South Holgate Street Railroad Crossing Study Phase II

January 2010

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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

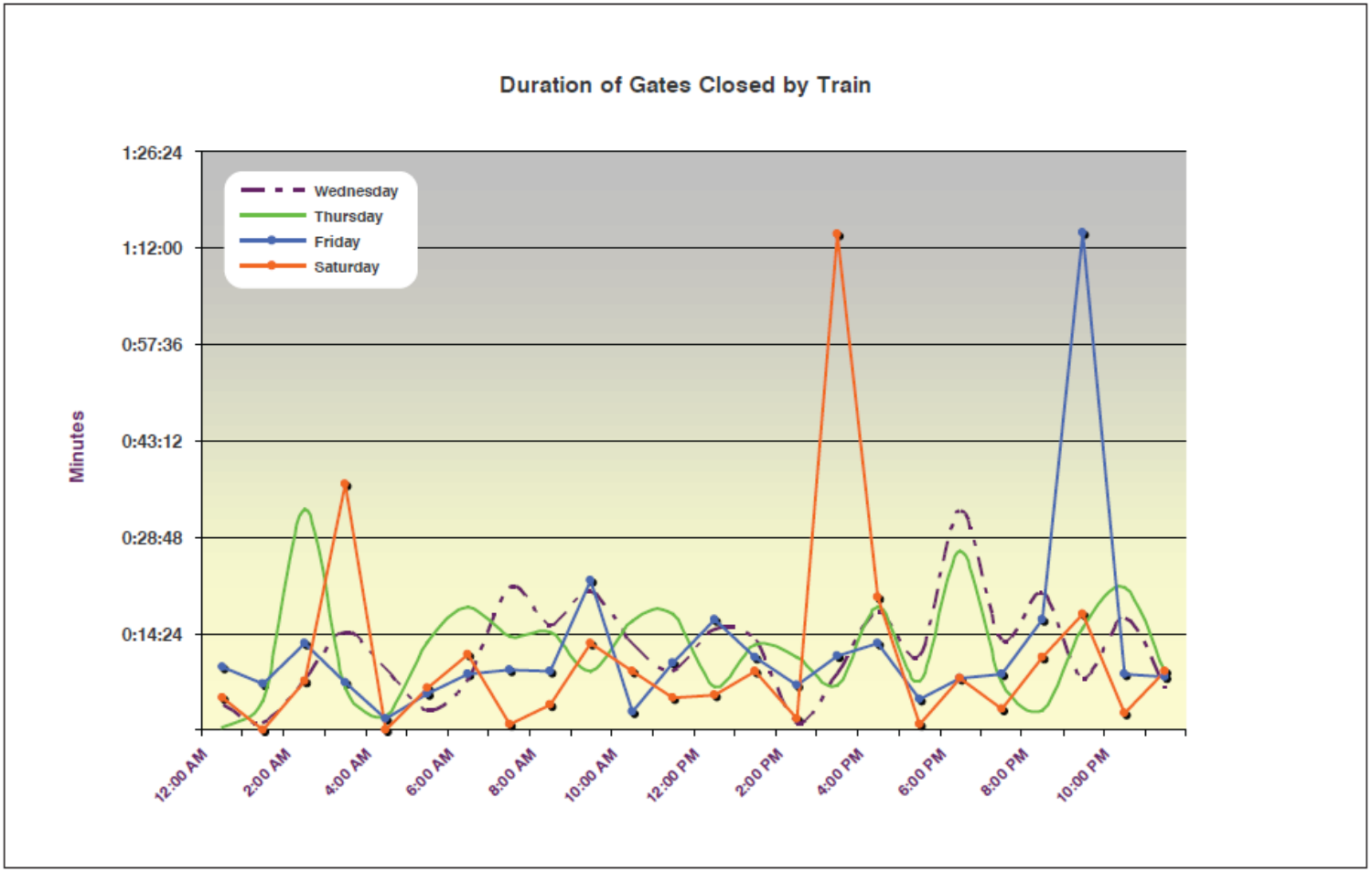
Type of Train	12:00AM	1:00AM	2:00AM	3:00AM	4:00AM	5:00AM	6:00AM	7:00AM	8:00AM	9:00AM	10:00AM	11:00AM
Amtrak							2	1		1		2
							0:13:50	0:01:10		0:01:10		0:02:32
Sounder						1	3	4	3			2
						0:01:10	0:04:20	0:12:50	0:04:40			0:02:00
Freight		1	2	1	1	3			1	2	1	2
		0:04:20	0:33:00	0:06:20	0:02:10	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	1			1		1	1			1	2	
												0:01:00	0:01:20			0:01:20		0:01:00	0:01:10			0:02:00	0:04:40	
												1.7%	2.2%			2.2%		1.7%	1.9%			3.3%	7.8%	
Sounder	No Data															4	3	3			1			
																0:07:20	0:05:20	0:03:27			0:01:40			
																12.2%	8.9%	5.7%			2.8%			
Freight	No Data											1	1	1	3	1	1	2		4		1		2
												0:01:20	0:05:10	0:02:50	0:10:20	0:04:00	0:03:20	0:03:30		0:08:44		0:01:10		0:07:00
												2.2%	8.6%	4.7%	17.2%	6.7%	5.6%	5.8%		14.6%		1.9%		11.7%
Multiple Trains	No Data																2		4		2	4	2	2
																	0:05:40		0:06:30		0:11:20	0:28:10	0:06:00	0:10:20
																	9.4%		10.8%		18.9%	46.9%	10.0%	17.2%
No Train	No Data													2		1				1				1
														0:01:40		0:02:00				0:00:30				0:00:50
														2.8%		3.3%				0.8%				1.4%
Total	No Data											2	2	3	3	7	6	6	5	5	3	6	4	5
												0:02:20	0:06:30	0:04:30	0:10:20	0:14:40	0:14:20	0:07:57	0:07:40	0:09:14	0:13:00	0:31:20	0:10:40	0:18:10
												3.9%	10.8%	7.5%	17.2%	24.4%	23.9%	13.2%	12.8%	15.4%	21.7%	52.2%	17.8%	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)
Amtrak				2	2	2	
				0:02:20	0:03:10	0:04:40	
				1.3%	1.3%	3.9%	
Sounder				10	1		
				0:16:07	0:01:40		
				9.0%	0.7%		
Freight				4	5	2	
				0:10:50	0:09:54	0:07:00	
				6.0%	4.1%	5.8%	
Multiple Trains				2	10	4	
				0:05:40	0:46:00	0:16:20	
				3.1%	19.2%	13.6%	
No Train				1	1	1	
				0:02:00	0:00:30	0:00:50	
				1.1%	0.2%	0.7%	
Total				19	19	9	
				0:36:57	1:01:14	0:28:50	
				20.5%	25.5%	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	2		3	5	4	6	1	4	1	2	1	1
												0:01:00	0:06:30		0:10:20	0:09:30	0:08:40	0:07:57	0:01:10	0:08:44	0:01:40	0:03:10	0:01:20	0:02:50
												1.7%	10.8%		17.2%	15.8%	14.4%	13.2%	1.9%	14.6%	2.8%	5.3%	2.2%	4.7%
Maintenance	No Data											1		3		2				1			1	2
												0:01:20		0:04:30		0:05:10				0:00:30			0:03:20	0:05:00
												2.2%		7.5%		8.6%				0.8%			5.6%	8.3%
Multiple Trains	No Data																2		4		2	4	2	2
																	0:05:40		0:06:30		0:11:20	0:28:10	0:06:00	0:10:20
																	9.4%		10.8%		18.9%	46.9%	10.0%	17.2%
Total	No Data											2	2	3	3	7	6	6	5	5	3	6	4	5
												0:02:20	0:06:30	0:04:30	0:10:20	0:14:40	0:14:20	0:07:57	0:07:40	0:09:14	0:13:00	0:31:20	0:10:40	0:18:10
												3.9%	10.8%	7.5%	17.2%	24.4%	23.9%	13.2%	12.8%	15.4%	21.7%	52.2%	17.8%	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)
Regular				15	8	2	
				0:26:07	0:14:44	0:04:10	
				14.5%	6.1%	3.5%	
Maintenance				2	1	3	
				0:05:10	0:00:30	0:08:20	
				2.9%	0.2%	6.9%	
Multiple Trains				2	10	4	
				0:05:40	0:46:00	0:16:20	
				3.1%	19.2%	13.6%	
Total				19	19	9	
				0:36:57	1:01:14	0:28:50	
				20.5%	25.5%	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
Amtrak							2	1		1		2	1	1	1			1	1	2	2	1	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	
							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%	
Sounder						1	3	4	3			2		1	3	3	2	3	2				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	
						1.9%	7.2%	21.4%	7.8%			3.3%		2.8%	8.9%	11.1%	3.6%	6.1%	3.9%				1.9%	
Freight		1	2	1	1	3			1	2	1	2	1	3	1		2	2	2	1		4	2	3
		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
		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%
Multiple Trains									2								4							
									0:08:30								0:11:20							
									14.2%								18.9%							
No Train	1					1	1			1	6	2	2		1									1
	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
	0.6%					1.9%	0.3%			0.6%	11.1%	1.7%	1.4%		0.8%									0.6%
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
	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
	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%

	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	17	3	6	1	6	1	
	0:41:52	0:15:00	0:08:22	0:00:50	0:09:40	0:08:00	
	2.9%	8.3%	2.3%	0.5%	4.0%	6.7%	
Sounder	28	10	6	8	2	1	1
	0:48:00	0:21:50	0:09:00	0:12:30	0:02:20	0:01:10	0:01:10
	3.3%	12.1%	2.5%	6.9%	1.0%	1.0%	0.3%
Freight	35	1	10	4	7	5	8
	2:52:20	0:01:30	0:46:00	0:07:40	0:39:50	0:20:40	0:56:40
	12.0%	0.8%	12.8%	4.3%	16.6%	17.2%	15.7%
Multiple Trains	6	2		4			
	0:19:50	0:08:30		0:11:20			
	1.4%	4.7%		6.3%			
No Train	16	1	12			1	2
	0:11:20	0:00:10	0:09:20			0:00:20	0:01:30
	0.8%	0.1%	2.6%			0.3%	0.4%
Total	102	17	34	17	15	8	11
	4:53:22	0:47:00	1:12:42	0:32:20	0:51:50	0:30:10	0:59:20
	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
Regular		1	1	1	1	4	3	2	3	2		4	2	4	2	2	4	5	4	2	2	4	2	2
		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
		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%
Maintenance	1		1			1	3	3	1	2	7	4	2	1	4	1		1	1	1		1	2	2
	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
	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%
Multiple Trains									2								4							
									0:08:30								0:11:20							
									14.2%								18.9%							
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
	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
	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%

	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	57	8	14	11	12	4	8
	2:32:32	0:11:20	0:44:02	0:17:10	0:29:10	0:19:50	0:31:00
	10.6%	6.3%	12.2%	9.5%	12.2%	16.5%	8.6%
Maintenance	39	7	20	2	3	4	3
	2:01:00	0:27:10	0:28:40	0:03:50	0:22:40	0:10:20	0:28:20
	8.4%	15.1%	8.0%	2.1%	9.4%	8.6%	7.9%
Multiple Trains	6	2		4			
	0:19:50	0:08:30		0:11:20			
	1.4%	4.7%		6.3%			
Total	102	17	34	17	15	8	11
	4:53:22	0:47:00	1:12:42	0:32:20	0:51:50	0:30:10	0:59:20
	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
Amtrak										3	1	1	1		1	1		1	1	2	2	2		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
										8.3%	1.7%	1.1%	2.2%		1.1%	1.4%		1.1%	1.4%	4.4%	6.4%	114.2%		2.2%
Sounder						1	3	4	4							3	3	3	2					
						0:01:20	0:03:40	0:09:00	0:07:30							0:05:30	0:03:40	0:03:50	0:02:30					
						2.2%	6.1%	15.0%	12.5%							9.2%	6.1%	6.4%	4.2%					
Freight	2	2	4	2	1	1				3	1	1	2	2		1	2		2	2	5	1	2	2
	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
	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%
Multiple Trains							2					2										2	2	
							0:04:40					0:04:00										0:02:00	0:04:20	
							7.8%					6.7%										3.3%	7.2%	
No Train			1						2	3	1	2	6	9	6	1	2		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					
			0.6%						1.9%	5.8%	0.8%	1.4%	4.4%	8.5%	10.0%	0.8%	2.8%		0.8%					
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
	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
	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%

	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	17		7	2	7	1	
	1:27:22		0:08:40	0:01:30	1:15:52	0:01:20	
	6.1%		2.4%	0.8%	31.6%	1.1%	
Sounder	23	11		9	2		1
	0:37:00	0:20:10		0:13:00	0:02:30		0:01:20
	2.6%	11.2%		7.2%	1.0%		0.4%
Freight	38		9	3	10	4	12
	2:07:40		0:37:50	0:11:50	0:26:00	0:10:30	0:41:30
	8.9%		10.5%	6.6%	10.8%	8.8%	11.5%
Multiple Trains	8	2	2		2	2	
	0:15:00	0:04:40	0:04:00		0:02:00	0:04:20	
	1.0%	2.6%	1.1%		0.8%	3.6%	
No Train	34	2	27	3	1		1
	0:22:47	0:01:10	0:18:37	0:02:10	0:00:30		0:00:20
	1.6%	0.6%	5.2%	1.2%	0.2%		0.1%
Total	120	15	45	17	22	7	14
	4:49:49	0:26:00	1:09:07	0:28:30	1:46:52	0:16:10	0:43:10
	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
Regular	2	2	2	1	1	2	2	2	2	4		2	3	2	1	3	4	4	3	2	4	2	2	3
	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
	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%
Maintenance			3	1			1	2	4	5	3	2	6	9	6	3	3		3	2	3	1		
			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		
			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%		
Multiple Trains							2					2										2	2	
							0:04:40					0:04:00										0:02:00	0:04:20	
							7.8%					6.7%										3.3%	7.2%	
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
	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
	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%

