City of Seattle

South Holgate Street Railroad Crossing Study Phase II

FINAL REPORT

Prepared for:

SDOT
Seattle Department of Transportation

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Executive Summary

PURPOSE OF THIS STUDY

This study re-evaluates the proposed consideration to close S Holgate Street between Occidental Avenue S and 3rd Avenue S in light of new information such as a final decision on the replacement of the Alaskan Way Viaduct and an emerging proposal from Amtrak to increase maintenance operations at its facility on both sides of S Holgate Street.

In addition, a key objective was to identify short and long-term capital improvements to enhance the safety and operational performance of S Holgate Street as it crosses the railroad tracks.

BACKGROUND

In 2003, the Washington State Department of Transportation (WSDOT) Rail Office commissioned a study to evaluate the traffic-related impacts of closing S Holgate Street between Occidental Avenue S and 3rd Avenue S as the street crosses the Burlington Northern Santa Fe (BNSF) railroad tracks. The results of this study indicated that the closure of S Holgate Street would eliminate vehicle delays due to trains and that the future levels of service in the SODO[1] area would operate adequately without S Holgate Street. The consultant hired by the WSDOT recommended that the City of Seattle permanently close S Holgate Street at the rail crossings.

After receiving comments from the affected agencies in 2005, the same WSDOT consultant re-evaluated the closure option and issued a new report, which, again, recommended that "S Holgate Street be closed as part of the Amtrak Pacific Northwest Maintenance Facility construction." This time the recommendation for closing S Holgate Street was tied to the proposed Amtrak maintenance facility construction. However, the report contained limited analysis or discussion about how the operations of the Amtrak facility would affect the duration of the train gate closures or traffic operations on S Holgate Street.

The Seattle Department of Transportation (SDOT) did not support the WSDOT consultant recommendation to close S Holgate Street and took the position that the S Holgate Street would remain open during construction of the Alaskan Way Viaduct replacement project, deferring any additional decision about the future status of S Holgate Street until a later date. In early 2009, the Washington State Legislature decided to fund a bored tunnel concept to replace the waterfront Alaskan Way Viaduct.

Since the release of the 2005 report, the City of Seattle, WSDOT, and other agencies have made several key decisions that would affect traffic in the SODO area, and bear upon the City's ultimate decision about S Holgate Street. The transportation facility improvements that are either under construction or being designed for construction at this time include:

- State Route 519 (SR 519) Phase II – This project will provide a westbound direct access off-ramp from Interstate 90 to S Atlantic Street, a S Royal Brougham Street grade-separated crossing of the railroad tracks, and the widening of the 1st Avenue South/South Atlantic Street intersection. While westbound access will be improved, additional traffic can be expected on Atlantic Street and 1st Avenue S, yet the project will improve AM level of service (LOS) at the intersection.

[1] The SODO Area in this study is defined with the area bounded by S. Jackson Street, I-5,

- South Spokane Street Viaduct Widening and 4th Avenue S and 1st Avenue S Ramps – This project will reduce congestion on the Viaduct and improve overall access, but is likely to attract additional traffic volumes to the SODO area.
- Sound Transit 2 (ST2)– There will be an increase in the number of Seattle to Tacoma "Sounder" commuter rail trains and more trips across South Holgate Street.
- Alaskan Way Viaduct Replacement – The bored tunnel under the Central Waterfront will not include direct access to the Seattle Downtown; therefore, there will be a greater reliance upon SODO arterials (such as Alaskan Way S, 1st Avenue S, and 4th Avenue S).

DATA GATHERING AND ANALYSIS

Fehr and Peers, the consultant to the City of Seattle on this project, and SDOT brought to bear an innovative tool for data-gathering and analysis: video monitoring of the railroad tracks which allowed the project team to collect data previously unrecorded.

Using an SDOT traffic camera, already located on 1st Avenue S and S Holgate Street, the consultant monitored the crossing for one entire week during the month of January 2009. Video surveillance enabled the project team to answers such questions as:

- When are the railroad gates down?
- For how long?
- For what reasons?
- Do closure times vary significantly depending upon time of day?
- How many pedestrians cross the tracks? (At a later time, direct observation focused on pedestrian traffic on a Seattle Mariner game day.)

CONCLUSIONS

- Unlike many commercial areas of the City, the SODO area does not have a traditional street grid network. In particular, the number of east-west arterials in this area is limited. A recent decision to construct a grade-separated structure over the railroad tracks on Royal Brougham Way S will further constrain the east-west traffic movements. In 2008, S Holgate Street carried about 12,000 vehicles per day. The closure of S Holgate Street would not shift this amount of traffic to just one street such as S Atlantic Street, but the impact of the street closure would be felt throughout the area.
- The video recording of the train crossings revealed that the train gates stop traffic movements about 20 percent of the day (about 12 minutes each hour). More than 50 percent of those gate closures are due to freight train operations. As Sound Transit's commuter rail, WSDOT's Amtrak *Cascades*, and intercity Amtrak passenger train services increase in the future, the frequency and duration of the train gate closures would increase, resulting in longer delays for vehicles. However, even if the gate closure time were to increase significantly, S Holgate Street would still provide significant access for the area.

- Prior studies did not assess the impacts of a possible closure upon pedestrians. As stated earlier, there are limited east-west street connections in SODO. Any closure of S Holgate would force pedestrians to walk considerable distances to either S Lander Street or S Atlantic Street. On the winter weekday during the video monitoring, 330 pedestrians crossed the tracks; on a baseball game day, between 5 and 7 PM, 426 people crossed the tracks. In addition, on a typical workday, Amtrak employees made 350 crossings of S Holgate.

- S Holgate Street primarily serves SODO businesses, industries, and the stadiums. In addition, S Holgate Street serves the people who live in the Beacon Hill neighborhood and travel to the waterfront or to the northwestern part of Seattle, such as Interbay or Ballard, for work, shopping or recreation. The closure of S Holgate Street would reduce accessibility for those people living on Beacon Hill and others east of I-5.

- As S Holgate Street is located 0.75 miles south of the King Street Train Station, the northbound passenger trains need to slow down as they pass the S Holgate Street crossing to come to a complete stop at the King Street Station, and similarly the southbound trains need to accelerate gradually after departing the train station. The closure of S Holgate Street would not help increase speeds of the passenger train operations.

A grade-separated overpass that carried all modes was considered, but preliminary analysis indicated that this was not a feasible option given its high estimated cost. The challenge presented by the overpass option is that there is not sufficient space to ramp up at a reasonable grade between Occidental Avenue S and the western railroad track, and to ramp down between the eastern track and 3rd Avenue S. A description and schematic design for the bridge structure necessary to achieve the needed clearances is provided later in the report.

While no reported collisions, involving trains, have taken place on the tracks, safety remains a chief concern of both SDOT and the railroad operators. These concerns can be addressed through the implementation of achievable and effective safety improvements which will be described in the next section of this report.

RECOMMENDATIONS

Based on the new information that this study assembled and our best forecast of the future conditions with the transportation improvement projects that were made recently, Fehr & Peers makes the following recommendations.

(1) The City of Seattle should not close S Holgate Street and should keep it open for vehicles and pedestrians except for the times when it is temporarily closed with lowered train gates. *However, if in the future (post-Viaduct replacement), conditions change significantly, such as a very major upturn in the number and duration of gate closures, the implementation of the S Lander Street Grade Separation Project or Amtrak's willingness to help fund a pedestrian and bicycle overpass over S Holgate Street, SDOT would consider revisiting the question of the long-term role of S Holgate Street*, and,

(2) The City and railroad operators should jointly implement the following safety enhancements as high priority capital improvement projects:

- Consolidate crossing gates. (Currently multiple gates are placed on S Holgate Street between Occidental Avenue S and 3rd Avenue S. The purpose of this action is to prevent vehicles from queuing up at one gate and extending back into the next gate.)
- Install quad-gates. (The quad-gates are designed to prevent a vehicle from going around the gate.)
- Complete gaps in the sidewalk system on S Holgate Street between 1st Avenue S and 4th Avenue S.
- Add crossing gates for pedestrians. (Include a pedestrian scaled gate to each quad-gate to prevent pedestrians from crossing the railroad tracks when a train is approaching.)
- Provide raised medians with a pedestrian refuge. Many railroad workers walk across S Holgate Street along the railroad tracks. (The raised medians would provide a space for them to wait for adequate breaks between vehicles on S Holgate Street, and, additionally, create conditions where they only need to cross half of the street at a time.)
- Add U-turn routes. (When drivers encounter a long train gate closure, they should be able to make a safe U-turn to choose an alternate route to cross the railroad tracks at a different cross street, such as S Lander Street or S Atlantic Street. The design of the median would need to accommodate a u-turn maneuver for all but the largest trucks.)
- Provide electronic message signs for drivers on area arterials to show when the train gates are down and provide an indication of how long the gates may be closed.

Chapter 1. Introduction

BACKGROUND

The S Holgate Railroad Street Crossing Study Phase II was initiated by the City of Seattle Department of Transportation (SDOT) with a grant from the Washington State Department of Transportation (WSDOT). This report summarizes the results of prior plans and studies, reviews the options that have been identified for the area, presents Fehr & Peers' updated analysis of baseline and future conditions, and provides recommendations.

The focus of this study is S Holgate Street between 1st Avenue S and 4th Avenue S in the SODO Area, which is located south of the core of Downtown Seattle. Between 1st and 4th Avenue S, S Holgate Street crosses a series of 13 mainline and spur railroad tracks owned by Burlington Northern Santa Fe Railroad (BNSF), and used by several railroad operators including BNSF, Amtrak, WSDOT and Sound Transit. S Holgate Street is a four-lane Minor Arterial street, designated as a Major Truck Street, and part of a network of major roadways that provide crucial routes for both freight and general transportation.

The SODO area contains the majority of the City's industrial land uses and associated industrial employment, but also contains some office, retail, and entertainment uses. Entertainment uses include two major sports stadiums–Qwest Field and Safeco Field. Major employers in SODO include Starbucks corporate headquarters, K2 Sports corporate headquarters, the McKinstry Company, Charlie's Produce, the United States Postal Service, the Port of Seattle, Tully's Coffee, and many more.

The area is also a freight hub, including the Port of Seattle's Terminals 25, 30 and 46 cargo facilities, and two rail yards—BNSF's Seattle International Gateway Rail Yard located west of Colorado Avenue, and Union Pacific's Argo Rail Yard, which cuts diagonally across the southern portion of SODO. As noted earlier, the BNSF mainline tracks run north-south through SODO between Occidental Avenue S and 3rd Avenue S.

Within the study area is a key transit hub – the King Street Station Area - where commuter rail, light rail, inter-city rail, and bus transit link to the surface street system through an interconnected series of stations and stops. Closer to S Holgate Street, two light rail stations serve SODO and the two sport stadiums.

The picture on the next page identifies S Holgate Street, the street system, railroad tracks, and Link light rail stations in the SODO Area.

The aerial identifies street system, LRT stations and railroad tracks in the study area.

Source: Fehr & Peers (2009), map courtesy of Google Earth

STUDY PURPOSE

In 2006, Fehr & Peers (as Mirai Associates) concluded its work on Phase I of the S Holgate Street Railroad Crossing Study and forwarded the following recommendations to the Seattle Department of Transportation (SDOT):

- S Holgate Street and Royal Brougham Way should remain open for traffic through the completion of the Alaskan Way Viaduct and Seawall Replacement Project (currently anticipated to be completed in 2018.)
- Identify near-term improvements to increase vehicle, pedestrian, bicycle and railroad safety.
- Continue to develop alternatives for long-term multi-modal improvements.

In 2007, WSDOT provided funds for SDOT to perform additional analyses of future conditions on S Holgate Street and to formulate actions for the City to undertake. The purpose of the Phase II study is stated as follows:

"To identify and prioritize key short-term (2015) and long-term (2030) transportation needs and improvements in the study area related to the railroad lines across S Holgate Street."

Since the release of the 2005 report, the City of Seattle, WSDOT, and other agencies have made several key decisions that would affect traffic in the SODO area, and bear upon the City's ultimate decision about S Holgate Street. The transportation facility improvements that are either under construction or being designed for construction at this time include:

- State Route (SR 519) Phase II. – This project will provide a westbound direct access off-ramp from Interstate 90 to S Atlantic Street, a S Royal Brougham Street grade-separated crossing of the railroad tracks, and the widening of the 1st Avenue South/South Atlantic Street intersection. While westbound access will be improved, additional traffic can be expected on Atlantic Street and 1st Avenue S.
- South Spokane Street Viaduct Widening and 4th Avenue S and 1st Avenue S Ramps. – This project will reduce congestion on the Viaduct and improve overall access, but is likely to attract additional traffic volumes to the SODO area.
- Sound Transit ST2 Plan. – There will be an increase in the number of Seattle to Tacoma "Sounder" commuter rail trips across South Holgate Street.
- Alaskan Way Viaduct Replacement. – The bored tunnel under the Central Waterfront will not include direct access to the Seattle Downtown; therefore, there will be a greater reliance upon SODO arterials such as Alaskan Way S, 1st Avenue S, and 4th Avenue S.)

In May, 2009, the Washington State legislature authorized WSDOT to construct a deep bored tunnel to replace the Alaskan Way Viaduct. According to the current schedule, the bored tunnel will be completed by 2016 and surface street improvements along the waterfront will likely be completed in 2017 or 2018.

"Therefore, the focus of this study is to formulate the City's possible actions after 2018."

Chapter 2. Prior Plans, Studies and Analyses

ACCESS DUWAMISH

In 1998, the City and Port of Seattle commissioned a partnership project to address access and congestion problems in the North Duwamish area. The project summary report, entitled *Access Duwamish* (June 2000), identified S Holgate Street as a truck route and recommended several key capital improvements to improve freight mobility and access, including SR 519 improvements, Spokane Street Viaduct widening, E Marginal Way/SR 99 ramps and the S Lander Street overcrossing projects. The report concluded that S Holgate Street was not a desirable location for a grade-separated overcrossing because of the engineering challenges involved.

S HOLGATE STREET RAILWAY CROSSING CLOSURE TRAFFIC STUDY (2003)

WSDOT commissioned a study in 2003 to evaluate the traffic-related impacts of closing S Holgate across the railroad tracks. The study analyzed the traffic impacts of the S Holgate Street closure during the AM and PM peak hours on the intersections in the vicinity of S Holgate Street. It concluded that with the closure, these intersections would continue to operate at an acceptable LOS and the potential for train-related collisions on S Holgate Street area would be eliminated. The study recommended that S Holgate Street be fully and permanently closed.

SDOT RESPONSES TO THE WSDOT STUDY CITED ABOVE

In 2004, SDOT made many comments on the 2003 S Holgate Street Railway Closure Traffic Study to WSDOT, some of which are listed below:

- S Holgate Street is an important route in the industrial district. Besides providing connections between heavily used north-south arterials, S Holgate Street provides a direct connection to Beacon Avenue S and the Beacon Hill neighborhood.
- S Holgate Street is a significant east-west freight route through the industrial district. The closure of S Holgate Street could severely impair freight operations.
- The analysis was incomplete because it did not recognize the traffic demand variations in the area for ferry operations and cruise ship traffic, and special events such as baseball and football games.
- The analysis for pedestrians and bike riders was insufficient.
- The City also expressed concerns about traffic impacts of the closure of S Holgate Street on the industrial area during the replacement for Alaskan Way Viaduct.

S HOLGATE STREET RAILWAY CROSSING CLOSURE TRAFFIC IMPACT ANALYSIS (2005)

To respond to the comments received from SDOT, (along with Sound Transit, King County Metro, and the Northwest Region of the Washington State Department of Transportation), the WSDOT Rail Office initiated the *S Holgate Street Railway Crossing Closure Traffic Impact Analysis* study to investigate the short- and long-term traffic impacts that could be caused by the closure of S Holgate Street. The report was issued in January 2005. This study also recommended that S Holgate Street should be closed to traffic at the railroad crossing based on the following reasons:

- The capacity of S Holgate Street would be significantly reduced with additional train traffic, such that vehicles would seek alternative routings with or without the closure.
- Extensive queuing resulting from crossing closures could impact traffic flow at other intersections.
- Anticipated expansion of the track area would make it difficult to control vehicle and pedestrian traffic.

S HOLGATE STREET RAILWAY CROSSING CLOSURE TRAFFIC IMPACT ANALYSIS – ADDENDUM NO. 1

WSDOT issued an addendum report in May 2005 to address the issues raised by City of Seattle staff on the initial report. The SDOT staff had expressed concerns that the 2005 report did not fully address all the comments that the SDOT staff had previously raised. The Addendum report included the following responses:

- Traffic volumes used in the initial report: SDOT staff had indicated that the traffic volumes used in the 2005 report appeared too low – the Addendum concluded that these volumes were accurate.
- Adjustments to the ferry traffic volumes – the Addendum stated that the closure of S Holgate Street would not have a measureable impact on ferry traffic.
- Cruise ship traffic – The Addendum concluded that traffic for cruise ships occurs on weekends and would not impact the weekday peak hour traffic. This report maintained a focus on the PM peak hour as the time period to evaluate the impact of the S Holgate Street closure.
- A comparison of the traffic forecast for the 2030 Alaskan Way Viaduct with the forecast for the S Holgate Closure Study concluded that the 2030 volumes from both studies were comparable. The Addendum did not address the City's comment regarding the construction traffic related to the Alaskan Way Viaduct replacement.
- Special events – the Addendum acknowledged that the closure of S Holgate Street would eliminate a major east-west crossing of the railroad during special events.

TRAFFIC IMPACT ANALYSIS ON S HOLGATE STREET AND S ROYAL BROUGHAM WAY CLOSURES

In 2005, SDOT asked Fehr & Peers (then Mirai Associates) to analyze the traffic impacts from closing S Holgate and other streets - focusing on the PM peak hour, event peak hour (Mariners ballgame on a weekday) and Alaskan Way Viaduct construction. This study recommended the following:

- S Holgate Street and Royal Brougham Way should remain open for traffic through the duration of the Alaskan Way Viaduct and Seawall Replacement Project.
- Identify near-term improvements that would increase railroad and traffic safety, and efficiency.
- Continue to develop alternatives for long-term improvements.

RELEVANT LARGE-SCALE CAPITAL PROJECTS

PREFERRED SR 519 PHASE II OPTION

In 2004, WSDOT completed Phase I of the SR 519 project consisting of a S Atlantic Street railroad overpass and a new eastbound on-ramp from S Atlantic Street to I-5 and I-90. The original plan, envisioned in 1997, was to have two parallel overpasses above the railroad tracks with the eastbound crossing on S Atlantic Street and the westbound crossing on S Royal Brougham Way. However, with the opening of Safeco Field in 1999 and Qwest Field in 2002, the affected agencies and Stadium District decided that the original SR 519 plan would required modification. In 2006, WSDOT, the City of Seattle and Port of Seattle announced the preferred SR 519 Phase II option, which included:

- New westbound off-ramp to S Atlantic Street from I-90.
- New S Royal Brougham Way railroad overpass connecting 3rd Avenue S to Occidental Avenue S along with a two-lane elevated arterial with bicycle lanes and an elevated pedestrian walkway.
- Improvements to the intersection of S Atlantic Street, east of 1st Avenue S.

Appendix F provides a sketch of the SR 519 phase II and a more detailed project description.

ALASKAN WAY VIADUCT

In early 2009, Washington Governor Chris Gregoire, King County Executive Ron Sims and Seattle Mayor Greg Nickels recommended that the Alaskan Way Viaduct along Seattle's Central Waterfront be replaced with a bored tunnel through downtown Seattle. The recommendation also included a new waterfront surface street, transit investments, and downtown waterfront and city street improvements. The 2009 state legislature approved funding to construct the state share of the Alaskan Way Viaduct project. According to the current schedule, the environmental review and preliminary design will be completed by the end of 2010 of 2nd quarter, 2011 and the construction of the tunnel by the end of 2016. The surface Alaskan Way improvements and waterfront promenade construction are anticipated to be completed in 2018.

As noted earlier, based on recommendations made to SDOT by Fehr & Peers (then Mirai Associates), SDOT advised Amtrak and WSDOT that S Holgate Street would not be closed for traffic operations while the Alaskan Way Viaduct was under construction. SDOT indicated that an additional study would be needed to evaluate whether it would be closed after the Alaskan Way Viaduct project was completed.

LONG-RANGE FACILITY IMPROVEMENT PLANS

BURLINGTON NORTHERN SANTA FE RAILROAD (BNSF)

BNSF staff indicated that they did not have a long-range facility plan given the market-driven nature of their business model. BNSF owns the tracks that are used by Amtrak, WSDOT and Sound Transit. For the freight operations, the national and local economies influence the length of each train and the frequency of the freight trains. BNSF has stated that it would be difficult to forecast the duration of time or frequencies of the train gate closures on S Holgate Street.

SOUND TRANSIT

On November 4, 2008, voters of the Central Puget Sound region approved the Sound Transit 2 (ST2) Plan. Through the ST2 Plan, Sound Transit will expand the commuter rail (Sounder) service and increase capacity by adding trains and expanding the length of the trains. Four round trips will be added to the segment between Tacoma and Downtown Seattle; adding to the eight round trips that are provided today. The ST2 Plan includes funds for constructing and operating a commuter rail yard and shop facility to support the level of service for Sounder trains at full operational capacity.

WSDOT AMTRAK CASCADES

The Washington State Department of Transportation (WSDOT) initiated an intercity passenger rail service called *Amtrak Cascades* in 1993. In the following year, WSDOT leased a Spanish-built Talgo train and provided two round trips between Seattle and Portland. Currently, Amtrak Cascades includes four round trips between Seattle and Portland, two of which serve Eugene, and three round trips between Seattle and Bellingham, one of which extends to Vancouver, BC.

A 2006 report entitled the *Long-Range Plan for Amtrak Cascades* indicated that by 2023, the goal is to provide 13 round trips between Seattle and Portland, and 4 round trips between Seattle and Vancouver BC. The current maximum authorized train speed is 79 miles per hour along the entire corridor. This plan assumed that the maximum train speeds would increase up to 110 miles per hour, reducing the travel time between Seattle and Portland by one hour. It also assumed that the reduced travel times would attract more riders. The plan projects that by 2023 ridership would increase by 2.5 million to about 3 million riders in the Vancouver-Seattle-Portland corridor.

AMTRAK MAINTENANCE FACILITY

A new Amtrak maintenance facility has been planned for the area from near Safeco Field to both sides of S Holgate Street. Construction is being undertaken in phases. Phase I, completed in 2002, included a rail car washer and a wheel maintenance building. Phase II, completed in 2008, relocated the mainline tracks to the east along 3rd Avenue NE. The final two phases are as of yet unfunded and include a primary maintenance and repair site on both sides of S Holgate Street for Amtrak and Sounder commuter rail. In fact, Amtrak is

considering a consolidation of much of its entire West Coast maintenance operations at this new facility.

Amtrak's consistent position has been that a full closure of S Holgate Street would achieve the following:

- Increase safety for its employees currently crossing S Holgate Street to get from one end of the maintenance facility to the other.
- Eliminate opportunity for collisions between trains and vehicles, pedestrians, and bicyclists crossing the tracks.
- Improve the overall efficiency of maintenance operations, now and in the future.
- Enable Amtrak to more fully secure its facilities and reduce the threat from vandalism, theft and terrorism.

An artist's rendering of the maintenance facility in the King Street Station area.

Source: Washington State Long-Range Plan for Amtrak Cascades, WSDOT, February 2006.

Chapter 3. S Holgate Railroad Crossing Survey Analysis and Results

In 2008, SDOT asked Fehr & Peers to identify and prioritize key short-term (2015) and long-term (2030) transportation needs and improvements in the study area related to the railroad lines across S Holgate Street. The S Holgate Railroad Crossing Study Phase II was initiated. The Phase II study area is identical to the Phase I study and is generally referred to as the South Downtown (SODO) area, which is bounded by Jackson Street in the north, I-5 in the east, S Spokane Street in the south, and Elliott Bay in the west. The study area is shown in **Figure 1**.

This chapter summarizes technical analyses that provide answers to the following questions:

1. Have the daily train volumes increased over the last several years?
2. What is the duration of time that the train gates are down on S Holgate Street?
3. Do the train gate closures vary by time of day?
4. How many pedestrians and bicycle use S Holgate Street crossing the railroad tracks?
5. The train operators are responsible for what percentage of the gate closures?

HISTORICAL MAINLINE TRAIN VOLUMES

BNSF staff provided historical mainline train volume data at the S Holgate railroad crossing. The data included freight train and passenger train volumes per day. The passenger train volumes included Sound Transit commuter rail and those operated by Amtrak. It appears that the freight volumes peaked in 2005 and 2006 and decreased in 2007 and 2008, while the passenger train volumes increased from 12 per day in 2004 to 18 per day in 2008 as shown in **Table 1**.

Table 1. Daily Mainline Train Counts for Freight and Passenger Services

Daily Mainline Train Counts			
	Freight	Passenger	Total
2004	43	12	55
2005	51	12	63
2006	51	15	66
2007	43	16	59
2008	42	18	60 (67*)

* This number was provided for December 2008

Source: BNSF

Figure 1. S Holgate Street Railroad Crossing Study Area

FEHR & PEERS
TRANSPORTATION CONSULTANTS
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STUDY AREA
FIGURE 1

COMPARISON OF ACTUAL MAINLINE TRAIN VOLUMES WITH PRIOR STUDY FORECASTS

The previous studies commissioned by WSDOT forecast increases in train volumes. It appears that the WSDOT forecasts were for freight and passenger trains using the mainline tracks. **Table 2** compares the actual mainline train volumes provided by BNSF with the forecast in the WSDOT report issued in 2005.

The WSDOT report indicated that 65 trains per day crossed S Holgate Street in 2004. However, BNSF recorded that the actual average train volume was 55 for that year, a difference of 10 trains. The WSDOT forecast of train volumes for 2007 and 2027 show a significant increase: 115 trains in 2007 and 234 trains in 2027. BNSF data showed that from 2004 to 2007, there was only an increase of 4 trains while the WSDOT study forecast an increase of 50 trains in the same 3-year period.

In addition to BNSF, we contacted Amtrak and Sound Transit to obtain future train volume forecasts. Neither agency could provide the long-term train volume forecasts that are comparable to the WSDOT 2027 forecast[2].

Table 2. Comparison of Mainline Train Volumes per Day

	Mainline Train Volumes Per Day	
	WSDOT Report	Actual (BNSF)
2004	65	55
2007	115 (Forecast)	59
2008		60
2027	234 (Forecast)	

Source: WSDOT and BNSF

COMPARISON OF CLOSURE TIMES FORECAST BY WSDOT

The 2005 WSDOT funded studies indicated that the average train gate closure time in 2004 ranged 8.1 to 8.8 minutes per hour, as shown in **Table 3**[3]. In 2009, Fehr and Peers, with the assistance of SDOT Traffic Management staff, continuously video-taped the train movements and gate closures for a week in January. Table 3 also shows the 2009 weekday actual gate closure times based on the video recordings.

The WSDOT report showed the forecast for the gate closure time on S Holgate Street for 2007 and 2027. The forecasts showed that in 2007 the gate would be closed for 23 to 24 minutes during the AM and PM peak hours, and for 12 minutes during the off peak hours.

However, the 2009 video survey showed that the actual AM and PM peak hour closure times were 11 to 12 minutes, or *half* of the earlier WSDOT forecast for 2007. Note that the prior off-peak hour forecast for 2007 is almost same as the 2009 actual. This table appears to show that the prior forecasts for 2007 assumed much higher train volumes for AM and PM peak

[2] We could not find any description that shows how the 2007 and 2027 WSDOT forecasts were developed.

[3] The WSDOT report failed to explain how the gate closure times were obtained.

hours than actually occurred. The earlier report does not provide information about how those forecasts were prepared and what assumptions were used. Therefore, it is not possible to assess whether the 2027 forecasts were fully valid or accurate. For example, the 2007 forecasts for AM and PM peak hour train gate closure times deviate 100 percent from the 2009 actual closure times as demonstrated by the video monitoring.

Table 3. Hourly and Average Train Gate Closure Times (Actual, 2004 and 2009 Data and 2007 and 2027 Forecasts)

	WSDOT Report			2009 Weekday Actual
	2004	2007 Forecast	2027 Forecast	
AM Peak Hour	8.2 min	24 min	46 min	11.9 min
PM Peak Hour	8.1 min	23 min	42 min	11.1 min
Off Peak Hour	8.8 min	12 min	20 min	12.5 min

Source: WSDOT (2004, 2007, and 2021) and Fehr & Peers (2009)

PEDESTRIANS AND BICYCLISTS CROSSING RAILROAD TRACKS (EAST-WEST)

The City of Seattle has a traffic camera located in the vicinity of the 1st Avenue S and S Holgate Street intersection. As we described earlier, the City video recorded the railroad crossing of S Holgate Street on a video for a week in January 2009. Specifically, on January 15, 2009, we counted pedestrians and bicycle riders who crossed the railroad tracks for the 24-hour period. We combined the pedestrian and bike counts for each hour and plotted the hourly volumes in **Figure 2**. Based on the video, pedestrians were present from the early morning to the late night hours. The pedestrian volumes peaked three times: 8 to 9 AM in the morning, 1 to 2 PM in the midday and 4 to 5 PM in the evening. About 50 people during the 4 to 5 PM period walked on S Holgate Street and crossed the railroad tracks. During the day, a total of 330 pedestrians and 50 bicyclists walked/rode on S Holgate Street and crossed the railroad tracks. Anecdotal evidence suggested these were area employees, bus riders seeking transfers, and patients from a nearby outpatient medical clinic.

PEDESTRIANS CROSSING S. HOLGATE STREET (NORTH-SOUTH)

In addition to the pedestrians and bikes traveling on S Holgate Street, about 350 other people crossed S Holgate Street along the railroad tracks in the north-south direction. They appeared to be the railroad workers. The hourly volumes of pedestrians crossing in the S Holgate Street area are shown in **Figure 3**. This pattern of pedestrians crossing S Holgate Street is quite different from the pedestrians walking along S Holgate Street and crossing the railroad tracks, in that there was one clearly defined peak hour from 2 to 3 PM.

Figure 2. Pedestrians and Bicyclists on S Holgate Crossing the Railroad Tracks (East-West Movements)

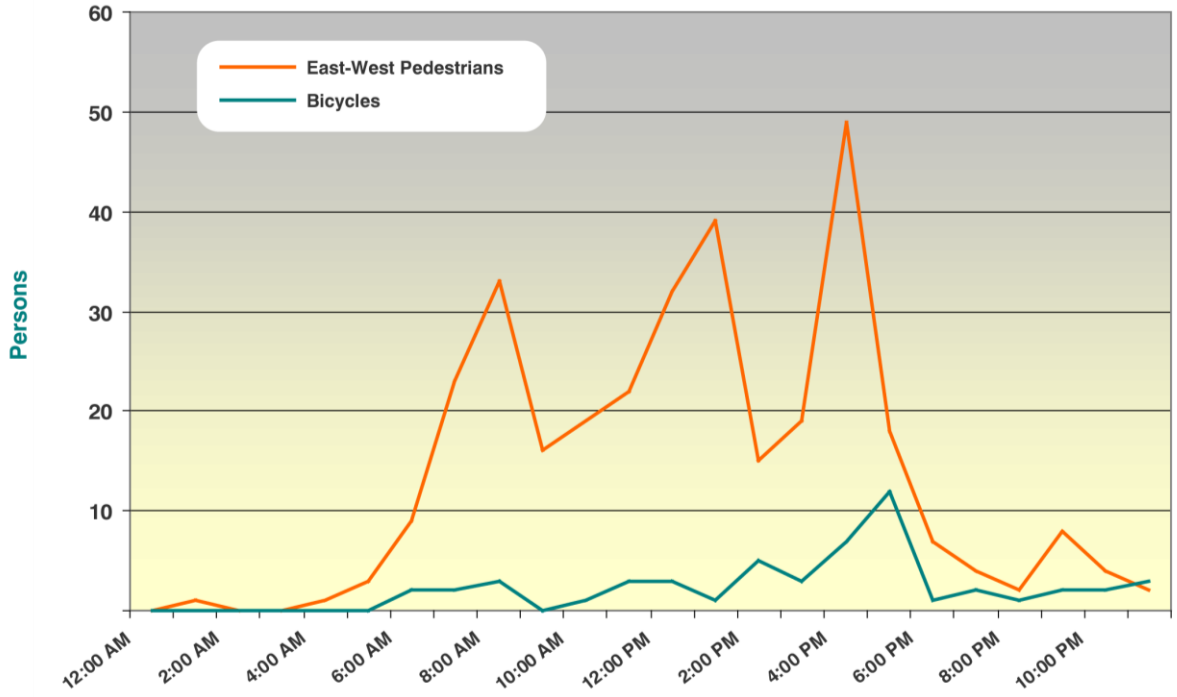
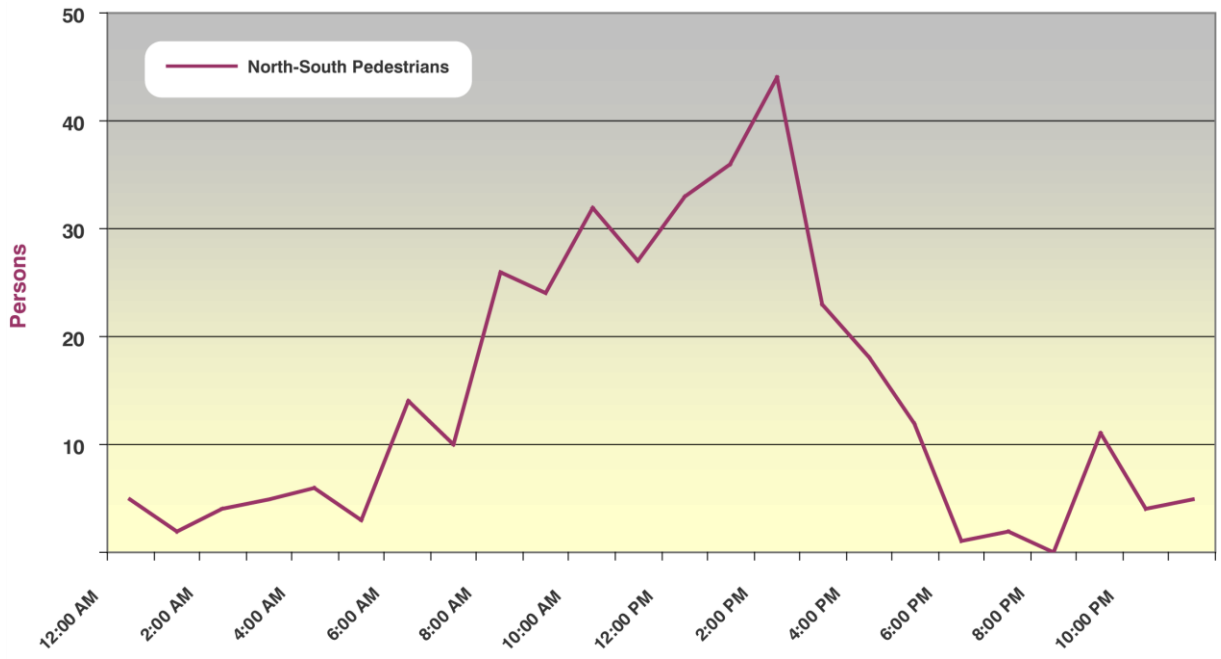


Figure 3. Pedestrians Crossing S Holgate Street (North-South Movements)



Source Figures 3 and 4: Fehr & Peers (2009)

SIDEWALK CONDITIONS

The aerial photo (**Figure 4)** shows the roadway and sidewalks along S Holgate Street between 1st Avenue S and 4th Avenue S, and the new mainline train track crossings near 3rd Avenue S. Sidewalks are provided on S Holgate Street between 3rd and 4th Avenues S, and between 1st Avenue S and Occidental Avenue S, as well as a short section on the north side where the old mainline train tracks cross S Holgate Street. There is no sidewalk on the south side between Occidental Avenue S and 3rd Avenue S where pedestrians walk either on the edge of the pavement or on the roadway surface.

Figure 4. Sidewalks on S Holgate Street between 1st Avenue South and 4th Avenue South

Source: Fehr & Peers

AVERAGE TIME PER GATE CLOSURE

As described earlier, SDOT recorded the traffic and train movements at the S Holgate Street railroad crossing for a week, from January 12 to 19, 2009. We found that the railroad gates on S Holgate Street closed an average of 112 times per day during the weekdays and 79 times during the weekends. During the weekday, the total time that the gates were closed to stop traffic was 4 hours and 50 minutes per day, about 20 percent of 24 hours. During the weekend, the gates were closed for 3 hours and 25 minutes, about 14 percent of the day.

Figure 5 summarizes of the average minutes per gate closure during the weekday. The average time per gate closure was 2.5 minutes. The figure also shows the average closure time per gate closure by five time periods: AM peak period, midday period, PM peak period, evening period and night periods. We found that in the evening and night periods the average time of each gate closure was longer, about 3 to 3.5 minutes.

AVERAGE TIME OF GATE CLOSURE PER HOUR

For weekdays, the average minutes per hour the gate was closed was 12 minutes as shown in **Figure 6**. The average closure time per hour during the evening period (6 to 10 PM) was 17 minutes, significantly higher than the 24-hour average, and the night AM (12 to 6 AM) period was about 7 minutes, lower than the daily average. Throughout the AM peak, midday and PM peak periods, the average gate closed time per hour was relatively constant - 11 to 12 minutes per hour. It should be noted that we observed several times during the recorded week when the gate was closed for more than 30 minutes.

Figure 5. Average Time of Each Railroad Gate Closure (Weekday)

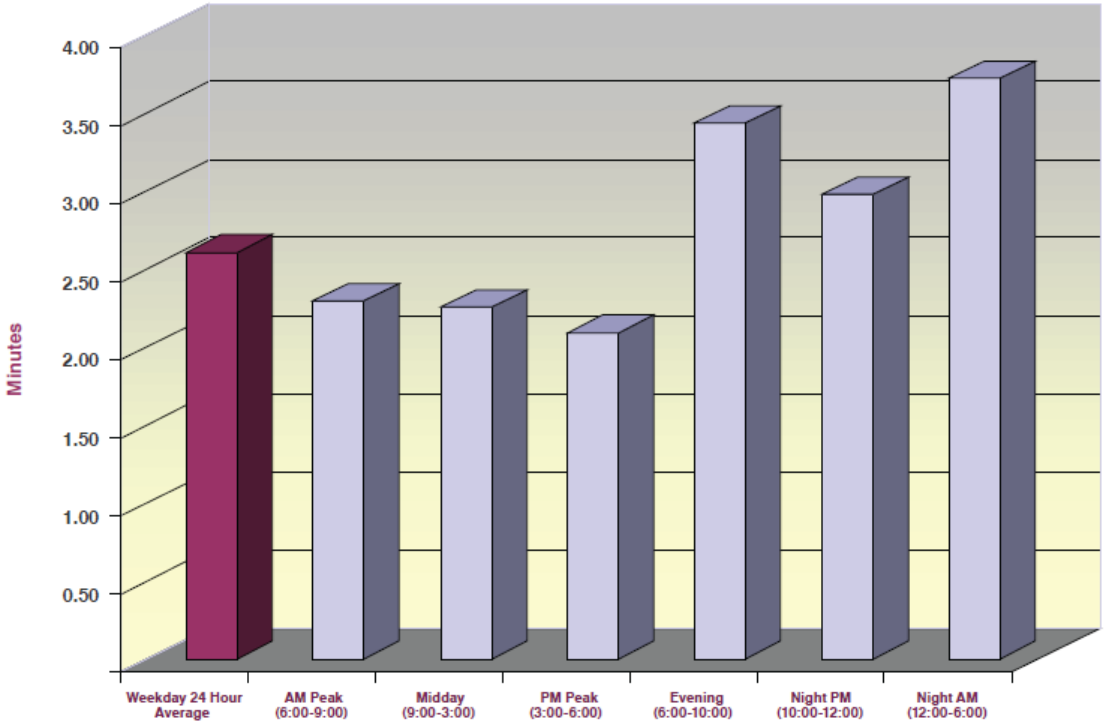
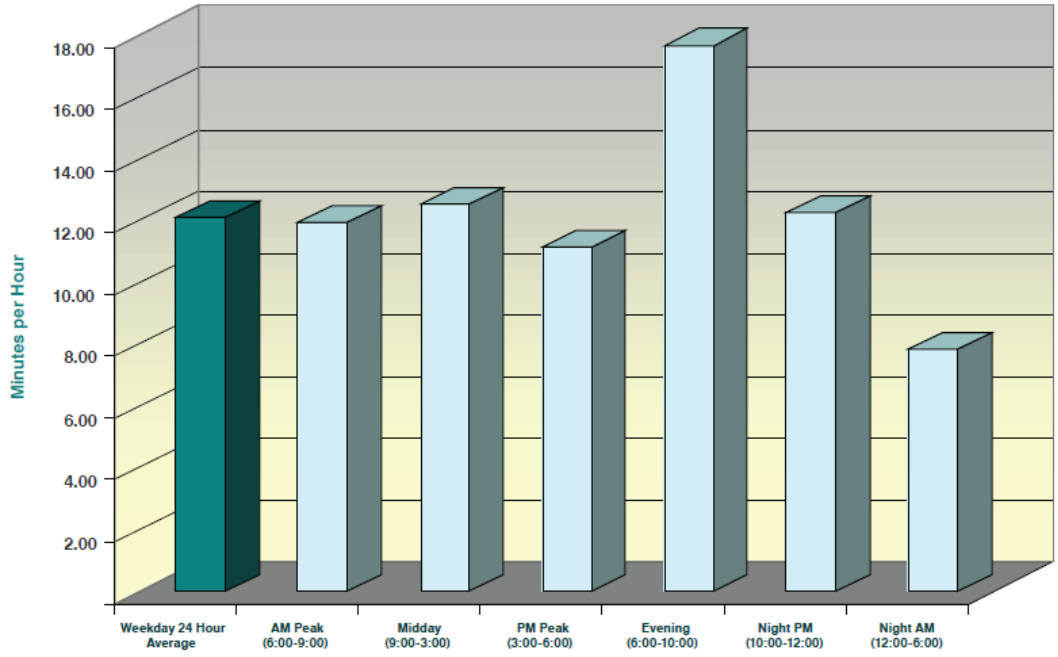


Figure 6. Average Time of Gate Closure in Minutes per Hour



Source for Figures 5 and 6: Fehr & Peers (2009)

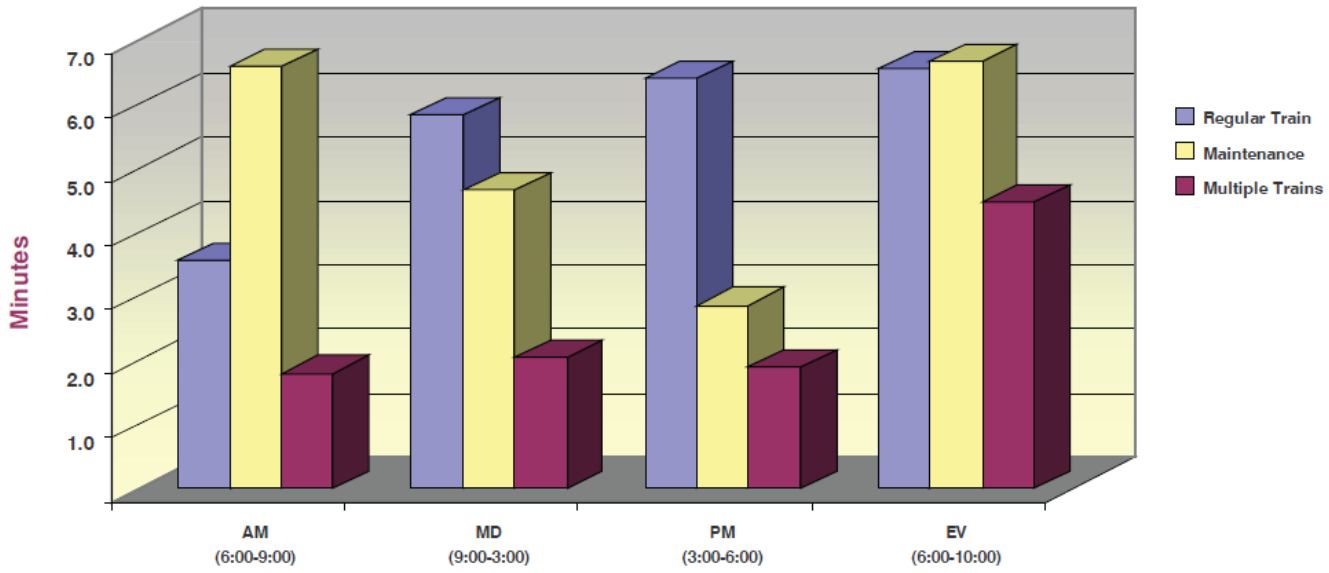
TIME OF GATE CLOSURES BY TYPE OF TRAIN OPERATION

When Fehr & Peers observed a gate closure and a train crossing S Holgate Street a judgment was made about the type of the train; in terms of the train being either a "regular train" (i.e. train moving quickly across S Holgate Street) or a "maintenance train" (i.e. train moving slowly often back and forth). The regular trains appeared to be long-haul trains and used the mainline tracks. We employed the label "maintenance train" if we saw a 1 to 3 car freight train or an engine only; a train involved in what appeared to be switching activities or lowered gates without train crossings. Finally, "multiple trains" is our term for two sets of trains crossing S Holgate Street simultaneously.

