.

This report is organized into several sections, beginning with a discussion of the methodology for analzying transportation impacts. The next section of the report summarizes the transportation impacts by comparing future expected impacts to exisiting impacts. This section of the report also identifies the key crossing locations. The final section of the report describes mitigation measures that could be used to decrease impacts from future train traffic at key crossings in Skagit County.


Alger
Edison
North-South Mainline
Burlington-Sumas Branch Line
Sedro-Woolley
Anacortes
Bay View
Burlington-Anacortes Branch Line
Burlington
Clear Lake
Mount Vernon
La Conner
Big Lake
North-South Mainline
Conway
Lake McMurray
Lake Ketchum
Whatcom County
Skagit County
Okanogan County
San Juan County
Island County
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Miles
At-Grade Rail Line Crossings in Skagit County
BNSF Rail Line

METHODOLOGY

A total of 60 at-grade crossings in Skagit County were analyzed for impacts from additional train traffic in the future. A series of questions were used to analyze impacts:

1. How much additional travel delay could vehicles and non-motorized users experience at at-grade crossings when additional trains are operating?
2. How will increased train volumes affect rail freight capacity in Skagit County?
3. How could added train traffic affect emergency services in Skagit County?
4. How much travel delay at at-grade crossings will constitute operational problems for the transportation system?
5. How will a series of crossings within close proximity to each other be affected by additional travel delay and vehicle queuing?
6. What improvements could be implemented to mitigate the impact of added train traffic?

These questions were answered by measuring the following criteria:

- Gate-Down Time and Vehicle Delay
- Impacts to Emergency Services
- Impacts to Safety
- Vehicle Queues

Gate-Down Time and Vehicle Delay

Gate-down time is a measure of the duration of time that a railroad crossing gate is down while a train passes, which can be used to measure travel delay. Long periods of gate-down time have the potential to increase congestion and cause delays to traffic at and near at-grade crossings in the county. Daily gate-down time is dependent on the length of trains, how fast they are travelling, and how many daily trains are scheduled.

Daily gate-down time was calculated by summing the total crossing time per train based on length and speed at the crossing. Trains will be assumed to have the following average lengths:

- Freight train (bulk material, intermodal container, special and generalized freight trains): 1.25 miles long
- Passenger train: 600 feet
- Commodity trains (coal and oil trains): 1.5-1.6 miles

Table 1. Typical Number of Cars or Intermodal Units by Train Service Type

Type of Train Service	Western Railroads
Auto	63.9
Bulk	112.4
General Merchandise	80.7
Intermodal	164.3
Average # of cars	**105.3**

Source: Association of American Railroads

Freight train length will be determined by multiplying the average dimension of BNSF rail equipment (http://www.bnsf.com/customers/equipment) by the average number of cars for trains on Western Class I railroads (Association of American Railroads, *National Rail Freight Infrastructure Capacity and Investment Study*, 2007). Tables 1 and 2 summarize the average number of cars for trains on Western Class I railroads and the average dimensions of BNSF rail equipment.

Passenger train length will be calculated based on equipment dimensions (Amtrak, *Amtrak Station Program and Planning Guide*, 2013) and the average number of cars used on the Amtrak Cascades route as reported by WSDOT (http://www.wsdot.wa.gov/Rail/TrainEquipment.htm). Commodity train lengths will be consistent with train lengths reported in commodity train studies for Washington State (Washington Department of Ecology, *Washington State 2014 Marine and Rail Oil Transportation Study*, 2014; Pacific International Terminals, Inc., P*roject Information Document*, 2011).

All trains (freight, passenger, and commodity trains) will be assumed to travel at 75 percent of the allowable speed at the crossing. Because train speeds vary depending on a variety of factors, such as cargo and length, this assumption provides a conservative estimate of train speeds through crossings. Data for the allowable speed at each crossing in the study area will be collected from the USDOT Crossing Inventory database. It will be assumed that all crossings in the study area have a crossing width of approximately 60 feet and a 20 second lead time and 10 second lag time during which gates were down but the train was not passing through the crossing.

Table 2. BNSF Equipment Lengths

Equipment Type	Min. Length	Max. Length
Boxcars	50	60
Refrigerated Boxcar	72	-
Gondola	52	66
Covered Hoppers	40	60
Open Top Hoppers	40	50
Coil Steel Car	40	-
Pipe Flatcars	90	-
Bulkhead Flatcars	65	90
Centerbeam Flatcar	60	90
Chain Tie-Down Flatcar	65	95
Covered Coil Car	45	66
Tank Car	20	-
Auto-Rack Bi-Level	93	-
Auto-Rack Tri-Level	93	-
Auto-Max	145	-
Domestic Container	45	53
Ocean Container	20	40
Trailers	45	53
Temp Controlled Trailer	45	53
Coal Cars	53	-
Average Length	**61.1**	

Source: BNSF

The following is an example of how gate-down time will be calculated at a crossing:

- Allowable speed at the crossing is 40 mph, so trains would travel through the crossing at 30 mph (40 mph x 0.75).
- Crossing calculation (in minutes): (((crossing width + train length)/train speed in feet/seconds) + lead/lag time))/60.
  - A freight train would create approximately 3.0 minutes of gate-down time per crossing event
  - A passenger train would create approximately 0.75 minutes of gate-down time per crossing event.
  - A commodity train would create approximately 3.7 minutes of gate-down time per crossing event.
- The gate-down time per train type will be multiplied by the volume of that train type at the crossing.
  - If there were 10 freight trains, 3 passenger trains, and 9 commodity trains, the daily gate-down time would be approximately 65 minutes (30 minutes+2 minutes+33 minutes).

Varying speeds at crossings and the different lengths of train have a substantial impact on the daily gate-down time at each crossing in the study area, as will be discussed in the report.

Impacts to Emergency Services

Analysts will evaluate potential impacts to emergency service delivery by qualitatively assessing network redundancy within a half-mile of at-grade crossings. Network redundancy is the ability for emergency responders to use alternate routes in the event of a crossing closure; network redundancy can be further reduced if all of the nearby alternate routes are on streets that also have at-grade crossings that could be blocked during the same crossing event.

The evaluation will categorize each at-grade crossing based on the impact to emergency service response times using the following definitions:

- *High Impact:* At-grade crossings that have poor network redundancy within a half-mile radius, or no alternate routes around the at-grade crossing, would be rated low. At-grade crossings that may have nearby alternate routes but routes are located on streets with other at-grade crossings were also rated poor since these crossings could also be blocked during a train crossing event. Emergency service providers would likely be impacted by delay from additional train traffic. Emergency responders would have to wait for crossings to clear during a train event and would not be able to take an alternate route.
- *Moderate Impact:* At-grade crossings that have moderate network redundancy within a half-mile radius, or only one alternate route around the at-grade crossing, would be rated moderately. Emergency service providers could use an alternate route to avoid the blocked crossing but would have limited alternate routes. If the alternate route was congested or less direct, emergency service providers would likely experience some delay from additional train traffic.
- *Low Impact:* At-grade crossings that have good network redundancy within a half-mile radius, or multiple alternate routes around the at-grade crossing, would be rated high. Emergency service providers could use multiple alternate routes to avoid the blocked crossing. This would allow responders to choose the most direct and/or least congested route around the crossing. Responders would likely experience little delay from additional train traffic.

Impacts to Safety

Safety for non-motorized users and vehicles will be assessed by reviewing the collision history at all at-grade crossings in Skagit County. With increased train traffic, the potential for collisions could increase, absent safety improvements to the crossings. This data will be collected from FRA Accident/Incident Reports and from WSDOT Collision reports.

Vehicle Queues

Vehicle queueing at at-grade crossings will be another measure used to determine impacts to the transportation system. Vehicle queue lengths at at-grade railroad crossings vary based on the length and speed of the train as well as roadway volumes. Analysts will estimate vehicle queues

using traffic volume data and daily gate down times at key crossings. Crossings that have expected traffic volumes of more than 5,000 daily vehicles in 2040 will be identified as key crossings for queue analysis. The rate of traffic flow approaching the at-grade crossing will be used to determine the number of vehicles in queue for each gate closure event during the day. Analysts will use the available roadway capacity to determine how fast the queue will dissipate immediately following each gate closure event. This methodology accounts for the effect of short durations between closures when a queue from one gate closure event does not completely dissipate before a second gate closure.

Identification of Key Crossings

Crossings that are more greatly impacted by additional train traffic will be selected for in-depth analysis, including identification of preliminary mitigation strategies to improve safety or reduce delay. The consultant team will select crossings for detailed analysis in consultation with SCOG and key stakeholders. Analysts will use a performance rating scale of one to five to rate crossings, with crossings that have a high impact, or lower performance, ranked lower. Analysts will include the following crossing characteristics in the performance rating:

- Maximum daily train volumes (freight and passenger) in 2040
- Daily gate-down time in 2040
- Average daily traffic volumes in 2040
- Roadway freight truck percentages
- Marginal increase in daily gate-down time in 2040 from existing conditions
- Marginal percent increase in daily gate-down time in 2040 from existing conditions
- Impact to emergency services
- Accident history

Analysts scored the performance for each crossing by summing the rating score (1 through 5) for the crossing characteristics 3 through 8. Each of the rated characteristics were equally weighted.

Mitigation

Crossings with the lowest performance will be selected for potential mitigation. The detailed analysis will include a queue length analysis and identification of preliminary mitigation strategies to improve safety or reduce delay at crossing locations.

Recommendations for mitigation, such as possible grade separation, were identified for key crossings. Other possible mitigation measures will also be explored for crossings where grade separation is not possible, such as:

- Grade crossing consolidation
- Revised signal timing
- Intelligent Transportation Systems (ITS)
- Upgrades and improvements to signage, lighting, and warning systems
- Policy changes

TRANSPORTATION IMPACTS ANALYSIS

This section of the report summarizes the analysis of potential impacts from future train traffic growth that could occur at at-grade crossings in Skagit County. Existing transportation conditions at at-grade crossings were compared to expected future conditions when additional trains are operating. Analysts compared delay at crossings, impacts to emergency services, impacts to safety, and vehicle queuing.

At-Grade Crossings in Skagit County

A total of 56 at-grade crossings in Skagit County along BNSF's North-South Mainline, the Burlington-Anacortes Branch Line, and the Burlington-Sumas Branch Line were analyzed in this report (see Figure 1). Crossings occur on a variety of roadways, from relatively high traffic volume locations such as Kincaid Street in Downtown Mount Vernon and SR 538 (East College Way, Mount Vernon), to locations with lower traffic volumes such as Bow Hill Road north of Burlington.

Anticipated Changes in Rail Traffic in Skagit County

The Washington State Department of Transportation (WSDOT) expects rail traffic in Washington State and in Skagit County to change in the future, as was reported in the Washington State Rail Plan (Washington Department of Transportation 2014). Economic and demographic growth will likely increase rail demand in the future, particularly for freight rail in and through Skagit County. Rail is increasingly being used as a mode of transport for freight for a number of reasons, including global sourcing fluctuations, fuel costs, labor availability, and highway congestion. WSDOT estimates that Washington's rail system will accommodate more than double the volume of cargo in 2040 when compared to 2010[1]. Population growth and development, particularly along the I-5 corridor, has also led to a renewed focus to develop intercity passenger rail service. Although total ridership on the Amtrak Cascades route is expected to grow by approximately 40 percent by 2040, the majority of that growth is not expected to be in Skagit County. On the Amtrak Cascades segment between Seattle and Vancouver, B.C., total ridership is expected to grow by approximately 20 percent, compared to 52 percent growth between Seattle and Portland and 25 percent growth between Portland and Eugene (Cambridge Systematics 2013).

Impacts to Rail Capacity

If no system capacity or operational improvements are made in the future, growth in train traffic could impact rail operations through Skagit County. WSDOT reports that the North-South Mainline through Skagit County could reach 100 percent capacity by 2040 (2014). Over- or at-capacity rail lines could result in scheduling conflicts and service unreliability for passenger and freight trains. However, BNSF has stated that it will likely address key capacity issues as they emerge. As train traffic growth occurs, it will be important for the State, local jurisdictions and agencies, and BNSF to coordinate planning and operational improvements to manage capacity concerns in the system.

1 Commodity exports, such as coal and oil, are also expected to increase freight train traffic in Skagit County beyond the estimates included in the State Rail Plan. New proposals for export facilities (or expansion of existing facilities) in and near Skagit County, influenced by an excess of commodity production will likely contribute to future rail traffic in the county.

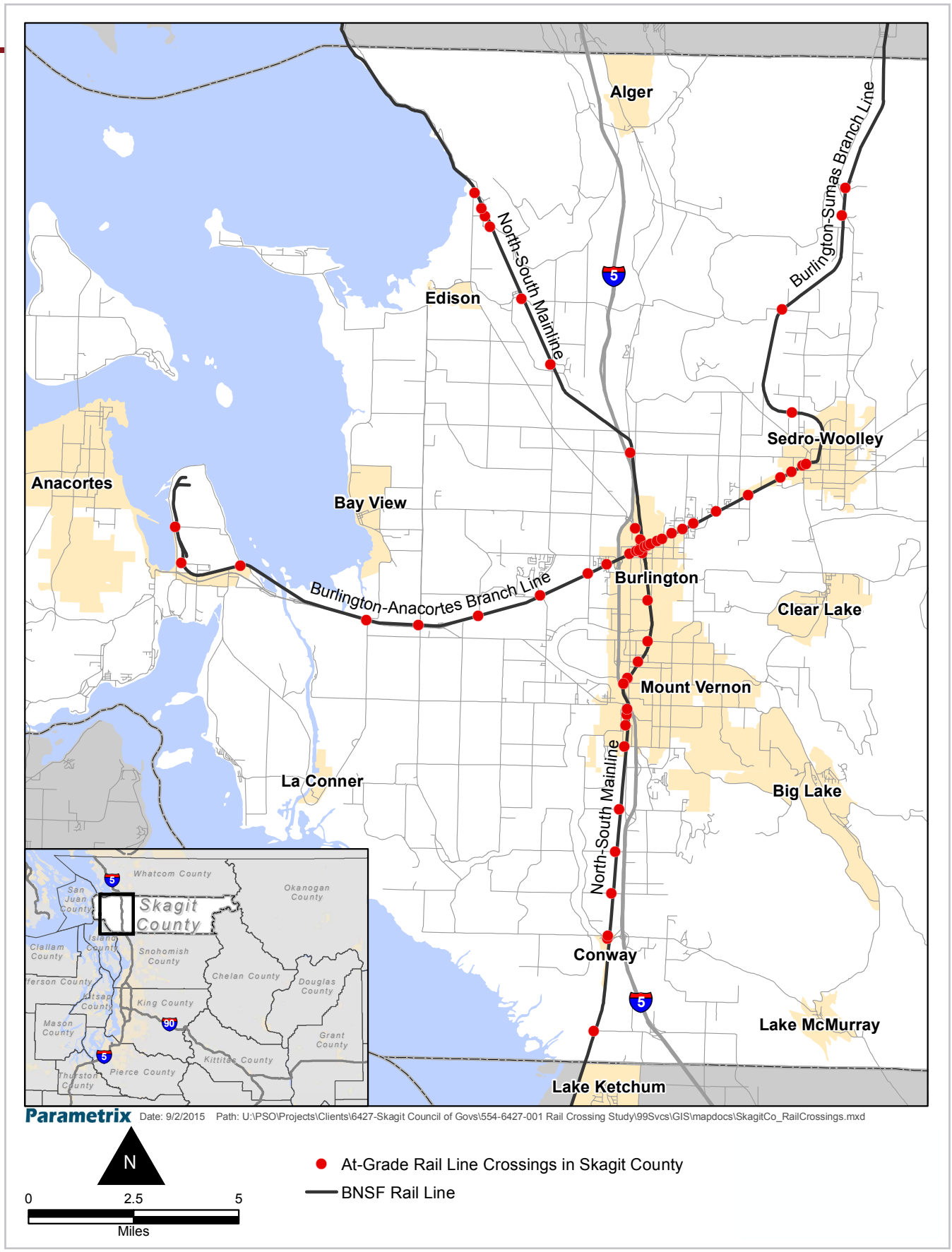


Figure 1. At-Grade Crossing Locations

Currently, a capacity improvement is being constructed in Mount Vernon to improve reliability and scheduling of train movements on the North-South Mainline. The project includes a siding upgrade to allow freight trains to move out of the way of faster moving passenger trains. The siding upgrade begins near Hickox Road and terminates 0.6 miles to the north just after Pederson Lane. The project will allow earlier departures of southbound morning passenger trains and improve schedule reliability.