	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	55	6	12	11	11	5	10
	2:23:00	0:07:30	0:39:10	0:20:00	0:27:40	0:11:50	0:36:50
	9.9%	4.2%	10.9%	11.1%	11.5%	9.9%	10.2%
Maintenance	57	7	31	6	9		4
	2:11:49	0:13:50	0:25:57	0:08:30	1:17:12		0:06:20
	9.2%	7.7%	7.2%	4.7%	32.2%		1.8%
Multiple Trains	8	2	2		2	2	
	0:15:00	0:04:40	0:04:00		0:02:00	0:04:20	
	1.0%	2.6%	1.1%		0.8%	3.6%	
Total	120	15	45	17	22	7	14
	4:49:49	0:26:00	1:09:07	0:28:30	1:46:52	0:16:10	0:43:10
	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
Amtrak							1	1		1		1		1	1	1		1	3	2		1		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
							1.9%	1.4%		1.7%		1.4%		3.1%	1.1%	2.2%		1.7%	5.6%	3.6%		2.2%		5.6%
Sounder																								
Freight	2			1	2			1	1	2	2	1				2		5		2	5		2	
	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	
	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%	
Multiple Trains							2					2		2									2	
							0:09:00					0:04:00		0:05:20									0:12:20	
							15.0%					6.7%		8.9%									20.6%	
No Train																1		1	2	1	9	7	2	13
																0:00:30		0:00:20	0:01:00	0:00:50	0:11:45	0:03:50	0:01:40	0:09:42
																0.8%		0.6%	1.7%	1.4%	19.6%	6.4%	2.8%	16.2%
Total	2			1	2		3	2	1	3	2	4		3	1	4		7	5	5	14	8	6	15
	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
	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%

	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	16	2	4	2	6	2	
	0:18:50	0:02:00	0:04:20	0:02:20	0:06:50	0:03:20	
	1.3%	1.1%	1.2%	1.3%	2.8%	2.8%	
Sounder							
Freight	28	2	5	7	7	2	5
	1:13:00	0:05:40	0:17:50	0:14:50	0:15:50	0:03:40	0:15:10
	5.1%	3.1%	5.0%	8.2%	6.6%	3.1%	4.2%
Multiple Trains	8	2	4			2	
	0:30:40	0:09:00	0:09:20			0:12:20	
	2.1%	5.0%	2.6%			10.3%	
No Train	36			2	19	15	
	0:29:37			0:00:50	0:17:25	0:11:22	
	2.1%			0.5%	7.3%	9.5%	
Total	88	6	13	11	32	21	5
	2:32:07	0:16:40	0:31:30	0:18:00	0:40:05	0:30:42	0:15:10
	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
Regular	2				2			2	1	3	2	2		1	1	2		3	3	1		1	2	2
	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
	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%
Maintenance				1			1									2		4	2	4	14	7	2	13
				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
				5.8%			1.9%									3.6%		7.8%	1.7%	13.1%	36.0%	6.4%	2.8%	16.2%
Multiple Trains							2					2		2									2	
							0:09:00					0:04:00		0:05:20									0:12:20	
							15.0%					6.7%		8.9%									20.6%	
Total	2			1	2		3	2	1	3	2	4		3	1	4		7	5	5	14	8	6	15
	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
	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%

	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	30	3	9	5	5	4	4
	1:04:20	0:06:30	0:22:10	0:11:10	0:05:50	0:07:00	0:11:40
	4.5%	3.6%	6.2%	6.2%	2.4%	5.8%	3.2%
Maintenance	50	1		6	27	15	1
	0:57:07	0:01:10		0:06:50	0:34:15	0:11:22	0:03:30
	4.0%	0.6%		3.8%	14.3%	9.5%	1.0%
Multiple Trains	8	2	4			2	
	0:30:40	0:09:00	0:09:20			0:12:20	
	2.1%	5.0%	2.6%			10.3%	
Total	88	6	13	11	32	21	5
	2:32:07	0:16:40	0:31:30	0:18:00	0:40:05	0:30:42	0:15:10
	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
Amtrak	Foggy						2	1		1		2		1	1				1		1	3	Foggy	
							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		
							15.8%	1.4%		2.2%		4.2%		2.5%	1.1%				1.9%		2.2%	6.7%		
Sounder	Foggy							2	2	3	5				2	2	3			1			Foggy	
								0:03:20	0:03:10	0:03:50	0:08:00				0:03:00	0:05:10	0:10:20			0:00:50				
								5.6%	5.3%	6.4%	13.3%				5.0%	8.6%	17.2%			1.4%				
Freight	Foggy									2	1	2	2	1	2		2	3	2	1	5	3	Foggy	
										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		
										11.7%	2.0%	16.7%	34.2%	0.9%	24.2%		11.7%	15.6%	5.0%	8.1%	22.5%	10.6%		
Multiple Trains	Foggy							2				2							2				Foggy	
								0:05:40				0:02:00							0:19:20					
								9.4%				3.3%							32.2%					
No Train	Foggy					1			1	1				2			1		2	2		1	Foggy	
						0:00:20			0:00:20	0:00:20				0:03:10			0:00:40		0:01:30	0:02:10		0:01:00		
						0.6%			0.6%	0.6%				5.3%			1.1%		2.5%	3.6%		1.7%		
Total	Foggy					1	2	5	3	7	6	6	2	4	5	2	6	3	7	4	6	7	Foggy	
						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		
						0.6%	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%		

	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	5		5		
		0:10:20	0:06:00		0:06:30		
		5.7%	1.7%		2.7%		
Sounder		4	10	5	1		
		0:06:30	0:14:50	0:15:30	0:00:50		
		3.6%	4.1%	8.6%	0.3%		
Freight			10	5	11		
			0:53:46	0:16:20	0:27:41		
			14.9%	9.1%	11.5%		
Multiple Trains		2	2		2		
		0:05:40	0:02:00		0:19:20		
		3.1%	0.6%		8.1%		
No Train		1	3	1	5		
		0:00:20	0:03:30	0:00:40	0:04:40		
		0.2%	1.0%	0.4%	1.9%		
Total		10	30	11	24		
		0:22:50	1:20:06	0:32:30	0:59:01		
		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
Regular	Foggy							2	1	3	1	3	1	1	5	1	3	2	2	1	2	4	Foggy	
								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		
								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%		
Maintenance	Foggy					1	2	1	2	4	5	1	1	3		1	3	1	3	3	4	3	Foggy	
						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		
						0.6%	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%		
Multiple Trains	Foggy							2				2							2				Foggy	
								0:05:40				0:02:00							0:19:20					
								9.4%				3.3%							32.2%					
Total	Foggy					1	2	5	3	7	6	6	2	4	5	2	6	3	7	4	6	7	Foggy	
						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		
						0.6%	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%		

	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		3	14	6	9		
		0:03:50	0:41:10	0:17:30	0:23:20		
		2.1%	11.4%	9.7%	9.7%		
Maintenance		5	14	5	13		
		0:13:20	0:36:56	0:15:00	0:16:21		
		7.4%	10.3%	8.3%	6.8%		
Multiple Trains		2	2		2		
		0:05:40	0:02:00		0:19:20		
		3.1%	0.6%		8.1%		
Total		10	30	11	24		
		0:22:50	1:20:06	0:32:30	0:59:01		
		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%**		

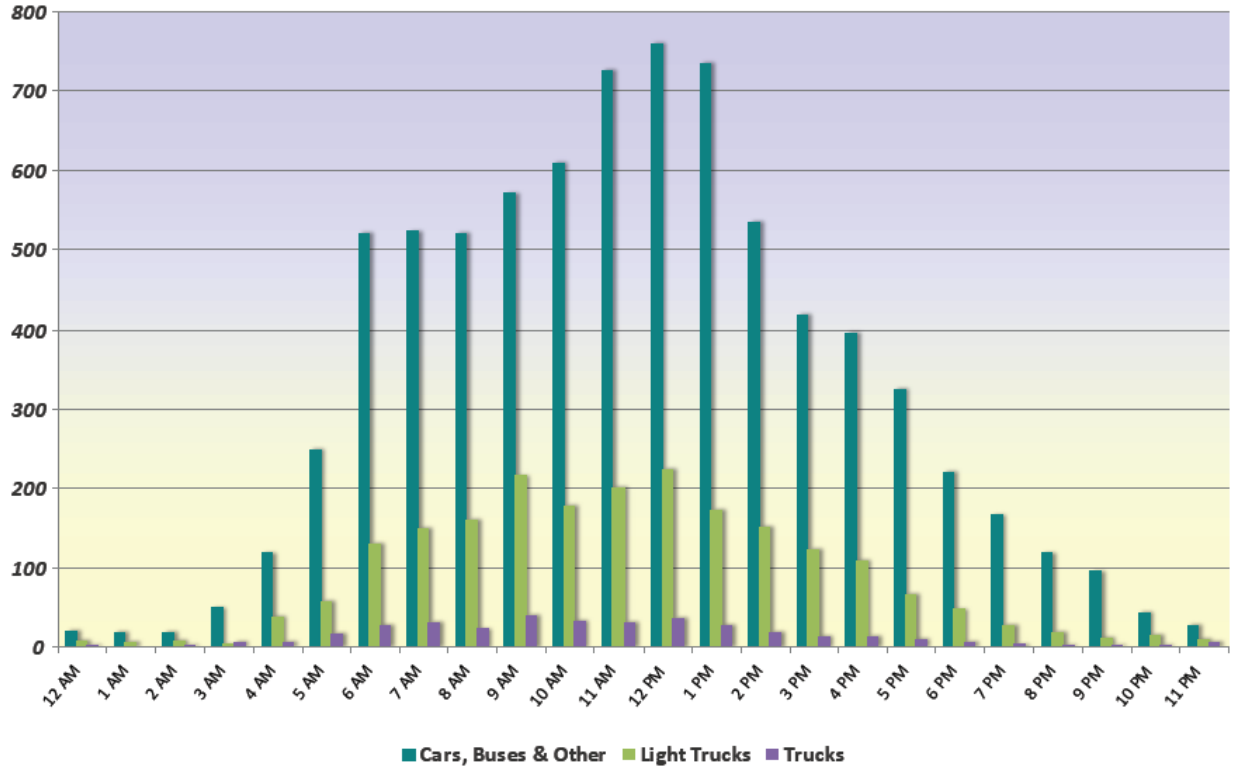
Source: Fehr & Peers

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)



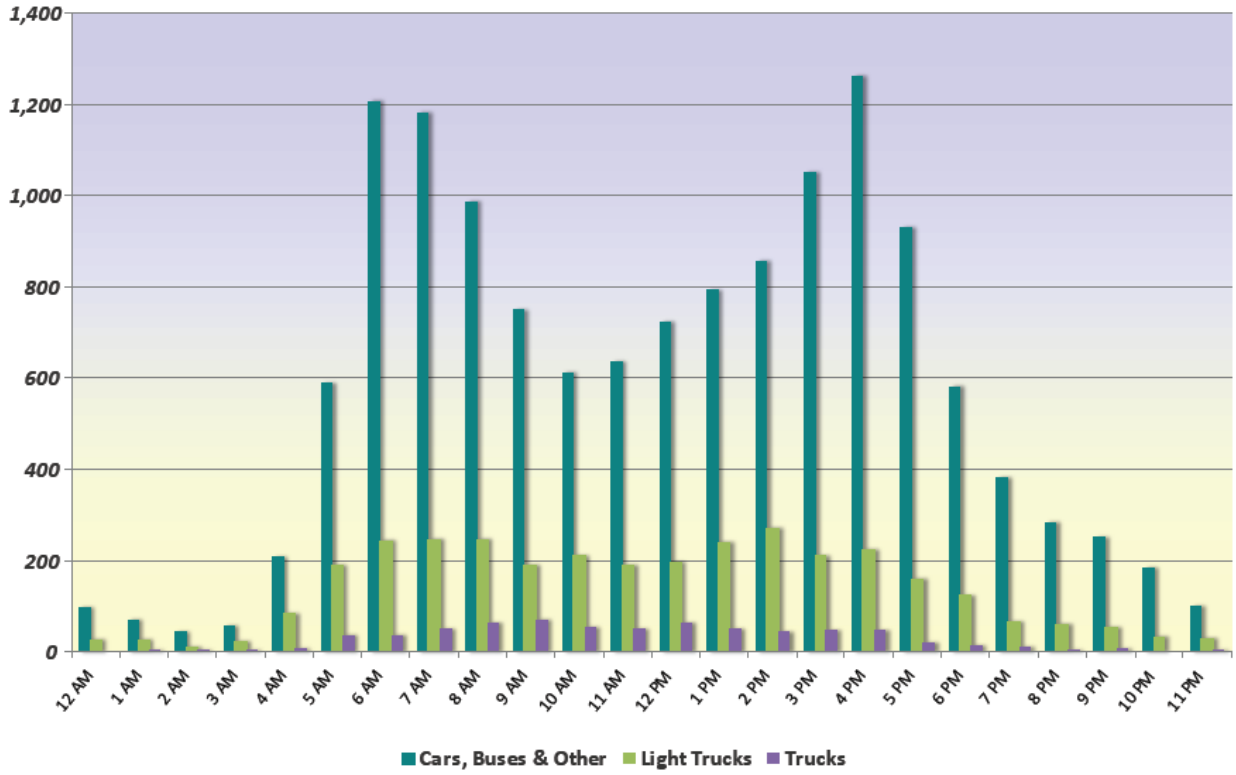
Source: Fehr & Peers

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)