Figure 7 shows the train gate closure time in minutes per hour separated by the type of the train operations: regular train, maintenance train, or multiple trains for the four time periods. During the AM peak period, the majority of the gate closure time is caused by maintenance trains. The condition is reversed in the PM peak period when regular train activities closed the gate for longer periods than the maintenance train activities.

On an average weekday, 51 percent of the gate closure time was caused by regular train operations, 38 percent by maintenance operations, and 11 percent by multiple trains. In summary, more than one-third of the gate closure time occurs because of maintenance operations. This is a significant finding because the previous studies did not discuss gate closures caused by the maintenance train operations.

Figure 7. Time of Gate Closures by Type of Train Operation



Source: Fehr & Peers (2009)

TIME AND PERCENT OF GATE CLOSURES BY TRAIN OPERATOR

Using the video recording, Fehr & Peers identified the operators of the trains when the gates came down - Amtrak, Sound Transit Sounder, or BNSF. We assumed that all freight trains were operated by BNSF. In some cases, multiple trains crossed S Holgate Street at the same time and we could not single out one operator, so we labeled this situation as "Multiple Trains". Also, there were cases when the gates moved down and up without a train passing by. In this case, we labeled it as "No Train". **Table 4** shows the total time and percent of gates that are closed by train operator during the 24-hours on Thursday, January 15, 2009. About 59 percent of the gate closure time was due to the freight trains operated by BNSF. Amtrak passenger trains, including the trains funded by WSDOT, were responsible for about 14 percent of the closure time; and Sounder commuter rail trains were responsible for 16 percent of the total closure time. Please note that the gate closure time included all train operational activities, such as, mainline movements that included scheduled passenger services, switching, and any other maintenance activities that used other tracks than the mainlines.

Table 4. Gate Closure Times by Train Operators During Average Weekday

Train Operator	Time of Gates Closed for Traffic (hour: min)	Percent of Time Gates Closed for Traffic
Amtrak	0:42	14.3%
Sound Transit (Sounder)	0:48	16.4%
BNSF (Freight)	2:52	58.7%
Multiple Trains	0:20	6.8%
No Train	0:11	3.9%
Total	4:53	100.00%
Note: Trains were observed Thursday January 15, 2009		

Source: Fehr & Peers

Chapter 4. Existing and Future Traffic Analysis

This chapter reviews the existing traffic conditions and summarizes the future traffic conditions with and without S Holgate Street. Some of the questions that are addressed in this chapter are:

- Did the traffic volumes on S Holgate Street increase over the last several years?
- Does S Holgate Street carry a large number of trucks?
- Would there be significant changes to traffic volumes on S Holgate Street on a baseball game day?
- What would intersection levels of service be in 2015 and 2030 with or without S Holgate Street?

DAILY TRAFFIC VOLUMES

The City of Seattle regularly collects daily traffic counts on arterial streets city-wide. When Fehr & Peers (Mirai Associates) conducted the Phase I study, we conducted extensive AM and PM peak period traffic counts. The Phase I study created a composite daily traffic count map showing 2005 to 2006 conditions using available daily traffic count data, which is shown in **Figure 8**. Both 1st Avenue S and 4th Avenue S are major arterials, each carrying over 20,000 vehicles per day in the vicinity of S Holgate Street. S Holgate Street itself carried 8,700 vehicles per day in 2005 to 2006.

[Note that S Holgate Street currently carries over 12,000 vehicles per day (SDOT, 2008). This change will be discussed at the next section, the Daily Traffic Volume Trend.]

Figure 8. Daily Traffic Volumes in 2005 – 2006

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AVERAGE WEEKDAY VOLUMES - 2005/2006 CONDITIONS
FIGURE 8

DAILY TRAFFIC VOLUME TRENDS

Based on the traffic counts provided by SDOT, the daily traffic volumes from 2000 to 2008 at three locations were plotted. These locations are:

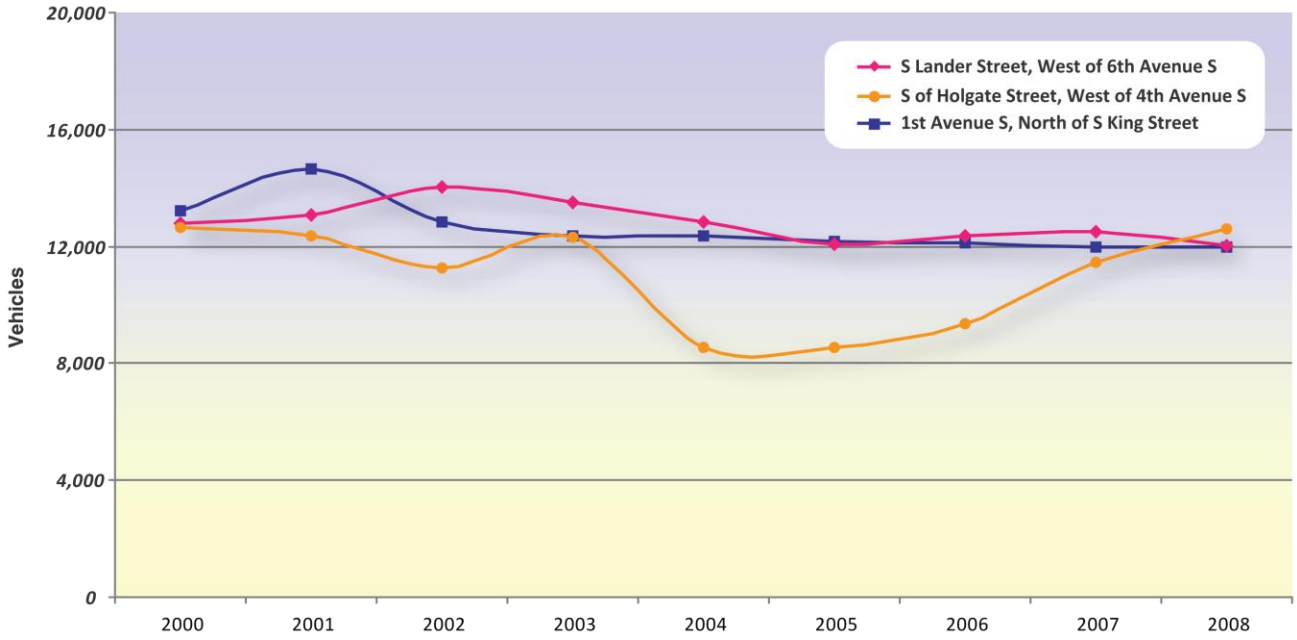
- S Holgate Street west of 4th Avenue S
- S Lander Street west of 6th Avenue S
- 1st Avenue S north of S King Street (This location is just north of the study area.)

Figure 9 shows the daily traffic volume change trends. In 2000, the traffic volume on S Holgate Street was about 12,000 vehicles per day (vpd). The volumes declined significantly from 2003 to 2004, to about 8,000 vpd. Since 2005, the S Holgate Street traffic volumes have gradually increased reaching the 2000 level in 2008, which was about 12,000 vpd.

S Lander Street has been carrying the same amount of traffic since 2002, about 12,000 vehicles per day. The traffic volumes on 1st Avenue S north of King Street have declined from 2002 to 2004. However, these volumes have has been steady since 2005 with about 12,000 vehicles per day.

It is difficult to find the exact cause of the traffic volume decline in 2004. The most reasonable explanation is that about 20 to 25 percent of the traffic on S Holgate Street shifted to S Atlantic Street when the SR 519 Phase I project was completed. Over the last few years as S Atlantic Street got more congested, the shifted traffic moved back to S Holgate Street.

Figure 9. Daily Traffic Volume Trends on S Lander Street, S Holgate Street and 1st Avenue S (2000 to 2008)

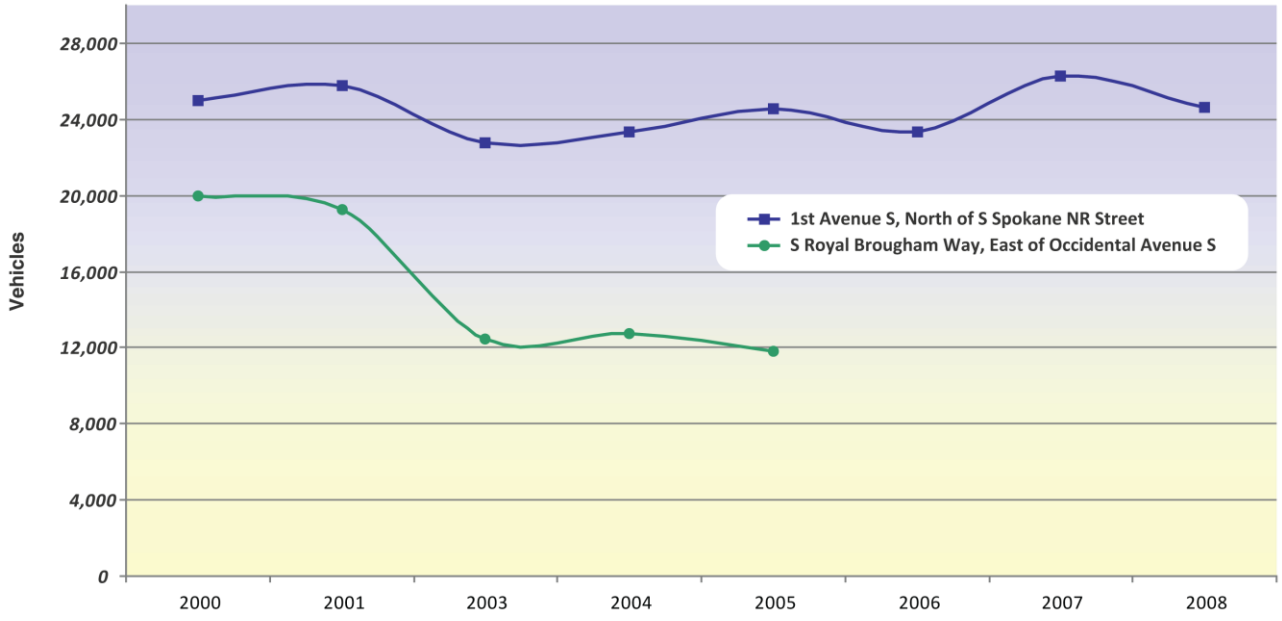


Source: SDOT

The historical daily volumes of S Royal Brougham Way east of Occidental Avenue S and 1st Avenue S north of S Spokane Street were also plotted, however, the counts on S Royal Brougham Way are available from only 2000 to 2005. As shown in **Figure 10**, traffic volumes on S Royal Brougham Way dropped significantly from 2001 to 2003, and remained at the 2003 level until 2005. Although it is not clear why this change occurred, it may be related to a shift of traffic to S Atlantic Street due to the new elevated structure over the railroad tracks and the opening of 4th Avenue S.

The traffic volumes on 1st Avenue S in the vicinity of Spokane Street have fluctuated between 23,000 to 26,000 vehicles per day during the last 8 years. However, no significant traffic volume increases have occurred during this time.

Figure 10. Daily Traffic Volumes on S Royal Brougham Way and 1st Avenue S (2000 to 2008)



Source: SDOT

TRUCK VOLUMES ON S HOLGATE STREET

The type of the vehicles traveling on S Holgate Street in 2005 is shown in **Table 5**. About 2 percent of the total vehicles that used S Holgate Street were heavy trucks, which we have defined as vehicles with multiple units and some single unit vehicles with three or more axels. Light trucks comprised about 21 percent of the total.

We also plotted hourly volumes showing light trucks and heavy trucks separated from all other vehicles in **Figure 11**. The overall PM peak hour occurs between 3 and 4 PM. However, the peak hour for truck traffic is in late morning between 11 AM and 12 PM. **Table 5** demonstrates that S Holgate Street is an important roadway for a significant volume of commercial vehicles.

Table 5. Daily Truck Volumes on S Holgate Street by Type of Vehicle (2008)

Vehicle Type	Volumes per Day	Percent
Trucks*	250	2.10%
Light Trucks**	2,500	21.10%
Passenger Cars	7,800	65.30%
Others***	1,400	11.50%
Total	11,950	100.00%

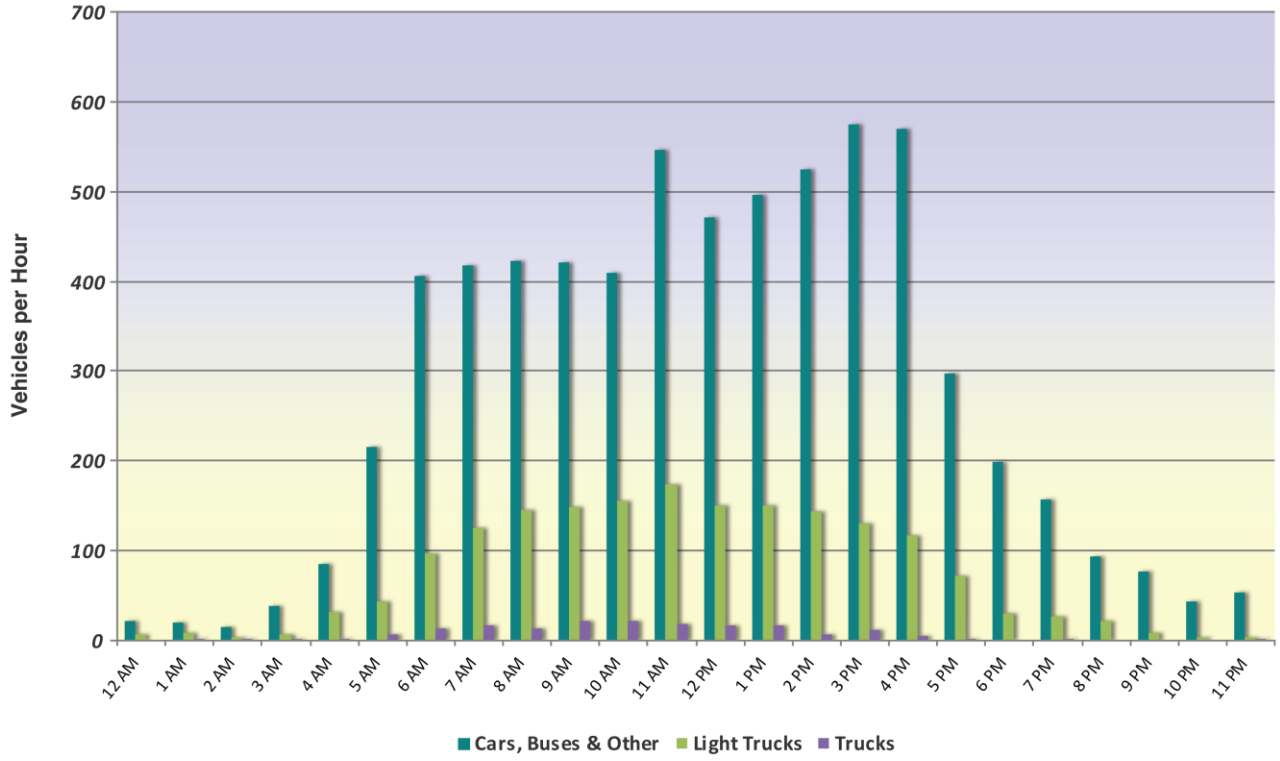
* Trucks are understood to be multiple unit vehicles (trailer trucks) and single-unit vehicles with 3 and 4 axels.

** Light Trucks are single unit, two-axle trucks with four or six tires.

*** Others include buses, motor cycles and vehicles that could not be classified.

Source: Fehr & Peers

Figure 11. Traffic Volumes Plotted by Hour and by Type of Vehicle



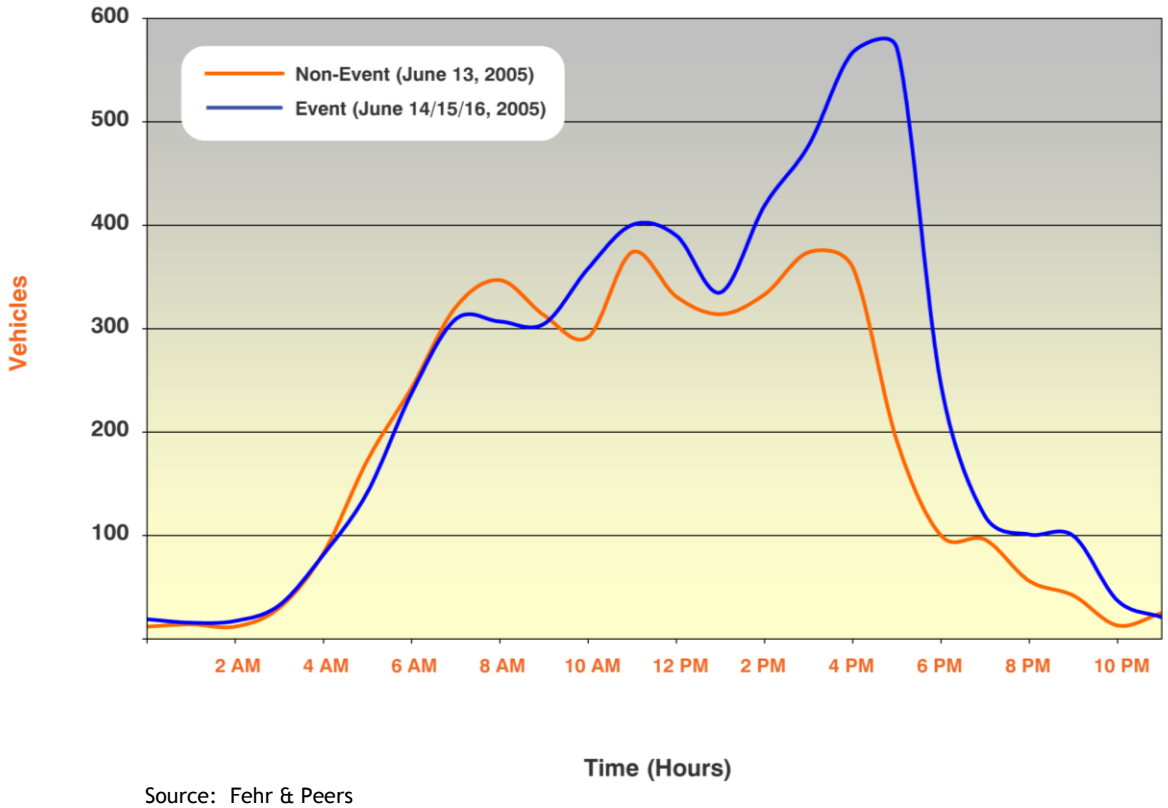
Source: Fehr & Peers

BALLGAME DAY TRAFFIC

A baseball event at the Safeco Field generates a significant amount of traffic in the SODO area. We obtained traffic counts for a ballgame day with a 7 PM game start time. The hourly westbound and eastbound traffic volumes on S Holgate Street were plotted with and without a ballgame as shown in **Figures 12** (westbound) and **13** (eastbound**)**. In the westbound direction, S Holgate Street carried a significantly higher volume of traffic between 2 and 6 PM on the ballgame day compared to a non-ballgame day. This corresponds to visitors entering the stadium from the East.

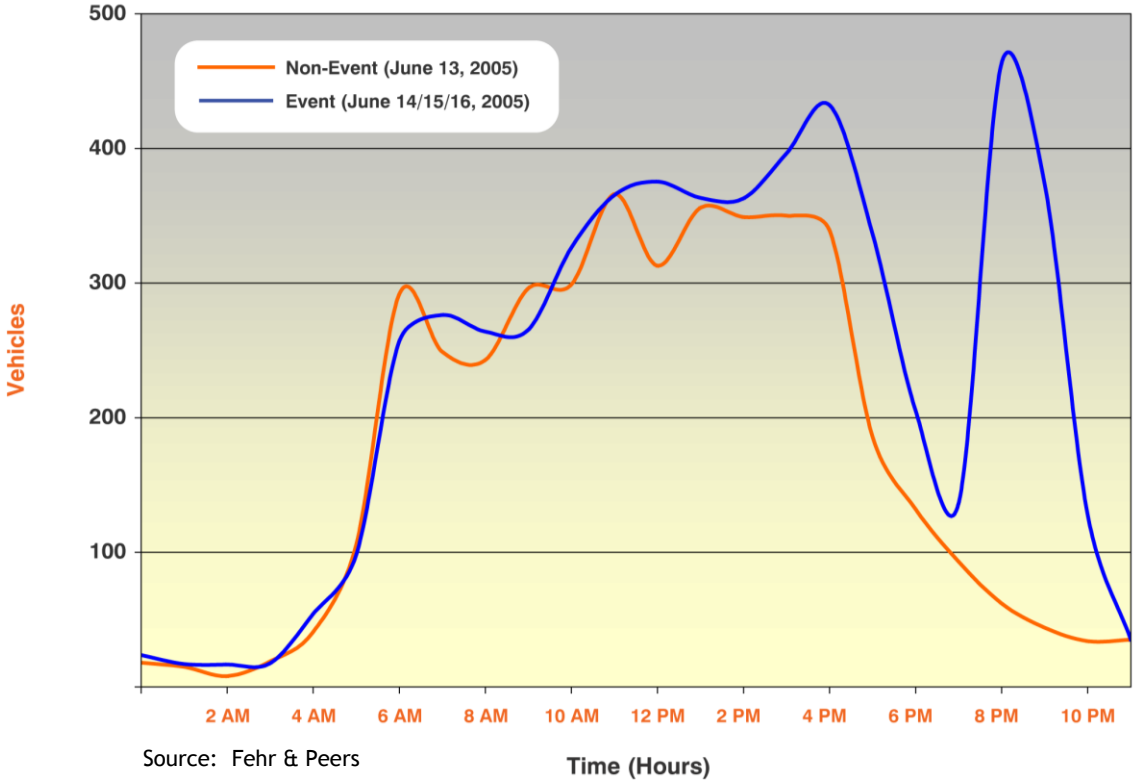
In the eastbound direction on S Holgate Street, the traffic volumes during 4 to 6 PM were slightly higher on a ballgame day, but the difference was less pronounced than the westbound direction. However, after the ballgame, a significant amount of traffic used S Holgate Street in the eastbound direction. The post ballgame traffic on S Holgate Street is highly peaked, which corresponds to the large volume of exiting traffic after the game. These figures show that S Holgate Street plays an important role in providing capacity to accommodate the traffic increase due to the baseball event. Since the traffic movements on the streets surrounding Safeco Field are restricted and the roadway capacity for traffic is not fully utilized due to heavy pedestrian traffic, there is no reasonable alternative roadway corridor that could accommodate the traffic of S Holgate Street, if it were to be closed.

Figure 12. Westbound Traffic Volumes on Holgate Street between 1st Avenue South and 4th Avenue South



Source: Fehr & Peers

Figure 13. Eastbound Holgate Street between 1st Avenue S and 4th Avenue S



Source: Fehr & Peers

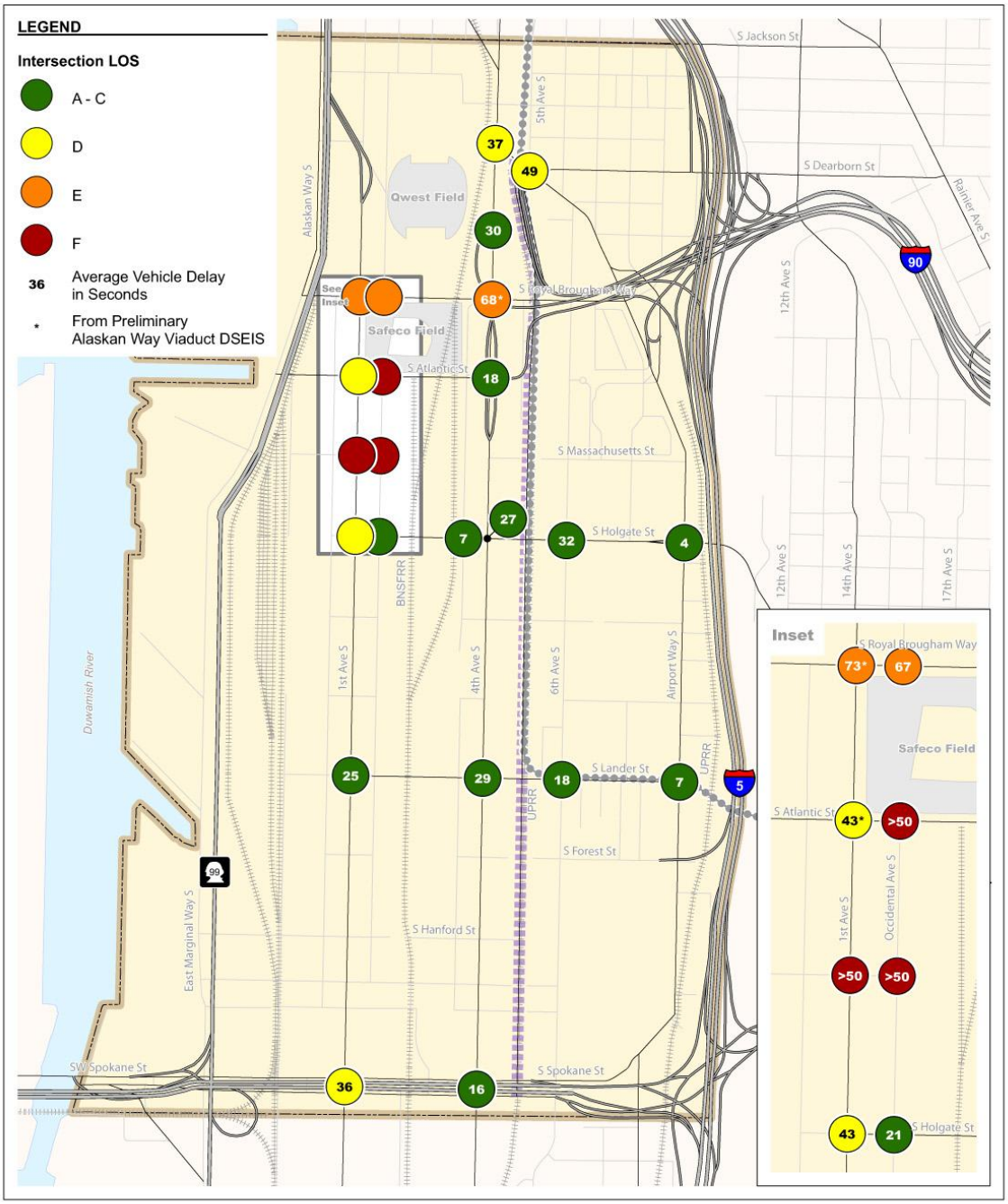
EXISTING LEVELS OF SERVICE (LOS)

The 2007 PM peak hour volumes on non-game days were used to calculate the level of service (LOS) at all signalized and several unsignalized intersections in the study area. **Figure 14** shows these intersections and their LOS. Traffic operations for the area surrounded by S Royal Brougham Way, 4th Avenue S, S Holgate Street and 1st Avenue S were simulated with SimTraffic; intersections outside this area were calculated with Synchro. The LOS analysis indicates poor traffic operations along S Royal Brougham Way, with intersections on 1st Avenue S and Occidental Avenue S between S Atlantic Street and S Massachusetts Street operating at LOS E or F. All other study intersections, including those on S Holgate Street operate well, with LOS D or better conditions.

TRAVEL PATTERN OF VEHICLES ON S HOLGATE STREET

Using the Seattle Travel Demand Forecasting model, the travel distribution of the vehicles using S Holgate Street were identified. **Figure 15** shows the westbound distribution pattern of the PM peak period traffic on S Holgate Street between Occidental Avenue S and 3rd Avenue S as 100 percent. Please note that this graphic does not show the traffic movements that go to or from driveways. The figure indicates that 38 percent of the vehicles traveling on S Holgate Street between 3rd Avenue S and Occidental Avenue come from Beacon Avenue S and that 34 percent go to the Alaskan Way Viaduct. This travel pattern shows that S Holgate Street serves as a major connector between the Beacon Hill area east of I-5 and the Seattle Central Waterfront and Alaskan Way Viaduct. The traffic distribution pattern of the eastbound vehicles, shown in **Figure 16**, is very similar to the westbound direction.

Figure 14. Existing Intersection LOS on Weekdays without a Baseball Game



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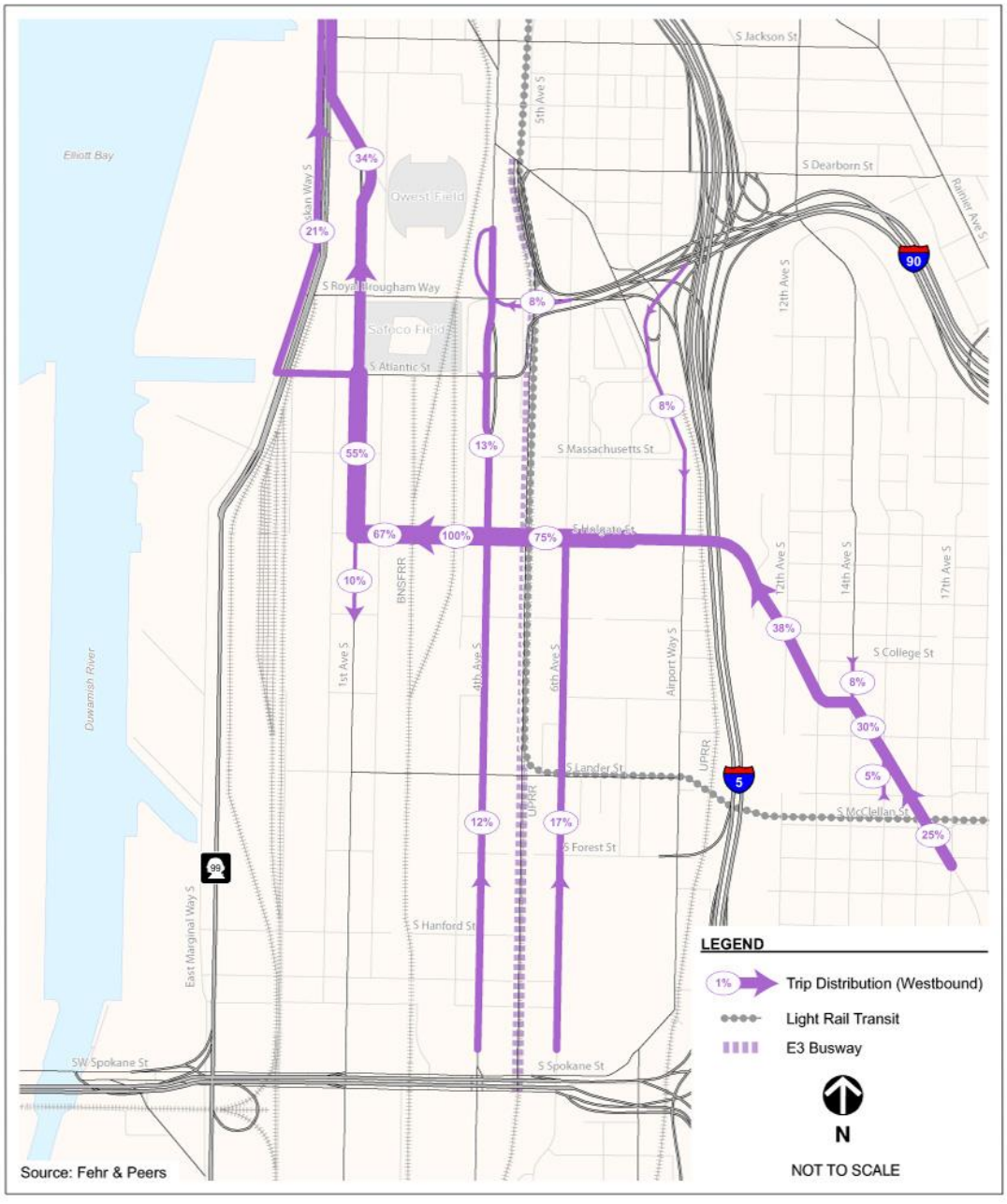
PM INTERSECTION LEVEL OF SERVICE - 2007/2008 CONDITIONS
FIGURE 14

Figure 15. The Distribution Pattern of the PM Peak Period Westbound Traffic on S Holgate Street



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EXISTING PM PEAK TRIP DISTRIBUTION - WESTBOUND
FIGURE 15

Figure 16. The Distribution Pattern of the PM Peak Period Eastbound Traffic on S Holgate Street

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EXISTING PM PEAK TRIP DISTRIBUTION - EASTBOUND
FIGURE 16

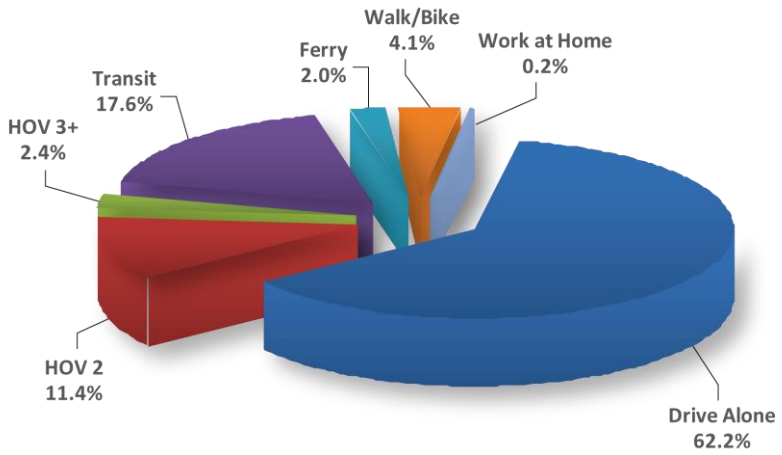
TRAVEL MODES OF COMMUTERS

To understand the use of the existing travel modes for workers and residents, we summarized the home-to-work travel modes using data from the 2000 US Census Transportation Planning Package. **Figure 17** shows the travel mode used by workers with their jobs in the study area. While 62 percent of the workers drive alone, a noticeable percent of the workers use transit and carpool:

- Carpools with 2 or more occupants: 14 percent
- Transit: 18 percent
- Walk and bike: 4 percent

King County Metro does not run regular buses on S Holgate Street between 1st Avenue S and 4th Avenue S. However, as noted earlier, many pedestrians appear to be transit riders who walk to their final destination from the bus stops located around S Holgate Street. It is estimated that the closure of S Holgate Street would significantly impact the bus riders who currently walk to their final destination along this route.

Figure 17. Study Area Workers Means of Transportation from Home to Work



Source: 2000 Census

2015 AND 2030 TRAVEL DEMAND AND TRAFFIC CONDITIONS

TRAVEL DEMAND MODEL

To forecast travel demand for the SODO area and to understand the impacts of the S Holgate Street closure to the streets surrounding the S Holgate Street, Fehr & Peers used the same version of the Seattle Travel Demand Forecasting model that was used for the Alaskan Way Viaduct (AWV) replacement study in 2008. The planning horizon for the AWV study was 2015, and the 2015 model was extensively validated for the AWV project. For 2030, Fehr & Peers used the 2030 Seattle Travel Demand model. Synchro was used to calculate levels of service for the streets surrounding S Holgate Street, and SimTraffic was developed to analyze future traffic operation conditions on S Holgate Street in the stadium area.

Appendix G shows the 2015 and 2030 household and employment forecasts in the Seattle model for the study area. These land use forecasts were prepared by the Puget Sound Regional Council in consultation with the City of Seattle. The study area includes slightly over 100 households today and is projected to increase to over 600 by 2030. The study area included about 30,000 jobs in 2005. The PSRC forecasts an increase to 35,000 jobs in 2015 and up to 38,000 in 2030. These household and employment forecasts were used to develop the Seattle Travel Demand Model.

2015 FACILITY IMPROVEMENT ASSUMPTIONS

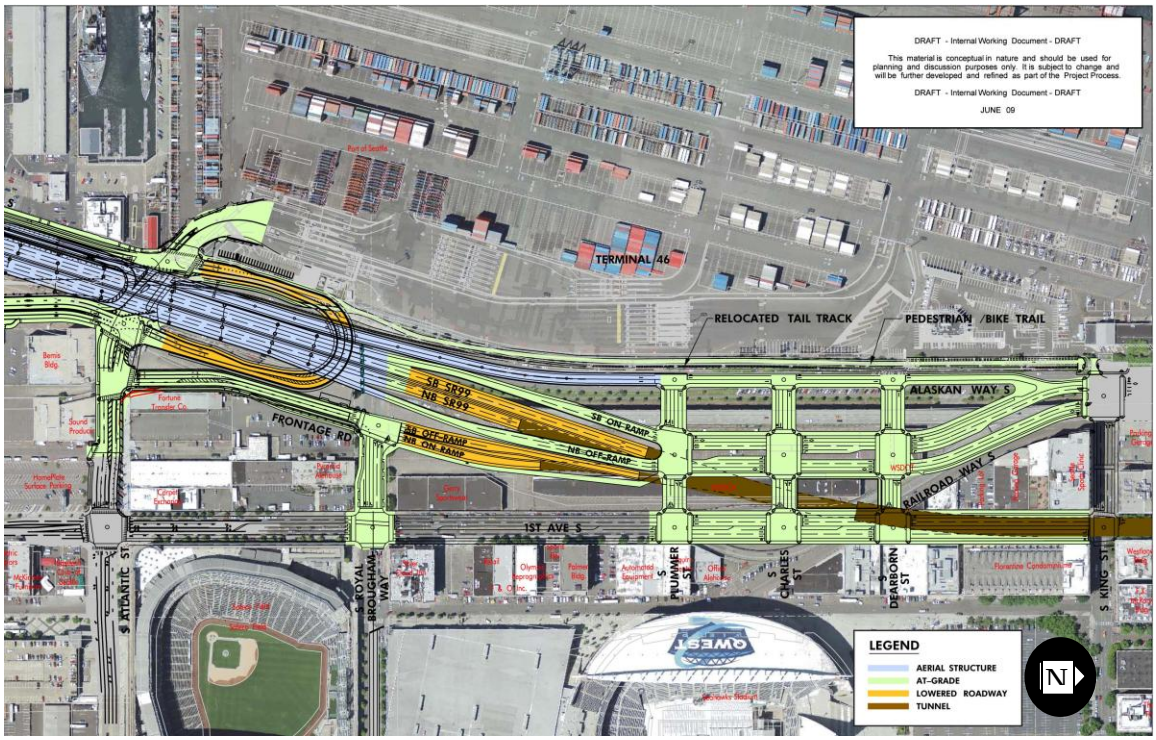
This study used the 2015 Seattle Travel Demand Model with the network called Scenario F in the AWV study, which included the following facilities in the SODO area under the 2015 conditions:

- A bored tunnel with four lanes and no access (ramps) in the tunnel will be constructed from S Royal Brougham Way to Harrison Street.
- A net set of the ramps northbound and southbound ramps in the vicinity of S Royal Brougham Way and SR 99 and surface Alaskan Way will be reconfigured as shown in **Figure 18**.
- HOV lanes on northbound SR 99 from S Holgate Street to term of off-ramp will be provided.
- One-way couplet on Main Street and Washington Street between Alaskan Way and 4th Avenue S will be provided.
- No change to 1st Avenue S between King Street and Cherry Street (two lanes) will take place. (May restrict parking.)
- Spokane Street Viaduct will be widened.
- SR 519 Phase II project will be completed. (We assumed that left turns at the Occidental Avenue S/ S Atlantic Street intersection would not be allowed.)
- Double left turn lanes on northbound 1st Avenue S to westbound S Royal Brougham Way.

Using the 2015 traffic volumes from the Seattle Travel Demand Forecasting model, levels of service at the key intersections in the study area were calculated using Synchro and

SimTraffic. Because of projected high levels of traffic congestion in the future after the completion of the AWV construction in the SODO area, we conducted a traffic operation analysis for the area bounded by S Royal Brougham Way, 4th Avenue S, S Holgate Street and SR 99 with SimTraffic.

Figure 18. Reconfigured SR 99 Northbound and Southbound Ramps and Streets in the Vicinity of the AWV South Portal Area

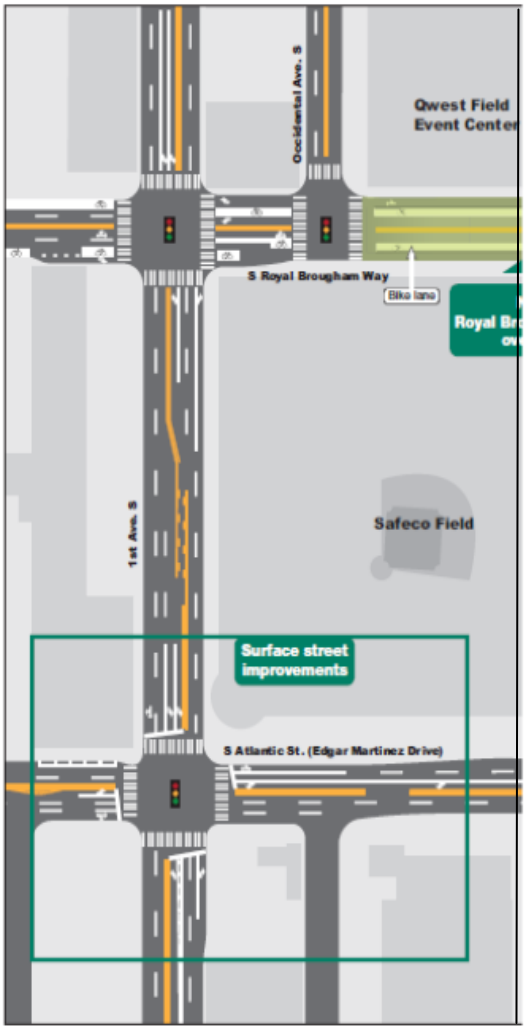


2015 OPERATIONAL ANALYSIS

Fehr & Peers initially evaluated the 2015 traffic conditions keeping S Holgate Street open for traffic. The lane configuration on the S Royal Brougham Way/1st Avenue S and S Atlantic Street/1st Avenue S intersections were taken from the SR 519 Intermodal Access Project Phase II web site as shown in **Figure 19**.

The SimTraffic model assumes that there will be double left turn lanes on northbound 1st Avenue S to westbound S Royal Brougham Way.

Figure 19. Lane configuration on the S Royal Brougham Way/1st Avenue S and S Atlantic Street/ 1st Avenue S intersections



Source: WSDOT SR 519 Website

Figure 20 shows the 2015 levels of service and delays from Synchro and SimTraffic with the assumption of increased capacity at the S Royal Brougham Way/1st Avenue S intersection.

