Dallas to Houston High-Speed Rail
Draft Environmental Impact Statement

Appendix E

Federal Railroad Administration

Dallas to Houston High-Speed Rail
Draft Environmental Impact Statement

Appendix E:
Technical Memorandums
Set 1 of 2

Air Quality
Noise and Vibration
Hazmat Initial Site Assessment
Wildlife Crossings
Waters of the U.S.
Transportation

Land Use
Socioeconomic
Environmental Justice
Soils and Geology
USACE 408 Impacts

Federal Railroad Administration

AECOM

TECHNICAL MEMORANDUM
AIR QUALITY

To: Jerry Smiley, AICP, AECOM

From: Carl Sepulveda, AECOM

Date: November 1, 2017

RE: DALLAS TO HOUSTON HSR – AIR QUALITY TECHNICAL MEMORANDUM AND CONSTRUCTION EMISSIONS AIR QUALITY ANAYSIS

Construction emissions account for emissions from construction equipment on site, employee trips to the construction site, delivery of construction materials (hauling by both trucks and rail) to the material storage yards and to the construction sites, and emissions from other on-road vehicles used during construction activities.

Included in this technical memorandum are:

- A summary of on-site construction elements and annual NO_x, VOC and GHG CO_2 emissions
- Construction material quantities used in the emissions calculations
- Locomotive line-haul emissions calculations
- Truck hauling emissions calculations
- On-road (non-hauling) vehicle emission calculations
- Equipment lists by construction activity
- Detailed construction phase equipment quantities
- Detailed construction emissions calculations for track, stations, TMFs, and MOWs
- Detailed construction GHG emissions calculations for track, stations, TMFs, and MOWs

Maximum Annual Construction-Related NO_x and VOC Emissions for Years 2018–2021[a] (tons/year)				
Construction Activity	**DFW NAA[b]**		**HGB NAA[c]**	
	NO_x (tons)	**VOC (tons)**	**NO_x (tons)**	**VOC (tons)**
Off-Road Construction Equipment	62.72	5.20	63.74	5.28
On-Road Construction Vehicles	33.14	11.44	27.13	9.73
Locomotive Hauling	3.27	0.17	4.89	0.26
Total	**99.13**	**16.81**	**95.76**	**15.27**

Source: AECOM, 2016

Notes:

[a] These construction emissions were estimated for Alternative C, which is used as a proxy to estimate construction emissions for all other alternatives. Total construction emissions of NO_x and VOC from all other alternatives would be lower and are estimated to differ from Alternative C by less than 2.2%.

[b] The applicable DFW NAA counties are Dallas and Ellis counties.

[c] The applicable HGB NAA counties are Harris and Waller counties.

Maximum Annual Construction-Related GHG Emissions for Years 2018–2021[a]	
Construction Activity	**CO_2e (metric tons)**
Off-Road Construction Equipment	35,132
On-Road Construction Vehicles	85,132
Locomotive Hauling	15,776
Total	**136,040**

Notes:

[a] The construction GHG emissions were estimated for the HSR Alternative C, which is used as a proxy to estimate construction emissions for all other alternatives. Total construction GHG emissions from all other alternatives would be lower and are estimated to differ from Alternative C by less than 2.2%.

HIGH SPEED RAIL PROJECT
DALLAS TO HOUSTON
CONSTRUCTION ANALYSIS
CONSTRUCTION MATERIAL QUANTITIES

Data Taken from Project Descriptions or Provided
Estimated Values
Data Used in Calculations

Item	Unit	Revised End to End Alignment A	Notes
Total Length	miles	241.09	
Drill Shafts	CY	3,562,743	
Column	CY	697,099	
Cap	CY	807,218	
Beams	CY	2,324,452	
Deck	CY	1,922,417	
Drainage	CY	250,000	
Systems	CY	133,000	
Electrical	CY	20,000	
Stations	CY	330,000	
Misc Other	CY	221,534	Assume concrete for cantenary poles included here
Total Concrete	CY	10,268,463	
Cement	Ton	1,568,508	Assume 50% delivered by rail and 50% by truck
Sand	Ton	3,722,318	Assume 50% delivered by rail and 50% by truck
Gravel	Ton	4,107,385	Assume 50% delivered by rail and 50% by truck
Reinforcement	lbs	2,567,115,750	
Structural Steel	lbs	13,205,875	stations, parking structures, trainset maintenance facilities and Cantenary poles
Sub-Ballast	CY	974,819	
Ballast	CY	2,293,441	
Concrete Ties	Each	1,371,124	
Rail	TF	2,742,247	
Excavation	CY	12,600,093	
Filling	CY	11,335,373	
Trainset Maintenance Facility	Each	2	
Maintenance-of-Way Facility	Each	5	

Notes:

Assume water available at batching/precasting sites

Assume 1 delivery of ballast every two weeks via locomotive

Assume 1 delivery of cement, sand and gravel every two weeks via locomotive

HIGH SPEED RAIL PROJECT
DALLAS TO HOUSTON
CONSTRUCTION ANALYSIS
MATERIAL HAULING LOCOMOTIVE EMISSIONS

HSR Material Hauling - Locomotive

Data Taken from Project Descriptions or Provided
Estimated Values
Data Used in Calculations

HSR Annual Material Hauling by Rail

HSR Alternative C Construction by Rail in DFW NAA per year						**Possible**	**Average Distance Traveled**	**Duration**
Source Geography	**Material Hauled**	**Total Quantity[1]**	**Units**	**Total Quantity**	**Units**	**Material Location**	**within NAA by rail (1-way mi)**	**of Activity (Years)**
Dallas Rail Connection	Sub-Ballast	23,550	cy	49,456	tons	C. Texas	30.9	4
Dallas Rail Connection	Ballast	55,406	cy	116,353	tons	C. Texas	30.9	4
	Sand			37,256	tons	C. Texas	30.9	4
	Gravel			41,110	tons	C. Texas	30.9	4
	Cement			15,699	tons	C. Texas	30.9	4
	Steel Reinforcing			33,916	tons	Out of State	30.9	3
	Steel Structural			211	tons	Out of State	30.9	3
	Rail			1,391	tons	Out of State	30.9	4
Ellis Rail Connection	Sub-Ballast	23,550	cy	49,456	tons	C. Texas	15.3	4
Ellis Rail Connection	Ballast	55,406	cy	116,353	tons	C. Texas	15.3	4
	Sand			37,256	tons	C. Texas	15.3	4
	Gravel			41,110	tons	C. Texas	15.3	4
	Cement			15,699	tons	C. Texas	15.3	4
	Steel Reinforcing			33,916	tons	Out of State	15.3	3
	Steel Structural			211	tons	Out of State	15.3	3
	Rail			1,391	tons	Out of State	15.3	4
HSR Alternative C Construction by Rail in HGB NAA per year						**Possible**	**Average Distance Traveled**	**Duration**
Source Geography	**Material Hauled**	**Total Quantity[1]**	**Units**	**Total Quantity**	**Units**	**Material Location**	**within NAA by rail (1-way mi)**	**of Activity (Years)**
HGB Rail Connection	Sub-Ballast	50,296	cy	105,621	tons	C. Texas	32.3	4
HGB Rail Connection	Ballast	118,329	cy	248,492	tons	C. Texas	32.3	4
	Sand			79,566	tons	C. Texas	32.3	4
	Gravel			87,797	tons	C. Texas	32.3	4
	Cement			33,527	tons	C. Texas	32.3	4
	Steel Reinforcing			72,432	tons	Out of State	32.3	3
	Steel Structural			450	tons	Out of State	32.3	3
	Rail			2,971	tons	Out of State	32.3	4

Total Alignment Length - (mi)	241.09	
DFW NAA Alignment Length (mi)	45.7	18.96%
HGB NAA Alignment Length (mi)	48.8	20.24%
Total Sub-Ballast (cy - total 4 yrs)	993,914	
Total Ballast (cy - total 4 yrs)	2,338,365	
Total Sand (tons - total 4 yrs)	1,572,340	
Total Gravel (tons - total 4 yrs)	1,734,996	
Total Cement (tons - total 4 yrs)	662,552	
Total Reinforing Steel (tons - total 4 yrs)	1,084,372	
Total Structural Steel (tons - total 4 yrs)	6,732	
Total Rail (tons - total 4 yrs)	58,715	

Notes:
(1) Total quantities was obtained from Construction Quantities and Construction Equipment list.
(2) Distance travelled by rail calculated for travel in NAA only.
(3) Density of ballast and sub-ballast was assumed to be 2.1 tons/cubic yard (based on California HSR calculations)
(4) Total rail = 2,795,962 TF. Weight of rail (UIC60 rail) is 42 lbs/ft (Source: http//www.railway-technical.com/track.shtml)

HSR Alternative C Construction Rail Hauling - Total Quantities (tons)			
Material	**DFW (2018-2021)**	**HGB (2018-2021)**	(50% to Dallas rail connection, 50% to Ellis Co. rail connection)
Sub-Ballast	98,911	105,621	
Ballast	232,707	248,492	
Sand	74,512	79,566	
Gravel	82,220	87,797	
Cement	31,398	33,527	
Steel Reinforcing	67,831	72,432	
Steel Structural	421	450	
Rail	2,782	2,971	

Emission Factors - Rail (g/gal)[1]	VOC	CO	NOx	SO2	PM10	PM2.5	CO2
2018	5.408	26.624	102.96	0.094	3.744	3.63168	10217

Emission Factors - Rail (g/ton-mile)[2]	VOC	CO	NOx	SO2	PM10	PM2.5	CO2
2018	0.011	0.056	0.218	0.0002	0.008	0.008	21.6

Notes

(1) Emission factors based on Tier 2 line-haul locomotive emission factors as listed in the EPA Report "Emission Factors for Locomotives - Large Line Haul", USEPA Office of Transportation and Air Quality, EPA-420-F-09-025, April 2009. Grams per gal calculations based on a 20.8 bhp-hr/gal conversion factor as listed in the same EPA report.

(2) The conversion factor of 473 ton-mile/gallon based on the report by the American Association of Railroads "The Environmental Benefits of Moving Freight by Rail, April 2016.

(3) 2018 was assumed to be the most conservative year, so rail emission factors in 2018 were used for all years.

(4) for DFW: Assume 50% to Dallas rail connection, 50% to Ellis Co. rail connection

HSR Alternative C Construction Rail Hauling Emissions per Year

Dallas Railroad Connection (Sta 100310+00)			VOC ER	VOC	VOC	NOx ER	NOx	NOx
	tons	**miles**	**g/ton-mile**	**g/yr**	**tons/yr**	**g/ton-mile**	**g/yr**	**tons/yr**
Sub-Ballast	49,456	30.9	0.011	17,472	0.019	0.218	332,645	0.367
Ballast	116,353	30.9	0.011	41,107	0.045	0.218	782,608	0.863
Sand	37,256	30.9	0.011	13,162	0.015	0.218	250,587	0.276
Gravel	41,110	30.9	0.011	14,524	0.016	0.218	276,510	0.305
Cement	15,699	30.9	0.011	5,546	0.006	0.218	105,592	0.116
Steel Reinforcing	33,916	30.9	0.011	11,982	0.013	0.218	228,121	0.251
Steel Structural	211	30.9	0.011	74	0.00008	0.218	1,416	0.002
Rail	1,391	30.9	0.011	492	0.001	0.218	9,358	0.010
					0.115			2.190

Ellis Railroad Connection (Sta 80650+00)			VOC ER	VOC	VOC	NOx ER	NOx	NOx
	tons	**miles**	**g/ton-mile**	**g/yr**	**tons/yr**	**g/ton-mile**	**g/yr**	**tons/yr**
Sub-Ballast	49,456	15.3	0.011	8,651	0.010	0.218	164,708	0.182
Ballast	116,353	15.3	0.011	20,354	0.022	0.218	387,505	0.427
Sand	37,256	15.3	0.011	6,517	0.007	0.218	124,077	0.137
Gravel	41,110	15.3	0.011	7,191	0.008	0.218	136,913	0.151
Cement	15,699	15.3	0.011	2,746	0.003	0.218	52,284	0.058
Steel Reinforcing	33,916	15.3	0.011	5,933	0.007	0.218	112,953	0.125
Steel Structural	211	15.3	0.011	37	0.000	0.218	701	0.001
Rail	1,391	15.3	0.011	243	0.0003	0.218	4,633	0.005
					0.057			1.084

Houston Railroad Connection (Sta 11250+00)			VOC ER	VOC	VOC	NOx ER	NOx	NOx
	tons	**miles**	**g/ton-mile**	**g/yr**	**tons/yr**	**g/ton-mile**	**g/yr**	**tons/yr**
Sub-Ballast	105,621	32.3	0.011	39,006	0.043	0.218	742,606	0.819
Ballast	248,492	32.3	0.011	91,768	0.101	0.218	1,747,118	1.926
Sand	79,566	32.3	0.011	29,384	0.032	0.218	559,419	0.617
Gravel	87,797	32.3	0.011	32,423	0.036	0.218	617,290	0.680
Cement	33,527	32.3	0.011	12,382	0.014	0.218	235,728	0.260
Steel Reinforcing	72,432	32.3	0.011	26,749	0.029	0.218	509,264	0.561
Steel Structural	450	32.3	0.011	166	0.000	0.218	3,162	0.003
Rail	2,971	32.3	0.011	1,097	0.001	0.218	20,890	0.023
					0.257			4.889

Notes:

1) pounds per gram = 0.0022046

2) tons per pound = 0.0005

Totals (tons)	
DFW VOC	0.17
DFW NOx	3.27
HGB VOC	0.26
HGB NOx	4.89

HIGH SPEED RAIL PROJECT
DALLAS TO HOUSTON
CONSTRUCTION ANALYSIS
MATERIAL HAULING TRUCK EMISSIONS

HSR Material Hauling

Data Taken from Project Descriptions or Provided
Estimated Values
Data Used in Calculations

Truck Capacity
20 cy/truck
30 tons/truck

Material Hauled	Total Quantity[1]	Units	Possible Origin Location	Duration of Activity (years)
From RR Connection / Precast Yard				
Sub-Ballast	993,914	CY	from rail connection yard	4
Ballast	2,338,365	CY	from rail connection yard	4
Concrete Rail Ties	1,397,981	Each	batch plant to construction site	4
Total Concrete	8,674,980	CY	batch plant to construction site	4
Rail	2,795,962	TF	Out of state	4
Excavation	7,541,885	CY	within alignment	4
Fill	25,425,626	CY	within alignment	4
Structural Steel	6,732	Ton	from rail connection yard	3
Reinforcing Steel	1,084,372	Ton	from rail connection yard	3
Construction Waste - Concrete	59,457	CY	within alignment	4
Construction Waste - Rebar	16,266	Ton	within alignment	4
To Precast Yard[2]				
Sand	1,861,159	Ton	Texas	4
Cement	784,254	Ton	Texas	4
Gravel	2,053,693	Ton	Texas	4

Notes:
(1) Information about total quantities was obtained from HSR Construction Quantities and Equipment Estimates.
(2) Number shown assumes 50% of total Sand, Cement, and Gravel delivered to precast yards by truck.
(3) Truck hauling emissions were calculated using a standard truck capacity of 20 cubic yards or 30 tons per truck, and by multiplying the emission factor by the anticipated distance traveled and the amount of material hauled per trip for each hauling method.

HSR Material Hauling Truck Calculations

Material Hauled	Total Truck Hauling Trips Alternative C	No. Trucks Trips HGB	No. Trucks Trips DAL	No. Trucks Trips Ellis/Freestone Co.
From RR Connection / Precast Yard				
Sub-Ballast	49,696	9,939	9,939	9,939
Ballast	116,918	23,384	23,384	23,384
Concrete Rail Ties	23,300	4,660	4,660	4,660
Total Concrete	433,749	86,750	86,750	86,750
Rail	1,957	391	391	391
Excavation	377,094	75,419	75,419	75,419
Fill	1,271,281	254,256	254,256	254,256
Structural Steel	224	45	45	45
Reinforcing Steel	36,146	7,229	7,229	7,229
Construction Waste - Concrete	2,973	595	595	595
Construction Waste - Rebar	542	108	108	108
To Precast Yard				
Sand	62,039	12,408	12,408	12,408
Cement	26,142	5,228	5,228	5,228
Gravel	68,456	13,691	13,691	13,691

Assumptions:
Weight of average concrete railway tie is 1,000 pounds
No. of trucks allocated based on ratio of railroad connection / precasting yards to total (5 total, 1 in Dal, 1 in Ellis Co. and 1 in Hou (20% each))
Weight of rail (UIC60 rail) is 42 lbs/ft (Source: http//www.railway-technical.com/track.shtml)

HSR Material Hauling Mileage Calcuations

Material Hauled	No. Trucks HGB	HGB Annual Miles	No. Trucks DAL	DAL Annual Miles	No. Trucks ELLIS	ELLIS Annual Miles	FREESTONE Annual Miles
From RR Connection / Precast Yard							
Sub-Ballast	9,939	57,150	9,939	42,241	9,939	32,302	12,424
Ballast	23,384	134,456	23,384	99,381	23,384	75,997	29,230
Concrete Rail Ties	4,660	26,795	4,660	19,805	4,660	15,145	5,825
Total Concrete	86,750	498,811	86,750	368,687	86,750	281,937	108,437
Rail	391	2,251	391	1,664	391	1,272	489
Excavation	75,419	433,658	75,419	320,530	75,419	245,111	94,274
Fill	254,256	1,461,973	254,256	1,080,589	254,256	826,333	317,820
Structural Steel	45	258	45	191	45	146	56
Reinforcing Steel	7,229	41,568	7,229	30,724	7,229	23,495	9,036
Construction Waste - Concrete	595	3,419	595	2,527	595	1,932	743
Construction Waste - Rebar	108	624	108	461	108	352	136
To Precast Yard							
Sand	12,408	176,810	12,408	192,320	12,408	102,364	15,510
Cement	5,228	74,504	5,228	81,040	5,228	43,134	6,535
Gravel	13,691	195,101	13,691	212,215	13,691	112,953	17,114
Total	**494,103**	**3,107,378**	**494,103**	**2,452,373**	**494,103**	**1,762,473**	**617,629**

Assumptions:
Distance traveled is estimated based on the origin of the material being delivered.
Average R/T Distance from Rail Connection Yard: HGB = 23 miles, Average R/T Distance DAL = 17 miles, Average R/T Distance Ellis Co = 13 miles, Average R/T Distance Freestone Co = 5 miles
Average roadway R/T distance within NAA to Rail Precast Yard: HGB = 57 miles, DAL = 62 miles, Ellis Co = 33 miles, Freestone Co. = 5 miles
Material haul: quantities will be delivered over a three or four-year time frame (2018-2021) for use in the construction phase (as per schedule).
Assume concrete will be hauled in support of concrete batch plant operations.

Data from MOVES2014a			
	2017 Long Haul Truck		
	Emissions in Grams per Mile		
	NOx	**VOC**	**SO2**
Ellis	**3.225**	**0.426**	
Dallas	**3.225**	**0.424**	
Freestone Co			**0.0034**
Harris	3.166	0.424	
Waller	3.168	0.424	
Average HGB Emissions	**3.167**	**0.424**	

Note:
Emissions averaged for Harris and Waller Counties

HSR Material Hauling Emissions - HGB

	Long Haul Truck	
	Emissions (Tons/Year)	
Year		
	NOx	**VOC**
Annual Emissions 2018 - 2021	**10.85**	**1.45**

Notes:
1) pounds per gram = 0.0022046
2) tons per pound = 0.0005

HSR Material Hauling Emissions - DAL

	Long Haul Truck	
	Emissions (Tons/Year)	
Year		
	NOx	**VOC**
Annual Emissions 2018 - 2021	**8.72**	**1.15**

Notes:
1) pounds per gram = 0.0022
2) tons per pound = 0.0005

HSR Material Hauling Emissions - Ellis Co

	Long Haul Truck	
	Emissions (Tons/Year)	
Year		
	NOx	**VOC**
Annual Emissions 2018 - 2021	**6.27**	**0.83**

Notes:
1) pounds per gram = 0.0022
2) tons per pound = 0.0005

Total NAA Truck Haul Annual Emissions

	NOx	**VOC**
DFW NAA (Dallas and Ellis counties)	**14.985**	**1.974**
HGB NAA (Harris and Waller counties)	**10.849**	**1.452**

HSR Material Hauling Emissions - Freestone Co.

	Long Haul Truck	
	Emissions (Tons/Year)	
Year		
	SO2	
Annual Emissions 2018 - 2021	**0.0023**	

Notes:
1) pounds per gram = 0.0022
2) tons per pound = 0.0005

HIGH SPEED RAIL PROJECT
DALLAS TO HOUSTON
CONSTRUCTION ANALYSIS
MATERIAL HAULING TRUCK EMISSIONS - TRACK CONSTRUCTION

HSR Material Hauling

Data Taken from Project Descriptions or Provided
Estimated Values
Data Used in Calculations

Truck Emissions - Track	**On-Road (Non-Haul) Trucks**		No Trucks Dal Co	No Trucks Ellis Co	No Trucks Harris Co	No Trucks Waller Co	No Trucks Freestone Co	Avg R/T Distance 40 Miles/Day Average R/T Distance	Total Miles Per Year 2018-2021	Total Miles Per Year 2018-2021	Total Miles Per Year 2018-2021	Total Miles Per Year 2018-2021
		County distance ratio to overall alignment	0.07003	0.11987	0.15787	0.03682	0.008	(miles)	Dallas Co	Ellis Co	Harris Co	Waller Co
Non-Haul Truck Category	Trucks	Total Number of Non-Haul Trucks										
Light Commercial Truck	Flatbed F350	24						40				
	Flat Bed F700	18										
	Total	**42**	**2.94126**	**5.03454**	**6.63054**	**1.54644**	**0.336**	Light Commercial Truck	**36,707**	**62,831**	**82,749**	**19,300**
Passenger Truck	Mechanics Truck (small)	29										
	Pick-up 1/2 Ton	597										
	Pick-up 3/4 Ton	383										
	Worker Trips	5620										
	Total	**6629**	**464.22887**	**794.61823**	**1046.52023**	**244.07978**	**53.032**	Passenger Truck	**5,793,576**	**9,916,836**	**13,060,572**	**3,046,116**
Single-Unit Short Haul	Fuel Truck	44										
	Water Truck 4000 gal	25										
		69	**4.83207**	**8.27103**	**10.89303**	**2.54058**	**0.552**	Single-Unit Short Haul	**60,304**	**103,222**	**135,945**	**31,706**

Worker Trips: Assume 47 mob and demob sites (30 vehicles/site) and 20 sites each for demo,land clearing, earth moving, road crossings,track at-grade,track elevated, and structures (20 vehicles/site)

Emission Rates	**Ellis Co**		**Ellis Co**		**Ellis Co**			**Freestone Co**	
Truck Category	**2017 JAN**		**2017 JUL**		**2017 Composite Efs (g/mi)**			**2017 Composite Efs (g/mi)**	
	NOX	**VOC**	**NOX**	**VOC**		**NOX**	**VOC**		**SO2**
Passenger Truck	0.694	0.311	0.634	0.417	Passenger Truck	0.664	0.364	All Trucks	0.0034
Light Commercial Truck	0.830	0.343	0.791	0.452	Light Commercial Truck	0.811	0.398		
Single Unit Short-Haul Truck	3.208	0.491	2.564	0.526	Single Unit Short-Haul Truck	2.886	0.508		
Single Unit Long-Haul Truck	3.573	0.423	2.878	0.429	Single Unit Long-Haul Truck	3.225	0.426		

Emission Rates	**Dallas Co**		**Dallas Co**		**Dallas Co**		
Truck Category	**2017 JAN**		**2017 JUL**		**2017 Composite Efs (g/mi)**		
	NOX	**VOC**	**NOX**	**VOC**		**NOX**	**VOC**
Passenger Truck	0.678	0.298	0.614	0.389	Passenger Truck	0.646	0.343
Light Commercial Truck	0.815	0.330	0.771	0.424	Light Commercial Truck	0.793	0.377
Single Unit Short-Haul Truck	3.206	0.487	2.560	0.514	Single Unit Short-Haul Truck	2.883	0.501
Single Unit Long-Haul Truck	3.573	0.422	2.878	0.426	Single Unit Long-Haul Truck	3.225	0.424

Emission Rates	**Harris Co**		**Harris Co**		**Harris Co**		
Truck Category	**2017 JAN**		**2017 JUL**		**2017 Composite Efs (g/mi)**		
	NOX	**VOC**	**NOX**	**VOC**		**NOX**	**VOC**
Passenger Truck	0.539	0.244	0.495	0.305	Passenger Truck	0.517	0.274
Light Commercial Truck	0.666	0.274	0.636	0.338	Light Commercial Truck	0.651	0.306
Single Unit Short-Haul Truck	2.927	0.456	2.411	0.479	Single Unit Short-Haul Truck	2.669	0.467
Single Unit Long-Haul Truck	3.461	0.423	2.872	0.425	Single Unit Long-Haul Truck	3.166	0.424

Emission Rates	**Waller Co**		**Waller Co**		**Waller Co (g/mi)**		
Truck Category	**2017 JAN**		**2017 JUL**		**2017 Composite Efs**		
	NOX	**VOC**	**NOX**	**VOC**		**NOX**	**VOC**
Passenger Truck	0.864	0.383	0.782	0.461	Passenger Truck	0.823	0.422
Light Commercial Truck	0.977	0.408	0.916	0.488	Light Commercial Truck	0.946	0.448
Single Unit Short-Haul Truck	2.926	0.455	2.416	0.478	Single Unit Short-Haul Truck	2.671	0.467
Single Unit Long-Haul Truck	3.459	0.422	2.877	0.425	Single Unit Long-Haul Truck	3.168	0.424

		NOx	**NOx**	**VOC**	**VOC**
Dallas Co		**Total Emissions (g)**	**Total Emissions (tons)**	**Total Emissions (g)**	**Total Emissions (tons)**
	Light Commercial Truck	29,104	0.032	13,837	0.015
	Passenger Truck	3,742,846	4.117	1,989,835	2.189
	Single Unit Short-Haul Truck	173,850	0.191	30,204	0.033
		NOx	**Nox**	**VOC**	**VOC**
Ellis Co		**Total Emissions (g)**	**Total Emissions (tons)**	**Total Emissions (g)**	**Total Emissions (tons)**
	Light Commercial Truck	50,934	0.056	24,985	0.027
	Passenger Truck	6,587,529	7.246	3,607,733	3.969
	Single Unit Short-Haul Truck	297,868	0.328	52,456	0.058
		NOx	**Nox**	**VOC**	**VOC**
Harris Co		**Total Emissions (g)**	**Total Emissions (tons)**	**Total Emissions (g)**	**Total Emissions (tons)**
	Light Commercial Truck	53,858	0.059	25,341	0.028
	Passenger Truck	6,752,344	7.428	3,583,544	3.942
	Single Unit Short-Haul Truck	362,864	0.399	63,512	0.070
Waller Co		**NOx**	**Nox**	**VOC**	**VOC**
	Light Commercial Truck	**Total Emissions (g)**	**Total Emissions (tons)**	**Total Emissions (g)**	**Total Emissions (tons)**
	Passenger Truck	18,261	0.020	8,643	0.010
	Single Unit Short-Haul Truck	2,506,540	2.757	1,285,649	1.414
		84,675	0.093	14,805	0.016

		VOC	**VOC**
Freestone Co		**Total Emissions (g)**	**Total Emissions (tons)**
	All Trucks	2,275	0.0025

Truck Emissions - Track

		NOx	**VOC**
DFW NAA		**Total Emissions (tons/yr)**	**Total Emissions (tons/yr)**
	Truck (non-haul)	11.970	6.291
HGB NAA		**NOx** **Total Emissions (tons/yr)**	**VOC** **Total Emissions (tons/yr)**
	Truck (non-haul)	10.756	5.480

HIGH SPEED RAIL PROJECT
DALLAS TO HOUSTON
CONSTRUCTION ANALYSIS
MATERIAL HAULING TRUCK EMISSIONS - STATION CONSTRUCTION

HSR Material Hauling

Data Taken from Project Descriptions or Provided
Estimated Values
Data Used in Calculations

Truck Emissions - Station	**On-Road (Non-Haul) Trucks**		No Trucks Dal Co	No Trucks Ellis Co	No Trucks Harris Co	No Trucks Waller Co	Average R/T Distance HGB	Total Miles Per Year 2018-2021	Total Miles Per Year 2018-2021	Total Miles Per Year 2018-2021	Total Miles Per Year 2018-2021
		No. of Stations in County	1	0	1	0	(miles)	Dallas Co	Ellis Co	Harris Co	Waller Co
Non-Haul Truck Category	Trucks	Total Number of Non-Haul Trucks									
Light Commercial Truck	Flatbed F350	3					**20**				
	Flat Bed F700	2									
	Total	**5**	**5**	**0**	**5**	**0**	Light Commercial Truck	**31,200**	**0**	**31,200**	**0**
Passenger Truck	Mechanics Truck (small)	1									
	Pick-up 1/2 Ton	8									
	Pick-up 3/4 Ton	8									
	Worker Trips	500									
	Total	**517**	**517**	**0**	**517**	**0**	Passenger Truck	**3,226,080**	**0**	**3,226,080**	**0**
Single-Unit Short Haul	Fuel Truck	1									
	Water Truck 4000 gal	1									
		2	**2**	**0**	**2**	**0**	Single-Unit Short Haul	**12,480**	**0**	**12,480**	**0**
Single-Unit Long Haul	Semi Tractor	2									
		2	**2**	**0**	**2**	**0**	Single-Unit Long Haul	**12,480**	**0**	**12,480**	**0**

Emission Rates	**Ellis Co**			**Ellis Co**			**Ellis Co**
Truck Category	**2017 JAN**			**2017 JUL**			**2017 Composite Efs (g/mi)**
	NOX	**VOC**	**NOX**	**VOC**		**NOX**	**VOC**
Passenger Truck	0.694	0.311	0.634	0.417	Passenger Truck	0.664	0.364
Light Commercial Truck	0.830	0.343	0.791	0.452	Light Commercial Truck	0.811	0.398
Single Unit Short-Haul Truck	3.208	0.491	2.564	0.526	Single Unit Short-Haul Truck	2.886	0.508
Single Unit Long-Haul Truck	3.573	0.423	2.878	0.429	Single Unit Long-Haul Truck	3.225	0.426
Emission Rates	**Dallas Co**		**Dallas Co**		**Dallas Co**		
Truck Category	**2017 JAN**		**2017 JUL**		**2017 Composite Efs (g/mi)**		
	NOX	**VOC**	**NOX**	**VOC**		**NOX**	**VOC**
Passenger Truck	0.678	0.298	0.614	0.389	Passenger Truck	0.646	0.343
Light Commercial Truck	0.815	0.330	0.771	0.424	Light Commercial Truck	0.793	0.377
Single Unit Short-Haul Truck	3.206	0.487	2.560	0.514	Single Unit Short-Haul Truck	2.883	0.501
Single Unit Long-Haul Truck	3.573	0.422	2.878	0.426	Single Unit Long-Haul Truck	3.225	0.424
Emission Rates	**Harris Co**		**Harris Co**		**Harris Co**		
Truck Category	**2017 JAN**		**2017 JUL**		**2017 Composite Efs (g/mi)**		
	NOX	**VOC**	**NOX**	**VOC**		**NOX**	**VOC**
Passenger Truck	0.539	0.244	0.495	0.305	Passenger Truck	0.517	0.274
Light Commercial Truck	0.666	0.274	0.636	0.338	Light Commercial Truck	0.651	0.306
Single Unit Short-Haul Truck	2.927	0.456	2.411	0.479	Single Unit Short-Haul Truck	2.669	0.467
Single Unit Long-Haul Truck	3.461	0.423	2.872	0.425	Single Unit Long-Haul Truck	3.166	0.424
Emission Rates	**Waller Co**		**Waller Co**		**Waller Co (g/mi)**		
Truck Category	**2017 JAN**		**2017 JUL**		**2017 Composite Efs**		
	NOX	**VOC**	**NOX**	**VOC**		**NOX**	**VOC**
Passenger Truck	0.864	0.383	0.782	0.461	Passenger Truck	0.823	0.422
Light Commercial Truck	0.977	0.408	0.916	0.488	Light Commercial Truck	0.946	0.448
Single Unit Short-Haul Truck	2.926	0.455	2.416	0.478	Single Unit Short-Haul Truck	2.671	0.467
Single Unit Long-Haul Truck	3.459	0.422	2.877	0.425	Single Unit Long-Haul Truck	3.168	0.424

		NOx	**NOx**	**VOC**	**VOC**
Dallas Co		**Total Emissions (g)**	**Total Emissions (tons)**	**Total Emissions (g)**	**Total Emissions (tons)**
	Light Commercial Truck	24,738	0.027	11,761	0.013
	Passenger Truck	2,084,157	2.293	1,108,015	1.219
	Single Unit Short-Haul Truck	35,978	0.040	6,251	0.007
	Single Unit Long-Haul Truck	40,249	0.044	5,291	0.006
		NOx	**Nox**	**VOC**	**VOC**
Ellis Co		**Total Emissions (g)**	**Total Emissions (tons)**	**Total Emissions (g)**	**Total Emissions (tons)**
	Light Commercial Truck	0	0.000	0	0.000
	Passenger Truck	0	0.000	0	0.000
	Single Unit Short-Haul Truck	0	0.000	0	0.000
	Single Unit Long-Haul Truck	0	0.000	0	0.000
		NOx	**Nox**	**VOC**	**VOC**
Harris Co		**Total Emissions (g)**	**Total Emissions (tons)**	**Total Emissions (g)**	**Total Emissions (tons)**
	Light Commercial Truck	20,307	0.022	9,555	0.011
	Passenger Truck	1,667,890	1.835	885,168	0.974
	Single Unit Short-Haul Truck	33,312	0.037	5,830	0.006
	Single Unit Long-Haul Truck	39,517	0.043	5,291	0.006
		NOx	**Nox**	**VOC**	**VOC**
Waller Co		**Total Emissions (g)**	**Total Emissions (tons)**	**Total Emissions (g)**	**Total Emissions (tons)**
	Light Commercial Truck	0	0.000	0	0.000
	Passenger Truck	0	0.000	0	0.000
	Single Unit Short-Haul Truck	0	0.000	0	0.000
	Single Unit Long-Haul Truck	0	0.000	0	0.000

Truck Emissions - Station

DFW NAA		**NOx**	**VOC**
		Total Emissions (tons/yr)	**Total Emissions (tons/yr)**
	Truck (non-haul)	2.404	1.244
HGB NAA		**NOx**	**VOC**
		Total Emissions (tons/yr)	**Total Emissions (tons/yr)**
	Truck (non-haul)	1.937	0.996

HIGH SPEED RAIL PROJECT
DALLAS TO HOUSTON
CONSTRUCTION ANALYSIS
MATERIAL HAULING TRUCK EMISSIONS - TMF CONSTRUCTION

HSR Material Hauling

Data Taken from Project Descriptions or Provided
Estimated Values
Data Used in Calculations

Truck Emissions - TMF	**On-Road (Non-Haul) Trucks**		No Trucks Dal Co	No Trucks Ellis Co	No Trucks Harris Co	No Trucks Waller Co	Average R/T Distance HGB (miles)	Total Miles Per Year 2018-2021 Dallas Co	Total Miles Per Year 2018-2021 Ellis Co	Total Miles Per Year 2018-2021 Harris Co	Total Miles Per Year 2018-2021 Waller Co
		No. TMF in County	1	0	1	0					
Non-Haul Truck Category	Trucks	Total Number of Non-Haul Trucks									
Light Commercial Truck	Flatbed F350	3					**20**				
	Flat Bed F700	2									
	Total	**5**	**5**	**0**	**5**	**0**	Light Commercial Truck	**31,200**	**0**	**31,200**	**0**
Passenger Truck	Mechanics Truck (small)	1									
	Pick-up 1/2 Ton	8									
	Pick-up 3/4 Ton	8									
	Worker Trips	250									
	Total	**267**	**267**	**0**	**267**	**0**	Passenger Truck	**1,666,080**	**0**	**1,666,080**	**0**
Single-Unit Short Haul	Fuel Truck	1									
	Water Truck 4000 gal	1									
		2	**2**	**0**	**2**	**0**	Single-Unit Short Haul	**12,480**	**0**	**12,480**	**0**
Single-Unit Long Haul	Semi Tractor	2									
		2	**2**	**0**	**2**	**0**	Single-Unit Long Haul	**12,480**	**0**	**12,480**	**0**

Emission Rates	**Ellis Co**		**Ellis Co**		**Ellis Co**		
Truck Category	**2017 JAN**		**2017 JUL**		**2017 Composite Efs (g/mi)**		
	NOX	**VOC**	**NOX**	**VOC**		**NOX**	**VOC**
Passenger Truck	0.694	0.311	0.634	0.417	Passenger Truck	0.664	0.364
Light Commercial Truck	0.830	0.343	0.791	0.452	Light Commercial Truck	0.811	0.398
Single Unit Short-Haul Truck	3.208	0.491	2.564	0.526	Single Unit Short-Haul Truck	2.886	0.508
Single Unit Long-Haul Truck	3.573	0.423	2.878	0.429	Single Unit Long-Haul Truck	3.225	0.426

Emission Rates	**Dallas Co**		**Dallas Co**		**Dallas Co**		
Truck Category	**2017 JAN**		**2017 JUL**		**2017 Composite Efs (g/mi)**		
	NOX	**VOC**	**NOX**	**VOC**		**NOX**	**VOC**
Passenger Truck	0.678	0.298	0.614	0.389	Passenger Truck	0.646	0.343
Light Commercial Truck	0.815	0.330	0.771	0.424	Light Commercial Truck	0.793	0.377
Single Unit Short-Haul Truck	3.206	0.487	2.560	0.514	Single Unit Short-Haul Truck	2.883	0.501
Single Unit Long-Haul Truck	3.573	0.422	2.878	0.426	Single Unit Long-Haul Truck	3.225	0.424

Emission Rates	**Harris Co**		**Harris Co**		**Harris Co**		
Truck Category	**2017 JAN**		**2017 JUL**		**2017 Composite Efs (g/mi)**		
	NOX	**VOC**	**NOX**	**VOC**		**NOX**	**VOC**
Passenger Truck	0.539	0.244	0.495	0.305	Passenger Truck	0.517	0.274
Light Commercial Truck	0.666	0.274	0.636	0.338	Light Commercial Truck	0.651	0.306
Single Unit Short-Haul Truck	2.927	0.456	2.411	0.479	Single Unit Short-Haul Truck	2.669	0.467
Single Unit Long-Haul Truck	3.461	0.423	2.872	0.425	Single Unit Long-Haul Truck	3.166	0.424

Emission Rates	**Waller Co**		**Waller Co**		**Waller Co (g/mi)**		
Truck Category	**2017 JAN**		**2017 JUL**		**2017 Composite Efs**		
	NOX	**VOC**	**NOX**	**VOC**		**NOX**	**VOC**
Passenger Truck	0.864	0.383	0.782	0.461	Passenger Truck	0.823	0.422
Light Commercial Truck	0.977	0.408	0.916	0.488	Light Commercial Truck	0.946	0.448
Single Unit Short-Haul Truck	2.926	0.455	2.416	0.478	Single Unit Short-Haul Truck	2.671	0.467
Single Unit Long-Haul Truck	3.459	0.422	2.877	0.425	Single Unit Long-Haul Truck	3.168	0.424

		NOx Total Emissions (g)	**NOx Total Emissions (tons)**	**VOC Total Emissions (g)**	**VOC Total Emissions (tons)**
Dallas Co	Light Commercial Truck	24,738	0.027	11,761	0.013
	Passenger Truck	1,076,344	1.184	572,224	0.629
	Single Unit Short-Haul Truck	35,978	0.040	6,251	0.007
	Single Unit Long-Haul Truck	40,249	0.044	5,291	0.006
		NOx Total Emissions (g)	**Nox Total Emissions (tons)**	**VOC Total Emissions (g)**	**VOC Total Emissions (tons)**
Ellis Co	Light Commercial Truck	0	0.000	0	0.000
	Passenger Truck	0	0.000	0	0.000
	Single Unit Short-Haul Truck	0	0.000	0	0.000
	Single Unit Long-Haul Truck	0	0.000	0	0.000
		NOx Total Emissions (g)	**Nox Total Emissions (tons)**	**VOC Total Emissions (g)**	**VOC Total Emissions (tons)**
Harris Co	Light Commercial Truck	20,307	0.022	9,555	0.011
	Passenger Truck	861,367	0.948	457,137	0.503
	Single Unit Short-Haul Truck	33,312	0.037	5,830	0.006
	Single Unit Long-Haul Truck	39,517	0.043	5,291	0.006
		NOx Total Emissions (g)	**Nox Total Emissions (tons)**	**VOC Total Emissions (g)**	**VOC Total Emissions (tons)**
Waller Co	Light Commercial Truck	0	0.000	0	0.000
	Passenger Truck	0	0.000	0	0.000
	Single Unit Short-Haul Truck	0	0.000	0	0.000
	Single Unit Long-Haul Truck	0	0.000	0	0.000

Truck Emissions - TMF

		NOx Total Emissions (tons/yr)	**VOC Total Emissions (tons/yr)**
DFW NAA			
	Truck (non-haul)	1.295	0.655
HGB NAA			
	Truck (non-haul)	1.050	0.526

HIGH SPEED RAIL PROJECT
DALLAS TO HOUSTON
CONSTRUCTION ANALYSIS
MATERIAL HAULING TRUCK EMISSIONS - MOW CONSTRUCTION

HSR Material Hauling

Data Taken from Project Descriptions or Provided
Estimated Values
Data Used in Calculations

Truck Emissions - MOW	**On-Road (Non-Haul) Trucks**		No Trucks Dal Co	No Trucks Ellis Co	No Trucks Harris Co	No Trucks Waller Co	Average R/T Distance HGB (miles)	Total Miles Per Year 2020-2021 Dallas Co	Total Miles Per Year 2020-2021 Ellis Co	Total Miles Per Year 2020-2021 Harris Co	Total Miles Per Year 2020-2021 Waller Co
		No. MOW Facilities in County	1	1	1	1					
Non-Haul Truck Category	Trucks	Total Number of Non-Haul Trucks									
Light Commercial Truck	Flatbed F350	2					**20**				
	Flat Bed F700	1									
	Total	**3**	**3**	**3**	**3**	**3**	Light Commercial Truck	**18,720**	**18,720**	**18,720**	**18,720**
Passenger Truck	Mechanics Truck (small)	1									
	Pick-up 1/2 Ton	4									
	Pick-up 3/4 Ton	4									
	Worker Trips	250									
	Total	**259**	**259**	**259**	**259**	**259**	Passenger Truck	**1,616,160**	**1,616,160**	**1,616,160**	**1,616,160**
Single-Unit Short Haul	Fuel Truck	1									
	Water Truck 4000 gal	1									
		2	**2**	**2**	**2**	**2**	Single-Unit Short Haul	**12,480**	**12,480**	**12,480**	**12,480**
Single-Unit Long Haul	Semi Tractor	1									
		1	**1**	**1**	**1**	**1**	Single-Unit Long Haul	**6,240**	**6,240**	**6,240**	**6,240**

Assumptions:
Trucks operate six days per week, 52 weeks per year

Emission Rates	**Ellis Co**			**Ellis Co**		**Ellis Co**	
Truck Category	**2017 JAN**			**2017 JUL**		**2017 Composite Efs (g/mi)**	
	NOX	**VOC**	**NOX**	**VOC**		**NOX**	**VOC**
Passenger Truck	0.694	0.311	0.634	0.417	Passenger Truck	0.664	0.364
Light Commercial Truck	0.830	0.343	0.791	0.452	Light Commercial Truck	0.811	0.398
Single Unit Short-Haul Truck	3.208	0.491	2.564	0.526	Single Unit Short-Haul Truck	2.886	0.508
Single Unit Long-Haul Truck	3.573	0.423	2.878	0.429	Single Unit Long-Haul Truck	3.225	0.426

Emission Rates	**Dallas Co**		**Dallas Co**		**Dallas Co**		
Truck Category	**2017 JAN**		**2017 JUL**		**2017 Composite Efs (g/mi)**		
	NOX	**VOC**	**NOX**	**VOC**		**NOX**	**VOC**
Passenger Truck	0.678	0.298	0.614	0.389	Passenger Truck	0.646	0.343
Light Commercial Truck	0.815	0.330	0.771	0.424	Light Commercial Truck	0.793	0.377
Single Unit Short-Haul Truck	3.206	0.487	2.560	0.514	Single Unit Short-Haul Truck	2.883	0.501
Single Unit Long-Haul Truck	3.573	0.422	2.878	0.426	Single Unit Long-Haul Truck	3.225	0.424

Emission Rates	**Harris Co**		**Harris Co**		**Harris Co**		
Truck Category	**2017 JAN**		**2017 JUL**		**2017 Composite Efs (g/mi)**		
	NOX	**VOC**	**NOX**	**VOC**		**NOX**	**VOC**
Passenger Truck	0.539	0.244	0.495	0.305	Passenger Truck	0.517	0.274
Light Commercial Truck	0.666	0.274	0.636	0.338	Light Commercial Truck	0.651	0.306
Single Unit Short-Haul Truck	2.927	0.456	2.411	0.479	Single Unit Short-Haul Truck	2.669	0.467
Single Unit Long-Haul Truck	3.461	0.423	2.872	0.425	Single Unit Long-Haul Truck	3.166	0.424

Emission Rates	**Waller Co**		**Waller Co**		**Waller Co (g/mi)**		
Truck Category	**2017 JAN**		**2017 JUL**		**2017 Composite Efs**		
	NOX	**VOC**	**NOX**	**VOC**		**NOX**	**VOC**
Passenger Truck	0.864	0.383	0.782	0.461	Passenger Truck	0.823	0.422
Light Commercial Truck	0.977	0.408	0.916	0.488	Light Commercial Truck	0.946	0.448
Single Unit Short-Haul Truck	2.926	0.455	2.416	0.478	Single Unit Short-Haul Truck	2.671	0.467
Single Unit Long-Haul Truck	3.459	0.422	2.877	0.425	Single Unit Long-Haul Truck	3.168	0.424

		NOx	**NOx**	**VOC**	**VOC**
Dallas Co		**Total Emissions (g)**	**Total Emissions (tons)**	**Total Emissions (g)**	**Total Emissions (tons)**
	Light Commercial Truck	14,843	0.016	7,057	0.008
	Passenger Truck	1,044,094	1.149	555,079	0.611
	Single Unit Short-Haul Truck	35,978	0.040	6,251	0.007
	Single Unit Long-Haul Truck	20,125	0.022	2,646	0.003
		NOx	**Nox**	**VOC**	**VOC**
Ellis Co		**Total Emissions (g)**	**Total Emissions (tons)**	**Total Emissions (g)**	**Total Emissions (tons)**
	Light Commercial Truck	15,175	0.017	7,444	0.008
	Passenger Truck	1,073,578	1.181	587,957	0.647
	Single Unit Short-Haul Truck	36,013	0.040	6,342	0.007
	Single Unit Long-Haul Truck	20,127	0.022	2,660	0.003
		NOx	**Nox**	**VOC**	**VOC**
Harris Co		**Total Emissions (g)**	**Total Emissions (tons)**	**Total Emissions (g)**	**Total Emissions (tons)**
	Light Commercial Truck	12,184	0.013	5,733	0.006
	Passenger Truck	835,558	0.919	443,440	0.488
	Single Unit Short-Haul Truck	33,312	0.037	5,830	0.006
	Single Unit Long-Haul Truck	19,758	0.022	2,646	0.003
		NOx	**Nox**	**VOC**	**VOC**
Waller Co		**Total Emissions (g)**	**Total Emissions (tons)**	**Total Emissions (g)**	**Total Emissions (tons)**
	Light Commercial Truck	17,713	0.019	8,383	0.009
	Passenger Truck	1,329,880	1.463	682,119	0.750
	Single Unit Short-Haul Truck	33,329	0.037	5,827	0.006
	Single Unit Long-Haul Truck	19,768	0.022	2,645	0.003

Truck Emissions - MOW

DFW NAA		**NOx**	**VOC**
		Total Emissions (tons/yr)	**Total Emissions (tons/yr)**
	Truck (non-haul)	2.486	1.293
HGB NAA		**NOx**	**VOC**
		Total Emissions (tons/yr)	**Total Emissions (tons/yr)**
	Truck (non-haul)	2.532	1.272

Houston Rail Project
Construction Emissions - Non-Road Engines (Stations)

Description	Equipment category based on NONROAD classification	SCC [1]	Fuel Type	Engine Technology Type	Equipment HP	Number of Equipment	Total Days	Total Weeks	Total Months	Usage Rate	Hours per Week per Engine	Total Working hrs
Cat 416 Comb BH/LDR	Tractor/Loader/Backhoe	2270002066	Diesel	T3	70	0		52		0	58	0
Cat 436 Comb BH/LDR	Tractor/Loader/Backhoe	2270002066	Diesel	T3	90	4		52		0.4	58	4,826
Cat 446 Comb BH/LDR	Tractor/Loader/Backhoe	2270002066	Diesel	T3	105	2		52		0.4	58	2,413
Cat D3	Crawler Tractor	2270002069	Diesel	T3	70	4		52		0.4	58	4,826
Cat D6N	Crawler Tractor	2270002069	Diesel	T3	165	2		52		0.4	58	2,413
Cat 320BL Backhoe	Excavators	2270002036	Diesel	T3	135	4		52		0.5	58	6,032
Cat 325BL Backhoe	Excavators	2270002036	Diesel	T3	180	2		52		0.5	58	3,016
Cat 330BL Backhoe	Excavators	2270002036	Diesel	T3	240	4		52		0.5	58	6,032
Cat 345BL Backhoe	Excavators	2270002036	Diesel	T3	290	0		52		0	58	0
Cat 365BL Backhoe	Excavators	2270002036	Diesel	T3	410	0		52		0	58	0
Cat 140G Grader	Graders	2270002048	Diesel	T3	150	3		52		0.25	58	2,262
60Ton R/T Crane	Cranes	2270002045	Diesel	T3	250	1		52		0.1	58	302
80Ton RT Crane	Cranes	2270002045	Diesel	T3	300	1		52		0.1	58	302
110 Ton Crawler Crane	Cranes	2270002045	Diesel	T3	330	1		52		0.1	58	302
150 Ton Crawler Crane	Cranes	2270002045	Diesel	T3	350	1		52		0.1	58	302
200-Ton LS248 / 14000 Crawler	Cranes	2270002045	Diesel	T3	400	1		52		0.1	58	302
230 Ton Crawler Crane / 888	Cranes	2270002045	Diesel	T3	400	0		52		0	58	0
275 Ton Crawler Crane / 999	Cranes	2270002045	Diesel	T3	450	0		52		0	58	0
300 Ton Crawler Crane	Cranes	2270002045	Diesel	T3	450	1		52		0.1	58	302
VME L120B Wheel Loader	Rubber Tire Loaders	2270002060	Diesel	T3	210	1		52		0.5	58	1,508
VME L90C Wheel Loader	Rubber Tire Loaders	2270002060	Diesel	T3	160	4		52		0.4	58	4,826
Bobcat 743	Skid Steer Loaders	2270002072	Diesel	T3	40	1		52		0.5	58	1,508
120' Aerial Lift	Aerial Lifts	2270003010	Diesel	T3	75	1		52		0.2	58	603
30' Aerial Lift	Aerial Lifts	2270003010	Diesel	T3	50	1		52		0.2	58	603
60' Aerial Lift	Aerial Lifts	2270003010	Diesel	T3	65	4		52		0.2	58	2,413
80' Aerial Lift	Aerial Lifts	2270003010	Diesel	T3	65	1		52		0.2	58	603
350HP VIB HMR/EXT I416	Generator Sets (powering pile driver)	2270006005	Diesel	T3	350	2		52		0.1	58	603
Cat 433 CS Roller	Roller	2270002015	Diesel	T3	105	2		52		0.25	58	1,508
Cat 563 -CS (84" Smooth Drum)	Roller	2270002015	Diesel	T3	145	2		52		0.25	58	1,508
Cat 563 -CP (84" Padfoot)	Roller	2270002015	Diesel	T3	145	2		52		0.25	58	1,508
PS 130Pneumatic Compactor	Roller	2270002015	Diesel	T3	230	1		52		0.4	58	1,206
Cat RM 500 Reclaimer	Paving Equipment	2270002021	Diesel	T3	450	0		52		0	58	0
Air Compressors	Air Compressor	2270006015	Diesel	T3	75	6		52		0.6	58	10,858
Generators	Generator Sets	2270006005	Diesel	T3	5	4		52		0.6	58	7,238
Grout Pump	Pumps	2270006010	Diesel	T3	15	5		52		0.6	58	9,048
Walk behind roller	Rollers	2270002015	Diesel	T3	7	3		52		0.6	58	5,429
Small Vac Sweeper	Sweepers	2270003030	Diesel	T3	150	2		52		0.6	58	3,619
All Welders	Welders	2270006025	Diesel	T3	50	2		52		0.6	58	3,619
Bidwell Deck Finishers	Paving Equipment	2270002021	Diesel	T3	50	0		52		0	58	0

Houston Rail Project

Construction Emissions - Non-Road Engines (Track)

Description	Equipment category based on NONROAD classification	SCC [1]	Fuel Type	Engine Technology Type	Equipment HP	Number of Equipment	Total Days	Total Weeks	Total Months	Usage Rate	Hours per Week per Engine	Total Working hrs
Cat 416 Comb BH/LDR	Tractor/Loader/Backhoe	2270002066	Diesel	T3	70	2		52		0.4	58	2,413
Cat 436 Comb BH/LDR	Tractor/Loader/Backhoe	2270002066	Diesel	T3	90	18		52		0.4	58	21,715
Cat 446 Comb BH/LDR	Tractor/Loader/Backhoe	2270002066	Diesel	T3	105	4		52		0.4	58	4,826
Cat D3	Crawler Tractor	2270002069	Diesel	T3	70	16		52		0.4	58	19,302
Cat D6N	Crawler Tractor	2270002069	Diesel	T3	165	7		52		0.4	58	8,445
Cat 320BL Backhoe	Excavators	2270002036	Diesel	T3	135	25		52		0.5	58	37,700
Cat 325BL Backhoe	Excavators	2270002036	Diesel	T3	180	8		52		0.5	58	12,064
Cat 330BL Backhoe	Excavators	2270002036	Diesel	T3	240	27		52		0.5	58	40,716
Cat 345BL Backhoe	Excavators	2270002036	Diesel	T3	290	0		52		0	58	0
Cat 365BL Backhoe	Excavators	2270002036	Diesel	T3	410	0		52		0	58	0
Cat 140G Grader	Graders	2270002048	Diesel	T3	150	12		52		0.25	58	9,048
60Ton R/T Crane	Cranes	2270002045	Diesel	T3	250	4		52		0.1	58	1,206
80Ton RT Crane	Cranes	2270002045	Diesel	T3	300	1		52		0.1	58	302
110 Ton Crawler Crane	Cranes	2270002045	Diesel	T3	330	1		52		0.1	58	302
150 Ton Crawler Crane	Cranes	2270002045	Diesel	T3	350	3		52		0.1	58	905
200-Ton LS248 / 14000 Crawler	Cranes	2270002045	Diesel	T3	400	2		52		0.1	58	603
230 Ton Crawler Crane / 888	Cranes	2270002045	Diesel	T3	400	1		52		0.1	58	302
275 Ton Crawler Crane / 999	Cranes	2270002045	Diesel	T3	450	0		52		0	58	0
300 Ton Crawler Crane	Cranes	2270002045	Diesel	T3	450	1		52		0.1	58	302
VME L120B Wheel Loader	Rubber Tire Loaders	2270002060	Diesel	T3	210	3		52		0.5	58	4,524
VME L90C Wheel Loader	Rubber Tire Loaders	2270002060	Diesel	T3	160	42		52		0.4	58	50,669
Bobcat 743	Skid Steer Loaders	2270002072	Diesel	T3	40	2		52		0.5	58	3,016
120' Aerial Lift	Aerial Lifts	2270003010	Diesel	T3	75	5		52		0.2	58	3,016
30' Aerial Lift	Aerial Lifts	2270003010	Diesel	T3	50	6		52		0.2	58	3,619
60' Aerial Lift	Aerial Lifts	2270003010	Diesel	T3	65	22		52		0.2	58	13,270
80' Aerial Lift	Aerial Lifts	2270003010	Diesel	T3	65	6		52		0.2	58	3,619
350HP VIB HMR/EXT I416	Generator Sets (powering pile driver)	2270006005	Diesel	T3	350	1		52		0.1	58	302
Cat 433 CS Roller	Roller	2270002015	Diesel	T3	105	6		52		0.25	58	4,524
Cat 563 -CS (84" Smooth Drum)	Roller	2270002015	Diesel	T3	145	5		52		0.25	58	3,770
Cat 563 -CP (84" Padfoot)	Roller	2270002015	Diesel	T3	145	7		52		0.25	58	5,278
PS 130Pneumatic Compactor	Roller	2270002015	Diesel	T3	230	3		52		0.4	58	3,619
Cat RM 500 Reclaimer	Paving Equipment	2270002021	Diesel	T3	450	2		52		0.1	58	603
Air Compressors	Air Compressor	2270006015	Diesel	T3	75	21		52		0.6	58	38,002
Generators	Generator Sets	2270006005	Diesel	T3	5	24		52		0.6	58	43,430
Grout Pump	Pumps	2270006010	Diesel	T3	15	13		52		0.6	58	23,525
Walk behind roller	Rollers	2270002015	Diesel	T3	7	12		52		0.6	58	21,715
Small Vac Sweeper	Sweepers	2270003030	Diesel	T3	150	24		52		0.6	58	43,430
All Welders	Welders	2270006025	Diesel	T3	50	12		52		0.6	58	21,715
Bidwell Deck Finishers	Paving Equipment	2270002021	Diesel	T3	50	1		52		0.1	58	302

HSR Rail Project
TMF Construction Emissions - Non-Road Engines

Description	Equipment category based on NONROAD classification	SCC [1]	Fuel Type	Engine Technology Type	Equipment HP	Number of Equipment	Total Days	Total Weeks	Total Months	Usage Rate	Hours per Week per Engine	Total Working hrs
Cat 416 Comb BH/LDR	Tractor/Loader/Backhoe	2270002066	Diesel	T3	70	0		52		0	58	0
Cat 436 Comb BH/LDR	Tractor/Loader/Backhoe	2270002066	Diesel	T3	90	4		52		0.4	58	4,826
Cat 446 Comb BH/LDR	Tractor/Loader/Backhoe	2270002066	Diesel	T3	105	2		52		0.4	58	2,413
Cat D3	Crawler Tractor	2270002069	Diesel	T3	70	4		52		0.4	58	4,826
Cat D6N	Crawler Tractor	2270002069	Diesel	T3	165	2		52		0.4	58	2,413
Cat 320BL Backhoe	Excavators	2270002036	Diesel	T3	135	4		52		0.5	58	6,032
Cat 325BL Backhoe	Excavators	2270002036	Diesel	T3	180	2		52		0.5	58	3,016
Cat 330BL Backhoe	Excavators	2270002036	Diesel	T3	240	4		52		0.5	58	6,032
Cat 345BL Backhoe	Excavators	2270002036	Diesel	T3	290	0		52		0	58	0
Cat 365BL Backhoe	Excavators	2270002036	Diesel	T3	410	0		52		0	58	0
Cat 140G Grader	Graders	2270002048	Diesel	T3	150	3		52		0.25	58	2,262
60Ton R/T Crane	Cranes	2270002045	Diesel	T3	250	1		52		0.1	58	302
80Ton RT Crane	Cranes	2270002045	Diesel	T3	300	1		52		0.1	58	302
110 Ton Crawler Crane	Cranes	2270002045	Diesel	T3	330	1		52		0.1	58	302
150 Ton Crawler Crane	Cranes	2270002045	Diesel	T3	350	1		52		0.1	58	302
200-Ton LS248 / 14000 Crawler	Cranes	2270002045	Diesel	T3	400	1		52		0.1	58	302
230 Ton Crawler Crane / 888	Cranes	2270002045	Diesel	T3	400	0		52		0	58	0
275 Ton Crawler Crane / 999	Cranes	2270002045	Diesel	T3	450	0		52		0	58	0
300 Ton Crawler Crane	Cranes	2270002045	Diesel	T3	450	1		52		0.1	58	302
VME L120B Wheel Loader	Rubber Tire Loaders	2270002060	Diesel	T3	210	1		52		0.5	58	1,508
VME L90C Wheel Loader	Rubber Tire Loaders	2270002060	Diesel	T3	160	4		52		0.4	58	4,826
Bobcat 743	Skid Steer Loaders	2270002072	Diesel	T3	40	1		52		0.5	58	1,508
120' Aerial Lift	Aerial Lifts	2270003010	Diesel	T3	75	1		52		0.2	58	603
30' Aerial Lift	Aerial Lifts	2270003010	Diesel	T3	50	1		52		0.2	58	603
60' Aerial Lift	Aerial Lifts	2270003010	Diesel	T3	65	4		52		0.2	58	2,413
80' Aerial Lift	Aerial Lifts	2270003010	Diesel	T3	65	1		52		0.2	58	603
350HP VIB HMR/EXT I416	Generator Sets (powering pile driver)	2270006005	Diesel	T3	350	2		52		0.1	58	603
Cat 433 CS Roller	Roller	2270002015	Diesel	T3	105	2		52		0.25	58	1,508
Cat 563 -CS (84" Smooth Drum)	Roller	2270002015	Diesel	T3	145	2		52		0.25	58	1,508
Cat 563 -CP (84" Padfoot)	Roller	2270002015	Diesel	T3	145	2		52		0.25	58	1,508
PS 130Pneumatic Compactor	Roller	2270002015	Diesel	T3	230	1		52		0.4	58	1,206
Cat RM 500 Reclaimer	Paving Equipment	2270002021	Diesel	T3	450	0		52		0	58	0
Air Compressors	Air Compressor	2270006015	Diesel	T3	75	6		52		0.6	58	10,858
Generators	Generator Sets	2270006005	Diesel	T3	5	4		52		0.6	58	7,238
Grout Pump	Pumps	2270006010	Diesel	T3	15	5		52		0.6	58	9,048
Walk behind roller	Rollers	2270002015	Diesel	T3	7	3		52		0.6	58	5,429
Small Vac Sweeper	Sweepers	2270003030	Diesel	T3	150	2		52		0.6	58	3,619
All Welders	Welders	2270006025	Diesel	T3	50	2		52		0.6	58	3,619
Bidwell Deck Finishers	Paving Equipment	2270002021	Diesel	T3	50	0		52		0	58	0

HSR Rail Project

MOW Construction Emissions - Non-Road Engines

Description	Equipment category based on NONROAD classification	SCC [1]	Fuel Type	Engine Technology Type	Equipment HP	Number of Equipment	Total Days	Total Weeks	Total Months	Usage Rate	Hours per Week per Engine	Total Working hrs
Cat 416 Comb BH/LDR	Tractor/Loader/Backhoe	2270002066	Diesel	T3	70	0		52		0	58	0
Cat 436 Comb BH/LDR	Tractor/Loader/Backhoe	2270002066	Diesel	T3	90	2		52		0.4	58	2,413
Cat 446 Comb BH/LDR	Tractor/Loader/Backhoe	2270002066	Diesel	T3	105	1		52		0.4	58	1,206
Cat D3	Crawler Tractor	2270002069	Diesel	T3	70	2		52		0.4	58	2,413
Cat D6N	Crawler Tractor	2270002069	Diesel	T3	165	1		52		0.4	58	1,206
Cat 320BL Backhoe	Excavators	2270002036	Diesel	T3	135	2		52		0.5	58	3,016
Cat 325BL Backhoe	Excavators	2270002036	Diesel	T3	180	1		52		0.5	58	1,508
Cat 330BL Backhoe	Excavators	2270002036	Diesel	T3	240	2		52		0.5	58	3,016
Cat 345BL Backhoe	Excavators	2270002036	Diesel	T3	290	0		52		0	58	0
Cat 365BL Backhoe	Excavators	2270002036	Diesel	T3	410	0		52		0	58	0
Cat 140G Grader	Graders	2270002048	Diesel	T3	150	2		52		0.25	58	1,508
60Ton R/T Crane	Cranes	2270002045	Diesel	T3	250	1		52		0.1	58	302
80Ton RT Crane	Cranes	2270002045	Diesel	T3	300	1		52		0.1	58	302
110 Ton Crawler Crane	Cranes	2270002045	Diesel	T3	330	1		52		0.1	58	302
150 Ton Crawler Crane	Cranes	2270002045	Diesel	T3	350	1		52		0.1	58	302
200-Ton LS248 / 14000 Crawler	Cranes	2270002045	Diesel	T3	400	1		52		0.1	58	302
230 Ton Crawler Crane / 888	Cranes	2270002045	Diesel	T3	400	0		52		0	58	0
275 Ton Crawler Crane / 999	Cranes	2270002045	Diesel	T3	450	0		52		0	58	0
300 Ton Crawler Crane	Cranes	2270002045	Diesel	T3	450	1		52		0.1	58	302
VME L120B Wheel Loader	Rubber Tire Loaders	2270002060	Diesel	T3	210	1		52		0.5	58	1,508
VME L90C Wheel Loader	Rubber Tire Loaders	2270002060	Diesel	T3	160	2		52		0.4	58	2,413
Bobcat 743	Skid Steer Loaders	2270002072	Diesel	T3	40	1		52		0.5	58	1,508
120' Aerial Lift	Aerial Lifts	2270003010	Diesel	T3	75	1		52		0.2	58	603
30' Aerial Lift	Aerial Lifts	2270003010	Diesel	T3	50	1		52		0.2	58	603
60' Aerial Lift	Aerial Lifts	2270003010	Diesel	T3	65	2		52		0.2	58	1,206
80' Aerial Lift	Aerial Lifts	2270003010	Diesel	T3	65	1		52		0.2	58	603
350HP VIB HMR/EXT I416	Generator Sets (powering pile driver)	2270006005	Diesel	T3	350	1		52		0.1	58	302
Cat 433 CS Roller	Roller	2270002015	Diesel	T3	105	1		52		0.25	58	754
Cat 563 -CS (84" Smooth Drum)	Roller	2270002015	Diesel	T3	145	1		52		0.25	58	754
Cat 563 -CP (84" Padfoot)	Roller	2270002015	Diesel	T3	145	1		52		0.25	58	754
PS 130Pneumatic Compactor	Roller	2270002015	Diesel	T3	230	1		52		0.4	58	1,206
Cat RM 500 Reclaimer	Paving Equipment	2270002021	Diesel	T3	450	0		52		0	58	0
Air Compressors	Air Compressor	2270006015	Diesel	T3	75	3		52		0.6	58	5,429
Generators	Generator Sets	2270006005	Diesel	T3	5	2		52		0.6	58	3,619
Grout Pump	Pumps	2270006010	Diesel	T3	15	3		52		0.6	58	5,429
Walk behind roller	Rollers	2270002015	Diesel	T3	7	2		52		0.6	58	3,619
Small Vac Sweeper	Sweepers	2270003030	Diesel	T3	150	1		52		0.6	58	1,810
All Welders	Welders	2270006025	Diesel	T3	50	1		52		0.6	58	1,810
Bidwell Deck Finishers	Paving Equipment	2270002021	Diesel	T3	50	0		52		0	58	0

HSR Rail Project

Construction Emissions Summary - Track

Total Construction Emissions (Entire Project)

	VOC (tons)	CO (tons)	PM10 (tons)	PM2.5 (tons)	SO2 (tons)	NOx (tons)	GHG - CO2e (tons)	GHG - CO2e (metric tons)
Non-Road Year 1	6.52	49.68	11.80	11.45	0.142	79.55	15,686.38	14,230.44
Non-Road Year 2	6.52	49.68	11.80	11.45	0.142	79.55	15,686.38	14,230.44
Non-Road Year 3	6.52	49.68	11.80	11.45	0.142	79.55	15,686.38	14,230.44
Non-Road Year 4	6.52	49.68	11.80	11.45	0.142	79.55	15,686.38	14,230.44
Total Project	**26.09**	**198.71**	**47.22**	**45.80**	**0.57**	**318.22**	**62,745.52**	**56,921.78**

Dallas-Fort Worth Ozone Nonattainment Area (Dallas and Ellis Counties) Construction Emissions

	VOC (tons)	CO (tons)	PM10 (tons)	PM2.5 (tons)	SO2 (tons)	NOx (tons)	GHG - CO2e (tons)
Non-Road Year 1	1.24	9.42	2.24	2.17	0.027	15.08	2,973.44
Non-Road Year 2	1.24	9.42	2.24	2.17	0.027	15.08	2,973.44
Non-Road Year 3	1.24	9.42	2.24	2.17	0.027	15.08	2,973.44
Non-Road Year 4	1.24	9.42	2.24	2.17	0.027	15.08	2,973.44
Total Project (DFW)	**4.95**	**37.67**	**8.95**	**8.68**	**0.11**	**60.32**	**11,893.77**

Houston-Galveston-Brazoria Ozone Nonattainment Area (Harris and Waller Counties) Construction Emissions

	VOC (tons)	CO (tons)	PM10 (tons)	PM2.5 (tons)	SO2 (tons)	NOx (tons)	GHG - CO2e (tons)
Non-Road Year 1	1.32	10.06	2.39	2.32	0.029	16.10	3,175.14
Non-Road Year 2	1.32	10.06	2.39	2.32	0.029	16.10	3,175.14
Non-Road Year 3	1.32	10.06	2.39	2.32	0.029	16.10	3,175.14
Non-Road Year 4	1.32	10.06	2.39	2.32	0.029	16.10	3,175.14
Total Project (HGB)	**5.28**	**40.22**	**9.56**	**9.27**	**0.12**	**64.41**	**12,700.57**

Note: 48-month construction schedule.

HSR Rail Project
Construction Emissions Summary - Station

Total Construction Emissions (per Station)

	VOC (tons)	CO (tons)	PM10 (tons)	PM2.5 (tons)	SO2 (tons)	NOx (tons)	GHG - CO2e (tons)	GHG - CO2e (metric tons)
Non-Road Year 1	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0.00
Non-Road Year 2	0.63	4.83	1.09	1.05	0.013	7.57	1,460.66	1,325.09
Non-Road Year 3	1.26	9.66	2.17	2.11	0.026	15.14	2,921.33	2,650.18
Non-Road Year 4	1.26	9.66	2.17	2.11	0.026	15.14	2,921.33	2,650.18
Total Project	**3.14**	**24.16**	**5.43**	**5.27**	**0.07**	**37.84**	**7,303.32**	**6,625.46**

Note: 30-month construction schedule.

HSR Rail Project
Construction Emissions Summary - TMF

Total Construction Emissions (Per TMF Facility)

	VOC (tons)	CO (tons)	PM10 (tons)	PM2.5 (tons)	SO2 (tons)	NOx (tons)	GHG - CO2e (tons)	GHG - CO2e (metric tons)
Non-Road Year 1	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0.00
Non-Road Year 2	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0.00
Non-Road Year 3	1.26	9.66	2.17	2.11	0.026	15.14	2,921.33	2,650.18
Non-Road Year 4	1.26	9.66	2.17	2.11	0.026	15.14	2,921.33	2,650.18
Total Project	**2.51**	**19.32**	**4.35**	**4.22**	**0.05**	**30.27**	**5,842.65**	**5,300.37**

Note: 24-month construction schedule.

HSR Rail Project

Construction Emissions Summary - MOW

Total Construction Emissions (per MOW Facility)

	VOC (tons)	**CO (tons)**	**PM10 (tons)**	**PM2.5 (tons)**	**SO2 (tons)**	**NOx (tons)**	**GHG - CO2e (tons)**	**GHG - CO2e (metric tons)**
Non-Road Year 1	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0.00
Non-Road Year 2	0.00	0.00	0.00	0.00	0.000	0.00	0.00	0.00
Non-Road Year 3	0.36	2.72	0.61	0.59	0.008	4.34	843.38	765.10
Non-Road Year 4	0.72	5.44	1.22	1.19	0.015	8.68	1,686.75	1,530.20
Total Project	**1.08**	**8.16**	**1.83**	**1.78**	**0.02**	**13.03**	**2,530.13**	2,295.29

Notes: One MOW each located in Dallas, Ellis, Waller, and Harris Counties.
18-Month construction schedule.

HIGH SPEED RAIL PROJECT
DALLAS TO HOUSTON
CONSTRUCTION ANALYSIS
MATERIAL HAULING LOCOMOTIVE GHG EMISSIONS

HSR Material Hauling - Locomotive

Data Taken from Project Descriptions or Provided
Estimated Values
Data Used in Calculations

HSR Annual Material Hauling by Rail								
HSR Alternative C Construction by Rail per year								
Source Geography	**Material Hauled**	**Total Quantity[1]**	**Units**	**Total Quantity**	**Units**	**Possible Material Location**	**Average Distance Traveled**	**Duration (Years)**
HGB Rail Connection	Sub-Ballast	248,479	cy	521,805	tons	C. Texas	241.09	4
HGB Rail Connection	Ballast	584,591	cy	1,227,642	tons	C. Texas	241.09	4
	Sand			393,085	tons	C. Texas	241.09	4
	Gravel			433,749	tons	C. Texas	241.09	4
	Cement			165,638	tons	C. Texas	241.09	4
	Steel Reinforcing			271,093	tons	Out of State	241.09	3
	Steel Structural			1,683	tons	Out of State	241.09	3
	Rail			14,679	tons	Out of State	241.09	4
Total Alignment Length - (mi)		241.09						
DFW NAA Alignment Length (mi)		45.7	18.96%					
HGB NAA Alignment Length (mi)		48.8	20.24%					
Freestone County SO2 NAA Alignment Length (mi)		0	0.00%					
Total Sub-Ballast (cy - total 4 yrs)		993,914						
Total Ballast (cy - total 4 yrs)		2,338,365						
Total Sand (tons - total 4 yrs)		1,572,340						
Total Gravel (tons - total 4 yrs)		1,734,996						
Total Cement (tons - total 4 yrs)		662,552						
Total Reinforing Steel (tons - total 3 yrs)		1,084,372						
Total Structural Steel (tons - total 3 yrs)		6,732						
Total Rail (tons - total 4 yrs)		58,715						

Notes:

(1) Total quantities was obtained from Construction Quantities and Construction Equipment list.

(2) Distance travelled by rail calculated for length of Alt. C alignment.

(3) Density of ballast and sub-ballast was assumed to be 2.1 tons/cubic yard (based on California HSR calculations)

(4) Total rail = 2,795,962 TF. Weight of rail (UIC60 rail) is 42 lbs/ft (Source: http//www.railway-technical.com/track.shtml)

HSR Alternative C Construction Rail Hauling - Total Quantities (tons)							
Material		**(2018-2021)**					
Sub-Ballast		521,805					
Ballast		1,227,642					
Sand		393,085					
Gravel		433,749					
Cement		165,638					
Steel Reinforcing		271,093					
Steel Structural		1,683					
Rail		14,679					
Emission Factors - Rail (g/gal)[1]							
	VOC	CO	NOx	SO2	PM10	PM2.5	CO2
2018	5.408	26.624	102.96	0.094	3.744	3.63168	10217
Emission Factors - Rail (g/ton-mile)[2]							
	VOC	CO	NOx	SO2	PM10	PM2.5	CO2
2018	0.011	0.056	0.218	0.0002	0.008	0.008	21.6

Notes

(1) Emission factors based on Tier 2 line-haul locomotive emission factors as listed in the EPA Report "Emission Factors for Locomotives - Large Line Haul", USEPA Office of Transportation and Air Quality, EPA-420-F-09-025, April 2009. Grams per gal calculations based on a 20.8 bhp-hr/gal conversion factor as listed in the same EPA report.

(2) The conversion factor of 473 ton-mile/gallon based on the report by the American Association of Railroads "The Environmental Benefits of Moving Freight by Rail, April 2016.

(3) 2018 was assumed to be the most conservative year, so rail emission factors in 2018 were used for all years.

(4) for DFW: Assume 50% to Dallas rail connection, 50% to Ellis Co. rail connection

HSR Alternative C Construction Rail Hauling Emissions per Year											
			VOC ER	**VOC**	**VOC**	**NOx ER**	**NOx**	**NOx**	**CO2 ER**	**CO2**	**CO2**
	tons	**miles**	**g/ton-mile**	**g/yr**	**tons/yr**	**g/ton-mile**	**g/yr**	**tons/yr**	**g/ton-mile**	**g/yr**	**tons/yr**
Sub-Ballast	521,805	241.09	0.011	1,438,344	1.585	0.218	27,383,862	30.185	21.6	2,717,374,909	2,995.4
Ballast	1,227,642	241.09	0.011	3,383,969	3.730	0.218	64,425,559	71.016	21.6	6,393,122,925	7,047.1
Sand	393,085	241.09	0.011	1,083,531	1.194	0.218	20,628,757	22.739	21.6	2,047,047,505	2,256.5
Gravel	433,749	241.09	0.011	1,195,620	1.318	0.218	22,762,768	25.091	21.6	2,258,811,219	2,489.9
Cement	165,638	241.09	0.011	456,578	0.503	0.218	8,692,537	9.582	21.6	862,584,058	950.8
Steel Reinforcing	271,093	241.09	0.011	747,262	0.824	0.218	14,226,724	15.682	21.6	1,411,756,361	1,556.2
Steel Structural	1,683	241.09	0.011	4,639	0.005	0.218	88,322	0.097	21.6	8,764,468	9.7
Rail	14,679	241.09	0.011	40,462	0.045	0.218	770,331	0.849	21.6	76,441,996	84.3
					9.205			175.242			17,389.778
	Totals (tons)										
VOC	9.20										
NOx	175.24			**Totals (metric tons)**							
CO2	17,390	CO2	15,776								

Notes:

1) pounds per gram = 0.0022046

2) tons per pound = 0.0005

HIGH SPEED RAIL PROJECT
DALLAS TO HOUSTON
CONSTRUCTION ANALYSIS
MATERIAL HAULING TRUCK GHG EMISSIONS

HSR Material Hauling

Data Taken from Project Descriptions or Provided

Estimated Values

Data Used in Calculations

Truck Capacity

20 cy/truck

30 tons/truck

Material Hauled	Total Quantity[1]	Units	Possible Origin Location	Duration of Activity (years)
From RR Connection / Precast Yard				
Sub-Ballast	993,914	CY	from rail connection yard	4
Ballast	2,338,365	CY	from rail connection yard	4
Concrete Rail Ties	1,397,981	Each	batch plant to construction site	4
Total Concrete	8,674,980	CY	batch plant to construction site	4
Rail	2,795,962	TF	Out of state	4
Excavation	7,541,885	CY	within alignment	4
Fill	25,425,626	CY	within alignment	4
Structural Steel	6,732	Ton	from rail connection yard	3
Reinforcing Steel	1,084,372	Ton	from rail connection yard	3
Construction Waste - Concrete	59,457	CY	within alignment	4
Construction Waste - Rebar	16,266	Ton	within alignment	4
To Precast Yard[2]				
Sand	1,572,340	Ton	Texas	4
Cement	662,552	Ton	Texas	4
Gravel	1,734,996	Ton	Texas	4

Notes:

(1) Information about total quantities was obtained from HSR Construction Material Quantities and Equipment Estimates.

(2) Number shown assumes 50% of total Sand, Cement, and Gravel delivered to precast yards by truck.

(3) Truck hauling emissions were calculated using a standard truck capacity of 20 cubic yards or 30 tons per truck, and by multiplying the emission factor by the anticipated distance traveled and the amount of material hauled per trip for each hauling method.

HSR Material Hauling Mileage Calcuations

Material Hauled	No. Trucks Total	Total Annual Miles
From RR Connection / Precast Yard		
Sub-Ballast	49,696	248,479
Ballast	116,918	584,591
Concrete Rail Ties	23,300	116,498
Total Concrete	433,749	2,168,745
Rail	1,957	9,786
Excavation	377,094	1,885,471
Fill	1,271,281	6,356,407
Structural Steel	224	1,496
Reinforcing Steel	36,146	240,972
Construction Waste - Concrete	2,973	14,864
Construction Waste - Rebar	542	2,711
To Precast Yard		
Sand	52,411	786,170
Cement	22,085	331,276
Gravel	57,833	867,498
Total	**2,446,210**	**13,614,964**

Assumptions:
Weight of average concrete railway tie is 1,000 pounds
Weight of rail (UIC60 rail) is 42 lbs/ft (Source: http//www.railway-technical.com/track.shtml)
Distance traveled is estimated based on the origin of the material being delivered.
Average R/T Distance from Rail Connection Yard: 20 miles.
Average R/T Distance to Rail Connection Yard: 60 miles.
Material haul: quantities will be delivered over a three or four-year time frame (2018-2021) for use in the construction phase (as per schedule).
Assume concrete will be hauled in support of concrete batch plant operations.

Data from MOVES2014a			
	2017 Long Haul Truck		
	Emissions in Grams per Mile		
	NOx	**VOC**	**CO2E**
Ellis	3.225	0.426	1,447
Dallas	3.225	0.424	1,447
Harris	3.166	0.424	1,432
Waller	3.168	0.424	1,430
Average HGB Emissions	**3.167**	**0.424**	**1,431**
Composite EF	**3.196**	**0.425**	**1439**

HSR Material Hauling Emissions - Total			
	Long Haul Truck		
	Emissions (Tons/Year)		
Year			
	CO2E	**CO2E (metric tons)**	
Annual Emissions 2018 - 2021	**21,591**	**19,587**	

Notes:
1) pounds per gram = 0.0022
2) tons per pound = 0.0005

HIGH SPEED RAIL PROJECT

DALLAS TO HOUSTON

CONSTRUCTION ANALYSIS

MATERIAL HAULING TRUCK GHG EMISSIONS - TRACK CONSTRUCTION

HSR Material Hauling

Data Taken from Project Descriptions or Provided

Estimated Values

Data Used in Calculations

Truck Emissions - Track	**On-Road (Non-Haul) Trucks**				
		County distance ratio to overall alignment	1	Average R/T Distance	Total Miles Per Year 2018-2021
Non-Haul Truck Category	Trucks	Total Number of Non-Haul Trucks	No Trucks Total Alignment	(miles)	
Light Commercial Truck	Flatbed F350	24		**40**	
	Flat Bed F700	18			
	Total	**42**	**42**	Light Commercial Truck	**524,160**
Passenger Truck	Mechanics Truck (small)	29			
	Pick-up 1/2 Ton	597			
	Pick-up 3/4 Ton	383			
	Worker Trips	5620			
	Total	**6629**	**6629**	Passenger Truck	**82,729,920**
Single-Unit Short Haul	Fuel Truck	44			
	Water Truck 4000 gal	25			
		69	**69**	Single-Unit Short Haul	**861,120**

Notes:

(1) Assume 312 working days per year.

(2) Number of trucks shown for entire Alternative C alignment.

Worker Trips: Assume 47 mob and demob sites (30 vehicles/site) and 20 sites each for demo,land clearing, earth moving, road crossings,track at-grade,track elevated, and structures (20 vehicles/site)

Emission Rates	**Ellis Co**	**Ellis Co**		**Ellis Co**
Truck Category	**2017 JAN**	**2017 JUL**		**2017 Composite Efs (g/mi)**
	CO2E	**CO2E**		**CO2E**
Passenger Truck	582	652	Passenger Truck	617
Light Commercial Truck	589	660	Light Commercial Truck	625
Single Unit Short-Haul Truck	1406	1602	Single Unit Short-Haul Truck	1,504
Single Unit Long-Haul Truck	1348	1545	Single Unit Long-Haul Truck	1,447

Emission Rates	**Dallas Co**	**Dallas Co**		**Dallas Co**
Truck Category	**2017 JAN**	**2017 JUL**		**2017 Composite Efs (g/mi)**
	CO2E	**CO2E**		**CO2E**
Passenger Truck	583	653	Passenger Truck	618
Light Commercial Truck	590	661	Light Commercial Truck	625
Single Unit Short-Haul Truck	1406	1602	Single Unit Short-Haul Truck	1,504
Single Unit Long-Haul Truck	1348	1545	Single Unit Long-Haul Truck	1,447

Emission Rates	**Harris Co**	**Harris Co**		**Harris Co**
Truck Category	**2017 JAN**	**2017 JUL**		**2017 Composite Efs (g/mi)**
	CO2E	**CO2E**		**CO2E**
Passenger Truck	575	635	Passenger Truck	605
Light Commercial Truck	583	643	Light Commercial Truck	613
Single Unit Short-Haul Truck	1405	1572	Single Unit Short-Haul Truck	1,488
Single Unit Long-Haul Truck	1348	1515	Single Unit Long-Haul Truck	1,432

Emission Rates	**Waller Co**	**Waller Co**		**Waller Co (g/mi)**
Truck Category	**2017 JAN**	**2017 JUL**		**2017 Composite Efs**
	CO2E	**CO2E**		**CO2E**
Passenger Truck	582	639	Passenger Truck	611
Light Commercial Truck	589	647	Light Commercial Truck	618
Single Unit Short-Haul Truck	1405	1567	Single Unit Short-Haul Truck	1,486
Single Unit Long-Haul Truck	1348	1511	Single Unit Long-Haul Truck	1,430

Emission Rates	**Other Co**	**Other Co**		**Other Co (g/mi)**
Truck Category	**2017 JAN**	**2017 JUL**		**2017 Composite Efs**
	CO2E	**CO2E**		**CO2E**
Passenger Truck	580.489	644.801	Passenger Truck	613
Light Commercial Truck	587.598	652.864	Light Commercial Truck	620
Single Unit Short-Haul Truck	1405.075	1585.893	Single Unit Short-Haul Truck	1,495
Single Unit Long-Haul Truck	1348.090	1529.215	Single Unit Long-Haul Truck	1,439

		CO2E	**CO2E**
Total Alignment		**Total Emissions (g)**	**Total Emissions (tons)**
	Light Commercial Truck	325,100,084	358
	Passenger Truck	50,684,071,838	55,752
	Single Unit Short-Haul Truck	1,287,790,967	1,417
	Single Unit Long-Haul Truck	0	0

Truck Emissions - Track Construction

Total Project		**CO2E**	**CO2E**
		Total Emissions (tons/yr)	**Total Emissions (metric tons/yr)**
	Truck (non-haul)	57,527	52,187

HIGH SPEED RAIL PROJECT
DALLAS TO HOUSTON
CONSTRUCTION ANALYSIS
MATERIAL HAULING TRUCK GHG EMISSIONS - STATION CONSTRUCTION

HSR Material Hauling

Data Taken from Project Descriptions or Provided
Estimated Values
Data Used in Calculations

Truck Emissions - Station	**On-Road (Non-Haul) Trucks**				
		No. of Stations in County	1	1	1
Non-Haul Truck Category	Trucks	Total Number of Non-Haul Trucks	No Trucks Dal Co	No Trucks Harris Co	No Trucks Central Co
Light Commercial Truck	Flatbed F350	3			
	Flat Bed F700	2			
	Total	**5**	**5**	**5**	**5**
Passenger Truck	Mechanics Truck (small)	1			
	Pick-up 1/2 Ton	8			
	Pick-up 3/4 Ton	8			
	Worker Trips	500			
	Total	**517**	**517**	**517**	**517**
Single-Unit Short Haul	Fuel Truck	1			
	Water Truck 4000 gal	1			
		2	**2**	**2**	**2**
Single-Unit Long Haul	Semi Tractor	2			
		2	**2**	**2**	**2**

Average R/T Distance (miles)	Total Miles Per Year 2018-2021 per County
20	
Light Commercial Truck	**31,200**
Passenger Truck	**3,226,080**
Single-Unit Short Haul	**12,480**
Single-Unit Long Haul	**12,480**

Notes:
(1) Assume 312 working days per year.
(2) Stations would be located in Dallas, Harris, and a centrally located county only.

Emission Rates	**Ellis Co**	**Ellis Co**		
Truck Category	**2017 JAN**	**2017 JUL**		
	CO2E	**CO2E**		**CO2E**
Passenger Truck	582	652	Passenger Truck	617
Light Commercial Truck	589	660	Light Commercial Truck	625
Single Unit Short-Haul Truck	1406	1602	Single Unit Short-Haul Truck	1,504
Single Unit Long-Haul Truck	1348	1545	Single Unit Long-Haul Truck	1,447

Emission Rates	**Dallas Co**	**Dallas Co**		
Truck Category	**2017 JAN**	**2017 JUL**		
	CO2E	**CO2E**		**CO2E**
Passenger Truck	583	653	Passenger Truck	618
Light Commercial Truck	590	661	Light Commercial Truck	625
Single Unit Short-Haul Truck	1406	1602	Single Unit Short-Haul Truck	1,504
Single Unit Long-Haul Truck	1348	1545	Single Unit Long-Haul Truck	1,447

Emission Rates	**Harris Co**	**Harris Co**		
Truck Category	**2017 JAN**	**2017 JUL**		
	CO2E	**CO2E**		**CO2E**
Passenger Truck	575	635	Passenger Truck	605
Light Commercial Truck	583	643	Light Commercial Truck	613
Single Unit Short-Haul Truck	1405	1572	Single Unit Short-Haul Truck	1,488
Single Unit Long-Haul Truck	1348	1515	Single Unit Long-Haul Truck	1,432

Emission Rates	**Waller Co**	**Waller Co**		
Truck Category	**2017 JAN**	**2017 JUL**		
	CO2E	**CO2E**		**CO2E**
Passenger Truck	582	639	Passenger Truck	611
Light Commercial Truck	589	647	Light Commercial Truck	618
Single Unit Short-Haul Truck	1405	1567	Single Unit Short-Haul Truck	1,486
Single Unit Long-Haul Truck	1348	1511	Single Unit Long-Haul Truck	1,430

Emission Rates	**Composite**	**Composite**		
Truck Category	**2017 JAN**	**2017 JUL**		
	CO2E	**CO2E**		**CO2E**
Passenger Truck	580.489	644.801	Passenger Truck	613
Light Commercial Truck	587.598	652.864	Light Commercial Truck	620
Single Unit Short-Haul Truck	1405.075	1585.893	Single Unit Short-Haul Truck	1,495
Single Unit Long-Haul Truck	1348.090	1529.215	Single Unit Long-Haul Truck	1,439

		CO2E	**CO2E**
Dallas Co		**Total Emissions (g)**	**Total Emissions (tons)**
	Light Commercial Truck	19,513,338	21
	Passenger Truck	1,993,475,484	2,193
	Single Unit Short-Haul Truck	18,769,421	21
	Single Unit Long-Haul Truck	18,053,818	20
		CO2E	**CO2E**
Harris Co		**Total Emissions (g)**	**Total Emissions (tons)**
	Light Commercial Truck	19,125,912	21
	Passenger Truck	1,951,867,117	2,147
	Single Unit Short-Haul Truck	18,571,051	20
	Single Unit Long-Haul Truck	17,868,240	20
		CO2E	**CO2E**
Centrally Located County		**Total Emissions (g)**	**Total Emissions (tons)**
	Light Commercial Truck	19,351,196	21
	Passenger Truck	1,976,441,782	2,174
	Single Unit Short-Haul Truck	18,663,637	21
	Single Unit Long-Haul Truck	17,954,383	20

Truck Emissions - Station

DFW NAA		**CO2E**	**CO2E**
		Total Emissions (tons/yr)	**Total Emissions (metric tons/yr)**
	Truck (non-haul)	2,255	2,046
HGB NAA		**CO2E**	**CO2E**
		Total Emissions (tons/yr)	**Total Emissions (metric tons/yr)**
	Truck (non-haul)	2,208	2,003
Centrally Located County		**CO2E**	**CO2E**
		Total Emissions (tons/yr)	**Total Emissions (metric tons/yr)**
	Truck (non-haul)	2,236	2,028
Total Project		**CO2E**	**CO2E**
		Total Emissions (tons/yr)	**Total Emissions (metric tons/yr)**
	Truck (non-haul)	6,699	6,077

HIGH SPEED RAIL PROJECT
DALLAS TO HOUSTON
CONSTRUCTION ANALYSIS
MATERIAL HAULING TRUCK GHG EMISSIONS - TMF CONSTRUCTION

HSR Material Hauling

Data Taken from Project Descriptions or Provided
Estimated Values
Data Used in Calculations

Truck Emissions - TMF	**On-Road (Non-Haul) Trucks**			
		No. of TMFs in County	1	1
Non-Haul Truck Category	Trucks	Total Number of Non-Haul Trucks	No Trucks Dal Co	No Trucks Harris Co
Light Commercial Truck	Flatbed F350	3		
	Flat Bed F700	2		
	Total	**5**	**5**	**5**
Passenger Truck	Mechanics Truck (small)	1		
	Pick-up 1/2 Ton	8		
	Pick-up 3/4 Ton	8		
	Worker Trips	250		
	Total	**267**	**267**	**267**
Single-Unit Short Haul	Fuel Truck	1		
	Water Truck 4000 gal	1		
		2	**2**	**2**
Single-Unit Long Haul	Semi Tractor	2		
		2	**2**	**2**

Average R/T Distance (miles)	Total Miles Per Year 2018-2021 per County
20	
Light Commercial Truck	**31,200**
Passenger Truck	**1,666,080**
Single-Unit Short Haul	**12,480**
Single-Unit Long Haul	**12,480**

Notes:
(1) Assume 312 working days per year.
(1) Assume two TMFs, one each in Dallas and Harris counties.

Emission Rates	**Ellis Co**	**Ellis Co**		
Truck Category	**2017 JAN**	**2017 JUL**		
	CO2E	**CO2E**		**CO2E**
Passenger Truck	582	652	Passenger Truck	617
Light Commercial Truck	589	660	Light Commercial Truck	625
Single Unit Short-Haul Truck	1406	1602	Single Unit Short-Haul Truck	1,504
Single Unit Long-Haul Truck	1348	1545	Single Unit Long-Haul Truck	1,447

Emission Rates	**Dallas Co**	**Dallas Co**		
Truck Category	**2017 JAN**	**2017 JUL**		
	CO2E	**CO2E**		**CO2E**
Passenger Truck	583	653	Passenger Truck	618
Light Commercial Truck	590	661	Light Commercial Truck	625
Single Unit Short-Haul Truck	1406	1602	Single Unit Short-Haul Truck	1,504
Single Unit Long-Haul Truck	1348	1545	Single Unit Long-Haul Truck	1,447

Emission Rates	**Harris Co**	**Harris Co**		
Truck Category	**2017 JAN**	**2017 JUL**		
	CO2E	**CO2E**		**CO2E**
Passenger Truck	575	635	Passenger Truck	605
Light Commercial Truck	583	643	Light Commercial Truck	613
Single Unit Short-Haul Truck	1405	1572	Single Unit Short-Haul Truck	1,488
Single Unit Long-Haul Truck	1348	1515	Single Unit Long-Haul Truck	1,432

Emission Rates	**Waller Co**	**Waller Co**		
Truck Category	**2017 JAN**	**2017 JUL**		
	CO2E	**CO2E**		**CO2E**
Passenger Truck	582	639	Passenger Truck	611
Light Commercial Truck	589	647	Light Commercial Truck	618
Single Unit Short-Haul Truck	1405	1567	Single Unit Short-Haul Truck	1,486
Single Unit Long-Haul Truck	1348	1511	Single Unit Long-Haul Truck	1,430

Emission Rates	**Composite**	**Composite**		
Truck Category	**2017 JAN**	**2017 JUL**		
	CO2E	**CO2E**		**CO2E**
Passenger Truck	580.489	644.801	Passenger Truck	613
Light Commercial Truck	587.598	652.864	Light Commercial Truck	620
Single Unit Short-Haul Truck	1405.075	1585.893	Single Unit Short-Haul Truck	1,495
Single Unit Long-Haul Truck	1348.090	1529.215	Single Unit Long-Haul Truck	1,439

		CO2E	**CO2E**
Dallas Co		**Total Emissions (g)**	**Total Emissions (tons)**
	Light Commercial Truck	19,513,338	21
	Passenger Truck	1,029,512,484	1,132
	Single Unit Short-Haul Truck	18,769,421	21
	Single Unit Long-Haul Truck	18,053,818	20
		CO2E	**CO2E**
Harris Co		**Total Emissions (g)**	**Total Emissions (tons)**
	Light Commercial Truck	19,125,912	21
	Passenger Truck	1,008,024,217	1,109
	Single Unit Short-Haul Truck	18,571,051	20
	Single Unit Long-Haul Truck	17,868,240	20

Truck Emissions - TMF			
DFW NAA		**CO2E**	**CO2E**
		Total Emissions (tons/yr)	**Total Emissions (metric tons/yr)**
	Truck (non-haul)	1,194	1,084
HGB NAA		**CO2E**	**CO2E**
		Total Emissions (tons/yr)	**Total Emissions (metric tons/yr)**
	Truck (non-haul)	1,170	1,061
Total Project		**CO2E**	**CO2E**
		Total Emissions (tons/yr)	**Total Emissions (metric tons/yr)**
	Truck (non-haul)	2,364	2,145

HIGH SPEED RAIL PROJECT
DALLAS TO HOUSTON
CONSTRUCTION ANALYSIS
MATERIAL HAULING TRUCK GHG EMISSIONS - MOW CONSTRUCTION

HSR Material Hauling

Data Taken from Project Descriptions or Provided
Estimated Values
Data Used in Calculations

Truck Emissions - MOW	**On-Road (Non-Haul) Trucks**						
		No. MOW Facilities in County	1	1	1	1	1
Non-Haul Truck Category	Trucks	Total Number of Non-Haul Trucks	No Trucks Dal Co	No Trucks Ellis Co	No Trucks Harris Co	No Trucks Waller Co	No Trucks Other Co
Light Commercial Truck	Flatbed F350	2					
	Flat Bed F700	1					
	Total	**3**	**3**	**3**	**3**	**3**	**3**
Passenger Truck	Mechanics Truck (small)	1					
	Pick-up 1/2 Ton	4					
	Pick-up 3/4 Ton	4					
	Worker Trips	250					
	Total	**259**	**259**	**259**	**259**	**259**	**259**
Single-Unit Short Haul	Fuel Truck	1					
	Water Truck 4000 gal	1					
		2	**2**	**2**	**2**	**2**	**2**
Single-Unit Long Haul	Semi Tractor	1					
		1	**1**	**1**	**1**	**1**	**1**

Notes:
(1) Assume five stand-alone MOW facilities.
(2) Assume 312 working days per year.

Average R/T Distance HGB (miles)	Total Miles Per Year 2018-2021 Per County
20	
Light Commercial Truck	**18,720**
Passenger Truck	**1,616,160**
Single-Unit Short Haul	**12,480**
Single-Unit Long Haul	**6,240**

Emission Rates	**Ellis Co**	**Ellis Co**		**Ellis Co**
Truck Category	**2017 JAN**	**2017 JUL**		**2017 Composite Efs (g/mi)**
	CO2E	**CO2E**		**CO2E**
Passenger Truck	582	652	Passenger Truck	617
Light Commercial Truck	589	660	Light Commercial Truck	625
Single Unit Short-Haul Truck	1406	1602	Single Unit Short-Haul Truck	1,504
Single Unit Long-Haul Truck	1348	1545	Single Unit Long-Haul Truck	1,447

Emission Rates	**Dallas Co**	**Dallas Co**		**Dallas Co**
Truck Category	**2017 JAN**	**2017 JUL**		**2017 Composite Efs (g/mi)**
	CO2E	**CO2E**		**CO2E**
Passenger Truck	583	653	Passenger Truck	618
Light Commercial Truck	590	661	Light Commercial Truck	625
Single Unit Short-Haul Truck	1406	1602	Single Unit Short-Haul Truck	1,504
Single Unit Long-Haul Truck	1348	1545	Single Unit Long-Haul Truck	1,447

Emission Rates	**Harris Co**	**Harris Co**		**Harris Co**
Truck Category	**2017 JAN**	**2017 JUL**		**2017 Composite Efs (g/mi)**
	CO2E	**CO2E**		**CO2E**
Passenger Truck	575	635	Passenger Truck	605
Light Commercial Truck	583	643	Light Commercial Truck	613
Single Unit Short-Haul Truck	1405	1572	Single Unit Short-Haul Truck	1,488
Single Unit Long-Haul Truck	1348	1515	Single Unit Long-Haul Truck	1,432

Emission Rates	**Waller Co**	**Waller Co**		**Waller Co (g/mi)**
Truck Category	**2017 JAN**	**2017 JUL**		**2017 Composite Efs**
	CO2E	**CO2E**		**CO2E**
Passenger Truck	582	639	Passenger Truck	611
Light Commercial Truck	589	647	Light Commercial Truck	618
Single Unit Short-Haul Truck	1405	1567	Single Unit Short-Haul Truck	1,486
Single Unit Long-Haul Truck	1348	1511	Single Unit Long-Haul Truck	1,430

Emission Rates	**Other Co**	**Other Co**		**Composite (g/mi)**
Truck Category	**2017 JAN**	**2017 JUL**		**2017 Composite Efs**
	CO2E	**CO2E**		**CO2E**
Passenger Truck	580	645	Passenger Truck	613
Light Commercial Truck	588	653	Light Commercial Truck	620
Single Unit Short-Haul Truck	1405	1586	Single Unit Short-Haul Truck	1,495
Single Unit Long-Haul Truck	1348	1529	Single Unit Long-Haul Truck	1,439

		CO2E	**CO2E**
Dallas Co		**Total Emissions (g)**	**Total Emissions (tons)**
	Light Commercial Truck	11,708,003	13
	Passenger Truck	998,665,668	1,099
	Single Unit Short-Haul Truck	18,769,421	21
	Single Unit Long-Haul Truck	9,026,909	10
		CO2E	**CO2E**
Ellis Co		**Total Emissions (g)**	**Total Emissions (tons)**
	Light Commercial Truck	11,692,278	13
	Passenger Truck	997,340,417	1,097
	Single Unit Short-Haul Truck	18,769,546	21
	Single Unit Long-Haul Truck	9,026,909	10
		CO2E	**CO2E**
Harris Co		**Total Emissions (g)**	**Total Emissions (tons)**
	Light Commercial Truck	11,475,547	13
	Passenger Truck	977,821,244	1,076
	Single Unit Short-Haul Truck	18,571,051	20
	Single Unit Long-Haul Truck	8,934,120	10
		CO2E	**CO2E**
Waller Co		**Total Emissions (g)**	**Total Emissions (tons)**
	Light Commercial Truck	11,567,041	13
	Passenger Truck	986,702,044	1,085
	Single Unit Short-Haul Truck	18,544,531	20
	Single Unit Long-Haul Truck	8,920,829	10
		CO2E	**CO2E**
Other Co		**Total Emissions (g)**	**Total Emissions (tons)**
	Light Commercial Truck	11,610,717	13
	Passenger Truck	990,132,343	1,089
	Single Unit Short-Haul Truck	18,663,637	21
	Single Unit Long-Haul Truck	8,977,192	10

Truck Emissions - MOW

DFW NAA		**CO2E**	**CO2E**
		Total Emissions (tons/yr)	**Total Emissions (metric tons/yr)**
	Truck (non-haul)	2,282	2,071
HGB NAA		**CO2E**	**CO2E**
		Total Emissions (tons/yr)	**Total Emissions (metric tons/yr)**
	Truck (non-haul)	2,247	2,038
Other Co.		**CO2E**	**CO2E**
		Total Emissions (tons/yr)	**Total Emissions (metric tons/yr)**
	Truck (non-haul)	1,132	1,027
		CO2E	**CO2E**
		Total Emissions (tons/yr)	**Total Emissions (metric tons/yr)**
Total Project	Truck (non-haul)	5,662	5,136

AIR QUALITY AND GREENHOUSE GAS OPERATIONAL EMISSIONS CALCULATIONS

Operational emissions of the proposed action would occur from power plants supplying electricity to operate the HSR (“train operation emissions”), which would represent an increase in emissions, and from reduction in vehicle travel (“vehicle emissions reduction”), due to HSR use, which would represent a decrease in emissions. The calculation of air quality and greenhouse (GHG) gas emissions were done using the same models, methodology and assumptions described below, because emissions factors for GHGs are available from the same sources and models as those for air quality criteria pollutants. Therefore, the details of calculations are presented together. The following subsections describe the modeling and estimate of these emissions.

TRAIN OPERATION EMISSIONS

Power Consumption

Emissions due to the power consumption, trains and stations were calculated using power consumption information supplied by the engineering firm retained by Texas Central Railway Partners to design the HSR. The following steps summarize the procedure:

- Calculate daily power consumption from train traction, station, maintenance facilities and signaling using consumption rates from project engineers
- Calculate annual power consumption based on operational assumptions for train, station, and maintenance facilities from project engineers
- Calculate power transmission and transformation losses using statewide average loss derived from Energy Information Agency (EIA) data for Texas
- Calculate annual total power consumption (including losses)
- Extract power generation emissions factors (EF) from EPA Emissions & Generation Resource Integrated Database (eGRID) database and National Renewable Energy Laboratory (NREL) data for the Electric Reliability Council (ERCOT) of Texas power sub-region.
- Calculate emissions using power consumption and EFs

Daily power consumption information was provided for initial service at an interim level of ridership, and full service at the full assumed level of ridership. Initially, the full service level was used, since it represented the maximum level of train activity and associated emissions. However, the initial service level was used due to concern that although the train activity would be lower, the emissions factors would be higher than in 2040 because the projected change would be less, due to a shorter time elapsed during the project downward trend. Therefore, initial service scenario was also calculated in case it resulted in higher net emissions. Train power consumption included the power used for traction (i.e. locomotion), onboard services (e.g. lights, controls, public address, etc.). Electricity generated due to regenerative braking was indicated by project engineers to be returned to the train’s power demand and accounted for in the power consumption provided. **Table E3.2-1** below provides the details of the consumption, operational assumptions provided by the engineers, and the calculated total daily demand. Because the service will be assumed to be provided 365 days a year, yearly power consumption was calculated assuming this. The power consumption of Alternative A is shown, because it is the longest track-length alternative with the highest power consumption, although the difference with the alternative consuming the least power (Alternative E) is negligible at 1 percent.

The EIA is an agency under the U.S. Department of Energy that collects statistics on energy including power generation (in megawatt-hours [MWh] or gigawatt-hours [GWh]) nationwide and by state. Data is obtained through surveys submitted by power management regions like ERCOT, and analysis of submitted data. The data includes an estimate of power lost through transmission and transformers. Power is lost in transmission as heat generated by the resistance of power line conductors, and in transformers mainly as heat also due to conductor resistance and due to other electrical effect losses. It is not practical to estimate losses at the project transmission line level due to the variability in what plant specifically would supply power, and necessary design detail has not yet been developed. Annual loss data for Texas from 1996 to 2013 (latest data available) was used to calculate a rate of loss as a percentage of power generated[1]. The percentage was observed to decline through this period with the rate steadying in the last few years. Advances in technology and power management have resulted in significantly increasing system efficiency, which explains this decline. The average in the last few years has been approximately 5 percent, which is consistent with nationwide data[2]. The loss percentage of 5 percent was assumed.

Table E3.2-1: Train Traction Power Consumption

Train Consumption		
Train Assumed	Shinkansen	
Operational Scenario	Initial Service Level	Full Service Level
Traction energy (MWh) consumed per round trip (each trainset)	7.5	8.5
Power consumption conditions		
Regenerative braking efficiency:	included	
On-board services consumption:	included	
Number of train trips per day	68	80
Total daily train power demand (MWh)	448.9	680.0

Source: Power consumption provided by TCRR engineers.

[1] Energy Information Agency. 2015. Table 10. Supply and disposition of electricity, 1990 through 2014. *Texas Electricity Profile*. Online date available at https://www.eia.gov/electricity/state/Texas/ (accessed January 25, 2016).
[2] Jackson, Roderick, Omer C. Onar, Harold Kirkham, Emily Fisher, Klaehn Burkes, Michael Starke, Olama Mohammed and George Weeks. 2015. Opportunities for Energy Efficiency Improvements in the U.S. Electricity Transmission and Distribution System. Oak Ridge National Laboratory (ORNL) Report ORNL/TM-2015/5. National Technical Information Service, Springfield, VA.

Table E3.2-2: Station and Facilities Power Consumption			
Station Consumption	**No. of Facilities**	**Total daily power consumption (MWh)**	**% Total Daily Demand**
Major Stations (Houston, Dallas)	2	209.4	17%
Brazos Valley Station	1	29.5	2%
Maintenance Facility Consumption			
Train Maintenance Facilities and additional MOW	2	129.3	11%
Maintenance of way (MOW) facility	5	34.4	3%
Switching and Substations			
Switching, subswitching and substations	36	109.8	9%
Signaling Consumption			
Communication House	47	4.4	0.4%
Sub-Signal House	3	2.7	0.2%
Signaling House (MSCH)	7	10.4	1%
Signaling House (ISCH)	6	9.0	1%
Total Daily Station & Facility Consumption (MWh)		538.9	44%

Source: Power consumption provided by TCRR engineers.

Table E3.2-3: Total Train Operations Power Consumption		
Operational Scenario	**ISL**	**FSL**
Total daily train power demand (MWh)	448.9	680.0
Total Daily Station & Facility Consumption (MWh)	538.9	538.9
Total Daily Operating Power Consumption (MWh)	987.8	1,218.9
Transmission & Transformer Losses		
Percentage lost	5%	5%
Power lost (MWh)	49	61
Total Daily Power + Losses (MWh)	1,037	1,280
Operating days/year	365	365
Total Electric Power Consumed per Year (MWH)	**378,562**	**467,143**

Source: Power consumption provided by TCRR engineers.

Emissions Factors

The power grid in Texas is interconnected throughout the state to meet demand. The ERCOT power subregion is the entity that manages and regulates the power grid for most of Texas, including the project corridor. Because there is no certain set of power plants designated or dedicated to providing electricity the HSR, power generation and distribution are interconnected statewide and primarily controlled by ERCOT, emissions from power supplied to the HSR were determined using ERCOT data.

The EPA's eGRID is a comprehensive source of data on the environmental characteristics of almost all electric power generated in the United States[3]. It is based on a yearly compilation of power plant-reported information on power generation, and emissions estimation. eGRID provides aggregation of this data by plant, power sub-region, and state. Emissions factors for the ERCOT subregion were used. Power in any subregion such as ERCOT is supplied by various sources such as natural gas, coal, nuclear, and to a smaller degree, renewable sources (e.g. wind, solar). The emissions factors for ERCOT reflect the blend of power generation of this subregion. Factors were available for NO_x, SO_2 and GHGs. Source emissions rates used in the calculation and reporting by sub-regions typically rely on those published in the EPA's AP-42, *Compilation of Air Pollutant Emission Factors*.

The eGRID data did not include VOC, CO, or PM_{10} emissions factor. These emissions factors were derived from a study of source energy and emission factors for energy use in buildings conducted by the NREL that included emissions from power[4]. Similar to eGRID, data was reported by power sub-region, including ERCOT. The emissions factors in this study were derived from the NREL's Life Cycle Inventory database for combustion of each fuel type in utility boilers and electricity and on the fuel totals used for electricity generation reported to EIA. The LCI also uses emission rates from AP-42. For VOC, the NREL study provided an emission factor for total non-methane organic compounds (TNMOC). In air monitoring, TNMOC is a group of organic compounds sampled and analyzed by a similar but more inclusive method than that used for VOC measured by standard gas chromatography, which is normally used for CAA standards comparison. Studies comparing measurement by both methods indicate that TNMOC can be 1 to almost 2 times the VOC result, and therefore are conservatively assumed to represent VOCs in air emissions inventories[5,6]. Therefore, the TNMOC emission factor was assumed to represent VOC. The ERCOT emissions factors for VOC, CO, and PM_{10} were used and reflect the Year 2004 data. No later comparable data was available. However, the use of earlier year factors is conservative, because emissions factors have been decreasing as time progresses, as discussed in the **Future Year Train Emissions Adjustment** section below.