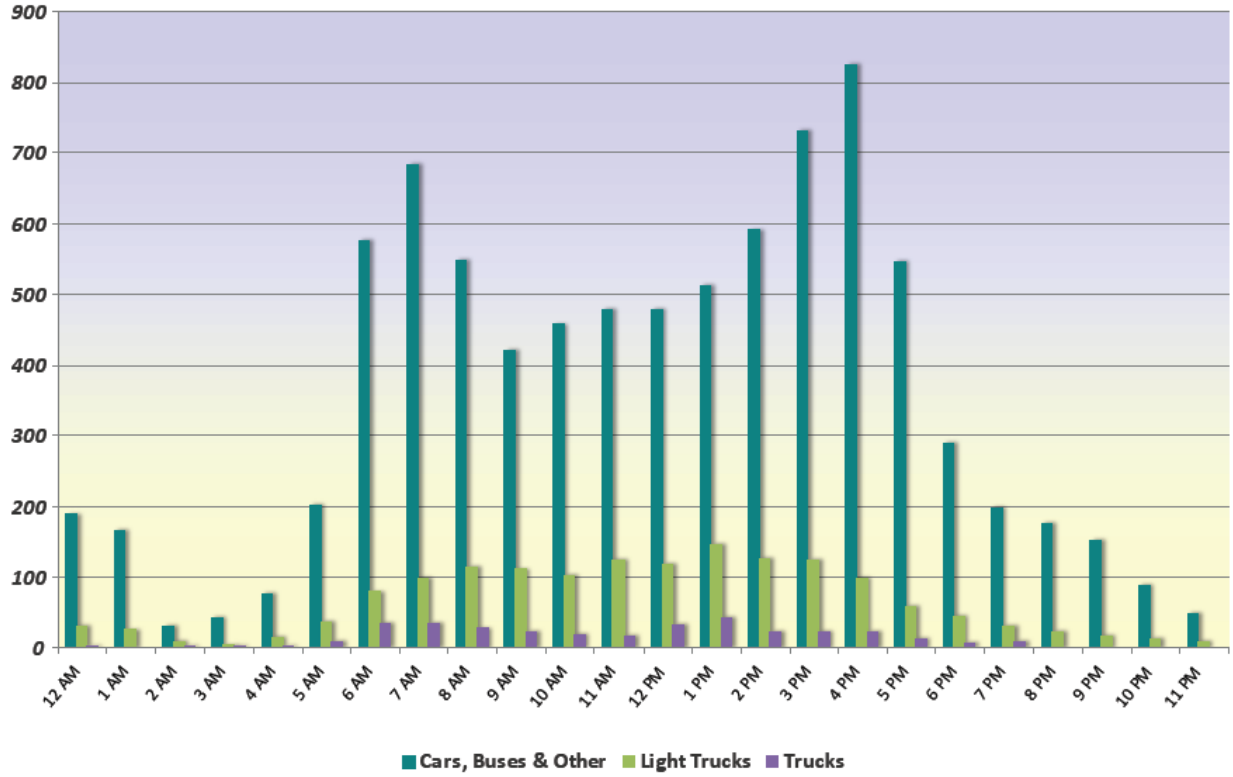
Source: Fehr & Peers

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:

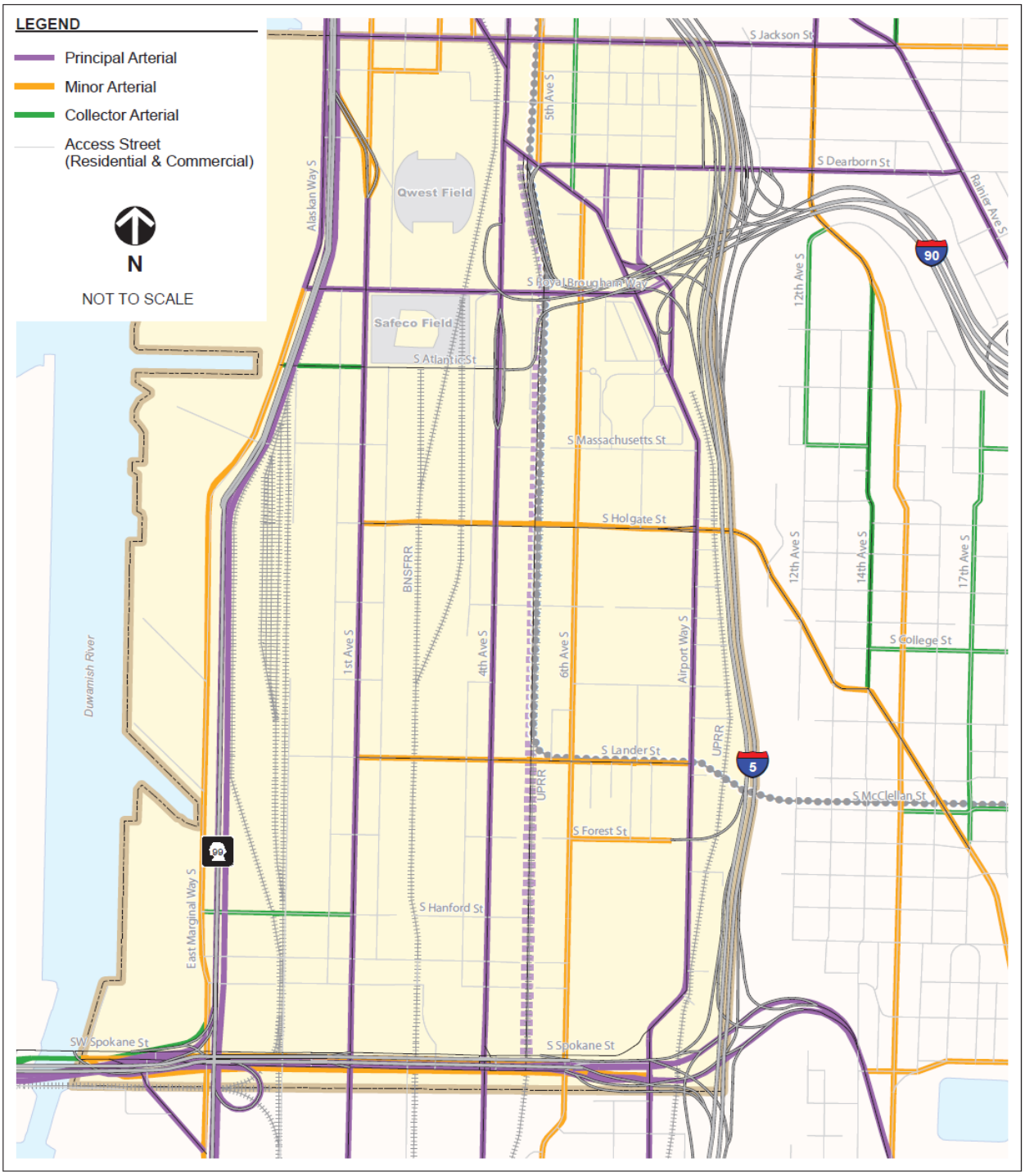
- S Holgate Street – Four-lane Minor Arterial that runs from Utah Avenue S to Airport Way S.
- S Spokane Street (surface street) – Five-lane Principal Arterial connecting West Seattle to local surface streets and I-5 ramps.
- S Lander Street – Five-lane Minor Arterial that runs from Utah Avenue S to 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.

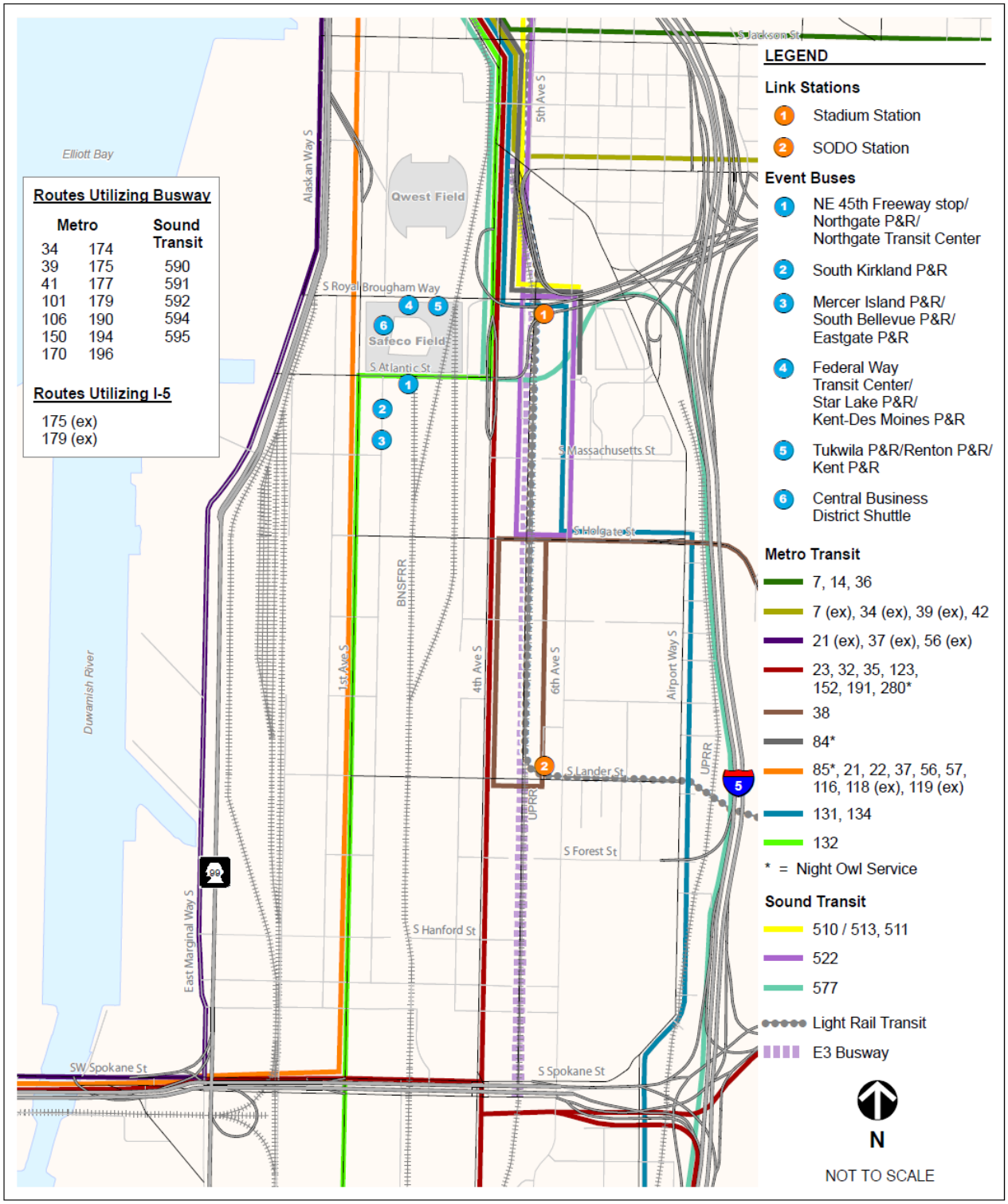
In 2005, the City of Seattle developed the *Seattle Transit Plan* to provide a vision of the future transit system within Seattle and a strategy to better connect urban villages. The plan has helped the City coordinate transit service improvements and commit to enhancing arterials for transit speed and 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

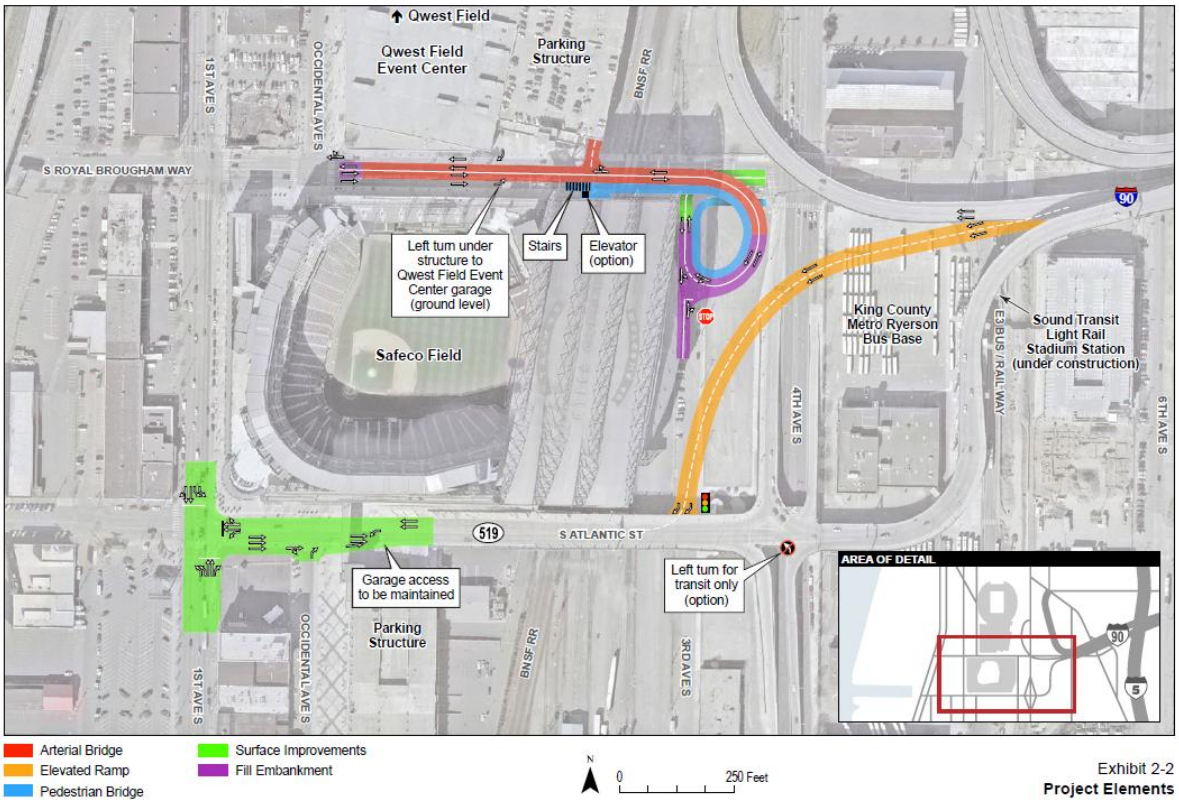


Exhibit 2-2
Project Elements

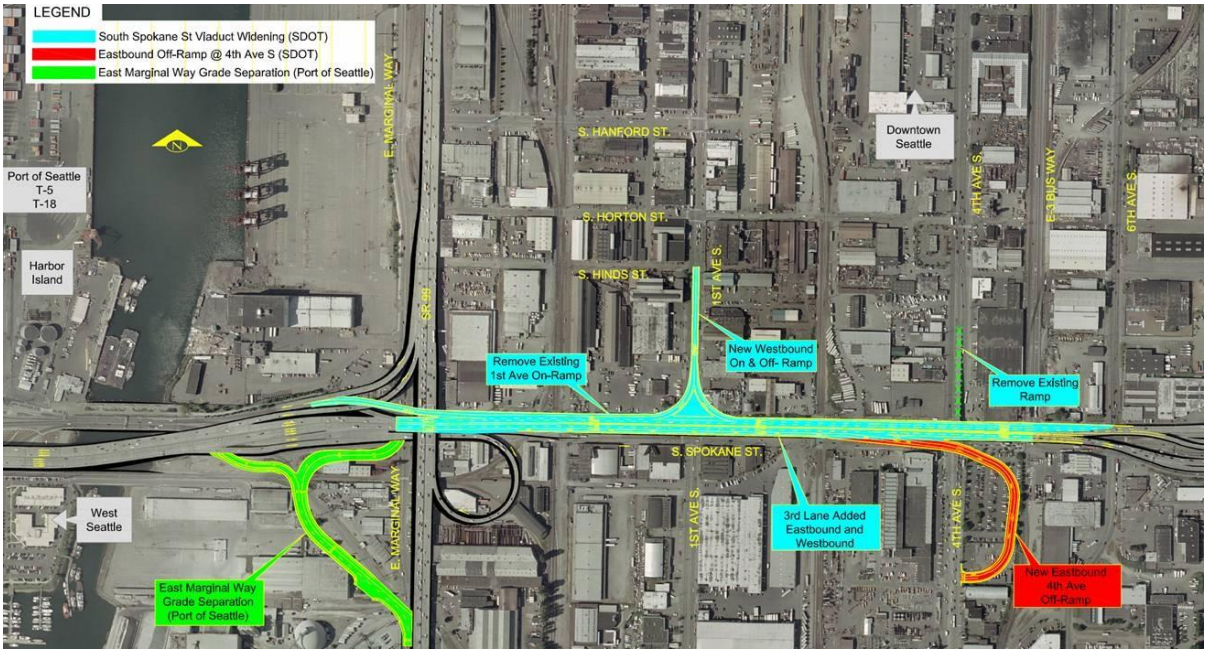
Source: WSDOT SR 519 Website

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.

