

APPENDIX F GRADE CROSSING DELAY AND SAFETY

F.1 TRAFFIC DELAY METHODOLOGY

For each grade crossing analyzed, SEA calculated the time that a particular crossing would be blocked for each train-crossing event and estimated the average delay per vehicle using that crossing in a 24-hour period. SEA used the average delay per vehicle at grade crossings to determine the LOS. The LOS is a letter grading system developed by the Transportation Research Board to express the amount of traffic congestion at signalized intersections. LOS is also used as a qualitative measure of road operating conditions and comfort level of passengers. LOS ranges from A (best) to F (worst). SEA analyzed average traffic delay for all vehicles over a 24-hour period and used the average delay per vehicle to determine LOS for each grade crossing based on ratings described in Table F.1-1.

**Table F.1-1
Grade Crossings Level of Service**

Level of Service (LOS)	Average Total Delay (seconds/vehicle)
A	≤5
B	>5 and ≤10
C	>10 and ≤20
D	>20 and ≤30
E	>30 and ≤45
F	>45

SEA used the following calculations to determine traffic delay at grade crossings. The traffic delay at a crossing includes the time for the train to pass, along with time for any warning device to engage.

Blocked Crossing Time:

$$(D_c) = \frac{L}{V \times 88} + 0.5 \text{ minutes}$$

L = Length of the train, in feet.

V = Train speed in miles per hour.

88 = Conversion factor from miles per hour to feet per minute (1 mile per hour = 88 feet per minute).

0.5 = Time required, in minutes, for gate closing and opening before and after train passage.¹

Crossing Delay per Stopped Vehicle:

$$(D_A) = \frac{D_C \times (S_C / (S_C - S_Q))}{2 \text{ minutes/vehicle}}$$

S_C = Vehicle departure rate, vehicles per hour per lane.²

S_Q = Average arrival rate, average daily traffic in vehicles per hour per lane.

2 = Denominator to reflect that vehicles do not experience delay for the entire time that the train blocks the grade crossing, but arrive on average at the midpoint of the train crossing period.

Number of Vehicles Delayed per Day:

$$T_D = \frac{D_C}{1,440} \times N \times \text{ADT vehicles / day}$$

1,440 = Minutes per day.

N = Number of trains per day.

ADT = Average daily traffic volume.

Average Delay per Vehicle (in a 24-hour period):

$$\text{Delay} = \frac{D_C}{1,440} \times N \times D_A \times 60 \text{ seconds / vehicle}$$

The following tables illustrate the results of the traffic delay analysis for the Proposed Action and the No-Build Alternative. The No-Action Alternative involves only the Bayport Loop Industrial Lead to Strang Yard. Table F.1-3 for the No-Build Alternative shows the existing conditions for the Bayport Loop Industrial Lead, which would remain the same under the No-Action Alternative.

¹ Not all crossings have gates as warning devices and thus blocked crossing times for such cases may be over-estimated.

² The vehicle departure rate depends on a wide range of factors such as the presence or absence of signals, number and type of lanes, lane width, grade, sight distances, type and peak vehicle traffic, and curve radius. Data on these factors are not readily available for the grade crossings included in this analysis and, thus, calculation of crossing-specific departure rates is not feasible. This analysis uses vehicle departure rates of 1800/hr for highways, 1400/hr for arterials, 900/hr for collectors, and 700/hr for local roads. For further information, see Transportation Research Board, National Research Council, *Highway Capacity Manual, Special Report 209*. Third Edition, 1994.