Gate-Down Time

Gate-down time is a measure of the duration of time that a railroad crossing gate is down while a train passes. Long periods of gate-down time have the potential to increase congestion and cause delays to traffic at or near at-grade crossings. The amount of gate-down time is dependent on the length and speed of individual trains and the total number of trains that pass through an at-grade crossing during the day.

Existing and expected future gate-down time at all at-grade crossings in Skagit County is summarized below.

Existing Gate-Down Time

On the North-South Mainline, there are currently between 17 and 46 freight train crossings each day (BNSF 2015):

- South of Burlington, there are 22 daily freight train crossings at at-grade crossings on the mainline
- North of Burlington, there are 17 daily freight train crossings on the mainline
- Two crossings on the mainline in Burlington (Pease Road and Greenleaf Avenue) experience additional train crossings as a result of train building activities. These crossings have an additional 24 daily freight train crossing events; these events typically consist of short, one-car trains as they are being moved to build longer trains.

Crossings on the North-South Mainline along which the Amtrak Cascades route currently operates also experience four daily passenger rail trips (two northbound and two southbound), for a total of between 21 and 50 total daily train crossings.

On the Burlington-Sumas Branch Line, there are two daily freight train crossings. On the Burlington-Anacortes Branch Line, there are four daily freight train crossings at most at-grade crossings. Similar to the Mainline, there are two crossings (S Walnut Street and Spruce Street) in Burlington that experience an additional 24 daily train crossings due to train building. No passenger trains operate on the branch lines. Figure 2 shows the distribution of existing train crossing volumes in Skagit County.

It is important to note that the exact number of train crossings at at-grade crossings can vary each day, so the exact number of crossings on any given day fluctuates.

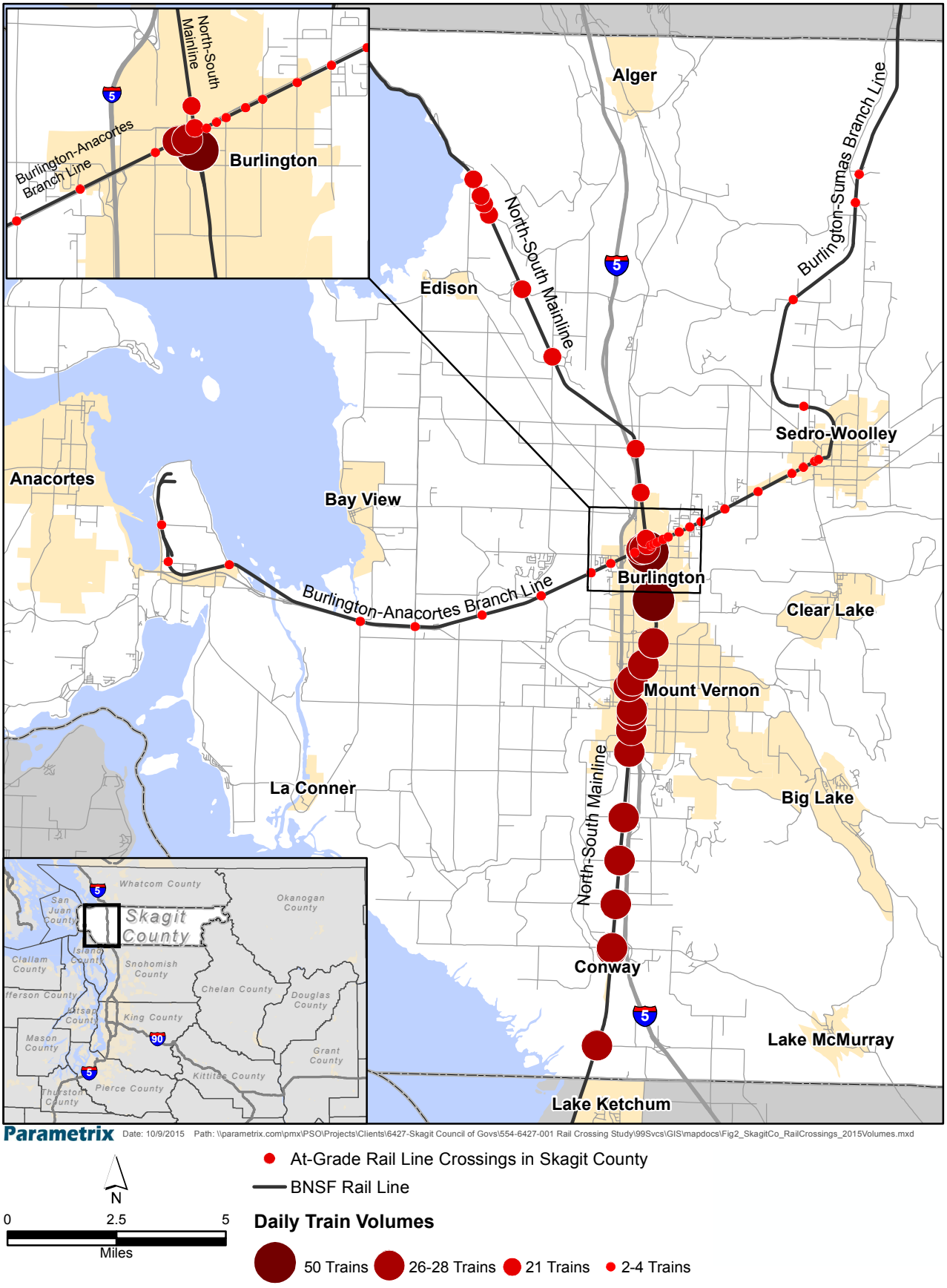


Figure 2. Existing Train Volumes at At-Grade Crossings

At all at-grade crossings in Skagit County, the variation in gate-down times range from approximately six minutes to one hour each day. Gate-down times by crossing and rail line are shown in Figures 3 through 5 (crossings on the North-South Mainline are listed from south to north and crossings on the Burlington-Sumas and Burlington-Anacortes branch lines are listed from west to east).

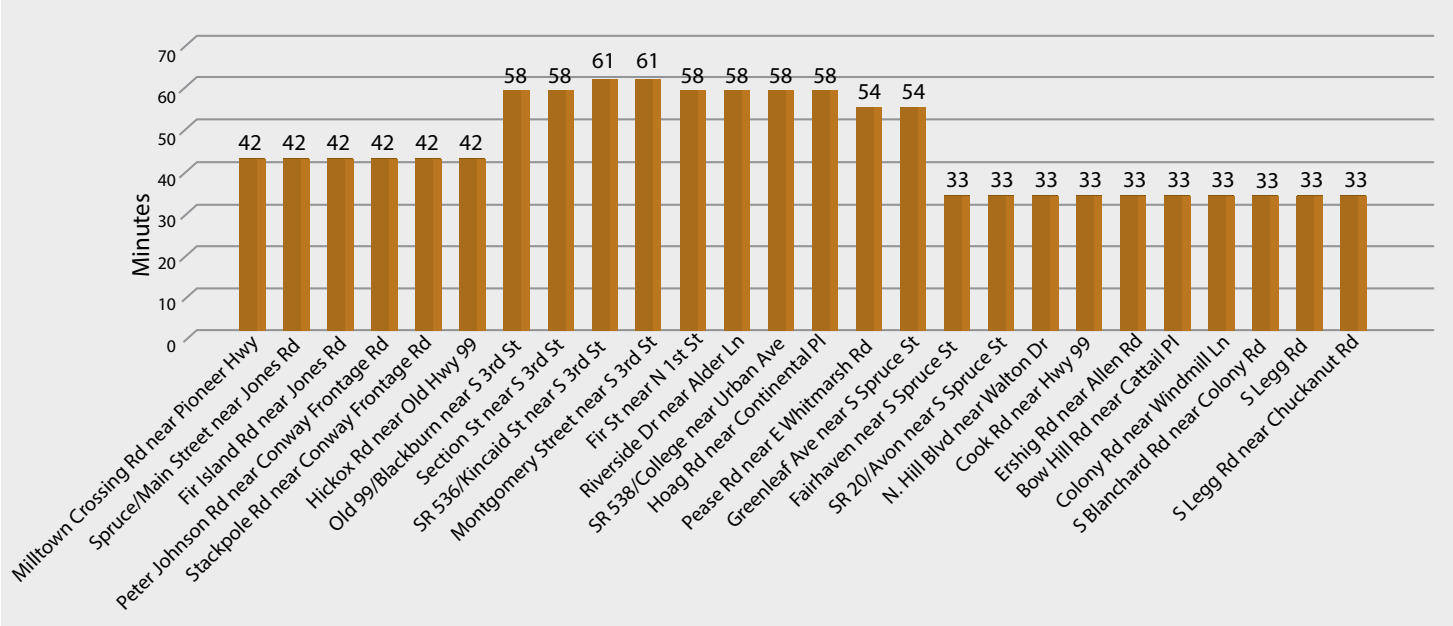


Figure 3. Existing Daily Gate-Down Time (minutes) on the North-South Mainline

On the North-South Mainline, daily gate-down time ranges between approximately 33 and 60 minutes. Daily gate-down time at crossings in Mount Vernon is higher compared to other crossings because of slower allowable speeds at crossings. Also, Skagit Station is located directly adjacent to the Kincaid Street crossing and the Montgomery Street crossing; passenger train loading and unloading at the station creates more gate-down time at these crossings than through passenger trains at other crossings.

On the Burlington-Sumas Branch Line, there is between approximately 6 minutes and 20 minutes of gate-down time each day. Gate down time is nearly double at three of the crossings (Fairhaven/ Cherry, SR 9, and Ferry Street) compared to other crossings due to slower train speeds allowable at the crossing.

On the Burlington-Anacortes Branch Line, daily gate-down time ranges between approximately 42 minutes and 60 minutes. Gate down time is higher than other crossings at S Walnut Street and Spruce Street due to higher train volumes from train building activity.

Table 3 (shown on pages 18 through 21) summarizes train volumes, allowable speeds at crossings, and daily gate-down time. Train crossings occur throughout the day, so the amount of gate-down time experienced for any one train crossing event would be a portion of the above mentioned total.

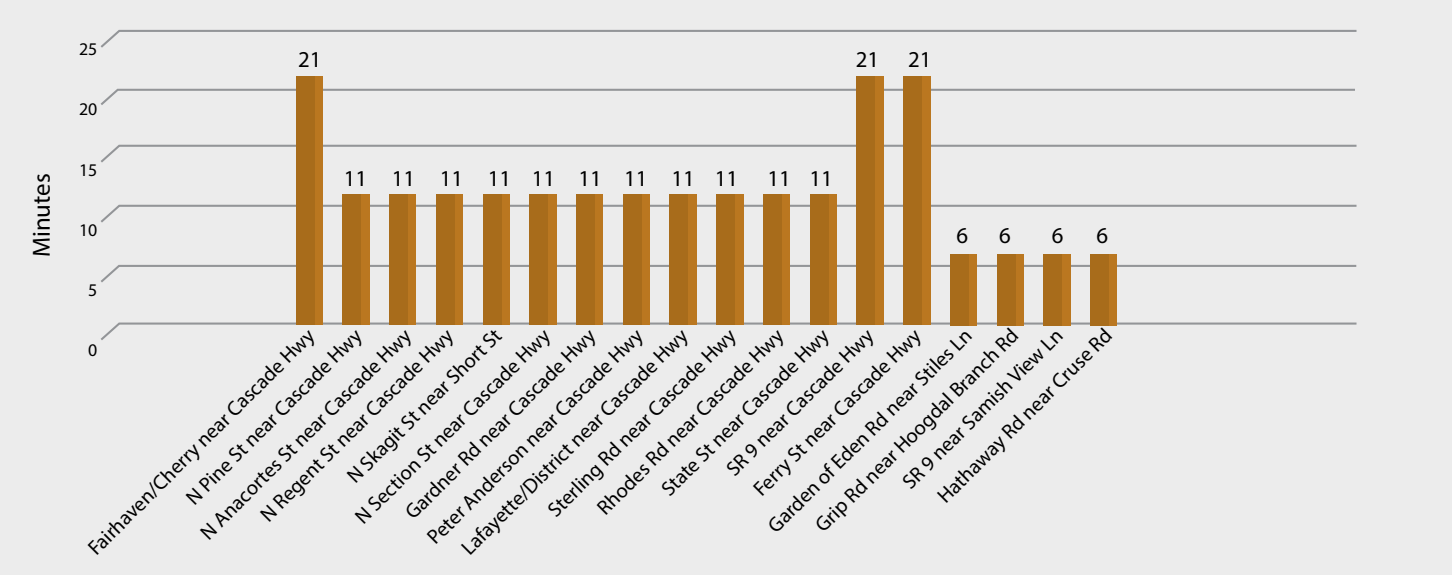


Figure 4. Existing Daily Gate-Down Time (minutes) on the Burlington-Sumas Mainline

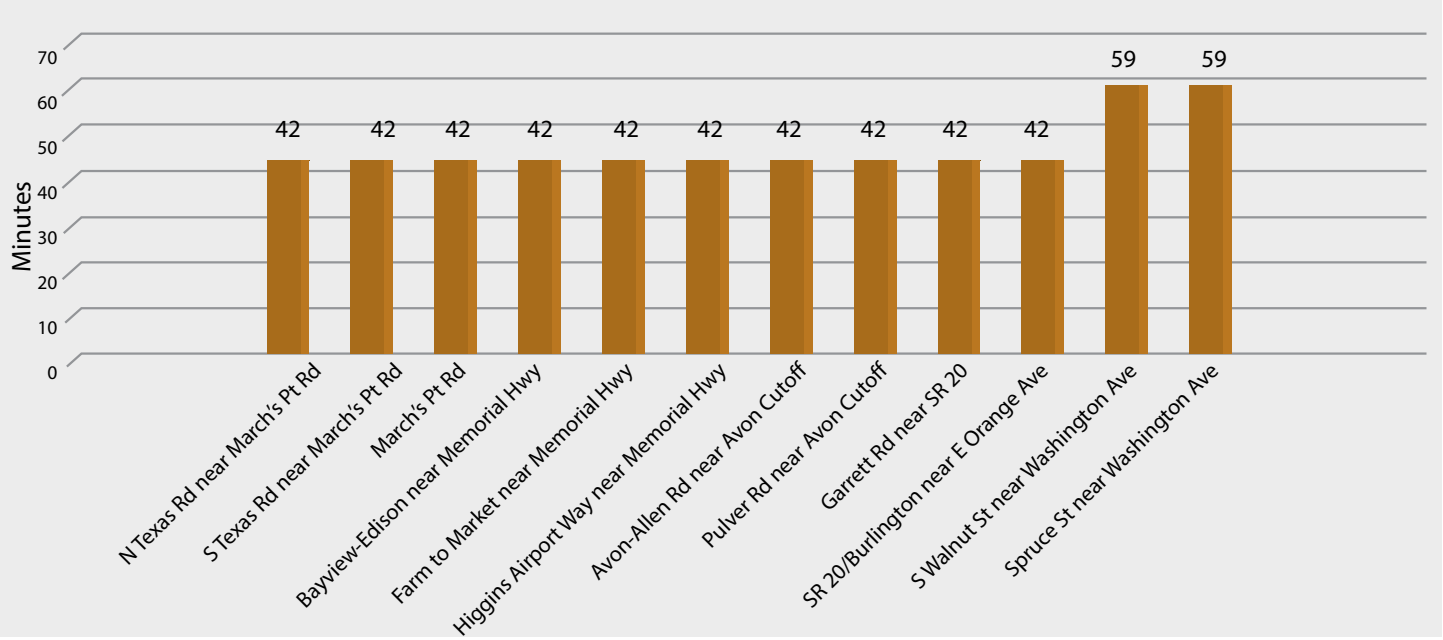


Figure 5. Existing Daily Gate-Down Time (minutes) on the Burlington-Anacortes Mainline