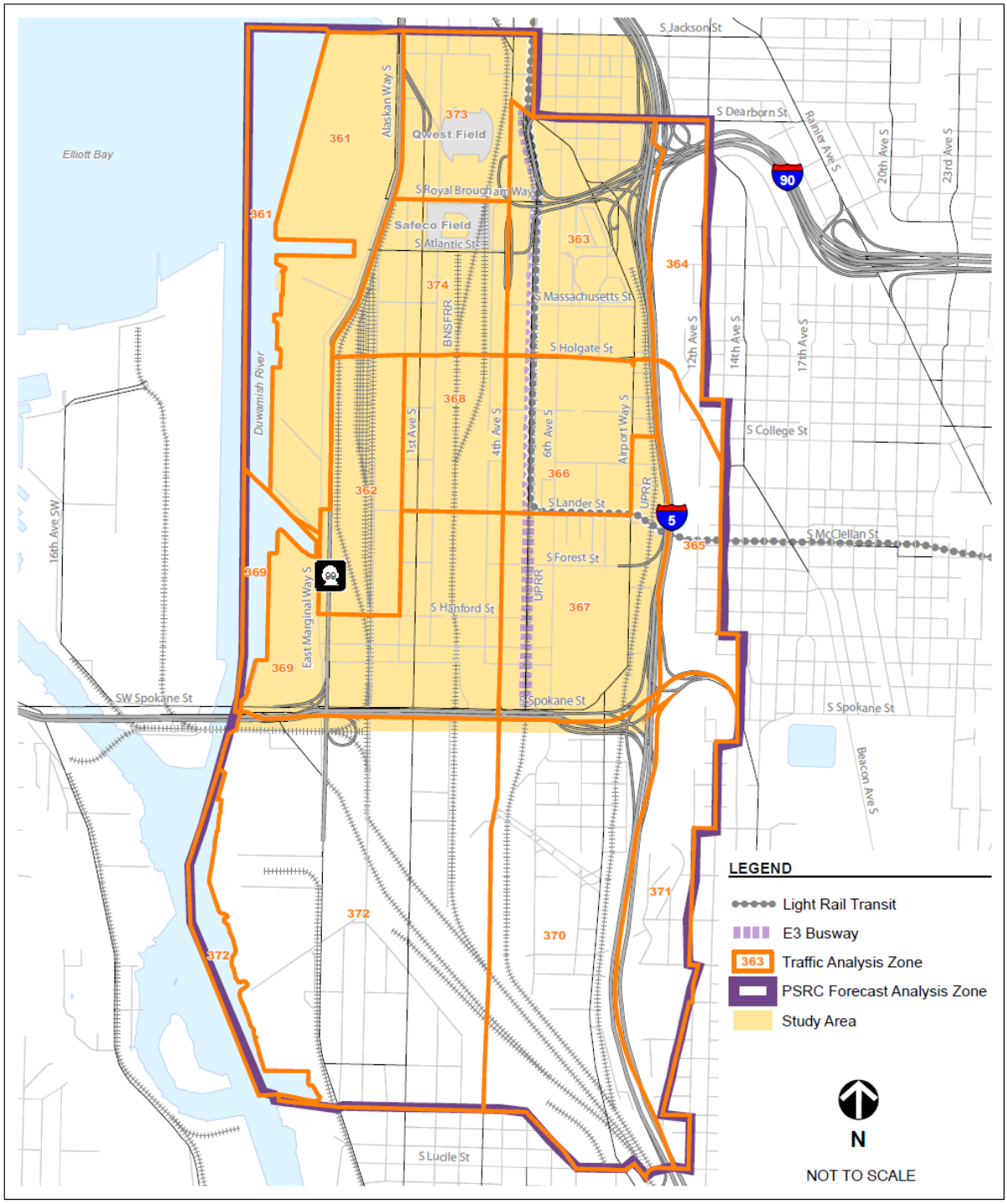
Exhibit G-1. Changes in Households and Employment (1970 to 2005) for SODO Traffic Analysis Zones

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

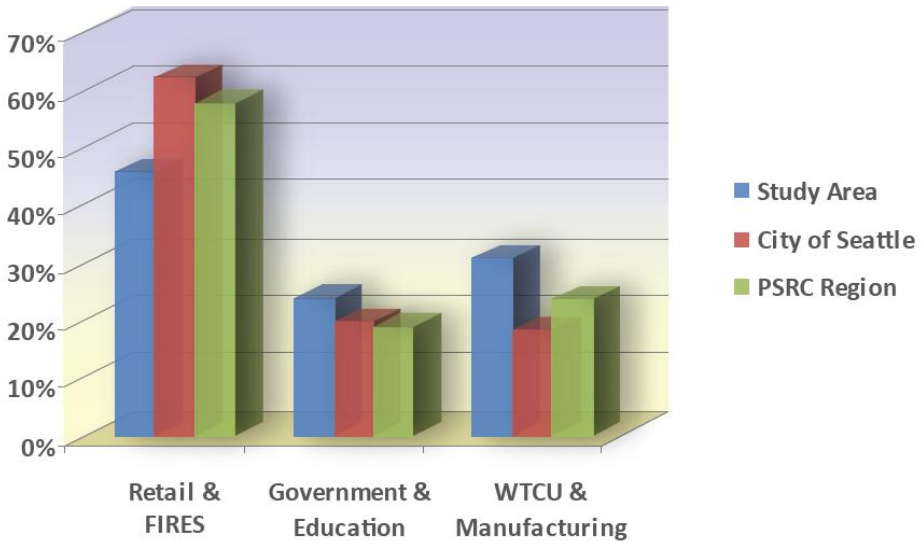
The SODO area has always been a major light manufacturing and warehousing area in the City of Seattle. What is unique to the study area is the mix of employment sectors. **Exhibit G-3** compares the regional composition of retail and services, government and education, and manufacturing and WTCU (wholesale, 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

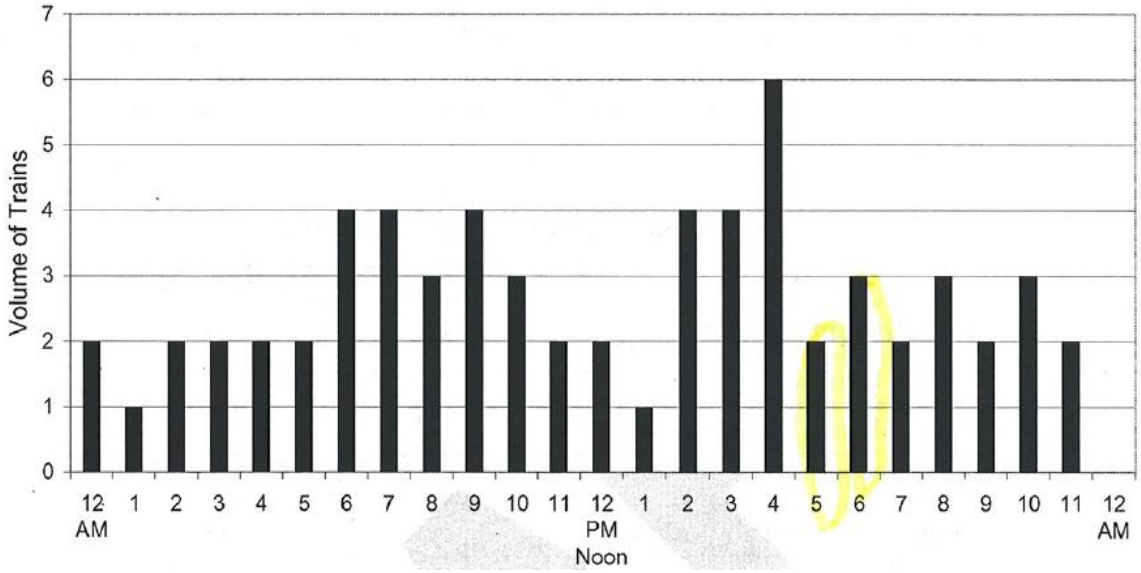
The study updated the 2003 traffic volumes in the previous study to the 2004 AM peak, off-peak and PM peak hour for the key intersections. Average weekday traffic volumes were obtained with 3-day 24-hour tube counts. The LOS analysis at these intersections showed that all intersections in the study area 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

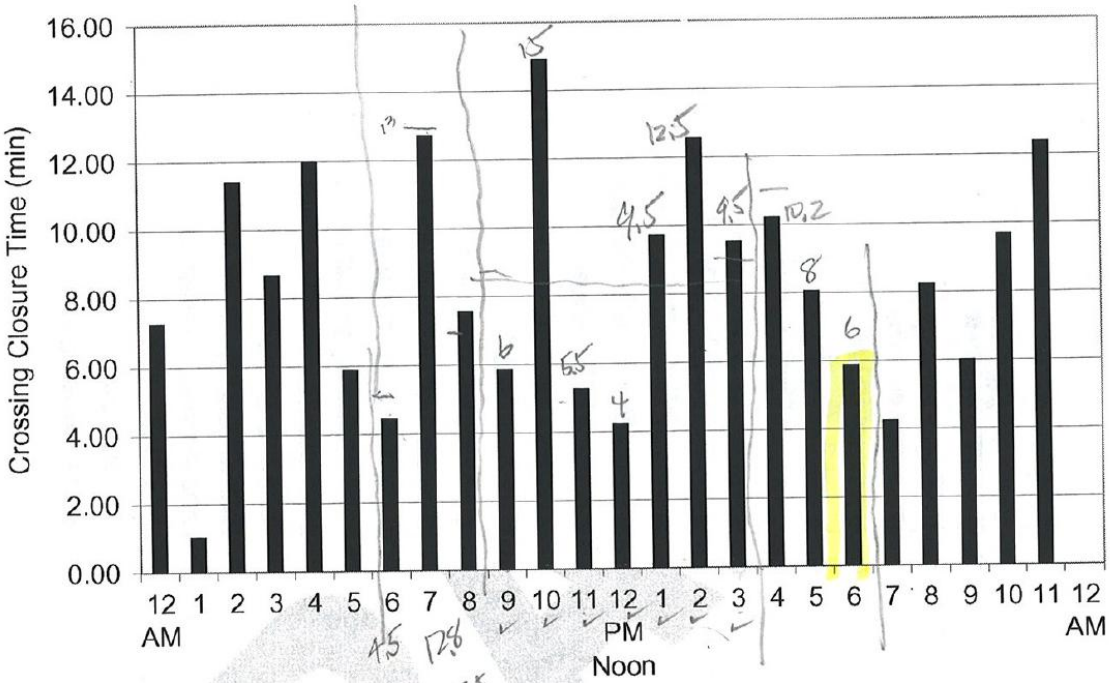
Duration of Gate Closure (2004)

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.