Appendix F: Grade Crossing Delay and Safety

Table F.1-2
Proposed Action Traffic Delay Analysis

Segments	FRA Crossing ID Number	Street Name	Length of Train (ft)	Train Speed (mph)	Blocked Crossing Time for Train = D_c (minutes)	S_c	Average Crossing Delay per Stopped Vehicle $D_A = D_c \times (S_c / (S_c - S_o)) / 2$ (minutes/vehicle)	Average Number of Trains per Day (N)			Average Daily Traffic (ADT)	No. of Road Lanes (NL)	Number of Vehicles Delayed per Day (T_o)			Average Delay per Vehicle (seconds)			Traffic Level of Service	
								Pre	Post	Δ			Pre	Post	Δ	Pre	Post	Δ	Pre	Post
New Grade Crossings	N/A	Old Hwy 146 (@ Port Rd)	1,551	7.5	2.85	700	1.54	2.00	2.00		2,460	2	10	10		0.36	0.36		A	
	N/A	PORT RD	1,551	7.5	2.85	700	1.63	2.00	2.00		4,260	2	17	17		0.39	0.39		A	
	N/A	HWY 146--NB entrance ramp	1,551	7.5	2.85	700	1.46	2.00	2.00		921	2	4	4		0.35	0.35		A	
	N/A	HWY 146--SB exit ramp	1,551	7.5	2.85	700	1.48	2.00	2.00		1,280	2	5	5		0.35	0.35		A	
	N/A	BAY AREA BLVD	2,545	7.5	4.36	700	2.97	12.50	12.50		17,920	4	678	678		6.74	6.74		B	
GH&H line	859598E	BRANTLEY ST.	3,618	17.5	2.85	700	1.49	3.40	5.40	2.00	1,490	2	10	16	6	0.60	0.96	0.35	A	A
	859597X	CHALLENGER 7 PKWY	3,618	17.5	2.85	700	1.48	3.40	5.40	2.00	2,880	5	19	31	11	0.60	0.95	0.35	A	A
	859596R	N. GATE	3,618	17.5	2.85	700	1.49	3.40	5.40	2.00	1,410	2	9	15	6	0.60	0.95	0.35	A	A
	859592N	GENOA RED BLUFF	3,618	17.5	2.85	700	3.12	3.40	5.40	2.00	18,280	2	123	195	72	1.26	2.00	0.74	A	A
	859589F	TIKI LANE	3,618	17.5	2.85	700	1.46	3.40	5.40	2.00	860	2	6	9	3	0.59	0.94	0.35	A	A
	859587S	SHAVER	3,618	20	2.56	1,400	1.53	3.40	5.40	2.00	21,960	4	132	210	78	0.55	0.88	0.33	A	A
	859584W	CORONATION DRIVE	3,618	17.5	2.85	700	1.49	3.40	5.40	2.00	1,380	2	9	15	5	0.60	0.95	0.35	A	A
	859583P	EDGEBROOK	3,618	17.5	2.85	1,400	1.64	3.40	5.40	2.00	21,900	5	147	234	87	0.66	1.05	0.39	A	A
	859579A	NEVADA	3,618	22.5	2.33	700	1.35	3.40	5.40	2.00	4,730	2	26	41	15	0.45	0.71	0.26	A	A
	859578T	SPENCER	3,618	17.5	2.85	700	1.95	3.40	5.40	2.00	22,600	5	152	241	89	0.79	1.25	0.46	A	A
	859577L	PENNSYLVANIA ¹	3,618	17.5	2.85	700	1.58	3.40	5.40	2.00	3,390	2	23	36	13	0.64	1.02	0.38	A	A
	859576E	VIRGINIA ST	3,618	17.5	2.85	700	1.48	3.40	5.40	2.00	1,180	2	8	13	5	0.60	0.95	0.35	A	A
	859575X	KENTUCKY ST.	3,618	17.5	2.85	700	1.51	3.40	5.40	2.00	1,810	2	12	19	7	0.61	0.97	0.36	A	A
	859574R	S. RICHEY ST.	3,618	17.5	2.85	1,400	1.67	3.40	5.40	2.00	19,770	4	133	211	78	0.67	1.07	0.40	A	A
	859570N	HOWARD DRIVE	3,618	17.5	2.85	1,400	1.60	3.40	5.40	2.00	18,280	5	123	195	72	0.65	1.02	0.38	A	A
	859569U	WYNE ST.	3,618	17.5	2.85	700	1.43	3.40	5.40	2.00	180	2	1	2	1	0.58	0.92	0.34	A	A
	859567F	PARKPLACEBLVD.	3,618	17.5	2.85	1,400	1.55	3.40	5.40	2.00	5,360	2	36	57	21	0.62	0.99	0.37	A	A
	859568M	PARK TERRACE	3,618	17.5	2.85	700	1.70	3.40	5.40	2.00	5,420	2	36	58	21	0.69	1.09	0.40	A	A
	859550C	BROADWAY ST.	3,618	17.5	2.85	1,400	1.61	3.40	5.40	2.00	15,660	4	105	167	62	0.65	1.03	0.38	A	A
	859549H	JUNIUS	3,618	15	3.24	700	1.70	3.40	5.40	2.00	1,580	2	12	19	7	0.78	1.24	0.46	A	A
Tower 30 to Tower 85	859548B	BOWIE ST	3,618	17.5	2.85	900	1.47	3.40	5.40	2.00	1,270	2	9	14	5	0.59	0.94	0.35	A	A
	859547U	LAWNDALE	3,618	17.5	2.85	700	1.91	3.40	5.40	2.00	17,090	4	115	183	68	0.77	1.22	0.45	A	A
	859546M	MANCHESTER ST.	3,618	17.5	2.85	700	1.45	3.40	5.40	2.00	630	2	4	7	2	0.59	0.93	0.34	A	A
	859533L	67TH ST.	3,813	17.5	2.98	700	1.55	5.00	7.00	2.00	1,260	2	13	18	5	0.96	1.34	0.38	A	A
	859530R	66TH ST.	3,813	17.5	2.98	700	1.56	5.00	7.00	2.00	1,570	2	16	23	6	0.97	1.35	0.39	A	A
	288035Y	HUGHES ST.	3,813	15	3.39	700	1.82	5.00	7.00	2.00	2,250	2	26	37	11	1.28	1.79	0.51	A	A
	288034S	HARRISBURG BLVD.	3,618	15	3.24	1,400	1.83	25.10	27.10	2.00	15,510	4	876	946	70	6.21	6.70	0.49	B	B
	288033K	SHERMAN ST.	3,618	15	3.24	700	1.73	25.10	27.10	2.00	2,130	2	120	130	10	5.86	6.33	0.47	B	B
	288032D	BRADY ST.	3,618	15	3.24	700	1.65	25.10	27.10	2.00	590	2	33	36	3	5.59	6.03	0.45	B	B
Tower 85 to Tower 87	288 024L	CANAL ST.	3,618	11	4.24	900	2.31	25.10	27.10	2.00	3,500	2	258	279	21	10.22	11.03	0.81	C	C
	288009J	OLD CLINTON RD.	3,618	12.5	3.79	700	1.91	25.10	27.10	2.00	190	2	13	14	1	7.55	8.15	0.60	B	B
	288010D	CLINTON DR.	3,618	12.5	3.79	700	1.94	25.10	27.10	2.00	2,580	6	170	184	14	7.70	8.32	0.61	B	B