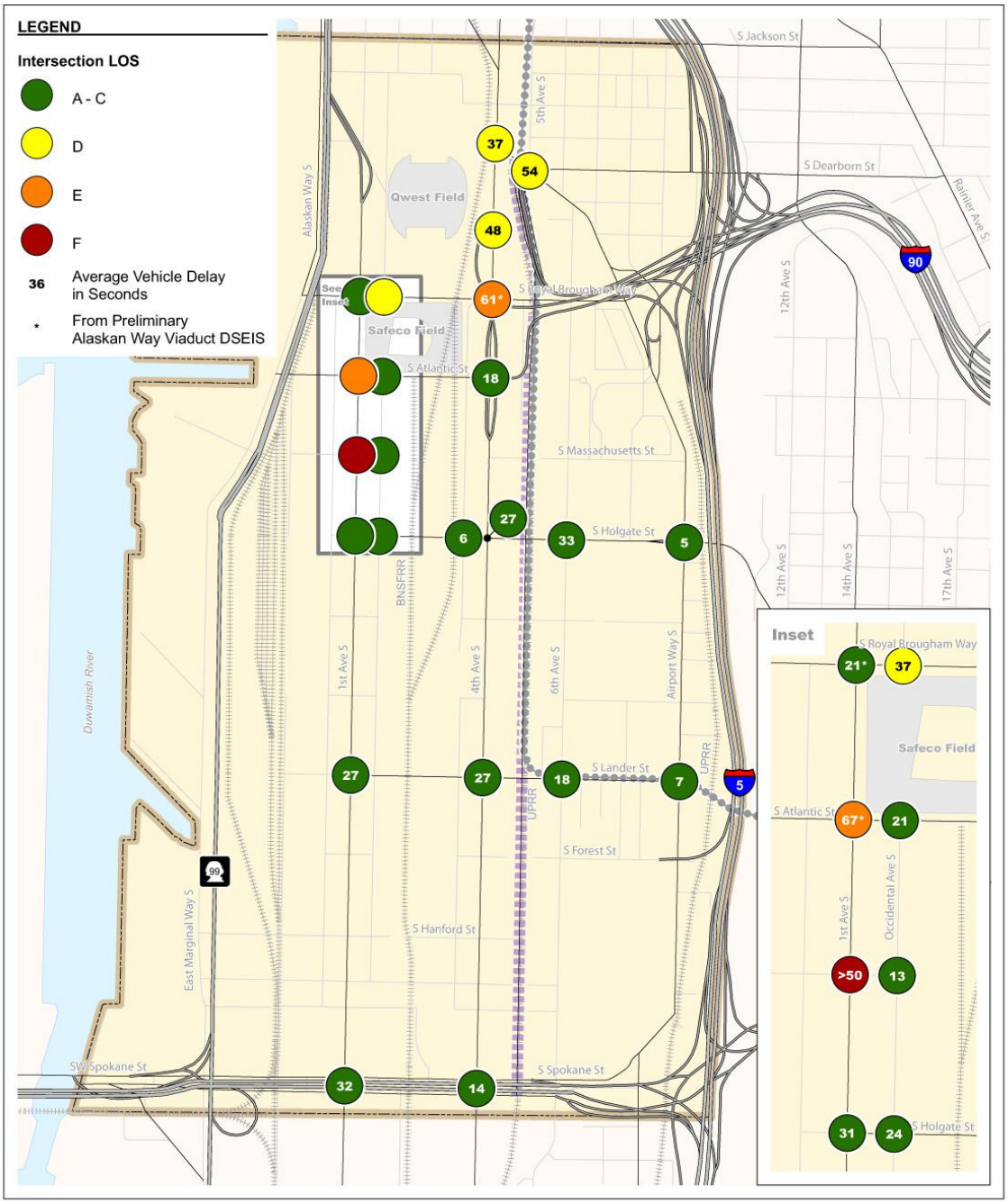
2015 OPERATIONAL ANALYSIS WITHOUT S HOLGATE STREET

Fehr & Peers re-ran the 2015 Seattle Travel Demand model without the S Holgate Street link between Occidental Avenue S and 3rd Avenue S in the network. The PM peak hour demand model volumes were adjusted and added to the Synchro/SimTraffic model. The 2015 PM peak hour levels of service without S Holgate Street are shown in **Figure 21**. The vehicles using S Holgate Street were re-routed to other corridors. The changes in the level of service without S Holgate Street were relatively minor during the PM peak hour.

2030 OPERATIONAL ANALYSIS WITH S HOLGATE STREET

Using the 2030 Seattle travel demand model with the bored bypass tunnel as the replacement for the waterfront section of the AWV structure, the 2030 travel volumes for the arterials in the SODO study area were obtained. Those volumes were used as input to the Synchro/ SimTraffic model to evaluate levels of service at the major intersections.

Figure 20. PM Intersection Level of Service – 2015 Base Conditions



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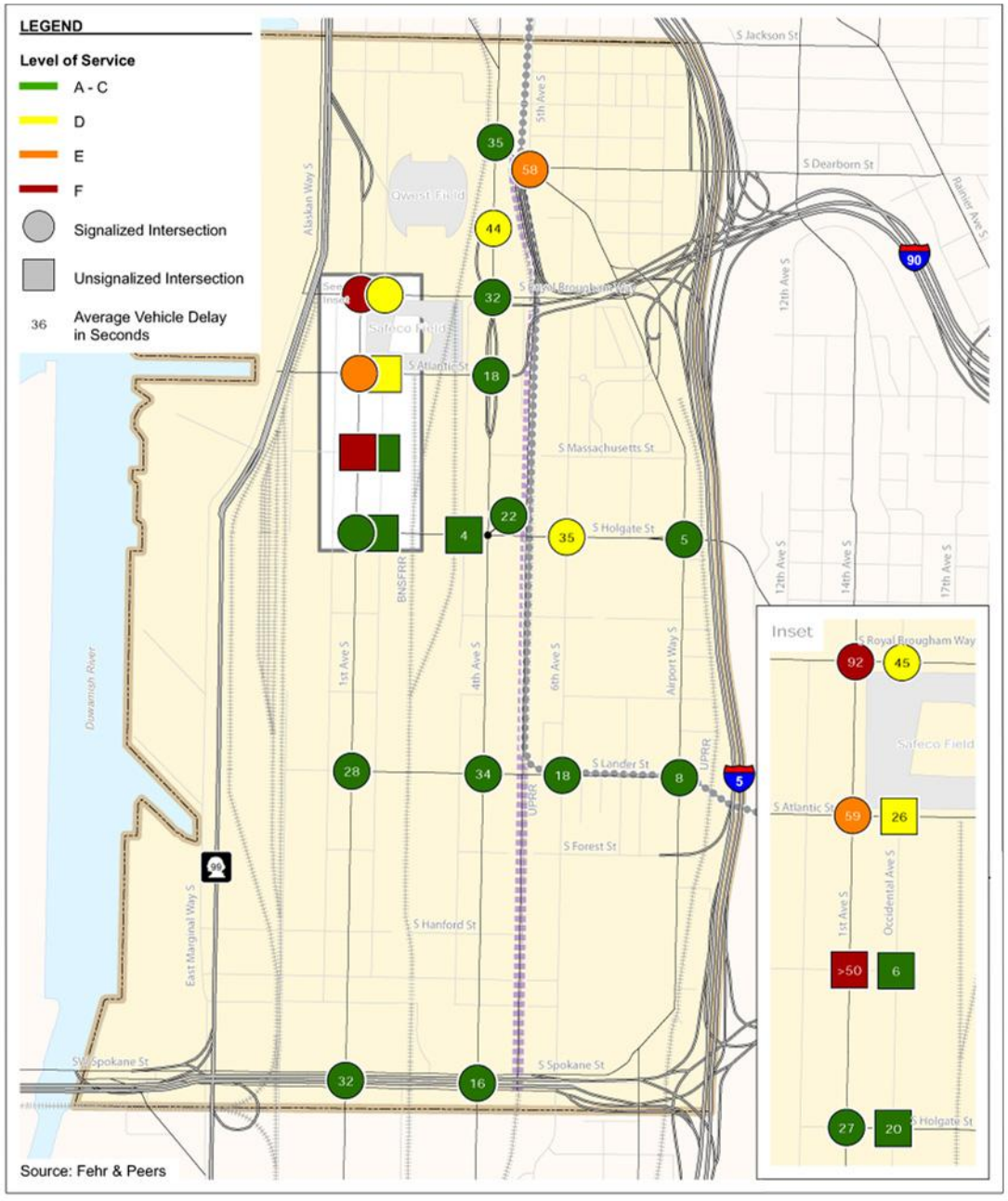
PM INTERSECTION LEVEL OF SERVICE - 2015 BASE CONDITIONS
FIGURE 20

Figure 21. PM Intersection Level of Service – 2015 with South Holgate Street Closure



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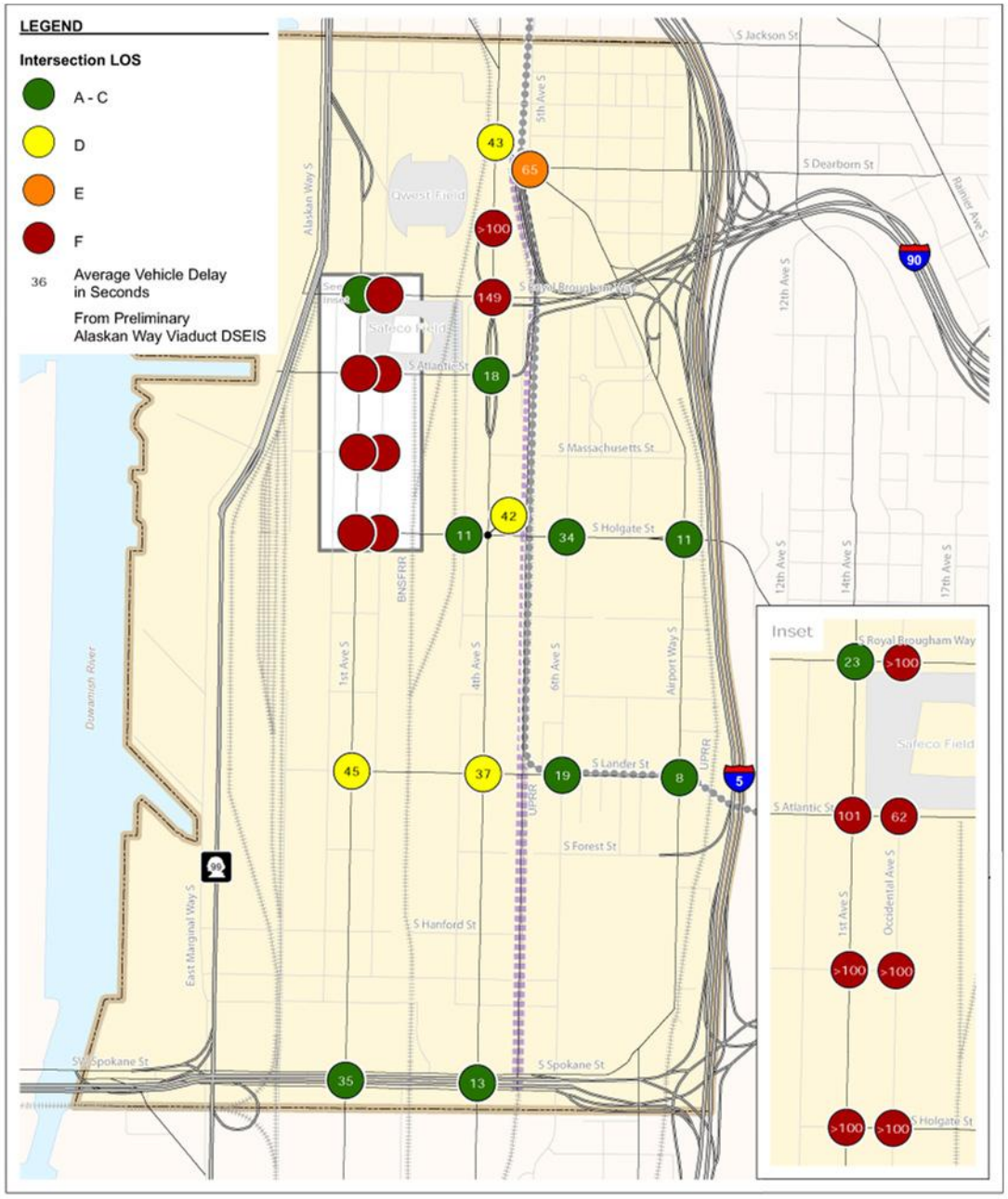
PM INTERSECTION LEVEL OF SERVICE - 2015 WITH SOUTH HOLGATE STREET CLOSURE
FIGURE 21

Figure 22. PM Intersection Level of Service – 2030 Base Conditions



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PM INTERSECTION LEVEL OF SERVICE - 2030 BASE CONDITIONS
FIGURE 22

The analysis showed that the vehicle travel demand throughout the study area would increase substantially from 2015 to 2030, particularly on 1st Avenue S. Even with the additional capacity assumed for the 2015 analysis at the 1st Avenue S/S Royal Brougham intersection the capacity at this intersection will not meet projected 2030 demand. This intersection would need further capacity expansion. For 2030 we assumed the following:

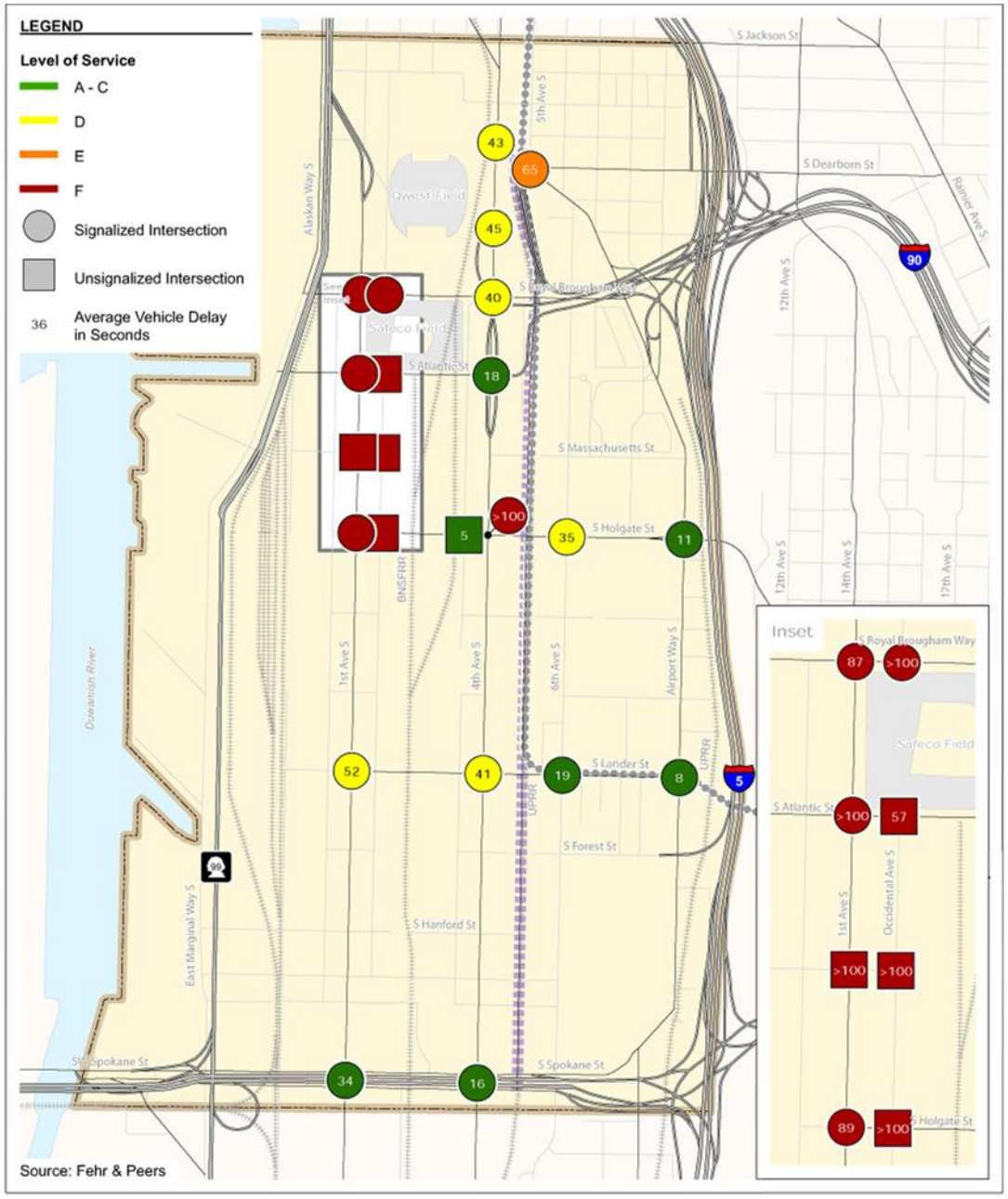
- Double northbound left turns on 1st Avenue S approaching S Royal Brougham Way as assumed for 2015.
- Increased capacity westbound and eastbound on S Royal Brougham Way approaches to 1st Avenue S. The westbound approach: a left turn lane, a left and through lane, a through lane, and a right turn lane. The eastbound approach: a left turn lane, two through lanes, and right turn lane.
- Increased westbound approach capacity at the S Atlantic Street/ 1st Avenue S intersection: double left turn lanes, two through lanes and double right turn lanes.

Figure 22 shows the 2030 PM peak hour levels of service with the assumption that S Holgate Street would remain open for traffic. The results indicate that about half of the study intersection will operate at LOS F. Many of those intersections will operate with a delay of longer than 100 seconds. Overall, the traffic operations model had trouble analyzing this scenario because of the extreme level of congestion.

2030 OPERATIONAL ANALYSIS WITHOUT S HOLGATE STREET

Figure 23 shows the intersection levels of service without S Holgate Street. Given the very high levels of congestion expected along 1st Avenue S and Occidental Avenue S between S Royal Brougham Way and S Holgate Street, it is difficult to compare traffic operations between the closure/no-closure scenarios at these study intersections. Outside of this area, the delay and LOS results between the two scenarios are similar although the closure scenario results in slightly less congestion along 4th Avenue S north of S Atlantic Street and slightly more congestion along S Lander Street Between 1st Avenue S and 4th Avenue S.

Figure 23. PM Intersection Level of Service – 2030 with South Holgate Street Closure



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PM INTERSECTION LEVEL OF SERVICE - 2030 WITH SOUTH HOLGATE STREET CLOSURE

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FIGURE 23

Chapter 5. Options for South Holgate Street

Based on the information assembled, analyzed, and summarized in the previous sections, the following options for SDOT regarding S Holgate Street were identified:

Option 1. No action – Keep S Holgate Street open for traffic with no additional improvements.

Option 2. Keep S Holgate Street open and install additional safety enhancements for all modes.

Option 3. Close S Holgate Street permanently (vacate right of way).

Option 4. Close S Holgate Street permanently for vehicles only and provide a pedestrian/bike overpass.

Option 5. Close S Holgate Street for part of the day depending upon level of railroad traffic.

Option 6. Construct a grade-separated crossing structure to span railroad tracks.

In the following section, each option is discussed in slightly more detail and pros and cons for each are provided.

OPTION 1. NO ACTION – KEEP S HOLGATE STREET OPEN FOR TRAFFIC

With this option, SDOT and the railroad agencies would not take any actions, and thus the street would continue to operate in the same way it operates today.

PROS:

- No new capital cost.
- Maintains the street grid for all modes of transportation which promotes mobility and access, particularly for area businesses.
- Continues to meet event traffic circulation needs.
- Provides flexibility to transit operations for events.
- Freight vehicle circulation needs will not be impacted.
- Will not contribute to degradation of vehicle level of service.

CONS:

- Does not address the safety concerns expressed by railroad operators.
- Pedestrians will continue to walk on street edges. The sidewalk in certain segments will not be provided.
- When the railroad gate is closed for a long time, drivers in the queues may be frustrated and make unsafe maneuvers such as uncontrolled U-turns or driving around the gates to get around an on-coming train.

OPTION 2. KEEP S HOLGATE STREET OPEN WITH SAFETY ENHANCEMENTS

With this option S Holgate Street would be kept open for traffic. SDOT and the railroad operators would work together to implement actions that enhance safety for all modes of transportation.

The following list identifies the possible safety improvements that the SDOT and the railroad operators could make in this corridor:

- Consolidate crossing gates. (Currently multiple gates are placed on S Holgate Street between Occidental Avenue S and 3rd Avenue S. The purpose of this action is to prevent drivers from queuing up at one gate and extending into the next gate.)
- Install quad-gates. (The quad-gates are designed to prevent a vehicle from going around the gate when a train is crossing S Holgate Street. A typical train gate design is to stop the traffic flow in each direction. Therefore, two gates are needed. The quad-gates are designed to prevent vehicles from going around the gate facing the traffic flow.)
- Construct sidewalks where needed on S Holgate Street between 1st Avenue S and 4th Avenue S.
- Add crossing gates for pedestrians. (Attach a pedestrian scaled gate to each of the quad-gates to prevent pedestrians from crossing the railroad tracks when a train is approaching. Figure 18 that shows the pedestrian gates.)
- Provide raised medians. (Many railroad workers walk across S Holgate Street along the railroad tracks. The raised medians would provide a space for them to wait for adequate breaks between vehicles on S Holgate Street, and additionally create conditions where they only need to cross half of the street at a time. Medians also deter drivers from driving around standard crossing gates.)
- Add U-turn routes. (When drivers encounter a long train gate closure, they should be able to make safe U-turn to choose an alternate route to cross the railroad tracks, for example at S Lander Street.)
- Provide electronic message signs for drivers on area arterials to show when the train gates are down and provide an indication of how long the gates may be closed.

A possible cross section of the S Holgate Street is illustrated in **Figure 24**. The S Holgate Street right of way is approximately 130 feet wide. The sidewalks should be a minimum of 6 feet. If there is enough space for a sidewalk to be wider than 6 feet; a 10-foot planting strip could be added on each side to better separate the pedestrians from the traffic.

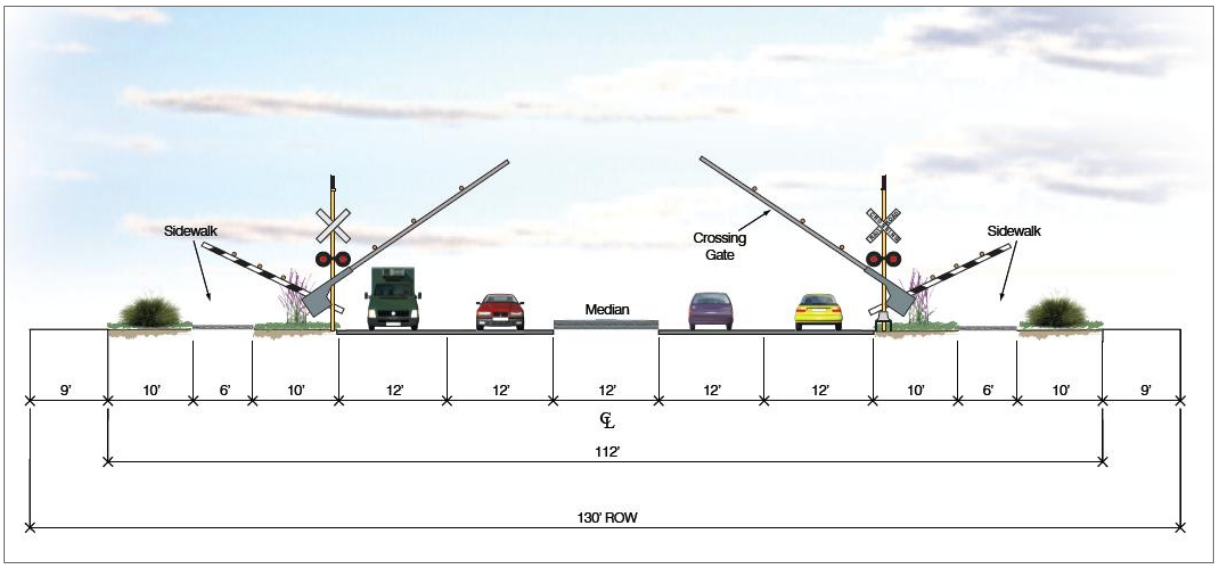
PROS:

- Fiscally feasible.
- Addresses safety concerns of the train operators.
- Maintains City street grid network and supports mobility and access for all modes.
- Reduces risk exposure for pedestrians.

CONS:

- Does not directly address Amtrak's desire for long-term maintenance efficiencies and facility security.

Figure 24. A Possible Cross Section for S Holgate Street



Source: Fehr & Peers

OPTION 3. CLOSE S HOLGATE STREET PERMANENTLY

With this option S Holgate Street would be closed between the east and west sides of the railroad tracks for through traffic, as well as for pedestrians and bicycles. This option assumes that the closed section of S Holgate Street right-of-way will be vacated. The option also assumes that the driveways located between Occidental Avenue S and the west railroad track would remain open; and that the intersection at 3rd Avenue S will continue to operate as it does.

PROS:

- Low cost to implement.
- Likely to increase efficiency for operations of the rail maintenance facilities.
- Eliminates the potential for rail/vehicle and pedestrian collisions.

CONS:

- Will increase traffic in other corridors.
- Will take a longer time to discharge vehicles from the stadium areas after a ballgame.
- Will force pedestrians to take circuitous routes to cross the railroad tracks and some pedestrian trips may be precluded given the distance to alternate routes.

- It may increase the pedestrian-train collision risk due to the pedestrians who may refuse to take alternative routes.

OPTION 4. CLOSE S HOLGATE STREET PERMANENTLY FOR VEHICLES ONLY AND PROVIDE PEDESTRIAN/BIKE OVERPASS.

This option would close S Holgate Street for vehicles only and a pedestrian overpass would be constructed over the railroad tracks. This option recognizes that the options for pedestrians to take alternative routes are limited, if S Holgate Street were to be closed permanently. This option would add some cost to Option 3.

PROS:

- Likely to increase efficiency for operation of the rail maintenance facilities.
- Eliminates the potential for rail/vehicle and pedestrian collisions.

CONS:

- Will be expensive to construct pedestrian overpass.
- Will increase vehicular traffic in other corridors.
- Will take a longer time to discharge vehicles from the stadium areas after a ballgame.

OPTION 5. CLOSE S HOLGATE STREET FOR PART OF DAY DEPENDING UPON LEVEL OF RAILROAD TRAFFIC

This option would close S Holgate Street for part of day aiming at the period when the train gates are down most frequently and for long periods of time. This option assumes that the train activities are concentrated during certain time periods and that the gate closure times are not evenly distributed throughout day.

PROS:

- Maintains some traffic capacity. However, how much traffic capacity can be provided depends on the duration and time of the opening.

CONS:

- Likely create confusion for drivers.
- It will be difficult to identify the best time of day for the S Holgate Street closure. Figure 6 (page 16) shows that the average closure time during AM peak period, midday period and PM peak period is evenly distributed. However, the evening period from 6 to 10 PM has a higher closure time than other periods.

OPTION 6. CONSTRUCT A GRADE-SEPARATED CROSSING STRUCTURE TO SPAN THE RAILROAD TRACKS

This option would construct a grade-separated structure over the railroad tracks. Because of the short distance between Occidental Avenue S and the western railroad track and between 3rd Avenue S and 4th Avenue S, it would not be possible to design an overcrossing that just goes over the railroad tracks. One of the concepts that Fehr & Peers developed for this option is shown in **Figure 25**. This concept includes a long structure that starts at about the intersection of S Massachusetts Street and S Occidental Avenue. It continues with a ramp up to a structure that turns 90 degrees at the S Occidental Avenue/S Holgate Street intersection and continues on to about 8th Avenue S and connects just west of an existing ramp to the existing structure that crosses I-5. Ramps to 4th Avenue S and 6th Avenue S from the elevated structure would have to be provided. The elevated structure would need two lanes with sidewalks on both sides. **Appendix K** provides more discussion on how this option was developed and analyzed.

We have not prepared a cost-estimate for this concept. However, it is estimated that the cost could be more than $ 40 million dollars.

PRO:

- Addresses all the negative impacts of the closure option.

CONS:

- Very expensive and unlikely to be funded within a reasonable time.
- The benefit/cost ratio would be low. (The benefit would be average travel time saving for the vehicles that travel S Holgate Street on the overpass roadway. While there will be travel time savings with the overpass, the cost is too high to be a reasonable cost benefit ratio that would put this option to a high priority project in the City's Capital Improvement Program.)
- This option would impact 4th Avenue S and 6th Avenue S as additional rights-of-way are needed to add the ramps.

Figure 25. Possible Grade-Separated Structure over S Holgate Street

Source: Fehr & Peers

Chapter 6. Conclusions and Consultant Recommendation

CONCLUSIONS

- Unlike many commercial areas of the City, the SODO area does not have a traditional street grid network. In particular, the number of east-west arterials in this area is limited. A recent decision to construct a grade-separated structure over the railroad tracks on Royal Brougham Way S will further constrain the east-west traffic movements. In 2008, S Holgate Street carried about 12,000 vehicles per day. The closure of S Holgate Street would not shift this amount of traffic to just one street such as S Atlantic Street, but the impact of the street closure would be felt throughout the area.

- The video recording of the train crossings revealed that the train gates stop traffic movements about 20 percent of day (about 12 minutes each hour). More than 50 percent of those gate closures are due to freight train operations. As Sound Transit's commuter rail, WSDOT's Amtrak Cascades, and intercity Amtrak passenger train services increase in the future, the frequency and duration of the train gate closures would increase, resulting in longer delays for vehicles. However, even if the gate closure time were to increase significantly, S Holgate Street would still provide significant access for the area.

- Prior studies did not assess a possible closure upon pedestrians. As stated earlier, there are limited east-west street connections in SODO. Any closure of S Holgate would force pedestrians to walk considerable distances to either S Lander Street or S Atlantic Street. On the winter weekday during the video monitoring, 330 pedestrians crossed the tracks; on a baseball game day, between 5 and 7 PM, 426 people crossed the tracks. In addition, on a typical workday, Amtrak employees made 350 crossings of S Holgate.

- S Holgate Street primarily serves SODO businesses, industries, and the stadiums. In addition, S Holgate Street serves the people who live in the Beacon Hill neighborhood and travel to the waterfront or to the northwestern part of Seattle, such as Interbay or Ballard, for work or shopping. The closure of S Holgate Street would reduce accessibility for those people living on Beacon Hill and others east of I-5.

- As S Holgate Street is located 0.75 miles south of the King Street Train Station, the northbound passenger trains need to slow down as they pass the S Holgate Street crossing to come to a complete stop at the King Street Station, and similarly the southbound trains need to accelerate gradually after departing the train station. The closure of S Holgate Street would not help increase speeds of the passenger train operations.

A grade-separated overpass that carried all modes was considered, but preliminary analysis indicated that this was not a feasible option given its high estimated cost. The challenge presented by the overpass option is that there is not sufficient space to ramp up at a reasonable grade between Occidental Avenue S and the western railroad track, and to ramp down between the eastern track and 3rd Avenue S. A description and schematic design for the bridge structure necessary to achieve the needed clearances is provided later in the report.

While no reported collisions have taken place on the tracks, involving trains, safety remains a chief concern of both SDOT and the railroad operators. These concerns can be addressed through the implementation of achievable and effective safety improvements which will be described in the next section of this report.

RECOMMENDATIONS

Fehr & Peers recommends:

Option 2 - Keep S Holgate Street Open with Safety Enhancements.

S Holgate Street is an important link in the SODO street network. It is one of the limited east-west arterials that businesses and industries rely on for access throughout SODO. S Holgate Street carries about 12,000 vehicles per day; any closure of the roadway would negatively affect local business delivery and circulation, as well as shift traffic to the limited number of the other east-west arterials in SODO. A closure of S Holgate would also force pedestrians and bicyclists to walk and ride considerable distances to either S Lander Street or S Atlantic Street to travel in an east-west direction. (*However, if in the future (post-Viaduct replacement), conditions change significantly, such as a very major upturn in the number and duration of gate closures, the implementation of the S Lander Street Grade Separation Project or Amtrak's willingness to help fund a pedestrian and bicycle overpass over S Holgate Street, SDOT would consider revisiting the question of the long-term role of S Holgate Street).*

Currently, railroad crossings halt traffic movements about 20 percent of the day. Planned increases in through movements by freight and passenger trains will not significantly increase closure times. Future maintenance activities by Amtrak, in particular, such as coupling and de-coupling, cleaning, train repair, cannot at this time, be forecast with any accuracy, therefore, known future conditions do not warrant closure.

Safety remains a chief concern for both SDOT and the railroad operators. These concerns can be addressed and the railroad crossing at S Holgate Street can be modified to enhance safety for all transportation modes without a full closure of S Holgate Street. SDOT should work with the railroad operators to implement the following safety improvements as high priority capital improvement projects.

- Consolidate crossing gates.
- Install quad-gates.
- Construct sidewalks where needed on S Holgate Street between 1st Avenue S and 4th Avenue S.
- Add crossing gates for pedestrians.
- Provide raised medians.
- Add U-turn routes.
- Provide electronic message signs for drivers on area arterials to show when the train gates are down and provide an indication of how long the gates may be closed. Although closures of S Holgate Street by train, for more than 10 minutes at a time, do not occur frequently, there were a number of such occurrences while recording rail crossings in January 2009. The purpose of the recommended dynamic message

signs (DMS) is to inform drivers who are intending to cross the tracks of potential excessive delay before they enter S Holgate Street from 1st Avenue or 4th Avenue. A train gate closure detection device would need to be installed and the duration of the closure should be monitored. In addition, a detection device to monitor vehicle queue lengths from the train gates to S Holgate Street should be installed. When the gates are in a lowered position for some defined time period (for example, more than five minutes), a warning sign for the drivers should be displayed. The exact wording of the sign should be evaluated more in detail at the implementation stage.

South Holgate Street Railroad Crossing Study Phase II

January 2010

Appendices

APPENDIX A. SUMMARY DATA OF VIDEO RECORDING SURVEY OF RAILROAD GATE CLOSURES DUE TO TRAIN CROSSINGS ON S HOLGATE STREET

S HOLGATE STREET RAILROAD GATE BLOCKAGE DATA

To understand the impacts of trains crossing on S Holgate Street, Fehr & Peers analyzed the video images that City of Seattle Department of Transportation (SDOT) recorded with their traffic camera. We counted the number of times the railroad gates closed, recorded the type of trains that crossed S Holgate Street, and observed the duration of each gate closure for a full week in January 2009. The following section discusses the methods used to collect the video data and summarizes the collected data.

Video Survey Method

To capture all the trains that crossed S Holgate Street, SDOT recorded the train crossing activities using their traffic camera located at the northwest corner of the intersection at 1st Avenue S/ S Holgate Street. The picture below shows a screen image of the video recording. The traffic camera was focused on the railroad crossing area on S Holgate Street. The camera screen captured two sets of tracks crossing gates on South Holgate Street and associated flashing lights in the middle of the street.

Example Image of South Holgate Street.

Source: Webcam image from City of Seattle Traffic Camera website

The video recordings covered one week and were initiated at 11:00 AM, January 13, 2009 and completed at 3:00 PM on January 20, 2009. The images were all usable except the video images obscured by fog between 12:00 AM and 5:00 AM on January 19 and between 10:00 PM, January 19 and 6:00 AM January 20.

Data Analysis

Fehr & Peers staff reviewed the week long video tape and recorded the following information for each gate closure:

- Date and time when the gate started to close;
- Location of the track closed (east tracks or west tracks);

- Type of train (Amtrak, Freight or Sounder);
- Direction (northbound or southbound);
- Type of train operation (regularly scheduled train or maintenance activity); and
- Time the gate was fully open.

The recorded data was summarized by time of day, service provider, rail service type and weekday or weekend. The terms used in summarizing the data are defined as follows:

Time Periods – The data was summarized in 5 time periods:

- AM peak period (6:00 AM to 9:00 AM)
- Midday period (9:00 AM to 3:00 PM)
- PM peak period (3:00 PM to 6:00 PM)
- Evening period (6:00 PM to 10:00 PM)
- Night period (10:00 PM to 6:00 AM)

Number of Trains – The average number of trains counted for each hour.

Duration of Gate Closure – The total average duration (hours, minutes, seconds) of closure by time of day recorded with the start and end time of each gate closure. The start time began when the railroad flashing lights started and ended when they stopped.

Percent Closure – The amount of time the gate was closed divided by the total time of the measured period. The percent closure for the time periods should not be added together to get percent closure for a 24-hour day.

Amtrak – The data for Amtrak represents all Amtrak train movements, including passenger rail passing through or maintenance activities such as track switching.

Sounder – The data for the Sound Transit commuter rail service, Sounder, represents all Sounder train movements, including passenger rail passing through or maintenance activities such as track changing or deadheading.

Freight – The data for freight represents all freight train activities, including activities such as track change, platform change or maintenance that involved closures of the gates.

Multiple Trains – The gate closure activities when more than one train crossed S Holgate Street at the same time.

Maintenance – The gate closure activities and number of trains with short freight trains, trains changing tracks or platforms, or trains that stopped at the crossing.

No Trains – The gate activities recorded with no trains while the gates were closed.

Exhibit A-1 and **Exhibit A-2** show the overall summary of S Holgate Street railroad gate closures on an average weekday by rail operator and type of train activity. **Exhibit A-3** and **Exhibit A-4** show the same information for the weekend. The summary shows that the S Holgate Street is closed for about 20 percent of a weekday and 14 percent of a weekend day. It is observed that there is no specific time period when gate closes were concentrated.

Exhibit A-1. Summary of Average Weekday S Holgate Street Railway Gate Closure by Rail Service

		Daily	AM Peak (6:00-9:00)	Midday (9:00-3:00)	PM Peak (3:00-6:00)	Evening (6:00-10:00)	Night (10:00- 6:00)
Amtrak	# of Times	16	2	5	1	5	3
	Duration (hour:min:sec)	0:53:32	0:07:20	0:06:55	0:01:10	0:19:56	0:06:06
	% of Time	3.7%	4.1%	1.9%	0.6%	8.3%	1.3%
Sounder	# of Times	25	9	5	8	2	1
	Duration (hour:min:sec)	0:48:48	0:16:12	0:11:44	0:14:40	0:03:10	0:01:44
	% of Time	3.4%	9.0%	3.3%	8.1%	1.3%	0.4%
Freight	# of Times	38	2	9	4	9	14
	Duration (hour:min:sec)	2:22:35	0:06:00	0:36:53	0:11:00	0:28:05	0:56:26
	% of Time	9.9%	3.3%	10.2%	6.1%	11.7%	11.8%
Multiple Trains	# of Times	13	2	4	2	3	2
	Duration (hour:min:sec)	0:31:23	0:05:22	0:12:16	0:05:38	0:17:50	0:06:27
	% of Time	2.2%	3.0%	3.4%	3.1%	7.4%	1.3%
No Train	# of Times	16	1	10	1	2	2
	Duration (hour:min:sec)	0:14:25	0:00:54	0:07:25	0:00:58	0:01:38	0:00:54
	% of Time	1.0%	0.5%	2.1%	0.5%	0.7%	0.2%
Total	# of Times	108	16	33	16	21	22
	Duration (hour:min:sec)	4:50:43	0:35:48	1:15:13	0:33:26	1:10:40	1:11:37
	% of Time	20.2%	19.9%	20.9%	18.6%	29.4%	14.9%

Source: Fehr & Peers

Exhibit A-2. Average Weekday S Holgate Street Railway Gate Closure by Train Activity

		Daily	AM Peak (6:00-9:00)	Midday (9:00-3:00)	PM Peak (3:00-6:00)	Evening (6:00-10:00)	Night (10:00- 6:00)
Regular	# of Times	57	7	12	10	10	14
	Duration (hour:min:sec)	2:29:27	0:10:40	0:35:01	0:19:14	0:26:13	0:48:21
	% of Time	10.4%	5.9%	9.7%	10.7%	10.9%	10.1%
Maintenance	# of Times	44	7	17	4	7	5
	Duration (hour:min:sec)	1:49:53	0:19:46	0:27:56	0:08:34	0:26:37	0:16:48
	% of Time	7.6%	11.0%	7.8%	4.8%	11.1%	3.5%
Multiple Trains	# of Times	10	2	4	2	3	2
	Duration (hour:min:sec)	0:31:23	0:05:22	0:12:16	0:05:38	0:17:50	0:06:27
	% of Time	2.2%	3.0%	3.4%	3.1%	7.4%	1.3%
Total	# of Times	112	16	33	16	21	21
	Duration (hour:min:sec)	4:50:43	0:35:48	1:15:13	0:33:26	1:10:40	1:11:37
	% of Time	20.2%	19.9%	20.9%	18.6%	29.4%	14.9%

Source: Fehr & Peers

Exhibit A-3. Average Weekend S Holgate Street Railway Gate Closure by Rail Service

	Value	Daily	AM Peak (6:00-9:00)	Midday (9:00-3:00)	PM Peak (3:00-6:00)	Evening (6:00-10:00)	Night (10:00- 6:00)
Amtrak	# of Times	20	2	5	3	6	4
	Duration (hour:min:sec)	0:30:40	0:04:45	0:05:15	0:03:00	0:09:20	0:08:20
	% of Time	2.1%	2.6%	1.5%	1.7%	3.9%	1.7%
Sounder	# of Times						
	Duration (hour:min:sec)						
	% of Time						
Freight	# of Times	32	3	8	5	8	8
	Duration (hour:min:sec)	2:13:45	0:07:00	0:26:15	0:45:40	0:18:50	0:36:00
	% of Time	9.3%	3.9%	7.3%	25.4%	7.8%	7.5%
Multiple Trains	# of Times	7	1	2	2	1	1
	Duration (hour:min:sec)	0:24:50	0:04:30	0:04:40	0:07:15	0:02:15	0:06:10
	% of Time	1.7%	2.5%	1.3%	4.0%	0.9%	1.3%
No Train	# of Times	20		1	1	11	7
	Duration (hour:min:sec)	0:15:53		0:00:40	0:00:25	0:09:07	0:05:41
	% of Time	1.1%		0.2%	0.2%	3.8%	1.2%
Total	# of Times	79	6	16	11	25	21
	Duration (hour:min:sec)	3:25:09	0:16:15	0:36:50	0:56:20	0:39:32	0:56:11
	% of Time	14.2%	9.0%	10.2%	31.3%	16.5%	11.7%

Source: Fehr & Peers

Exhibit A-4. Average Weekend S Holgate Street Railway Gate Closure by Train Activity

	Value	Daily	AM Peak (6:00-9:00)	Midday (9:00-3:00)	PM Peak (3:00-6:00)	Evening (6:00-10:00)	Night (10:00- 6:00)
Regular	# of Times	33	3	11	5	7	8.5
	Duration (hour:min:sec)	1:45:20	0:05:30	0:28:30	0:37:50	0:11:45	0:21:45
	% of Time	7.3%	3.1%	7.9%	21.0%	4.9%	4.5%
Maintenance	# of Times	39	3	3	5	18	11.5
	Duration (hour:min:sec)	1:14:59	0:06:15	0:03:40	0:11:15	0:25:32	0:28:16
	% of Time	5.2%	3.5%	1.0%	6.3%	10.6%	5.9%
Multiple Trains	# of Times	7	1	2	2	1	1
	Duration (hour:min:sec)	0:24:50	0:04:30	0:04:40	0:07:15	0:02:15	0:06:10
	% of Time	1.7%	2.5%	1.3%	4.0%	0.9%	1.3%
Total	# of Times	79	6	16	11	25	21
	Duration (hour:min:sec)	3:25:09	0:16:15	0:36:50	0:56:20	0:39:32	0:56:11
	% of Time	14.2%	9.0%	10.2%	31.3%	16.5%	11.7%

Note: Sounder trains do not operate over the weekend and that reduces the number of train activities across the S Holgate Street on weekends.