Table 3. Existing Daily Gate-Down Time (minutes) on the Burlington-Sumas Mainline

USDOT Crossing Number	City	Cross Streets	Max Speed at Crossing	2015 Freight Train Volume	2015 Passenger Train Volume	2015 Daily Gate-Down Time
North-South Mainline (listed south to north)						
084727X	SC	Milltown Crossing Road near Pioneer Hwy	79	22	4	42
084733B	SC	Spruce/Main Street near Jones Rd	79	22	4	42
084734H	SC	Fir Island Rd near Jones Rd	79	22	4	42
084735P	SC	Peter Johnson Rd near Conway Frontage Rd	79	22	4	42
084736W	SC	Stackpole Rd near Conway Frontage Rd	79	22	4	42
084737D	SC	Hickox Rd near Old Hwy 99	79	22	4	42
084739S	Mount Vernon	Old 99/Blackburn near S 3rd St	50	22	4	58
084741T	Mount Vernon	Section St near S 3rd Street	50	22	4	58
084744N	Mount Vernon	SR 536 - Kincaid near S 3rd Street	50	22	4	61
084746C	Mount Vernon	Montgomery Street near S 3rd St	50	22	4	61
084753M	Mount Vernon	Fir St near N 1st St	50	22	4	58
084758W	Mount Vernon	Riverside Drive near Alder Ln	50	22	4	58
084759D	Mount Vernon	College - SR 538 near Urban Ave	50	22	4	58
084760X	Mount Vernon	Hoag Rd near Continental Pl	50	22	4	58
084763T	Burlington	Pease Rd near E Whitmarsh Rd	79	46	4	54
084764A	Burlington	Greenleaf Avenue near S Spruce St	79	46	4	54
084765G	Burlington	Fairhaven near S Spruce St	79	17	4	33
084766N	Burlington	SR 20 - Avon near S Spruce St	79	17	4	33
077833N	Burlington	North Hill Blvd near Walton Dr	79	17	4	33
084775M	SC	Cook Rd near Hwy 99	79	17	4	33
084784L	SC	Ershig Rd near Allen Rd	79	17	4	33
084785T	SC	Bow Hill Rd near Cattail Pl	79	17	4	33
084787G	SC	Colony Rd near Windmill Ln	79	17	4	33
084788N	SC	S Blanchard Rd near Colony Rd	79	17	4	33

Table 3. Existing Daily Gate-Down Time (minutes) on the Burlington-Sumas Mainline, cont.

USDOT Crossing Number	City	Cross Streets	Max Speed at Crossing	2015 Freight Train Volume	2015 Passenger Train Volume	2015 Daily Gate-Down Time
084789V	SC	S Legg Rd	79	17	4	33
084791W	SC	N Legg Rd near Chuckanut Dr	79	17	4	33
Burlington-Sumas Branch Line (listed west to east)						
092261C	Burlington	Fairhaven/Cherry near Cascade Hwy	10	2	0	21
092262J	Burlington	N Pine St near Cascade Hwy	20	2	0	11
092263R	Burlington	N Anacortes St near Cascade Hwy	20	2	0	11
092264X	Burlington	N Regent St near Avon Ave	20	2	0	11
092265E	Burlington	N Skagit St near Short St	20	2	0	11
092266L	Burlington	N Section St near Cascade Hwy	20	2	0	11
092267T	Burlington	Gardner Rd near Cascade Hwy	20	2	0	11
092269G	SC	Peter Anderson near Cascade Hwy	20	2	0	11
092270B	SC	Lafayette/District near Cascade Hwy	20	2	0	11
092273W	SC	Sterling Rd near Cascade Hwy	20	2	0	11
085005U	Sedro Woolley	Rhodes Rd near Cascade Hwy	20	2	0	11
085006B	Sedro Woolley	State St near Cascade Hwy	20	2	0	11
085007H	Sedro Woolley	SR 9 near Cascade Hwy	10	2	0	21
085008P	Sedro Woolley	Ferry St near Cascade Highway	10	2	0	21
085101W	SC	Garden of Eden near Stiles Ln	40	2	0	6
085103K	SC	Grip Rd near Hoogdal Branch Rd	40	2	0	6
085105Y	SC	SR 9 near Samish View Ln	40	2	0	6
085106F	SC	Hathaway Rd near Cruse Rd	40	2	0	6
Burlington-Anacortes Branch Line (listed west to east)						
084708T	SC	N Texas Rd near March's Pt Road	10	4	0	42
092232S	SC	S Texas Rd near March's Point Rd	10	4	0	42
092234F	SC	March's Pt Rd	10	4	0	42

Table 3. Existing Daily Gate-Down Time (minutes) on the Burlington-Sumas Mainline, cont.

USDOT Crossing Number	City	Cross Streets	Max Speed at Crossing	2015 Freight Train Volume	2015 Passenger Train Volume	2015 Daily Gate-Down Time
092241R	SC	Bayview-Edison near Memorial Hwy	10	4	0	42
092242X	SC	Farm to Market near Memorial Hwy	10	4	0	42
092246A	SC	Higgins Airport Way near Memorial Hwy	10	4	0	42
092249V	SC	Avon-Allen Rd near Avon Cutoff	10	4	0	42
092252D	SC	Pulver Rd near Avon Cutoff	10	4	0	42
929012P	Burlington	Garrett Road near SR 20	10	4	0	42
092255Y	Burlington	SR20-Burlington near E Orange Ave	10	4	0	42
092259B	Burlington	S Walnut St near Washington Ave	10	28	0	59
092260V	Burlington	Spruce St near Washington Ave	10	28	0	59

Future Gate-Down Time

WSDOT expects freight rail traffic in Skagit County to increase from existing conditions in the future, as described in the State Rail Plan (2014). WSDOT projections, plus additional commodity train projections not included in the WSDOT State Rail Plan, indicate that in 2040, daily freight train volumes at crossings on the North-South Mainline in Skagit County will increase to between approximately 55 and 85 trains from the current 17 to 46 trains at crossings. The estimated 55 to 85 daily freight trains includes:

- The existing 17 to 46 daily trains,
- Ten future daily freight trains as included in the WSDOT State Rail Plan,
- An additional 24 commodity trains north of Burlington to 26 commodity trains south of Burlington (Gateway Pacific Terminal; Washington State Department of Ecology),
- Four daily passenger trains, similar to existing conditions.

On the Burlington-Anacortes Branch Line, an additional three trains are expected between Burlington and Anacortes. Four additional trains are expected on the Burlington-Sumas Branch Line. Figure 6 summarizes the distribution of future train volumes in the County.

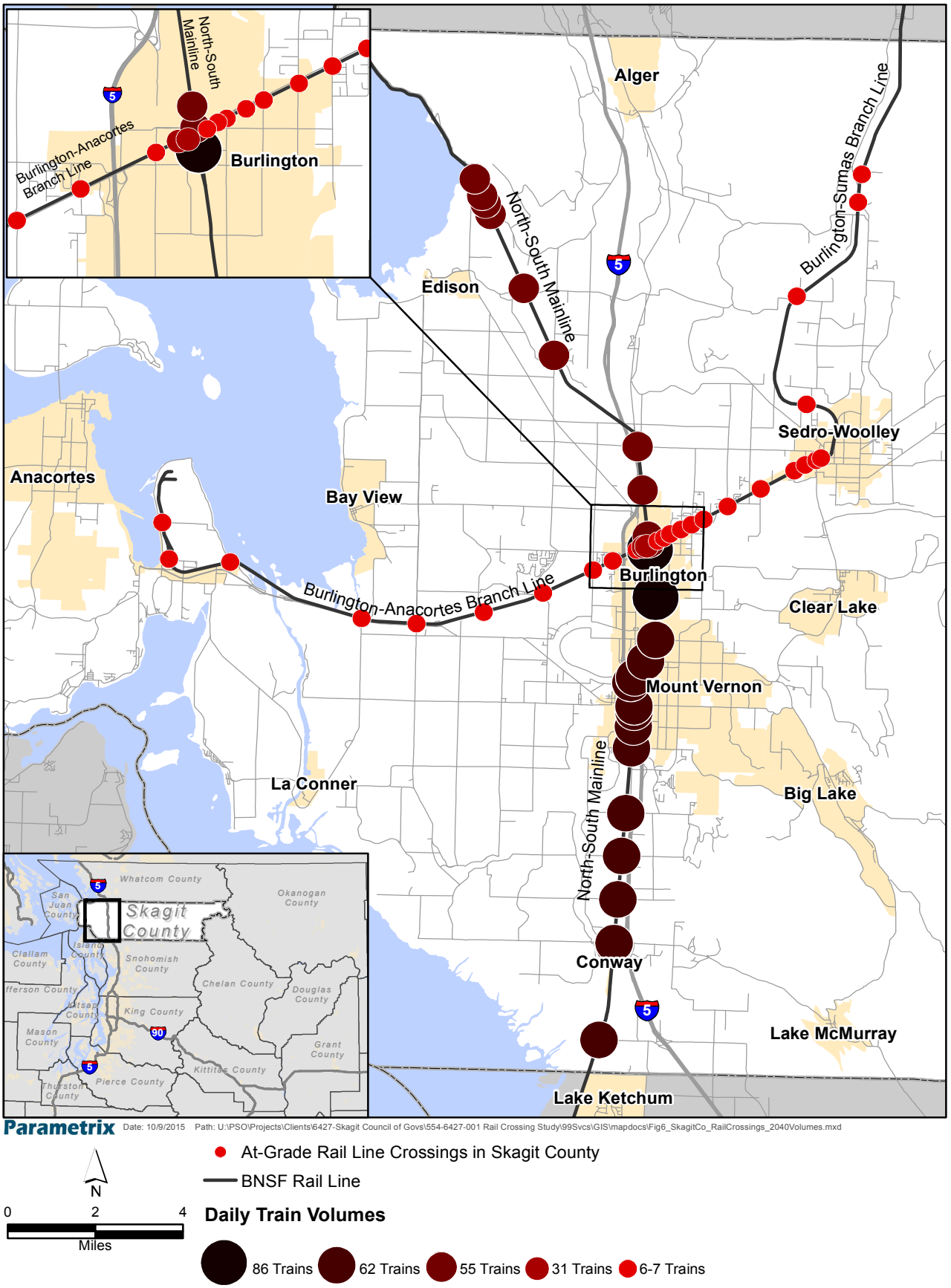


Figure 6. Future Train Volumes at At-Grade Crossings

With the predicted freight and passenger train volumes in 2040, daily gate-down time at at-grade crossings in Skagit County would increase by between approximately 12 minutes and 1 hour 45 minutes. Figures 7 through 9 show the increases in gate-down time at crossings in Skagit County (crossings on the North-South Mainline are listed from south to north and crossings on the Burlington-Sumas and Burlington-Anacortes branch lines are listed from west to east).

On the North-South Mainline, daily gate-down time would increase by between approximately 135 and 210 percent depending on the location of the crossing. Total daily gate-down time on the North-South Mainline in 2040 would be between 1 hour 40 minutes and 2 hours and 45 minutes of delay.

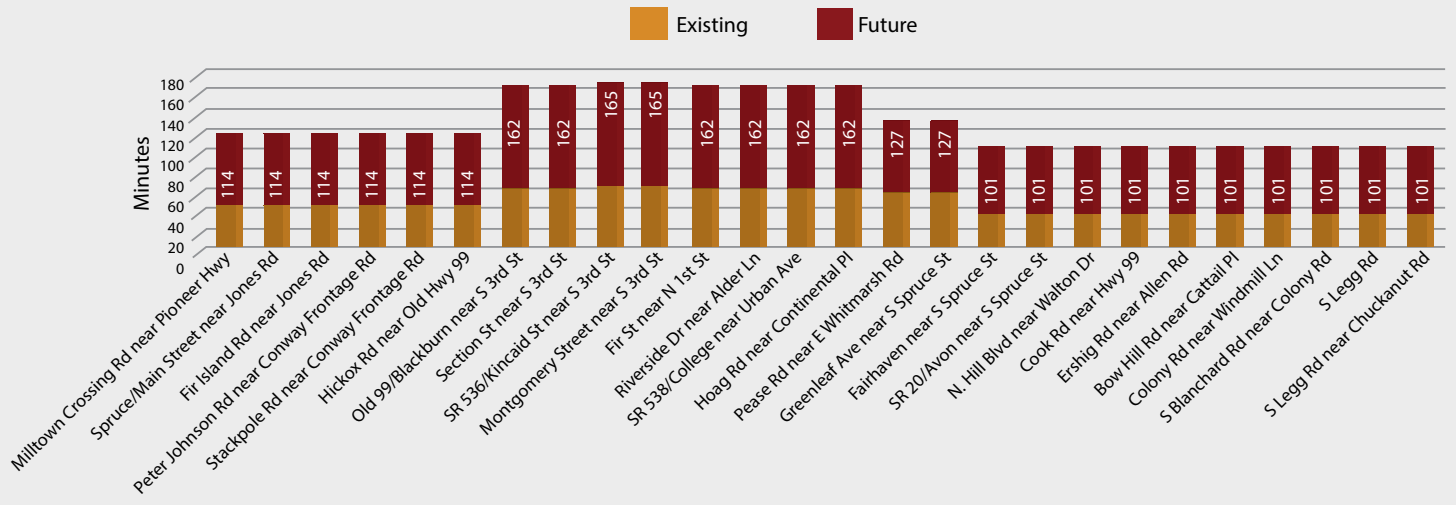


Figure 7. Future Daily Gate-Down Time (minutes) on the North-South Mainline

On the Burlington-Sumas Branch Line, crossings would increase in daily gate-down time by 200 percent. Total daily gate-down time on the Burlington-Sumas Branch Line would be between approximately 18 minutes and one hour five minutes in 2040.