Appendix F: Grade Crossing Delay and Safety

Table F.1-2 (continued)
Proposed Action Traffic Delay Analysis

Segments	FRA Crossing ID Number	Street Name	Length of Train (ft)	Train Speed (mph)	Blocked Crossing Time for Train = D_c (minutes)	S_c	Average Crossing Delay per Stopped Vehicle $D_A = D_c \times (S_c / (S_c - S_p)) / 2$ (minutes/vehicle)	Average Number of Trains per Day (N)			Average Daily Traffic (ADT)	No. of Road Lanes (NL)	Number of Vehicles Delayed per Day (T_v)			Average Delay per Vehicle (seconds)			Traffic Level of Service	
								Pre	Post	Δ			Pre	Post	Δ	Pre	Post	Δ	Pre	Post
Tower 87 to Dayton	287996C	MARKET	3,618	15	3.24	700	1.74	25.10	27.10	2.00	2,250	2	127	137	10	5.89	6.35	0.47	B	B
	287994N	LYONS AVE.	3,618	15	3.24	700	1.65	25.10	27.10	2.00	640	2	36	39	3	5.60	6.04	0.45	B	B
	287982U	WALLISVILLE RD.	3,618	15	3.24	700	1.79	25.10	27.10	2.00	3,110	2	176	190	14	6.05	6.53	0.48	B	B
	758293C	FIELDS	4,209	40	1.70	1,400	0.87	20.70	22.70	2.00	1,650	2	40	44	4	1.27	1.39	0.12	A	A
	745074B	OATES ROAD	4,209	25	2.41	700	1.32	20.70	22.70	2.00	4,490	3	156	171	15	2.76	3.02	0.27	A	A
	762907S	RALSTON RD	4,209	45	1.56	900	0.85	20.70	22.70	2.00	3,540	2	80	87	8	1.15	1.26	0.11	A	A
	762905D	HEATHER ROW RD	4,209	45	1.56	700	0.81	20.70	22.70	2.00	1,380	2	31	34	3	1.10	1.20	0.11	A	A
	762904W	CE KING PKWY	4,209	57.5	1.33	700	0.96	20.70	22.70	2.00	10,380	2	199	218	19	1.11	1.21	0.11	A	A
	762901B	VAN HUT RD	4,209	57.5	1.33	1,400	0.73	20.70	22.70	2.00	5,970	2	114	125	11	0.84	0.92	0.08	A	A
	762897N	RESERVOIR RD	4,209	57.5	1.33	700	0.79	20.70	22.70	2.00	2,660	1	51	56	5	0.91	1.00	0.09	A	A
	762895A	AQUEDUCT RD	4,209	57.5	1.33	700	0.67	20.70	22.70	2.00	70	1	1	1	0	0.77	0.84	0.07	A	A
	762892E	SHELDON RD.	4,209	57.5	1.33	1,400	0.72	20.70	22.70	2.00	4,890	2	94	103	9	0.82	0.90	0.08	A	A
	762872T	FIRST ST or MILLER WILSON RD	4,209	57.5	1.33	900	0.74	20.70	22.70	2.00	4,430	2	85	93	8	0.85	0.93	0.08	A	A
	762869K	RAMSEY RD	4,209	57.5	1.33	700	0.69	20.70	22.70	2.00	1,400	2	27	29	3	0.80	0.88	0.08	A	A
	762866P	BOHEMAN HALL RD or ADLONG JOHNSON RD	4,209	57.5	1.33	1,400	0.68	20.70	22.70	2.00	690	1	13	14	1	0.78	0.86	0.08	A	A
	762865H	CROSBY E GATE RD	4,209	57.5	1.33	700	0.71	20.70	22.70	2.00	1,870	2	36	39	3	0.81	0.89	0.08	A	A
	762861F	LORD RD	4,209	57.5	1.33	700	0.67	20.70	22.70	2.00	420	2	8	9	1	0.77	0.85	0.07	A	A
	762859E	SHADY LANE	4,209	57.5	1.33	1,400	0.67	20.70	22.70	2.00	270	2	5	6	0	0.77	0.84	0.07	A	A
	762856J	COUNTY RD 604	4,209	57.5	1.33	700	0.68	20.70	22.70	2.00	250	1	5	5	0	0.78	0.85	0.08	A	A
Baytown Subdivision	762855C	COUNTY RD 603	4,209	57.5	1.33	700	0.68	20.70	22.70	2.00	400	1	8	8	1	0.78	0.86	0.08	A	A
	762853N	WOLF ISLAND	4,209	57.5	1.33	1,400	0.68	20.70	22.70	2.00	1,420	2	27	30	3	0.78	0.86	0.08	A	A
	762852G	SW. DAYTON or STILSON RD	4,209	57.5	1.33	700	0.68	20.70	22.70	2.00	270	1	5	6	0	0.78	0.85	0.08	A	A
	762790L	US 90	2,526	7.5	4.33	1,400	2.39	14.90	16.90	2.00	15,640	5	700	794	94	6.41	7.27	0.86	B	B

¹1996 ADT DATA Lafayette Subdivision: FRA maximum of 70 mph is for passengers. Freight max is 60 (based on time table). Thus, for crossings with FRA minimum/maximum range of 55/70, SEA used 55/60 instead, for an average of 57.5; average of typical minimum and maximum speed based on FRA data would be 62.5.