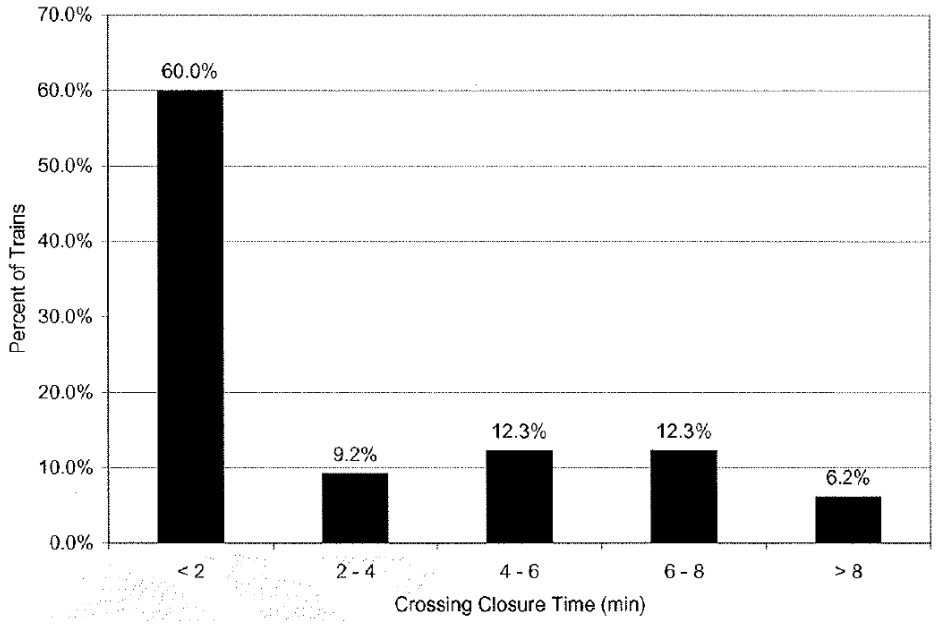
Exhibit H-2. Duration of Gate Closure Time by Time-of-Day



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

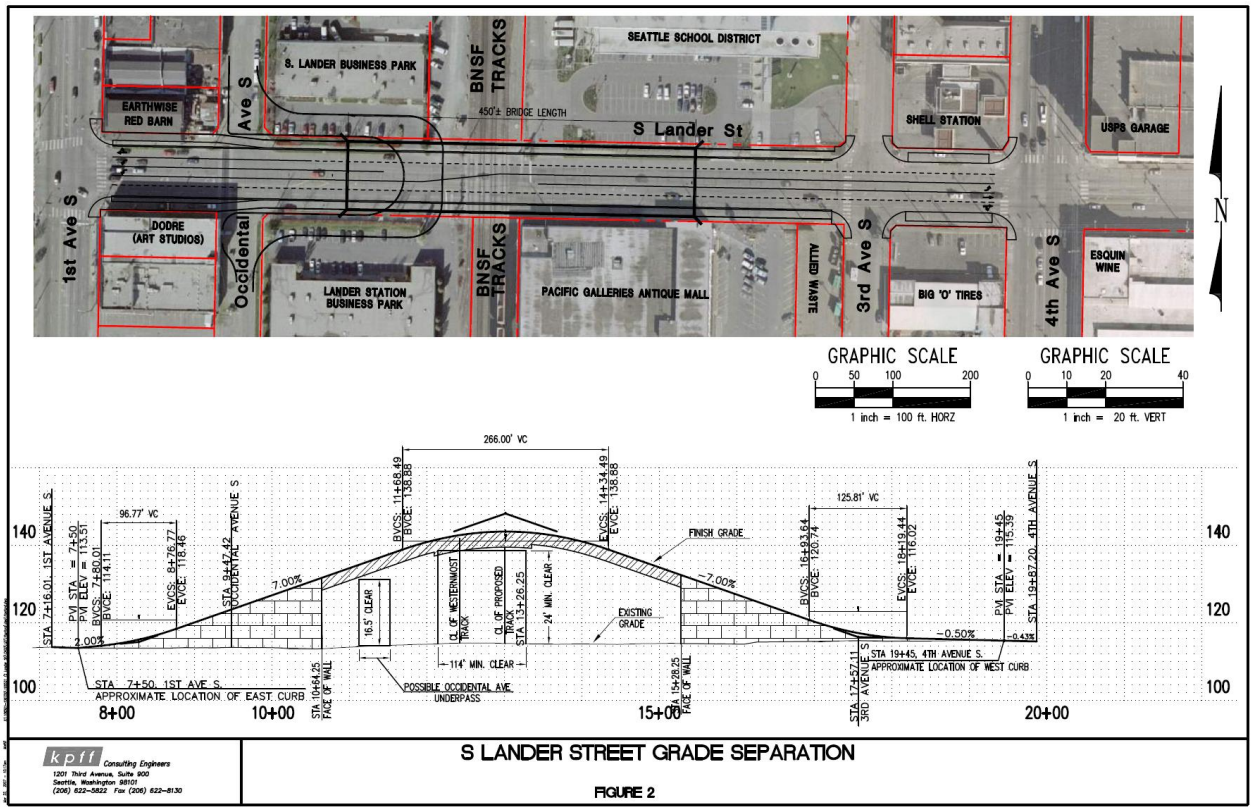
Early planning estimates place the project cost at approximately $75 million. SDOT has roughly $20 million from the "Bridging the Gap" program and is pursuing additional funding for this project.

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

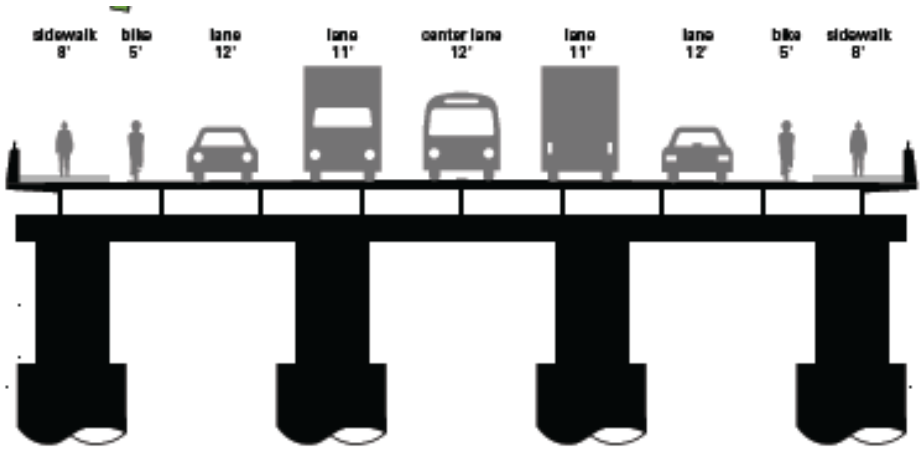
To provide more general information on this project, the information prepared for the public meetings in 2007 is shown in **Exhibit I-3**.

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

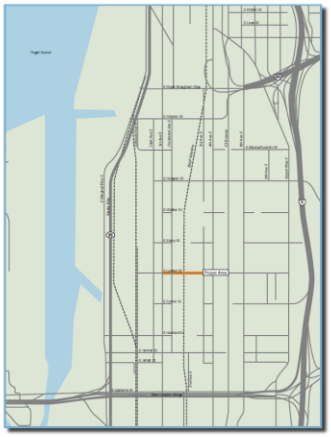
Exhibit I-3. Information Prepared for Public Meetings in 2007 (several graphics)

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

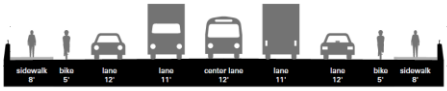
Cost Estimate:
$75–80 million

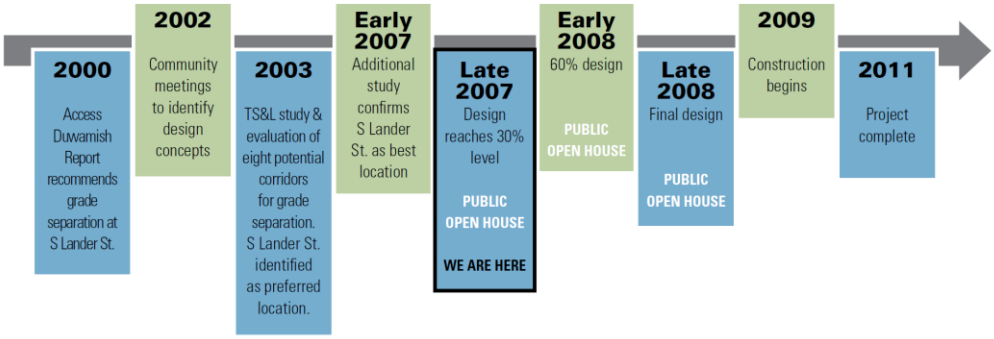
Funding:

- $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

SDOT Seattle Department of Transportation — BRIDGING the GAP

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

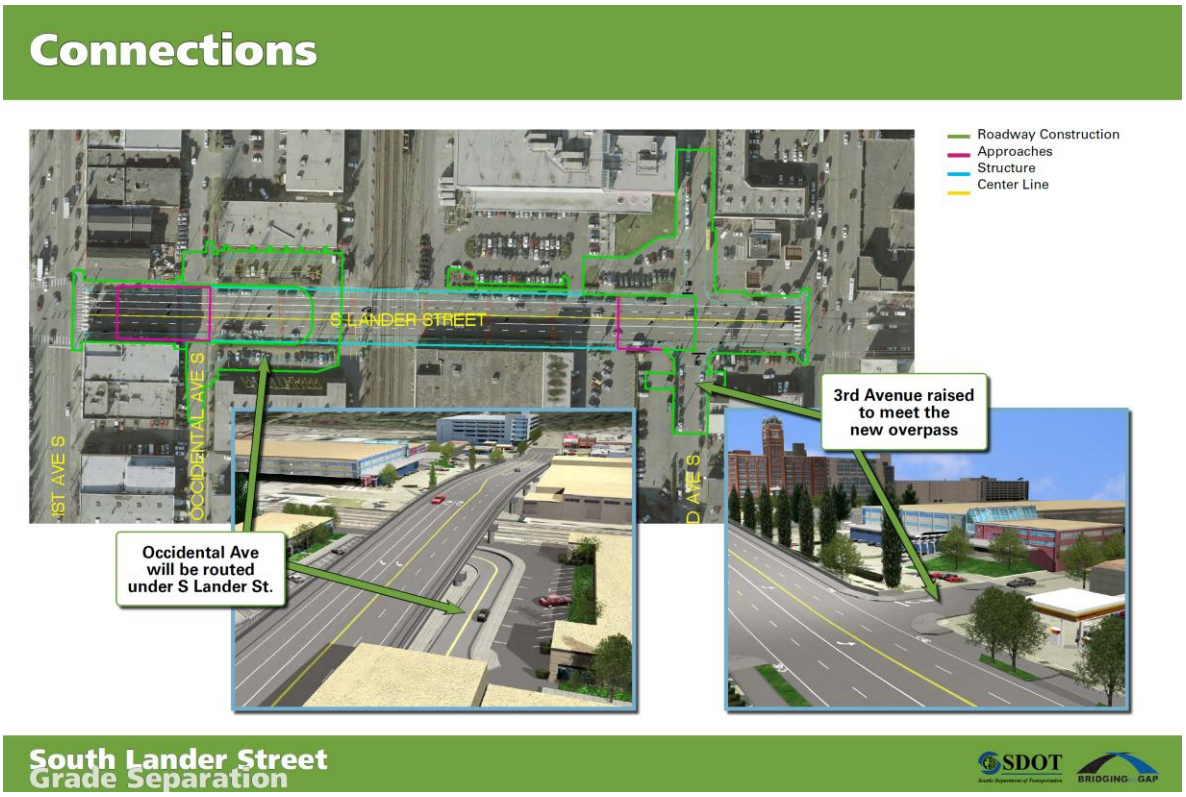
Benefits

- 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

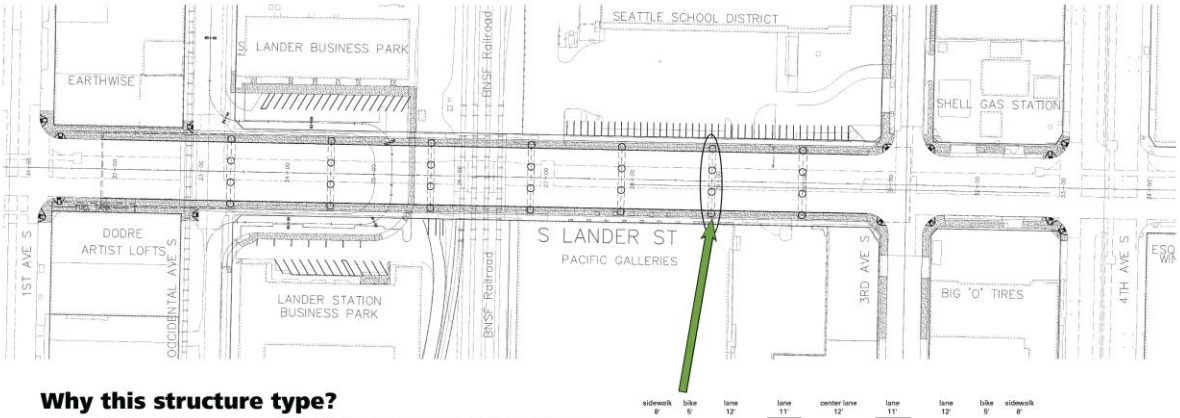
Weaknesses

- 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

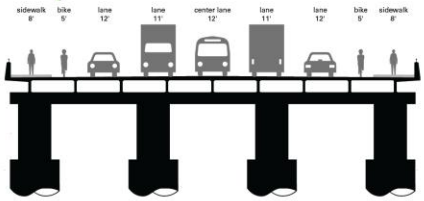

Connections
Roadway Construction
Approaches
Structure
Center Line
S LANDER STREET
OCCIDENTAL AVE S
3rd Avenue raised to meet the new overpass
Occidental Ave will be routed under S Lander St.
South Lander Street Grade Separation
SDOT
BRIDGING GAP