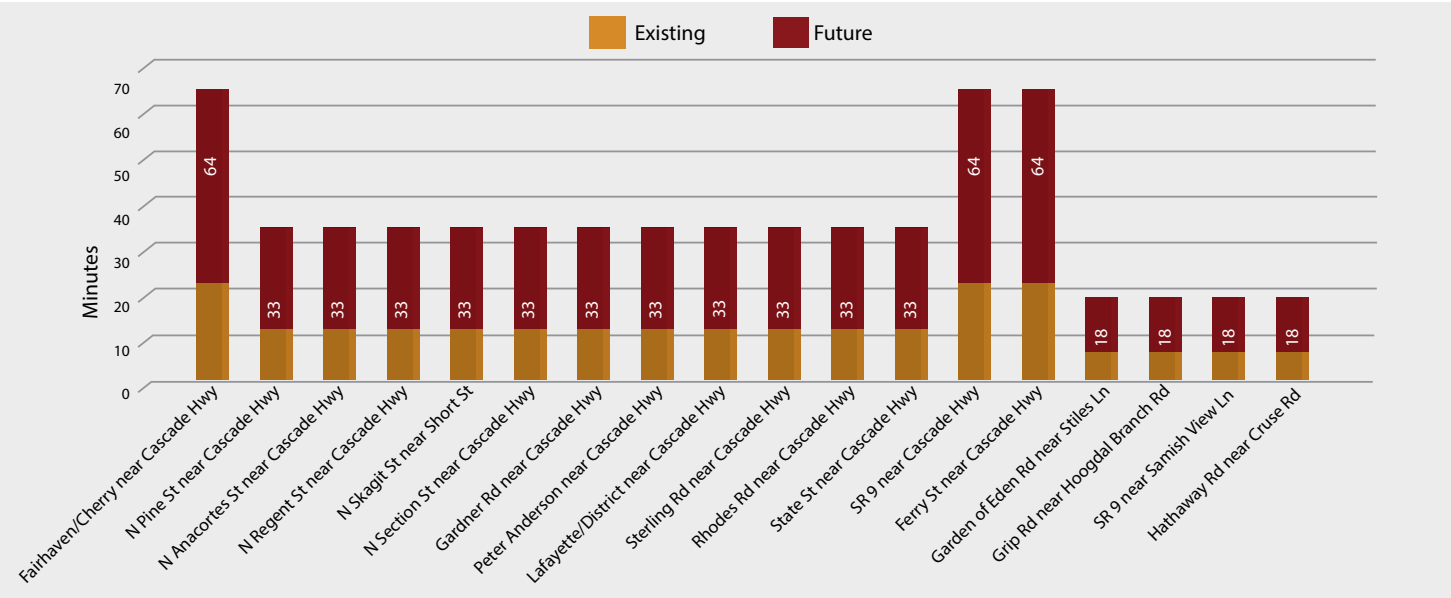


Figure 8. Existing Daily Gate-Down Time (minutes) on the Burlington-Sumas Mainline

Crossings on the Burlington-Anacortes Branch Line would increase by between approximately 60 and 85 percent. On the Burlington-Anacortes Branch Line, there would be approximately one hour 20 minutes to one hour 35 minutes of daily gate-down time.

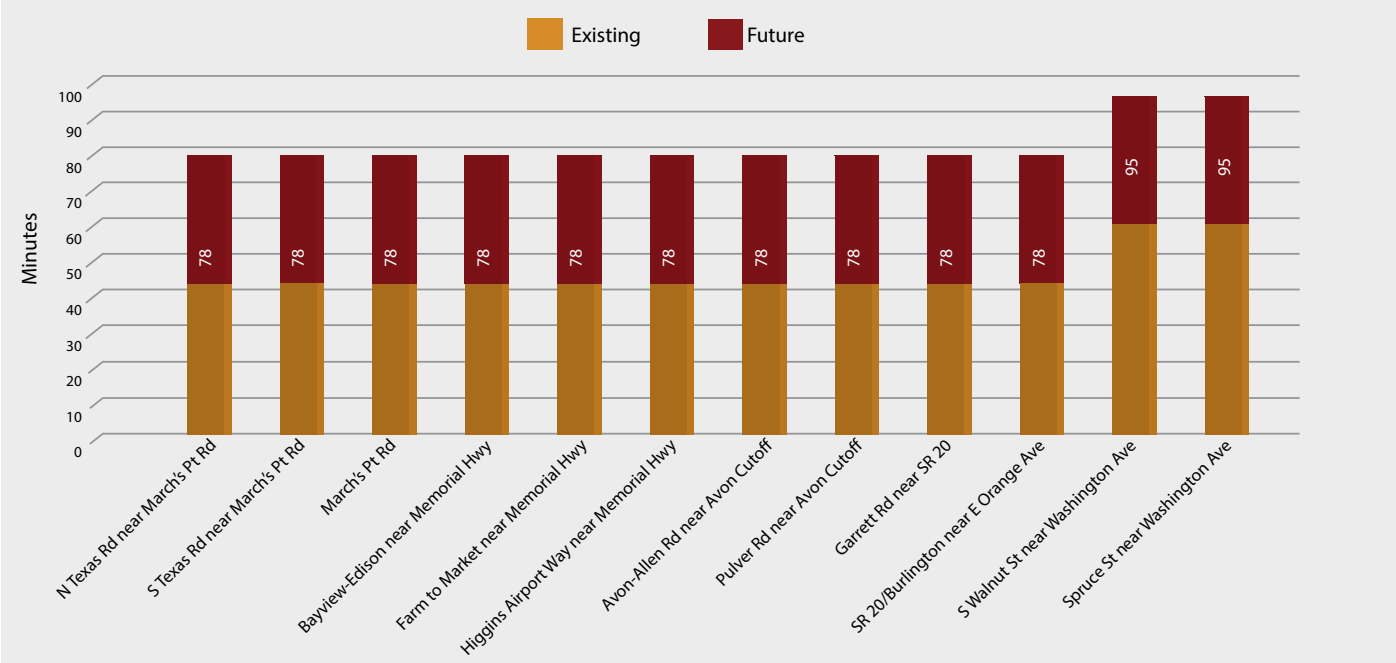


Figure 9. Existing Daily Gate-Down Time (minutes) on the Burlington-Anacortes Mainline

Table 4 summarizes train volumes and daily gate-down time in 2040. At-grade crossings on the North-South Mainline are expected to experience larger increases in daily gate-down time because of the number of expected future trains on this line.

Table 4. Future (2040) Train Volumes, Speed, and Gate-Down Time by Rail Line

USDOT Crossing Number	City	Cross Streets	Max Speed at Crossing	2015 Freight Train Volume	2015 Passenger Train Volume	2015 Daily Gate-Down Time
North-South Mainline (listed south to north)						
084727X	SC	Milltown Crossing Road near Pioneer Hwy	79	58	4	114
084733B	SC	Spruce/Main Street near Jones Rd	79	58	4	114
084734H	SC	Fir Island Rd near Jones Rd	79	58	4	114
084735P	SC	Peter Johnson Rd near Conway Frontage Rd	79	58	4	114
084736W	SC	Stackpole Rd near Conway Frontage Rd	79	58	4	114

Table 4. Future (2040) Train Volumes, Speed, and Gate-Down Time by Rail Line, cont.

USDOT Crossing Number	City	Cross Streets	Max Speed at Crossing	2015 Freight Train Volume	2015 Passenger Train Volume	2015 Daily Gate-Down Time
084737D	SC	Hickox Rd near Old Hwy 99	79	58	4	114
084739S	Mount Vernon	Old 99/Blackburn near S 3rd St	50	58	4	162
084741T	Mount Vernon	Section St near S 3rd Street	50	58	4	162
084744N	Mount Vernon	SR 536 - Kincaid near S 3rd Street	50	58	4	165
084746C	Mount Vernon	Montgomery Street near S 3rd St	50	58	4	165
084753M	Mount Vernon	Fir St near N 1st St	50	58	4	162
084758W	Mount Vernon	Riverside Drive near Alder Ln	50	58	4	162
084759D	Mount Vernon	College - SR 538 near Urban Ave	50	58	4	162
084760X	Mount Vernon	Hoag Rd near Continental Pl	50	58	4	162
084763T	Burlington	Pease Rd near E Whitmarsh Rd	79	82	4	127
084764A	Burlington	Greenleaf Avenue near S Spruce St	79	82	4	127
084765G	Burlington	Fairhaven near S Spruce St	79	51	4	101
084766N	Burlington	SR 20 - Avon near S Spruce St	79	51	4	101
077833N	Burlington	North Hill Blvd near Walton Dr	79	51	4	101
084775M	SC	Cook Rd near Hwy 99	79	51	4	101
084784L	SC	Ershig Rd near Allen Rd	79	51	4	101
084785T	SC	Bow Hill Rd near Cattail Pl	79	51	4	101
084787G	SC	Colony Rd near Windmill Ln	79	51	4	101
084788N	SC	S Blanchard Rd near Colony Rd	79	51	4	101
084789V	SC	S Legg Rd	79	51	4	101
084791W	SC	N Legg Rd near Chuckanut Dr	79	51	4	101
Burlington-Sumas Branch Line (listed west to east)						
092261C	Burlington	Fairhaven/Cherry near Cascade Hwy	10	6	0	64
092262J	Burlington	N Pine St near Cascade Hwy	20	6	0	33
092263R	Burlington	N Anacortes St near Cascade Hwy	20	6	0	33
092264X	Burlington	N Regent St near Avon Ave	20	6	0	33
092265E	Burlington	N Skagit St near Short St	20	6	0	33
092266L	Burlington	N Section St near Cascade Hwy	20	6	0	33

Table 4. Future (2040) Train Volumes, Speed, and Gate-Down Time by Rail Line, cont.

USDOT Crossing Number	City	Cross Streets	Max Speed at Crossing	2015 Freight Train Volume	2015 Passenger Train Volume	2015 Daily Gate-Down Time
092267T	Burlington	Gardner Rd near Cascade Hwy	20	6	0	33
092269G	SC	Peter Anderson near Cascade Hwy	20	6	0	33
092270B	SC	Lafayette/District near Cascade Hwy	20	6	0	33
092273W	SC	Sterling Rd near Cascade Hwy	20	6	0	33
085005U	Sedro Woolley	Rhodes Rd near Cascade Hwy	20	6	0	33
085006B	Sedro Woolley	State St near Cascade Hwy	20	6	0	33
085007H	Sedro Woolley	SR 9 near Cascade Hwy	10	6	0	64
085008P	Sedro Woolley	Ferry St near Cascade Highway	10	6	0	64
085101W	SC	Garden of Eden near Stiles Ln	40	6	0	18
085103K	SC	Grip Rd near Hoogdal Branch Rd	40	6	0	18
085105Y	SC	SR 9 near Samish View Ln	40	6	0	18
085106F	SC	Hathaway Rd near Cruse Rd	40	6	0	18
Burlington-Anacortes Branch Line (listed west to east)						
084708T	SC	N Texas Rd near March's Pt Road	10	7	0	78
092232S	SC	S Texas Rd near March's Point Rd	10	7	0	78
092234F	SC	March's Pt Rd	10	7	0	78
092241R	SC	Bayview-Edison near Memorial Hwy	10	7	0	78
092242X	SC	Farm to Market near Memorial Hwy	10	7	0	78
092246A	SC	Higgins Airport Way near Memorial Hwy	10	7	0	78
092249V	SC	Avon-Allen Rd near Avon Cutoff	10	7	0	78
092252D	SC	Pulver Rd near Avon Cutoff	10	7	0	78
929012P	Burlington	Garrett Road near SR 20	10	7	0	78
092255Y	Burlington	SR20-Burlington near E Orange Ave	10	7	0	78
092259B	Burlington	S Walnut St near Washington Ave	10	31	0	95
092260V	Burlington	Spruce St near Washington Ave	10	31	0	95

Emergency Services

Increased gate-down time, or crossing blockage, could result in longer average response times for emergency vehicles. During a crossing event, fire and medical emergency vehicles responding to an emergency may be delayed more frequently during crossing events at an at-grade crossing. At-grade crossings in areas that have poor network redundancy could disproportionately impact emergency response times when future trains are operating. Network redundancy is the presence of alternate routes around an at-grade crossing within a half-mile of the crossing; network redundancy can be reduced if all of the nearby alternate routes are on streets that also have at-grade crossings blocked during the same crossing event.

With additional trains in the future, emergency response vehicles could experience additional crossing delays of between 1 minute 45 seconds and 13 minutes per train crossing event. Analysts evaluated potential impacts to emergency service delivery by assessing network redundancy within a half-mile of at-grade crossings in Skagit County. The evaluation categorized each at-grade crossing based on the impact on emergency service response times using the following definitions:

- High Impact: At-grade crossings that have poor network redundancy within a half-mile radius, or no alternate routes around the at-grade crossing, would be rated as a high impact. At-grade crossings that may have nearby alternate routes but routes are located on streets with other at-grade crossings were also rated poor since these crossings could also be blocked during a train crossing event. Emergency service providers would likely be impacted by delay from additional train traffic. Emergency responders would have to wait for crossings to clear during a train event and would not be able to take an alternate route.
- Moderate Impact: At-grade crossings that have moderate network redundancy within a half-mile radius, or only one alternate route around the at-grade crossing, would be rated as a moderate impact. Emergency service providers could use an alternate route to avoid the blocked crossing but would have limited alternate routes. If the alternate route was congested or less direct, emergency service providers would likely experience some delay from additional train traffic.
- Low Impact: At-grade crossings that have good network redundancy within a half-mile radius, or multiple alternate routes around the at-grade crossing, would be rated as a low impact. Emergency service providers could use multiple alternate routes to avoid the blocked crossing. This would allow responders to choose the most direct and/or least congested route around the crossing. Responders would likely experience little delay from additional train traffic.

Of the 56 at-grade crossings in Skagit County, six would have a moderate impact from future train traffic on emergency response services. The following crossings each have a grade-separated crossing within a half-mile, which could allow emergency vehicles to bypass the at-grade crossing during a crossing event:

- Ferry Street near Cascade Highway
- S Texas Road near March's Point Road
- N Legg Road near Chuckanut Drive

- Cook Road near Highway 99
- Montgomery Street near S 3rd St
- SR 536 /Kincaid near S 3rd Street

The remaining 50 crossings would have a high impact to emergency service delivery because no alternate routes around a blocked at-grade crossing currently exist. The majority of crossings in Skagit County are located in areas where there are few parallel connections and/or a lack of grade-separated crossings.

Impacts to Safety

With increased train crossings in the future, the potential for accidents at and near at-grade crossings could increase absent safety improvements. Although collisions with trains are often due to motorists or pedestrians disregarding safety precautions at crossings, increased train crossing events could result in additional incidents near crossings due to traffic congestion. Table 5, beginning on page 28, summarizes the 3-year collision history at and within 250 feet of at-grade crossings in Skagit County that have had at least one collision.

Crossings that have a higher collision history could be prioritized for safety improvements near the crossing to help mitigate any impacts from additional gate-down time.

Table 5. Collisions at and within 250 feet of At-Grade Crossings in Skagit County

USDOT Crossing Number	Cross Streets	2015 Average Daily Traffic Volumes	2015 Train Volume (Freight & Passenger)	3-Year Collision History (2012-2014)	Accidents per Million Entering Vehicles	Accidents per Thousand Entering Trains
North-South Mainline (listed south to north)						
084727X	Milltown Crossing Road near Pioneer Hwy	20	26	4	152.2	0.14
084733B	Spruce/Main Street near Jones Rd	570	26	1	1.6	0.04
084739S	Old 99/Blackburn near S 3rd St	4,470	26	5	1.0	0.18
084741T	Section St near S 3rd Street	3,290	26	2	0.6	0.07
084744N	SR 536 - Kincaid near S 3rd Street	21,400	26	23	1.0	0.81
084746C	Montgomery Street near S 3rd St	1,360	26	3	2.0	0.11
084753M	Fir St near N 1st St	7,570	26	2	0.2	0.07
084758W	Riverside Drive near Alder Ln	20,310	26	13	0.6	0.46
084759D	College - SR 538 near Urban Ave	23,280	26	13	0.5	0.46

Table 5. Collisions at and within 250 feet of At-Grade Crossings in Skagit County, cont.