859568M: FRA minimum/maximum of 5/10 is not consistent with adjacent crossings (because trains would not change speed this quickly), thus speed was set equal to that on adjacent crossings.

859577L and 859583P: Changed FRA functional classification based on review of maps and aerial photos.

Appendix F: Grade Crossing Delay and Safety

**Table F.1-3
No-Build Alternative Traffic Delay Analysis**

Segments	FRA Crossing ID Number	Street Name	Length of Train (ft)	Train Speed (mph)	Blocked Crossing Time for Train= D _c (minutes)	S _c	Average Crossing Delay per Stopped Vehicle D _a = D _c x (S _c /(S _c - S _o))/2 (minutes/vehicle)	Average Number of Trains per Day (N)			Average Daily Traffic (ADT)	No. of Road Lanes (NL)	Number of Vehicles Delayed per Day (T _b)			Average Delay per Vehicle (seconds)			Traffic Level of Service	
								Pre	Post	Δ			Pre	Post	Δ	Pre	Post	Δ	Pre	Post
Bayport Loop - South of Bay Area Boulevard/Port Road	755672S	N. BOUND FRONT RD	1,551	7.5	2.85	700	1.46	10.50	12.50	2.00	920	2	19	23	4	1.83	2.17	0.35	A	A
	758824W	PORT ROAD	1,551	7.5	2.85	700	1.52	10.50	12.50	2.00	4,420	4	92	109	17	1.90	2.26	0.36	A	A
Bayport Loop - North of Bay Area Boulevard/Port Road	758835J	BAY AREA BLVD	2,545	7.5	4.36	700	2.97	10.50	12.50	2.00	17,920	4	569	678	108	5.66	6.74	1.08	B	B
	758839L	BAY AREA BLVD	2,545	7.5	4.36	700	3.27	10.50	12.50	2.00	11,250	2	357	425	68	6.24	7.43	1.19	B	B
Bayport Loop Industrial Lead	758826K	FAIRMONT PKWY	2,961	10	3.86	700	3.20	7.40	9.40	2.00	26,610	4	528	671	143	3.81	4.84	1.03	A	A
Strang Subdivision (Strang Yard to Pasadena Junction)	758848K	HOUSTON RD	2,604	15	2.47	700	1.31	12.10	14.10	2.00	1,980	2	41	48	7	1.64	1.91	0.27	A	A
	758849S	UNDERWOOD RD ¹	2,604	15	2.47	1,400	1.66	12.10	14.10	2.00	17,010	2	353	412	58	2.06	2.40	0.34	A	A
	758 854N	IVY ST.	2,604	15	2.47	700	1.25	12.10	14.10	2.00	880	4	18	21	3	1.56	1.82	0.26	A	A
	758 855V	CENTER ST.	2,604	15	2.47	700	1.54	12.10	14.10	2.00	16,370	5	340	396	56	1.91	2.23	0.32	A	A
	758856C	SHABBONA/ROBI ST.	2,604	15	2.47	700	1.43	12.10	14.10	2.00	4,510	2	94	109	15	1.78	2.07	0.29	A	A
	755675M	SH 225 WBFRONTAGE	2,604	10.5	3.32	900	1.78	12.10	14.10	2.00	2,930	2	82	95	14	2.98	3.47	0.49	A	A
	755362X	TENNECO RD.	2,604	10.5	3.32	700	1.75	12.10	14.10	2.00	1,810	2	50	59	8	2.93	3.42	0.48	A	A
	869756E	SOUTH ST (ETHYL)	2,604	10.5	3.32	700	1.78	12.10	14.10	2.00	2,330	2	65	76	11	2.98	3.47	0.49	A	A
	869754R	JEFFERSON ST.	2,604	10.5	3.32	700	1.92	12.10	14.10	2.00	4,610	2	129	150	21	3.22	3.75	0.53	A	A
	869753J	DAVISON	2,604	10.5	3.32	700	1.66	12.10	14.10	2.00	20	2	1	1	0	2.78	3.24	0.46	A	A
	869752C	WITTER	2,604	10.5	3.32	700	1.71	12.10	14.10	2.00	990	2	28	32	5	2.86	3.33	0.47	A	A
	869723S	N. RICHEY ST.	2,812	10.5	3.54	700	1.78	20.10	22.10	2.00	230	2	11	13	1	5.29	5.82	0.53	B	B
Strang Subdivision (Tower 30 to Sinco Junction)	755363E	LIGHT CO RD	2,578	7.5	4.41	700	2.36	13.10	15.10	2.00	2,180	2	87	101	13	5.66	6.53	0.86	B	B
	755364L	DODGE	2,578	7.5	4.41	700	2.53	13.10	15.10	2.00	2,180	1	87	101	13	6.09	7.02	0.93	B	B
	755365T	SHAW	2,578	7.5	4.41	700	2.31	13.10	15.10	2.00	1,580	2	63	73	10	5.56	6.41	0.85	B	B
	755366A	LAWNDALE ST.	2,578	7.5	4.41	1,400	2.28	13.10	15.10	2.00	4,770	4	191	220	29	5.49	6.33	0.84	B	B
	755369V	ALLEN GENOA RD.	2,578	7.5	4.41	1,400	2.41	13.10	15.10	2.00	5,810	2	233	268	36	5.80	6.68	0.89	B	B
	755374S	LAWNDALE ²	2,578	7.5	4.41	700	2.38	13.10	15.10	2.00	4,960	4	199	229	30	5.72	6.59	0.87	B	B
	755375Y	CENTRAL ST.	2,578	16.25	2.30	900	1.33	13.10	15.10	2.00	5,740	2	120	139	18	1.67	1.92	0.25	A	A
	755376F	CENTRAL ST.	2,578	16.25	2.30	1,800	1.21	13.10	15.10	2.00	3,860	2	81	93	12	1.51	1.75	0.23	A	A
	755382J	MANCHESTER ST	2,578	12.5	2.84	700	1.67	13.10	15.10	2.00	4,930	2	128	147	19	2.59	2.98	0.39	A	A
	869708P	FRIO ST.	2,578	10.5	3.29	700	1.67	13.10	15.10	2.00	450	2	13	16	2	2.99	3.45	0.46	A	A
	859544Y	FENNELL	2,578	7.5	4.41	700	2.23	13.10	15.10	2.00	360	2	14	17	2	5.35	6.17	0.82	B	B
	859543S	SAN ANTONIO ST.	2,578	5.5	5.83	700	2.92	13.10	15.10	2.00	50	2	3	3	0	9.28	10.69	1.42	B	C
Tower 30 to Tower 85 (mp 4.5-2.1)	859533L	67TH ST.	3,813	17.5	2.98	700	1.55	5.00	7.00	2.00	1,260	2	13	18	5	0.96	1.34	0.38	A	A
	859530R	66TH ST.	3,813	17.5	2.98	700	1.56	5.00	7.00	2.00	1,570	2	16	23	6	0.97	1.35	0.39	A	A
	288035Y	HUGHES ST.	3,813	15	3.39	700	1.82	5.00	7.00	2.00	2,250	2	26	37	11	1.28	1.79	0.51	A	A