The emission factor for combustion effects was used. Regional emissions factors expressed as mass of pollutant per unit power reflect the pollutant contribution and generated power amounts from combustion (e.g. gas, coal) and non-combustion (e.g. wind, nuclear) generation. Because non-combustion power generation does not contribute pollutants, it has the effect of diluting the overall regional emission factor. Because the NREL emissions factors only reflected combustion

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[3] U.S. Environmental Protection Agency (EPA). 2016. eGRID. Online database available at https://www.epa.gov/energy/egrid (Accessed February 2016)

[4] Deru, M. and P. Torcellini. Source Energy and Emission Factors for Energy Use in Buildings Technical Report NREL/TP-550-38617 Revised June 2007

[5] Maris, Christophe, Myeong Chung, Udo Krischke, Richard Meller and Suzanne Paulson. An Investigation of the Relationship Between Total Non-Methane Organic Carbon and the Sum of Speciated Hydrocarbons and Carbonyls Measured by Standard GC/FID: Measurements in the South Coast Air Basin. Presentation given at the Air Resources Board (ARB) Research Seminar, June 17, 2002, California EPA Headquarters, 1001 "I" Street, Sacramento, CA. Department of Atmospheric Sciences, University of California at Los Angeles. Available at http://www.arb.ca.gov/research/seminars/paulson/paulson.htm (Accessed 5/10/2016)

[6] U.S. Department of the Interior (USDOI) Bureau of Ocean Energy Management (BOEM). 2015. Gulf of Mexico Air Emissions Calculations Instructions and PRA Statement. Office of Management and Budget (OMB) Form OMB Control No. 1010-0151, BOEM Instructions for Form 0138.

generation, it was necessary to adjust them to reflect the contribution of non-combustion power to give overall emissions rates that reflect the total regional power mix. This was calculated using the percent of non-combustion power, using eGRID data for 2004 to be consistent with the NREL emissions factors, which were for 2004. eGRID did not begin explicitly listing combustion vs non-combustion generation distribution until 2005, but the 2004 distribution data for hydroelectric, nuclear, solar, and wind generation, which comprise the non-combustion portion, was used. More detail on combustion and non-combustion power and emissions factors, and their calculation is provided in the **Future Year Train Emissions Adjustment** section below.

Future Year Train Emissions Adjustment
Because the available power generation and emissions factor data used to calculate train operation emissions only reflect current and historical data and practices, they do not incorporate the improvements to emissions controls that vehicle emissions models account for in future years, and they do not reflect the increasing percentage of power from renewable or non-fossil fuel energy.

Electric power generation in Texas comes from 1) combustion sources such as natural gas and coal, and minor sources such as oil and biomass, and 2) non-combustion sources such as wind, nuclear, solar, and hydroelectric generation. Only the combustion sources produce criteria pollutants. EIA state-level data for power generation by source was used to calculate the non-combustion portions[7]. This data indicates a strong trend between 1990 and 2013 of an increasing percentage of power by noncombustion sources, changing from 6 percent to 17 percent. **Figure E3.2-1** below shows this trend in black markers and plot line. This trend means that an increasing portion of power generated would not produce emissions, and the overall emission rate per power generated should have dropped. The eGRID data by state corroborates this, indicating a Year 2000 NOx emission rate of 2.308 lbs/MWh and a Year 2012 rate of 0.699 lbs/MWh, a decrease of 70 percent.

The increasing percentage of non-combustion power reflects the significant increase in renewable energy, most notably, wind power in Texas. The decrease in the NO_x emission rate reflects the increasing non-combustion power, but also the improvements in plant emissions controls and shifts to lower NO_x fossil fuel generation such as natural gas. Two methods were used to project this trend to the future years of 2024 and 2040: using the 1990-2013 simple average annual rate of change of 0.48 percent (orange markers and line), and inserting a linear-fit trend line and extending it to 2040 (thin black line). This resulted in projections of non-combustion power in 2024 constituting between 21 percent and 23 percent of total power generated, and in 2040 constituting between 27 percent and 30 percent of total power generated. The more conservative trend line values of 21 percent and 27 percent for 2024 and 204 were selected. These rates would be used to estimate an effect on the future year overall NO_x rate. The change in non-combustion power percentage was predicted using state-level data which will differ slightly from ERCOT, as the state statistics include the small portions of Texas outside of ERCOT. However, checks of the eGrid ERCOT data between 2005 and 2012 indicate that the ERCOT non-combustion percent

[7] Energy Information Agency. "Table 5. Electric power industry generation by primary energy source, 1990 through 2013" Texas Electricity Profile. 2015. https://www.eia.gov/electricity/state/Texas/. (accessed January 25, 2016)

power is 1 to 3 percent higher for the same years. Therefore, using state-level data is a conservative projection of the change in non-combustion percent power.

Overall emissions factors or rates per unit of power generated for subregions such as ERCOT are derived from the emissions produced by the combustion sources divided by the sum of all (combustion plus non-combustion) power generated, as shown in the following example for NO_x:

$$\frac{\text{lbs}_{\text{NOx}}}{(\text{megawatt-hours}_{\text{Combust}} + \text{megawatt-hours}_{\text{Noncombust}})} = \text{EF}_{\text{NOx-TOTAL}} \qquad \{1\}$$

eGRID calculates and lists related emission rates and quantities for combustion sources only, which is shown in the following example for NOx:

$$\frac{\text{lbs}_{\text{NOx}}}{(\text{megawatt-hours}_{\text{Combust}})} = \text{EF}_{\text{NOx-Combust}} \qquad \{2\}$$

The equations above follow general calculations of combustion and non-combustion power emissions rates that can be found in eGRID and NREL technical documentation[8,9]. Equation 1 can be rewritten using Equation 2 as follows:

$$\frac{\text{EF}_{\text{NOx-Combust}} \times \text{megawatt-hours}_{\text{Combust}}}{(\text{megawatt-hours}_{\text{Combust}} + \text{megawatt-hours}_{\text{Noncombust}})} = \text{EF}_{\text{NOx-TOTAL}} \qquad \{3\}$$

The megawatt-hour terms collectively are equivalent to the percent of total power generation that combustion power generation comprises. Therefore, Equation 4 becomes:

$$\text{EF}_{\text{NOx-Combust}} \times \%\ \text{power generation}_{\text{Combust}} = \text{EF}_{\text{NOx-TOTAL}} \qquad \{4\}$$

Expressing the percent power generation from combustion using the non-combustion percentage, Equation 4 becomes:

$$\text{EF}_{\text{NOx-Combust}} \times (1 - \%\ \text{power generation}_{\text{Noncombust}}) = \text{EF}_{\text{NOx-TOTAL}} \qquad \{5\}$$

As long as the combustion EF remains constant, the overall NOx emission factor can be calculated using the change in percent of non-combustion power. However, as shown before, the NO_x emission rate has decreased substantially with some of that decrease attributable to reduction of

[8] Deru, M. and P. Torcellini. Source Energy and Emission Factors for Energy Use in Buildings Technical Report NREL/TP-550-38617 Revised June 2007

[9] Abt Associates. 2015. The Emissions and Generation Resource Integrated Database Technical Support Document for eGRID with Year 2012 Data. Technical report prepared for Clean Air Markets Division, Office of Atmospheric Programs, U.S. Environmental Protection Agency Washington, DC. Abt Associates, Bethesda, MD.

combustion emission rates. eGRID only began tracking subregion combustion emission rates since 2005. This data indicates an average decrease of the combustion NO_x EF of 7 percent per year[10]. Available eGRID information was used to project the change in combustion emission rates of NO_x, SO_2, and the GHGs (CO_2, CH_4, N_2O) to estimate emissions based on the emission rates change indicated by the data[11]. The eGRID data was used to project future $EF_{combust}$ using the average rate of change or percent change calculated with the 2004-2012 data, and applied to extrapolate future values in 2024 and 2040. The annual change is compounding, and therefore follows the general Equation 6 below for value growth of a compounded rate of change, similar to calculating future value in financial calculations. The projections for NO_x, SO_2, and the GHGs are shown in **Figures E3.2- 2** through **6**. The projected $EF_{combust}$ was then used in Equation 5 to calculate the overall EF_{total} for power generation in ERCOT in the Year 2040 for NO_x, SO_2, and the GHGs. The resultant EF_{total} are shown in **Table E3.2-4** below.

$$FV = PV(1+r)^n \quad \{6\}$$

Where:
FV = future value
PV = present value
r = annual rate of change
n = time period

Table E3.2-4: eGRID ERCOT Current and Projected Emissions Rates

	Combustion Emissions Rates ($EF_{combust}$)									
	NO_x		SO_2		CO_2		CH_4		N_2O	
Year	(lb/MWH)	Avg. Annual Change	(lb/MWH)	Avg. Annual Change	(lb/MWH)	Avg. Annual Change	(lb/GWH)	Avg. Annual Change	(lb/GWH)	Avg. Annual Change
2012	0.7522	-7%	2.38	-8%	1,413	-3%	20.6	-1%	15.2	-3%
2024	0.3153	-	0.82	-	954	-	18.2	-	10.5	-
2040	0.0989	-	0.20	-	565	-	15.4	-	6.4	-
	Calculated Overall Emissions Rates (EF_{total})									
2024	0.230	-	0.600	-	696	-	0.013	-	0.008	-
2040	0.072	-	0.146	-	413	-	0.011	-	0.005	-

Source: Data sourced from USEPA eGRID database available at https://www.epa.gov/energy/egrid

The eGRID data did not track VOC, PM_{10} or CO historically; therefore it could not be used to estimate the change in the combustion emissions rates for those pollutants. The EPA maintains and aggregates data from the National Emissions Inventory (NEI) which is a comprehensive and detailed estimate of air emissions of criteria pollutants, criteria precursors, and hazardous air pollutants from major air emissions sources. The state average annual emissions trends data contains aggregation of the NEI emissions by Tier 1 categories[12]. National inventories typically follow IPCC tiered categorization of emissions and factors by sources, and Tier 1 is the most basic level. Tier 1 categories include fuel combustion by electric utilities and track VOC, PM_{10} and CO by

[10] U.S. Environmental Protection Agency (EPA). 2016. eGRID. Online database available at https://www.epa.gov/energy/egrid
[11] ibid
[12] EPA. 2016. Air Pollutant Emissions Trends Data. Online data available at https://www.epa.gov/air-emissions-inventories/air-pollutant-emissions-trends-data (Accessed May 30, 2016)

year. The Texas annual emissions (in thousands of tons) for this category were used. To maintain consistency with projections for the other pollutants from eGRID, the available data from 2004 and forward was used. By pairing this emissions data with power generation (i.e. MWh) for equivalent categories from the EIA data discussed in the Power Consumption section above, a relative change in the emissions rates per unit of power generated could be estimated to assess whether combustion power plants were improving emissions for these pollutants too. State EIA data for combustion-generated power for electric utilities and independent producers of electricity (i.e. privatized power providers) was used, as this most closely matches the Tier 1 category for electric utilities[13]. The annual emissions for each pollutant were divided by the total category power generated to provide annual emissions rate for state electric utilities.

These state-level emissions rates were not used directly for EF calculations and projections, but rather to estimate the rate of improvement of power plant emissions of these pollutants in Texas and ERCOT. The most current year ERCOT EFs for VOC, PM_{10} and CO sourced from NREL were more consistent with eGRID estimations used for the other pollutants. Even though the estimate of improvements are state-level, Texas is dominated by ERCOT power, and improvements in emissions would be largely reflective of improvements within ERCOT. **Figures E3.2-7** through **9** show the NEI-based emissions rates for VOC, PM_{10} and CO which show gradual downward trends. The average percent change from this data was then used to project changes in the NREL-based $EF_{combust}$ factors for VOC, PM_{10} and CO for the Year 2012 (conservatively assumed the same as 2004) to forecast these factors for the Years 2024 and 2040. The projection was conducted in the same manner as NO_x, SO_2, and the GHGs. **Table E3.2-5** summarizes the percent change calculated and the projected 2024 and 2040 $EF_{combust}$ factors. The projected $EF_{combust}$ was then used in Equation 5 to calculate the overall EF_{total} for power generation in ERCOT in the Years 2024 and 2040 for VOC, PM_{10} and CO. The resultant EF_{total} are shown in **Table E3.2-5**.

Table E3.2-5: NREL ERCOT Current and Projected Emissions Rates

Combustion Emissions Rates ($EF_{combust}$)						
	VOC		PM_{10}		CO	
Year	(lb/MWH)	Avg. Annual Change	(lb/MWH)	Avg. Annual Change	(lb/MWH)	Avg. Annual Change
2012	0.0522	-2.5%	0.0855	-5.4%	0.401	-2.9%
2024	0.039	-	0.0437	-	0.282	-
2040	0.0259	-	0.0178	-	0.176	-
Overall Emissions Rates (EF_{total})						
2024	0.028	-	0.032	-	0.206	-
2040	0.019	-	0.013	-	0.128	-

Source: Baseline 2012 data from Deru, M. and P. Torcellini, Source Energy and Emission Factors for Energy Use in Buildings Technical Report NREL/TP-550-38617 Revised June 2007. Projected Data estimated using average change derived from EPA NEI data in *Air Pollutant Emissions Trends Data*, available online at https://www.epa.gov/air-emissions-inventories/air-pollutant-emissions-trends-data

The 2024 and 2040 EF_{total} for all pollutants were then multiplied by the train operations annual power consumption to calculate the train operations emissions in tons per year. These results are shown in **Table E3.2-6** below.

[13] EIA. 1990-2014 Net Generation by State by Type of Producer by Energy Source (EIA-906, EIA-920, and EIA-923) (Revised: November 2015). Online data available at https://www.eia.gov/electricity/data/state/

Table E3.2-6: Train Operations Emissions in the Year 2040								
Emissions (tons per year)								
NO_x	VOC	PM_{10}	SO_2	CO	CO_2	CH_4	N_2O	$CO_{2equivalent}$
43.6	5.3	6.0	113.6	38.9	131,819	2.5	1.5	132,316
16.9	4.4	3.0	34.0	30.0	96,354	2.6	1.1	96,747

Source: AECOM, 2016

VEHICLE EMISSIONS REDUCTION

The shift in travel mode due to the HSR from passenger vehicles to high speed rail use would result in passenger vehicles no longer making the round trip from Dallas to Houston and vice versa. This would eliminate the emissions from those vehicles. This section presents the estimate of emissions from these vehicles.

Reduction in Vehicle Miles Traveled

Ridership information from the January 14, 2016 Memorandum, *Station Area Guidance for EIS Documentation* and the May 15, 2017 report *Texas Central Dallas to Houston High-Speed Rail Final Draft Conceptual Engineering Report* – FDCEv5, provided by ARUP, Texas Central Partners, and Freese and Nichols, Inc. (hereafter referred to as the "1/14/2016 Station Area Guidance Memo" and the "May 15, 2017 Final Draft Conceptual Engineering Report") were used to derive the expected numbers of cars no longer making the trip between Dallas and Houston. These documents contained projections and assumptions of ridership and travel mode being used to plan station capacities, including vehicles expected, and parking requirements.

The May 15, 2017 Final Draft Conceptual Engineering Report assumed an annual ridership of 7,200,000 passengers for the 2040 FSL, and the 1/14/2016 Station Area Guidance Memo contained an estimate of existing and projected travel mode share of people traveling between Dallas and Houston from a planning forecast report provided for the project. These assumptions are displayed in the calculations shown below. The estimated 2013 mode share represents the existing percentage of passengers expected to use either cars, airplanes, or bus to make the Dallas-Houston trip, in the absence of the HSR project. This mode share and the annual ridership were used to calculate the number of passengers that would be using cars to travel between Houston and Dallas on IH-45.

The May 15, 2017 Final Draft Conceptual Engineering Report also contained an assumption of average passenger occupancy of cars, which was 1.2 passengers per car that was used to derive the numbers of cars that would now be expected to show up at HSR stations. This was used to derive the number of cars expected from the passengers estimated using this mode. This information was used to calculate the number of passengers traveling by car as follows:

Table E3.2-7: Existing and Projected Mode Share of People Traveling Between Dallas and Houston		
Trip Type	**2013 Market**	**2043 Market**
Car	89%	73%
HSR	-	21%
Air	9%	3%
Bus	2%	2%

Source: TCRR. Memorandum, Station Area Guidance for EIS Documentation, January 14, 2016

2024 Calculation:

4,400,000 passengers/year X 89% car share = 3,916,000 passengers using car

3,916,000 passengers/1.2 passengers/car = 3,263,334 cars/year

2040 Calculation:

7,200,000 passengers/year X 89% car share = 6,408,000 passengers using car

6,408,000 passengers/1.2 passengers/car = 5,340,000 cars/year

The 1/14/2016 Station Area Guidance Memo contained projections of rates of ground transportation activity into the stations generated from park and ride, passenger drop off, rental car etc. in terms of vehicles per hour for the Dallas and Houston stations. The distribution of trips originating in Dallas versus Houston were assumed to reflect the proportion between these ground activity rates; that is the more active station would have a larger share of the 3.3 million or 5.34 million passenger car trips calculated. **Table E3.2-8** shows the distribution of trips and **Table E3.2-9** provides the resulting annual numbers of cars inferred for each city from this distribution.

Table E3.2-8: Distribution of Trips Between Dallas and Houston

Metro Area	No. Ground Transport Vehicles Arriving and Departing Station (vehicles/hr)		Inferred Trip Balance	
	Low	High	Low	High
Dallas	1320	1610	47%	47%
Houston	1500	1830	53%	53%

Source: Vehicles/hour from TCRR. Memorandum, Station Area Guidance for EIS Documentation, January 14, 2016

Table E3.2-9: Number of Cars Originating from Each City Assuming Inferred Trip Balance

Operating Scenario	ISL	FSL	Percentage (%)
Total cars/year	3,263,334	5,340,000	
Dallas	1,527,316	2,499,244	47%
Houston	1,736,018	2,840,756	53%

Source: AECOM, 2016

City center origin travel was assumed for simplicity, and because the origin of car trips going to Dallas from Houston, and vice versa, would be anticipated to come from all around the respective urban cores to connect to IH-45. This would include major metropolitan areas north and south of city centers that would tend to average out shorter and longer distances past the city centers. Also, since the proposed Dallas and Houston stations are relatively close to city centers and IH-45 is relatively centered east-west in both of these cities, car trips from outlying east or west areas would still travel inward to connect to or use IH-45 in the absence of the HSR, and with the HSR, would still travel close to the city center to the proposed stations. Therefore trip distance along IH-45 was assumed to average out to trip lengths from the city centers. Assumption of city center

Highway centerline geospatial data from TxDOT was used to calculate a city center-to-city center distance of 239 miles between Houston and Dallas.

Consistent with the average length of stay assumption of 2 days in the 1/14/2016 Station Area Guidance Memo, it would be expected that travel between Houston and Dallas using HSR would primarily be temporary travel for business, tourism, or visitation, and not supplant travel for one-way moves etc. Since Dallas and Houston are already major airline hubs, use of HSR to connect from one city to the other to catch connecting flights to other destinations would be anticipated to be negligible. Considering this, round trips from either Houston or Dallas back to the origin was assumed.

Table E3.2-10: Assumed Trip Distances

Trip	Distance (miles)
City center-City-Center	239
Assume round trip	478

Source: AECOM, 2016

The round trip distance and calculated cars/year were used to calculate the vehicle miles traveled (VMT) that would have been traveled in the absence of the HSR as follows:

Round trip distance X cars/year = VMT

Table E3.2-11: Calculated VMT

Metro Share of VMT	VMT	
	ISL	FSL
Dallas VMT	730,057,145	1,194,638,721
Houston VMT	829,816,507	1,357,881,279
Total VMT avoided	1,559,873,652	2,552,520,000

Source: AECOM, 2016

Emissions Factors

The MOVES2014a, was used to derive emissions factors[14]. Because the HSR stations that would generate the majority of the HSR travel are located in Houston and Dallas, vehicles that would have otherwise used IH-45 to travel between Houston and Dallas would overwhelmingly be expected to originate in the counties of these two metropolitan areas. For consistency with the construction emissions estimated, the NAA counties in the project corridor were used MOVES 2014a to define vehicle characteristics.

MOVES input data from the two relevant MPOs was used to provide regional and county model inputs for meteorological, inspection and monitoring program, age and vehicle class distributions. MPOs are the regional organizations designated under the Clean Air Act to provide coordinated transportation planning for their designated metropolitan areas to comply with SIPs under the

[14] U.S. Environmental Protection Agency. 2016. MOVES (Motor Vehicle Emission Simulator). Air quality emissions modeling system available at https://www3.epa.gov/otaq/models/moves/ (Accessed February 2016)

Transportation Conformity Rules. The Harris-Galveston Area Council (H-GAC) MPO website for the 2040 Regional Transportation Plan (RTP) conformity demonstration and the North Central Texas Council of Governments (NCTCOG) website for conformity demonstration of the Metropolitan Transportation Plan (MTP) [named Mobility 2040], and the 2015-2018 Transportation Improvement Plan (TIP) were used[15,16]. The demonstrations from both of these MPOs contain the results and input data used to model base and future year vehicle emissions (including 2040) from the roadway and other approved transportation improvements to demonstrate consistency with State Implementation Plan (SIP) for compliance with the CAA Transportation Conformity rules under 40 CFR 51 and 93. These demonstrations used MOVES, and reflect the local characteristics of climate, fuel, vehicle age and VMT mix, and other inputs required for MOVES. Key assumptions and model inputs used to generate emissions factors are listed in **Table E3.2-12**.

Information for the years 2024 and 2040 were sought for the reasons previously exaplined to match the ISL and FSL years. For 2024, Year 2025 and 2027 projected input data was available from the Houston and Dallas MPOs, respectively. The information from these years would be conservative for estimating net air emissions impacts, because future years tend to represent better parameters for fuel type, inspection programs etc. that reduce car air emissions, and therefore would reduce the amount emissions avoided through train usage. This would result in higher net emissions than using Year 2024 data. In practicality, the difference in these factors between 2025 or 2027 and 2024 would not be significant. For 2040, input data for that year was available from the MPO sources. Other internal MOVES data projected for the Years 2024 and 2040 were used. The time of year chosen to generate emissions factors was January and July, to represent the range of conditions that affect fuel and meteorological parameters.

The modeling assumed a rural restricted road type which is defined for rural highways that can only be accessed by an on-ramp. Though IH-45 is an urban highway within the Dallas and Houston metropolitan areas (including the 30-mile length north of BW-8 in Houston to Conroe) most of the length through the project corridor is highway in a rural area with access primarily through on ramps from service or frontage roads. From an emissions reduction standpoint, this is a conservatively low assumption, given that the metropolitan segments are not modeled as urban highways, which would result in greater vehicle emissions calculated that would otherwise be avoided through HSR use.

The vehicle speed assumed was an average speed of 40 miles per hour (MPH) which was the average speed (39 MPH rounded up) projected by TxDOT in 2035 for IH-45 travel between DFW and Houston, contained in the Project Planning Documentation for the State's funding application for the High-Speed Intercity Passenger Rail (HSIPR) Program[17]. This speed reflects a decrease from the 2002 average of 59 MPH, commensurate with the increasing traffic volume trend observed in traffic data, and the exceedance of the highway's design capacity in future years.

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[15] Houston-Galveston Area Council (H-GAC). 2016. 2040 RTP Conformity. Available at http://www.h-gac.com/taq/airquality_model/conformity/2040-RTP-Conformity.aspx (Accessed May 2016)

[16] North Central Texas Council of Governments (NCTCOG). 2016. 2016 Transportation Conformity. Available at http://nctcog.org/trans/air/conformity/2016TransportationConformity.asp (Accessed May 2016)

[17] Texas Department of Transportation. 2011. Section 5: Planning Documentation, TxDOT Narrative Application Form for the High-Speed Intercity Passenger Rail (HSIPR) Program March 2011 Notice of Funding Availability (NOFA)

Because the large majority of passengers that would use HSR for Dallas-Houston travel would be those using passenger vehicles (and not commercial light or heavy duty trucks), emissions factors for passenger cars and trucks were calculated. Emissions avoided for travel by bus and aircraft were not calculated as they represent a relatively minor portion of the projected travel mode shift. On a relative basis, shifting to HSR from bus travel would result in some reduction of criteria pollutants. One study showed that per passenger mile traveled; operational NOx emissions from some transit rail systems including Massachusetts Green Line light rail and CAHSR would be approximately an order of magnitude (12X to 35X) lower than those from bus and for PM, approximately 7 times lower[18]. Given the small percentage (2%) of bus travel mode shift, the reductions would be minor.

Table E3.2-12: MOVES Assumptions Used for Vehicle Emissions Modeling

Assumption/Input	Value/description	Source	Comments
Years	2024 and 2040	EIS assumption	Year of HSR full service
Counties	Dallas, Ellis, Harris, and Waller	EIS assumption	NAA counties in project area
Time of Year modeled	January & July	EIS assumption	
Meteorological	Avg. January & Avg. July temp and RH	DFW, Houston airport station data	
Road grade	Avg. = 0.03%	Difference in city center USGS topographic elevations ÷ IH-45 trip distance	Effect on model results same as grade = 0%
Road type	Rural restricted	Bulk of IH-45 between Houston and Dallas is rural highway accessed by on-ramp	
Speed	Avg. = 40 MPH	TxDOT HSIPR Application Planning Documentation	
Vehicle types	Passenger cars and trucks	EIS assumption	Majority of passengers using HSR would otherwise use passenger vehicles
Vehicle age distribution	2040 for NAA counties	H-GAC, NCTOG input files	
VMT mix	2040 Houston District	H-GAC input files NCTOG input files	
Inspection and maintenance (I&M)	2040 Houston District	H-GAC input files NCTOG input files	
Fuel type and formulations	MOVES defaults	MOVES model	

Source: AECOM, 2016

Emissions

The resultant emissions factors generated for the DFW and HGB NAA counties in the project area, for January and July, were averaged to provide emission factors for each of the NAA areas for the criteria pollutants, expressed as grams per mile (g/mile) and converted to pounds per mile (lbs/mile) shown in **Tables E3.2-13a** and **b,** and **Tables E3.2-14a** and **b**. The total annual VMT

[18] Chester, Mikhail, and Arpad Horvath. "Life-Cycle Environmental Assessment of California High Speed Rail." Access, 2010: 5.

avoided and emission factors were used to calculate the emissions that would have occurred in the absence of the HSR as shown in **Tables E3.2-15a** and **b**.

Table E3.2-13a: HGB Passenger Vehicle Emissions Factors – 2024							
County/Month	**HGB Emissions Factors(g/mile)**						
Harris	**CO**	**NO_x**	**VOC**	**PM_{10}**	**$PM_{2.5}$**	**SO_2**	**CO_2 Eq.**
January	1.3653	0.0915	0.0759	0.0344	0.0074	0.0018	274.7
July	2.0132	0.0898	0.1024	0.0343	0.0073	0.0020	299.0
Average	1.6893	0.0907	0.0892	0.0344	0.0074	0.0019	286.8
Waller							
January	1.8162	0.1449	0.1096	0.0356	0.0085	0.0020	301.3
July	3.0433	0.1560	0.1476	0.0352	0.0081	0.0022	326.6
Average	2.4297	0.1504	0.1286	0.0354	0.0083	0.0021	313.9
HGB Project Avg.	**2.0595**	**0.1206**	**0.1089**	**0.0349**	**0.0078**	**0.0020**	**300.4**
	Converted to lb/mile						
HGB Project Avg.	0.0045	2.66E-04	0.0002	7.69E-05	1.73E-05	4.4E-06	0.662

Source: Factors derived from EPA MOVES2014a modeling.

Table E3.2-13b: HGB Passenger Vehicle Emissions Factors – 2040							
County/Month	**HGB Emissions Factors(g/mile)**						
Harris	**CO**	**NO_x**	**VOC**	**PM_{10}**	**$PM_{2.5}$**	**SO_2**	**CO_2 Eq.**
January	0.4313	0.0161	0.0438	0.0330	0.0058	0.0013	184.7
July	0.6788	0.0151	0.0513	0.0331	0.0058	0.0014	201.6
Average	*0.5551*	*0.0156*	*0.0475*	*0.0330*	*0.0058*	*0.0013*	*193.1*
Waller							
January	0.4868	0.0186	0.0570	0.0329	0.0059	0.0013	188.6
July	0.9080	0.0204	0.0661	0.0330	0.0060	0.0014	205.2
Average	*0.6974*	*0.0195*	*0.0616*	*0.0329*	*0.0060*	*0.0013*	*196.9*
HGB Project Avg.	***0.6262***	***0.0176***	***0.0546***	***0.0330***	***0.0059***	***0.0013***	***195.0***
	Converted to lb/mile						
HGB Project Avg.	***0.0014***	***3.87E-05***	***0.0001***	***7.27E-05***	***1.30E-05***	***2.9E-06***	***0.430***

Source: Factors derived from EPA MOVES2014a modeling.

Table E3.2-14a: DFW Passenger Vehicle Emissions Factors – 2025							
County/Month	**DFW Emissions Factors(g/mile)**						
Dallas	**CO**	**NO_x**	**VOC**	**PM_{10}**	**$PM_{2.5}$**	**SO_2**	**CO_2 Eq.**
January	1.4011	0.1081	0.0787	0.0346	0.0077	0.0018	270.3
July	2.1350	0.0936	0.1102	0.0342	0.0073	0.0020	298.7
Average	1.7680	0.1009	0.0945	0.0344	0.0075	0.0019	284.5
Ellis							
January	1.7904	0.1414	0.0962	0.0353	0.0084	0.0019	281.1
July	2.7202	0.1221	0.1328	0.0352	0.0083	0.0021	309.8
Average	2.2553	0.1318	0.1145	0.0353	0.0083	0.0020	295.5
DFW Project Avg.	***2.0117***	***0.1163***	***0.1045***	***0.0348***	***0.0079***	***0.0019***	***290.0***
	Converted to lb/mile						
DFW Project Avg.	0.0044	2.56E-04	0.0002	7.68E-05	1.74E-05	4.28E-06	0.639

Source: Factors derived from EPA MOVES2014a modeling.

Table E3.2-14b: DFW Passenger Vehicle Emissions Factors – 2040							
County/Month	**DFW Emissions Factors(g/mile)**						
Dallas	**CO**	**NO_x**	**VOC**	**PM_{10}**	**$PM_{2.5}$**	**SO_2**	**CO_2 Eq.**
January	0.5871	0.0291	0.0527	0.0326	0.0059	0.0013	186.3
July	0.8826	0.0247	0.0633	0.0327	0.0060	0.0014	205.7
Average	*0.7348*	*0.0269*	*0.0580*	*0.0327*	*0.0060*	*0.0013*	*196.0*
Ellis							
January	0.8258	0.0443	0.0636	0.0331	0.0064	0.0013	195.6
July	1.2070	0.0367	0.0760	0.0335	0.0067	0.0015	215.2
Average	*1.0164*	*0.0405*	*0.0698*	*0.0333*	*0.0066*	*0.0014*	*205.4*
DFW Project Avg.	***0.8756***	***0.0337***	***0.0639***	***0.0330***	***0.0063***	***0.0014***	***200.7***
	Converted to lb/mile						
DFW Project Avg.	***0.0019***	***7.43E-05***	***0.0001***	***7.27E-05***	***1.38E-05***	***3E-06***	***0.442***

Source: Factors derived from EPA MOVES2014a modeling.

Table E3.2-15a: 2025 Passenger Vehicle Emissions Reduction							
Emissions (TPY)							
VMT	**CO**	**NO_x**	**VOC**	**PM_{10}**	**$PM_{2.5}$**	**SO_2**	**CO_2 Eq.**
Houston Trip Emissions							
829,816,507	1,883.8	110.3	99.6	31.9	7.2	1.8	274,762
Dallas Trip Emissions							
730,057,145	1,618.9	93.6	84.1	28.0	6.4	1.6	233,362
TOTAL	**3,502.7**	**203.9**	**183.7**	**59.9**	**13.5**	**3.4**	**508,124**

Source: AECOM, 2016.

Table E3.2-15b: 2040 Passenger Vehicle Emissions Reduction							
Emissions (TPY)							
VMT	CO	NO_x	VOC	PM_{10}	$PM_{2.5}$	SO_2	CO_2 Eq.
Houston Trip Emissions							
1,357,881,279	937.3	26.3	81.7	49.4	8.8	2.0	291,898
Dallas Trip Emissions							
1,194,638,721	1,153.1	44.4	84.2	43.4	8.3	1.8	264,249
TOTAL	**2,090.4**	**70.7**	**165.8**	**92.8**	**17.1**	**3.8**	**556,147**

Source: AECOM, 2016.

NET OPERATIONAL EMISSIONS

The train operation emissions represent increases in emissions due to the proposed action. The vehicle emissions reduction represents emissions reduced by the proposed action. The vehicle VMT reduction emissions were subtracted from the train operation emissions to calculate the net emissions due to the proposed action. **Table E3.2-16** below shows the results using the 2024 and 2040 train operations emissions factors and the 2024 and 2040 passenger vehicles emissions reductions calculated above.

Table E3.2-16: Net Operational Emissions					
NO_x	VOC	PM10	SO_2	CO	$CO_{2eq.}$
Year 2024 (Initial Service Level)					
(160.3)	(178.3)	(53.9)	110.2	(3,464)	(375,808)
Year 2040 (Future Service Level)					
(53.8)	(161.4)	(89.7)	30.3	(2,060)	(459,401)

Source: AECOM, 2016.

As shown, there are net reductions of all the estimated criteria pollutants except SO_2. This is commonly the case in other high speed rail projects, comparing train power consumption emissions vs vehicle emissions[19,20,21]. This net increase in SO_2 occurs because electric power generation from coal produces significantly more SO_2 than other forms of power generation and passengers vehicles produce very little SO_2 due to the nature of the fuel, its refinement, and car emission controls. Even in places where coal constitutes a small percentage of power generation, such as California, power consumption for traction and station power still produces more SO_2 than vehicles eliminated by travel mode shift[22]. The emissions are relatively small, no counties in the project area are in nonattainment of the SO_2 standard, and the proposed action results in net reduction of all the other pollutants. The net result of the proposed action is that emissions for

[19] California High-Speed Rail Authority and USDOT Federal Railroad Administration. 2012. FINAL California High-Speed Train Project Environmental Impact Report/Environmental Impact Statement, Merced to Fresno Section Project EIR/EIS

[20] Florida High-Speed Rail Authority and USDOT Federal Railroad Administration. 2005. Final Environmental Impact Statement. Florida High Speed Rail Tampa to Orlando.

[21] USDOT Federal Railroad Administration. 2011. Final Environmental Impact Statement and Final Section 4(f) Evaluation for the Proposed DesertXpress High-Speed Passenger Train Victorville, California to Las Vegas, Nevada

[22] ibid California High-Speed Rail Authority and USDOT Federal Railroad Administration 2012

most pollutants would be reduced over the long term. Therefore no adverse significant impact is expected from the proposed action.

GENERAL CONFORMITY OPERATIONAL EMISSIONS

The conformity analysis focuses on the criteria pollutants for which nonattainment is designated, and for the NAAs at both ends of the project alignment (HGB and DFW) and the one in the middle (Freestone-Anderson). Not all of the proposed project length is located in a NAA. Therefore, the emissions attributable to the NAAs in the project had to be estimated. The following describes the estimate of the portion of operational emissions that would occur in the HGB, DFW and Freestone-Anderson NAAs. It should be noted that the project only traverses through the Freestone County portion of the Freestone-Anderson NAA.

Train General Conformity Emissions

The general conformity (GC) regulations in 40 CFR 93, states at Rule 93.153(d)(1) that the portion of an action that includes major or minor new or modified stationary sources that require a permit under the new source review (NSR) program or the prevention of significant deterioration program of the CAA, is exempt from the GC rules. Power plants are permitted as stationary sources under these programs and emissions from them would therefore be exempt. Therefore, power plant emissions from electricity demand by the HSR train would be exempt. However, the operational analysis included the power plant emissions for demonstration, even though they do not technically apply to determining GC applicability. The emissions due to train and station power consumption of electricity from the power grid are relatively indirect effects spatially since they occur at distant power plants located away from the proposed project. These emissions would occur at the power plants meeting the operational demand at any particular time that the trains and stations are operating, which can be any number of regional power plants connected to the ERCOT grid. The interconnectivity and power demand management across the ERCOT sub-region make it impractical to identify or directly attribute the HSR power demand throughout the year to any particular set of power plants within ERCOT. The proposed substations would also be distributed along the HSR alignment across the 10 project counties, further complicating attribution to specific power plants.

However, assumptions can be made and analyzed about the fraction of power used by HSR operations being supplied by power plants in the NAA counties. The EPA eGRID database contains plant-level statistics by subregion that was used to calculate the fractions under two basic assumptions. The most current data (2012) was used.[23] The following summarizes those assumptions and the resulting effect on NAA NO_x, VOC, and SO_2 emissions.

Assumption 1: Uniform Demand on ERCOT Plants – This assumes the entire HSR operation draws power from the ERCOT grid uniformly, and the proportion of HSR power drawn from plants in the NAA reflects the percentage of annual power generated that the NAA plants generate compared to total ERCOT annual power generation. For this assumption, generation from the plants in all 8 HGB counties was used for the HGB percent, generation in the Freestone county power plant, and generation from all 10 DFW counties was used for the DFW percent. Drawing from NAA-wide

[23] U.S. Environmental Protection Agency (EPA). 2016. eGRID. Online database available at https://www.epa.gov/energy/egrid (Accessed February 2016)

plants was assumed because plants and power distribution to demand areas within the NAAs tend to be more regionally spread rather than concentrated in individual counties, larger plants that meet higher demands tend to be located in less populated counties, and such indirect emissions in non-project counties would still occur within the NAA. The emissions were calculated using the current and projected 2040 EFs, for comparison. The results are provided in **Tables E3-17a** and **b** below:

Table E3-17a: Assumption 1 Train Operation General Conformity Emissions - 2024									
				Annual Emissions (tons)					
Region	Annual Generated (MWh)	% of ERCOT MWh	Portion of Annual HSR Power Consumption	Current EFs			2040 EFs		
ERCOT	360,221,517			NOx	VOC	SO_2	NOx	VOC	SO_2
DFW NAA	28,859,992	8%	30,329	9	1	-	3	0.4	-
HGB NAA	76,009,178	21%	79,879	24	2	-	9	1.1	-
Freestone NAA (SO_2 only)	12,593,140	3%	13,234	-	-	13		-	4.0

Source: AECOM, 2016.

Table E3-17b: Assumption 1 Train Operation General Conformity Emissions - 2040									
				Annual Emissions (tons)					
Region	Annual Generated (MWh)	% of ERCOT MWh	Portion of Annual HSR Power Consumption	Current EFs			2040 EFs		
ERCOT	360,221,517			NOx	VOC	SO_2	NOx	VOC	SO_2
DFW NAA	28,859,992	8%	37,426	**11**	**1**	**-**	**1**	**0.4**	**-**
HGB NAA	76,009,178	21%	98,570	**30**	**3**	**-**	**4**	**0.9**	**-**
Freestone NAA (SO_2 only)	12,593,140	3%	16,331	**-**	**-**	**16**	**-**	**-**	**1.2**

Source: AECOM, 2016.

Assumption 2: Station and TMF on Location, Traction Along Alignment – This assumes that the traction power of the HSR operation draws power uniformly from plants along the alignment evenly. However, the station, TMFs, and a maintenance-of-way (MOW) facility associated with each TMF, which comprise 28 percent of the daily demand, are assumed to draw from plants in their respective locations. The major stations in Houston and Dallas, which are in NAAs comprise 17 percent of the FSL daily demand, while the mid-point station in Grimes, representing 2 percent of the daily demand is not in an NAA. There are no stations in the Freestone NAA. The TMFs which together comprise 11 percent of the FSL daily demand are at the Dallas and Houston ends of the project. The other train components, such MOW facilities along the alignment, and signaling houses comprise 14 percent of FSL daily demand, are evenly distributed along the alignment, and are included with traction power in the calculation and apportionment. The percentages of daily demand for the ISL scenario are very similar to those for the FSL. The results are provided in **Table E3-18** below.

Table E3-18: Assumption 2 Train Operation General Conformity Emissions

Table E3-18a: Trackside Power Consumption				
	ISL		FSL	
Component	% Daily Demand	Portion of Annual HSR Power Consumption	% Daily Demand	Portion of Annual HSR Power Consumption
Traction	45%	172,029	56%	260,610

MOW	3%	13,184	3%	13,184
Switching & subs	11%	42,081	9%	42,081
Signaling	3%	10,156	2%	10,156
Totals	63%	237,449	70%	326,031

Source: AECOM, 2016.

Table E3-18b: Distribution on Plants Along Alignment

County	NAA	%	Portion of Trackside Consumption ISL	Portion of Trackside Consumption FSL
Dallas	DFW	17%	39,575	54,338
Ellis	DFW	17%	39,575	54,338
Freestone	FRE	17%	39,575	54,338
Limestone	-	17%	39,575	54,338
Grimes	-	17%	39,575	54,338
Harris	HGB	17%	39,575	54,338
	Totals	100%	237,449	326,031
		DFW Total	79,150	108,677
		HGB Total	39,575	54,338
		FRE Total	39,575	54,338

Source: AECOM, 2016.

Table E3-18c: Station and Maintenance Facilities

Facility	NAA	% Daily Demand	Portion of Annual HSR Power Consumption
ISL (Year 2024)			
Dallas Station	DFW	10.6%	40,126
Houston Station	HGB	10.6%	40,126
Grimes Station	-	3%	11,306
Dallas TMF + 1 MOW	DFW	6.5%	24,777
Houston TMF + 1 MOW	HGB	6.5%	24,777
	Totals	37%	141,113
		DFW Total	64,903
		HGB Total	64,903
FSL (Year 2040)			
Dallas Station	DFW	8.6%	40,126
Houston Station	HGB	8.6%	40,126
Grimes Station	-	2%	11,306
Dallas TMF + 1 MOW	DFW	5.3%	24,777
Houston TMF + 1 MOW	HGB	5.3%	24,777
	Totals	30%	141,113
		DFW Total	64,903
		HGB Total	64,903

Source: AECOM, 2016.

Table E3-18d: DFW and HGB NAA Total Trackside, Station, & TMF Power and Emissions					
		Portion of Annual HSR Power Consumption	Annual Emissions (tons)		
			NOx	VOC	SO_2
ISL (Year 2024)					
Current Emissions Factors	DFW	144,053	43.8	3.8	
	HGB	104,478	31.8	2.7	
	FRE	39,575			38.1
2024 EFs	DFW	16.6	2.0		16.6
	HGB	12.0	1.5		12.0
	FRE			11.9	
FSL (Year 2040)					
Current Emissions Factors	DFW	173,580	52.8	4.5	
	HGB	119,242	36.3	3.1	
	FRE	54,338			64.6
2040 EFs	DFW	173,580	6.3	1.6	
	HGB	119,242	4.3	1.1	
	FRE	54,338			4.0

Source: AECOM, 2016.

As shown, in none of the assumptions of distribution or assumptions of emissions factors do the annual emissions apportioned to the DFW or HGB NAAs exceed the *de minimis* thresholds of 100 tons for a moderate NAA, nor do those apportioned to the Freestone NAA exceed the *de minimis* thresholds of 100 tons for its nonattainment designation. Texas power plants in the future would continue to improve emissions and derive a greater percentage of power from non-combustion sources; therefore, they would more closely reflect the projected 2024 and 2040 emissions than emissions with current EFs. Even absent of the improvements, train operation emissions would not be expected to exceed *de minimis* thresholds for NO_x, VOC, or SO_2.

Vehicle Emissions Reduction General Conformity Emissions

Since vehicle emissions are directly tied to the vehicle travel producing the emissions, those emissions occurring in NAAs can be more readily estimated geographically than power plant emissions. The segments of IH-45 within the DFW, HGB and FRE NAAs used to conduct the city center-to-city center trips discussed in Table 3-37 above would be the location where such emissions would take place. These are emissions within the NAAs that would have occurred in the absence of the HSR. The geospatial data used in the vehicle emissions reduction analysis was used to calculate the segment lengths in the HGB NAA, in the DFW NAA, and in the FRE NAA. IH-45 passes through the counties listed in **Tables E3-19a** through **f** below. Conceptually, the vehicle activity in each NAA would be comprised of local cars leaving, then returning to the NAA, and visiting cars arriving then departing the NAA through the associated lengths of IH-45 for the HGB and DFW NAAs. For the FRE NAA, conceptually, the vehicle activity would be comprised of cars passing through Freestone County from Dallas going to Houston and vice versa. The segment lengths, arriving/leaving assumptions and numbers of annual vehicles from **Table E3.2-9**, were used to calculate the VMT. The same EFs and methodology described in Vehicle Emissions

Reduction section were then used to calculate the emissions. **Tables E3-19a** through **f** below provides the results of the estimated emissions.

Table E3-19: Vehicle Emissions Reduction General Conformity Emissions

Table E3-19a: DFW NAA IH-45 Miles and VMT		
Dallas County miles	17.9	
Ellis County miles	23.5	
Total length in NAA	41.4	
Dallas vehicle travel miles leaving for Houston	41.4	
Dallas vehicle travel miles returning from Houston	41.4	
Total Dallas vehicle trip miles	82.8	
	ISL	**FSL**
Dallas no. of vehicles	1,527,316	2,499,244
Dallas vehicle VMT	126,400,689	206,837,449
Houston vehicle miles arriving	41.4	
Houston vehicle miles departing	41.4	
Total Houston vehicle trip miles	82.8	
	ISL	**FSL**
Houston no. of vehicles	1,736,018	2,840,756
Houston vehicle VMT	143,672,833	235,100,951
DFW NAA VMT	**270,073,522**	**441,938,400**

Source: AECOM, 2016.

Table E3-19b: DFW NAA Vehicle Emissions Reduction	
Emissions (TPY)	
NOx	**VOC**
ISL (2024)	
34.63	31.10
FSL (2040)	
12.23	28.71

Source: AECOM, 2016.

Table E3-19c: HGB NAA IH-45 Miles and VMT		
Montgomery County miles	27.9	
Harris County miles	56.8	
Total length in NAA	84.6	
Houston vehicle miles leaving for Dallas	84.6	
Houston vehicle miles returning from Dallas	84.6	
Total Houston vehicle trip miles	169.2	
	ISL	**FSL**
Houston no. of vehicles	1,736,018	2,840,756
Houston vehicle VMT	293,803,652	480,769,514
Dallas vehicle miles arriving	84.6	
Dallas vehicle miles departing	84.6	
Total Dallas vehicle trip miles	169.2	
	ISL	**FSL**
Dallas no. of vehicles	1,527,316	2,499,244

Dallas vehicle VMT	258,482,994	422,972,086
HGB NAA VMT	**552,286,646**	**903,741,600**

Source: AECOM, 2016.

Table E3-19d: HGB NAA Vehicle Emissions Reduction	
HGB Emissions (TPY)	
NOx	**VOC**
ISL (2024)	
73.39	66.28
FSL (2040)	
25.02	58.71

Source: AECOM, 2016.

Table E3-19e: FRE NAA IH-45 Miles and VMT		
Freestone County miles	31.9	
Dallas veh. miles heading for Houston	31.9	
Dallas veh. miles returning from Houston	31.9	
Total Dallas veh. trip pass through miles	63.8	
	ISL	**FSL**
Dallas no. vehicles	1,527,316	2,499,244
Dallas vehicle VMT	97,442,774	159,451,779
Houston veh. miles heading for Dallas	31.9	
Houston veh. miles returning from Dallas	31.9	
Total Houston veh. trip pass through miles	63.8	
	ISL	**FSL**
Houston # veh.	1,736,018	2,840,756
Houston veh. VMT	110,757,935	181,240,221
FRE NAA VMT	**208,200,709**	**340,692,000**

Source: AECOM, 2016.

Table E3-19f: FRE NAA Vehicle Emissions Reduction
FRE Emissions SO_2 (TPY)
ISL (2024)
0.45
FSL (2040)
0.50

Source: AECOM, 2016.

Net General Conformity Emissions

Using the 2024 and 2040 train operation emissions and vehicle emissions reduction for each NAA, the net operational emissions within each NAA was calculated with the two assumptions of train power draw on the power grid discussed above. The results are provided in **Table E3-20** and **Table E3-21** below. Under the assumption that the train draws uniformly from the ERCOT power grid, there would be net reductions in all pollutants. Under the assumption that the train draws power from stations along the track evenly and stations and TMFs draw from plants in the counties of their location, net reductions in all pollutants except NO_x were estimated. The increase in NO_x is comparatively negligible and well below the current moderate nonattainment threshold of 100 TPY. Considering these results, operational emissions of the regulated pollutants in NAAs due to the proposed action are below *de minimis* thresholds and a general conformity determination is not necessary.

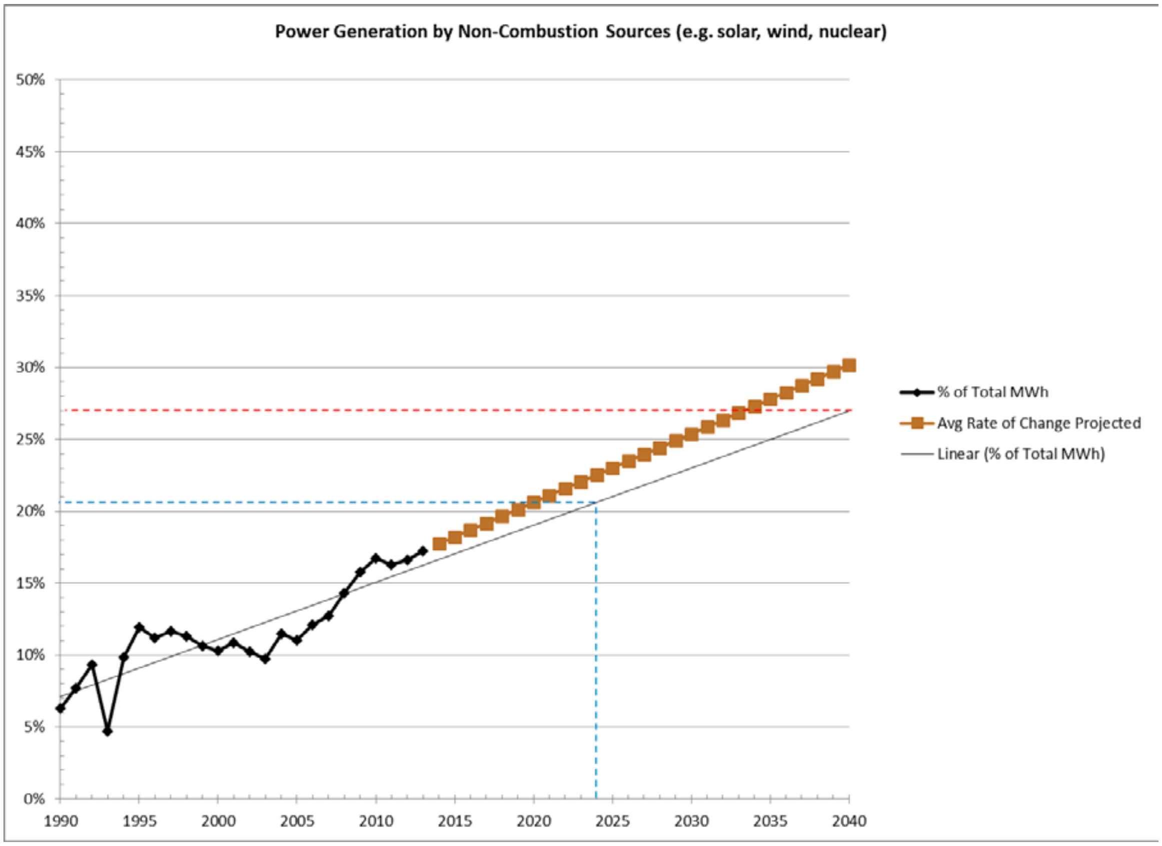
Table E3-20: Net General Conformity Emissions – 2024 (ISL)									
	Train Operation Emissions (tons)			Vehicle Emissions Reduction (TPY)			Net Emissions (TPY)		
NAA	**NOx**	**VOC**	**SO_2**	**NOx**	**VOC**	**SO_2**	**NOx**	**VOC**	**SO_2**
Assumption 1 – Uniform ERCOT Power									
DFW	3.5	0.4		34.6	31.1		-31.1	-30.7	
HGB	9.2	1.1		73.4	66.3		-64.2	-65.2	
FRE			4.0			0.45			3.52
Assumption 2 – Station and TMF on Location, Traction Along Alignment									
DFW	16.6	2.0		34.6	31.1		-18.1	-29.1	
HGB	12.0	1.5		73.4	66.3		-61.4	-64.8	
FRE			11.9			0.45			11.4

Source: AECOM, 2016.

Table E3-21: Net General Conformity Emissions – 2040 (FSL)									
	Train Operation Emissions (tons)			**Vehicle Emissions Reduction (TPY)**			**Net Emissions (TPY)**		
NAA	**NOx**	**VOC**	**SO_2**	**NOx**	**VOC**	**SO_2**	**NOx**	**VOC**	**SO_2**
Assumption 1 – Uniform ERCOT Power									
DFW	1.4	0.4		12.2	28.7		-10.9	-28.4	
HGB	3.6	0.9		25.0	58.7		-21.5	-57.8	
FRE			1.2			0.50			0.69
Assumption 2 – Station and TMF on Location, Traction Along Alignment									
DFW	6.3	1.6		12.2	28.7		-6.0	-27.1	
HGB	4.3	1.1		25.0	58.7		-20.7	-57.6	
FRE			4.0			0.50			3.5

Source: AECOM, 2016.

Figure E3.2-1: Texas Power Generation by Non-Combustion Sources



Source: EIA, Table 5 Electric power industry generation by primary energy source, 1990 through 2013 for State of Texas

Figure E3.2-2

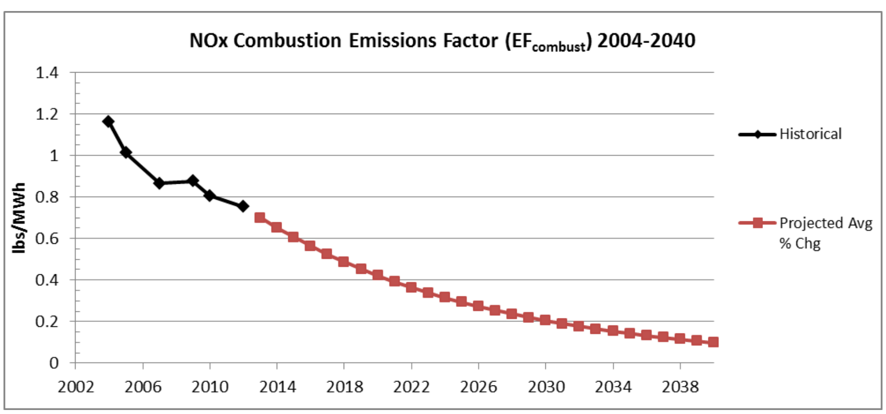


Figure E3.2-3

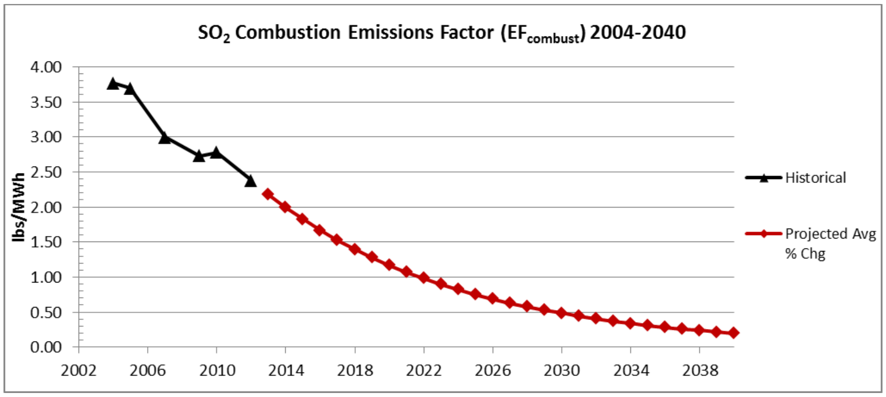


Figure E3.2-4

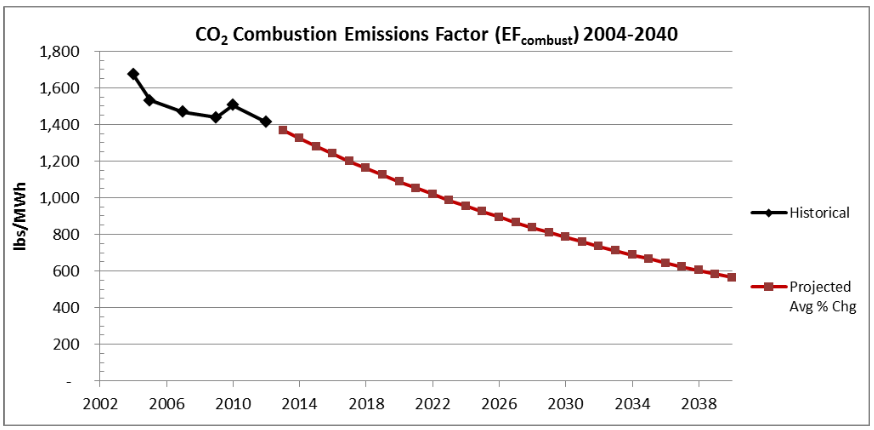


Figure E3.2-5

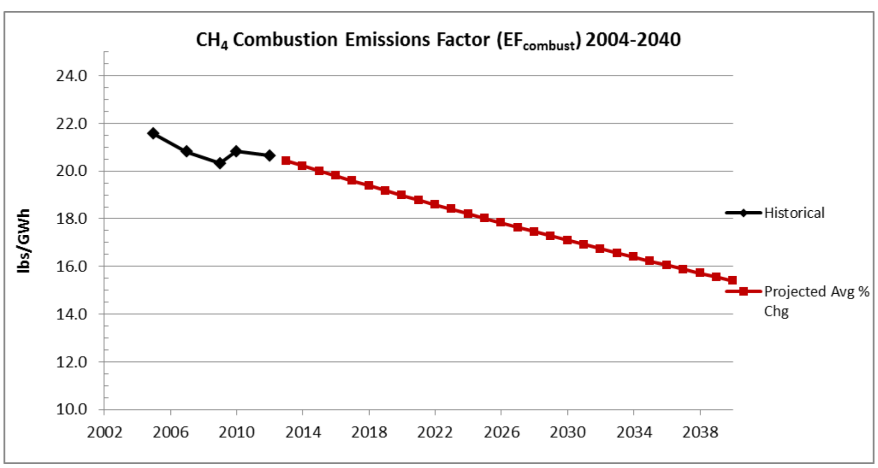


Figure E3.2-6

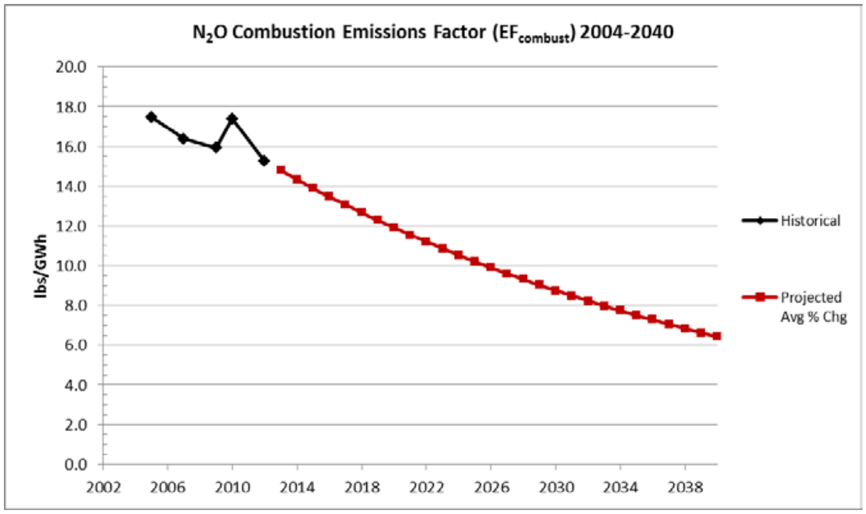


Figure E3.2-7

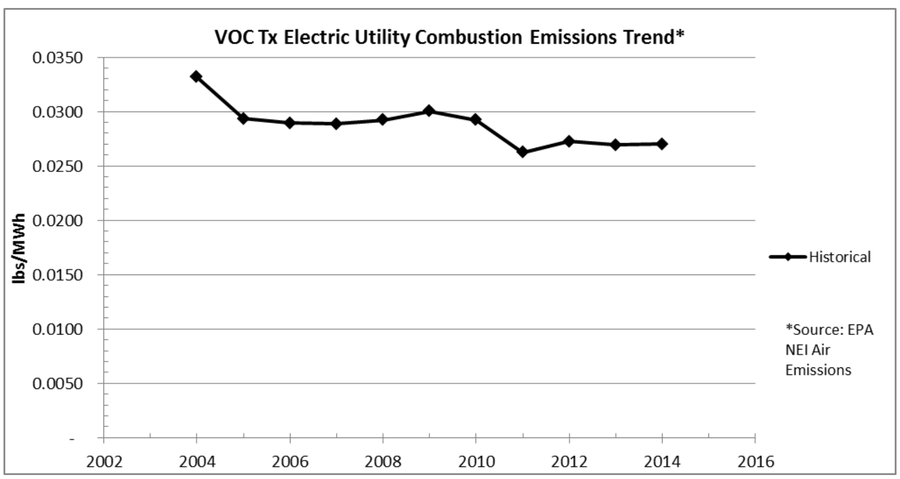


Figure E3.2-8

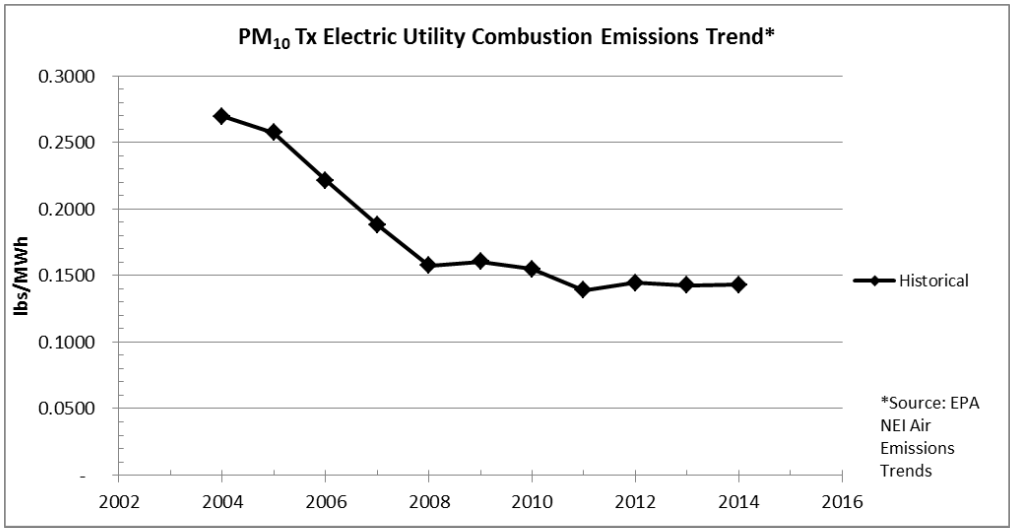
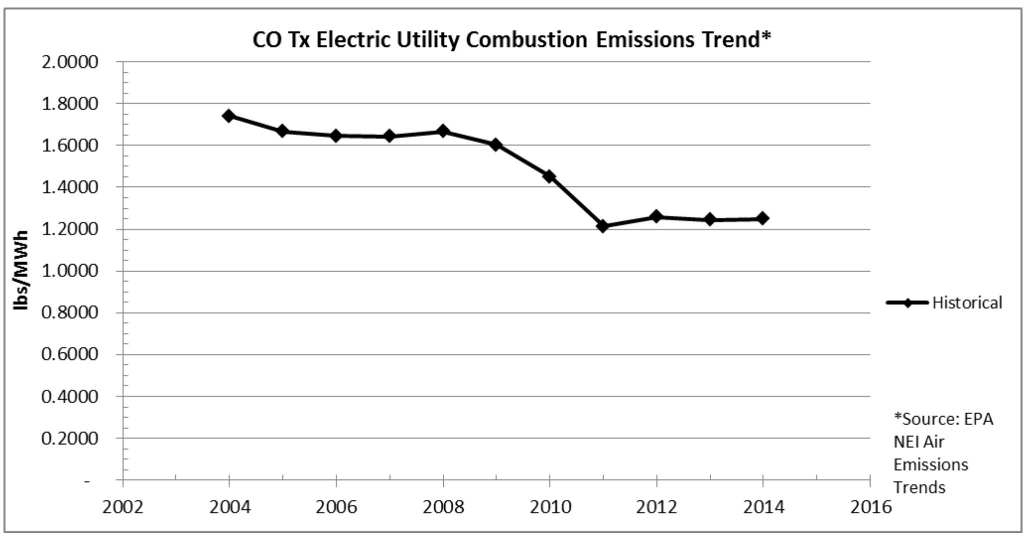


Figure E3.2-9



AECOM

TECHNICAL MEMORANDUM
NOISE AND VIBRATION

To: Jerry Smiley, AICP, AECOM

From: Lance Meister and David Towers, Cross Spectrum Acoustics

Date: November 1, 2017

RE: Dallas to Houston HSR –Noise and Vibration

Introduction

This technical report describes the existing noise and vibration conditions and impact analysis for operation and construction of the Dallas to Houston High-Speed Rail (HSR) Project along six alternative routes (A-F) through ten counties between Dallas and Houston, TX. Sensitive receptors or receivers along these routes include residential and institutional sites.

Regulatory Context

Several federal laws and guidelines are relevant to the assessment of ground transportation noise impacts:

- FRA Railroad Noise Emission Compliance Regulations (49 C.F.R.§ 210) prescribes minimum compliance regulations for enforcement of the Railroad Noise Emission Standards established by the Environmental Protection Agency in 40 C.F.R. Part 201
- The Noise Control Act of 1972 (42 U.S.C.§ 4910) was the first comprehensive statement of national noise policy. It declared "it is the policy of the U.S. to promote an environment for all Americans free from noise that jeopardizes their health or welfare."
- HUD Environmental Standards (24 C.F.R. Part 51) establishes standards for noise exposure used to assess the suitability of sites for new residential development
- OSHA Occupational Noise Exposure; Hearing Conversation Amendment (FR 48 (46), 9738—9785) establishes noise exposure limits in the work place
- EPA Railroad Noise Emission Standards (40 C.F.R. Part 201) establishes standards for noise emissions from railroads

For vibration, federal standards for safe vibration levels for residential buildings are limited to the safe blasting levels established by the U.S. Bureau of Mines (USBM RI 8507).

There are no state-wide noise or vibration regulations that apply to transportation systems. The TxDOT *Guidelines for Analysis and Abatement of Roadway Traffic Noise* applies to vehicular traffic. Texas does not have separate guidance for rail noise and vibration.

Local noise and vibration regulations are contained in city ordinances and general plans. Although noise and vibration from transportation systems are typically exempt from local regulations, noise and vibration from project construction activities and stationary sources (e.g., traction power substations) shall comply with the following local regulations:

City of Lancaster

Ordinance #2006-04-13 of the Lancaster Development Code includes environmental performance standards for both noise and vibration. Section 14.704 of the ordinance specifies noise limits of 56 dBA during daytime hours (7 AM – 7 PM) and 49 dBA during nighttime hours (7 PM – 7 AM) near property lines, which could be applied to stationary sources. Although there are no specific noise limits for construction activities, such noise is restricted to the hours between 6 AM and 9 PM. In addition, Section 14.708 of the ordinance includes property-line vibration standards based on frequency and ground displacement that could be applied to construction activities.

City of Wilmer

Section 8.06 of the Wilmer Code of Ordinances includes property-line limits on environmental sound levels from stationary sources in terms of A-weighted, statistical percentile noise metrics measured over a 10-minute to 30-minute period. These metrics include the L_1 (level exceeded 1 percent of the period), the L_{10} (level exceeded 10 percent of the period) and the L_{90} (level exceeded 90 percent of the period). The L_1 (near maximum) noise level from stationary sources is limited to 15 dBA above the ambient L_{90} (background) noise level. There are also L_{10} and L_{90} limits based on land use and time of day. For residential land use, the L_{10} and L_{90} limits are 65 dBA and 55 dBA, respectively, during daytime hours (7AM – 10 PM) and 60 dBA and 50 dBA, respectively, during nighttime hours (10 PM – 7 AM). For construction work, the L_{10} and L_{90} limits are 85 dBA and 75 dBA, respectively, at any time.

City of Houston

Chapter 30 of the City of Houston Code of Ordinances specifies noise limits of 65 dBA and 58 dBA at residential property lines for daytime and nighttime periods, respectively. However, noise from railroad equipment on railroad ROWs is exempted. Noise from construction between the hours of 7 AM and 8 PM is also exempted, provided the noise levels do not exceed 75 dBA at residential property lines.

Overview

For the No Build Alternative, existing sources throughout the study area (e.g. highways and freight trains) would continue to generate noise and vibration in the future. In addition, noise and vibration levels may increase, depending on changes in highway and rail traffic as well as the construction of any new transportation facilities unrelated to the Project. While there is insufficient information currently available to determine if there would be any noise or vibration impacts in the future from these and other sources, any significant projects that might be included in the No Build Alternative would have a separate environmental assessment to determine noise or vibration impacts and potential mitigation measures, if required.

As a summary of the assessment for the Build Alternatives with no mitigation, **Table 1-1** provides a comparison of the projected noise and vibration impacts from HSR operations by Build Alternative and land use. As shown in the table, HSR operations are projected to result in severe noise impacts at 15-19 residences and moderate noise impacts at 231-261 residences, depending on the route. In addition, moderate noise impact is predicted at one institutional site for all alternatives. No vibration impact is predicted from HSR operations for any of the Build Alternatives, and no noise or vibration impacts are anticipated due to activities at any of the proposed train station locations.

Table 1-1: Comparison of Noise and Vibration Impacts by Build Alternative

Type of Impact		Alt A	Alt B	Alt C	Alt D	Alt E	Alt F
Severe Noise Impact	Residential	17	19	15	17	19	15
	Institutional	0	0	0	0	0	0
Moderate Noise Impact	Residential	247	261	242	236	250	231
	Institutional	1	1	1	1	1	1
Vibration Impact	Residential	0	0	0	0	0	0
	Institutional	0	0	0	0	0	0

Source: Cross-Spectrum Acoustics, 2016

With regard to the effects of noise from passing trains on animals, noise impact would be expected to occur only within about 15 feet from the tracks for HSR trains operating on viaduct at the maximum speed of 205 mph. Because no animals would be this close to the tracks, noise impact on wildlife is not anticipated. Similarly, increased annoyance due to the startle effect of noise from rapidly passing trains at the maximum train speed of 205 mph would only occur within about 45 feet from the tracks, which is within the ROW. Therefore, increased noise annoyance due to startle should not be an issue.

In terms of HSR noise mitigation, the results of the assessment indicate that that the impact locations tend to be scattered geographically such that the use of sound barriers as a practical mitigation measure may be limited. However, the application of sound barriers at specific locations will be investigated as the engineering design advances and the alternatives are refined. Where sound barriers are not practical, building sound insulation would be the most likely noise mitigation alternative.

The results of the vibration impact assessment indicate that no impacts are projected from HSR operations. Therefore, no operational vibration mitigation is required.

During Project construction, the potential for noise impact at residential sites would extend to distances of 40-200 feet from daytime construction and to distances of 125-630 feet from nighttime construction, depending on the activity. Although some activities may cause noticeable ground-borne vibration, it is unlikely that such activities would occur close enough to sensitive structures to have any significant damage effects. However, there is some potential for vibration annoyance or interference with the use of sensitive equipment at locations up to 500 from certain construction activities. To mitigate potential construction noise and vibration impacts, construction activities will be carried out in compliance with all applicable local regulations and appropriate mitigation measures will be applied.

NOISE AND VIBRATION CONCEPTS

This section describes the characteristics of transportation-related noise and vibration and the associated noise and vibration metrics.

Noise

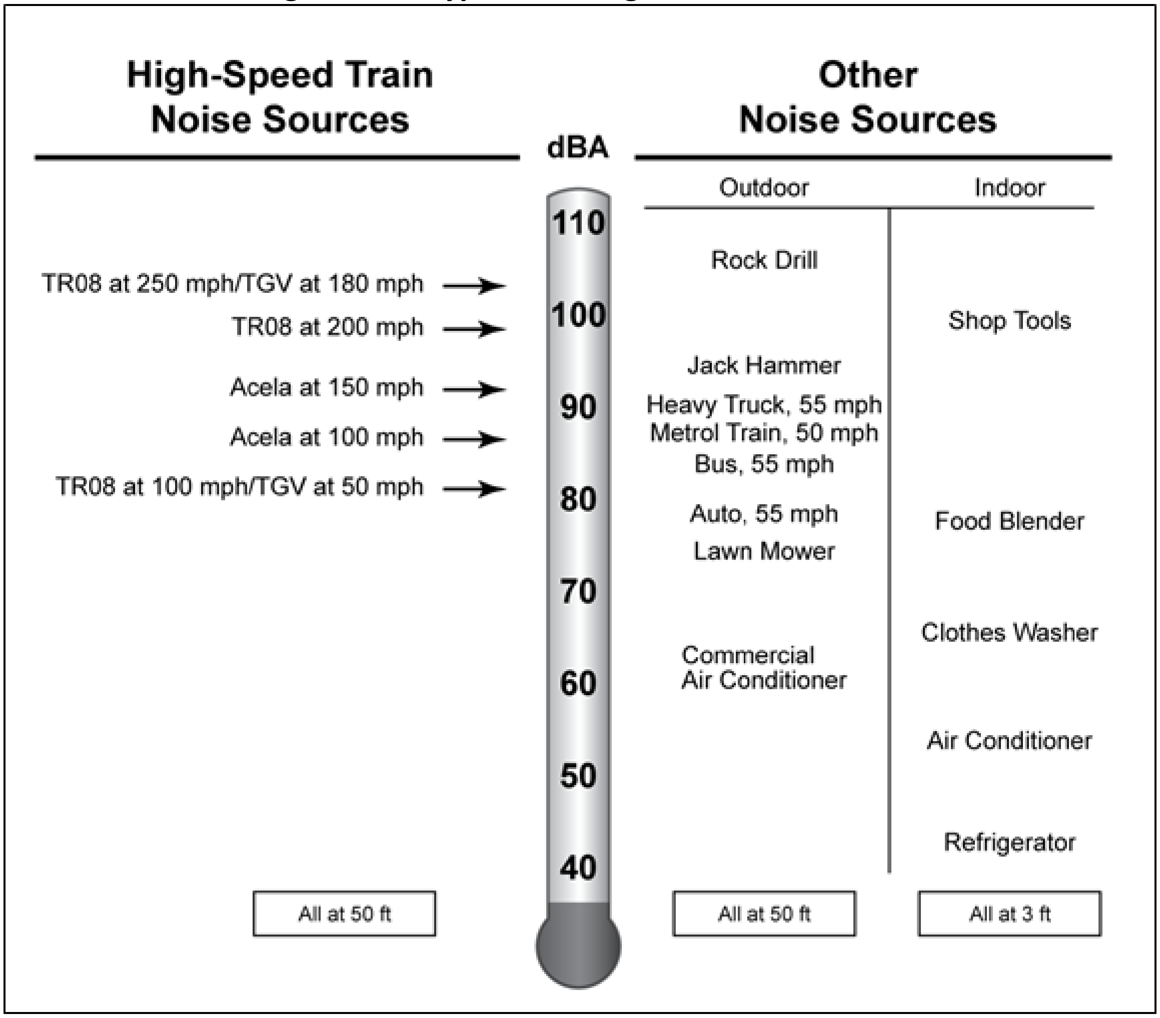
Noise Fundamentals and Descriptors

Sound is mechanical energy transmitted by pressure waves in a compressible medium such as air. Noise is generally defined as unwanted or excessive sound. Environmental noise sources may include traffic, aircraft, industrial activities, other human activity, or sounds in nature. Distant sources of noise combine to create background noise. Background noise may be fairly constant from moment to moment, and varies gradually from hour to hour as the activity levels of the distant noise sources change. Superimposed on the background noise is a succession of identifiable noisy events of relatively brief duration that are either near to a receiver or are of sufficiently high amplitude to dominate the noise environment at a location. Examples include the passing of a train, the over-flight of an airplane, the sound of a horn or siren, the barking of a dog, landscape maintenance activities, or the screeching of brakes. The descriptors used in the measurement of noise environments are summarized below.

Sound can vary in intensity by over one million times within the range of human hearing. Because the range of actual sound pressures is so large (e.g. the sound pressure of a painful sound can be over one million times the sound pressure of the quietest sound that a human can hear), sound intensity is normally presented in a more manageable range by using the ratio between the sound pressure of the source of interest (e.g., passenger and freight trains) or background noise and a reference pressure (which approximates the quietest sound that a human can hear), and expressing this ratio in logarithmic form. The basic unit for measuring environmental sound levels is the decibel (dB).

Sound is characterized by both its amplitude and frequency (or pitch). The human ear does not hear all frequencies equally. In particular, the ear deemphasizes low and very high frequencies. In the 1930s, acoustical scientists studied the way that humans hear various sounds and developed response characteristics to represent the sensitivity of a typical ear. The “A” curve or “A-weighting scheme” represents the sensitivity of the human ear to various frequencies of environmental noise. A-weighting tends to deemphasize sounds of very low or very high frequencies and emphasize sound at middle frequencies. Sound levels that have been weighted according to the A-curve are expressed as A-weighted decibels (dBA). On this scale, the human range of hearing extends from approximately 3 dBA to around 140 dBA. **Figure 2–1** presents examples of A-weighted sound levels from high-speed train sources and common indoor and outdoor sounds.

Figure 2–1: Typical A-Weighted Sound Levels



Source: FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012.

As noted above, sounds in the environment constantly change. Various noise descriptors have been developed to allow the comparison of different types of environmental noise and to define noise emissions. The descriptors used in this report are described below:

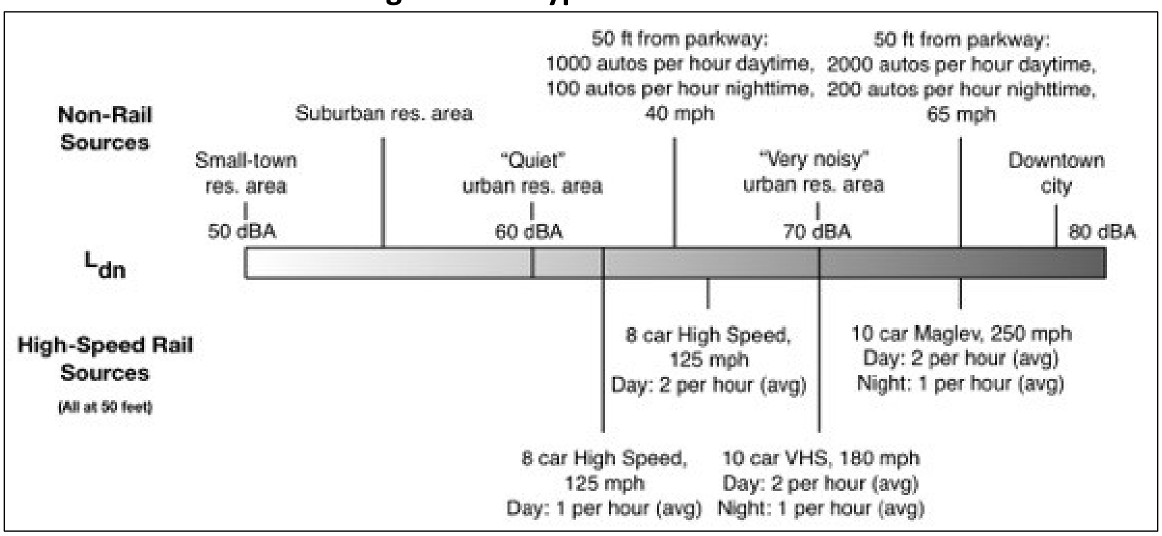
Maximum Sound Level (Lmax): The Lmax is the highest noise level achieved during a noise event or measurement period. Standard sound level meters have two settings, FAST and SLOW, which represent different time constants. For trains, Lmax measured using the FAST setting will typically be 1 to 3 dB greater than Lmax using the SLOW setting. Lmax values expressed in this report refer to the SLOW setting, which uses a time constant of 1 second.

Sound Exposure Level (SEL): The SEL describes a receiver's cumulative noise exposure from a single noise event. It is represented by the total A-weighted sound energy during the event, normalized to a one-second interval. It is the primary descriptor for low- and high-speed rail vehicle noise emissions, and is also a useful intermediate quantity for estimating the Leq and Ldn due to train pass-bys.

Equivalent Sound Level (Leq): Leq describes a receptor's cumulative noise exposure from noise events that occur during a specified period of time. It is sometimes referred to as the energy-average sound level. The Leq represents a constant sound that, over a specified period, has the same sound energy as the time-varying sound. The Hourly Equivalent Sound Level, Leq(h), is a measure of the accumulated sound exposure over a full hour. The Federal Highway Administration (FHWA) uses the peak traffic Leq(h) as the metric for establishing highway noise impact. The Federal Railroad Administration (FRA) uses Leq(h) to evaluate potential noise impacts to institutional land uses and to land uses where serenity and quiet are essential.

Day-Night Sound Level (Ldn): Ldn describes the cumulative noise exposure from those noise events that occur within a 24-hour period, with noise levels between 10 p.m. and 7 a.m. increased by 10 dB to account for greater nighttime sensitivity to noise. The effect of the penalty is that, when calculating Ldn, any event that occurs during the nighttime is equivalent to 10 of the same event during the daytime. Ldn is the most common measure of total community noise over a 24-hour period and is used by the Federal Railroad Administration (FRA) to evaluate potential noise impacts from proposed high-speed train projects at residential locations. Typical Ldn values for high-speed rail and non-rail sources are shown in **Figure 2-2**.

Figure 2–2: Typical Ldn Values

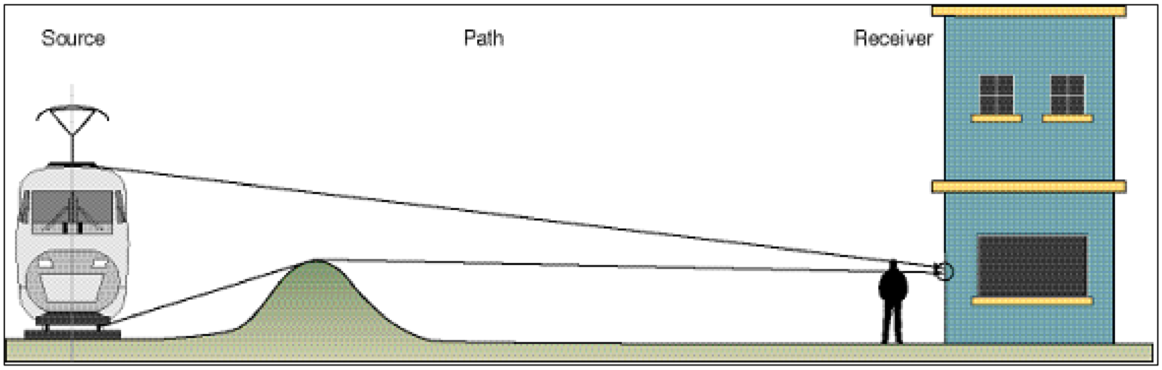


Source: FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012.

Transportation Noise

Highways and rail lines tend to be the most dominant noise sources when located in a typical community environment. Each source has distinctive noise characteristics with regard to both pitch and amplitude. Within the project area, areas along both sides of the proposed alignment would be exposed to existing highway and rail noise. Noise from a source can be evaluated in terms of a Source-Path-Receiver framework, as illustrated in **Figure 2–3**, in which the source of noise is a train moving on its tracks. The path describes the intervening course between the source and the receiver, wherein the noise levels are reduced by distance, topographical and man-made obstacles, reflections from surfaces, atmospheric effects, and other factors. At each receiver, the noise from all sources and source paths combines and comprises the noise environment at that location.

Figure 2–3: Source-Path-Receiver



Source: FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012.

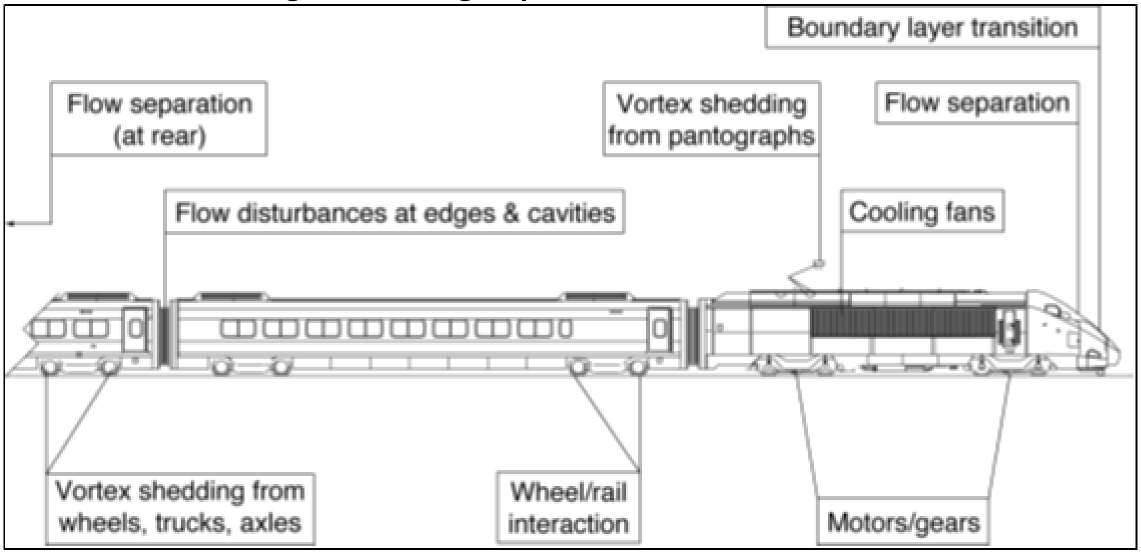
The noise from a train moving on its tracks is produced by several individual noise-generating mechanisms, each with its own characteristics (in terms of location, intensity, frequency content, directivity, and speed dependence) that depend on the train type. The most common train types include freight, commuter rail, light rail and high-speed rail. Conventional train noise sources would include locomotives, wheel/rail interaction, and audible warning devices at grade crossings, including train horns and warning bells.

For high speed rail, train noise characteristics are speed-dependent. For speeds below about 40 miles per hour (mph), referred to as Regime I by FRA guidance, noise emissions are dominated by the propulsion units, cooling fans, and under-car and top-of-car auxiliary equipment, such as compressors and air conditioning units.

In the speed range from 60 mph to about 150 mph, referred to as Regime II, mechanical noise, resulting from wheel/rail interaction and structural vibrations, dominates the noise emission from trains. In the project area, existing trains seldom exceed 79 mph; therefore, this speed range is the top end of noise characteristics for trains with which most people are familiar.

The aerodynamic noise component begins to be an important factor when the train speed exceeds about 160 mph (referred to as Regime III). Aerodynamic noise is generated from high-velocity airflow over the train. For a conventional steel-wheeled train, the components of aerodynamic noise are generated by unsteady flow separations at the front and rear of the train and on structural elements of the train (mainly in the regions encompassing the trucks, the pantograph, inter-coach gaps, and discontinuities along the surface), and a turbulent boundary layer generated over the entire surface of the train. The distribution of noise sources on a typical high-speed train is shown in **Figure 2–4**.

Figure 2–4: High-Speed Train Noise Sources



Source: FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012.

Noise from trains also depends on the type and configuration of the track structure. Typical noise levels refer to conventional rail operations at grade on ballast and tie track. For trains on elevated structures, train noise is increased, partially due to the loss of sound absorption by the ground and partially due to extra sound radiation from the bridge structure. Moreover, the sound from trains on elevated structures spreads about twice as far as it does from at-grade operations of the same train, because the sound source is higher above the ground and, therefore, is less affected by ground attenuation and shielding.

Horns are an example of a train noise source that is dominant at any train speed. Audible warning devices at grade crossings, including train horns and warning bells, are a common feature of conventional trains and a vital safety component of railroad operations. Persons living near railroad tracks often find horns to be annoying.

Another source of potential annoyance is wheel squeal that is produced by wheel-rail interaction, particularly on a curve where the radius of curvature is smaller than 100 times the truck length. According to the predecessor to FTA, a typical truck length for freight trains of about 5-1/2 feet (1.7 meters) and radius of curvature greater than 560 feet (170 meters) would not be expected to produce wheel squeal. Wheel squeal is normally an issue with transit systems where small-radius curves often occur. Freight trains and modern high-speed train tracks are typically designed to minimize this occurrence by limiting track curvature and incorporating design features such as canting at the curve to reduce wheel flange contact with the rail.

Noise from road traffic is generated by a wide variety of vehicle types, makes, and models. In general, the noise associated with highway vehicles can be divided into three vehicle classes: automobiles, medium trucks, and heavy trucks. Each class has its own noise characteristics depending on vehicle type, speed, and the condition of the roadway surface. These noise characteristics have been documented by FHWA. The noise from nearby and distant arterial streets and highways is a major source of background sound in an urban/suburban environment.

Ground-borne Vibration

Vibration Fundamentals and Descriptors

Ground-borne vibration from trains refers to the fluctuating or oscillatory motion experienced by persons on the ground and in buildings near railroad tracks. Vibration can be described in terms of displacement, velocity, or acceleration. Displacement is the easiest descriptor to understand. For a vibrating floor, the displacement is simply the distance that a point on the floor moves away from its static position. Velocity represents the instantaneous speed of the floor movement, and acceleration is the rate of change of the speed. Although displacement is easier to understand, the response of humans, buildings, and equipment to vibration is more accurately described using velocity or acceleration.

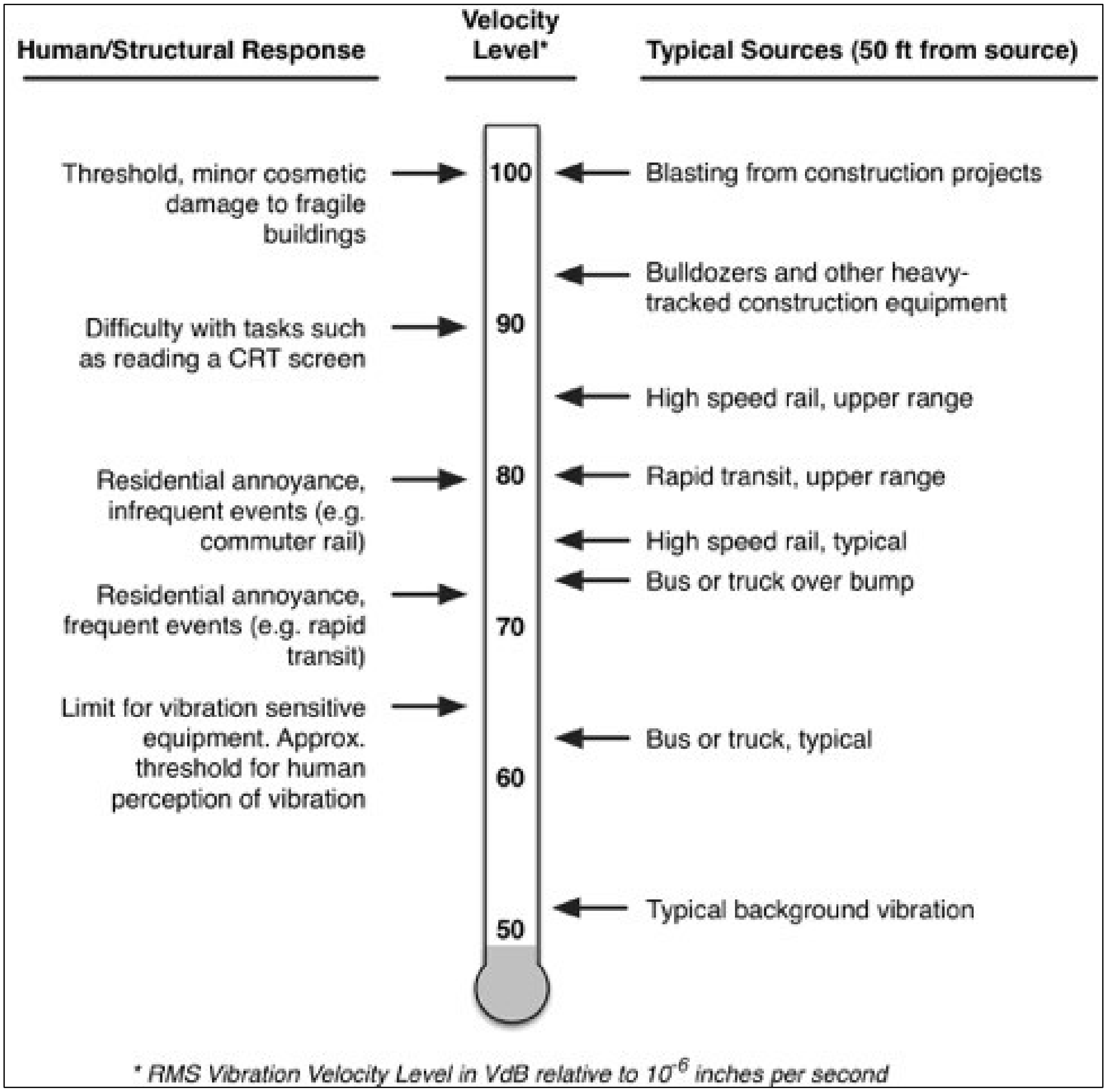
Two methods are used for quantifying vibration. The peak particle velocity (PPV) is defined as the maximum instantaneous positive or negative peak of the vibration signal. PPV often is used in monitoring of blasting vibration, since it is related to the stresses experienced by buildings. Although PPV is appropriate for evaluating the potential of building damage, it is not suitable for evaluating human response. It takes some time for the human body to respond to vibration impulses. In a sense, the human body responds to an average of the vibration amplitude. Because the net average of a vibration signal is zero, the root mean square (RMS) amplitude is used to describe the "smoothed" vibration amplitude.

PPV and RMS velocities are normally described in inches per second in the U.S. and in meters per second in the rest of the world. Although it is not universally accepted, decibel notation is in common use for vibration. Decibel notation compresses the range of numbers required to describe vibration. Vibration levels in this report are referenced to 1 x 10-6 inches per second (in/sec). Although not a universally accepted notation, the abbreviation "VdB" is used in this document for vibration decibels to reduce the potential for confusion with sound decibels.

Common vibration sources and human and structural response to ground-borne vibration are illustrated in **Figure 2-5**. Typical vibration levels can range from below 50 VdB to 100 VdB (0.000316 in/sec to 0.1 in/sec). The human threshold of perception is approximately 65 VdB.

Ground-borne noise is a low-volume, low-frequency rumble inside buildings, resulting when ground vibration causes the flexible walls of the building to resonate and generate noise. Ground-borne noise is normally not a consideration when trains are elevated or at grade. In these situations, the airborne noise usually overwhelms ground-borne noise, so the airborne noise level is the major consideration. However, ground-borne noise becomes an important consideration where there are sections of the corridor that are in a tunnel or where sensitive interior spaces are well-isolated from the airborne noise. In these situations, airborne noise is not a major path and ground-borne noise becomes the most important path into the building. Ground-borne noise may also need to be considered in cases where the airborne noise from a project is mitigated by a sound wall.

Figure 2-5: Typical Levels of Ground-borne Vibration



Source: FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012.

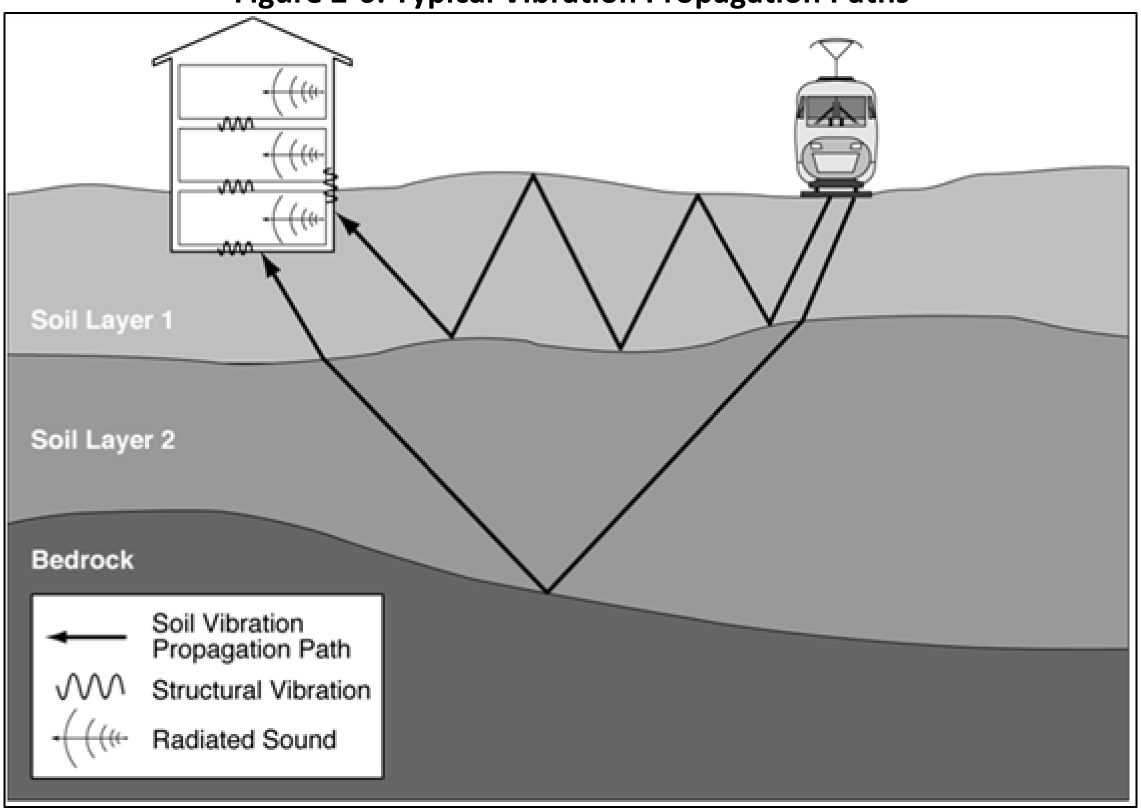
Transportation Vibration

The interaction of steel wheels rolling on steel rails causes vibration that is transmitted through the ground and into nearby buildings. Of concern to many building occupants is that the resulting building vibration could damage the building structure. In fact, the vibration from steel wheel/steel rail systems is almost always well below the vibration thresholds used to protect even fragile historic buildings from minor cosmetic damage. However, there are several different ways in which the building vibration may be intrusive and annoying to building occupants. First, the vibratory motion of room surfaces may felt. Second, the vibration may cause rattling of dishes and bric-a-brac on shelves, items hanging on walls, or windows. Third, the surfaces put into motion by ground-borne vibration will radiate sound that may be audible as a low-frequency rumbling noise that sometimes is akin to distant thunder.

The amount of energy generated by the wheels rolling on the track and then transmitted into the ground depends on factors such as the smoothness of the wheels and rails, the vehicle suspension system, and the track support system. The same speed-dependent vibration generation mechanisms are common to conventional and high-speed trains. Vibration levels increase with speed although the rate of the increase varies. A common assumption for high-speed trains is that the vibration levels are proportional to 20 times the logarithm of speed. For example, when train speed increases from 75 mph to 125 mph, the expected increase in ground-borne vibration is 4.4 VdB if all other conditions are the same.

As with noise, a source-path-receiver relationship exists for vibration. Vibration experienced at the receiver is a function of the magnitude of the source and the path that the vibration takes to get to the receiver, as shown in **Figure 2-6**. High-frequency vibration decays more rapidly than low-frequency vibration as the vibrational energy passes through the ground. Soil conditions have a strong influence on the attenuation of ground-borne vibration. For the purposes of high-speed rail assessments, vibration is reported in terms of vibration velocity level or VdB, which is the maximum RMS vibration velocity level using a decibel reference of 1µin/sec (1×10^{-6} in/sec).

Figure 2-6: Typical Vibration Propagation Paths



Source: FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012.

NOISE AND VIBRATION CRITERIA

Noise and vibration impact guidelines have been adopted by the FRA that prescribe methods for analyzing and assessing noise and vibration impacts. The impact criteria are based on maintaining a noise environment considered acceptable for land uses where noise may have an effect. The FRA guidance manual provides noise and vibration criteria for both construction and operation as described below.

Construction Noise Impact Criteria

Table 3-1 presents the FRA general assessment criteria for construction noise. The criteria are given in terms of 1-hour Leq for residential, commercial and industrial land use. The 1-hour Leq is estimated by combining the noise levels from the two noisiest pieces of equipment, assuming they both operate at the same time during a one-hour period. The construction noise limits are normally assessed at the noise-sensitive receiver property line.

Table 3-1: FRA General Assessment Criteria for Construction Noise

Land Use	1-Hour Leq (dBA)	
	Day	Night
Residential	90	80
Commercial	100	100
Industrial	100	100

Source: FRA, “High-Speed Ground Transportation Noise and Vibration Impact Assessment,” Final Report DOT/FRA/ORD-12/15, September 2012.

Construction Vibration Impact Criteria

Guidelines in the FRA guidance manual provide the basis for the construction vibration assessment. FRA provides construction vibration criteria designed primarily to prevent building damage, and to assess whether vibration might interfere with vibration-sensitive building activities or temporarily annoy building occupants during the construction period. The FRA criteria include two ways to express vibration levels: (1) root-mean-square (RMS) VdB for annoyance and activity interference, and (2) peak particle velocity (PPV), which is the maximum instantaneous peak of a vibration signal used for assessments of damage potential.

To avoid temporary annoyance to building occupants during construction or construction interference with vibration-sensitive equipment inside special-use buildings, such as a magnetic resonance imaging (MRI) machine, FRA recommends using the long-term vibration criteria provided below in the section on operational vibration impact assessment criteria.

Table 3-2 shows the FRA building damage criteria for construction activity; the table lists PPV limits for four building categories. These limits are used to estimate potential problems that should be addressed during final design.

Table 3-2: Construction Vibration Damage Criteria		
Building Category	**PPV (inch/sec)**	**Approximate L_v***
I. Reinforced concrete, steel, or timber (no plaster)	0.5	102
II. Engineered concrete and masonry (no plaster)	0.3	98
III. Non-engineered timber and masonry buildings	0.2	94
IV. Buildings extremely susceptible to vibration damage	0.12	90
* RMS vibration velocity level in VdB relative to 1 micro-inch/second.		

Source: FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012.

Operational Noise Impact Criteria

The U.S. Department of Transportation has published guidelines that establish procedures for analyzing and assessing noise and vibration impacts from rail projects. Noise impact criteria have been adopted by the Federal Transit Administration (FTA) to assess the contribution of noise from conventional rail systems to the existing environment and by the Federal Railroad Administration (FRA) to assess the contribution of noise from high-speed rail systems to the existing environment. These guidelines include impact criteria that are based on maintaining a noise environment considered acceptable for land uses where noise may have an effect. The noise exposure is measured in terms of the Day-Night Sound Level (Ldn) for residential land uses or in terms of the hourly equivalent sound level (Leq(h)) for other land uses.

Ldn depends on the number of events during the day and night separately – and also on each event's duration, which is affected by vehicle speed. The FRA and FTA have adopted Ldn as the measure of cumulative noise impact for residential land uses (those involving sleep), because:

- L_{dn} correlates well with the results of attitudinal surveys of residential noise impact,
- L_{dn} increases with the duration of transit events, which is important to people's reaction,
- L_{dn} takes into account the number of transit events over the full 24 hours, which is also important to people's reaction,
- L_{dn} takes into account the increased sensitivity to noise at night when most people are asleep,
- L_{dn} allows composite measurements to capture all sources of community noise combined,
- L_{dn} allows quantitative comparison of transit noise with other types of community noises,
- L_{dn} is the designated metric of choice of other Federal agencies such as the Department of Housing and Urban Development (HUD), the Federal Aviation Administration (FAA), and the Environmental Protection Agency (EPA), and
- L_{dn} has wide international acceptance.

Hourly Leq is adopted by FRA and FTA as the measure of cumulative noise impact for non-residential land uses (those not involving sleep) because:

- L_{eq} correlates well with speech interference in conversation and on the telephone – as well as interruption of TV, radio, and music enjoyment,

- L_{eq} increases with the duration of events, which is important to people's reaction,
- L_{eq} takes into account the number of events over the hour, which is also important to people's reaction, and
- L_{eq} is used by the Federal Highway Administration in assessing highway-traffic noise impact.

Thus, the hourly Leq noise descriptor can be used to compare and contrast modal alternatives such as highway versus rail. Leq is computed for the loudest facility hour during noise-sensitive activity at each particular non-residential land use.

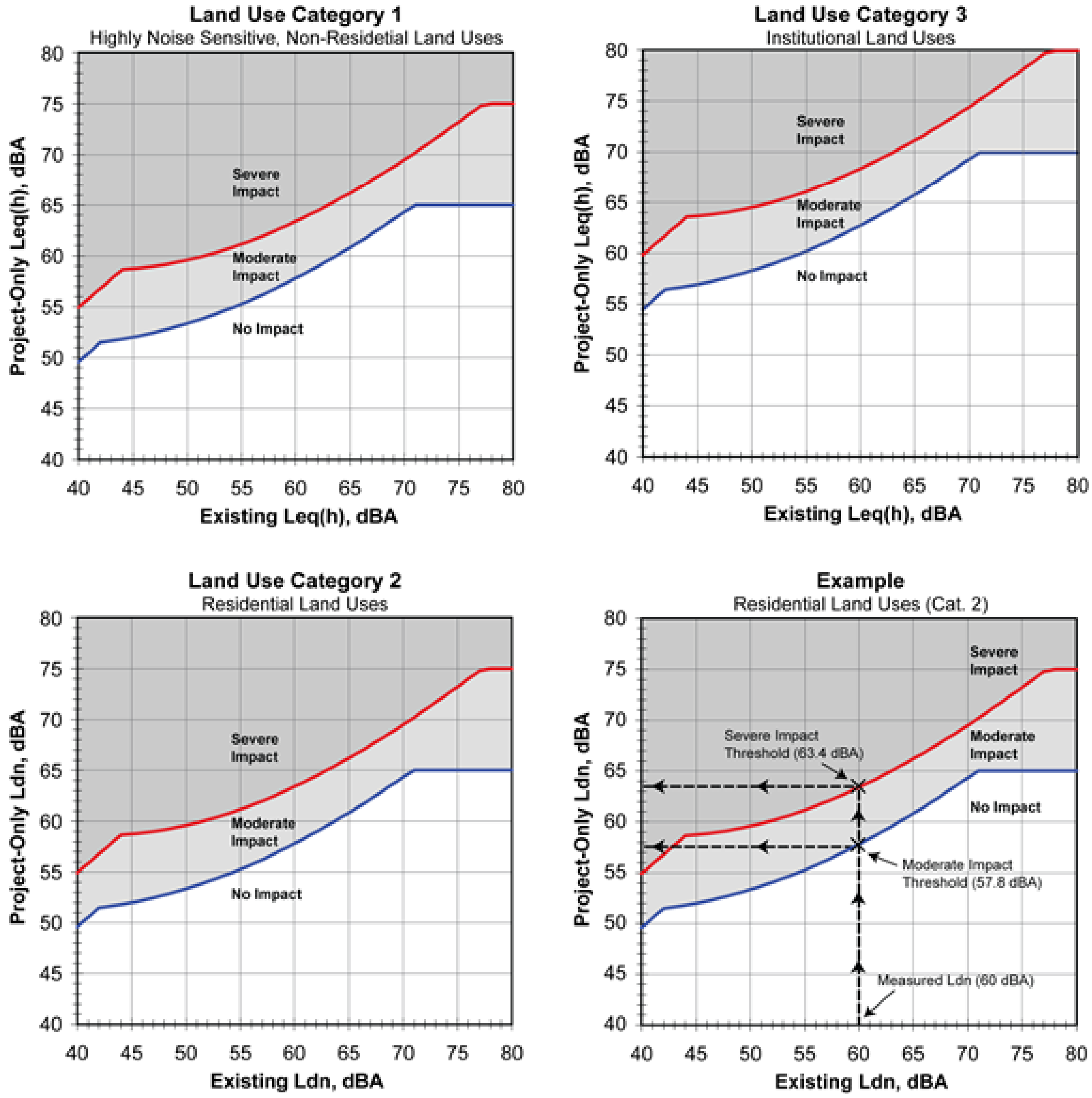
The noise impact criteria are defined by the two curves shown in **Figure 3-**1. These criteria are based on change in noise exposure using a sliding scale. Although higher project noise levels are allowed in areas with high levels of existing noise, smaller increases in total noise exposure are allowed with increasing levels of existing noise. Furthermore, the criteria curves incorporate a maximum limit for project noise. The FRA noise impact criteria include the following three levels of impact, as shown in **Figure 3-1**:

- **No Impact:** In this range, the proposed project is considered to have negligible impact since, on average, the introduction of the project will result in an insignificant increase in the number of people highly annoyed by the new project noise.

- **Moderate Impact:** At the moderate impact range, changes in the cumulative noise level are noticeable to most people, but may not be sufficient to cause strong, adverse reactions from the community. In this transitional area, other project-specific factors must be considered to determine the magnitude of the impact and the need for mitigation, such as the existing level, predicted increase over existing noise levels and the types and numbers of noise-sensitive land uses affected.

- **Severe Impact:** At the severe impact range, a significant percentage of people would be highly annoyed by the new project noise. Severe noise impacts are considered to be "significant" under NEPA, and should be avoided if possible. Noise mitigation should be applied for severe impacts where feasible.

Figure 3–1: Noise Impact Criteria for Transit and High-Speed Rail Projects



Source: FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012.

The magnitude of impact is assessed by comparing the project noise exposure to the existing noise exposure for three land use categories. Descriptions of these categories are given in **Table 3–3**. The noise exposure is measured in terms of Ldn for residential land uses and in terms of Leq(h) for other land uses. The exterior noise criteria are to be applied outside the building locations for residential land use and at either the property line or the nearest point of use for parks and other significant outdoor use. It is important to note that the criteria specify a comparison of future project noise with existing noise and not with projections of future "no-build" noise exposure.

Table 3–3: Federal Railroad Administration Land Use Categories and Metrics for High-Speed Train Noise Impact Assessments		
Land Use Category	**Noise Metric (dBA)**	**Land Use Category**
1	Outdoor $L_{eq}(h)^*$	Tracts of land where quiet is an essential element in their intended purpose. This category includes lands set aside for serenity and quiet, and such land uses as outdoor amphitheaters and concert pavilions, as well as National Historic Landmarks with significant outdoor use.
2	Outdoor L_{dn}	Residences and buildings where people normally sleep. This category includes homes, hospitals where nighttime sensitivity to noise is assumed to be of utmost importance.
3	Outdoor $L_{eq}(h)^*$	Institutional land uses with primarily daytime and evening use. This category includes schools, libraries, and churches, where it is important to avoid interference with such activities as speech, meditation, and concentration. Buildings with interior spaces where quiet is important, such as medical offices, conference rooms, recording studios, and concert halls fall into this category, as well as places for meditation or study associated with cemeteries, monuments, and museums. Certain historical sites, parks, and recreational facilities are also included.
* L_{eq} for the noisiest hour of transit-related activity during hours of noise sensitivity.		

Source: FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012.

The process of determining impact severity is to first determine land use from **Table 3–3**. The land use category determines the noise metric that should be used to determine level of impact (Ldn for Category 2, and Leq(h) for Category 1 and Category 3 land uses). The next step is to draw a vertical line at the value of the existing exterior noise exposure (including existing train traffic and all other community noise sources) for the property from the bottom axis of **Figure 3–1**. The impact thresholds are where the vertical line intersects the moderate and severe impact threshold curves.