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



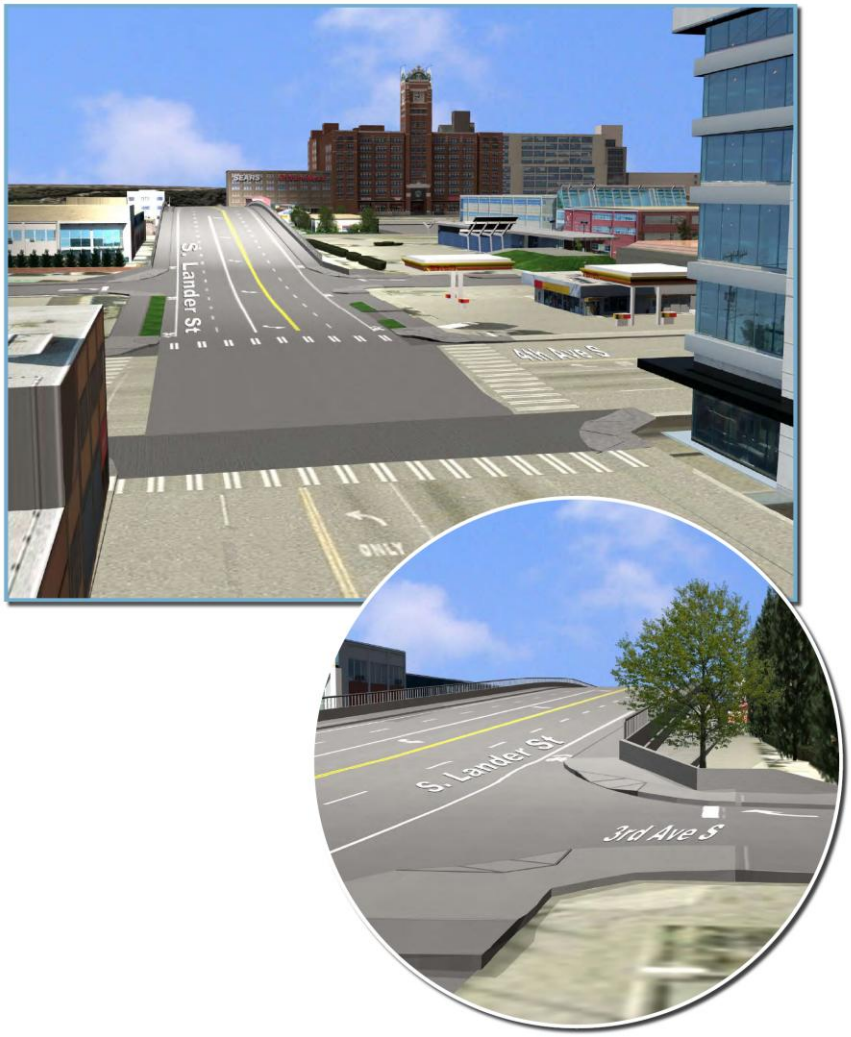
South Lander Street Grade Separation

View Looking East

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

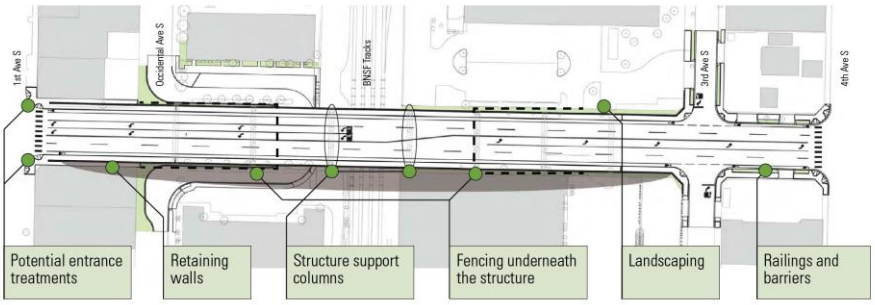
South Lander Street Grade Separation

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

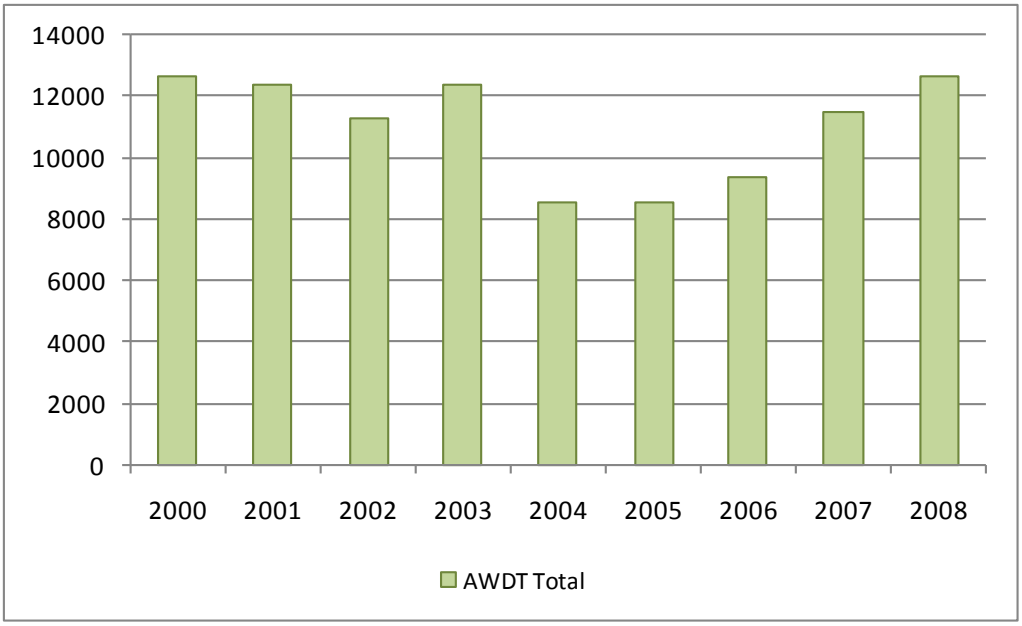
APPENDIX J. HISTORICAL TRAFFIC VOLUME TRENDS

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.

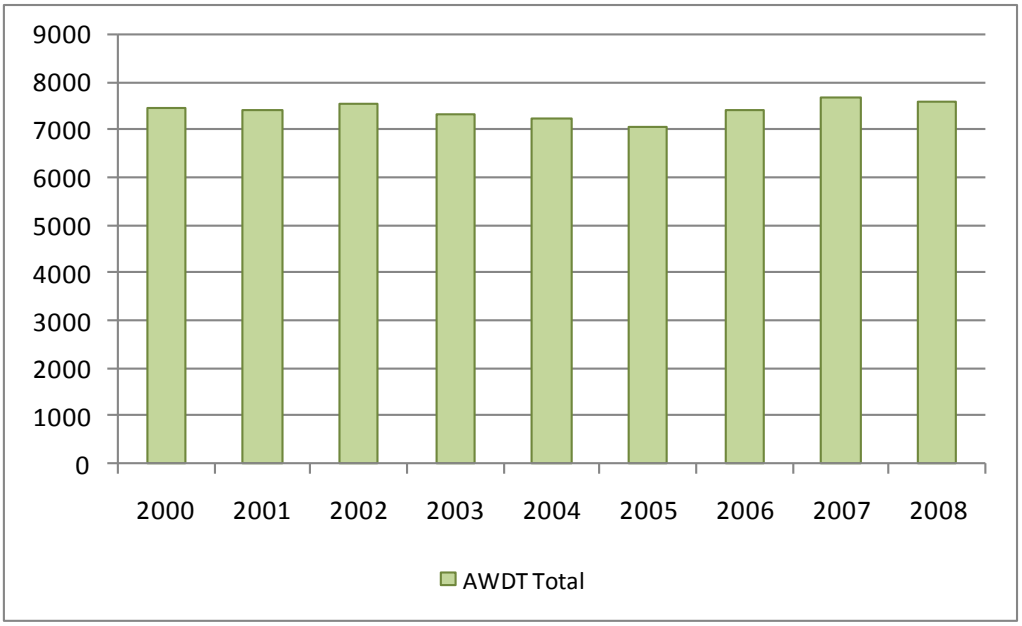
Exhibit J-1. Average Weekday Traffic Volumes on South Holgate Street between 3rd Avenue South and 4th Avenue South



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.

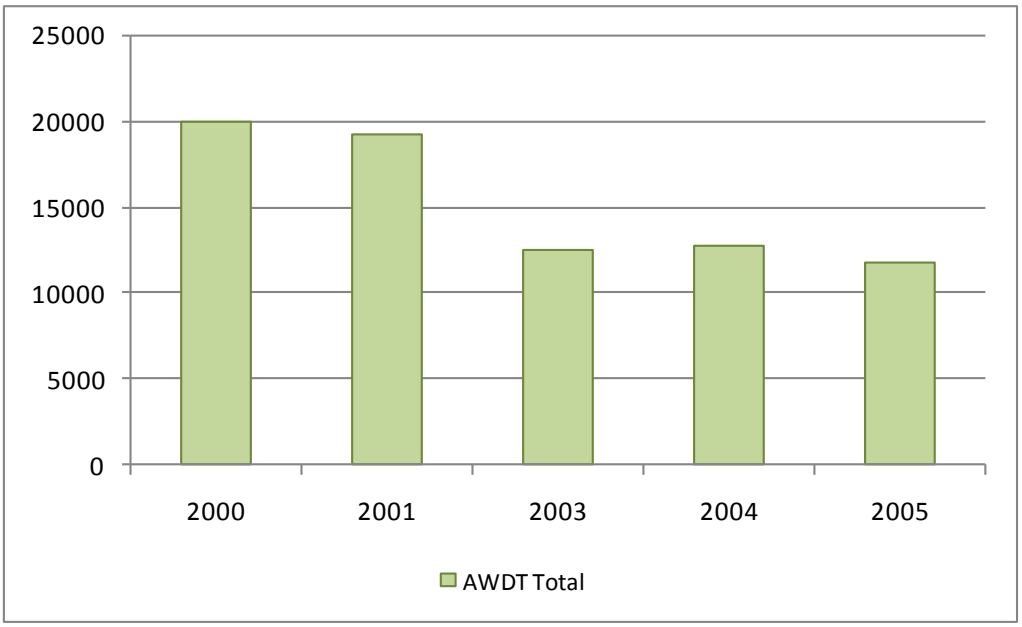
Exhibit J-3. Average Weekday Traffic Volumes on S Lander Street between 4th Avenue S and 6th Avenue S

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

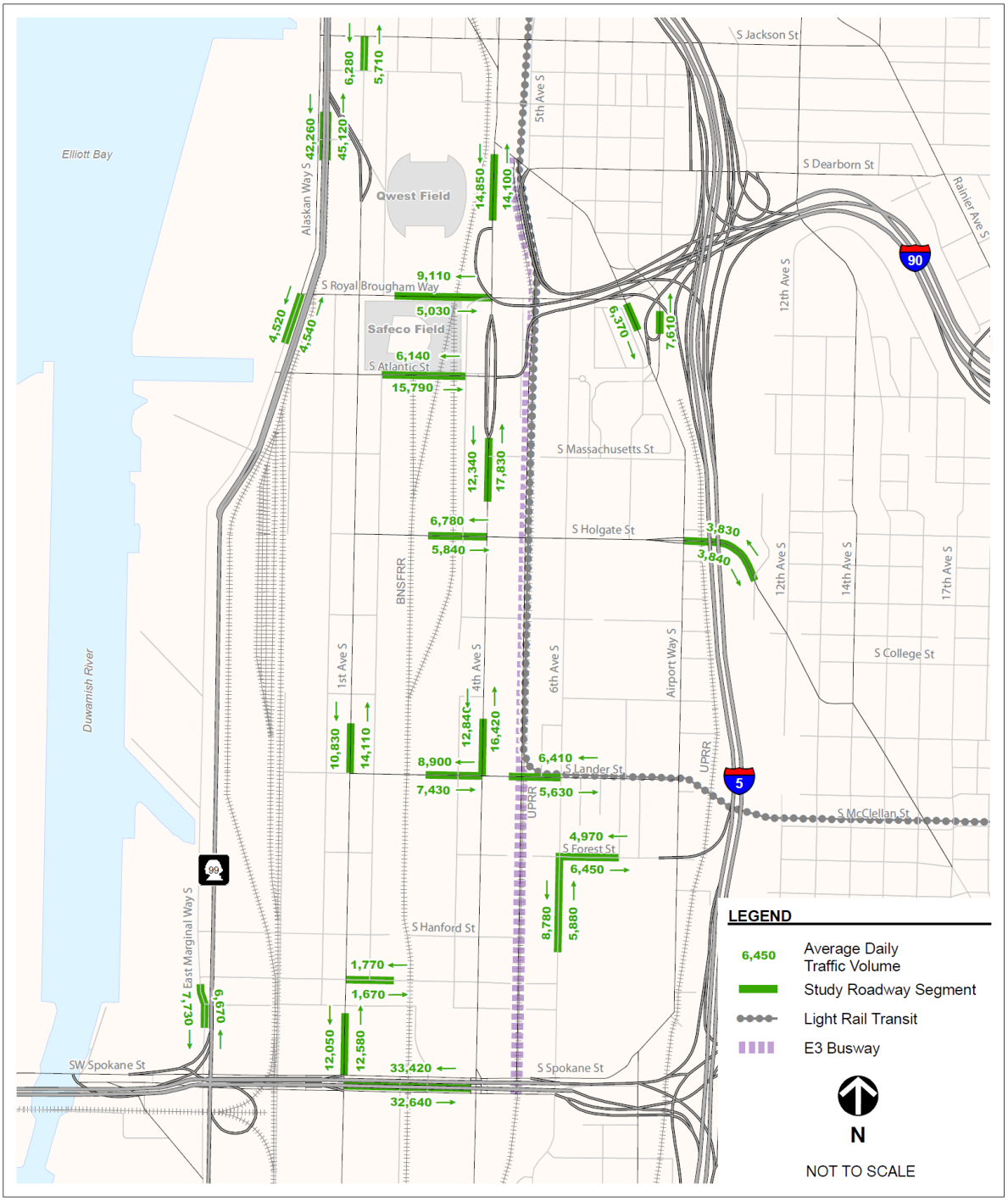
EXISTING TRAFFIC VOLUMES IN THE STUDY AREA

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.