Source: Fehr & Peers

Exhibit A-5. Numbers and Duration of Railroad Gates Down Due to Trains on S Holgate Street (January 15, 2009)

Numbers and Duration of Railroad Gates Down Due to Trains on South Holgate Street

Blockage Duration (Minutes)
No Blockage By Train
0-5
5-15
>15

AM on Thursday January 15, 2009

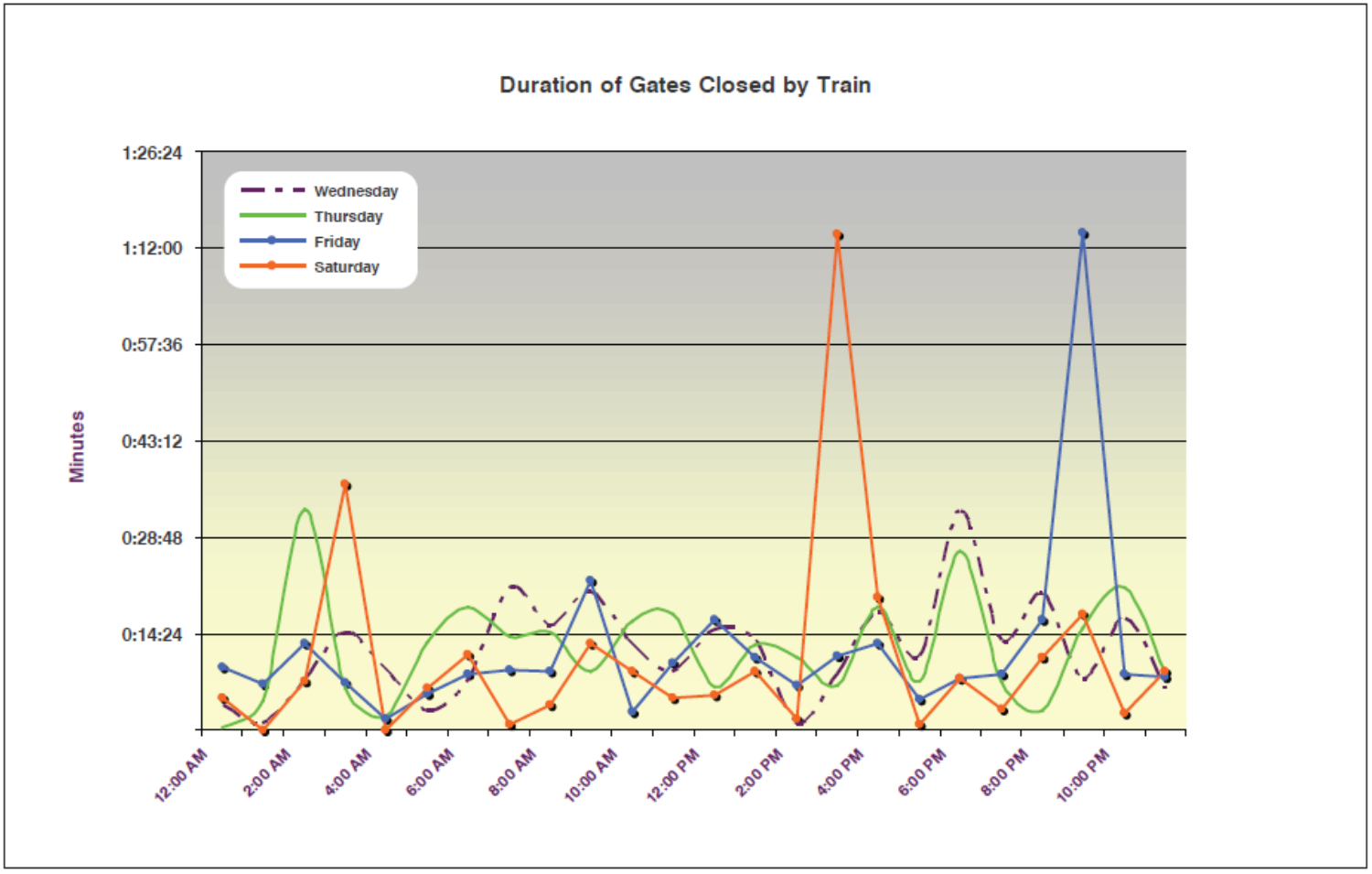
Type of Train	12:00AM	1:00AM	2:00AM	3:00AM	4:00AM	5:00AM	6:00AM	7:00AM	8:00AM	9:00AM	10:00AM	11:00AM
Amtrak							2	1		1		2
							0:13:50	0:01:10		0:01:10		0:02:32
Sounder						1	3	4	3			2
						0:01:10	0:04:20	0:12:50	0:04:40			0:02:00
Freight		1	2	1	1	3			1	2	1	2
		0:04:20	0:33:00	0:06:20	0:02:10	0:10:50			0:01:30	0:07:20	0:09:40	0:11:50
Multiple Trains									2			
									0:08:30			
No Train	1					1	1			1	6	2
	0:00:20					0:01:10	0:00:10			0:00:20	0:06:40	0:01:00
Total	1	1	2	1	1	5	6	5	6	4	7	8
	0:00:20	0:04:20	0:33:00	0:06:20	0:02:10	0:13:10	0:18:20	0:14:00	0:14:40	0:08:50	0:16:20	0:17:22

PM on Thursday January 15, 2009

Type of Train	12:00PM	1:00PM	2:00PM	3:00PM	4:00PM	5:00PM	6:00PM	7:00PM	8:00PM	9:00PM	10:00PM	11:00PM
Amtrak	1	1	1			1	1	2	2	1	1	
	0:01:30	0:01:30	0:01:40			0:00:50	0:02:10	0:03:30	0:02:50	0:01:10	0:08:00	
Sounder		1	3	3	2	3	2				1	
		0:01:40	0:05:20	0:06:40	0:02:10	0:03:40	0:02:20				0:01:10	
Freight	1	3	1		2	2	2	1		4	2	3
	0:04:10	0:09:40	0:03:20		0:04:50	0:02:50	0:22:10	0:03:40		0:14:00	0:12:10	0:08:30
Multiple Trains					4							
					0:11:20							
No Train	2		1									1
	0:00:50		0:00:30									0:00:20
Total	4	5	6	3	8	6	5	3	2	5	4	4
	0:06:30	0:12:50	0:10:50	0:06:40	0:18:20	0:07:20	0:26:40	0:07:10	0:02:50	0:15:10	0:21:20	0:08:50

Source: Fehr & Peers

Exhibit A-6. Duration of Railroad Gates Closed by Train



Source: Fehr & Peers

Exhibit A-7. Frequency and Duration of Gate Closures on Tuesday January 13, 2009

1/13/2009 (Tuesday)

By Types of Trains

	12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
Amtrak	No Data											1 0:01:00 1.7%	1 0:01:20 2.2%			1 0:01:20 2.2%		1 0:01:00 1.7%	1 0:01:10 1.9%			1 0:02:00 3.3%	2 0:04:40 7.8%	
Sounder	No Data															4 0:07:20 12.2%	3 0:05:20 8.9%	3 0:03:27 5.7%			1 0:01:40 2.8%			
Freight	No Data											1 0:01:20 2.2%	1 0:05:10 8.6%	1 0:02:50 4.7%	3 0:10:20 17.2%	1 0:04:00 6.7%	1 0:03:20 5.6%	2 0:03:30 5.8%		4 0:08:44 14.6%		1 0:01:10 1.9%		2 0:07:00 11.7%
Multiple Trains	No Data																2 0:05:40 9.4%		4 0:06:30 10.8%		2 0:11:20 18.9%	4 0:28:10 46.9%	2 0:06:00 10.0%	2 0:10:20 17.2%
No Train	No Data													2 0:01:40 2.8%		1 0:02:00 3.3%				1 0:00:30 0.8%				1 0:00:50 1.4%
Total	No Data											2 0:02:20 3.9%	2 0:06:30 10.8%	3 0:04:30 7.5%	3 0:10:20 17.2%	7 0:14:40 24.4%	6 0:14:20 23.9%	6 0:07:57 13.2%	5 0:07:40 12.8%	5 0:09:14 15.4%	3 0:13:00 21.7%	6 0:31:20 52.2%	4 0:10:40 17.8%	5 0:18:10 30.3%

Total	AM (6:00-9:00)	MD (9:00-3:00)	PM (3:00-6:00)	EV (6:00-10:00)	NI (10:00-12:00)	NI (12:00-6:00)
			2 0:02:20 1.3%	2 0:03:10 1.3%	2 0:04:40 3.9%	
			10 0:16:07 9.0%	1 0:01:40 0.7%		
			4 0:10:50 6.0%	5 0:09:54 4.1%	2 0:07:00 5.8%	
			2 0:05:40 3.1%	10 0:46:00 19.2%	4 0:16:20 13.6%	
			1 0:02:00 1.1%	1 0:00:30 0.2%	1 0:00:50 0.7%	
			19 0:36:57 20.5%	19 1:01:14 25.5%	9 0:28:50 24.0%	

By Purpose

	12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
Regular	No Data											1 0:01:00 1.7%	2 0:06:30 10.8%		3 0:10:20 17.2%	5 0:09:30 15.8%	4 0:08:40 14.4%	6 0:07:57 13.2%	1 0:01:10 1.9%	4 0:08:44 14.6%	1 0:01:40 2.8%	2 0:03:10 5.3%	1 0:01:20 2.2%	1 0:02:50 4.7%
Maintenance	No Data											1 0:01:20 2.2%		3 0:04:30 7.5%		2 0:05:10 8.6%				1 0:00:30 0.8%			1 0:03:20 5.6%	2 0:05:00 8.3%
Multiple Trains	No Data																2 0:05:40 9.4%		4 0:06:30 10.8%		2 0:11:20 18.9%	4 0:28:10 46.9%	2 0:06:00 10.0%	2 0:10:20 17.2%
Total	No Data											2 0:02:20 3.9%	2 0:06:30 10.8%	3 0:04:30 7.5%	3 0:10:20 17.2%	7 0:14:40 24.4%	6 0:14:20 23.9%	6 0:07:57 13.2%	5 0:07:40 12.8%	5 0:09:14 15.4%	3 0:13:00 21.7%	6 0:31:20 52.2%	4 0:10:40 17.8%	5 0:18:10 30.3%

Total	AM (6:00-9:00)	MD (9:00-3:00)	PM (3:00-6:00)	EV (6:00-10:00)	NI (10:00-12:00)	NI (12:00-6:00)
			15 0:26:07 14.5%	8 0:14:44 6.1%	2 0:04:10 3.5%	
			2 0:05:10 2.9%	1 0:00:30 0.2%	3 0:08:20 6.9%	
			2 0:05:40 3.1%	10 0:46:00 19.2%	4 0:16:20 13.6%	
			19 0:36:57 20.5%	19 1:01:14 25.5%	9 0:28:50 24.0%	

Legend

2	Number of Times Train Gates Closed in One Hour
0:02:20	Total Duration of Gate Closure Time in One Hour (hour:minute:second)
3.90%	Percent of Closed Time in One Hour

Total Duration of Gate Closure Time in One Hour	
	No train
	Blockage duration greater than 0 and less than or equal to 5 minutes
	Blockage duration greater than 5 and less than or equal to 15 minutes
	Blockage duration greater than 15 and less than or equal to 30 minutes
	Blockage duration greater than 30 minutes

Source: Fehr & Peers

Exhibit A-8. Frequency and Duration of Gate Closures on Wednesday January 14, 2009

1/14/2009 (Wednesday)

By Types of Trains

	12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM	Total	AM (6:00-9:00)	MD (9:00-3:00)	PM (3:00-6:00)	EV (6:00-10:00)	NI (10:00-12:00)	NI (12:00-6:00)
Amtrak	1	1						1	1	1			1	2	1			1	1	1	1	1	2	2	18	2	5	1	4	4	2
	0:02:10	0:01:00						0:08:10	0:00:40	0:01:20			0:01:22	0:03:50	0:01:00			0:01:10	0:01:10	0:01:10	0:01:00	0:01:10	0:02:20	0:03:50	0:31:22	0:08:50	0:07:32	0:01:10	0:04:30	0:06:10	0:03:10
	3.6%	1.7%						13.6%	1.1%	2.2%			2.3%	6.4%	1.7%			1.9%	1.9%	1.9%	1.7%	1.9%	3.9%	6.4%	2.2%	4.9%	2.1%	0.6%	1.9%	5.1%	0.9%
Sounder						1	3	2	4	1	1	1	3			2	4	2	1	1					26	9	6	8	2		1
						0:01:50	0:05:20	0:04:20	0:06:20	0:07:40	0:02:30	0:02:10	0:06:30			0:04:04	0:09:40	0:02:30	0:01:10	0:07:20					1:01:24	0:16:00	0:18:50	0:16:14	0:08:30		0:01:50
						3.1%	8.9%	7.2%	10.6%	12.8%	4.2%	3.6%	10.8%			6.8%	16.1%	4.2%	1.9%	12.2%					4.3%	8.9%	5.2%	9.0%	3.5%		0.5%
Freight	1		3	3	2	1	1	2	1	2	1	1		3		1	1	1	2	3	5	2	2	1	39	4	7	3	12	3	10
	0:01:30		0:07:34	0:14:40	0:09:00	0:01:00	0:02:10	0:04:00	0:08:40	0:08:20	0:03:50	0:01:40		0:08:20		0:04:18	0:02:00	0:02:00	0:07:50	0:04:52	0:17:50	0:06:30	0:09:10	0:02:30	2:07:44	0:14:50	0:22:10	0:08:18	0:37:02	0:11:40	0:33:44
	2.5%		12.6%	24.4%	15.0%	1.7%	3.6%	6.7%	14.4%	13.9%	6.4%	2.8%		13.9%		7.2%	3.3%	3.3%	13.1%	8.1%	29.7%	10.8%	15.3%	4.2%	8.9%	8.2%	6.2%	4.6%	15.4%	9.7%	9.4%
Multiple Trains								2			2	2	2				2	2	2				2		16	2	6	4	2	2	
								0:03:50			0:05:40	0:05:00	0:06:40				0:05:50	0:05:20	0:21:50				0:05:10		0:59:20	0:03:50	0:17:20	0:11:10	0:21:50	0:05:10	
								6.4%			9.4%	8.3%	11.1%				9.7%	8.9%	36.4%				8.6%		4.1%	2.1%	4.8%	6.2%	9.1%	4.3%	
No Train								1		5	3		1	1					1		2				14	1	10		3		
								0:01:00		0:03:14	0:00:45		0:00:30	0:01:10					0:00:50		0:01:40				0:09:09	0:01:00	0:05:39		0:02:30		
								1.7%		5.4%	1.2%		0.8%	1.9%					1.4%		2.8%				0.6%	0.6%	1.6%		1.0%		
Total	2	1	3	3	2	2	4	8	6	9	7	4	7	6	1	3	7	6	7	5	8	3	6	3	113	18	34	16	23	9	13
	0:03:40	0:01:00	0:07:34	0:14:40	0:09:00	0:02:50	0:07:30	0:21:20	0:15:40	0:20:34	0:12:45	0:08:50	0:15:02	0:13:20	0:01:00	0:08:22	0:17:30	0:11:00	0:32:50	0:13:22	0:20:30	0:07:40	0:16:40	0:06:20	4:48:59	0:44:30	1:11:31	0:36:52	1:14:22	0:23:00	0:38:44
	6.1%	1.7%	12.6%	24.4%	15.0%	4.7%	12.5%	35.6%	26.1%	34.3%	21.2%	14.7%	25.1%	22.2%	1.7%	13.9%	29.2%	18.3%	54.7%	22.3%	34.2%	12.8%	27.8%	10.6%	20.1%	24.7%	19.9%	20.5%	31.0%	19.2%	10.8%

By Purpose

	12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM	Total	AM (6:00-9:00)	MD (9:00-3:00)	PM (3:00-6:00)	EV (6:00-10:00)	NI (10:00-12:00)	NI (12:00-6:00)
Regular	2	1	3	3	2	2	4	2	5	2	1	2	1	4	1	2	3	4	4	1	3	3	2	3	60	11	11	9	11	5	13
	0:03:40	0:01:00	0:07:34	0:14:40	0:09:00	0:02:50	0:07:30	0:02:00	0:13:40	0:05:10	0:02:30	0:03:50	0:01:22	0:10:00	0:01:00	0:05:12	0:04:30	0:05:40	0:10:10	0:02:40	0:15:40	0:07:40	0:09:10	0:06:20	2:32:48	0:23:10	0:23:52	0:15:22	0:36:10	0:15:30	0:38:44
	6.1%	1.7%	12.6%	24.4%	15.0%	4.7%	12.5%	3.3%	22.8%	8.6%	4.2%	6.4%	2.3%	16.7%	1.7%	8.7%	7.5%	9.4%	16.9%	4.4%	26.1%	12.8%	15.3%	10.6%	10.6%	12.9%	6.6%	8.5%	15.1%	12.9%	10.8%
Maintenance								4	1	7	4		4	2		1	2		1	4	5		2		37	5	17	3	10	2	
								0:15:30	0:02:00	0:15:24	0:04:35		0:07:00	0:03:20		0:03:10	0:07:10		0:00:50	0:10:42	0:04:50		0:02:20		1:16:51	0:17:30	0:30:19	0:10:20	0:16:22	0:02:20	
								25.8%	3.3%	25.7%	7.6%		11.7%	5.6%		5.3%	11.9%		1.4%	17.8%	8.1%		3.9%		5.3%	9.7%	8.4%	5.7%	6.8%	1.9%	
Multiple Trains								2			2	2	2				2	2	2				2		16	2	6	4	2	2	
								0:03:50			0:05:40	0:05:00	0:06:40				0:05:50	0:05:20	0:21:50				0:05:10		0:59:20	0:03:50	0:17:20	0:11:10	0:21:50	0:05:10	
								6.4%			9.4%	8.3%	11.1%				9.7%	8.9%	36.4%				8.6%		4.1%	2.1%	4.8%	6.2%	9.1%	4.3%	
Total	2	1	3	3	2	2	4	8	6	9	7	4	7	6	1	3	7	6	7	5	8	3	6	3	113	18	34	16	23	9	13
	0:03:40	0:01:00	0:07:34	0:14:40	0:09:00	0:02:50	0:07:30	0:21:20	0:15:40	0:20:34	0:12:45	0:08:50	0:15:02	0:13:20	0:01:00	0:08:22	0:17:30	0:11:00	0:32:50	0:13:22	0:20:30	0:07:40	0:16:40	0:06:20	4:48:59	0:44:30	1:11:31	0:36:52	1:14:22	0:23:00	0:38:44
	6.1%	1.7%	12.6%	24.4%	15.0%	4.7%	12.5%	35.6%	26.1%	34.3%	21.2%	14.7%	25.1%	22.2%	1.7%	13.9%	29.2%	18.3%	54.7%	22.3%	34.2%	12.8%	27.8%	10.6%	20.1%	24.7%	19.9%	20.5%	31.0%	19.2%	10.8%

Legend

2	Number of Times Train Gates Closed in One Hour
0:02:20	Total Duration of Gate Closure Time in One Hour (hour:minute:second)
3.90%	Percent of Closed Time in One Hour

Total Duration of Gate Closure Time in One Hour

- No train
- Blockage duration greater than 0 and less than or equal to 5 minutes
- Blockage duration greater than 5 and less than or equal to 15 minutes
- Blockage duration greater than 15 and less than or equal to 30 minutes
- Blockage duration greater than 30 minutes

Source: Fehr & Peers

Exhibit A-9. Frequency and Duration of Gate Closures on Thursday January 15, 2009

1/15/2009 (Thursday)

By Types of Trains

	12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM	Total	AM (6:00-9:00)	MD (9:00-3:00)	PM (3:00-6:00)	EV (6:00-10:00)	NI (10:00-12:00)	NI (12:00-6:00)
Amtrak							2	1		1		2	1	1	1			1	1	2	2	1	1		17	3	6	1	6	1	
							0:13:50	0:01:10		0:01:10		0:02:32	0:01:30	0:01:30	0:01:40			0:00:50	0:02:10	0:03:30	0:02:50	0:01:10	0:08:00		0:41:52	0:15:00	0:08:22	0:00:50	0:09:40	0:08:00	
							23.1%	1.9%		1.9%		4.2%	2.5%	2.5%	2.8%			1.4%	3.6%	5.8%	4.7%	1.9%	13.3%		2.9%	8.3%	2.3%	0.5%	4.0%	6.7%	
Sounder						1	3	4	3			2		1	3	3	2	3	2				1		28	10	6	8	2	1	1
						0:01:10	0:04:20	0:12:50	0:04:40			0:02:00		0:01:40	0:05:20	0:06:40	0:02:10	0:03:40	0:02:20				0:01:10		0:48:00	0:21:50	0:09:00	0:12:30	0:02:20	0:01:10	0:01:10
						1.9%	7.2%	21.4%	7.8%			3.3%		2.8%	8.9%	11.1%	3.6%	6.1%	3.9%				1.9%		3.3%	12.1%	2.5%	6.9%	1.0%	1.0%	0.3%
Freight		1	2	1	1	3			1	2	1	2	1	3	1		2	2	2	1		4	2	3	35	1	10	4	7	5	8
		0:04:20	0:33:00	0:06:20	0:02:10	0:10:50			0:01:30	0:07:20	0:09:40	0:11:50	0:04:10	0:09:40	0:03:20		0:04:50	0:02:50	0:22:10	0:03:40		0:14:00	0:12:10	0:08:30	2:52:20	0:01:30	0:46:00	0:07:40	0:39:50	0:20:40	0:56:40
		7.2%	55.0%	10.6%	3.6%	18.1%			2.5%	12.2%	16.1%	19.7%	6.9%	16.1%	5.6%		8.1%	4.7%	36.9%	6.1%		23.3%	20.3%	14.2%	12.0%	0.8%	12.8%	4.3%	16.6%	17.2%	15.7%
Multiple Trains									2								4								6	2		4			
									0:08:30								0:11:20								0:19:50	0:08:30		0:11:20			
									14.2%								18.9%								1.4%	4.7%		6.3%			
No Train	1					1	1			1	6	2	2		1									1	16	1	12			1	2
	0:00:20					0:01:10	0:00:10			0:00:20	0:06:40	0:01:00	0:00:50		0:00:30									0:00:20	0:11:20	0:00:10	0:09:20			0:00:20	0:01:30
	0.6%					1.9%	0.3%			0.6%	11.1%	1.7%	1.4%		0.8%									0.6%	0.8%	0.1%	2.6%			0.3%	0.4%
Total	1	1	2	1	1	5	6	5	6	4	7	8	4	5	6	3	8	6	5	3	2	5	4	4	102	17	34	17	15	8	11
	0:00:20	0:04:20	0:33:00	0:06:20	0:02:10	0:13:10	0:18:20	0:14:00	0:14:40	0:08:50	0:16:20	0:17:22	0:06:30	0:12:50	0:10:50	0:06:40	0:18:20	0:07:20	0:26:40	0:07:10	0:02:50	0:15:10	0:21:20	0:08:50	4:53:22	0:47:00	1:12:42	0:32:20	0:51:50	0:30:10	0:59:20
	0.6%	7.2%	55.0%	10.6%	3.6%	21.9%	30.6%	23.3%	24.4%	14.7%	27.2%	28.9%	10.8%	21.4%	18.1%	11.1%	30.6%	12.2%	44.4%	11.9%	4.7%	25.3%	35.6%	14.7%	20.4%	26.1%	20.2%	18.0%	21.6%	25.1%	16.5%

By Purpose

	12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM	Total	AM (6:00-9:00)	MD (9:00-3:00)	PM (3:00-6:00)	EV (6:00-10:00)	NI (10:00-12:00)	NI (12:00-6:00)
Regular		1	1	1	1	4	3	2	3	2		4	2	4	2	2	4	5	4	2	2	4	2	2	57	8	14	11	12	4	8
		0:04:20	0:06:10	0:06:20	0:02:10	0:12:00	0:04:20	0:02:20	0:04:40	0:07:50		0:14:22	0:05:40	0:11:10	0:05:00	0:03:50	0:07:00	0:06:20	0:06:00	0:05:30	0:02:50	0:14:50	0:12:10	0:07:40	2:32:32	0:11:20	0:44:02	0:17:10	0:29:10	0:19:50	0:31:00
		7.2%	10.3%	10.6%	3.6%	20.0%	7.2%	3.9%	7.8%	13.1%		23.9%	9.4%	18.6%	8.3%	6.4%	11.7%	10.6%	10.0%	9.2%	4.7%	24.7%	20.3%	12.8%	10.6%	6.3%	12.2%	9.5%	12.2%	16.5%	8.6%
Maintenance	1		1			1	3	3	1	2	7	4	2	1	4	1		1	1	1		1	2	2	39	7	20	2	3	4	3
	0:00:20		0:26:50			0:01:10	0:14:00	0:11:40	0:01:30	0:01:00	0:16:20	0:03:00	0:00:50	0:01:40	0:05:50	0:02:50		0:01:00	0:20:40	0:01:40		0:00:20	0:09:10	0:01:10	2:01:00	0:27:10	0:28:40	0:03:50	0:22:40	0:10:20	0:28:20
	0.6%		44.7%			1.9%	23.3%	19.4%	2.5%	1.7%	27.2%	5.0%	1.4%	2.8%	9.7%	4.7%		1.7%	34.4%	2.8%		0.6%	15.3%	1.9%	8.4%	15.1%	8.0%	2.1%	9.4%	8.6%	7.9%
Multiple Trains									2								4								6	2		4			
									0:08:30								0:11:20								0:19:50	0:08:30		0:11:20			
									14.2%								18.9%								1.4%	4.7%		6.3%			
Total	1	1	2	1	1	5	6	5	6	4	7	8	4	5	6	3	8	6	5	3	2	5	4	4	102	17	34	17	15	8	11
	0:00:20	0:04:20	0:33:00	0:06:20	0:02:10	0:13:10	0:18:20	0:14:00	0:14:40	0:08:50	0:16:20	0:17:22	0:06:30	0:12:50	0:10:50	0:06:40	0:18:20	0:07:20	0:26:40	0:07:10	0:02:50	0:15:10	0:21:20	0:08:50	4:53:22	0:47:00	1:12:42	0:32:20	0:51:50	0:30:10	0:59:20
	0.6%	7.2%	55.0%	10.6%	3.6%	21.9%	30.6%	23.3%	24.4%	14.7%	27.2%	28.9%	10.8%	21.4%	18.1%	11.1%	30.6%	12.2%	44.4%	11.9%	4.7%	25.3%	35.6%	14.7%	20.4%	26.1%	20.2%	18.0%	21.6%	25.1%	16.5%

Legend

2	Number of Times Train Gates Closed in One Hour
0:02:20	Total Duration of Gate Closure Time in One Hour (hour:minute:second)
3.90%	Percent of Closed Time in One Hour

Total Duration of Gate Closure Time in One Hour	
	No train
	Blockage duration greater than 0 and less than or equal to 5 minutes
	Blockage duration greater than 5 and less than or equal to 15 minutes
	Blockage duration greater than 15 and less than or equal to 30 minutes
	Blockage duration greater than 30 minutes

Source: Fehr & Peers

Exhibit A-10. Frequency and Duration of Gate Closures on Friday January 16, 2009

1/16/2009 (Friday)

By Types of Trains

	12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM	Total	AM (6:00-9:00)	MD (9:00-3:00)	PM (3:00-6:00)	EV (6:00-10:00)	NI (10:00-12:00)	NI (12:00-6:00)
Amtrak										3	1	1	1		1	1		1	1	2	2	2		1	17		7	2	7	1	
										0:05:00	0:01:00	0:00:40	0:01:20		0:00:40	0:00:50		0:00:40	0:00:50	0:02:40	0:03:50	1:08:32		0:01:20	1:27:22		0:08:40	0:01:30	1:15:52	0:01:20	
										8.3%	1.7%	1.1%	2.2%		1.1%	1.4%		1.1%	1.4%	4.4%	6.4%	114.2%		2.2%	6.1%		2.4%	0.8%	31.6%	1.1%	
Sounder						1	3	4	4							3	3	3	2						23	11		9	2		1
						0:01:20	0:03:40	0:09:00	0:07:30							0:05:30	0:03:40	0:03:50	0:02:30						0:37:00	0:20:10		0:13:00	0:02:30		0:01:20	
						2.2%	6.1%	15.0%	12.5%							9.2%	6.1%	6.4%	4.2%						2.6%	11.2%		7.2%	1.0%		0.4%	
Freight	2	2	4	2	1	1				3	1	1	2	2		1	2		2	2	5	1	2	2	38		9	3	10	4	12
	0:09:20	0:06:50	0:12:40	0:07:00	0:01:40	0:04:00				0:13:50	0:01:10	0:04:30	0:12:30	0:05:50		0:04:10	0:07:40		0:03:50	0:05:40	0:12:40	0:03:50	0:04:00	0:06:30	2:07:40		0:37:50	0:11:50	0:26:00	0:10:30	0:41:30
	15.6%	11.4%	21.1%	11.7%	2.8%	6.7%				23.1%	1.9%	7.5%	20.8%	9.7%		6.9%	12.8%		6.4%	9.4%	21.1%	6.4%	6.7%	10.8%	8.9%		10.5%	6.6%	10.8%	8.8%	11.5%
Multiple Trains							2					2										2	2		8	2	2		2	2	
							0:04:40					0:04:00										0:02:00	0:04:20		0:15:00	0:04:40	0:04:00		0:02:00	0:04:20	
							7.8%					6.7%										3.3%	7.2%		1.0%	2.6%	1.1%		0.8%	3.6%	
No Train			1						2	3	1	2	6	9	6	1	2		1						34	2	27	3	1		1
			0:00:20						0:01:10	0:03:30	0:00:30	0:00:50	0:02:40	0:05:07	0:06:00	0:00:30	0:01:40		0:00:30						0:22:47	0:01:10	0:18:37	0:02:10	0:00:30		0:00:20
			0.6%						1.9%	5.8%	0.8%	1.4%	4.4%	8.5%	10.0%	0.8%	2.8%		0.8%						1.6%	0.6%	5.2%	1.2%	0.2%		0.1%
Total	2	2	5	2	1	2	5	4	6	9	3	6	9	11	7	6	7	4	6	4	7	5	4	3	120	15	45	17	22	7	14
	0:09:20	0:06:50	0:13:00	0:07:00	0:01:40	0:05:20	0:08:20	0:09:00	0:08:40	0:22:20	0:02:40	0:10:00	0:16:30	0:10:57	0:06:40	0:11:00	0:13:00	0:04:30	0:07:40	0:08:20	0:16:30	1:14:22	0:08:20	0:07:50	4:49:49	0:26:00	1:09:07	0:28:30	1:46:52	0:16:10	0:43:10
	15.6%	11.4%	21.7%	11.7%	2.8%	8.9%	13.9%	15.0%	14.4%	37.2%	4.4%	16.7%	27.5%	18.3%	11.1%	18.3%	21.7%	7.5%	12.8%	13.9%	27.5%	123.9%	13.9%	13.1%	20.1%	14.4%	19.2%	15.8%	44.5%	13.5%	12.0%

By Purpose

	12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM	Total	AM (6:00-9:00)	MD (9:00-3:00)	PM (3:00-6:00)	EV (6:00-10:00)	NI (10:00-12:00)	NI (12:00-6:00)
Regular	2	2	2	1	1	2	2	2	2	4		2	3	2	1	3	4	4	3	2	4	2	2	3	55	6	12	11	11	5	10
	0:09:20	0:06:50	0:08:50	0:04:50	0:01:40	0:05:20	0:02:40	0:02:20	0:02:30	0:13:40		0:05:10	0:13:50	0:05:50	0:00:40	0:06:00	0:09:30	0:04:30	0:03:20	0:06:00	0:13:10	0:05:10	0:04:00	0:07:50	2:23:00	0:07:30	0:39:10	0:20:00	0:27:40	0:11:50	0:36:50
	15.6%	11.4%	14.7%	8.1%	2.8%	8.9%	4.4%	3.9%	4.2%	22.8%		8.6%	23.1%	9.7%	1.1%	10.0%	15.8%	7.5%	5.6%	10.0%	21.9%	8.6%	6.7%	13.1%	9.9%	4.2%	10.9%	11.1%	11.5%	9.9%	10.2%
Maintenance			3	1			1	2	4	5	3	2	6	9	6	3	3		3	2	3	1			57	7	31	6	9		4
			0:04:10	0:02:10			0:01:00	0:06:40	0:06:10	0:08:40	0:02:40	0:00:50	0:02:40	0:05:07	0:06:00	0:05:00	0:03:30		0:04:20	0:02:20	0:03:20	1:07:12			2:11:49	0:13:50	0:25:57	0:08:30	1:17:12		0:06:20
			6.9%	3.6%			1.7%	11.1%	10.3%	14.4%	4.4%	1.4%	4.4%	8.5%	10.0%	8.3%	5.8%		7.2%	3.9%	5.6%	112.0%			9.2%	7.7%	7.2%	4.7%	32.2%		1.8%
Multiple Trains							2					2										2	2		8	2	2		2	2	
							0:04:40					0:04:00										0:02:00	0:04:20		0:15:00	0:04:40	0:04:00		0:02:00	0:04:20	
							7.8%					6.7%										3.3%	7.2%		1.0%	2.6%	1.1%		0.8%	3.6%	
Total	2	2	5	2	1	2	5	4	6	9	3	6	9	11	7	6	7	4	6	4	7	5	4	3	120	15	45	17	22	7	14
	0:09:20	0:06:50	0:13:00	0:07:00	0:01:40	0:05:20	0:08:20	0:09:00	0:08:40	0:22:20	0:02:40	0:10:00	0:16:30	0:10:57	0:06:40	0:11:00	0:13:00	0:04:30	0:07:40	0:08:20	0:16:30	1:14:22	0:08:20	0:07:50	4:49:49	0:26:00	1:09:07	0:28:30	1:46:52	0:16:10	0:43:10
	15.6%	11.4%	21.7%	11.7%	2.8%	8.9%	13.9%	15.0%	14.4%	37.2%	4.4%	16.7%	27.5%	18.3%	11.1%	18.3%	21.7%	7.5%	12.8%	13.9%	27.5%	123.9%	13.9%	13.1%	20.1%	14.4%	19.2%	15.8%	44.5%	13.5%	12.0%

Legend

2	Number of Times Train Gates Closed in One Hour
0:02:20	Total Duration of Gate Closure Time in One Hour (hour:minute:second)
3.90%	Percent of Closed Time in One Hour

Total Duration of Gate Closure Time in One Hour

	No train
	Blockage duration greater than 0 and less than or equal to 5 minutes
	Blockage duration greater than 5 and less than or equal to 15 minutes
	Blockage duration greater than 15 and less than or equal to 30 minutes
	Blockage duration greater than 30 minutes

Source: Fehr & Peers

Exhibit A-11. Frequency and Duration of Gate Closures on Saturday January 17, 2009

1/17/2009 (Saturday)

By Types of Trains

	12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM	Total	AM (6:00-9:00)	MD (9:00-3:00)	PM (3:00-6:00)	EV (6:00-10:00)	NI (10:00-12:00)	NI (12:00-6:00)
Amtrak			2				1	1		2		1	1		1	2	1	1	1	1	1	3		4	23	2	5	4	6	4	2
			0:04:40				0:06:40	0:00:50		0:03:00		0:01:00	0:01:20		0:00:50	0:02:00	0:00:50	0:00:50	0:01:10	0:01:10	0:01:40	0:07:50		0:08:40	0:42:30	0:07:30	0:06:10	0:03:40	0:11:50	0:08:40	0:04:40
			7.8%				11.1%	1.4%		5.0%		1.7%	2.2%		1.4%	3.3%	1.4%	1.4%	1.9%	1.9%	2.8%	13.1%		14.4%	3.0%	4.2%	1.7%	2.0%	4.9%	7.2%	1.3%
Sounder																															
Freight	1		1	5		2	3		1	3	2	1	1	3	1	2	1		2	2	2	2	1		36	4	11	3	8	1	9
	0:04:50		0:02:40	0:36:50		0:06:20	0:04:40		0:03:40	0:09:10	0:08:40	0:03:50	0:03:20	0:08:50	0:00:50	1:12:00	0:04:30		0:06:00	0:02:00	0:04:20	0:09:30	0:02:30		3:14:30	0:08:20	0:34:40	1:16:30	0:21:50	0:02:30	0:50:40
	8.1%		4.4%	61.4%		10.6%	7.8%		6.1%	15.3%	14.4%	6.4%	5.6%	14.7%	1.4%	120.0%	7.5%		10.0%	3.3%	7.2%	15.8%	4.2%		13.5%	4.6%	9.6%	42.5%	9.1%	2.1%	14.1%
Multiple Trains																	4				2				6			4	2		
																	0:14:30				0:04:30				0:19:00			0:14:30	0:04:30		
																	24.2%				7.5%				1.3%			8.1%	1.9%		
No Train										1			1						1		1				4		2		2		
										0:00:50			0:00:30						0:00:30		0:00:20				0:02:10		0:01:20		0:00:50		
										1.4%			0.8%						0.8%		0.6%				0.2%		0.4%		0.3%		
Total	1		3	5		2	4	1	1	6	2	2	3	3	2	4	6	1	4	3	6	5	1	4	69	6	18	11	18	5	11
	0:04:50		0:07:20	0:36:50		0:06:20	0:11:20	0:00:50	0:03:40	0:13:00	0:08:40	0:04:50	0:05:10	0:08:50	0:01:40	1:14:00	0:19:50	0:00:50	0:07:40	0:03:10	0:10:50	0:17:20	0:02:30	0:08:40	4:18:10	0:15:50	0:42:10	1:34:40	0:39:00	0:11:10	0:55:20
	8.1%		12.2%	61.4%		10.6%	18.9%	1.4%	6.1%	21.7%	14.4%	8.1%	8.6%	14.7%	2.8%	123.3%	33.1%	1.4%	12.8%	5.3%	18.1%	28.9%	4.2%	14.4%	17.9%	8.8%	11.7%	52.6%	16.2%	9.3%	15.4%

By Purpose

	12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM	Total	AM (6:00-9:00)	MD (9:00-3:00)	PM (3:00-6:00)	EV (6:00-10:00)	NI (10:00-12:00)	NI (12:00-6:00)
Regular	1		1	2		2		1	1	4	2	2	1	2	1	3		1	2	1	2	3	1	2	35	2	12	4	8	3	6
	0:04:50		0:02:40	0:06:30		0:06:20		0:00:50	0:03:40	0:11:00	0:08:40	0:04:50	0:01:20	0:08:10	0:00:50	1:03:40		0:00:50	0:05:00	0:01:10	0:04:50	0:06:40	0:02:30	0:02:00	2:26:20	0:04:30	0:34:50	1:04:30	0:17:40	0:04:30	0:20:20
	8.1%		4.4%	10.8%		10.6%		1.4%	6.1%	18.3%	14.4%	8.1%	2.2%	13.6%	1.4%	106.1%		1.4%	8.3%	1.9%	8.1%	11.1%	4.2%	3.3%	10.2%	2.5%	9.7%	35.8%	7.4%	3.8%	5.6%
Maintenance			2	3			4			2			2	1	1	1	2		2	2	2	2		2	28	4	6	3	8	2	5
			0:04:40	0:30:20			0:11:20			0:02:00			0:03:50	0:00:40	0:00:50	0:10:20	0:05:20		0:02:40	0:02:00	0:01:30	0:10:40		0:06:40	1:32:50	0:11:20	0:07:20	0:15:40	0:16:50	0:06:40	0:35:00
			7.8%	50.6%			18.9%			3.3%			6.4%	1.1%	1.4%	17.2%	8.9%		4.4%	3.3%	2.5%	17.8%		11.1%	6.4%	6.3%	2.0%	8.7%	7.0%	5.6%	9.7%
Multiple Trains																	4				2				6			4	2		
																	0:14:30				0:04:30				0:19:00			0:14:30	0:04:30		
																	24.2%				7.5%				1.3%			8.1%	1.9%		
Total	1		3	5		2	4	1	1	6	2	2	3	3	2	4	6	1	4	3	6	5	1	4	69	6	18	11	18	5	11
	0:04:50		0:07:20	0:36:50		0:06:20	0:11:20	0:00:50	0:03:40	0:13:00	0:08:40	0:04:50	0:05:10	0:08:50	0:01:40	1:14:00	0:19:50	0:00:50	0:07:40	0:03:10	0:10:50	0:17:20	0:02:30	0:08:40	4:18:10	0:15:50	0:42:10	1:34:40	0:39:00	0:11:10	0:55:20
	8.1%		12.2%	61.4%		10.6%	18.9%	1.4%	6.1%	21.7%	14.4%	8.1%	8.6%	14.7%	2.8%	123.3%	33.1%	1.4%	12.8%	5.3%	18.1%	28.9%	4.2%	14.4%	17.9%	8.8%	11.7%	52.6%	16.2%	9.3%	15.4%

Legend

2	Number of Times Train Gates Closed in One Hour
0:02:20	Total Duration of Gate Closure Time in One Hour (hour:minute:second)
3.90%	Percent of Closed Time in One Hour

Total Duration of Gate Closure Time in One Hour

	No train
	Blockage duration greater than 0 and less than or equal to 5 minutes
	Blockage duration greater than 5 and less than or equal to 15 minutes
	Blockage duration greater than 15 and less than or equal to 30 minutes
	Blockage duration greater than 30 minutes

Source: Fehr & Peers

Exhibit A-12. Frequency and Duration of Gate Closures on Sunday January 18, 2009

1/18/2009 (Sunday)

By Types of Trains

	12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM	Total	AM (6:00-9:00)	MD (9:00-3:00)	PM (3:00-6:00)	EV (6:00-10:00)	NI (10:00-12:00)	NI (12:00-6:00)
Amtrak							1	1		1		1		1	1	1		1	3	2		1		2	16	2	4	2	6	2	
							0:01:10	0:00:50		0:01:00		0:00:50		0:01:50	0:00:40	0:01:20		0:01:00	0:03:20	0:02:10		0:01:20		0:03:20	0:18:50	0:02:00	0:04:20	0:02:20	0:06:50	0:03:20	
							1.9%	1.4%		1.7%		1.4%		3.1%	1.1%	2.2%		1.7%	5.6%	3.6%		2.2%		5.6%	1.3%	1.1%	1.2%	1.3%	2.8%	2.8%	
Sounder																															
Freight	2			1	2			1	1	2	2	1				2		5		2	5		2		28	2	5	7	7	2	5
	0:06:40			0:03:30	0:05:00			0:01:40	0:04:00	0:09:20	0:05:00	0:03:30				0:05:20		0:09:30		0:06:00	0:09:50		0:03:40		1:13:00	0:05:40	0:17:50	0:14:50	0:15:50	0:03:40	0:15:10
	11.1%			5.8%	8.3%			2.8%	6.7%	15.6%	8.3%	5.8%				8.9%		15.8%		10.0%	16.4%		6.1%		5.1%	3.1%	5.0%	8.2%	6.6%	3.1%	4.2%
Multiple Trains							2					2		2									2		8	2	4			2	
							0:09:00					0:04:00		0:05:20									0:12:20		0:30:40	0:09:00	0:09:20			0:12:20	
							15.0%					6.7%		8.9%									20.6%		2.1%	5.0%	2.6%			10.3%	
No Train																1		1	2	1	9	7	2	13	36			2	19	15	
																0:00:30		0:00:20	0:01:00	0:00:50	0:11:45	0:03:50	0:01:40	0:09:42	0:29:37			0:00:50	0:17:25	0:11:22	
																0.8%		0.6%	1.7%	1.4%	19.6%	6.4%	2.8%	16.2%	2.1%			0.5%	7.3%	9.5%	
Total	2			1	2		3	2	1	3	2	4		3	1	4		7	5	5	14	8	6	15	88	6	13	11	32	21	5
	0:06:40			0:03:30	0:05:00		0:10:10	0:02:30	0:04:00	0:10:20	0:05:00	0:08:20		0:07:10	0:00:40	0:07:10		0:10:50	0:04:20	0:09:00	0:21:35	0:05:10	0:17:40	0:13:02	2:32:07	0:16:40	0:31:30	0:18:00	0:40:05	0:30:42	0:15:10
	11.1%			5.8%	8.3%		16.9%	4.2%	6.7%	17.2%	8.3%	13.9%		11.9%	1.1%	11.9%		18.1%	7.2%	15.0%	36.0%	8.6%	29.4%	21.7%	10.6%	9.3%	8.7%	10.0%	16.7%	25.6%	4.2%

By Purpose

	12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM	Total	AM (6:00-9:00)	MD (9:00-3:00)	PM (3:00-6:00)	EV (6:00-10:00)	NI (10:00-12:00)	NI (12:00-6:00)
Regular	2				2			2	1	3	2	2		1	1	2		3	3	1		1	2	2	30	3	9	5	5	4	4
	0:06:40				0:05:00			0:02:30	0:04:00	0:10:20	0:05:00	0:04:20		0:01:50	0:00:40	0:05:00		0:06:10	0:03:20	0:01:10		0:01:20	0:03:40	0:03:20	1:04:20	0:06:30	0:22:10	0:11:10	0:05:50	0:07:00	0:11:40
	11.1%				8.3%			4.2%	6.7%	17.2%	8.3%	7.2%		3.1%	1.1%	8.3%		10.3%	5.6%	1.9%		2.2%	6.1%	5.6%	4.5%	3.6%	6.2%	6.2%	2.4%	5.8%	3.2%
Maintenance				1			1									2		4	2	4	14	7	2	13	50	1		6	27	15	1
				0:03:30			0:01:10									0:02:10		0:04:40	0:01:00	0:07:50	0:21:35	0:03:50	0:01:40	0:09:42	0:57:07	0:01:10		0:06:50	0:34:15	0:11:22	0:03:30
				5.8%			1.9%									3.6%		7.8%	1.7%	13.1%	36.0%	6.4%	2.8%	16.2%	4.0%	0.6%		3.8%	14.3%	9.5%	1.0%
Multiple Trains							2					2		2									2		8	2	4			2	
							0:09:00					0:04:00		0:05:20									0:12:20		0:30:40	0:09:00	0:09:20			0:12:20	
							15.0%					6.7%		8.9%									20.6%		2.1%	5.0%	2.6%			10.3%	
Total	2			1	2		3	2	1	3	2	4		3	1	4		7	5	5	14	8	6	15	88	6	13	11	32	21	5
	0:06:40			0:03:30	0:05:00		0:10:10	0:02:30	0:04:00	0:10:20	0:05:00	0:08:20		0:07:10	0:00:40	0:07:10		0:10:50	0:04:20	0:09:00	0:21:35	0:05:10	0:17:40	0:13:02	2:32:07	0:16:40	0:31:30	0:18:00	0:40:05	0:30:42	0:15:10
	11.1%			5.8%	8.3%		16.9%	4.2%	6.7%	17.2%	8.3%	13.9%		11.9%	1.1%	11.9%		18.1%	7.2%	15.0%	36.0%	8.6%	29.4%	21.7%	10.6%	9.3%	8.7%	10.0%	16.7%	25.6%	4.2%