The concept of a sliding scale for noise impact is difficult to grasp and may be clarified by the example illustrated in the bottom right graph in **Table 3–1**. Assume that the existing noise has been measured to be 60 dBA Ldn. This is the total noise from all existing noise sources over a 24-hour period: traffic, aircraft, lawn mowers, children playing, birds chirping, etc. Starting at 60 dBA on the horizontal axis, follow the vertical line up to where it intersects the moderate and severe impact curves. Then refer to the left axis to read off the impact thresholds. As shown in the example, an existing noise level of 60 dBA Ldn gives thresholds of 57.8 dBA Ldn for moderate impact and 63.4 dBA Ldn for severe impact. Note that the values are given in tenths of a decibel to avoid confusion from rounding off; in reality it is not possible to perceive a tenth of a decibel change in sound level.

The thresholds of 57.8 dBA and 63.4 dBA are for the project noise. If the predicted project noise is greater than 57.8 dBA Ldn, then there is moderate impact and noise mitigation must be considered. If the predicted project noise exceeds 63.4 dBA Ldn, then there is severe impact and, as discussed above, noise mitigation must be included in the project unless there are compelling reasons why mitigation is unfeasible.

To supplement the noise impact criteria in **Figure 3-1**, FRA provides guidelines for identifying noise-sensitive locations where increased annoyance can occur due to the sudden increase in noise (the startle effect) from the rapid approach of high-speed trains. This effect depends on the train speed and is confined to an area very close to the tracks. For example, 200 mph train operations would have the potential for increased annoyance within about 40 feet of the track centerline. Thus, the area where rapid onset rates of train noise may cause startle is typically within the right-of-way limits of the rail corridor.

FRA also addresses impacts on wildlife (mammals and birds) and domestic animals (livestock and poultry). Noise exposure limits for each are an SEL of 100 dBA from passing trains, as shown in **Table 3-4**.

Table 3-4: FRA Interim Criteria for Train Noise Effects on Animals

Animal Category	Class	Noise Metric	Noise Level (dBA)
Domestic	Mammals (Livestock)	SEL	100
	Birds (Poultry)	SEL	100
Wild	Mammals	SEL	100
	Birds	SEL	100

Source: FRA, “High-Speed Ground Transportation Noise and Vibration Impact Assessment,” Final Report DOT/FRA/ORD-12/15, September 2012.

Operational Vibration Impact Criteria

FRA vibration impact levels, expressed in terms of the maximum root-mean-square (RMS) vibration level, are affected by the receptor land-use category and the number of vibration events per day. The impact level also depends on the type of analysis being conducted (i.e., ground-borne vibration or ground-borne noise).

The FRA manual states that the vibration impact thresholds are based on the maximum vibration level (Lmax) as a train passes. Lmax is defined to be the maximum average vibration level over a 1-second interval using RMS averaging. Most studies of train vibration report the RMS average vibration level over the period when trains are passing the measurement position. A more rigorous definition is the RMS average vibration level between the points where the vibration level is greater than Lmax-3, which are also defined as the “3 dB down points.” The RMS average vibration level is defined as Lplateau.

FRA provides guidelines to assess the human response to different levels of ground-borne noise and vibration. These are shown in **Table 3–5**. In addition, the guidelines provide criteria for special buildings that are sensitive to ground-borne noise and vibration. The impact criteria for these special buildings are shown in **Table 3–6**. The criteria depend on land use category as well as the frequency of the vibration events (e.g. train pass-bys). “Frequent Events” is defined as more than 70 vibration events per day, “Occasional Events” is defined as 30-70 vibration events per day while “Infrequent Events” is defined as less than 30 vibration events per day.

Table 3-5: Ground-borne Vibration and Noise Impact Criteria						
Land Use Category	Ground-Borne Vibration Impact Levels (VdB re 1 micro-inch /sec)			Ground-Borne Noise Impact Levels (dBA re 20 micro Pascals)		
	Frequent Events	Occasional Events	Infrequent Events	Frequent Events	Occasional Events	Infrequent Events
Category 1: Buildings where vibration would interfere with interior operations.	65 VdB*	65 VdB*	65 VdB*	N/A**	N/A**	N/A**
Category 2: Residences and buildings where people normally sleep.	72 VdB	75 VdB	80 VdB	35 dBA	38 dBA	43 dBA
Category 3: Institutional land uses with primarily daytime use.	75 VdB	78 VdB	83 VdB	40 dBA	43 dBA	48 dBA

* This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. For equipment that is more sensitive, a Detailed Vibration Analysis must be performed.
** Vibration-sensitive equipment is generally not sensitive to ground-borne noise.

Source: FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012.

Table 3-5 and **Table 3-6** include separate FRA criteria for ground-borne noise (the "rumble" that radiates from the motion of room surfaces in buildings from ground-borne vibration). Although the criteria are expressed in dBA, which emphasizes the more audible middle and high frequencies, the criteria are significantly lower than airborne noise criteria to account for the annoying low-frequency character of ground-borne noise. Because airborne noise often masks ground-borne noise for above-ground (i.e., at-grade or elevated) alignments, ground-borne noise criteria apply primarily to operations in a tunnel, where airborne noise is not a factor, and to buildings with sensitive interior spaces that are well insulated from exterior noise.

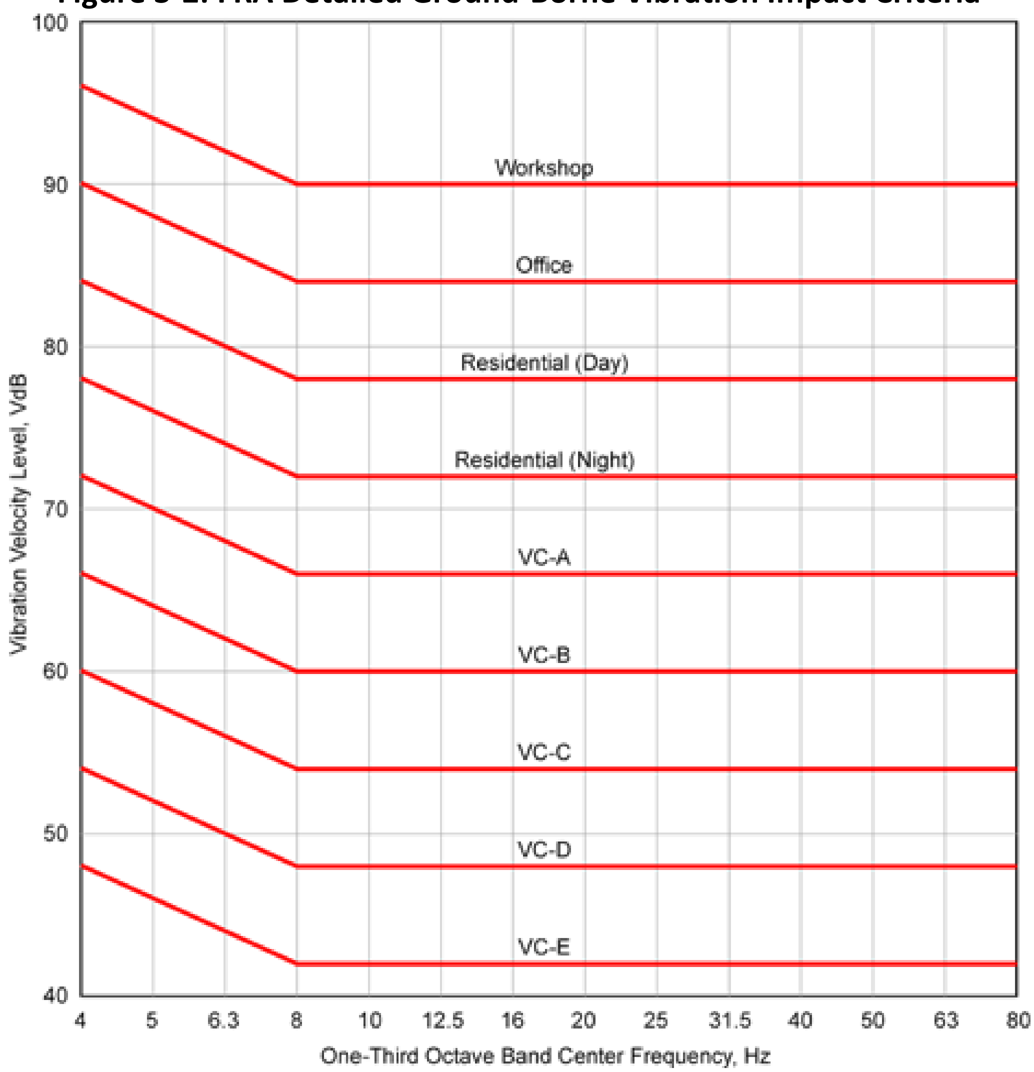
Table 3-6: Ground-borne Vibration and Noise Impact Criteria for Special Buildings				
Type of Building or Room	Ground-Borne Vibration Impact Levels (VdB re 1 micro-inch/sec)		Ground-Borne Noise Impact Levels (dBA re 20 micro-Pascals)	
	Frequent Events	Occasional or Infrequent Events	Frequent Events	Occasional or Infrequent Events
Concert Halls	65 VdB	65 VdB	25 dBA	25 dBA
TV Studios	65 VdB	65 VdB	25 dBA	25 dBA
Recording Studios	65 VdB	65 VdB	25 dBA	25 dBA
Auditoriums	72 VdB	80 VdB	30 dBA	38 dBA
Theaters	72 VdB	80 VdB	35 dBA	43 dBA

Source: FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012.

Specification of mitigation measures requires more detailed information and more refined impact criteria using the frequency distribution, or spectrum of the vibration energy. A detailed vibration analysis uses impact criteria in terms of the 1/3-octave band frequency spectrum. A detailed vibration analysis has been conducted for the Dallas to Houston High-Speed Rail assessment. **Figure 3-2** shows the FRA detailed ground-borne vibration impact criteria used in assessing this project's impacts.

The criteria in **Figure 3-2** are based on exceedances of the 1/3-octave band vibration levels over the frequency range of 8 to 80 Hz. For example, if the vibration levels in any frequency band from a high-speed train exceed the Residential (Night) line in **Figure 3-2** at a residential location, a vibration impact would be assessed. In addition, the detailed criteria are used to assess vibration impact at highly sensitive locations using the VC-A through VC-E thresholds shown in the figure. Descriptions of the curves are shown in **Table 3-7**.

Figure 3-2: FRA Detailed Ground-Borne Vibration Impact Criteria



Source: FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012.

Table 3-7: Interpretation of Vibration Criteria for Detailed Analysis		
Criterion Curve (See Figure 3-4)	**Max Lv (VdB)[1]**	**Description of Use**
Workshop	90	Distinctly feelable vibration. Appropriate to workshops and non-sensitive areas.
Office	84	Feelable vibration. Appropriate to offices and non-sensitive areas.
Residential Day	78	Barely feelable vibration. Adequate for computer equipment and low-power optical microscopes (up to 20X).
Residential Night, Operating Rooms	72	Vibration not feelable, but ground-borne noise may be audible inside quiet rooms. Suitable for medium-power optical microscopes (100X) and other equipment of low sensitivity.
VC-A	66	Adequate for medium- to high-power optical microscopes (400X), microbalances, optical balances, and similar specialized equipment.
VC-B	60	Adequate for high-power optical microscopes (1000X), inspection and lithography equipment to 3-micron line widths.
VC-C	54	Appropriate for most lithography and inspection equipment to 1-micron detail size.
VC-D	48	Suitable in most instances for the most demanding equipment, including electron microscopes operating to the limits of their capability.
VC-E	42	The most demanding criterion for extremely vibration-sensitive equipment.
[1] As measured in 1/3-octave bands of frequency over the frequency range 8 to 80 Hz.		

Source: FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012.

EXISTING NOISE AND VIBRATION

This section includes a description of the noise and vibration sensitive land use within the Study Area, as well as the noise and vibration measurements conducted to characterize the existing conditions for the Project.

Existing Noise Conditions

Noise-sensitive land use within the Study Area was identified based on Geographic Information System (GIS) data, aerial photography, drawings, plans and a field survey. Based on the information from these sources, a noise measurement program was developed and carried out as described below.

Noise Measurement Procedures and Equipment

To document the existing noise conditions for the Project, a series of noise measurements were conducted in January 2016 along the routes for the Build Alternatives. Because the thresholds for impact in the FRA noise criteria are based on the existing noise levels, measuring the existing noise and characterizing noise levels at sensitive locations is an important step in the impact assessment. The noise measurements included both long-term (24-hour) and short-term (one hour) monitoring of the A-weighted sound level at noise-sensitive locations within the Study Area.

The noise measurements were performed with NTi Audio model XL2 noise monitors and Larson Davis model 820 noise monitors that conform to American National Standard Institute (ANSI) standards for Type 1 (precision) sound measurement equipment. Calibrations, traceable to the

National Institute of Standards and Technology (NIST) were conducted before and after each measurement. The noise monitors were set to continuously monitor and record multiple noise level metrics, as well as obtain audio recordings, where appropriate, during the measurement periods.

At each site, the measurement was conducted at the approximate set back of the building or buildings relative to the Project alignment. The measurement microphones were protected with windscreens and positioned approximately 5 feet above the ground and at least 10 feet away from any major reflecting surface.

Noise Measurement Locations and Results

Table 4-1 summarizes the results of the existing noise measurement program and **Figures 4-1 through 4-4** show the locations of the 26 long-term noise monitoring sites (LT) and 19 short-term noise monitoring sites (ST) for the Project. The results of the existing noise measurements were used to characterize the existing noise levels at all noise-sensitive locations within the Study Area. **Appendix A** includes photographs of the noise measurement sites and **Appendix B** provides detailed noise measurement data.

Descriptions of the noise-sensitive land uses, as well as the associated noise measurement sites and sources, are provided below by county and segment.

Table 4-1: Summary of Existing Noise Measurements

Site No.	Measurement Location	County	Seg	Measurement Start		Meas. Dur. (hr)	Noise Level (dBA)	
				Date	Time		Leq	Ldn
LT-1	4019-4099 Bulova St, Dallas (Residences)	Dallas	1	1/21/2016	14:00	24	75	72
LT-1A	5125 Cleveland Rd, Dallas (Residences)	Dallas	1	5/11/2017	11:20	3**	50	53
LT-1B	1345 E Belt Line Rd, Lancaster (Residences)	Dallas	1	5/12/2017	2:49	3**	68	70
LT-1C	1786 Nail Dr, Lancaster (Residences)	Dallas	1	5/11/2017	14:00	3**	44	45
LT-2	911 FM 813, Palmer (Residence)	Ellis	2A	1/21/2016	9:09	24	62	55
LT-3	508 Old Waxahachie Rd, Waxahachie (Residence)	Ellis	2A	1/20/2016	16:00	24	58	53
LT-4	NW Co Rd 1320, Ennis (Residence)	Navarro	3A	1/20/2016	11:00	24	48	36
LT-5	SW 2120, Richland (Residence)	Navarro	3C	1/19/2016	15:17	24	50	46
LT-6	FM 1366, Wortham (Residential Parcel)	Freestone	4	1/19/2016	14:07	24	44	43
LT-7	132-264 CR 890, Teague (Ranch House)	Freestone	4	1/19/2016	14:00	24	49	42
LT-8	N Fwy Service Rd, Teague (Ranch)	Freestone	3C	1/18/2016	12:23	24	58	50
LT-9	633 LCR 882, Jewett (Ranch House)	Limestone	4	1/18/2016	12:00	24	52	48

Table 4-1: Summary of Existing Noise Measurements								
Site No.	Measurement Location	County	Seg	Measurement Start		Meas. Dur. (hr)	Noise Level (dBA)	
				Date	Time		Leq	Ldn
LT-10	Beddingfield Rd, Marquez (Residence)	Leon	4	1/18/2016	11:00	24	53	42
LT-11	N Fwy Service Rd, Buffalo (Ranch)	Leon	3C	1/18/2016	10:00	24	63	55
LT-12	534 FM 39 (Residence)	Leon	4	1/18/2016	14:00	24	60	62
LT-13	2076-2765 W Feeder Rd (Residence)	Leon	3C	1/18/2016	16:00	24	53	55
LT-14	7652 Greenbriar Rd (Residence)	Madison	3C	1/18/2016	13:00	24	63	65
LT-15	1977 Poteet Rd (Residence)	Madison	4	1/18/2016	17:00	24	48	50
LT-16	6113 FM 1696 (Residence)	Grimes	5	1/19/2016	14:00	24	45	47
LT-17	10735 TX-90 (Ranch)	Grimes	5	1/20/2016	16:00	24	47	49
LT-18	5126 FM 1774 (Residence)	Grimes	5	1/19/2016	20:00	24	60	62
LT-19	119 Plantation Drive, Todd Mission (Residence)	Waller	5	1/22/2016	12:39	24	47	49*
LT-20	21512 Binford Rd (Residence)	Harris	5	1/22/2016	10:56	24	49	51*
LT-21	1218 Canyon Arbor Way (Residence)	Harris	5	1/20/2016	19:00	24	67	69*
LT-22	14812 Hempstead Rd (Residence)	Harris	5	1/19/2016	21:00	24	44	46*
LT-23	11217 Todd St., Houston (Residence)	Harris	5	1/21/2016	14:00	24	47	49
ST-1	1213 Coleman Ave, Dallas (Residence)	Dallas	1	1/22/2016	11:40	1	63	61
ST-2	4412 Kolloch Dr, Dallas (Residence)	Dallas	1	1/21/2016	15:00	1	62	60
ST-3	6350 J. J. Lemmon Rd, Dallas (College Park Baptist Church)	Dallas	1	1/21/2016	17:10	1	54	52
ST-4	2607 Ferris Rd, Lancaster (Residence)	Ellis	2A	1/22/2016	10:00	1	52	50
ST-5	369 Farmer Rd, Ennis (Residential Area)	Ellis	2B	1/20/2016	16:31	1	62	60
ST-6	SW 1000, Corsicana (Residence)	Navarro	3B	1/20/2016	11:00	1	41	39
ST-7	117-123 CR 1041, Wortham (Residential Area)	Freestone	3C	1/19/2016	17:30	1	31	29
ST-8	N Fwy Service Rd & CR 1090, Streetman (Residential Area)	Freestone	3C	1/19/2016	16:00	1	54	52
ST-9	Old Mexia-Fairfield Rd, Fairfield (Parcel Adjacent to Several Hotels)	Freestone	3C	1/18/2016	13:50	1	70	68
ST-10	164 & FM 39, Groesbeck (Residential Area)	Limestone	4	1/18/2016	15:30	1	63	61
ST-11	N Fwy Service Rd & CR 306, Buffalo (Parcel Adjacent to Several Hotels)	Leon	3C	1/18/2016	17:00	1	68	66
ST-12	20559 I-45 Frontage Rd	Leon	3C	1/19/2016	9:06	1	61	59

Table 4-1: Summary of Existing Noise Measurements								
Site No.	Measurement Location	County	Seg	Measurement Start		Meas. Dur. (hr)	Noise Level (dBA)	
				Date	Time		Leq	Ldn
	(Residence)							
ST-13	5192 Dawkins Rd (Residence)	Madison	4	1/19/2016	11:12	1	54	52
ST-14	3159 Clark Rd (Residence)	Madison	4	1/20/2016	12:00	1	56	54
ST-15	15619 TX-90 (Residence)	Grimes	5	1/20/2016	14:47	1	53	51
ST-16	CR 341, Plantersville (Residence)	Grimes	5	1/21/2016	9:20	1	50	48
ST-17	31205 Hegar Rd (Residence)	Waller	5	1/21/2016	9:11	1	47	45
ST-18	6734 Limestone St (Residence)	Harris	5	1/21/2016	15:17	1	57	55
ST-19	20710 May Showers Circle (Residence)	Harris	5	1/21/2016	17:23	1	61	59

*Measurements were interrupted before 24 hours due to a noise monitor battery connection problem. Ldn was estimated using methods contained in the FRA guidance manual.
**Due to limited access, three one hour measurements were made at these sites. The Ldn was estimated using methods contained in the FRA guidance manual.

Source: Cross-Spectrum Acoustics, 2016.

Figure 4-1: Existing Noise Measurement Locations (Sheet 1 of 4)

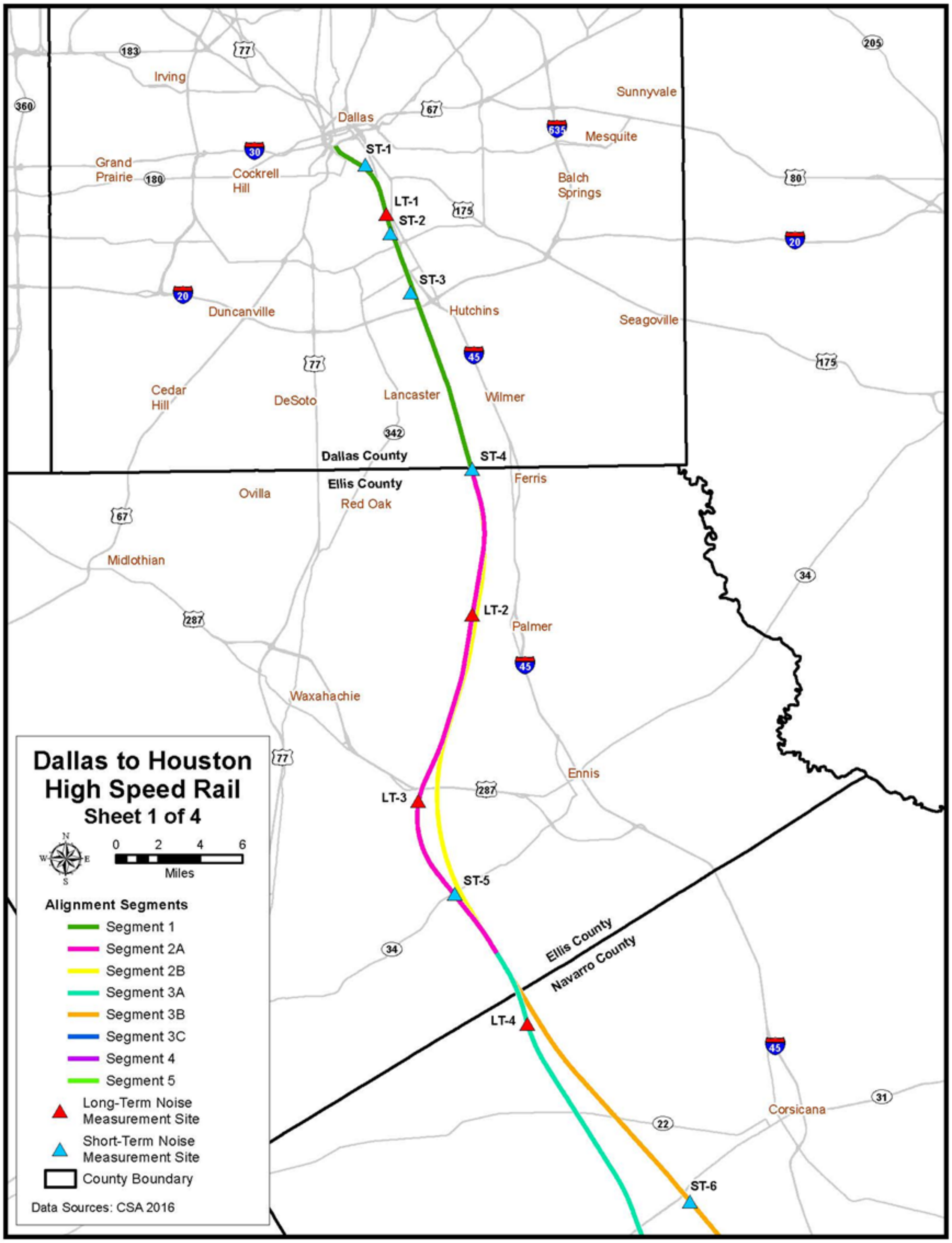


Figure 4-2: Existing Noise Measurement Locations (Sheet 2 of 4)

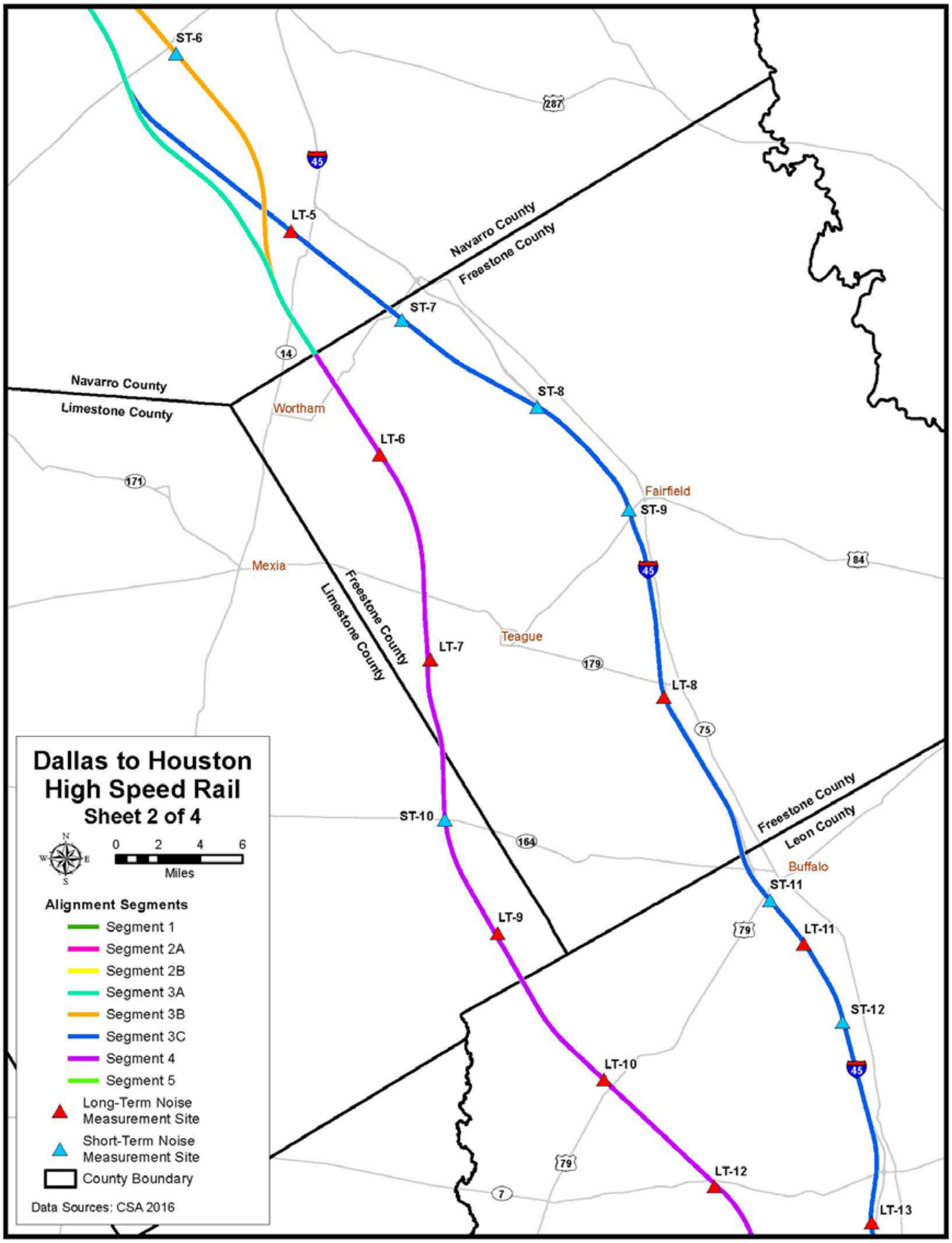


Figure 4-3: Existing Noise Measurement Locations (Sheet 3 of 4)

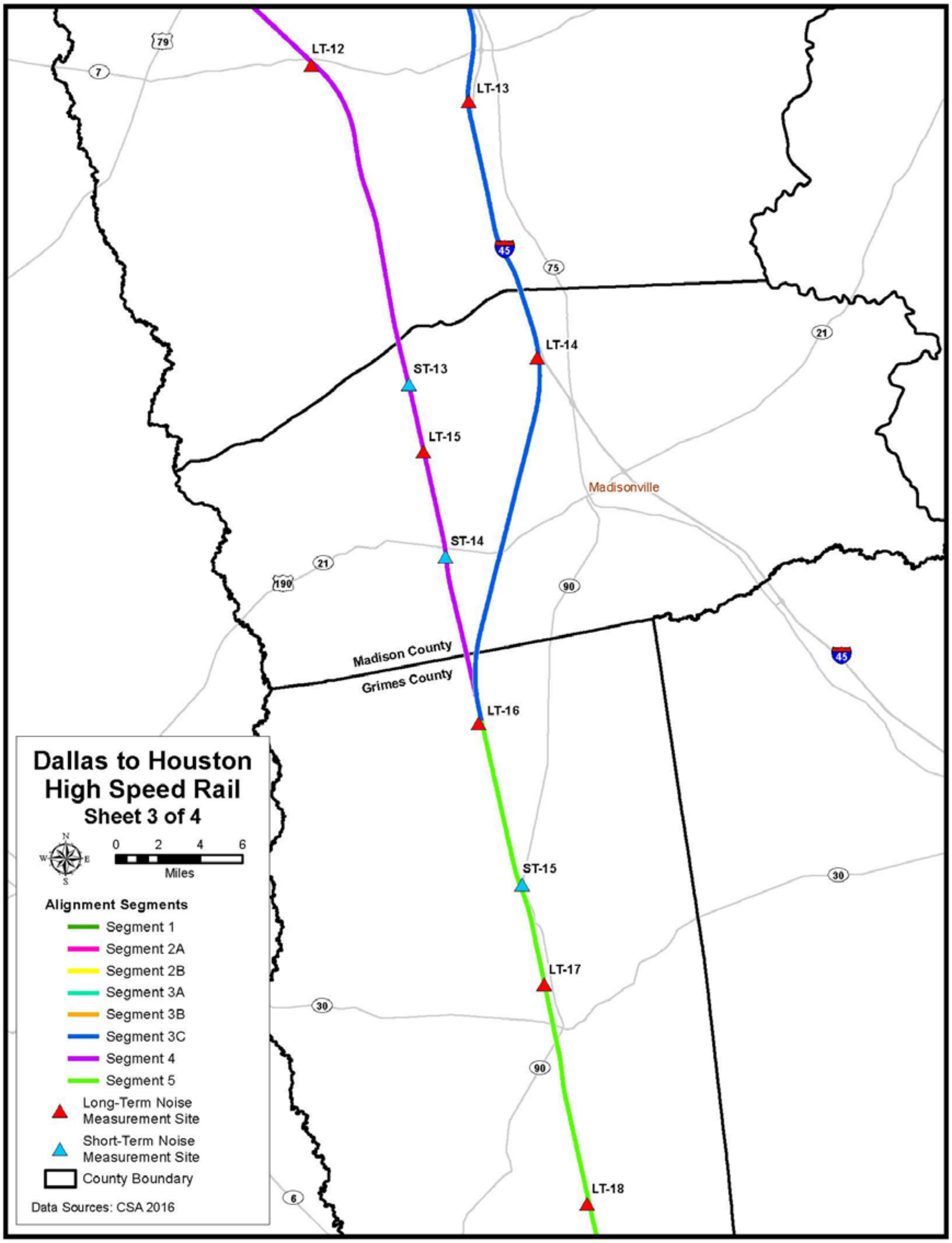
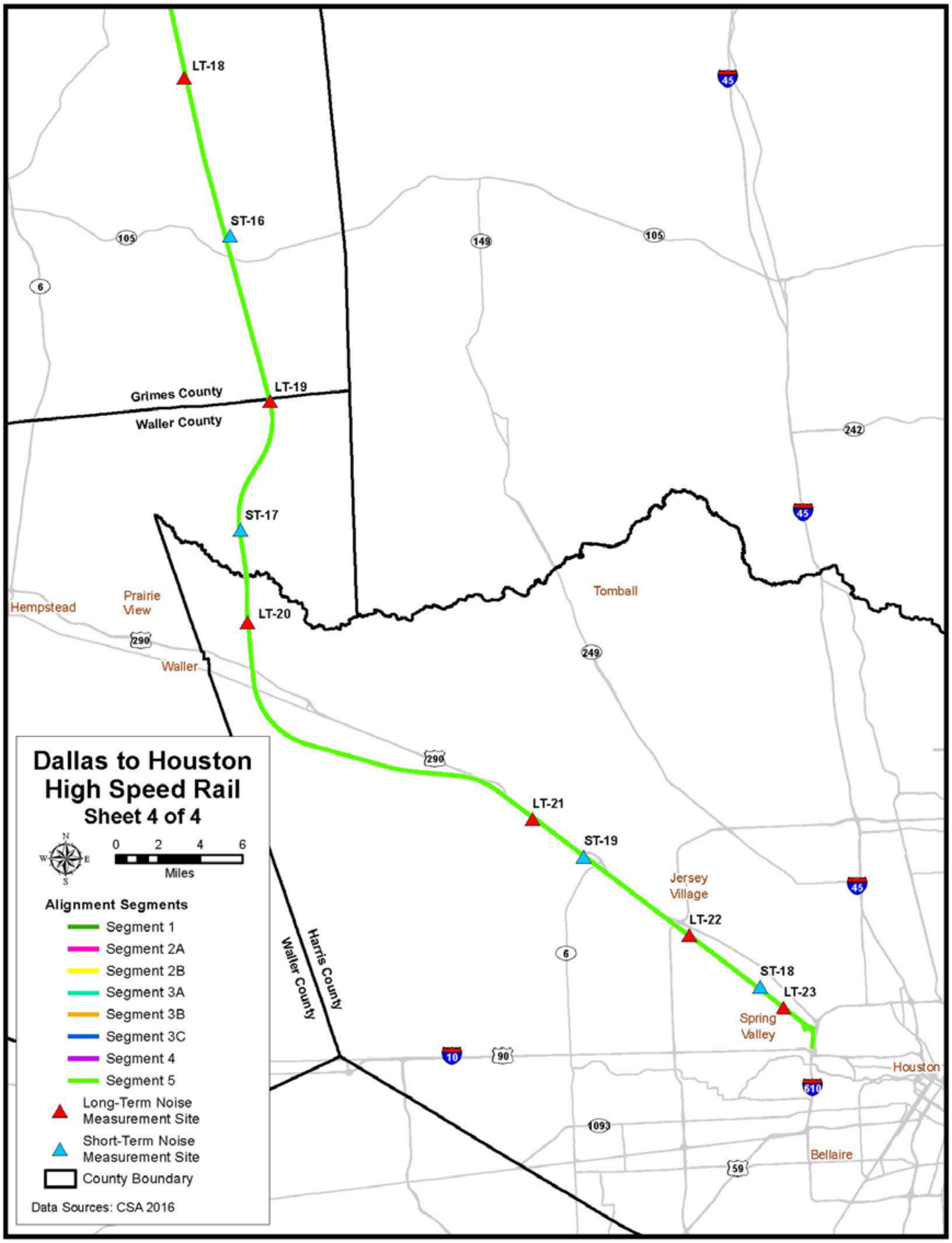


Figure 4-4: Existing Noise Measurement Locations (Sheet 4 of 4)



Dallas County

Segment 1

The noise-sensitive land use along the proposed alignment in Dallas County from the northern terminus to Route 12 (South Great Trinity Forest Avenue) is typically dense, urban commercial/industrial land use along the existing freight tracks and IH-45. Several urban residential neighborhoods are located in the areas north of South Lamar Street, along Kolloch Drive from East Illinois Avenue to Route 12, and along Le May and Le Forge Avenues. Multi-family residential complexes are located near East Overton Rd and Southern Oaks Boulevard and at Kolloch Drive and Linfield Road.

The Imperial Institute of America, a school with institutional land use, is located on Mayforge Drive near East Illinois Avenue. South of Route 12 to IH-20, the proposed alignment runs parallel to existing freight tracks and IH-45 through a largely wooded area with a few dense suburban residential neighborhoods to the west along Golden Gate Drive and J.J. Lemmon Road. Several parks and churches are located in this suburban area as well. South of IH-20 to the Dallas/Ellis County line is typically rural farm land with scattered single-family residences along the proposed alignment.

Descriptions of the noise measurements conducted along Segment 1 in Dallas are as follows:

Site LT-1: 4019-4099 Bulova Street, Dallas. The Ldn measured at this location was 72 dBA. The dominant noise source was traffic on IH-45. Noise levels were measured for 24 hours near the gate to this parcel.

Site LT-1A: 5125 Cleveland Rd, Dallas. The Ldn measured at this location was 53 dBA. The dominant noise sources were rural sounds and local traffic. Noise levels were measured during three separate one hour periods throughout the day along Cleveland Rd in front of the property.

Site LT-1B: 1345 E. Beltline Road, Lancaster. The Ldn measured at this location was 70 dBA. The dominant noise source was traffic on E Beltline Rd. Noise levels were measured during three separate one hour periods throughout the day along E Beltline Rd in front of the property.

Site LT-1C: 1786 Nail Drive, Lancaster. The Ldn measured at this location was 45 dBA. The dominant noise source was rural sounds. Noise levels were measured during three separate one hour periods throughout the day along Nail Drive in front of the property.

Site ST-1: 1213 Coleman Avenue, Dallas. The Leq measured at this location was 63 dBA. The dominant noise sources were traffic on Lamar Street, traffic on Cedar Crest Boulevard and freight train activity. Noise levels were measured for one hour on the side of the road within the public right-of-way (ROW).

Site ST-2: 4412 Kolloch Drive, Dallas. The Leq measured at this location was 62 dBA. The dominant noise sources were traffic on IH-45 and freight train activity. Noise levels were measured for one hour in the side yard of this residence.

Site ST-3: 6350 J.J. Lemmon Road, Dallas (College Park Baptist Church). The Leq measured at this location was 54 dBA. The dominant noise sources were traffic on J.J. Lemmon Road and distant traffic on IH-45. Noise was measured for one hour in the rear parking area of the church.

Ellis County

Segment 2A

The noise and vibration sensitive land use along the proposed Segment 2A in Ellis County is typically rural farm land with scattered single family residences. Descriptions of the noise measurements conducted along Segment 2A in Ellis County are as follows:

Site LT-2: FM 813, Palmer. The Ldn measured at this location was 55 dBA. The dominant noise source was local community traffic. Noise levels were measured for 24 hours in the back yard of this residence.

Site LT-3: 508 Old Waxahachie Road, Waxahachie. The Ldn measured at this location was 53 dBA. The dominant noise sources were local traffic on Old Waxahachie Road and distant traffic on Route 287. Noise levels were measured for 24 hours in the front yard of the residence.

Site ST-4: 2607 Ferris Road, Lancaster. The Leq measured at this location was 52 dBA. The dominant noise sources were wind and livestock. Noise levels were measured for one hour in the field behind the residence.

Site ST-5: 369 Farmer Rd, Ennis. The Leq measured at this location was 62 dBA. The dominant noise source was traffic on Route 34. Noise levels were measured for one hour on the side of the road within the public ROW.

Segment 2B

The noise-sensitive land use along the proposed Segment 2B in Ellis County is typically rural farm land with scattered single family residences. The noise measurement sites used to characterize Segment 2B in Ellis County are the same as those used for Segment 2A.

Navarro County

Segment 3A

The noise-sensitive land use along the proposed Segment 3A in Navarro County is typically rural farm land with scattered single family residences. A description of the noise measurement conducted along Segment 3A in Navarro County is as follows:

Site LT-4: NW County Road 1320, Ennis. The Ldn measured at this location was 36 dBA. The dominant noise sources were distant traffic and livestock. Noise levels were measured for 24 hours in the front yard of the residence.

Segment 3B

The noise-sensitive land use along the proposed Segment 3B in Navarro County is typically rural farm land with scattered single family residences. A description of the noise measurement conducted along Segment 3B in Navarro County is as follows:

Site ST-6: SW 1000, Corsicana. The Leq measured at this location was 41 dBA. The dominant noise source was traffic from Route 31. Noise levels were measured for one hour in the back yard of the residence.

Segment 3C

The noise-sensitive land use along the proposed Segment 3C in Navarro County is typically rural farm land with scattered single family residences. A description of the noise measurement conducted along Segment 3C in Navarro County is as follows:

Site LT-5: SW 2120, Richland. The Ldn measured at this location was 46 dBA. The dominant noise sources were farm activity and distant freight trains/horns. Noise levels were measured for 24 hours in the field behind the ranch house.

Segment 4

The noise-sensitive land use along the proposed Segment 4 in Navarro County is typically rural farm land with scattered single family residences.

The noise measurement site used to characterize Segment 4 in Navarro County is the same as for Segment 3C.

Freestone County

Segment 3C

The noise-sensitive land use along the proposed Segment 3C in Freestone County is typically rural farm land with scattered single family residences. Segment 3C runs parallel to IH-45 from just south of FM 833 until the Freestone/Leon County line. This area remains typically rural farm land until the City of Fairfield, where the land use becomes slightly denser and largely commercial/industrial. South of Fairfield, the land use returns to rural farm land and oil fields with scattered single family residences. Descriptions of the noise measurements conducted along Segment 3C in Freestone County are as follows:

Site LT-8: N Fwy Service Road, Teague. The Ldn measured at this location was 50 dBA. The dominant noise sources were traffic on IH-45 and farm activity. Noise levels were measured for 24 hours adjacent to the pond on this ranch.

Site ST-7: 117-123 County Road 1041, Wortham. The Leq measured at this location was 31 dBA. The dominant noise source was distant wildlife. Noise levels were measured for one hour on the side of the road within the public ROW.

Site ST-8: N Freeway Service Road at County Road 1090, Streetman. The Leq measured at this location was 54 dBA. The dominant noise source was traffic on IH-45. Noise levels were measured for one hour on the side of the road within the public ROW.

Site ST-9: N Freeway Service Road at Old Mexia-Fairfield Road, Fairfield. The Leq measured at this location was 70 dBA. The dominant noise source was traffic on IH-45. Noise levels were measured for one hour on the side of the road within the public ROW.

Segment 4

The noise-sensitive land use along the proposed Segment 4 in Freestone County is typically rural farm land with scattered single family residences. Descriptions of the noise measurements conducted along Segment 4 in Freestone County are as follows:

Site LT-6: FM 1366, Wortham. The Ldn measured at this location was 43 dBA. The dominant noise sources were local community traffic and farm activity. Noise levels were measured for 24 hours adjacent to the back house on this parcel.

Site LT-7: Approx. 132-264 CR 890, Teague. The Ldn measured at this location was 42 dBA. The dominant noise sources were local community traffic and farm activity. Noise levels were measured for 24 hours adjacent to the ranch house.

Limestone County

Segment 4

The noise-sensitive land use along the proposed Segment 4 in Limestone County is typically rural farm land/oil fields with scattered single family residences. Descriptions of the noise measurements conducted along Segment 4 in Limestone County are as follows:

Site LT-9: 633 Local County Road 882, Jewett. The Ldn measured at this location was 48 dBA. The dominant noise sources were local community traffic and farm activity. Noise levels were measured for 24 hours adjacent to the ranch house.

Site ST-10: FM 39 at East Yeagua Street, Groesbeck. The Leq measured at this location was 63 dBA. The dominant noise sources were traffic on FM 39 and traffic on East Yeagua Street. Noise levels were measured for one hour on the side of the road within the public ROW.

Leon County

Segment 3C

The noise-sensitive land uses for Segment 3C in Leon County include mostly rural areas with single family residences and the cities of Buffalo and Centerville. The City of Buffalo is a mixture of single family houses and commercial areas with a church close to the proposed route. Descriptions of the noise measurements conducted along Segment 3C in Leon County are as follows:

Site LT-11: N Freeway Service Road, Buffalo. The Ldn measured at this location was 55 dBA. The dominant noise sources were traffic on IH-45 and distant freight trains/horns. Noise levels were measured for 24 hours adjacent to the driveway of this ranch.

Site LT-13: 2076-2765 West Feeder Road. The measured Ldn at this location was 53 dBA. This 24-hour measurement was taken at the southern edge of the property facing a small pond. The dominant noise sources were local traffic from West Feeder Road, IH-45 and neighborhood activity.

Site ST-11: N Freeway Service Road at County Road 306, Buffalo. The Leq measured at this location was 68 dBA. The dominant noise source was traffic on IH-45. Noise levels were measured for one hour on the side of the road within the public ROW.

Site ST-12: 20559 IH-45 Frontage Road. The measured Leq at this location was 61 dBA. The dominant noise sources were local traffic from the frontage road and IH-45. Noise levels were measured in the front yard of the property for a period of one hour.

Segment 4

The noise-sensitive land uses for Segment 4 in Leon County include scattered single family residences. This segment also includes Leon High School. Descriptions of the noise measurements conducted along Segment 4 in Leon County are as follows:

Site LT-10: Beddingfield Road, Marquez. The Ldn measured at this location was 42 dBA. The dominant noise sources were local community traffic and farm activity. Noise levels were measured for 24 hours in the back yard of the residence.

Site LT-12: 534 FM 39. The measured Ldn at this location was 60 dBA. The dominant noise source was distant local traffic. Noise levels were measured for 24 hours on the north side of a dirt road that accesses the property.

Madison County

Segment 3C

The noise-sensitive land uses for Segment 3C in Madison County include rural areas with scattered single family residences. A description of the noise measurement conducted along Segment 3C in Madison County is as follows:

Site LT-14: 7652 Greenbrier Road. The measured Ldn at this location was 63 dBA. Noise levels were measured for 24 hours. This measurement was taken in the front yard of the property. The major noise sources were local traffic on IH-45, farming activity and noise from the manufacturing facility located at the northern edge of the property.

Segment 4

The noise-sensitive land uses for Segment 3C in Madison County include rural areas with scattered single family residences. Descriptions of the noise measurements conducted along Segment 4 in Madison County are as follows:

Site LT-15: 1977 Poteet Road. The measured Ldn at this location was 48 dBA. The dominant noise source was local traffic on Poteet Road. Noise levels were measured for 24 hours on the south side of the property facing a corral.

Site ST- 13: 5192 Dawkins Road. The measured Leq at this location was 54 dBA. The dominant noise source was local traffic. Noise levels were measured in front of the residence by the gate facing Dawkins Road for a period of one hour.

Site ST-14: 3159 Clark Road. The measured Leq at this location was 56 dBA. The dominant noise sources were local traffic on Clark Road, wind, farming activities and electrical noise from power lines. Noise levels were measured at the main gate for a period of one hour.

Grimes County

Segment 3C

The noise-sensitive land uses for Segment 3C in Grimes County include rural areas with scattered single family residences. A description of the noise measurement conducted along Segment 3C in Grimes County is as follows:

Site LT-16: 6113 FM 1696. The Ldn measured at this location was 45 dBA. Noise levels were measured for 24 hours and the measurement was performed at northeast edge of the property overlooking at the power lines. The dominant noise sources were wind and farming activities.

Segment 4

The noise-sensitive land uses for Segment 4 in Grimes County include rural areas with scattered single family residences. The noise measurement sites used to characterize Segment 4 in Grimes County are the same as those used for Segment 3C.

Segment 5

The noise-sensitive land uses for Segment 5 in Grimes County include rural areas with scattered single family residences and the Town of Singleton. Singleton is a mixture of single family residences and commercial and industrial areas. Descriptions of the noise measurements conducted along Segment 5 in Grimes County are as follows:

Site LT-17: 10735 Route 90. The Ldn measured at this location was 47 dBA. Noise levels were measured for 24 hours and the measurement was conducted at the eastern side of the property at a distance of about 150 feet from a metallic shed. The dominant noise source was distant local traffic.

Site LT-18: 5126 FM 1774. The measured Ldn at this location was 60 dBA. The dominant noise sources were barking dogs and local traffic from FM 1774. Noise levels were measured for 24 hours on the northern side of the property at a distance of 150 feet from FM 1774.

Site ST-15: 15619 TX-90. The measured Leq at this location was 53 dBA. The dominant noise source was local traffic from TX 90, livestock and other farm animals and farming activities. Noise levels were measured in front of the house near the driveway for a period of one hour.

Site ST-16: County Road 341, Plantersville. The measured Leq at this location was 50 dBA. The dominant noise source was local traffic from County Road 341. Noise levels were measured at the back of the property near a shed for a period of one hour.

Waller County

Segment 5

The noise-sensitive land uses for Segment 5 in Waller County include rural areas with scattered single family residences. Descriptions of the noise measurements along Segment 5 in Waller County are as follows:

Site LT-19: 119 Plantation Drive, Todd Mission. The measured Ldn at this location was 47 dBA. Noise levels were measured for 24 hours at the front northern edge of the property. The dominant noise sources were local traffic from Plantation Drive and neighborhood activity.

Site ST-17: 31205 Hegar Road. The measured Leq at this location was 47 dBA. The major noise sources were local traffic from Hegar Road and Joseph Road. Noise levels were measured in the front yard of the residence for a period of one hour.

Harris County

Segment 5

The noise-sensitive land uses for Segment 5 in Harris County include some rural areas, industrial and commercial areas and residential neighborhoods. Between the county's northern boundaries where the proposed route crosses SH 99, the land use is mostly rural with scattered single family residences. Between SH 99 and Fry Road, the segment runs through a mostly rural area with scattered single-family residences and commercial uses.

Between Fry Road and SH 6 North, both sides of the proposed route include a mixture of commercial and industrial areas with residential neighborhoods. The neighborhoods have both single and multi-family residences. Within this vicinity are four churches and Cy-Fair High School. Between SH 6 North and the West Sam Houston Parkway, there is a mix of commercial and residential areas north of the proposed route. The residential areas are a mixture of single- and multi-family housing. South of the route is a mixture of industrial and commercial usage. There are also two churches along this stretch of the segment.

Between the West Sam Houston Parkway and IH-610, the land use around the segment is mostly commercial and industrial with a few residential areas with single-family houses. Also within this section are six places of worship and Bane Elementary School. Along IH-610, the route passes through a mixture of industrial and commercial areas.

Descriptions of the noise measurements conducted along Segment 5 in Harris County are as follows:

Site LT-20: 21512 Binford Road. The measured Ldn at this location was 49 dBA. Noise levels were measured for 24 hours at the northern edge of the property at the setback distance of the residence. Traffic noise from Binford Road was not significant during the measurement period.

Site LT-21: 12118 Canyon Arbor Way. The measured Ldn at this location was 67 dBA. Noise levels were measured for 24 hours at the northern edge of the property near a residence. The dominant noise source was local traffic from US-290.

Site LT-22: 14812 Hempstead Road. The measured Ldn at this location was 44 dBA. Noise levels were measured for 24 hours at the front yard of the property facing Hempstead Road. The dominant noise sources were local traffic on Hempstead Road and Union Pacific trains, located parallel to Hempstead Road.

Site LT-23: 11217 Todd Street. The measured Ldn at this location was 47 dBA. The dominant noise sources were local traffic on Todd Street, Harland Drive and Hempstead Road, plus Union Pacific trains. Noise levels were measured for 24 hours on the northern edge of the property.

Site ST-18: 6734 Limestone Street. The measured Leq at this location was 57 dBA. The dominant noise source was local traffic on Limestone Street and Hempstead Road. Noise levels were measured in front of the residence for a period of one hour.

Site ST-19: 20710 May Showers Circle. The measured Leq at this location was 61 dBA. The major noise sources were local traffic on Hempstead Road, Huffmeister Road and residential activities in May Showers Circle. Noise levels were measured in the front yard of the property for a period of one hour.

Existing Vibration Conditions

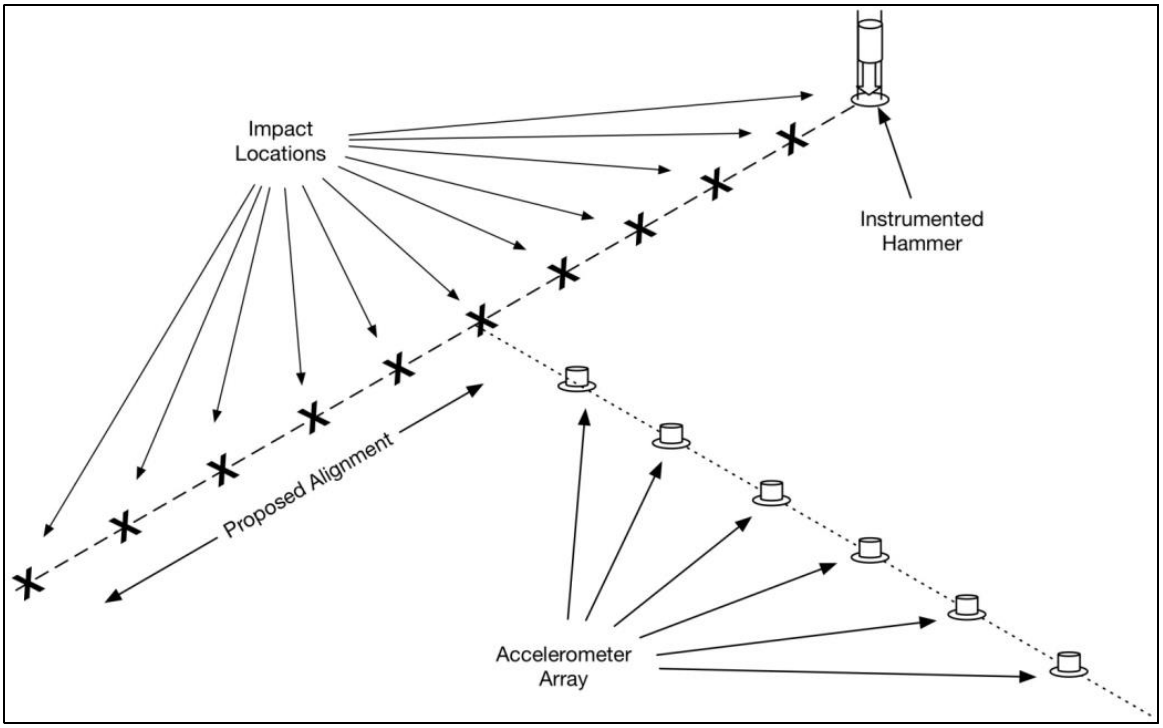
Vibration Measurement Procedures and Equipment

Vibration-sensitive land use for the project was identified based on GIS data, aerial photography, drawings, plans and a field survey. Except for parks and other exterior areas, the vibration sensitive land uses along the routes of the Build Alternatives are the same as described above in **Section 4.1** (Existing Noise Conditions).

Vibration propagation measurements were conducted in the Study Area during January 2016 to determine the vibration response characteristics of the ground near vibration-sensitive locations. A custom-built instrumented hammer was used to impart an impulsive force to the ground. The magnitude of the force was calculated based on the acceleration and mass of the falling hammer. The resulting vibration signals were measured using high-sensitivity accelerometers (PCB Model 393C and 393B05) mounted in a vertical direction on pavement or on steel spikes driven into the ground. The signals from the hammer and accelerometers were recorded using Data Translation DT9837A digital acquisition hardware. Data Translation's QuickDAQ software, running on a laptop computer, was used to review the measurement data.

The vibration propagation test procedure is shown schematically in **Figure 4-5**. The instrumented hammer was used to generate impulses at specific locations spaced 15 feet apart along a line on or parallel to the proposed HSR alignment. A line of accelerators was placed perpendicular to the line of impacts as shown in the figure. The relationship between the input force and the resulting vibration measured by the accelerometers, called the transfer mobility (TM), was calculated using proprietary software in the Cross-Spectrum Acoustics (CSA) laboratory. The transfer mobility represents the vibration propagation characteristics of the ground at the measurement site and at other sites with similar geology. Vibration levels from a HSR vehicle were estimated by mathematically combining the force generated by a train (the force density) with the transfer mobility as described in the Detailed Vibration Assessment methodology provided in the FRA guidance manual.

Figure 4-5: Vibration Propagation Measurement Schematic



Source: Cross-Spectrum Acoustics, 2016.

For the laboratory analysis, the following steps were used to calculate the transfer mobility at each measurement site:

- Narrow-band transfer functions for each accelerometer/force pair were computed using custom CSA software. Signal processing and averaging techniques were used to maximize the signal-to-noise ratio for each measurement. Numerical integration was used to convert the acceleration data into velocity.
- The narrowband data were converted to one-third-octave band data.
- Numerical integration was used to convert the measured point source transfer mobility (PSTM) data into line source transfer mobilities (LSTM).
- For each one-third-octave band, linear or quadratic regression was used to determine smoothed estimates for each line source transfer mobility as a function of distance from the source.

The FRA manual provides more details regarding the propagation test and analysis procedures.

Vibration Measurement Locations

Table 4-2 and **Figures 4-6 through 4-9** describe the locations of the eleven vibration measurement sites. Photographs of each site are included in Appendix A.

Table 4-2: Summary of Vibration Propagation Measurement Sites				
Site No.	Measurement Location	County	Segments	Date
V-1	4360 Kolloch Drive, Dallas (Church)	Dallas	1	1/18/2016
V-2	103 Coffee Rd.	Ellis	2A, 2B	1/18/2016
V-3	710 FM 2100	Navarro	3A, 3B, 3C	1/19/2016
V-4	N Fwy Service Rd., Fairfield	Freestone	3C, 4	1/19/2016
V-5	LCR 828, Personville	Limestone	4	1/20/2016
V-6	6734 FM 977 (Residence)	Leon	4	1/20/2016
V-7	10290 Greenbriar Rd. (Residential Parcel)	Madison	3C	1/20/2016
V-8	10063 CR 311 (Residence)	Grimes	5	1/21/2016
V-9	Plantation Dr., Todd Mission	Waller	5	1/21/2016
V-10	Josey Ranch Rd., Houston	Harris	5	1/22/2016
V-11	21610 U.S. 290 Frontage Rd., Houston	Harris	5	1/22/2016

Source: Cross-Spectrum Acoustics, 2016.

Descriptions of the vibration measurement sites and the areas they represent are provided below by county and segment.

Dallas County

Segment 1

Site V-1: 4360 Kolloch Dr. The vibration propagation measurement was conducted in the parking lot of Friendship Missionary Baptist Church. The measurement results at this site are representative of the ground-borne vibration propagation conditions of the soil this area, including all vibration-sensitive land use along the I-45 corridor in Dallas between S Lamar St. and the I-20 junction along Segment 1.

Ellis County

Segment 2A

Site V-2: 103 Coffee Rd. The vibration propagation measurement was conducted along Coffee Rd. with the sensors placed in the adjacent field. The measurement results at this site are representative of the ground-borne vibration propagation conditions of the soil this area, including all vibration-sensitive land use west of I-45 from Hutchins to Bardwell along both Segments 2A and 2B.

Segment 2B

The vibration measurement results used to characterize the vibration propagation conditions along Segment 2B in Ellis County are the same as those used for Segment 2A.

Figure 4-6: Vibration Propagation Measurement Locations (Sheet 1 of 4)

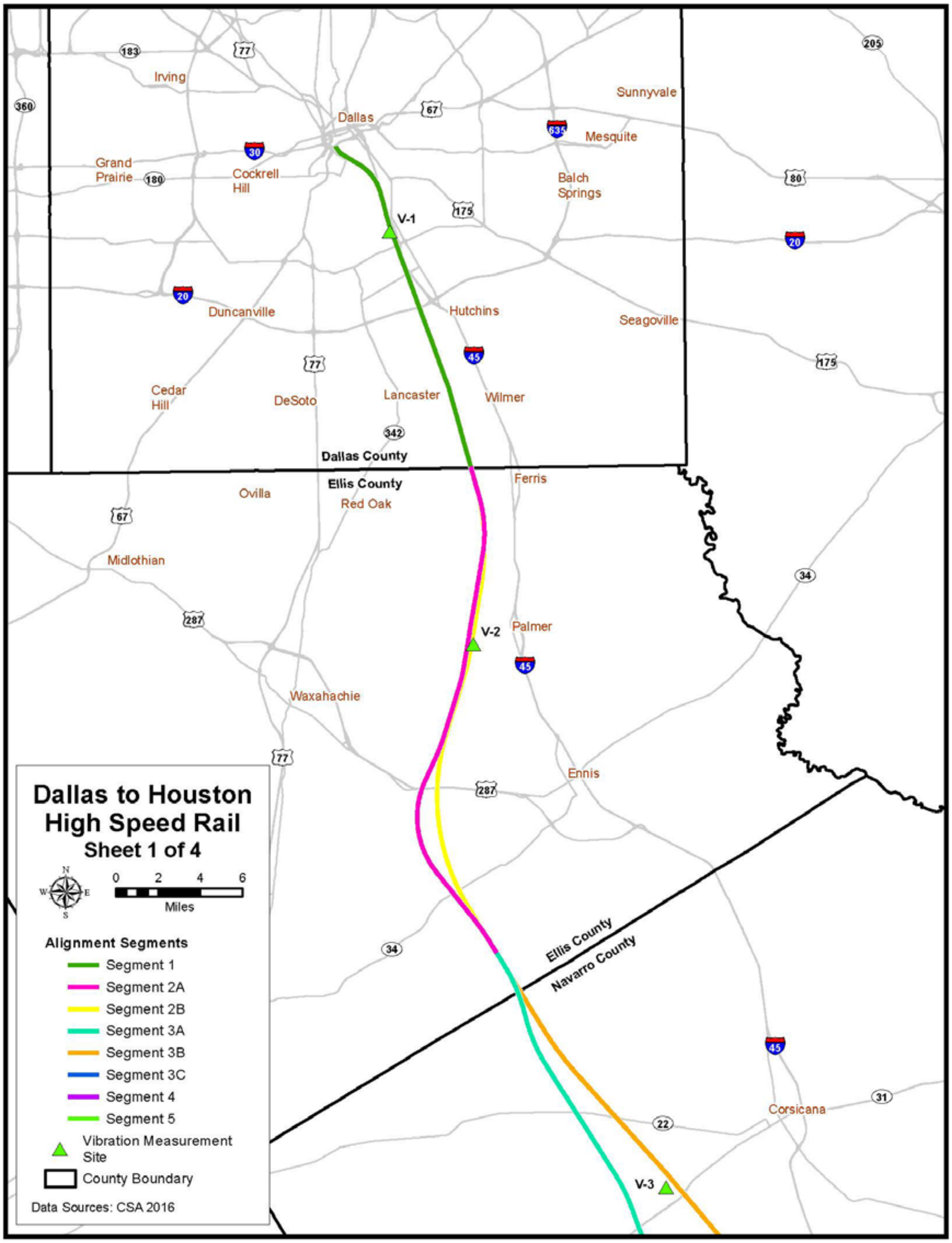


Figure 4-7: Vibration Propagation Measurement Locations (Sheet 2of 4)

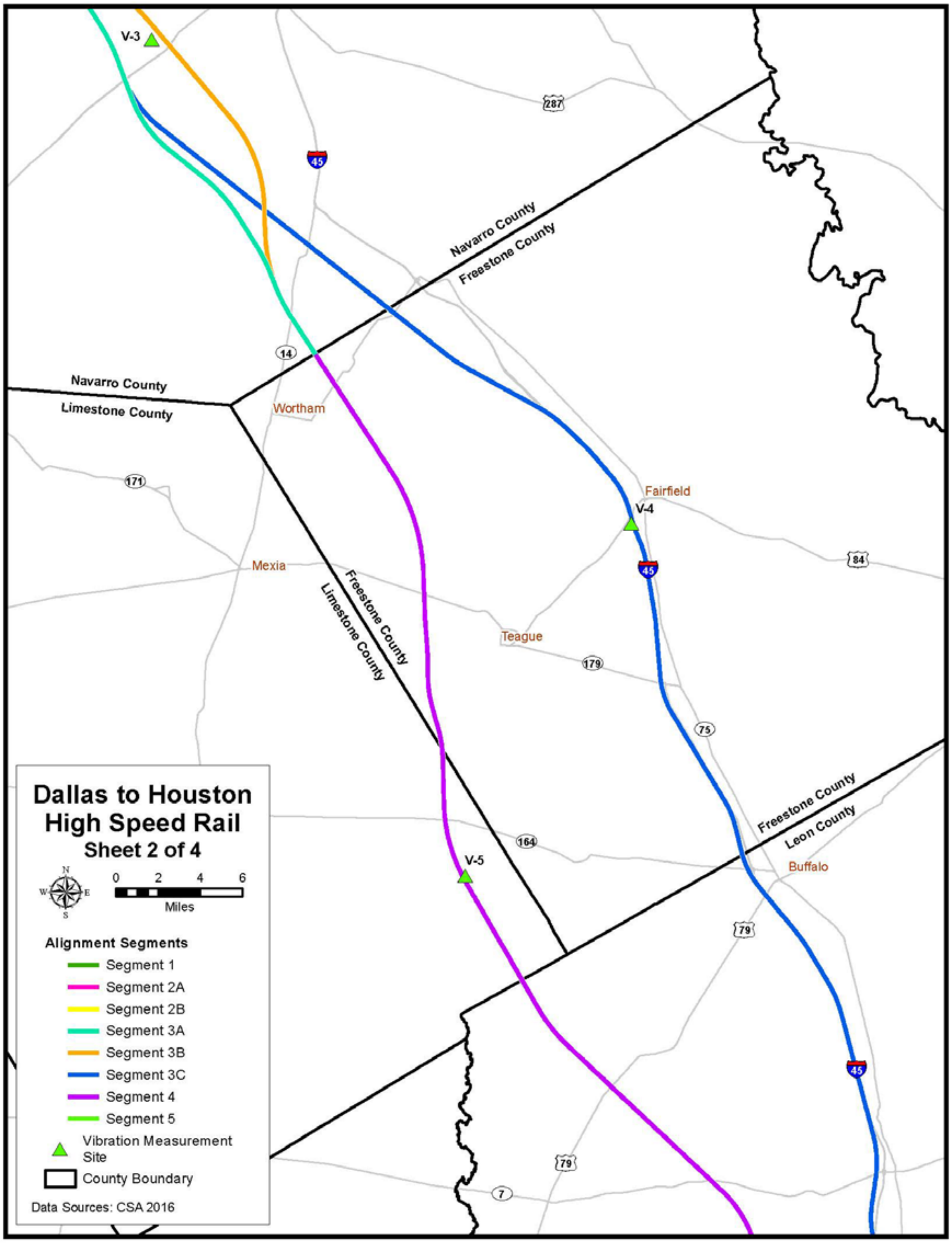


Figure 4-8: Vibration Propagation Measurement Locations (Sheet 3 of 4)

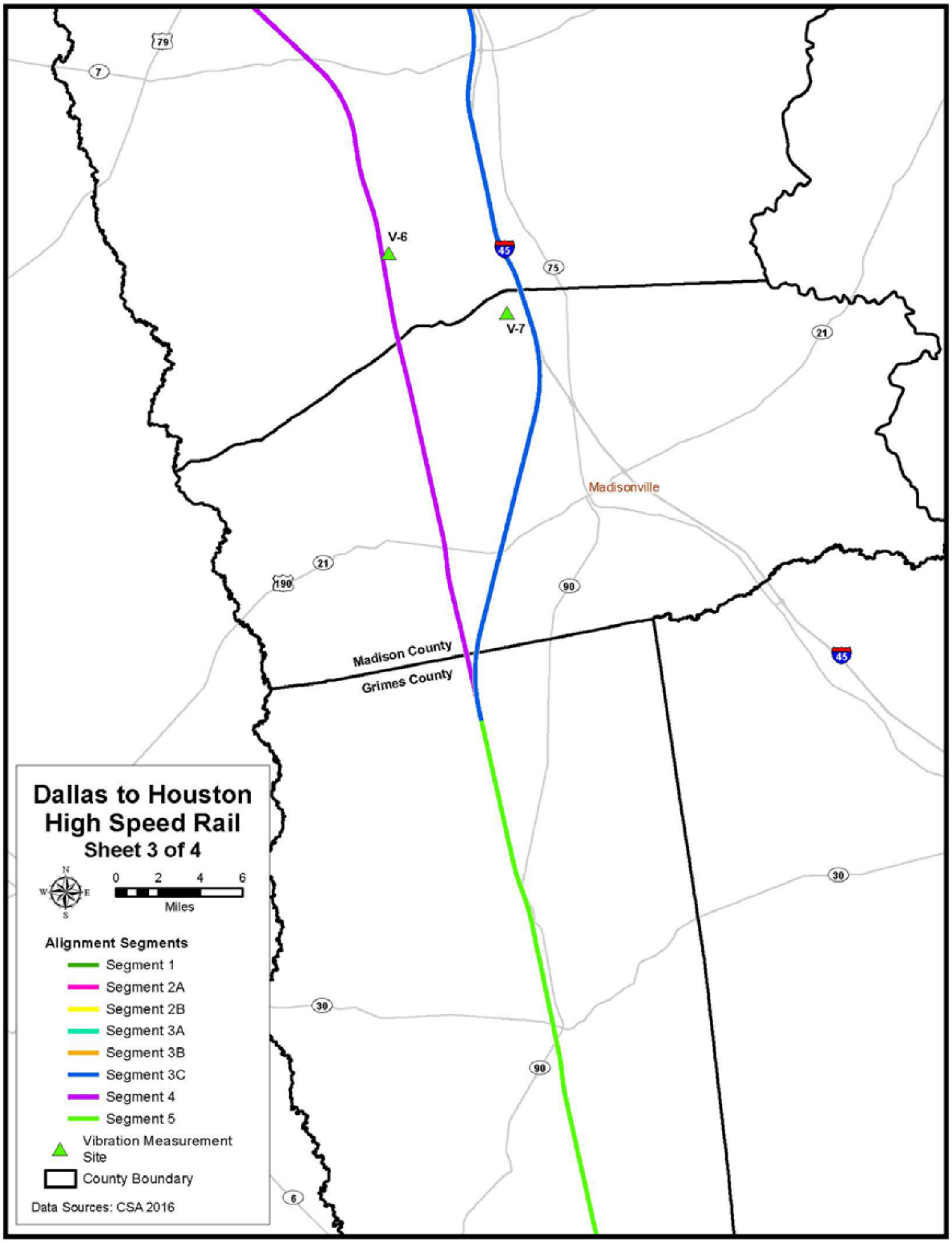
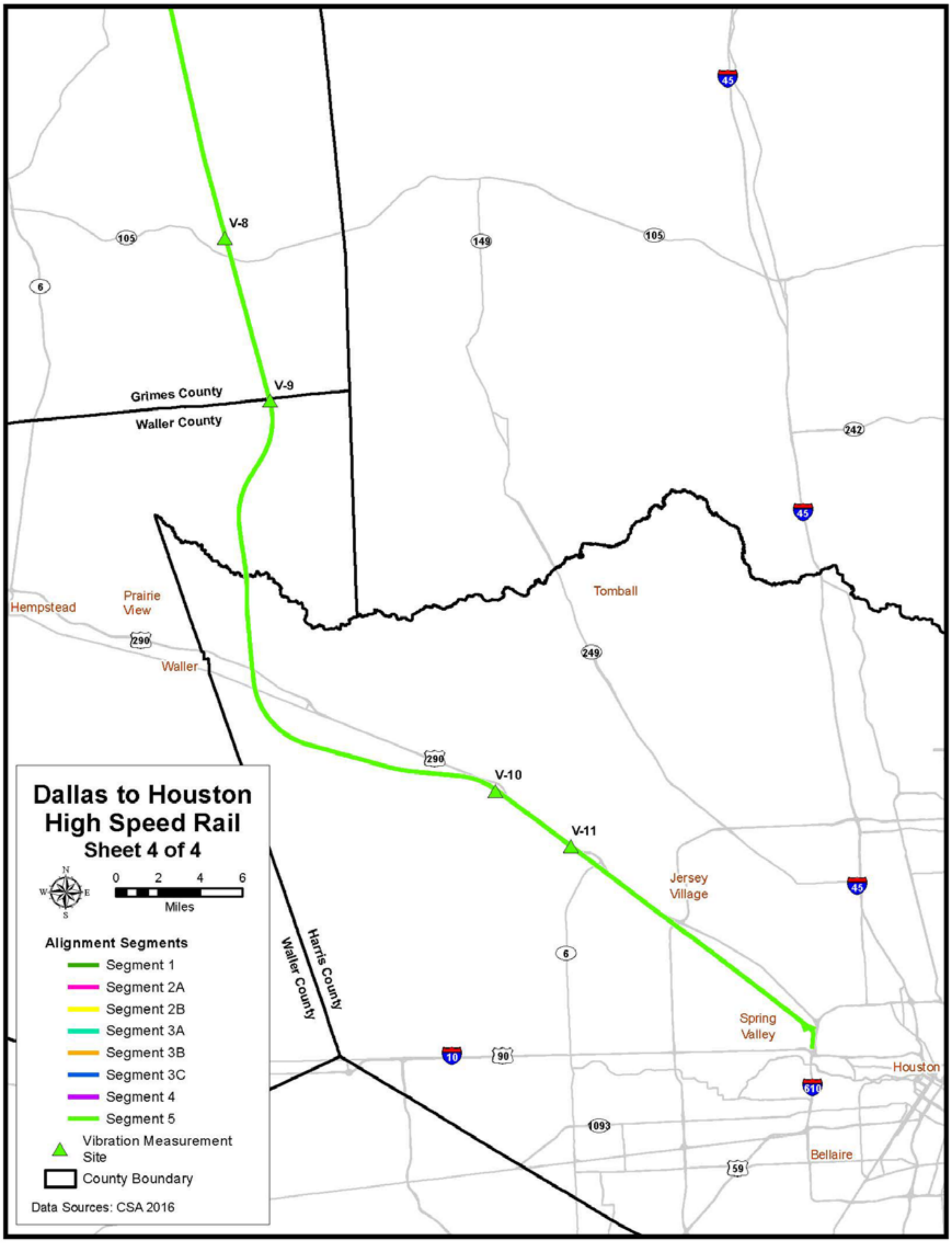


Figure 4-9: Vibration Propagation Measurement Locations (Sheet 4 of 4)



Navarro County

Segment 3A

Site V-3: 710 FM 2100. The vibration propagation measurement was conducted along FM 2100 with the sensors in the front yard of the property. The measurement results at this site are representative of the ground-borne vibration propagation conditions of the soil this area, including all vibration-sensitive land use in Navarro County along the northern portions of Segments 3A, 3B, 3C and 4 including the towns of Barry and Oak Valley.

Segment 3B

The vibration measurement results used to characterize the vibration propagation conditions along Segment 3B in Navarro County are the same as those used for Segment 3A.

Segment 3C

The vibration measurement results used to characterize the vibration propagation conditions along Segment 3C in Navarro County are the same as those used for Segment 3A.

Segment 4

The vibration measurement results used to characterize the vibration propagation conditions along Segment 4 in Navarro County are the same as those used for Segment 3A.

Freestone County

Segment 3C

Site V-4: N Fwy Service Rd., Fairfield. The vibration propagation measurement was conducted along the western edge of the gas field with the sensors in the adjoining field. The measurement results at this site are representative of the ground-borne vibration propagation conditions of the soil this area, including all vibration-sensitive land use between Fairfield and Teague in Freestone County following Route 179 on the east and Segment 4 on the west.

Segment 4

The vibration measurement results used to characterize the vibration propagation conditions along Segment 4 in Freestone County are the same as those used for Segment 3C.

Limestone County

Segment 4

Site V-5: LCR 828, Personville. The vibration propagation measurement was conducted in the front pasture of the property along the driveway. The measurement results at this site are representative of the ground-borne vibration propagation conditions of the soil this area, including all vibration-sensitive land use along Segment 4 west of the towns of Donie and Jewett.

Leon County

Segment 3C

Site V-7: 10290 Greenbriar Rd. The vibration propagation measurement was conducted along Greenbriar Rd. with the sensors located in the field to the north of the house. The measurement results at this site are representative of the ground-borne vibration propagation conditions of the soil this area, including all vibration-sensitive land use along the southern part of Segment 3C in south Leon County and north Madison County, including the towns of Centerville and Leona.

Segment 4

Site V-6: 6734 FM 977. The vibration propagation measurement was conducted in the front yard of the property. The measurement results at this site are representative of the ground-borne vibration propagation conditions of the soil this area, including all vibration-sensitive land use along the southern part of Segment 4 in southern Leon County and northern Madison County.

Madison County

Segment 3C

The vibration measurement results used to characterize the vibration propagation conditions along Segment 3C in Madison County are the same as those used for Segment 3C in Leon County.

Segment 4

The vibration measurement results used to characterize the vibration propagation conditions along Segment 4 in Madison County are the same as those used for Segment 4 in Leon County.

Grimes County

Segment 3C

The vibration measurement results used to characterize the vibration propagation conditions along Segment 3C in Grimes County are the same as those used for Segment 3C in Leon County.

Segment 4

The vibration measurement results used to characterize the vibration propagation conditions along Segment 4 in Grimes County are the same as those used for Segment 4 in Leon County.

Segment 5

Site V-8: 10063 CR 311. The vibration propagation measurement was conducted along CR 311 with the sensors located in the front yard of the property. The measurement results at this site are representative of the ground-borne vibration propagation conditions of the soil this area, including all vibration-sensitive land use along Segment 5 in Grimes co. from Roans Prairie to State Highway 105.

Waller County

Segment 5

Site V-9: Plantation Dr., Todd Mission. The vibration propagation measurement was conducted along Plantation Dr. with the sensors located in an empty lot. The measurement results at this site are representative of the ground-borne vibration propagation conditions of the soil this area, including all vibration-sensitive land use along Segment 5 in south Grimes County and north Waller County.

Harris County

Segment 5

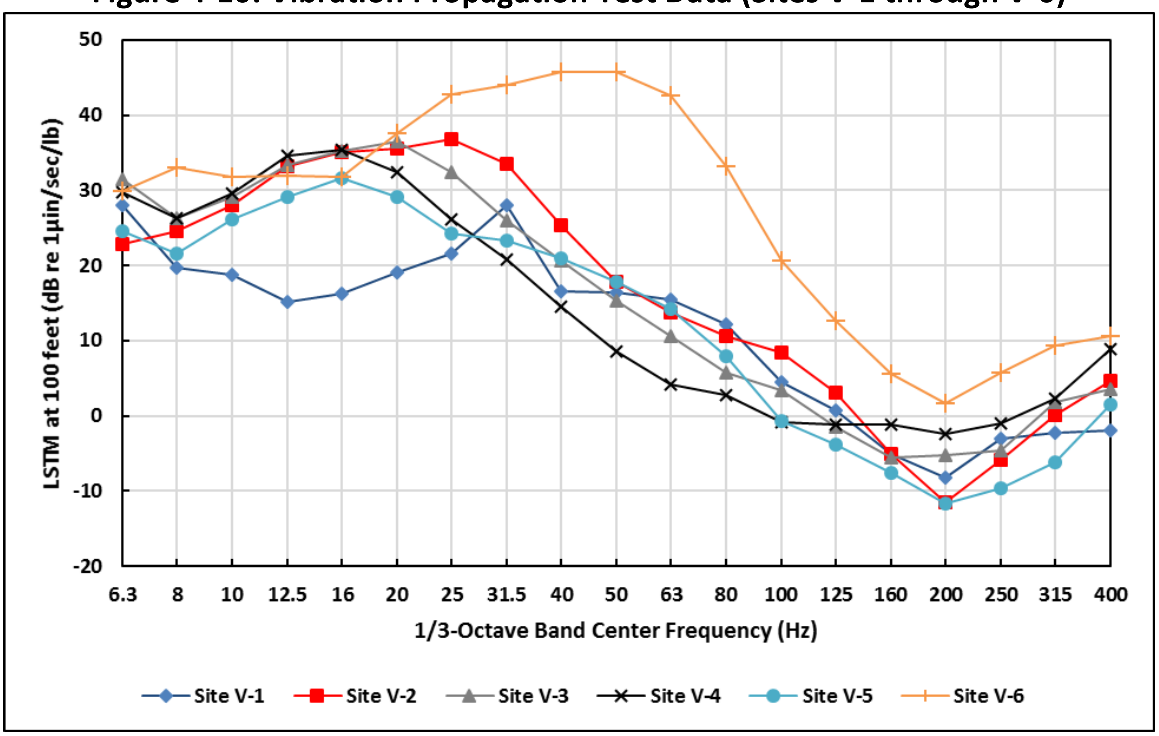
Site V-10: Josey Ranch Rd., Houston. The vibration propagation measurement was conducted along Josey Ranch Rd. with the sensors located in the field to the west. The results at this measurement site are representative of the ground-borne vibration propagation conditions of the soil this area, including all vibration-sensitive land use along US 290 close to Fry Rd for Segment 5.

Site V-11: 21610 U.S. 290 Frontage Rd. The vibration propagation measurement was conducted in the field northeast of the train tracks. The measurement results at this site are representative of the ground-borne vibration propagation conditions of the soil this area, including all vibration-sensitive land use along U.S. 290 between Lee Way Dr. and Huffmeister Rd. in Houston.

4.2.3 Vibration Measurement Results

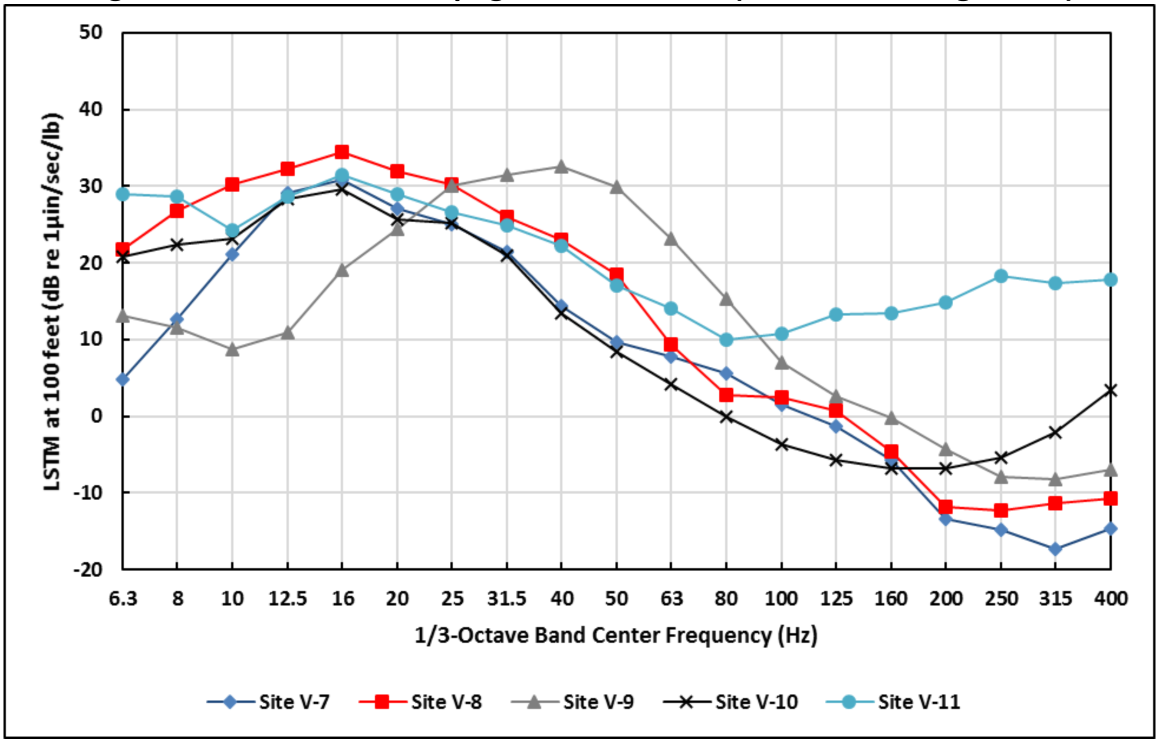
Representative results of the vibration propagation tests are shown in **Figure 4-10** (for Sites V-1 through V-6) and in **Figure 4-11** (for Sites V-7 through V-11) in terms of the measured LSTM as a function of vibration frequency at a distance of 100 feet. Higher LSTM levels in these figures indicate more efficient vibration propagation. Detailed vibration propagation data are provided in Appendix C.

Figure 4-10: Vibration Propagation Test Data (Sites V-1 through V-6)



Source: Cross-Spectrum Acoustics, 2016.

Figure 4-11: Vibration Propagation Test Data (Sites V-7 through V-11)



Source: Cross-Spectrum Acoustics, 2016.

NOISE AND VIBRATION PREDICTION METHODOLOGY

Noise and vibration impacts due to the Project construction and operation were analyzed by using the methodology contained in the FRA and FTA guidance manuals. The FRA Guidance Manual was used as the primary source of guidance for analysis of high speed rail noise and vibration impacts and mitigation and the FTA guidance was used to supplement the FRA guidance for non-high speed rail sources of noise and vibration. The following sections provide additional details regarding the methodology for the noise and vibration impact assessments.

Airborne Noise

Operational Noise

Noise levels from HSR operations were projected based on sound data gathered by Texas Central Railroad (TCRR) in Japan for the Tokaido Shinkansen N700A train, the proposed project's operating plan and the general noise assessment methods included in the FRA guidance manual (Chapter 4, Initial Noise Evaluation). Significant factors are summarized below:

- Based on TCRR measurement data for the Tokaido Shinkansen N700A train, the predictions assume a Reference Sound Exposure Level (SEL) of 87 dBA at a distance of 50 feet from the track centerline in all speed regimes.
- For the Final Operating Scenario (FOS) in the analysis year (2040), it is assumed that trains will run every 10 to 15 minutes in each direction between 05:30 and 23:30, with the last trains departing from Dallas and Houston at 22:00.

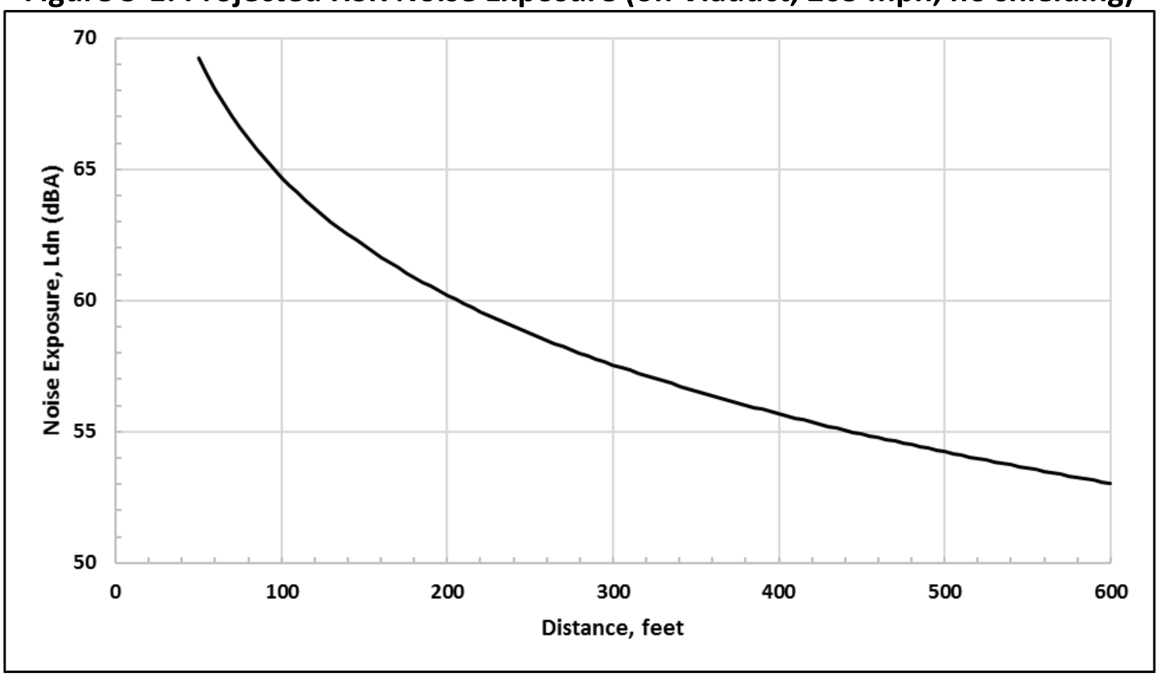
- It is assumed that the trainsets will be 8-car EMU fixed consists with a length of 204.7 meters.
- It is assumed that the trains will operate at a maximum speed of 205 mph along most of the route, except in the vicinity of the stations.

As an example, the projected noise exposure (Ldn) from HSR operations under worst-case conditions (i.e. on viaduct at the maximum speed of 205 mph, without shielding from intervening terrain or structures) is shown in **Figure 5-1** as a function of distance from the near track centerline.

Startle Due to Rapid Onset Rates

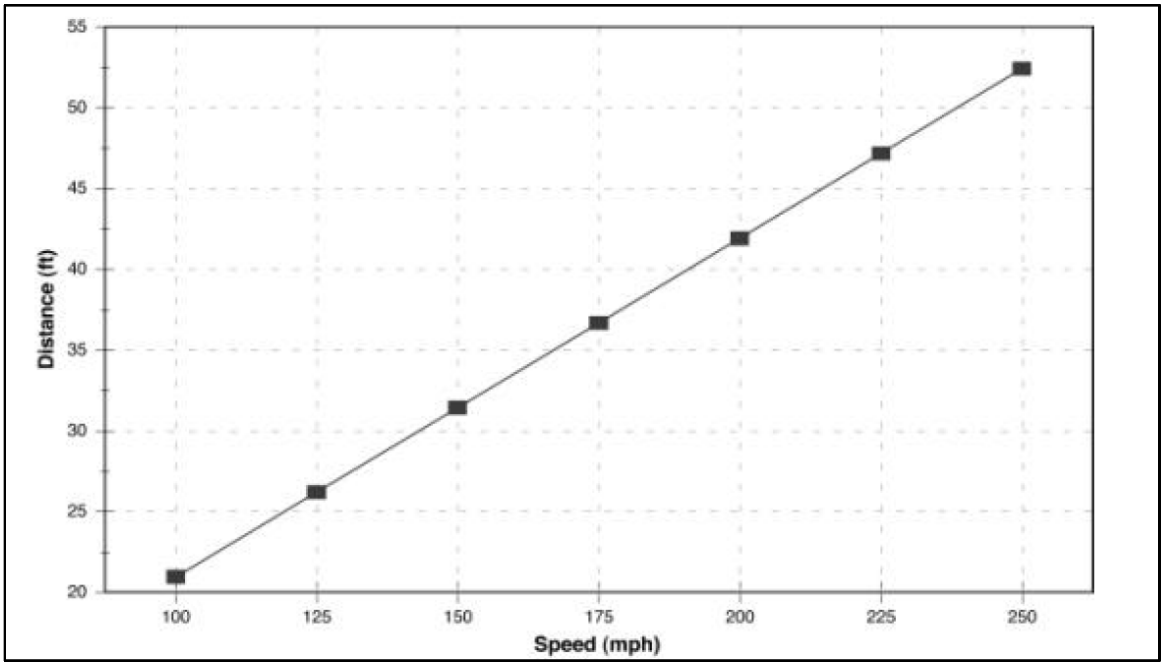
Rapid onset rates (very rapid changes in noise level) due to high speed train noise may cause startle effects at distances very close to the proposed tracks. The onset rate is defined as the rate of change of increasing noise level in decibels per second during a noise event. The duration of such an event is short (typically a few seconds for high-speed trains). For a given speed, onset rates will decrease as the distances from the trains to the noise-sensitive receivers increase. **Figure 5-2** shows the distance from the tracks versus speed relationship for rapid onset rates.

Figure 5-1: Projected HSR Noise Exposure (on Viaduct, 205 mph, no shielding)



Source: Cross-Spectrum Acoustics, 2016.

Figure 5-2: Distance from Tracks within which Startle Can Occur for HSR



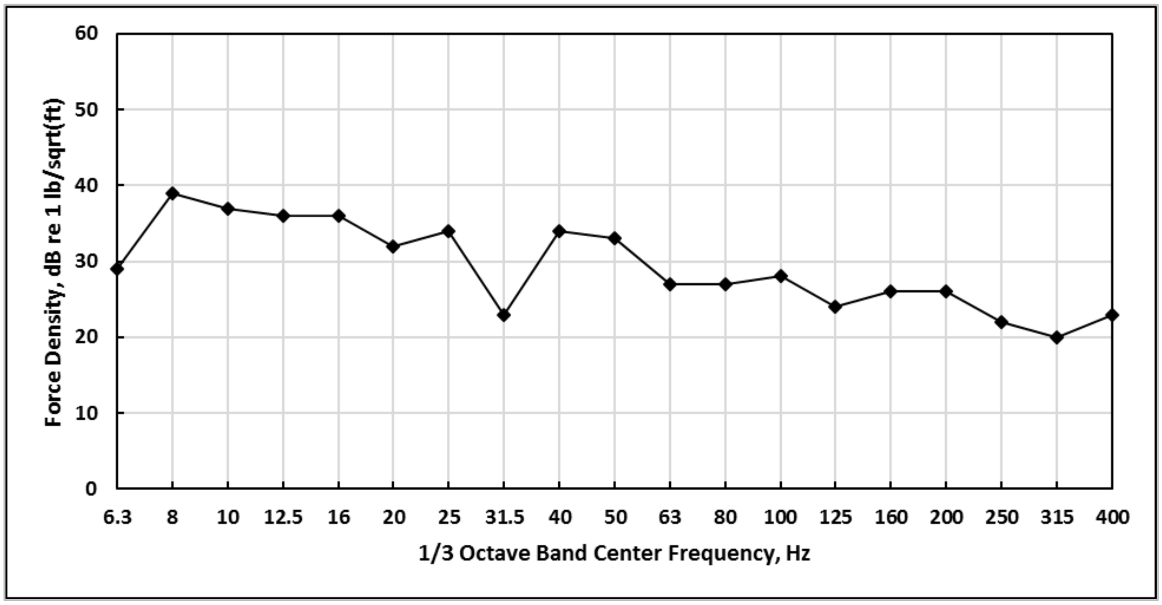
Source: FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012.

Ground-borne Vibration

Ground-borne vibration levels from HSR operations were projected using the detailed vibration assessment prediction methods included in the FRA guidance manual (Chapter 9, Detailed Vibration Assessment). Significant factors are summarized below:

- The train vibration source level was based on the Force Density Level for the Pendolino EMU high-speed train as reported in Figure 9-5 of the FRA guidance manual and shown below in **Figure 5-3**.
- It is assumed that the trains will operate at a maximum speed of 205 mph along most of the route, except in the vicinity of the stations.
- It is assumed that ground-borne noise would be masked by airborne noise from HSR operations at typical structures along the alternative routes and thus ground-borne noise impacts were not assessed.

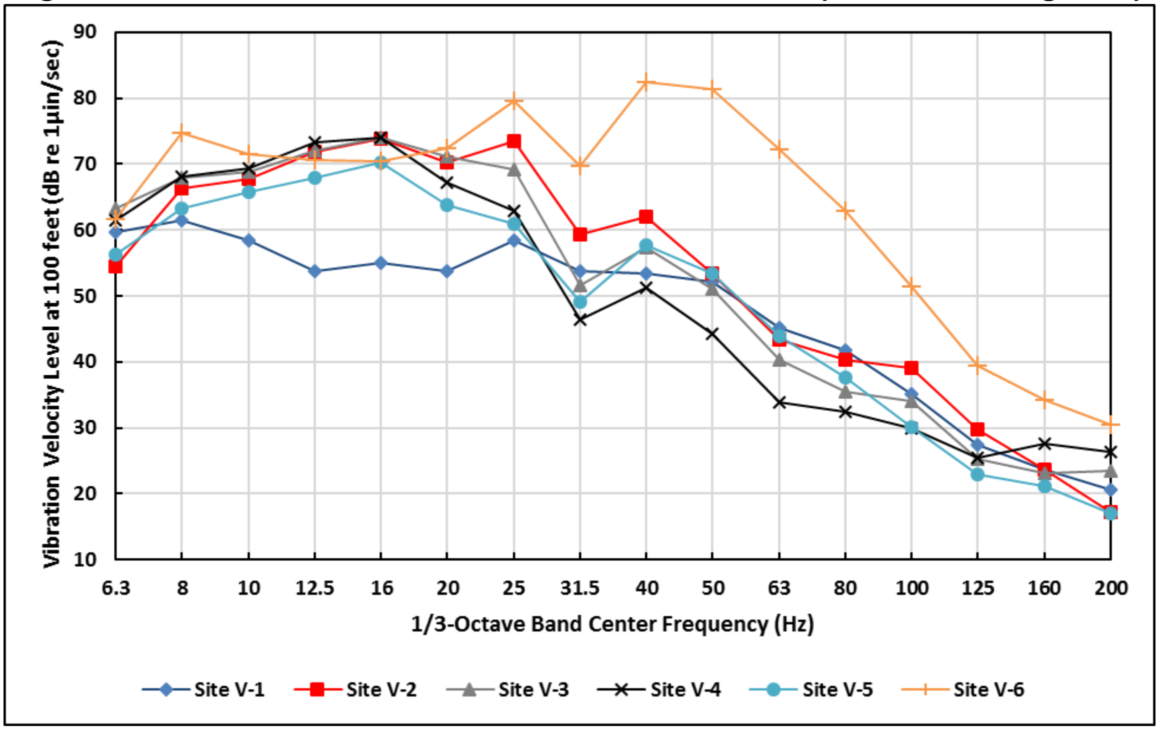
Figure 5-3: Force Density for Pendolino EMU High-Speed Train at 150 mph



Source: FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012.

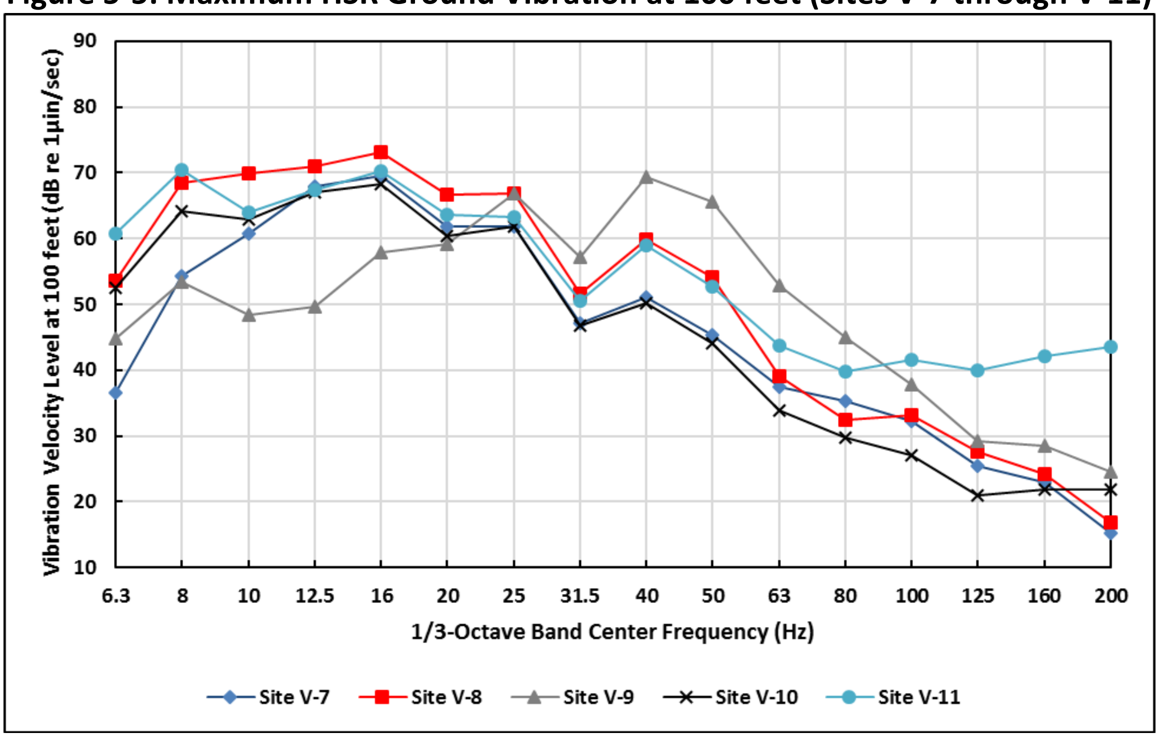
The above force density spectrum was combined with the LSTM data at each vibration measurement site to project ground vibration levels from future HSR operations using the FRA detailed vibration analysis methodology. As an example of the results, the projected ground vibration level spectra from HSR operations at a distance of 100 feet from the near track under worst-case conditions (i.e. at grade and at the maximum speed of 205 mph) are shown in **Figure 5-4** (for Sites V-1 through V-6) and in **Figure 5-5** (for Sites V-7 through V-11). These results suggest that HSR ground vibration levels at 100 feet from the tracks will marginally exceed the FRA vibration criterion of 72 VdB for residential land use in the areas represented by Sites V-2, V-3, V-4 and V-8, but will significantly exceed this criterion in the area represented by Site V-6.

Figure 5-4: Maximum HSR Ground Vibration at 100 feet (Sites V-1 through V-6)



Source: FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012.

Figure 5-5: Maximum HSR Ground Vibration at 100 feet (Sites V-7 through V-11)



Source: FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012.

Construction Noise and Vibration

Construction noise and impacts are assessed using a combination of the methods and construction source data contained in the FRA Manual and the FHWA Roadway Construction Noise Model (RCNM). Typical noise levels generated by representative pieces of equipment are listed in **Table 5-1**.

The noise exposure at a receiver location may be calculated using decibel addition of all operating construction equipment using the following equation:

$$L_{eq}(n) = L_{max} + 10 \times \log(U.F.) - 20 \times \log(D/50) - A_{shielding}$$

where:

$L_{eq}(n)$ = noise exposure at a receiver resulting from the operation of a single piece of equipment over n hours,

L_{max} = noise emission level of the particular piece of equipment at the reference distance of 50 feet (taken from **Table 5-1**),

$A_{shielding}$ = shielding provided by barriers, building, or terrain,

D = distance from the receiver to the piece of equipment in feet, and

U.F. = usage factor that accounts for the fraction of time that the equipment is in use over the specified time period. For Leq(1) assume a U.F. equal to 100% and for 8 hours or more use the values in **Table 5-1**.

The combination of noise from several pieces of equipment operating during the same time period is obtained from decibel addition of the Leq of each single piece of equipment calculated using the above equations.

Construction vibration is assessed for areas where there is potential for impact from construction activities. Such activities include blasting, pile driving, demolition, and drilling or excavation in close proximity to sensitive structures. Typical vibration levels generated by representative pieces of equipment are listed in **Table 5-2**.

Table 5-1: Construction Equipment Noise Emission Levels		
Equipment	**Typical Noise Level (dBA) 50 ft from Source**	**Usage Factor (U.F.), %**
Air Compressor	80	40
Backhoe	80	40
Ballast Equalizer	82	50
Ballast Tamper	83	50
Compactor	82	20
Concrete Mixer	85	40
Concrete Pump	82	20
Concrete Vibrator	76	20
Crane, Derrick	88	16
Crane, Mobile	83	16
Dozer	85	16
Generator	82	50
Grader	85	40
Impact Wrench	85	50
Jack Hammer	88	20
Loader	80	40
Paver	85	50
Pile Driver (Impact)	101	20
Pile Driver (Vibratory)	95	20
Pneumatic Tool	85	50
Pump	77	50
Rail Saw	90	20
Rock Drill	85	20
Roller	85	20
Saw	76	20
Scarifier	83	20
Scraper	85	40
Shovel	82	40
Spike Driver	77	20
Tie Cutter	84	20
Tie Handler	80	20
Tie Inserter	85	20
Truck	84	40

Sources: (1) FRA, “High-Speed Ground Transportation Noise and Vibration Impact Assessment,” Final Report DOT/FRA/ORD-12/15, September 2012 and (2) FHWA, “Construction Noise Handbook, Final Report FHWA-HEP-06-015, August 2006.

Table 5-2: Vibration Source Levels for Construction Equipment			
Equipment		**PPV at 25 ft (in/sec)**	**Approximate Lv † at 25 ft**
Pile Driver (impact)	upper range	1.518	112
	typical	0.644	104
Pile Driver (vibratory)	upper range	0.734	105
	typical	0.170	93
Clam shovel drop (slurry wall)		0.202	94
Hydromill (slurry wall)	in soil	0.008	66
	in rock	0.017	75
Vibratory roller		0.210	94
Hoe ram		0.089	87
Large bulldozer		0.089	87
Caisson drilling		0.089	87
Loaded trucks		0.076	86
Jackhammer		0.035	79
Small bulldozer		0.003	58
† RMS velocity in decibels (VdB) re 1 µinch/second			

Source: FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012.

For damage assessment the following equation is used:

PPVequip = PPVref × [(25/D)]^1.5

where:

PPVequip = the peak particle velocity in in/sec of the equipment adjusted for distance

PPVref = the reference vibration level in in/sec at 25 feet from **Table 5-2**, and

D = the distance from the equipment to the receiver in feet.

For annoyance assessment the following equation is used:

Lv (D) = Lv (25 ft) - 30×Log(D/25)

where:

Lv(D) = RMS vibration level at distance D

Lv(25 ft) = RMS vibration level at 25 ft from **Table 5-2**, and

D = the distance from the equipment to the receiver in feet.

NOISE AND VIBRATION IMPACT ASSESSMENT

Station Noise Assessment

The proposed station locations include one site in Dallas, one site near College Station and three site options in Houston. Excluding noise impacts from train operations (addressed below), sources of potential noise impact in the vicinity of train stations includes auto and bus traffic associated with access roads and parking facilities. For these sources, FTA guidance suggests impact screening distances in the range of 100-225 feet. For the station sites under consideration, however, it does not appear that there is any noise-sensitive land use within these distances. Thus noise impacts are not anticipated due to HSR station activities.

Maintenance Facility Noise Impacts

There are two proposed Trainset Maintenance Facilities (TMF) and five Maintenance-of-Way Facilities (MOWF) along each build alternative. For maintenance facilities, FTA guidance (Chapter 3 of the FTA Guidance Manual)[1] suggests an impact screening distance of 1,000 feet from the center of the facility. If no sensitive receptors are found within that distance, no further noise analysis is required. For all the TMF and MOWF facilities, there are no noise-sensitive land uses within this distance. Thus, noise impacts are not anticipated due to TMF or MOWF operations.

Operational Noise Assessment

The assessment of noise impacts from HSR operations is summarized by county and segment in **Table 6-1** for FTA Category 2 (residential) land use and in **Table 6-2** for FTA Category 3 (institutional) land use. The results include a tabulation of location information for each sensitive receptor group, the existing noise levels, the projections of future noise levels, the impact criteria, and whether there will be noise impacts. The tables also show the total number of moderate and severe noise impacts for each location, without mitigation.

[1] FTA, "Transit Noise and Vibration Impact Assessment," Final Report FTA-VA-90-1003-06, May 2006.