USDOT Crossing Number	Cross Streets	2015 Average Daily Traffic Volumes	2015 Train Volume (Freight & Passenger)	3-Year Collision History (2012-2014)	Accidents per Million Entering Vehicles	Accidents per Thousand Entering Trains
084760X	Hoag Rd near Continental Pl	14,440	26	1	0.1	0.04
084763T	Pease Rd near E Whitmarsh Rd	3,210	50	6	1.7	0.11
084764A	Greenleaf Avenue near S Spruce St	3,990	50	1	0.2	0.02
084765G	Fairhaven near S Spruce St	7,900	21	9	1.0	0.39
084766N	SR 20 - Avon near S Spruce St	14,940	21	24	1.5	1.04
084775M	Cook Rd near Hwy 99	12,470	21	23	1.7	1.00
084787G	Colony Rd near Windmill Ln	470	21	1	1.9	0.04
Burlington-Sumas Branch Line (listed west to east)						
092261C	Fairhaven/Cherry near Cascade Hwy	11,590	2	3	0.2	1.37
092262J	N Pine St near Cascade Hwy	820	2	4	4.5	1.83
092263R	N Anacortes St near Cascade Hwy	1,790	2	1	0.5	0.46
092264X	N Regent St near Avon Ave	600	2	4	6.1	1.83
092265E	N Skagit St near Short St	1,490	2	1	0.6	0.46
092266L	N Section St near Cascade Hwy	820	2	5	5.6	2.28
092267T	Gardner Rd near Cascade Hwy	1,400	2	6	3.9	2.74
092269G	Peter Anderson near Cascade Hwy	640	2	2	2.8	0.91
092273W	Sterling Rd near Cascade Hwy	1,610	2	7	4.0	3.20
085005U	Rhodes Rd near Cascade Hwy	730	2	13	16.3	5.94
085006B	State St near Cascade Hwy	660	2	26	36.3	11.87
Burlington-Anacortes Branch Line (listed west to east)						
092234F	March's Pt Rd	280	4	1	3.2	0.23
092241R	Bayview-Edison near Memorial Hwy	1,430	4	13	8.3	2.97
092242X	Farm to Market near Memorial Hwy	4,290	4	9	1.9	2.05
092246A	Higgins Airport Way near Memorial Hwy	2,000	4	5	2.3	1.14

Table 5. Collisions at and within 250 feet of At-Grade Crossings in Skagit County, cont.

USDOT Crossing Number	Cross Streets	2015 Average Daily Traffic Volumes	2015 Train Volume (Freight & Passenger)	3-Year Collision History (2012-2014)	Accidents per Million Entering Vehicles	Accidents per Thousand Entering Trains
092249V	Avon-Allen Rd near Avon Cutoff	2,040	4	14	6.3	3.20
092252D	Pulver Rd near Avon Cutoff	1,270	4	6	4.3	1.37
929012P	Garrett Road near SR 20	-	4	30	N/A	6.85
092259B	S Walnut St near Washington Ave	830	28	1	1.1	0.03

Vehicle Queuing

This section summarizes the queue analysis completed for high volume intersections during the PM peak. Crossings that have the potential to create operational issues at nearby intersections are also highlighted in this section.

Methodology

Vehicle queueing at at-grade crossings is another measure used to determine impacts to the transportation system from increased future train traffic at at-grade crossings. Analysts completed a queue analysis for at-grade crossings on streets that are expected to have an average daily traffic (ADT) volume of 5,000 or more vehicles in 2040, which include the following 18 crossings:

- Fir Island Road near Jones Road ..... Skagit County
- Old 99/Blackburn near S 3rd Street ..... Mount Vernon
- SR 536/Kincaid near S 3rd Street ..... Mount Vernon
- Fir Street near N 1st Street ..... Mount Vernon
- Riverside Drive near Alder Lane ..... Mount Vernon
- SR 538/College near Urban Avenue ..... Mount Vernon
- Hoag Road near Continental Place ..... Mount Vernon
- Greenleaf Avenue near S Spruce Street ..... Burlington
- Fairhaven near S Spruce Street ..... Burlington
- SR 20/Avon near S Spruce Street ..... Burlington
- Cook Road near Highway 99 ..... Skagit County
- SR 9 near Cascade Highway ..... Sedro-Woolley
- Ferry Street near Cascade Highway ..... Sedro-Woolley
- Farm to Market near Memorial Highway ..... Skagit County
- Higgins Airport Way near Memorial Highway ..... Skagit County
- SR20/Burlington near E Orange Avenue ..... Burlington
- Spruce Street near Washington Avenue ..... Burlington
- Fairhaven/Cherry near Cascade Highway ..... Burlington

To determine the anticipated maximum impact to the roadway network, analysts performed the queue length analysis using PM peak hour traffic volumes. Traffic volumes are higher during the PM peak hour than any other time of day, so rail crossing events that occur during the PM peak hour result in the longest queues compared to any other time of day. Because freight train crossing events create longer periods of gate-down time than passenger trains or train-building activities, the queue length analysis was completed for freight train crossing events. Also, passenger trains are not currently operating through Skagit County during the PM peak hour. Freight trains are longer than passenger trains, which results in longer periods of gate-down time and a more substantial impact on the roadway network.

Analysts determined the anticipated maximum queue length during the PM peak hour and noted locations where queues at a crossing are expected to extend into upstream intersections. Analysts also noted locations where queues at a nearby intersection could have the potential to extend through an at-grade crossing.

Queue lengths were determined by assuming a freight train arrives at a crossing sometime during the PM peak hour. The PM peak hour volume was used to calculate how many vehicles would arrive at the crossing when the gates were down, and how long it would take for vehicles to dissipate once the train passes and the gates are open to traffic again. The maximum queue would typically occur a short time after the gates open to vehicle traffic again.

Queue lengths were calculated with existing year 2015 traffic volumes and future year 2040 traffic volumes at each crossing. Vehicle queue lengths at at-grade crossings vary depending on the number of lanes, the length of gate-down time during a crossing event, and the approaching vehicle volume.

Vehicle queues and congestion at crossings can become problematic when vehicle queues at a crossing back into nearby upstream intersections, causing congestion to ripple through the surrounding transportation network. Crossing events can also cause queues to form at nearby intersections downstream of the crossing. If a platoon of vehicles forms while stopped at a crossing during a train crossing event, and a downstream intersection does not have enough capacity to serve the platoon of vehicles, a queue will form at the intersection. This can potentially cause vehicles to be backed up into the rail crossing even after the crossing event and could take several signal cycles to dissipate.

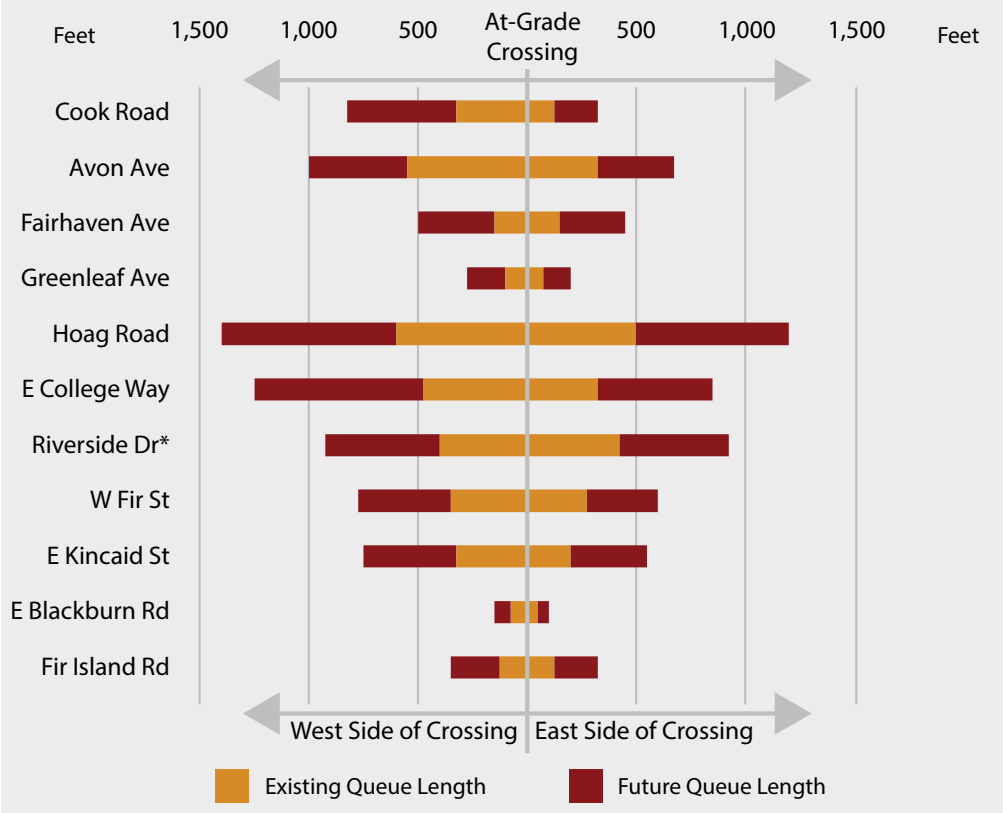
Queue Lengths

Figure 10 illustrates the existing and future anticipated maximum queue lengths east and west of the crossings on the North-South Mainline during the PM peak hour.

The maximum queue lengths on the North-South Mainline are expected to be between approximately 80 and 230 percent longer in 2040 than they are today. The increase in queue lengths is a result of increased traffic volume on the roadways and longer periods of gate-down time due to increased and longer freight trains.

Traffic volumes are generally higher on the eastbound approaches than on the westbound approaches during the PM peak hour, so the queues on the eastbound approaches to the crossings are longer than the queues on the westbound approaches.

Figures 11 and 12 illustrate the existing and future anticipated maximum queue lengths that occur at the crossings on the Burlington-Sumas Branch Line during the PM peak hour.



NOTE: THE RIVERSIDE DRIVE CROSSING IS ORIENTED NORTHEAST/SOUTHWEST; THE QUEUES AT THE CROSSING OCCUR ON THE NORTH AND SOUTH APPROACHES TO THE CROSSING

Figure 10. Existing (2015) and Future (2040) Queue Lengths on the North-South Mainline

The maximum queue lengths on the Burlington-Sumas Branch Line are expected to be between 50 and 70 percent longer in 2040 than they are today. Similar to crossings on the Mainline, the increase in queue lengths is a result of increased traffic volume on the roadways, and longer periods of gate-down time due to increased freight train traffic.

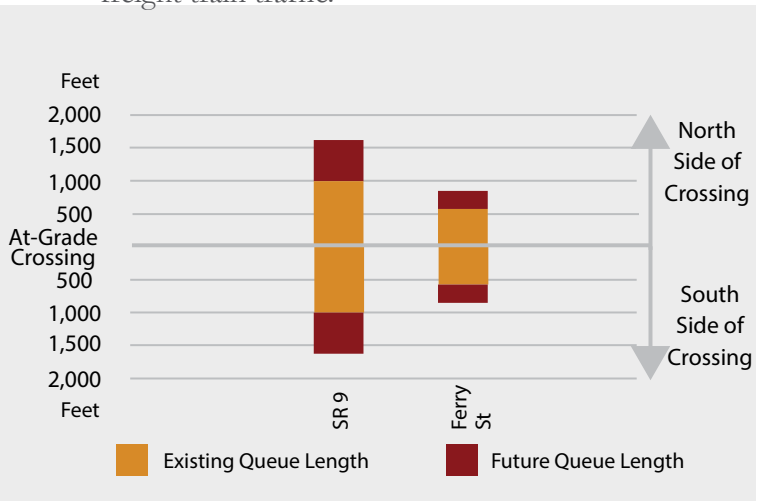


Figure 11. Existing (2015) and Future (2040) Queue Lengths on the Burlington-Sumas Branch Line (east-west portion of the line)

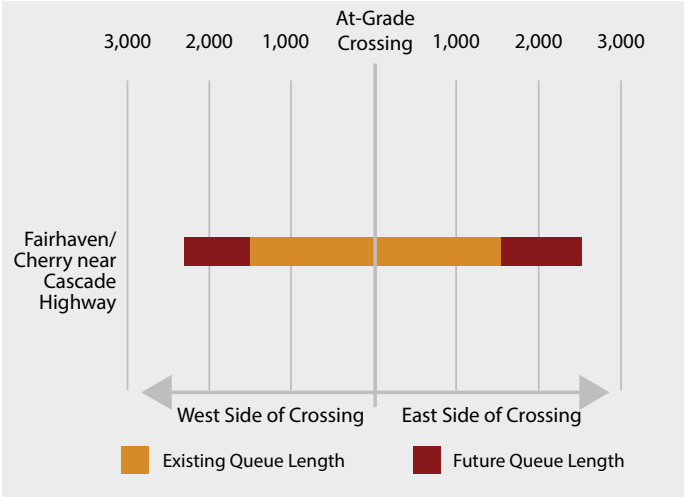


Figure 12. Existing (2015) and Future (2040) Queue Lengths on the Burlington-Sumas Branch Line (north-south portion of the line)

Traffic volumes approaching either sides of crossings on the Burlington-Sumas Branch Line are generally similar, so the queue lengths are similar.

Figure 13 illustrates the existing and future anticipated maximum queue lengths that occur at the crossings on the Burlington-Anacortes Branch Line during the PM peak hour.

The maximum queue lengths on the Burlington-Anacortes Branch Line are expected to be between 50 and 95 percent longer in 2040 than they are today. This is because of increased traffic volume on the roadways, and longer periods of gate-down time due to increased and longer freight train traffic. The percent increase in maximum queue lengths is also expected to be higher on the Burlington-Anacortes Branch Line than on the Burlington-Sumas Branch Line because train lengths are expected to be longer.

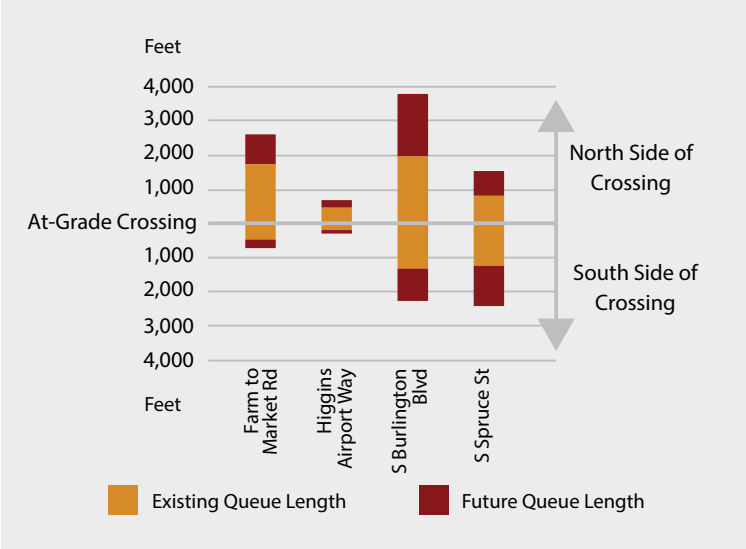


Figure 13. Existing (2015) and Future (2040) Queue Lengths on the Burlington-Anacortes Branch Line

Generally, southbound volumes at crossings on the Burlington-Anacortes Branch Line are higher than northbound volumes, which results in longer queues on the southbound approaches. However, at the Spruce Street crossing, the northbound volume is higher than the southbound volume during the PM peak hour. This results in longer queues at the northbound approach at S Spruce Street.

Adjacent Intersection Impacts

This section documents locations where queues at a rail crossing have the potential to impact operations at upstream intersections, and vice versa. Table 6 lists intersections and at-grade crossings that may be impacted by queuing.