Legend

2	Number of Times Train Gates Closed in One Hour
0:02:20	Total Duration of Gate Closure Time in One Hour (hour:minute:second)
3.90%	Percent of Closed Time in One Hour

Total Duration of Gate Closure Time in One Hour	
	No train
	Blockage duration greater than 0 and less than or equal to 5 minutes
	Blockage duration greater than 5 and less than or equal to 15 minutes
	Blockage duration greater than 15 and less than or equal to 30 minutes
	Blockage duration greater than 30 minutes

Source: Fehr & Peers

Exhibit A-13. Frequency and Duration of Gate Closures on Monday January 19, 2009

1/19/2009 (Monday)

By Types of Trains

	12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM	Total	AM (6:00-9:00)	MD (9:00-3:00)	PM (3:00-6:00)	EV (6:00-10:00)	NI (10:00-12:00)	NI (12:00-6:00)
Amtrak	Foggy						2	1		1		2		1	1				1		1	3	Foggy			3	5		5		
							0:09:30	0:00:50		0:01:20		0:02:30		0:01:30	0:00:40				0:01:10		0:01:20	0:04:00				0:10:20	0:06:00		0:06:30		
							15.8%	1.4%		2.2%		4.2%		2.5%	1.1%				1.9%		2.2%	6.7%				5.7%	1.7%		2.7%		
Sounder	Foggy							2	2	3	5				2	2	3			1			Foggy			4	10	5	1		
								0:03:20	0:03:10	0:03:50	0:08:00				0:03:00	0:05:10	0:10:20			0:00:50						0:06:30	0:14:50	0:15:30	0:00:50		
								5.6%	5.3%	6.4%	13.3%				5.0%	8.6%	17.2%			1.4%						3.6%	4.1%	8.6%	0.3%		
Freight	Foggy									2	1	2	2	1	2		2	3	2	1	5	3	Foggy				10	5	11		
										0:07:00	0:01:12	0:10:00	0:20:30	0:00:34	0:14:30		0:07:00	0:09:20	0:03:00	0:04:50	0:13:31	0:06:20					0:53:46	0:16:20	0:27:41		
										11.7%	2.0%	16.7%	34.2%	0.9%	24.2%		11.7%	15.6%	5.0%	8.1%	22.5%	10.6%					14.9%	9.1%	11.5%		
Multiple Trains	Foggy							2				2							2				Foggy			2	2		2		
								0:05:40				0:02:00							0:19:20							0:05:40	0:02:00		0:19:20		
								9.4%				3.3%							32.2%							3.1%	0.6%		8.1%		
No Train	Foggy					1			1	1				2			1		2	2		1	Foggy			1	3	1	5		
						0:00:20			0:00:20	0:00:20				0:03:10			0:00:40		0:01:30	0:02:10		0:01:00				0:00:20	0:03:30	0:00:40	0:04:40		
						0.6%			0.6%	0.6%				5.3%			1.1%		2.5%	3.6%		1.7%				0.2%	1.0%	0.4%	1.9%		
Total	Foggy					1	2	5	3	7	6	6	2	4	5	2	6	3	7	4	6	7	Foggy			10	30	11	24		
						0:00:20	0:09:30	0:09:50	0:03:30	0:12:30	0:09:12	0:14:30	0:20:30	0:05:14	0:18:10	0:05:10	0:18:00	0:09:20	0:25:00	0:07:50	0:14:51	0:11:20					0:22:50	1:20:06	0:32:30	0:59:01		
						0.6%	15.8%	16.4%	5.8%	20.8%	15.3%	24.2%	34.2%	8.7%	30.3%	8.6%	30.0%	15.6%	41.7%	13.1%	24.8%	18.9%				12.7%	22.3%	18.1%	24.6%		

By Purpose

	12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM	Total	AM (6:00-9:00)	MD (9:00-3:00)	PM (3:00-6:00)	EV (6:00-10:00)	NI (10:00-12:00)	NI (12:00-6:00)
Regular	Foggy							2	1	3	1	3	1	1	5	1	3	2	2	1	2	4	Foggy			3	14	6	9		
								0:02:10	0:01:40	0:08:20	0:01:00	0:07:00	0:05:10	0:01:30	0:18:10	0:01:10	0:08:10	0:08:10	0:03:00	0:04:50	0:06:50	0:08:40				0:03:50	0:41:10	0:17:30	0:23:20		
								3.6%	2.8%	13.9%	1.7%	11.7%	8.6%	2.5%	30.3%	1.9%	13.6%	13.6%	5.0%	8.1%	11.4%	14.4%				2.1%	11.4%	9.7%	9.7%		
Maintenance	Foggy					1	2	1	2	4	5	1	1	3		1	3	1	3	3	4	3	Foggy			5	14	5	13		
						0:00:20	0:09:30	0:02:00	0:01:50	0:04:10	0:08:12	0:05:30	0:15:20	0:03:44		0:04:00	0:09:50	0:01:10	0:02:40	0:03:00	0:08:01	0:02:40				0:13:20	0:36:56	0:15:00	0:16:21		
						0.6%	15.8%	3.3%	3.1%	6.9%	13.7%	9.2%	25.6%	6.2%		6.7%	16.4%	1.9%	4.4%	5.0%	13.4%	4.4%				7.4%	10.3%	8.3%	6.8%		
Multiple Trains	Foggy							2				2							2				Foggy			2	2		2		
								0:05:40				0:02:00							0:19:20							0:05:40	0:02:00		0:19:20		
								9.4%				3.3%							32.2%							3.1%	0.6%		8.1%		
Total	Foggy					1	2	5	3	7	6	6	2	4	5	2	6	3	7	4	6	7	Foggy			10	30	11	24		
						0:00:20	0:09:30	0:09:50	0:03:30	0:12:30	0:09:12	0:14:30	0:20:30	0:05:14	0:18:10	0:05:10	0:18:00	0:09:20	0:25:00	0:07:50	0:14:51	0:11:20				0:22:50	1:20:06	0:32:30	0:59:01		
						0.6%	15.8%	16.4%	5.8%	20.8%	15.3%	24.2%	34.2%	8.7%	30.3%	8.6%	30.0%	15.6%	41.7%	13.1%	24.8%	18.9%				12.7%	22.3%	18.1%	24.6%		

Legend

2	Number of Times Train Gates Closed in One Hour
0:02:20	Total Duration of Gate Closure Time in One Hour (hour:minute:second)
3.90%	Percent of Closed Time in One Hour

Total Duration of Gate Closure Time in One Hour

	No train
	Blockage duration greater than 0 and less than or equal to 5 minutes
	Blockage duration greater than 5 and less than or equal to 15 minutes
	Blockage duration greater than 15 and less than or equal to 30 minutes
	Blockage duration greater than 30 minutes

Source: Fehr & Peers

Exhibit A-14. Frequency and Duration of Gate Closures on Monday January 20, 2009

1/20/2009 (Tuesday)

By Types of Trains

	12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM	Total	AM (6:00-9:00)	MD (9:00-3:00)	PM (3:00-6:00)	EV (6:00-10:00)	NI (10:00-12:00)	NI (12:00-6:00)
Amtrak	Foggy							1	1			1	1	1	1	No Data										2	4				
								0:00:58	0:01:30			0:00:50	0:01:20	0:01:00	0:00:50											0:02:28	0:04:00				
								1.6%	2.5%			1.4%	2.2%	1.7%	1.4%											1.4%	1.1%				
Sounder	Foggy						3	2	4	1		1	1			No Data										9	3				
							0:03:00	0:04:20	0:09:08	0:02:50		0:11:40	0:01:30													0:16:28	0:16:00				
							5.0%	7.2%	15.2%	4.7%		19.4%	2.5%													9.1%	4.4%				
Freight	Foggy						1		2	3	1		2	1		No Data										3	7				
							0:09:40		0:04:00	0:06:40	0:02:20		0:09:50	0:05:50												0:13:40	0:24:40				
							16.1%		6.7%	11.1%	3.9%		16.4%	9.7%												7.6%	6.9%				
Multiple Trains	Foggy							2		4		6				No Data										2	10				
								0:04:11		0:16:50		0:21:10														0:04:11	0:38:00				
								7.0%		28.1%		35.3%														2.3%	10.6%				
No Train	Foggy						1	1								No Data										2					
							0:01:30	0:00:22																		0:01:52					
							2.5%	0.6%																		1.0%					
Total	Foggy						5	6	7	8	1	8	4	2	1	No Data										18	24				
							0:14:10	0:09:51	0:14:38	0:26:20	0:02:20	0:33:40	0:12:40	0:06:50	0:00:50											0:38:39	1:22:40				
							23.6%	16.4%	24.4%	43.9%	3.9%	56.1%	21.1%	11.4%	1.4%											21.5%	23.0%				

By Purpose

	12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM	Total	AM (6:00-9:00)	MD (9:00-3:00)	PM (3:00-6:00)	EV (6:00-10:00)	NI (10:00-12:00)	NI (12:00-6:00)
Regular	Foggy						3	2	2	2	1	1	3	1	1	No Data										7	9				
							0:03:00	0:02:08	0:02:20	0:05:50	0:02:20	0:00:50	0:11:10	0:05:50	0:00:50											0:07:28	0:26:50				
							5.0%	3.6%	3.9%	9.7%	3.9%	1.4%	18.6%	9.7%	1.4%											4.1%	7.5%				
Maintenance	Foggy						2	2	5	2		1	1	1		No Data										9	5				
							0:11:10	0:03:32	0:12:18	0:03:40		0:11:40	0:01:30	0:01:00												0:27:00	0:17:50				
							18.6%	5.9%	20.5%	6.1%		19.4%	2.5%	1.7%												15.0%	5.0%				
Multiple Trains	Foggy							2		4		6				No Data										2	10				
								0:04:11		0:16:50		0:21:10														0:04:11	0:38:00				
								7.0%		28.1%		35.3%														2.3%	10.6%				
Total	Foggy						5	6	7	8	1	8	4	2	1	No Data										18	24				
							0:14:10	0:09:51	0:14:38	0:26:20	0:02:20	0:33:40	0:12:40	0:06:50	0:00:50											0:38:39	1:22:40				
							23.6%	16.4%	24.4%	43.9%	3.9%	56.1%	21.1%	11.4%	1.4%											21.5%	23.0%				

Legend

2	Number of Times Train Gates Closed in One Hour
0:02:20	Total Duration of Gate Closure Time in One Hour (hour:minute:second)
3.90%	Percent of Closed Time in One Hour

Total Duration of Gate Closure Time in One Hour

	No train
	Blockage duration greater than 0 and less than or equal to 5 minutes
	Blockage duration greater than 5 and less than or equal to 15 minutes
	Blockage duration greater than 15 and less than or equal to 30 minutes
	Blockage duration greater than 30 minutes

Source: Fehr & Peers

APPENDIX B. HOURLY VOLUMES AND VEHICLE TYPES ON EAST–WEST STREETS

- South Holgate Street
- South Lander Street
- South Atlantic Street
- South Royal Brougham Way

DEFINITION OF VEHICLE CLASSIFICATION

Cars – Includes all sedans, coupes, and station wagons.

Buses – Includes passenger-carrying buses with two axles and six tires or three or more axles.

Light Trucks – Includes single unit, two-axle trucks with four or six tires.

Trucks – Includes three-axle single unit trucks, four-axle single unit trucks, five-axle single trailer trucks, six-axle single trailer trucks, and six-axle multi-trailer trucks.

Other – Includes all unclassified vehicles.

Exhibit B-1. Vehicle Types and Hourly Volumes on South Holgate Street (2005)

S Holgate Street Between 1st and 4th: Two-Way Volumes								
Date	Time	Cars	Buses	Light Trucks	Trucks	Other	Hourly Total	Truck %
6/13/2005	12:00 AM	16	1	7	0	4	28	**0.00%**
6/13/2005	1:00 AM	16	0	8	1	4	29	**3.45%**
6/13/2005	2:00 AM	12	0	4	1	3	20	**5.00%**
6/13/2005	3:00 AM	34	0	6	2	5	47	**4.26%**
6/13/2005	4:00 AM	65	2	31	2	19	119	**1.68%**
6/13/2005	5:00 AM	158	6	44	7	52	267	**2.62%**
6/13/2005	6:00 AM	335	6	97	14	65	517	**2.71%**
6/13/2005	7:00 AM	375	2	126	16	40	559	**2.86%**
6/13/2005	8:00 AM	348	2	145	14	73	582	**2.41%**
6/13/2005	9:00 AM	348	5	148	21	68	590	**3.56%**
6/13/2005	10:00 AM	355	1	155	22	54	587	**3.75%**
6/13/2005	11:00 AM	470	2	173	18	74	737	**2.44%**
6/13/2005	12:00 PM	392	4	151	17	75	639	**2.66%**
6/13/2005	1:00 PM	415	6	150	16	75	662	**2.42%**
6/13/2005	2:00 PM	445	3	144	7	77	676	**1.04%**
6/13/2005	3:00 PM	502	3	131	11	69	716	**1.54%**
6/13/2005	4:00 PM	518	4	117	5	47	691	**0.72%**
6/13/2005	5:00 PM	276	0	72	2	22	372	**0.54%**
6/13/2005	6:00 PM	176	1	30	0	21	228	**0.00%**
6/13/2005	7:00 PM	114	1	26	1	42	184	**0.54%**
6/13/2005	8:00 PM	81	0	21	0	13	115	**0.00%**
6/13/2005	9:00 PM	64	0	8	0	13	85	**0.00%**
6/13/2005	10:00 PM	31	0	3	0	12	46	**0.00%**
6/13/2005	11:00 PM	40	0	4	1	13	58	**1.72%**
		5,586	**49**	**1,801**	**178**	**940**	**8,554**	
		65.30%	**0.57%**	**21.05%**	**2.08%**	**10.99%**		

Source: Fehr & Peers

Exhibit B-2. Vehicle Types and Hourly Volumes on South Lander Street (2005)

S Lander Street Between 1st and 4th: Two-Way Volumes								
Date	Time	Cars	Buses	Light Trucks	Trucks	Other	Hourly Total	Truck %
6/13/2005	12:00:00 AM	14	0	8	1	7	30	**3.33%**
6/13/2005	1:00:00 AM	14	1	5	0	4	24	**0.00%**
6/13/2005	2:00:00 AM	15	0	8	2	4	29	**6.90%**
6/13/2005	3:00:00 AM	46	0	4	6	3	59	**10.17%**
6/13/2005	4:00:00 AM	95	1	39	5	22	162	**3.09%**
6/13/2005	5:00:00 AM	215	2	58	18	31	324	**5.56%**
6/13/2005	6:00:00 AM	431	8	129	26	83	677	**3.84%**
6/13/2005	7:00:00 AM	443	8	149	30	73	703	**4.27%**
6/13/2005	8:00:00 AM	447	7	161	23	67	705	**3.26%**
6/13/2005	9:00:00 AM	486	8	215	40	76	825	**4.85%**
6/13/2005	10:00:00 AM	513	2	177	32	94	818	**3.91%**
6/13/2005	11:00:00 AM	626	11	201	30	88	956	**3.14%**
6/13/2005	12:00:00 PM	668	4	224	36	88	1,020	**3.53%**
6/13/2005	1:00:00 PM	664	6	171	26	66	933	**2.79%**
6/13/2005	2:00:00 PM	456	5	151	20	74	706	**2.83%**
6/13/2005	3:00:00 PM	333	7	122	14	79	555	**2.52%**
6/13/2005	4:00:00 PM	318	4	109	13	74	518	**2.51%**
6/13/2005	5:00:00 PM	259	2	66	9	63	399	**2.26%**
6/13/2005	6:00:00 PM	181	3	47	5	35	271	**1.85%**
6/13/2005	7:00:00 PM	133	1	26	4	32	196	**2.04%**
6/13/2005	8:00:00 PM	88	0	19	1	31	139	**0.72%**
6/13/2005	9:00:00 PM	77	3	12	2	16	110	**1.82%**
6/13/2005	10:00:00 PM	40	0	15	2	3	60	**3.33%**
6/13/2005	11:00:00 PM	26	0	9	5	0	40	**12.50%**
		6,588	**83**	**2,125**	**350**	**1,113**	**10,259**	
		64.22%	**0.81%**	**20.71%**	**3.41%**	**10.85%**		

Source: Fehr & Peers

Exhibit B-3. Hourly Truck Volumes on South Lander Street (2005)

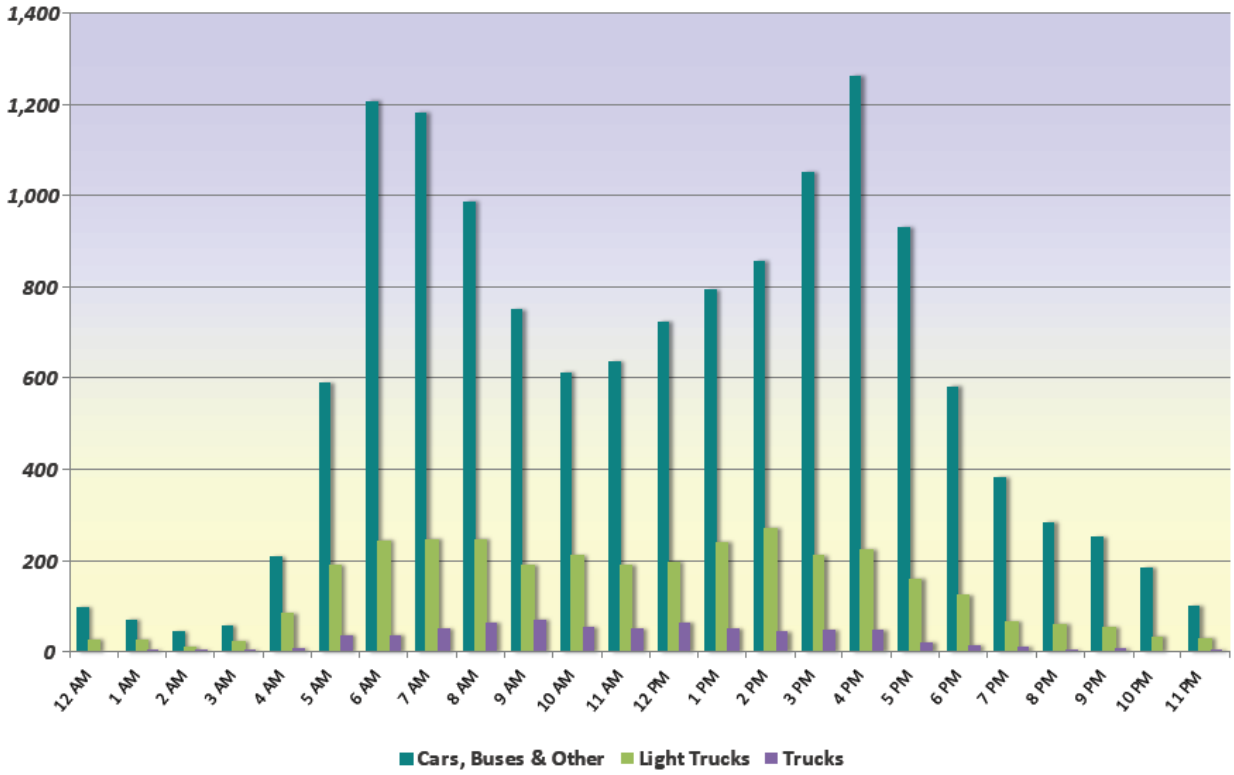
Source: Fehr & Peers

Exhibit B-4. Vehicle Types and Hourly Volumes on South Atlantic Street (2005)

S Atlantic Street Between 1st & 4th: Two-Way Volumes								
Date	Time	Cars	Buses	Light Trucks	Trucks	Other	Hourly Total	Truck %
6/13/2005	12:00:00 AM	84	2	26	0	10	122	**0.00%**
6/13/2005	1:00:00 AM	63	3	26	3	5	100	**3.00%**
6/13/2005	2:00:00 AM	41	1	9	5	2	58	**8.62%**
6/13/2005	3:00:00 AM	51	2	22	2	4	81	**2.47%**
6/13/2005	4:00:00 AM	190	7	82	6	11	296	**2.03%**
6/13/2005	5:00:00 AM	513	24	189	36	51	813	**4.43%**
6/13/2005	6:00:00 AM	1,085	28	245	38	94	1,490	**2.55%**
6/13/2005	7:00:00 AM	1,063	17	246	51	98	1,475	**3.46%**
6/13/2005	8:00:00 AM	907	12	248	65	68	1,300	**5.00%**
6/13/2005	9:00:00 AM	686	15	189	71	49	1,010	**7.03%**
6/13/2005	10:00:00 AM	561	7	210	52	44	874	**5.95%**
6/13/2005	11:00:00 AM	581	6	191	50	48	876	**5.71%**
6/13/2005	12:00:00 PM	638	14	198	63	71	984	**6.40%**
6/13/2005	1:00:00 PM	712	15	242	51	65	1,085	**4.70%**
6/13/2005	2:00:00 PM	774	12	271	45	70	1,172	**3.84%**
6/13/2005	3:00:00 PM	965	11	210	47	73	1,306	**3.60%**
6/13/2005	4:00:00 PM	1,161	20	225	48	77	1,531	**3.14%**
6/13/2005	5:00:00 PM	887	9	160	19	34	1,109	**1.71%**
6/13/2005	6:00:00 PM	557	3	122	12	22	716	**1.68%**
6/13/2005	7:00:00 PM	365	3	68	9	12	457	**1.97%**
6/13/2005	8:00:00 PM	274	4	59	5	7	349	**1.43%**
6/13/2005	9:00:00 PM	240	2	54	8	7	311	**2.57%**
6/13/2005	10:00:00 PM	176	2	33	1	6	218	**0.46%**
6/13/2005	11:00:00 PM	97	2	30	3	1	133	**2.26%**
		12,671	**221**	**3,355**	**690**	**929**	**17,866**	
		70.92%	**1.24%**	**18.78%**	**3.86%**	**5.20%**		

Source: Fehr & Peers

Exhibit B-5. Hourly Truck Volumes on South Atlantic Street (2005)



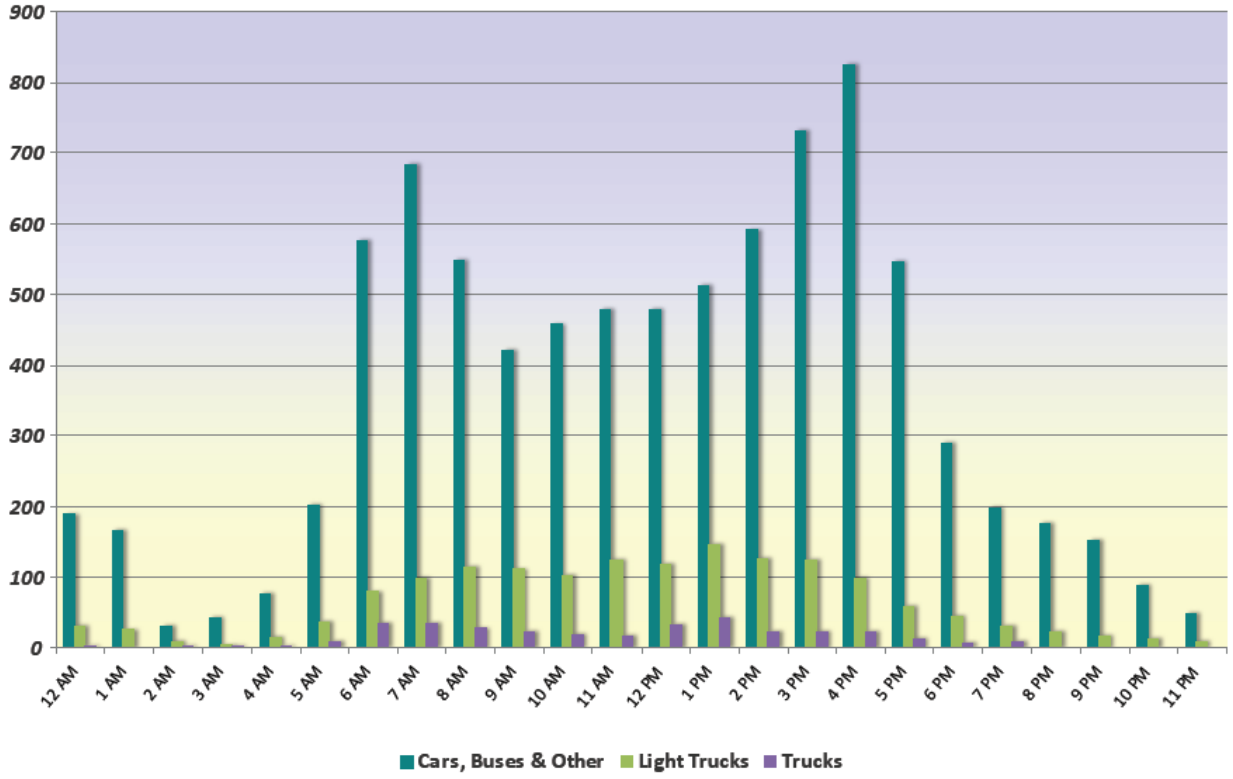
Source: Fehr & Peers

Exhibit B-6. Vehicle Types and Hourly Volumes on South Royal Brougham Way (2005)

S Royal Brougham Street Between 1st and 4th: Two-Way Volumes								
Date	Time	Cars	Buses	Light Trucks	Trucks	Other	Hourly Total	Truck %
6/13/2005	12:00:00 AM	120	0	30	2	69	221	**0.90%**
6/13/2005	1:00:00 AM	92	1	25	1	73	192	**0.52%**
6/13/2005	2:00:00 AM	23	0	8	2	8	41	**4.88%**
6/13/2005	3:00:00 AM	35	1	5	3	6	50	**6.00%**
6/13/2005	4:00:00 AM	55	1	16	2	21	95	**2.11%**
6/13/2005	5:00:00 AM	149	1	36	8	51	245	**3.27%**
6/13/2005	6:00:00 AM	495	4	79	34	76	688	**4.94%**
6/13/2005	7:00:00 AM	543	3	99	34	138	817	**4.16%**
6/13/2005	8:00:00 AM	455	3	114	28	90	690	**4.06%**
6/13/2005	9:00:00 AM	335	3	112	23	84	557	**4.13%**
6/13/2005	10:00:00 AM	368	4	103	20	85	580	**3.45%**
6/13/2005	11:00:00 AM	416	3	124	18	59	620	**2.90%**
6/13/2005	12:00:00 PM	369	4	118	32	105	628	**5.10%**
6/13/2005	1:00:00 PM	449	5	145	43	58	700	**6.14%**
6/13/2005	2:00:00 PM	523	3	126	23	64	739	**3.11%**
6/13/2005	3:00:00 PM	639	4	125	24	88	880	**2.73%**
6/13/2005	4:00:00 PM	689	5	98	23	130	945	**2.43%**
6/13/2005	5:00:00 PM	480	3	57	13	62	615	**2.11%**
6/13/2005	6:00:00 PM	270	0	45	7	21	343	**2.04%**
6/13/2005	7:00:00 PM	183	1	30	8	14	236	**3.39%**
6/13/2005	8:00:00 PM	166	1	23	1	10	201	**0.50%**
6/13/2005	9:00:00 PM	140	0	18	1	12	171	**0.58%**
6/13/2005	10:00:00 PM	75	0	12	1	12	100	**1.00%**
6/13/2005	11:00:00 PM	44	0	8	0	5	57	**0.00%**
		7,113	**50**	**1,556**	**351**	**1,341**	**10,411**	
		68.32%	**0.48%**	**14.95%**	**3.37%**	**12.88%**		

Source: Fehr & Peers

Exhibit B-7. Hourly Truck Volumes on South Royal Brougham Way (2005)



Source: Fehr & Peers

APPENDIX C. PASSENGER RAIL SERVICES

Both Sound Transit Sounder Commuter Rail service and Amtrak passenger service operate within the study area. Current passenger rail speeds in the vicinity of the S Holgate Street crossing are set at 20 mph. There are a total of 43 trains operating on weekdays, 22 arrivals and 21 departures at the King Street Station. As no Sounder commuter trains operate on weekends or holidays, the number of passenger trains drops to 10 arrivals and 9 departures on weekends and holidays.

Amtrak Passenger Rail

Amtrak provides intercity passenger rail services with two routes through the study area: *Cascades* and *Coast Starlight*. The Amtrak *Cascades* route connects Vancouver, BC with Eugene-Springfield, Oregon. The *Coast Starlight* operates between Seattle and Los Angeles, California. Through the study area, these two routes operate a total of ten southbound and northbound trains per day. During the weekday AM peak period, one southbound train travels through the study area. During the weekday PM peak period, one southbound and one northbound train travel through the study area. **Exhibit C-1 and C-2** provide the names of the train service and their departure and arrival times at King Street Station for all passenger services, including Sound Transit commuter rail.

Sound Transit Commuter Rail

Sound Transit commuter rail service connects the King Street and the Tacoma Dome Stations. Service is currently provided during the weekday AM and PM peak periods. Six northbound trips and two southbound trips are provided in the AM peak period. The northbound trips arrive at King Street Station between 6:00 and 9:00 AM. The southbound trips leave King Street Station at 6:10 and 6:50 AM. During the PM peak period, six southbound trips and two northbound trips are scheduled. The southbound trips leave King Street Station between 3:35 and 6:45 PM. The northbound trips arrive at King Street Station at 5:42 and 6:34 PM. Currently, eight trips are scheduled during each of the AM and PM peak periods, resulting in the Sound Transit trains crossing the S Holgate Street at-grade crossing a total of up to 16 times.

Exhibit C-1. King Street Station Departures (January 2009)

Departures				
Agency	Name of Train	Time	Destination	Service
Sound Transit	Sounder	6:10 AM	Tacoma	M-F
Sound Transit	Sounder	6:50 AM	Tacoma	M-F
Amtrak	Amtrak Cascades	7:30 AM	Portland	Daily
Amtrak	Amtrak Cascades	7:40 AM	Bellingham-Vancouver BC	Daily
Amtrak	NW Trailways	8:50 AM	Spokane	Daily
Amtrak	Coast Starlight	9:45 AM	Portland-LA	Daily
Amtrak	Amtrak Cascades	10:45 AM	Vancouver BC	Daily
Amtrak	Amtrak Cascades	11:20 AM	Portland	Daily
Amtrak	Amtrak Cascades	12:20 PM	Bellingham	Daily
Amtrak	Amtrak Cascades	1:15 PM	Vancouver BC	Daily
Amtrak	Amtrak Cascades	2:20 PM	Portland-Eugene	Daily
Sound Transit	Sounder	3:35 PM	Tacoma	M-F
Sound Transit	Sounder	4:05 PM	Everett	M-F
Amtrak	NW Trailways	4:15 PM	Wenatchee	Daily
Sound Transit	Sounder	4:20 PM	Tacoma	M-F
Sound Transit	Sounder	4:33 PM	Everett	M-F
Amtrak	Empire Builder	4:45 PM	Spokane-Chicago	Daily
Sound Transit	Sounder	4:45 PM	Tacoma	M-F
Sound Transit	Sounder	5:05 PM	Everett	M-F
Sound Transit	Sounder	5:10 PM	Tacoma	M-F
Amtrak	Amtrak Cascades	5:30 PM	Portland-Eugene	Daily
Sound Transit	Sounder	5:35 PM	Everett	M-F
Sound Transit	Sounder	5:55 PM	Tacoma	M-F
Amtrak	Amtrak Cascades	6:30 PM	Vancouver BC	Daily
Amtrak	Amtrak Cascades	6:40 PM	Bellingham	Daily
Sound Transit	Sounder	6:45 PM	Tacoma	M-F
Amtrak	Amtrak Cascades	9:15 PM	Vancouver BC	Daily

Source: Amtrak Railroad

Exhibit C-2. King Street Station Arrivals (January 2009)

Arrivals				
Agency	Name of Train	Time	Origin	Service
Sound Transit	Sounder	5:59 AM	Tacoma	M-F
Sound Transit	Sounder	6:39 AM	Tacoma	M-F
Sound Transit	Sounder	6:44 AM	Everett	M-F
Sound Transit	Sounder	7:14 AM	Everett	M-F
Sound Transit	Sounder	7:19 AM	Tacoma	M-F
Sound Transit	Sounder	7:44 AM	Everett	M-F
Sound Transit	Sounder	7:49 AM	Tacoma	M-F
Sound Transit	Sounder	8:14 AM	Everett	M-F
Sound Transit	Sounder	8:19 AM	Tacoma	M-F
Amtrak	NW Trailways	8:50 AM	Tacoma	Daily
Sound Transit	Sounder	8:59 AM	Tacoma	M-F
Amtrak	Coast Starlight	9:15 AM	Vancouver BC	Daily
Amtrak	Empire Builder	10:20 AM	Chicago-Boise	Daily
Amtrak	Amtrak Cascades	10:55 AM	Vancouver BC	Daily
Amtrak	Amtrak Cascades	12:00 PM	Eugene-Portland	Daily
Amtrak	Amtrak Cascades	12:30 PM	Vancouver BC	Daily
Amtrak	NW Trailways	1:05 PM	Wenatchee	Daily
Amtrak	Amtrak Cascades	3:55 PM	Eugene-Portland	Daily
Amtrak	Amtrak Cascades	4:00 PM	Vancouver BC	Daily
Amtrak	NW Trailways	4:45 PM	Wenatchee	Daily
Amtrak	Amtrak Cascades	5:00 PM	Bellingham	Daily
Sound Transit	Sounder	5:42 PM	Tacoma	M-F
Amtrak	Amtrak Cascades	6:20 PM	Eugene-Portland	Daily
Sound Transit	Sounder	6:34 PM	Tacoma	M-F
Amtrak	Amtrak Cascades	8:30 PM	Vancouver BC	Daily
Amtrak	Amtrak Cascades	9:45 PM	Eugene-Portland	Daily
Amtrak	Amtrak Cascades	10:05 PM	Vancouver BC	Daily

Source: Amtrak Railroad

APPENDIX D. STREET CLASSIFICATION

The City of Seattle classifies streets based on the American Association of State Highway and Transportation Officials (AASHTO) standards. They are classified according to the different level of emphasis on traffic movement versus direct access to adjacent property.

At one end of the hierarchy, a freeway emphasizes traffic movement while restricting access to adjacent land. At the other end, a local street provides easy access to adjacent residential, commercial, and industrial land uses. Transportation improvements developed in accordance with the street classification system will help discourage higher speed "through traffic" from using local neighborhood streets, and "local traffic" from congesting regional travel facilities. This not only improves the efficiency of the transportation system, but also maintains the livability of city neighborhoods.

The Arterial Classifications Map is shown in **Exhibit D-1**. This map defines the City arterial network in the study area, which includes Principal, Minor and Collector Arterials. The arterials in the study area are listed as follows:

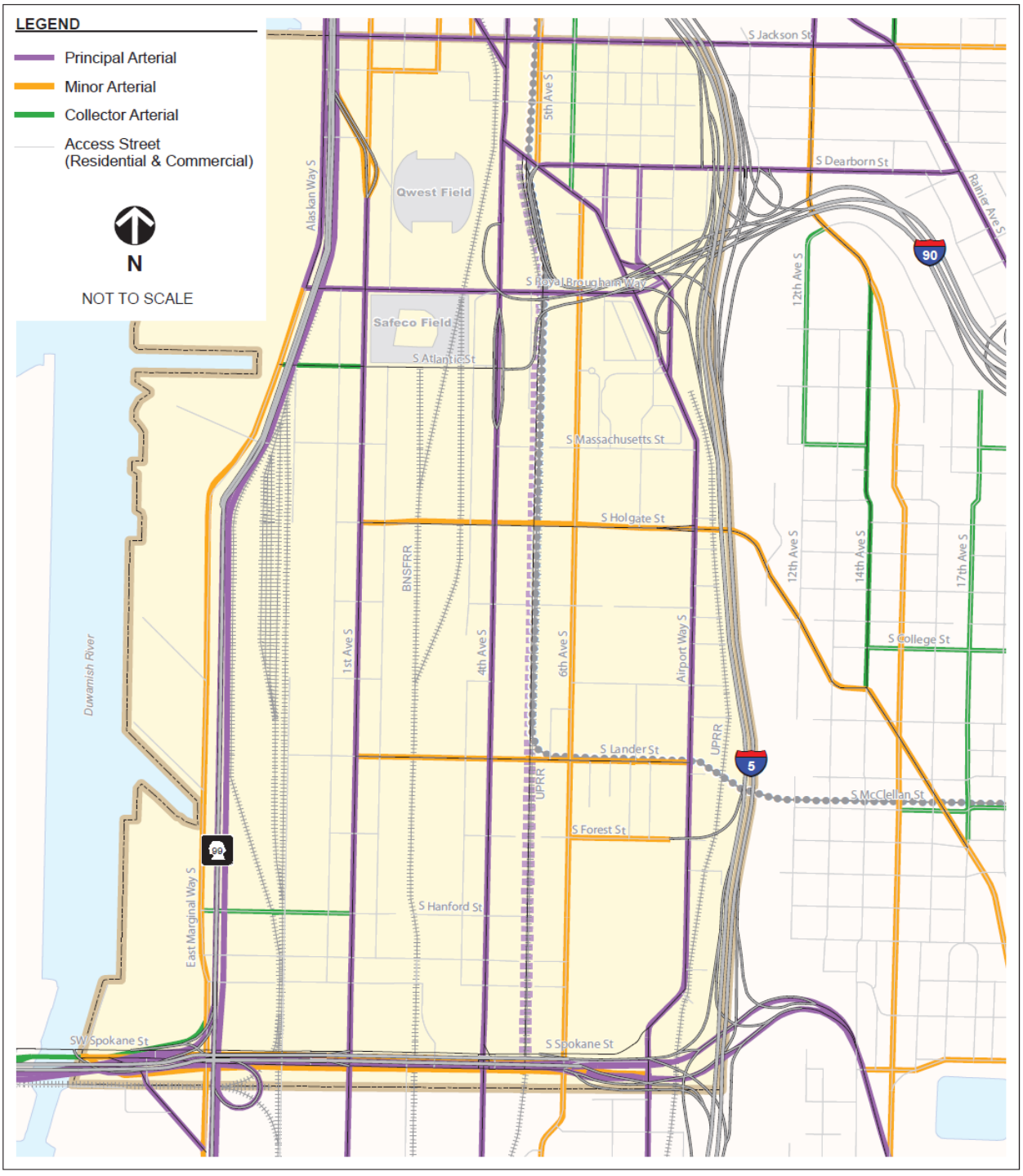
- S Holgate Street – Four-lane Minor Arterial that runs from Utah Avenue S to Airport Way S.
- S Spokane Street (surface street) – Five-lane Principal Arterial connecting West Seattle to local surface streets and I-5 ramps.
- S Lander Street – Five-lane Minor Arterial that runs from Utah Avenue S to Airport Way S.
- S Royal Brougham Way – Six-lane Principal Arterial connecting Alaskan Way S and Airport Way S. (This street will be reconfigured to have only two lanes between 1st Avenue S and 3rd Avenue S as a part of the SR 519 Phase II project improvements.)
- S Atlantic Street – A eastbound two-lane road from Alaskan Way S to 1st Avenue S, and four lane road from 1st Avenue S to 4th Avenue S connecting to eastbound I-90. (While this street has not been classified, it should be since it connects with I-90.)
- 1st Avenue S – Five-lane Principal Arterial from S Jackson Street to S Spokane Street.
- 4th Avenue S – Six-lane Principal Arterial from S Jackson Street to S Spokane Street.
- 6th Avenue S – Four-lane Minor Arterial from S Atlantic Street to S Spokane Street.
- Airport Way S - Five-lane Principal Arterial from 4th Avenue S to 5th Avenue S and a four-lane Principal Arterial from 5th Avenue S to S Spokane Street.

Exhibit D-2 shows the Transit Street Classification Map. The transit service in the study area is discussed in **Appendix E**.

The Major Truck Street Classification Map shown in **Exhibit D-3** defines a network of streets known as "major truck streets" that accommodate trucks in order to preserve and improve commercial transportation mobility and access.

S Holgate Street is designated as a major truck route, while S Lander Street is not.

Exhibit D-1. Arterial Street Classification – Downtown Seattle



Source: Seattle Department of Transportation

Exhibit D-2. Transit Street Classification – Downtown Seattle

Source: Seattle Department of Transportation

Exhibit D-3. Major Truck Routes Downtown Seattle

Source: Seattle Department of Transportation

APPENDIX E. TRANSIT SERVICE

Both King County Metro and Sound Transit provide transit service within the study area.

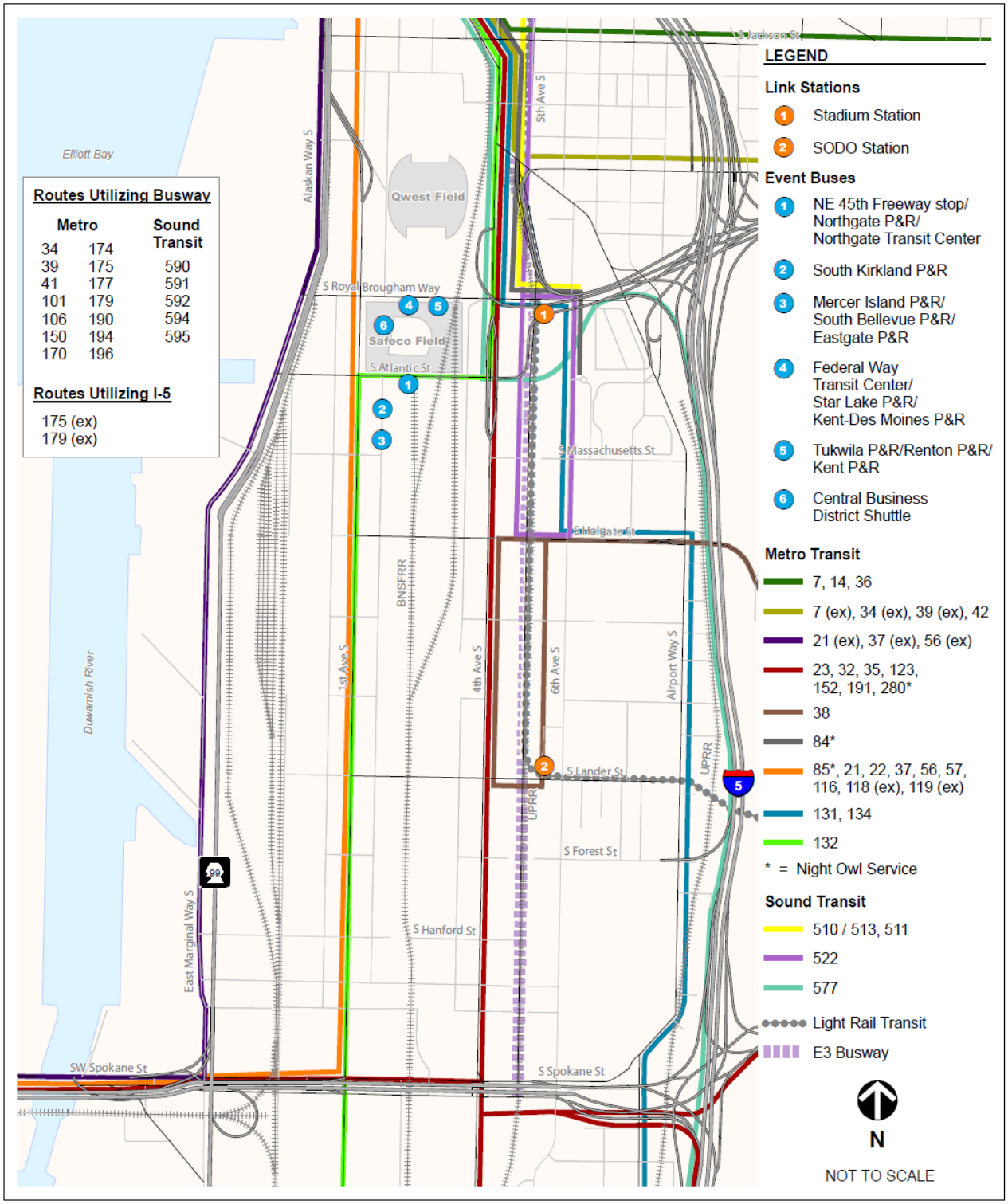
In 2005, the City of Seattle developed the *Seattle Transit Plan* to provide a vision of the future transit system within Seattle and a strategy to better connect urban villages. The plan has helped the City coordinate transit service improvements and commit to enhancing arterials for transit speed and reliability. The *Seattle Transit Plan* shown previously in Figure D-2 designates transit streets with the following definitions:

- Transit Way: Provides frequent, high speed, high capacity and intermediate capacity service.
- Principal Transit Street: Provides for high-volume transit service, often for regional or citywide trips.
- Major Transit Street: Provides concentrated transit service to connect and reinforce major activity centers and residential area.
- Minor Transit Street: Provides local and neighborhood transit service.
- Local Transit Street: Provides local and neighborhood transit service.