Table 3.4-12: Summary of Noise Impacts for Residential Land Use										
County/ Segment	Location	Side of Track	Near Track Dist. (ft)	Existing Noise Level (Ldn)	Project Noise Levels – Ldn (dBA)			Number and Type of Impacts		Mapbook Page
					HSR	FRA Criteria				
						Mod.	Sev.	Mod.	Sev.	
Dallas (1)	Dallas Station to IH-20	NB	243-415	72	54-57	65	71	0	0	--
				53		54	60	0	0	--
Dallas (1)	Dallas Station to IH-20	SB	348-1001	72	48-55	65	71	0	0	--
				53		54	60	0	0	--
Dallas (1)	IH-20 to Bluff Springs Rd	NB	270-793	53	49-56	54	60	1	0	7
				70		64	69	0	0	--
				45		52	59	5	0	10-11
Dallas (1)	IH-20 to Bluff Springs Rd	SB	223-970	53	48-58	54	60	0	0	--
				70		64	69	0	0	--
				45		52	59	3	0	11
Ellis (1)	IH-20 to Bluff Springs Rd	NB	188-910	45	49-59	52	59	8	1	11-12
Ellis (1)	IH-20 to Bluff Springs Rd	SB	174-2612	45	42-59	52	59	9	1	11-12
Ellis (2A)	Bluff Springs Rd to FM 813	NB	527-2986	45	39-52	52	59	1	0	13
				55		55	61	0	0	--
Ellis (2A)	Bluff Springs Rd to FM 813	SB	199-2715	45	41-59	52	59	4	0	13-16
				55		55	61	4	0	13-16
Ellis (2A)	FM 813 to TX 287	NB	824-1690	55	44-49	55	61	0	0	--
				53		55	61	0	0	--
Ellis (2A)	FM 813 to TX 287	SB	211-989	55	46-58	55	61	1	0	18

Table 3.4-12: Summary of Noise Impacts for Residential Land Use

County/ Segment	Location	Side of Track	Near Track Dist. (ft)	Existing Noise Level (Ldn)	Project Noise Levels – Ldn (dBA)			Number and Type of Impacts		Mapbook Page
					HSR	FRA Criteria				
						Mod.	Sev.	Mod.	Sev.	
Ellis (2A)	FM 813 to TX 287			53		55	61	0	0	--
Ellis (2A)	TX 287 to TX 34	NB	281-2148	53	43-56	55	61	1	0	23
				52		54	60	0	0	--
Ellis (2A)	TX 287 to TX 34	SB	289-805	53	48-56	55	61	1	0	22
				52		54	60	0	0	--
Ellis (2A)	TX 34 to TX 22	NB	No noise sensitive receptors.							--
Ellis (2A)	TX 34 to TX 22	SB	167-905	53	49-60	55	61	2	0	25
				36		50	55	0	0	--
Ellis (2B)	Bluff Springs Rd to FM 813	NB	385-2987	55	39-54	55	61	2	0	29
				45		52	59	0	0	--
Ellis (2B)	Bluff Springs Rd to FM 813	SB	205-2715	55	41-58	55	61	0	0	--
Ellis (2B)	Bluff Springs Rd to FM 813	SB		45		52	59	1	0	30
Ellis (2B)	FM 813 to TX 287	NB	179-947	55	48-59	55	61	1	0	33
Ellis (2B)	FM 813 to TX 287	NB		53		55	61	0	0	--
Ellis (2B)	FM 813 to TX 287	SB	585-1784	55	44-49	55	61	0	0	--
				53		55	61	0	0	--
Ellis (2B)	TX 287 to TX 34	NB	455-2908	53	39-53	55	61	0	0	--
				60		58	63	0	0	--
Ellis (2B)	TX 287 to TX 34	SB	959	53	46	55	61	0	0	--

Table 3.4-12: Summary of Noise Impacts for Residential Land Use

County/ Segment	Location	Side of Track	Near Track Dist. (ft)	Existing Noise Level (Ldn)	Project Noise Levels – Ldn (dBA)			Number and Type of Impacts		Mapbook Page
					HSR	FRA Criteria				
						Mod.	Sev.	Mod.	Sev.	
				60		58	63	0	0	--
Ellis (2B)	TX 34 to TX 22	NB	No noise sensitive receptors.							
Ellis (2B)	TX 34 to TX 22	SB	1388-1556	53	44-46	55	61	0	0	--
Ellis (3A)	TX 34 to TX 22	NB	No noise sensitive receptors.							
Ellis (3A)	TX 34 to TX 22	SB	977	36	46	50	55	0	0	--
Ellis (3B)	TX 34 to TX 22	NB	No noise sensitive receptors.							
Ellis (3B)	TX 34 to TX 22	SB	1311	36	44	50	55	0	0	--
Ellis (3C)	TX 34 to TX 22	NB	No noise sensitive receptors.							
Ellis (3C)	TX 34 to TX 22	SB	977	36	46	50	55	0	0	--
Navarro (3A)	TX 34 to TX 22	NB	396-923	36	47-52	50	55	1	0	45
Navarro (3A)	TX 34 to TX 22	SB	360-2879	36	39-53	50	55	1	0	46
Navarro (3A)	TX 22 to TX 31	NB	290-632	39	49-54	50	55	1	0	51
				36		50	55	0	0	--
Navarro (3A)	TX 22 to TX 31	SB	560-1034	39	46-52	50	55	0	0	--
				36		50	55	0	0	--
Navarro (3A)	TX 31 to FM 3194	NB	261-546	46	50-57	52	59	1	0	55
Navarro (3A)	TX 31 to FM 3194	SB	740	46	45	52	59	0	0	--
Navarro (3A)	FM 3194 to Navarro County Line	NB	656	46	51	52	59	0	0	--
Navarro (3A)	FM 3194 to Navarro County Line	SB	No noise sensitive receivers.							--

Table 3.4-12: Summary of Noise Impacts for Residential Land Use										
County/ Segment	Location	Side of Track	Near Track Dist. (ft)	Existing Noise Level (Ldn)	Project Noise Levels – Ldn (dBA)			Number and Type of Impacts		Mapbook Page
					HSR	FRA Criteria				
						Mod.	Sev.	Mod.	Sev.	
Navarro (3B)	TX 34 to TX 22	NB	611-2905	36	39-51	50	55	1	0	65
Navarro (3B)	TX 34 to TX 22	SB	222-1002	36	46-58	50	55	3	1	65-67
Navarro (3B)	TX 22 to TX 31	NB	261-996	46	48-57	52	59	1	0	70
				39		50	55	0	0	--
Navarro (3B)	TX 22 to TX 31	SB	324-759	46	48-55	52	59	3	0	70
Navarro (3B)	TX 31 to Bonner Ave	NB	228-1001	46	43-56	52	59	2	0	70-73
Navarro (3B)	TX 31 to Bonner Ave	SB	204-1017	46	43-63	52	59	2	0	70
Navarro (3B)	TX 31 to Bonner Ave	SB		39		50	55	4	0	70
Navarro (3B)	Bonner Ave to Navarro County Line	NB	142-1016	46	48-61	52	59	1	1	73-75
Navarro (3B)	Bonner Ave to Navarro County Line	SB	No noise sensitive receptors.							--
Navarro (3C)	TX 34 to TX 22	NB	396-923	36	47-52	50	55	1	0	83
Navarro (3C)	TX 34 to TX 22	SB	360-2879	36	39-53	50	55	1	0	84
Navarro (3C)	TX 22 to TX 31	NB	290-632	36	49-54	50	55	0	0	--
				39		50	55	1	0	89
Navarro (3C)	TX 22 to TX 31	SB	566-1034	39	46-52	20	55	0	0	--
Navarro (3C)	TX 31 to TX 14	NB	786-2780	46	37-50	52	59	0	0	--
Navarro (3C)	TX 31 to TX 14	SB	No noise sensitive receptors.							--
Navarro (3C)	TX 14 to Navarro County Line	NB	176-1000	46	46-59	52	59	0	1	95
Navarro (3C)	TX 14 to Navarro County Line	SB	571-940	46	47-51	52	59	0	0	--
Freestone (3C)	Navarro County Line to FM 1090	NB	177-885	29	47-60	50	55	2	2	99-100

Table 3.4-12: Summary of Noise Impacts for Residential Land Use										
County/ Segment	Location	Side of Track	Near Track Dist. (ft)	Existing Noise Level (Ldn)	Project Noise Levels – Ldn (dBA)			Number and Type of Impacts		Mapbook Page
					HSR	FRA Criteria				
						Mod.	Sev.	Mod.	Sev.	
Freestone (3C)	Navarro County Line to FM 1090	SB	568-989	29	47-50	50	55	0	0	--
Freestone (3C)	FM 1090 to US 84	NB	No noise sensitive receptors.							--
Freestone (3C)	FM 1090 to US 84	SB	232-511	52	51-57	54	60	3	0	102-104
Freestone (3C)	FM 1090 to US 84	SB		68		63	68	0	0	--
Freestone (3C)	US 84 to TX 179	NB	No noise sensitive receptors.							--
Freestone (3C)	US 84 to TX 179	SB	226-452	50	52-58	53	60	1	0	106
Freestone (3C)	US 84 to TX 179	SB		68		63	68	0	0	--
Freestone (3C)	TX 179 to Freestone County Line	NB	No noise sensitive receptors.							--
Freestone (3C)	TX 179 to Freestone County Line	SB								--
Freestone (4)	Navarro County Line to FM 930	NB	785-905	42	47-48	52	57	0	0	--
				43		52	58	0	0	--
Freestone (4)	Navarro County Line to FM 930	SB	739	43	48	52	58	0	0	--
Freestone (4)	FM 930 to Freestone County Line	NB	812-989	42	49-50	52	57	0	0	--
Freestone (4)	FM 930 to Freestone County Line	SB	125-993	42	47-62	52	57	2	4	161-165
Limestone (4)	Limestone County	NB	345-862	48	50-54	53	59	3	0	170-173
Limestone (4)	Limestone County	SB	452-832	48	48-54	53	59	0	0	--
Leon (3C)	Freestone County Line to CR 3051	NB	No noise sensitive receptors.							--

Table 3.4-12: Summary of Noise Impacts for Residential Land Use										
County/ Segment	Location	Side of Track	Near Track Dist. (ft)	Existing Noise Level (Ldn)	Project Noise Levels – Ldn (dBA)			Number and Type of Impacts		Mapbook Page
					HSR	FRA Criteria				
						Mod.	Sev.	Mod.	Sev.	
Leon (3C)	Freestone County Line to CR 3051	SB	322-503	55	51-56	55	61	1	0	118
Leon (3C)	CR 3051 to TX 7	NB	221-334	55	54-56	55	61	1	0	126
Leon (3C)	CR 3051 to TX 7	SB	220-428	55	52-58	55	61	3	0	121-122
Leon (3C)	TX 7 to FM 977	NB	500	55	53	55	61	0	0	--
Leon (3C)	TX 7 to FM 977	SB	No noise sensitive receptors.							--
Leon (4)	Limestone County Line to US 79	NB	708	42	49	51	57	0	0	--
Leon (4)	Limestone County Line to US 79	SB	883-1003	42	47-49	51	57	0	0	--
Leon (4)	US 79 to TX 7	NB	296-885	42	47-57	51	57	0	1	177
Leon (4)	US 79 to TX 7	SB	519	42	53	51	57	1	0	179
				62		59	64	0	0	--
Leon (4)	TX 7 to FM 977	NB	347-797	42	49-54	51	57	1	0	180
				62		59	64	0	0	--
Leon (4)	TX 7 to FM 977	SB	211-843	62	49-59	59	64	0	0	--
				52		54	60	0	0	--
Leon (4)	FM 977 to FM 2289	NB	307-604	52	50-54	54	60	1	0	187
Leon (4)	FM 977 to FM 2289	SB	386-907	52	47-53	54	60	0	0	--
Madison (3C)	FM 977 to Waldrip Rd	NB	No noise sensitive receptors.							--
Madison (3C)	FM 977 to Waldrip Rd	SB	158-379	65	55-61	61	66	0	0	--
Madison (3C)	Waldrip Rd to FM 1452	NB	338	50	56	53	60	1	0	144
Madison (3C)	Waldrip Rd to FM 1452	SB	532-640	50	51	53	60	0	0	--
Madison (3C)	FM 1452 to FM 1696	NB	787-970	54	47-50	55	61	0	0	--

Table 3.4-12: Summary of Noise Impacts for Residential Land Use										
County/ Segment	Location	Side of Track	Near Track Dist. (ft)	Existing Noise Level (Ldn)	Project Noise Levels – Ldn (dBA)			Number and Type of Impacts		Mapbook Page
					HSR	FRA Criteria				
						Mod.	Sev.	Mod.	Sev.	
Madison (3C)	FM 1452 to FM 1696	SB	No noise sensitive receivers.							--
Madison (4)	FM 977 to FM 2289	NB	288-420	52	52-55	54	60	1	0	190
Madison (4)	FM 977 to FM 2289	SB	338-982	52	47-54	54	60	0	0	--
Madison (4)	FM 2289 to US 190	NB	353-714	50	50-55	53	60	0	0	--
				54		55	61	1	0	196
Madison (4)	FM 2289 to US 190	SB	213-693	50	49-57	53	60	1	0	192
Madison (4)	US 190 to FM 1696	NB	182-909	54	49-60	55	61	3	0	196-197
Madison (4)	US 190 to FM 1696	SB	436-990	54	46-54	55	61	0	0	--
Grimes (5)	FM 1696 to FM 39	NB	231-589	47	52-58	52	59	1	0	210
Grimes (5)	FM 1696 to FM 39	NB		49		53	59	0	0	--
Grimes (5)	FM 1696 to FM 39	SB	No noise sensitive receptors.							--
Grimes (5)	FM 39 to TX 90	NB	313-1014	49	46-56	53	59	3	0	211-212
Grimes (5)	FM 39 to TX 90	SB	332-852	49	47-56	53	59	1	0	211
Grimes (5)	TX 90 to CR 215	NB	329-1001	49	44-55	53	59	0	0	--
Grimes (5)	TX 90 to CR 215	SB	422-798	49	45-53	53	59	1	0	214
Grimes (5)	CR 215 to TX 105	NB	395-850	48	48-54	53	59	1	0	222
Grimes (5)	CR 215 to TX 105	SB	391-1749	48	44-54	53	59	3	0	222-223
Grimes (5)	TX 105 to Grimes County Line	NB	157-1010	49	46-60	53	59	5	1	227
				48		53	59	0	0	--
Grimes (5)	TX 105 to Grimes County Line	SB	563-1958	49	42-52	53	59	0	0	--

<table>
<tr><th colspan="11">Table 3.4-12: Summary of Noise Impacts for Residential Land Use</th></tr>
<tr><th rowspan="3">County/ Segment</th><th rowspan="3">Location</th><th rowspan="3">Side of Track</th><th rowspan="3">Near Track Dist. (ft)</th><th rowspan="3">Existing Noise Level (Ldn)</th><th colspan="3">Project Noise Levels – Ldn (dBA)</th><th colspan="2" rowspan="2">Number and Type of Impacts</th><th rowspan="3">Mapbook Page</th></tr>
<tr><th rowspan="2">HSR</th><th colspan="2">FRA Criteria</th></tr>
<tr><th>Mod.</th><th>Sev.</th><th>Mod.</th><th>Sev.</th></tr>
<tr><td>Waller (5)</td><td>Waller County</td><td>NB</td><td rowspan="2">209-994</td><td>45</td><td rowspan="2">46-58</td><td>52</td><td>59</td><td>5</td><td>0</td><td>228</td></tr>
<tr><td>Waller (5)</td><td>Waller County</td><td>NB</td><td>49</td><td>53</td><td>59</td><td>3</td><td>0</td><td>231-232</td></tr>
<tr><td>Waller (5)</td><td>Waller County</td><td>SB</td><td rowspan="2">157-1000</td><td>45</td><td rowspan="2">46-60</td><td>52</td><td>59</td><td>3</td><td>0</td><td>228-229</td></tr>
<tr><td>Waller (5)</td><td>Waller County</td><td>SB</td><td>49</td><td>53</td><td>59</td><td>13</td><td>1</td><td>231</td></tr>
<tr><td>Harris (5)</td><td>Harris County Line to Old Hwy 290</td><td>NB</td><td>190-1006</td><td>51</td><td>48-59</td><td>54</td><td>60</td><td>3</td><td>0</td><td>235</td></tr>
<tr><td>Harris (5)</td><td>Harris County Line to Old Hwy 290</td><td>SB</td><td>330-995</td><td>51</td><td>47-55</td><td>54</td><td>60</td><td>1</td><td>0</td><td>235</td></tr>
<tr><td>Harris (5)</td><td>Old Hwy 290 to Grand Pkwy</td><td>NB</td><td>356-1009</td><td>51</td><td>46-54</td><td>54</td><td>60</td><td>1</td><td>0</td><td>238</td></tr>
<tr><td>Harris (5)</td><td>Old Hwy 290 to Grand Pkwy</td><td>SB</td><td>210-1010</td><td>51</td><td>46-56</td><td>54</td><td>60</td><td>7</td><td>0</td><td>239</td></tr>
<tr><td>Harris (5)</td><td>Grand Pkwy to TX 6</td><td>NB</td><td rowspan="2">155-520</td><td>59</td><td rowspan="2">52-60</td><td>57</td><td>63</td><td>0</td><td>0</td><td>--</td></tr>
<tr><td>Harris (5)</td><td>Grand Pkwy to TX 6</td><td>NB</td><td>69</td><td>64</td><td>69</td><td>0</td><td>0</td><td>--</td></tr>
<tr><td>Harris (5)</td><td>Grand Pkwy to TX 6</td><td>SB</td><td rowspan="2">81-518</td><td>59</td><td rowspan="2">52-64</td><td>57</td><td>63</td><td>1</td><td>0</td><td>244</td></tr>
<tr><td>Harris (5)</td><td>Grand Pkwy to TX 6</td><td>SB</td><td>69</td><td>64</td><td>69</td><td>16</td><td>0</td><td>246-247</td></tr>
<tr><td>Harris (5)</td><td>TX 6 to Blalock Rd</td><td>NB</td><td>262-501</td><td>46</td><td>52-56</td><td>52</td><td>59</td><td>3</td><td>0</td><td>247-250</td></tr>
<tr><td>Harris (5)</td><td>TX 6 to Blalock Rd</td><td>SB</td><td colspan="7">No noise sensitive receptors.</td><td>--</td></tr>
<tr><td>Harris (5)</td><td>Blalock Rd to Houston Station</td><td>NB</td><td rowspan="3">110-510</td><td>55</td><td rowspan="3">52-62</td><td>55</td><td>64</td><td>23</td><td>0</td><td>251-252</td></tr>
<tr><td>Harris (5)</td><td>Blalock Rd to Houston Station</td><td>NB</td><td>46</td><td>52</td><td>59</td><td>2</td><td>1</td><td>251</td></tr>
<tr><td>Harris (5)</td><td>Blalock Rd to Houston Station</td><td>NB</td><td>49</td><td>53</td><td>59</td><td>62</td><td>7</td><td>251-252</td></tr>
</table>

Table 3.4-12: Summary of Noise Impacts for Residential Land Use										
County/ Segment	Location	Side of Track	Near Track Dist. (ft)	Existing Noise Level (Ldn)	Project Noise Levels – Ldn (dBA)			Number and Type of Impacts		Mapbook Page
					HSR	FRA Criteria				
						Mod.	Sev.	Mod.	Sev.	
Harris (5)	Blalock Rd to Houston Station	SB	227-524	55	52-57	55	64	81	0	251-252
Harris (5)	Blalock Rd to Houston Station	SB		49		49	56	5	0	252

Source: Cross-Spectrum Acoustics, 2016.

Table 6-2: Summary of Noise Impacts for Institutional Land Use												
County	Seg.	Location	Side of Track	Near Track Dist. (ft.)	Speed (mph)	Existing Noise Level Leq (dBA)	TX HSR Noise Levels – Leq (dBA)			Type and # of Impacts		Mapbook Page
							TX HSR Project	FTA Criteria				
								Mod.	Sev.	Mod.	Sev.	
Dallas	1	Friendship Missionary Baptist Church	SB	362	205	75	53	70	73	0	0	4
Dallas	1	The Church of Revelation	SB	411	205	75	52	70	73	0	0	4
Dallas	1	College Park Baptist Church	SB	670	205	50	49	58	60	0	0	6
Dallas	1	Full Faith Deliverance Church	SB	463	205	50	52	58	60	0	0	6
Ellis	2B	Palmyra Studios	NB	963	205	62	45	64	65	0	0	31
Freestone	4	Lebanon Church	NB	454	205	44	50	57	59	0	0	156
Freestone	4	Furney-Richardson School	NB	837	205	49	48	58	59	0	0	162
Grimes	5	Shiloh Church Cemetery	SB	988	205	45	46	57	59	0	0	202
Harris	5	Fairbanks United Methodist Church	NB	451	205	44	52	57	59	0	0	250
Harris	5	Christian Family Church	NB	177	205	44	58	57	59	1	0	250
Harris	5	Pentecostal Church New Jerusalem	SB	199	205	47	57	57	59	0	0	252

Source: Cross-Spectrum Acoustics, 2016.

The noise impact locations are shown graphically in **Appendix D, Cultural Resources and Community Facilities Mapbook** and the projected noise impacts are described below by county and segment.

Dallas County

- **Segment 1**
  - **I-20 to Bluff Springs Rd (NB) (Mapbook Page 1-6):** There are six single-family residences along the northbound side of the proposed alignment between Interstate-20 and Bluff Springs Rd along Segment 1 projected to have moderate noise impacts. The noise impacts at this location are due to HSR operations and low existing noise levels.
  - **I-20 to Bluff Springs Rd (SB) (Mapbook Page 1-6):** There are three single-family residences along the southbound side of the proposed alignment between Interstate-20 and the Bluff Springs Rd along Segment 1 projected to have moderate noise impacts. The noise impacts at this location are due to HSR operations and low existing noise levels.

Ellis County

- **Segment 1**
  - **I-20 to Bluff Springs Rd (NB) (Mapbook Page 6-12):** There are nine single-family residences along the northbound side of the proposed alignment between Interstate-20 and Bluff Springs Rd along Segment 1 projected to have moderate or severe noise impacts. The noise impacts at this location are due to HSR operations and low existing noise levels.
  - **I-20 to Bluff Springs Rd (SB) (Mapbook Page 6-12):** There are ten single-family residences along the southbound side of the proposed alignment between Interstate-20 and Bluff Springs Rd along Segment 1 projected to have moderate or severe noise impacts. The noise impacts at this location are due to HSR operations and low existing noise levels.
- **Segment 2A**
  - **Bluff Springs Rd to FM 813 (NB) (Mapbook Page 12-16):** There is one single-family residence along the northbound side of the proposed alignment between the Bluff Springs Rd and Farm to Market 813 along Segment 2A projected to have moderate noise impacts. The noise impact at this location is due to HSR operations and low existing noise levels.
  - **Bluff Springs Rd to FM 813 (SB) (Mapbook Page 12-16):** There are eight single-family residences along the southbound side of the proposed alignment between the Bluff Springs Rd and Farm to Market 813 along Segment 2A projected to have moderate noise impacts. The noise impacts at this location are due to HSR operations and low existing noise levels.
  - **FM 813 to TX 287 (SB) (Mapbook Page 16-22):** There is one single-family residence along the southbound side of the proposed alignment between Farm to Market 813 and TX 287 along Segment 2A projected to have a moderate

noise impact. The noise impact at this location is due to HSR operations and low existing noise levels.

  - **TX 287 to TX 34 (NB) (Mapbook Page 16-22):** There is one single-family residence along the northbound side of the proposed alignment between TX 287 and TX 34 along Segment 2A projected to have a moderate noise impact. The noise impact at this location is due to HSR operations and low existing noise levels.
  - **TX 287 to TX 34 (SB) (Mapbook Page 22-25):** There is one single-family residence along the southbound side of the proposed alignment between TX 287 and TX 34 along Segment 2A projected to have a moderate noise impact. The noise impact at this location is due to HSR operations and low existing noise levels.
  - **TX 34 to TX 22 (SB) (Mapbook Page 22-25):** There are two single-family residences along the southbound side of the proposed alignment between TX 34 and TX 22 along Segment 2A projected to have moderate noise impacts. The noise impacts at this location are due to HSR operations and low existing noise levels.

- **Segment 2B**
  - **Bluff Springs Rd to FM 813 (NB) (Mapbook Page 28-32):** There are two single-family residences along the northbound side of the proposed alignment between Bluff Springs Rd and Farm to Market 813 along Segment 2B projected to have moderate noise impacts. The noise impacts at this location are due to HSR operations and low existing noise levels.
  - **Bluff Springs Rd to FM 813 (SB) (Mapbook Page 28-32):** There is one single-family residence along the southbound side of the proposed alignment between Bluff Springs Rd and Farm to Market 813 along Segment 2B projected to have a moderate noise impact. The noise impact at this location is due to HSR operations and low existing noise levels.
  - **FM 813 to TX 287 (NB) (Mapbook Page 32-38):** There is one single-family residence along the northbound side of the proposed alignment between Farm to Market 813 and TX 287 along Segment 2B projected to have a moderate noise impact. The noise impact at this location is due to HSR operations and low existing noise levels.

<u>Navarro County</u>

- **Segment 3A**
  - **TX 34 to TX 22 (NB) (Mapbook Page 43-48):** There is one single-family residence along the northbound side of the proposed alignment between TX 34 and TX 22 along Segment 3A in Navarro County projected to have a moderate noise impact. The noise impact at this location is due to HSR operations and low existing noise levels.
  - **TX 34 to TX 22 (SB) (Mapbook Page 43-48):** There is one residence along the southbound side of the proposed alignment between TX 34 and TX 22 along Segment 3A in Navarro County projected to have a moderate noise impact. The noise impact at this location is due to HSR operations and low existing noise levels.

- **TX 22 to TX 31 (NB) (Mapbook Page 48-52):** There is one residence along the northbound side of the proposed alignment between TX 22 and TX 31 along Segment 3A projected to have a moderate noise impact. The noise impact at this location is due to HSR operations and low existing noise levels.
- **TX 31 to FM 3194 (NB) (Mapbook Page 52-57):** There is one residence along the northbound side of the proposed alignment between TX 31 to Farm to Market 3194 along Segment 3A in Navarro County projected to have a moderate noise impact. The noise impact at this location is due to HSR operations and low existing noise levels.

- **Segment 3B**
  - **TX 34 to TX 22 (NB) (Mapbook Page 63-67):** There is one residence along the northbound side of the proposed alignment between TX 34 and TX 22 along Segment 3B projected to have a moderate noise impact. The noise impact at this location is due HSR operations and low existing noise levels.
  - **TX 34 to TX 22 (SB) (Mapbook Page 63-67):** There are four residences along the southbound side of the proposed alignment between TX 34 and TX 22 along Segment 3B projected to have moderate or severe noise impacts. The noise impacts at this location are due to HSR operations and low existing noise levels.
  - **TX 22 to TX 31 (NB) (Mapbook Page 67-70):** There is one residence along the northbound side of the proposed alignment between TX 22 and TX 31 along Segment 3B projected to have a moderate noise impact. The noise impact at this location is due to HSR operations and low existing noise levels.
  - **TX 22 to TX 31 (SB) (Mapbook Page 67-70):** There are three residences along the southbound side of the proposed alignment between TX 22 and TX 31 along Segment 3B projected to have moderate noise impacts. The noise impacts at this location are due to HSR operations and low existing noise levels.
  - **TX 31 to Bonner Ave (NB) (Mapbook Page 70-73):** There are two single-family residences along the northbound side of the proposed alignment between TX 31 and Bonner Ave along Segment 3B projected to have moderate noise impacts. The noise impacts at this location are due to HSR operations and low existing noise levels.
  - **TX 31 to Bonner Ave (SB) (Mapbook Page 70-73):** There are six single-family residences along the southbound side of the proposed alignment between TX 31 and Bonner Ave along Segment 3B projected to have moderate noise impacts. The noise impacts at this location are due to HSR operations and low existing noise levels.
  - **Bonner Ave to Navarro County Line (NB) (Mapbook Page 73-80):** There are two single-family residences along the northbound side of the proposed alignment between Bonner Ave and Navarro County Line along Segment 3B projected to have moderate or severe noise impacts. The noise impacts at this location are due to HSR operations and low existing noise levels.
- **Segment 3C**
  - **TX 34 to TX 22 (NB) (Mapbook Page 82-86):** There is one single-family residence along the northbound side of the proposed alignment between TX 34 and TX 22 along Segment 3C projected to have a moderate noise impact. The noise impact at this location is due to HSR operations and low existing noise levels.

- **TX 34 to TX 22 (SB) (Mapbook Page 82-86):** There is one single-family residence along the southbound side of the proposed alignment between TX 34 and TX 22 along Segment 3C projected to have a moderate noise impact. The noise impact at this location is due to HSR operations and low existing noise levels.
- **TX 22 to TX 31 (NB) (Mapbook Page 86-90):** There is one single-family residence along the northbound side of the proposed alignment between TX 22 and TX 31 along Segment 3C projected to have a moderate noise impact. The noise impact at this location is due to HSR operations and low existing noise levels.
- **TX 14 to Navarro County Line (NB) (Mapbook Page 95-97):** There is one single-family residence along the northbound side of the proposed alignment between TX 14 and the Navarro County Line along Segment 3C projected to have a severe noise impact. The noise impact at this location is due to HSR operations and low existing noise levels.

<u>Freestone County</u>

- **Segment 3C**
  - **Navarro County Line to FM 1090 (NB) (Mapbook Page 97-102):** There are four single-family residences along the northbound side of the proposed alignment between Navarro County Line and FM 1090 projected to have moderate or severe noise impacts. The noise impacts at this location are due to HSR operations and low existing noise levels.
  - **FM 1090 to US 84 (SB) (Mapbook Page 102-106):** There are three single-family residences along the southbound side of the proposed alignment between Farm to Market 1090 and US 84 projected to have moderate noise impacts. The noise impacts at this location are due to HSR operations and low existing noise levels.
  - **US 84 to TX 179 (SB) (Mapbook Page 106-111):** There is one single-family residence along the southbound side of the proposed alignment between US 84 and TX 179 projected to have a moderate noise impact. The noise impact at this location is due to HSR operations and low existing noise levels.
- **Segment 4**
  - **FM 930 to Freestone County Line (SB) (Mapbook Page 160-166):** There are six residences along the southbound side of the proposed alignment between Farm to Market 930 and the Freestone County Line projected to have moderate or severe noise impacts. The noise impacts at this location are due to HSR operations and low existing noise levels.

<u>Limestone County</u>

- **Segment 4**
  - **NB (Mapbook Page 166-173):** There are three residences along the northbound side of the proposed alignment in Limestone County projected to have moderate noise impacts. The noise impacts at this location are due to HSR operations and low existing noise levels.

<u>Leon County</u>

- **Segment 3C**

- **Freestone County Line to CR 3051 (SB) (Mapbook Page 116-121):** There is one residence along the southbound side of the proposed alignment between the Freestone County Line and CR 3051 projected to have a moderate noise impact. The noise impact at this location is due to HSR operations and low existing noise levels.
- **CR 3051 to TX 7 (NB) (Mapbook Page 121-127):** There is one residence along the northbound side of the proposed alignment between County Road 3051 and TX 7 projected to have a moderate noise impact. The noise impact at this location is due to HSR operations and low existing noise levels.
- **CR 3051 to TX 7 (SB) (Mapbook Page 121-127):** There are three residences along the southbound side of the proposed alignment between County Road 3051 and TX 7 projected to have moderate noise impacts. The noise impacts at this location are due to HSR operations and low existing noise levels.

- **Segment 4**
    - **US 79 to TX 7 (NB) (Mapbook Page 177-180):** There is one residence along the northbound side of the proposed alignment between US 79 and TX 7 projected to have a severe noise impact. The noise impact at this location is due to HSR operations and low existing noise levels.
    - **US 79 to TX 7 (SB) (Mapbook Page 177-180):** There is one residence along the southbound side of the proposed alignment between US 79 and TX 7 projected to have a moderate noise impact. The noise impact at this location is due to HSR operations and low existing noise levels.
    - **TX 7 to FM 977 (NB) (Mapbook Page 180-186):** There is one single-family residence along the northbound side of the proposed alignment between TX 7 and Farm to Market 977 projected to have a moderate noise impact. The noise impact at this location is due to HSR operations and low existing noise levels.
    - **FM 977 to FM 2289 (NB) (Mapbook Page 186-189):** There is one single-family residences along the northbound side of the proposed alignment between Farm to Market 977 and Farm to Market 2289 along Segment 4 projected to have a moderate noise impact. The noise impact at this location is due to HSR operations and low existing noise levels.

Madison County

- **Segment 3C**
    - **Waldrip Rd to FM 1452 (NB) (Mapbook Page 140-149):** There is one single-family residence along the northbound side of the proposed alignment between Waldrip Rd and Farm to Market 1452 projected to have a moderate noise impact. The noise impact at this location is due to HSR operations and low existing noise levels.
- **Segment 4**
    - **FM 977 to FM 2289 (NB) (Mapbook Page 189-191):** There is one single-family residences along the northbound side of the proposed alignment between Farm to Market 977 and Farm to Market 2289 projected to have a moderate noise impact. The noise impact at this location is due to HSR operations and low existing noise levels.

- **FM 2289 to US 190 (NB) (Mapbook Page 191-196):** There is one single-family residence along the northbound side of the proposed alignment between Farm to Market 2289 and US 190 projected to have a moderate noise impact. The noise impact at this location is due to HSR operations and low existing noise levels.
- **FM 2289 to US 190 (SB) (Mapbook Page 191-196):** There is one single-family residence along the southbound side of the proposed alignment between Farm to Market 2289 and US 190 projected to have a moderate noise impact. The noise impact at this location is due to HSR operations and low existing noise levels.
- **US 190 to FM 1696 (NB) (Mapbook Page 196-201):** There are three single-family residences along the northbound side of the proposed alignment between US 290 and Farm to Market 1696 projected to have moderate noise impacts. The noise impacts at this location are due to HSR operations and low existing noise levels.

Grimes County

- **Segment 5**
    - **FM 1696 to FM 39 (NB) (Mapbook Page 201-208):** There is one single-family residence along the northbound side of the proposed alignment between Farm to Market 1696 and Farm to Market 39 projected to have a moderate noise impact. The noise impact at this location is due to HSR operations and low existing noise levels.
    - **FM 39 to TX 90 (NB) (Mapbook Page 208-212):** There are three single-family residences along the northbound side of the proposed alignment between Farm to Market 39 and TX 90 projected to have moderate noise impacts. The noise impacts at this location are due to HSR operations and low existing noise levels.
    - **FM 39 to TX 90 (SB) (Mapbook Page 208-212):** There is one single-family residence along the southbound side of the proposed alignment between Farm to Market 39 and TX 90 projected to have a moderate noise impact. The noise impact at this location is due to HSR operations and low existing noise levels.
    - **TX 90 to CR 215 (SB) (Mapbook Page 212-218):** There is one single-family residence along the southbound side of the proposed alignment between TX 90 and County Road 215 projected to have a moderate noise impact. The noise impact at this location is due to HSR operations and low existing noise levels.
    - **CR 215 to TX 105 (NB) (Mapbook Page 218-223):** There is one single-family residence along the northbound side of the proposed alignment between County Road 215 and TX 105 projected to have a moderate noise impact. The noise impact at this location is due to HSR operations and low existing noise levels.
    - **CR 215 to TX 105 (SB) (Mapbook Page 218-223):** There are three single-family residences along the northbound side of the proposed alignment between County Road 215 and TX 105 projected to have moderate noise impacts. The noise impacts at this location are due to HSR operations and low existing noise levels.
    - **TX 105 to Grimes County Line (NB) (Mapbook Page 223-228):** There are six single-family residences along the northbound side of the proposed alignment

between TX 105 and Grimes County Line that are projected to have moderate or severe noise impacts. The noise impacts at this location are due to HSR operations and low existing noise levels.

Waller County

- **Segment 5**
  - **NB (Mapbook Page 228-233):** There are eight single-family residences along the northbound side of the proposed alignment in Waller County projected to have moderate noise impacts. The noise impacts at this location are due to HSR operations and low existing noise levels.
  - **SB (Mapbook Page 228-233):** There are 17 single-family residences along the southbound side of the proposed alignment in Waller County projected to have moderate or severe noise impacts. The noise impacts at this location are due to HSR operations and low existing noise levels.

Harris County

- **Segment 5**
  - **Harris County Line to Old Hwy 290 (NB) (Mapbook Page 233-237):** There are three single-family residences along the northbound side of the proposed alignment between the Harris County line and Old Hwy 290 projected to have moderate noise impacts. The noise impacts at this location are due to HSR operations and low existing noise levels.
  - **Harris County Line to Old Hwy 290 (NB) (Mapbook Page 233-237):** There is one single-family residence along the northbound side of the proposed alignment between the Harris County line and Old Hwy 290 projected to have a moderate noise impact. The noise impact at this location is due to HSR operations and low existing noise levels.
  - **Old Hwy 290 to Grand Pkwy (NB) (Mapbook Page 237-242):** There is one single-family residence along the northbound side of the proposed alignment between Old Hwy 290 and Grand Pkwy projected to have moderate noise impact. The noise impact at this location are due to HSR operations and low existing noise levels.
  - **Old Hwy 290 to Grand Pkwy (SB) (Mapbook Page 237-242):** There are seven single-family residences along the southbound side of the proposed alignment between Old Hwy 290 and Grand Pkwy projected to have moderate noise impacts. The noise impacts at this location are due to HSR operations and low existing noise levels.
  - **Grand Pkwy to TX 6 (SB) (Mapbook Page 242-247):** There are 17 single-family residences along the southbound side of the proposed alignment between Grand Pkwy and TX 6 projected to have moderate noise impacts. The noise impacts at this location are due to HSR operations and low existing noise levels.
  - **TX 6 to Blalock Rd (NB) (Mapbook Page 247-251):** There is one single-family residence and two hotels along the northbound side of the proposed alignment between TX 6 and Blalock Rd projected to have moderate noise impacts. The noise impacts at this location are due to HSR operations and low existing noise levels.

- **Blalock Rd to Houston Station (NB) (Mapbook Page 251-257):** There are 95 single and multi-family residences along the northbound side of the proposed alignment between Blalock Rd to the Houston Station projected to have moderate or severe noise impacts. The noise impacts at this location are due to HSR operations and low existing noise levels.
- **Blalock Rd to Houston Station (SB) (Mapbook Page 251-257):** There are 86 single and multi-family residences along the southbound side of the proposed alignment between Blalock Rd and the Houston Station projected to have moderate noise impacts. The noise impacts at this location are due to HSR operations and low existing noise levels.
- **Christian Family Church (Mapbook Page 250):** The Christian Family Church is projected to have a moderate noise impact. The noise impact at this location is due to HSR operations.

With regard to potential increased annoyance due to the startle effect of noise from passing trains, at the maximum train speed of 205 mph this effect would only occur within about 45 feet from the tracks which is within the ROW. Therefore, increased noise annoyance due to startle should not be an issue.

Finally, with regard to the effects of noise from passing trains on animals, the FRA noise exposure criterion limit is a Sound Exposure Level (SEL) of 100 dBA. For the TX HSR trains operating on viaduct at the maximum speed of 205 mph, this limit would only be exceeded within about 15 feet from the tracks and within the HSR ROW. Because no animals would be this close to the tracks, noise impact on wildlife is not anticipated.

Operational Vibration Assessment

Based on a Detailed Vibration Analysis, the assessment of vibration impacts from HSR operations is summarized by county and segment in **Table 6-3** for FTA Category 2 (residential) land use and in **Table 6-4** for FTA Category 3 (institutional) land use. The results include a tabulation of location information for each sensitive receptor group, the projections of future vibration levels, the impact criteria, and whether there will be vibration impacts.

Table 6-3: Summary of Vibration Impacts for Residential Land Use									
County	Segment	Location	Side of Track	Near Track Dist (ft.)	Speed (mph)	TX HSR Vibration Levels (VdB)		Number of Impacts	Mapbook Page
						TX HSR Project	FTA Impact Criterion		
DALLAS	1	Dallas Station to I-20	NB	243-415	205	41	72	0	1-6
DALLAS	1	Dallas Station to I-20	SB	348-1001	205	37	72	0	1-6
DALLAS	1	IH-20 to Bluff Springs Rd	NB	270-793	205	53	72	0	6-12
DALLAS	1	IH-20 to Bluff Springs Rd	SB	223-970	205	53	72	0	6-12
ELLIS	1	IH-20 to Bluff Springs Rd	NB	188-910	205	53	72	0	6-12
ELLIS	1	IH-20 to Bluff Springs Rd	SB	174-2612	205	53	72	0	6-12
ELLIS	2A	Bluff Springs Rd to FM 813	NB	527-2986	205	63	72	0	12-16
ELLIS	2A	Bluff Springs Rd to FM 813	SB	199-2715	205	66	72	0	12-16
ELLIS	2A	FM 813 to TX 287	NB	824-1690	205	54	72	0	16-22
ELLIS	2A	FM 813 to TX 287	SB	211-989	205	67	72	0	16-22
ELLIS	2A	TX 287 to TX 34	NB	281-2148	205	65	72	0	22-25
ELLIS	2A	TX 287 to TX 34	SB	289-805	205	65	72	0	22-25
ELLIS	2A	TX 34 to TX 22	NB	No sensitive receptors.					--
ELLIS	2A	TX 34 to TX 22	SB	167-905	205	71	72	0	25-27
ELLIS	2B	Bluff Springs Rd to FM 813	NB	385-2987	205	67	72	0	28-32
ELLIS	2B	Bluff Springs Rd to FM 813	SB	205-2715	205	62	72	0	28-32
ELLIS	2B	FM 813 to TX 287	NB	179-947	205	61	72	0	32-38
ELLIS	2B	FM 813 to TX 287	SB	585-1784	205	66	72	0	32-38
ELLIS	2B	TX 287 to TX 34	NB	455-2908	205	62	72	0	38-41

Table 6-3: Summary of Vibration Impacts for Residential Land Use									
County	Segment	Location	Side of Track	Near Track Dist (ft.)	Speed (mph)	TX HSR Vibration Levels (VdB)		Number of Impacts	Mapbook Page
						TX HSR Project	FTA Impact Criterion		
ELLIS	2B	TX 287 to TX 34	SB	959	205	64	72	0	38-41
ELLIS	2B	TX 34 to TX 22	NB	No sensitive receptors.					--
ELLIS	2B	TX 34 to TX 22	SB	1388-1556	205	68	72	0	41-43
ELLIS	3A	TX 34 to TX 22	NB	No sensitive receptors.					--
ELLIS	3A	TX 34 to TX 22	SB	977	205	70	72	0	43-44
ELLIS	3B	TX 34 to TX 22	NB	No sensitive receptors.					--
ELLIS	3B	TX 34 to TX 22	SB	1311	205	70	72	0	62-63
ELLIS	3C	TX 34 to TX 22	NB	No sensitive receptors.					--
ELLIS	3C	TX 34 to TX 22	SB	977	205	70	72	0	81-82
NAVARRO	3A	TX 34 to TX 22	NB	396-923	205	66	72	0	43-48
NAVARRO	3A	TX 34 to TX 22	SB	360-2879	205	66	72	0	43-48
NAVARRO	3A	TX 22 to TX 31	NB	290-632	205	67	72	0	48-52
NAVARRO	3A	TX 22 to TX 31	SB	560-1034	205	64	72	0	48-52
NAVARRO	3A	TX 31 to FM 3194	NB	261-546	205	67	72	0	52-57
NAVARRO	3A	TX 31 to FM 3194	SB	740	205	64	72	0	52-57
NAVARRO	3A	FM 3194 to Navarro County Line	NB	656	205	54	72	0	57-61
NAVARRO	3A	FM 3194 to Navarro County Line	SB	No sensitive receptors.					--
NAVARRO	3B	TX 34 to TX 22	NB	611-2905	205	64	72	0	63-67
NAVARRO	3B	TX 34 to TX 22	SB	222-1002	205	64	72	0	63-67

Table 6-3: Summary of Vibration Impacts for Residential Land Use									
County	Segment	Location	Side of Track	Near Track Dist (ft.)	Speed (mph)	TX HSR Vibration Levels (VdB)		Number of Impacts	Mapbook Page
						TX HSR Project	FTA Impact Criterion		
NAVARRO	3B	TX 22 to TX 31	NB	261-996	205	64	72	0	67-70
NAVARRO	3B	TX 22 to TX 31	SB	324-759	205	64	72	0	67-70
NAVARRO	3B	TX 31 to Bonner Ave	NB	228-1001	205	68	72	0	70-73
NAVARRO	3B	TX 31 to Bonner Ave	SB	204-1017	205	69	72	0	70-73
NAVARRO	3B	Bonner Ave to Navarro County Line	NB	142-1016	205	61	72	0	73-80
NAVARRO	3B	Bonner Ave to Navarro County Line	SB	No sensitive receptors.					--
NAVARRO	3C	TX 34 to TX 22	NB	396-923	205	66	72	0	82-86
NAVARRO	3C	TX 34 to TX 22	SB	360-2879	205	66	72	0	82-86
NAVARRO	3C	TX 22 to TX 31	NB	290-632	205	67	72	0	86-90
NAVARRO	3C	TX 22 to TX 31	SB	566-1034	205	64	72	0	86-90
NAVARRO	3C	TX 31 to TX 14	NB	786-2780	205	56	72	0	90-95
NAVARRO	3C	TX 31 to TX 14	SB	No sensitive receptors.					--
NAVARRO	3C	TX 14 to Navarro County Line	NB	176-1000	205	66	72	0	95-97
NAVARRO	3C	TX 14 to Navarro County Line	SB	571-940	205	69	72	0	95-97
FREESTONE	3C	Navarro County Line to FM 1090	NB	177-885	205	56	72	0	97-102
FREESTONE	3C	Navarro County Line to FM 1090	SB	568-989	205	58	72	0	97-102
FREESTONE	3C	FM 1090 to US 84	NB	No sensitive receptors.					--
FREESTONE	3C	FM 1090 to US 84	SB	232-511	205	63	72	0	102-106

Table 6-3: Summary of Vibration Impacts for Residential Land Use									
County	Segment	Location	Side of Track	Near Track Dist (ft.)	Speed (mph)	TX HSR Vibration Levels (VdB)		Number of Impacts	Mapbook Page
						TX HSR Project	FTA Impact Criterion		
FREESTONE	3C	US 84 to TX 179	NB	No sensitive receptors.					--
FREESTONE	3C	US 84 to TX 179	SB	226-452	205	60	72	0	106-111
FREESTONE	3C	TX 179 to Freestone County Line	NB	No sensitive receptors.					--
FREESTONE	3C	TX 179 to Freestone County Line	SB						--
FREESTONE	4	Navarro County Line to FM 930	NB	785-905	205	56	72	0	153-160
FREESTONE	4	Navarro County Line to FM 930	SB	739	205	56	72	0	153-160
FREESTONE	4	FM 930 to Freestone County Line	NB	812-989	205	45	72	0	160-166
FREESTONE	4	FM 930 to Freestone County Line	SB	125-993	205	65	72	0	160-166
LIMESTONE	4	Limestone County	NB	345-862	205	60	72	0	166-173
LIMESTONE	4	Limestone County	SB	452-832	205	55	72	0	166-173
LEON	3C	Freestone County Line to CR 3051	NB	No sensitive receptors.					--
LEON	3C	Freestone County Line to CR 3051	SB	322-503	205	58	72	0	116-121
LEON	3C	CR 3051 to TX 7	NB	221-334	205	72	72	0	121-127
LEON	3C	CR 3051 to TX 7	SB	220-428	205	71	72	0	121-127
LEON	3C	TX 7 to FM 977	NB	500	205	64	72	0	127-136
LEON	3C	TX 7 to FM 977	SB	No sensitive receptors.					--

Table 6-3: Summary of Vibration Impacts for Residential Land Use									
County	Segment	Location	Side of Track	Near Track Dist (ft.)	Speed (mph)	TX HSR Vibration Levels (VdB)		Number of Impacts	Mapbook Page
						TX HSR Project	FTA Impact Criterion		
LEON	4	Limestone County Line to US 79	NB	708	205	56	72	0	173-177
LEON	4	Limestone County Line to US 79	SB	883-1003	205	54	72	0	173-177
LEON	4	US 79 to TX 7	NB	296-885	205	66	72	0	177-180
LEON	4	US 79 to TX 7	SB	519	205	58	72	0	177-180
LEON	4	TX 7 to FM 977	NB	347-797	205	70	72	0	180-186
LEON	4	TX 7 to FM 977	SB	211-843	205	67	72	0	180-186
LEON	4	FM 977 to FM 2289	NB	307-604	205	70	72	0	186-189
LEON	4	FM 977 to FM 2289	SB	386-907	205	69	72	0	186-189
MADISON	3C	FM 977 to Waldrip Rd	NB	No sensitive receptors.					--
MADISON	3C	FM 977 to Waldrip Rd	SB	158-379	205	51	72	0	136-140
MADISON	3C	Waldrip Rd to FM 1452	NB	338	205	34	72	0	140-149
MADISON	3C	Waldrip Rd to FM 1452	SB	532-640	205	37	72	0	140-149
MADISON	3C	FM 1452 to FM 1696	NB	787-970	205	28	72	0	149-152
MADISON	3C	FM 1452 to FM 1696	SB	No sensitive receptors.					--
MADISON	4	FM 977 to FM 2289	NB	288-420	205	70	72	0	189-191
MADISON	4	FM 977 to FM 2289	SB	338-982	205	67	72	0	189-191
MADISON	4	FM 2289 to US 190	NB	353-714	205	35	72	0	191-196
MADISON	4	FM 2289 to US 190	SB	213-693	205	55	72	0	191-196
MADISON	4	US 190 to FM 1696	NB	182-909	205	48	72	0	196-201

Table 6-3: Summary of Vibration Impacts for Residential Land Use									
County	Segment	Location	Side of Track	Near Track Dist (ft.)	Speed (mph)	TX HSR Vibration Levels (VdB)		Number of Impacts	Mapbook Page
						TX HSR Project	FTA Impact Criterion		
MADISON	4	US 190 to FM 1696	SB	436-990	205	34	72	0	196-201
GRIMES	5	FM 1696 to FM 39	NB	231-589	205	60	72	0	201-208
GRIMES	5	FM 1696 to FM 39	SB	No sensitive receptors.					--
GRIMES	5	FM 39 to TX 90	NB	313-1014	205	62	72	0	208-212
GRIMES	5	FM 39 to TX 90	SB	332-852	205	60	72	0	208-212
GRIMES	5	TX 90 to CR 215	NB	329-1001	205	59	72	0	212-218
GRIMES	5	TX 90 to CR 215	SB	422-798	205	60	72	0	212-218
GRIMES	5	CR 215 to TX 105	NB	395-850	205	60	72	0	218-223
GRIMES	5	CR 215 to TX 105	SB	391-1749	205	51	72	0	218-223
GRIMES	5	TX 105 to Grimes County Line	NB	157-1010	205	55	72	0	223-228
GRIMES	5	TX 105 to Grimes County Line	SB	563-1968	205	51	72	0	223-228
WALLER	5	Waller County	NB	209-994	205	54	72	0	228-233
WALLER	5	Waller County	SB	157-1000	205	54	72	0	228-233
HARRIS	5	Harris County Line to Old Hwy 290	NB	190-1006	205	47	72	0	233-237
HARRIS	5	Harris County Line to Old Hwy 290	SB	330-995	205	42	72	0	233-237
HARRIS	5	Old Hwy 290 to Grand Pkwy	NB	356-1009	205	59	72	0	237-242
HARRIS	5	Old Hwy 290 to Grand Pkwy	SB	210-1010	205	62	72	0	237-242
HARRIS	5	Grand Pkwy to TX 6	NB	155-520	205	54	72	0	242-247

Table 6-3: Summary of Vibration Impacts for Residential Land Use									
County	Segment	Location	Side of Track	Near Track Dist (ft.)	Speed (mph)	TX HSR Vibration Levels (VdB)		Number of Impacts	Mapbook Page
						TX HSR Project	FTA Impact Criterion		
HARRIS	5	Grand Pkwy to TX 6	SB	81-518	205	60	72	0	242-247
HARRIS	5	TX 6 to Blalock Rd	NB	262-501	205	52	72	0	247-251
HARRIS	5	TX 6 to Blalock Rd	SB	No sensitive receptors.					
HARRIS	5	Blalock Rd to Houston Station	NB	110-510	205	60	72	0	251-257
HARRIS	5	Blalock Rd to Houston Station	SB	227-524	205	53	72	0	251-257

Source: Cross-Spectrum Acoustics, 2016.

Table 6-4: Summary of Vibration Impacts for Institutional Land Use									
County	Segment	Location	Side of Track	Near Track Dist (ft.)	Speed (mph)	TX HSR Vibration Levels (VdB)		Number of Impacts	Mapbook Page
						TX HSR Project	FTA Impact Criterion		
DALLAS	1	Friendship Missionary Baptist Church	SB	363	205	37	78	0	4
DALLAS	1	The Church of Revelation	SB	412	205	36	78	0	4
DALLAS	1	College Park Baptist Church	SB	670	205	31	78	0	6
DALLAS	1	Full Faith Deliverance Church	SB	463	205	34	78	0	6
ELLIS	2B	Palmyra Studios	NB	963	205	64	65	0	31
FREESTONE	4	Lebanon Church	NB	454	205	59	78	0	156
FREESTONE	4	Furney-Richardson School	NB	837	205	45	78	0	162
GRIMES	5	Shiloh Church Cemetery	SB	988	205	18	78	0	202
HARRIS	5	Fairbanks United Methodist Church	NB	451	205	48	78	0	250
HARRIS	5	Christian Family Church	NB	177	205	55	78	0	250
HARRIS	5	Pentecostal Church New Jerusalem	SB	199	205	55	78	0	252

Source: Cross-Spectrum Acoustics, 2016.

As shown in **Table 6-3**, HSR operations will result in no vibration impacts.

Construction Assessment

Construction noise and vibration assessment criteria were taken from the 2012 FRA guidance manual, “High=Speed Ground Transportation Noise and Vibration Impact Assessment”. The impact criteria are based on maintaining a noise environment considered acceptable for land uses where noise may have an effect, and FRA’s construction vibration criteria are designed primarily to prevent building damage, and to assess whether vibration might interfere with vibration-sensitive building activities or temporarily annoy building occupants during the construction period.

Noise-sensitive and vibration-sensitive land uses in the Study Area were initially identified based on GIS data, aerial photography, drawings, plans and a field survey. Procedures from the FRA guidance manual[2] were applied for establishing the extent of the Study Area to be evaluated for the noise and vibration impact analyses. The screening distances applicable to these analyses are 1,300 feet for noise impact (new HSR corridor in a rural area) and 275 feet for vibration (frequent operation at speeds of 200 to300 mph near residential land use). These distances

[2] FRA, “High-Speed Ground Transportation Noise and Vibration Impact Assessment,” Final Report DOT/FRA/ORD-12/15, September 2012.

from the FRA guidance manual are based on assumptions for the HSR operations and existing environment, and are meant to provide a distance within which any potential impacts from HSR operations would be identified. Beyond these distances, no impacts would occur.

Noise measurements of the A-weighted sound level for both long-term (24-hour) and short-term (one-hour) periods were then collected at representative locations to document existing noise conditions at sensitive receivers (e.g., residences and institutional sites). The measurement locations were selected to represent the existing noise conditions in areas adjacent to each segment of the Build Alternatives in each county within the Study Area (see **Figures 3.4-5 through 3.4-8** for noise measurement locations). Because the FRA noise criteria (see **Section 3.4.3.2**) are based on the existing noise levels, measuring the existing noise and characterizing noise levels at sensitive locations in the Study Area was the first step in the impact assessment.

Ground-borne vibration tests were also performed at representative locations in the Study Area to determine how vibration travels through the ground near vibration-sensitive locations (e.g., residential or institutional buildings). The test sites were selected to represent the soil conditions along the Build Alternatives in each county within the Study Area (see **Figures 3.4-9 through 3.4-12** for vibration measurement locations). At each location, tests were conducted by impacting the ground with an instrumented weight and measuring the response of the soil at various distances. The results of the ground vibration tests were combined with vehicle (train) information to predict vibration levels from operations at sensitive locations along each of the Build Alternatives. More information about the vibration testing procedures, instrumentation and detailed results is provided in the **Appendix E, Noise and Vibration Technical Memorandum**.

Project information for use in the analysis was obtained from TCRR[3], consisting of: (1) plan and profile maps of the Build Alternatives including crossover locations, MOW facility plans, layover/storage locations, station locations and TPSS locations; (2) trainset characteristics and operational data and; (3) sound data gathered in Japan for the Tokaido Shinkansen N700-A train. Available information about the Shinkansen system and the results of field noise and vibration measurements were used in the prediction and assessment when applying the methodology from the FRA guidance manual.[4] The FTA guidance manual[5] was used to supplement the FRA guidance manual.

Construction Noise

By using the FRA criteria provided in **Table 3-1** and the construction equipment noise emission levels in **Table 5-1**, and assuming that construction noise is reduced by 6 dB for each doubling of distance from the center of the work site, it is possible to estimate the screening distances for potential construction noise impact at residential locations for various construction activities. These estimates, shown in **Table 6-5**, suggest that the potential for construction noise impact at residential sites would extend to distances of 40-200 feet from daytime construction and to

[3] TCRR, "*Texas Central Partners Texas High Speed Rail Final Draft Conceptual Engineering Report-FDCERv7*," September 15, 2017.
[4] FRA, "High-Speed Ground Transportation Noise and Vibration Impact Assessment," Final Report DOT/FRA/ORD-12/15, September 2012.
[5] FTA, "Transit Noise and Vibration Impact Assessment," Final Report FTA-VA-90-1003-06, May 2006.

distances of 125-630 feet from nighttime construction, depending on the activity. The greater impact distances apply to those construction activities that include pile driving. Descriptions of the types of equipment that would be used for each construction activity are provided below.

Table 6-5: Construction Noise Impact Screening Distances for Residences

Construction Activity	1-Hr Leq at 50 feet (dBA)	Residential Noise Impact Screening Distance (feet)	
		Daytime (90 dBA Limit)	Nighttime (80 dBA Limit)
Clearing and Grubbing	88	40	125
Demolition	91	55	175
Earthworks	88	40	125
Highways/Roadways	88	40	125
Drainage	88	40	125
Structures	102	200	630
Utility Relocations	88	40	125
Trackwork	88	40	125
Stations	102	200	630
MOW Facilities	102	200	630
Trainset Maintenance	102	200	630

Source: Cross-Spectrum Acoustics, 2016

Clearing and Grubbing

Clearing and grubbing will involve the use of backhoes, loaders, dozers, excavators, manlifts, trucks, air compressors and generators. The two noisiest items will be dozers and excavators, each with a noise emission level of 85 dBA at 50 feet, yielding a combined 1-hour Leq of 88 dBA at 50 feet. It is estimated that residences within a distance of 40 feet will be exposed to noise levels exceeding the 90 dBA criterion for daytime construction and that residences within a distance of 125 feet will be exposed to noise levels exceeding the 80 dBA nighttime criterion.

Demolition

Demolition will involve the use of hydraulic hammers, dozers, excavators, graders, loaders, cranes, manlifts, trucks, air compressors, generators and welders. The noisiest items will be the hydraulic hammers, with a noise emission level of 90 dBA at 50 feet, followed by dozers, excavators and graders, with noise emission levels of 85 dBA at 50 feet, yielding a combined 1-hour Leq of 91 dBA at 50 feet for the two noisiest equipment items operating together. It is estimated that residences within a distance of 55 feet will be exposed to noise levels exceeding the 90 dBA criterion for daytime construction and that residences within a distance of 175 feet will be exposed to noise levels exceeding the 80 dBA nighttime criterion.

Earthworks

Earthworks construction will involve the use of backhoes, loaders, dozers, excavators, graders, manlifts, rollers, compactors, trucks, air compressors and generators. The noisiest items will be the dozers, excavators, graders, rollers and compactors, each with a noise emission level of 85 dBA at 50 feet, yielding a combined 1-hour Leq of 88 dBA for the two noisiest equipment items operating together. It is estimated that residences within a distance of 40 feet will be exposed to noise levels exceeding the 90 dBA criterion for daytime construction and that residences within a distance of 125 feet will be exposed to noise levels exceeding the 80 dBA nighttime criterion.

Highways/Roadways

Highway and roadway construction will involve the use of backhoes, loaders, dozers, excavators, graders, rollers, compactors, trucks, air compressors and generators. The noisiest items will be the dozers, excavators, graders, rollers and compactors, each with a noise emission level of 85 dBA at 50 feet, yielding a combined 1-hour Leq of 88 dBA for the two noisiest equipment items operating together. It is estimated that residences within a distance of 40 feet will be exposed to noise levels exceeding the 90 dBA criterion for daytime construction and that residences within a distance of 125 feet will be exposed to noise levels exceeding the 80 dBA nighttime criterion.

Drainage

Drainage construction will involve the use of backhoes, dozers, excavators, graders, cranes, rollers, compactors, trucks, air compressors and generators. The noisiest items will be the dozers, excavators, graders, rollers and compactors, each with a noise emission level of 85 dBA at 50 feet, yielding a combined 1-hour Leq of 88 dBA for the two noisiest equipment items operating together. It is estimated that residences within a distance of 40 feet will be exposed to noise levels exceeding the 90 dBA criterion for daytime construction and that residences within a distance of 125 feet will be exposed to noise levels exceeding the 80 dBA nighttime criterion.

Structures

The construction of structures will involve the use of pile drivers, hydraulic hammers, backhoes, dozers, excavators, graders, loaders, cranes, rollers, compactors, manlifts, trucks, air compressors, generators and welders. The noisiest two items will be an impact pile driver, with a noise emission level of 101 dBA at 50 feet, and a vibratory pile driver, with a noise emission level of 95 dBA at 50 feet, yielding a combined 1-hour Leq of 102 dBA at 50 feet. It is estimated that residences within a distance of 200 feet will be exposed to noise levels exceeding the 90 dBA criterion for daytime construction and that residences within a distance of 630 feet will be exposed to noise levels exceeding the 80 dBA nighttime criterion.

Utility Relocations

The relocation of utilities will involve the use of backhoes, dozers, excavators, graders, cranes, manlifts, rollers, compactors, trucks, air compressors and generators. The noisiest items will be the dozers, excavators, graders, rollers and compactors, each with a noise emission level of 85 dBA at 50 feet, yielding a combined 1-hour Leq of 88 dBA for the two noisiest equipment items operating together. It is estimated that residences within a distance of 40 feet will be exposed to noise levels exceeding the 90 dBA criterion for daytime construction and that residences within a distance of 125 feet will be exposed to noise levels exceeding the 80 dBA nighttime criterion.

Trackwork

Trackwork construction will involve the use of backhoes, dozers, excavators, graders, cranes, loaders, rollers, compactors, trucks, air compressors and generators. The noisiest items will be the dozers, excavators, graders, rollers and compactors, each with a noise emission level of 85 dBA at 50 feet, yielding a combined 1-hour Leq of 88 dBA for the two noisiest equipment items operating together. It is estimated that residences within a distance of 40 feet will be exposed to noise levels exceeding the 90 dBA criterion for daytime construction and that residences within a distance of 125 feet will be exposed to noise levels exceeding the 80 dBA nighttime criterion.

Stations

Station construction will involve the use of pile drivers, hydraulic hammers, backhoes, dozers, excavators, graders, loaders, cranes, rollers, compactors, manlifts, trucks, air compressors, generators and welders. The noisiest two items will be an impact pile driver, with a noise emission level of 101 dBA at 50 feet, and a vibratory pile driver, with a noise emission level of 95 dBA at 50 feet, yielding a combined 1-hour Leq of 102 dBA at 50 feet. It is estimated that residences within a distance of 200 feet will be exposed to noise levels exceeding the 90 dBA criterion for daytime construction and that residences within a distance of 630 feet will be exposed to noise levels exceeding the 80 dBA nighttime criterion.

MOW Facilities

The construction of MOW facilities will involve the use of pile drivers, hydraulic hammers, backhoes, dozers, excavators, graders, loaders, cranes, rollers, compactors, manlifts, trucks, air compressors, generators and welders. The noisiest two items will be an impact pile driver, with a noise emission level of 101 dBA at 50 feet, and a vibratory pile driver, with a noise emission level of 95 dBA at 50 feet, yielding a combined 1-hour Leq of 102 dBA at 50 feet. It is estimated that residences within a distance of 200 feet will be exposed to noise levels exceeding the 90 dBA criterion for daytime construction and that residences within a distance of 630 feet will be exposed to noise levels exceeding the 80 dBA nighttime criterion.

Trainset Maintenance

The construction of trainset maintenance facilities will involve the use of pile drivers, hydraulic hammers, backhoes, dozers, excavators, graders, loaders, cranes, rollers, compactors, manlifts, trucks, air compressors, generators and welders. The noisiest two items will be an impact pile driver, with a noise emission level of 101 dBA at 50 feet, and a vibratory pile driver, with a noise emission level of 95 dBA at 50 feet, yielding a combined 1-hour Leq of 102 dBA at 50 feet. It is estimated that residences within a distance of 200 feet will be exposed to noise levels exceeding the 90 dBA criterion for daytime construction and that residences within a distance of 630 feet will be exposed to noise levels exceeding the 80 dBA nighttime criterion.

Construction Vibration

During construction, some activities may cause ground-borne vibration, most notably pile driving for structures and vibratory compaction for ground improvements. While it is unlikely that such activities will occur within 50 feet of sensitive structures where damage effects could be of concern, there could be some potential for vibration annoyance or interference with the use of sensitive equipment. **Table 6-6** provides the approximate distances within which receivers could experience construction-related vibration annoyance effects. Descriptions of the types of construction equipment that would generate the highest levels of ground-borne vibration for each construction activity are provided below.

Table 6-6: Construction Vibration Impact Screening Distances				
Construction Activity	Maximum Vibration Level at 25 feet (VdB)	Vibration Impact Screening Distance (feet)		
		Category 1 (65 VdB Limit)	Category 2 (72 VdB Limit)	Category 3 (75 VdB Limit)
Clearing and Grubbing	87	135	80	65
Demolition	87	135	80	65
Earthworks	94	230	135	105
Highways/Roadways	94	230	135	105
Drainage	94	230	135	105
Structures	104	500	290	230
Utility Relocations	94	230	135	105
Trackwork	94	230	135	105
Stations	104	500	290	230
MOW Facilities	104	500	290	230
Trainset Maintenance	104	500	290	230

Source: Cross-Spectrum Acoustics, 2016

Clearing and Grubbing

Clearing and grubbing will involve the use of backhoes, loaders, dozers, excavators, manlifts, trucks, air compressors and generators. The items that will generate the highest levels of ground- borne vibration are backhoes, dozers and excavators, each with a vibration source level of 87 VdB at 25 feet. It is estimated that receivers within a distances of 135 feet, 80 feet and 65 feet will be exposed to vibration levels exceeding the criteria for Category 1, Category 2 and Category 3 land use, respectively.

Demolition

Demolition will involve the use of hydraulic hammers, dozers, excavators, graders, loaders, cranes, manlifts, trucks, air compressors, generators and welders. The items that will generate the highest levels of ground- borne vibration are hydraulic hammers, backhoes, dozers and excavators, each with a vibration source level of 87 VdB at 25 feet. It is estimated that receivers within a distances of 135 feet, 80 feet and 65 feet will be exposed to vibration levels exceeding the criteria for Category 1, Category 2 and Category 3 land use, respectively.

Earthworks

Earthworks construction will involve the use of backhoes, loaders, dozers, excavators, graders, manlifts, rollers, compactors, trucks, air compressors and generators. The items that will generate the highest levels of ground- borne vibration are vibratory rollers and compactors, with a vibration source level of 94 VdB at 25 feet. It is estimated that receivers within a distances of 230 feet, 135 feet and 105 feet will be exposed to vibration levels exceeding the criteria for Category 1, Category 2 and Category 3 land use, respectively.

Highways/Roadways

Highway and roadway construction will involve the use of backhoes, loaders, dozers, excavators, graders, rollers, compactors, trucks, air compressors and generators. The items that will generate the highest levels of ground- borne vibration are vibratory rollers and compactors, with a vibration source level of 94 VdB at 25 feet. It is estimated that receivers within a distances of 230 feet, 135 feet and 105 feet will be exposed to vibration levels exceeding the criteria for Category 1, Category 2 and Category 3 land use, respectively.

Drainage

Drainage construction will involve the use of backhoes, dozers, excavators, graders, cranes, rollers, compactors, trucks, air compressors and generators. The items that will generate the highest levels of ground- borne vibration are vibratory rollers and compactors, with a vibration source level of 94 VdB at 25 feet. It is estimated that receivers within a distances of 230 feet, 135 feet and 105 feet will be exposed to vibration levels exceeding the criteria for Category 1, Category 2 and Category 3 land use, respectively.

Structures

The construction of structures will involve the use of pile drivers, hydraulic hammers, backhoes, dozers, excavators, graders, loaders, cranes, rollers, compactors, manlifts, trucks, air compressors, generators and welders. The items that will generate the highest levels of ground-borne vibration are impact pile drivers, with a typical vibration source level of 104 VdB at 25 feet. It is estimated that receivers within a distances of 500 feet, 290 feet and 230 feet will be exposed to vibration levels exceeding the criteria for Category 1, Category 2 and Category 3 land use, respectively.

Utility Relocations

The relocation of utilities will involve the use of backhoes, dozers, excavators, graders, cranes, manlifts, rollers, compactors, trucks, air compressors and generators. The items that will generate the highest levels of ground- borne vibration are vibratory rollers and compactors, with a vibration source level of 94 VdB at 25 feet. It is estimated that receivers within a distances of 230 feet, 135 feet and 105 feet will be exposed to vibration levels exceeding the criteria for Category 1, Category 2 and Category 3 land use, respectively.

Trackwork

Trackwork construction will involve the use of backhoes, dozers, excavators, graders, cranes, loaders, rollers, compactors, trucks, air compressors and generators. The items that will generate the highest levels of ground- borne vibration are vibratory rollers and compactors, with a vibration source level of 94 VdB at 25 feet. It is estimated that receivers within a distances of 230 feet, 135 feet and 105 feet will be exposed to vibration levels exceeding the criteria for Category 1, Category 2 and Category 3 land use, respectively.

Stations

Station construction will involve the use of pile drivers, hydraulic hammers, backhoes, dozers, excavators, graders, loaders, cranes, rollers, compactors, manlifts, trucks, air compressors, generators and welders. The items that will generate the highest levels of ground- borne vibration are impact pile drivers, with a typical vibration source level of 104 VdB at 25 feet. It is estimated that receivers within a distances of 500 feet, 290 feet and 230 feet will be exposed to vibration levels exceeding the criteria for Category 1, Category 2 and Category 3 land use, respectively.

MOW Facilities
The construction of MOW facilities will involve the use of pile drivers, hydraulic hammers, backhoes, dozers, excavators, graders, loaders, cranes, rollers, compactors, manlifts, trucks, air compressors, generators and welders. The items that will generate the highest levels of ground-borne vibration are impact pile drivers, with a typical vibration source level of 104 VdB at 25 feet. It is estimated that receivers within a distances of 500 feet, 290 feet and 230 feet will be exposed to vibration levels exceeding the criteria for Category 1, Category 2 and Category 3 land use, respectively.

Trainset Maintenance
The construction of trainset maintenance facilities will involve the use of pile drivers, hydraulic hammers, backhoes, dozers, excavators, graders, loaders, cranes, rollers, compactors, manlifts, trucks, air compressors, generators and welders. The items that will generate the highest levels of ground- borne vibration are impact pile drivers, with a typical vibration source level of 104 VdB at 25 feet. It is estimated that receivers within a distances of 500 feet, 290 feet and 230 feet will be exposed to vibration levels exceeding the criteria for Category 1, Category 2 and Category 3 land use, respectively.

MITIGATION

Operational Noise Mitigation

Potential noise mitigation measures for HSR operations include the following:

- <u>Install sound barriers</u>. Depending on the height and location relative to the tracks, sound barriers can achieve between 5 and 15 dB of noise reduction. The primary requirements for an effective sound barrier are that the barrier must (1) be high enough and long enough to break the line-of-sight between the sound source and the receiver, (2) be of an impervious material with a minimum surface density of 4 pounds per square foot and (3) not have any gaps or holes between the panels or at the bottom. Because many materials meet these requirements, aesthetics, durability, cost and maintenance considerations usually determine the selection of materials for sound barriers. Depending on the situation, sound barriers can become visually intrusive. Typically, the sound barrier style is selected with input from the public and local jurisdictions to reduce the visual effect of barriers on adjacent lands uses. For example, sound barriers could be solid or transparent, with various colors, materials and surface treatments.

- <u>Install building sound insulation</u>. Sound insulation of residences and institutional buildings to improve the outdoor-to-indoor noise reduction is a mitigation measure that can be provided by the project when the use of sound barriers is not feasible in providing a reasonable level (5 to 7 dB) of noise reduction. Although this approach has no effect on noise in exterior areas, it may be the best choice for sites where sound barriers are not feasible or desirable and for buildings where indoor sensitivity is of most concern. Substantial improvements in building sound insulation (on the order of 5 to 10 dB) can often be achieved by adding an extra layer of glazing to windows, by sealing holes in exterior surfaces that act as sound leaks and by providing forced ventilation and air conditioning so that windows do not need to be opened.

- Acquire limited property rights. In certain cases, it may be possible to acquire limited property rights for the construction of sound barriers at locations where they will be most effective.

The results of the noise impact assessment indicate that that the impact locations tend to be scattered geographically which suggests that the use of sound barriers as a practical mitigation measure may be limited. The application of sound barriers at specific locations will be investigated as the engineering design advances and the alternatives are refined. Where sound barriers are not practical, building sound insulation would be the most likely noise mitigation alternative.

Construction Noise and Vibration Mitigation

The following noise and vibration control mitigation measures will be implemented as necessary during project construction:

- Install temporary construction site sound barriers near noise sources.
- Limit or avoid nighttime construction near residential neighborhoods.
- Locate stationary construction equipment as far as possible from noise-sensitive sites.
- Re-route construction-related truck traffic along roadways that will cause the least disturbance to residents.
- During nighttime work, use smart back-up alarms, which automatically adjust the alarm level based on the background noise level, or switch off back-up alarms and replace with spotters.
- Use low-noise emission equipment.
- Implement noise-deadening measures for truck loading and operations.
- Monitor and maintain equipment to meet noise limits.
- Line or cover storage bins, conveyors, and chutes with sound-deadening material.
- Use acoustic enclosures, shields, or shrouds for equipment and facilities.
- Use high-grade engine exhaust silencers and engine-casing sound insulation.
- Minimize the use of generators to power equipment.
- Limit use of public address systems.
- Grade surface irregularities on construction sites.
- Use moveable sound barriers at the source of the construction activity.

APPENDIX A: NOISE AND VIBRATION MEASUREMENT SITE PHOTOGRAPHS

Figure A-1. Noise Measurement Site LT-1 – 4019-4099 Bulova St, Dallas; Dallas County; Segment 1

Figure A-2. Noise Measurement Site LT-1A – 5125 Cleveland Rd, Dallas; Dallas County; Segment 1

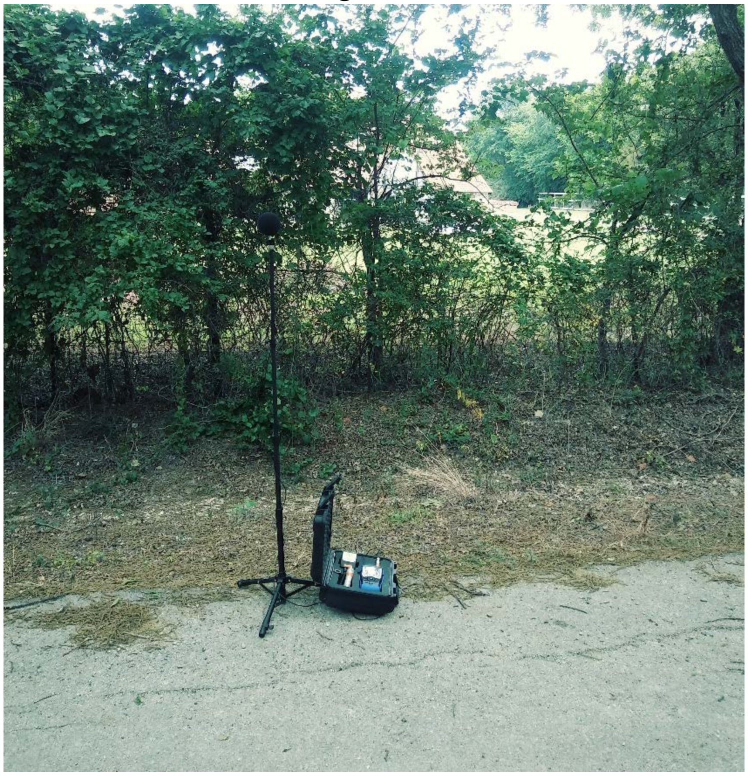


Figure A-3. Noise Measurement Site LT-1B – 1345 E Belt Line Rd, Lancaster; Dallas County; Segment 1

Figure A-4. Noise Measurement Site LT-1C – 1786 Nail Dr, Lancaster; Dallas County; Segment 1

Figure A-5. Noise Measurement Site LT-2 – 911 FM 813, Palmer; Ellis County; Segment 2C

Figure A-6. Noise Measurement Site LT-3 – 508 Old Waxahachie Rd, Waxahachie; Ellis County; Segment 2A

Figure A-7. Noise Measurement Site LT-4 – NW Co Rd 1320, Ennis; Navarro County; Segment 3A

Figure A-8. Noise Measurement Site LT-5 – SW 2120, Richland; Navarro County; Segment 3C

Figure A-9. Noise Measurement Site LT-6 – FM 1366, Wortham; Freestone County; Segment 4

Figure A-10. Noise Measurement Site LT-7 – 132-264 CR 890, Teague; Freestone County; Segment 4

Figure A-11. Noise Measurement Site LT-8 – N Fwy Service Rd, Teague; Freestone County; Segment 3C

Figure A-12. Noise Measurement Site LT-9 – 633 LCR 882, Jewett; Limestone County; Segment 4

Figure A-13. Noise Measurement Site LT-10 -- Beddingfield Rd, Marquez; Leon County; Segment 4

Figure A-14. Noise Measurement Site LT-11 – N Fwy Service Rd, Buffalo; Leon County; Segment 3C

Figure A-15. Noise Measurement Site LT-12 – 534 FM 39; Leon County; Segment 4

Figure A-16. Noise Measurement Site LT-13 – 2076-2765 W Feeder Rd; Leon County; Segment 3C

Figure A-17. Noise Measurement Site LT-14 – 7652 Greenbriar Rd; Madison County; Segment 3C

Figure A-18. Noise Measurement Site LT-15 – 1977 Poteet Rd; Madison County; Segment 4

Figure A-19. Noise Measurement Site LT-16 – 6113 FM 1696; Grimes County; Segment 5

Figure A-20. Noise Measurement Site LT-17 – 10735 TX-90; Grimes County; Segment 5

Figure A-21. Noise Measurement Site LT-18 – 5126 FM 1774; Grimes County; Segment 5

Figure A-22. Noise Measurement Site LT-19 – 119 Plantation Dr; Waller County; Segment 5

Figure A-23. Noise Measurement Site LT-20 – 21512 Binford Rd; Harris County; Segment 5

Figure A-24. Noise Measurement Site LT-21 –1218 Canyon Arbor Way; Harris County; Segment 5

Figure A-25. Noise Measurement Site LT-22 –14812 Hempstead Rd; Harris County; Segment 5

Figure A-26. Noise Measurement Site LT-23 – 11217 Todd St; Harris County; Segment 5

Figure A-27. Noise Measurement Site ST-1 – 1213 Coleman Ave, Dallas; Dallas County; Segment 1

Figure A-28. Noise Measurement Site ST-2 –4412 Kolloch Dr, Dallas; Dallas County; Segment 1

Figure A-29. Noise Measurement Site ST-3 – 6350 J. J. Lemmon Rd, Dallas; Dallas County; Segment 1

Figure A-30. Noise Measurement Site ST-4 –2607 Ferris Rd, Lancaster; Ellis County; Segment 2A

Figure A-31. Noise Measurement Site ST-5 –369 Farmer Rd, Ennis; Ellis County; Segment 2B

Figure A-32. Noise Measurement Site ST-6 – SW 1000, Corsicana; Navarro County; Segment 3B

Figure A-33. Noise Measurement Site ST-7 – 117-123 CR 1041, Wortham; Freestone County; Segment 3C

Figure A-34. Noise Measurement Site ST-8 – N Fwy Service Rd & CR 1090, Streetman; Freestone County; Segment 3C

Figure A-35. Noise Measurement Site ST-9 – Old Mexia-Fairfield Rd, Fairfield; Freestone County; Segment 3C

Figure A-36. Noise Measurement Site ST-10 – 164 & FM 39, Groesbeck

Figure A-37. Noise Measurement Site ST-11 – N Fwy Service Rd & CR 306, Buffalo; Leon County; Segment 3C

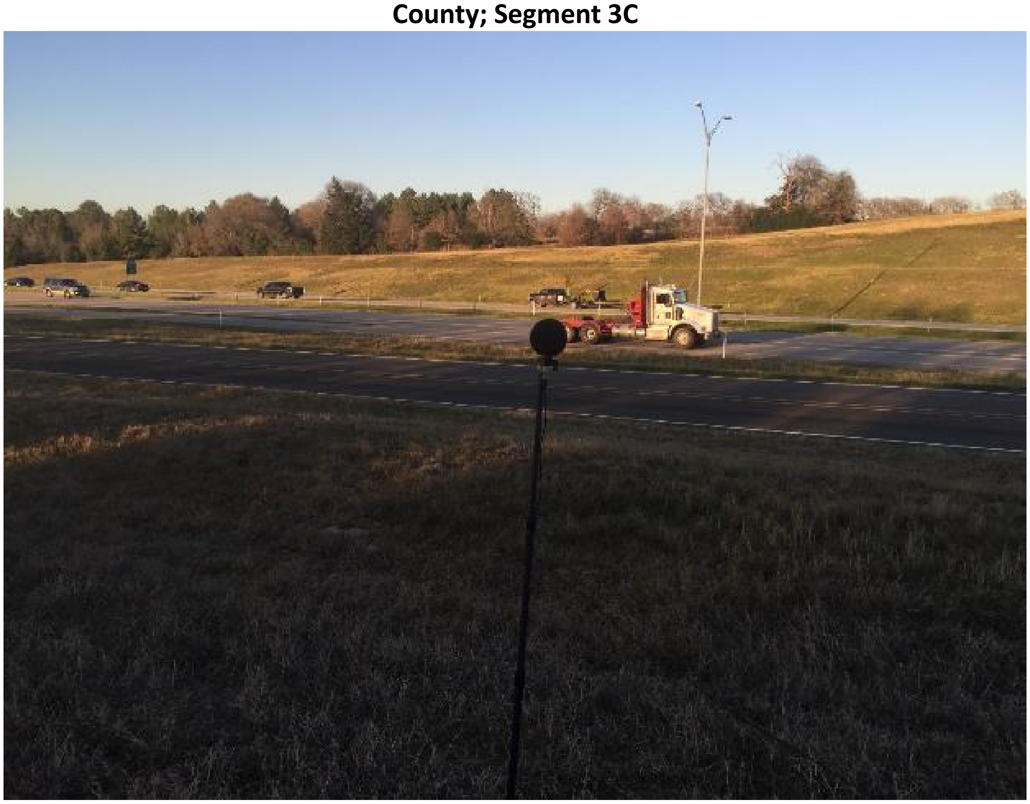


Figure A-38. Noise Measurement Site ST-12 – 20559 I-45 Frontage Rd; Leon County; Segment 3C

Figure A-39. Noise Measurement Site ST-13 – 5192 Dawkins Rd; Madison County; Segment 4

Figure A-40. Noise Measurement Site ST-14 – 3159 Clark Rd; Madison County; Segment 4

Figure A-41. Noise Measurement Site ST-15 – 15619 TX-90; Grimes County; Segment 5

Figure A-42. Noise Measurement Site ST-16 – CR 341, Plantersville; Grimes County; Segment 5

Figure A-43. Noise Measurement Site ST-18 – 6734 Limestone St; Harris County; Segment 5

Figure A-44. Noise Measurement Site ST-19 –20710 May Showers Circle; Harris County; Segment 5

Figure A-45. Vibration Propagation Measurement Site V-1 – 4360 Kolloch Drive; Dallas County; Segment 1

Figure A-46. Vibration Propagation Measurement Site V-2 – 103 Coffee Road; Ellis County; Segments 2A and 2B

Figure A-47. Vibration Propagation Measurement Site V-3 – 710 FM 2100; Navarro County; Segments 3A, 3B and 3C

Figure A-48. Vibration Propagation Measurement Site V-4 – N Fwy Service Road, Fairfield; Freestone County; Segments 3C and 4

Figure A-49. Vibration Propagation Measurement Site V-5 – LCR 828, Personville; Limestone County; Segment 4

Figure A-50. Vibration Propagation Measurement Site V-6 – 6734 FM 977; Leon County; Segment 4

Figure A-51. Vibration Propagation Measurement Site V-7 – 10290 Greenbriar Road; Madison County; Segment 3C

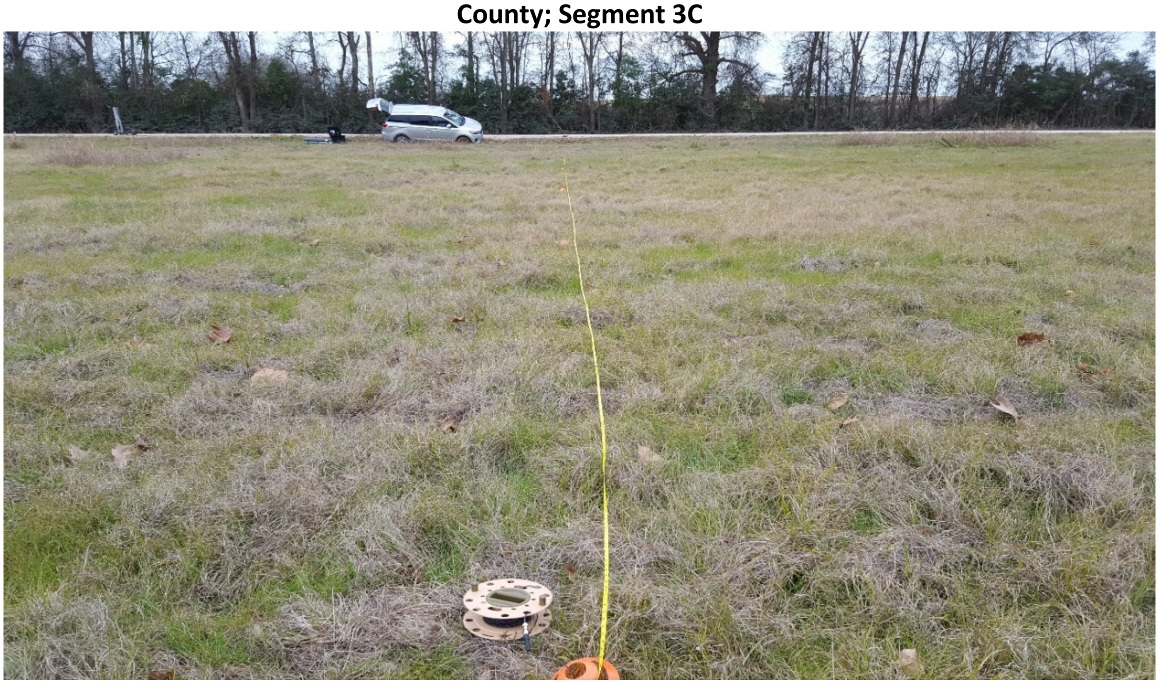


Figure A-52. Vibration Propagation Measurement Site V-8 – 10063 CR 311; Grimes County; Segment 5

Figure A-53. Vibration Propagation Measurement Site V-9 – Plantation Drive, Todd Mission; Waller County; Segment 5

Figure A-54. Vibration Propagation Measurement Site V-10 – Josey Ranch Road, Houston; Harris County; Segment 5

Figure A-55. Vibration Propagation Measurement Site V-11 – 21610 U.S. 290 Frontage Road, Houston; Harris County; Segment 5