Appendix F: Grade Crossing Delay and Safety

Table F.1-3 (continued)
No-Build Alternative Traffic Delay Analysis

Segments	FRA Crossing ID Number	Street Name	Length of Train (ft)	Train Speed (mph)	Blocked Crossing Time for Train= D _c (minutes)	S _c	Average Crossing Delay per Stopped Vehicle D _c = D _c x (S _c /(S _c - S _o))/2 (minutes/vehicle)	Average Number of Trains per Day (N)			Average Daily Traffic (ADT)	No. of Road Lanes (NL)	Number of Vehicles Delayed per Day (T _b)			Average Delay per Vehicle (seconds)			Traffic Level of Service	
								Pre	Post	Δ			Pre	Post	Δ	Pre	Post	Δ	Pre	Post
Tower 85 to Tower 87	288034S	HARRISBURG BLVD.	3,618	15	3.24	1,400	1.83	25.10	27.10	2.00	15,510	4	876	946	70	6.21	6.70	0.49	B	B
	288033K	SHERMAN ST.	3,618	15	3.24	700	1.73	25.10	27.10	2.00	2,130	2	120	130	10	5.86	6.33	0.47	B	B
	288032D	BRADY ST.	3,618	15	3.24	700	1.65	25.10	27.10	2.00	590	2	33	36	3	5.59	6.03	0.45	B	B
	288024L	CANAL ST.	3,618	11	4.24	900	2.31	25.10	27.10	2.00	3,500	2	258	279	21	10.22	11.03	0.81	C	C
	288009J	OLD CLINTON RD.	3,618	12.5	3.79	700	1.91	25.10	27.10	2.00	190	2	13	14	1	7.55	8.15	0.60	B	B
	288010D	CLINTON DR.	3,618	12.5	3.79	700	1.94	25.10	27.10	2.00	2,580	6	170	184	14	7.70	8.32	0.61	B	B
	287996C	MARKET	3,618	15	3.24	700	1.74	25.10	27.10	2.00	2,250	2	127	137	10	5.89	6.35	0.47	B	B
	287994N	LYONS AVE.	3,618	15	3.24	700	1.65	25.10	27.10	2.00	640	2	36	39	3	5.60	6.04	0.45	B	B
	287982U	WALLISVILLE RD.	3,618	15	3.24	700	1.79	25.10	27.10	2.00	3,110	2	176	190	14	6.05	6.53	0.48	B	B
Tower 87 to Dayton	758293C	FIELDS	4,209	40	1.70	1,400	0.87	20.70	22.70	2.00	1,650	2	40	44	4	1.27	1.39	0.12	A	A
	745074B	OATES ROAD	4,209	25	2.41	700	1.32	20.70	22.70	2.00	4,490	3	156	171	15	2.76	3.02	0.27	A	A
	762907S	RALSTON RD	4,209	45	1.56	900	0.85	20.70	22.70	2.00	3,540	2	80	87	8	1.15	1.26	0.11	A	A
	762905D	HEATHER ROW RD	4,209	45	1.56	700	0.81	20.70	22.70	2.00	1,380	2	31	34	3	1.10	1.20	0.11	A	A
	762904W	CE KING PKWY	4,209	57.5	1.33	700	0.96	20.70	22.70	2.00	10,380	2	199	218	19	1.11	1.21	0.11	A	A
	762901B	VAN HUT RD	4,209	57.5	1.33	1,400	0.73	20.70	22.70	2.00	5,970	2	114	125	11	0.84	0.92	0.08	A	A
	762897N	RESERVOIR RD	4,209	57.5	1.33	700	0.79	20.70	22.70	2.00	2,660	1	51	56	5	0.91	1.00	0.09	A	A
	762895A	AQUEDUCT RD	4,209	57.5	1.33	700	0.67	20.70	22.70	2.00	70	1	1	1	0	0.77	0.84	0.07	A	A
	762892E	SHELDON RD.	4,209	57.5	1.33	1,400	0.72	20.70	22.70	2.00	4,890	2	94	103	9	0.82	0.90	0.08	A	A
	762872T	FIRST ST or MILLER WILSON RD	4,209	57.5	1.33	900	0.74	20.70	22.70	2.00	4,430	2	85	93	8	0.85	0.93	0.08	A	A
	762869K	RAMSEY RD	4,209	57.5	1.33	700	0.69	20.70	22.70	2.00	1,400	2	27	29	3	0.80	0.88	0.08	A	A
	762866P	BOHEMAN HALL RD or ADLONG JOHNSON RD	4,209	57.5	1.33	1,400	0.68	20.70	22.70	2.00	690	1	13	14	1	0.78	0.86	0.08	A	A
	762865H	CROSBY E GATE RD	4,209	57.5	1.33	700	0.71	20.70	22.70	2.00	1,870	2	36	39	3	0.81	0.89	0.08	A	A
	762861F	LORD RD	4,209	57.5	1.33	700	0.67	20.70	22.70	2.00	420	2	8	9	1	0.77	0.85	0.07	A	A
	762859E	SHADY LANE	4,209	57.5	1.33	1,400	0.67	20.70	22.70	2.00	270	2	5	6	0	0.77	0.84	0.07	A	A
	762856J	COUNTY RD 604	4,209	57.5	1.33	700	0.68	20.70	22.70	2.00	250	1	5	5	0	0.78	0.85	0.08	A	A
	762855C	COUNTY RD 603	4,209	57.5	1.33	700	0.68	20.70	22.70	2.00	400	1	8	8	1	0.78	0.86	0.08	A	A
	762853N	WOLF ISLAND	4,209	57.5	1.33	1,400	0.68	20.70	22.70	2.00	1,420	2	27	30	3	0.78	0.86	0.08	A	A
	762852G	SW. DAYTON or STILSON RD	4,209	57.5	1.33	700	0.68	20.70	22.70	2.00	270	1	5	6	0	0.78	0.85	0.08	A	A
Baytown Subdivision	762790L	US 90	2,526	7.5	4.33	1,400	2.39	14.90	16.90	2.00	15,640	5	700	794	94	6.41	7.27	0.86	B	B