Exhibit E-1 shows the transit routes in the study area, excluding all the transit routes that operate in the E-3 Busway.

Exhibit E-2 shows the transit service characteristics of the local transit routes, such as bus frequency and time periods for service provided by Sound Transit and King County Metro within the study area. The service area is primarily West Seattle, Harbor Island, Beacon Hill and the Rainier Valley.

Exhibit E-1. Transit Routes (excluding Routes using the Busway and I-5)



Source: King County Metro

Exhibit E-2. Local Seattle Transit Service in the Study Area

Bus Route #	Route Direction	Weekday						Weekend	
		Daily Trips	Approx Time Range			Peak Head-way	Off-Peak Head-way	Sat	Sun
7	To Rainier Beach	113	4:07 AM	to	3:38 AM	9	15	Y	Y
	To Downtown	112	5:10 AM	to	4:29 AM	10	14		
14	To Downtown, Mt. Baker	56	5:05 AM	to	1:13 AM	16	27	Y	Y
	To Downtown, Summit	50	4:52 AM	to	12:12 AM	16	31		
21	To Arbor Heights	39	5:35 AM	to	1:21 AM	30	33	Y	Y
	To Downtown	39	5:19 AM	to	12:49 AM	30	32		
22	To White Center	27	9:09 AM	to	7:13 PM	33	30	Y	Y
	To Downtown	27	5:24 AM	to	6:33 PM	33	31		
23	To White Center	39	5:12 AM	to	12:12 AM	33	30	Y	Y
	To Downtown Seattle	38	5:44 AM	to	12:10 AM	30	31		
32	To Beacon Hill, Rainier Beach	4	4:26 PM	to	5:57 PM	30	n/a	N	N
	To Downtown Seattle	5	6:09 AM	to	8:09 AM	30	n/a		
34/39	To Rainier Beach	30	5:52 AM	to	9:13 PM	24	43	N/Y	N/Y
	To Beacon Hill, Downtown	32	6:09 AM	to	6:49 PM	23	29		
35	To Harbor Island	2	6:40 AM	to	7:16 AM	36	n/a	N	N
	To Downtown	2	3:52 PM	to	4:22 PM	30	n/a		
36	To Beacon Hill, Rainier Beach	109	4:47 AM	to	1:23 AM	9	13	Y	Y
	To Beacon Hill, Downtown	97	5:15 AM	to	1:49 AM	9	16		
37	To Alaska Junction	8	3:42 PM	to	7:19 PM	26	87	Y	N
	To Downtown	9	5:59 AM	to	10:09 AM	30	70		
38	Beacon Hill	28	6:00AM	to	9:10 PM	33	37	Y	Y
41	To Downtown Seattle	84	5:28 AM	to	12:30 AM	9	19	Y	Y
	To Northgate, Lake City	86	5:54 AM	to	1:06 AM	9	18		
56/57	To Alki, Alaska Junction	35	5:45 AM	to	12:36 AM	33	35	Y/N	Y/N
	To Downtown	34	6:08 AM	to	12:24 AM	23	46		
84	Madison Park-Madrona Night Owl service	2	2:02 AM	to	3:17 AM	n/a	75	Y	Y
85	W. Seattle-Admiral District-White Center Night Owl Service	2	2:15 AM	to	3:30 AM	n/a	75	Y	Y
116	To Fauntleroy Ferry Terminal	6	3:26 PM	to	5:50 PM	29	n/a	N	N
	To Seattle	10	5:55 AM	to	8:51 AM	26	n/a		
118/119	To Vashon Island	3	2:17 PM	to	5:03 PM	n/a	n/a	Y/N	N
	To Seattle	3	7:37 AM	to	9:36 AM	15	n/a		

Source: King County Metro

APPENDIX F. SR 519 PHASE II AND SPOKANE STREET VIADUCT IMPROVEMENT PROJECTS

Changes are being made to the transportation facilities in the study area and those impacts will likely be felt throughout the area. Construction for the SR 519 Intermodal Access Project Phase II is underway. S Royal Brougham Way has been torn up in 2009 and traffic movements on the street have been restricted. Alaskan Way Viaduct construction related to the section between S Holgate Street and King Street will be initiated in the summer of 2009. Construction for replacing the central waterfront of the Alaskan Way Viaduct will continue up to 2017.The S Spokane Street viaduct widening project is also underway, which is scheduled to be complete in 2012.

SR 519 Phase II Project

Construction of Phase I of the SR 519 project made a significant impact on the usage of S Royal Brougham Way and S Atlantic Street in the immediate area of Qwest Field, the Exhibit Hall, and Safeco Field. Although traffic demand was slightly reduced on S Holgate Street, when Phase I was completed in the spring of 2004 traffic demand has since returned to what it was before construction.

While the Phase I project improved the eastbound traffic movements, the Phase II project was designed to improve westbound traffic movements. In 2005, an agreement was reached between WSDOT, the City of Seattle, the Port of Seattle and the Stadium District to improve the westbound movements. The preferred alternative included three components:

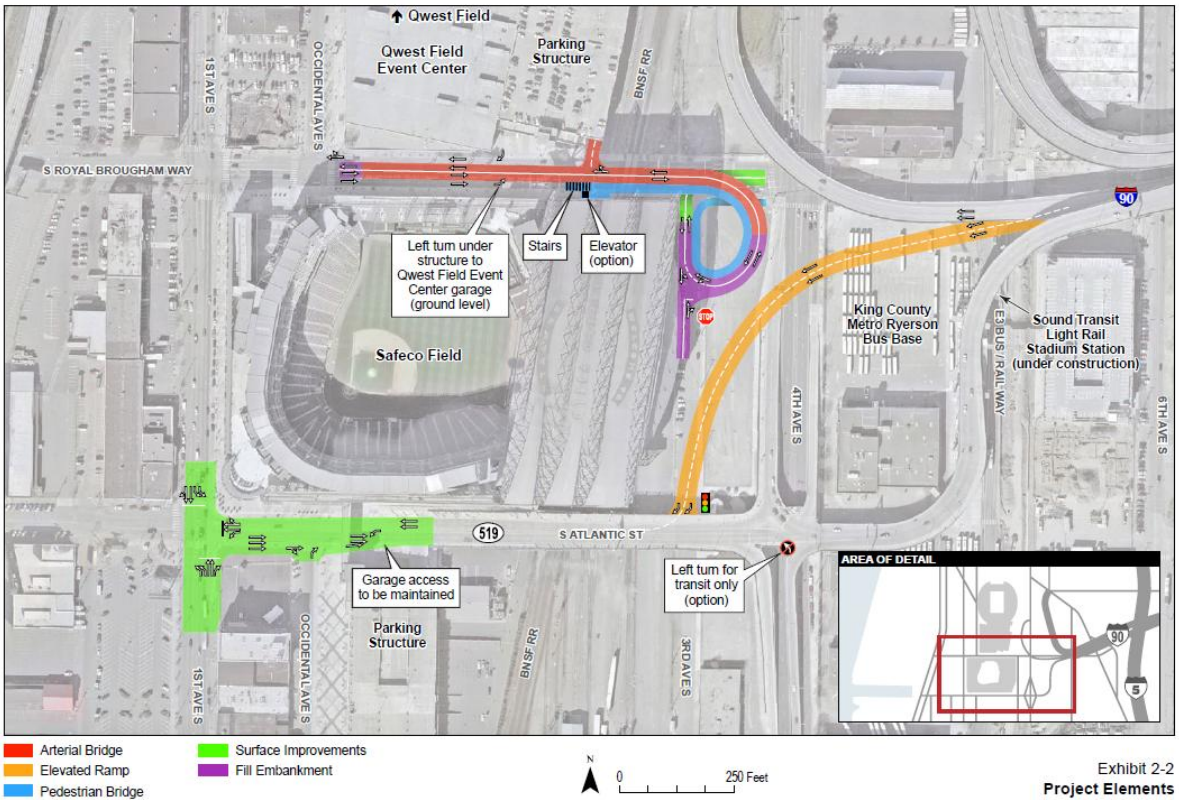
(1) a new I-90 off-ramp to South Atlantic Street (I-90 off-ramp);

(2) a new S Royal Brougham Way railroad overpass (BNSF Railway overpass); and

(3) roadway widening along S Atlantic Street east of 1st Avenue S and improvements to the intersection of 1st Avenue S/S Atlantic Street.

Exhibit F-1 illustrates the concepts for the SR 519 Phase II improvements, which are currently under construction.

Exhibit F-1. SR 519 Phase II Improvement Concept



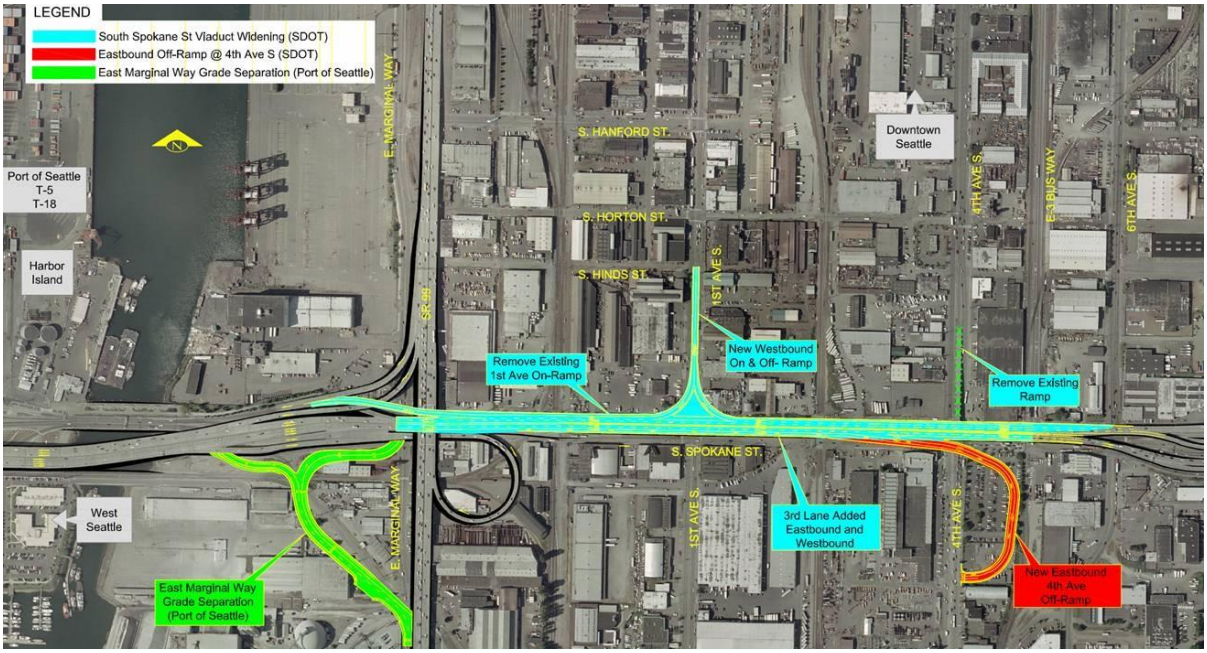
Source: WSDOT SR 519 Website

S Spokane Street Viaduct Project

SDOT is making extensive improvements to the S Spokane Street Viaduct, the 60-year-old elevated roadway that connects I-5 to the West Seattle Bridge. The project will widen the viaduct to three lanes in each direction, as well as adding a two-lane off-ramp eastbound to Fourth Avenue S. One exit lane will be only for buses allowing a transit connection to the E-3 Busway, when the nearby Alaskan Way Viaduct closes in 2012 to make room for a new highway or surface street. There will be on- and off-ramps westbound at First Avenue S. Construction is currently underway to add a new eastbound off-ramp from the Spokane Street Viaduct to 4th Avenue S.

The widening of the S Spokane Street Viaduct is the fourth and final phase of a project that was conceptually designed in 1995 and implemented in phases due to available funding. **Exhibit F-2** shows the improvements in the S Spokane Street Viaduct Project.

Exhibit F-2. S Spokane Street Viaduct Improvement Project



Source: Seattle Department of Transportation

APPENDIX G. HOUSEHOLDS AND EMPLOYMENT

Fehr & Peers forecast the 2015 and 2030 traffic conditions based on the household and employment projections from the Seattle Travel Demand Model.

Exhibit G-1 shows historical household and employment data (1970 to 2005) in the PSRC Forecast Analysis Zone (FAZ). The FAZ for the Duwamish Industrial area shown in **Exhibit G-2** is larger than the study area for S Holgate Street Closure Study. It includes the area south of S Spokane Street and the residential areas east of I-5. In 1970, there were over 1,000 households but by 1980 the households declined by a half to about 600 within the Duwamish FAZ area. Total employment in the has increased steadily in the recent decades appearing to have peaked in 2000. In 2005, the total employment decreased to about 41,000 jobs in the Duwamish FAZ area.

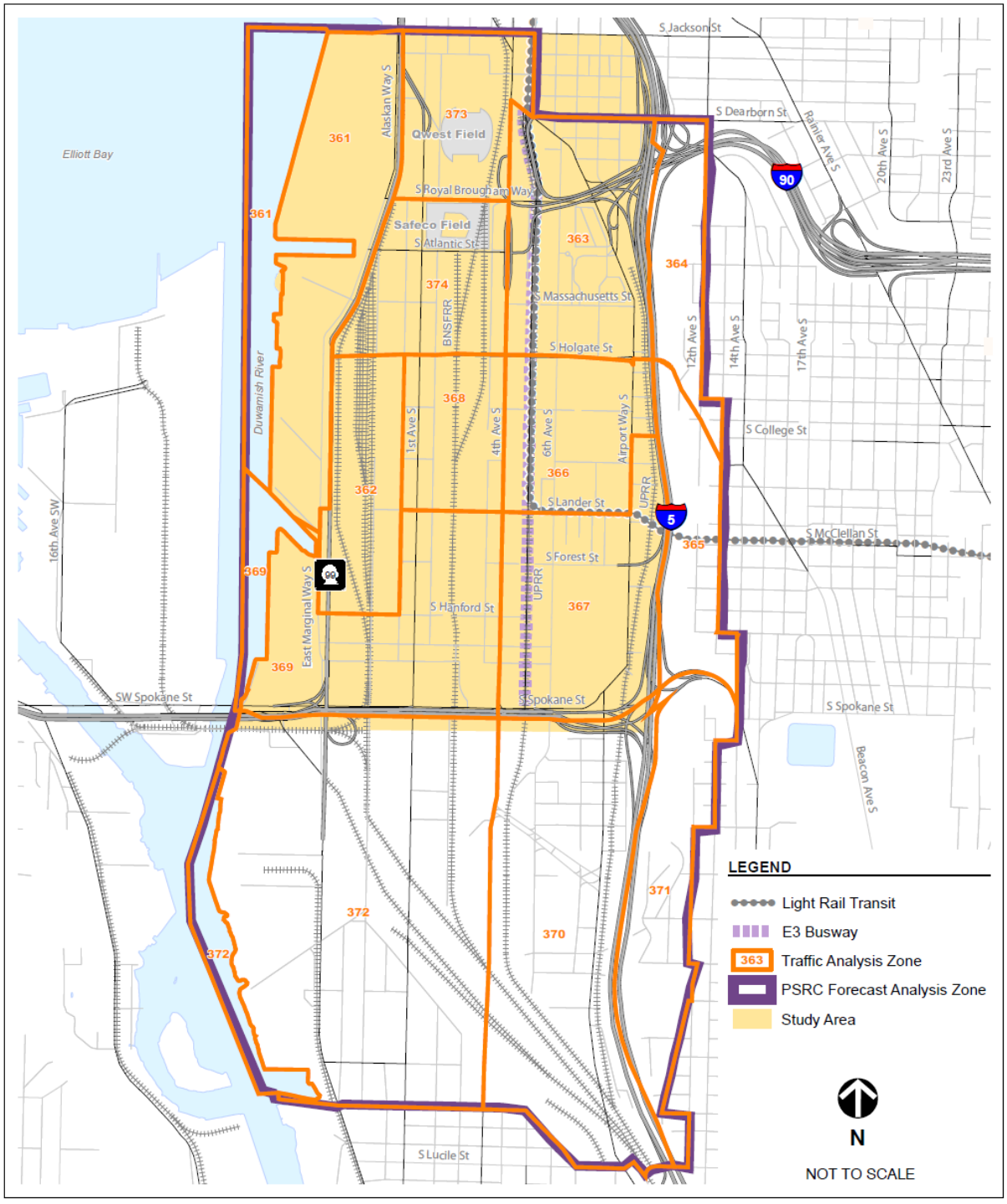
Exhibit G-1. Changes in Households and Employment (1970 to 2005) for SODO Traffic Analysis Zones

Year	Households	Employment
1970	1,270	36,300
1980	570	35,000
1990	780	36,600
2000	990	43,200
2005	990	41,500

Source: Puget Sound Regional Council

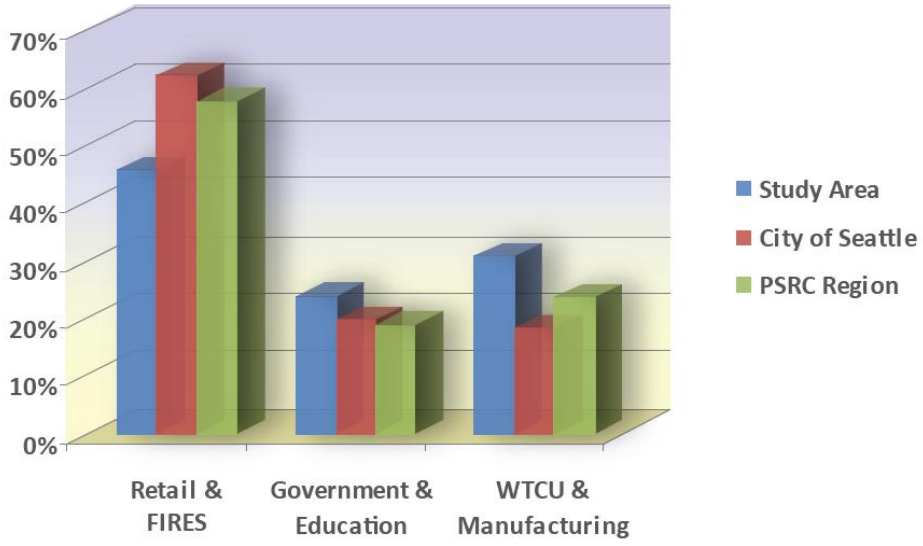
The SODO area has always been a major light manufacturing and warehousing area in the City of Seattle. What is unique to the study area is the mix of employment sectors. **Exhibit G-3** compares the regional composition of retail and services, government and education, and manufacturing and WTCU (wholesale, transportation, communications and utilities) workers to those for the City of Seattle and the study area. As expected, the study area has a higher share of WTCU/Manufacturing jobs than the region or the city as a whole. And even though the study area is perceived to be a light industrial area, it has a greater number of retail/office jobs than manufacturing jobs.

Exhibit G-2. Study Area, Traffic Analysis Zones, and PSRC Forecast Analysis Zones



Source: Puget Sound Regional Council/Seattle Model

Exhibit G-3. Employment Distribution for the Study Area, City of Seattle, and the Region



Source: Puget Sound Regional Council

For the S Holgate Street Study area, the household and employment projections used for the Seattle travel demand model were summed with the Traffic Analysis Zones (TAZ) within the study area as shown in Exhibit 2. The household and employment forecasts summarized in **Exhibit G-4** show that **o**ver the next 20 years, employment will grow by about 25 percent while households are forecast to increase by nearly 400 percent. These increases will add traffic in the study area.

Exhibit G-4. Seattle Model Land Use Growth Assumptions in the Study Area

Year	Households	Employment
2005	134	29,541
2015	380	34,572
2030	651	37,902

Source: Puget Sound Regional Council

APPENDIX H. REVIEW OF PREVIOUS REPORTS

ACCESS DUWAMISH - A FREIGHT MOBILITY AND ECONOMIC STRATEGY FOR THE DUWAMISH AREA (JUNE 2000)

This study identified and analyzed the freight access and mobility problems in the Duwamish area and evaluated a wide range of specific solutions aimed at alleviating congestion, reducing modal conflicts and eliminating safety problems. Recognizing the scope of the problem in the North Duwamish Corridor and the diversity of interests, the following four goals were the focus of the study:

- Provide for the efficient movement of goods and people to ensure the economic vitality of the area;
- Reduce modal conflict and enhance connections;
- Contribute to regional air quality objectives by planning improvements that reduce congestion and transportation related pollution; and,
- Reduce safety hazards and ensure a safe operating environment for all modes of transportation.

The report stated that access to the North Duwamish area was limited. In addition, circulation for people and freight was also limited because of mode conflicts and congestion. People moved through the area many ways - in cars, buses, on bicycles, and on foot, and on passenger rail, ferry service and freight trucks. In 1998, more than 200,000 vehicles and 60 trains made their way through the area every day and the report projected that by 2010 it would approach 300,000 vehicles and more than 80 trains.

The report pointed out that the six at-grade rail crossings in the North Duwamish area were blocked by trains up to a cumulative total of 40 hours per day. The study projected that it would increase to nearly 60 hours of blockage per day by 2010.

Issues/Problems

Major impediments to freight movements and access in the North Duwamish were identified as:

- Limited accessibility to/from the North Duwamish area and the regional transportation system.
- The numerous rail lines resulted in difficult traffic circulation within the area, particularly in the east-west direction. Special events at the stadiums and exhibition hall exacerbated these conflicts.
- Within North Duwamish conflicts among various modes provided challenges for efficiently separating and/or managing the overall transportation system.
- The existing rail system was insufficient to accommodate the expected growth in freight and passenger travel within the study area.
- Growth had been anticipated in major industrial uses and other land uses throughout North Duwamish.
- Several major construction projects were programmed during the next 5 to 10 years, requiring close attention to construction traffic management for all modes of travel.

The report stated that a majority of the problems were caused by the lack of sufficient east-west streets throughout the North Duwamish area, intermodal conflicts caused by the numerous at-grade railroad crossings, and limitations of the existing ramps to/from the freeways: I-5, I-90, SR 99 and Spokane Street Viaduct/ West Seattle Freeway.

More than 19,000 one-way truck trips were made into and out of the North Duwamish project area each day, the report stated that the number of trips were expected to increase by 1 percent per year through 2010. Depending on the location, trucks represented 5 to 28 percent of total daily traffic on a street.

Furthermore, access to the Port of Seattle marine terminals was of critical importance not only to the region and state, but to the entire nation.

Recommendations

Based on the extensive evaluation of potential improvement projects, the following projects were recommended for implementation.

- FAST Corridor Phases 1 and 2
  - SR 519 Intermodal Access Project Phase 1
  - Spokane Street Viaduct Widening
  - Ramps between E Marginal Way and SR 99
  - SR 519 Phase 2
  - Lander Street Overcrossing
- Other Railroad Grade Separations
  - N Waterfront Access (Broad Street)
- Highway Access Improvements
  - SR 99 Half Interchange on-ramp
  - Directional signs to Port Terminals

It should be noted that a grade-separated overcrossing over S Holgate Street was considered by the study, but was not recommended because of the potential high cost.

S HOLGATE STREET RAILWAY CROSSING CLOSURE TRAFFIC STUDY SEATTLE WASHINGTON: TRAFFIC IMPACT ANALYSIS (DECEMBER 2003)

This report was prepared for the Washington State Department of Transportation (WSDOT) by Gary Struthers Associates (GSA) and issued in December 2003. The purpose of the study was to evaluate the traffic impacts to the streets and intersections adjacent to S Holgate Street, if the S Holgate Street were to be closed. It forecast the 2020 conditions without S Holgate Street between Occidental Avenue S and 3rd Avenue S based on the 2003 conditions as the base year.

2003 Train Volumes

The GSA report showed that a total of 63 passenger and freight trains crossed S Holgate Street in 2003. The average time per closure was 3 minutes and 10 seconds. The daily trains that crossed S Holgate Street in 2003 were categorized as follows:

- 3 Sounder trains crossed 12 times per day

- 3 Amtrak/Cascades trains crossed 9 times per day
- 42 freight trains crossed per day

2003 Intersection Levels of Service (LOS)

The study identified key intersections likely to be impacted by the closure of S Holgate Street and the consultant calculated the intersection LOS analysis with 2003 traffic count volumes. The analyses showed that all studied intersections operated at an acceptable LOS during the AM and PM peak hour except for the S Royal Brougham Way/1st Avenue S intersection which operated at LOS E for the AM peak hour.

2003 Traffic Conditions with the Closure

The report used total average delay as one of the key factors to evaluate the traffic impacts of the closure of S Holgate Street. Vehicle delays due to train crossings during the AM and PM peak hour were calculated as follows:

- AM Peak Hour:
  - Traffic volume – 634 vehicles per hour
  - Average duration of train crossing – 0.13 hours (7.8 minutes)
  - Total delay – 5.87 vehicle-hours
- PM Peak Hour:
  - Traffic volume – 780 vehicles per hour
  - Average duration of train crossing – 0.19 hours
  - Total delay – 16.32 vehicle-hours

Pedestrian and Bicycle Crossings

The report included observations for pedestrians and bicycles. It indicated that two pedestrians and one bicycle crossed the railroad tracks during the PM peak hour.

Accidents

The train-related accident history at S Holgate Street railroad crossing obtained from FRA (Federal Railroad Administration) showed two train-vehicular accidents without fatal injuries. With the closure of S Holgate Street, any potential for train-related accidents would be eliminated.

Emergency Vehicles

The report indicated that there were no apparent issues regarding emergency response as the ability to respond improved with the grade-separated ramp on S Atlantic Street while trains were present. Lander Street is preferred over Holgate Street as it is wider.

Transit

This report indicated that King County Metro did not have any revenue service using S Holgate Street between 1st Avenue S and 4th Avenue S. The report cited that Metro had an average of 20 “deadhead” buses using S Holgate Street to access the Central and Ryerson operating bases. However, Metro confirmed only 3 deadhead routes per day.

Metro has been using S Holgate Street to access the E-3 Busway during Mariners baseball games. Sound Transit operates Express Buses in the vicinity of S Holgate Street, but no Sound Transit buses used S Holgate Street across the railroad tracks.

2020 Traffic and 2015 Train Volumes

The Struthers (GSA) report evaluated the traffic impacts of the S Holgate Street closure for the 2020 time horizon. The 2020 traffic volumes were obtained with annual growth factors with the assumption that all major planned transportation improvement projects would be completed.

Amtrak and BNSF provided estimated train volumes for 2015 as follows:

- Sounder – 60 trains per day: an increase of 48 trains
- Cascade – 22 trains per day: an increase of 13 trains
- Freight – 92 trains per day: an increase of 50 trains

The study estimated that in 2020 the S Royal Brougham Way/1st Avenue S intersection would operate at LOS E in the AM peak hour without the S Holgate Street closure. All remaining analysis intersections were estimated to operate at an acceptable level of service for AM and PM peak hours.

Using the 2020 vehicles and 2015 train volumes, the GSA report calculated vehicle delays during the AM and PM peak hour as follows:

- AM Peak Hour:
  - Traffic volume – 414 vehicles per hour
  - Duration of average train crossing – 0.36 hours
  - Total delay – 28.19 vehicle-hours
- PM Peak Hour:
  - Traffic volume – 798 vehicles per hour
  - Duration of average train crossing – 0.53 hours
  - Total delay – 127.20 vehicle-hours

The report commented that the acceptable emergency vehicle response would be maintained in the study area.

There was not much information available on future Metro services and the report indicated that Metro could expand services in future.

GSA reported the analyses results for 2020 with the closure of S Holgate Street and stated that all intersections studied would operate at an acceptable LOS.

Recommendations

The GSA report recommended that S Holgate Street be closed for vehicle crossings because the street closure would:

- Maintain or improve level of service compared to No Action at all analysis intersections.
- Eliminate approximately 9,000 existing (2003) and 9,200 daily vehicles by 2020 on S Holgate Street between Occidental Avenue S and 3rd Avenue South.

- Maintain an acceptable emergency response to the S Holgate Street area.
- Eliminate the potential for vehicle/ train accidents.
- Eliminate vehicle delay on S Holgate Street due to train crossings.

S HOLGATE STREET RAILWAY CROSSING CLOSURE TRAFFIC IMPACT ANALYSIS (JANUARY 2005)

The WSDOT Rail Office initiated this study to evaluate short- and long-term impacts created by the closure of S Holgate Street between Occidental Avenue S and 3rd Avenue South. The closure was proposed to "support the planned Amtrak Pacific Northwest Maintenance Facility". It indicated that "the current plan calls for 9 new maintenance and 5 new mainline tracks to be installed between 3rd Avenue S and the 5 existing mainline tracks for a total of 19 tracks."

This report was prepared to provide additional analysis in response to questions raised by SDOT, Sound Transit, King County Metro, and the Northwest Region Office of the WSDOT on the 2003 S Holgate Street Railway Crossing Closure Study (GSA), reviewed previously.

2004 Traffic Volumes and LOS

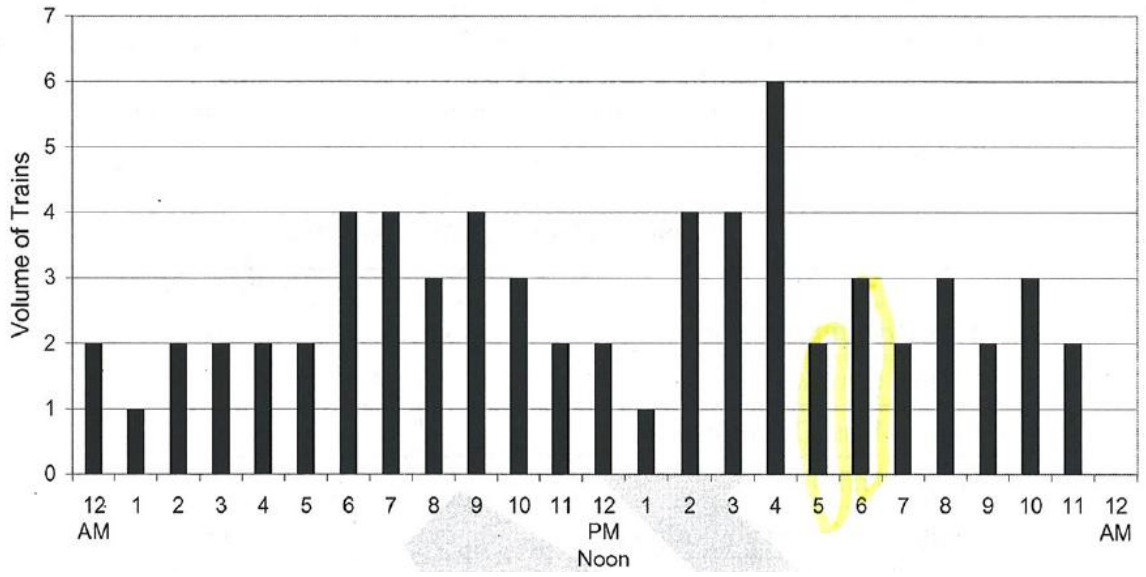
The study updated the 2003 traffic volumes in the previous study to the 2004 AM peak, off-peak and PM peak hour for the key intersections. Average weekday traffic volumes were obtained with 3-day 24-hour tube counts. The LOS analysis at these intersections showed that all intersections in the study area operated at acceptable LOS per City of Seattle standards for AM peak, off-peak and PM peak hours, except the S Royal Brougham Way/1st Avenue S intersection. The heavy southbound left-turn movement generated considerable queues on 1st Avenue S at both S Royal Brougham Way and S Atlantic Street for AM and PM peak hours.

BNSF provided the daily train volumes at the S Holgate Street gate crossing for the year 2004 as follows:

- Sound Transit Sounder – 6 trains per day
- Amtrak Cascade – 6 trains per day
- Amtrak Long Distance – 2 trains per day
- Freight – 51 trains per day

The report provided the train volume data for each hour of day, as shown in **Exhibit H-1**. In 2004, four trains crossed S Holgate Street during the AM peak hour and six trains during the PM peak hour. Sounder commuter trains are concentrated in the peak hours while Amtrak Cascades trains ran during the off-peak hours. However, freight trains operated on demand throughout the day.

Exhibit H-1. Average Train Volume by Time of Day (2004)



Source: WSDOT 2005 Report

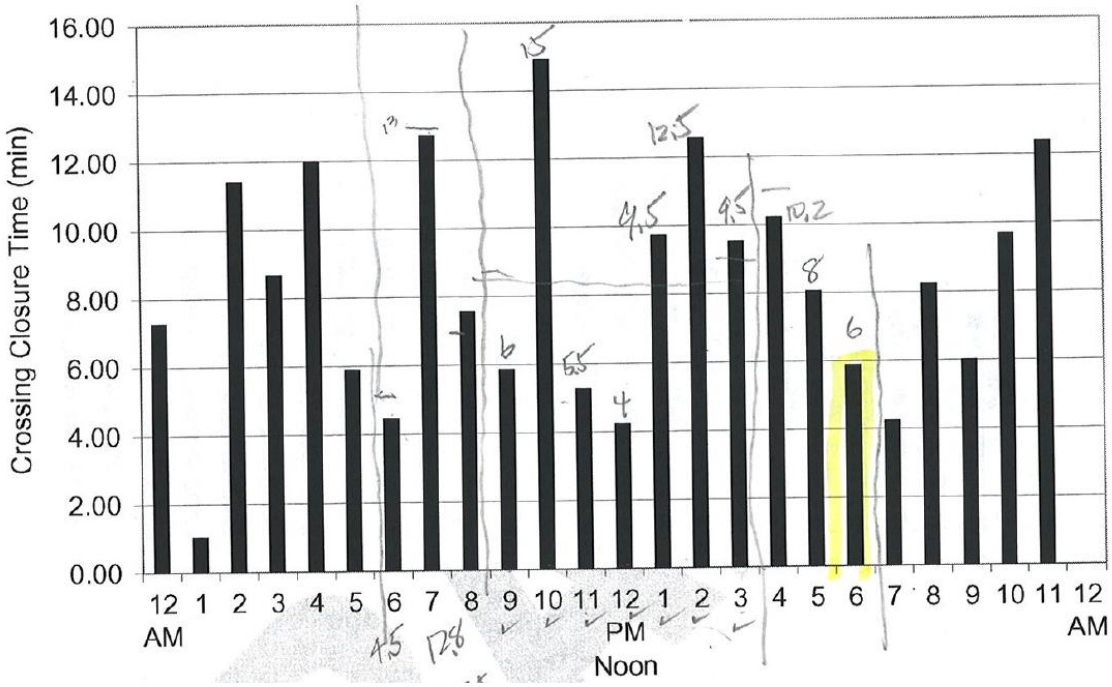
Duration of Gate Closure (2004)

The report summarized the crossing closure time on S Holgate Street for all trains by time of day. The following outlines the estimated duration of the gate closure time on S Holgate Street:

- AM street peak hour – 22 percent (13 minutes)
- PM street peak hour – 17 percent (10 minutes)
- 10:00 AM to 11:00 AM – 25 percent (15 minutes)

Exhibit H-2 shows the duration of gate closure time by time of day.

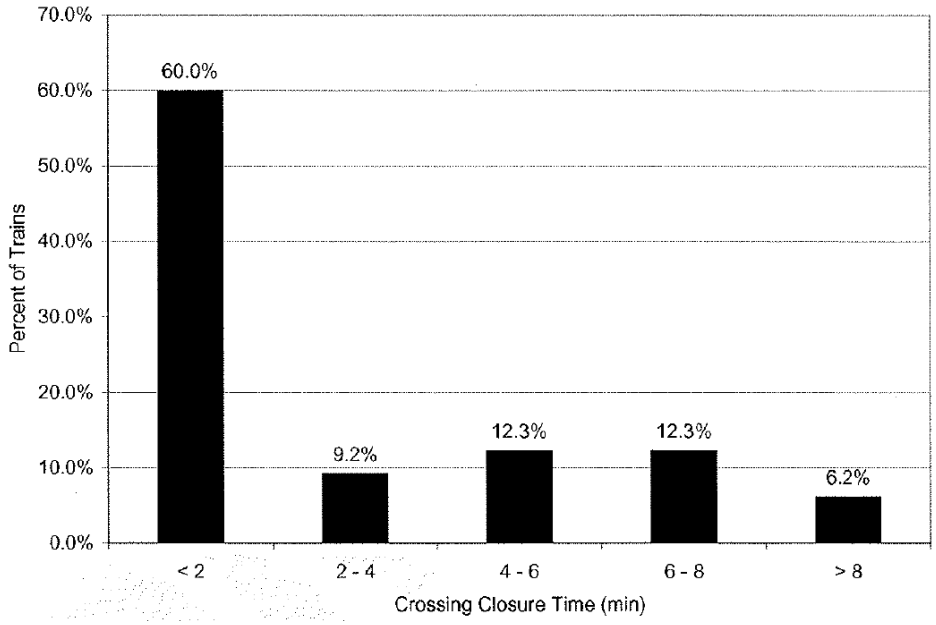
Exhibit H-2. Duration of Gate Closure Time by Time-of-Day



Source: WSDOT 2005 Report

It is interesting to note that 60 percent of trains that crossed S Holgate Street took less than 2 minutes to cross the street and only 6 percent of trains took more than 8 minutes. The percentage of trains by crossing closure durations is shown in **Exhibit H-3**.

Exhibit H-3. Percent of Trains by Crossing Closure Time



Source: WSDOT 2005 Report

Average Vehicle Delays

Average vehicle delays at all at-grade railway crossings for 2004 were estimated as follows:

- S Holgate Street
- AM Peak Hour – average delay (12 seconds per vehicle) and total delay (1.5 vehicle hours)
- Off-Peak Hour – average delay (16 seconds per vehicle) and total delay (3.1 vehicle hours)
- PM Peak Hour – average delay (17 seconds per vehicle) and total delay (2.9 vehicle hours)

Non-Motorized Transportation

Non-motorized activities were found to be minimal. Pedestrians were counted at the S Holgate Street/ 3rd Avenue S intersection in November 2004. The report showed that 10 pedestrians and 2 bicycles crossed the railroad tracks during the AM peak hour, 26 pedestrians and 4 bicycles crossed during the off-peak hours and 10 pedestrians and 4 bicycles crossed during the PM peak hour.

2007 and 2027 Traffic Impact Analysis of S Holgate Street Closure

The study analyzed the impact of S Holgate Street closure for the horizon years of 2007 and 2027.

The report concluded that all studied intersections would operate at acceptable LOS for both 2007 and 2027 with and without the S Holgate Street closure. It pointed out that LOS would improve by modifying lane channelization for the new SR 519 ramps and optimizing traffic signals timings.

Maintenance Facility Improvement Plan

The report pointed out that there would be a need to store, maintain, and repair Sounder and Amtrak trains at the new proposed Amtrak Pacific Northwest Maintenance Facility site. It stated that the proposed plan calls for a multi-track layout, which might cause a safety problem without the road closure. The grade-separated structure option was "screened out" of consideration, as required track clearances would not allow at-grade intersections with 1st Avenue S or 4th Avenue South.

2027 Train Volumes

The report assumed that Amtrak Cascades would increase up to 28 trains per day by 2027, up from the current 6 trains per day. The report stated that Amtrak's goal is to provide hourly daylight service from Seattle to Portland and complete it in a 2.5-hour travel time and provide every other hour service from Seattle to Vancouver BC in a 3-hour travel time.

The report stated that Sound Transit would increase its commuter train service from 6 to 42 trains per day on the Seattle-Tacoma segment and Seattle-Everett segment by 2027.

The report indicated that, with the proposed Amtrak maintenance facility, the total number of daily trains crossing S Holgate Street would increase significantly. In 2027, the report estimated a total of 232 trains per day would cross S Holgate Street.

Available Crossing Time in 2007

The report concluded that "in 2027 S Holgate Street would be open to traffic approximately 14 minutes during the AM peak and 18 minutes during the PM peak. Train operations would block the roadway for the rest of the hour. S Holgate Street would be open to traffic for approximately 40 minutes during the off-peak hour."

Recommendations

The study recommended that the S Holgate Street railway crossing be closed as a part of the Amtrak Maintenance Facility construction because:

- The capacity of S Holgate Street would be significantly reduced with the additional train traffic, such that vehicles would seek alternative routings with or without the closure.
- Extensive queuing resulting from the crossing closure would impact traffic flow at other intersections.
- The extensive track area would make it difficult to control vehicle and pedestrian traffic.
- The increase in left-turn movements, generated by the growth in the area and the diverted traffic by the closure, would be accommodated by other streets.
- Additional grade-separated railway crossings should be considered to provide additional capacity for traffic in the east-west direction.

S HOLGATE STREET RAILWAY CROSSING CLOSURE TRAFFIC IMPACT ANALYSIS – ADDENDUM 1 (MAY 2005)

This report dated January 2005 was prepared as an addendum to the report entitled "S Holgate Street Railway Crossing Closure Traffic Impact Analysis (2004)" prepared by Gary Struthers Associates to address specific issues raised by the City of Seattle. The following are concerns expressed by the City:

- The traffic volumes used in the 2004 report were low. This could have been attributed to the fact that the counts were conducted in November 2004 when there was construction work going on S Holgate Street. Also, seasonal variations caused by ferry and cruise ships were not fully incorporated in the baseline traffic volumes.
- The traffic impacts of other major roadway projects, specially the Alaskan Way Viaduct Project, were not considered.
- The traffic impact analysis did not address the impact of a S Holgate Street closure on special event traffic issues at two major stadium facilities – Safeco Field and Qwest Field.

Responses to City of Seattle Comments

The report stated that, based on historical traffic data for the month of November and average annual daily traffic (AADT) volumes, the November 2004 traffic volumes used for the earlier study were not low.

The analysis of ferry traffic volumes estimated a possible increase in traffic during PM peak hour by about 1.9 percent (46 trips), which would not have measureable impact on LOS at the study intersections.

The report stated that cruise ship traffic typically occurs on weekends and would not impact the weekday peak hour traffic volumes or LOS.

The consultant reported the 2030 traffic volumes forecasted for the S Holgate Street and Alaskan Way Viaduct traffic studies are comparable in total volumes. However, it indicated the possibility of some discrepancies in directional orientation as a result of the new viaduct access points.

The report noted that during Safeco Field ballgame events S Royal Brougham Way and S Atlantic Street are closed for east-west street traffic movements to accommodate pedestrian traffic. If S Holgate Street were closed, east-west traveling vehicles would be forced to use S Lander Street, not be a convenient route for many. As a result, traffic congestion around the stadium would increase.

If S Holgate Street were to remain open, significant additional delay and safety hazards would be created for non-motorized traffic, due to the extensive railroad crossing and train volumes. For traffic operations and safety as well as pedestrian safety concerns, the report suggested that S Holgate Street should be closed.