APPENDIX B: NOISE MEASUREMENT DATA

Figure B-2. Long-Term Noise Measurement Data – Site LT-1

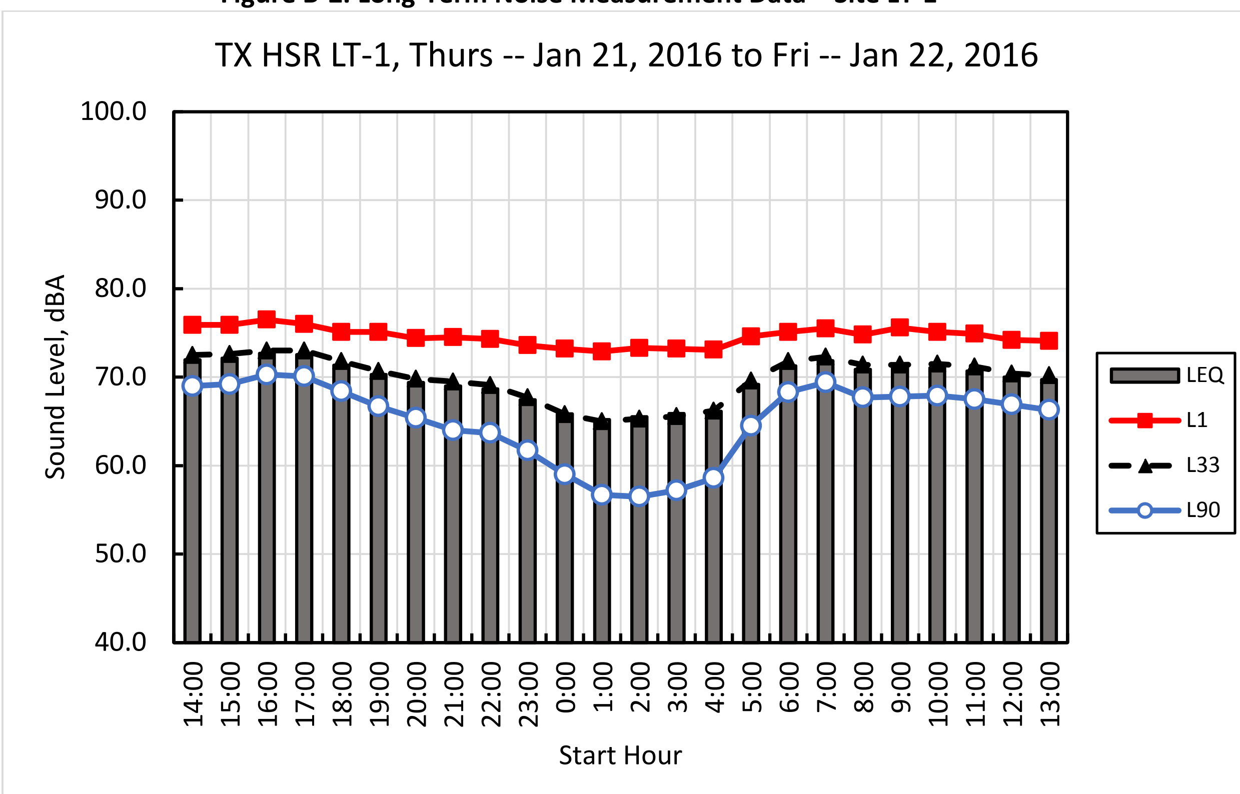


Figure B-3. Long-Term Noise Measurement Data – Site LT-2

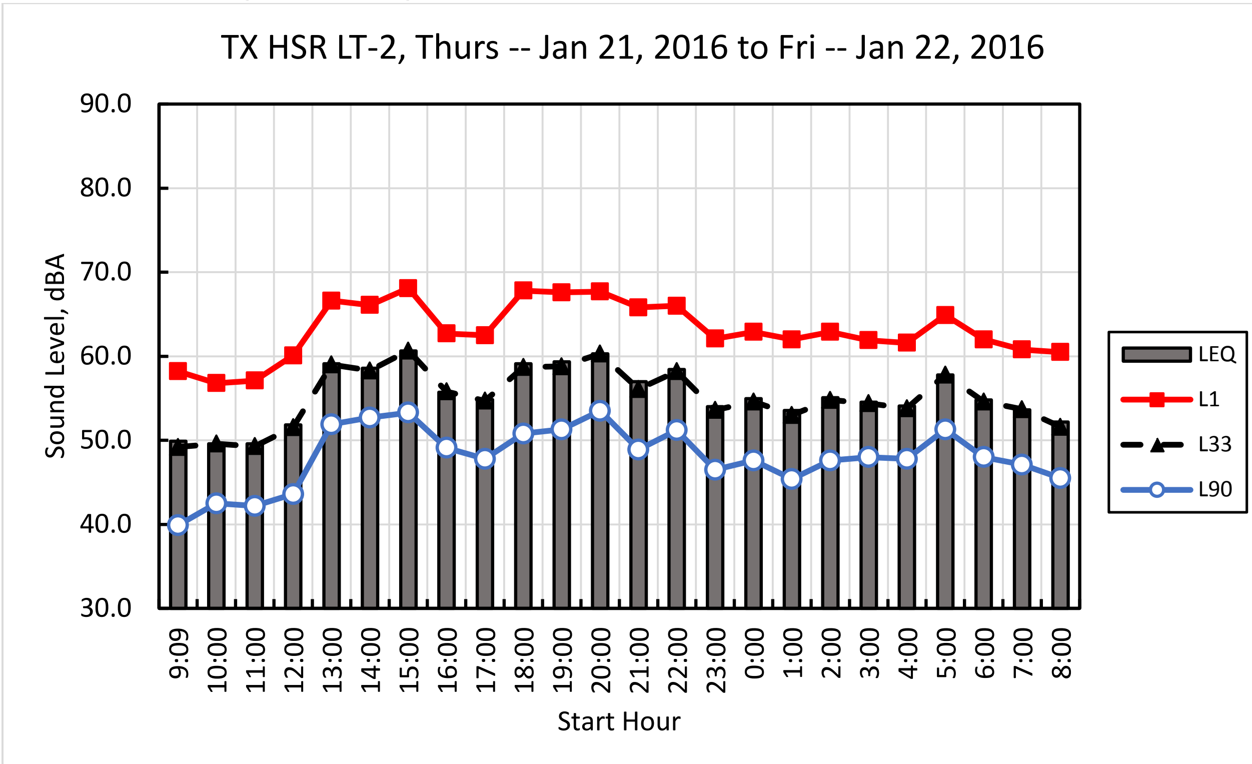


Figure B-4. Long-Term Noise Measurement Data – Site LT-3

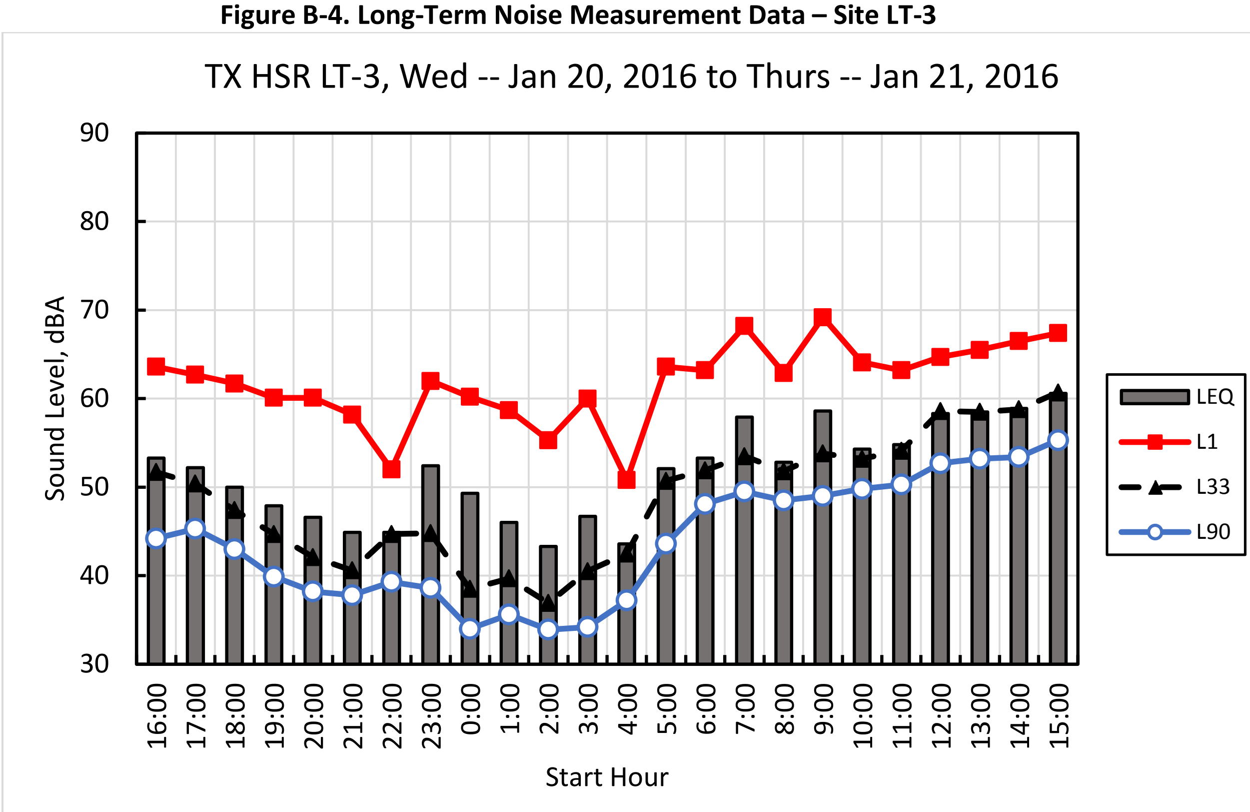


Figure B-5. Long-Term Measurement Data – Site LT-4

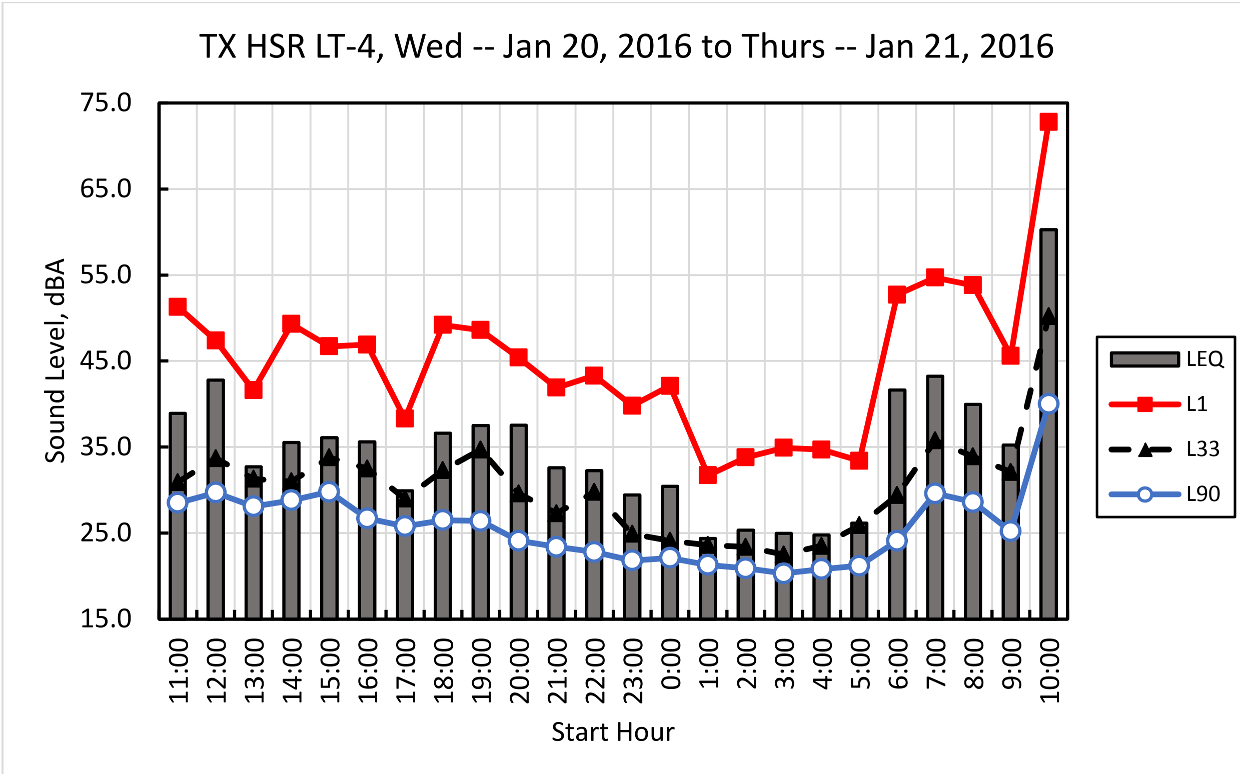


Figure B-6. Long-Term Measurement Data – Site LT-5

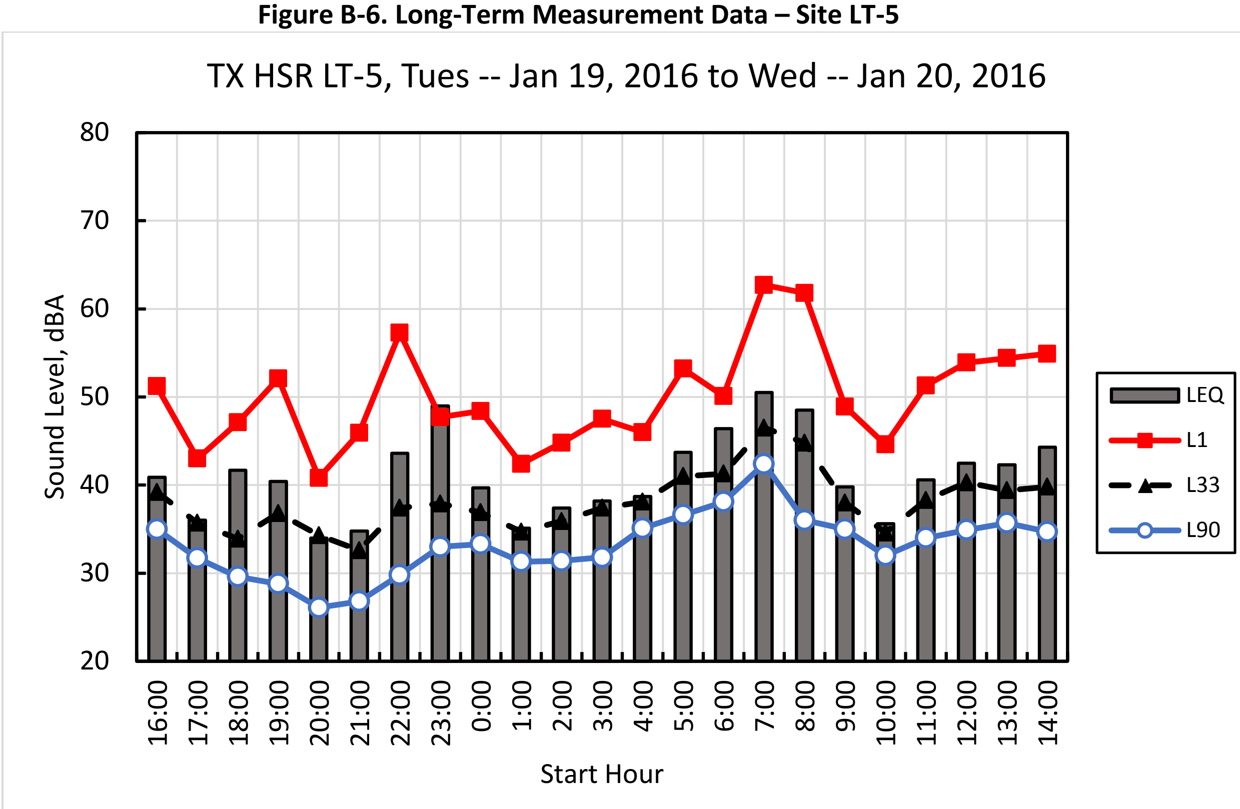


Figure B-7. Long-Term Measurement Data – Site LT-6

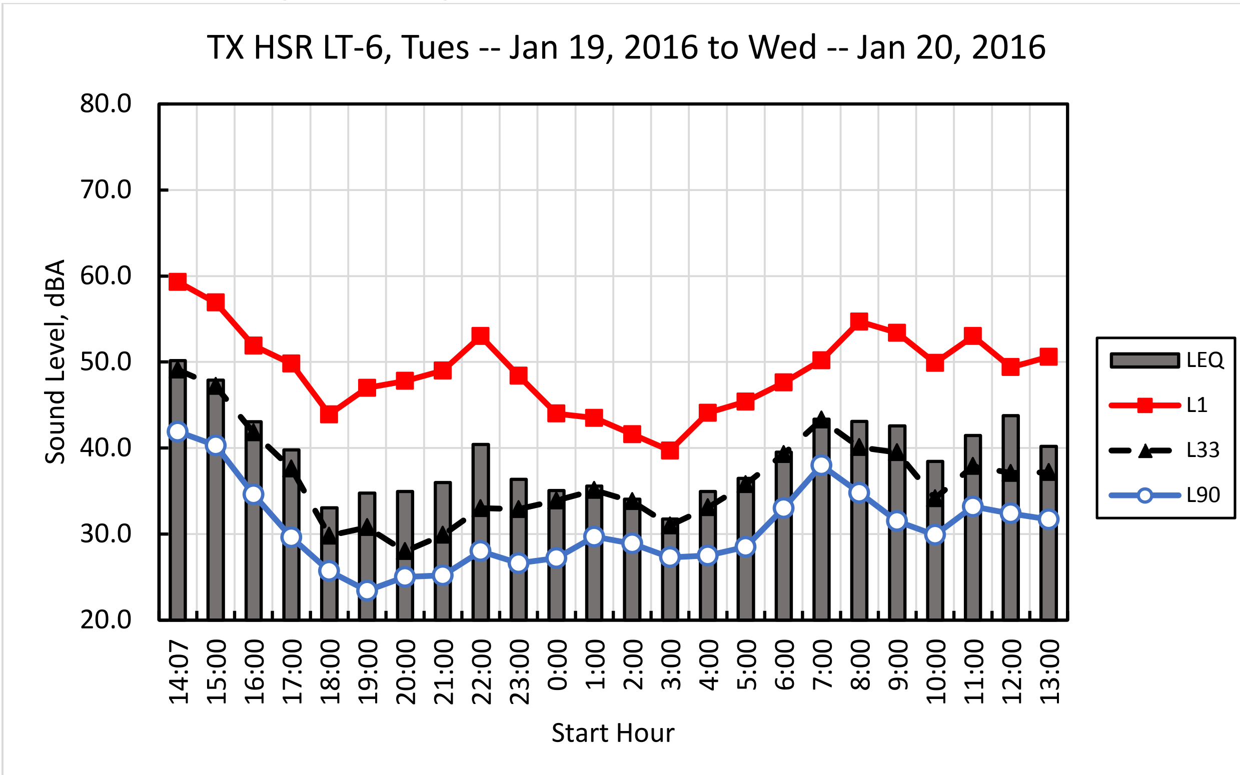


Figure B-8. Long-Term Measurement Data – Site LT-7

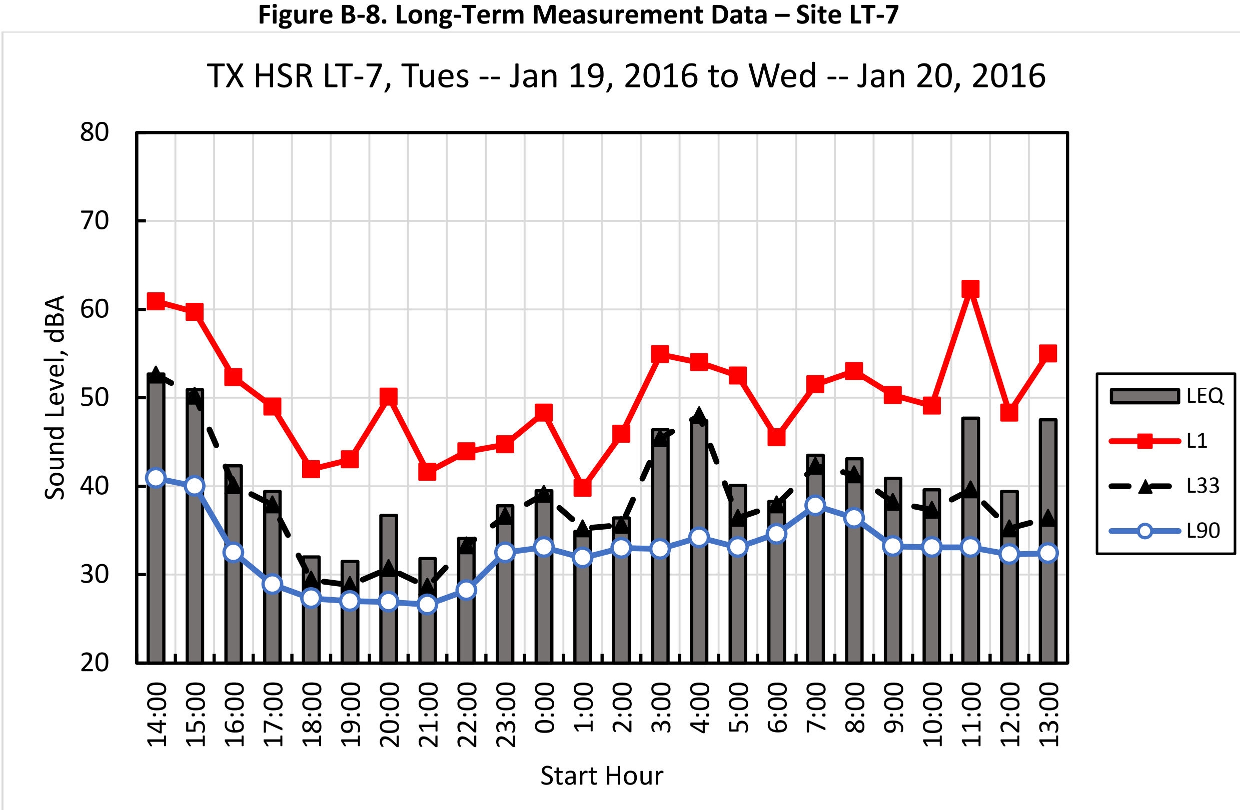


Figure B-9. Long-Term Measurement Data – Site LT-8

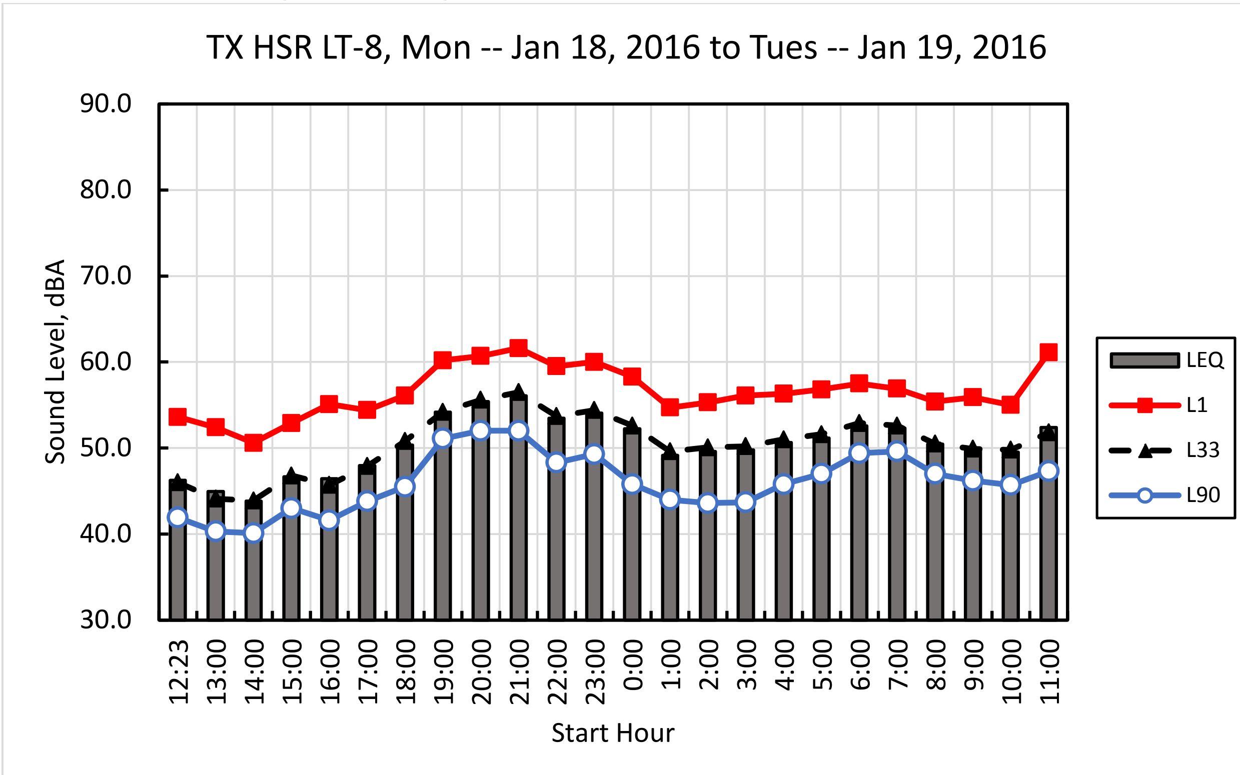


Figure B-10. Long-Term Measurement Data – Site LT-9

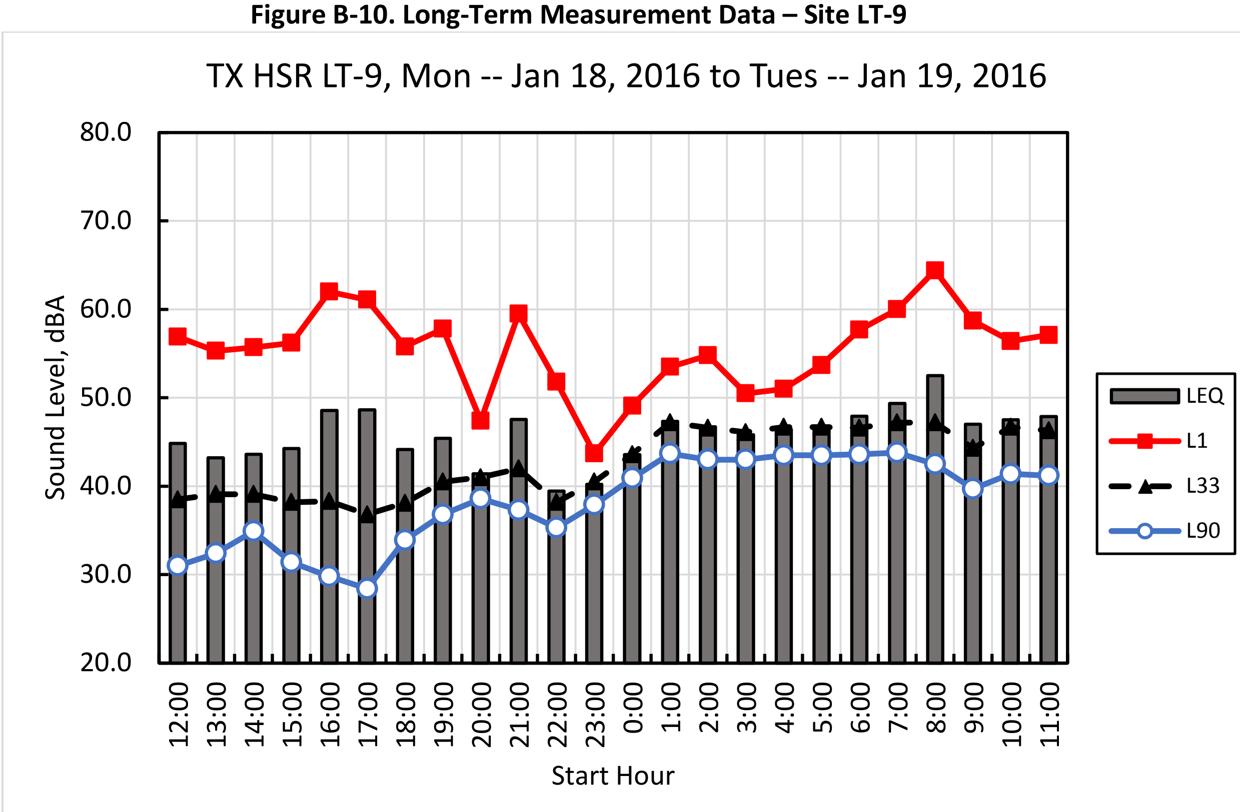


Figure B-11. Long-Term Measurement Data – Site LT-10

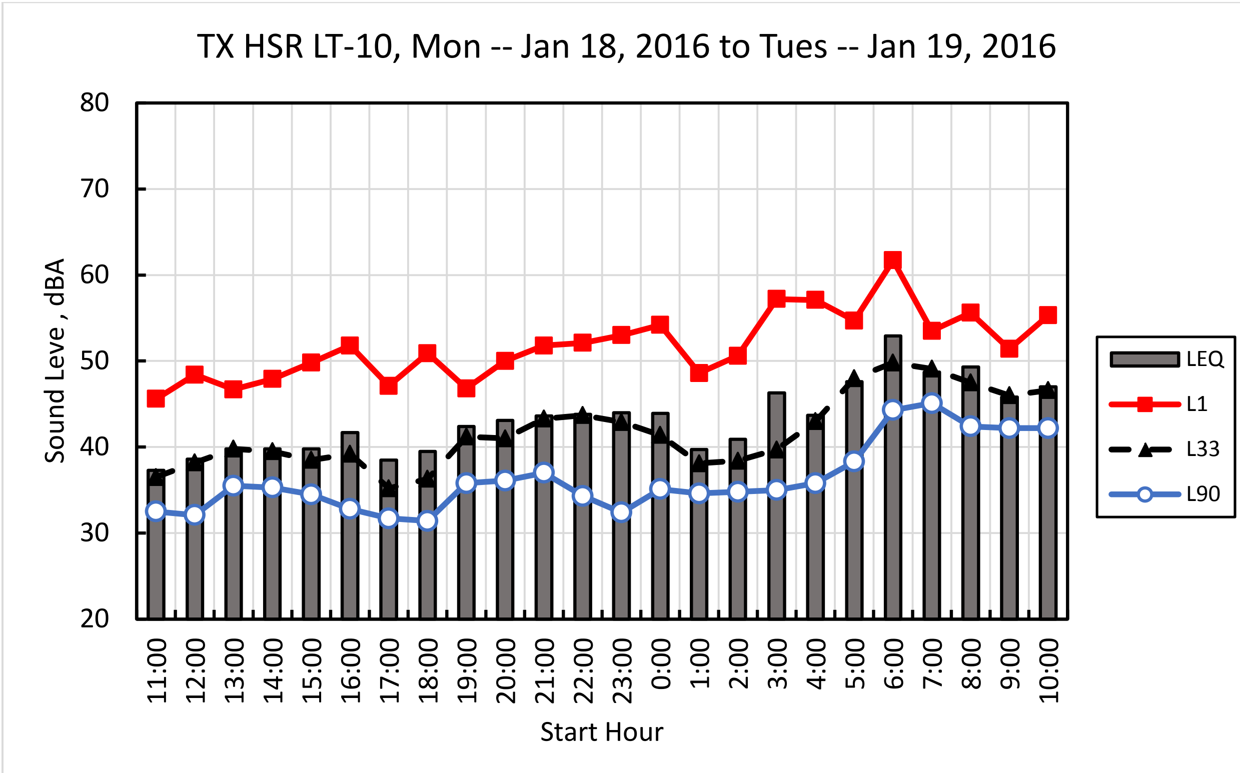


Figure B-12. Long-Term Measurement Data – Site LT-11

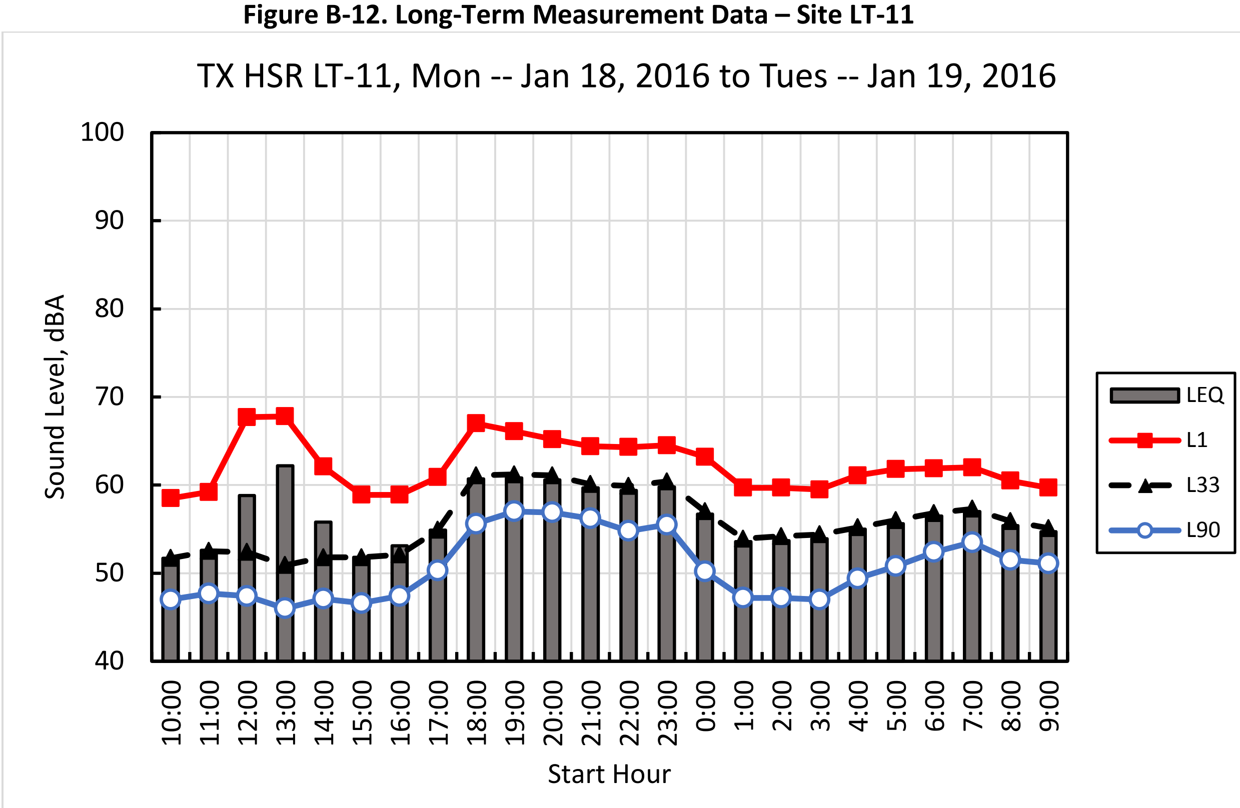


Figure B-13. Long-Term Measurement Data – Site LT-12

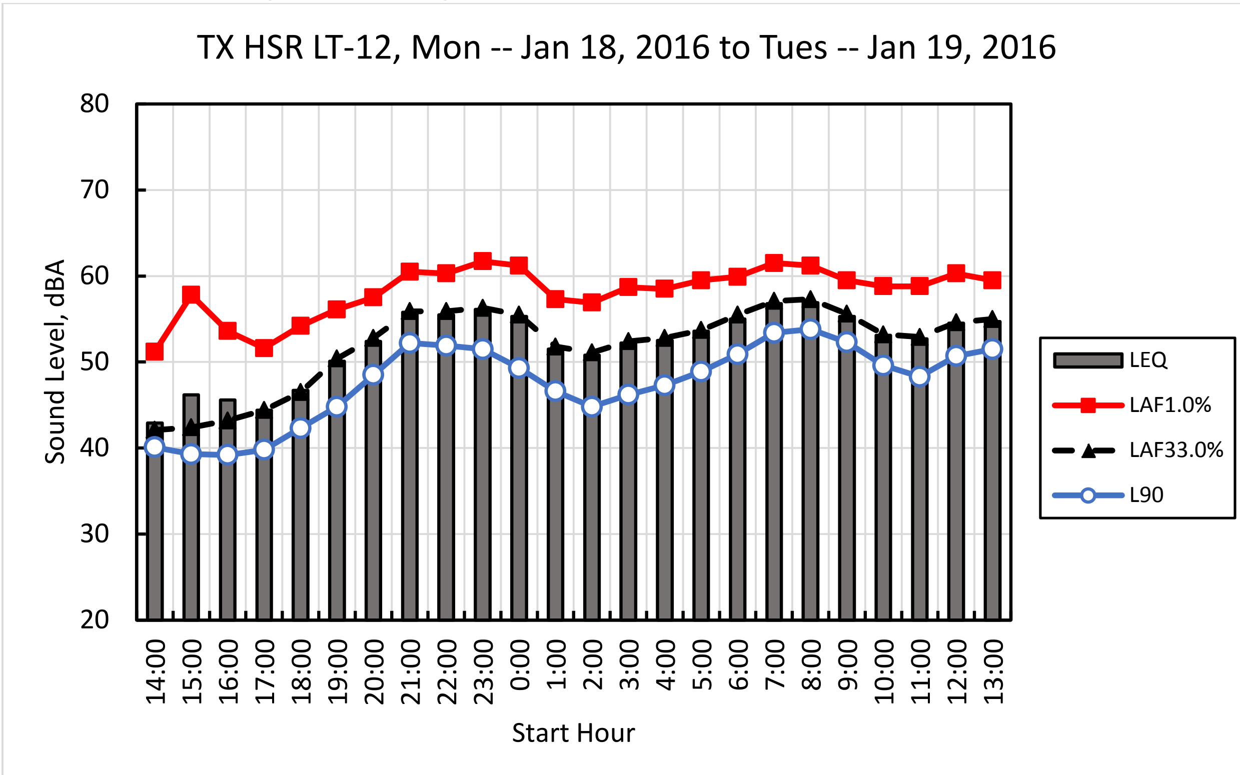


Figure B-14. Long-Term Measurement Data – Site LT-13

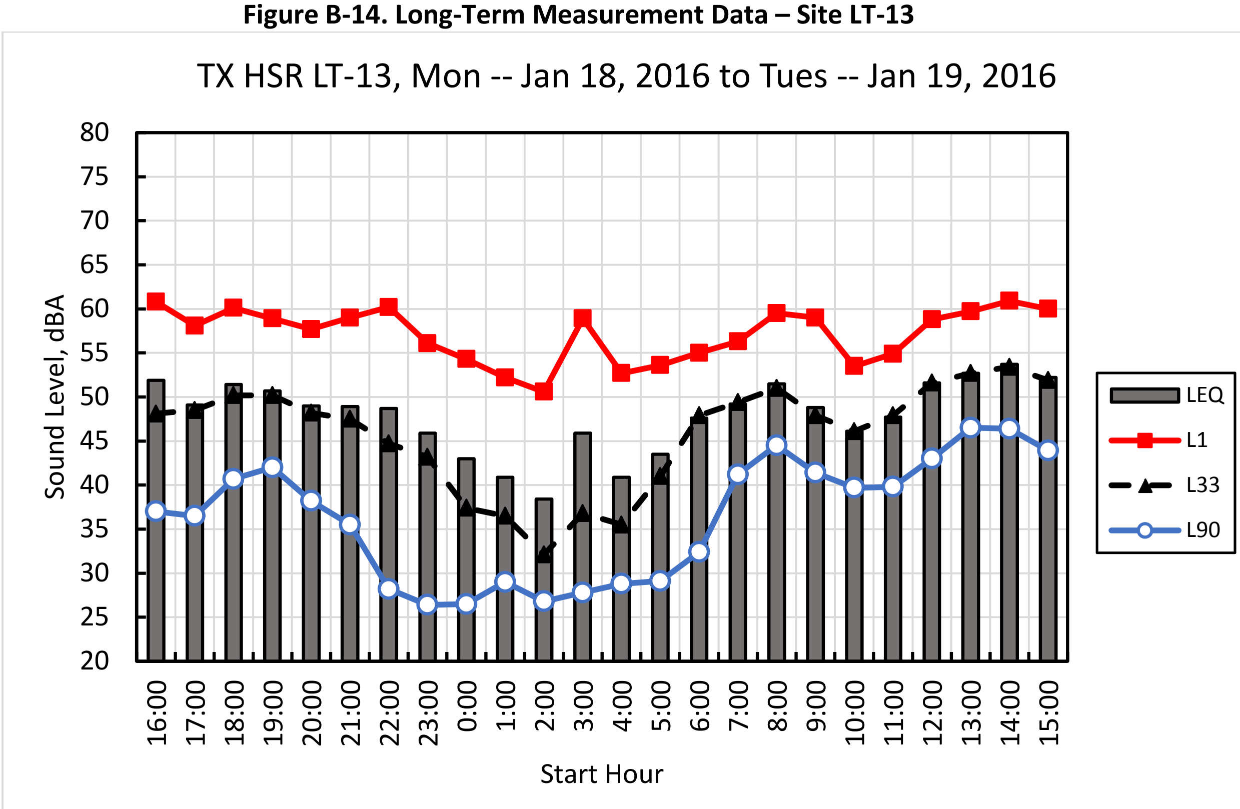


Figure B-15. Long-Term Measurement Data – Site LT-14

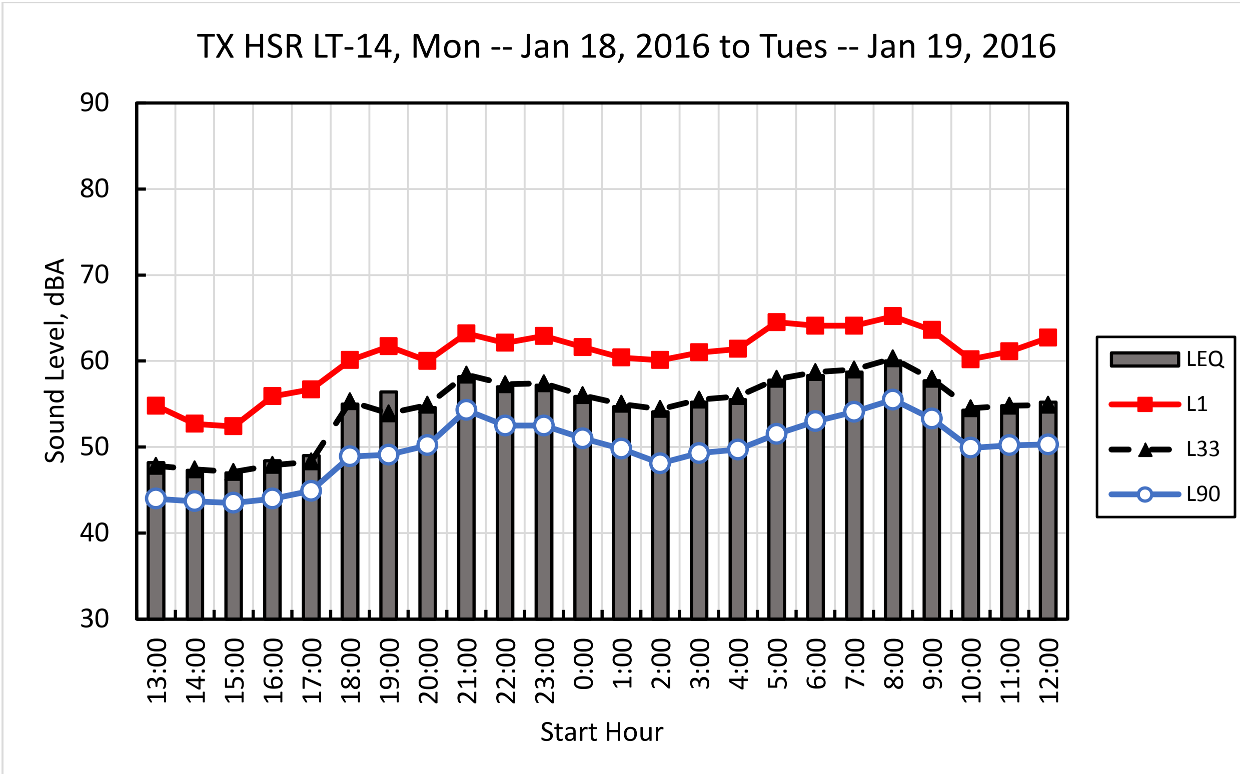


Figure B-16. Long-Term Measurement Data – Site LT-15

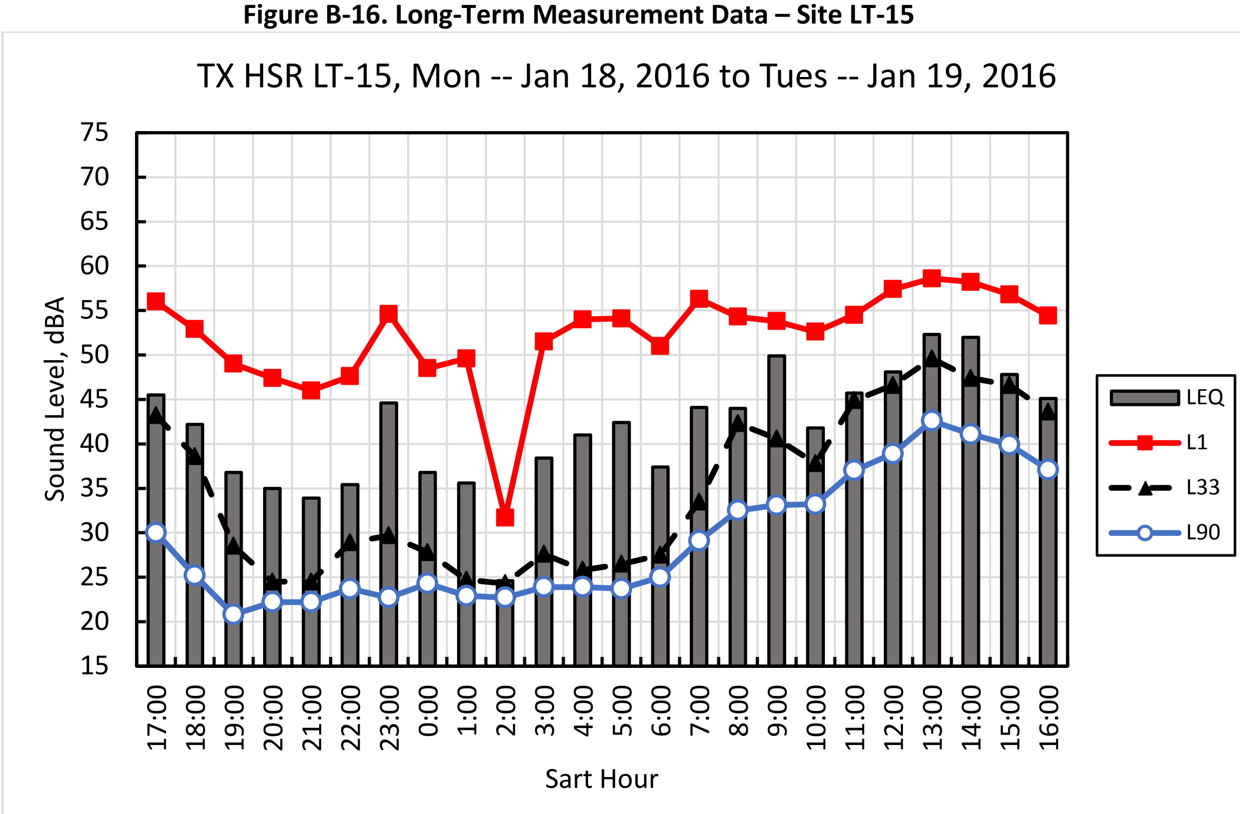


Figure B-17. Long-Term Measurement Data – Site LT-16

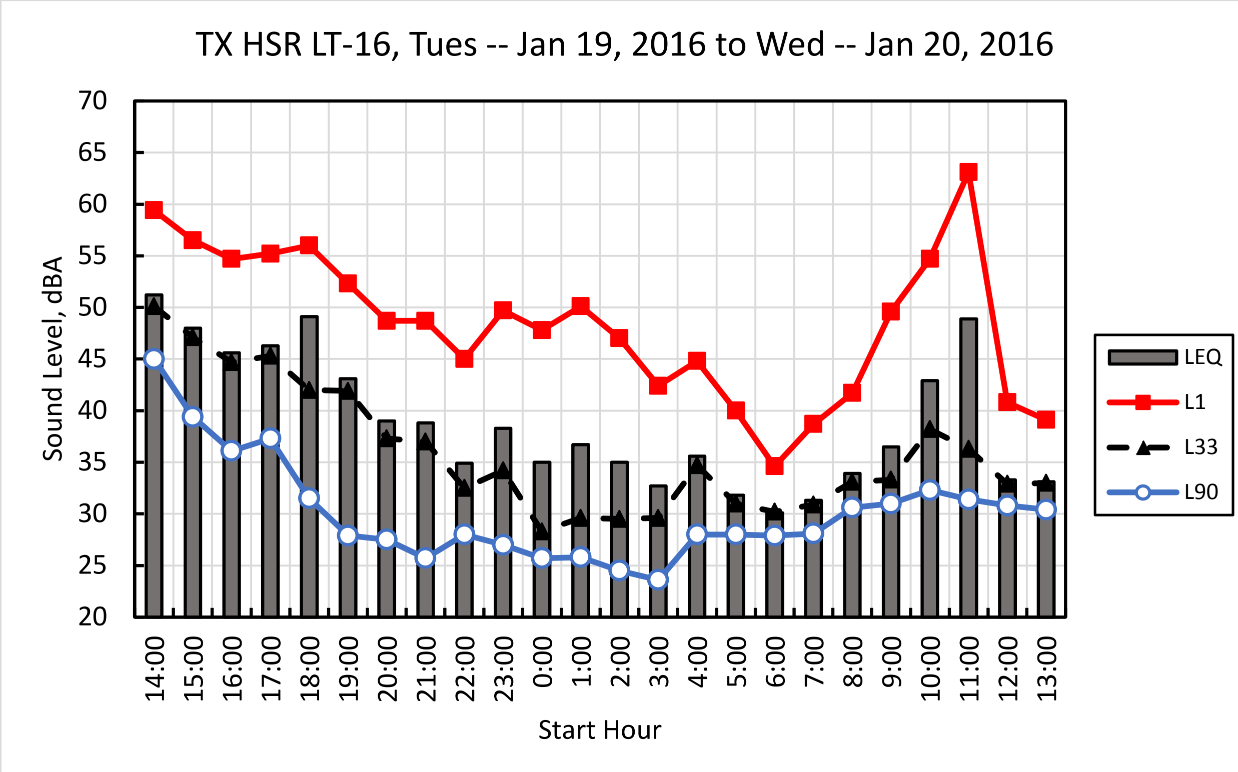


Figure B-18. Long-Term Measurement Data – Site LT-17

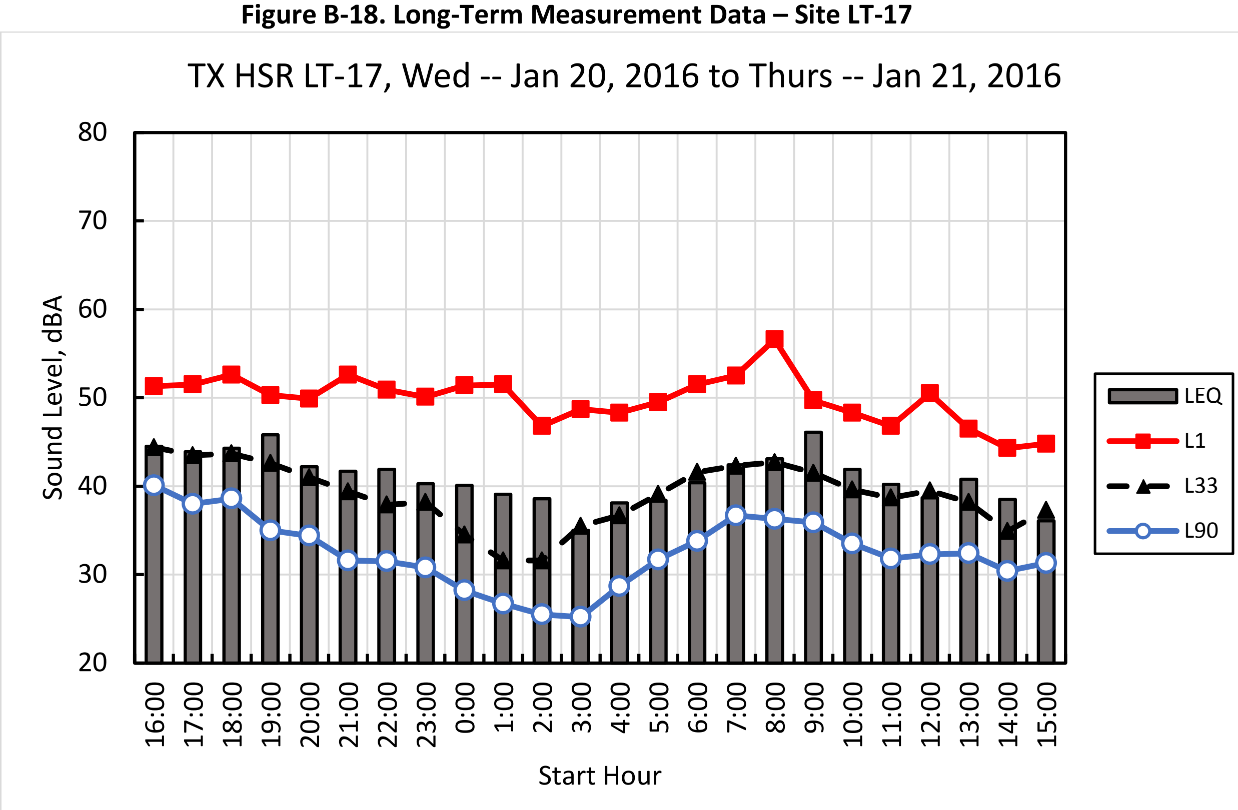


Figure B-19. Long-Term Measurement Data – Site LT-18

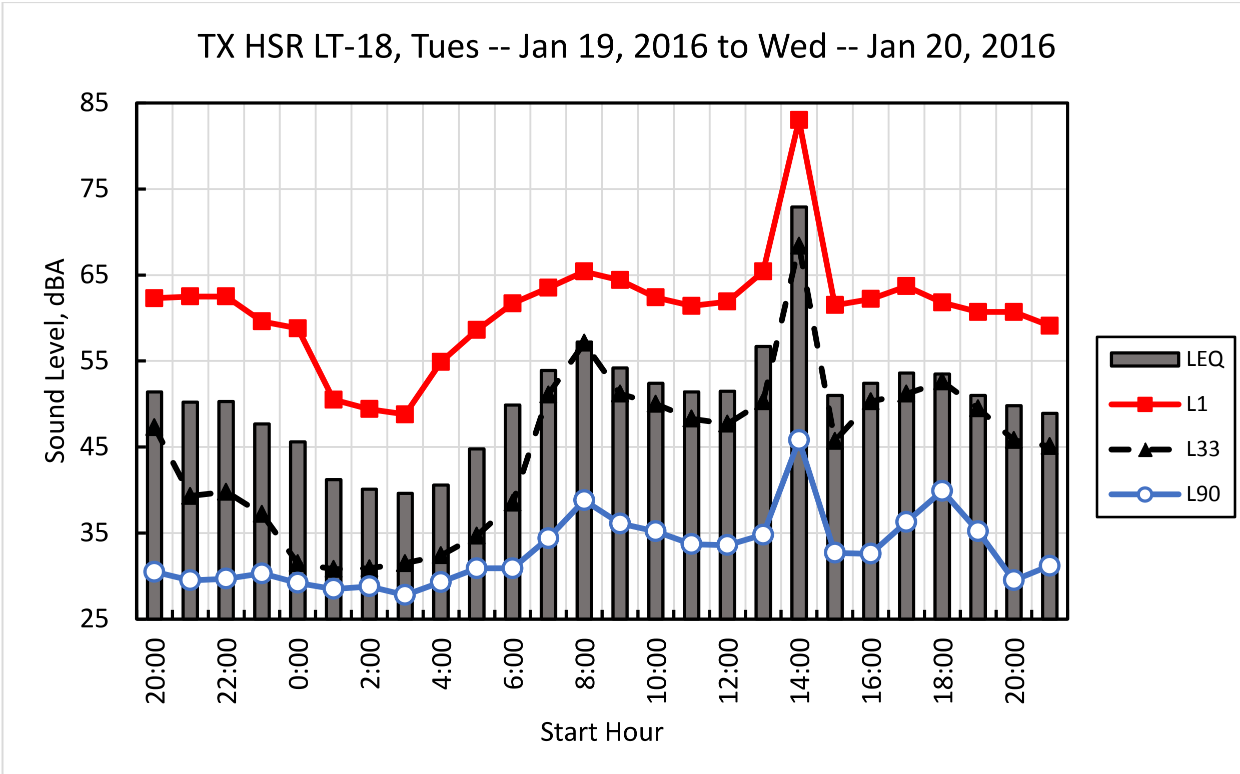
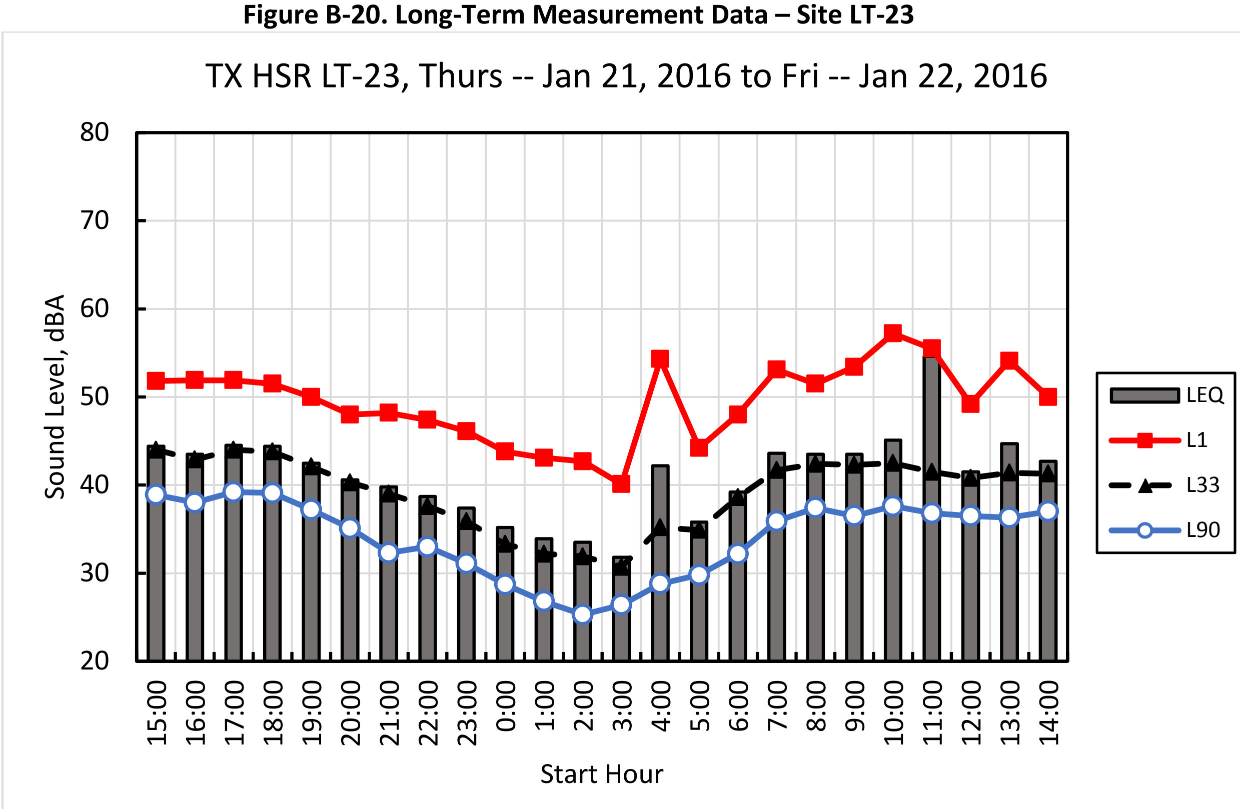


Figure B-20. Long-Term Measurement Data – Site LT-23



APPENDIX C: VIBRATION MEASUREMENT DATA

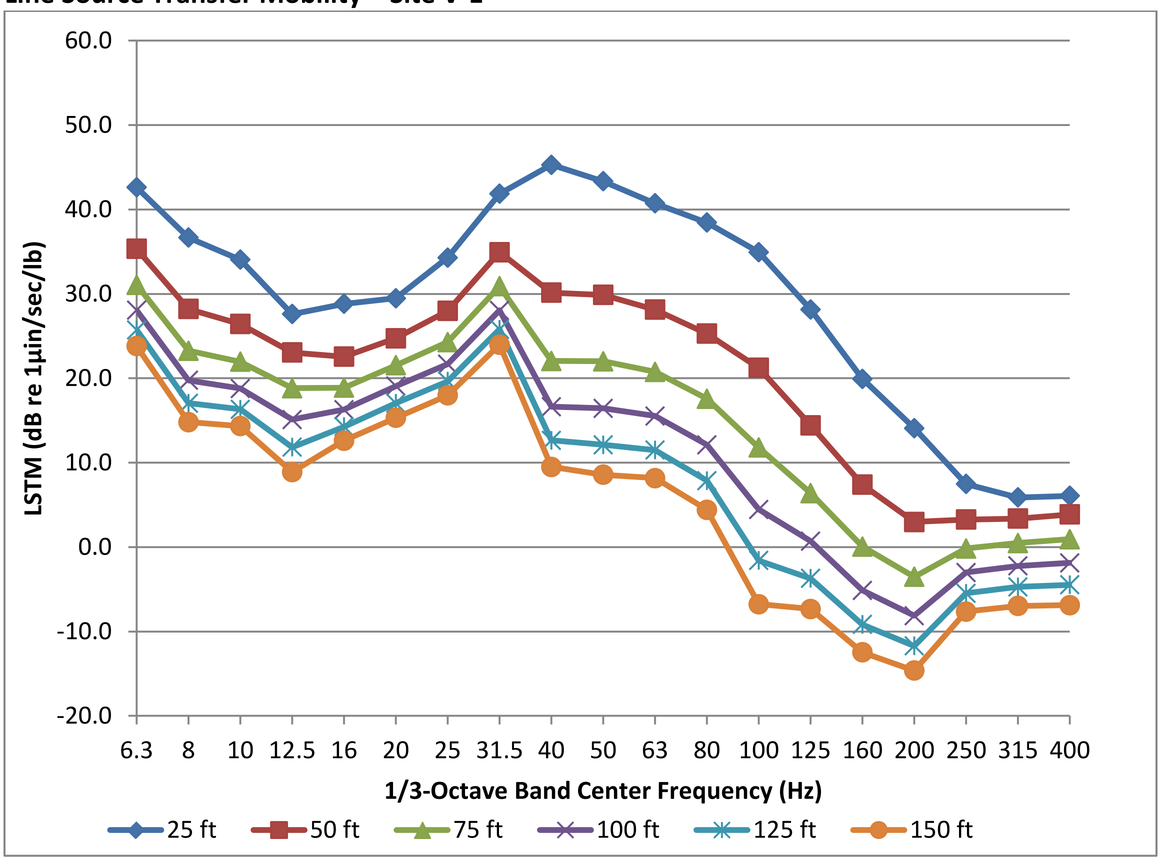
Site V-1

1/3-Octave Band Transfer Mobility Coefficients – Site V-1

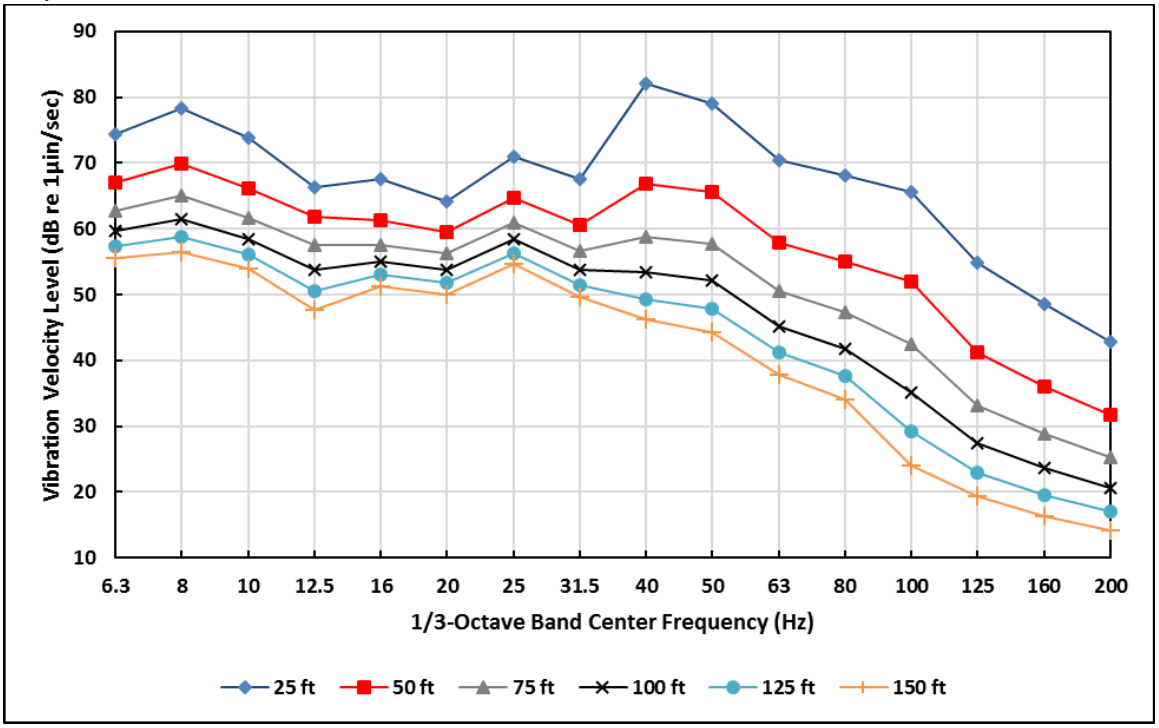
Coefficients	6.3 Hz	8 Hz	10 Hz	12.5 Hz	16 Hz	20 Hz	25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz
A	76.4	76.0	69.5	4.0	58.0	39.6	63.6	74.0	137.3	105.8	99.2	99.6	58.3	91.9	78.2	65.7
B	24.2	-28.1	-25.4	43.1	-20.8	-0.1	-21.0	-23.0	-78.6	-44.7	-41.8	-43.7	7.0	-45.6	-41.6	-36.9
C	0.0	0.0	0.0	-18.8	0.0	-5.1	0.0	0.0	9.1	0.0	0.0	0.0	-16.9	0.0	0.0	0.0

$$TM = A + B * \log(dist) + C * \log(dist)^2$$

Line Source Transfer Mobility – Site V-1



Projected HSR Ground Vibration Levels – Site V-1



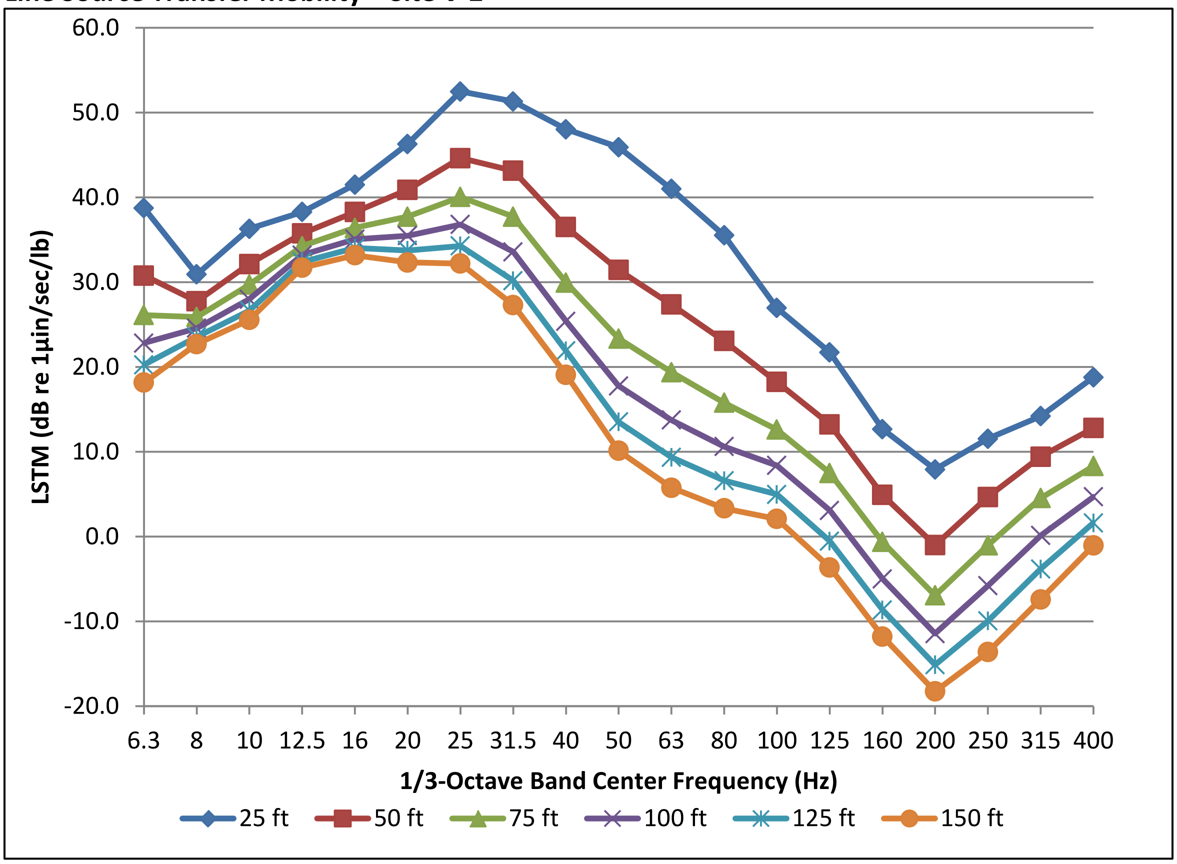
Site V-2

1/3-Octave Band Transfer Mobility Coefficients – Site V-2

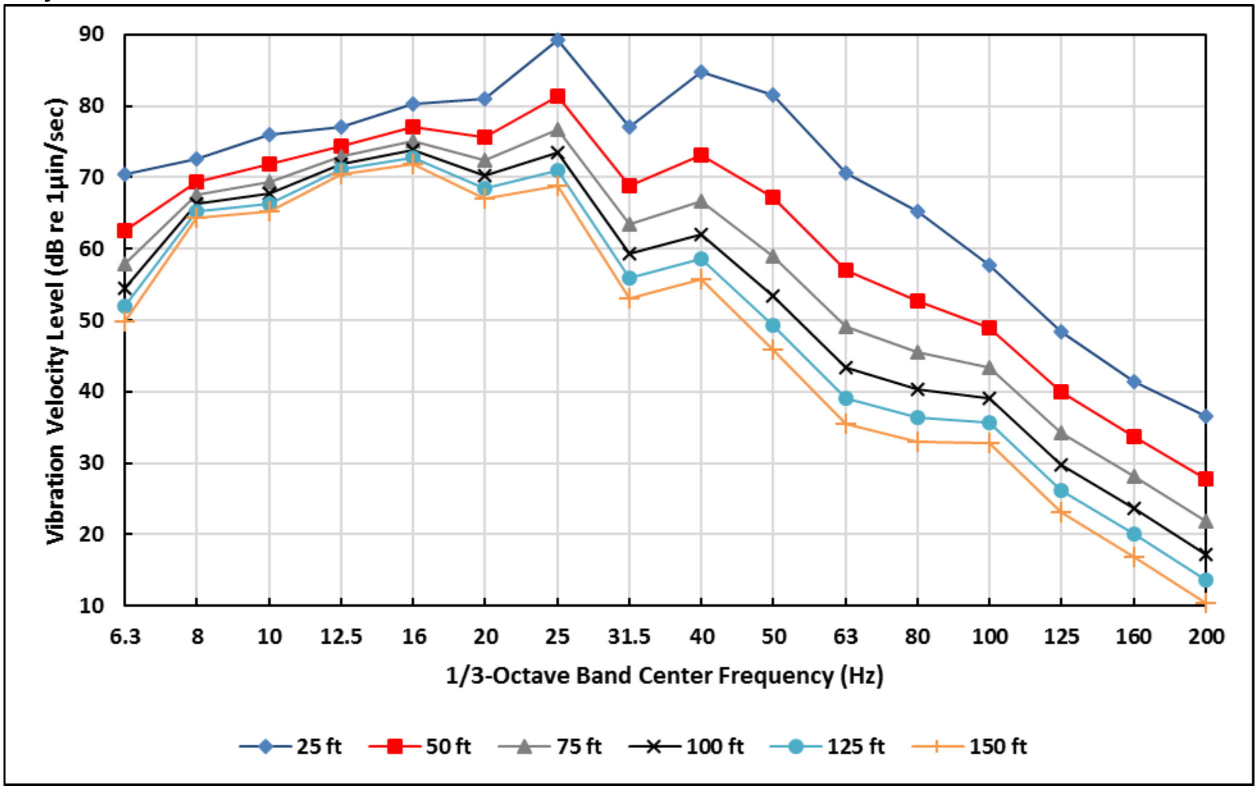
Coefficients	6.3 Hz	8 Hz	10 Hz	12.5 Hz	16 Hz	20 Hz	25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz
A	75.7	45.7	55.6	50.1	56.5	71.4	88.9	70.6	107.0	123.7	104.3	93.4	52.4	39.4	20.5	29.4
B	26.5	-10.5	-13.8	-8.4	-10.7	-17.9	-26.1	-2.8	-45.4	-61.8	-45.3	-41.4	-9.4	0.1	11.0	-3.6
C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-7.8	2.3	4.4	0.0	0.0	-6.3	-9.2	-11.9	-8.4

$$TM = A + B * \log(dist) + C * \log(dist)^2$$

Line Source Transfer Mobility – Site V-2



Projected HSR Ground Vibration Levels – Site V-2



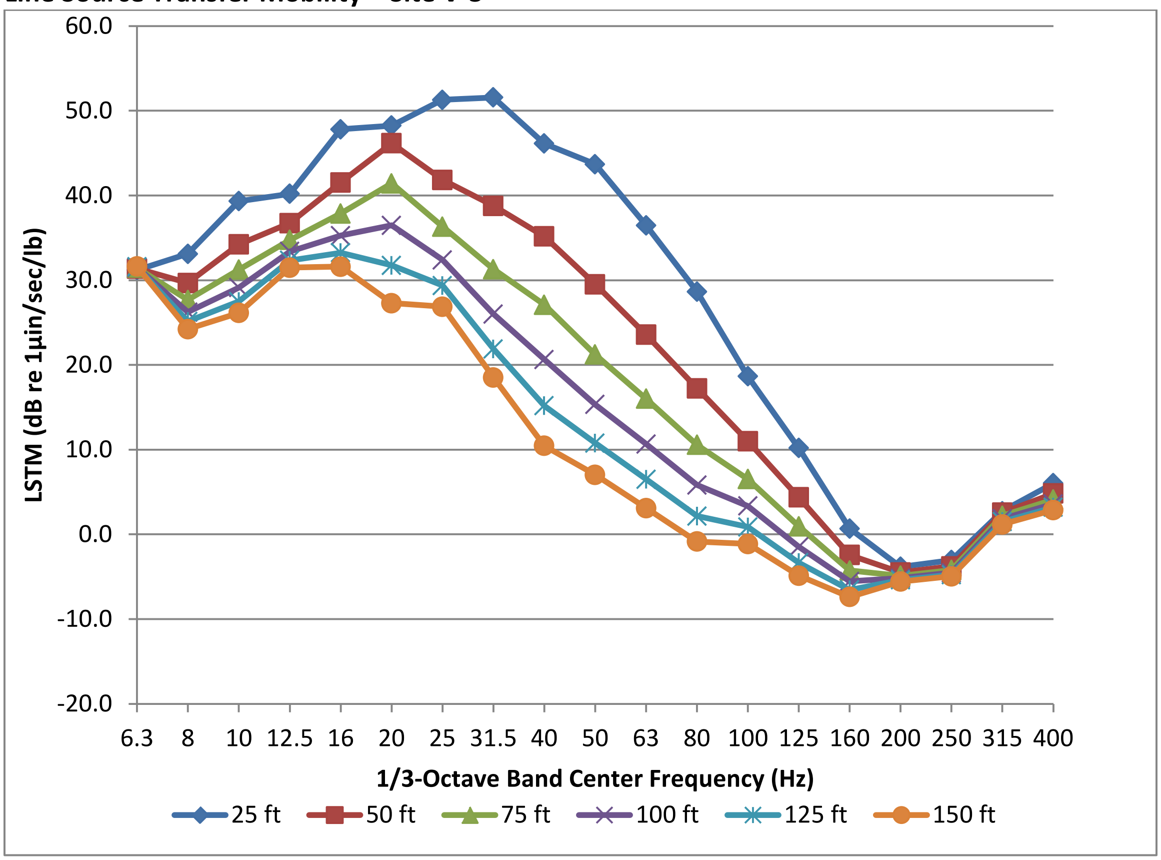
Site V-3

1/3-Octave Band Transfer Mobility Coefficients – Site V-3

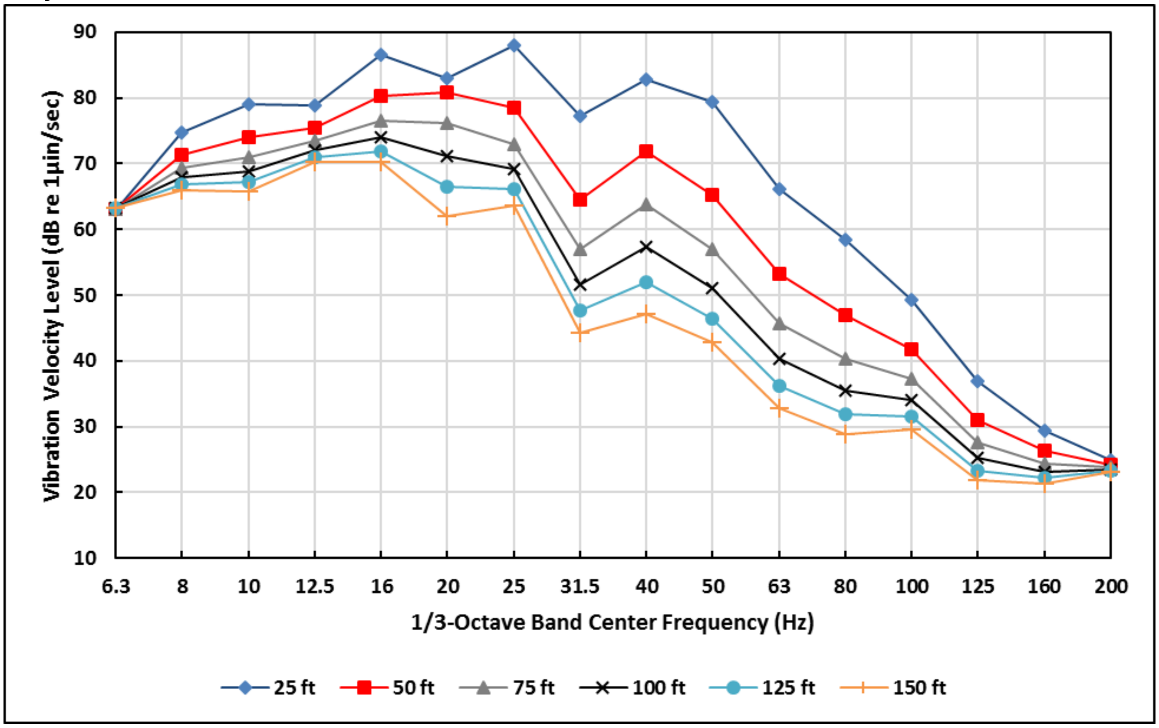
Coefficients	6.3 Hz	8 Hz	10 Hz	12.5 Hz	16 Hz	20 Hz	25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz
A	30.5	49.1	63.0	57.9	76.9	-41.5	95.2	111.0	49.9	109.6	96.4	81.6	54.2	37.2	15.2	-0.7
B	0.5	-11.4	-16.9	-13.6	-20.8	122.8	-31.4	-42.5	25.0	-47.1	-42.9	-37.9	-25.4	-19.3	-10.4	-2.2
C	0.0	0.0	0.0	0.7	0.0	-41.9	0.0	0.0	-19.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0

$$TM = A + B * \log(dist) + C * \log(dist)^2$$

Line Source Transfer Mobility – Site V-3



Projected HSR Ground Vibration Levels – Site V-3



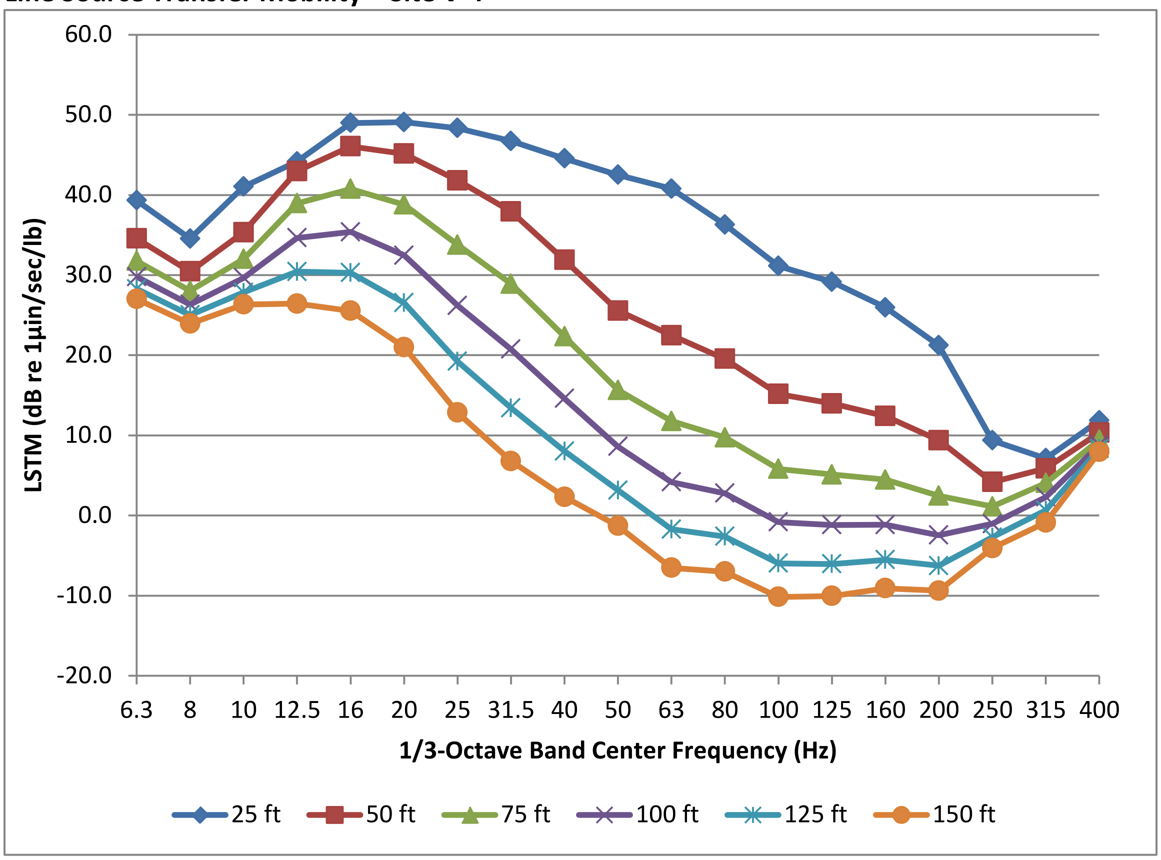
Site V-4

1/3-Octave Band Transfer Mobility Coefficients – Site V-4

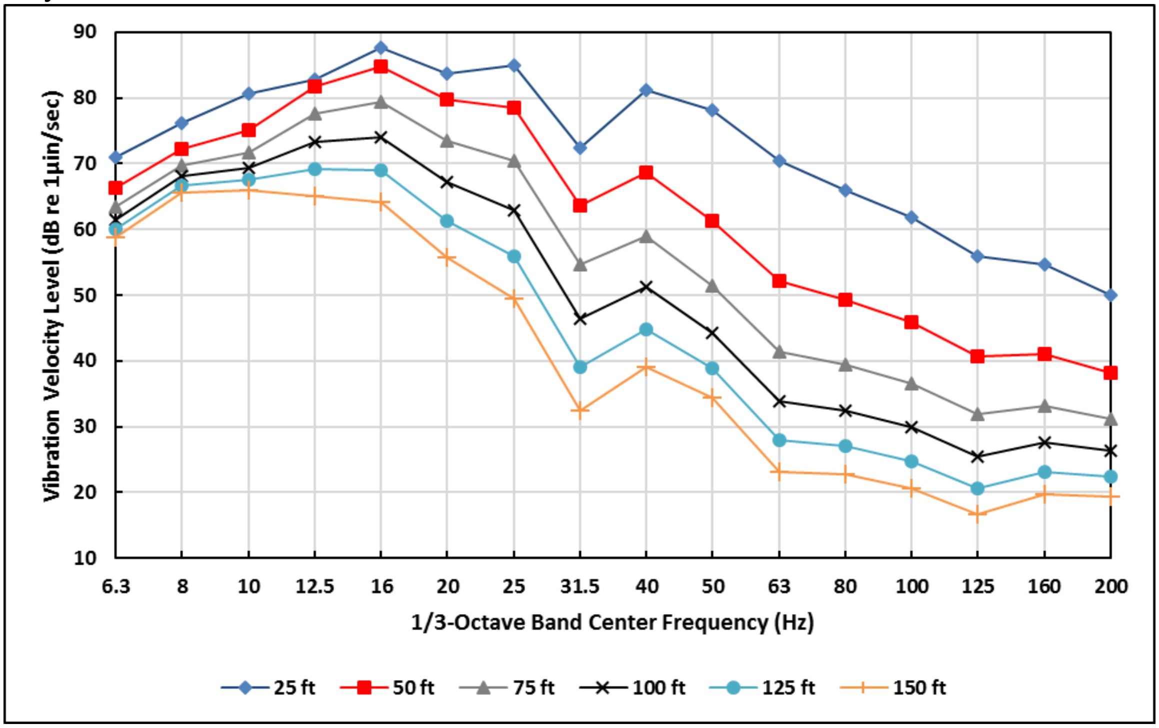
Coefficients	6.3 Hz	8 Hz	10 Hz	12.5 Hz	16 Hz	20 Hz	25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz
A	61.4	53.6	67.4	-44.0	-38.9	-47.3	-40.5	-22.9	42.3	121.2	125.8	114.1	105.3	99.5	88.9	76.2
B	15.8	-13.6	-18.9	118.1	122.6	136.4	133.6	114.8	37.5	-56.3	-60.8	-55.7	-53.1	-50.3	-45.0	-39.3
C	0.0	0.0	0.0	-39.4	-42.7	-48.3	-50.2	-46.5	-25.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0

$$TM = A + B * \log(dist) + C * \log(dist)^2$$

Line Source Transfer Mobility – Site V-4



Projected HSR Ground Vibration Levels – Site V-4



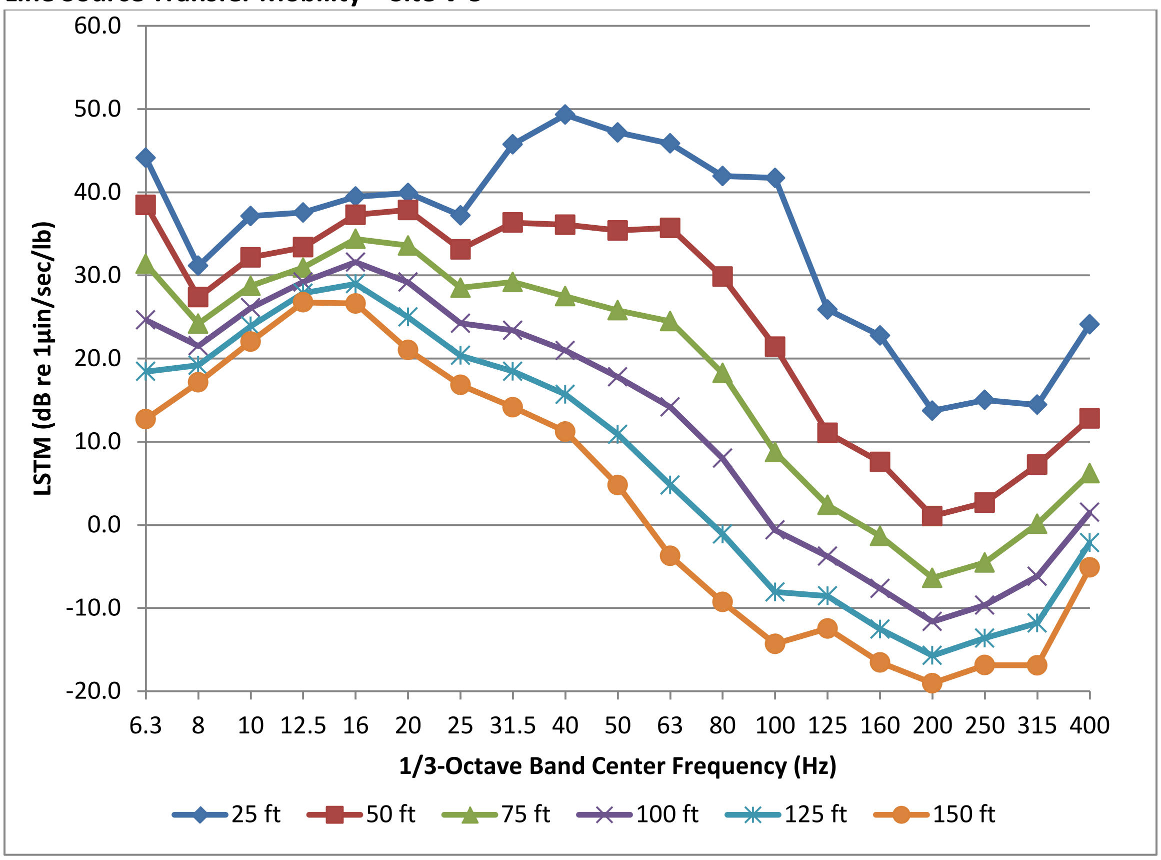
Site V-5

1/3-Octave Band Transfer Mobility Coefficients – Site V-5

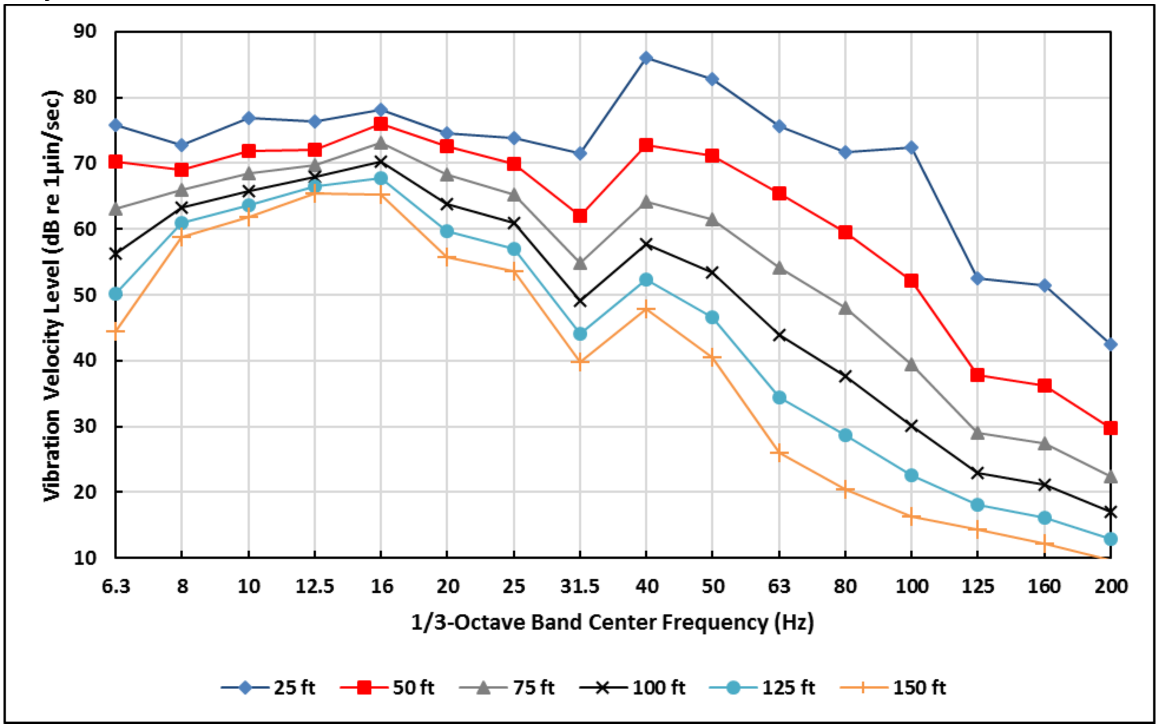
Coefficients	6.3 Hz	8 Hz	10 Hz	12.5 Hz	16 Hz	20 Hz	25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz
A	-37.3	21.4	46.0	57.0	3.3	-37.6	-6.5	42.7	85.6	25.5	-56.4	-29.3	113.1	94.8	93.4	72.6
B	121.6	23.1	2.0	-13.9	53.1	106.6	68.2	29.6	-11.1	60.4	161.1	126.1	-37.6	-49.3	-50.5	-42.1
C	-45.3	-11.5	-6.0	0.0	-19.5	-36.6	-26.4	-19.7	-10.6	-32.2	-62.9	-53.7	-9.6	0.0	0.0	0.0

$$TM = A + B * \log(dist) + C * \log(dist)^2$$

Line Source Transfer Mobility – Site V-5



Projected HSR Ground Vibration Levels – Site V-5



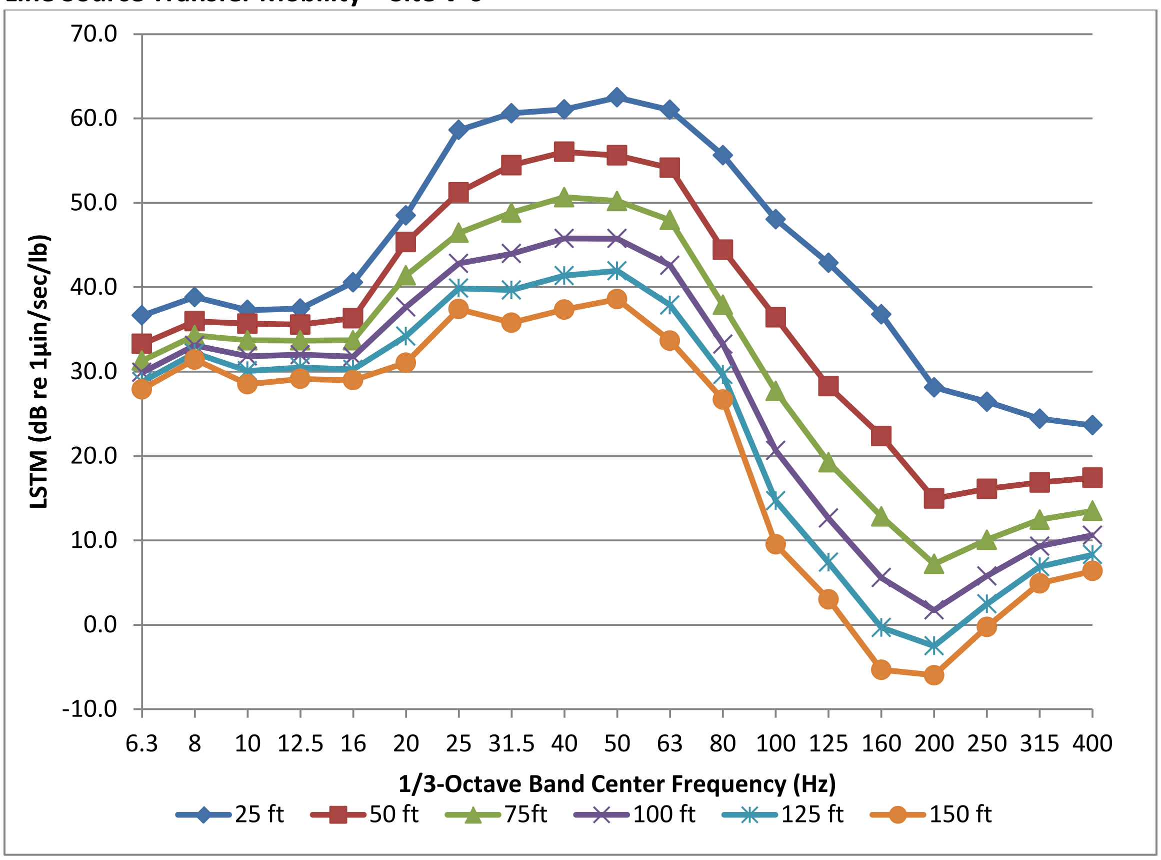
Site V-6

1/3-Octave Band Transfer Mobility Coefficients – Site V-6

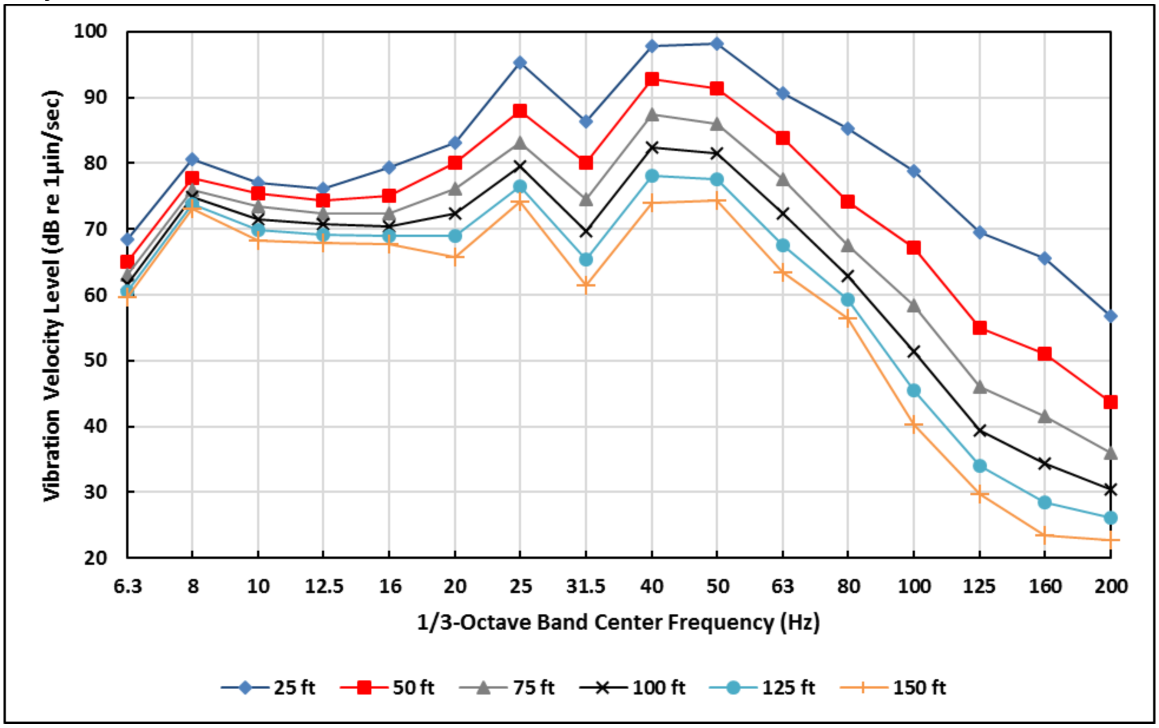
Coefficients	6.3 Hz	8 Hz	10 Hz	12.5 Hz	16 Hz	20 Hz	25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz
A	52.4	52.1	15.0	24.2	56.5	4.0	79.4	32.1	16.0	55.1	31.5	107.6	47.8	97.3	72.8	89.4
B	-11.2	-9.5	33.5	22.4	-9.1	66.7	-6.9	54.0	72.6	28.4	57.2	-37.2	32.0	-31.1	-7.5	-43.8
C	0.0	0.0	-12.5	-9.3	-1.6	-24.9	-5.7	-24.0	-28.8	-16.6	-25.8	0.0	-22.8	-5.6	-13.0	0.0

$$TM = A + B * \log(dist) + C * \log(dist)^2$$

Line Source Transfer Mobility – Site V-6



Projected HSR Ground Vibration Levels – Site V-6



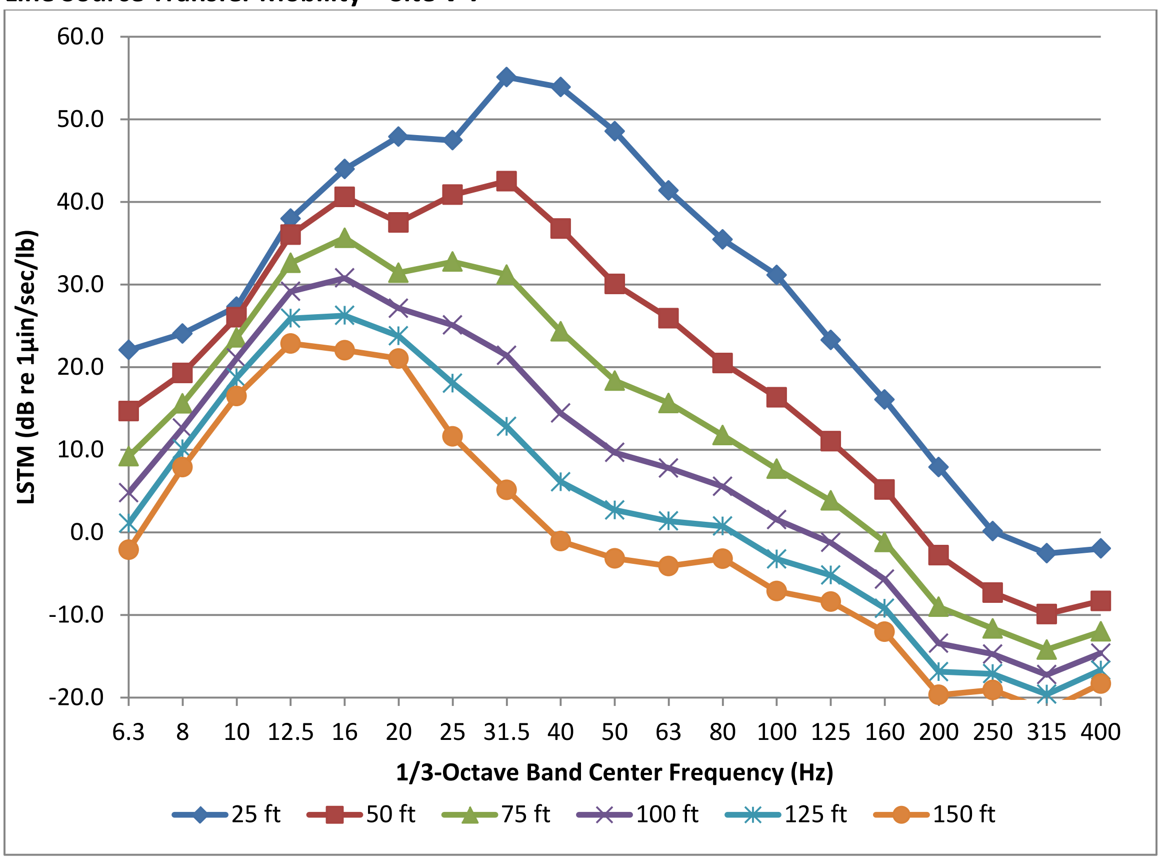
Site V-7

1/3-Octave Band Transfer Mobility Coefficients – Site V-7

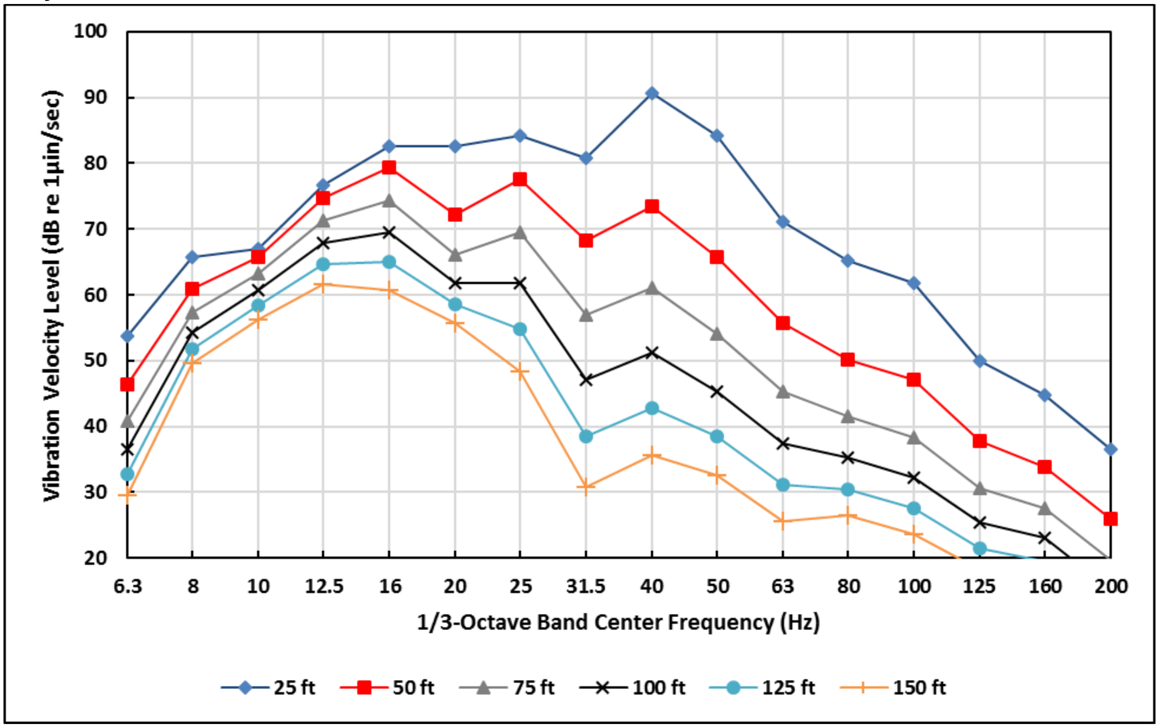
Coefficients	6.3 Hz	8 Hz	10 Hz	12.5 Hz	16 Hz	20 Hz	25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz
A	24.1	21.9	-14.7	-17.7	-25.4	96.1	-42.4	2.1	64.7	109.6	77.4	104.8	99.9	80.2	66.5	57.4
B	17.6	15.9	58.3	77.9	99.5	-34.5	135.1	103.6	32.7	-29.0	-4.9	-49.6	-49.2	-40.7	-36.1	-35.4
C	-13.6	-10.3	-20.2	-27.2	-35.7	0.0	-50.7	-46.9	-28.9	-10.5	-15.0	0.0	0.0	0.0	0.0	0.0

$$TM = A + B * \log(dist) + C * \log(dist)^2$$

Line Source Transfer Mobility – Site V-7



Projected HSR Ground Vibration Levels – Site V-7



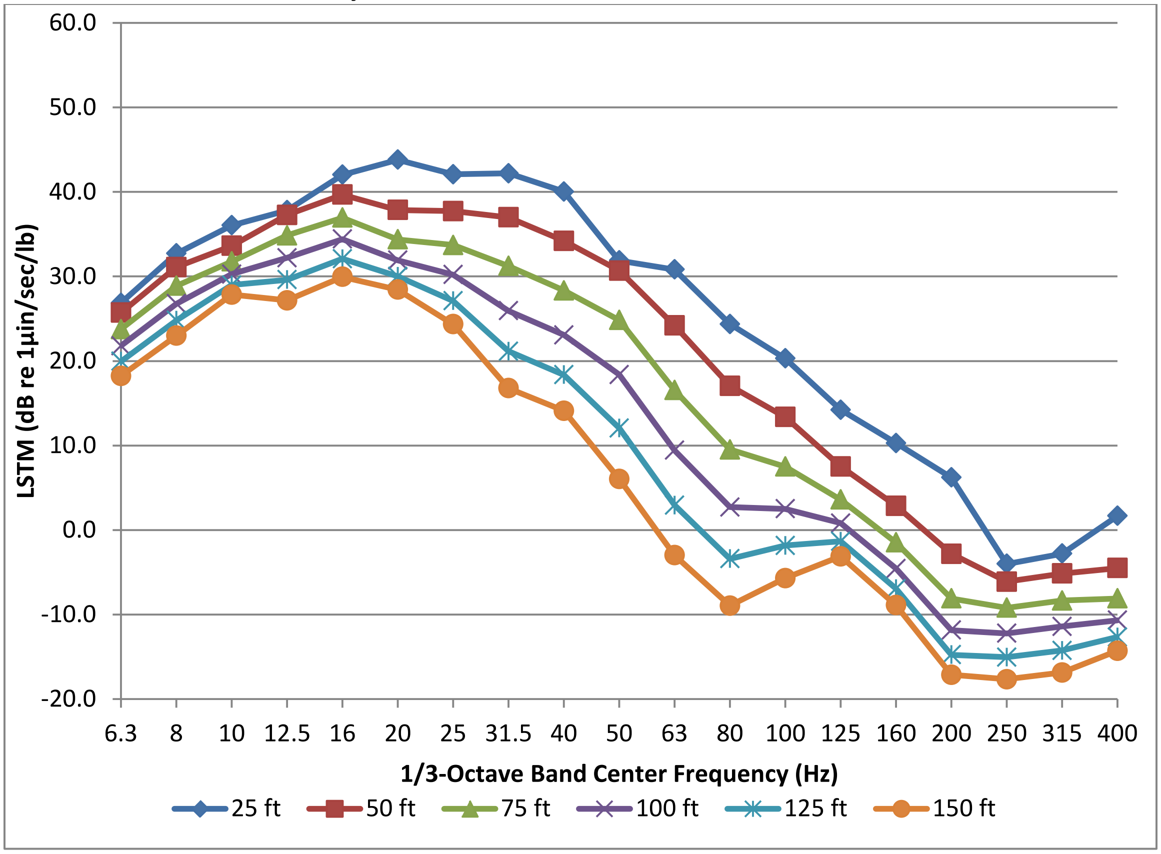
Site V-8

1/3-Octave Band Transfer Mobility Coefficients – Site V-8

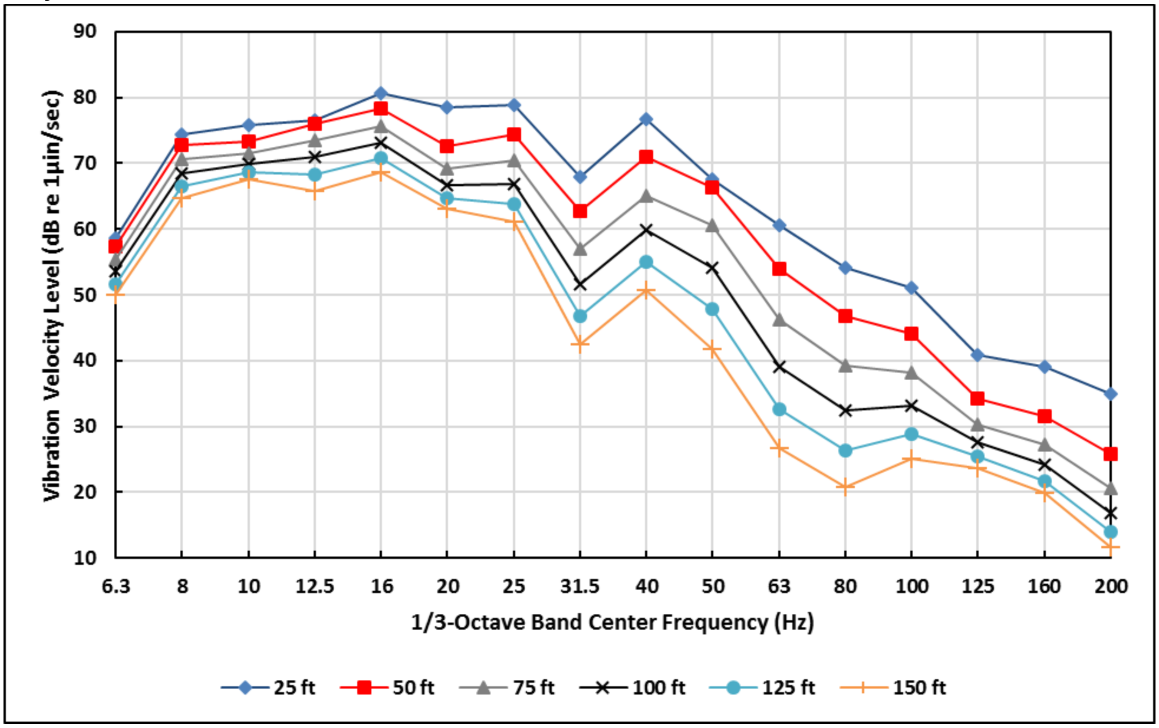
Coefficients	6.3 Hz	8 Hz	10 Hz	12.5 Hz	16 Hz	20 Hz	25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz
A	-4.1	4.6	34.9	-18.5	14.3	71.4	20.8	-10.1	-2.4	108.1	-45.2	-34.3	0.8	45.4	44.7	48.1
B	43.5	41.0	8.1	74.9	42.6	-19.7	39.7	82.5	71.3	185.8	117.2	96.4	44.4	-22.3	-24.7	-30.0
C	-15.3	-15.0	-5.2	-24.8	-16.2	0.0	-17.5	-32.2	-29.3	-61.3	-44.9	-39.0	-21.8	0.0	0.0	0.0

$$TM = A + B * \log(dist) + C * \log(dist)^2$$

Line Source Transfer Mobility – Site V-8



Projected HSR Ground Vibration Levels – Site V-8



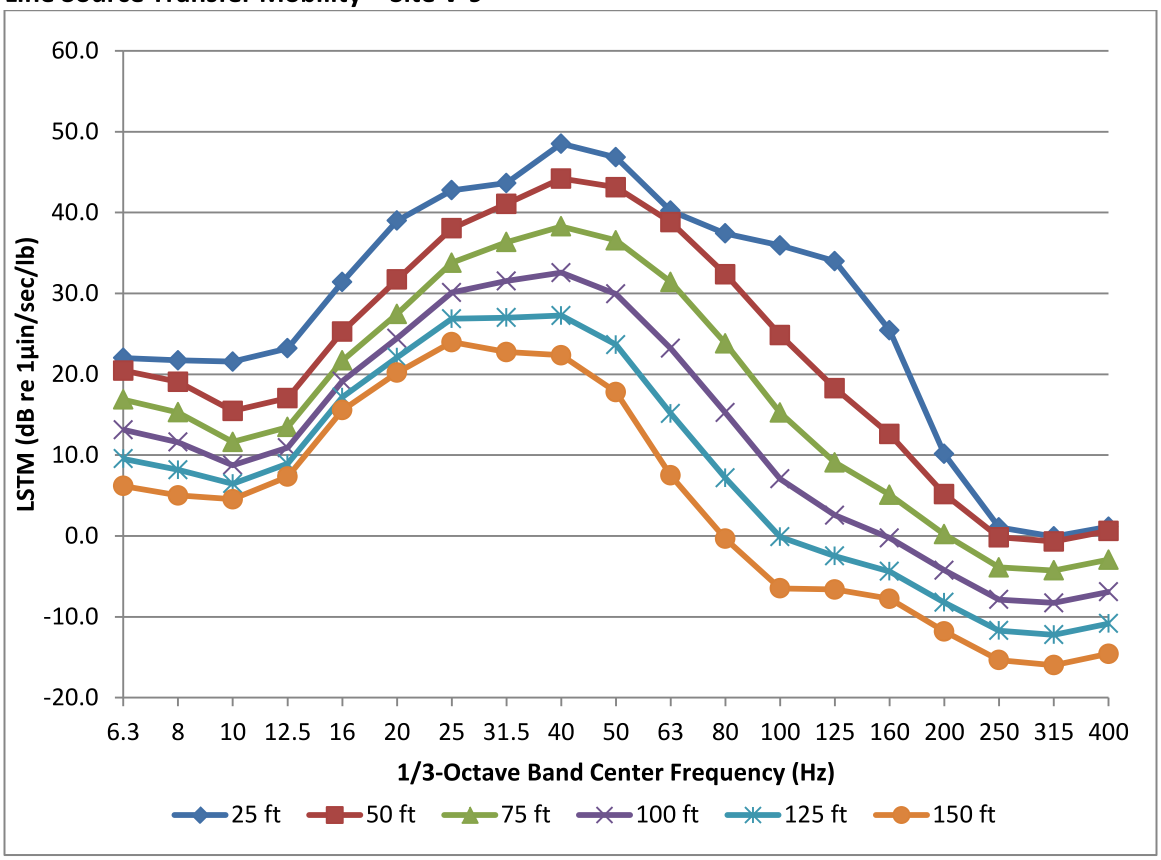
Site V-9

1/3-Octave Band Transfer Mobility Coefficients – Site V-9

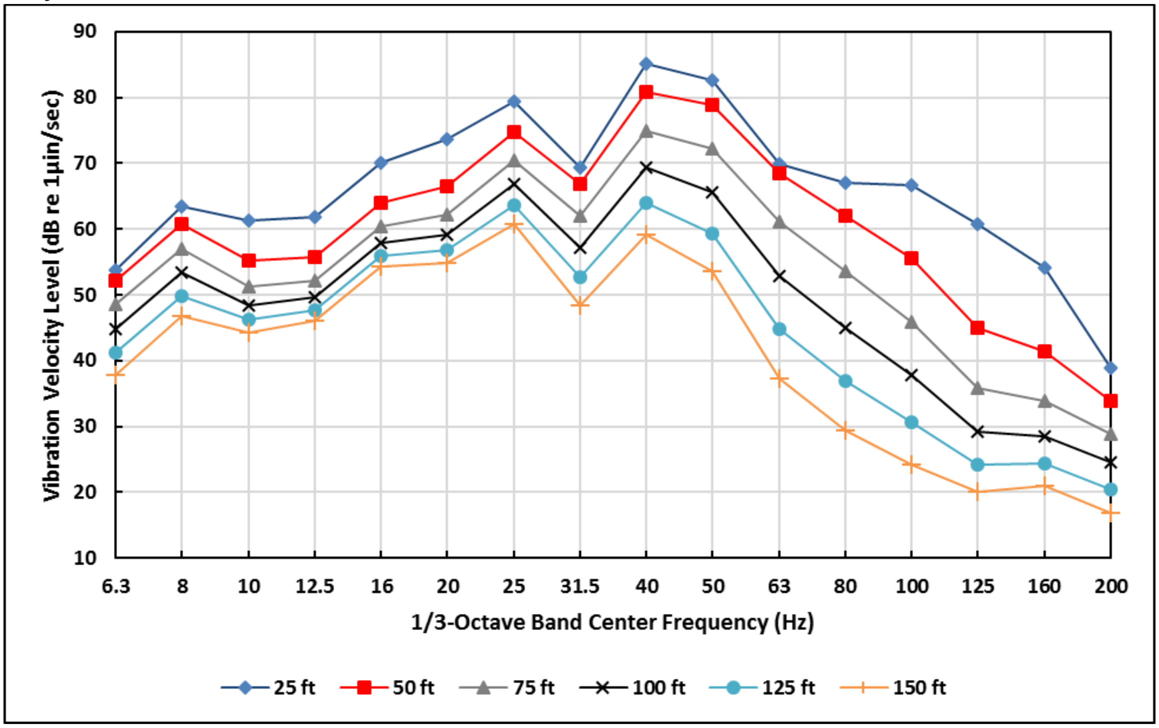
Coefficients	6.3 Hz	8 Hz	10 Hz	12.5 Hz	16 Hz	20 Hz	25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz
A	-46.1	-28.9	41.8	51.7	59.9	72.8	22.3	-35.3	-27.5	-60.1	139.3	-97.2	-0.6	106.9	85.1	-25.1
B	93.1	73.2	-9.7	-20.4	-20.4	-24.2	39.5	110.0	111.0	149.7	238.0	189.3	78.0	-52.2	-42.7	59.5
C	-31.8	-26.5	-3.4	0.0	0.0	0.0	-17.8	-38.3	-40.4	-52.3	-78.4	-66.5	-37.1	0.0	0.0	-24.5

$$TM = A + B * \log(dist) + C * \log(dist)^2$$

Line Source Transfer Mobility – Site V-9



Projected HSR Ground Vibration Levels – Site V-9



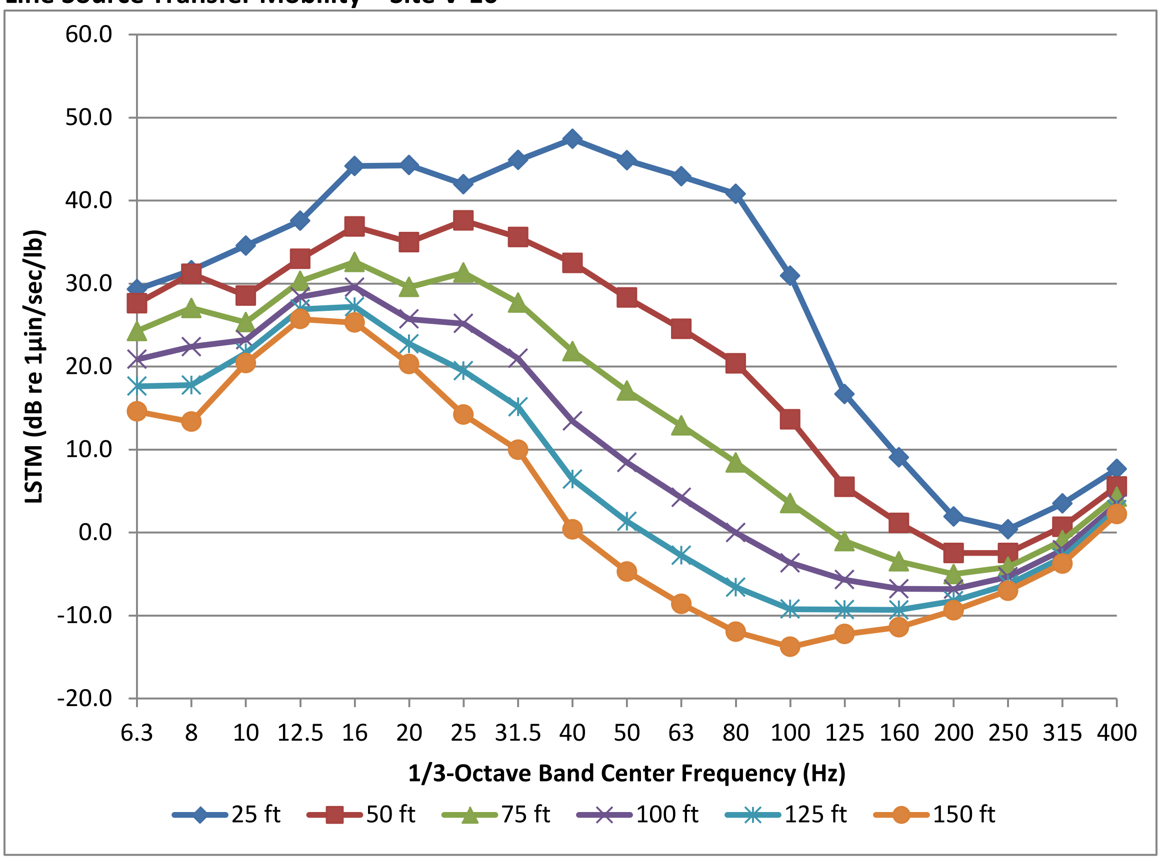
Site V-10

1/3-Octave Band Transfer Mobility Coefficients – Site V-10

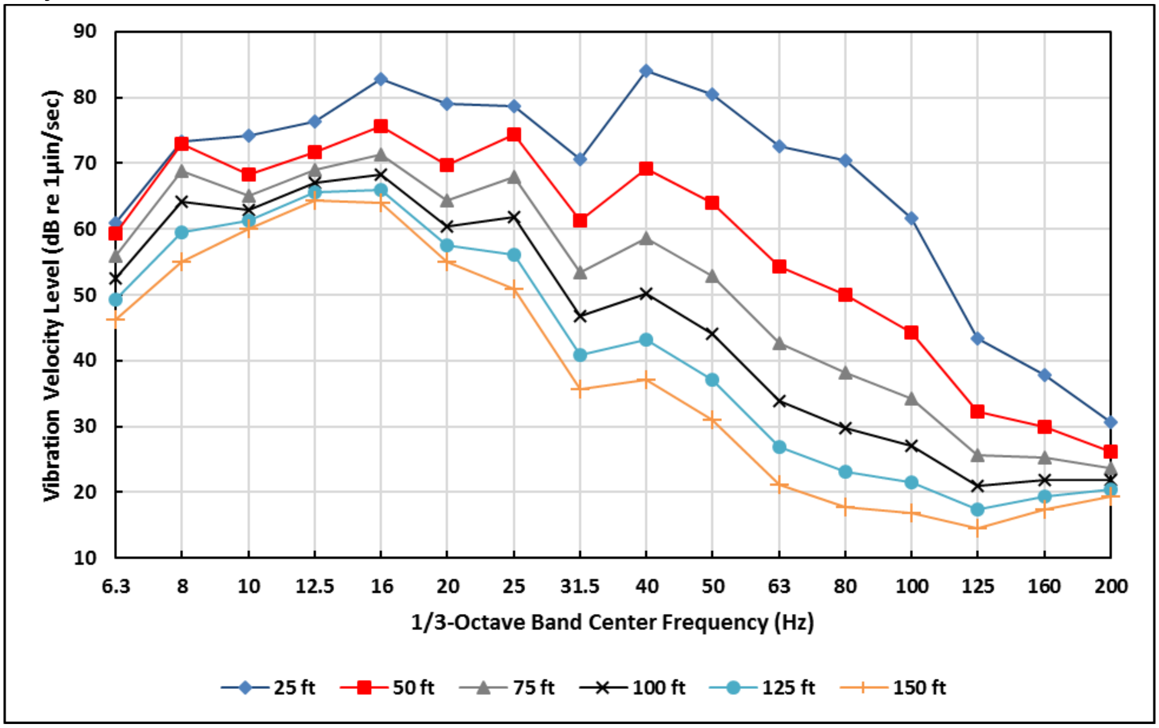
Coefficients	6.3 Hz	8 Hz	10 Hz	12.5 Hz	16 Hz	20 Hz	25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz
A	-29.1	-76.4	71.3	58.8	78.1	87.3	-43.1	17.9	62.5	78.4	102.5	135.6	111.3	68.6	45.8	22.2
B	80.8	142.0	-31.5	-15.2	-24.3	-30.8	122.9	60.4	21.1	1.5	-27.5	-67.8	-57.5	-37.1	-26.3	-14.5
C	-27.9	-46.3	3.7	0.0	0.0	0.0	-44.4	-29.5	-22.8	-18.2	-10.8	0.0	0.0	0.0	0.0	0.0

$$TM = A + B * \log(dist) + C * \log(dist)^2$$

Line Source Transfer Mobility – Site V-10



Projected HSR Ground Vibration Levels – Site V-10



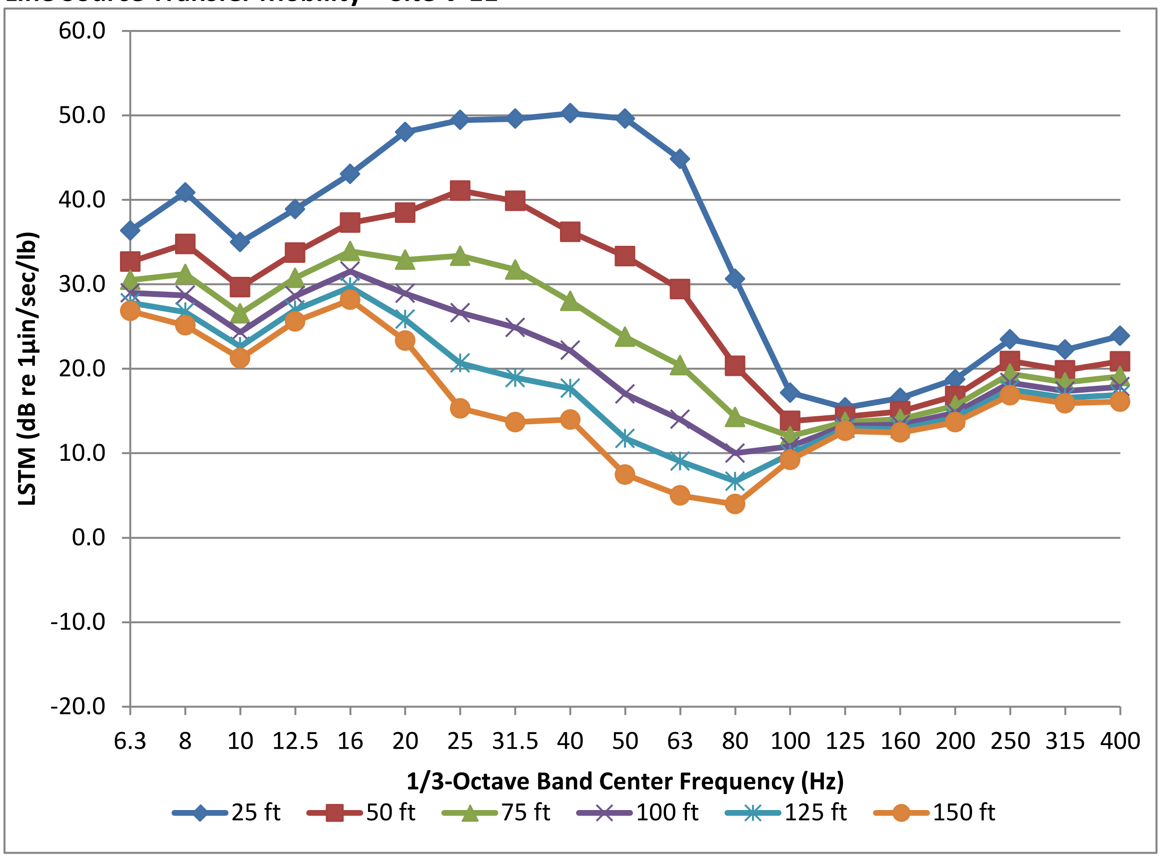
Site V-11

1/3-Octave Band Transfer Mobility Coefficients – Site V-11

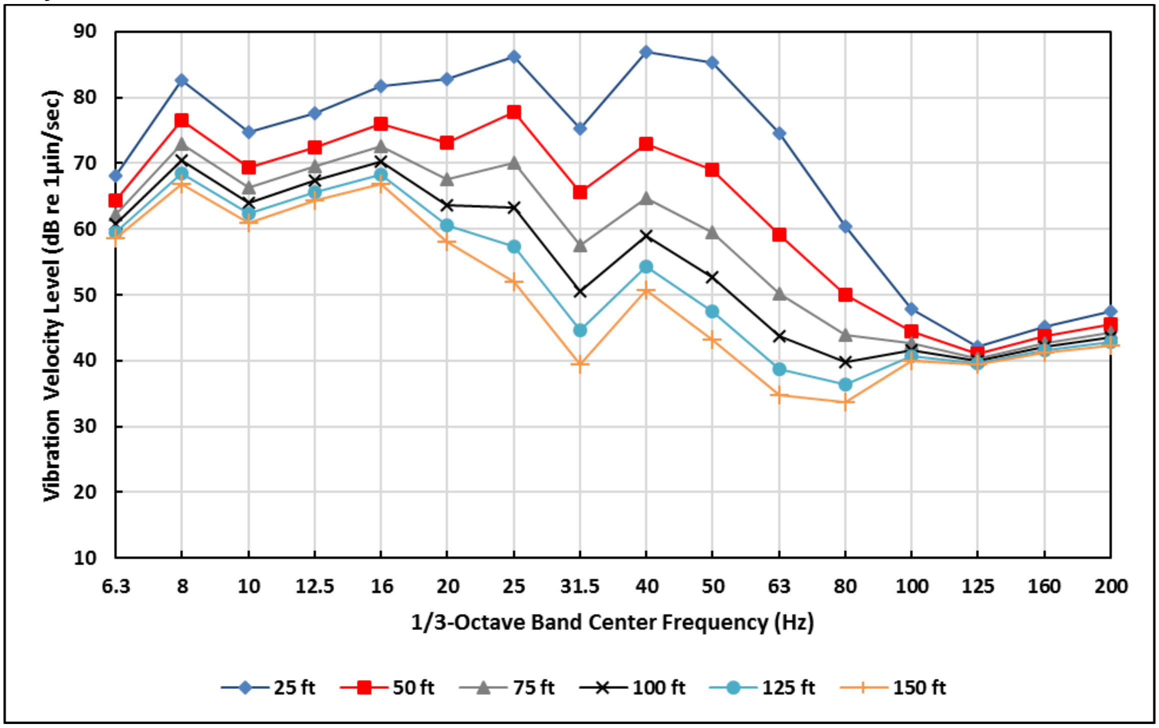
Coefficients	6.3 Hz	8 Hz	10 Hz	12.5 Hz	16 Hz	20 Hz	25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz
A	53.5	69.1	59.7	62.7	69.8	92.4	8.0	25.7	115.4	125.3	116.4	78.6	37.0	20.4	23.9	27.9
B	-12.2	-20.2	-17.7	-17.1	-19.1	-31.7	76.9	57.7	-46.6	-54.2	-51.2	-34.3	-16.7	-3.5	-5.3	-6.5
C	0.0	0.0	0.0	0.0	0.0	0.0	-33.8	-29.1	0.0	0.0	0.0	0.0	1.8	0.0	0.0	0.0

$$TM = A + B * \log(dist) + C * \log(dist)^2$$

Line Source Transfer Mobility – Site V-11



Projected HSR Ground Vibration Levels – Site V-11



TECHNICAL MEMORANDUM
HAZARDOUS MATERIALS INITIAL SITE ASSESSMENT REPORT

To: Jerry Smiley, AICP, AECOM

From: Huda Shihada, AECOM

Date: November 1, 2017

RE: Dallas to Houston HSR – Hazmat Initial Site Assessment

This technical memorandum includes the following sections:

- Hazardous Materials Initial Site Assessment (ISA) Report
- Photographic Log

Hazardous Materials Initial Site Assessment (ISA) Report

TxDOT Environmental Affairs Division
Effective Date: 12/2014
510.02.DS
Version 3

Hazardous Materials Initial Site Assessment (ISA) Report

Completion of the ISA complies with the Federal Highway Administration's (FHWA's) policy dealing with hazardous materials discussed in FHWA's *Supplemental Hazardous Waste Guidance* (January 16, 1997) located at http://www.environment.fhwa.dot.gov/guidebook/vol1/doc7b.pdf.

This FHWA policy emphasizes three objectives: 1) the need to identify and assess potentially contaminated sites early in project development, 2) to coordinate early with federal/ state/ local agencies to assess the contamination and the cleanup needed; and 3) to determine and implement measures early to avoid or minimize involvement with substantially contaminated properties.

In addition, completion of the ISA will reduce construction delays that result from unexpected hazardous material discoveries and reduce the department's liability associated with the purchase of contaminated right of way.

Maintain a copy of the completed ISA report with all applicable attachments in the project administrative record.

For additional information, refer to TxDOT's online manual: *Hazardous Materials in Project Development:* http://onlinemanuals.txdot.gov/txdotmanuals/haz/index.htm

Abbreviations and Acronyms

ACM	Asbestos Containing Material
ASTs	Aboveground Storage Tanks
ASTM	American Society for Testing and Materials
CERCLIS	Comprehensive Environmental Response Compensation and Liability Information System
COG	Council of Government
ECOS	Environmental Compliance Oversight System
ERNS	Emergency Response Notification System
ESA	Environmental Site Assessment
IIR	Issues Identification and Resolution Form in ECOS
ISA	Initial Site Assessment
LPST	Leaking Petroleum Storage Tank
MSWLF	Municipal Solid Waste Landfill
NPL	National Priorities List
PST	Petroleum Storage Tank
RCRA	Resource Conservation and Recovery Act
ROW	Right of Way
RPST	Registered Petroleum Storage Tank
TCEQ	Texas Commission on Environmental Quality
TRC	Texas Railroad Commission
TSD	Treatment Storage and Disposal Facility
USGS	United States Geological Survey
UST	Underground Storage Tank
VCP	Voluntary Cleanup Program

TxDOT Hazardous Materials Initial Site Assessment (ISA) Report

Project Information			
CSJ No:N/A	City:Dallas to Houston	Zip Code:N/A	County:Dallas, Ellis, Navarro, Grimes, Leon, Madision, Waller, Harris, Limestone, and Freestone
HWY:Various Roads between Dallas and Houston Texas	Limits:Dallas to Houston Texas		

Section 1: Identify Previously Completed Environmental Site Assessments, Known Hazmat Conditions, Preliminary Project Design and Right-of-Way Requirements	
Yes/No	**Obtain information/comments from design, right of way, and/or environmental staff. Attach maps and/or details as appropriate.**
☐ Yes ☒ No	Has a Phase I Environmental Site Assessment (ESA) been prepared for this project? If one or more Phase I ESAs have been prepared for this project, please use applicable information from the Phase I ESA(s) to help complete the ISA.
☐ Yes ☒ No ☐ Unknown	Are there any previous environmental assessments, testing or studies performed within the proposed project area related to contamination issues? If yes, explain here if there are any concerns to the proposed project:
☐ Yes ☒ No	Are preliminary plans detailed enough to show excavation, ROW features, pipelines, utilities and storm sewer details? If no, explain here what information is limited or unavailable:

Section 2: Demolition and Renovation Information	
☒Yes ☐No	Are there proposed bridge or building demolition or renovation operations for this project?
If yes, describe the bridge or building locations, anticipated demolitions and/or renovations here:Assuming several instances where roads and structures associated with roads will need to be re-routed in order to complete construction	
If yes, record asbestos and/or lead-in-paint concerns or testing needs on an IIR form in ECOS. Detailed instructions for completing an ECOS IIR Form are located in the Non-Project Documentation section of ECOS under the heading Hazmat. Contact the ECOS help desk for assistance preparing the IIR Form, if necessary.	
Note: ACM inspections are required for all bridge and building renovation and demolition projects. Refer to the guidance found at TxDOT's *Environmental Compliance Toolkit* web page for additional information. **Note:** Contact ENV-HMM staff for assistance with lead-in-paint issues.	

Section 3: Identify Project Activities	
3.1 Yes/No	**Using the preliminary design and ROW information for this project, determine if the project includes any of the activities listed below.**
☒ Yes ☐ No	**Project Excavations:** Will the work consist of substantial excavation operations. Substantial excavation includes, but is not necessarily limited to: • Underpass construction, • Storm sewer installations, • Trenching or tunneling that would require temporary or permanent shoring.
☐ Yes ☒ No	**Dewatering:** Are there proposed de-watering operations. If yes, what is the estimated depth to groundwater?

☒ Yes ☐ No	**Utility Adjustments:** Are there proposed pipeline and underground utility installation or adjustments?
☒ Yes ☐ No	**Encroachments:** Are there known or potential encroachments into the project area? Encroachments include soil and groundwater contamination, dump sites, tanks, and other issues in the ROW.
☒ Yes ☐ No	**ROW and Easements:** Are there any acquisitions of new ROW, easements, temporary construction easements planned for the project?

3.2 Complete the appropriate box below:

☒ If Section 3.1 contains any "Yes" answers, please proceed to Section 4.

☐ If Section 3.1 contains all "No" answers, proceed to Section 6, Site Survey. Please perform a site survey documenting the results in Section 6 and then mark the appropriate box below. If a Phase I ESA has been prepared for this project, you may use the applicable site survey information from the Phase I ESA.

☐ The site survey did not identify evidence of any environmental concerns listed in Section 6. The ISA is complete. Complete section 10 and maintain a copy of the ISA and all applicable attachments in the administrative record.

☐ The site survey identified evidence of environmental concerns listed in Section 6. Continue with Section 4.