¹1996 ADT DATA Lafayette Subdivision: FRA maximum of 70 mph is for passengers. Freight max is 60 (based on time table). Thus, for crossings with FRA minimum/maximum range of 55/70, SEA used 55/60 instead, for an average of 57.5; average of typical minimum and maximum speed based on FRA data would be 62.5.

²1992 ADT DATA 758826K: Crossing is just prior to junction of Industrial lead with the Loop. Train speed would be less than the 20 mph indicated in FRA database. SEA used 10 mph.
758824W: FRA minimum/maximum of 15/20 is not consistent with adjacent crossings (because trains would not change speed this quickly) and probably operations, thus speed was set equal to that on adjacent crossings.
755375Y and 755376F: FRA minimum/maximum speeds are different, but crossings are located very close together. SEA used the average of the FRA minimum/maximum speeds for the two crossings.

F.2 TRAFFIC SAFETY METHODOLOGY

SEA analyzed the potential impacts of the Proposed Action and Alternatives on grade crossings and considered whether the proposed rail construction and operation would significantly affect traffic safety at grade crossings. To evaluate the potential need for grade separation at proposed grade crossings, SEA analyzed the proposed grade crossings based on USDOT guidelines. These guidelines suggest that grade crossings should be considered for grade separation or otherwise eliminated across the railroad right-of-way whenever one or more of the following conditions exist:

- The highway is a part of the designated Interstate Highway System.
- The highway is otherwise designed to have full controlled access.
- The posted highway speed equals or exceeds 70 mph.
- ADT exceeds 100,000 in urban areas or 50,000 in rural areas.
- Maximum authorized train speed exceeds 110 mph.
- An average of 150 or more trains per day or 300 million-gross-tons per year.
- An average of 75 or more passenger trains per day in urban areas or 30 or more passenger trains per day in rural areas.
- Crossing exposure (the product of the number of trains per day and ADT) exceeds 1,000,000 in urban areas or 250,000 in rural areas.
- Passenger train crossing exposure (the product of the number of passenger trains per day and ADT) exceeds 800,000 in urban areas or 200,000 in rural areas.
- The expected accident frequency for active devices with gates, as calculated by USDOT: Accident Prediction Formula, including 5-year history, exceeds 0.5.
- Vehicle delay exceeds 40 vehicle hours per day.

SEA evaluated the proposed grade crossings in relation to these USDOT criteria for requirement of grade separation. SEA concluded that grade separation is not warranted for any of the crossings associated with the Proposed Action and Alternatives because the proposed location and operational characteristics of the proposed new rail crossings would not meet any of the USDOT criteria. Nevertheless, the Applicants have proposed to grade separate the crossings at Red Bluff Road and Space Center Boulevard.