APPENDIX I. SOUTH LANDER STREET OVERCROSSING PROJECT

SDOT reported on the city's web site in December 2007 that the 30% design milestone for the S Lander Street project was complete and that work had begun on the next stage of design. The first project newsletter was mailed out in October 2007 and a public open house was held on October 23 in the SODO district to give the public an opportunity to review and provide feedback on the 30% plans and undecided design elements.

Background and General Project Information

This project was recommended in the *Access Duwamish* Report in 2000, which was a comprehensive study of transportation and freight needs for the Duwamish area. The report recommended a series of projects to separate the railroad tracks from street crossings including S Lander Street, to increase safety, and to improve mobility in the area.

In the S Lander Street Overcrossing Project, the bridge structure over the BNSF railroad tracks will touch down at First Avenue S and Fourth Avenue S on S Lander Street, providing a roadway that will no longer be impacted by the railroad operations.

In January 2007, SDOT staff and a design consultant began the early stages of design and the process of meeting with property owners immediately adjacent to the project. The first step was to re-confirm S Lander Street as the preferred location for the grade separation. An initial analysis performed in 2002, looked at all the east-west grade separation options in the SODO area. The study recommended S Lander Street as the location for the project, but also recommended a closer look at S Hanford Street. In early 2007, a new analysis and memorandum were prepared, comparing S Lander Street with S Hanford Street as the location for grade separation. Once again, S Lander Street was recommended as the location for the grade separation project.

Typical Cross Section

The proposed typical cross section includes four vehicle travel lanes (two eastbound and two westbound), a center lane for turns at the intersections, two 5-foot bicycle lanes and two 8-foot wide sidewalks. **Exhibit I-1** shows the general concept of the S Lander Street overcrossing and **Exhibit I-2** shows a typical cross section of the overpass as designed in the 30 percent process.

Cost Estimate

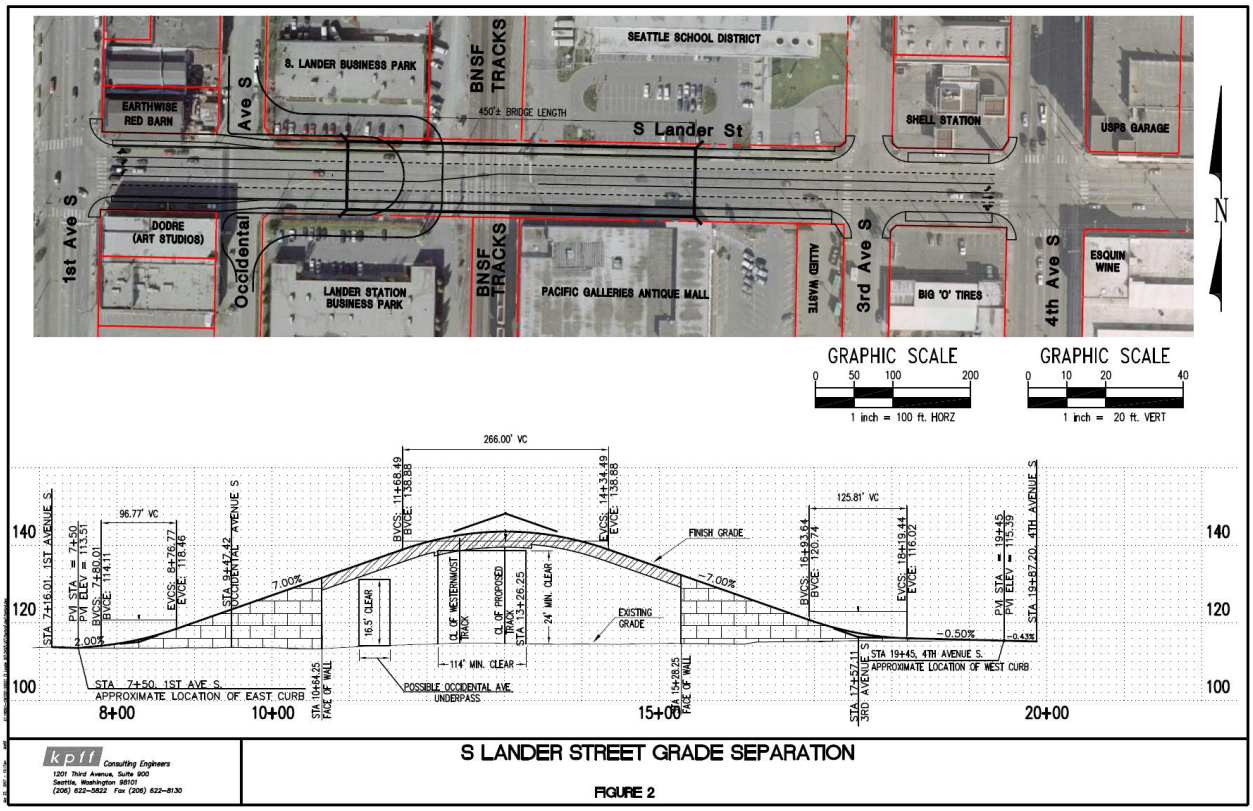
Early planning estimates place the project cost at approximately $75 million. SDOT has roughly $20 million from the "Bridging the Gap" program and is pursuing additional funding for this project.

The city expected that construction would start in mid-2009 and take about two years to complete. However, this project is on-hold due to the uncertain funding situation at this time.

Public Information

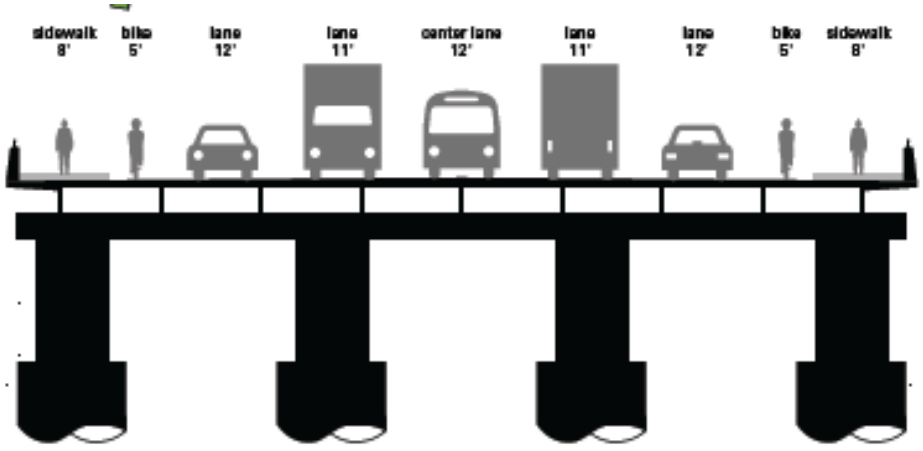
To provide more general information on this project, the information prepared for the public meetings in 2007 is shown in **Exhibit I-3**.

Exhibit I-1. Conceptual Drawing of S Lander Street Overcrossing



Source: Seattle Department of Transportation

Exhibit I-2. Proposed S Launder Street Overcrossing Typical Cross Section



Source: Seattle Department of Transportation

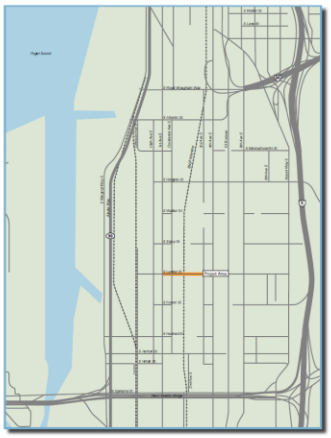
Exhibit I-3. Information Prepared for Public Meetings in 2007 (several graphics)

Overview

What are we doing?

Relieving a serious chokepoint in the Duwamish area by:

- Building an overpass between 1st Avenue S and 4th Avenue S
- Closing the at-grade crossing of the Burlington Northern Santa Fe (BNSF) railroad tracks on S Lander Street
- Separating vehicular, pedestrian, and bicycle traffic from rail traffic



Benefits

- Improves safety
- Keeps commuters and traffic moving
- Reduces delays caused by trains
- Improves access to the Port, the stadiums, and the future Sound Transit light rail station
- Provides congestion relief during major construction
- Reduces emissions from idling vehicles

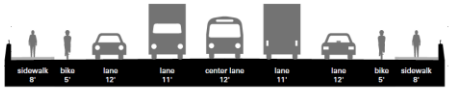
Cost Estimate:
$75–80 million

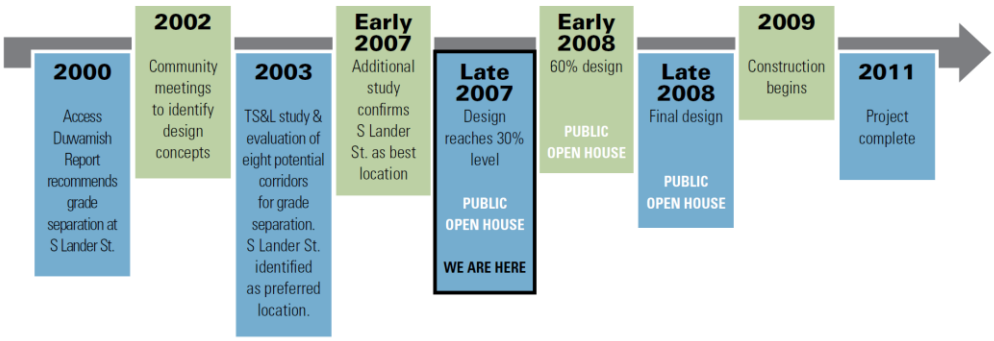
Funding:

- $20 million Bridging the Gap
- $8.3 Freight Mobility Strategic Investment Board
- Additional funding still needed

S Lander Street Today...

S Lander Street Tomorrow...





South Lander Street Grade Separation

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Alternatives We Studied

How did we choose the S Lander St. Alternative?

- Eight corridors were considered for grade separation
- Underpass and overpass alternatives were reviewed
- Utility relocation requirements and right-of-way needs identified an overpass as the best option
- S Lander Street identified as the preferred location, but the TS&L recommended further study of the S Hanford Street Alternative

S Lander Street Alternative

Benefits

- Closes an existing at-grade crossing
- Improves safety conditions for all users on an existing arterial
- Ideally suited to provide pedestrian and transit connections to the future Sound Transit S Lander Street light rail station
- No impact to rail-dependent businesses
- Can be built in existing right-of-way, minimal property acquisition needed

Weaknesses

- Some adjacent businesses lose direct access to S Lander Street
- Loss of visibility to some businesses on S Lander Street

S Hanford Street Alternative

Benefits

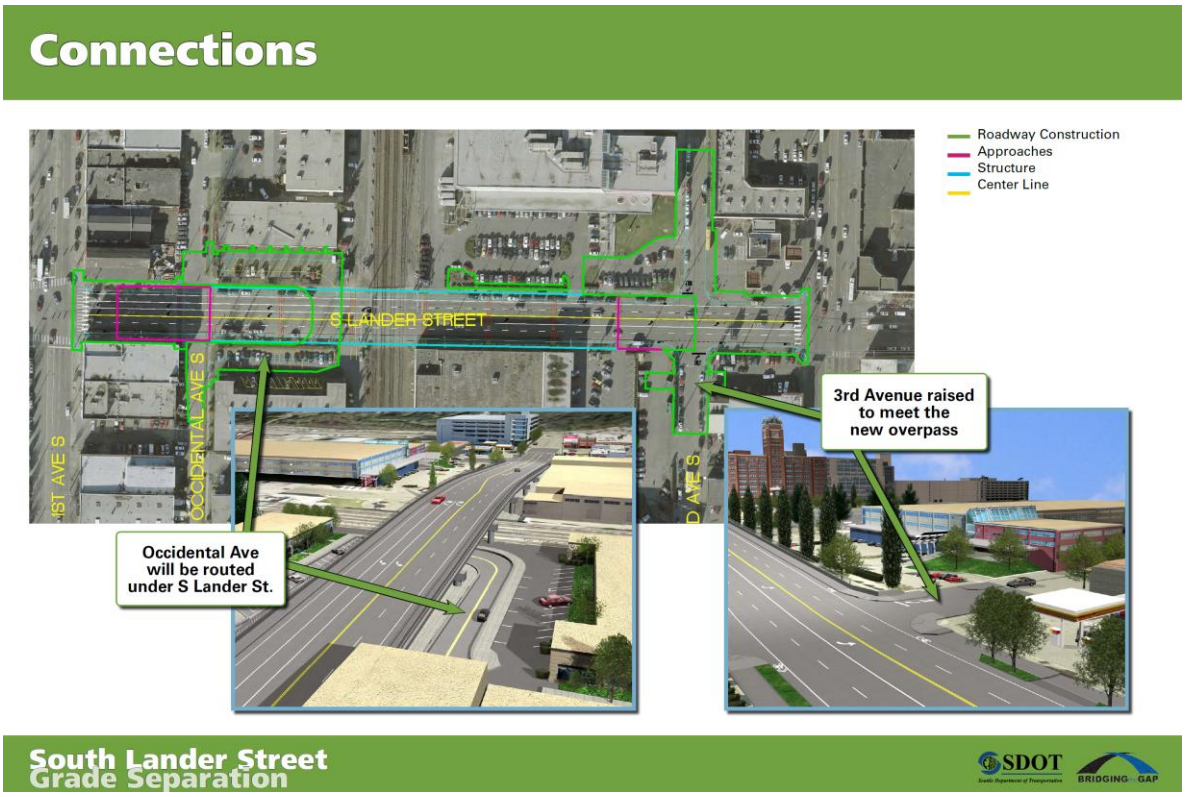
- Creates a new east-west connection
- Adds additional capacity to the road network
- Provides a direct link between Port of Seattle terminals on East Marginal Way South, BNSF Seattle International Gateway, and Stacey Yards

Weaknesses

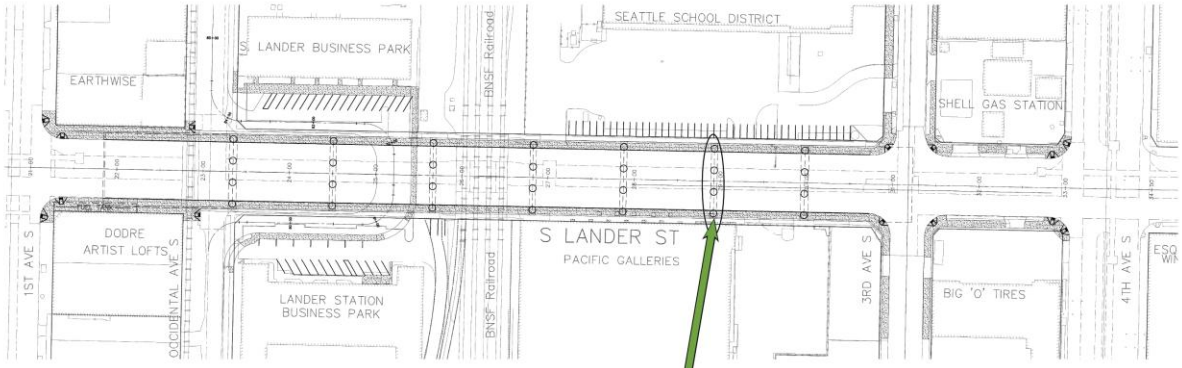
- Does not close an existing at-grade crossing
- Close to Spokane Street, which already meets some of the area's grade separation needs
- Proposed 1st Avenue S and 4th Avenue S ramps to the Spokane Street viaduct will lessen the benefit of a grade separation at S Hanford St.
- Requires up to 50,000 square feet of property acquisition
- Not located in an area that is heavily traveled by pedestrians
- Two rail-dependent businesses impacted
- Does not resolve safety issues relating to at-grade crossing of S Lander Street

South Lander Street Grade Separation

SDOT Seattle Department of Transportation BRIDGING the GAP

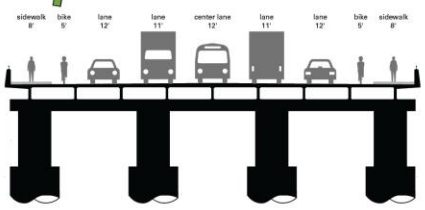

Connections
Roadway Construction
Approaches
Structure
Center Line
S LANDER STREET
OCCIDENTAL AVE S
1ST AVE S
D AVE S
Occidental Ave will be routed under S Lander St.
3rd Avenue raised to meet the new overpass
South Lander Street
Grade Separation
SDOT
BRIDGING the GAP

Plan & Structure Type



Why this structure type?

- Five-span structure allows us to maintain Occidental Avenue as a thru street and replace lost on-street parking
- Concrete structure is less costly to maintain than a steel structure
- Structure will match industrial feel of the area
- Foundations will be drilled shafts positioned between existing utilities
- Concrete columns will continue up out of the shafts to support the bridge structure



South Lander Street Grade Separation

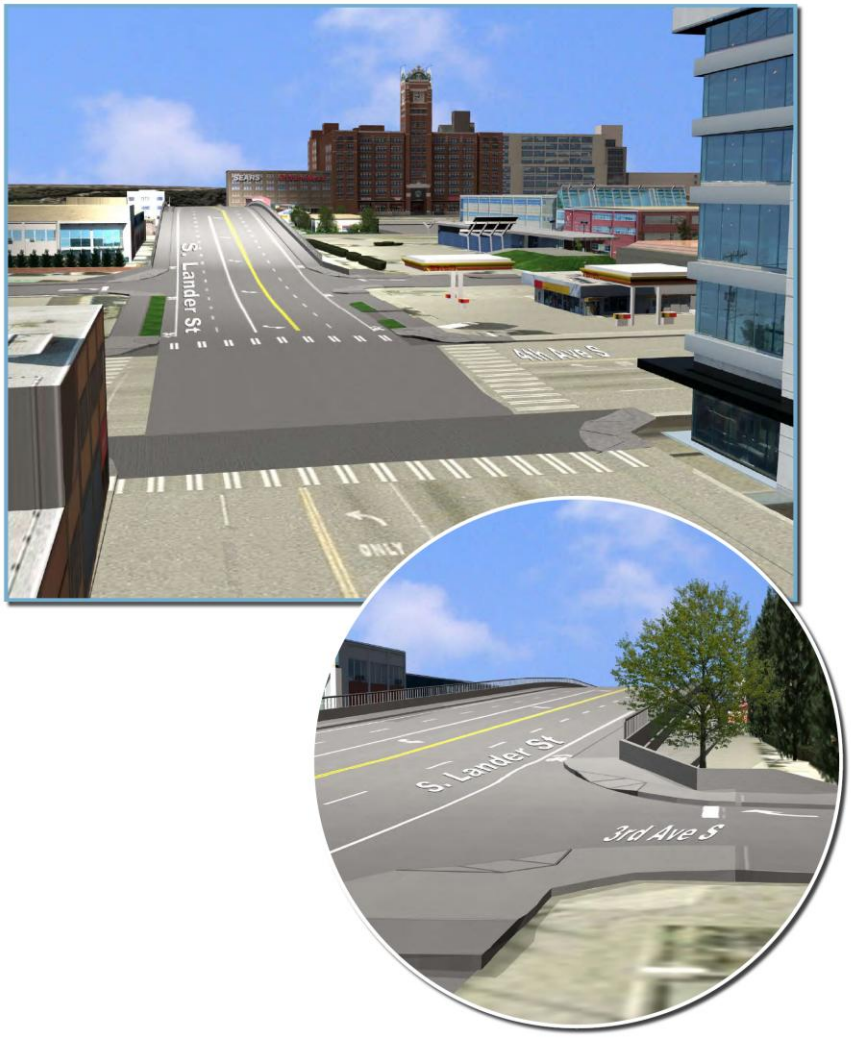
View Looking East

Pedestrian access to buildings along S Lander St. will be maintained.

South Lander Street Grade Separation

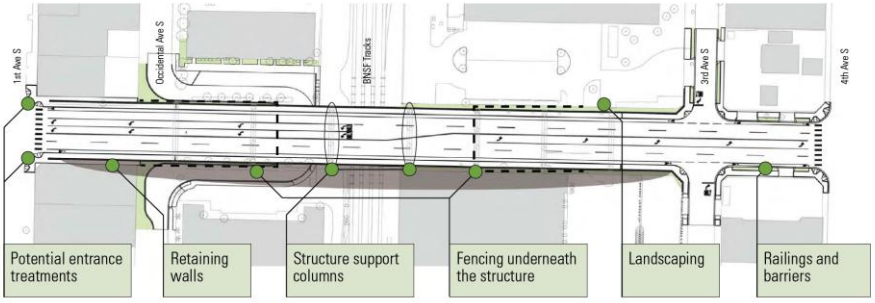
SDOT Seattle Department of Transportation BRIDGING the GAP

View Looking West



South Lander Street Grade Separation

Potential Design Features



Please tell us what features are most important to you

Final design will depend upon available funding, so we have some difficult choices to make. Here are design options we are considering. Place a sticker next to the three designs elements you would most like to see addressed in the final design.

Entrance Ideas

	your priority
Decorative railings	
Special paving	
Accent lighting	

Retaining Wall Ideas

	your priority
Concrete form liner	
Vines	
Artwork	

Railing and Barrier Ideas

	your priority
Pre-cast concrete	
Metal rails	

Column Treatment Ideas

	your priority
Painting or texturing	
Architectural/ Artistic Veneer	
Accent lighting	

Landscape Planting Ideas

	your priority
Low growing	
Drought tolerant	
Safety-enhancing design elements	
Enhanced stormwater design	

Fencing Ideas

	your priority
Architectural fencing	
Vine screens	
Art opportunities	

Note: Photos are examples of possible design features, and are not the specific design features we will use.

South Lander Street Grade Separation

SDOT Seattle Department of Transportation BRIDGING the GAP

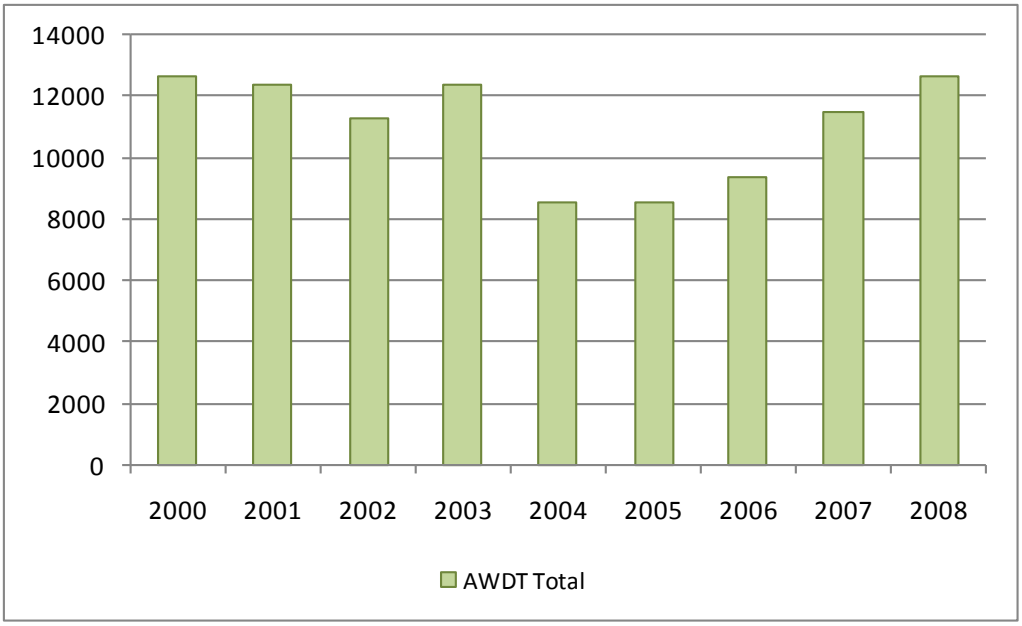
APPENDIX J. HISTORICAL TRAFFIC VOLUME TRENDS

South Holgate Street

Traffic volumes at two locations on S Holgate Street were plotted between the years of 2000 and 2008 to understand changes over the past several years.

Exhibit J-1 shows the Average Weekday Traffic (AWDT) volumes on S Holgate Street between 3rd Avenue S and 4th Avenue S. S Holgate Street carried over 12,000 vehicles per day prior to 2003, more or less constantly. However, the daily traffic volumes substantially decreased to just over 8,000 vehicles per day in 2004 and 2005. The cause of these traffic volume reductions is likely the opening of the Atlantic Street grade-separated roadway and the eastbound connection to I-90. However, the daily traffic volumes on S Holgate Street have been increasing since 2005 and the 2008 average daily volume reached the pre-2003 level of 12,000 vehicles per day.

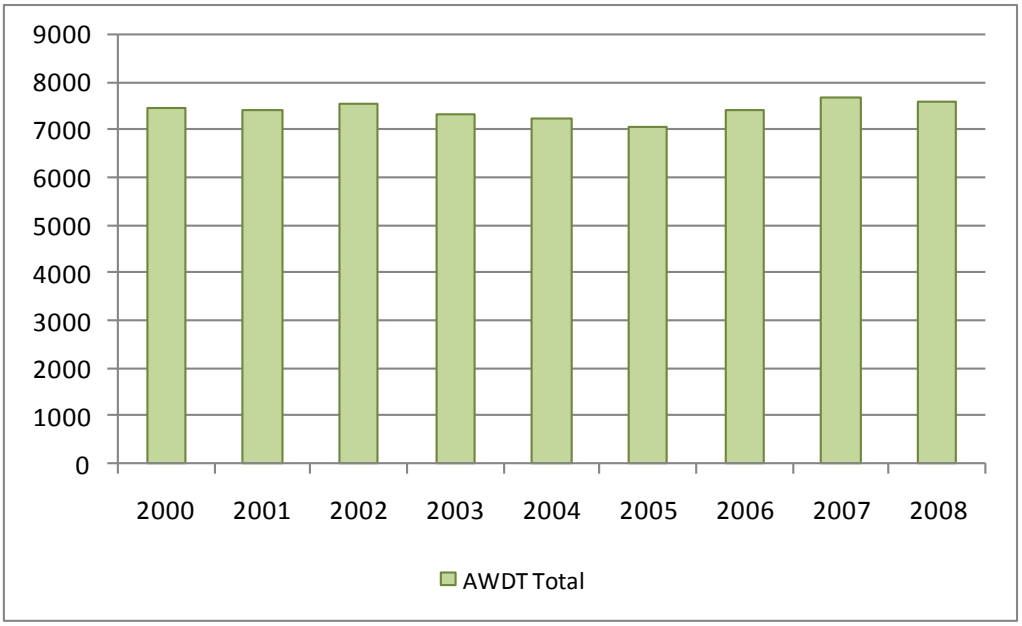
Exhibit J-1. Average Weekday Traffic Volumes on South Holgate Street between 3rd Avenue South and 4th Avenue South



Source: Fehr & Peers

Exhibit J-2 shows the two-way AWDT volumes on the S Holgate viaduct at a location east of Airport Way S for the eight years from 2000 to 2008. The average daily volumes on the S Holgate Street viaduct have not changed significantly. This section of S Holgate Street has been carrying about 7,500 vehicles per day.

Exhibit J-2. Average Weekday Traffic Volumes on South Holgate Street East of Airport Way South



Source: Fehr & Peers

S Lander Street

S Lander Street is one of the east-west arterials in the SODO area, which may be affected if S Holgate Street were to close. S Lander Street at the railroad tracks is carrying about 16,000 vehicles per day. The section east of 4th Avenue S is carrying about 12,000 vehicles per day. **Exhibit J-3** shows the two-way AWDT volumes on S Lander Street between 4th Avenue S and 6th Avenue S.

During the last several years, the volumes on S Lander Street east of 4th Avenue S have declined slightly from a peak of 14,000 vehicles per day in 2003.

Exhibit J-3. Average Weekday Traffic Volumes on S Lander Street between 4th Avenue S and 6th Avenue S

Source: Fehr & Peers

S Royal Brougham Way

While the traffic count data on S Royal Brougham Way are missing for the most recent year, we were able to plot the daily traffic volume trend. **Exhibit J-4** shows AWDT on S Royal Brougham Way east of Occidental Avenue S for the five years prior to 2006. In 2000, it carried 20,000 vehicles per day. The daily traffic volume in 2003 decreased to 12,500 vehicles per day. Today, SR 519 construction is taking place and the street between Occidental Avenue S and 4th Avenue S is closed for traffic. When SR 519 construction is complete in June 2010, an overpass structure will separate the roadway from the railroad tracks, however, there will be only two lanes and the roadway will not directly connect to 4th Avenue South. It is expected that the volumes will continue to decrease from the 2008 level, putting more traffic pressure on S Atlantic Street.

Exhibit J-4. Average Weekday Traffic Volumes on S Royal Brougham Way between Occidental Avenue S and 3rd Avenue South

Source: Fehr & Peers

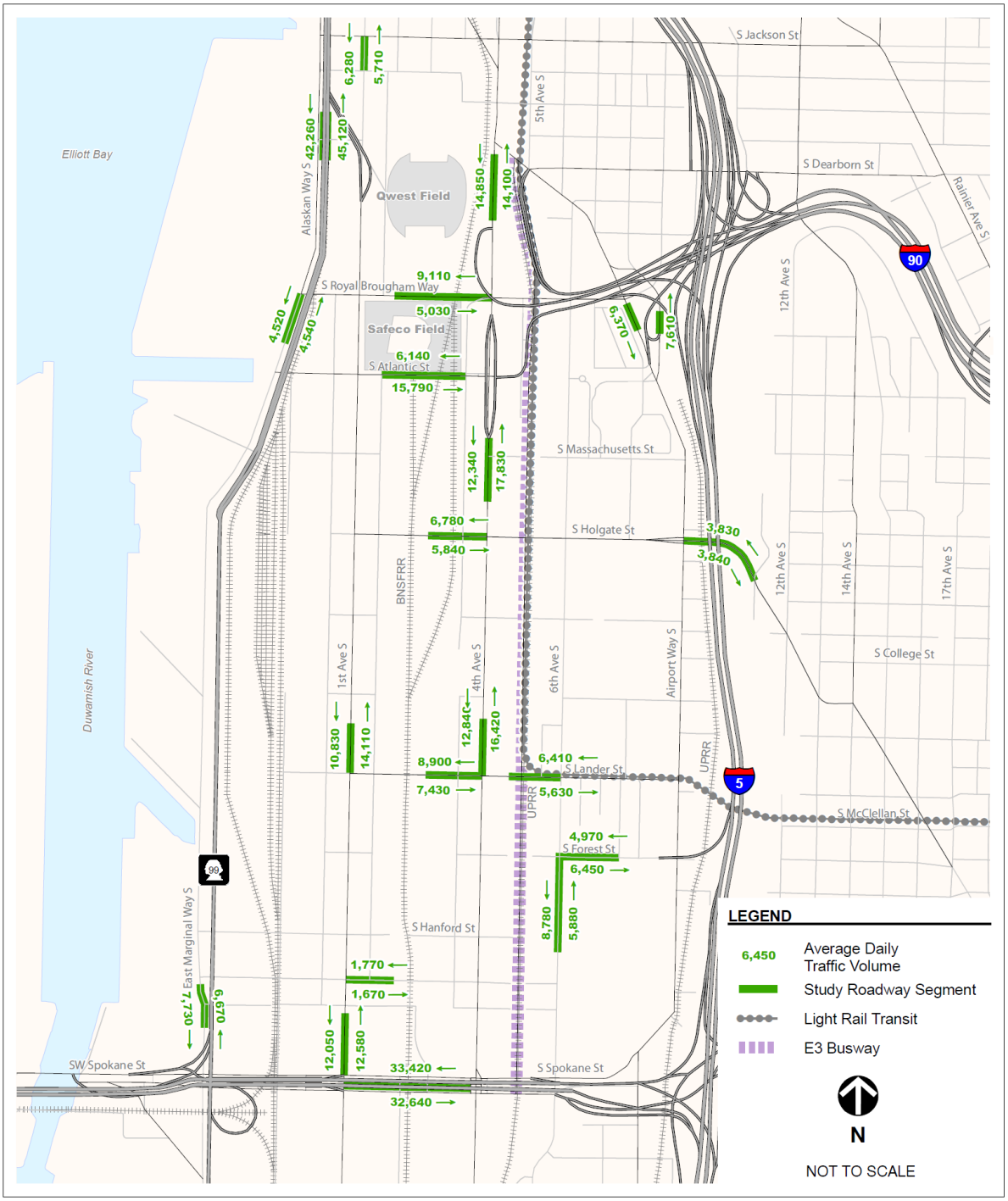
EXISTING TRAFFIC VOLUMES IN THE STUDY AREA

Exhibit J-5 shows the existing average weekday traffic volumes. The volumes were taken from the SDOT counts, those from the previous studies.

Exhibit J-6 shows the existing average AM peak hour volumes.

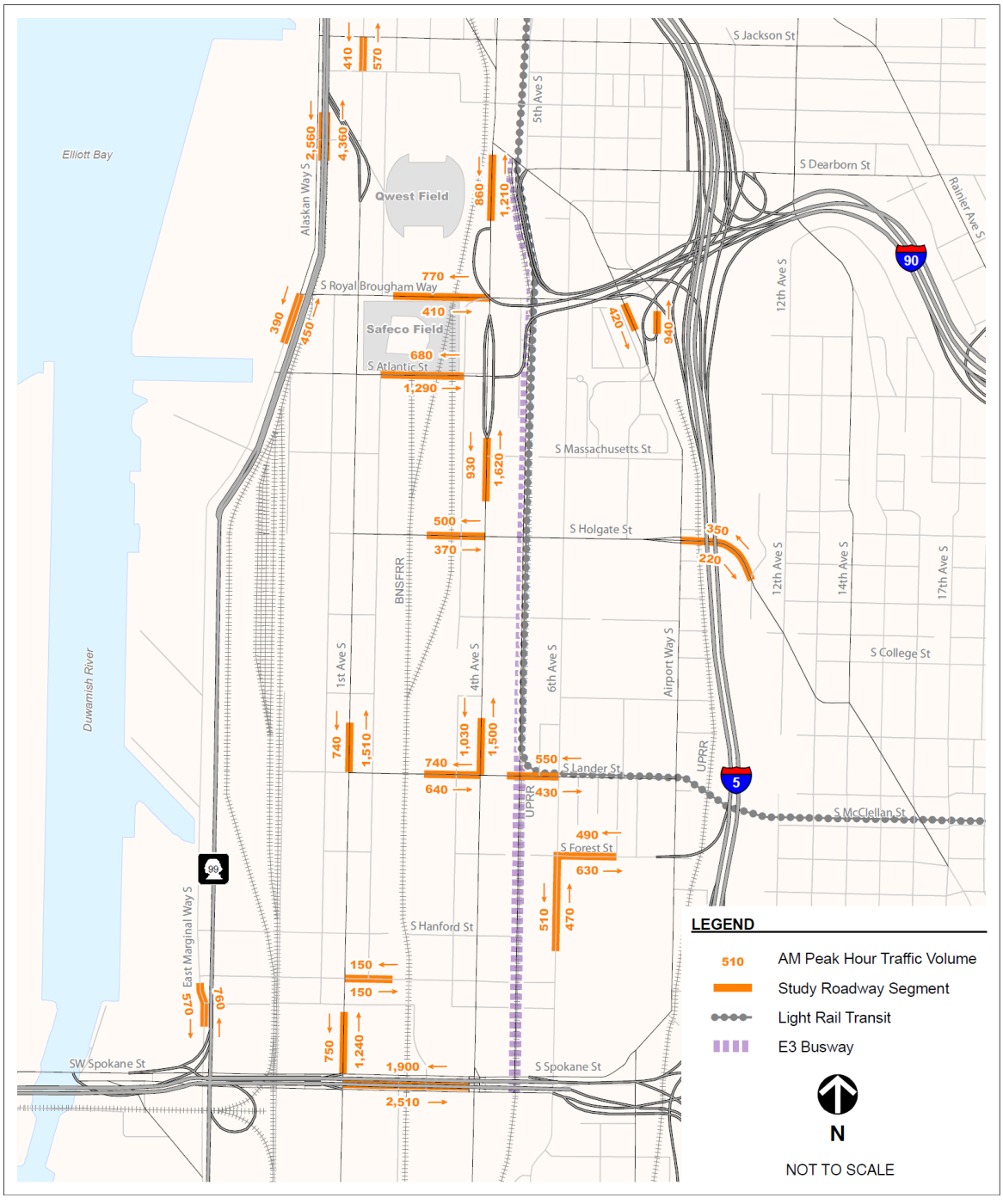
Exhibit J-7 shows the existing average PM peak hour volumes.

Exhibit J-5. Existing Average Weekday Traffic Volumes (2008)



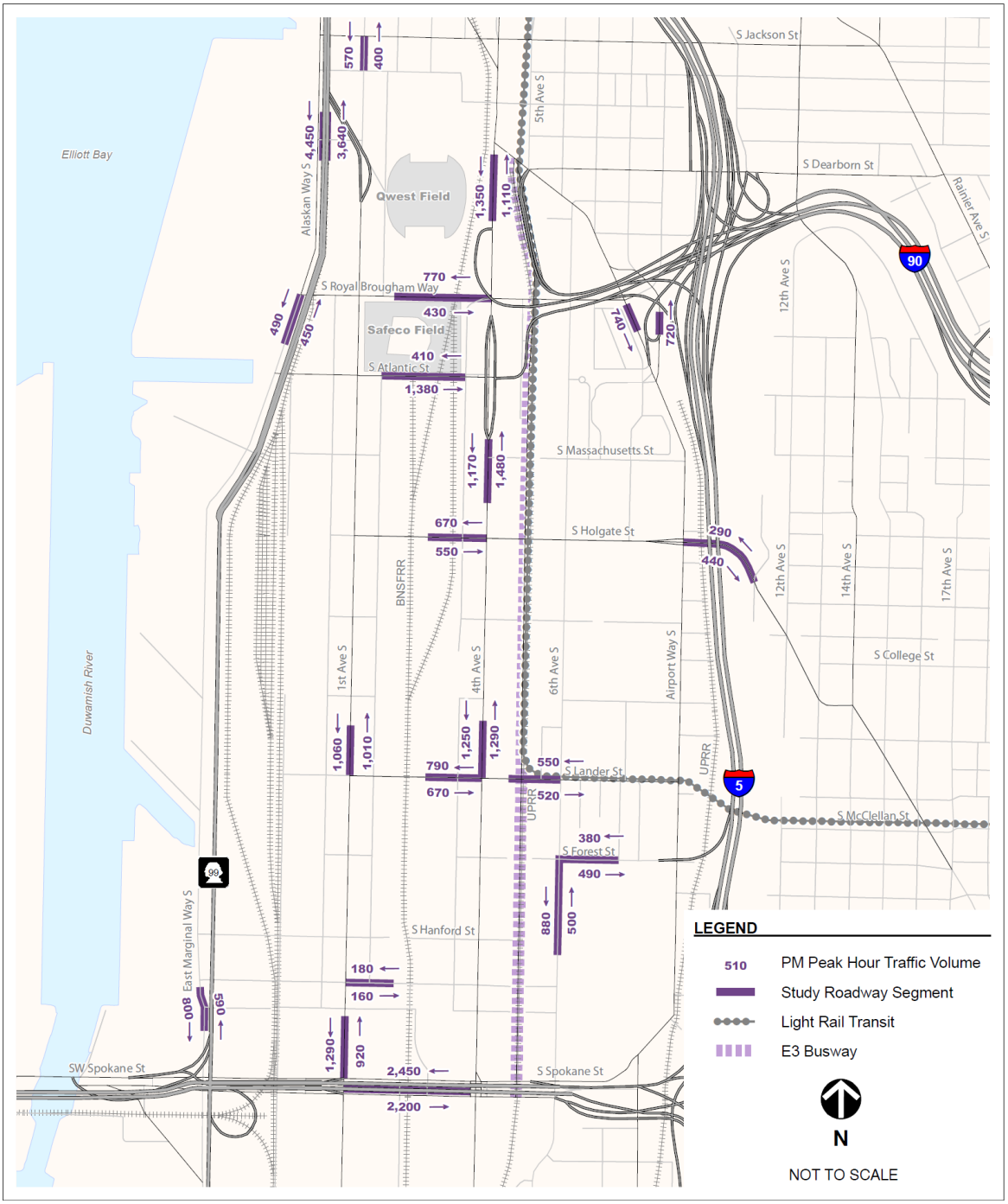
Source: Fehr & Peers

Exhibit J-6. Existing AM Peak Hour Traffic Volumes (2008)



Source: Fehr & Peers

Exhibit J-7. Existing PM Peak Hour Traffic Volumes (2008)



Source: Fehr & Peers

APPENDIX K. PRELIMINARY GRADE SEPARATION ANALYSIS

Fehr & Peers evaluated the preliminary feasibility of a S Holgate Street grade separation, with a structure constructed over the railroad tracks between 1st Avenue S and 4th Avenue S. This appendix identifies a potential layout by evaluating roadway grades for the feasibility.

S Holgate Street is an east-west Minor Arterial and a major truck route that provides direct access to the S Holgate Street/ Beacon Avenue S overpass over Interstate 5. The overpass serves as the only connection across I-5 for approximately 1.5 miles between I-90 and the West Seattle Freeway. S Holgate Street serves about 12,600 vehicles per day in the section between 1st Avenue S and 4th Avenue S; the overpass serves about 7,600 vehicles per day during a weekday in 2008.

Standards

We have considered several different conceptual overpass layouts for a grade-separated structure on S Holgate Street between Occidental Avenue S and 3rd Avenue S. The overpass would need a minimum of 23.5 feet of clearance over the railroad tracks and 21.5 feet over spur railroad lines per Burlington Northern Santa Fe (BNSF) standards. It would also need a minimum of 16.5 feet of clearance over an intersection based on the WSDOT standards. The maximum grade that WSDOT allows for ramps is 7% assuming a 25 to 30 mph design speed. However, the desirable ramp grade is 5% (WSDOT Design Manual figure 940-2).

Conceptual Bridge Design

The conceptual overpass designs ranged from 1,200 to 2,700 horizontal feet, as shown in **Exhibit K-1**.The overpass would have two 11-foot travel lanes with 6-foot sidewalks and 2-foot outside barriers. A 5-foot bike lane should be provided to a space between the road and the sidewalk in each direction. It would have ramps onto 4th Avenue S and 6th Avenue S to allow vehicles more access points to the overpass. The 4th Avenue S ramps would be between 500 and 560 horizontal feet and the 6th Avenue S ramps would be approximately 460 feet. Both 4th Avenue and 6th Avenue would have to be widened to accommodate the ramps. We assumed that there would be some surface streets to provide local access to the properties. However, surface lanes would not be provided across the railroad tracks.

West End Alternatives

We identified two alternative concepts for ramp locations on the west side of the railroad tracks.

Alternative W-1

The first alternative assumes that the upper level roadway begins immediately east of the S Holgate Street/1st Avenue S intersection. It would extend approximately 400 horizontal feet with a grade of 7.1%, 0.1 percent beyond WSDOT standards. This ramp would block the intersection at S Holgate Street/Occidental Avenue S because there is not enough clearance. Therefore, this alternative assumes that through traffic movements on Occidental Avenue S at this intersection would be eliminated. At the end of the ramp, the bridge would continue 320 horizontal feet with a grade of 1.1%, and then it would tie into the midsection of the bridge.

Alternative W-2

Under the second alternative, the upper roadway section begins on Occidental Avenue S approximately 260 feet south of S Massachusetts Street and 430 feet north of S Holgate Street. This ramp would have a 5% grade for about 520 horizontal feet and the section would curve 90 degrees over the intersection at S Holgate Street. This alternative would provide the minimum required clearance over the intersection, which would allow it to remain in operation. After the ramp, the bridge would have a 60 foot section with a 3.3% grade followed by a 390 foot section with a 1.1%grade. At

the end of the ramp, the bridge would continue 320 horizontal feet with a grade of 1.1%, and then tie into the midsection of the bridge.

Bridge Section over Railroad Tracks

The bridge section over the railroad tracks between the western and eastern section alternatives shares a section common to all design concepts considered. This section would be 240 horizontal feet with a grade of 0.7%.

East End Alternatives

We have identified four alternative ramps for the eastern side of the railroad tracks.

Alternative E-1

The first alternative assumes that the S Holgate Street upper level roadway would come down to the surface before the intersection at 4th Avenue S. The ramp would extend horizontally for 200 feet with a grade of 14.8%, which exceeds the standard by 7.8 percent. This alternative would not be acceptable.

Alternative E-2

The second alternative would begin at the midsection, and then continue for 290 horizontal feet at a grade of 2.2%, followed by 290 horizontal feet with a 7.8% grade. This ramp would end before the E-3 busway. It would include 500 foot ramps on 4th Avenue S to provide additional access to the railroad crossing. The down grade of 7.8% is 0.8 percent over the maximum allowable grade.