Section 4: Current and Past Land Use Information

Reviewed?	**Review and assess current and past land use (up to 50 years) in the project area. Document and attach sources that were reviewed.** If one or more Phase I ESAs were prepared for this project, please use applicable information from the Phase I ESAs to help complete this section of the ISA.		
☒Yes ☐ No ☐ Not Available ☐ Not Applicable	**4.1 Review Current and if possible Past USGS 7.5 Minute Topographic Maps of the project area:** Look for oil & gas pipelines, tanks, landfills or other industrial features. Describe any concerns:Observed on the 1970 Satsuma topo map was a location that used to be a tank farm area. The 1970 Hedwig Village topo showed an area that used to be a sewage disposal pond, and the 1967 Houston Heights topo displayed an area that was a pond in past years.		
	List Topo Maps Reviewed:	Dates:	Comments:
	All available 7.5 minute, 15 minute, and 30 minute maps that were available and not duplications.	Various years through 1891-2013	The time frame listed for topographic coverage does not include a complete coverage of the entire project area for any given year. Coverage was obtained for areas for years available.
☒Yes ☐ No ☐ Not Available ☐ Not Applicable	**4.2 Review Current Aerial Photographs and if possible Past Aerial Photographs of the project area:** Look for oil & gas pipelines, tanks, landfills or other industrial features. Describe any concerns:Aerials displayed areas where former manufacturing site were located that are no longer there or now inactive including a tank farm, metal processsing site, and other non-identifiable manufacturing facilties. Also observed serveral medium sized ponds located in the Houston area in 1971.		
	List All Aerial Photos Reviewed:	Photo Dates:	Comments:

<table>
<tr><th colspan="4">Section 4: Current and Past Land Use Information</th></tr>
<tr><td>Reviewed?</td><td colspan="3">Review and assess current and past land use (up to 50 years) in the project area. Document and attach sources that were reviewed. If one or more Phase I ESAs were prepared for this project, please use applicable information from the Phase I ESAs to help complete this section of the ISA.</td></tr>
<tr><td></td><td>Obtainable Aerials from EDR</td><td>1938, 1939, 1942, 1944, 1952, 1953, 1960, 1961, 1962, 1963, 1964, 1965, 1968, 1972, 1973, 1977, 1978, 1981, 1982, 1983, 1989, 1996, 2004, and 2014</td><td>The years listed do not represent an entire coverage of the project area for each year listed.</td></tr>
<tr><td rowspan="3">☐Yes
☒ No
☐ Not Available
☐ Not Applicable</td><td colspan="3">4.3 Review Current and Past Right-of-Way Maps/Files: Look for oil & gas pipelines, tanks, landfills, or other industrial features.
Describe any concerns:</td></tr>
<tr><td>List Maps/ Files & Dates Reviewed:</td><td colspan="2">Comments:</td></tr>
<tr><td></td><td colspan="2"></td></tr>
<tr><td rowspan="3">☒Yes
☐ No
☐ Not Available
☐ Not Applicable</td><td colspan="3">4.4 Review Sanborn Fire Insurance Maps/Files: Look for tanks, oil & gas pipelines, landfills, or other industrial features.
Describe any concerns:Concerns with certain types of industriess adjacent or in the LOD are Mosher Manufacturing Co-Foundry and Machine Shpo, Trinity Cotton Oil Company, Dallas Cotton Mills, Armstrong Packing Company, Guiberson Corporation Manufacture of Oil, City of Dallas Garbage and Incenerator, Texas Pipeline Company, Brown Brick Compnay, Proctor and Gamble Company Vegetable Oil Refinery and Soap Factory.</td></tr>
<tr><td>List Maps/ Files & Dates Reviewed:</td><td colspan="2">Comments:</td></tr>
<tr><td>Dallas Maps from 1921 and 1922</td><td colspan="2"></td></tr>
<tr><td>☐Yes
☒ No
☐ Not Available
☐ Not Applicable</td><td colspan="3">4.5 Review TxDOT As-Built Plans:
Any concerns identified during previous work within the project limits?
If yes, explain:
If known, what is the previous Project CSJ:</td></tr>
<tr><td>☐Yes
☒ No
☐ Not Available
☐ Not Applicable</td><td colspan="3">4.6 Review TxDOT Geotechnical Soil Boring Logs:
Any concerns noted on the boring logs such as unusual odors, visible contamination, trash, waste or debris?
If yes explain:</td></tr>
<tr><td>☐Yes
☒ No
☐ Not Available
☐ Not Applicable</td><td colspan="3">4.7 Review TxDOT Temporary Use ROW Agreements (permits issued by the district to entities to occupy a portion of the ROW):
Any concerns such as monitor wells or treatment systems within the ROW?
If yes, explain:</td></tr>
<tr><td>☐Yes
☒ No
☐ Not Available
☐ Not Applicable</td><td colspan="3">4.8 Review Notifications of Contamination to TxDOT (These are typically letters from TCEQ or third parties explaining the presence of contamination on TxDOT ROW):
Any concerns regarding contamination of ROW from off-site sources?
If yes, explain:</td></tr>
</table>

Section 5: Complete a Regulatory Records Review (Database Search)
Note: The purpose of the database search is to obtain and review standard sources of environmental information from government agency records that will help identify potential hazardous material issues within the project limits and surrounding properties. A list of standard databases of environmental information from government agency records is included in Section5.1. To enhance and supplement the standard sources of environmental information, other information such as local records and/or additional state records should be reviewed when, in the judgment of the environmental professional, such additional records are (1) reasonably ascertainable, and (2) are sufficiently useful, accurate, and complete in light of the objective of the regulatory records review. Standard database source information or other record information from government agencies may be obtained directly from appropriate government agencies or from commercial services. If one or more Phase I ESAs were prepared for this project, please use applicable information from the Phase I ESAs to help complete this section of the ISA. **Mark the appropriate box below:** ☐ A Database search was conducted through a contracted service. Indicate in Section 5.1, and if applicable, Section 5.2, the regulatory records searched and make any comments if potential environmental concerns are identified. A complete copy of the database search findings (contractor's report deliverable) should be maintained in the project administrative record with the ISA. ☒ A Database search was conducted in-house. Include in Section 5.1 the regulatory records searched and make any comments if potential environmental concerns are identified. For in-house database searches, not all databases need to be reviewed for each project, but at a minimum the databases listed in Section 5.1 marked in bold with a star must be reviewed. Include database records that list potential issues in the project administrative record with the ISA. It is not necessary to include records of negative findings in the project administrative record. Most state and federal databases are located at the following websites: Federal EPA databases link: http://www.epa.gov/enviro/. Texas TCEQ databases link: http://www15.tceq.texas.gov/crpub/

Section 5.1 Standard Database Sources of Environmental Information from Government Agency Records

Regulatory Record	Reviewed	Recommended Minimum Search Distance from Project Limits (miles)	Comment Field: Provide any comments related to potential issues discovered within the database.
NPL list*	☒ Yes	1.0	See Table 3.5-2 in Section 3.5 of EIS
Federal Delisted *NPL* list*	☒ Yes	0.5	No findings have been identified within one mile of the Project Area
Federal CERCLIS list*	☒ Yes	0.5	See Table 3.5-2 in Section 3.5 of EIS.
Federal CERCLIS No Further Remedial Action Planned (NFRAP) site list*	☒ Yes	0.5	See Table 3.5-2 in Section 3.5 of EIS.
Federal RCRA Corrective Action (CORRACTS) list	☐ Yes ☒ No	1.0	
Federal RCRA non-CORRACTS Treatment Storage Disposal (TSD) facilities list	☐ Yes ☒ No	0.5	

Federal Institutional Controls/ Engineering Controls Registry http://www.epa.gov/ictssw07/public/export/regionalReport/REGION6.HTM	☐ Yes ☒ No	0.5	
Federal RCRA generators	☒ Yes ☐ No	*property* and *adjoining properties*	See Table 3.5-2 in Section 3.5 of EIS.
Federal ERNS	☐ Yes ☒ No	*property* only	
TCEQ Industrial Hazardous Waste (IHW) Corrective Action sites*	☒ Yes ☐ No	1.0	See Table 3.5-2 in Section 3.5 of EIS.
TCEQ Superfund sites*	☒ Yes	1.0	No findings have been identified within one mile of the Project Area
Closed and abandoned municipal solid waste landfill sites* **http://www.tceq.texas.gov/permitting/waste_permits/msw_permits/msw-data**	☒ Yes	0.5	See Table 3.5-2 in Section 3.5 of EIS.
TCEQ leaking petroleum storage tank remediation lists (LPST)*	☒ Yes	0.5	See Table 3.5-2 in Section 3.5 of EIS.
TCEQ registered petroleum storage tank lists (PST)*	☒ Yes	*property* and *adjoining properties*	See Table 3.5-2 in Section 3.5 of EIS.
TCEQ voluntary cleanup program (VCP) sites*	☒ Yes	0.5	See Table 3.5-2 in Section 3.5 of EIS.
TCEQ Innocent Owner/ Operator (IOP) sites	☒ Yes ☐ No	0.5	See Table 3.5-2 in Section 3.5 of EIS.
TCEQ Dry Cleaners Remediation Database*	☒ Yes ☐ No	0.5	No findings have been identified within one mile of the Project Area
TCEQ Brownfields Database	☒ Yes ☐ No	0.5	See Table 3.5-2 in Section 3.5 of EIS.
Texas Railroad Commission VCP sites* http://www.rrc.state.tx.us/oil-gas/environmental-cleanup-programs/site-remediation/voluntary-cleanup-program/	☒ Yes	0.5	No findings have been identified within one mile of the Project Area

Section 5.2 List below other records reviewed such as local records and/or additional state records	
Record source	Environmental Concerns (If Yes describe)
TCEQ Central File Registry	☒ YesSee Table 3.5-2 in Section 3.5 of EIS describing possible hazardous materials and waste sites located in or adjacent to the project area. ☐ No
EPA Envirofacts website	☒ YesSee Table 3.5-2 in Section 3.5 of EIS describing possible hazardous materials and waste sites located in or adjacent to the project area. ☐ No

Section 6: Complete a Project Site Survey
Note: Document site survey and findings. Describe location, size of concern. Attach site maps and photographs as appropriate. If a Phase I ESA has been prepared for this project, you may use the applicable site survey information from the Phase I ESA.
Site Survey Date(s):1/18 through 1/29 2016

6.1 Current Land Use Type: ☒ Undeveloped to light commercial (agricultural, residential, offices, retail, light commercial). ☒ Developed/commercial (automotive repair, gas stations, manufacturing, dry cleaners, military base, waste collection and handling facilities, other industrial sites). Describe: Areas in and surrounding the project area consist of a variety activities including, undeveloped, gas stations, oil/gas facilities, quarry, industrial, and commercial	
Evidence? (Yes/No)	**6.2 Specific Concerns Identified (as necessary provide a description for each "Yes" checked).**
☒Yes ☐No	• underground storage tanks.
☐Yes ☒No	• vent pipes, fill pipes, or access ways indicating a fill pipe protruding from the ground.
☒Yes ☐No	• aboveground storage tanks.
☐Yes ☒No	• electrical and transformer equipment storage or evidence of release.
☐Yes ☒No	• injection wells, cisterns, sumps, dry wells. Added information may be attained from the oil/gas section of the DEIS
☒Yes ☐No	• groundwater monitoring wells and/or groundwater treatment systems. located at active LPST sites
☐Yes ☒No	• flooring, drains, or walls stained by substances other than water or emitting foul odors.
☒Yes ☐No	• vats, 55-gallon drums (labeled/unlabeled), canisters, barrels, bottles, etc.
☒Yes ☐No	• stockpiling, storage of material.
☐Yes ☒No	• evidence of liquid spills.
☒Yes ☐No	• surface dumping of trash, garbage, refuse, rubbish, debris half exposed/buried, etc. Witness several areas where dumping was being done along the ROW or adjacent to the ROW
☐Yes ☒No	• damaged or discarded automotive or industrial batteries.
☐Yes ☒No	• stained, discolored, barren, exposed or foreign (fill) soil.
☐Yes ☒No	• dead, damaged or stressed vegetation.
☐Yes ☒No	• oil sheen or films on surface water, seeps, lagoons, ponds, or drainage basins.
☐Yes ☒No	• pits, ponds, or lagoons associated with waste treatment or waste disposal.
☐Yes ☒No	• changes in drainage patterns from possible fill areas.
☒Yes ☐No	• security fencing, protected areas, placards, warning signs.
☐Yes ☒No	• dead animals (fish, birds, etc.) possibly due to contamination.
☐Yes ☒No	• other concerns.
6.3 Describe adjoining properties and any visible hazardous material concerns. List adjacent businesses, factories, abandoned sites, etc. that may be the source of hazardous materials concerns. A variety of commercial, industrial, and manufacturing facilities exists along the route adjacent to the project area. Examples would be gas stations, quarries, oil/gas facilities, auto repair, etc.	
6.4 Describe Concerns Observed in the Site Survey. Indicate whether the concern is associated with existing ROW, proposed ROW acquisition or easements. As necessary, provide additional information about the evidence identified; include photographs as an attachment to the ISA. Several locations are inactive/vacant facilities that were identified in one or more of the databases reviewed for contmination or are existing facilities that deal with hazadous materials and wastes. Several facilties are located inside the LOD or directly adjacent to the LOD.	

Section 7: Interviews		
Section 7.1 Were interviews conducted? ☐Yes ☒No Possible interviewees include: local residents, TxDOT staff, fire department personnel, city or county department of health/environmental staff; city or county planning staff; TCEQ staff; TRC staff; current and former property owners or operators. If one or more Phase I ESAs were prepared for this project, please use applicable interview information from the Phase I ESAs to help complete this section of the ISA.		
Section 7.2 Interview Summary: Complete this section if interviews were conducted. Add additional rows as needed. Attach record of communications to the ISA.		
Name:	Title:	Date:
Describe any potential concerns:		
Name:	Title:	Date:
Describe any potential concerns:		
Name:	Title:	Date:
Describe any potential concerns:		

Section 8: Identified Hazardous Material Concerns
On the list below, indicate Yes or No whether the hazardous material concern was identified. If Yes, record the hazardous material concern on an Issues Identification and Resolution (IIR) Form in ECOS. If the ISA preparer is unsure how to complete the IIR Form, the responsibility to complete the Hazmat IIR may be assigned within ECOS to ENV Hazmat Staff. *Detailed instructions for completing an ECOS IIR Form are located in the Non-Project Documentation section of ECOS under the heading Hazmat. Contact the ECOS help desk for assistance preparing the IIR Form if necessary.* Hazardous materials concerns identified below will require additional assessment work. In most cases, resolution to the concerns should be completed prior to project letting. For additional information regarding scheduling considerations, internal/external coordination and recommended practices for resolving hazmat issues please refer to TxDOT's *Environmental Tool Kit* web site. Contact ENV Pollution Prevention and Abatement (PPA) for additional assistance.

8.1 Identify the Hazardous Material Concerns		
Concern Identified?	**Type of Concern** Record the hazardous material concerns on an Issues Identification and Resolution (IIR) Form in ECOS.	
☒**Yes** ☐**No** ☐**NA**	**Current or Past Land Use Concern:** This concern is associated with hazardous material issues identified in Section 4. Note: *On the ECOS IIR, the Available Contaminated Media would be "Other".*	
	☒Yes ☐No	One or more concerns identified in Section 4.
	☐Yes ☒No	No obvious concerns were identified but additional research is needed as a result of unique or unusual current or past land use. Request additional assistance from ENV.
☒**Yes** ☐**No**	**Site Visit Concerns:** This is associated with any hazardous material issues discovered following the completion of Section 6. On the *ECOS* IIR, the Available Contaminated Media would be "Other".	
	☒Yes ☐No	One or more concerns identified.
	☐Yes ☒No	No listed concerns identified but additional research is needed as a result of unique or

8.1 Identify the Hazardous Material Concerns		
Concern Identified?	**Type of Concern** Record the hazardous material concerns on an Issues Identification and Resolution (IIR) Form in ECOS.	
		unusual project site conditions. Request assistance from ENV.
☐**Yes** ☐**No** ☒**NA**	**Interview Concerns:** This concern is associated with any hazardous material issues discovered during an interview listed in Section 7. In the IIR, the Available Contaminated Media would be "Other".	
	☐Yes ☐No	One or more concerns identified after completing interviews.
	☐Yes ☐No	No listed concerns identified but additional research is needed as a result of unique or unusual project site conditions. Request assistance from ENV.
☒**Yes** ☐**No**	**Asbestos and/or Lead in Paint Concerns:** The following are related to ACM and LBP identified in Section 2. Select below all that apply.	
	☐Yes ☒No	Bridge Demolition/ Renovation without Steel Structures
	☐Yes ☒No	Bridge Demolition/ Renovation with Steel Structures
	☒Yes ☐No	ROW Structure(s) Demolition
	☐Yes ☐No	Enhancement Project Demolition/Renovation
	☐Yes ☐No	Other- Describe
☒**Yes** ☐**No**	**Petroleum Storage Tank Concerns:** PSTs can be any underground or aboveground storage tanks that are used to store petroleum based fluids. Typically, these are gasoline and diesel refueling facilities. Select below all that apply.	
	☒Yes ☐No	ROW acquisition or partial acquisition of a parcel with one or more PSTs.
	☐Yes ☒No	Other- Describe:
☒**Yes** ☐**No**	**Leaking Petroleum Storage Tank (LPST) Concerns:** An LPST parcel will only need to be identified once in the following list. LPST sites are PSTs that have caused or suspected to have caused a release to the environment.	
	☐Yes ☒No	Additional Research is needed or uncertain of impacts from an LPST. Request assistance from ENV.
	☒Yes ☐No	Acquisition of a Parcel with an LPST.
	☒Yes ☐No	An LPST is located within 0.25 miles of the project.
	☐Yes ☒No	Other- Describe

☒Yes ☐No	**Oil and Gas Production Activity Concerns**: TxDOT is concerned with the acquisition of oil and gas production wells (and ancillary equipment). Typically, these are oil/gas wells, piping, ancillary production equipment, pipelines, etc. Select below all that apply.	
	☒Yes ☐No	Additional Research needed or uncertain of impacts. Request assistance from ENV.
	☐Yes ☒No	Database search identified TRC VCP Site within 0.5 miles of project.
	☒Yes ☐No	Oil/ Gas Wells within future ROW.
	☒Yes ☐No	Pipelines requiring adjustment.
	☒Yes ☐No	Other- Describe:
☒Yes ☐No	**Non-LPST Source Contamination Concerns**: These parcels or locations have a potential for soil and/or groundwater contamination. Typically, they are contaminated locations (even potentially contaminated locations) that are not associated with LPST sites. Select below all that apply.	
	☐Yes ☒No	Additional Research is needed or uncertain of impacts from a Non-LPST site. Request assistance from ENV.
	☐Yes ☒No	Database search identified a CERCLA NPL(s) site within 1 mile of project.
	☒Yes ☐No	Database search identified CERCLA (to include NFRAP) within 0.5 miles of project.
	☐Yes ☒No	Database search identified RCRA Corrective Action(s) site within 1 mile of project.
	☐Yes ☒No	Database search identified RCRA TSD Facilities within 0.5 miles of project.
	☒Yes ☐No	Database search identified TCEQ IHW Corrective Action Sites within 1 mile.
	☐Yes ☒No	Database search identified TCEQ Superfund Sites within 1 mile of project.
	☒Yes ☐No	Database search identified TCEQ VCP Sites within 0.5 miles of project.
	☒Yes ☐No	Database search identified TCEQ IOP Sites within 0.5 miles of project.
	☐Yes ☒No	Other- Describe:
☒Yes ☐No	**Landfills/ Waste Pits/ Dump Site Concerns:** This is associated with any known or unknown (based on visual observations) landfills, dump sites, or waste pits. Typically, the local Council of Governments (COG) should maintain a list of all closed and open landfills in your project area. Select below all that apply.	
	☐Yes ☒No	Additional research is needed or uncertain of impacts. Request assistance from ENV.
	☒Yes ☐No	Database search identified active/closed/abandoned MSW landfill sites within .5 miles of the project.
	☐Yes ☒No	Other- Describe

8.2 Did the ISA identify any potential Hazardous material concerns?

☐ No hazardous materials concerns were identified as a result of the ISA performed for the proposed action. No further hazardous materials action is required. The ISA is complete for this project. Any unanticipated hazardous materials impacts encountered during the project construction phase will be addressed in accordance with regulatory requirements. No further assessment is required. Complete Sections 9 and 10 and maintain a copy of the ISA and all applicable attachments in the project administrative record.

☒ Yes, the ISA identified one or more hazardous materials concerns for this project. An IIR form has been completed in ECOS. Complete Sections 9 and 10 and maintain a copy of the ISA and all applicable attachments in the project administrative record.

Section 9: Reference Materials Utilized (Identify any referenced materials attached to this ISA)			
Referenced Materials Used	☐ Project Map	☐ USGS Topo Maps	☐ Aerial Photographs
	☐ ROW Maps/Files	☐ Sanborn Fire Insurance Maps	☐ Temporary Use Agreements
	☐ TxDOT As-Built Plans	☐ Notifications	☒ Photographs
	☐ Record of Communications	☐ Regulatory Database	☐ Record of Interviews
	☒ Other:Table 3.5-2 in Section 3.5 of EIS describing possible hazardous materials and waste sites located within the study area.		

Section 10: Contact/Completed by		
Name:	Josh Orr	**Tel: 512-571-8662**
Title:	Environmental Scientist	
Firm (District Section):	AECOM	
Address:	9400 Amberglen Blvd. Austin, TX 78729	
Signature:		**Date:6/14/2016**

Appendix A

The following table shows the revision history for this guidance document.

Revision History	
Effective Date Month, Year	**Reason for and Description of Change**
4/2014	Version 1 released in May 2014.
8/2014	Version 2 released in August 2014. Removed introductory note describing ISA threshold criteria. Note was removed because the ISA threshold criteria are located in other TxDOT guidance.
12/2014	Version 3 released in December 2014. Modifications to Section 2: Clarified this section to better define what asbestos and lead-in-paint concerns are. Changes were made due to numerous comments from the end-user. An additional note was added to this section. This note directs end-users to ENV-HMM for further assistance related to lead-in-paint issues. Modifications to Section 3: The question concerning Project Excavations in Section 3.1 was modified to match the definition used in *Scoping Procedure for Categorically Excluded TxDOT Projects* for Hazardous Materials found in the NEPA and Project Development Toolkit. Modifications to Section 5: Web links were modified based on changes made by regulatory agency websites. Modifications to 8.2: Clarified the "Yes" answer in 8.2 to remove the need for additional assessments for all identified hazardous materials concerns. The question was modified due to comments by the end-user.

Attachment 1

Photographic Log

PHOTOGRAPHIC LOG

Client Name: Texas Central Rail	**Site Location:** Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	**Project No.** 60418787

Photo No. **1**	**Date:** January 18, 2016
Direction Photo Taken: North	
Description: Map ID 18 River Liquor store and parking lot	

Photo No. **2**	**Date:** January 18, 2016
Direction Photo Taken: South	
Description: Map ID 20 vacant tract of land formerly Jacks Service station	

AECOM

PHOTOGRAPHIC LOG

Client Name: Texas Central Rail	**Site Location:** Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	**Project No.** 60418787

Photo No. 3	**Date:** January 18, 2016

Direction Photo Taken:

North

Description:

Map ID 19 vacant tract of land, formerly Alford Refrigerated Warehouses

Photo No. 4	**Date:** January 18, 2016

Direction Photo Taken:

Northeast

Description:

Map ID 21 abandoned building

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. 5	Date: January 18, 2016
Direction Photo Taken:	
Northeast	
Description:	
Map ID 26 vacant property, formerly Refrigerated Transport.	

Photo No. 6	Date: January 18, 2016
Direction Photo Taken:	
North	
Description:	
Map ID 33 active storage yard for demo equipment.	

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. 7

Date: January 18, 2016

Direction Photo Taken:

West

Description:

Map ID 36 Quick Stop Liquor store and parking lot

Photo No. 8

Date: January 18, 2016

Direction Photo Taken:

West

Description:

Map ID 37 active gas station

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No.	Date:
9	January 18, 2016

Direction Photo Taken:

Northwest

Description:

Map ID 38 active ASTs on property

Photo No.	Date:
10	January 18, 2016

Direction Photo Taken:

Northwest

Description:

Map ID 43 active scrap metal yard entrance

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. 11

Date: January 18, 2016

Direction Photo Taken:

North

Description:

Map ID 45 entrance gate to active concrete plant

Photo No. 12

Date: January 18, 2016

Direction Photo Taken:

West

Description:

Map ID 46 active site yard

AECOM

PHOTOGRAPHIC LOG

Client Name: Texas Central Rail	**Site Location:** Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	**Project No.** 60418787

Photo No. 13

Date: January 18, 2016

Direction Photo Taken:

South

Description:

Map ID 48 entrance of active site

Photo No. 14

Date: January 18, 2016

Direction Photo Taken:

West

Description:

Map ID 49 entrance to active concrete plant

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No.	Date:
15a	January 18, 2016

Direction Photo Taken:

Southwest

Description:

Map ID 52 active OxyChem facility

Photo No.	Date:
15b	March 15, 2016

Direction Photo Taken:

West

Description:

Map ID 52 active OxyChem facility. Soil staining/discoloration at southeastern side of facility

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No.	Date:
15c	March 15, 2016

Direction Photo Taken:

Northwest

Description:

Map ID 52 active OxyChem facility. Spill/release at southeastern side of facility

Photo No.	Date:
16	January 18, 2016

Direction Photo Taken:

South

Description:

Map ID 53 fenced-in property from northern edge

AECOM

PHOTOGRAPHIC LOG

Client Name: Texas Central Rail	**Site Location:** Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	**Project No.** 60418787

Photo No. **17**

Date: January 18, 2016

Direction Photo Taken:

Northwest

Description:

Map ID 54 entrance to active metals recycling site

Photo No. **18**

Date: January 18, 2016

Direction Photo Taken:

North

Description:

Map ID 66 front gate of property

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. 19

Date: January 18, 2016

Direction Photo Taken:

Southeast

Description:

Map ID 67 active fueling station

Photo No. 20

Date: January 18, 2016

Direction Photo Taken:

West

Description:

Map ID 68 entrance to current property.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. 21

Date: January 18, 2016

Direction Photo Taken:

East

Description:

Map ID 86 vacant tract of land from west edge.

Photo No. 22

Date: January 18, 2016

Direction Photo Taken:

East

Description:

Map ID 90 vacant lot from west edge

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No.	Date:
23	January 18, 2016

Direction Photo Taken:

Northeast

Description:

Map ID 93 security fence and on-site building

Photo No.	Date:
25	January 18, 2016

Direction Photo Taken:

North

Description:

Map ID 95 current residential tract of land

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. **27**

Date: January 25, 2016

Direction Photo Taken:

North

Description:

Map ID 98 Royal Food and Beverage.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No.	Date:
28a	January 25, 2016

Direction Photo Taken:

South

Description:

Map ID 99 Penneco Bardwell Site.

Photo No.	Date:
28b	May 12, 2016

Direction Photo Taken:

East

Description:

Map ID 99 Penneco Bardwell Site.

PHOTOGRAPHIC LOG

Client Name: Texas Central Rail	**Site Location:** Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	**Project No.** 60418787

Photo No. 29

Date: January 25, 2016

Direction Photo Taken:

North

Description:

Map ID 100 Former Jack Herod Trucking.

Photo No. 30

Date: January 25, 2016

Direction Photo Taken:

East

Description:

Map ID 103 Lone Star Aggregates.

AECOM

PHOTOGRAPHIC LOG

Client Name:	**Site Location:**	**Project No.**
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. 31

Date: January 25, 2016

Direction Photo Taken:

West

Description:

Possible Location of Map ID 105.

Photo No. 32

Date: January 25, 2016

Direction Photo Taken:

South

Description:

Map ID 107 Coopers Farm Country Store.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. 33

Date: January 25, 2016

Direction Photo Taken:

North

Description:

Map ID 108 and 118 I-45 Shell Truck Stop and Halliburton Energy Services.

Photo No. 34

Date: January 25, 2016

Direction Photo Taken:

West

Description:

Map ID 110 Professional Wireline Rental Fairfield Facility.

AECOM

PHOTOGRAPHIC LOG

Client Name:	**Site Location:**	**Project No.**
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. 35

Date: January 25, 2016

Direction Photo Taken:

West

Description:

Map ID 112 Loves Country Store 288.

Photo No. 36

Date: January 25, 2016

Direction Photo Taken:

North

Description:

Map ID 114 Coles One Stop.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. 37

Date: January 25, 2016

Direction Photo Taken:

North

Description:

Map ID 120 Jet Travel Plaza.

Photo No. 38

Date: January 25, 2016

Direction Photo Taken:

South

Description:

Map ID 121 Dew Truck Stop One.

AECOM

PHOTOGRAPHIC LOG

Client Name: Texas Central Rail	**Site Location:** Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	**Project No.** 60418787

Photo No. 39	**Date:** January 25, 2016

Direction Photo Taken:

North

Description:

Map ID 122 Lucky J's Travel Center.

Photo No. 40	**Date:** January 25, 2016

Direction Photo Taken:

North

Description:

Map ID 129 Triangle Petroleum.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. 41

Date: January 25, 2016

Direction Photo Taken:

North

Description:

Map ID 130 Woody's Smokehouse 1.

Photo No. 42

Date: January 25, 2016

Direction Photo Taken:

South

Description:

Map ID's 131 and 132 Exxon RS 63615 and Texan Food Mart.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. **43**

Date: January 25, 2016

Direction Photo Taken:

North

Description:

Map Id 133 Ryder Oil now Alli Oil Co.

Photo No. **44**

Date: January 25, 2016

Direction Photo Taken:

North

Description:

Map Id 134 Centerville Asphalt Plant.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. 45

Date: January 25, 2016

Direction Photo Taken:

South

Description:

Map ID 138 HC Chandler and Son Inc.

Photo No. 46

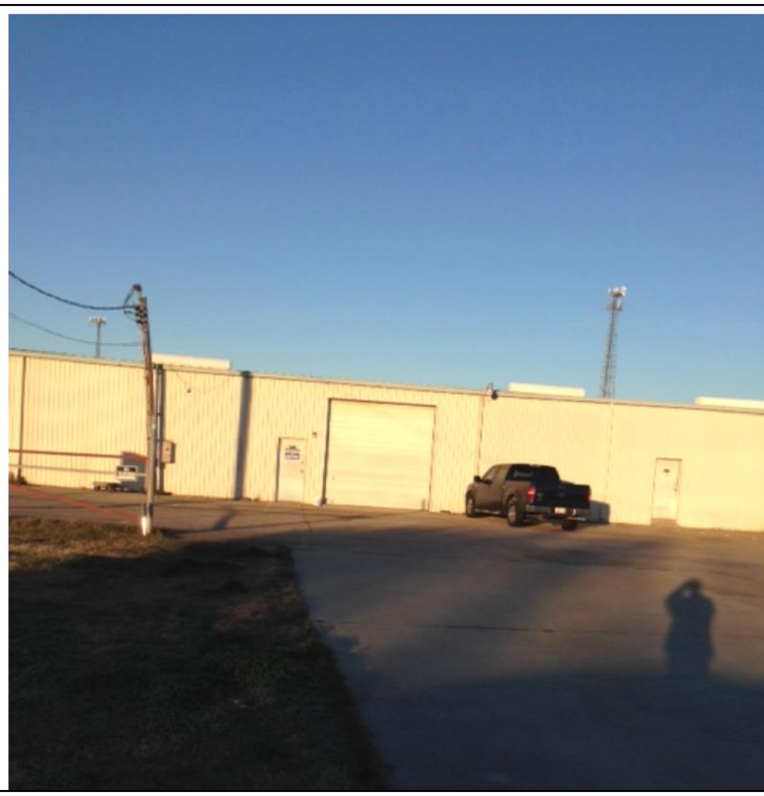
Date: January 28, 2016

Direction Photo Taken:

North

Description:

Map ID 144 APD Holdings III Cypress.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. **47**

Date: January 28, 2016

Direction Photo Taken:

North

Description:

Map ID 145 Timewise Exxon 823.

Photo No. **48**

Date: January 28, 2016

Direction Photo Taken:

North

Description:

Map ID 146 Hewlett-Packard Company.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. 49

Date: January 28, 2016

Direction Photo Taken:

East

Description:

Map ID 147 Plant 11.

Photo No. 50

Date: January 28, 2016

Direction Photo Taken:

West

Description:

Map ID 152 Wyman Gordon Forgings.

PHOTOGRAPHIC LOG

Client Name: Texas Central Rail	**Site Location:** Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	**Project No.** 60418787

Photo No. 51	**Date:** January 28, 2016

Direction Photo Taken:

West

Description:

Map ID 158 SPX Flow Control Houston.

Photo No. 52	**Date:** January 28, 2016

Direction Photo Taken:

East

Description:

Map ID 162 West End Lumber.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. 53

Date: January 28, 2016

Direction Photo Taken:

East

Description:

Map ID 169 Varn Products now Akzonobel.

Photo No. 54

Date: January 28, 2016

Direction Photo Taken:

West

Description:

Map ID 174 Eldridge Fast Stop Shell and now Lone Star Chevrolet.

AECOM	PHOTOGRAPHIC LOG

Client Name: Texas Central Rail	**Site Location:** Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	**Project No.** 60418787

Photo No. **55**	**Date:** January 28, 2016
Direction Photo Taken: North	
Description: Map ID 176 Fabmark now Sparkle Sign.	

Photo No. **56**	**Date:** January 28, 2016
Direction Photo Taken: North	
Description: Map ID 178 Jones Road Exxon 69395.	

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. **57** | **Date:** January 28, 2016

Direction Photo Taken:

South

Description:

Map ID 181 Concrete Batch Plant Houston 539 and United Rentals.

Photo No. **58** | **Date:** January 28, 2016

Direction Photo Taken:

East

Description:

Map ID 184 Guardsman and Cytex Industries now CSE W-Industries.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No.	Date:
59	January 28, 2016

Direction Photo Taken:

North

Description:

Map ID 191 Elg Ireland Alloys, Inc. now Versa Tech.

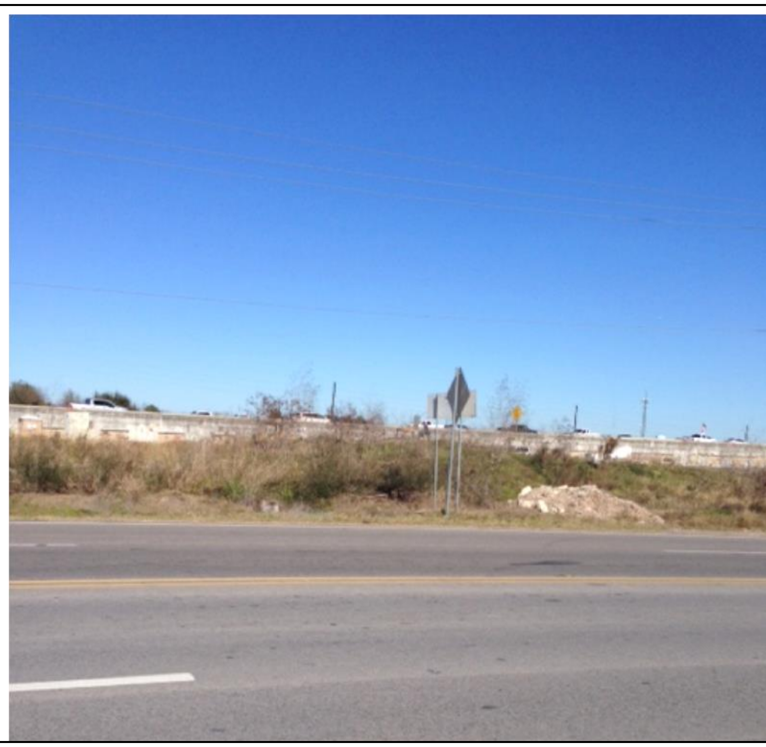
Photo No.	Date:
60	January 28, 2016

Direction Photo Taken:

West

Description:

Map ID 199 Texaco Service Station/Star Enterprise.



Client Name: Texas Central Rail	**Site Location:** Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	**Project No.** 60418787

Photo No. 61	**Date:** January 28, 2016
Direction Photo Taken: South	
Description: Map ID 202 former Shell station.	

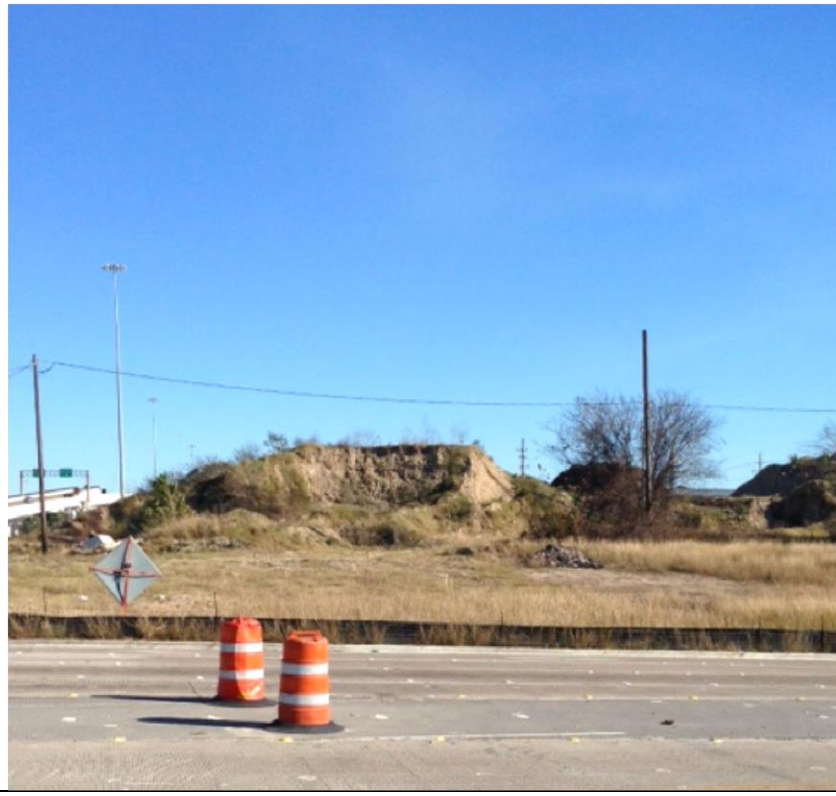


Photo No. 62	**Date:** January 28, 2016
Direction Photo Taken: West	
Description: Map Id 204 former SPM Houston Mfg.	

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. **63**	**Date:** January 28, 2016	
Direction Photo Taken: West		
Description: Map ID 205 Houston 2 US Army Reserve Center.		

Photo No. **64**	**Date:** January 28, 2016	
Direction Photo Taken: East		
Description: Map ID 210 AMSA 4.		

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No.	Date:
66	January 28, 2016

Direction Photo Taken:

North

Description:

Map ID 215 Gavlon Industries.

AECOM	PHOTOGRAPHIC LOG	
Client Name: Texas Central Rail	**Site Location:** Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	**Project No.** 60418787

Photo No. **67**	**Date:** January 28, 2016	
Direction Photo Taken: West		
Description: Map ID 216 Sunbelt Steel Texas.		

Photo No. **68**	**Date:** January 28, 2016	
Direction Photo Taken: East		
Description: Map ID 218 Living Earth Technologies.		

AECOM

PHOTOGRAPHIC LOG

Client Name:

Texas Central Rail

Site Location:

Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas

Project No.

60418787

Photo No. **69**

Date: January 28, 2016

Direction Photo Taken:

North

Description:

Map ID 224 BJ Stringer.

Photo No. **70**

Date: January 28, 2016

Direction Photo Taken:

West

Description:

Map ID 235 City of Houston Transfer Station Facility.

AECOM	PHOTOGRAPHIC LOG

Client Name: Texas Central Rail	**Site Location:** Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	**Project No.** 60418787

Photo No. **71** | **Date:** January 28, 2016

Direction Photo Taken:

North

Description:

Map ID 236 Matthew-Price Industries.

Photo No. **72** | **Date:** January 28, 2016

Direction Photo Taken:

East

Description:

Map ID 241 CY Fair Tire.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No.	Date:
73	January 28, 2016

Direction Photo Taken:

East

Description:

Map ID 246 Teague Water Maintenance.

Photo No.	Date:
74	January 28, 2016

Direction Photo Taken:

North

Description:

Map ID 258 Midwest Paint and Body now Coastal Metal Recycling.

AECOM

PHOTOGRAPHIC LOG

Client Name: Texas Central Rail	**Site Location:** Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	**Project No.** 60418787

Photo No. 75

Date: January 28, 2016

Direction Photo Taken:

South

Description:

Map ID 263 Los Gas and Diesel LPST 112333 now vacant lot.

Photo No. 76

Date: January 28, 2016

Direction Photo Taken:

East

Description:

Map ID 283 Bio Energy Landscape Maintenance.

AECOM	PHOTOGRAPHIC LOG

Client Name: Texas Central Rail	**Site Location:** Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	**Project No.** 60418787

Photo No. **77**	**Date:** January 28, 2016
Direction Photo Taken: North	
Description: Map ID 297 Sandvik Rock Tools Facility.	

Photo No. **78**	**Date:** January 28, 2016
Direction Photo Taken: West	
Description: Map ID 299 Chamdal Food Mart.	

AECOM	PHOTOGRAPHIC LOG

Client Name: Texas Central Rail	**Site Location:** Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	**Project No.** 60418787

Photo No. **79**	**Date:** January 28, 2016
Direction Photo Taken: East	
Description: Map ID 319 Rectorseal.	

Photo No. **80**	**Date:** January 28, 2016
Direction Photo Taken: North	
Description: Map ID 332 American Door Products.	

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No.	Date:
81	January 28, 2016

Direction Photo Taken:

West

Description:

Map ID 337 Penske Truck Leasing.

Photo No.	Date:
82	January 28, 2016

Direction Photo Taken:

East

Description:

Map ID 391 Southern Pacific Transport.

AECOM	PHOTOGRAPHIC LOG

Client Name:	**Site Location:**	**Project No.**
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. 83	**Date:** January 28, 2016
Direction Photo Taken: North	
Description: Map ID 400 Firestone Master Care Center now Northwest Mall.	

Photo No. 84	**Date:** January 28, 2016
Direction Photo Taken: North	
Description: Map ID 401 Electro Welding.	

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. 85

Date: January 28, 2016

Direction Photo Taken:

South

Description:

Map ID 403 Lunsford Estate Property/V&G.

Photo No. 86

Date: January 28, 2016

Direction Photo Taken:

North

Description:

Map ID 405 Tex-Tube.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No.	Date:
87	January 28, 2016

Direction Photo Taken:

West

Description:

Map ID 406 Wheel World.

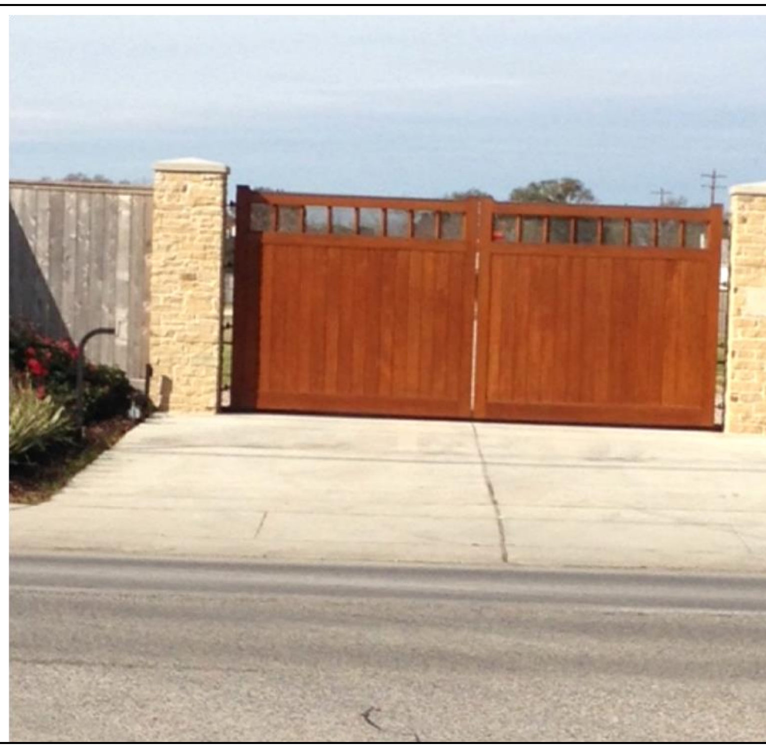
Photo No.	Date:
88	January 28, 2016

Direction Photo Taken:

West

Description:

Map ID 407 South Texas Equipment.



AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No.	Date:	
89	January 28, 2016	
Direction Photo Taken: North		
Description: Map ID 408 Bergen Brunswig Drug now Prologis.		

Photo No.	Date:	
90	January 28, 2016	
Direction Photo Taken: East		
Description: Map ID 410 Celotex The Houston Plant.		

PHOTOGRAPHIC LOG

Client Name: Texas Central Rail	**Site Location:** Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	**Project No.** 60418787

Photo No. 91	**Date:** January 28, 2016

Direction Photo Taken:

North

Description:

Map ID 412, 413, and 415 Fant Children's Trust Property now New Process Steel.

Photo No. 92	**Date:** January 28, 2016

Direction Photo Taken:

South

Description:

Map ID 414 Amber Booth.

PHOTOGRAPHIC LOG

Client Name: Texas Central Rail	**Site Location:** Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	**Project No.** 60418787

Photo No. **93**	**Date:** January 28, 2016

Direction Photo Taken:

South

Description:

Map ID 419 and 440 McKinley Paper and Patrick Media Group of Houston.

Photo No. **94**	**Date:** January 28, 2016

Direction Photo Taken:

West

Description:

Map ID 423 Zenneca and Former Stauffer Management.

AECOM	PHOTOGRAPHIC LOG

Client Name: Texas Central Rail	**Site Location:** Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	**Project No.** 60418787

Photo No. 95	**Date:** January 28, 2016
Direction Photo Taken: North	
Description: Map ID 428 Hughes MPD.	

Photo No. 96	**Date:** January 28, 2016
Direction Photo Taken: North	
Description: Map ID 430 Southline Metal Products.	

PHOTOGRAPHIC LOG

Client Name: Texas Central Rail	**Site Location:** Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	**Project No.** 60418787

Photo No. 97

Date: January 29, 2016

Direction Photo Taken:

East

Description:

Map ID 431 Kennametal Firth Sterling.

Photo No. 98

Date: January 29, 2016

Direction Photo Taken:

North

Description:

Map ID 432 Kvaener Oilfield Products-Western Plume now North Post Oak Lofts.

AECOM

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. **99**

Date: January 29, 2016

Direction Photo Taken:

North

Description:

Map ID 434 West Loop 6 & 7 now Strip Center.

Photo No. **100**

Date: January 29, 2016

Direction Photo Taken:

North

Description:

Map ID 439 Malibu Grand Prix.

AECOM		**PHOTOGRAPHIC LOG**
Client Name: Texas Central Rail	**Site Location:** Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	**Project No.** 60418787

Photo No. **101**	**Date:** January 29, 2016
Direction Photo Taken: East	
Description: Map ID 438 Graebel Houston Movers.	

Photo No. **102**	**Date:** January 29, 2016
Direction Photo Taken: North	
Description: Map ID 437 A Division of Cummins Southern Plains no is feeder road construction with parking lot.	

PHOTOGRAPHIC LOG

Client Name: Texas Central Rail	**Site Location:** Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	**Project No.** 60418787

Photo No. 103

Date: January 29, 2016

Direction Photo Taken:

West

Description:

Map ID 441 Post Oak Memorial Office Park.

Photo No. 104

Date: January 29, 2016

Direction Photo Taken:

North

Description:

Map ID 444 MTSO now Pitney Bowes Management Services.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Texas Central Rail	Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	60418787

Photo No. 105

Date: January 29, 2016

Direction Photo Taken:

South

Description:

Map ID 443 Malibu Grand Prix now TxDOT concrete batch plant.

Photo No. 106

Date: January 29, 2016

Direction Photo Taken:

North

Description:

Map ID 447 and 449 Duratherm Inc. /Bird Environmental and Business Park.

PHOTOGRAPHIC LOG		
Client Name: Texas Central Rail	**Site Location:** Dallas, Ellis, Navarro, Limestone, Freestone, Leon, Grimes, Madison, Waller, and Harris Counties, Texas	**Project No.** 60418787

Photo No. 107	**Date:** January 29, 2016
Direction Photo Taken: North	
Description: Map ID 450 Laroche Industries.	

Note:
Photos #24, #26 and #65, that correspond to Map IDs 94, 96 and 214 were removed from the hazardous materials sites list based on revisions to the LOD.

TECHNICAL MEMORANDUM
WILDLIFE CROSSINGS

To: Jerry Smiley, AICP, AECOM

From: Jennifer Oakley, AECOM

Date: November 1, 2017

RE: **DALLAS TO HOUSTON HSR – WILDLIFE CROSSINGS**

Linear transportation projects can create movement barriers for many wildlife species, including amphibians, reptiles and small and large mammals, resulting in impacts to individual species and ecosystems. Indirect effects to wildlife species from habitat fragmentation could include interrupting migration corridors resulting in potentially lowered reproductive success rates (restricted gene flow). Fragmentation could also divide existing populations into subpopulations, potentially increasing predation on small animals due to lack of cover and general disturbance of wildlife communities immediately adjacent to the Dallas to Houston High-Speed Rail Project corridor. To mitigate such impacts, wildlife crossings provide permanent structures that are integrated into the landscape to reduce fragmentation and limit the impacts of wildlife movement barriers. The Build Alternatives would include design features to avoid impacts to wildlife corridors to the maximum extent practicable. Minimization of potential impacts would include the use of viaducts and incorporating wildlife crossings at a frequency to minimize direct and indirect impacts to wildlife. Other mitigation design elements include elevated tracks, underpasses, and specific structures for wildlife crossings which could allow for unimpeded wildlife movement.

This technical memorandum details proposed wildlife crossing design considerations and recommendations for the Build Alternatives based on currently available scientific literature. Due to the average lifespan of wildlife crossing structures (approximately 70 to 80 years), the location and design of the crossings would consider the changing dynamics of habitat and climatic conditions and the target species populations over time. Target species include native species with the potential to occur along the Build Alternatives, such as white-tailed deer (*Odocoileus virginianus*), bobcat (*Lynx rufus*) as well as threatened and endangered species, and exclude non-native species such as feral pigs (*Sus scrofa*). Once a preferred alternative has been selected, design plans would be further refined based upon field studies and close coordination with landowners, wildlife agencies and species-specific experts. The design plans would identify optimal wildlife-friendly crossing locations to maintain or enhance crossings, dispersal, and migration opportunities for wildlife across the Build Alternatives. TCRR would be responsible for initiating coordination with landowners, wildlife agencies and species-specific experts, ensuring correct construction and placement of all wildlife crossings and post construction monitoring and maintenance of all wildlife crossings.

General Design Considerations

The potential impacts to wildlife movement would be dependent on the permeability of the Build Alternatives (i.e., the presence of elevated or viaduct structures, road crossings or wildlife crossings), the amount of non-urban land within and adjacent to the Build Alternatives, and identified habitat linkages and corridors within and adjacent to the corridor. A detailed understanding of the wildlife and associated habitats with the potential to occur within the corridor is important to determine specific characteristics of individual wildlife crossing locations and specifications in order to minimize and mitigate impacts to wildlife movements. Corridor-wide considerations focus on the permeability and connectivity of the landscape along the Build Alternatives including topography, locations of threatened and/or endangered species, migration corridors, unfragmented areas of wildlife habitat, watersheds and other similar concerns. Frequency and placement of wildlife crossings should support habitat connectivity and be tailored to any target species. Research suggests that the design of a wildlife crossing can be just as important as the crossing location.[1, 2, 3]

A general summary of wildlife crossing design considerations and recommendations based on a review of available literature is provided below. These recommendations would be incorporated into more detailed designs, as appropriate, and as required to mitigate potential impacts identified by the FRA analyses.[4, 5, 6]

- Include key project stakeholders along with researchers and professionals familiar with wildlife and ecology in the Study Area in design development to address local concerns.
- Publically available data, including National Wetlands Inventory (NWI), National Hydrography Data (NHD), Ecological Mapping Systems of Texas (EMST) and Natural Resources Conservation Service (NRCS) soils data will be utilized in the determination of optimum placement of wildlife crossings.
- Integrate wildlife crossings into the natural landscape and take advantage of existing wildlife corridors when deciding on the placement of wildlife crossings.
- Ensure that wildlife crossings connect to and from larger regional corridor networks to address habitat fragmentation (division of a particular habitat) and avoid ecological dead-ends (a connection that fails to connect to similar habitat).
- Incorporate a variety of styles of crossings to ensure opportunities for all species present in the corridor (for example, amphibians need tunnels that are wet and cool, while small mammals need cover in the form of logs, rocks and bushes) .
- Place crossings in areas with limited noise and human activity, such as away from cities and towns, to the greatest extent applicable.

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[1] TCRR, "*Texas Central Partners Texas High Speed Rail Final Draft Conceptual Engineering Report-FDCERv7*," September 15, 2017.

[2] Clevenger, Anthony P. and Huijser, Marcel P. *Wildlife Crossing Structure Handbook Design and Evaluation in North America.* Federal Highway Administration, 2011.

[3] Iuell, B.; Bekker, C.J.; Cuperus, R.; Dufek, J.; Fry, G.; Hicks, C.; Hlavac, V.; Keller, V.; Rosell, C.; Sangwine, T.; Torslov, N.; and Wandall, B. *Wildlife and Traffic: A European Handbook for Identifying Conflicts and Designing Solutions*. NKKV Publishers, Brussels, Belguim, 2003.

[4] TCRR, "*Texas Central Partners Texas High Speed Rail Final Draft Conceptual Engineering Report-FDCERv7*," September 15, 2017.

[5] Clevenger, Anthony P. and Huijser, Marcel P. *Wildlife Crossing Structure Handbook Design and Evaluation in North America.* Federal Highway Administration, 2011.

[6] Iuell, B.; Bekker, C.J.; Cuperus, R.; Dufek, J.; Fry, G.; Hicks, C.; Hlavac, V.; Keller, V.; Rosell, C.; Sangwine, T.; Torslov, N.; and Wandall, B. *Wildlife and Traffic: A European Handbook for Identifying Conflicts and Designing Solutions*. NKKV Publishers, Brussels, Belguim, 2003.

- Locate crossings away from highways and other hazard areas to prevent wildlife mortality due to exposure to traffic or other threats, unless studies or expertise from researchers and professionals indicate a high mortality along certain areas necessitating placement of wildlife crossings in such locations.
- Ensure adequate provision and effective design of wildlife crossings to prevent wildlife from crossing adjacent roadways and threatening driver safety after project implementation including areas that the Build Alternatives parallel adjacent roadway corridors.
- In areas where the Build Alternatives parallel roadway corridors, wildlife crossings would be placed to avoid funneling wildlife towards roadways but would be placed in locations with high road mortality, as these areas are considered population sinks and known wildlife corridors.
- Protect both sides of wildlife crossings with long-term conservation easements, particularly at larger crossings.
- Place crossings creating a straight line of sight for wildlife to encourage use of the crossings.
- Consider long-term maintenance requirements of passages and fencing to ensure effectiveness of crossings, especially the bottom of passages in riparian areas and holes in fencing.
- Wildlife crossings in highly urbanized areas, namely in the City of Dallas and Houston, would be limited due to anticipated low wildlife populations.

General Wildlife

To provide a basis for detailed design of wildlife crossings for the Draft EIS stage of the Project, the project team used information gathered during the review of drainage and infrastructure elements to target preliminary locations for the placement of crossings. In addition, areas were identified for further investigation based on proposed embankment length, proximity to water resources, surrounding fragmentation, proximity to viaduct crossings and vegetation type and cover (shown on **Wildlife Crossings Mapbook**). These preliminary locations were identified and mapped in GIS considering the following basic assumptions: [7]

- Viaduct sections would allow “free movement” and would not require wildlife crossings.
- Embankment sections, stations, and large maintenance facilities would “constrict movement” and require wildlife crossings.
- Wildlife crossings would be moved, as appropriate; to take advantage of proposed drainage design features (i.e. culverts).
- Wildlife crossings would be placed regardless of frequency to accommodate special situations (i.e. fenced stations or maintenance facilities and large road crossings).
- Wildlife crossings in highly urbanized areas, namely in the City of Dallas and Houston, would be limited due to anticipated low wildlife populations.

[7] TCRR, “*Texas Central Partners Texas High Speed Rail Final Draft Conceptual Engineering Report-FDCERv7*,” September 15, 2017.

In order for a crossing to be effective for a target species, it would be critical to determine the minimum structure size necessary through environmental analysis. Recommendations for sizing and specifications of wildlife crossings based on current available literature includes:[8, 9, 10]

- Wildlife crossings designed to accommodate small to large wildlife should utilize microhabitat complexity and escape cover (e.g. logs, rock piles) to encourage use by the smaller wildlife. In addition, to encourage use by smaller wildlife, incorporating tunnel sub compartments within the larger wildlife crossings should be considered.
- To encourage use of all wildlife crossings by amphibians and reptiles, natural ponds and riparian habitats should be incorporated into the crossing design. In addition, crossings should maintain existing riparian vegetation, soil moisture and natural light at crossings, where applicable.
- If a closed bottom (i.e. concrete floor) is incorporated into a wildlife crossing, it is recommended that a soil substrate of at least 6 inches be applied to the interior of the crossing.
- For wildlife crossings designed for small to medium-sized wildlife, ensure that sufficient cover and protection is incorporated into the crossing design. These crossings should be placed in known routes of seasonal migration, dispersal or other movement events for target amphibians and reptiles to encourage use by these species.
- The recommended dimension of a wildlife crossing underpass for small to large mammals is 32 feet wide and greater than 13 feet high with a minimum recommendation of 23 feet wide and 13 feet high.
- The minimum recommended dimension of a wildlife crossing underpass incorporated into large creek culvert crossings is greater than 10 feet wide and greater than 13 feet high with a minimum of six and a half feet wide and 10 feet high. This size could be used for small to large mammals as well as amphibians and reptiles. For smaller modified culverts, the recommended dimension for small to medium-sized mammals and amphibians and reptiles is greater than three feet wide and greater than four feet high with a minimum of one and a half feet wide and greater than three feet high.
- For wildlife crossings designed for small to medium-sized mammals, the recommended size is one to four feet wide and one to four feet high or a diameter of one to four feet.
- Amphibian and reptile tunnel dimensions would vary depending on target species. The recommended size range for tunnels is one to three feet in diameter.
- Tunnels installed for the passage of amphibians and reptiles should be placed between upland habitat and wetland breeding grounds or between isolated wetlands. The tunnels should be placed to allow for migration of adults to travel from breeding grounds, migration of adults returning to upland habitat, and the emigration of metamorphs from breeding ponds.

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[8] Clevenger, Anthony P. and Huijser, Marcel P. *Wildlife Crossing Structure Handbook Design and Evaluation in North America.* Federal Highway Administration, 2011.

[9] Iuell, B.; Bekker, C.J.; Cuperus, R.; Dufek, J.; Fry, G.; Hicks, C.; Hlavac, V.; Keller, V.; Rosell, C.; Sangwine, T.; Torslov, N.; and Wandall, B. *Wildlife and Traffic: A European Handbook for Identifying Conflicts and Designing Solutions*. NKKV Publishers, Brussels, Belguim, 2003.

[10] Roads & Ecological Infrastructure: Concepts and Applications for Small Animals, Edited by Kimberly M. Andrews, Priya Nanjappa, and Seth P. D. Riley, The Wildlife Society, 2015, Chapter 6: The Current Planning and Design Process

Riparian and Flooding Areas

Wildlife corridors are generally associated with riparian habitats; therefore, wildlife crossings placed in riparian areas can be desirable for the free movement of wildlife. If the riparian habitat would be retained or cover would be provided along the walls of underpasses, small and medium-sized wildlife are more likely to utilize wildlife crossings placed in these areas. In addition, these types of crossings can be easily adapted for amphibians and reptiles.[11] A large number of the wildlife crossings would be placed in association or in conjunction with creek crossings within the Study Area. These creek corridors are often the only sufficiently vegetated areas in otherwise predominantly agricultural or developed areas. They frequently serve as wildlife travel corridors and as foraging and resting habitat for wildlife.

Where the track configuration would be on an embankment, creeks would be carried through culverts. These culverts would be designed to accommodate the 100-year flood with three feet of freeboard. Culverts would be used by some species during dry periods to cross the alignment, but during heavy rain events these crossings may be flooded. However, additional culvert design features should be considered to allow safe passage for wildlife at these crossings during flood events. In areas where culvert placement or structure does not allow for these additional design features, the design team would review the need for additional crossings at higher elevations.

Once a preferred alternative has been selected, the considerations and recommendations below would be incorporated into more detailed design as appropriate.[12, 13, 14]

- Culverts for wildlife crossings can be placed near those used to convey stormwater, but should be placed at an elevation above the design flood elevation. Travel routes to these wildlife crossing culverts would also need to be above the 100-year flood elevations and should have appropriate cover.
- Wildlife crossings incorporated into culvert design should include minimal clearing widths to reduce impacts on existing vegetation. Where practicable, open designs should be considered to provide ample natural lighting to allow for natural vegetative growth.
- Wildlife crossings incorporated into culvert design should consider specifications to accommodate amphibians and reptiles as well as small to large mammals.
- Even in riparian zones, culverts should be built with dry ledges for use by water-shy wildlife, and ledges should be located above the design flood elevation.
- Where wildlife crossings are incorporated into creek culverts, specific size specifications for each crossing would be based on the results of the environmental analyses, as well as coordination with local land owners, trained biologists, and wildlife agencies (A minimum size recommendation is provided above in **General Wildlife**).
- Avoid importation of soils from outside the Study Area.

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[11] Clevenger, Anthony P. and Huijser, Marcel P. *Wildlife Crossing Structure Handbook Design and Evaluation in North America.* Federal Highway Administration, 2011.

[12] TCRR, "*Texas Central Partners Texas High Speed Rail Final Draft Conceptual Engineering Report-FDCERv7*," September 15, 2017.

[13] Clevenger, Anthony P. and Huijser, Marcel P. *Wildlife Crossing Structure Handbook Design and Evaluation in North America.* Federal Highway Administration, 2011.

[14] Iuell, B.; Bekker, C.J.; Cuperus, R.; Dufek, J.; Fry, G.; Hicks, C.; Hlavac, V.; Keller, V.; Rosell, C.; Sangwine, T.; Torslov, N.; and Wandall, B. *Wildlife and Traffic: A European Handbook for Identifying Conflicts and Designing Solutions*. NKKV Publishers, Brussels, Belguim, 2003.

- Escape cover should be provided for small to medium wildlife to avoid predation and encourage use.
- Box culverts have been found effective in both riparian and upland situations, especially when used in conjunction with fencing to guide (or "funnel") animals into the culvert.
- Selection of the substrate in the floor of the culvert has been demonstrated to be important and should be the same or similar to the substrate in the surrounding habitat.
- Long-term monitoring and maintenance of the culverts should be considered to maintain effectiveness, especially following precipitation events.
- Boulders, riprap, or other coarse materials should not be used to maintain the aprons on culverts used for passage by small-bodied animals since rough materials may be difficult to navigate for small and hoofed wildlife unless a smooth pathway is provided.

Frequency of Wildlife Crossings

Factors that influence landscape connectivity (the degree to which the landscape facilitates or impedes wildlife movement and ecological flows) include terrain, habitat type, levels of human activity and climate. Therefore, in order to determine optimum frequency, spacing and placement of wildlife crossings along the Build Alternatives, considerations include the variability of landscape, population densities, species movement data, biology for target species and the juxtaposition of wildlife habitat, including critical habitat that intersects the LOD and the connectivity requirements for the target species. In general, landscapes that are highly fragmented with little natural habitat would require fewer wildlife crossings as compared to relatively intact, less fragmented landscapes.[15] To facilitate spacing of wildlife crossings, the home ranges for target species would be determined through environmental analysis once a final build alternative is selected. The size of a particular species' home range is directly related to the size of the animal and its ability to move.[16] In addition, habitat suitability models should be created for target species including previously mentioned factors as well as land cover, elevation, topographic position, slope, aspect, proximity to water resources and soil characteristics. Habitat utilization is influenced by but not limited to food resource availability, mating and nesting sites, avoidance of predators, and hazards and competition with other species.[17] The design team would work with the environmental analysis team to develop impact mitigation standards, which would prescribe a minimum crossing density (crossings/mile) based on the biology of the target species (large vs. small vs. amphibian/reptilian), habitat fragmentation (highly fragmented vs. largely intact), habitat types, and construction type (i.e. viaduct vs. embankment). Individual wildlife crossing needs would also be identified for any target species found within the corridor that are federally listed as threatened or endangered and would consider the species' home range and habitat suitability models. A minimum crossing frequency of one-half mile (+/- 0.1 mile) would be applied along the Build Alternative where wildlife migration would be constricted.[18, 19]

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[15] Clevenger, Anthony P. and Huijser, Marcel P. *Wildlife Crossing Structure Handbook Design and Evaluation in North America.* Federal Highway Administration, 2011.

[16] Bissonett, John A. and Cramer, Patricia C. *Evaluation of the Use and Effectiveness of Wildlife Crossings, NCHRP Report 615*. Transportation Research Board, Washington D.C., 2008.

[17] Corridor Design. "Conceptual steps for designing wildlife corridors." http://corridordesign.org/designing_corridors. 2013. Accessed July 28, 2016

[18] TCRR, "*Texas Central Partners Texas High Speed Rail Final Draft Conceptual Engineering Report-FDCERv7*," September 15, 2017.

[19] Clevenger, Anthony P. and Huijser, Marcel P. *Wildlife Crossing Structure Handbook Design and Evaluation in North America.* Federal Highway Administration, 2011.

Additional recommendations and considerations for frequency and spacing of wildlife crossings based on current available literature includes:[20, 21, 22]

- Determine land use within and adjacent to the LOD based on aerial photography and EMST data to identify areas considered urban vs. non-urban.
- Preliminary wildlife crossings in areas with soils types preferred by the Houston toad would be placed every 500 feet; however, to allow for safe passage of amphibians and reptiles, including the Houston Toad, and increase the acceptance of the tunnels, it is recommended that tunnels be placed no more than 100 feet apart and in close proximity to breeding ponds.

The final number, types and spacing of wildlife crossings would be based upon the results of the environmental analyses, coordination with wildlife agencies and local subject matter experts once a preferred alternative is selected.

Land Use and Ownership

Land use and property ownership would be considered when determining the placement and design of wildlife crossings. Communication and coordination with land owners will aid in identifying potential issues related to unwanted wildlife movement onto or off of their property. As appropriate to mitigate impacts, existing rural fences that would allow wildlife species to pass through would be improved.[23]

During design, crossings would generally be placed on larger tracts of land with suitable habitat where ingress and egress are confined to the same property; if ingress and egress to the crossing are located on separate properties, special arrangements such as conservation easements would likely be necessary with individual landowners.[24]

Project-Specific Considerations

Embankment Sections

Wildlife crossings would be integrated along embankment sections at sufficient intervals along the Build Alternatives in order to facilitate wildlife movement and prevent wildlife movement barriers. At this level of design development, it is assumed that these crossings would most often be integrated with culvert crossings for drainage because wildlife corridors are generally associated with riparian habitats, culverts, employing wildlife-friendly designs such as catwalk sections [25], could be used by some species during dry periods to cross the Build Alternatives. Additional information regarding these types of crossings is provided above in **Riparian and Flooding Areas**. Based on the number and frequency of culvert crossings and proximity to

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[20] Clevenger, Anthony P. and Huijser, Marcel P. *Wildlife Crossing Structure Handbook Design and Evaluation in North America.* Federal Highway Administration, 2011.

[21] Iuell, B.; Bekker, C.J.; Cuperus, R.; Dufek, J.; Fry, G.; Hicks, C.; Hlavac, V.; Keller, V.; Rosell, C.; Sangwine, T.; Torslov, N.; and Wandall, B. *Wildlife and Traffic: A European Handbook for Identifying Conflicts and Designing Solutions*. NKKV Publishers, Brussels, Belguim, 2003.

[22] Jochimsen, Denim M.; Peterson, Charles R.; Andrews, Kimberly M.; and Gibbons, J. Whitfield. A Literature Review of the Effects of Roads on Amphibians and Reptiles and the Measures Used to Minimize those Effects. Idaho Fish and Game Department, 2004.

[23] Ibid.

[24] Ibid.

[25] Andrews, K.M., P. Nanjappa, and S.P.D. Riley. Roads and Ecological Infrastructure. Johns Hopkins Press. Baltimore, Maryland. 2015.

viaduct sections, it is recommended that a minimum of 74 wildlife crossings are constructed along the approximately 120.6 miles of embankment sections (shown on **Wildlife Crossings Mapbook)**. Approximately 69 miles of embankment were identified for further investigation based on embankment length, proximity to water resources, amount or lack of habitat fragmentation, distance to viaduct crossings and vegetation cover (woodland, grassland and agricultural) (shown on **Wildlife Crossings Mapbook)**. For the total number of proposed wildlife crossings and the miles identified for further investigation by segment, refer to **Table 1**. Additional typical details for culverts and wildlife crossings have been included in the Draft Conceptual Engineering Report.[26]

Table 1: Comparison by Segment

Segments	Miles on Embankment	# of Potential Minimum Wildlife Crossings	Miles of Further Investigation
Segment 1	2.9	0	3.1
Segment 2A	5.7	2	2.1
Segment 2B	6.4	2	3.2
Segment 3A	8.8	5	4.8
Segment 3B	10.7	9	5.5
Segment 3C	30.2	16	20.6
Segment 4	28.6	21	14.9
Segment 5	27.5	19	15.0

Source: AECOM, 2017

Identifying optimal locations for wildlife crossings as well as the final size and frequency of proposed wildlife crossings would be determined through field investigations by trained biologists, more detailed Project designs and coordination with local land owners and wildlife agencies.

Crossings would be located in areas with appropriate vegetation which provide sufficient wildlife cover to encourage the use of these crossings. This would be especially important for smaller and less mobile species. Wooded bottomlands, mesic and upland forests and woodlands or other areas with cover vegetation, such as vegetated fence lines, would be more attractive to wildlife and would have a greater frequency of crossings.

Viaduct Sections

Corridor segments with viaducts would not require many special considerations other than the placement of security fences or other barriers to prevent access by wildlife to the rail and access roads constructed on viaduct.

Viaducts are generally used where the track configuration would be located more than 20 feet (6.1 meters) above the surrounding grade. In addition, viaducts would also be used to cross floodplains and large water resources to minimize fill in those areas. Viaducts would be placed

[26] TCRR, "*Texas Central Partners Texas High Speed Rail Final Draft Conceptual Engineering Report-FDCERv7*," September 15, 2017.

to minimize disturbance to habitats, vegetation and riparian areas and would be designed wide enough to conserve riparian habitats and maintain local landform. Based on the current conceptual design, approximately 60 percent of the Build Alternatives would be constructed on viaduct. The viaducts would be constructed between approximately 5 and 80 feet from natural ground to the lowest elevation of the viaduct beam. The placement of viaducts along the Build Alternatives would provide unimpeded wildlife movement in floodplains and riparian areas where there would be significant wildlife habitat as well as other wildlife movement corridors. To mitigate impacts, expanded use of viaducts would be investigated as an infrastructure approach in critical wildlife habitat areas and areas with significant wildlife populations.

Fencing

In order to further reduce the risk of wildlife collisions and ensure the safe operation of the HSR system, fencing would be used to divert or funnel wildlife into the wildlife crossings. Fencing for the entire Build Alternative and for all crossings would be securely designed and tamper-proof so that animals cannot burrow, chew, climb or otherwise access the HSR line.[27] Standard fencing would consist of various sizes of page wire or similar material fencing at minimum of 12 feet high for large mammals and six feet high for small mammals. Fencing would be reinforced with dense, high-resistant wire mesh as applicable. Given propensity of the feral pig for cursorial (digging/rooting) behavior, protection of the HSR line from these animals would be a key consideration. High-strength buried fencing, or electrified fencing, would be required in areas with established pig populations and where the grade separation of the tracks and the natural ground is minimal. Typical details in the conceptual design for potential fencing types that could be employed at different locations along the Build Alternatives are included in the Draft Conceptual Engineering drawings.[28] In addition, long-term monitoring and maintenance of fencing should be considered to maintain integrity and effectiveness following installation.

Wildlife Overpasses

Wildlife overpasses are typically employed along roadways to reduce traffic mortality for wildlife, provide safe passage for large-bodied mammals and improve roadway safety. However, given that the majority of the HSR line would be constructed on an embankment or on an elevated viaduct with overhead catenary, the use of overpasses would likely be cost prohibitive except in select locations. In locations where topography or soils would not support culverts below track level, the use of overpasses would be considered.[29]

The following are considerations and recommendations related to overpasses for wildlife crossings:[30, 31]

- Typically the highest cost option, overpasses are typically used over multi-lane roadways, roadways with high-density and fast-driving traffic, high-speed railway line in areas where wildlife/vehicle collisions are relatively frequent and result in severe injuries or fatalities, or when special status species or ungulates (e.g. white-tailed deer

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[27] TCRR, "*Texas Central Partners Texas High Speed Rail Final Draft Conceptual Engineering Report-FDCERv7*," September 15, 2017.
[28] Ibid.
[29] Ibid.
[30] Clevenger, Anthony P. and Huijser, Marcel P. *Wildlife Crossing Structure Handbook Design and Evaluation in North America.* Federal Highway Administration, 2011.
[31] Iuell, B.; Bekker, C.J.; Cuperus, R.; Dufek, J.; Fry, G.; Hicks, C.; Hlavac, V.; Keller, V.; Rosell, C.; Sangwine, T.; Torslov, N.; and Wandall, B. *Wildlife and Traffic: A European Handbook for Identifying Conflicts and Designing Solutions*. NKKV Publishers, Brussels, Belguim, 2003.

[*Odocoileus virginianus*]) and small to large mammals (e.g. bobcat [*Lynx rufus*] and rabbits) are involved.

- The placement of overpasses should be oriented and sized to the occurrence and behavior of the target species. The overpass should be wide enough at its narrowest point to function as a habitat corridor. In general, the minimum width recommendation for overpasses is 130 to 165 feet.
- In general, larger wildlife requires wider overpasses than smaller wildlife. In addition, smaller wildlife tends to rely on special habitat features, such as vegetation for cover.
- To ensure performance and function, wildlife overpasses should be situated in areas with high landscape permeability, are known wildlife travel corridors, and have minimal human disturbance.
- Fencing and vegetation can be used to direct animals to the overpass.
- Substrate and vegetation on the overpass should match that of surrounding landscapes and provide cover and refuge for small to medium wildlife.
- Soil depth should be sufficient for water retention for plant growth and support trees, if applicable, while providing adequate drainage.
- Overpasses can be effectively used to maintain habitat connectivity, especially when used in conjunction with vegetation and fencing to guide animals to over-crossing. Overpasses themselves may serve as intermediate habitat for smaller-sized organisms.
- Vegetation is often used to provide a sight and sound barrier at edges of overpass to encourage use by disturbance-shy animals.
- Long-term monitoring and maintenance of the structure and drainage system should be considered to maintain effectiveness and safety of the overpass.

Species-Specific Crossings

The effectiveness of the type of wildlife crossings utilized along the Build Alternatives would differ based on the target species. A list of wildlife species with the potential to occur in the Study Area is provided in **Section 3.6, Natural Ecological Systems and Protected Species** in the Draft EIS. For the purposes of identifying minimum recommended wildlife crossing width and heights, the target species are combined in to general groups consisting of large mammals (e.g. white-tailed deer), medium-sized mammals (e.g. bobcat, coyote [*Canis latrans*] and raccoon [*Procyon lotor*]), small mammals (e.g. ground squirrels and mice), and amphibians and reptiles (e.g. frogs, toads, snakes and lizards). As a general rule, wildlife crossings should be designed to allow for the movement of the greatest diversity of species.

As no standard design document is available for Texas-specific species, the project team would consult guidelines, successful designs, and Best Management Practices (BMPs) for wildlife crossings in other geographic areas, such as those by the California Department of Transportation (Caltrans) and the Arizona Game and Fish Department (AZGFD) as identified in the Draft Conceptual Engineering Report, and the Federal Highway Administration (FHWA) and European Commission. Guidance from these and similar sources would be adapted to create successful design approaches for species specific to the Study Area.

Houston Toad

The Houston toad is a federal and state-listed endangered species. Therefore, this species and its habitat are afforded federal protection under the Endangered Species Act, as discussed in **Section 3.6, Natural Ecological Systems and Protected Species**. Once a preferred alternative has been selected, canopy cover and soil type should be taken into consideration for optimizing locations of wildlife crossings within Houston toad habitat. All other considerations would correspond with general amphibian and reptile target species.

Future Design Development Approach for Wildlife Crossings

The level of detail developed for the design and placement of wildlife crossings would increase through the planning and design process. Examples of typical details and proposed approaches to mitigation of impacts have been provided with the Draft Conceptual Engineering design to support the Draft EIS. Location-specific treatments and more advanced typical details would be provided in support of the Final EIS following input from the FRA, USFWS and TPWD.

In addition to the literature review, engineers and biologists from the project team have initiated planning-level design development to identify opportunities for wildlife crossings along the Build Alternatives. The planning level efforts completed to date in preparation of the Draft Conceptual Engineering include:[32]

- Drainage Design – Identified existing creek corridors along the Build Alternatives and bridge underpasses or culvert crossings required to meet drainage needs.
- Infrastructure Type Selection – Selected the proposed infrastructure type, namely embankment versus viaduct section; selection driven largely by track configuration and by constructability considerations, but identifies opportunities for wildlife crossing locations.
- Species List for Wildlife Crossings along the Preferred Alternative – Developed a list of species within the Study Area that would require some type of crossing to prevent interruptions to normal migrations patterns or require special considerations due to their protected status (i.e., threatened or endangered).
- Maps of Wildlife Crossing Areas – Performed a desktop analysis to identify the following:
    - Viaduct areas = free wildlife crossing, no special considerations
    - Highly urbanized areas where wildlife crossings would be low priority
    - Crossing locations along embankment sections at a specified interval (for purposes of this exercise, spacing would follow recommendations for white tailed deer)
    - Areas with special crossing considerations for the Houston toad
- Typical Sections for Wildlife Crossings and Fencing – Identified typical wildlife crossing and fencing details that could be modified for the Build Alternatives to meet the requirements of target species (i.e. white-tailed deer and Houston toad) and HSR safety needs.

Considerations and recommendations that should be incorporated into future design along with the planning level efforts mentioned above include the following:[33, 34]

[32] TCRR, "*Texas Central Partners Texas High Speed Rail Final Draft Conceptual Engineering Report-FDCERv7*," September 15, 2017.
[33] Jochimsen, Denim M.; Peterson, Charles R.; Andrews, Kimberly M.; and Gibbons, J. Whitfield. A Literature Review of the Effects of Roads on Amphibians and Reptiles and the Measures Used to Minimize those Effects. Idaho Fish and Game Department, 2004.
[34] Roads & Ecological Infrastructure: Concepts and Applications for Small Animals, Edited by Kimberly M. Andrews, Priya Nanjappa, and Seth P. D. Riley, The Wildlife Society, 2015, Chapter 6: The Current Planning and Design Process

- While highly urbanized areas were considered low priority during the initial planning level efforts, it is recommended that areas along roadway corridors, including IH-45, consider placing wildlife crossings in locations with high road mortality and known wildlife corridors while avoiding funneling wildlife toward the roadways.
- Preliminary wildlife crossings were based on a frequency of every one-half mile. While this spacing is adequate for general wildlife crossings to allow for safe passage of small to large wildlife, tunnels should be placed every 100 feet to allow for the safe passage of amphibians and reptiles, including the Houston Toad, and increase acceptance of the tunnels.
- It is recommended that canopy cover be considered in determining optimum placement of wildlife crossings in Houston toad habitat.
- All bridges and culverts along existing roadways should be mapped and cataloged to assist in optimal placement of wildlife crossings.

The project team used GIS, design plans and aerial photography to analyze existing creek corridors along the Build Alternatives and bridge underpasses, or culvert crossings required to meet drainage needs. This information was compared to the proposed infrastructure type to identify and compare those locations where wildlife migration across the Build Alternatives would be impacted by design. In general, the project team considered viaduct sections with bridge overpasses to be areas of "free movement" for wildlife, where all species within the corridor would be able to easily navigate the corridor without special crossing considerations. As stated previously, approximately 60 percent of the Build Alternatives would be constructed on viaduct to increase permeability of the corridor for wildlife crossings. Conversely, embankment sections with culverted drainage crossings were considered "constricted" by the project team in terms of wildlife movement, thus potentially requiring special design treatments in the form of specialized culvert design and separate wildlife crossings in upland areas, to facilitate passage across the Build Alternatives.[35] The potential locations for specialized culvert design to incorporate wildlife crossings are provided on **Wildlife Crossings Mapbook**. Based on these locations, a minimum of 74 wildlife crossings is recommended along the 120.6 miles of embankment within the Build Alternatives. In addition, areas were identified for further investigation based on proximity to water resources, existing fragmentation, distance to viaduct crossings and vegetation cover (woodland, grassland and agricultural) are shown on **Wildlife Crossings Mapbook**. For the total number of proposed wildlife crossings and the miles identified for further investigation by segment refer to **Table 1**.

For the Final EIS, mitigation measures to address identified impacts would be provided, including site-specific crossing treatments. The level of detail required would be refined through coordination with regulatory bodies during the Final EIS stage, but it is expected that the following actions would be required:[36]

- Field Survey – The Study Area would be surveyed by qualified biologists to determine habitat suitability of crossings proposed in the planning-level design
    - Additional studies in areas identified for further investigation on **Wildlife Crossings Mapbook** would be conducted to determine the need and placement

[35] TCRR, "*Texas Central Partners Texas High Speed Rail Final Draft Conceptual Engineering Report-FDCERv7*," September 15, 2017.
[36] Ibid.

of additional crossings. Approximately 69 miles of the embankment sections were identified for further investigation. For the total number of proposed wildlife crossings and the miles identified for further investigation by segment refer to **Table 1**.
    - In addition, areas identified as listed species habitat would require further investigation to determine the need for additional crossings in those areas
- Develop Site-Specific Requirements for Fencing – Further refine typical details for fencing based on species-specific requirements. Identify locations along the preferred alternative for each fencing type. Where field survey and consultation with local resource agencies and subject matter experts indicate the presence of established feral pig populations, detailed design of specialized fencing would be advanced given the animal's ability to dig, the damage that the animal can do to sensitive systems, and the harm that can be caused by impact with an HSR trainset.
- Develop Site-Specific Crossing Treatments – Document requirements for wildlife treatments (fencing and crossings) based on site-specific habitats and target species. Identify treatments proposed at each location along the preferred alternative.
- Property Impacts – Identify any additional ROW requirements associated with provision of wildlife crossings, such as the purchase of conservation easements in the vicinity of wildlife crossings. Wildlife crossing designs would consider property ownership on either side of the crossing to minimize the need for special arrangements and conservation easements.
- Engage Local Subject Matter Experts – The location and design of wildlife crossings would be informed by local subject matters experts and resource agencies during design as appropriate.

Conclusion and Limitations

This technical memorandum identifies proposed wildlife crossing areas requiring further investigation, considerations, and recommendations for frequency and dimensions for wildlife crossings. The following includes limitations of this technical memorandum:

- The information presented is broad and meant to provide considerations and recommendations for the largest diversity of species possible.
- The considerations and recommendations are based on current literature and not based on agency or landowner coordination or field analysis which is essential when determining optimum placement, type, and frequency of wildlife crossings.
- Specific locations of potential existing wildlife crossings incorporated into existing roadways was not known when determining potential placement of wildlife crossings and areas for further investigation along the Study Area. Therefore, coordination with transportation agencies to determine exact locations of existing wildlife crossings, if any, should be conducted.
- Home ranges and habitat suitability models for target species is not included in publicly available data and was not mapped by the project team at the time that this technical memorandum was prepared.
- Crossings associated with NHD and NWI data relies upon accuracy of those publicly available databases and should be field verified.
- The minimum potential wildlife crossings presented in the technical memorandum is subject to change based on further environmental analysis and coordination.

TECHNICAL MEMORANDUM
WATERS OF THE U.S.

To: Megan Inman, AECOM

From: Jennifer Oakley, AECOM

Date: November 1, 2017

RE: Dallas to Houston HSR – Waters of the U.S.

This technical memorandum identifies the streams, wetlands and waterbodies that occur within the Dallas to Houston HSR Study Area. The tables provided in this memorandum include streams, wetlands and waterbodies based on NHD, NWI and field collected data (as of April 25, 2017) construction type (access road, rail, stormwater drainage, facility, station and temporary fill), crossing type (fill, excavation, viaduct and culvert) and acres of estimated impacts at each crossing. For additional information on waters of the U.S. and descriptions of the crossing types refer to Section 3.7, Waters of the U.S. of the DEI

Dallas County

Table 1: Estimated Stream Impacts – Dallas County						
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 1	
					Temp	Perm
					linear feet	
1	Unnamed	Perennial	Access Road	Viaduct	0.00	0.00
1	Unnamed	Perennial	Station	Viaduct	0.00	0.01
2	Trinity River	Artificial	Access Road	Viaduct	0.00	0.00
2	Trinity River	Artificial	Stormwater Drainage	Excavation	0.00	451.0
2	Trinity River	Artificial	Rail	Viaduct	0.00	0.00
2	Trinity River	Artificial	Temporary Fill	Fill	43.5	0.00
3	Unnamed	Perennial	Access Road	Viaduct	0.00	0.00
3	Unnamed	Perennial	Stormwater Drainage	Excavation	0.00	165.1
3	Unnamed	Perennial	Rail	Viaduct	0.00	0.00
3	Unnamed	Artificial	Access Road	Viaduct	0.00	0.00
3	Unnamed	Artificial	Rail	Viaduct	0.00	0.00
3	NCB2S8	Intermittent	Temporary Fill	Fill	17.0	0.00
3	NCB2S8	Intermittent	Rail	Viaduct	0.00	0.00
3	NCB2S8	Intermittent	Access Road	Viaduct	0.00	0.00
4	Honey Springs Branch	Intermittent	Rail	Viaduct	0.00	0.00
4	NCC2S1	Intermittent	Access Road	Viaduct	0.00	0.00
4	NCC2S1	Intermittent	Rail	Viaduct	0.00	0.00
5	NCC3S1	Perennial	Rail	Viaduct	0.00	0.00
5	NCC3S1	Perennial	Access Road	Viaduct	0.00	0.00
5	NCC3S5	Ephemeral	Access Road	Viaduct	0.00	0.00
5	NCC3S5	Ephemeral	Rail	Viaduct	0.00	0.00
5	NCC3S7	Perennial	Access Road	Viaduct	0.00	0.00
5	NCC3S7	Perennial	Rail	Viaduct	0.00	0.00

Table 1: Estimated Stream Impacts – Dallas County						
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 1	
					Temp	Perm
					linear feet	
6	NCC3S3	Perennial	Access Road	Viaduct	0.00	0.00
6	NCC3S3	Perennial	Rail	Viaduct	0.00	0.00
6	Newton Creek	Perennial	Rail	Viaduct	0.00	0.00
6	Whites Branch	Perennial	Rail	Viaduct	0.00	0.00
9	Unnamed	Artificial	Access Road	Fill	0.00	321.7
9	Unnamed	Artificial	Stormwater Drainage	Excavation	0.00	247.1
9	Unnamed	Artificial	Rail	Fill	0.00	82.9
9	Unnamed	Intermittent	Access Road	Fill	0.00	54.6
10	Tenmile Creek	Perennial	Access Road	Viaduct	0.00	0.00
10	Tenmile Creek	Perennial	Rail	Viaduct	0.00	0.00
11	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00
11	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00
11	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00
				Total	60.5	1,322.4

Source: USGS, 2016; FNI, 2017

*Stream ID # (N) indicates a specific feature recorded in the field whereas stream names (or those "unnamed") indicate features mapped via data not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each stream is separated by construction type.

Table 2: Estimated Wetland Impacts – Dallas County						
Natural Resources Mapbook Page #	Wetland ID/ Classification*	Wetland Type	Construction Type	Crossing Type	Segment 1	
					Temp	Perm
					acres	
2	NCB2FW6	Forested	Access Road	Viaduct/Conversion	0.00	0.01
2	NCB2FW6	Forested	Stormwater Drainage	Excavation	0.00	0.05
2	NCB2FW6	Forested	Rail	Viaduct/Conversion	0.00	0.11

Table 2: Estimated Wetland Impacts – Dallas County						
Natural Resources Mapbook Page #	Wetland ID/ Classification*	Wetland Type	Construction Type	Crossing Type	Segment 1	
					Temp	Perm
					acres	
2	NCB2FW6	Forested	Facility	Fill	0.00	0.03
2	NCB2FW6	Forested	Access Road	Viaduct/Conversion	0.00	0.08
2	NCB2FW6	Forested	Rail	Viaduct/Conversion	0.00	0.01
2	NCB2FW6	Forested	Facility	Fill	0.00	0.02
2	NCB2FW6	Forested	Access Road	Viaduct/Conversion	0.00	0.01
2	NCB2FW6	Forested	Stormwater Drainage	Excavation	0.00	0.06
2	NCB2FW6	Forested	Rail	Viaduct/Conversion	0.00	0.03
2	NCB2FW1	Forested	Access Road	Viaduct/Conversion	0.00	0.09
2	NCB2FW1	Forested	Stormwater Drainage	Excavation	0.00	1.5
2	NCB2FW1	Forested	Rail	Viaduct/Conversion	0.00	0.08
2	PFO1A	Forested	Access Road	Viaduct/Conversion	0.00	0.01
2	PFO1A	Forested	Stormwater Drainage	Excavation	0.00	0.15
2	PFO1A	Forested	Rail	Viaduct/Conversion	0.00	0.13
2	PFO1A	Forested	Temporary Fill	Fill	0.05	0.00
2	NCB2EW2	Emergent	Access Road	Viaduct	0.00	0.00
2	NCB2EW2	Emergent	Stormwater Drainage	Excavation	0.00	<0.01
2	NCB2EW2	Emergent	Rail	Viaduct	0.00	0.00
2	PFO1A	Forested	Stormwater Drainage	Excavation	0.00	0.10
2	PEM1A	Emergent	Access Road	Viaduct	0.00	0.00
2	PEM1A	Emergent	Stormwater Drainage	Excavation	0.00	2.12
2	PEM1A	Emergent	Rail	Viaduct	0.00	0.00
2	PEM1A	Emergent	Temporary Fill	Fill	0.27	0.00
3	PEM1A	Emergent	Access Road	Viaduct	0.00	0.00
3	PEM1A	Emergent	Rail	Viaduct	0.00	0.00
4	PFO1A	Forested	Utilities	Viaduct/Conversion	0.01	0.00
5	NCC2EW2	Emergent	Access Road	Viaduct	0.00	0.00

Table 2: Estimated Wetland Impacts – Dallas County						
Natural Resources Mapbook Page #	Wetland ID/ Classification*	Wetland Type	Construction Type	Crossing Type	Segment 1	
					Temp	Perm
					acres	
5	NCC3SW4	Scrub/Shrub	Access Road	Viaduct	0.00	0.00
5	NCC3SW4	Scrub/Shrub	Rail	Viaduct	0.00	0.00
5	NCC3FW8	Forested	Rail	Viaduct	0.00	0.04
5	NCC3FW1	Forested	Access Road	Viaduct/Conversion	0.00	0.04
5	NCC3FW1	Forested	Rail	Viaduct/Conversion	0.00	0.14
5	NCC3FW1	Forested	Access Road	Viaduct/Conversion	0.00	0.02
5	NCC3FW99	Forested	Utilities	Fill	0.10	0.00
5	NCC3FW99	Forested	Access Road	Viaduct/Conversion	0.00	0.13
5	NCC3FW99	Forested	Rail	Viaduct/Conversion	0.00	1.3
6	NCC3FW98	Forested	Rail	Viaduct/Conversion	0.00	0.07
6	PFO1A	Forested	Rail	Viaduct/Conversion	0.00	0.60
7	PFO1C	Forested	Access Road	Fill	0.00	<0.01
10	PFO1A	Forested	Access Road	Viaduct/Conversion	0.00	0.35
10	PFO1A	Forested	Rail	Viaduct/Conversion	0.00	0.75
10	PFO1C	Forested	Rail	Viaduct/Conversion	0.00	0.04
2	NCB2FW6	Forested	Access Road	Viaduct/Conversion	0.00	0.01
				Total	0.43	8.1

Source: USFWS, 2016; FNI, 2017

*Wetland ID # (N) indicates a specific feature recorded in the field. Wetland classifications (P) indicate wetlands not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each wetland is separated by construction type.

P - Palustrine
EM – Emergent
FO – Forested
FO1 – Broad-leaved Deciduous Forested
EM1 - Persistent Emergent
A - Temporarily Flooded
C - Seasonally Flooded

Table 3: Estimated Waterbody Impacts – Dallas County						
Natural Resources Mapbook Page #	Waterbody ID/Name *	Waterbody Type	Construction Type	Crossing Type	Segment 1	
					Temp	Perm
					acres	
2	NCB2PD5	Pond	Access Road	Viaduct	0.00	0.00
2	NCB2PD5	Pond	Facility	Fill	0.00	0.08
2	NCB2PD5	Pond	Temporary Fill	Fill	<0.01	0.00
2	NCB2PD5	Pond	Facility	Fill	0.00	0.01
2	NCB2PD5	Pond	Access Road	Viaduct	0.00	0.00
2	NCB2PD5	Pond	Stormwater Drainage	Excavation	0.00	0.13
2	NCB2PD5	Pond	Rail	Viaduct	0.00	0.00
2	Unnamed	Pond	Stormwater Drainage	Excavation	0.00	0.26
2	Unnamed	Pond	Rail	Viaduct	0.00	0.00
2	Unnamed	Pond	Access Road	Viaduct	0.00	0.00
2	Unnamed	Pond	Stormwater Drainage	Excavation	0.00	0.62
3	Unnamed	Pond	Access Road	Viaduct	0.00	0.00
3	Unnamed	Pond	Rail	Viaduct	0.00	0.00
7	Unnamed	Pond	Rail	Viaduct	0.00	0.00
7	Unnamed	Pond	Access Road	Viaduct	0.00	0.00
8	Mooreland Lake	Lake	Rail	Viaduct	0.00	0.00
9	Unnamed	Pond	Access Road	Fill	0.00	0.05
9	Unnamed	Pond	Stormwater Drainage	Excavation	0.00	0.43
9	Unnamed	Pond	Rail	Fill	0.00	0.55
				Total	<0.01	2.1

Source: USGS, 2016; USFWS, 2016; FNI, 2017

*Waterbody ID # (N) indicates a specific feature recorded in the field. Waterbody classifications (P) indicate wetlands not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each waterbody is separated by construction type.

Ellis County

Natural Resources Mapbook Page #	Stream ID/ Name*	Classification	Construction Type	Crossing Type	Segment 1		Segment 2A		Segment 2B		Segment 3A		Segment 3B		Segment 3C	
Table 4: Estimated Stream Impacts for – Ellis County																
					Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet		linear feet		linear feet		linear feet	
12	Long Branch	Perennial	Access Road	Viaduct	0.00	0.00	--	--	--	--	--	--	--	--	--	--
12	Long Branch	Perennial	Rail	Viaduct	0.00	0.00	--	--	--	--	--	--	--	--	--	--
13	Bear Creek	Perennial	Access Road	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
13	Bear Creek	Perennial	Rail	Viaduct	--	--	0.00	0.00	0.00	0.00	--	--	--	--	--	--
13	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
13	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
13	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
13	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
13	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
13	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
13	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
13	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
13	Unnamed	Intermittent	Access Road	Excavation	--	--	--	--	0.00	152.8	--	--	--	--	--	--
13	Unnamed	Intermittent	Access Road	Fill	--	--	--	--	0.00	276.5	--	--	--	--	--	--
13	Unnamed	Intermittent	Rail	Fill	--	--	--	--	0.00	276.5	--	--	--	--	--	--
13	Unnamed	Artificial	Access Road	Fill	--	--	0.00	5.6	--	--	--	--	--	--	--	--
13	Unnamed	Artificial	Rail	Fill	--	--	0.00	152.8	--	--	--	--	--	--	--	--
13	Unnamed	Artificial	Rail	Excavation	--	--	--	--	0.00	5.6	--	--	--	--	--	--
13	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
13	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
14	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--

Natural Resources Mapbook Page #	Stream ID/ Name*	Classification	Construction Type	Crossing Type	Segment 1		Segment 2A		Segment 2B		Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet		linear feet		linear feet		linear feet	
14	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
15	NCF3S10	Perennial	Rail	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
15	Brushy Creek	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
15	Brushy Creek	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
15	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
15	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
15	NCG3S7	Ephemeral	Access Road	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
15	NCG3S7	Ephemeral	Rail	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
15	NCG3S8	Ephemeral	Access Road	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
15	NCG3S8	Ephemeral	Rail	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
15	NCG3S2	Ephemeral	Access Road	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
15	NCG3S2	Ephemeral	Rail	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
15	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
15	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
15	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
15	NCG3S3	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
15	NCG3S3	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
16	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
16	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
16	Unnamed	Artificial	Access Road	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
16	Unnamed	Artificial	Rail	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
16	Red Oak Creek	Perennial	Access Road	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
16	Red Oak Creek	Perennial	Rail	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--

Table 4: Estimated Stream Impacts for – Ellis County

Table 4: Estimated Stream Impacts for – Ellis County																
Natural Resources Mapbook Page #	Stream ID/ Name*	Classification	Construction Type	Crossing Type	Segment 1		Segment 2A		Segment 2B		Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet		linear feet		linear feet		linear feet	
16	NCG3S4	Perennial	Access Road	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
16	NCG3S4	Perennial	Rail	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
17	Unnamed	Artificial	Access Road	Fill	--	--	0.00	11.6	--	--	--	--	--	--	--	--
17	Unnamed	Artificial	Rail	Fill	--	--	0.00	11.6	--	--	--	--	--	--	--	--
17	Unnamed	Artificial	Rail	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
17	Unnamed	Artificial	Access Road	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
17	Unnamed	Intermittent	Access Road	Fill	--	--	0.00	246.0	--	--	--	--	--	--	--	--
17	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
17	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
17	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
17	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
17	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
17	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
17	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
17	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
17	Bone Branch	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
17	Bone Branch	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
18	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
18	Bone Branch	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
18	Bone Branch	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
18	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
18	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
18	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--

Natural Resources Mapbook Page #	Stream ID/ Name*	Classification	Construction Type	Crossing Type	Segment 1		Segment 2A		Segment 2B		Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet		linear feet		linear feet		linear feet	
18	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
18	Grove Creek	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
18	Grove Creek	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
18	NCH3S13	Perennial	Access Road	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
18	NCH3S13	Perennial	Rail	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
18	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
18	Grove Creek	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
18	Grove Creek	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
19	NCH3S6	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
19	NCH3S6	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
19	Cottonwood Creek	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
19	Cottonwood Creek	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
19	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	--	--	0.00	82.1	--	--	--	--	--	--
19	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
19	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
19	Unnamed	Artificial	Access Road	Fill	--	--	--	--	0.00	280.8	--	--	--	--	--	--
19	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	--	--	0.00	172.3	--	--	--	--	--	--
19	Unnamed	Intermittent	Rail	Fill	--	--	--	--	0.00	125.6	--	--	--	--	--	--
19	Unnamed	Intermittent	Temporary Fill	Fill	--	--	2.5	0.00	--	--	--	--	--	--	--	--
19	Unnamed	Intermittent	Temporary Fill	Fill	--	--	--	--	2.5	0.00	--	--	--	--	--	--
19	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	2.5	0.00	--	--	--	--	--	--

Table 4: Estimated Stream Impacts for – Ellis County																
Natural Resources Mapbook Page #	Stream ID/ Name*	Classification	Construction Type	Crossing Type	Segment 1		Segment 2A		Segment 2B		Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet		linear feet		linear feet		linear feet	
19	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
19	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
20	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
20	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
20	Mustang Creek	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
20	Mustang Creek	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
20	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
20	Mustang Creek	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
20	Mustang Creek	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
20	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
20	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
20	NCI3S1	Ephemeral	Access Road	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
20	NCI3S1	Ephemeral	Rail	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
20	NCI3S2	Ephemeral	Access Road	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
20	NCI3S2	Ephemeral	Rail	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
22	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
22	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
22	NCI3S5	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
22	NCI3S5	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
22, 23	Waxahachie Creek	Perennial	Rail	Viaduct	--	--	0.00	0.00	0.00	0.00	--	--	--	--	--	--
22	NCI3S7	Perennial	Rail	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
23	Waxahachie Creek	Perennial	Access Road	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--

Table 4: Estimated Stream Impacts for – Ellis County																
Natural Resources Mapbook Page #	Stream ID/ Name*	Classification	Construction Type	Crossing Type	Segment 1		Segment 2A		Segment 2B		Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet		linear feet		linear feet		linear feet	
23	Unnamed	Perennial	Access Road	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
40	Unnamed	Perennial	Rail	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
40	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
40	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
23	Unnamed	Intermittent	Utilities	Viaduct	--	--	52.3	0.00	--	--	--	--	--	--	--	--
23	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
23	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
40	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
40	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
40	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
40	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
24	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
24	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
24	Unnamed	Intermittent	Utilities	Viaduct	--	--	--	--	40.2	0.00	--	--	--	--	--	--
24	NCJ3S9	Ephemeral	Stormwater Drainage	Excavation	--	--	0.00	301.3	--	--	--	--	--	--	--	--
24	NCJ3S9	Ephemeral	Access Road	Fill	--	--	0.00	22.2	--	--	--	--	--	--	--	--
24	NCJ3S9	Ephemeral	Rail	Fill	--	--	0.00	265.6	--	--	--	--	--	--	--	--
24	Unnamed	Intermittent	Access Road	Fill	--	--	--	--	0.00	121.5	--	--	--	--	--	--
41	Unnamed	Intermittent	Rail	Fill	--	--	--	--	0.00	305.6	--	--	--	--	--	--
25	Elm Branch	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
25	Elm Branch	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
25	NCJ3S3	Ephemeral	Stormwater Drainage	Excavation	--	--	0.00	86.2	--	--	--	--	--	--	--	--
25	NCJ3S3	Ephemeral	Access Road	Fill	--	--	0.00	68.2	--	--	--	--	--	--	--	--

Table 4: Estimated Stream Impacts for – Ellis County																
Natural Resources Mapbook Page #	Stream ID/ Name*	Classification	Construction Type	Crossing Type	Segment 1		Segment 2A		Segment 2B		Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet		linear feet		linear feet		linear feet	
25	NCJ3S3	Ephemeral	Rail	Fill	--	--	0.00	190.6	--	--	--	--	--	--	--	--
25	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
25	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
26	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	--	--	0.00	81.0	--	--	--	--	--	--
26	Unnamed	Intermittent	Access Road	Fill	--	--	--	--	0.00	30.6	--	--	--	--	--	--
26	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
26	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
26	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
26	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
26	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
26	NCK4S2	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
26	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
26	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
26	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
26	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
26	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
26	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
26	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
26	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
26	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
26	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
26	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
26	NCK4S2	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
26	NCK4S3	Ephemeral	Access Road	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
26	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--

Table 4: Estimated Stream Impacts for – Ellis County																
Natural Resources Mapbook Page #	Stream ID/ Name*	Classification	Construction Type	Crossing Type	Segment 1		Segment 2A		Segment 2B		Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet		linear feet		linear feet		linear feet	
26	NCK4S3	Ephemeral	Rail	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
27	NCK4S4	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
27	NCK4S4	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--	--	--	--	--	--	--
27	Big Onion Creek	Perennial	Access Road	Viaduct	--	--	--	--	0.00	0.00	--	--	--	--	--	--
27	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	--	--	0.00	0.00	--	--	--	--
27	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	--	--	--	--	0.00	0.00	--	--
27	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	--	--	--	--	0.00	0.00	--	--
27	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	--	--	--	--	--	--	0.00	0.00
27	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	--	--	0.00	0.00	--	--	--	--
27	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	--	--	--	--	--	--	0.00	0.00
27	Clear Creek	Intermittent	Stormwater Drainage	Excavation	--	--	--	--	--	--	0.00	21.9	0.00	118.1	0.00	21.9
27	Clear Creek	Intermittent	Rail	Fill	--	--	--	--	--	--	--	--	0.00	117.4	--	--
27	Clear Creek	Intermittent	Access Road	Viaduct	--	--	--	--	--	--	0.00	0.00	--	--	0.00	0.00
27	Clear Creek	Intermittent	Rail	Viaduct	--	--	--	--	--	--	0.00	0.00	--	--	0.00	0.00
27	Clear Creek	Intermittent	Access Road	Fill	--	--	--	--	--	--	--	--	0.00	62.4	--	--
				Total	0.00	0.00	54.8	1,361.6	45.2	1,910.8	0.00	21.9	0.00	297.9	0.00	21.9

Source: USGS, 2016; FNI, 2017

*Stream ID # (N) indicates a specific feature recorded in the field whereas stream names (or those "unnamed") indicate features mapped via data not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each stream is separated by construction type.

'--' - not present

Table 5: Estimated Wetland Impacts – Ellis County														
Natural Resources Mapbook Page #	Wetland ID/ Classification*	Wetland Type	Construction Type	Crossing Type	Segment 2A		Segment 2B		Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet		linear feet		linear feet	
13	PFO1C	Forested	Access Road	Viaduct/ Conversion	--	--	0.00	0.03	--	--	--	--	--	--
13	PFO1C	Forested	Rail	Viaduct/ Conversion	--	--	0.00	0.05	--	--	--	--	--	--
13	PFO1C	Forested	Rail	Viaduct/ Conversion	0.00	0.05	--	--	--	--	--	--	--	--
16	PFO1A	Forested	Access Road	Viaduct/ Conversion	--	--	0.00	0.12	--	--	--	--	--	--
16	PFO1A	Forested	Rail	Viaduct/ Conversion	--	--	0.00	0.69	--	--	--	--	--	--
16	NCG3EW2	Emergent	Access Road	Viaduct	0.00	0.00	--	--	--	--	--	--	--	--
16	NCG3EW2	Emergent	Rail	Viaduct	0.00	0.00	--	--	--	--	--	--	--	--
17	NCG3EW14	Emergent	Access Road	Fill	0.00	0.07	--	--	--	--	--	--	--	--
17	NCG3EW16	Emergent	Access Road	Fill	0.00	0.04	--	--	--	--	--	--	--	--
17	NCG3EW15	Emergent	Access Road	Fill	0.00	0.06	--	--	--	--	--	--	--	--
17	NCG3EW17	Emergent	Access Road	Fill	0.00	0.37	--	--	--	--	--	--	--	--
17	NCG3EW17	Emergent	Rail	Fill	0.00	0.42	--	--	--	--	--	--	--	--
17	NCG3EW18	Emergent	Stormwater Drainage	Excavation	0.00	<0.01	--	--	--	--	--	--	--	--
17	NCG3EW18	Emergent	Access Road	Fill	0.00	0.08	--	--	--	--	--	--	--	--
17	NCG3EW19	Emergent	Access Road	Fill	0.00	0.01	--	--	--	--	--	--	--	--
17	NCG3EW20	Emergent	Access Road	Fill	0.00	0.03	--	--	--	--	--	--	--	--
17	PEM1Fh	Emergent	Rail	Viaduct	0.00	0.00	--	--	--	--	--	--	--	--
18	PFO1C	Forested	Access Road	Viaduct/ Conversion	--	--	0.00	0.01	--	--	--	--	--	--
18	PFO1C	Forested	Rail	Viaduct/ Conversion	--	--	0.00	0.05	--	--	--	--	--	--
18	PFO1C	Forested	Access Road	Viaduct/ Conversion	0.00	0.05	--	--	--	--	--	--	--	--
18	PFO1C	Forested	Rail	Viaduct/ Conversion	0.00	0.12	--	--	--	--	--	--	--	--
18	PFO1C	Forested	Access Road	Viaduct/ Conversion	0.00	0.02	--	--	--	--	--	--	--	--

Table 5: Estimated Wetland Impacts – Ellis County														
Natural Resources Mapbook Page #	Wetland ID/ Classification*	Wetland Type	Construction Type	Crossing Type	Segment 2A		Segment 2B		Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet		linear feet		linear feet	
18	PFO1C	Forested	Rail	Viaduct/ Conversion	0.00	0.25	--	--	--	--	--	--	--	--
19	NCH3EW2	Emergent	Rail	Viaduct	0.00	0.00	--	--	--	--	--	--	--	--
19	NCH3EW3	Emergent	Rail	Fill	0.00	0.02	--	--	--	--	--	--	--	--
22	PFO1A	Forested	Access Road	Viaduct/ Conversion	0.00	<0.01	--	--	--	--	--	--	--	--
22	PFO1A	Forested	Rail	Viaduct/ Conversion	0.00	0.09	--	--	--	--	--	--	--	--
22	PFO1A	Forested	Rail	Viaduct/ Conversion	0.00	0.19	--	--	--	--	--	--	--	--
23	PFO1C	Forested	Access Road	Viaduct/ Conversion	--	--	0.00	0.01	--	--	--	--	--	--
23	PFO1C	Forested	Rail	Viaduct/ Conversion	--	--	0.00	0.09	--	--	--	--	--	--
23	NCI3EW100	Emergent	Access Road	Viaduct	0.00	0.00	--	--	--	--	--	--	--	--
23	NCI3EW100	Emergent	Rail	Viaduct	0.00	0.00	--	--	--	--	--	--	--	--
23	NCI3EW99	Emergent	Rail	Viaduct	0.00	0.00	--	--	--	--	--	--	--	--
25	NCJ3EW1	Emergent	Maintenance Facility	Fill	0.00	0.21	--	--	--	--	--	--	--	--
26	PFO1C	Forested	Access Road	Viaduct/ Conversion	0.00	<0.01	--	--	--	--	--	--	--	--
26	PFO1C	Forested	Rail	Viaduct/ Conversion	0.00	0.01	--	--	--	--	--	--	--	--
26	PFO1C	Forested	Access Road	Viaduct/ Conversion	--	--	0.00	<0.01	--	--	--	--	--	--
26	PFO1C	Forested	Rail	Viaduct/ Conversion	--	--	0.00	0.01	--	--	--	--	--	--
26	PFO1C	Forested	Access Road	Viaduct/ Conversion	0.00	<0.01	--	--	--	--	--	--	--	--
26	PFO1C	Forested	Access Road	Viaduct/ Conversion	--	--	0.00	0.05	--	--	--	--	--	--
26	PFO1C	Forested	Rail	Viaduct/ Conversion	--	--	0.00	<0.01	--	--	--	--	--	--
27	NCK4EW5	Emergent	Access Road	Viaduct	0.00	0.00	--	--	--	--	--	--	--	--
27	PFO1C	Forested	Access Road	Viaduct/ Conversion	--	--	--	--	0.00	0.01	--	--	--	--

Table 5: Estimated Wetland Impacts – Ellis County														
Natural Resources Mapbook Page #	Wetland ID/ Classification*	Wetland Type	Construction Type	Crossing Type	Segment 2A		Segment 2B		Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet		linear feet		linear feet	
27	PFO1C	Forested	Access Road	Viaduct/ Conversion	--	--	--	--	--	--	--	--	0.00	0.01
27	PFO1C	Forested	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.01	--	--	--	--
27	PFO1C	Forested	Access Road	Viaduct/ Conversion	--	--	--	--	0.00	0.12	--	--	--	--
27	PFO1C	Forested	Rail	Viaduct/ Conversion	--	--	--	--	0.00	0.15	--	--	--	--
27	PFO1C	Forested	Stormwater Drainage	Excavation	--	--	--	--	--	--	0.00	0.05	--	--
27	PFO1C	Forested	Rail	Fill	--	--	--	--	--	--	0.00	0.02	--	--
				Total	0.00	2.1	0.00	1.1	0.00	0.29	0.00	0.35	0.00	0.29

Source: USFWS, 2016; FNI, 2017

*Wetland ID # (N) indicates a specific feature recorded in the field. Wetland classifications (P) indicate wetlands not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each wetland is separated by construction type.