Table 6. Collisions at and within 250 feet of At-Grade Crossings in Skagit County

At-Grade Crossing	Intersection	Queuing at Adjacent At-Grade Rail Crossing Impacts Nearby Intersection		Queuing at Adjacent Intersection Impacts Nearby At-Grade Rail Crossing	
		Existing Conditions (2015)	Future Conditions (2040)	Existing Conditions (2015)	Future Conditions (2040)
North-South Mainline (listed south to north)					
SR 536/Kincaid St near S 3rd St	E Kincaid St and S 3rd Street	X	X	X	X
	E Kincaid St and I-5 Southbound Ramps		X	X	X
Fir/Cameron St near N 1st Street; Riverside Dr near Alder Ln	Riverside Drive/N 4th Street and W Fir Street		X		X
SR 538/College near Urban Ave	E College Way and Urban Ave	X	X		X
	E College Way and Continental Place				X
Hoag Rd near Continental Pl	Hoag Road/Martin Road and N Laventure Rd				X
Fairhaven near S Spruce St	E Fairhaven and S Spruce Street*		X		X
Cook Rd near Highway 99	Cook Road and Old Highway 99	X	X		
Burlington-Sumas Branch Line (listed west to east)					
Fairhaven/Cherry near Cascade Hwy	E Fairhaven Ave and S Anacortes Street*	X	X		X
State Street near Cascade Highway	SR 9 and W State St	X	X	X	X
Burlington-Anacortes Branch Line (listed west to east)					
Farm to Market near Memorial Hwy	Memorial Highway and Farm to Market Road	X	X		
Higgins Airport Way near Memorial Hwy	Memorial Highway and Higgins Airport Way	X	X		
SR20-Burlington near E Orange Ave	S Burlington Blvd and W Fairhaven Ave	X	X		X
	S Burlington Blvd and E Rio Vista Ave	X	X		X

Figure 14 shows the locations of at-grade crossings that could impact or be impacted by vehicle queuing. The majority of these crossings are located on the North-South Mainline south of Burlington.

When queues from a rail crossing extend into adjacent intersections, congestion and delay could increase on some or all movements through the intersection depending on the intersection configuration. There is also the potential for vehicles to pull into the intersection and block other movements while waiting for the queue from the rail crossing to dissipate.

When queues from adjacent intersections extend into the rail crossing, it is possible for vehicles to be unable to clear the crossing before a train crossing event.

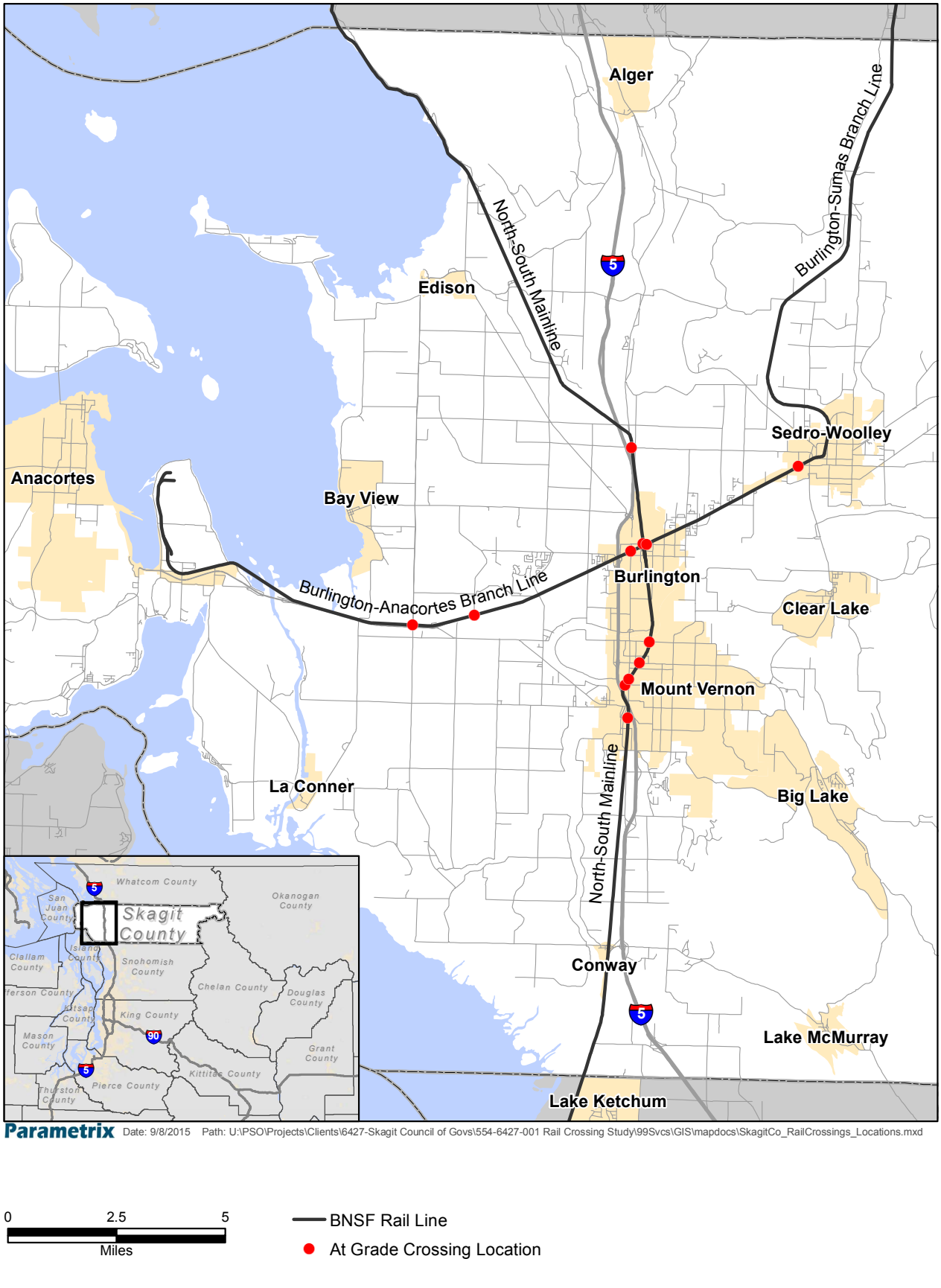


Figure 14. At-Grade Crossings that Impact or are Impacted by Queuing

Key Crossings

Crossings that could be disproportionately impacted by increased train traffic in the future were identified for a more in-depth analysis, including identification of preliminary mitigation strategies to improve safety or reduce delay. Analysts rated crossing characteristics on a scale of 1 to 5, with crossings that have a high impact, or lower performance, ranked lower.

The factors that were used to describe the total impacts included:

1. Maximum daily train volumes (freight and passenger) in 2040
2. Daily gate-down time in 2040
3. Average daily traffic volumes in 2040
4. Roadway freight truck percentages
5. Marginal increase in daily gate-down time in 2040 from existing conditions
6. Marginal percent increase in daily gate-down time in 2040 from existing conditions
7. Impact to emergency services
8. Accident history

Analysts scored the performance for each crossing by summing the rating score (1 through 5) for the crossing characteristics 3 through 8. Each of the rated characteristics were equally weighted.

Table 7, starting on page 38, summarizes the performance ratings for all of the at-grade crossings in Skagit County. There were 12 crossings identified as key crossings based on their performance. Crossings that had a performance score of 20 or less, had a projected average daily traffic volume of 15,000 or more in 2040, or were identified by key stakeholders were selected as key crossings. This included the following crossings (shown on Figure 15):

- Old 99/Blackburn Road near S 3rd Street.....Mount Vernon
- SR 536/Kincaid near S 3rd Street.....Mount Vernon
- Fir Street near 1st Street.....Mount Vernon
- Riverside Drive near Alder Lane.....Mount Vernon
- SR 538/College near Urban Avenue.....Mount Vernon
- Hoag Road near Continental Pl.....Mount Vernon
- Fairhaven near S Spruce St.....Burlington
- SR 20/ Avon near S Spruce Street.....Burlington
- Cook Road near Highway 99.....Skagit County
- Fairhaven/Cherry Street near Cascade Highway.....Burlington
- State St near Cascade Highway.....Sedro-Woolley
- SR 9 near Cascade Highway.....Sedro-Woolley
- Ferry St near Cascade Highway.....Sedro-Woolley
- SR 20/Burlington near E Orange Avenue.....Burlington

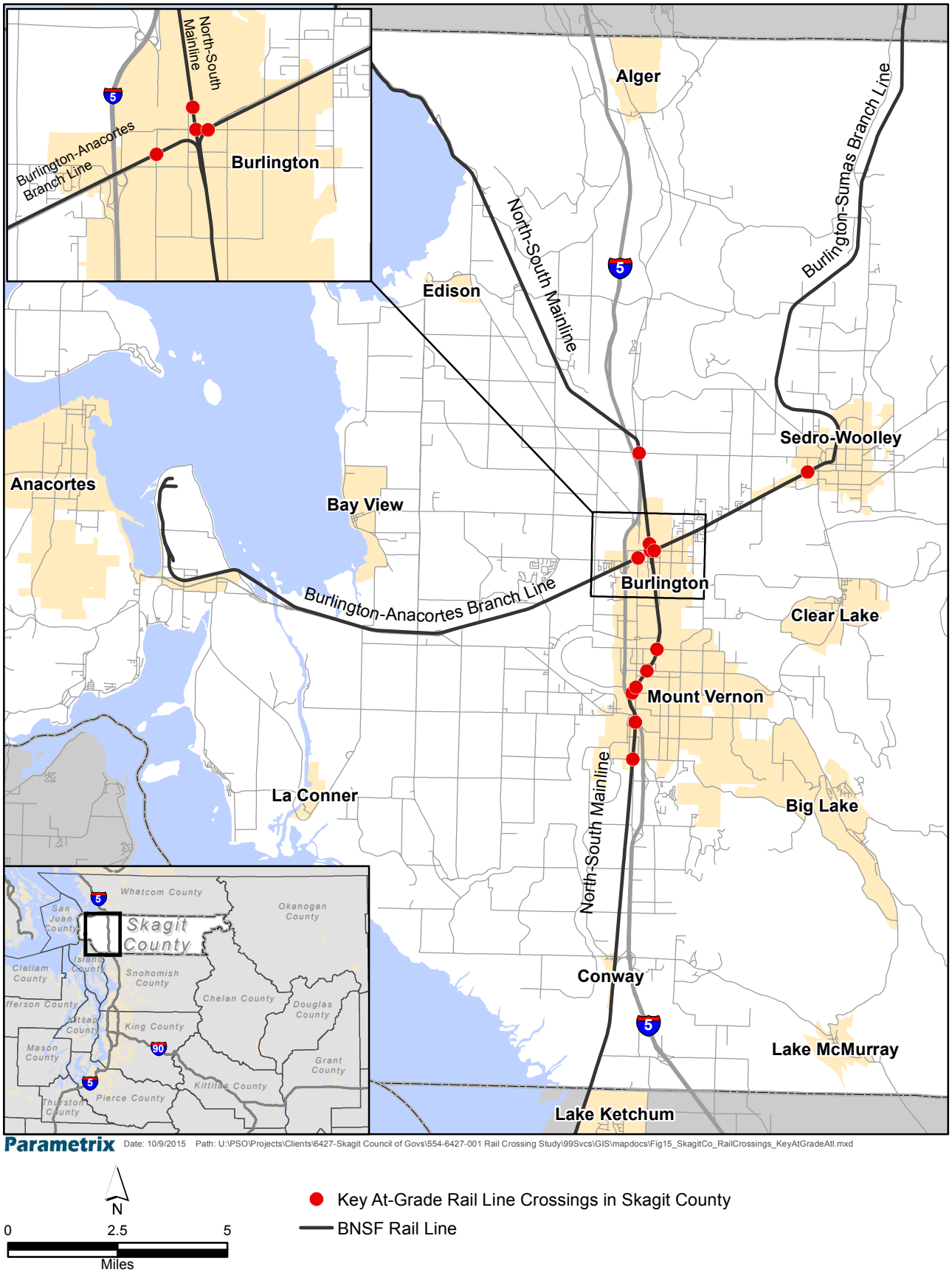


Figure 15. Key At-Grade Crossings Locations

Table 7. At-Grade Crossing Performance Summary

KEY TO RANKING

HIGH IMPACT/LOWER PERFORMING — LOW IMPACT/HIGHER PERFORMING

USDOT Crossing Number	City	Cross Streets	2040 Maximum Daily Train Volumes (Freight and Passenger)	2040 Daily Gate-Down Time (min)	2040 Average Daily Traffic Volume	Freight Truck %	2040 Marginal Increase in Daily Gate-Down Time from Existing (min)	2040 Marginal Percent Increase in Gate Down-Time From Existing	Impact to Emergency Services	3-Year Accident History	Accidents per Million Entering Vehicles	Accidents per Thousand Entering Trains	Score
North-South Mainline (shown south to north)													
084727X	SC	Milltown Crossing Road near Pioneer Hwy	62	114	30	0%	72	174%	High	4	152.2	0.14	23
084733B	SC	Spruce/Main Street near Jones Rd	62	114	710	20%	72	174%	High	1	1.6	0.04	22
084734H	SC	Fir Island Rd near Jones Rd	62	114	7,870	15%	72	174%	High	None	0.0	0.00	23
084735P	SC	Peter Johnson Rd near Conway Frontage Rd	62	114	120	5%	72	174%	High	None	0.0	0.00	27
084736W	SC	Stackpole Rd near Conway Frontage Rd	62	114	320	5%	72	174%	High	None	0.0	0.00	27
084737D	SC	Hickox Rd near Old Hwy 99	62	114	620	5%	72	174%	High	None	0.0	0.00	27
084739S	Mount Vernon	Old 99/Blackburn near S 3rd St	62	162	63,701	3%	104	179%	High	5	1.0	0.18	19
084741T	Mount Vernon	Section St near S 3rd Street	62	162	4,700	5%	104	179%	High	2	0.6	0.07	22
084744N	Mount Vernon	SR 536 - Kincaid near S 3rd Street	62	165	30,520	4%	104	170%	Moderate	23	1.0	0.81	18
084746C	Mount Vernon	Montgomery Street near S 3rd St	62	165	1,950	10%	104	179%	Moderate	3	2.0	0.11	24
084753M	Mount Vernon	Fir St near N 1st St	62	162	10,800	8%	104	179%	High	2	0.2	0.07	20
084758W	Mount Vernon	Riverside Drive near Alder Ln	62	162	28,960	5%	104	179%	High	13	0.6	0.46	17
084759D	Mount Vernon	College - SR 538 near Urban Ave	62	162	33,210	7%	104	179%	High	13	0.5	0.46	17
084760X	Mount Vernon	Hoag Rd near Continental Pl	62	162	20,590	3%	104	179%	High	1	0.1	0.04	21
084763T	Burlington	Pease Rd near E Whitmarsh Rd	86	127	4,520	15%	72	134%	High	6	1.7	0.11	22
084764A	Burlington	Greenleaf Avenue near S Spruce St	86	127	5,620	9%	72	134%	High	1	0.2	0.02	22
084765G	Burlington	Fairhaven near S Spruce St	55	101	11,130	8%	68	209%	High	9	1.0	0.39	20
084766N	Burlington	SR 20 - Avon near S Spruce St	55	101	21,050	6%	68	209%	High	24	1.5	1.04	17
077833N	Burlington	North Hill Blvd near Walton Dr	55	101	1,450	2%	68	209%	High	None	0.0	0.00	28
084775M	SC	Cook Rd near Hwy 99	55	101	17,570	12%	68	209%	Moderate	23	1.7	1.00	18
084784L	SC	Ershig Rd near Allen Rd	55	101	850	10%	68	209%	High	None	0.0	0.00	26

Table 7. At-Grade Crossing Performance Summary, cont.