SEA quantitatively analyzed the traffic safety at existing grade crossings using the accident history from the past five years and calculated the potential change in the number of years between accidents due to the proposed railroad construction and operation. SEA did not calculate predicted accident frequencies for new grade crossings because they lack the necessary data on accident history. SEA used FRA's PC Accident Prediction System (PCAPS) to calculate baseline accident frequencies and accident frequencies that would result from an increase of an average of two trains per day. In doing so, SEA used the information on public grade crossings in the FRA database (available at <http://safetydata.fra.dot.gov/OfficeofSafety/>) with the

exception of train count and ADT information. The train count information used in the analysis is described in Appendix C. PCAPS requires that the user specify the number of day trains, the number of night trains, and the number of switching trains. For this analysis, SEA assumed that the trains are 50 percent night trains, 50 percent day trains, and 0 percent switching trains.³ It is SEA's understanding that this is consistent with how the railroads (that are the source of the train count information) normally report their information to the FRA, i.e., assume an equal distribution between day and night. The ADT information was provided by TxDOT and is based on 2001 data, with the exception of three crossings that use 1996 or 1992 data because 2001 data were not available.

The following tables show the results of the traffic safety analysis for the Proposed Action and No-Build Alternative. The results for the other Build Alternatives are the same as those for the Proposed Action except that three fewer grade public crossings on the GH&H line would be affected by Alternatives 2B and 2D. The results for the No-Action Alternative would be the same for pre- and post-project conditions. Pre-project No-Action Alternative conditions can be seen in Table F.2-2 for the Bayport Loop and Industrial Lead.

³ Train counts entered into the PCAPS model must be integer values. For rail segments with an odd number of trains, SEA assumed for this analysis that there would be one more day train than night train. For example, for a segment with 21 trains, SEA assumed 11 trains would be day trains and 10 trains would be night trains. This is a conservative assumption in that it yields a higher predicted accident frequency than would result from the opposite assumption. Further, SEA rounded non-integer train traffic estimates upwards (e.g., 3.4 trains per day on the GH&H line was rounded to 4) for input into PCAPS, which also results in conservative (higher) predicted accident frequencies.

Table F.2-1
Proposed Action Traffic Safety Analysis Results for Grade Crossings

Segments	Crossing	Street	Predicted Annual Accident Frequency		
			Pre	Post	Change
GH&H line (South of Tower 30)	859598E	BRANTLEY ST.	0.012	0.014	0.002
	859597X	CHALLENGER 7 PKWY	0.021	0.024	0.003
	859596R	N. GATE	0.015	0.018	0.003
	859592N	GENOA RED BLUFF	0.004	0.005	0.001
	859589F	TIKI LANE	0.020	0.023	0.003
	859587S	SHAVER	0.012	0.014	0.002
	859584W	CORONATION DRIVE	0.024	0.028	0.004
	859583P	EDGEBROOK	0.009	0.010	0.002
	859579A	NEVADA	0.062	0.068	0.006
	859578T	SPENCER	0.021	0.025	0.003
	859577L	PENNSYLVANIA	0.137	0.151	0.014
	859576E	VIRGINIA ST	0.027	0.032	0.005
	859575X	KENTUCKY ST.	0.011	0.013	0.002
	859574R	S. RICHEY ST.	0.064	0.070	0.006
	859570N	HOWARD DRIVE	0.023	0.027	0.004
	859569U	WYNE ST.	0.024	0.028	0.004
	859567F	PARKPLACEBLVD.	0.015	0.018	0.003
	859568M	PARK TERRACE	0.022	0.025	0.003
	859550C	BROADWAY ST.	0.015	0.018	0.003
	859549H	JUNIUS	0.083	0.090	0.007
Tower 30 to Tower 85	859 533L	67TH ST.	0.009	0.011	0.001
	859 530R	66TH ST.	0.018	0.021	0.003
	288 035Y	HUGHES ST.	0.052	0.057	0.005
Tower 85 to Tower 87	288 034S	HARRISBURG BLVD.	0.094	0.095	0.002
	288 033K	SHERMAN ST.	0.023	0.023	0.001
	288 032D	BRADY ST.	0.046	0.047	0.001
	288 024L	CANAL ST.	0.023	0.023	0.001
	288 009J	OLD CLINTON RD.	0.011	0.011	0.000
	288010D	CLINTON DR.	0.032	0.033	0.001
	287996C	MARKET	0.099	0.101	0.002
	287 994N	LYONS AVE.	0.075	0.077	0.002
	287 982U	WALLISVILLE RD.	0.064	0.066	0.001
Tower 87 to Dayton Junction	758293C	FIELDS	0.020	0.021	0.001
	745074B	OATES ROAD	0.028	0.029	0.001
	762907S	RALSTON RD	0.021	0.022	0.001
	762905D	HEATHER ROW RD	0.017	0.018	0.001
	762904W	CE KING PKWY	0.027	0.028	0.001
	762901B	VAN HUT RD	0.024	0.025	0.001

Table F.2-1 (continued)
Proposed Action Traffic Safety Analysis Results for Grade Crossings

Segments	Crossing	Street	Predicted Annual Accident Frequency		
			Pre	Post	Change
Baytown Subdivision	762897N	RESERVOIR RD	0.018	0.018	0.001
	762895A	AQUEDUCT RD	0.003	0.003	0.000
	762892E	SHELDON RD.	0.023	0.024	0.001
	762872T	FIRST ST or MILLER WILSON RD	0.022	0.023	0.001
	762869K	RAMSEY RD	0.017	0.018	0.001
	762866P	BOHEMAN HALL RD or ADLONG JOHNSON RD	0.054	0.056	0.002
	762865H	CROSBY E GATE RD	0.018	0.019	0.001
	762861F	LORD RD	0.042	0.043	0.001
	762859E	SHADY LANE	0.008	0.008	0.000
	762856J	COUNTY RD 604	0.042	0.044	0.001
	762855C	COUNTY RD 603	0.011	0.011	0.000
	762853N	WOLF ISLAND	0.064	0.065	0.002
	762852G	SW. DAYTON or STILSON RD	0.008	0.008	0.000
	762790L	US 90	0.131	0.134	0.003