P - Palustrine

FO1 - Broad-leaved Deciduous Forested

A - Temporarily Flooded C - Seasonally Flooded

'--' - not present

Table 6: Estimated Waterbody Impacts – Ellis County										
Natural Resources Mapbook Page #	Waterbody ID/Name *	Waterbody Type	Construction Type	Crossing Type	Segment 1		Segment 2A		Segment 2B	
					Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet	
12	Unnamed	Pond	Rail	Viaduct	0.00	0.00	--	--	--	--
12	Unnamed	Pond	Access Road	Viaduct	0.00	0.00	--	--	--	--
13	Unnamed	Pond	Rail	Fill	--	--	0.00	<0.01	--	--
13	Unnamed	Pond	Access Road	Fill	--	--	0.00	0.31	--	--
13	Unnamed	Pond	Rail	Excavation	--	--	--	--	0.00	<0.01
13	Unnamed	Pond	Access Road	Excavation	--	--	--	--	0.00	0.31
15	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.00	0.00

Table 6: Estimated Waterbody Impacts – Ellis County										
Natural Resources Mapbook Page #	Waterbody ID/Name *	Waterbody Type	Construction Type	Crossing Type	Segment 1		Segment 2A		Segment 2B	
					Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet	
15	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.00	0.00
15	NCG3PD3	Pond	Access Road	Viaduct	--	--	0.00	0.00	--	--
15	NCG3PD3	Pond	Rail	Viaduct	--	--	0.00	0.00	--	--
15	NCG3PD4	Pond	Rail	Viaduct	--	--	0.00	0.00	--	--
16	Unnamed	Pond	Access Road	Fill	--	--	--	--	0.00	0.03
16	NCG3PD10	Pond	Access Road	Viaduct	--	--	0.00	0.00	--	--
16	NCG3PD10	Pond	Rail	Viaduct	--	--	0.00	0.00	--	--
16	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.00	0.00
16	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.00	0.00
16	NCG3PD24	Pond	Access Road	Viaduct	--	--	0.00	0.00	--	--
16	NCG3PD24	Pond	Rail	Viaduct	--	--	0.00	0.00	--	--
17	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.00	0.00
17	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.00	0.00
17	NCG3PD16	Pond	Access Road	Fill	--	--	0.00	0.17	--	--
17	Unnamed	Pond	Access Road	Fill	--	--	0.00	0.10	--	--
17	Unnamed	Pond	Access Road	Fill	--	--	0.00	0.25	--	--
17	Unnamed	Pond	Rail	Fill	--	--	0.00	0.25	--	--
17	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.00	0.00
17	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.00	0.00
17	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.00	0.00
17	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.00	0.00
17	Unnamed	Pond	Access Road	Viaduct	--	--	0.00	0.00	--	--
17	Unnamed	Pond	Rail	Viaduct	--	--	0.00	0.00	--	--
17	Unnamed	Pond	Rail	Viaduct	--	--	0.00	0.00	--	--
18	NCH3PD5	Pond	Rail	Viaduct	--	--	0.00	0.00	--	--
19	NCH3PD7	Pond	Access Road	Viaduct	--	--	0.00	0.00	--	--
19	NCH3PD7	Pond	Rail	Viaduct	--	--	0.00	0.00	--	--

Table 6: Estimated Waterbody Impacts – Ellis County										
Natural Resources Mapbook Page #	Waterbody ID/Name *	Waterbody Type	Construction Type	Crossing Type	Segment 1		Segment 2A		Segment 2B	
					Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet	
19	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.21
19	Unnamed	Pond	Rail	Fill	--	--	--	--	0.00	1.0
19	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.00	0.00
20	NCI3PD2	Pond	Rail	Viaduct	--	--	0.00	0.00	--	--
20	NCI3PD1	Pond	Access Road	Viaduct	--	--	0.00	0.00	--	--
20	NCI3PD1	Pond	Rail	Viaduct	--	--	0.00	0.00	--	--
20	NCI3PD3	Pond	Rail	Viaduct	--	--	0.00	0.00	--	--
22	NCI3PD9	Pond	Facility	Fill	--	--	0.00	0.23	--	--
22	NCI3PD10	Pond	Facility	Fill	--	--	0.00	0.14	--	--
22	NCI3PD100	Pond	Access Road	Viaduct	--	--	0.00	0.00	--	--
22	NCI3PD100	Pond	Rail	Viaduct	--	--	0.00	0.00	--	--
22	NCI3PD101	Pond	Access Road	Viaduct	--	--	0.00	0.00	--	--
22	NCI3PD101	Pond	Rail	Viaduct	--	--	0.00	0.00	--	--
22	NCI3PD99	Pond	Access Road	Viaduct	--	--	0.00	0.00	--	--
22	NCI3PD99	Pond	Rail	Viaduct	--	--	0.00	0.00	--	--
23	NCI3PD5	Pond	Rail	Viaduct	--	--	0.00	0.00	--	--
24	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.00	0.00
24	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.00	0.00
24	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.00	0.00
24	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.00	0.00
24	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.00	0.00
25	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.00	0.00
25	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.00	0.00
25	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.00	0.00
25	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.00	0.00
25	NCJ3PD29	Pond	Access Road	Fill	--	--	0.00	0.03	--	--
25	NCJ3PD19	Pond	Maintenance Facility	Fill	--	--	0.00	1.1	--	--

Table 6: Estimated Waterbody Impacts – Ellis County										
Natural Resources Mapbook Page #	Waterbody ID/Name *	Waterbody Type	Construction Type	Crossing Type	Segment 1		Segment 2A		Segment 2B	
					Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet	
25	NCJ3PD19	Pond	Rail	Viaduct	--	--	0.00	0.00	--	--
25	NCJ3PD20	Pond	Rail	Viaduct	--	--	0.00	0.00	--	--
25	Unnamed	Pond	Maintenance Facility	Fill	--	--	0.00	0.24	--	--
26	Unnamed	Pond	Access Road	Fill	--	--	--	--	0.00	0.21
26	NCK3PD2	Pond	Access Road	Viaduct	--	--	0.00	0.00	--	--
26	NCK3PD2	Pond	Rail	Viaduct	--	--	0.00	0.00	--	--
26	Unnamed	Pond	Access Road	Fill	--	--	--	--	0.00	0.09
26	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.00	0.00
26	NCK3PD4	Pond	Stormwater Drainage	Excavation	--	--	0.00	0.28	--	--
26	NCK3PD4	Pond	Maintenance Facility	Fill	--	--	0.00	0.05	--	--
26	NCK3PD4	Pond	Rail	Viaduct	--	--	0.00	0.00	--	--
				Total	0.00	0.00	0.00	3.1	0.00	1.9

Source: USGS, 2016; USFWS, 2016; FNI, 2017

*Waterbody ID # (N) indicates a specific feature recorded in the field. Waterbody classifications (P) indicate waterbodies not yet field-verified. Jurisdictional determination to be confirmed by the USACE. Each waterbody is separated by construction type.

'--' – Not Present

Navarro County

Table 7: Estimated Stream Impacts – Navarro County										
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet	
45	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--
45	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--

Table 7: Estimated Stream Impacts – Navarro County										
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet	
45	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--	0.00	0.00
45	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--	0.00	0.00
45	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
45	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
45	Chambers Creek	Artificial	Access Road	Viaduct	--	--	0.00	0.00	--	--
45, 46	Chambers Creek	Artificial	Rail	Viaduct	0.00	0.00	0.00	0.00	0.00	0.00
46	NCL4S2	Ephemeral	Rail	Viaduct	0.00	0.00	--	--	--	--
46	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--
46	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--
46	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--
46	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--
47	Unnamed	Intermittent	Stormwater Drainage	Excavation	0.00	410.0	--	--	--	--
47	Unnamed	Intermittent	Access Road	Fill	0.00	376.1	--	--	--	--
47	Unnamed	Intermittent	Rail	Fill	0.00	25.7	--	--	--	--
47	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	--	--	0.00	410.0
47	Unnamed	Intermittent	Access Road	Fill	--	--	--	--	0.00	376.1
47	Unnamed	Intermittent	Rail	Fill	--	--	--	--	0.00	25.7
47	NCL4S4	Ephemeral	Access Road	Fill	0.00	35.0	--	--	--	--
47	NCL4S4	Ephemeral	Rail	Fill	0.00	200.2	--	--	--	--
47	Briar Creek	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--
47	Briar Creek	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--
67	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--
67	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--
67	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	0.00	637.1	--	--
67	Unnamed	Intermittent	Access Road	Fill	--	--	0.00	506.3	--	--
67	Unnamed	Intermittent	Rail	Fill	--	--	0.00	263.5	--	--
48	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--	--	--

Table 7: Estimated Stream Impacts – Navarro County										
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet	
48	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--	--	--
48	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
48	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
67	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--
49	Unnamed	Intermittent	Temporary Fill	Fill	24.2	0.00	--	--	--	--
49	Unnamed	Intermittent	Temporary Fill	Fill	--	--	--	--	24.2	0.00
68	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	0.00	111.7	--	--
68	Unnamed	Intermittent	Access Road	Fill	--	--	0.00	55.1	--	--
68	Unnamed	Intermittent	Rail	Fill	--	--	0.00	295.9	--	--
49	Unnamed	Intermittent	Stormwater Drainage	Excavation	0.00	476.6	--	--	--	--
49	Unnamed	Intermittent	Access Road	Fill	0.00	481.8	--	--	--	--
48	Unnamed	Intermittent	Rail	Fill	0.00	325.4	--	--	--	--
49	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	--	--	0.00	476.6
49	Unnamed	Intermittent	Access Road	Fill	--	--	--	--	0.00	481.8
48	Unnamed	Intermittent	Rail	Fill	--	--	--	--	0.00	325.4
68	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	0.00	17.4	--	--
68	Unnamed	Intermittent	Access Road	Fill	--	--	0.00	31.3	--	--
68	Unnamed	Intermittent	Rail	Fill	--	--	0.00	265.7	--	--
49	Unnamed	Intermittent	Temporary Fill	Fill	315.0	0.00	--	--	--	--
49	Unnamed	Intermittent	Temporary Fill	Fill	--	--	--	--	315.0	0.00
49	Unnamed	Intermittent	Stormwater Drainage	Excavation	0.00	158.3	--	--	--	--
49	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--	--	--
49	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--	--	--
49	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
49	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
49	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	--	--	0.00	158.3
68	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--		112.9	--	--

Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet	
68	Unnamed	Intermittent	Rail	Fill	--	--		186.6	--	--
68	Unnamed	Intermittent	Temporary Fill	Fill	--	--	11.7	0.00	--	--
68	Unnamed	Intermittent	Temporary Fill	Fill	--	--	367.1	0.00	--	--
68	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--
68	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--
68	Unnamed	Intermittent	Temporary Fill	Fill	--	--	616.7	0.00	--	--
49	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--	--	--
49	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--	--	--
49	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
49	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
49	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--	--	--
49	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--	--	--
49	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
49	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
50	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--	--	--
50	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
50	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--	--	--
50	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
50	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--	--	--
50	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--	--	--
50	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
50	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
69	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--
69	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--
50	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--	--	--
50	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--	--	--
50	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00

Table 7: Estimated Stream Impacts – Navarro County										
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet	
50	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
69	Unnamed	Artificial	Rail	Viaduct	--	--	0.00	0.00	--	--
69	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--
69	Unnamed	Intermittent	Access Road	Fill	--	--	0.00	78.9	--	--
69	Unnamed	Intermittent	Access Road	Fill	--	--	0.00	636.9	--	--
69	Unnamed	Intermittent	Access Road	Fill	--	--	0.00	167.6	--	--
69	Unnamed	Artificial	Rail	Viaduct	--	--	0.00	0.00	--	--
70	Unnamed	Artificial	Rail	Viaduct	--	--	0.00	0.00	--	--
70	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--
70	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--
70	Cedar Creek	Intermittent	Access Road	Fill	--	--	0.00	336.1	--	--
70	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--
70	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--
70	Unnamed	Intermittent	Rail	Fill	--	--	0.00	220.2	--	--
70	Unnamed	Artificial	Stormwater Drainage	Excavation	--	--	0.00	252.3	--	--
70	Unnamed	Artificial	Access Road	Fill	--	--	0.00	132.4	--	--
51	Unnamed	Intermittent	Stormwater Drainage	Excavation	0.00	99.8	--	--	--	--
51	Unnamed	Intermittent	Access Road	Fill	0.00	56.2	--	--	--	--
51	Unnamed	Intermittent	Rail	Fill	0.00	215.8	--	--	--	--
51	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	--	--	0.00	99.8
51	Unnamed	Intermittent	Access Road	Fill	--	--	--	--	0.00	56.2
51	Unnamed	Intermittent	Rail	Fill	--	--	--	--	0.00	215.8
70	Cedar Creek	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--
70	Cedar Creek	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--
70	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--
70	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--
51	Unnamed	Intermittent	Stormwater Drainage	Excavation	0.00	253.3	--	--	--	--

Table 7: Estimated Stream Impacts – Navarro County										
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet	
52	Unnamed	Intermittent	Access Road	Fill	0.00	744.0	--	--	--	--
51	Unnamed	Intermittent	Rail	Fill	0.00	299.5	--	--	--	--
51	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	--	--	0.00	253.3
52	Unnamed	Intermittent	Access Road	Fill	--	--	--	--	0.00	744.0
51	Unnamed	Intermittent	Rail	Fill	--	--	--	--	0.00	299.5
71	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--
71	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--
71	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--
71	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--
72	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	0.00	305.5	--	--
72	Unnamed	Intermittent	Access Road	Fill	--	--	0.00	94.5	--	--
72	Unnamed	Intermittent	Rail	Fill	--	--	0.00	526.3	--	--
53	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
72	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--
72	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--
53	Unnamed	Intermittent	Systems	Fill	0.00	92.6	--	--	--	--
72	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	0.00	124.2	--	--
72	Unnamed	Intermittent	Access Road	Fill	--	--	0.00	34.2	--	--
72	Unnamed	Intermittent	Rail	Fill	--	--	0.00	217.1	--	--
53	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
53	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
53	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--	--	--
53	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--	--	--
54	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--	--	--
54	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--	--	--
73	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	0.00	299.4	--	--
73	Unnamed	Intermittent	Access Road	Fill	--	--	0.00	78.0	--	--

Table 7: Estimated Stream Impacts – Navarro County										
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet	
54	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
54	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
73	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	0.00	384.7	--	--
73	Unnamed	Intermittent	Access Road	Fill	--	--	0.00	517.6	--	--
73	Unnamed	Intermittent	Rail	Fill	--	--	0.00	298.9	--	--
54	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--	--	--
54	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--	--	--
54	NCO6S3	Ephemeral	Access Road	Viaduct	0.00	0.00	--	--	--	--
54	NCO6S3	Ephemeral	Rail	Viaduct	0.00	0.00	--	--	--	--
54	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
54	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
92	Briar Creek	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
92	Briar Creek	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
93	Richland Creek	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
93	Richland Creek	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
74	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--
74	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--
55	NCO6S7	Perennial	Rail	Viaduct	0.00	0.00	--	--	--	--
55	NCO6S7	Perennial	Access Road	Viaduct	0.00	0.00	--	--	--	--
93	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
93	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
74	Richland Creek	Artificial	Access Road	Viaduct	--	--	0.00	0.00	--	--
74	Richland Creek	Artificial	Rail	Viaduct	--	--	0.00	0.00	--	--
55	NCO6S9	Intermittent	Access Road	Viaduct	0.00	0.00	--	--	--	--
55	NCO6S9	Intermittent	Rail	Viaduct	0.00	0.00	--	--	--	--
56	Unnamed	Intermittent	Systems	Fill	--	--	--	--		2.7
56	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00

Table 7: Estimated Stream Impacts – Navarro County										
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet	
56	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
56	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
56	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
56	Unnamed	Intermittent	Stormwater Drainage	Excavation	0.00	11.1	--	--	--	--
56	NCO6S99	Intermittent	Stormwater Drainage	Excavation	0.00	163.8	--	--	--	--
56	NCO6S99	Intermittent	Rail	Fill	0.00	283.6	--	--	--	--
94	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
94	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
57, 94	Pin Oak Creek	Intermittent	Access Road	Viaduct	0.00	0.00	--	--	0.00	0.00
57, 94	Pin Oak Creek	Intermittent	Rail	Viaduct	0.00	0.00	--	--	0.00	0.00
56	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--	--	--
56	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--	--	--
75	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
75	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
75	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	0.00	252.8	--	--
75	Unnamed	Intermittent	Access Road	Fill	--	--	0.00	37.9	--	--
75	Unnamed	Intermittent	Rail	Fill	--	--	0.00	263.4	--	--
76	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--
76	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--
76	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	--	--	0.00	82.6
76	Unnamed	Intermittent	Access Road	Fill	--	--	--	--	0.00	44.4
76	Unnamed	Intermittent	Rail	Fill	--	--	--	--	0.00	66.3
57	NCP7S5	Ephemeral	Access Road	Viaduct	0.00	0.00	--	--	--	--
57	NCP7S5	Ephemeral	Rail	Viaduct	0.00	0.00	--	--	--	--
76	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	--	--	0.00	305.9
76	Unnamed	Intermittent	Access Road	Fill	--	--	--	--	0.00	161.6
76	Unnamed	Intermittent	Rail	Fill	--	--	--	--	0.00	205.8

Table 7: Estimated Stream Impacts – Navarro County										
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet	
76	Unnamed	Intermittent	Temporary Fill	Fill					30.8	0.00
76	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
76	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
58	NCP7S8	Ephemeral	Access Road	Viaduct	0.00	0.00	--	--	--	--
58	NCP7S8	Ephemeral	Rail	Viaduct	0.00	0.00	--	--	--	--
96	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
96	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
58	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--
58	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--
58	NCP7S99	Ephemeral	Access Road	Viaduct	0.00	0.00	--	--	--	--
58	NCP7S99	Ephemeral	Rail	Viaduct	0.00	0.00	--	--	--	--
58	NCP7S10	Intermittent	Access Road	Viaduct	0.00	0.00	--	--	--	--
58	NCP7S10	Intermittent	Rail	Viaduct	0.00	0.00	--	--	--	--
96	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
96	Little Pin Oak Creek	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
60, 96	Little Pin Oak Creek	Intermittent	Rail	Viaduct	--	--	0.00	0.00	0.00	0.00
58	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--	--	--
58	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--	--	--
97	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	--	--	0.00	204.3
97	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
97	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
97	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	9.4	0.00
59	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--
59	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--
59	NCP7S12	Ephemeral	Stormwater Drainage	Excavation	0.00	42.7				
59	NCP7S12	Ephemeral	Access Road	Viaduct	0.00	0.00	--	--	--	--
59	NCP7S12	Ephemeral	Rail	Viaduct	0.00	0.00	--	--	--	--

Table 7: Estimated Stream Impacts – Navarro County										
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet	
97	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
97	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
97	Mesquite Creek	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
97	Mesquite Creek	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
59	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--
97	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	--	--	0.00	159.5
97	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
97	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
59	NCQ7S2	Intermittent	Access Road	Viaduct	0.00	0.00	--	--	--	--
59	NCQ7S2	Intermittent	Rail	Viaduct	0.00	0.00	--	--	--	--
59	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--
98	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
98	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
60	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--
60	NCQ7S7	Intermittent	Access Road	Viaduct	0.00	0.00	--	--	--	--
60	NCQ7S7	Intermittent	Rail	Viaduct	0.00	0.00	--	--	--	--
98	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	--	--	0.00	325.9
98	Unnamed	Intermittent	Access Road	Fill	--	--	--	--	0.00	45.5
98	Unnamed	Intermittent	Rail	Fill	--	--	--	--	0.00	278.5
60	NCQ7S4	Intermittent	Rail	Viaduct	0.00	0.00	--	--	--	--
60	NCQ7S4	Intermittent	Access Road	Viaduct	0.00	0.00	--	--	--	--
61	NCQ7S6	Ephemeral	Access Road	Viaduct	0.00	0.00	--	--	--	--
61	NCQ7S6	Ephemeral	Rail	Viaduct	0.00	0.00	--	--	--	--
62	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--	--	--
62	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--	--	--
62	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	0.00	0.7	--	--
62	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--

Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet	
62	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--
62	Unnamed	Intermittent	Stormwater Drainage	Excavation	0.00	66.8	--	--	--	--
				Total	339.2	4,818.2	995.5	7,742.8	379.4	5,805.5

Table 7: Estimated Stream Impacts – Navarro County

Source: USGS, 2016; FNI, 2017

*Stream ID # (N) indicates a specific feature recorded in the field whereas stream names (or those "unnamed") indicate features mapped via data not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each stream is separated by construction type.

'--' - not present

Table 8: Estimated Wetland Impacts – Navarro County

Natural Resources Mapbook Page #	Wetland ID/Classification*	Wetland Type	Construction Type	Crossing Type	Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm
					acres		acres		acres	
46	NCL4EW1	Emergent	Access Road	Viaduct	0.00	0.00	--	--	--	--
46	NCL4EW1	Emergent	Rail	Viaduct	0.00	0.00	--	--	--	--
46	NCL4EW1	Emergent	Access Road	Viaduct	0.00	0.00	--	--	--	--
46	NCL4EW1	Emergent	Rail	Viaduct	0.00	0.00	--	--	--	--
46	NCL4EW99	Emergent	Access Road	Viaduct	0.00	0.00	--	--	--	--
46	NCL4EW99	Emergent	Rail	Viaduct	0.00	0.00	--	--	--	--
47	NCL4EW10	Emergent	Access Road	Viaduct	0.00	0.00	--	--	--	--
47	NCL4EW10	Emergent	Rail	Viaduct	0.00	0.00	--	--	--	--
48	NCL4EW9	Emergent	Access Road	Excavation	0.00	0.24	--	--	--	--
48	NCL4EW11	Emergent	Access Road	Excavation	0.00	<0.01	--	--	--	--
67	PFO1C	Forested	Access Road	Viaduct/Conversion	--	--	0.00	0.01	--	--
67	PFO1C	Forested	Rail	Viaduct/Conversion	--	--	0.00	0.05	--	--
50	NCM5EW21	Emergent	Access Road	Viaduct	0.00	0.00	--	--	--	--
50	NCM5EW21	Emergent	Rail	Viaduct	0.00	0.00	--	--	--	--
50	NCM5EW22	Emergent	Access Road	Viaduct	0.00	0.00	--	--	--	--

Table 8: Estimated Wetland Impacts – Navarro County										
Natural Resources Mapbook Page #	Wetland ID/Classification*	Wetland Type	Construction Type	Crossing Type	Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm
					acres		acres		acres	
50	NCM5EW22	Emergent	Rail	Viaduct	0.00	0.00	--	--	--	--
69	PEM1Fh	Emergent	Rail	Viaduct	--	--	0.00	0.00	--	--
51	NCM5EW23	Emergent	Stormwater Drainage	Excavation	0.00	0.24	--	--	--	--
50	NCM5EW23	Emergent	Rail	Fill	0.00	0.04	--	--	--	--
51	NCM5EW24	Emergent	Rail	Fill	0.00	0.03	--	--	--	--
70	PEM1Ch	Emergent	Rail	Viaduct	--	--	0.00	0.00	--	--
70	PFO1A	Forested	Access Road	Fill	--	--	0.00	0.15	--	--
70	PEM1C	Emergent	Access Road	Fill	--	--	0.00	0.12	--	--
70	PFO1C	Forested	Stormwater Drainage	Excavation	--	--	0.00	0.07	--	--
70	PFO1C	Forested	Access Road	Fill	--	--	0.00	0.01	--	--
70	PFO1A	Forested	Access Road	Viaduct/Conversion	--	--	0.00	0.07	--	--
70	PFO1A	Forested	Rail	Viaduct/Conversion	--	--	0.00	0.89	--	--
52	NCN5EW4	Emergent	Rail	Excavation	0.00	0.13	--	--	--	--
71	PFO1C	Forested	Access Road	Viaduct/Conversion	--	--	0.00	0.01	--	--
71	PFO1C	Forested	Rail	Viaduct/Conversion	--	--	0.00	0.07	--	--
71	PFO1A	Forested	Access Road	Viaduct/Conversion	--	--	0.00	0.05	--	--
71	PFO1A	Forested	Rail	Viaduct/Conversion	--	--	0.00	0.06	--	--
53	NCN5EW14	Emergent	Tempoary Fill	Fill	0.46	0.00	--	--	--	--
53	NCN5EW12	Emergent	Tempoary Fill	Fill	0.19	0.00	--	--	--	--
53	NCN5EW7	Emergent	Tempoary Fill	Fill	0.93	0.00	--	--	--	--
53	NCN5EW12	Emergent	Tempoary Fill	Fill	0.02	0.00	--	--	--	--
53	NCN5EW12	Emergent	Rail	Viaduct	0.01	0.00	--	--	--	--
53	NCN5EW12	Emergent	Access Road	Viaduct	0.02	0.00	--	--	--	--
53	NCN5EW12	Emergent	Access Road	Viaduct	0.00	0.00	--	--	--	--
53	NCN5EW12	Emergent	Rail	Viaduct	0.00	0.00	--	--	--	--
53	NCN5EW6	Emergent	Tempoary Fill	Fill	0.04	0.00	--	--	--	--
53	NCN5EW3	Emergent	Tempoary Fill	Fill	0.17	0.00	--	--	--	--
53	NCN5EW13	Emergent	Tempoary Fill	Fill	1.38	0.00	--	--	--	--

Table 8: Estimated Wetland Impacts – Navarro County										
Natural Resources Mapbook Page #	Wetland ID/Classification*	Wetland Type	Construction Type	Crossing Type	Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm
					acres		acres		acres	
53	NCN5EW5	Emergent	Tempoary Fill	Fill	0.10	0.00	--	--	--	--
53	NCN5EW9	Emergent	Tempoary Fill	Fill	0.11	0.00	--	--	--	--
53	NCN5EW15	Emergent	Tempoary Fill	Fill	0.08	0.00	--	--	--	--
53	NCN5EW16	Emergent	Tempoary Fill	Fill	0.24	0.00	--	--	--	--
53	NCN5EW16	Emergent	Rail	Viaduct	0.00	0.00	--	--	--	--
53	NCN5EW16	Emergent	Access Road	Viaduct	0.00	0.00	--	--	--	--
53	NCN5EW16	Emergent	Rail	Viaduct	0.00	0.00	--	--	--	--
53	NCN5EW16	Emergent	Tempoary Fill	Fill	0.58	0.00	--	--	--	--
53	NCN5EW16	Emergent	Tempoary Fill	Fill	0.04	0.00	--	--	--	--
53	NCN5EW16	Emergent	Rail	Viaduct	0.04	0.00	--	--	--	--
72	PFO1C	Forested	Stormwater Drainage	Excavation	--	--	0.00	0.20	--	--
72	PFO1C	Forested	Access Road	Fill	--	--	0.00	0.04	--	--
72	PFO1C	Forested	Rail	Fill	--	--	0.00	0.21	--	--
53	NCN5EW10	Emergent	Tempoary Fill	Fill	0.54	0.00	--	--	--	--
53	NCN5EW10	Emergent	Access Road	Viaduct	0.00	0.00	--	--	--	--
53	NCN5EW10	Emergent	Rail	Viaduct	0.00	0.00	--	--	--	--
53	NCN5EW10	Emergent	Access Road	Viaduct	0.00	0.00	--	--	--	--
53	NCN5EW10	Emergent	Rail	Viaduct	0.00	0.00	--	--	--	--
53	NCN5EW10	Emergent	Tempoary Fill	Fill	1.39	0.00	--	--	--	--
53	NCN5EW10	Emergent	Access Road	Viaduct	<0.01	0.00	--	--	--	--
53	NCN5EW10	Emergent	Tempoary Fill	Fill	0.92	0.00	--	--	--	--
53	NCN5EW10	Emergent	Access Road	Viaduct	0.09	0.00	--	--	--	--
53	NCN5EW10	Emergent	Rail	Viaduct	0.83	0.00	--	--	--	--
53	NCN5EW11	Emergent	Tempoary Fill	Fill	0.10	0.00	--	--	--	--
53	NCN5EW11	Emergent	Rail	Viaduct	0.00	0.00	--	--	--	--
53	NCN5EW11	Emergent	Tempoary Fill	Fill	0.12	0.00	--	--	--	--
72	PFO1A	Forested	Access Road	Viaduct/Conversion	--	--	0.00	0.16	--	--
72	PFO1A	Forested	Rail	Viaduct/Conversion	--	--	0.00	1.32	--	--

Table 8: Estimated Wetland Impacts – Navarro County										
Natural Resources Mapbook Page #	Wetland ID/Classification*	Wetland Type	Construction Type	Crossing Type	Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm
					acres		acres		acres	
54	PEM1A	Emergent	Access Road	Viaduct	0.00	0.00	--	--	--	--
54	PEM1A	Emergent	Rail	Viaduct	0.00	0.00	--	--	--	--
54	PFO1C	Forested	Access Road	Viaduct/Conversion	0.00	0.01	--	--	--	--
54	PFO1C	Forested	Rail	Viaduct/Conversion	0.00	0.07	--	--	--	--
59	PFO1C	Forested	Access Road	Viaduct/Conversion	--	--	0.00	0.04	--	--
59	PFO1C	Forested	Rail	Viaduct/Conversion	--	--	0.00	0.19	--	--
59	NCQ7EW3	Emergent	Stormwater Drainage	Excavation	0.00	0.35	--	--	--	--
59	NCQ7EW3	Emergent	Access Road	Viaduct	0.00	0.00	--	--	--	--
59	NCQ7EW3	Emergent	Rail	Viaduct	0.00	0.00	--	--	--	--
59	NCQ7EW3	Emergent	Rail	Viaduct	0.00	0.00	--	--	--	--
59	NCQ7EW3	Emergent	Access Road	Viaduct	0.00	0.00	--	--	--	--
59	NCQ7EW6	Emergent	Access Road	Viaduct	0.00	0.00	--	--	--	--
59	NCQ7EW6	Emergent	Rail	Viaduct	0.00	0.00	--	--	--	--
59	NCQ7EW6	Emergent	Rail	Viaduct	0.00	0.00	--	--	--	--
59	PEM1C	Emergent	Rail	Viaduct	--	--	0.00	0.00	--	--
60	NCQ7EW99	Emergent	Access Road	Viaduct	0.00	0.00	--	--	--	--
60	NCQ7EW99	Emergent	Rail	Viaduct	0.00	0.00	--	--	--	--
60	NCQ7FW1	Forested	Rail	Viaduct/Conversion	0.00	0.04	--	--	--	--
61	NCQ8EW2	Emergent	Rail	Viaduct	0.00	0.00	--	--	--	--
62	NCQ8FW3	Forested	Rail	Viaduct/Conversion	0.00	0.06	--	--	--	--
				Total	8.5	2.9	0.00	4.8	0.00	8.0

Source: USFWS, 2016; FNI, 2017

*Wetland ID # (N) indicates a specific feature recorded in the field. Wetland classifications (P) indicate wetlands not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each wetland is separated by construction type.

P - Palustrine
EM - Emergent
EM1 - Persistent Emergent
FO - Forested
FO1 - Broad-leaved Deciduous Forested
A - Temporarily Flooded
C - Seasonally Flooded
h - Diked/Impounded
'--' - not present

Table 9: Estimated Waterbody Impacts – Navarro County										
Natural Resources Mapbook Page #	Waterbody ID/Name *	Waterbody Type	Construction Type	Crossing Type	Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm
					acres		acres		acres	
45	Unnamed	Pond	Rail	Viaduct	--	--	0.00	0.00	--	--
45	Unnamed	Pond	Access Road	Viaduct	0.00	0.00	--	--	--	--
45	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.00	0.00
46	Unnamed	Pond	Access Road	Viaduct	--	--	0.00	0.00	--	--
46	Unnamed	Pond	Rail	Viaduct	--	--	0.00	0.00	--	--
46	NCL4PD43	Pond	Access Road	Viaduct	0.00	0.00	--	--	--	--
46	NCL4PD5	Pond	Access Road	Viaduct	0.00	0.00	--	--	--	--
46	NCL4PD7	Pond	Access Road	Viaduct	0.00	0.00	--	--	--	--
46	NCL4PD11	Pond	Stormwater Drainage	Excavation	0.00	0.03	--	--	--	--
46	NCL4PD11	Pond	Rail	Fill	0.00	0.78	--	--	--	--
46	Unnamed	Pond	Rail	Fill	--	--	0.00	0.26	--	--
47	Unnamed	Pond	Stormwater Drainage	Excavation	0.00	0.23	--	--	--	--
47	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.23
47	NCL4PD36	Pond	Access Road	Fill	0.00	0.09	--	--	--	--
47	NCL4PD19	Pond	Access Road	Fill	0.00	<0.01	--	--	--	--
47	NCL4PD19	Pond	Stormwater Drainage	Excavation	0.00	0.02	--	--	--	--
47	NCL4PD19	Pond	Rail	Fill	0.00	0.19	--	--	--	--
47	NCL4PD20	Pond	Rail	Fill	0.00	0.57	--	--	--	--
48	Unnamed	Pond	Access Road	Excavation	0.00	0.07	--	--	--	--
48	Unnamed	Pond	Access Road	Excavation	--	--	--	--	0.00	0.07
48	Unnamed	Pond	Stormwater Drainage	Excavation	0.00	<0.01	--	--	--	--
48	Unnamed	Pond	Rail	Fill	0.00	<0.01	--	--	--	--
48	Unnamed	Pond	Stormwater Drainage	Excavation	0.00	0.09	--	--	--	--
48	Unnamed	Pond	Access Road	Fill	0.00	0.21	--	--	--	--
48	Unnamed	Pond	Rail	Fill	--	--	--	--	0.00	<0.01
48	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.09
48	Unnamed	Pond	Access Road	Fill	--	--	--	--	0.00	0.21
48	Unnamed	Pond	Rail	Viaduct	0.00	0.00	--	--	--	--

Natural Resources Mapbook Page #	Waterbody ID/Name *	Waterbody Type	Construction Type	Crossing Type	Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm
					acres		acres		acres	
Table 9: Estimated Waterbody Impacts – Navarro County										
48	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.00	0.00
49	NCM5PD6	Pond	Access Road	Viaduct	0.00	0.00	--	--	--	--
49	Unnamed	Pond	Temporary Fill	Fill	0.03	0.00	--	--	--	--
49	Unnamed	Pond	Temporary Fill	Fill	--	--	--	--	0.03	0.00
69	Unnamed	Pond	Rail	Viaduct	--	--	0.00	0.00	--	--
50	NCM5PD31	Pond	Access Road	Viaduct	0.00	0.00	--	--	--	--
50	NCM5PD31	Pond	Rail	Viaduct	0.00	0.00	--	--	--	--
69	Soil Conservation Service Site 138 Reservoir	Lake/Pond	Rail	Viaduct	--	--	0.00	0.00	--	--
50	NCM5PD35	Pond	Access Road	Fill	0.00	0.01	--	--	--	--
50	NCM5PD35	Pond	Rail	Fill	0.00	0.53	--	--	--	--
50	NCM5PD35	Pond	Stormwater Drainage	Excavation	0.00	0.76	--	--	--	--
51	NCM5PD36	Pond	Access Road	Fill	0.00	0.11	--	--	--	--
51	NCM5PD36	Pond	Rail	Fill	0.00	0.29	--	--	--	--
70	Unnamed	Pond	Access Road	Fill	--	--	0.00	0.05	--	--
70	Unnamed	Pond	Access Road	Fill	--	--	0.00	<0.01	--	--
70	Unnamed	Pond	Rail	Fill	--	--	0.00	0.29	--	--
70	Unnamed	Pond	Access Road	Fill	--	--	0.00	0.39	--	--
70	Unnamed	Pond	Access Road	Fill	--	--	0.00	0.04	--	--
70	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	0.00	0.11	--	--
70	Unnamed	Pond	Access Road	Fill	--	--	0.00	0.06	--	--
70	Unnamed	Pond	Rail	Excavation	--	--	0.00	0.22	--	--
52	Unnamed	Pond	Access Road	Fill	0.00	0.01	--	--	--	--
52	Unnamed	Pond	Rail	Fill	0.00	0.44	--	--	--	--
52	Unnamed	Pond	Access Road	Fill	--	--	--	--	0.00	0.01
52	Unnamed	Pond	Rail	Fill	--	--	--	--	0.00	0.44
71	Unnamed	Pond	Temporary Fill	Fill	--	--	0.18	0.00	--	--
71	Unnamed	Pond	Temporary Fill	Fill	--	--	0.33	0.00	--	--

Table 9: Estimated Waterbody Impacts – Navarro County										
Natural Resources Mapbook Page #	Waterbody ID/Name *	Waterbody Type	Construction Type	Crossing Type	Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm
					acres		acres		acres	
71	Unnamed	Pond	Temporary Fill	Fill	--	--	0.18	0.00	--	--
71	Unnamed	Pond	Rail	Viaduct	--	--	0.00	0.00	--	--
52	NCN5PD5	Pond	Rail	Fill	0.00	0.24	--	--	--	--
71	Unnamed	Pond	Access Road	Fill	--	--	0.00	<0.01	--	--
71	Unnamed	Pond	Rail	Fill	--	--	0.00	0.76	--	--
71	Unnamed	Pond	Rail	Fill	--	--	0.00	0.01	--	--
52	NCN5PD7	Pond	Access Road	Fill	0.00	0.06	--	--	--	--
71	Unnamed	Pond	Access Road	Fill	--	--	0.00	0.08	--	--
71	Unnamed	Pond	Rail	Excavation	--	--	0.00	0.17	--	--
72	Unnamed	Pond	Access Road	Excavation	--	--	0.00	0.10	--	--
72	Unnamed	Pond	Access Road	Excavation	--	--	0.00	0.32	--	--
53	NCN5PD12	Pond	Temporary Fill	Fill	0.23	0.00	--	--	--	--
72	Unnamed	Pond	Rail	Fill	--	--	0.00	<0.01	--	--
72	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	0.00	0.50	--	--
73	Unnamed	Pond	Rail	Fill	--	--	0.00	0.28	--	--
54	NCO6PD10	Pond	Rail	Fill	0.00	0.04	--	--	--	--
74	Unnamed	Pond	Rail	Viaduct	--	--	0.00	0.00	--	--
93	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.00	0.00
93	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.00	0.00
74	Unnamed	Pond	Access Road	Viaduct	--	--	0.00	0.00	--	--
74	Unnamed	Pond	Rail	Viaduct	--	--	0.00	0.00	--	--
74	Unnamed	Pond	Rail	Viaduct	--	--	0.00	0.00	--	--
74	Unnamed	Pond	Access Road	Viaduct	--	--	0.00	0.00	--	--
74	Unnamed	Pond	Rail	Viaduct	--	--	0.00	0.00	--	--
56	NCO6PD18	Pond	Access Road	Viaduct	0.00	0.00	--	--	--	--
56	NCO6PD18	Pond	Rail	Viaduct	0.00	0.00	--	--	--	--
75	Unnamed	Pond	Rail	Excavation	--	--	0.00	0.14	--	--
75	Unnamed	Pond	Rail	Excavation	--	--	0.00	0.09	--	--

Table 9: Estimated Waterbody Impacts – Navarro County										
Natural Resources Mapbook Page #	Waterbody ID/Name *	Waterbody Type	Construction Type	Crossing Type	Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm
					acres		acres		acres	
56	Unnamed	Pond	Rail	Excavation	0.00	0.35	--	--	--	--
75	Unnamed	Pond	Rail	Fill	--	--	0.00	0.08	--	--
75	Unnamed	Pond	Access Road	Fill	--	--	0.00	0.10	--	--
56	Unnamed	Pond	Rail	Excavation	0.00	0.06	--	--	--	--
56	NCO6PD99	Pond	Rail	Excavation	0.00	0.07	--	--	--	--
56	Unnamed	Pond	Stormwater Drainage	Excavation	0.00	1.0	--	--	--	--
56	Unnamed	Pond	Rail	Excavation	0.00	1.2	--	--	--	--
56	Unnamed	Pond	Access Road	Excavation	0.00	0.14	--	--	--	--
57	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.00	0.00
57	NCP7PD15	Pond	Access Road	Viaduct	0.00	0.00	--	--	--	--
57	NCP7PD15	Pond	Rail	Viaduct	0.00	0.00	--	--	--	--
57	NCP7PD15	Pond	Temporary Fill	Fill	0.01	0.00	--	--	--	--
57	NCP7PD39	Pond	Temporary Fill	Fill	0.09	0.00	--	--	--	--
57	NCP7PD16	Pond	Rail	Viaduct	0.00	0.00	--	--	--	--
57	NCP7PD16	Pond	Temporary Fill	Fill	0.41	0.00	--	--	--	--
76	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.00	0.00
76	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.00	0.00
58	Unnamed	Pond	Rail	Viaduct	--	--	0.00	0.00	--	--
96	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.00	0.00
96	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.00	0.00
96	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.00	0.00
58	Unnamed	Pond	Access Road	Viaduct	0.00	0.00	--	--	--	--
58	Unnamed	Pond	Rail	Viaduct	0.00	0.00	--	--	--	--
58	Unnamed	Pond	Rail	Fill	--	--	0.00	0.08	--	--
96	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.00	0.00
58	Unnamed	Pond	Access Road	Viaduct	0.00	0.00	--	--	--	--
58	Unnamed	Pond	Rail	Viaduct	0.00	0.00	--	--	--	--
97	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.00	0.00

Table 9: Estimated Waterbody Impacts – Navarro County										
Natural Resources Mapbook Page #	Waterbody ID/Name *	Waterbody Type	Construction Type	Crossing Type	Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm
					acres		acres		acres	
59	NCP7PD42	Pond	Rail	Viaduct	0.00	0.00	--	--	--	--
59	Unnamed	Pond	Rail	Fill	--	--	0.00	0.12	--	--
59	NCQ7PD1	Pond	Rail	Fill	0.00	0.04	--	--	--	--
59	NCQ7PD5	Pond	Rail	Viaduct	0.00	0.00	--	--	--	--
59	NCQ7PD5	Pond	Access Road	Viaduct	0.00	0.00	--	--	--	--
59	NCQ7PD5	Pond	Rail	Viaduct	0.00	0.00	--	--	--	--
59	Unnamed	Pond	Rail	Viaduct	--	--	0.00	0.00	--	--
60	NCQ7PD8	Pond	Rail	Viaduct	0.00	0.00	--	--	--	--
60	Unnamed	Pond	Rail	Fill	--	--	0.00	0.03	--	--
60	Unnamed	Pond	Rail	Fill	--	--	0.00	0.20	--	--
60	Unnamed	Pond	Access Road	Viaduct	--	--	0.00	0.00	--	--
60	Unnamed	Pond	Rail	Fill	--	--	0.00	0.14	--	--
60	NCQ7PD9	Pond	Access Road	Viaduct	0.00	0.00	--	--	--	--
60	NCQ7PD9	Pond	Rail	Viaduct	0.00	0.00	--	--	--	--
60	NCQ7PD12	Pond	Access Road	Viaduct	0.00	0.00	--	--	--	--
60	NCQ7PD12	Pond	Rail	Viaduct	0.00	0.00	--	--	--	--
60	NCQ7PD21	Pond	Access Road	Viaduct	0.00	0.00	--	--	--	--
60	NCQ7PD21	Pond	Access Road	Viaduct	0.00	0.00	--	--	--	--
60	NCQ7PD13	Pond	Rail	Viaduct	0.00	0.00	--	--	--	--
61	Unnamed	Pond	Rail	Viaduct	--	--	0.00	0.00	--	--
61	Unnamed	Pond	Rail	Viaduct	0.00	0.00	--	--	--	--
61	Unnamed	Pond	Rail	Viaduct	--	--	0.00	0.00	--	--
61	NCQ7PD15	Pond	Rail	Viaduct	0.00	0.00	--	--	--	--
62	Unnamed	Pond	Access Road	Viaduct	0.00	0.00	--	--	--	--
62	Unnamed	Pond	Stormwater Drainage	Excavation	0.00	0.00	--	--	--	--
62	Unnamed	Pond	Rail	Viaduct	0.00	0.00	--	--	--	--
62	Unnamed	Pond	Access Road	Viaduct	--	--	0.00	0.00	--	--
62	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	0.00	0.00	--	--

Table 9: Estimated Waterbody Impacts – Navarro County										
Natural Resources Mapbook Page #	Waterbody ID/Name *	Waterbody Type	Construction Type	Crossing Type	Segment 3A		Segment 3B		Segment 3C	
					Temp	Perm	Temp	Perm	Temp	Perm
					acres		acres		acres	
62	Unnamed	Pond	Rail	Viaduct	--	--	0.00	0.00	--	--
62	Unnamed	Pond	Stormwater Drainage	Excavation	0.00	0.00	--	--	--	--
				Total	0.77	7.6	0.69	4.6	0.03	1.1

Source: USGS, 2016; USFWS, 2016; FNI, 2017

*Waterbody ID # (N) indicates a specific feature recorded in the field. Waterbody classifications (P) indicate waterbodies not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each waterbody is separated by construction type.
'--' - not present

Freestone County

Table 10: Estimated Stream Impacts – Freestone County								
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					linear feet		linear feet	
98	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
98	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
99	Unnamed	Intermittent	Stormwater Drainage	Excavation	0.00	279.5	--	--
99	Unnamed	Intermittent	Access Road	Fill	0.00	895.4	--	--
99	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
99	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
99	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
99	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
99	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
99	Unnamed	Intermittent	Utilities	Viaduct	126.1	0.00	--	--
99	Tehuacana Creek	Perennial	Access Road	Viaduct	0.00	0.00	--	--
99	Tehuacana Creek	Perennial	Rail	Viaduct	0.00	0.00	--	--
100, 158	Little Tehuacana Creek	Intermittent	Access Road	Viaduct	0.00	0.00	0.00	0.00
100	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--

Table 10: Estimated Stream Impacts – Freestone County								
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					linear feet		linear feet	
100, 158	Little Tehuacana Creek	Intermittent	Rail	Viaduct	0.00	0.00	0.00	0.00
100	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
100	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
100	Unnamed	Intermittent	Temporary Fill	Fill	1,184.2	0.00	--	--
100	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
100	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
100	Unnamed	Intermittent	Temporary Fill	Fill	2,593.0	0.00	--	--
100	Unnamed	Intermittent	Access Road	Viaduct	0.03	0.00	--	--
62	CER8S1	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
62	CER8S1	Intermittent	Rail	Viaduct	--	--	0.00	0.00
62	CER8S2	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
62	CER8S2	Intermittent	Rail	Viaduct	--	--	0.00	0.00
62	CER8S3	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
62	CER8S3	Intermittent	Rail	Viaduct	--	--	0.00	0.00
100	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
100	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
101	Unnamed	Intermittent	Access Road	Fill	0.00	47.1	--	--
101	Unnamed	Artificial	Stormwater Drainage	Excavation	0.00	147.4	--	--
101	Unnamed	Artificial	Rail	Fill	0.00	224.2	--	--
101	Unnamed	Intermittent	Stormwater Drainage	Excavation	0.00	302.7	--	--
101	Unnamed	Intermittent	Rail	Fill	0.00	212.2	--	--
101	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
101	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
101	Dry Creek	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
101	Dry Creek	Intermittent	Rail	Viaduct	0.00	0.00	--	--
101	Dry Creek	Intermittent	Rail	Viaduct	0.00	0.00	--	--
101	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--

Table 10: Estimated Stream Impacts – Freestone County								
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					linear feet		linear feet	
155	CER8S6	Ephemeral	Rail	Viaduct	--	--	0.00	0.00
155	CER8S5	Ephemeral	Rail	Viaduct	--	--	0.00	0.00
155	CER8S100	Ephemeral	Rail	Viaduct	--	--	0.00	0.00
101	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
101	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
101	Unnamed	Intermittent	Stormwater Drainage	Excavation	0.00	136.6	--	--
101	Unnamed	Intermittent	Access Road	Fill	0.00	108.7	--	--
101	Unnamed	Intermittent	Rail	Fill	0.00	354.2	--	--
155	CER8S99	Intermittent	Rail	Viaduct	--	--	0.00	0.00
155	CER8S98	Ephemeral	Access Road	Viaduct	--	--	0.00	0.00
155	CER8S98	Ephemeral	Rail	Viaduct	--	--	0.00	0.00
102	Cedar Creek	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
102	Cedar Creek	Intermittent	Rail	Viaduct	0.00	0.00	--	--
155	Unnamed	Artificial	Access Road	Viaduct	--	--	0.00	0.00
155	Unnamed	Artificial	Rail	Viaduct	--	--	0.00	0.00
102	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
102	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
102	Caney Creek	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
102	Caney Creek	Intermittent	Rail	Viaduct	0.00	0.00	--	--
156	CER8S10	Ephemeral	Maintenance Facility	Fill	--	--	0.00	186.1
156	CER8S10	Ephemeral	Rail	Viaduct	--	--	0.00	0.00
156	CER8S14	Ephemeral	Rail	Viaduct	--	--	0.00	0.00
156	CER8S14	Ephemeral	Maintenance Facility	Fill	--	--	0.00	28.1
156	CER8S13	Ephemeral	Maintenance Facility	Fill	--	--	0.00	18.6
156	Jackson Branch	Intermittent	Maintenance Facility	Fill	--	--	0.00	305.6
156	Jackson Branch	Intermittent	Access Road	Viaduct	--	--	0.00	0.00

Table 10: Estimated Stream Impacts – Freestone County								
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					linear feet		linear feet	
156	CER8S9	Ephemeral	Access Road	Viaduct	--	--	0.00	0.00
103	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
103	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
156	CER8S11	Perennial	Access Road	Viaduct	--	--	0.00	0.00
156	CER8S11	Perennial	Rail	Viaduct	--	--	0.00	0.00
103	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
103	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
157	CES8S1	Ephemeral	Access Road	Viaduct	--	--	0.00	0.00
157	CES8S2	Ephemeral	Access Road	Fill	--	--	0.00	68.4
157	CES8S2	Ephemeral	Rail	Fill	--	--	0.00	31.6
104	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
104	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
157	CES9S1	Ephemeral	Rail	Viaduct	--	--	0.00	0.00
157	CES9S2	Ephemeral	Access Road	Viaduct	--	--	0.00	0.00
157	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
157	CES9S1	Ephemeral	Access Road	Viaduct	--	--	0.00	0.00
105	Cottonwood Creek	Perennial	Access Road	Viaduct	0.00	0.00	--	--
104	Cottonwood Creek	Perennial	Rail	Viaduct	0.00	0.00	--	--
105	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
105	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
158	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
158	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00
158	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	0.00	135.8
158	Unnamed	Intermittent	Access Road	Fill	--	--	0.00	76.7
158	Unnamed	Intermittent	Rail	Fill	--	--	0.00	208.6
159	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	0.00	159.2
159	Unnamed	Intermittent	Access Road	Fill	--	--	0.00	79.5

Table 10: Estimated Stream Impacts – Freestone County								
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					linear feet		linear feet	
159	Unnamed	Intermittent	Rail	Fill	--	--	0.00	300.5
159	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
159	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00
159	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
159	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00
159	CES9S9	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
159	CES9S9	Intermittent	Rail	Viaduct	--	--	0.00	0.00
106	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
106	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
160	CET9S3	Ephemeral	Stormwater Drainage	Excavation	--	--	0.00	37.5
160	CET9S3	Ephemeral	Access Road	Fill	--	--	0.00	87.5
160	CET9S3	Ephemeral	Rail	Fill	--	--	0.00	220.2
160	CET9S4	Ephemeral	Rail	Fill	--	--	0.00	334.5
160	CET9S4	Ephemeral	Stormwater Drainage	Excavation	--	--	0.00	317.8
160	CET9S4	Ephemeral	Access Road	Fill	--	--	0.00	160.8
160	Unnamed	Intermittent	Access Road	Fill	--	--	0.00	2.0
107	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
160	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	0.00	48.9
160	Unnamed	Intermittent	Rail	Fill	--	--	0.00	197.4
161	Unnamed	Artificial	Stormwater Drainage	Excavation	--	--	0.00	696.7
161	Unnamed	Artificial	Rail	Fill	--	--	0.00	39.8
108	Unnamed	Intermittent	Maintenance Facility	Fill	0.00	782.8	--	--
108	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
108	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
161	Unnamed	Intermittent	Access Road	Fill	--	--	0.00	443.5
108	Unnamed	Intermittent	Maintenance	Fill	0.00	127.4	--	--

Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					linear feet		linear feet	
			Facility					
108	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
108	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
161	CET9S7	Ephemeral	Access Road	Viaduct	--	--	0.00	0.00
161	CET9S7	Ephemeral	Rail	Viaduct	--	--	0.00	0.00
161	CET9S7	Ephemeral	Temporary Fill	Fill	--	--	766.2	0.00
162	Unnamed	Intermittent	Access Road	Fill	--	--	0.00	98.8
109	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
109	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
162	CET9S7	Ephemeral	Access Road	Fill	--	--	0.00	544.3
162	CET9S9	Ephemeral	Access Road	Viaduct	--	--	0.00	0.00
162	CET9S9	Ephemeral	Rail	Viaduct	--	--	0.00	0.00
162	CET9S10	Ephemeral	Access Road	Fill	--	--	0.00	62.7
162	CET9S10	Ephemeral	Rail	Fill	--	--	0.00	32.0
109	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
109	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
109	Upper Keechi Creek	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
109	Upper Keechi Creek	Intermittent	Rail	Viaduct	0.00	0.00	--	--
162	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	0.00	617.1
163	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
163	CEU9S2	Ephemeral	Access Road	Viaduct	--	--	0.00	0.00
163	CEU9S2	Ephemeral	Rail	Viaduct	--	--	0.00	0.00
163	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
163	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
110	Hog Creek	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
110	Hog Creek	Intermittent	Rail	Viaduct	0.00	0.00	--	--
164	Patton Creek	Intermittent	Access Road	Viaduct	--	--	0.00	0.00

Table 10: Estimated Stream Impacts – Freestone County

Table 10: Estimated Stream Impacts – Freestone County								
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					linear feet		linear feet	
164	Patton Creek	Intermittent	Rail	Viaduct	--	--	0.00	0.00
164	CEU9S5	Ephemeral	Access Road	Viaduct	--	--	0.00	0.00
164	CEU9S5	Ephemeral	Rail	Viaduct	--	--	0.00	0.00
111	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
111	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
164	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
165	Perry Creek	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
165	Perry Creek	Intermittent	Rail	Viaduct	--	--	0.00	0.00
113	Caroline Creek	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
113	Caroline Creek	Intermittent	Rail	Viaduct	0.00	0.00	--	--
113	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
113	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
113	Unnamed	Intermittent	Stormwater Drainage	Excavation	0.00	22.8	--	--
113	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
113	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
167	Chambers Creek	Intermittent	Rail	Viaduct	--	--	0.00	0.00
114	Unnamed	Intermittent	Rail	Fill	0.00	446.9	--	--
114	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
114	Unnamed	Intermittent	Stormwater Drainage	Excavation	0.00	81.4	--	--
114	Unnamed	Intermittent	Access Road	Fill	0.00	153.2	--	--
114	Unnamed	Intermittent	Rail	Fill	0.00	86.2	--	--
114	Wilkerson Spring Branch	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
114	Wilkerson Spring Branch	Intermittent	Rail	Viaduct	0.00	0.00	--	--
115	Fulks Dugout	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
115	Fulks Dugout	Intermittent	Rail	Viaduct	0.00	0.00	--	--
116	Whitney Branch	Intermittent	Access Road	Viaduct	0.00	0.00	--	--

Table 10: Estimated Stream Impacts – Freestone County								
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					linear feet		linear feet	
116	Whitney Branch	Intermittent	Rail	Viaduct	0.00	0.00	--	--
116	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
116	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
117	Buffalo Creek	Perennial	Rail	Viaduct	0.00	0.00	--	--
				Total	3,903.4	4,408.8	766.2	5,539.9

Source: USGS, 2016; FNI, 2017

*Stream ID # (C) indicates a specific feature recorded in the field whereas stream names (or those “unnamed”) indicate features mapped via data not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each stream is separated by construction type.

'--' - not present

Table 11: Estimated Wetland Impacts – Freestone County								
Natural Resources Mapbook Page #	Wetland ID/ Classification*	Wetland Type	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					acres		acres	
100	PFO1A	Forested	Access Road	Viaduct/Conversion	0.00	0.1	--	--
100	PFO1A	Forested	Rail	Viaduct/Conversion	0.00	0.6	--	--
100	PFO1C	Forested	Access Road	Viaduct/Conversion	0.00	0.01	--	--
100	PFO1C	Forested	Rail	Viaduct/Conversion	0.00	0.05	--	--
100	PFO1A	Forested	Temporary Fill	Fill	1.8	0.00	--	--
100	PFO1A	Forested	Access Road	Viaduct/Conversion	<0.01	0.00	--	--
100	PFO1A	Forested	Access Road	Viaduct/Conversion	0.00	0.12	--	--
100	PFO1A	Forested	Rail	Viaduct/Conversion	0.00	0.44	--	--
100	PFO1C	Forested	Rail	Viaduct/Conversion	0.00	0.05	--	--
62	CER8EW17	Emergent	Rail	Viaduct	--	--	0.00	0.00
100	PFO1C	Forested	Temporary Fill	Fill	0.9	0.00	--	--
62	CER8EW10	Emergent	Temporary Fill	Fill	--	--	0.03	0.00
62	CER8EW9	Emergent	Temporary Fill	Fill	--	--	0.03	0.00
62	CER8EW11	Emergent	Access Road	Fill	--	--	0.00	0.02

Table 11: Estimated Wetland Impacts – Freestone County								
Natural Resources Mapbook Page #	Wetland ID/ Classification*	Wetland Type	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					acres		acres	
155	CER8EW8	Emergent	Temporary Fill	Fill	--	--	0.02	0.00
101	PEM1F	Emergent	Rail	Fill	0.00	0.11	--	--
155	CER8EW7	Emergent	Temporary Fill	Fill	--	--	0.04	0.00
155	CER8EW5	Emergent	Temporary Fill	Fill	--	--	0.07	0.00
155	CER8EW18	Emergent	Temporary Fill	Fill	--	--	<0.01	0.00
101	PFO1C	Forested	Access Road	Viaduct/Conversion	0.00	0.04	--	--
101	PFO1C	Forested	Rail	Viaduct/Conversion	0.00	0.18	--	--
155	CER8SW1	Scrub/Shrub	Rail	Viaduct	--	--	0.00	0.00
102	PFO1C	Forested	Access Road	Viaduct/Conversion	0.00	0.09	--	--
102	PFO1C	Forested	Rail	Viaduct/Conversion	0.00	0.09	--	--
156	PFO1C	Forested	Maintenance Facility	Fill	--	--	0.00	0.13
155	PFO1C	Forested	Rail	Viaduct/Conversion	--	--	0.00	0.06
155	PFO1C	Forested	Access Road	Viaduct/Conversion	--	--	0.00	0.07
102	PSS1/EM1A	Forested	Access Road	Viaduct/Conversion	0.00	1.9	--	--
102	PSS1/EM1A	Forested	Rail	Viaduct/Conversion	0.00	2.6	--	--
102	PEM1Ch	Emergent	Access Road	Viaduct	0.00	0.00	--	--
156	PFO1A	Forested	Access Road	Viaduct/Conversion	--	--	0.00	0.01
156	PFO1A	Forested	Rail	Viaduct/Conversion	--	--	0.00	0.94
156	PFO1A	Forested	Access Road	Viaduct/Conversion	--	--	0.00	<0.01
156	PFO1A	Forested	Rail	Viaduct/Conversion	--	--	0.00	0.07
156	CER8EW16	Emergent	Access Road	Viaduct	--	--	0.00	0.00
156	CER8EW16	Emergent	Rail	Viaduct	--	--	0.00	0.00
156	CER8EW15	Emergent	Rail	Viaduct	--	--	0.00	0.00
156	CER8EW15	Emergent	Access Road	Viaduct	--	--	0.00	0.00
156	CER8EW14	Emergent	Utilities	Fill	--	--	0.02	0.00
156	CER8EW14	Emergent	Rail	Viaduct	--	--	0.00	0.00
156	CER8FW5	Forested	Utilities	Fill	--	--	<0.01	0.00

Table 11: Estimated Wetland Impacts – Freestone County								
Natural Resources Mapbook Page #	Wetland ID/ Classification*	Wetland Type	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					acres		acres	
156	CER8FW5	Forested	Rail	Viaduct	--	--	0.00	0.00
156	CER8EW13	Emergent	Rail	Viaduct	--	--	0.00	0.00
156	CER8EW12	Emergent	Access Road	Viaduct	--	--	0.00	0.00
156	CER8EW12	Emergent	Rail	Viaduct	--	--	0.00	0.00
157	CES8EW1	Emergent	Rail	Fill	--	--	0.00	0.06
105	PEM1C	Emergent	Access Road	Viaduct	0.00	0.00	--	--
105	PEM1C	Emergent	Rail	Viaduct	0.00	0.00	--	--
105	PFO1A	Forested	Access Road	Viaduct/Conversion	0.00	0.05	--	--
105	PFO1A	Forested	Rail	Viaduct/Conversion	0.00	0.09	--	--
158	PFO1C	Forested	Access Road	Viaduct/Conversion	--	--	0.00	0.05
158	PFO1C	Forested	Rail	Viaduct/Conversion	--	--	0.00	0.06
162	PFO1C	Forested	Access Road	Fill	--	--	0.00	0.04
162	CEU9EW4	Emergent	Access Road	Fill	--	--	0.00	0.09
162	CEU9EW4	Emergent	Rail	Fill	--	--	0.00	0.09
163	CEU9EW3	Emergent	Access Road	Viaduct	--	--	0.00	0.00
163	CEU9EW3	Emergent	Rail	Viaduct	--	--	0.00	0.00
164	PFO1C	Forested	Access Road	Viaduct/Conversion	--	--	0.00	0.01
164	PFO1C	Forested	Rail	Viaduct/Conversion	--	--	0.00	0.18
165	PEM1C	Emergent	Access Road	Viaduct	--	--	0.00	0.00
165	PEM1C	Emergent	Rail	Viaduct	--	--	0.00	0.00
165	PEM1C	Emergent	Access Road	Viaduct	--	--	0.00	0.00
165	PEM1C	Emergent	Rail	Viaduct	--	--	0.00	0.00
165	PEM1A	Emergent	Access Road	Viaduct	--	--	0.00	0.00
165	PEM1A	Emergent	Rail	Viaduct	--	--	0.00	0.00
165	PFO1A	Forested	Access Road	Viaduct/Conversion	--	--	0.00	0.12
165	PFO1A	Forested	Rail	Viaduct/Conversion	--	--	0.00	0.86
112	PEM1A	Emergent	Rail	Viaduct	0.00	0.00	--	--
114	PFO1A	Forested	Stormwater	Excavation	0.00	0.12	--	--

Table 11: Estimated Wetland Impacts – Freestone County								
Natural Resources Mapbook Page #	Wetland ID/ Classification*	Wetland Type	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					acres		acres	
			Drainage					
114	PFO1A	Forested	Access Road	Fill	0.00	0.07	--	--
116	PEM1C	Emergent	Access Road	Viaduct	0.00	0.00	--	--
116	PEM1C	Emergent	Rail	Viaduct	0.00	0.00	--	--
117	PFO1A	Forested	Access Road	Viaduct/Conversion	0.00	0.08	--	--
117	PFO1A	Forested	Rail	Viaduct/Conversion	0.00	2.6	--	--
				Total	2.7	9.4	0.21	2.9

Source: USFWS, 2016; FNI, 2017

*Wetland ID # (C) indicates a specific feature recorded in the field. Wetland classifications (P) indicate wetlands not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each wetland is separated by construction type.

P - Palustrine
EM1 - Persistent Emergent
FO1 - Broad-leaved Deciduous Forested
SS1 - Broad-leaved Deciduous Scrub-Shrub
C - Seasonally Flooded
EM - Emergent
FO - Forested
SS - Scrub-Shrub
A - Temporarily Flooded
'--' - not present

Table 12: Estimated Waterbody Impacts – Freestone County								
Natural Resources Mapbook Page #	Waterbody ID/Name	Waterbody Type	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					acres		acres	
99	Unnamed	Pond	Access Road	Fill	0.00	0.12	--	--
99	Unnamed	Pond	Rail	Fill	0.00	0.15	--	--
100	Unnamed	Pond	Rail	Viaduct	0.00	0.00	--	--
62	CER8PD1	Pond	Rail	Viaduct	--	--	0.00	0.00
100	Unnamed	Pond	Temporary Fill	Fill	0.44	0.00	--	--
100	Unnamed	Pond	Temporary Fill	Fill	0.11	0.00	--	--
100	Unnamed	Pond	Temporary Fill	Fill	0.09	0.00	--	--
100	Unnamed	Pond	Temporary Fill	Fill	0.48	0.00	--	--
62	CER8PD4	Pond	Access Road	Fill	--	--	0.00	0.01

Table 12: Estimated Waterbody Impacts – Freestone County								
Natural Resources Mapbook Page #	Waterbody ID/Name	Waterbody Type	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					acres		acres	
101	Unnamed	Pond	Stormwater Drainage	Excavation	0.00	0.08	--	--
101	Unnamed	Pond	Rail	Fill	0.00	0.21	--	--
101	Unnamed	Pond	Rail	Fill	0.00	0.04	--	--
155	CER8PD7	Pond	Temporary Fill	Fill	--	--	0.16	0.00
155	CER8PD8	Pond	Temporary Fill	Fill	--	--	0.12	0.00
155	CER8PD9	Pond	Temporary Fill	Fill	--	--	0.02	0.00
155	CER8PD9	Pond	Access Road	Viaduct	--	--	0.00	0.00
155	CER8PD9	Pond	Rail	Viaduct	--	--	0.00	0.00
101	Unnamed	Pond	Access Road	Fill	0.00	0.07	--	--
155	CER8PD11	Pond	Rail	Viaduct	--	--	0.00	0.00
155	Unnamed	Pond	Access Road	Viaduct	--	--	0.00	0.00
155	Unnamed	Pond	Rail	Viaduct	--	--	0.00	0.00
103	Unnamed	Pond	Access Road	Viaduct	0.00	0.00	--	--
103	Unnamed	Pond	Rail	Viaduct	0.00	0.00	--	--
156	Unnamed	Pond	Maintenance Facility	Fill	--	--	0.00	0.16
156	Unnamed	Pond	Maintenance Facility	Fill	--	--	0.00	<0.01
156	Unnamed	Pond	Rail	Fill	--	--	0.00	0.17
156	CER8PD23	Pond	Access Road	Viaduct	--	--	0.00	0.00
156	CER8PD23	Pond	Rail	Viaduct	--	--	0.00	0.00
156	CER8PD23	Pond	Access Road	Viaduct	--	--	0.00	0.00
156	CER8PD23	Pond	Rail	Viaduct	--	--	0.00	0.00
156	CER8PD22	Pond	Access Road	Viaduct	--	--	0.00	0.00
156	CER8PD22	Pond	Rail	Viaduct	--	--	0.00	0.00
103	Unnamed	Pond	Rail	Viaduct	0.00	0.00	--	--
157	CES8PD2	Pond	Access Road	Fill	--	--	0.00	0.30
157	CES8PD2	Pond	Rail	Fill	--	--	0.00	0.33
157	CES8PD3	Pond	Access Road	Fill	--	--	0.00	0.02

Table 12: Estimated Waterbody Impacts – Freestone County								
Natural Resources Mapbook Page #	Waterbody ID/Name	Waterbody Type	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					acres		acres	
157	CES8PD3	Pond	Utilities	Fill	--	--	0.01	0.00
157	CES9PD1	Pond	Rail	Fill	--	--	0.00	<0.01
157	CES9PD2	Pond	Access Road	Viaduct	--	--	0.00	0.00
157	CES9PD2	Pond	Stormwater Drainage	Excavation	--	--	0.00	0.34
158	CES9PD4	Pond	Access Road	Viaduct	--	--	0.00	0.00
158	CES9PD4	Pond	Rail	Viaduct	--	--	0.00	0.00
158	CES9PD5	Pond	Access Road	Fill	--	--	0.00	0.03
158	CES9PD5	Pond	Stormwater Drainage	Excavation	--	--	0.00	0.07
158	CES9PD5	Pond	Rail	Fill	--	--	0.00	0.53
105	Unnamed	Pond	Rail	Fill	0.00	0.01	--	--
105	Unnamed	Pond	Utilities	Fill	0.00	0.07	--	--
158	Unnamed	Pond	Access Road	Viaduct	--	--	0.00	0.00
158	Unnamed	Pond	Rail	Fill	--	--	0.00	0.15
159	Unnamed	Pond	Access Road	Viaduct	--	--	0.00	0.00
160	CET9PD4	Pond	Rail	Fill	--	--	0.00	0.01
160	CET9PD4	Pond	Stormwater Drainage	Excavation	--	--	0.00	0.03
160	CET9PD6	Pond	Stormwater Drainage	Excavation	--	--	0.00	0.09
160	CET9PD6	Pond	Rail	Fill	--	--	0.00	0.15
160	CET9PD6	Pond	Stormwater Drainage	Excavation	--	--	0.00	0.17
160	CET9PD6	Pond	Access Road	Fill	--	--	0.00	0.42
160	CET9PD7	Pond	Access Road	Fill	--	--	0.00	0.04
160	CET9PD7	Pond	Rail	Fill	--	--	0.00	0.09
107	Unnamed	Pond	Maintenance Facility	Fill	0.00	0.09	--	--
108	Unnamed	Pond	Access Road	Viaduct	0.00	0.00	--	--
108	Unnamed	Pond	Maintenance Facility	Fill	0.00	0.67	--	--

Natural Resources Mapbook Page #	Waterbody ID/Name	Waterbody Type	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					acres		acres	
108	Unnamed	Pond	Maintenance Facility	Fill	0.00	0.12	--	--
161	Unnamed	Pond	Rail	Fill	--	--	0.00	0.17
161	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	0.00	0.37
108	Unnamed	Pond	Access Road	Viaduct	0.00	0.00	--	--
161	Unnamed	Pond	Rail	Fill	--	--	0.00	0.08
161	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	0.00	0.11
161	CET9PD27	Pond	Temporary Fill	Fill	--	--	0.30	0.00
161	CET9PD18	Pond	Temporary Fill	Fill	--	--	0.08	0.00
161	CET9PD18	Pond	Access Road	Fill	--	--	0.00	0.04
161	CET9PD18	Pond	Rail	Fill	--	--	0.00	0.10
162	Unnamed	Pond	Access Road	Fill	--	--	0.00	0.10
162	CET9PD20	Pond	Rail	Fill	--	--	0.00	0.06
162	CET9PD20	Pond	Access Road	Fill	--	--	0.00	0.16
162	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	0.00	<0.01
162	Unnamed	Pond	Access Road	Fill	--	--	0.00	0.15
110	Unnamed	Pond	Access Road	Fill	0.00	0.02	--	--
163	CEU9PD3	Pond	Access Road	Viaduct	--	--	0.00	0.00
163	CEU9PD5	Pond	Access Road	Viaduct	--	--	0.00	0.00
163	CEU9PD5	Pond	Rail	Viaduct	--	--	0.00	0.00
163	CEU9PD7	Pond	Access Road	Viaduct	--	--	0.00	0.00
163	CEU9PD7	Pond	Rail	Viaduct	--	--	0.00	0.00
164	CEU9PD17	Pond	Stormwater Drainage	Excavation	--	--	0.00	0.13
164	CEU9PD11	Pond	Access Road	Fill	--	--	0.00	<0.01
164	CEU9PD11	Pond	Rail	Fill	--	--	0.00	0.04
111	Unnamed	Pond	Access Road	Viaduct	0.00	0.00	--	--
111	Unnamed	Pond	Rail	Viaduct	0.00	0.00	--	--

Table 12: Estimated Waterbody Impacts – Freestone County								
Natural Resources Mapbook Page #	Waterbody ID/Name	Waterbody Type	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					acres		acres	
166	Unnamed	Pond	Rail	Viaduct	--	--	0.00	0.00
166	Unnamed	Pond	Access Road	Viaduct	--	--	0.00	0.00
166	Unnamed	Pond	Rail	Viaduct	--	--	0.00	0.00
				Total	1.1	1.7	0.69	4.6

Source: USGS, 2016; USFWS, 2016; FNI, 2017

*Waterbody ID # (C) indicates a specific feature recorded in the field. Waterbody classifications (P) indicate waterbodies not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each waterbody is separated by construction type.

'--' - not present

Limestone County

Table 13: Estimated Stream Impacts – Limestone County						
Natural Resources Mapbook Page #	Stream ID/Stream Name*	Classification	Construction Type	Crossing Type	Segment 4	
					Temp	Perm
					linear feet	
167	Chambers Creek	Intermittent	Access Road	Viaduct	0.00	0.00
167	Unnamed	Intermittent	Stormwater Drainage	Excavation	0.00	120.6
167	Unnamed	Intermittent	Rail	Fill	0.00	162.9
167	CEV9S12	Ephemeral	Access Road	Viaduct	0.00	0.00
167	CEV9S12	Ephemeral	Rail	Viaduct	0.00	0.00
167	CEV9S11	Ephemeral	Access Road	Viaduct	0.00	0.00
167	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00
167	CEV9S7	Ephemeral	Access Road	Viaduct	0.00	0.00
167	CEV9S7	Ephemeral	Rail	Viaduct	0.00	0.00
167	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00
167	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00
168	CEV9S10	Ephemeral	Facility	Fill	0.00	72.7
168	CEV9S10	Ephemeral	Rail	Viaduct	0.00	0.00

Table 13: Estimated Stream Impacts – Limestone County						
Natural Resources Mapbook Page #	Stream ID/Stream Name*	Classification	Construction Type	Crossing Type	Segment 4	
					Temp	Perm
					linear feet	
168	CEW9S1	Intermittent	Access Road	Viaduct	0.00	0.00
168	CEW9S1	Intermittent	Rail	Viaduct	0.00	0.00
168	CEW9S13	Ephemeral	Access Road	Viaduct	0.00	0.00
168	CEW9S13	Ephemeral	Rail	Viaduct	0.00	0.00
168	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00
168	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00
168	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00
168	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00
169	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00
169	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00
169	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00
169	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00
169	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00
169	CEW9S9	Perennial	Access Road	Viaduct	0.00	0.00
169	CEW9S9	Perennial	Rail	Viaduct	0.00	0.00
170	CEW9S100	Ephemeral	Access Road	Fill	0.00	589.1
170	CEW9S100	Ephemeral	Rail	Fill	0.00	795.9
170	CEW9S12	Intermittent	Access Road	Viaduct	0.00	0.00
170	CEW9S12	Intermittent	Rail	Viaduct	0.00	0.00
170	CEW9S99	Ephemeral	Access Road	Viaduct	0.00	0.00
170	CEW9S99	Ephemeral	Rail	Viaduct	0.00	0.00
171	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00
171	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00
172	Sanders Creek	Intermittent	Access Road	Viaduct	0.00	0.00
172	Sanders Creek	Intermittent	Rail	Viaduct	0.00	0.00
172	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00
172	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00
172	Coots Branch	Intermittent	Access Road	Viaduct	0.00	0.00

Table 13: Estimated Stream Impacts – Limestone County						
Natural Resources Mapbook Page #	Stream ID/Stream Name*	Classification	Construction Type	Crossing Type	Segment 4	
					Temp	Perm
					linear feet	
172	Coots Branch	Intermittent	Rail	Viaduct	0.00	0.00
172	CEX10S10	Ephemeral	Access Road	Viaduct	0.00	0.00
172	CEX10S10	Ephemeral	Rail	Viaduct	0.00	0.00
173	CEX10S16	Ephemeral	Stormwater Drainage	Excavation	0.00	50.3
173	CEX10S16	Ephemeral	Access Road	Fill	0.00	315.8
173	Unnamed	Artificial	Access Road	Fill	0.00	784.4
173	Unnamed	Intermittent	Stormwater Drainage	Excavation	0.00	280.9
173	Lies Branch	Intermittent	Access Road	Viaduct	0.00	0.00
173	Lies Branch	Intermittent	Rail	Viaduct	0.00	0.00
173	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00
173	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00
174	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00
174	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00
174	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00
174	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00
174	Lambs Creek	Intermittent	Access Road	Viaduct	0.00	0.00
174	Lambs Creek	Intermittent	Rail	Viaduct	0.00	0.00
				Total	0.00	3,172.6

Source: USGS, 2016; FNI, 2017

*Stream ID # (N) indicates a specific feature recorded in the field whereas stream names (or those "unnamed") indicate features mapped via data not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each stream is separated by construction type.

Table 14: Estimated Wetland Impacts – Limestone County						
Natural Resources Mapbook Page #	Wetland ID/Classification*	Wetland Type	Construction Type	Crossing Type	Segment 4	
					Temp	Perm
					acres	
168	PFO1C	Forested	Access Road	Viaduct/Conversion	0.00	0.01
168	PFO1C	Forested	Rail	Viaduct	0.00	0.08

Table 14: Estimated Wetland Impacts – Limestone County						
Natural Resources Mapbook Page #	Wetland ID/Classification*	Wetland Type	Construction Type	Crossing Type	Segment 4	
					Temp	Perm
					acres	
169	PFO1A	Forested	Rail	Viaduct	0.00	0.90
169	CEW9EW13	Emergent	Access Road	Viaduct	0.00	0.00
169	CEW9EW13	Emergent	Rail	Viaduct	0.00	0.00
169	CEW9EW12	Emergent	Access Road	Viaduct	0.00	0.00
169	CEW9EW12	Emergent	Rail	Viaduct	0.00	0.00
169	CEW9EW14	Emergent	Access Road	Viaduct	0.00	0.00
169	CEW9EW14	Emergent	Rail	Viaduct	0.00	0.00
169	CEW9EW8	Emergent	Rail	Viaduct	0.00	0.00
170	CEW9FW99	Forested	Access Road	Viaduct/Conversion	0.00	0.03
170	CEW9FW99	Forested	Rail	Viaduct	0.00	0.08
170	PFO1C	Forested	Access Road	Viaduct/Conversion	0.00	0.01
171	PFO1C	Forested	Access Road	Viaduct/Conversion	0.00	0.02
171	PFO1C	Forested	Rail	Viaduct	0.00	0.27
171	PEM1C	Emergent	Access Road	Viaduct	0.00	0.00
171	PEM1C	Emergent	Rail	Viaduct	0.00	0.00
172	PFO1C	Forested	Access Road	Viaduct/Conversion	0.00	0.03
172	PFO1C	Forested	Rail	Viaduct	0.00	0.07
172	PFO1C	Forested	Access Road	Viaduct/Conversion	0.00	0.03
172	PFO1C	Forested	Rail	Viaduct	0.00	0.06
173	CEX10EW2	Emergent	Rail	Fill	0.00	0.08
173	CEX10EW3	Emergent	Access Road	Fill	0.00	0.05
173	CEX10EW3	Emergent	Rail	Fill	0.00	<0.01
173	PFO1C	Forested	Stormwater Drainage	Excavation	0.00	0.05
173	PFO1C	Forested	Access Road	Viaduct/Conversion	0.00	0.38
173	PFO1C	Forested	Rail	Viaduct	0.00	0.12
173	CEY10EW1	Emergent	Access Road	Viaduct	0.00	0.00
173	CEY10EW1	Emergent	Rail	Viaduct	0.00	0.00
174	PFO1C	Forested	Access Road	Viaduct/Conversion	0.00	0.04

Table 14: Estimated Wetland Impacts – Limestone County						
Natural Resources Mapbook Page #	Wetland ID/Classification*	Wetland Type	Construction Type	Crossing Type	Segment 4	
					Temp	Perm
					acres	
174	PFO1C	Forested	Rail	Viaduct	0.00	0.05
				Total	0.00	2.4

Source: USFWS, 2016; FNI, 2017

*Wetland ID # (C) indicates a specific feature recorded in the field. Wetland classifications (P) indicate wetlands not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each wetland is separated by construction type

P - Palustrine
FO – Forested
FO1 - Broad-leaved Deciduous Forested
C – Seasonally Flooded
EM - Emergent
EM1 – Persistent Emergent
A - Temporarily Flooded

Table 15: Estimated Waterbody Impacts – Limestone County						
Natural Resources Mapbook Page #	Waterbody ID/Name *	Waterbody Type	Construction Type	Crossing Type	Segment 4	
					Temp	Perm
					acres	
168	CEW9PD26	Pond	Access Road	Viaduct	0.00	0.00
168	CEW9PD26	Pond	Rail	Viaduct	0.00	0.00
169	Unnamed	Pond	Rail	Viaduct	0.00	0.00
169	CEW9PD10	Pond	Access Road	Viaduct	0.00	0.00
169	CEW9PD10	Pond	Rail	Viaduct	0.00	0.00
171	Unnamed	Pond	Access Road	Fill	0.00	<0.01
171	Unnamed	Pond	Access Road	Fill	0.00	0.10
171	Unnamed	Pond	Rail	Fill	0.00	0.04
172	Unnamed	Pond	Access Road	Fill	0.00	0.11
172	CEX10PD25	Pond	Access Road	Fill	0.00	0.05
173	CEX10PD26	Pond	Rail	Fill	0.00	0.16
173	CEX10PD37	Pond	Access Road	Fill	0.00	0.22
173	CEX10PD37	Pond	Rail	Fill	0.00	0.02
173	CEX10PD27	Pond	Access Road	Fill	0.00	0.23
173	CEX10PD27	Pond	Rail	Fill	0.00	0.08
173	Unnamed	Pond	Access Road	Fill	0.00	0.36

Table 15: Estimated Waterbody Impacts – Limestone County						
Natural Resources Mapbook Page #	Waterbody ID/Name *	Waterbody Type	Construction Type	Crossing Type	Segment 4	
					Temp	Perm
					acres	
173	Unnamed	Pond	Stormwater Drainage	Excavation	0.00	0.08
173	CEY10PD3	Pond	Rail	Viaduct	0.00	0.00
173	CEY10PD4	Pond	Rail	Viaduct	0.00	0.00
173	CEY10PD6	Pond	Rail	Viaduct	0.00	0.00
174	CEY10PD14	Pond	Rail	Viaduct	0.00	0.00
174	CEY10PD14	Pond	Utilities	Fill	0.00	<0.01
				Total	0.00	1.5

Source: USGS, 2016; USFWS, 2016; FNI, 2017
*Waterbody ID # (C) indicates a specific feature recorded in the field. Waterbody classifications (P) indicate waterbodies not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each waterbody is separated by construction type.

Leon County

Table 16: Estimated Stream Impacts – Leon County								
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					linear feet		linear feet	
117	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
117	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
118	Unnamed	Intermittent	Stormwater Drainage	Fill	0.00	204.7	--	--
118	Unnamed	Intermittent	Rail	Fill	0.00	179.1	--	--
118	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
118	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
118	Cane Branch	Intermittent	Temporary Fill	Fill	50.4	0.00	--	--
118	Cane Branch	Intermittent	Rail	Viaduct	0.00	0.00	--	--
118	Cane Branch	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
118	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
118	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
119	Copper Creek	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
119	Copper Creek	Intermittent	Rail	Viaduct	0.00	0.00	--	--
120	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--

Table 16: Estimated Stream Impacts – Leon County								
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					linear feet		linear feet	
120	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
120	Unnamed	Perennial	Access Road	Viaduct	0.00	0.00	--	--
120	Bliss Creek	Perennial	Access Road	Viaduct	0.00	0.00	--	--
120	Bliss Creek	Perennial	Rail	Viaduct	0.00	0.00	--	--
120	Bliss Creek	Perennial	Access Road	Viaduct	0.00	0.00	--	--
120	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
120	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
121	Right Branch	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
121	Right Branch	Intermittent	Rail	Viaduct	0.00	0.00	--	--
121	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
121	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
174	CEY10S7	Ephemeral	Access Road	Viaduct	--	--	0.00	0.00
174	CEY10S7	Ephemeral	Rail	Viaduct	--	--	0.00	0.00
175	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
175	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00
122	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
122	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
175	CEY10S8	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
175	CEY10S8	Intermittent	Rail	Viaduct	--	--	0.00	0.00
175	CEY10S9	Ephemeral	Access Road	Viaduct	--	--	0.00	0.00
122	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
122	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
175	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
123	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
123	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
123	Unnamed	Intermittent	Access Road	Excavation	0.00	108.8	--	--
176	CEZ11S2	Intermittent	Rail	Viaduct	--	--	0.00	0.00
123	Unnamed	Intermittent	Access Road	Fill	0.00	280.0	--	--
123	Unnamed	Intermittent	Rail	Fill	0.00	210.9	--	--

Table 16: Estimated Stream Impacts – Leon County								
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					linear feet		linear feet	
123	Unnamed	Intermittent	Stormwater Drainage	Excavation	0.00	0.0	--	--
123	Unnamed	Intermittent	Access Road	Fill	0.00	116.0	--	--
123	Unnamed	Intermittent	Rail	Fill	0.00	139.3	--	--
123	Unnamed	Intermittent	Stormwater Drainage	Excavation	0.00	107.8	--	--
123	Unnamed	Intermittent	Access Road	Fill	0.00	108.6	--	--
177	CEZ11S8	Perennial	Access Road	Viaduct	--	--	0.00	0.00
177	CEZ11S8	Perennial	Rail	Viaduct	--	--	0.00	0.00
124	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
124	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
177	CEZ11S11	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
177	CEZ11S10	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
178	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	0.00	31.0
177	Unnamed	Intermittent	Rail	Fill	--	--	0.00	242.1
178	Unnamed	Intermittent	Temporary Fill	Fill	--	--	894.7	0.00
178	Unnamed	Intermittent	Maintenance Facility	Fill	--	--	0.00	131.5
178	Cedar Creek	Intermittent	Temporary Fill	Fill	--	--	146.0	0.00
178	Cedar Creek	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
178	Cedar Creek	Intermittent	Rail	Viaduct	--	--	0.00	0.00
178	Unnamed	Intermittent	Temporary Fill	Fill	--	--	245.1	0.00
178	Unnamed	Intermittent	Maintenance Facility	Fill	--	--	0.00	16.0
178	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
178	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00
125	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
125	Smith Branch	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
125	Lower Keechi Creek	Artificial	Access Road	Viaduct	0.00	0.00	--	--
125	Lower Keechi Creek	Artificial	Access Road	Viaduct	0.00	0.00	--	--

Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					linear feet		linear feet	
125	Lower Keechi Creek	Artificial	Rail	Viaduct	0.00	0.00	--	--
178	Unnamed	Intermittent	Rail	Fill	--	--	0.00	663.8
178	Unnamed	Artificial	Stormwater Drainage	Excavation	--	--	0.00	31.1
178	Unnamed	Artificial	Access Road	Fill	--	--	0.00	89.5
125	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
125	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
179	Brushy Creek	Intermittent	Maintenance Facility	Fill	--	--	0.00	33.1
179	Brushy Creek	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
179	Brushy Creek	Intermittent	Rail	Viaduct	--	--	0.00	0.00
179	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
179	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00
126	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
126	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
179	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
179	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00
126	Tiger Branch	Intermittent	Access Road	Excavation	0.00	218.9	--	--
126	Tiger Branch	Intermittent	Stormwater Drainage	Excavation	0.00	65.2	--	--
179	Unnamed	Intermittent	Rail	Fill	--	--	0.00	142.7
179	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
126	Mill Branch	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
126	Mill Branch	Intermittent	Rail	Viaduct	0.00	0.00	--	--
180	Little Brushy Creek	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
180	Little Brushy Creek	Intermittent	Rail	Viaduct	--	--	0.00	0.00
127	Bain Branch	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
127	Bain Branch	Intermittent	Rail	Viaduct	0.00	0.00	--	--
127	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
127	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--

Table 16: Estimated Stream Impacts – Leon County

Table 16: Estimated Stream Impacts – Leon County								
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					linear feet		linear feet	
127	Unnamed	Intermittent	Stormwater Drainage	Excavation	0.00	64.6	--	--
127	Unnamed	Intermittent	Access Road	Fill	0.00	351.8	--	--
181	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
181	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00
128	Unnamed	Intermittent	Stormwater Drainage	Excavation	0.00	132.3	--	--
128	Unnamed	Intermittent	Rail	Fill	0.00	33.6	--	--
181	CEAA13S11	Ephemeral	Rail	Fill	--	--	0.00	116.0
181	CEAA13S10	Ephemeral	Rail	Fill	--	--	0.00	80.7
181	CEAA13S12	Ephemeral	Access Road	Excavation	--	--	0.00	14.2
181	CEAA13S12	Ephemeral	Access Road	Viaduct	--	--	0.00	0.00
182	Spring Creek	Perennial	Access Road	Viaduct	--	--	0.00	0.00
182	Spring Creek	Perennial	Rail	Viaduct	--	--	0.00	0.00
128	Beaver Creek	Perennial	Access Road	Viaduct	0.00	0.00	--	--
128	Beaver Creek	Perennial	Rail	Viaduct	0.00	0.00	--	--
128	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
128	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
182	Unnamed	Artificial	Access Road	Viaduct	--	--	0.00	0.00
182	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00
182	Unnamed	Intermittent	Temporary Fill	Fill	--	--	216.8	0.00
182	Spring Creek	Perennial	Access Road	Fill	--	--	0.00	79.9
182	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	0.00	222.4
182	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
182	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00
131	McDaniel Creek	Perennial	Maintenance Facility	Fill	0.00	155.9	--	--
130	Unnamed	Intermittent	Maintenance Facility	Fill	0.00	189.5	--	--
130	Unnamed	Intermittent	Maintenance Facility	Fill	0.00	161.9	--	--

Table 16: Estimated Stream Impacts – Leon County								
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					linear feet		linear feet	
130	Unnamed	Intermittent	Maintenance Facility	Fill	0.00	260.2	--	--
130	Cedar Creek	Intermittent	Maintenance Facility	Fill	0.00	418.3	--	--
131	Unnamed	Intermittent	Maintenance Facility	Fill	0.00	388.9	--	--
132	Unnamed	Intermittent	Maintenance Facility	Fill	0.00	180.1	--	--
132	Unnamed	Intermittent	Maintenance Facility	Fill	0.00	518.4	--	--
129	Unnamed	Intermittent	Maintenance Facility	Fill	0.00	235.0	--	--
129	Unnamed	Intermittent	Maintenance Facility	Fill	0.00	126.7	--	--
129	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
129	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
131	Unnamed	Intermittent	Maintenance Facility	Fill	0.00	154.7	--	--
132	Unnamed	Intermittent	Maintenance Facility	Fill	0.00	168.8	--	--
132	Unnamed	Intermittent	Maintenance Facility	Fill	0.00	160.4	--	--
132	Unnamed	Intermittent	Maintenance Facility	Fill	0.00	185.1	--	--
132	Spring Creek	Perennial	Maintenance Facility	Fill	0.00	217.8	--	--
132	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
132	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00
134	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
135, 185	Boggy Creek	Perennial	Access Road	Viaduct	0.00	0.00	0.00	0.00
135, 185	Boggy Creek	Perennial	Rail	Viaduct	0.00	0.00	0.00	0.00
135	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
135	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
136	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
136	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--

Table 16: Estimated Stream Impacts – Leon County								
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					linear feet		linear feet	
185	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
185	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00
136	Leona Branch	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
136	Leona Branch	Intermittent	Rail	Viaduct	0.00	0.00	--	--
186	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
186	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00
186	Unnamed	Intermittent	Facility	Fill	--	--	0.00	83.7
186	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
186	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00
186	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00
137	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
137	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
186	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
186	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00
187	Yellow Branch	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
187	Yellow Branch	Intermittent	Rail	Viaduct	--	--	0.00	0.00
138	Mustang Creek	Perennial	Access Road	Viaduct	0.00	0.00	--	--
138	Mustang Creek	Perennial	Rail	Viaduct	0.00	0.00	--	--
138	Spring Branch	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
138	Spring Branch	Intermittent	Rail	Viaduct	0.00	0.00	--	--
188	CEAD13S2	Intermittent	Stormwater Drainage	Excavation	--	--	0.00	284.1
188	CEAD13S2	Intermittent	Access Road	Fill	--	--	0.00	89.2
188	CEAD13S8	Ephemeral	Rail	Fill	--	--	0.00	448.7
188	CEAD13S2	Intermittent	Rail	Fill	--	--	0.00	658.3
188	CEAD13S5	Ephemeral	Access Road	Fill	--	--	0.00	33.5
188	CEAD13S5	Ephemeral	Rail	Fill	--	--	0.00	55.1
188	CEAD13S2	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
188	CEAD13S2	Intermittent	Rail	Viaduct	--	--	0.00	0.00

Table 16: Estimated Stream Impacts – Leon County								
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					linear feet		linear feet	
188	Copeland Branch	Intermittent	Rail	Fill	--	--	0.00	29.9
188	Copeland Branch	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
188	CEAD13S6	Ephemeral	Stormwater Drainage	Excavation	--	--	0.00	514.1
188	CEAD13S6	Ephemeral	Access Road	Fill	--	--	0.00	63.5
188	CEAD13S7	Ephemeral	Stormwater Drainage	Excavation	--	--	0.00	77.1
188	CEAD13S7	Ephemeral	Access Road	Fill	--	--	0.00	43.0
139	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
139	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
139	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
139	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
189	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	0.00	353.4
189	Unnamed	Intermittent	Access Road	Fill	--	--	0.00	30.6
189	East Caney Creek	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
189	East Caney Creek	Intermittent	Rail	Viaduct	--	--	0.00	0.00
190	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
190	Unnamed	Intermittent	Utilities	Viaduct	--	--	0.00	0.00
190	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	0.00	382.0
190	Unnamed	Intermittent	Access Road	Fill	--	--	0.00	216.8
				Total	50.4	5,843.3	1,502.7	5,256.6

Source: USGS, 2016; FNI, 2017

*Stream ID # (C) indicates a specific feature recorded in the field whereas stream names (or those "unnamed") indicate features mapped via data not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each stream is separated by construction type.

'--' - not present

Table 17: Estimated Wetland Impacts – Leon County								
Natural Resources Mapbook Page #	Wetland ID/ Classification*	Wetland Type	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					acres		acres	
118	PEM1C	Emergent	Temporary Fill	Fill	0.02	0.00	--	--
118	PEM1C	Emergent	Access Road	Viaduct	0.00	0.00	--	--
118	PEM1C	Emergent	Rail	Viaduct	0.00	0.00	--	--
119	PSS1/EM1A	Scrub/Shrub	Access Road	Viaduct	0.00	0.00	--	--
119	PFO1A	Forested	Access Road	Viaduct/Conversion	0.00	0.05	--	--
120	PFO1C	Forested	Access Road	Viaduct/Conversion	0.00	<0.01	--	--
120	PFO1C	Forested	Rail	Viaduct/Conversion	0.00	0.05	--	--
120	PEM1C	Emergent	Access Road	Viaduct	0.00	0.00	--	--
121	PEM1C	Emergent	Access Road	Viaduct	0.00	0.00	--	--
121	PEM1C	Emergent	Rail	Viaduct	0.00	0.00	--	--
121	PEM1A	Emergent	Access Road	Viaduct	0.00	0.00	--	--
176	CEZ11EW5	Emergent	Access Road	Viaduct	--	--	0.00	0.00
176	CEZ11EW5	Emergent	Rail	Viaduct	--	--	0.00	0.00
177	CEZ11FW3	Forested	Access Road	Viaduct/Conversion	--	--	0.00	0.12
177	CEZ11FW3	Forested	Rail	Viaduct/Conversion	--	--	0.00	0.03
177	CEZ11FW4	Forested	Access Road	Viaduct/Conversion	--	--	0.00	0.06
177	CEZ11FW4	Forested	Access Road	Viaduct/Conversion	--	--	0.00	0.01
177	CEZ11EW4	Emergent	Access Road	Viaduct	--	--	0.00	0.00
178	PFO1C	Forested	Access Road	Viaduct/Conversion	--	--	0.00	0.07
178	PFO1C	Forested	Rail	Viaduct/Conversion	--	--	0.00	0.11
125	PEM1C	Emergent	Access Road	Viaduct	0.00	0.00	--	--
125	PEM1C	Emergent	Rail	Viaduct	0.00	0.00	--	--
125	PEM1A	Emergent	Access Road	Viaduct	0.00	0.00	--	--
125	PEM1A	Emergent	Rail	Viaduct	0.00	0.00	--	--
179	PFO1C	Forested	Maintenance Facility	Fill	--	--	0.00	0.06
179	PFO1C	Forested	Access Road	Viaduct/Conversion	--	--	0.00	0.01
179	PFO1C	Forested	Rail	Viaduct/Conversion	--	--	0.00	0.18

Table 17: Estimated Wetland Impacts – Leon County								
Natural Resources Mapbook Page #	Wetland ID/ Classification*	Wetland Type	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					acres		acres	
179	PEM1C	Emergent	Access Road	Viaduct	--	--	0.00	0.00
179	PEM1C	Emergent	Rail	Viaduct	--	--	0.00	0.00
179	PFO1C	Forested	Rail	Viaduct/Conversion	--	--	0.00	0.11
179	PFO1A	Forested	Access Road	Viaduct/Conversion	--	--	0.00	0.19
179	PFO1A	Forested	Rail	Viaduct/Conversion	--	--	0.00	0.23
179	PFO1C	Forested	Access Road	Viaduct/Conversion	--	--	0.00	0.01
179	PFO1C	Forested	Rail	Viaduct/Conversion	--	--	0.00	0.06
179	PEM1A	Emergent	Access Road	Viaduct	--	--	0.00	0.00
179	PEM1A	Emergent	Rail	Viaduct	--	--	0.00	0.00
180	PFO1C	Forested	Access Road	Viaduct/Conversion	--	--	0.00	0.08
180	PFO1C	Forested	Rail	Viaduct/Conversion	--	--	0.00	0.22
181	CEAA12EW2	Emergent	Access Road	Viaduct	--	--	0.00	0.00
181	CEAA12EW2	Emergent	Rail	Viaduct	--	--	0.00	0.00
181	CEAA12EW3	Emergent	Rail	Viaduct	--	--	0.00	0.00
181	CEAA12EW3	Emergent	Temporary Fill	Fill	--	--	0.08	0.00
181	CEAA13EW1	Emergent	Temporary Fill	Fill	--	--	0.07	0.00
128	PFO1C	Forested	Access Road	Viaduct/Conversion	0.00	0.16	--	--
128	PFO1C	Forested	Rail	Viaduct/Conversion	0.00	0.07	--	--
182	PFO1C	Forested	Access Road	Viaduct/Conversion	--	--	0.00	0.05
182	PFO1C	Forested	Rail	Viaduct/Conversion	--	--	0.00	0.13
131	PFO1C	Forested	Maintenance Facility	Fill	0.00	0.07	--	--
130	PFO1C	Forested	Maintenance Facility	Fill	0.00	0.25	--	--
132	PEM1A	Emergent	Rail	Viaduct	--	--	0.00	0.00
129	PFO1C	Forested	Maintenance Facility	Fill	0.00	0.08	--	--
132	PFO1C	Forested	Maintenance Facility	Fill	0.00	0.16	--	--
134	PFO1C	Forested	Rail	Viaduct/Conversion	0.00	0.05	--	--
135	PFO/EM1F	Forested	Access Road	Viaduct/Conversion	0.00	0.59	--	--

Table 17: Estimated Wetland Impacts – Leon County

Natural Resources Mapbook Page #	Wetland ID/ Classification*	Wetland Type	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					acres		acres	
135	PFO1A	Forested	Access Road	Viaduct/Conversion	0.00	0.12	--	--
135	PEM1C	Emergent	Access Road	Viaduct	0.00	0.00	--	--
135	PEM1C	Emergent	Rail	Viaduct	0.00	0.00	--	--
135	PEM1/FO1F	Emergent	Access Road	Viaduct	0.00	0.00	--	--
135	PEM1F	Emergent	Access Road	Viaduct	0.00	0.00	--	--
135	PEM1F	Emergent	Rail	Viaduct	0.00	0.00	--	--
135	PFO1F	Forested	Access Road	Viaduct/Conversion	0.00	0.25	--	--
185	PEM1Ch	Emergent	Access Road	Viaduct	--	--	0.00	0.00
137	PFO1A	Forested	Access Road	Viaduct/Conversion	0.00	2.1	--	--
138	PFO1A	Forested	Rail	Viaduct/Conversion	0.00	0.25	--	--
138	PFO1C	Forested	Access Road	Viaduct/Conversion	0.00	0.21	--	--
138	PFO1C	Forested	Rail	Viaduct/Conversion	0.00	0.06	--	--
187	PEM1A	Emergent	Access Road	Fill	--	--	0.00	0.15
187	PEM1C	Emergent	Access Road	Fill	--	--	0.00	>0.01
187	PEM1Ch	Emergent	Stormwater Drainage	Excavation	--	--	0.00	<0.01
187	PEM1Ch	Emergent	Rail	Fill	--	--	0.00	0.34
187	PEM1Ch	Emergent	Access Road	Fill	--	--	0.00	0.17
138	PSS1C	Forested	Access Road	Viaduct/Conversion	0.00	0.01	--	--
138	PSS1C	Forested	Rail	Viaduct/Conversion	0.00	0.05	--	--
188	CEAD13EW1	Emergent	Rail	Fill	--	--	0.00	0.02
188	PFO1C	Forested	Rail	Fill	--	--	0.00	0.02
188	PFO1C	Forested	Access Road	Viaduct/Conversion	--	--	0.00	0.03
189	PFO1C	Forested	Access Road	Viaduct/Conversion	--	--	0.00	0.02
189	PFO1C	Forested	Rail	Viaduct/Conversion	--	--	0.00	0.06
190	PFO1C	Forested	Access Road	Viaduct/Conversion	--	--	0.00	0.14
190	PEM1C	Emergent	Stormwater Drainage	Excavation	--	--	0.00	0.22
190	PEM1C	Emergent	Access Road	Fill	--	--	0.00	0.11

Table 17: Estimated Wetland Impacts – Leon County								
Natural Resources Mapbook Page #	Wetland ID/ Classification*	Wetland Type	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					acres		acres	
				Total	0.02	4.6	0.15	3.0

Source: USFWS, 2016; FNI, 2017

*Wetland ID # (C) indicates a specific feature recorded in the field. Wetland classifications (P) indicate wetlands not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each wetland is separated by construction type.