KEY TO RANKING

HIGH IMPACT/LOWER PERFORMING — LOW IMPACT/HIGHER PERFORMING

USDOT Crossing Number	City	Cross Streets	2040 Maximum Daily Train Volumes (Freight and Passenger)	2040 Daily Gate-Down Time (min)	2040 Average Daily Traffic Volume	Freight Truck %	2040 Marginal Increase in Daily Gate-Down Time from Existing (min)	2040 Marginal Percent Increase in Gate Down-Time From Existing	Impact to Emergency Services	3-Year Accident History	Accidents per Million Entering Vehicles	Accidents per Thousand Entering Trains	Score
084785T	SC	Bow Hill Rd near Cattail Pl	55	101	1,670	10%	68	209%	High	None	0.0	0.00	26
084787G	SC	Colony Rd near Windmill Ln	55	101	580	12%	68	209%	High	1	1.9	0.04	23
084788N	SC	S Blanchard Rd near Colony Rd	55	101	40	0%	68	209%	High	None	0.0	0.00	26
084789V	SC	S Legg Rd	55	101	290	5%	68	209%	High	None	0.0	0.00	27
084791W	SC	N Legg Rd near Chuckanut Dr	55	101	240	5%	68	209%	Moderate	None	0.0	0.00	29
Burlington-Sumas Branch Line (shown west to east)													
092261C	Burlington	Fairhaven/Cherry near Cascade Hwy	6	64	16,330	10%	42	200%	High	3	0.2	1.37	20
092262J	Burlington	N Pine St near Cascade Hwy	6	33	1,160	10%	22	200%	High	4	4.5	1.83	23
092263R	Burlington	N Anacortes St near Cascade Hwy	6	33	2,520	10%	22	200%	High	1	0.5	0.46	24
092264X	Burlington	N Regent St near Avon Ave	6	33	840	10%	22	200%	High	4	6.1	1.83	23
092265E	Burlington	N Skagit St near Short St	6	33	2,100	10%	22	200%	High	1	0.6	0.46	25
092266L	Burlington	N Section St near Cascade Hwy	6	33	1,160	10%	22	200%	High	5	5.6	2.28	23
092267T	Burlington	Gardner Rd near Cascade Hwy	6	33	1,980	10%	22	200%	High	6	3.9	2.74	23
092269G	SC	Peter Anderson near Cascade Hwy	6	33	910	10%	22	200%	High	2	2.8	0.91	24
092270B	SC	Lafayette/District near Cascade Hwy	6	33	750	10%	22	200%	High	None	0.0	0.00	27
092273W	SC	Sterling Rd near Cascade Hwy	6	33	2,270	10%	22	200%	High	7	4.0	3.20	22
085005U	Sedro Woolley	Rhodes Rd near Cascade Hwy	6	33	1,070	10%	22	200%	High	13	16.3	5.94	21
085006B	Sedro Woolley	State St near Cascade Hwy	6	33	960	1%	22	200%	High	26	36.3	11.87	19
085007H	Sedro Woolley	SR 9 near Cascade Hwy	6	64	7,260	6%	42	200%	High	None	0.0	0.00	26
085008P	Sedro Woolley	Ferry St near Cascade Highway	6	64	11,950	8%	42	200%	Moderate	None	0.0	0.00	27
085101W	SC	Garden of Eden near Stiles Ln	6	18	1,500	8%	12	200%	High	None	0.0	0.00	29
085103K	SC	Grip Rd near Hoogdal Branch Rd	6	18	670	8%	12	200%	High	None	0.0	0.00	29

Table 7. At-Grade Crossing Performance Summary, cont.

KEY TO RANKING

HIGH IMPACT/LOWER PERFORMING — LOW IMPACT/HIGHER PERFORMING

USDOT Crossing Number	City	Cross Streets	2040 Maximum Daily Train Volumes (Freight and Passenger)	2040 Daily Gate-Down Time (min)	2040 Average Daily Traffic Volume	Freight Truck %	2040 Marginal Increase in Daily Gate-Down Time from Existing (min)	2040 Marginal Percent Increase in Gate Down-Time From Existing	Impact to Emergency Services	3-Year Accident History	Accidents per Million Entering Vehicles	Accidents per Thousand Entering Trains	Score
085105Y	SC	SR 9 near Samish View Ln	6	18	2,760	10%	12	200%	High	None	0.0	0.00	28
085106F	SC	Hathaway Rd near Cruse Rd	6	18	150	8%	12	200%	High	None	0.0	0.00	29
Burlington-Anacortes Branch Line (shown west to east)													
084708T	SC	N Texas Rd near March's Pt Road	7	53	360	10%	36	84%	High	None	0.0	0.00	29
092232S	SC	S Texas Rd near March's Point Rd	7	53	2,130	10%	36	84%	Moderate	None	0.0	0.00	31
092234F	SC	March's Pt Rd	7	53	390	10%	36	84%	High	1	3.2	0.23	25
092241R	SC	Bayview-Edison near Memorial Hwy	7	53	1,760	10%	36	84%	High	13	8.3	2.97	22
092242X	SC	Farm to Market near Memorial Hwy	7	53	5,270	12%	36	84%	High	9	1.9	2.05	22
092246A	SC	Higgins Airport Way near Memorial Hwy	7	53	2,450	5%	36	84%	High	5	2.3	1.14	25
092249V	SC	Avon-Allen Rd near Avon Cutoff	7	53	2,880	10%	36	84%	High	14	6.3	3.20	21
092252D	SC	Pulver Rd near Avon Cutoff	7	53	1,790	10%	36	84%	High	6	4.3	1.37	24
929012P	Burlington	Garrett Road near SR 20	7	53	N/A	N/A	36	84%	High	30	N/A	6.85	21
092255Y	Burlington	SR20-Burlington near E Orange Ave	7	53	19,888	10%	36	84%	High	None	0.0	0.00	26
092259B	Burlington	S Walnut St near Washington Ave	31	69	1,170	10%	36	61%	High	1	1.1	0.03	27
092260V	Burlington	Spruce St near Washington Ave	31	69	7,900	10%	36	61%	High	None	0.0	0.00	27

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MITIGATION

There are a number of mitigation measures that could reduce transportation impacts from additional future train traffic at at-grade crossings in Skagit County. Mitigation measures that could be used at any at-grade crossing vary based on surrounding development, the roadway network, and topography, among other things. In some cases, a combination of mitigation strategies could be used to reduce impacts. Potential mitigation measures are summarized below.

Grade Separation

Grade separation of existing at-grade crossings would separate vehicular traffic from train traffic to reduce conflict areas, increase safety, and eliminate delays at crossings. Grade separation would also improve emergency service response by reducing delay to response times and the potential for railway-roadway crashes. Delays on freight-classified routes would also be improved. While grade separation can be a desirable solution, these improvements are typically very costly and involve substantial amounts of public funding. Grade separation projects could cost between approximately $30 million to $200 million each.

Public funding for grade separation projects is difficult to secure. A variety of traditional funding sources, such as TIGER grants and Freight Mobility Strategic Investment Board (FMSIB) grants are awarded in highly competitive processes and are often insufficient to provide the amount of funds required to complete a grade separation project. The newly enacted FAST Act authorizes $305 billion from the Highway Trust Fund and the General Fund for transportation projects, including grade separation projects. The Surface Transportation Block Grant Program (STBGP), the Railway-Highway Grade Crossings Program, and the Nationally Significant Highway and Freight Projects Program are some of the subcategories of the FAST Act that could provide funding for grade separation projects. State legislative funding packages can also contain funding for grade separation projects. Many grade separation projects take several years to complete once funding is secured.

Grade Crossing Consolidation

At-grade crossings that are redundant (other crossings nearby allow access to the same roads or areas), are not designated emergency routes, or have low traffic volumes could be closed to reduce impacts from future train traffic. However, closing an at-grade crossing could result in increased transportation impacts at other nearby crossings by shifting vehicle volumes to other roadways. Crossings that could be considered for closure would need to be assessed for potential impacts to other crossings prior to final closing. Grade crossing consolidation requires a petition be filed with the Utilities and Transportation Commission by the jurisdiction, and would include a public hearing and input from the Railroad Company and WSDOT Rail.

Signal Timing

Signal timing could be used to mitigate delay and congestion experienced by vehicles at at-grade crossings. Signal timing is the process of optimizing the operations of signalized intersections so that vehicles, pedestrians, and bicyclists are moved in the most efficient manner possible. Signals could be optimized to empty the queue or move vehicles, pedestrians, and bicycles through the street

system near an at-grade crossing during a crossing event. This could reduce the total number of people impacted by gate-down time. Optimized signal timing could ensure that vehicles, pedestrians, and bicyclists that are not traveling in the direction of a blocked at-grade crossing would receive more green time while a train passes. Signal timing could provide some safety and emergency response mitigation by reducing the number of impacted vehicles and the potential for crashes, and by providing increased green time to traffic moving away from the at-grade crossing

Intelligent Transportation Systems (ITS)

ITS uses information technology and communications to manage traffic in a safe, coordinated and efficient manner. ITS improvements could be used in the form of advanced signage and warnings to alert drivers that a train is approaching an at-grade crossing. This could allow vehicles, pedestrians, and bicyclists to choose alternate routes to avoid a blocked at-grade crossing. ITS improvements could reduce the total number of affected vehicles and emergency response impacts by allowing vehicles to use alternate routes. Safety could also be improved through advanced warnings by reducing the number of potential train-vehicle conflicts. ITS improvements could also be used to monitor illegal crossings and to enforce traffic laws at at-grade crossings. Over time, this could reduce illegal crossings and improve safety at the crossing.

A system to notify motorists of train schedules could also be implemented in coordination with BNSF. This would provide advance information via message signs or cell phone apps when at-grade crossings would be blocked by a train. Motorists could use this information to choose an alternative route or delay travel to avoid the blocked crossing.

Costs for ITS improvements, such as variable message signs (electronic signs used to give traveler information), can range between $30,000 to $45,000 for one unit with approximately $2,000 in operating costs per unit per year (USDOT, ITS Costs Database, 2015). However, the actual cost of implementing ITS can be higher if other system components, such as a traffic management center, are also needed. Traffic management centers, the central offices where transportation crews monitor and operate the ITS, can cost between $4 million and $11 million to construct. Other costs can include employees, hardware, and software for the system. Currently, there is no traffic management center located in Skagit County. However, the City of Burlington currently has the ability to monitor and update signal timing from the Public Works Department for some signals in the city. It is possible that a qualified staff person could use this existing ITS infrastructure for train crossing information, which could reduce the need for a large new infrastructure investment.

Crossing Improvements

Upgrades and improvements to at-grade crossings could help mitigate impacts from increased train traffic. Upgrades could include new signals, active warning devices, signage, lighting, full-width gates, and automated or wayside horns. These types of improvements could help to prevent illegal crossings and to ensure that vehicles, pedestrians, and bicyclists are aware that a train is approaching the at-grade crossing. This could help to reduce accidents and improve safety.

Policy

Policy measures could be considered to mitigate impacts from additional future train traffic. Potential policy measures could include:

- Scheduling train traffic for lower volume time periods: BNSF could schedule train movements to occur during non-peak hours, such as midday or evening periods. This could reduce delay and congestion during peak hours, which are characterized by higher vehicle volumes at most at-grade crossings. However, this could result in more frequent crossing events during non-peak hours and could have the potential to affect the ability of the transportation system to fully recover if crossing events occurred too closely together.
- Limiting train lengths: BNSF could work with customers to limit train lengths to shorten the gate-down time of any one train crossing event. This could reduce the overall amount of daily gate-down time and could reduce the total time that a gate is down during any single crossing event. This would help reduce delay and queuing at at-grade crossings.

Policy measures could be combined with any of the other mitigation strategies to reduce transportation impacts.

Mitigation Strategies for Key Crossings

Each of the key crossings identified in the Transportation Impacts Analysis Chapter of this report were evaluated for potential mitigation strategies. The complexity of grade separation at crossings was rated as low, medium, or high based on characteristics such as surrounding development, the roadway network, and topography. High complexity crossings are crossings where grade separation would be complicated and higher cost and low complexity grade separated crossings could be implemented more easily. The Mitigation Summary Sheet on the following pages summarize the specific mitigation strategies proposed for key crossings in Skagit County. A cost range ($: low cost to $$$$: high cost) is also provided for each of the proposed mitigation strategies. For ITS improvements, the cost range does not include a transportation management center, which would require a large, up-front capital investment.

Key Crossing Location

Old 99/Blackburn Road near S 3rd Street (Mount Vernon)

Grade Separation Complexity

High

Proposed Mitigation Strategy(ies) and Cost Range ($-$$$$)

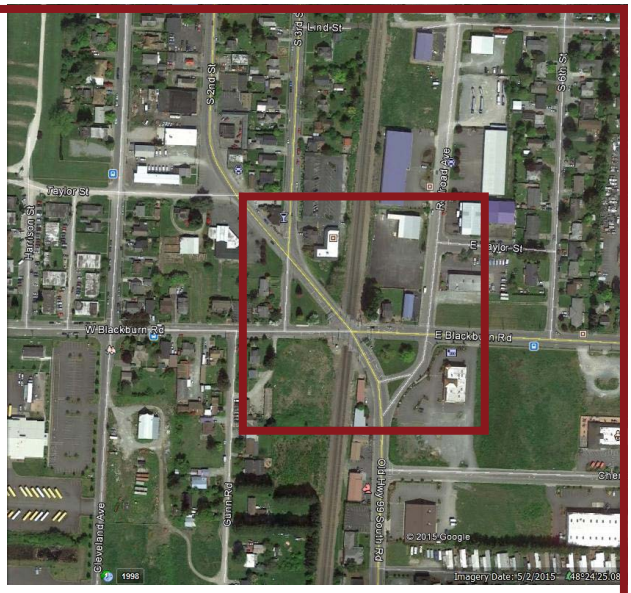
Grade Separation - overcrossing for vehicles ($$$$)

Notes

- May need to reorient nearby roadways.
- Overcrossing would need to provide access to Blackburn Rd and Old Hwy 99.
- High cost.

Current Proposed Projects

- None



Key Crossing Location

SR 536/Kincaid near S 3rd Street (Mount Vernon)

Grade Separation Complexity

High

Proposed Mitigation Strategy(ies) and Cost Range ($-$$$$)

ITS – advanced signage/warning on I-5 and other locations to alert drivers of train crossing and to provide alternate route information ($).

Notes

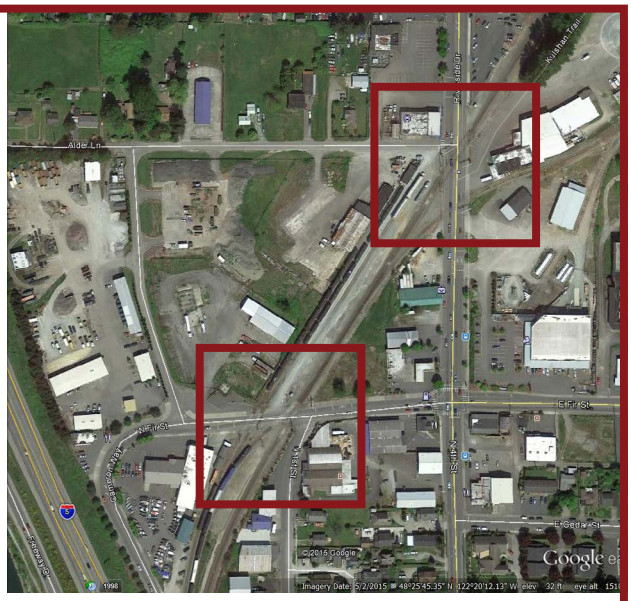
- Street network and nearby development makes grade separation difficult.
- Dual left on southbound approach of S 3rd St gets backed up during a crossing event and can block the entire intersection.
- Need to maintain access to Skagit Station.
- ITS to alert drivers to 2nd St overcrossing during train event.
- New frontage road along I-5 could provide additional circulation during crossing event.