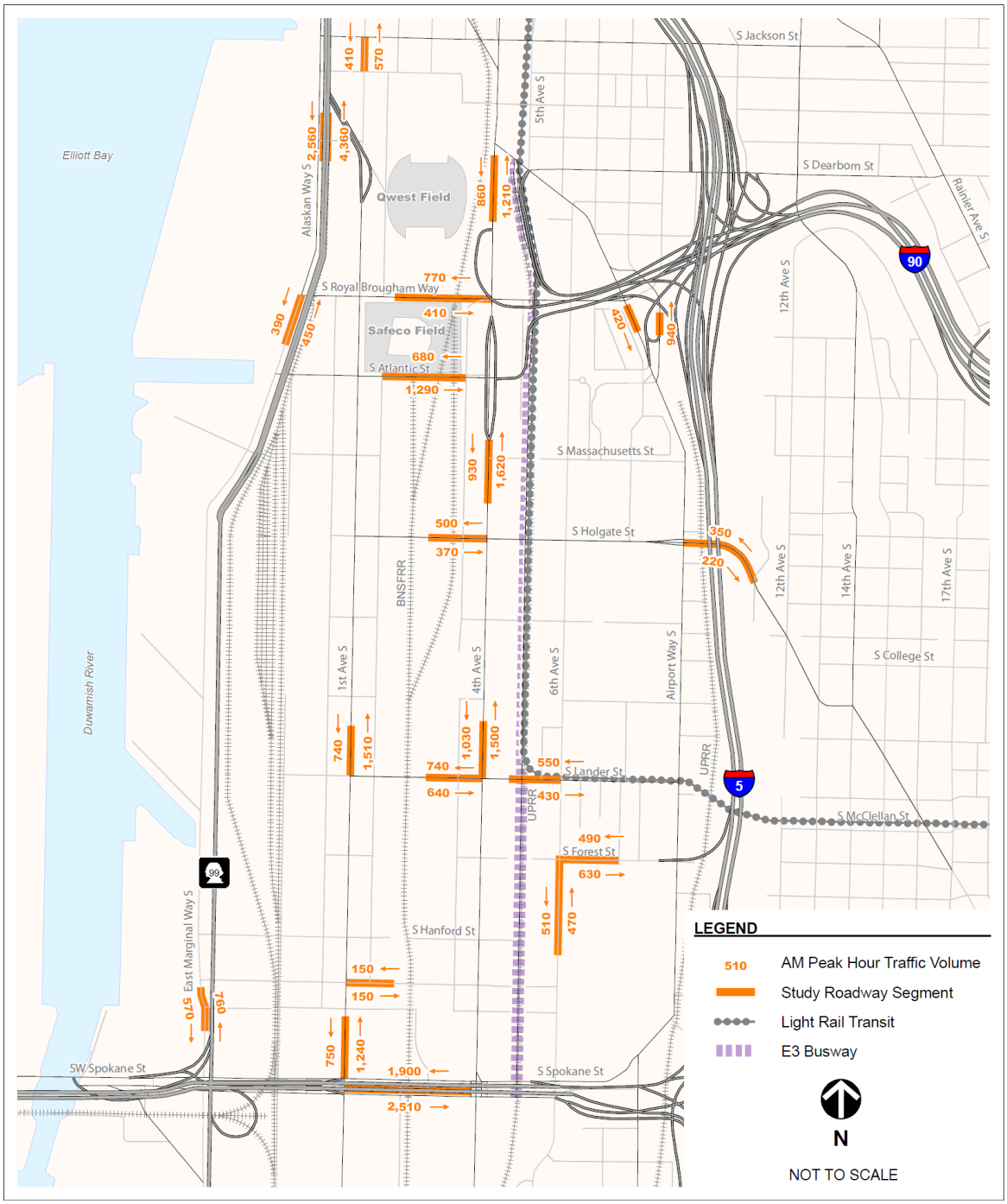
Exhibit J-7 shows the existing average PM peak hour volumes.

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



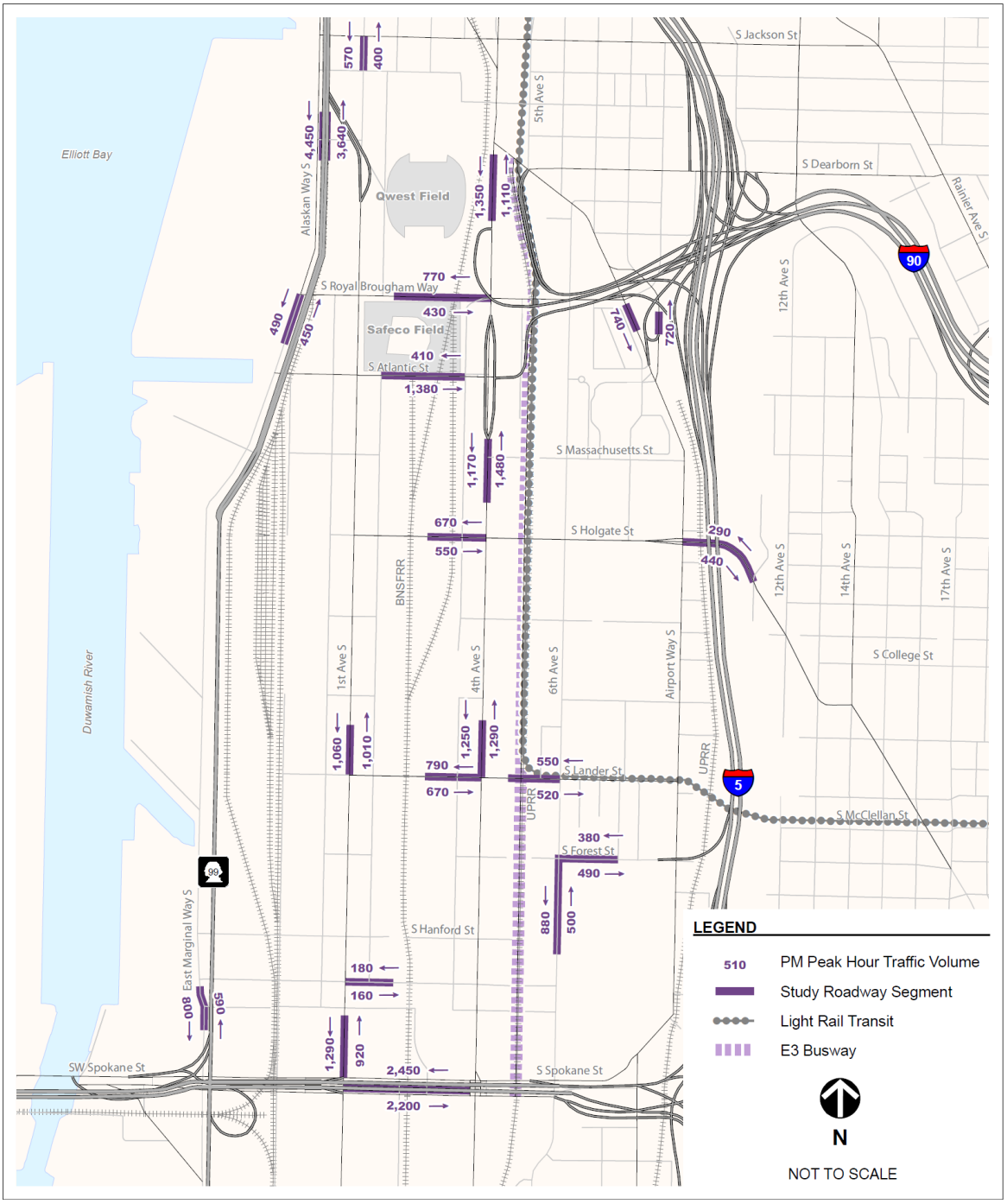
Source: Fehr & Peers

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.

<u>Alternative W-1</u>

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.

<u>Alternative W-2</u>

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.

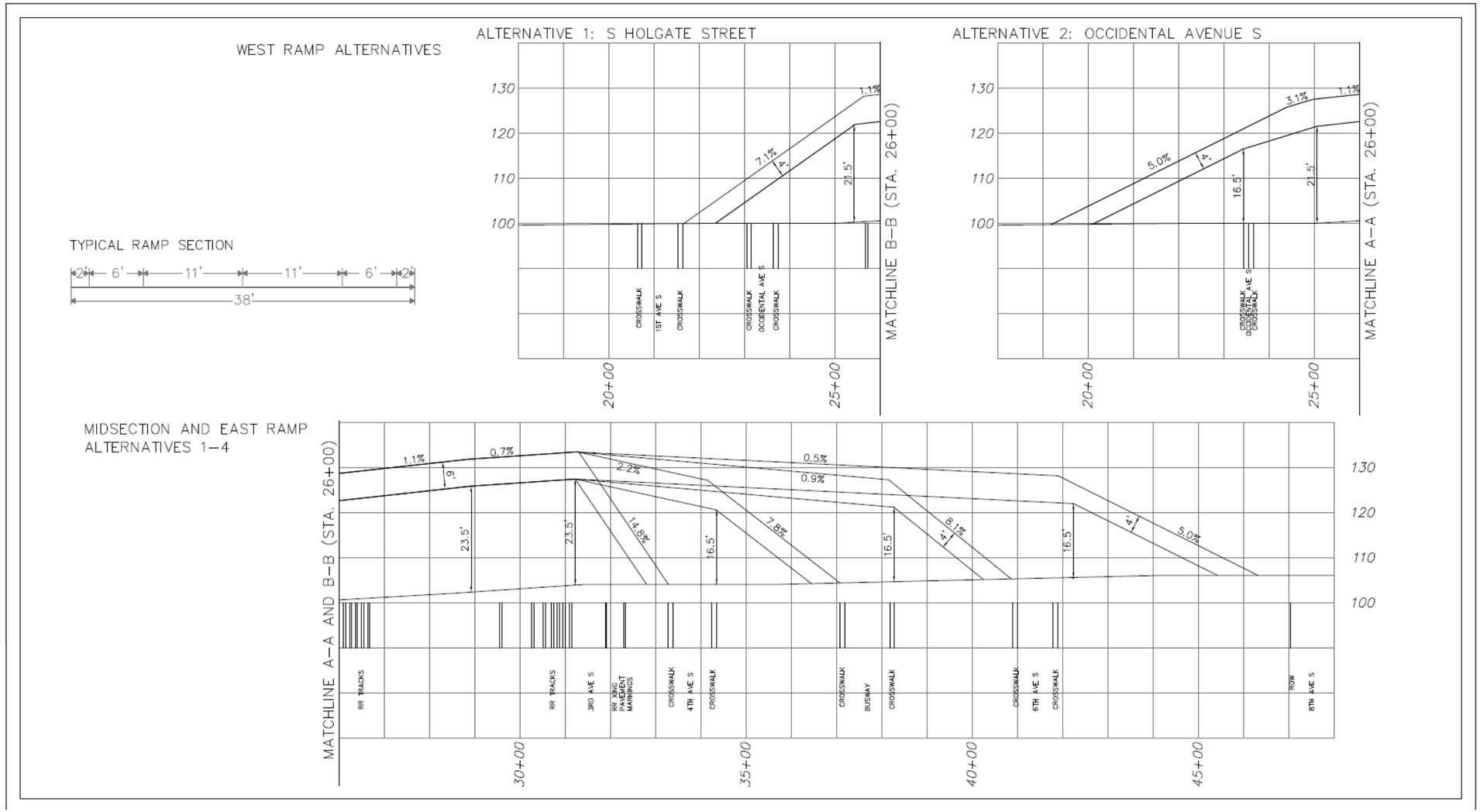
Alternative E-4

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

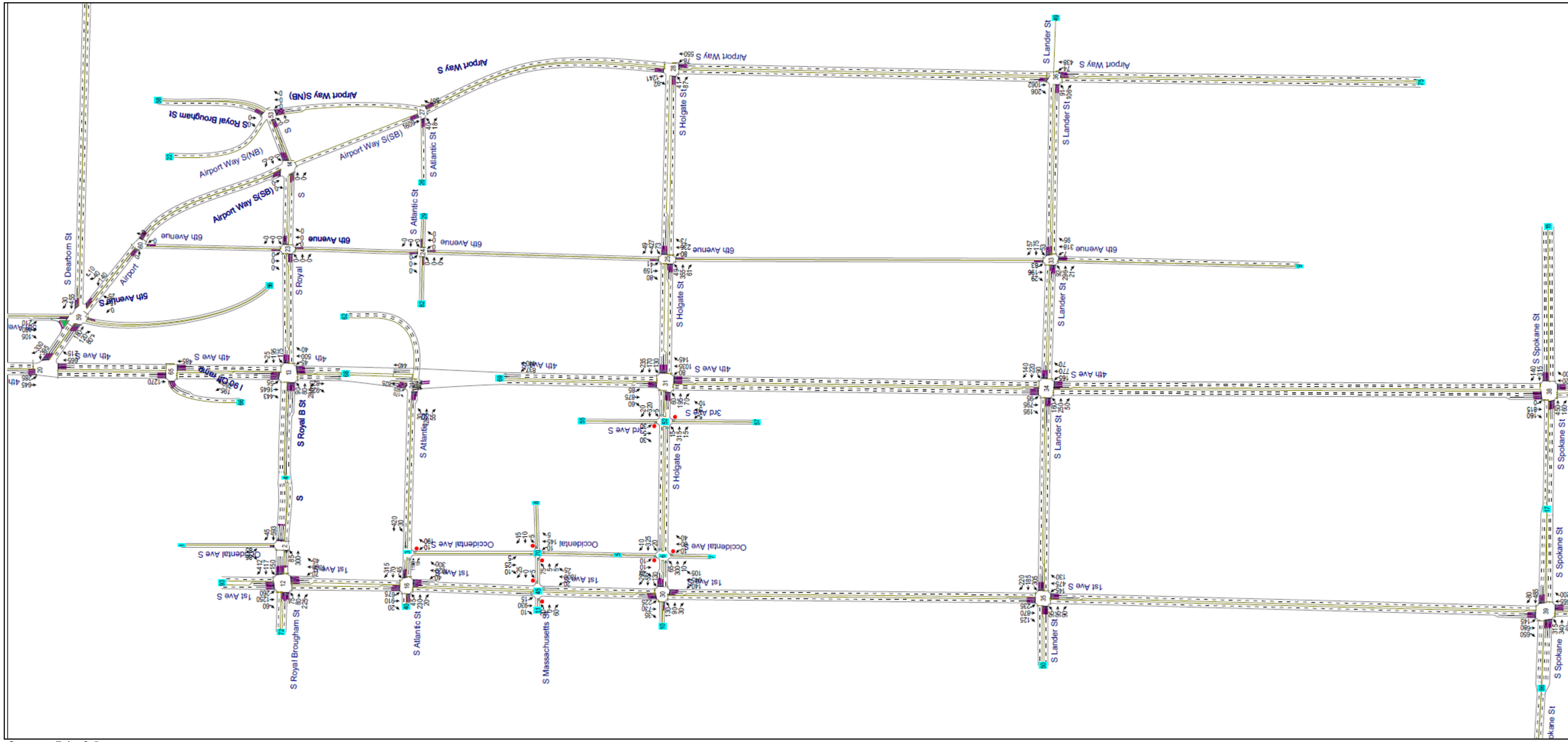
2007 Intersection Approach Volumes
PM Peak Hour