Alternative E-3

The third alternative would begin at the midsection, and then continue for 690 horizontal feet with a 0.9% grade, followed by a 270 foot section with 8.1% grade. This ramp would end before 6th Avenue S. It would include 540 foot ramps on 4th Avenue S to provide additional access to the upper roadway. The down grade would be 1.1 percent over the standard.

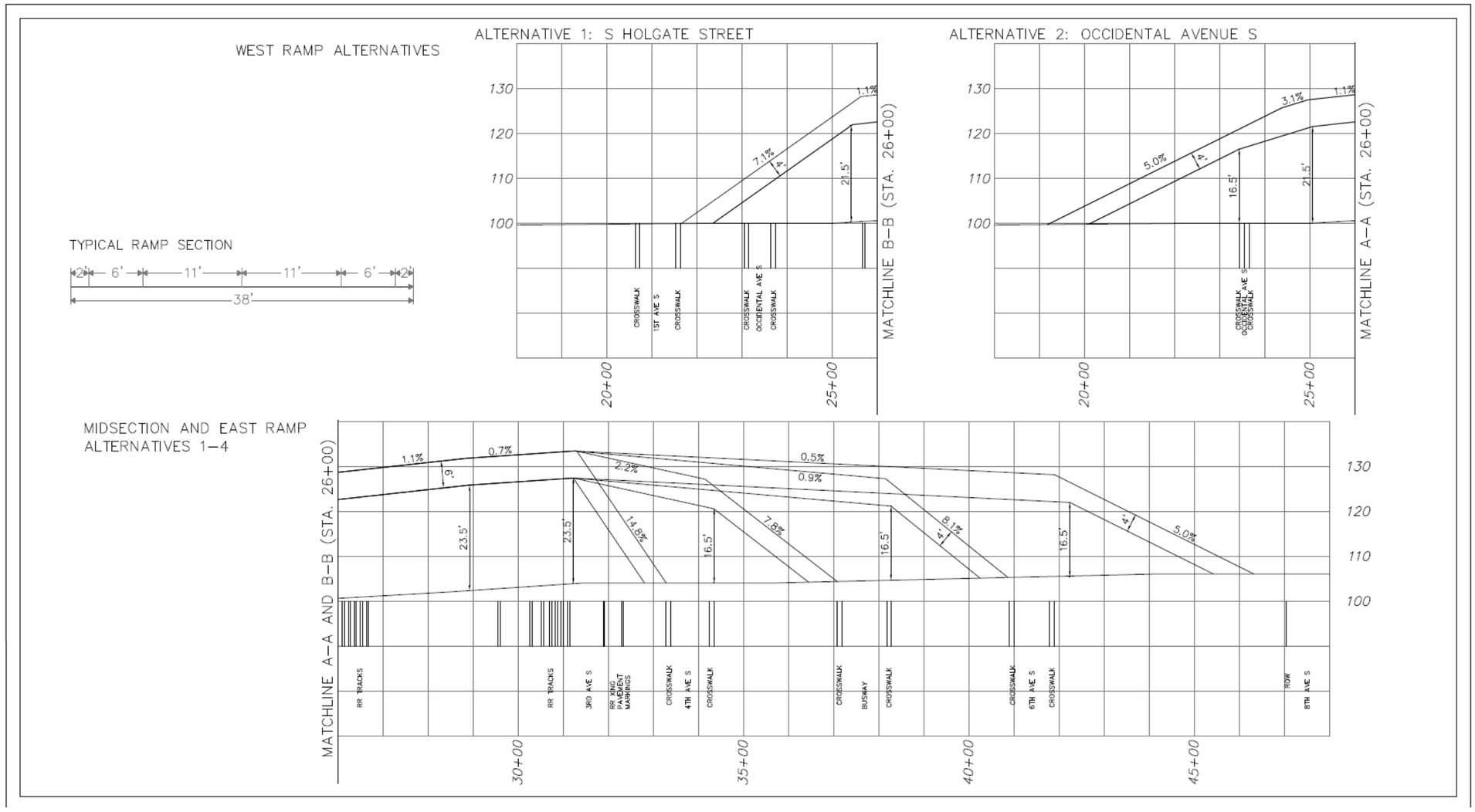
Alternative E-4

The fourth alternative would begin at the midsection, and then continue for 1,070 horizontal feet with a 0.5% grade, followed by a 440 foot section with a 5.0% grade. It would include 550 foot ramps on 4th Avenue S and 460 foot ramps on 6th Avenue S to provide additional access to the upper roadway. The upper roadway ramp would end about 70 feet before the intersection at 8th Avenue S.

Key Findings

Any grade separated roadway design over the BNSF railroad tracks on S Holgate Street would be constrained by the grades and clearance limitations set by WSDOT and BNSF. These standards eliminate all but two of the conceptual design alternatives that we analyzed. The design that meets the standards would be the 2,700 feet overpass structure, the longest among the alternatives evaluated. It would begin on Occidental Avenue S between S Massachusetts Street and S Holgate Street and end about 70 feet west of 8th Avenue S, as shown in **Exhibit K-2**. A feasible design concept is the combination of Alternative W-2 for the west end section, the mid-section and Alternative E-4 for the east section.

Exhibit K-1. Occidental Avenue South/South Holgate Street Crossing Profile



Source: Fehr & Peers

Exhibit K-2. A Sketch of Possible Grade Separated Roadway on S Holgate Street

Source: Fehr & Peers

APPENDIX L. 2007, 2015 AND 2030 INTERSECTION APPROACH VOLUMES

The following exhibits show the intersection approach volumes for the years of 2007, 2015 and 2030.

Exhibit L-1. 2007 Intersection Approach Volumes

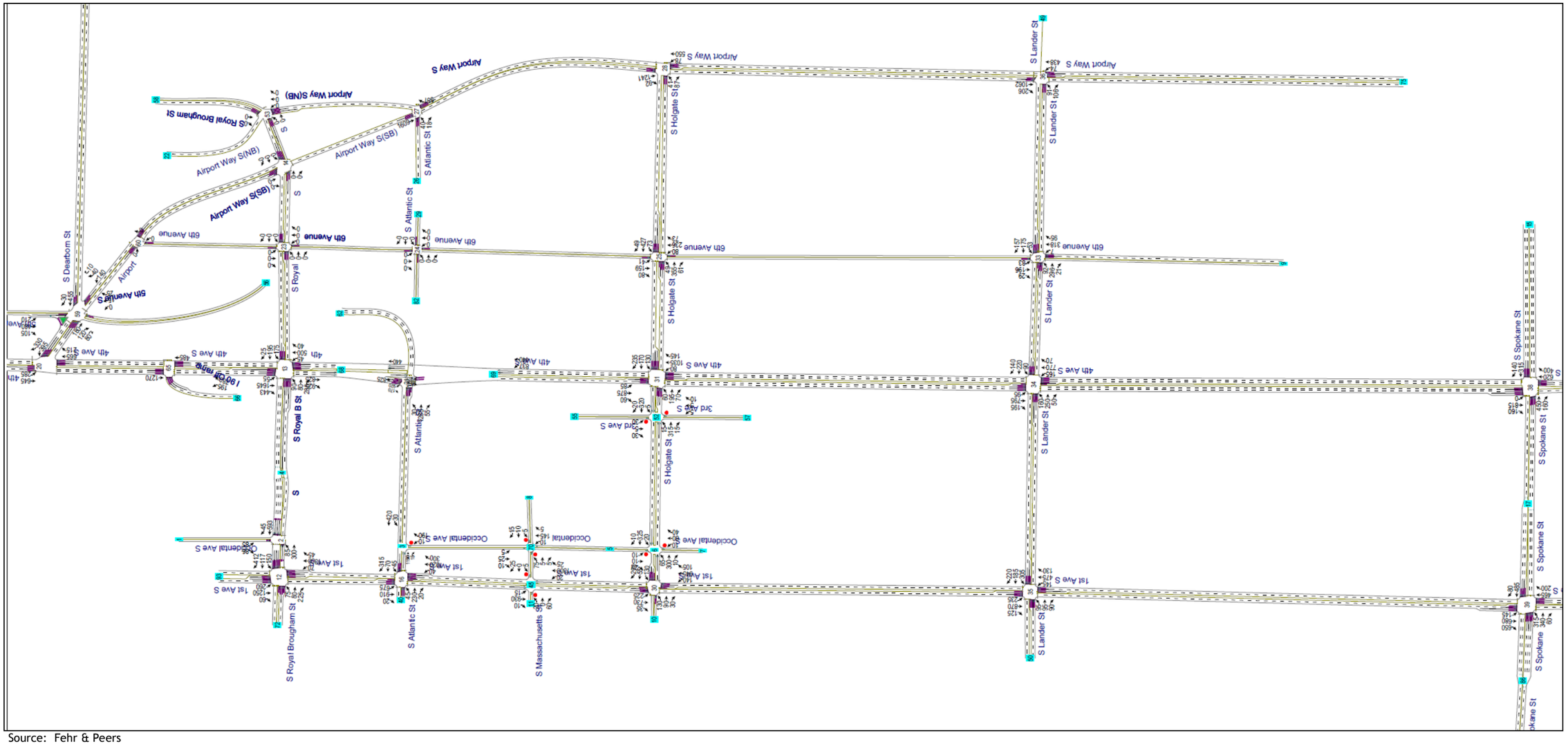
2007 Intersection Approach Volumes
PM Peak Hour

Intersection ID	Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
2	Occidental Ave S & S Royal Brougham Way				85		86	85	300			593	45
3	Occidental Ave S & S Atlantic St	10		190					1,190	15	30	420	
6	Occidental Ave S & S Holgate St	10	60	40	10	10	25	65	300	10	20	325	10
12	1st Ave S & S Royal Brougham Way	70	1,300	45	260	1,250	60	75	80	225	150	117	412
13	4th Ave S & S Royal Brougham Way	45	500	40	55	1,645	443	90	80	285	175	195	25
16	1st Ave S & S Atlantic St	40	1,020	300	675	910	20	45	230	20	45	70	315
20	4th Ave S & Airport Way		665	215	285	645					395		330
21	4th Ave S & S Atlantic St	270		675	920		170	30	1,285	55			
25	6th Ave S & S Holgate St	80	236	73	41	159	80	49	355	61	73	427	49
28	Airport Way S & S Holgate St	78	550			1,241	92	41		87			
30	1st Ave S & S Holgate St	140	945	105	225	730	35	130	90	30	130	55	270
31	4th Ave S & S Holgate St	80	1,035	145	85	875	60	60	195	70	130	170	235
33	6th Ave S & S Lander St	7	318	95	83	196	29	92	296	21	53	175	157
34	4th Ave S & S Lander St	165	770	70	95	795	195	160	250	50	90	220	140
35	1st Ave S & S Lander St	145	475	130	235	870	125	95	95	90	305	185	220
36	Airport Way S & S Lander St	74	438			1,062	206	91		106			
38	4th Ave S & S Spokane St		620	400		815	160		450	160		315	140
39	1st Ave S & S Spokane St		465	200	145	680	650	315	340	60		485	80
45	1st Ave S & S Massachusetts St	20	1,300	25	15	930	10	20		60	5		25
52	3rd Ave S & S Holgate St	5	5	10	30	5	30	15	315	15	5	320	20
59	Airport Way & S Dearborn St		15	25	210	180	105		180	120		455	30
65	4th Ave S & I-90 Off Ramp		485			1,270		195		780			
70	Occidental Ave S & S Massachusetts St	10	145	5	5	25	10	75	5	5	5	10	15

NBL	Northbound Left Turn Vehicles
NBT	Northbound Through Vehicles
NBR	Northbound Right Turn Vehicles
SBL	Southbound Left Turn Vehicles
SBT	Southbound Through Vehicles
SBR	Southbound Right Turn Vehicles
EBL	Eastbound Left Tunrn Vehicles
EBT	Eastbound Through Vehicles
EBR	Eastbound Right Turn Vehicles
WBL	Westbound Left Turn Vehicles
WBT	Westbound Through Vehicles
WBR	Westbound Right Turn Vehicles

Source: Fehr & Peers

Exhibit L-2. 2007 Synchro Network and Approach Volumes



Source: Fehr & Peers

Exhibit L-3. 2015 Intersection Approach Volumes with S Holgate Street

2015 Intersection Approach Volumes with S Holgate Street Open

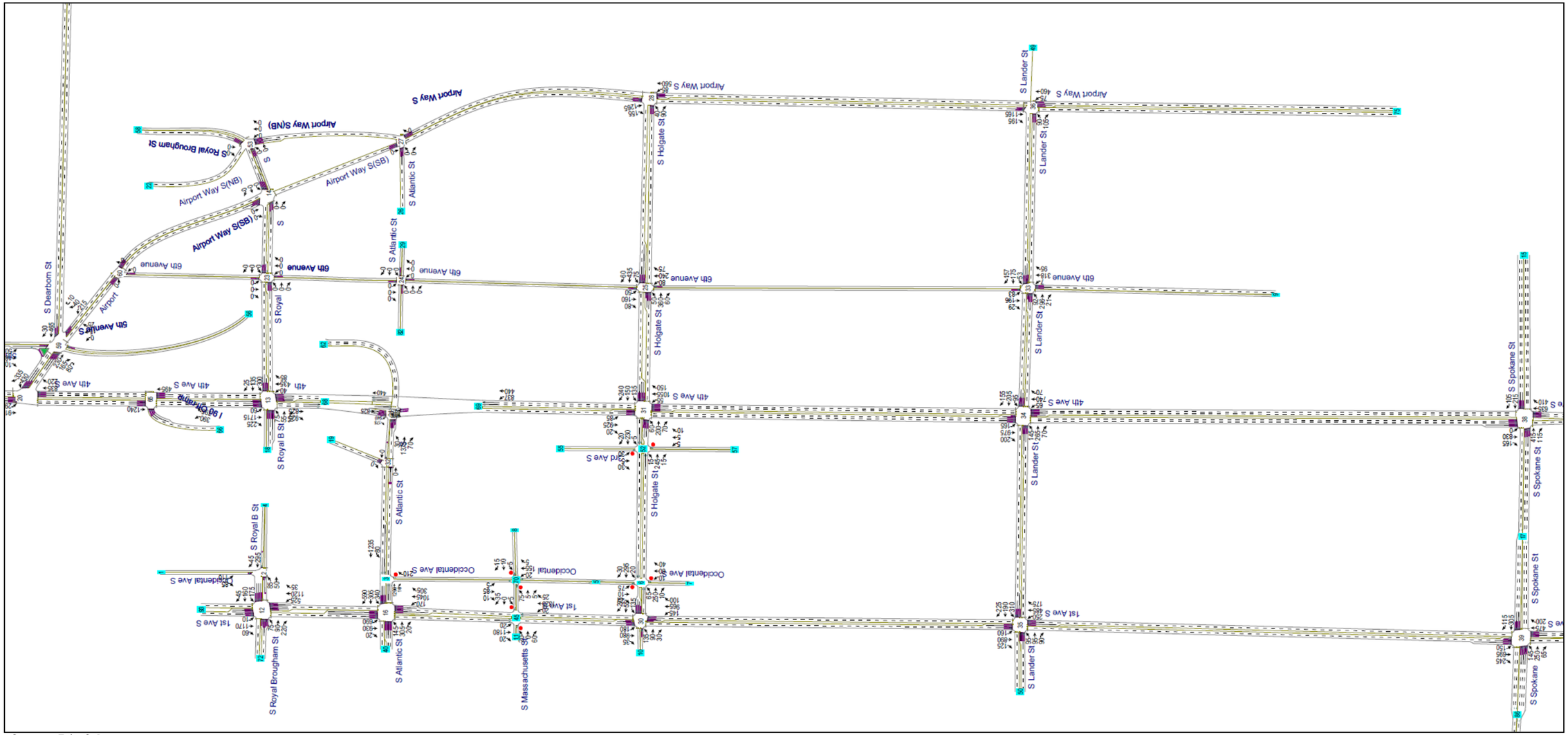
PM Peak Hour

Intersection ID	Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
2	Occidental Ave S & S Royal Brougham Way				110		85	85	50			295	45
3	Occidental Ave S & S Atlantic St			210					1,290	10	80	1,235	
6	Occidental Ave S & S Holgate St	10	60	40	75	10	25	65	250	10	20	295	30
12	1st Ave S & S Royal Brougham Way	525	1,120	35	10	1,170	60	75	90	220	175	160	45
13	4th Ave S & S Royal Brougham Way	40	435	85	60	1,715	225	75	55	10	300	135	25
16	1st Ave S & S Atlantic St	170	1,045	305	690	930	20	145	305	20	340	305	590
20	4th Ave S & Airport Way		835	220	290	915					430		335
21	4th Ave S & S Atlantic St	270		690	940		175	30	1,375	70			
25	6th Ave S & S Holgate St	80	240	75	50	160	80	50	360	60	75	435	60
28	Airport Way S & S Holgate St	85	560			1,265	155	40		90			
30	1st Ave S & S Holgate St	145	965	100	180	980	35	135	90	30	135	55	275
31	4th Ave S & S Holgate St	55	1,055	150	85	925	20	60	200	70	135	150	240
33	6th Ave S & S Lander St	7	318	95	83	196	29	92	296	21	53	175	157
34	4th Ave S & S Lander St	65	740	70	165	975	200	145	265	70	95	205	155
35	1st Ave S & S Lander St	250	485	175	160	890	125	95	95	90	310	190	225
36	Airport Way S & S Lander St	75	460			1,165	195	90		105			
38	4th Ave S & S Spokane St		635	410		830	165		415	115		215	105
39	1st Ave S & S Spokane St		475	200	150	695	245	145	250	65		305	115
45	1st Ave S & S Massachusetts St	20	1,325	25	20	1,180	20	20		60	5		35
52	3rd Ave S & S Holgate St	5	5	10	30	5	30	15	245	15	5	230	20
59	Airport Way & S Dearborn St		15	25	505	185	105		230	165		465	30
65	4th Ave S & I-90 Off Ramp		495			1,240		390		795			
70	Occidental Ave S & S Massachusetts St	20	155	5	5	85	10	75	5	5	5	10	15

NBL	Northbound Left Turn Vehicles
NBT	Northbound Through Vehicles
NBR	Northbound Right Turn Vehicles
SBL	Southbound Left Turn Vehicles
SBT	Southbound Through Vehicles
SBR	Southbound Right Turn Vehicles
EBL	Eastbound Left Turn Vehicles
EBT	Eastbound Through Vehicles
EBR	Eastbound Right Turn Vehicles
WBL	Westbound Left Turn Vehicles
WBT	Westbound Through Vehicles
WBR	Westbound Right Turn Vehicles

Source: Fehr & Peers

Exhibit L-4. 2015 Synchro Network and Approach Volumes with S Holgate Street



Source: Fehr & Peers

Exhibit L-5. 2015 Intersection Approach Volumes without S Holgate Street

2015 Intersection Approach Volumes without S Holgate Street Open

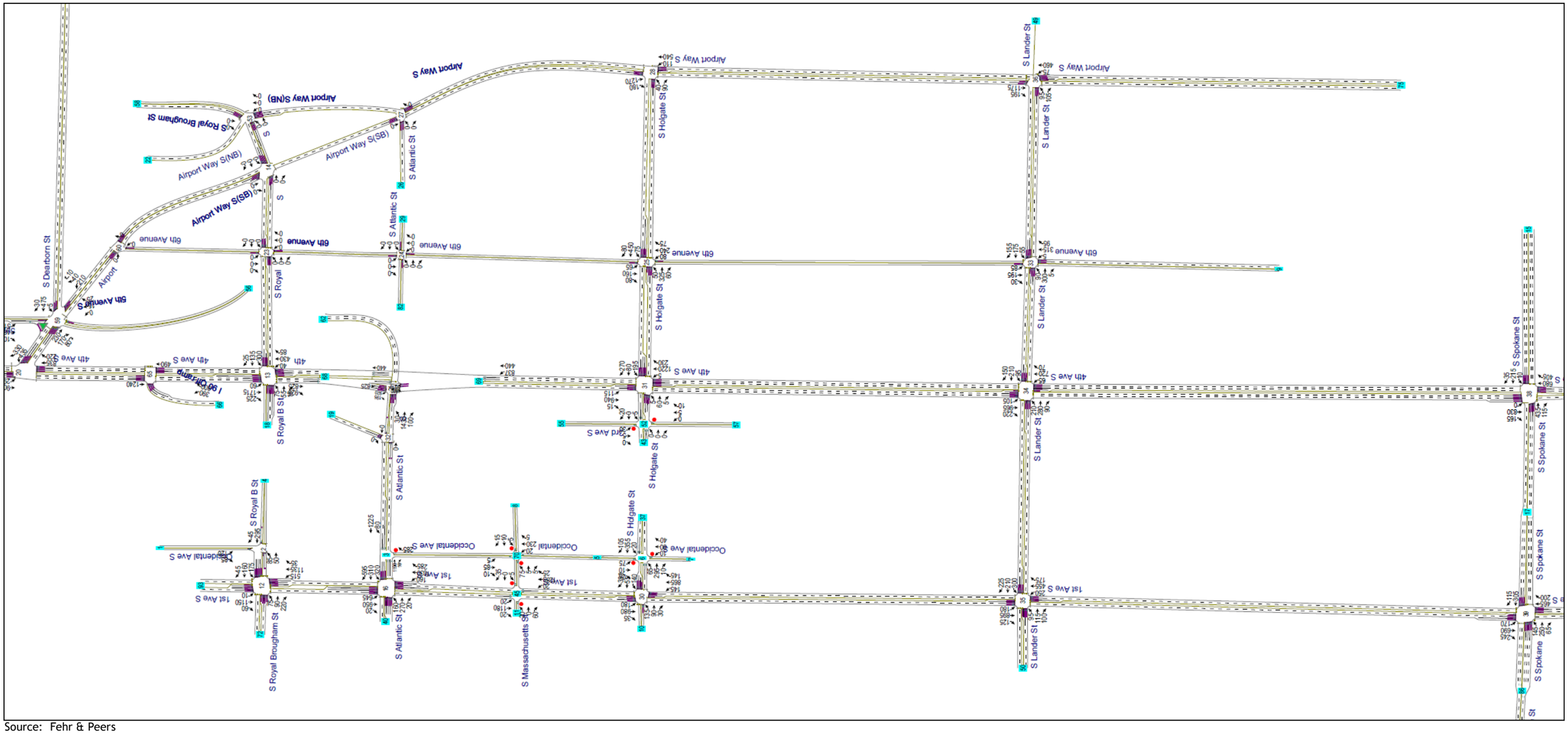
PM Peak Hour

Intersection ID	Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
2	Occidental Ave S & S Royal Brougham Way				120		85	85	50			295	45
3	Occidental Ave S & S Atlantic St			285					1,190	10	80	1,225	
6	Occidental Ave S & S Holgate St	10	60	40	75	10	25	65	295	10	20	355	105
12	1st Ave S & S Royal Brougham Way	515	1,135	35	10	1,150	60	75	90	220	175	160	45
13	4th Ave S & S Royal Brougham Way	40	430	85	60	1,715	225	75	55	15	300	135	25
16	1st Ave S & S Atlantic St	160	1,030	285	645	950	20	160	270	20	320	310	595
20	4th Ave S & Airport Way		835	220	295	905					435		330
21	4th Ave S & S Atlantic St	270		680	920		195	30	1,430	100			
25	6th Ave S & S Holgate St	80	240	75	65	160	80	50	325	60	75	450	80
28	Airport Way S & S Holgate St	110	540			1,270	180	40		90			
30	1st Ave S & S Holgate St	145	865	145	180	980	35	135	90	30	140	55	330
31	4th Ave S & S Holgate St	5	1,220	230	115	940	15	5	60	5	195	80	270
33	6th Ave S & S Lander St	5	315	95	85	195	30	90	300	5	55	175	155
34	4th Ave S & S Lander St	65	720	70	105	965	220	210	280	90	95	210	150
35	1st Ave S & S Lander St	250	455	175	180	895	125	95	115	100	300	210	225
36	Airport Way S & S Lander St	75	460			1,175	195	95		105			
38	4th Ave S & S Spokane St		680	405		830	165		435	115	10	215	35
39	1st Ave S & S Spokane St		465	200	170	690	245	145	250	65		305	115
45	1st Ave S & S Massachusetts St	20	1,285	25	20	1,180	20	20		60	5		35
52	3rd Ave S & S Holgate St		5	10	30	5					5		20
59	Airport Way & S Dearborn St		15	25	510	185	100		230	170	5	475	30
65	4th Ave S & I-90 Off Ramp		490			1,240		390		800			
70	Occidental Ave S & S Massachusetts St	20	230	5	5	85	10	75	5	5	5	10	15

NBL	Northbound Left Turn Vehicles
NBT	Northbound Through Vehicles
NBR	Northbound Right Turn Vehicles
SBL	Southbound Left Turn Vehicles
SBT	Southbound Through Vehicles
SBR	Southbound Right Turn Vehicles
EBL	Eastbound Left Turn Vehicles
EBT	Eastbound Through Vehicles
EBR	Eastbound Right Turn Vehicles
WBL	Westbound Left Turn Vehicles
WBT	Westbound Through Vehicles
WBR	Westbound Right Turn Vehicles

Source: Fehr & Peers

Exhibit L-6. 2015 Synchro Network and Approach Volumes without S Holgate Street



Source: Fehr & Peers

Exhibit L-7. 2030 Intersection Approach Volumes with S Holgate Street

2030 Intersection Approach Volumes with S Holgate Street Open

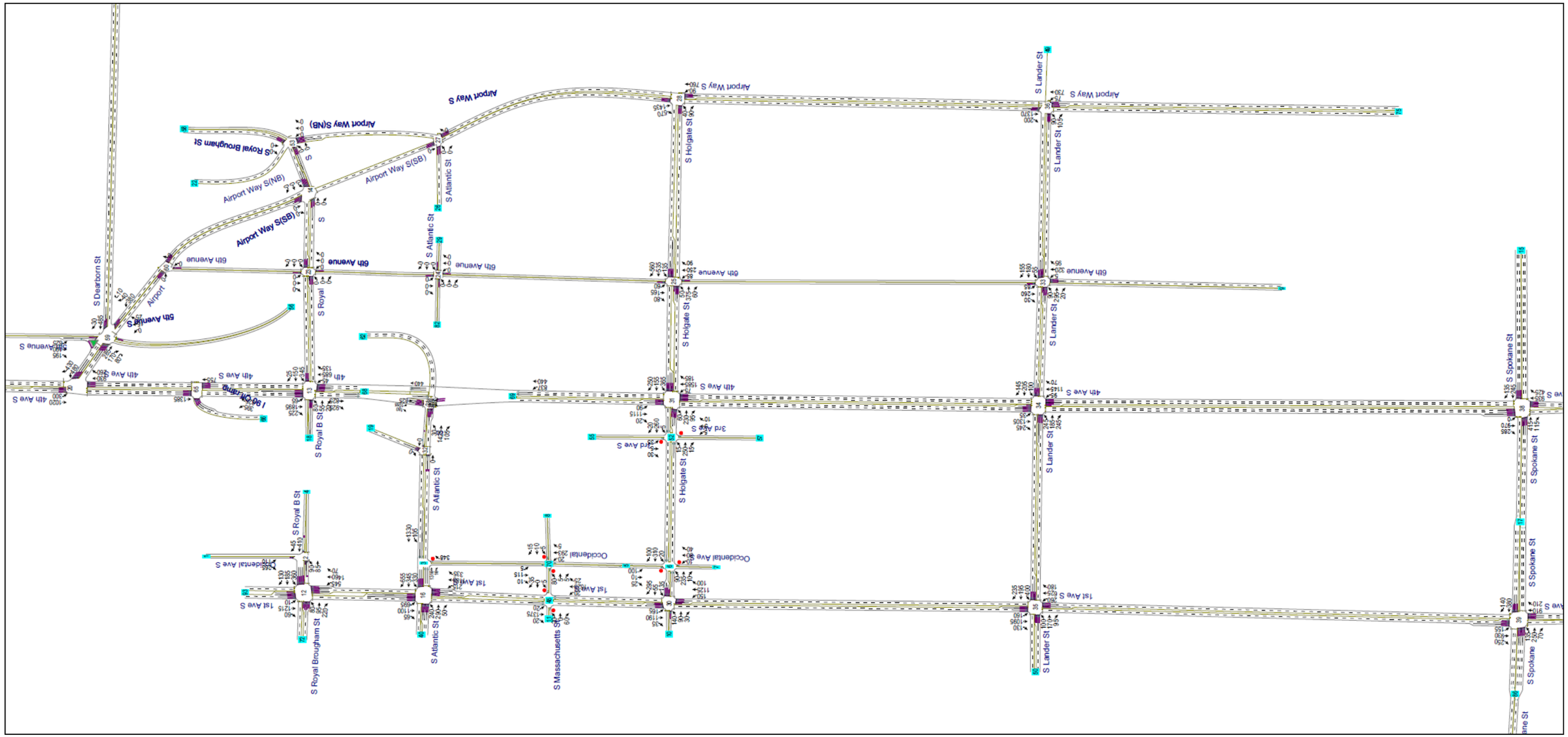
PM Peak Hour

Intersection ID	Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
2	Occidental Ave S & S Royal Brougham Way				110		265	90	85			410	45
3	Occidental Ave S & S Atlantic St			348					1,310	10	105	1,330	
6	Occidental Ave S & S Holgate St	10	80	40	100	10	25	90	235	10	20	310	100
12	1st Ave S & S Royal Brougham Way	545	1,460	70	10	1,215	60	80	95	220	360	185	130
13	4th Ave S & S Royal Brougham Way	45	685	135	65	1,895	225	80	55	20	345	150	25
16	1st Ave S & S Atlantic St	215	1,185	335	695	1,100	65	240	290	50	330	345	655
20	4th Ave S & Airport Way		930	260	300	1,020					480		430
21	4th Ave S & S Atlantic St	280		760	1,055		180	30	1,425	105			
25	6th Ave S & S Holgate St	85	250	90	60	165	80	50	375	60	135	535	560
28	Airport Way S & S Holgate St	90	760			1,435	570	40		90			
30	1st Ave S & S Holgate St	150	1,125	100	165	1,190	35	140	90	30	135	55	295
31	4th Ave S & S Holgate St	75	1,585	185	90	1,115	20	60	230	95	365	155	250
33	6th Ave S & S Lander St	5	320	95	85	260	30	90	295	20	55	180	155
34	4th Ave S & S Lander St	95	1,145	70	35	1,305	245	245	185	245	100	205	145
35	1st Ave S & S Lander St	260	625	180	160	1,095	130	100	170	95	400	195	235
36	Airport Way S & S Lander St	75	730			1,370	200	90		105			
38	4th Ave S & S Spokane St		935	425		970	285		415	115		245	135
39	1st Ave S & S Spokane St		910	210	155	930	250	135	250	70		380	140
45	1st Ave S & S Massachusetts St	20	1,525	25	20	1,375	20	20		60	5		35
52	3rd Ave S & S Holgate St	5	5	10	35	5	30	15	250	15	5	260	20
59	Airport Way & S Dearborn St												
65	4th Ave S & I-90 Off Ramp		755			1,385		395		825			
70	Occidental Ave S & S Massachusetts St	20	293	5	5	115	10	80	5	5	5	10	15

NBL	Northbound Left Turn Vehicles
NBT	Northbound Through Vehicles
NBR	Northbound Right Turn Vehicles
SBL	Southbound Left Turn Vehicles
SBT	Southbound Through Vehicles
SBR	Southbound Right Turn Vehicles
EBL	Eastbound Left Turn Vehicles
EBT	Eastbound Through Vehicles
EBR	Eastbound Right Turn Vehicles
WBL	Westbound Left Turn Vehicles
WBT	Westbound Through Vehicles
WBR	Westbound Right Turn Vehicles

Source: Fehr & Peers

Exhibit L-8. 2030 Synchro Network and Approach Volumes with S Holgate Street



Source: Fehr & Peers

Exhibit L-9. 2030 Intersection Approach Volumes without S Holgate Street

2030 Intersection Approach Volumes without S Holgate Street Open

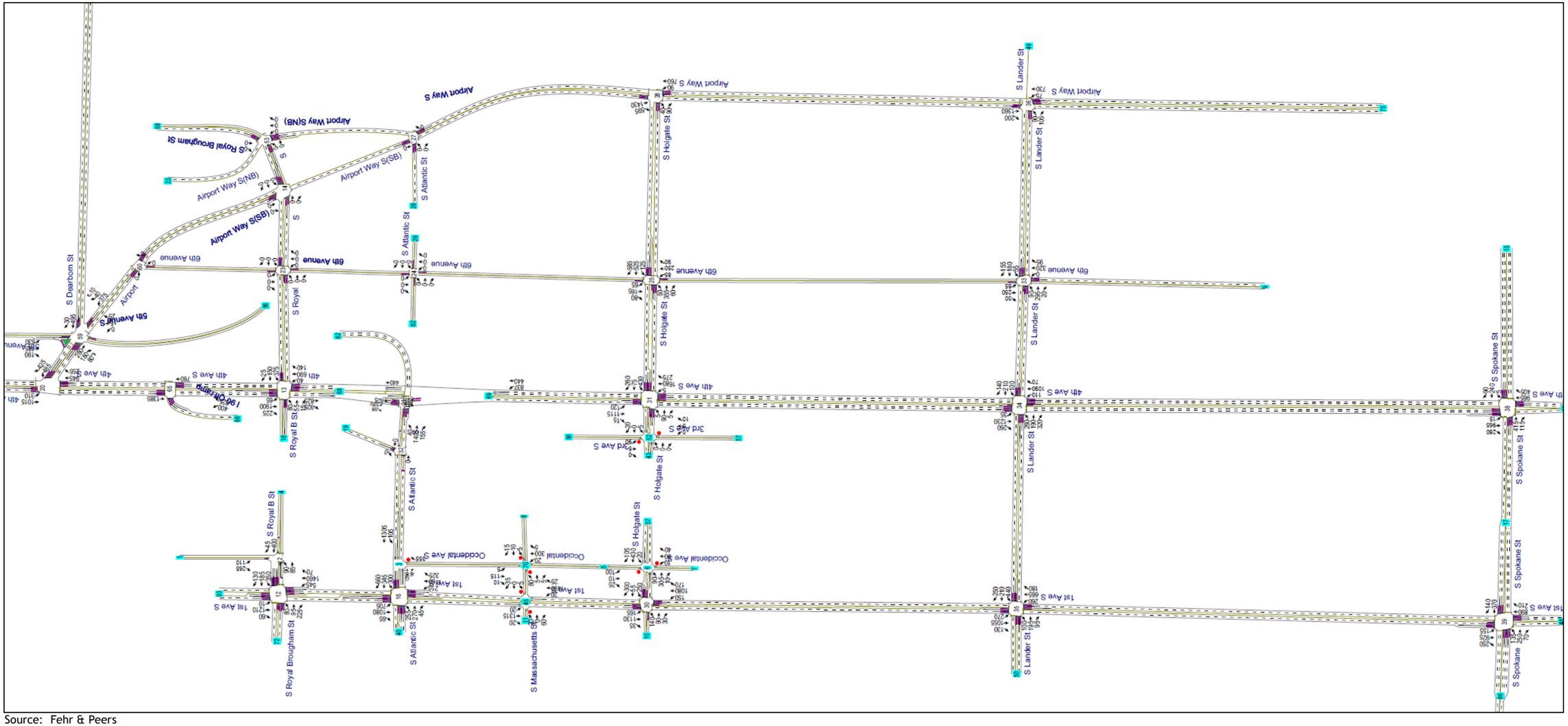
PM Peak Hour

Intersection ID	Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
2	Occidental Ave S & S Royal Brougham Way				110		265	90	85			400	45
3	Occidental Ave S & S Atlantic St			355					1,290	10	105	1,305	
6	Occidental Ave S & S Holgate St	10	80	40	100	10	25	90	305	10	20	430	105
12	1st Ave S & S Royal Brougham Way	545	1,460	70	10	1,210	60	80	95	225	350	185	130
13	4th Ave S & S Royal Brougham Way	40	690	140	65	1,900	225	80	55	15	375	150	25
16	1st Ave S & S Atlantic St	210	1,160	325	705	1,080	65	255	270	45	300	345	660
20	4th Ave S & Airport Way		945	255	310	1,015					485		425
21	4th Ave S & S Atlantic St	280		770	1,050		205	40	1,405	155			
25	6th Ave S & S Holgate St	85	250	90	65	165	80	50	355	60	125	525	585
28	Airport Way S & S Holgate St	90	760			1,430	595	40		90			
30	1st Ave S & S Holgate St	150	1,080	170	165	1,130	35	140	90	30	250	55	300
31	4th Ave S & S Holgate St	5	1,680	275	120	1,115	15	5	90	5	430	75	260
33	6th Ave S & S Lander St		320	95	85	250	30	90	295	20	55	180	155
34	4th Ave S & S Lander St	110	1,090	70	35	1,230	260	260	190	320	100	210	140
35	1st Ave S & S Lander St	260	665	180	270	1,055	130	100	195	95	440	210	250
36	Airport Way S & S Lander St	75	730			1,360	200	90		105			
38	4th Ave S & S Spokane St		965	405	15	965	280		415	115	5	240	90
39	1st Ave S & S Spokane St		890	210	155	925	250	135	250	70		370	140
45	1st Ave S & S Massachusetts St	20	1,490	25	20	1,315	20	20		60	5		35
52	3rd Ave S & S Holgate St		5	10	90	5					5		20
59	Airport Way & S Dearborn St		15	25	630	185	190		280	180		495	30
65	4th Ave S & I-90 Off Ramp		760			1,385		400		825			
70	Occidental Ave S & S Massachusetts St	20	300	5	5	115	10	80	5	5	5	10	15

NBL	Northbound Left Turn Vehicles
NBT	Northbound Through Vehicles
NBR	Northbound Right Turn Vehicles
SBL	Southbound Left Turn Vehicles
SBT	Southbound Through Vehicles
SBR	Southbound Right Turn Vehicles
EBL	Eastbound Left Turn Vehicles
EBT	Eastbound Through Vehicles
EBR	Eastbound Right Turn Vehicles
WBL	Westbound Left Turn Vehicles
WBT	Westbound Through Vehicles
WBR	Westbound Right Turn Vehicles

Source: Fehr & Peers

Exhibit L-10. 2030 Synchro Network and Approach Volumes without S Holgate Street



Source: Fehr & Peers

APPENDIX M. DYNAMIC MESSAGE SIGN (DMS)

Background

A dynamic message sign or variable message sign is an electronic traffic sign often used on roadways to give travelers up-to-date information about special occurrences. Such signs warn of traffic congestion, collisions, incidents, roadwork zones, or speed limits on a specific highway segment. In some urban areas, DMS are also used within parking information systems to guide drivers to available parking spaces. They may also ask drivers to take alternative routes, limit travel speed, warn of duration and location of the incidents, or just inform of the traffic conditions.

European Application

Between 1994 and 1999, the European Union supported several projects to install dynamic message signs in urban areas. In London and Southampton (UK), the DMS were used exclusively to disseminate information about incidents or events. The DMS in Piraeus, Greece, Toulouse, France, and Turin, Italy provided route guidance to drivers, advising on the direction to travel to reach specific destinations. In Piraeus, information was also disseminated about ferry departure times and gates. Congestion information was disseminated in Lyon, Paris and Valencia. The information provided applied to specific routes, describing traffic conditions or quantifying queue lengths or travel times. In Bristol, UK, the DMS were used to encourage use of Park and Ride service by displaying city air quality information or comparative travel times by car and bus. The VMS in Paris, Lyon and Turin disseminated information about events and incidents in addition to normal operation.

Reviewing the DMSs in European cities installed in 1990s, researchers found that:

1. Simple text information was found to be most easily read and understood by drivers rather than using symbols and pictures.
2. It is important to carefully select the location of DMSs. They recommended that locations be carefully chosen so that they are sufficiently upstream of major decision points.
3. Travel time information was found to be well regarded by drivers.
4. The significant deployment of DVS to inform drivers of traffic conditions proved successful in terms of improving network travel times and reducing environmental impacts. (Footnote: Effectiveness of Using Variable Message Signs to Disseminate Dynamic Traffic Information: Evidence from Field Trails in European Cities, Kiron Chatterjee and Mike McDonald, December 2003)

Examples of Dynamic Message Signs

The following pictures show some of the DMSs that were installed in Europe and the US. These examples should provide general sense of how DMSs have been used for arterials in urban areas and freeways.

Photo 1. Freeway lane closure DMS in Tennessee

Photo 2. Delay warning DMS in Ontario, Canada

Photo 3. DMS at a freeway ramp in Europe

Photo 4. An example DMS designed for arterial locations in Europe

Photo 5. Warning DMS in Britain

Photo 6. Directional DMS in Europe

Washington State Application

Many Dynamic Message Signs have been permanently installed on freeways and highways in recent years in the US. Most of those freeway signs have been related to travel time information for drivers. In Washington State, several sets of driver information systems have been installed: one example is related to the Intelligent Transportation System Operations in the Seattle-Bellevue urban area that include variable message signs. Dynamic message signs are located along I-5, I-405, and SR 167. The signs display information about destination travel times, collisions, roadwork zones, special events, and alerts. Another example is a system to inform the travelers who are intending to cross the Canadian Border about projected wait time to cross the border in several corridors. Example photos of the DMSs installed along I-5 and I-405 in this area are shown below.

Photo 7. DMS installed along I-5 in Seattle

Photo 8. DMS shown along I-405, image taken from WSDOT web site

Research of DMS Effectiveness

Several research projects concluded that dynamic message signs can be effective tools in communicating traffic information to motorists. DMSs are often used to disseminate real-time traffic information, enabling agencies to keep motorists aware of current roadway conditions. A common use of DMSs is route guidance. DMSs warn drivers of congested roadways and can provide alternate route suggestions. Significant benefits possible through route guidance are travel time reductions, increased speeds, and decreased number of stops.

Because DMSs have numerous applications and benefits, it is necessary to consider the goals of a particular DMS before evaluating its performance. Benefits will vary depending upon the intended use of the DMS, its location, and its period of use. Benefits achieved by DMSs include: improved safety, time savings, increased throughput, cost savings, reduced emissions, and reduced fuel consumption. These benefits can be quantified to determine the effectiveness of the DMS. It is also necessary to consider qualitative measures, such as customer satisfaction, when evaluating DMSs. (Footnote: Guidelines for the Evaluation of Dynamic Message Sign Performance, John M. Mounce, Gerald Ullman, Geza Pesti, and Valmon Pezoldt, March 2007)

Manual Uniform Traffic Control Devices (MUTCD) Guidelines

The *MUTCD, Streets and Highways 2003 Editions Including Revision 1 dated November 2004*, provides guidelines for changeable message signs as follows:

"Changeable message signs, with more sophisticated technologies, are gaining widespread use to inform road users of variable situations, particularly along congested traffic corridors. Highway and transportation organizations are encouraged to develop and experiment with changeable message signs and to carefully evaluate such installations so that experience is gained toward adoption of future standards.

Changeable message signs (including portable changeable message signs) that display a regulatory or warning message may use a black background with a white, yellow, orange, red, or fluorescent yellow-green legend as appropriate, except where specifically restricted in this Manual for a particular sign.

Changeable message signs, both permanent and portable, may be used by State and local highway agencies to display safety or transportation-related messages. State and local highway agencies may develop and establish a policy regarding the display of safety and transportation-related messages on permanent and changeable message signs that specifies the allowable messages and applications, consistent with the provisions of this Manual." (Section 2A.07)

Application of DMS to S Holgate Street Area

Although closures of S Holgate Street by train for more than 10 minutes at a time do not occur frequently, we observed a number of such occurrences while we recorded the rail crossings in January 2009. There were no predictable patterns regarding long gate closures. The purpose of the recommended DMS in the S Holgate Street railroad crossing area is to inform the drivers who are intending to cross the railroads on S Holgate Street of potential excessive delays before they enter S

Holgate Street from 1st Avenue S or 4th Avenue S. A train gate closure detection device would need to be installed and the duration of the closure should be monitored. In addition, a detection device to monitor vehicle queues lengths from the train gates on S Holgate Street should be installed. When the gates are in the lowered position for some defined time period (for example, more than 5 minutes), a warning sign for drivers should be displayed. The exact wording of the sign should be evaluated more in detail at the implementation stage.