Current Proposed Projects

- Frontage road along I-5 between Kincaid and Section St (page 253 in CIP): http://www.mountvernonwa.gov/DocumentCenter/View/4170
  - Project could increase impacts at Section St crossing, but would likely be an overall net benefit.

Key Crossing Location

Fir Street near 1st Street and Riverside Drive near Alder Lane (Mount Vernon)



Grade Separation Complexity

Medium

Proposed Mitigation Strategy(ies) and Cost Range ($-$$$$)

- Frontage Road between Cameron Way and Roosevelt Ave ($$-$$$)
- ITS – advanced signage/warning in downtown Mt Vernon and near both railroad crossings to alert drivers of train crossing and to provide alternate route ($).
- Signal timing ($).

Notes

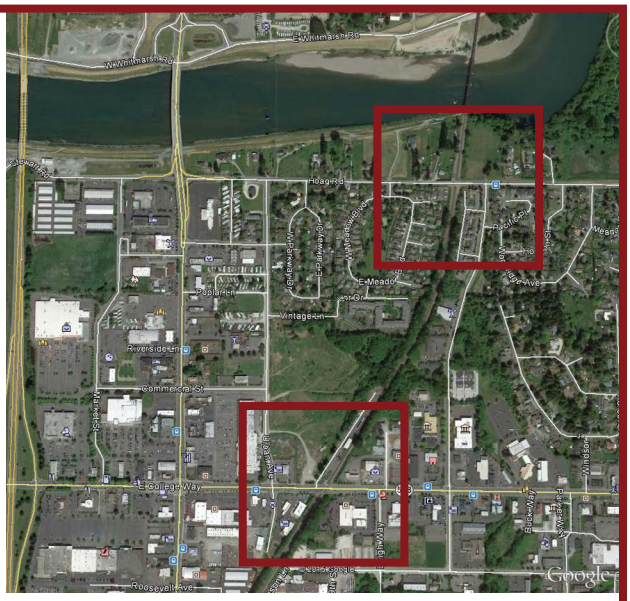
- Moderate to high cost for frontage road (depending on property acquisitions).
- Proposed frontage road along I-5 would improve access and circulation and provide alternate route during crossing event.
- ITS could be used to provide information to alert drivers of crossing event and alternate routes.
- Signal timing improvements to direct traffic away from the crossing could be used in the short term.

Current Proposed Projects

- Frontage road along I-5 (page 4-19 in 2007 Comprehensive Plan Transportation Element): http://www.mountvernonwa.gov/DocumentCenter/View/20

Key Crossing Location

SR 538/College near Urban Avenue and Hoag Road near Continental Pl (Mount Vernon)



Grade Separation Complexity

Low

Proposed Mitigation Strategy(ies) and Cost Range ($-$$$$)

- Grade separation at College Way – undercrossing for vehicles ($$$).
- ITS – advanced signage/warning near Hoag Rd to alert drivers of train crossing and to provide alternate route ($).

Notes

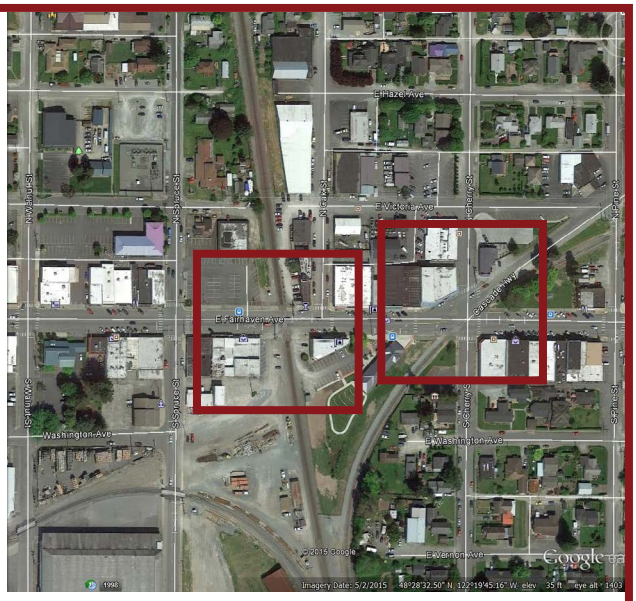
- Access issues to properties surrounding College Way.
- Would grade separate College Way.
- ITS near Hoag Rd to direct drivers to undercrossing during crossing event.

Current Proposed Projects

- None

Key Crossing Location

Fairhaven near S Spruce St and Fairhaven/Cherry St near Cascade Hwy (Burlington)



Grade Separation Complexity

High

Proposed Mitigation Strategy(ies) and Cost Range ($-$$$$)

- ITS – advanced signage/warning to alert drivers of train crossing and to provide information on alternate route ($).
  - Alternate route could be provided on Gilkey Road approximately 0.75 miles to the south (existing proposed overpass project).

Notes

- Existing street network and surrounding land development would make grade separation difficult.
- Proposed grade separated overcrossing at Gilkey Road would provide alternate route over railroad.
- ITS and signal timing could also be used to supplement the grade separated crossing.

Current Proposed Projects

- Gilkey Road Overpass (pg 6 of 2014-2019 TIP): http://burlingtonwa.gov/DocumentCenter/View/39

Key Crossing Location

SR 20/Avon Ave near S Spruce St (Burlington)

Grade Separation Complexity

Medium

Proposed Mitigation Strategy(ies) and Cost Range ($-$$$$)

- Grade separation – undercrossing for vehicles ($$$-$$$$).

Notes

- Would close intersections of Spruce St and Oak St.

Current Proposed Projects

- None

Key Crossing Location

Cook Rd near Hwy 99 (Skagit County)

Grade Separation Complexity

Medium

Proposed Mitigation Strategy(ies) and Cost Range ($-$$$$)

- Grade separation – overcrossing for vehicles ($$$-$$$$).

Notes

- Could impact I-5 interchange.
- Could lower the railroad as well at higher cost.
- Could require property acquisitions.

Current Proposed Projects

- Cook Road Reconstruction: http://www.skagitcounty.net/PublicWorksEngineering/Documents/TIP%202016-2021.pdf

Key Crossing Location

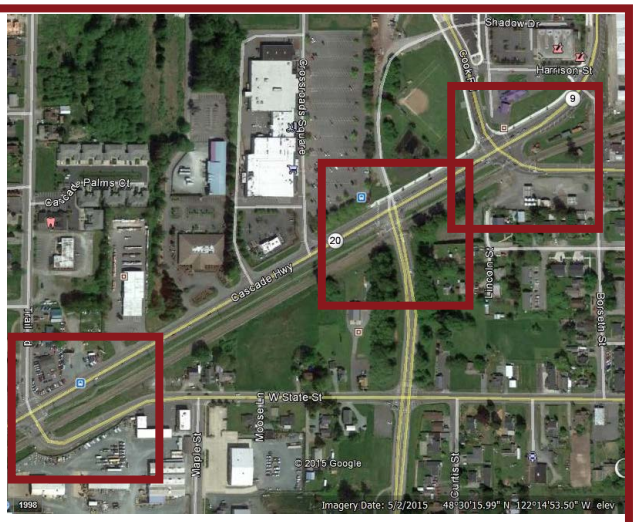
State St, SR 9, and Ferry St near Cascade Hwy (Sedro-Wooley)

Grade Separation Complexity

High

Proposed Mitigation Strategy(ies) and Cost Range ($-$$$$)

- ITS – advanced signage/warning to alert drivers of train crossing and to provide alternate route information (grade separated crossing exists at Cascade Hwy near Metcalf St) ($).



Notes

- Lower train volumes on this rail line.
- Nearby undercrossing at Cascade Hwy near Metcalf St.

Current Proposed Projects

- None

Key Crossing Location

SR 20/Burlington near E Orange Ave (Burlington)

Grade Separation Complexity

High

Proposed Mitigation Strategy(ies) and Cost Range ($-$$$$)

- Grade separation – undercrossing for vehicles ($$$$).

Notes

- Would close Orange Ave at Burlington Boulevard.
- Would require reorienting access to some nearby properties.
- Could require some property acquisition.

Current Proposed Projects

- None

Short-Term Priorities for Mitigation

Five short-term improvement projects and an overall region-wide ITS strategy could be prioritized to mitigate impacts from future train traffic at at-grade crossings:

- Grade separation of SR 538/College Way and ITS improvements at Hoag Rd .....Mount Vernon
- Grade separation of Cook Road near Highway 99 ..... Skagit County
- Grade separation of SR 20/Avon near S Spruce St..... Burlington
- Frontage road along I-5 near Fir Street and Riverside Drive .....Mount Vernon
- Frontage road along I-5 near SR 536/Kincaid near S 3rd Street .....Mount Vernon
- Region-wide ITS Strategy

These short-term priorities for mitigation were chosen because each would reduce impacts near at-grade crossings that had a low performance rating and are anticipated to have high traffic volumes in 2040. The proposed mitigation measures would reduce the impacts to transportation from additional train traffic in the future by providing information on alternate routes around blocked crossings, reducing congestion near crossings, or by grade separating a crossing.

SR 538/College Way and Hoag Rd

The proposed mitigation for the crossings at College Way and Hoag Road include grade separation of College Way and ITS improvements near Hoag Road to direct traffic to the alternate route during a crossing event. College Way is a high traffic crossing location along the North-South Mainline. Crossings on the North-South Mainline are anticipated to experience a larger proportional increase in train traffic by 2040; the average daily traffic is also expected to be over 30,000 vehicles in 2040 at College Way, which could result in substantial impacts to delay and queuing. Grade separating College Way would be a relatively low complexity project compared to other locations and could cost between approximately $30 million to $40 million to construct. ITS improvements near Hoag Road could include advanced warning signs to alert drivers of a train crossing event and to provide information on the alternate route on College Way. The ITS solutions would include a component to detect crossing events or could be coordinated with BNSF. The ITS solutions at Hoag Road could cost from approximately $120,000 to $270,000 (This cost only includes the signs. As detailed in the ITS section above, additional costs such as traffic management infrastructure may be necessary). The combination of these mitigation strategies would help relieve transportation impacts at both of these crossings.

Cook Road

The proposed mitigation for Cook Road includes grade separation of the crossing. Cook Road is a priority for mitigation because there would be higher traffic volumes (nearly 20,000 vehicles per day are anticipated in 2040) at the crossing and queuing from train crossing events could affect operations on I-5. This crossing would also experience a larger proportional increase in train traffic because it is located on the North-South Mainline. Grade separation of Cook Road would be a medium complexity project and could cost between approximately $30 million to $40 million to construct. Other improvements to Cook Road near the rail crossing are included in WSDOT's Six Year Transportation Improvement Program (TIP) for 2016-2021. These improvements are intended

to relieve existing and forecasted congestion on the segment of Cook Road between I-5 to Green Road. These improvements could be combined with grade separation of the rail crossing to further improve operations and reduce congestion.

SR 20/Avon Ave

The proposed mitigation for the crossing at SR 20/Avon Avenue includes grade separation of the crossings. This would be a medium complexity project. In 2040, it is anticipated that average daily traffic at the crossing would be more than 20,000 vehicles. This crossing is also on the North-South Mainline, which will experience a larger proportional increase in train traffic by 2040. Grade separation of SR 20 could cost between approximately $30 million to $40 million to complete.

Fir Street and Riverside Drive

The proposed mitigation for the crossings at Fir Street and Riverside Drive include a frontage road between Cameron Way and Roosevelt Ave, and ITS to alert drivers of a crossing event and of alternate routes around a blocked crossing. Signal timing improvements to keep traffic flowing and to direct traffic away from the crossing could also be used in the short-term. The frontage road would allow traffic to avoid the blocked crossings and could also be accessible from downtown Mount Vernon as well. Riverside Drive is anticipated to be a high traffic volume roadway. The crossings are also located on the North-South Mainline, which will experience a larger proportional increase in train traffic by 2040 . The frontage road would cost approximately $4.02 million to construct. Additional costs could include right-of-way acquisition. The ITS solutions could cost from approximately $120,000 to $270,000 (This cost only includes the signs. As detailed in the ITS section above, additional costs such as traffic management infrastructure may be necessary).

SR 536/Kincaid Street

The proposed mitigation for the at-grade crossing at SR 536/Kincaid Street includes ITS and a new frontage road along I-5. Traffic volumes on Kincaid Street are expected to be over 30,000 daily vehicles in 2040. This crossing is also on the North-South Mainline, which will experience a larger proportional increase in train traffic by 2040. The frontage road along I-5 would improve circulation near the at-grade crossing and could redistribute some traffic away from Kincaid Street. This project would also construct a new southbound on-ramp to I-5, which could help reduce congestion and queuing near the crossing. The ITS solutions could provide information on alternate routes around the at-grade crossing, including the 2nd Street Overpass and the frontage road near Fir Street and Riverside Drive once complete. ITS improvements could also provide information on crossing events to drivers on I-5. The frontage road along I-5 would cost approximately $20 million (this cost includes a park-and-ride facility, southbound on-ramp, and frontage road). ITS improvements could cost from approximately $180,000 to $450,000 (This cost only includes the signs. As detailed in the ITS section above, additional costs such as traffic management infrastructure may be necessary).

ITS Strategy

An ITS strategy implemented in Skagit County could include a rail traffic component. This system would provide information to drivers regarding crossing events before they happen. The FRA is currently developing this type of ITS, called Intelligent Grade Crossings. The system would provide advance warning of approaching trains. The system could also alert train operators to obstacles or trapped vehicles at at-grade crossings, which could help improve safety and reduce collisions.

REFERENCES

Amtrak. *Amtrak Station Program and Planning Guidelines*. May 2013.

Association of American Railroads. *National Rail Freight Infrastructure Capacity and Investment Study*. Prepared by Cambridge Systematics, Inc. September 2007.

BNSF. Customer Equipment Website. Retrieved July 9, 2015, from http://www.bnsf.com/customers/equipment.

BNSF. Existing Train Volumes in Skagit County. Provided by Rick Wagner to SCOG. September 2015.

Cambridge Systematics. *Technical Note 4b: Passenger Rail Ridership Forecasts*. August 2013.

Federal Railroad Administration, Office of Safety Analysis. Crossing Inventory and Accident Reports Website. Retrieved May 29 and June 01 2015 from http://safetydata.fra.dot.gov/officeofsafety/publicsite/crossing/crossing.aspx.

Pacific International Terminals, Inc.. P*roject Information Document: Gateway Pacific Terminal*. February 2011.

Washington Department of Ecology. *Washington State 2014 Marine and Rail Oil Transportation Study*. March 2014 .

WSDOT. Amtrak Cascades Train Equipment Website. Retrieved July 8, 2015 from www.wsdot.wa.gov/Rail/TrainEquipment.htm

WSDOT. Collision Reports. Provided by SCOG. Collected June 2015.

WSDOT. *Washington State Rail Plan 2013-2035*. Prepared by Cambridge Systematics, Inc. March 2014.

USDOT. ITS Costs Database. Intelligent Transportation Systems Webiste. Retrieved December 09, 2015 from http://www.itscosts.its.dot.gov/