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

FEHR & PEERS
TRANSPORTATION CONSULTANTS

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

2015 Intersection Approach Volumes with S Holgate Street Open

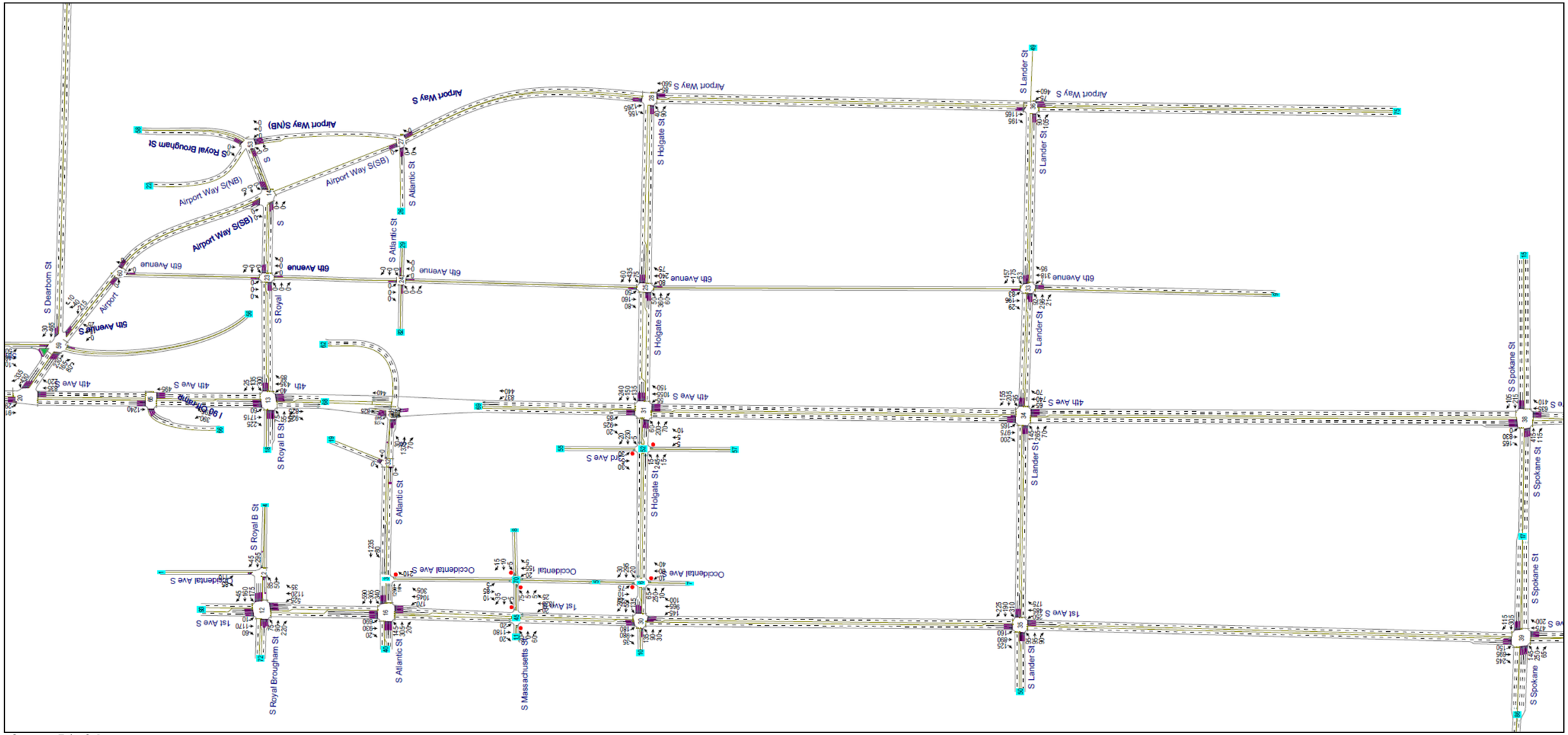
PM Peak Hour

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

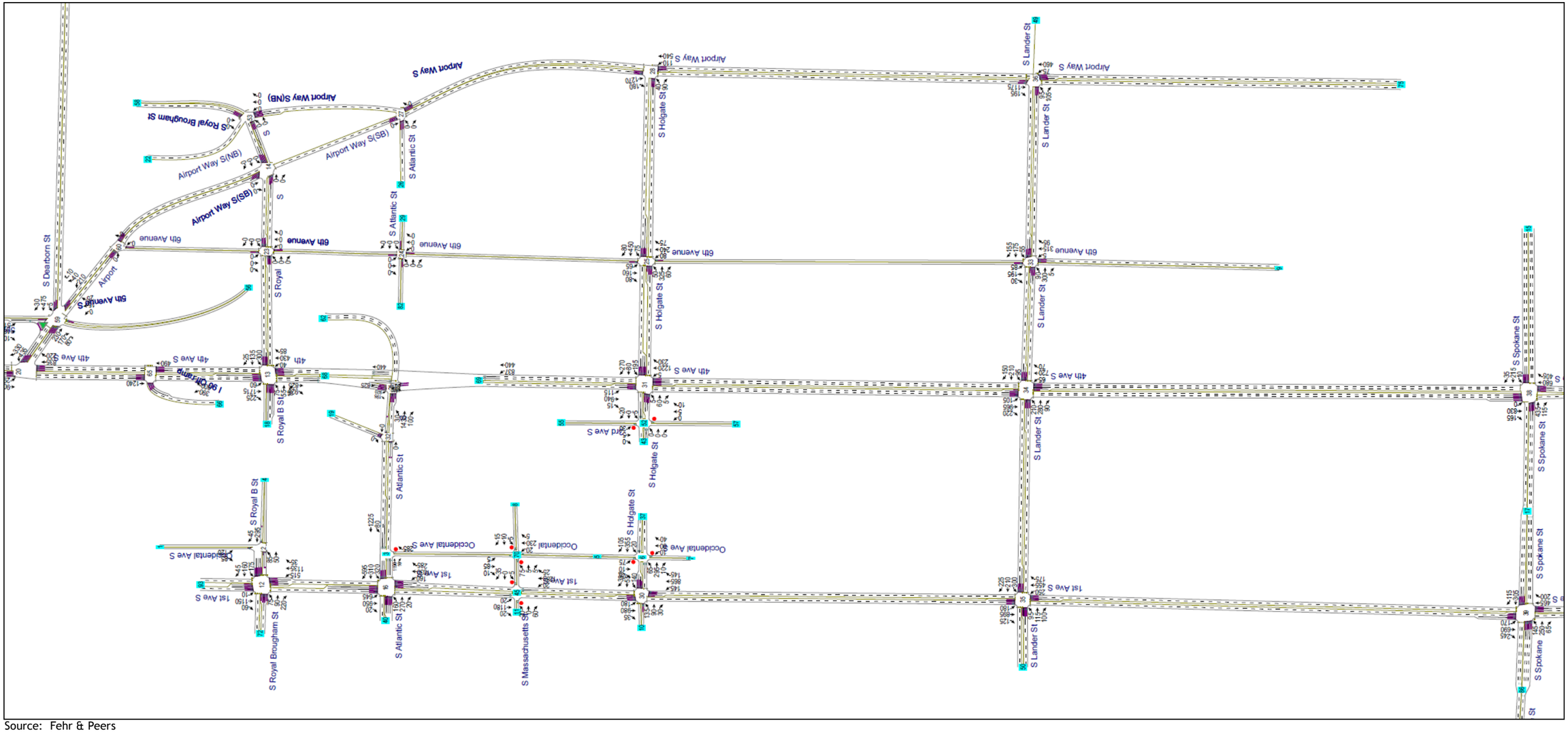
PM Peak Hour

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

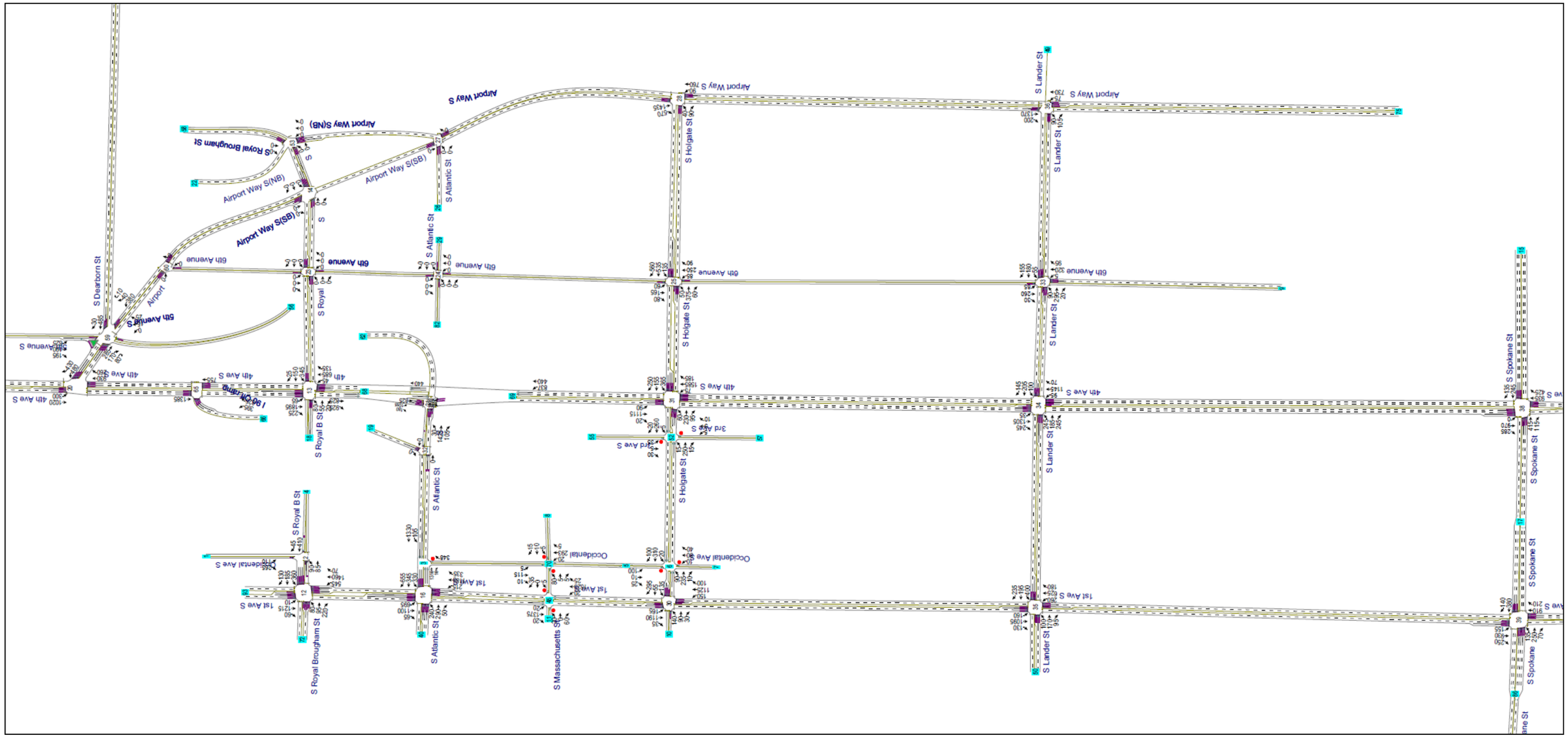
PM Peak Hour

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

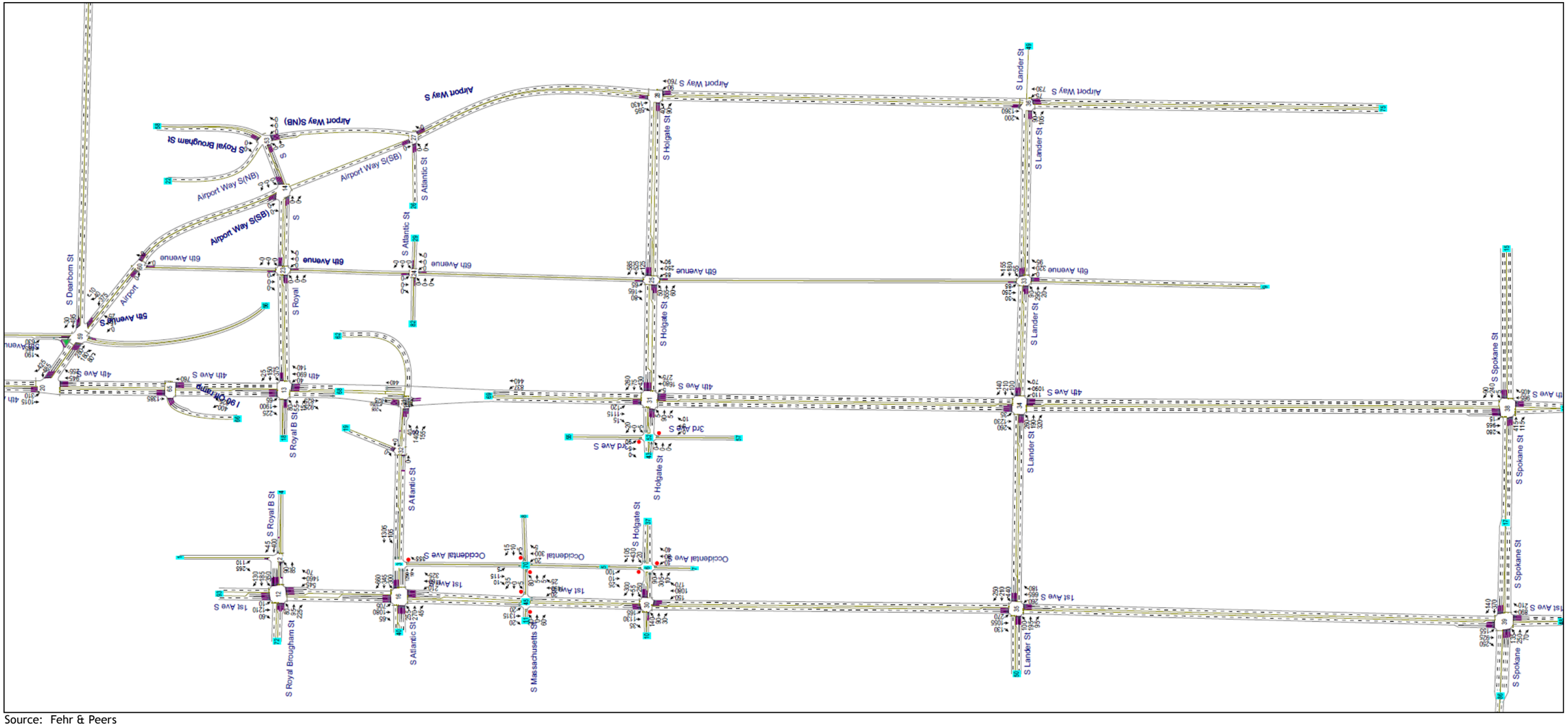
2030 Intersection Approach Volumes without S Holgate Street Open
PM Peak Hour

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.