Table F.2-2
No-Build Alternative Traffic Safety Analysis Results for Grade Crossings

Segments	Crossing	Street	Predicted Annual Accident Frequency		
			Pre	Post	Change
Bayport Loop - South of Bay Area Boulevard/ Port Road	755672S	N.BOUND.FRONT.RD	0.018	0.019	0.001
	758824W	PORT ROAD	0.022	0.023	0.001
Bayport Loop - North of Bay Area Boulevard/ Port Road	758835J	BAY AREA BLVD	0.074	0.076	0.003
	758839L	BAY AREA BLVD	0.019	0.021	0.001
Bayport Industrial Lead	758826K	FAIRMONT PKWY	0.072	0.076	0.004
Strang Subdivision (Strang Yard to Pasadena Junction)	758848K	HOUSTON RD	0.017	0.018	0.001
	758849S	UNDERWOOD RD	0.022	0.024	0.002
	758854N	IVY ST.	0.017	0.019	0.001
	758855V	CENTER ST.	0.070	0.075	0.005
	758856C	SHABBONA/ROBI ST.	0.024	0.026	0.002
	755675M	SH 225 WBFrontage	0.019	0.020	0.001
	755362X	TENNECO RD.	0.010	0.010	0.001
	869756E	SOUTH ST (ETHYL)	0.014	0.015	0.001
	869754R	JEFFERSON ST.	0.032	0.033	0.002
	869753J	DAVISON	0.004	0.004	0.000
	869752C	WITTER	0.020	0.021	0.001
	869723S	N. RICHEY ST.	0.015	0.015	0.001
Strang Subdivision (Sinco Junction to Tower 30)	755363E	LIGHT CO RD	0.030	0.031	0.002
	755364L	DODGE	0.031	0.033	0.002
	755365T	SHAW	0.028	0.030	0.002
	755366A	LAWNDALE ST.	0.105	0.108	0.003
	755369V	ALLEN GENOA RD.	0.020	0.021	0.001
	755374S	LAWNDALE	0.022	0.023	0.001
	755375Y	CENTRAL ST.	0.020	0.021	0.001
	755376F	CENTRAL ST.	0.018	0.019	0.001
	755382J	MANCHESTER ST	0.055	0.057	0.002
	869708P	FRIO ST.	0.032	0.033	0.002
	859544Y	FENNELL	0.028	0.029	0.002
	859543S	SAN ANTONIO ST.	0.015	0.016	0.001
Tower 30 to Tower 85	859533L	67TH ST.	0.009	0.011	0.001
	859530R	66TH ST.	0.018	0.021	0.003
	288035Y	HUGHES ST.	0.052	0.057	0.005
Tower 85 to Tower 87	288034S	HARRISBURG BLVD.	0.094	0.095	0.002
	288033K	SHERMAN ST.	0.023	0.023	0.001
	288032D	BRADY ST.	0.046	0.047	0.001
	288024L	CANAL ST.	0.023	0.023	0.001
	288009J	OLD CLINTON RD.	0.011	0.011	0.000
	288010D	CLINTON DR.	0.032	0.033	0.001
	287996C	MARKET	0.099	0.101	0.002

Table F.2-2 (continued)
No-Build Alternative Traffic Safety Analysis Results for Grade Crossings

Segments	Crossing	Street	Predicted Annual Accident Frequency		
			Pre	Post	Change
Tower 87 to Dayton Junction	287994N	LYONS AVE.	0.075	0.077	0.002
	287982U	WALLISVILLE RD.	0.064	0.066	0.001
	758293C	FIELDS	0.020	0.021	0.001
	745074B	OATES ROAD	0.028	0.029	0.001
	762907S	RALSTON RD	0.021	0.022	0.001
	762905D	HEATHER ROW RD	0.017	0.018	0.001
	762904W	CE KING PKWY	0.027	0.028	0.001
	762901B	VAN HUT RD	0.024	0.025	0.001
	762897N	RESERVOIR RD	0.018	0.018	0.001
	762895A	AQUEDUCT RD	0.003	0.003	0.000
	762892E	SHELDON RD.	0.023	0.024	0.001
	762872T	FIRST ST or MILLER WILSON RD	0.022	0.023	0.001
	762869K	RAMSEY RD	0.017	0.018	0.001
	762866P	BOHEMAN HALL RD or ADLONG JOHNSON RD	0.054	0.056	0.002
	762865H	CROSBY E GATE RD	0.018	0.019	0.001
	762861F	LORD RD	0.042	0.043	0.001
	762859E	SHADY LANE	0.008	0.008	0.000
	762856J	COUNTY RD 604	0.042	0.044	0.001
	762855C	COUNTY RD 603	0.011	0.011	0.000
	762853N	WOLF ISLAND	0.064	0.065	0.002
	762852G	SW. DAYTON or STILSON RD	0.008	0.008	0.000
Baytown Subdivision	762790L	US 90	0.131	0.134	0.003