P - Palustrine
EM1 - Persistent Emergent
FO1 - Broad-leaved Deciduous Forested
SS1 - Broad-leaved Deciduous Scrub-Shrub
C - Seasonally Flooded
h - Diked/Impounded
EM - Emergent
FO - Forested
SS - Scrub-Shrub
A - Temporarily Flooded
F – Semi-permanently Flooded
'--' - not present

Table 18: Estimated Waterbody Impacts – Leon County								
Natural Resources Mapbook Page #	Waterbody ID/Name *	Waterbody Type	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					acres		acres	
174	Unnamed	Pond	Access Road	Viaduct	--	--	0.00	0.00
174	Unnamed	Pond	Rail	Viaduct	--	--	0.00	0.00
174	CEY10PD16	Pond	Access Road	Viaduct	--	--	0.00	0.00
174	CEY10PD16	Pond	Rail	Viaduct	--	--	0.00	0.00
176	CEZ11PD2	Pond	Access Road	Viaduct	--	--	0.00	0.00
176	CEZ11PD2	Pond	Rail	Viaduct	--	--	0.00	0.00
123	Unnamed	Pond	Access Road	Fill	0.00	0.04	--	--
123	Unnamed	Pond	Access Road	Excavation	0.00	0.06	--	--
177	CEZ11PD3	Pond	Access Road	Viaduct	--	--	0.00	0.00
177	CEZ11PD3	Pond	Rail	Viaduct	--	--	0.00	0.00
177	CEZ11PD4	Pond	Access Road	Viaduct	--	--	0.00	0.00
177	CEZ11PD4	Pond	Rail	Viaduct	--	--	0.00	0.00
177	CEZ11PD11	Pond	Rail	Viaduct	--	--	0.00	0.00
177	Unnamed	Pond	Access Road	Fill	--	--	0.00	0.05

Table 18: Estimated Waterbody Impacts – Leon County								
Natural Resources Mapbook Page #	Waterbody ID/Name *	Waterbody Type	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					acres		acres	
177	Unnamed	Pond	Rail	Fill	--	--	0.00	0.10
177	Unnamed	Pond	Rail	Fill	--	--	0.00	0.10
178	Unnamed	Pond	Temporary Fill	Fill	--	--	0.11	0.00
178	Unnamed	Pond	Temporary Fill	Fill	--	--	0.07	0.00
178	CEZ11PD7	Pond	Access Road	Viaduct	--	--	0.00	0.00
178	CEZ11PD7	Pond	Rail	Viaduct	--	--	0.00	0.00
178	Unnamed	Pond	Access Road	Viaduct	--	--	0.00	0.00
178	Unnamed	Pond	Rail	Fill	--	--	0.00	0.10
125	Unnamed	Pond	Access Road	Viaduct	0.00	0.00	--	--
178	Unnamed	Pond	Rail	Fill	--	--	0.00	0.01
178	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	0.00	0.15
178	Unnamed	Pond	Access Road	Fill	--	--	0.00	0.18
179	Unnamed	Pond	Rail	Fill	--	--	0.00	0.38
126	Unnamed	Pond	Access Road	Viaduct	0.00	0.00	--	--
127	Unnamed	Pond	Rail	Viaduct	0.00	0.00	--	--
127	Unnamed	Pond	Access Road	Viaduct	0.00	0.00	--	--
181	CEAA12PD7	Pond	Access Road	Viaduct	--	--	0.00	0.00
181	CEAA12PD7	Pond	Rail	Viaduct	--	--	0.00	0.00
127	Unnamed	Pond	Access Road	Fill	0.00	0.02	--	--
127	Unnamed	Pond	Stormwater Drainage	Excavation	0.00	0.07	--	--
181	CEAA12PD9	Pond	Rail	Viaduct	--	--	0.00	0.00
181	CEAA12PD9	Pond	Temporary Fill	Fill	--	--	0.01	0.00
181	CEAA13PD10	Pond	Rail	Viaduct	--	--	0.00	0.00
181	Unnamed	Pond	Rail	Viaduct	--	--	0.00	0.00
182	Unnamed	Pond	Access Road	Viaduct	--	--	0.00	0.00
182	Unnamed	Pond	Temporary Fill	Fill	--	--	0.01	0.00
182	Unnamed	Pond	Access Road	Viaduct	--	--	0.00	0.00

Table 18: Estimated Waterbody Impacts – Leon County								
Natural Resources Mapbook Page #	Waterbody ID/Name *	Waterbody Type	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					acres		acres	
182	Unnamed	Pond	Temporary Fill	Fill	--	--	0.01	0.00
129	Unnamed	Pond	Maintenance Facility	Fill	0.00	0.12	--	--
130	Unnamed	Pond	Maintenance Facility	Excavation	0.00	0.09	--	--
135	Unnamed	Pond	Access Road	Viaduct	0.00	0.00	--	--
136	Unnamed	Pond	Access Road	Viaduct	0.00	0.00	--	--
136	Unnamed	Pond	Access Road	Viaduct	0.00	0.00	--	--
188	CEAD13PD14	Pond	Access Road	Fill	--	--	0.00	0.04
188	Unnamed	Pond	Rail	Fill	--	--	0.00	0.03
188	Unnamed	Pond	Access Road	Fill	--	--	0.00	0.05
188	Unnamed	Pond	Rail	Excavation	--	--	0.00	<0.01
188	CEAD13PD15	Pond	Access Road	Excavation	--	--	0.00	0.10
188	CEAD13PD15	Pond	Rail	Excavation	--	--	0.00	0.10
188	CEAD13PD17	Pond	Stormwater Drainage	Excavation	--	--	0.00	0.01
188	CEAD13PD17	Pond	Access Road	Fill	--	--	0.00	0.18
188	CEAD13PD17	Pond	Rail	Fill	--	--	0.00	0.27
122	Unnamed	Pond	Access Road	Viaduct	0.00	0.00	--	--
122	Unnamed	Pond	Rail	Viaduct	0.00	0.00	--	--
185	Unnamed	Lake	Access Road	Viaduct	--	--	0.00	0.00
185	Unnamed	Lake	Rail	Viaduct	--	--	0.00	0.00
137	Unnamed	Pond	Stormwater Drainage	Excavation	0.00	0.02	--	--
187	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	0.00	0.03
187	Unnamed	Pond	Rail	Fill	--	--	0.00	0.05
187	Unnamed	Pond	Access Road	Fill	--	--	0.00	0.11
174	Unnamed	Pond	Access Road	Viaduct	--	--	0.00	0.00
174	Unnamed	Pond	Rail	Viaduct	--	--	0.00	0.00
174	CEY10PD16	Pond	Access Road	Viaduct	--	--	0.00	0.00

Table 18: Estimated Waterbody Impacts – Leon County								
Natural Resources Mapbook Page #	Waterbody ID/Name *	Waterbody Type	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					acres		acres	
174	CEY10PD16	Pond	Rail	Viaduct	--	--	0.00	0.00
176	CEZ11PD2	Pond	Access Road	Viaduct	--	--	0.00	0.00
176	CEZ11PD2	Pond	Rail	Viaduct	--	--	0.00	0.00
123	Unnamed	Pond	Access Road	Fill	0.00	0.04	--	--
123	Unnamed	Pond	Access Road	Excavation	0.00	0.06	--	--
177	CEZ11PD3	Pond	Access Road	Viaduct	--	--	0.00	0.00
177	CEZ11PD3	Pond	Rail	Viaduct	--	--	0.00	0.00
177	CEZ11PD4	Pond	Access Road	Viaduct	--	--	0.00	0.00
177	CEZ11PD4	Pond	Rail	Viaduct	--	--	0.00	0.00
177	CEZ11PD11	Pond	Rail	Viaduct	--	--	0.00	0.00
177	Unnamed	Pond	Access Road	Fill	--	--	0.00	0.05
177	Unnamed	Pond	Rail	Fill	--	--	0.00	0.10
177	Unnamed	Pond	Rail	Fill	--	--	0.00	0.10
178	Unnamed	Pond	Temporary Fill	Fill	--	--	0.11	0.00
178	Unnamed	Pond	Temporary Fill	Fill	--	--	0.07	0.00
178	CEZ11PD7	Pond	Access Road	Viaduct	--	--	0.00	0.00
178	CEZ11PD7	Pond	Rail	Viaduct	--	--	0.00	0.00
178	Unnamed	Pond	Access Road	Viaduct	--	--	0.00	0.00
178	Unnamed	Pond	Rail	Fill	--	--	0.00	0.10
125	Unnamed	Pond	Access Road	Viaduct	0.00	0.00	--	--
178	Unnamed	Pond	Rail	Fill	--	--	0.00	0.01
178	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	0.00	0.15
178	Unnamed	Pond	Access Road	Fill	--	--	0.00	0.18
179	Unnamed	Pond	Rail	Fill	--	--	0.00	0.38
126	Unnamed	Pond	Access Road	Viaduct	0.00	0.00	--	--
127	Unnamed	Pond	Rail	Viaduct	0.00	0.00	--	--
127	Unnamed	Pond	Access Road	Viaduct	0.00	0.00	--	--
181	CEAA12PD7	Pond	Access Road	Viaduct	--	--	0.00	0.00

Table 18: Estimated Waterbody Impacts – Leon County								
Natural Resources Mapbook Page #	Waterbody ID/Name *	Waterbody Type	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					acres		acres	
181	CEAA12PD7	Pond	Rail	Viaduct	--	--	0.00	0.00
127	Unnamed	Pond	Access Road	Fill	0.00	0.02	--	--
127	Unnamed	Pond	Stormwater Drainage	Excavation	0.00	0.07	--	--
181	CEAA12PD9	Pond	Rail	Viaduct	--	--	0.00	0.00
181	CEAA12PD9	Pond	Temporary Fill	Fill	--	--	0.01	0.00
181	CEAA13PD10	Pond	Rail	Viaduct	--	--	0.00	0.00
181	Unnamed	Pond	Rail	Viaduct	--	--	0.00	0.00
182	Unnamed	Pond	Access Road	Viaduct	--	--	0.00	0.00
182	Unnamed	Pond	Temporary Fill	Fill	--	--	0.01	0.00
182	Unnamed	Pond	Access Road	Viaduct	--	--	0.00	0.00
182	Unnamed	Pond	Temporary Fill	Fill	--	--	0.01	0.00
129	Unnamed	Pond	Maintenance Facility	Fill	0.00	0.12	--	--
130	Unnamed	Pond	Maintenance Facility	Excavation	0.00	0.09	--	--
135	Unnamed	Pond	Access Road	Viaduct	0.00	0.00	--	--
136	Unnamed	Pond	Access Road	Viaduct	0.00	0.00	--	--
136	Unnamed	Pond	Access Road	Viaduct	0.00	0.00	--	--
188	CEAD13PD14	Pond	Access Road	Fill	--	--	0.00	0.04
188	Unnamed	Pond	Rail	Fill	--	--	0.00	0.03
188	Unnamed	Pond	Access Road	Fill	--	--	0.00	0.05
188	Unnamed	Pond	Rail	Excavation	--	--	0.00	<0.01
188	CEAD13PD15	Pond	Access Road	Excavation	--	--	0.00	0.10
188	CEAD13PD15	Pond	Rail	Excavation	--	--	0.00	0.10
188	CEAD13PD17	Pond	Stormwater Drainage	Excavation	--	--	0.00	0.01
188	CEAD13PD17	Pond	Access Road	Fill	--	--	0.00	0.18
188	CEAD13PD17	Pond	Rail	Fill	--	--	0.00	0.27
122	Unnamed	Pond	Access Road	Viaduct	0.00	0.00	--	--

Table 18: Estimated Waterbody Impacts – Leon County								
Natural Resources Mapbook Page #	Waterbody ID/Name *	Waterbody Type	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					acres		acres	
122	Unnamed	Pond	Rail	Viaduct	0.00	0.00	--	--
185	Unnamed	Lake	Access Road	Viaduct	--	--	0.00	0.00
185	Unnamed	Lake	Rail	Viaduct	--	--	0.00	0.00
137	Unnamed	Pond	Stormwater Drainage	Excavation	0.00	0.02	--	--
187	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	0.00	0.03
187	Unnamed	Pond	Rail	Fill	--	--	0.00	0.05
187	Unnamed	Pond	Access Road	Fill	--	--	0.00	0.11
				Total	0.00	0.42	0.21	2.0

Source: USGS, 2016; USFWS, 2016; FNI, 2017
*Waterbody ID # (C) indicates a specific feature recorded in the field. Waterbody classifications (P) indicate waterbodies not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each waterbody is separated by construction type.
'--' - not present

Madison County

Table 19: Estimated Stream Impacts – Madison County								
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					linear feet		linear feet	
140	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
140	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
140	Twomile Creek	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
140	Twomile Creek	Intermittent	Rail	Viaduct	0.00	0.00	--	--
140	Larrison Creek	Intermittent	Access Road	Fill	0.00	1,369.2	--	--
141	Unnamed	Intermittent	Stormwater Drainage	Excavation	0.00	48.7	--	--
141	Unnamed	Intermittent	Access Road	Fill	0.00	153.3	--	--

Table 19: Estimated Stream Impacts – Madison County								
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					linear feet		linear feet	
141	Larrison Creek	Intermittent	Access Road	Fill	0.00	181.2	--	--
141	Larrison Creek	Intermittent	Rail	Fill	0.00	507.6	--	--
190	Unnamed	Intermittent	Access Road	Fill	--	--	0.00	4.5
190	CEAD14S2	Intermittent	Access Road	Fill	--	--	0.00	685.7
190	CEAE14S1	Ephemeral	Access Road	Viaduct	--	--	0.00	0.00
190	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00
141	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
141	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
191	Unnamed	Artificial	Access Road	Viaduct	--	--	0.00	0.00
191	Salt Creek	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
191	Salt Creek	Intermittent	Rail	Viaduct	--	--	0.00	0.00
191	Salt Creek	Intermittent	Utilities	Viaduct	--	--	0.00	0.00
142	Greenbriar Creek	Intermittent	Stormwater Drainage	Excavation	0.00	461.6	--	--
191	Caney Creek	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
191	Caney Creek	Intermittent	Rail	Viaduct	--	--	0.00	0.00
192	CEAE14S5	Ephemeral	Access Road	Viaduct	--	--	0.00	0.00
192	CEAE14S5	Ephemeral	Rail	Viaduct	--	--	0.00	0.00
192	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
192	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00
143	Unnamed	Intermittent	Stormwater Drainage	Excavation	0.00	338.4	--	--
143	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
143	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
143	Unnamed	Artificial	Rail	Fill	0.00	170.7	--	--
143, 144	Greenbriar Creek	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
143, 144	Greenbriar Creek	Intermittent	Rail	Viaduct	0.00	0.00	--	--
193	CEAE14S7	Intermittent	Utilities	Viaduct	--	--	9.7	0.00
193	CEAE14S7	Intermittent	Access Road	Viaduct	--	--	0.00	0.00

Table 19: Estimated Stream Impacts – Madison County								
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					linear feet		linear feet	
193	CEAE14S7	Intermittent	Rail	Viaduct	--	--	0.00	0.00
193	Brushy Creek	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
193	Brushy Creek	Intermittent	Rail	Viaduct	--	--	0.00	0.00
144	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
144	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
193	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
193	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00
194	CEAF14S11	Ephemeral	Access Road	Fill	--	--	0.00	283.8
194	CEAF14S12	Ephemeral	Access Road	Fill	--	--	0.00	217.4
145	Caney Creek	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
145	Caney Creek	Intermittent	Rail	Viaduct	0.00	0.00	--	--
194	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
194	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00
194	Unnamed	Intermittent	Utilities	Viaduct	--	--	0.00	0.00
194	Unnamed	Intermittent	Utilities	Viaduct	--	--	232.2	0.00
194	CEAF14S10	Ephemeral	Rail	Viaduct	--	--	0.00	0.00
145	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
195	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
195	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
195	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
195	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00
145	Ferry Branch	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
145	Ferry Branch	Intermittent	Rail	Viaduct	0.00	0.00	--	--
145	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
145	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
195	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	0.00	116.7
195	Unnamed	Intermittent	Access Road	Fill	--	--	0.00	204.1
195	Unnamed	Intermittent	Rail	Fill	--	--	0.00	101.1

Table 19: Estimated Stream Impacts – Madison County								
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					linear feet		linear feet	
195	CEAF14S7	Ephemeral	Stormwater Drainage	Excavation	--	--	0.00	29.1
195	CEAF14S7	Ephemeral	Rail	Fill	--	--	0.00	458.8
146	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
146	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
195	CEAF14S13	Ephemeral	Access Road	Viaduct	--	--	0.00	0.00
195	CEAF14S13	Ephemeral	Rail	Viaduct	--	--	0.00	0.00
196	CEAF14S9	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
196	CEAF14S9	Intermittent	Rail	Viaduct	--	--	0.00	0.00
196	CEAF14S9	Intermittent	Utilities	Viaduct	--	--	312.9	0.00
196	CEAG14S20	Ephemeral	Rail	Viaduct	--	--	0.00	0.00
196	CEAG14S20	Ephemeral	Utilities	Viaduct	--	--	13.9	0.00
196	CEAG14S19	Ephemeral	Access Road	Viaduct	--	--	0.00	0.00
196	CEAG14S19	Ephemeral	Rail	Viaduct	--	--	0.00	0.00
196	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
196	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00
147	Unnamed	Intermittent	Access Road	Fill	0.00	128.5	--	--
147	Unnamed	Intermittent	Rail	Fill	0.00	59.2	--	--
196	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
196	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00
196	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
196	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00
196	CEAG14S6	Ephemeral	Rail	Viaduct	--	--	0.00	0.00
196	CEAG14S7	Ephemeral	Access Road	Viaduct	--	--	0.00	0.00
196	CEAG14S7	Ephemeral	Rail	Viaduct	--	--	0.00	0.00
147	Pooles Branch	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
147	Pooles Branch	Intermittent	Rail	Viaduct	0.00	0.00	--	--
148	Iron Creek	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
148	Iron Creek	Intermittent	Rail	Viaduct	0.00	0.00	--	--

Table 19: Estimated Stream Impacts – Madison County								
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					linear feet		linear feet	
197	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
198	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00
197	Unnamed	Intermittent	Utilities	Viaduct	--	--	0.00	0.00
148	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
148	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
198	CEAG14S10	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
198	CEAG14S10	Intermittent	Rail	Viaduct	--	--	0.00	0.00
198	CEAG14S10	Intermittent	Utilities	Viaduct	--	--	0.00	0.00
198	CEAG14S18	Perennial	Access Road	Viaduct	--	--	0.00	0.00
198	CEAG14S18	Perennial	Rail	Viaduct	--	--	0.00	0.00
198	CEAG14S18	Perennial	Utilities	Viaduct	--	--	0.00	0.00
149, 198	Kickapoo Creek	Intermittent	Access Road	Viaduct	0.00	0.00	0.00	0.00
149, 198	Kickapoo Creek	Intermittent	Rail	Viaduct	0.00	0.00	0.00	0.00
198	Kickapoo Creek	Intermittent	Utilities	Viaduct	--	--	0.00	0.00
198	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
198	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00
198	Unnamed	Intermittent	Utilities	Viaduct	--	--	0.00	0.00
149	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
149	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
149	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--
149	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
198	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	0.00	85.6
198	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
198	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00
198	Unnamed	Intermittent	Utilities	Viaduct	--	--	0.00	0.00
199	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
199	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00
199	Unnamed	Intermittent	Utilities	Viaduct	--	--	0.00	0.00

Table 19: Estimated Stream Impacts – Madison County								
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					linear feet		linear feet	
150	Unnamed	Artificial	Access Road	Viaduct	0.00	0.00	--	--
150	Unnamed	Artificial	Rail	Viaduct	0.00	0.00	--	--
199	CEAH14S1	Ephemeral	Stormwater Drainage	Excavation	--	--	0.00	12.7
199	CEAH14S1	Ephemeral	Access Road	Viaduct	--	--	0.00	0.00
199	CEAH14S1	Ephemeral	Rail	Viaduct	--	--	0.00	0.00
199	CEAH14S1	Ephemeral	Utilities	Viaduct	--	--	0.00	0.00
199	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00
199	Unnamed	Intermittent	Utilities	Viaduct	--	--	34.7	0.00
150	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
199	CEAH14S2	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
199	CEAH14S2	Intermittent	Rail	Viaduct	--	--	0.00	0.00
199	CEAH14S2	Intermittent	Utilities	Viaduct	--	--	0.00	0.00
199	Unnamed	Intermittent	Utilities	Viaduct	--	--	0.00	0.00
151	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--
151	CEAH14S4	Intermittent	Access Road	Viaduct	--	--	0.00	0.00
151	CEAH14S4	Intermittent	Rail	Viaduct	--	--	0.00	0.00
151	Bedias Creek	Perennial	Access Road	Viaduct	--	--	0.00	0.00
151	Bedias Creek	Perennial	Rail	Viaduct	0.00	0.00	0.00	0.00
151	Bedias Creek	Perennial	Utilities	Viaduct	--	--	0.00	0.00
				Total	0.00	3,418.3	603.4	2,199.6

Source: USGS, 2016; FNI, 2017

*Stream ID # (C) indicates a specific feature recorded in the field whereas stream names (or those "unnamed") indicate features mapped via data not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each stream is separated by construction type.

'--' - not present

Table 20: Estimated Wetland Impacts – Madison County								
Natural Resources Mapbook Page #	Wetland ID/ Classification*	Wetland Type	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					acres		acres	
140	PEM1C	Emergent	Access Road	Fill	0.00	0.44	--	--
190	PFO1C	Forested	Access Road	Fill	--	--	0.00	<0.01
190	PEM1C	Emergent	Access Road	Viaduct	--	--	0.00	0.00
190	PEM1C	Emergent	Rail	Viaduct	--	--	0.00	0.00
190	PFO1Fh	Forested	Rail	Viaduct/Conversion	--	--	0.00	0.04
191	PEM1C	Emergent	Utilities	Fill	--	--	0.00	0.06
191	PFO1C	Forested	Utilities	Fill	--	--	0.00	0.04
191	PFO1C	Forested	Access Road	Viaduct/Conversion	--	--	0.00	0.02
191	PFO1C	Forested	Rail	Viaduct/Conversion	--	--	0.00	0.07
191	PEM1C	Emergent	Rail	Viaduct	--	--	0.00	0.00
191	PFO1C	Forested	Access Road	Viaduct/Conversion	--	--	0.00	0.02
191	PFO1C	Forested	Rail	Viaduct/Conversion	--	--	0.00	0.10
143	PFO1C	Forested	Access Road	Viaduct/Conversion	0.00	0.07	--	--
143	PFO1C	Forested	Rail	Viaduct/Conversion	0.00	0.12	--	--
193	PFO1A	Forested	Access Road	Viaduct/Conversion	--	--	0.00	0.02
193	PFO1A	Forested	Rail	Viaduct/Conversion	--	--	0.00	0.40
144	PFO1A	Forested	Access Road	Viaduct/Conversion	0.00	0.07	--	--
144	PFO1A	Forested	Rail	Viaduct/Conversion	0.00	0.11	--	--
144	PEM1C	Emergent	Utilities	Fill	0.02	0.00	--	--
145	PEM1C	Emergent	Access Road	Viaduct	0.00	0.00	--	--
145	PEM1C	Emergent	Rail	Viaduct	0.00	0.00	--	--
145	PEM1A	Emergent	Facility	Fill	0.00	1.3	--	--
145	PEM1A	Emergent	Rail	Viaduct	0.00	0.00	--	--
195	CEAF14EW2	Emergent	Rail	Fill	--	--	0.00	0.03
195	CEAF14EW3	Emergent	Rail	Fill	--	--	0.00	0.01
147	PFO1A	Forested	Access Road	Viaduct/Conversion	0.00	<0.01	--	--

Table 20: Estimated Wetland Impacts – Madison County								
Natural Resources Mapbook Page #	Wetland ID/ Classification*	Wetland Type	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					acres		acres	
147	PFO1A	Forested	Rail	Viaduct/Conversion	0.00	0.09	--	--
148	PFO1A	Forested	Access Road	Viaduct/Conversion	0.00	<0.01	--	--
148	PFO1A	Forested	Rail	Viaduct/Conversion	0.00	0.06	--	--
197	CEAG14EW9	Emergent	Rail	Viaduct	--	--	0.00	0.00
198	PFO1A	Forested	Utilities	Fill	--	--	0.00	0.41
198	PFO1A	Forested	Access Road	Viaduct/Conversion	--	--	0.00	0.15
198	PFO1A	Forested	Rail	Viaduct/Conversion	--	--	0.00	0.80
198	PFO1A	Forested	Utilities	Fill	--	--	0.00	0.06
198	PFO1A	Forested	Rail	Viaduct/Conversion	--	--	0.00	0.01
198	PFO1A	Forested	Access Road	Viaduct/Conversion	--	--	0.00	0.02
198	PEM1Ah	Emergent	Utilities	Fill	--	--	0.00	0.23
149	PFO1A	Forested	Access Road	Viaduct/Conversion	0.00	0.28	--	--
149	PFO1A	Forested	Rail	Viaduct/Conversion	0.00	3.7	--	--
199	PEM1A	Emergent	Stormwater Drainage	Excavation	--	--	0.00	0.06
199	PEM1A	Emergent	Access Road	Excavation	--	--	0.00	0.15
199	CEAH14FW12	Forested	Utilities	Fill	--	--	0.00	0.01
199	CEAH14FW12	Forested	Access Road	Viaduct/Conversion	--	--	0.00	0.01
199	CEAH14FW12	Forested	Rail	Viaduct/Conversion	--	--	0.00	0.01
199	CEAH14EW18	Emergent	Utilities	Fill	--	--	0.00	0.05
199	CEAH14EW18	Emergent	Access Road	Viaduct	--	--	0.00	0.00
199	CEAH14EW18	Emergent	Rail	Viaduct	--	--	0.00	0.00
199	CEAH14EW3	Emergent	Rail	Viaduct	--	--	0.00	0.00
151	PFO1A	Forested	Rail	Viaduct/Conversion	0.00	7.1	--	--
151	CEAH14EW4	Emergent	Access Road	Viaduct	--	--	0.00	0.00
151	CEAH14EW4	Emergent	Rail	Viaduct	--	--	0.00	0.00
151	CEAH14EW5	Emergent	Rail	Viaduct	--	--	0.00	0.00

Table 20: Estimated Wetland Impacts – Madison County								
Natural Resources Mapbook Page #	Wetland ID/ Classification*	Wetland Type	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					acres		acres	
151	PFO1A	Forested	Utilities	Fill	--	--	0.00	3.1
151	PFO1A	Forested	Access Road	Viaduct/Conversion	--	--	0.00	0.74
151	PFO1A	Forested	Rail	Viaduct/Conversion	--	--	0.00	4.9
151	PFO1F	Forested	Utilities	Fill	--	--	0.00	0.19
				Total	0.02	13.4	0.00	11.7

Source: USFWS, 2016; FNI, 2017

*Wetland ID # (C) indicates a specific feature recorded in the field. Wetland classifications (P) indicate wetlands not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each wetland is separated by construction type.

P - Palustrine
EM1 - Persistent Emergent
FO1 - Broad-leaved Deciduous Forested
C - Seasonally Flooded
h - Diked/Impounded
EM - Emergent
FO - Forested
A - Temporarily Flooded
F - Semipermanently Flooded
'--' - not present

Table 21: Estimated Waterbody Impacts – Madison County								
Natural Resources Mapbook Page #	Waterbody ID/Name *	Waterbody Type	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					acres		acres	
140	Unnamed	Pond	Access Road	Fill	0.00	0.26	--	--
190	Unnamed	Pond	Temporary Fill	Fill	--	--	0.10	0.00
191	Unnamed	Pond	Access Road	Viaduct	--	--	0.00	0.00
191	Unnamed	Pond	Rail	Viaduct	--	--	0.00	0.00
191	Unnamed	Pond	Utilities	Fill	--	--	0.00	0.40
141	Unnamed	Pond	Access Road	Fill	0.00	0.06	--	--
141	Unnamed	Pond	Stormwater Drainage	Excavation	0.00	0.19	--	--
191	Unnamed	Pond	Utilities	Fill	--	--	0.00	<0.01

Table 21: Estimated Waterbody Impacts – Madison County								
Natural Resources Mapbook Page #	Waterbody ID/Name *	Waterbody Type	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					acres		acres	
141	Unnamed	Pond	Access Road	Excavation	0.00	<0.01	--	--
141	Unnamed	Pond	Rail	Excavation	0.00	0.15	--	--
141	Unnamed	Pond	Rail	Excavation	0.00	0.06	--	--
142	Unnamed	Pond	Access Road	Fill	0.00	0.13	--	--
192	CEAE14PD8	Pond	Access Road	Viaduct	--	--	0.00	0.00
192	CEAE14PD8	Pond	Rail	Viaduct	--	--	0.00	0.00
143	Unnamed	Pond	Stormwater Drainage	Excavation	0.00	0.04	--	--
143	Unnamed	Pond	Access Road	Fill	0.00	0.01	--	--
143	Unnamed	Pond	Rail	Fill	0.00	0.40	--	--
143	Unnamed	Pond	Rail	Fill	0.00	0.03	--	--
193	CEAF14PD10	Pond	Access Road	Excavation	--	--	0.00	<0.01
193	CEAF14PD10	Pond	Facility	Excavation	--	--	0.00	0.03
193	CEAF14PD10	Pond	Stormwater Drainage	Excavation	--	--	0.00	0.11
193	CEAF14PD9	Pond	Facility	Fill	--	--	0.00	0.22
194	CEAF14PD5	Pond	Access Road	Fill	--	--	0.00	0.05
194	CEAF14PD6	Pond	Access Road	Fill	--	--	0.00	0.22
145	Unnamed	Swamp	Rail	Viaduct	0.00	0.00	--	--
145	Unnamed	Swamp	Facility	Fill	0.00	1.5	--	--
145	Unnamed	Pond	Rail	Viaduct	0.00	0.00	--	--
195	CEAG14PD23	Pond	Rail	Viaduct	--	--	0.00	0.00
146	Unnamed	Pond	Rail	Fill	0.00	0.13	--	--
147	Unnamed	Swamp	Access Road	Viaduct	0.00	0.00	--	--
147	Unnamed	Swamp	Rail	Viaduct	0.00	0.00	--	--
148	Unnamed	Pond	Access Road	Viaduct	0.00	0.00	--	--
148	Unnamed	Pond	Rail	Viaduct	0.00	0.00	--	--
148	Unnamed	Pond	Access Road	Viaduct	0.00	0.00	--	--
198	CEAG14PD16	Pond	Access Road	Viaduct	--	--	0.00	0.00

Table 21: Estimated Waterbody Impacts – Madison County								
Natural Resources Mapbook Page #	Waterbody ID/Name *	Waterbody Type	Construction Type	Crossing Type	Segment 3C		Segment 4	
					Temp	Perm	Temp	Perm
					acres		acres	
198	CEAG14PD24	Pond	Rail	Viaduct	--	--	0.00	0.00
198	CEAG14PD99	Pond	Access Road	Viaduct	--	--	0.00	0.00
198	CEAG14PD99	Pond	Rail	Viaduct	--	--	0.00	0.00
150	Unnamed	Pond	Access Road	Viaduct	0.00	0.00	--	--
150	Unnamed	Pond	Rail	Viaduct	0.00	0.00	--	--
199	CEAH14PD3	Pond	Access Road	Fill	--	--	0.00	0.06
199	CEAH14PD4	Pond	Access Road	Viaduct	--	--	0.00	0.00
199	CEAH14PD4	Pond	Utilities	Fill	--	--	0.00	<0.01
199	CEAH14PD4	Pond	Stormwater Drainage	Excavation	--	--	0.00	0.21
150	Unnamed	Pond	Rail	Viaduct	0.00	0.00	--	--
150	Unnamed	Pond	Rail	Viaduct	0.00	0.00	--	--
151	CEAH14PD6	Pond	Access Road	Viaduct	--	--	0.00	0.00
151	CEAH14PD6	Pond	Rail	Viaduct	--	--	0.00	0.00
142	Unnamed	Pond	Access Road	Viaduct	0.00	0.00	--	--
142	Unnamed	Pond	Rail	Viaduct	0.00	0.00	--	--
142	Unnamed	Pond	Stormwater Drainage	Excavation	0.00	0.15	--	--
198	Unnamed	Pond	Access Road	Viaduct	--	--	0.00	0.00
198	Unnamed	Pond	Rail	Viaduct	--	--	0.00	0.00
198	Unnamed	Pond	Utilities	Fill	--	--	0.00	0.04
				Total	0.00	3.1	0.10	1.3

Source: USGS, 2016; USFWS, 2016; FNI, 2017

*Waterbody ID # (C) indicates a specific feature recorded in the field. Waterbody classifications (P) indicate waterbodies not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each waterbody is separated by construction type.

'--' - not present

Grimes County

Table 22: Estimated Stream Impacts – Grimes County										
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4		Segment 5	
					Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet	
151	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--	--	--
151	CEAH14S7	Ephemeral	Access Road	Viaduct	--	--	0.00	0.00	--	--
151	CEAH14S7	Ephemeral	Rail	Viaduct	--	--	0.00	0.00	--	--
151	CEAH14S7	Ephemeral	Utilities	Viaduct	--	--	0.00	0.00	--	--
151	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--	--	--
151	CEAH14S8	Ephemeral	Access Road	Viaduct	--	--	0.00	0.00	--	--
151	CEAH14S8	Ephemeral	Rail	Viaduct	--	--	0.00	0.00	--	--
151	CEAH14S10	Ephemeral	Access Road	Viaduct	--	--	0.00	0.00	--	--
151	CEAH14S10	Ephemeral	Rail	Viaduct	--	--	0.00	0.00	--	--
152	CEAH14S11	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--
152	CEAH14S11	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--
152	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--	--	--
152, 153	Panky Creek	Intermittent	Rail	Viaduct	0.00	0.00	--	--	0.00	0.00
152	Panky Creek	Intermittent	Stormwater Drainage	Excavation	0.00	71.8	--	--	--	--
152	Unnamed	Intermittent	Stormwater Drainage	Excavation	0.00	978.5	--	--	--	--
152	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--	--	--
152	CEAI15S1	Ephemeral	Access Road	Viaduct	--	--	0.00	0.00	--	--
152	CEAI15S1	Ephemeral	Rail	Viaduct	--	--	0.00	0.00	--	--
152	CEAI15S7	Ephemeral	Access Road	Viaduct	--	--	0.00	0.00	--	--
152	CEAI15S7	Ephemeral	Rail	Viaduct	--	--	0.00	0.00	--	--
152	Unnamed	Intermittent	Stormwater Drainage	Excavation	0.00	335.8	--	--	--	--
152	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--	--	--
152	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--	--	--
152	CEAI15S2	Ephemeral	Access Road	Viaduct	--	--	0.00	0.00	--	--
152	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--

Table 22: Estimated Stream Impacts – Grimes County										
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4		Segment 5	
					Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet	
152	CEAI15S2	Ephemeral	Rail	Viaduct	--	--	0.00	0.00	--	--
152	Unnamed	Intermittent	Access Road	Fill	0.00	62.1	--	--	--	--
152	Unnamed	Intermittent	Rail	Fill	0.00	108.1	--	--	--	--
152	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	0.00	108.1	--	--
152	Unnamed	Intermittent	Access Road	Fill	--	--	0.00	62.1	--	--
152	Unnamed	Intermittent	Rail	Fill	--	--	0.00	108.1	--	--
152	Unnamed	Intermittent	Stormwater Drainage	Excavation	0.00	108.1	--	--	--	--
153	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--	--	--
153	Unnamed	Intermittent	Facility	Fill	--	--	0.00	101.4	--	--
153	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--
153	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--
153	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--	--	--
153	Unnamed	Intermittent	Rail	Viaduct	--	--	0.00	0.00	--	--
153	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00	--	--	--	--
153	Unnamed	Intermittent	Access Road	Viaduct	--	--	0.00	0.00	--	--
153	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00	--	--	--	--
153	Panky Creek	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
153	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
204	CEAJ15S11	Ephemeral	Access Road	Viaduct	--	--	--	--	0.00	0.00
204	CEAJ15S11	Ephemeral	Rail	Viaduct	--	--	--	--	0.00	0.00
204	CEAJ15S12	Ephemeral	Access Road	Viaduct	--	--	--	--	0.00	0.00
204	CEAJ15S12	Ephemeral	Rail	Viaduct	--	--	--	--	0.00	0.00
204	CEAJ15S1	Ephemeral	Stormwater Drainage	Excavation	--	--	--	--	0.00	288.6
204	CEAJ15S1	Ephemeral	Access Road	Fill	--	--	--	--	0.00	114.5
204	CEAJ15S1	Ephemeral	Rail	Viaduct	--	--	--	--	0.00	0.00
204	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	--	--	0.00	230.2

Table 22: Estimated Stream Impacts – Grimes County										
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4		Segment 5	
					Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet	
204	Unnamed	Intermittent	Access Road	Fill	--	--	--	--	0.00	116.8
204	Unnamed	Intermittent	Access Road	Fill	--	--	--	--	0.00	66.8
204	Unnamed	Intermittent	Access Road	Fill	--	--	--	--	0.00	82.6
205	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
205	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
205	South Bedias Creek	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
205	South Bedias Creek	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
205	Turkey Creek	Artificial	Rail	Fill	--	--	--	--	0.00	996.8
205	Turkey Creek	Intermittent	Stormwater Drainage	Excavation	--	--	--	--	0.00	334.5
205	Turkey Creek	Intermittent	Access Road	Fill	--	--	--	--	0.00	176.1
205	Turkey Creek	Intermittent	Maintenance Facility	Fill	--	--	--	--	0.00	676.0
206	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
206	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
206	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
206	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
206	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
206	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
206	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
207	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
207	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
207	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
207	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
207	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	--	--	0.00	86.9
207	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
207	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
207	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00

Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4		Segment 5	
					Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet	
207	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
207	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
207	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
208	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
208	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
208	CEAK15S8	Ephemeral	Access Road	Viaduct	--	--	--	--	0.00	0.00
208	CEAK15S8	Ephemeral	Rail	Viaduct	--	--	--	--	0.00	0.00
208	CEAK15S8	Ephemeral	Temporary Fill	Fill	--	--	--	--	778.2	0.00
208	CEAK15S17	Ephemeral	Temporary Fill	Fill	--	--	--	--	205.2	0.00
209	CEAK15S9	Ephemeral	Access Road	Viaduct	--	--	--	--	0.00	0.00
209	CEAK15S9	Ephemeral	Rail	Viaduct	--	--	--	--	0.00	0.00
209	CEAK15S15	Ephemeral	Temporary Fill	Fill	--	--	--	--	276.6	0.00
209	CEAK15S18	Ephemeral	Facility	Fill	--	--	--	--	0.00	526.7
209	CEAK15S16	Ephemeral	Temporary Fill	Fill	--	--	--	--	376.8	0.00
209	CEAK15S9	Ephemeral	Facility	Fill	--	--	--	--	0.00	166.4
209	CEAK15S18	Ephemeral	Temporary Fill	Fill	--	--	--	--	174.1	0.00
209	CEAK15S10	Ephemeral	Temporary Fill	Fill	--	--	--	--	1,036.5	0.00
209	CEAK15S9	Ephemeral	Temporary Fill	Fill	--	--	--	--	717.4	0.00
209	Unnamed	Intermittent	Temporary Fill	Fill	--	--	--	--	73.9	0.00
209	CEAK15S10	Ephemeral	Access Road	Viaduct	--	--	--	--	0.00	0.00
209	CEAK15S10	Ephemeral	Rail	Viaduct	--	--	--	--	0.00	0.00
209	Unnamed	Intermittent	Temporary Fill	Fill	--	--	--	--	56.8	0.00
209	CEAK15S14	Ephemeral	Access Road	Viaduct	--	--	--	--	0.00	0.00
209	CEAK15S14	Ephemeral	Rail	Viaduct	--	--	--	--	0.00	0.00
209	CEAK15S13	Ephemeral	Access Road	Viaduct	--	--	--	--	0.00	0.00
209	CEAK15S13	Ephemeral	Rail	Viaduct	--	--	--	--	0.00	0.00
209	CEAK15S11	Perennial	Access Road	Viaduct	--	--	--	--	0.00	0.00
209	CEAK15S11	Perennial	Rail	Viaduct	--	--	--	--	0.00	0.00

Table 22: Estimated Stream Impacts – Grimes County										
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4		Segment 5	
					Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet	
209	CEAK15S12	Ephemeral	Access Road	Viaduct	--	--	--	--	0.00	0.00
209	CEAK15S12	Ephemeral	Rail	Viaduct	--	--	--	--	0.00	0.00
210	Unnamed	Intermittent	Access Road	Fill	--	--	--	--	0.00	202.3
210	Unnamed	Artificial	Stormwater Drainage	Excavation	--	--	--	--	0.00	115.2
210	Unnamed	Artificial	Rail	Fill	--	--	--	--	0.00	305.7
210	Sulphur Creek	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
210	Sulphur Creek	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
210	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
210	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
210	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
210	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
211	CEAL15S5	Ephemeral	Access Road	Viaduct	--	--	--	--	0.00	0.00
211	CEAL15S5	Ephemeral	Rail	Viaduct	--	--	--	--	0.00	0.00
211	CEAL15S8	Ephemeral	Access Road	Fill	--	--	--	--	0.00	254.2
211	CEAL15S9	Ephemeral	Access Road	Fill	--	--	--	--	0.00	87.1
211	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
211	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
212	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	--	--	0.00	111.8
212	Unnamed	Intermittent	Access Road	Fill	--	--	--	--	0.00	168.6
212	Unnamed	Intermittent	Rail	Fill	--	--	--	--	0.00	451.8
212	Unnamed	Intermittent	Station	Fill	--	--	--	--	0.00	77.8
212	CEAL15S7	Ephemeral	Station	Fill	--	--	--	--	0.00	265.7
213	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
213	CEAM16S13	Ephemeral	Rail	Viaduct	--	--	--	--	0.00	0.00
213	CEAM16S3	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
213	Rocky Creek	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00

Table 22: Estimated Stream Impacts – Grimes County										
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4		Segment 5	
					Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet	
213	Unnamed	Artificial	Stormwater Drainage	Excavation	--	--	--	--	0.00	147.0
213	Unnamed	Artificial	Rail	Fill	--	--	--	--	0.00	448.8
213	Unnamed	Intermittent	Access Road	Fill	--	--	--	--	0.00	205.3
213	Unnamed	Intermittent	Access Road	Excavation	--	--	--	--	0.00	86.2
213	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	--	--	0.00	176.1
213	Unnamed	Intermittent	Rail	Excavation	--	--	--	--	0.00	208.3
214	CEAM16S6	Intermittent	Stormwater Drainage	Excavation	--	--	--	--	0.00	419.4
214	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	--	--	0.00	191.8
214	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
214	CEAM16S6	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
214	CEAM16S6	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
214	CEAM16S11	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
214	CEAM16S11	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
214	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
215	CEAM16S9	Ephemeral	Access Road	Viaduct	--	--	--	--	0.00	0.00
215	CEAM16S9	Ephemeral	Rail	Viaduct	--	--	--	--	0.00	0.00
215	CEAM16S10	Ephemeral	Access Road	Viaduct	--	--	--	--	0.00	0.00
215	CEAM16S10	Ephemeral	Rail	Viaduct	--	--	--	--	0.00	0.00
215	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
215	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
215	Unnamed	Artificial	Access Road	Viaduct	--	--	--	--	0.00	0.00
215	Unnamed	Artificial	Rail	Viaduct	--	--	--	--	0.00	0.00
216	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
216	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
216	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	--	--	0.00	331.5
216	Unnamed	Intermittent	Access Road	Fill	--	--	--	--	0.00	99.1

Table 22: Estimated Stream Impacts – Grimes County										
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4		Segment 5	
					Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet	
216	Unnamed	Intermittent	Rail	Fill	--	--	--	--	0.00	276.0
217	CEAN16S3	Ephemeral	Access Road	Fill	--	--	--	--	0.00	287.4
218	CEAO16S1	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
218	CEAO16S1	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
218	CEAO16S2	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
218	CEAO16S2	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
218	Bums Creek	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
218	Bums Creek	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
218	Unnamed	Intermittent	Maintenance Facility	Fill	--	--	--	--	0.00	65.0
218	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
218	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
218	CEAO16S9	Ephemeral	Stormwater Drainage	Excavation	--	--	--	--	0.00	17.9
218	CEAO16S9	Ephemeral	Access Road	Viaduct	--	--	--	--	0.00	0.00
218	CEAO16S9	Ephemeral	Rail	Viaduct	--	--	--	--	0.00	0.00
219	Haynie Creek	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
219	Haynie Creek	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
219	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
219	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
219	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	--	--	0.00	239.8
219	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
219	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
220	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	--	--	0.00	91.4
221	Caney Creek	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
221	Caney Creek	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
221	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
221	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00

Table 22: Estimated Stream Impacts – Grimes County										
Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4		Segment 5	
					Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet	
221	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
221	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
222	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	--	--	0.00	156.9
222	CEAP16S10	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
222	CEAP16S9	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
222	CEAP16S9	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
223	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
223	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
224	Hurricane Creek	Intermittent	Temporary Fill	Fill	--	--	--	--	1,465.1	0.00
224	Hurricane Creek	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
224	Hurricane Creek	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
224	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
224	Unnamed	Artificial	Temporary Fill	Fill	--	--	--	--	2,341.6	0.00
225	Kickapoo Creek	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
225	Kickapoo Creek	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
225	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
225	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
226	Unnamed	Intermittent	Access Road	Viaduct	--	--	--	--	0.00	0.00
226	Unnamed	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
226	CEAR17S97	Ephemeral	Stormwater Drainage	Excavation	--	--	--	--	0.00	80.8
226	CEAR17S97	Ephemeral	Rail	Viaduct	--	--	--	--	0.00	0.00
226	CEAR17S8	Ephemeral	Stormwater Drainage	Excavation	--	--	--	--	0.00	95.5
226	CEAR17S8	Ephemeral	Access Road	Fill	--	--	--	--	0.00	80.1
226	CEAR17S10	Ephemeral	Access Road	Fill	--	--	--	--	0.00	77.2

Natural Resources Mapbook Page #	Stream ID/Name*	Classification	Construction Type	Crossing Type	Segment 3C		Segment 4		Segment 5	
					Temp	Perm	Temp	Perm	Temp	Perm
					linear feet		linear feet		linear feet	
226	CEAR17S10	Ephemeral	Rail	Fill	--	--	--	--	0.00	49.7
226	CEAR17S8	Intermittent	Rail	Fill	--	--	--	--	0.00	232.9
226	CEAR17S9	Ephemeral	Stormwater Drainage	Excavation	--	--	--	--	0.00	105.4
226	CEAR17S9	Ephemeral	Access Road	Fill	--	--	--	--	0.00	88.4
226	CEAR17S9	Ephemeral	Rail	Fill	--	--	--	--	0.00	236.0
227	CEAR17S13	Ephemeral	Rail	Fill	--	--	--	--	0.00	84.0
227	CEAR17S11	Ephemeral	Access Road	Fill	--	--	--	--	0.00	74.0
227	CEAR17S11	Ephemeral	Rail	Fill	--	--	--	--	0.00	30.6
227	CEAR17S12	Ephemeral	Rail	Fill	--	--	--	--	0.00	217.3
227	CEAR17S14	Ephemeral	Rail	Fill	--	--	--	--	0.00	124.3
227	CEAR17S2	Intermittent	Stormwater Drainage	Excavation	--	--	--	--	0.00	213.4
227	CEAR17S2	Intermittent	Rail	Fill	--	--	--	--	0.00	476.5
227	CEAR17S2	Intermittent	Access Road	Fill	--	--	--	--	0.00	158.6
227	Unnamed	Intermittent	Access Road	Fill	--	--	--	--	0.00	334.8
227	Unnamed	Intermittent	Stormwater Drainage	Excavation	--	--	--	--	0.00	160.0
227	Unnamed	Intermittent	Access Road	Fill	--	--	--	--	0.00	163.4
227	Unnamed	Intermittent	Rail	Fill	--	--	--	--	0.00	222.6
227	CEAR17S3	Ephemeral	Access Road	Fill	--	--	--	--	0.00	1.7
228	CEAR17S98	Ephemeral	Rail	Viaduct	--	--	--	--	0.00	0.00
228	CEAR17S7	Ephemeral	Rail	Viaduct	--	--	--	--	0.00	0.00
228	CEAR17S4	Intermittent	Rail	Viaduct	--	--	--	--	0.00	0.00
				Total	0.00	1,664.4	0.00	379.7	7,502.1	12,657.9

Table 22: Estimated Stream Impacts – Grimes County

Source: USGS, 2016; FNI, 2017

*Stream ID # (C) indicates a specific feature recorded in the field whereas stream names (or those "unnamed") indicate features mapped via data not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each stream is separated by construction type.

'--' - not present

Table 23: Estimated Wetland Impacts – Grimes County										
Natural Resources Mapbook Page #	Wetland ID/ Classification*	Wetland Type	Construction Type	Crossing Type	Segment 3C		Segment 4		Segment 5	
					Temp	Perm	Temp	Perm	Temp	Perm
					acres		acres		acres	
151	PFO1A	Forested	Access Road	Viaduct/Conversion	--	--	0.00	0.09	--	--
151	PFO1A	Forested	Utilities	Fill	--	--	0.00	0.33	--	--
151	PFO1A	Forested	Rail	Viaduct/Conversion	--	--	0.00	0.69	--	--
151	CEAH14EW17	Emergent	Rail	Viaduct	--	--	0.00	0.00	--	--
151	CEAH14FW10	Forested	Access Road	Viaduct/Conversion	--	--	0.00	0.05	--	--
151	CEAH14FW10	Forested	Rail	Viaduct/Conversion	--	--	0.00	0.39	--	--
152	CEAH14FW11	Forested	Access Road	Viaduct/Conversion	--	--	0.00	0.04	--	--
152	CEAH14FW11	Forested	Rail	Viaduct/Conversion	--	--	0.00	0.63	--	--
152	CEAH14EW15	Emergent	Access Road	Viaduct	--	--	0.00	0.00	--	--
152	CEAH14EW15	Emergent	Rail	Viaduct	--	--	0.00	0.00	--	--
152	CEAH14FW9	Forested	Rail	Viaduct/Conversion	--	--	0.00	0.29	--	--
152	CEAH15SW1	Scrub/Shrub	Rail	Viaduct	--	--	0.00	0.00	--	--
152	CEAH15EW5	Emergent	Access Road	Viaduct	--	--	0.00	0.00	--	--
152	CEAH15EW5	Emergent	Rail	Viaduct	--	--	0.00	0.00	--	--
152	PFO1A	Forested	Stormwater Drainage	Excavation	0.00	0.06	--	--	--	--
152	PFO1A	Forested	Rail	Viaduct/Conversion	0.00	0.10	--	--	--	--
153	PFO1A	Forested	Access Road	Viaduct/Conversion	--	--	--	--	0.00	0.04
153	PFO1A	Forested	Rail	Viaduct/Conversion	--	--	--	--	0.00	0.23
208	CEAK15EW100	Emergent	Rail	Fill	--	--	--	--	0.00	0.01
208	CEAK15EW100	Emergent	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.10
208	CEAK15EW100	Emergent	Access Road	Fill	--	--	--	--	0.00	0.11
208	CEAK15EW2	Emergent	Temporary Fill	Fill	--	--	--	--	0.08	0.00
208	CEAK15EW3	Emergent	Temporary Fill	Fill	--	--	--	--	0.07	0.00
208	CEAK15FW1	Forested	Temporary Fill	Fill	--	--	--	--	0.22	0.00
208	CEAK15EW1	Emergent	Temporary Fill	Fill	--	--	--	--	2.1	0.00
209	CEAK15EW101	Emergent	Temporary Fill	Fill	--	--	--	--	0.04	0.00
209	CEAK15EW102	Emergent	Facility	Fill	--	--	--	--	0.00	0.31

Table 23: Estimated Wetland Impacts – Grimes County										
Natural Resources Mapbook Page #	Wetland ID/ Classification*	Wetland Type	Construction Type	Crossing Type	Segment 3C		Segment 4		Segment 5	
					Temp	Perm	Temp	Perm	Temp	Perm
					acres		acres		acres	
210	PEM1F	Emergent	Access Road	Viaduct	--	--	--	--	0.00	0.00
210	PEM1F	Emergent	Rail	Viaduct	--	--	--	--	0.00	0.00
212	PEM1A	Emergent	Rail	Viaduct	--	--	--	--	0.00	0.00
213	CEAM16EW2	Emergent	Rail	Viaduct	--	--	--	--	0.00	0.00
218	PFO1A	Forested	Access Road	Viaduct/Conversion	--	--	--	--	0.00	0.05
218	PFO1A	Forested	Rail	Viaduct/Conversion	--	--	--	--	0.00	0.07
219	PFO1A	Forested	Access Road	Viaduct/Conversion	--	--	--	--	0.00	0.02
219	PFO1A	Forested	Rail	Viaduct/Conversion	--	--	--	--	0.00	0.13
220	CEAO16SW1	Scrub/Shrub	Access Road	Fill	--	--	--	--	0.00	0.10
221	PEM1A	Emergent	Access Road	Viaduct	--	--	--	--	0.00	0.00
221	PEM1C	Emergent	Access Road	Viaduct	--	--	--	--	0.00	0.00
221	PEM1C	Emergent	Rail	Viaduct	--	--	--	--	0.00	0.00
221	PEM1A	Emergent	Access Road	Viaduct	--	--	--	--	0.00	0.00
221	PEM1A	Emergent	Rail	Viaduct	--	--	--	--	0.00	0.00
222	PFO1A	Forested	Access Road	Fill	--	--	--	--	0.00	0.01
223	PFO1A	Forested	Access Road	Viaduct/Conversion	--	--	--	--	0.00	0.03
223	PFO1A	Forested	Rail	Viaduct/Conversion	--	--	--	--	0.00	0.08
224	PEM1C	Emergent	Temporary Fill	Fill	--	--	--	--	0.12	0.00
224	PFO1C	Forested	Temporary Fill	Fill	--	--	--	--	0.57	0.00
224	PFO1C	Forested	Access Road	Viaduct/Conversion	--	--	--	--	0.00	0.01
224	PFO1C	Forested	Rail	Viaduct/Conversion	--	--	--	--	0.00	0.11
224	PEM1C	Emergent	Temporary Fill	Fill	--	--	--	--	0.08	0.00
224	PEM1C	Emergent	Access Road	Viaduct	--	--	--	--	0.00	0.00
224	PEM1C	Emergent	Rail	Viaduct	--	--	--	--	0.00	0.00
224	PEM1C	Emergent	Temporary Fill	Fill	--	--	--	--	0.10	0.00
224	PEM1C	Emergent	Temporary Fill	Fill	--	--	--	--	0.10	0.00
224	PEM1C	Emergent	Temporary Fill	Fill	--	--	--	--	0.25	0.00

Table 23: Estimated Wetland Impacts – Grimes County										
Natural Resources Mapbook Page #	Wetland ID/ Classification*	Wetland Type	Construction Type	Crossing Type	Segment 3C		Segment 4		Segment 5	
					Temp	Perm	Temp	Perm	Temp	Perm
					acres		acres		acres	
224	PEM1C	Emergent	Temporary Fill	Fill	--	--	--	--	0.43	0.00
225	PFO1A	Forested	Access Road	Viaduct/Conversion	--	--	--	--	0.00	0.02
225	PFO1A	Forested	Rail	Viaduct/Conversion	--	--	--	--	0.00	0.06
226	CEAR17EW99	Emergent	Rail	Viaduct	--	--	--	--	0.00	0.00
226	CEAR17EW99	Emergent	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.09
226	CEAR17EW98	Emergent	Rail	Viaduct	--	--	--	--	0.00	0.00
228	CEAR17EW1	Emergent	Rail	Viaduct	--	--	--	--	0.00	0.00
228	CEAR17EW3	Emergent	Rail	Viaduct	--	--	--	--	0.00	0.00
228	CEAR17FW3	Forested	Rail	Viaduct/Conversion	--	--	--	--	0.00	0.11
228	CEAR17FW1	Forested	Access Road	Viaduct/Conversion	--	--	--	--	0.00	0.01
228	CEAR17FW1	Forested	Access Road	Viaduct/Conversion	--	--	--	--	0.00	0.01
228	CEAR17FW1	Forested	Rail	Viaduct/Conversion	--	--	--	--	0.00	0.14
228	CEAR17FW1	Forested	Access Road	Viaduct/Conversion	--	--	--	--	0.00	0.14
228	CEAR17FW1	Forested	Rail	Viaduct/Conversion	--	--	--	--	0.00	0.57
228	PFO1C	Forested	Rail	Viaduct/Conversion	--	--	--	--	0.00	0.13
228	PFO1A	Forested	Access Road	Fill	--	--	--	--	0.00	<0.01
228	PFO1A	Forested	Rail	Fill	--	--	--	--	0.00	0.17
				Total	0.00	0.16	0.00	2.5	4.2	2.9

Source: USFWS, 2016; FNI, 2017

*Wetland ID # (C) indicates a specific feature recorded in the field. Wetland classifications (P) indicate wetlands not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each wetland is separated by construction type.

P - Palustrine
EM1 - Persistent Emergent
FO1 - Broad-leaved Deciduous Forested
C - Seasonally Flooded
'--' - not present
EM - Emergent
FO - Forested
A - Temporarily Flooded
F - Semipermanently Flooded

Natural Resources Mapbook Page #	Waterbody ID/Name *	Waterbody Type	Construction Type	Crossing Type	Segment 3C Temp	Segment 3C Perm	Segment 4 Temp	Segment 4 Perm	Segment 5 Temp	Segment 5 Perm
					acres		acres		acres	
151	CEAH14PD7	Pond	Rail	Viaduct	--	--	0.00	0.00	--	--
151	Unnamed	Pond	Rail	Viaduct	0.00	0.00	--	--	--	--
152	Unnamed	Pond	Rail	Viaduct	0.00	0.00	--	--	--	--
152	Unnamed	Pond	Stormwater Drainage	Excavation	0.00	0.27	--	--	--	--
152	Unnamed	Pond	Rail	Fill	0.00	0.29	--	--	--	--
152	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	0.00	0.27	--	--
152	Unnamed	Pond	Rail	Fill	--	--	0.00	0.29	--	--
153	Unnamed	Pond	Stormwater Drainage	Excavation	0.00	0.02	--	--	--	--
153	Unnamed	Pond	Rail	Fill	0.00	0.31	--	--	--	--
153	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	0.00	0.02	--	--
153	Unnamed	Pond	Rail	Fill	--	--	0.00	0.31	--	--
203	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.00	0.00
203	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.00	0.00
204	Unnamed	Pond	Access Road	Fill	--	--	--	--	0.00	0.14
205	Unnamed	Pond	Rail	Fill	--	--	--	--	0.00	0.09
205	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.04
205	Unnamed	Pond	Rail	Fill	--	--	--	--	0.00	0.17
206	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.00	0.00
206	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.01
208	CEAK15PD2	Pond	Rail	Excavation	--	--	--	--	0.00	0.27
208	CEAK15PD100	Pond	Access Road	Fill	--	--	--	--	0.00	0.02
208	CEAK15PD100	Pond	Rail	Fill	--	--	--	--	0.00	0.52
208	CEAK15PD4	Pond	Access Road	Fill	--	--	--	--	0.00	0.23
208	CEAK15PD4	Pond	Rail	Fill	--	--	--	--	0.00	0.32
208	CEAK15PD10	Pond	Temporary Fill	Fill	--	--	--	--	0.18	0.00
209	CEAK15PD9	Pond	Facility	Fill	--	--	--	--	0.00	0.63

Table 24: Estimated Waterbody Impacts – Grimes County

Table 24: Estimated Waterbody Impacts – Grimes County										
Natural Resources Mapbook Page #	Waterbody ID/Name *	Waterbody Type	Construction Type	Crossing Type	Segment 3C		Segment 4		Segment 5	
					Temp	Perm	Temp	Perm	Temp	Perm
					acres		acres		acres	
209	CEAK15PD5	Pond	Access Road	Viaduct	--	--	--	--	0.00	0.00
209	CEAK15PD5	Pond	Rail	Viaduct	--	--	--	--	0.00	0.00
209	CEAK15PD5	Pond	Temporary Fill	Fill	--	--	--	--	<0.01	0.00
209	CEAK15PD6	Pond	Access Road	Viaduct	--	--	--	--	0.00	0.00
209	CEAK15PD6	Pond	Rail	Viaduct	--	--	--	--	0.00	0.00
210	Unnamed	Pond	Access Road	Fill	--	--	--	--	0.00	0.24
210	Unnamed	Reservoir	Rail	Fill	--	--	--	--	0.00	0.19
210	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.16
210	Unnamed	Pond	Rail	Fill	--	--	--	--	0.00	0.37
210	Unnamed	Reservoir	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.01
210	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	--	--	0.00	<0.01
211	CEAL15PD8	Pond	Rail	Viaduct	--	--	--	--	0.00	0.00
211	CEAL15PD9	Pond	Rail	Fill	--	--	--	--	0.00	0.94
211	CEAL15PD10	Pond	Access Road	Fill	--	--	--	--	0.00	0.08
211	CEAL15PD11	Pond	Rail	Fill	--	--	--	--	0.00	0.10
211	CEAL15PD24	Pond	Access Road	Fill	--	--	--	--	0.00	0.72
211	Unnamed	Pond	Access Road	Fill	--	--	--	--	0.00	0.16
211	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.26
211	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.00	0.00
211	CEAL15PD16	Pond	Access Road	Viaduct	--	--	--	--	0.00	0.00
211	CEAL15PD16	Pond	Rail	Viaduct	--	--	--	--	0.00	0.00
212	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.12
212	Unnamed	Pond	Rail	Fill	--	--	--	--	0.00	0.61
212	CEAM16PD1	Pond	Temporary Fill	Fill	--	--	--	--	0.27	0.00
213	CEAM16PD5	Pond	Rail	Viaduct	--	--	--	--	0.00	0.00
213	Unnamed	Pond	Access Road	Fill	--	--	--	--	0.00	0.04

Table 24: Estimated Waterbody Impacts – Grimes County										
Natural Resources Mapbook Page #	Waterbody ID/Name *	Waterbody Type	Construction Type	Crossing Type	Segment 3C		Segment 4		Segment 5	
					Temp	Perm	Temp	Perm	Temp	Perm
					acres		acres		acres	
213	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.29
213	Unnamed	Pond	Rail	Fill	--	--	--	--	0.00	0.70
213	Unnamed	Pond	Rail	Excavation	--	--	--	--	0.00	0.11
214	CEAM16PD8	Pond	Access Road	Fill	--	--	--	--	0.00	0.05
214	CEAM16PD9	Pond	Rail	Viaduct	--	--	--	--	0.00	0.00
214	CEAM16PD9	Pond	Access Road	Fill	--	--	--	--	0.00	0.06
215	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.00	0.00
215	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.00	0.00
215	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.00	0.00
215	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.00	0.00
215	Unnamed	Pond	Access Road	Fill	--	--	--	--	0.00	0.15
215	Unnamed	Pond	Access Road	Fill	--	--	--	--	0.00	0.05
216	Unnamed	Pond	Rail	Fill	--	--	--	--	0.00	0.06
216	Unnamed	Pond	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.07
216	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.00	0.00
216	Unnamed	Pond	Access Road	Excavation	--	--	--	--	0.00	<0.01
217	CEAN16PD9	Pond	Access Road	Fill	--	--	--	--	0.00	0.20
217	Unnamed	Pond	Access Road	Fill	--	--	--	--	0.00	0.34
217	CEAN16PD12	Pond	Access Road	Fill	--	--	--	--	0.00	<0.01
217	CEAN16PD12	Pond	Rail	Fill	--	--	--	--	0.00	0.08
217	CEAN16PD13	Pond	Access Road	Fill	--	--	--	--	0.00	0.12
218	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.00	0.00
218	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.00	0.00
218	Unnamed	Pond	Rail	Fill	--	--	--	--	0.00	0.01
218	Unnamed	Pond	Access Road	Fill	--	--	--	--	0.00	0.15
218	CEAO16PD14	Pond	Access Road	Excavation	--	--	--	--	0.00	0.01
218	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.00	0.00
219	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.00	0.00

Natural Resources Mapbook Page #	Waterbody ID/Name *	Waterbody Type	Construction Type	Crossing Type	Segment 3C Temp	Segment 3C Perm	Segment 4 Temp	Segment 4 Perm	Segment 5 Temp	Segment 5 Perm
					acres		acres		acres	
219	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.00	0.00
220	CEAO16PD11	Pond	Access Road	Fill	--	--	--	--	0.00	0.15
221	Unnamed	Pond	Access Road	Excavation	--	--	--	--	0.00	0.02
221	Unnamed	Pond	Rail	Excavation	--	--	--	--	0.00	0.14
222	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.00	0.00
222	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.00	0.00
222	Unnamed	Pond	Access Road	Fill	--	--	--	--	0.00	0.01
222	Unnamed	Pond	Rail	Fill	--	--	--	--	0.00	0.36
224	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.00	0.00
224	Unnamed	Pond	Temporary Fill	Fill	--	--	--	--	0.53	0.00
224	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.00	0.00
224	Unnamed	Pond	Temporary Fill	Fill	--	--	--	--	1.4	0.00
225	Unnamed	Pond	Access Road	Viaduct	--	--	--	--	0.00	0.00
225	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.00	0.00
226	CEAR17PD2	Pond	Access Road	Excavation	--	--	--	--	0.00	0.06
226	CEAR17PD3	Pond	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.01
227	CEAR17PD5	Pond	Access Road	Fill	--	--	--	--	0.00	0.09
227	CEAR17PD7	Pond	Stormwater Drainage	Excavation	--	--	--	--	0.00	0.02
228	CEAR17PD11	Pond	Rail	Excavation	--	--	--	--	0.00	0.01
228	CEAR17PD12	Pond	Rail	Viaduct	--	--	--	--	0.00	0.00
228	CEAR17PD13	Pond	Rail	Viaduct	--	--	--	--	0.00	0.00
228	Unnamed	Pond	Rail	Viaduct	--	--	--	--	0.00	0.00
				Total	0.00	0.89	0.00	0.89	2.4	9.8

Table 24: Estimated Waterbody Impacts – Grimes County

Source: USGS, 2016; USFWS, 2016; FNI, 2017

*Waterbody ID # (C) indicates a specific feature recorded in the field. Waterbody classifications (P) indicate waterbodies not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each waterbody is separated by construction type.

'--' - not present

Waller County

Table 25: Estimated Stream Impacts – Waller County						
Natural Resources Mapbook Page #	Stream ID/ Name*	Classification	Construction Type	Crossing Type	Segment 5	
					Temp	Perm
					linear feet	
229	SCAS17S4	Ephemeral	Access Road	Fill	0.00	37.7
229	Unnamed	Intermittent	Stormwater Drainage	Excavation	0.00	17.6
229	Unnamed	Intermittent	Access Road	Fill	0.00	63.0
229	SCAS17S4	Ephemeral	Stormwater Drainage	Excavation	0.00	95.1
230	Walnut Creek	Perennial	Access Road	Viaduct	0.00	0.00
230	Walnut Creek	Perennial	Rail	Viaduct	0.00	0.00
230	Unnamed	Artificial	Access Road	Viaduct	0.00	0.00
230	Unnamed	Artificial	Rail	Viaduct	0.00	0.00
231	Brushy Creek	Intermittent	Access Road	Viaduct	0.00	0.00
231	Brushy Creek	Intermittent	Rail	Viaduct	0.00	0.00
232	Threemile Creek	Intermittent	Access Road	Viaduct	0.00	0.00
232	Threemile Creek	Intermittent	Rail	Viaduct	0.00	0.00
232	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00
232	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00
232	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00
232	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00
233	Unnamed	Intermittent	Maintenance Facility	Fill	0.00	186.3
233	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00
233	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00
234	Unnamed	Intermittent	Maintenance Facility	Fill	0.00	345.4
234	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00
234	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00
234	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00
234	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00
				Total	0.00	745.1

Source: USGS, 2016; FNI, 2017

*Stream ID # (S) indicates a specific feature recorded in the field whereas stream names (or those "unnamed") indicate features mapped via data not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each stream is separated by construction type.

Table 26: Estimated Wetland Impacts – Waller County						
Natural Resources Mapbook Page #	Wetland ID/Classification*	Wetland Type	Construction Type	Crossing Type	Segment 5	
					Temp	Perm
					acres	
229	PEM1F	Emergent	Stormwater Drainage	Excavation	0.00	<0.01
229	SCAS17EW2	Emergent	Stormwater Drainage	Excavation	0.00	0.01
230	PFO1A	Forested	Access Road	Viaduct/Conversion	0.00	0.03
230	PFO1A	Forested	Rail	Viaduct/Conversion	0.00	0.09
230	PFO1C	Forested	Rail	Viaduct/Conversion	0.00	0.05
232	PFO1A	Forested	Access Road	Viaduct/Conversion	0.00	0.16
232	PFO1A	Forested	Rail	Viaduct/Conversion	0.00	0.84
232	PFO1C	Forested	Access Road	Viaduct/Conversion	0.00	0.08
232	PFO1C	Forested	Rail	Viaduct/Conversion	0.00	0.31
232	PFO1A	Forested	Access Road	Viaduct/Conversion	0.00	0.36
232	PFO1A	Forested	Rail	Viaduct/Conversion	0.00	1.9
232	PFO1A	Forested	Access Road	Viaduct/Conversion	0.00	0.01
232	PFO1A	Forested	Rail	Viaduct/Conversion	0.00	0.07
233	PEM1A	Emergent	Maintenance Facility	Fill	0.00	0.06
233	PEM1A	Emergent	Rail	Fill	0.00	0.10
233	PEM1A	Emergent	Access Road	Fill	0.00	0.22
233	PEM1C	Emergent	Rail	Viaduct	0.00	0.00
233	PFO1C	Forested	Access Road	Viaduct/Conversion	0.00	0.04
233	PFO1C	Forested	Rail	Viaduct/Conversion	0.00	0.05
233	PFO1C	Forested	Maintenance Facility	Fill	0.00	0.09
233	PEM1C	Emergent	Rail	Viaduct	0.00	0.00
233	PEM1Fh	Emergent	Access Road	Fill	0.00	0.18
233	PEM1Fh	Emergent	Maintenance Facility	Fill	0.00	0.50
233	PEM1Fh	Emergent	Access Road	Fill	0.00	0.27
234	PEM1C	Emergent	Access Road	Viaduct	0.00	0.00

Table 25: Estimated Stream Impacts – Waller County						
Natural Resources Mapbook Page #	Stream ID/ Name*	Classification	Construction Type	Crossing Type	Segment 5	
					Temp	Perm
					linear feet	
234	PEM1C	Emergent	Rail	Viaduct	0.00	0.00
234	PFO1C	Forested	Rail	Viaduct/Conversion	0.00	0.02
				Total	0.00	5.5

Source: USFWS, 2016; FNI, 2017

*Wetland ID # (S) indicates a specific feature recorded in the field. Wetland classifications (P) indicate wetlands not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each wetland is separated by construction type.

P - Palustrine
EM1 - Persistent Emergent
FO1 - Broad-leaved Deciduous Forested
C - Seasonally Flooded
h - Diked/Impounded
EM - Emergent
FO - Forested
A - Temporarily Flooded
F – Semi-permanently Flooded

Table 27: Estimated Waterbody Impacts – Waller County						
Natural Resources Mapbook Page #	Waterbody ID/ Name *	Waterbody Type	Construction Type	Crossing Type	Segment 5	
					Temp	Perm
					acres	
229	Unnamed	Pond	Stormwater Drainage	Excavation	0.00	0.01
229	SCAS17PD99	Pond	Stormwater Drainage	Excavation	0.00	0.01
229	SCAS17PD1	Pond	Facility	Excavation	0.00	<0.01
229	SCAS17PD1	Pond	Rail	Fill	0.00	0.13
229	SCAS17PD2	Pond	Rail	Excavation	0.00	0.02
229	SCAS17PD2	Pond	Access Road	Fill	0.00	0.05
229	SCAS17PD2	Pond	Access Road	Excavation	0.00	0.01
229	SCAS17PD2	Pond	Rail	Excavation	0.00	0.04
229	SCAS17PD3	Pond	Stormwater Drainage	Excavation	0.00	0.10
229	SCAS17PD4	Pond	Access Road	Excavation	0.00	0.03
229	SCAS17PD4	Pond	Stormwater Drainage	Excavation	0.00	0.04
229	SCAS17PD4	Pond	Rail	Excavation	0.00	<0.01
232	Unnamed	Pond	Access Road	Viaduct	0.00	0.00
232	Unnamed	Pond	Rail	Viaduct	0.00	0.00

Table 27: Estimated Waterbody Impacts – Waller County						
Natural Resources Mapbook Page #	Waterbody ID/ Name *	Waterbody Type	Construction Type	Crossing Type	Segment 5	
					Temp	Perm
					acres	
233	Unnamed	Pond	Rail	Fill	0.00	0.01
233	Unnamed	Pond	Access Road	Fill	0.00	0.08
				Total	0.00	0.53

Source: USGS, 2016; USFWS, 2016; FNI, 2017

*Waterbody ID # (S) indicates a specific feature recorded in the field. Waterbody classifications (P) indicate waterbodies not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each waterbody is separated by construction type.

Harris County

Table 28: Estimated Stream Impacts – Harris County						
Natural Resources Mapbook Page #	Stream ID/ Name*	Classification	Construction Type	Crossing Type	Segment 5	
					Temp	Perm
					linear feet	
234	Spring Creek	Intermittent	Access Road	Viaduct	0.00	0.00
234	Spring Creek	Intermittent	Rail	Viaduct	0.00	0.00
235	Unnamed	Perennial	Access Road	Viaduct	0.00	0.00
235	Unnamed	Perennial	Rail	Viaduct	0.00	0.00
237	Unnamed	Artificial	Access Road	Viaduct	0.00	0.00
240	Unnamed	Artificial	Access Road	Fill	0.00	123.1
240	Unnamed	Artificial	Stormwater Drainage	Excavation	0.00	374.0
240	Unnamed	Artificial	Access Road	Fill	0.00	195.2
240	Unnamed	Artificial	Rail	Fill	0.00	470.5
240	Unnamed	Artificial	Stormwater Drainage	Excavation	0.00	10.2
240	Unnamed	Intermittent	Stormwater Drainage	Excavation	0.00	8.1
240	Unnamed	Artificial	Access Road	Fill	0.00	1,154.4
240	Unnamed	Artificial	Rail	Fill	0.00	197.5
241	Unnamed	Artificial	Stormwater Drainage	Excavation	0.00	107.0
241	Unnamed	Artificial	Access Road	Fill	0.00	52.2

Natural Resources Mapbook Page #	Stream ID/ Name*	Classification	Construction Type	Crossing Type	Segment 5	
					Temp	Perm
					linear feet	
241	Unnamed	Artificial	Maintenance Facility	Fill	0.00	3,629.8
241	Unnamed	Artificial	Rail	Fill	0.00	192.8
241	Unnamed	Artificial	Stormwater Drainage	Excavation	0.00	135.4
241	Unnamed	Artificial	Access Road	Fill	0.00	49.1
241	Unnamed	Artificial	Maintenance Facility	Fill	0.00	824.3
241	Unnamed	Artificial	Rail	Fill	0.00	232.8
241	Unnamed	Artificial	Maintenance Facility	Fill	0.00	18.1
241	SCAW18S3	Intermittent	Stormwater Drainage	Excavation	0.00	190.5
241	SCAW18S3	Intermittent	Maintenance Facility	Fill	0.00	537.0
241	SCAW18S3	Intermittent	Rail	Fill	0.00	175.9
241	Unnamed	Artificial	Maintenance Facility	Fill	0.00	115.7
241	SCAW18S2	Ephemeral	Stormwater Drainage	Excavation	0.00	49.2
241	SCAW18S2	Ephemeral	Maintenance Facility	Fill	0.00	36.5
241	SCAW18S2	Ephemeral	Rail	Fill	0.00	170.6
242	Unnamed	Artificial	Stormwater Drainage	Excavation	0.00	7.6
242	Unnamed	Artificial	Access Road	Fill	0.00	73.5
242	Unnamed	Artificial	Maintenance Facility	Fill	0.00	20.7
242	Unnamed	Artificial	Rail	Fill	0.00	995.2
243	Unnamed	Intermittent	Temporary Fill	Fill	3,890.0	0.00
242	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00
242	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00
243	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00
243	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00
243	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00
243	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00
243	Unnamed	Artificial	Stormwater Drainage	Excavation	0.00	158.6
243	Unnamed	Artificial	Access Road	Fill	0.00	56.1
243	Unnamed	Artificial	Rail	Fill	0.00	193.8

Table 28: Estimated Stream Impacts – Harris County						
Natural Resources Mapbook Page #	Stream ID/ Name*	Classification	Construction Type	Crossing Type	Segment 5	
					Temp	Perm
					linear feet	
244	SCAW19S5	Perennial	Access Road	Viaduct	0.00	0.00
244	SCAW19S5	Perennial	Rail	Viaduct	0.00	0.00
244	SCAW19S6	Intermittent	Access Road	Viaduct	0.00	0.00
244	SCAW19S6	Intermittent	Rail	Viaduct	0.00	0.00
246	Cypress Creek	Perennial	Rail	Viaduct	0.00	0.00
246	SCAW20S1	Perennial	Access Road	Viaduct	0.00	0.00
246	SCAW20S1	Perennial	Rail	Viaduct	0.00	0.00
246	Unnamed	Artificial	Rail	Viaduct	0.00	0.00
246	SCAW20S2	Ephemeral	Rail	Viaduct	0.00	0.00
247	SCAX20S2	Ephemeral	Rail	Viaduct	0.00	0.00
247	SCAX20S1	Ephemeral	Access Road	Viaduct	0.00	0.00
247	Unnamed	Artificial	Access Road	Viaduct	0.00	0.00
249	Unnamed	Artificial	Maintenance Facility	Fill	0.00	74.9
249	Unnamed	Artificial	Access Road	Viaduct	0.00	0.00
249	Unnamed	Artificial	Rail	Viaduct	0.00	0.00
249	SCAX21S2	Intermittent	Maintenance Facility	Fill	0.00	33.0
249	SCAX21S2	Intermittent	Access Road	Viaduct	0.00	0.00
249	SCAX21S2	Intermittent	Rail	Viaduct	0.00	0.00
249	SCAX22S1	Perennial	Access Road	Viaduct	0.00	0.00
249	SCAX22S1	Perennial	Rail	Viaduct	0.00	0.00
250	Cole Creek	Intermittent	Access Road	Viaduct	0.00	0.00
250	SCAY22S1	Perennial	Facility	Fill	0.00	98.6
250	SCAY22S1	Perennial	Access Road	Viaduct	0.00	0.00
250	SCAY22S1	Perennial	Rail	Viaduct	0.00	0.00
252	Unnamed	Intermittent	Access Road	Viaduct	0.00	0.00
252	Unnamed	Intermittent	Rail	Viaduct	0.00	0.00
252	SCAY22S2	Intermittent	Access Road	Viaduct	0.00	0.00
254	Unnamed	Artificial	Access Road	Viaduct	0.00	0.00

Table 28: Estimated Stream Impacts – Harris County						
Natural Resources Mapbook Page #	Stream ID/ Name*	Classification	Construction Type	Crossing Type	Segment 5	
					Temp	Perm
					linear feet	
254	Unnamed	Artificial	Rail	Viaduct	0.00	0.00
				Total	3,890.0	10,761.6

Source: USGS, 2016; FNI, 2017

*Stream ID # (S) indicates a specific feature recorded in the field whereas stream names (or those "unnamed") indicate features mapped via data not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each stream is separated by construction type.

Table 29: Estimated Wetland Impacts – Harris County								
Natural Resources Mapbook Page #	Wetland ID/ Classification*	Wetland Type	Construction Type	Crossing Type	Segment 5		Northwest Transit Center Terminal	
					Temp	Perm	Temp	Perm
					acres		acres	
234	PFO1A	Forested	Access Road	Viaduct/Conversion	0.00	0.01	--	--
234	PFO1A	Forested	Rail	Viaduct/Conversion	0.00	0.08	--	--
235	SCAU17EW1	Emergent	Rail	Fill	0.00	0.13	--	--
235	SCAU17EW1	Emergent	Access Road	Fill	0.00	0.24	--	--
236	PEM1C	Emergent	Access Road	Fill	0.00	0.41	--	--
236	PEM1C	Emergent	Rail	Fill	0.00	1.7	--	--
236	SCAU17EW7	Emergent	Rail	Viaduct	0.00	0.00	--	--
236	SCAU17EW4	Emergent	Access Road	Viaduct	0.00	0.00	--	--
236	SCAU17EW4	Emergent	Rail	Viaduct	0.00	0.00	--	--
236	SCAU17EW4	Emergent	Access Road	Viaduct	0.00	0.00	--	--
236	SCAU17EW4	Emergent	Rail	Viaduct	0.00	0.00	--	--
237	PEM1C	Emergent	Rail	Viaduct	0.00	0.00	--	--
237	SCAU17EW5	Emergent	Access Road	Viaduct	0.00	0.00	--	--
237	SCAU17EW5	Emergent	Rail	Viaduct	0.00	0.00	--	--
237	PEM1C	Emergent	Access Road	Viaduct	0.00	0.00	--	--
237	PEM1Cx	Emergent	Access Road	Viaduct	0.00	0.00	--	--
237	Pf	Other	Rail	Viaduct	0.00	0.00	--	--
237	Pf	Other	Access Road	Viaduct	0.00	0.00	--	--

Table 29: Estimated Wetland Impacts – Harris County

Natural Resources Mapbook Page #	Wetland ID/ Classification*	Wetland Type	Construction Type	Crossing Type	Segment 5		Northwest Transit Center Terminal	
					Temp	Perm	Temp	Perm
					acres		acres	
238	Pf	Other	Rail	Viaduct	0.00	0.00	--	--
238	PSS1Cx	Scrub/Shrub	Temporary Fill	Fill	0.83	0.00	--	--
238	SCAV17EW10	Emergent	Rail	Viaduct	0.00	0.00	--	--
238	SCAV17EW9	Emergent	Access Road	Viaduct	0.00	0.00	--	--
239	SCAV17EW6	Emergent	Rail	Viaduct	0.00	0.00	--	--
239	SCAV17EW7	Emergent	Access Road	Viaduct	0.00	0.00	--	--
239	SCAV17EW7	Emergent	Rail	Viaduct	0.00	0.00	--	--
239	PEM1A	Emergent	Stormwater Drainage	Excavation	0.00	1.0	--	--
239	PEM1A	Emergent	Access Road	Fill	0.00	0.34	--	--
239	PEM1A	Emergent	Rail	Fill	0.00	3.4	--	--
239	PEM1C	Emergent	Stormwater Drainage	Excavation	0.00	0.38	--	--
239	PEM1C	Emergent	Access Road	Fill	0.00	0.47	--	--
239	PEM1C	Emergent	Rail	Fill	0.00	2.0	--	--
239	Pf	Other	Temporary Fill	Fill	0.63	0.00	--	--
239	Pf	Other	Stormwater Drainage	Excavation	0.00	0.11	--	--
239	Pf	Other	Access Road	Fill	0.00	0.09	--	--
239	Pf	Other	Rail	Fill	0.00	0.72	--	--
239	SCAV17EW8	Emergent	Stormwater Drainage	Excavation	0.00	0.28	--	--
240	SCAV17EW8	Emergent	Access Road	Fill	0.00	2.3	--	--
240	SCAV17EW8	Emergent	Rail	Fill	0.00	6.7	--	--
240	SCAW17EW1	Emergent	Stormwater Drainage	Excavation	0.00	0.74	--	--
240	SCAW17EW1	Emergent	Rail	Fill	0.00	5.2	--	--
240	SCAW17EW1	Emergent	Access Road	Viaduct	0.00	0.00	--	--
240	Pf	Other	Rail	Fill	0.00	0.24	--	--
240	PEM1Cx	Emergent	Rail	Fill	0.00	0.09	--	--
240	PEM1Cx	Emergent	Access Road	Fill	0.00	0.55	--	--
240	Pf	Other	Stormwater Drainage	Excavation	0.00	0.51	--	--
240	Pf	Other	Stormwater Drainage	Excavation	0.00	0.50	--	--

Table 29: Estimated Wetland Impacts – Harris County								
Natural Resources Mapbook Page #	Wetland ID/ Classification*	Wetland Type	Construction Type	Crossing Type	Segment 5		Northwest Transit Center Terminal	
					Temp	Perm	Temp	Perm
					acres		acres	
240	Pf	Other	Rail	Fill	0.00	0.12	--	--
241	Pf	Other	Maintenance Facility	Fill	0.00	2.7	--	--
241	Pf	Other	Stormwater Drainage	Excavation	0.00	1.4	--	--
241	Pf	Other	Rail	Fill	0.00	0.30	--	--
241	Pf	Other	Stormwater Drainage	Excavation	0.00	<0.01	--	--
243	PEM1C	Emergent	Temporary Fill	Fill	<0.01	0.00	--	--
243	PEM1A	Emergent	Temporary Fill	Fill	0.10	0.00	--	--
243	PEM1C	Emergent	Temporary Fill	Fill	0.47	0.00	--	--
243	PEM1C	Emergent	Temporary Fill	Fill	0.26	0.00	--	--
243	Pf	Other	Temporary Fill	Fill	2.8	0.00	--	--
243	PEM1F	Emergent	Rail	Viaduct	0.00	0.00	--	--
243	PEM1F	Emergent	Access Road	Viaduct	0.00	0.00	--	--
243	PEM1Cx	Emergent	Stormwater Drainage	Excavation	0.00	0.02	--	--
243	PEM1Cx	Emergent	Access Road	Fill	0.00	0.02	--	--
243	PEM1Cx	Emergent	Rail	Fill	0.00	0.09	--	--
243	SCAW19EW6	Emergent	Stormwater Drainage	Excavation	0.00	0.14	--	--
243	SCAW19EW6	Emergent	Access Road	Fill	0.00	1.3	--	--
243	SCAW19EW6	Emergent	Rail	Fill	0.00	4.3	--	--
243	Pf	Other	Stormwater Drainage	Excavation	0.00	0.28	--	--
243	Pf	Other	Rail	Fill	0.00	8.6	--	--
243	Pf	Other	Access Road	Viaduct	0.00	0.00	--	--
243	SCAW19EW6	Emergent	Stormwater Drainage	Excavation	0.00	4.8	--	--
244	SCAW19EW6	Emergent	Rail	Fill	0.00	0.69	--	--
244	SCAW19EW6	Emergent	Access Road	Fill	0.00	3.8	--	--
244	SCAW19EW7	Emergent	Access Road	Fill	0.00	0.19	--	--
244	SCAW19EW7	Emergent	Rail	Fill	0.00	0.37	--	--
244	Pf	Other	Rail	Fill	0.00	0.01	--	--
244	Pf	Other	Access Road	Viaduct	0.00	0.00	--	--

Table 29: Estimated Wetland Impacts – Harris County								
Natural Resources Mapbook Page #	Wetland ID/ Classification*	Wetland Type	Construction Type	Crossing Type	Segment 5		Northwest Transit Center Terminal	
					Temp	Perm	Temp	Perm
					acres		acres	
244	SCAW19EW8	Emergent	Access Road	Fill	0.00	0.02	--	--
244	SCAW19EW8	Emergent	Rail	Fill	0.00	0.12	--	--
244	SCAW19EW9	Emergent	Access Road	Fill	0.00	0.11	--	--
244	SCAW19EW9	Emergent	Rail	Fill	0.00	0.42	--	--
245	PEM1F	Emergent	Rail	Viaduct	0.00	0.00	--	--
245	PEM1A	Emergent	Rail	Viaduct	0.00	0.00	--	--
245	PEM1A	Emergent	Access Road	Viaduct	0.00	0.00	--	--
245	SCAW20SW2	Scrub/Shrub	Rail	Viaduct	0.00	0.00	--	--
245	SCAW20SW2	Scrub/Shrub	Access Road	Viaduct	0.00	0.00	--	--
246	SCAW20EW1	Emergent	Access Road	Viaduct	0.00	0.00	--	--
247	SCAX20EW2	Emergent	Rail	Viaduct	0.00	0.00	--	--
247	PEM1Cx	Emergent	Access Road	Viaduct	0.00	0.00	--	--
247	SCAX21EW3	Emergent	Access Road	Viaduct	0.00	0.00	--	--
247	SCAX21EW3	Emergent	Rail	Viaduct	0.00	0.00	--	--
247	SCAX21EW2	Emergent	Access Road	Viaduct	0.00	0.00	--	--
247	SCAX21EW2	Emergent	Rail	Viaduct	0.00	0.00	--	--
247	PEM1Cx	Emergent	Rail	Viaduct	0.00	0.00	--	--
247	PEM1C	Emergent	Stormwater Drainage	Excavation	0.00	0.04	--	--
247	PEM1C	Emergent	Access Road	Viaduct	0.00	0.00	--	--
247	PSS1A	Scrub/Shrub	Stormwater Drainage	Excavation	0.00	0.08	--	--
247	PSS1C	Scrub/Shrub	Stormwater Drainage	Excavation	0.00	0.05	--	--
248	SCAX21EW4	Emergent	Rail	Viaduct	0.00	0.00	--	--
249	PFO1Ad	Forested	Access Road	Viaduct/Conversion	0.00	0.01	--	--
249	SCAX21SW1	Scrub/Shrub	Rail	Viaduct	0.00	0.00	--	--
249	PFO1Ad	Forested	Maintenance Facility	Fill	0.00	0.01	--	--
249	SCAX22FW2	Forested	Rail	Viaduct/Conversion	0.00	<0.01	--	--
249	SCAX22FW2	Forested	Access Road	Viaduct/Conversion	0.00	0.03	--	--
249	SCAX22EW2	Emergent	Rail	Viaduct	0.00	0.00	--	--

Table 29: Estimated Wetland Impacts – Harris County								
Natural Resources Mapbook Page #	Wetland ID/ Classification*	Wetland Type	Construction Type	Crossing Type	Segment 5		Northwest Transit Center Terminal	
					Temp	Perm	Temp	Perm
					acres		acres	
249	SCAX22EW2	Emergent	Access Road	Viaduct	0.00	0.00	--	--
249	SCAX22EW1	Emergent	Access Road	Viaduct	0.00	0.00	--	--
250	SCAX22FW3	Forested	Temporary Fill	Fill	<0.01	0.00	--	--
250	SCAX22FW3	Forested	Temporary Fill	Fill	<0.01	0.00	--	--
250	SCAX22FW3	Forested	Temporary Fill	Fill	0.03	0.00	--	--
250	SCAY22EW2	Emergent	Temporary Fill	Fill	<0.01	0.00	--	--
250	SCAX22SW1	Scrub/Shrub	Temporary Fill	Fill	0.44	0.00	--	--
250	SCAY22EW2	Emergent	Access Road	Viaduct	0.00	0.00	--	--
250	SCAY22EW2	Emergent	Rail	Viaduct	0.00	0.00	--	--
250	SCAY22EW2	Emergent	Access Road	Viaduct	0.00	0.00	--	--
250	SCAY22EW2	Emergent	Rail	Viaduct	0.00	0.00	--	--
250	SCAY22EW2	Emergent	Temporary Fill	Fill	0.17	0.00	--	--
250	PEM1A	Emergent	Facility	Fill	0.00	0.02	--	--
250	PEM1A	Emergent	Rail	Viaduct	0.00	0.00	--	--
250	PEM1A	Emergent	Access Road	Viaduct	0.00	0.00	--	--
250	PEM1Cx	Emergent	Access Road	Viaduct	0.00	0.00	--	--
255	SCAZ24EW1	Emergent	Facility	Fill	--	--	0.00	<0.01
255	SCAZ24EW1	Emergent	Rail	Viaduct	--	--	0.00	0.00
				Total	5.8	58.0	0.00	<0.01

Source: USFWS, 2016; FNI, 2017

*Wetland ID # (S) indicates a specific feature recorded in the field. Wetland classifications (P) indicate wetlands not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each wetland is separated by construction type.

P - Palustrine
EM1 - Persistent Emergent
FO1 - Broad-leaved Deciduous Forested
SS1 - Broad-leaved Deciduous Scrub-Shrub
C - Seasonally Flooded
d- Partly Drained/Ditched
x – Excavated
EM - Emergent
FO - Forested
SS - Scrub-Shrub
A - Temporarily Flooded
F - Semipermanently Flooded
f - Farmed
'--' - not present

Table 30: Estimated Waterbody Impacts – Harris County								
Natural Resources Mapbook Page #	Waterbody ID/Name *	Waterbody Type	Construction Type	Crossing Type	Segment 5		Northwest Transit Center Terminal	
					Temp	Temp	Temp	Perm
					acres		acres	
235	SCAU17PD2	Pond	Access Road	Fill	0.00	0.18	--	--
235	SCAU17PD2	Pond	Rail	Fill	0.00	0.30	--	--
235	Unnamed	Pond	Rail	Viaduct	0.00	0.00	--	--
236	SCAU17PD7	Pond	Rail	Viaduct	0.00	0.00	--	--
236	SCAU17PD8	Pond	Access Road	Viaduct	0.00	0.00	--	--
236	SCAU17PD8	Pond	Rail	Viaduct	0.00	0.00	--	--
238	Unnamed	Pond	Access Road	Viaduct	0.00	0.00	--	--
238	Unnamed	Pond	Rail	Viaduct	0.00	0.00	--	--
239	SCAV17PD2	Pond	Rail	Viaduct	0.00	0.00	--	--
239	Unnamed	Pond	Access Road	Fill	0.00	0.01	--	--
239	Unnamed	Pond	Rail	Fill	0.00	0.06	--	--
239	Unnamed	Swamp	Temporary Fill	Fill	3.23	0.00	--	--
239	Unnamed	Swamp	Access Road	Fill	0.00	0.30	--	--
239	Unnamed	Swamp	Stormwater Drainage	Excavation	0.00	1.73	--	--
239	Unnamed	Swamp	Rail	Fill	0.00	1.49	--	--
242	Unnamed	Pond	Access Road	Viaduct	0.00	0.00	--	--
242	Unnamed	Pond	Rail	Viaduct	0.00	0.00	--	--
245	Unnamed	Pond	Rail	Viaduct	0.00	0.00	--	--
246	SCAW20PD3	Pond	Access Road	Viaduct	0.00	0.00	--	--
246	SCAW20PD4	Pond	Access Road	Viaduct	0.00	0.00	--	--
246	SCAW20PD4	Pond	Rail	Viaduct	0.00	0.00	--	--
248	Unnamed	Pond	Access Road	Viaduct	0.00	0.00	--	--
248	Unnamed	Pond	Rail	Viaduct	0.00	0.00	--	--
248	SCAX21PD3	Pond	Access Road	Viaduct	0.00	0.00	--	--
248	SCAX21PD3	Pond	Rail	Viaduct	0.00	0.00	--	--
255	SCAZ24PD2	Pond	Rail	Viaduct	--	--	0.00	0.00
255	SCAZ24PD2	Pond	Station	Fill	--	--	0.00	0.04

Table 30: Estimated Waterbody Impacts – Harris County								
Natural Resources Mapbook Page #	Waterbody ID/Name *	Waterbody Type	Construction Type	Crossing Type	Segment 5		Northwest Transit Center Terminal	
					Temp	Temp	Temp	Perm
					acres		acres	
				Total	3.2	4.1	0.00	0.04

Source: USGS, 2016; USFWS, 2016; FNI, 2017

*Waterbody ID # (S) indicates a specific feature recorded in the field. Waterbody classifications (P) indicate waterbodies not yet field-verified. Jurisdictional determinations to be confirmed by the USACE. Each waterbody is separated by construction type.

'--' – Not Present

TECHNICAL MEMORANDUM
TRANSPORTATION

To: Jerry Smiley, AICP, AECOM

From: Sam Higgins, AECOM

Date: November 1, 2017

RE: **DALLAS TO HOUSTON HSR –TRANSPORTATION**

This technical memorandum summarizes the data collection used as inputs for determining the station area traffic impacts for the Dallas to Houston High-Speed Rail Project (the Project) and to summarize the results of the traffic impact analyses and street modifications needed to maintain No Build, or better, intersection Level of Service (LOS) and delay condition.

The traffic data collection includes descriptions of the required data and data sources for the traffic operational analysis, including:

- Traffic counts
- Signal timing plans
- Intersection geometry
- Travel demand models

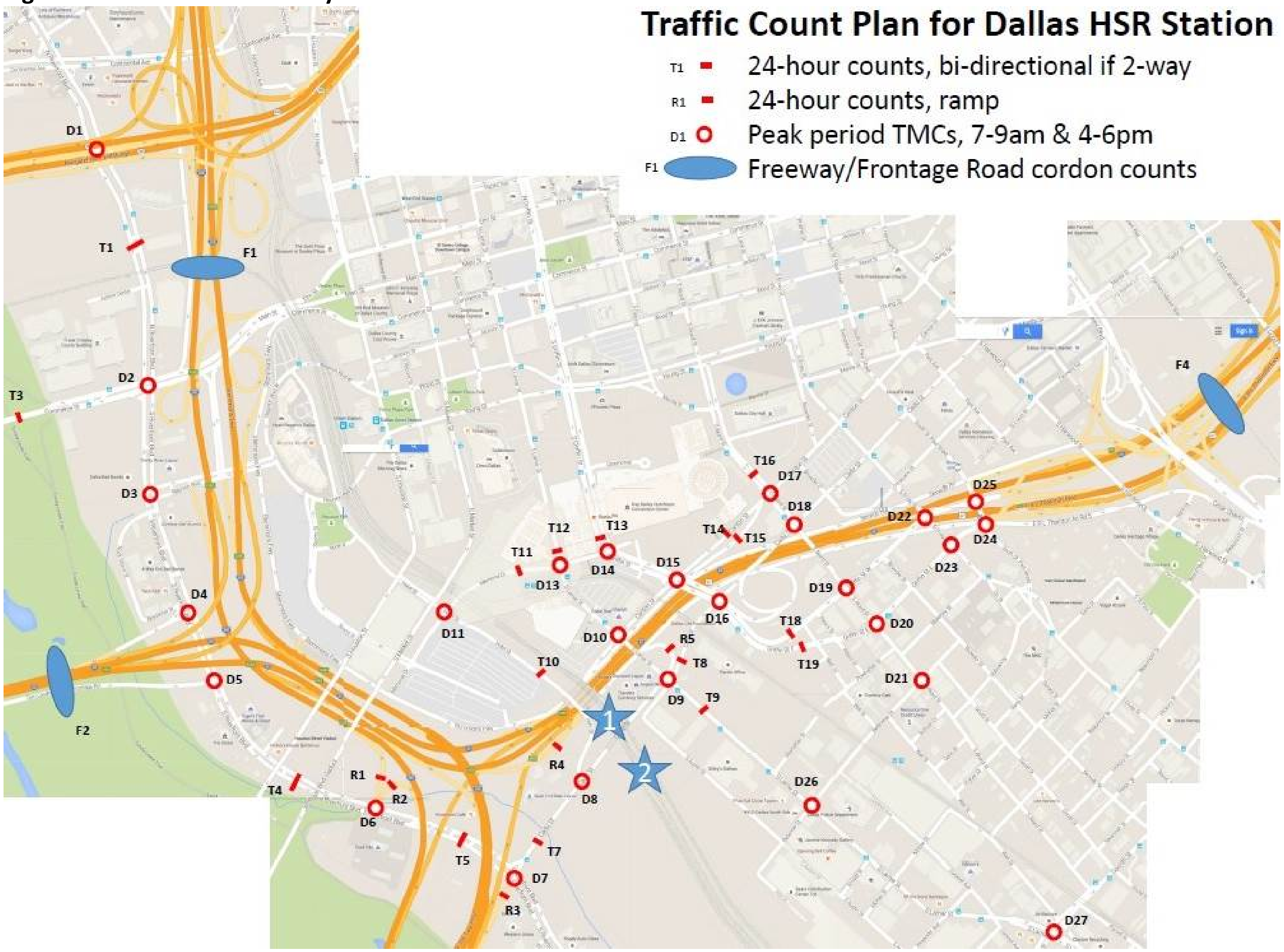
The traffic operation overview describes the station area traffic volumes and patterns and the subsequent impact they have on the roadway network and the modification needed to mitigate the impacts. The subsections include:

- Trip generation and distribution
- Trip assignment
- Existing conditions
- Traffic impacts
- Intersection mitigation

DATA COLLECTION

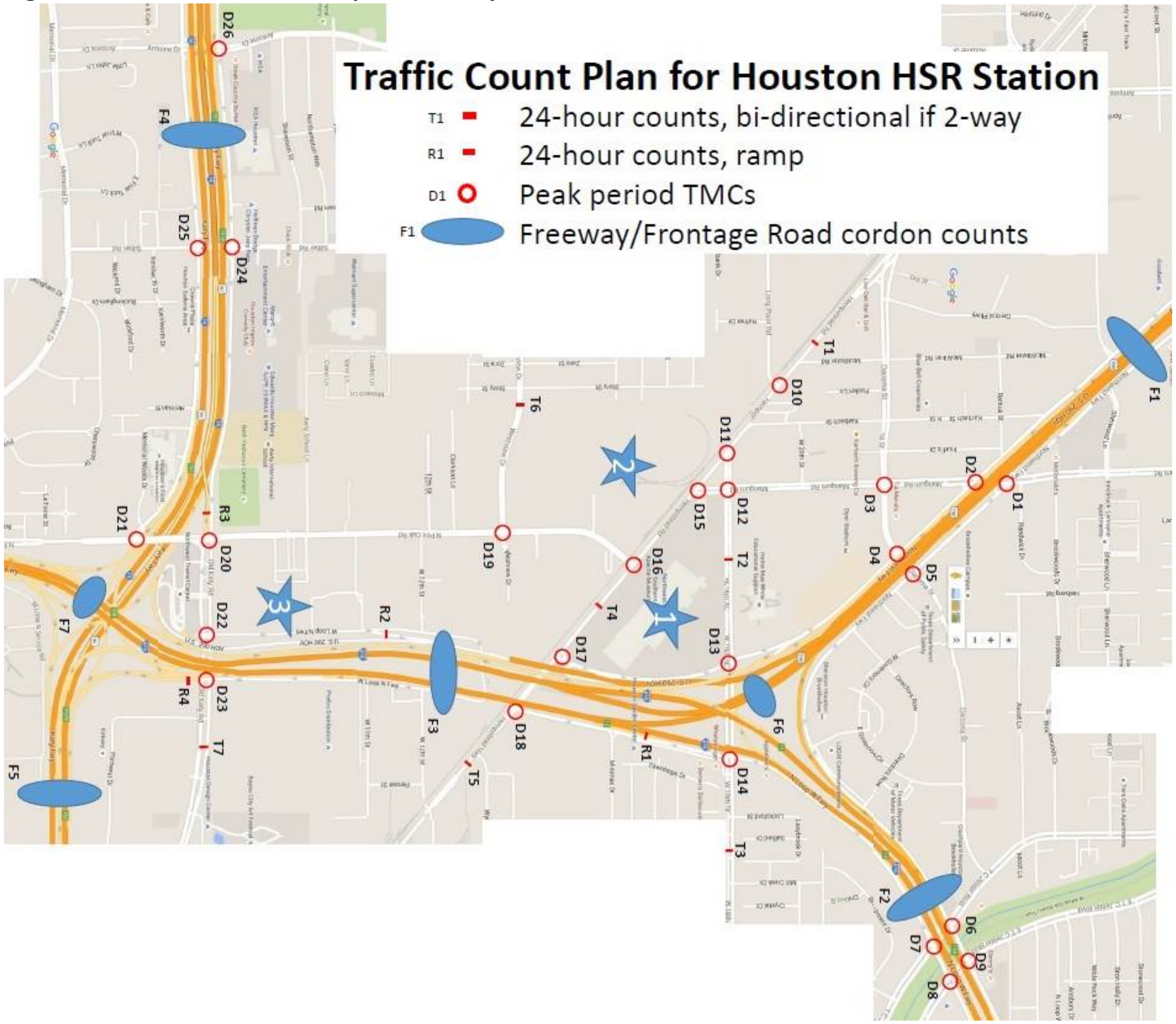
To establish existing conditions and to assist in developing future year conditions, traffic counts in the station areas were collected, as depicted in **Figures 1** and **2**.

Figure 1: Dallas Terminal Study Area Traffic Counts



Source: Freese and Nichols, 2015

Figure 2: Houston Terminal Options Study Area Traffic Counts



Source: Freese and Nichols, 2015

In addition to the Dallas and Houston study areas, traffic counts were conducted at and near the intersection of SH 30 and SH 90 in Grimes County for the Brazos Valley Station.

All of the traffic counts collected for the project are included in **Attachment A**.

Signal Timing Plans

For the signalized intersections in Dallas and Houston, the existing signal timing plans were needed to determine existing LOS and to establish the specifics of the signal operations. The signal timing plans for Dallas and Houston are located in **Attachment B**.

Intersection Geometry

Existing aerial photography and field observations were used to determine the existing intersection geometries. Future year intersection geometries were determined using roadway design schematics for committed improvement projects on Riverfront Boulevard and the Horseshoe (IH-30/IH-35) in Dallas, and US 290 and IH-610 in Houston.

Travel Demand Models

Metropolitan Planning Organizations (MPOs) use travel demand models to estimate the traffic volumes for future year conditions. The Dallas Terminal area is within the travel demand model operated by the North Central Texas Council of Governments. The study area for the Houston Terminal options falls within the travel demand model area operated by the Houston-Galveston Area Council. Year 2040 model runs were prepared for this study and were obtained from the MPOs. The models provide 2040 AM and PM peak hour approach volumes which were distributed into turning movements based on the existing turning percentages. These 2040 volumes were used as the background volume to describe the No Build conditions.

TRAFFIC OPERATIONS OVERVIEW

The collected data informed the analysis of the station area traffic impacts and corresponding mitigation measures. This section summarizes the traffic operations of the stations and the operational analyses of the traffic impacts and mitigation.

Trip Generation and Distribution

The vehicle trips generated by the stations are based on a variety of factors, including ridership forecasts, station locations, mode choice for travel to and from the stations and the proposed operations of the Project. These factors were incorporated into a Station Area Guidance Memorandum (see **Attachment C**) which summarized the trip generation and distribution for the stations.

Trip Assignment

The station layouts include areas of access and parking that are categorized as drive and park (D&P), rental cars (RC), pick-up/drop-off (PU/DO) or taxi/shuttle (T&S). The generated station trips were assigned to the roadway network using the overall distribution from the Station Area Guidance Memorandum. The roadway routing needed to get to the proper driveway or parking facility at the station was also determined based on vehicular mode. The resulting volumes were then added to the 2040 background volumes to develop Build conditions to analyze the intersection traffic impacts. The Vehicle Trip Allocation Figures are included in **Attachment D**.

Existing Conditions

Tables 1 through **3** describe the existing LOS and delay at the station area intersections. The Synchro reports are provided in **Attachment E**.

Table 1: Dallas Terminal Existing LOS (Delay in Seconds per Vehicle)			
Map ID	**Intersection**	**AM**	**PM**
		Existing	**Existing**
1	Woodall Rodgers Fwy / River Front Blvd	C (33)	D (37)
2	Riverfront Blvd / Commerce St	D (40)	D (46)
3	Reunion Blvd / Riverfront Blvd	A (8)	A (8)
4	WB IH-30 / Riverfront Blvd	A (8)	B (11)
5	EB I-30 / Riverfront Blvd	B (17)	C (23)
6	IH-35E / Riverfront Blvd	A (6)	A (10)
7	Riverfront Blvd / Cadiz St	D (53)	C (34)
8	Cadiz St / Hotel St (unsignalized)	A (1)	A (1)
9	Cadiz St / Lamar St	B (15)	B (15)
10	Canton St / Lamar St	B (12)	B (12)
11	Hotel St / Memorial Dr (unsignalized)	A (4)	A (4)
13	Lamar St / Memorial Dr	B (12)	B (13)
14	Griffin St / Memorial Dr	C (24)	B (19)
15	Canton St / Griffin St	A (9)	B (12)
16	Cadiz St / Griffin St	B (14)	A (8)
17	Canton St / Akard St	B (12)	B (17)
18	Cadiz St / Akard St	B (13)	B (11)
19	Griffin St W / Akard St	B (11)	B (13)
20	Griffin St E / Akard St	B (12)	B (12)
21	Belleview St / Akard St (unsignalized)	A (3)	A (10)
22	Griffin St W / Ervay St	A (5)	A (6)
23	Griffin St E / Ervay St	B (12)	C (20)
24	Griffin St E / St Paul St	A (8)	A (7)
25	Griffin St W / St Paul St	B (10)	C (20)
26	Lamar St / Belleview St	B (13)	B (11)
27	Lamar St / Corinth St	C (21)	B (20)
28	Corinth St / Riverfront Blvd	C (21)	D (53)

*Intersection 12 was removed from the analysis.

Table 2: Brazos Valley Station Existing LOS (Delay in Seconds per Vehicle)			
Map ID	Intersection	AM	PM
		Existing	Existing
1	SH 30 / SH 90 (unsignalized)	B (10)	B (11)

Table 3: Houston Terminal Options Existing LOS (Delay in Seconds per Vehicle)			
Map ID	Intersection	AM	PM
		Existing	Existing
1	NB US 290 / Mangum Rd	C (29)	C (25)
2	SB US 290 / Mangum Rd	C (33)	C (34)
3	Mangum Rd / Dacoma St	C (33)	C (29)
4	SB US 290 / Dacoma St	C (32)	C (29)
5	NB US 290 / Dacoma St	C (25)	C (33)
6	WB IH-610 / TC Jester Blvd	**E** (73)	D (40)
7	EB IH-610 / TC Jester Blvd	D (48)	D (46)
8	EB IH-610 / E TC Jester Blvd	D (39)	D (37)
9	WB IH-610 / E TC Jester Blvd	**F** (91)	C (29)
10	Long Point Rd / Hempstead Rd	B (17)	B (18)
11	18th St / Hempstead Rd (unsignalized)	A (2)	A (2)
12	Mangum Rd / 18th St	C (26)	C (34)
13	SB IH-610 / 18th St	C (28)	D (43)
14	NB IH-610 / 18th St	D (38)	C (35)
15	Mangum Rd / Hempstead Rd	C (25)	C (29)
16	Post Oak Rd / Hempstead Rd	C (27)	C (29)
17	SB IH-610 / Hempstead Rd	C (29)	C (31)
18	NB IH-610 / Hempstead Rd	B (12)	B (16)
19	Post Oak Rd / Westview Dr	B (19)	C (31)
20	Post Oak Rd / Old Katy Rd	D (46)	**F** (98)
21	Post Oak Rd / EB IH-10	C (24)	B (17)
22	SB IH-610 / Old Katy Rd	C (24)	**E** (59)
23	NB IH-610 / Old Katy Rd	C (23)	D (52)
24	WB IH-10 / Silber Rd	C (25)	C (28)
25	EB IH-10 / Silber Rd	C (24)	D (47)
26	WB IH-10 / Antoine Dr	C (31)	C (26)

Traffic Impacts

The impacts of the station traffic on the study area intersections are indicated in **Tables 4** through **8**. The tables list peak period intersection conditions in the No Build and Build Alternative conditions, with a column identifying intersections that would experience a substantial impact from the traffic generated by the station. The Project would have a substantial impact if it:

(a) Would worsen the horizon year LOS (in either peak period) from D or better to E or F, or
(b) Would increase average seconds of delay where the No Build LOS is already E or F.

The Synchro reports are provided in **Attachment E**.

Table 4: Dallas Terminal Impacts
LOS (Delay in Seconds per Vehicle)

Map ID	Intersection	AM NB	PM NB	AM Build	PM Build	Impact
1	Woodall Rodgers Fwy/Riverfront Blvd	**F (119)**	D (48)	**F (128)**	**E (76)**	**Y**
2	Riverfront Blvd/Commerce St	**F (90)**	**F (98)**	**F (155)**	**F (100)**	**N**
3	Reunion Blvd/Riverfront Blvd	C (25)	B (17)	C (28)	B (17)	N
4	WB IH-30/Riverfront Blvd	A (9)	B (13)	A (9)	C (20)	N
5	EB IH-30/Riverfront Blvd	C (28)	C (23)	C (35)	D (35)	N
6	IH-35E/Riverfront Blvd	A (8)	B (13)	B (14)	B (15)	N
7	Riverfront Blvd/Cadiz St	**F (175)**	**F (127)**	**F (412)**	**F (303)**	**N**
8	Cadiz St/Hotel St (unsignalized)	A (1)	A (3)	A (1)	A (3)	N
9	Cadiz St/Lamar St	**E (61)**	**F (90)**	**F (85)**	**F (151)**	**Y**
10	Canton St/Lamar St	B (13)	B (15)	B (13)	B (15)	N
11	Hotel St/Memorial Dr (unsignalized)	A (4)	A (4)	A (9)	B (10)	N
13	Lamar St/Memorial Dr	B (16)	B (14)	B (17)	B (15)	N
14	Griffin St/Memorial Dr	D (53)	C (28)	C (27)	C (30)	N
15	Canton St/Griffin St	A (10)	C (21)	B (16)	C (22)	N
16	Cadiz St/Griffin St	B (15)	B (13)	C (27)	C (25)	N
17	Canton St/Akard St	C (26)	**E (66)**	C (32)	**F (107)**	**N**
18	Cadiz St/Akard St	C (29)	B (14)	D (36)	C (25)	N
19	Griffin St W/Akard St	B (15)	B (11)	C (26)	B (17)	N
20	Griffin St E/Akard St	B (15)	C (21)	B (11)	C (32)	N
21	Belleview St/Akard St (unsignalized)	**E (47)**	**F (1710)**	**F (95)**	**F (1897)**	**Y**
22	Griffin St W/Ervay St	B (16)	A (6)	C (25)	A (4)	N
23	Griffin St E/Ervay St	B (15)	B (12)	C (29)	B (15)	N
24	Griffin St E/St Paul St	A (7)	D (42)	A (8)	D (47)	N
25	Griffin St W/St Paul St	B (18)	B (15)	B (15)	C (28)	N
26	Lamar St/Belleview St	B (19)	B (16)	F (145)	D (48)	Y
27	Lamar St/Corinth St	D (35)	**E (56)**	D (45)	**E (62)**	N
28	Corinth St/Riverfront Blvd	**F (189)**	**F (189)**	**F (214)**	**F (193)**	**N**

*Intersection 12 was removed from the analysis.

Table 5: Brazos Valley Station Impact LOS (Delay in Seconds per Vehicle)						
Map ID	**Intersection**	**AM No Build**	**PM No Build**	**AM Build**	**PM Build**	**Impact**
1	SH 30/SH 90	D (52)	D (33)	**F (63)**	**F (50)**	**Y**

Table 6: Northwest Transit Center Terminal Impacts LOS (Delay in Seconds per Vehicle)						
Map ID	**Intersection**	**AM No Build**	**PM No Build**	**AM Build**	**PM Build**	**Impact**
1	NB US 290/Mangum Rd	D (43)	**E (76)**	D (47)	**F (117)**	**N**
2	SB US 290/Mangum Rd	D (39)	D (54)	E (60)	**E (76)**	**N**
3	Mangum Rd/Dacoma St	D (46)	**E (62)**	**D (53)**	**F (83)**	**Y**
4	SB US 290/Dacoma St	**F (141)**	**F (104)**	**F (154)**	**F (146)**	**Y**
5	NB US 290/Dacoma St	**F (89)**	**F (97)**	**F (98)**	**F (123)**	**Y**
6	WB IH-610/TC Jester Blvd	**F (329)**	**F (188)**	**F (201)**	**F (181)**	**Y**
7	EB IH-610/TC Jester Blvd	**F (110)**	**F (202)**	**F (107)**	**F (191)**	**Y**
8	EB IH-610/E TC Jester Blvd	**F (122)**	**F (121)**	**F (153)**	**E (74)**	**Y**
9	WB IH-610/E TC Jester Blvd	**F (315)**	**F (128)**	**F (367)**	**F (137)**	**Y**
10	Long Point Rd/Hempstead Rd	**F (81)**	**F (92)**	**F (85)**	**F (86)**	**Y**
11	18th St/Hempstead Rd (unsignalized)	**F (61)**	**F (184)**	**F (67)**	**F (192)**	**Y**
12	Mangum Rd/18th St	D (41)	**E (67)**	**D (53)**	**F (92)**	**N**
13	SB IH-610/18th St	D (52)	**F (124)**	**E (63)**	**F (148)**	**Y**
14	NB IH-610/18th St	**E (67)**	**F (106)**	**F (81)**	**F (142)**	**Y**
15	Mangum Rd/Hempstead Rd	C (24)	C (32)	C (30)	D (45)	Y
16	Post Oak Rd/Hempstead Rd	**F (96)**	**F (102)**	**F (190)**	**F (170)**	**Y**
17	SB IH-610/Hempstead Rd	**E (63)**	**F (99)**	**E (55)**	**F (112)**	**Y**
18	NB IH-610/Hempstead Rd	C (27)	**F (107)**	C (27)	**F (83)**	**Y**
19	Post Oak Rd/Westview Dr	**F (92)**	**E (77)**	**F (137)**	**F (119)**	**Y**
20	Post Oak Rd/Old Katy Rd	**F (179)**	**F (354)**	**F (351)**	**F (490)**	**Y**
21	Post Oak Rd/EB IH-10	**F (117)**	**F (95)**	**F (92)**	**E (67)**	**Y**
22	SB IH-610/Old Katy Rd	D (35)	**F (145)**	**E (70)**	**F (161)**	**Y**
23	NB IH-610/Old Katy Rd	**E (56)**	**F (143)**	**F (117)**	**F (252)**	**Y**
24	WB IH-10/Silber Rd	D (51)	**F (132)**	**F (83)**	**F (87)**	**Y**
25	EB IH-10/Silber Rd	**E (74)**	**F (253)**	**F (111)**	**F (250)**	**Y**
26	WB IH-10/Antoine Dr	**F (119)**	**F (83)**	**F (125)**	**F (91)**	**Y**

Table 7: Northwest Mall Terminal Impacts LOS (Delay in Seconds per Vehicle)						
Map ID	Intersection	AM No Build	PM No Build	AM Build	PM Build	Impact
1	NB US 290/Mangum Rd	D (43)	**E (76)**	**E (70)**	**F (118)**	**Y**
2	SB US 290/Mangum Rd	D (39)	D (54)	**E (73)**	**F (82)**	**Y**
3	Mangum Rd/Dacoma St	D (46)	**E (62)**	**E (64)**	**F (98)**	**Y**
4	SB US 290/Dacoma St	**F (141)**	**F (104)**	**F (161)**	**F (147)**	**Y**
5	NB US 290/Dacoma St	**F (89)**	**F (97)**	**F (107)**	**F (142)**	**Y**
6	WB IH-610/TC Jester Blvd	**F (329)**	**F (188)**	**F (220)**	**F (165)**	**Y**
7	EB IH-610/TC Jester Blvd	**F (110)**	**F (202)**	**F (109)**	**F (177)**	**Y**
8	EB IH-610/E TC Jester Blvd	**F (122)**	**F (121)**	**F (144)**	**F (89)**	**Y**
9	WB IH-610/E TC Jester Blvd	**F (315)**	**F (128)**	**F (393)**	**F (188)**	**Y**
10	Long Point Rd/Hempstead Rd	**F (81)**	**F (92)**	**F (85)**	**F (88)**	**Y**
11	18th St/Hempstead Rd (unsignalized)	**F (61)**	**F (184)**	**F (67)**	**F (192)**	**Y**
12	Mangum Rd/18th St	D (41)	**E (67)**	**E (57)**	**F (93)**	**N**
13	SB IH-610/18th St	D (52)	**F (124)**	**F (134)**	**F (257)**	**Y**
14	NB IH-610/18th St	E (67)	**F (106)**	**F (120)**	**F (203)**	**Y**
15	Mangum Rd/Hempstead Rd	C (24)	C (32)	C (24)	C (34)	**N**
16	Post Oak Rd/Hempstead Rd	**F (96)**	**F (102)**	**F (216)**	**F (248)**	**Y**
17	SB IH-610/Hempstead Rd	**E (63)**	**F (99)**	**E (80)**	**F (134)**	**Y**
18	NB IH-610/Hempstead Rd	C (27)	**F (107)**	D (36)	**F (87)**	**Y**
19	Post Oak Rd/Westview Dr	**F (92)**	**E (77)**	**F (119)**	**F (153)**	**Y**
20	Post Oak Rd/Old Katy Rd	**F (179)**	**F (354)**	**F (245)**	**F (399)**	**Y**
21	Post Oak Rd/EB IH-10	**F (117)**	**F (95)**	**E (70)**	**E (64)**	**Y**
22	SB IH-610/Old Katy Rd	D (35)	**F (145)**	D (48)	**F (132)**	**Y**
23	NB IH-610/Old Katy Rd	**E (56)**	**F (143)**	**D (51)**	**F (154)**	**Y**
24	WB IH-10/Silber Rd	D (51)	**F (132)**	**F (83)**	**E (74)**	**Y**
25	EB IH-10/Silber Rd	**E (74)**	**F (253)**	**F (107)**	**F (235)**	**Y**
26	WB IH-10/Antoine Dr	**F (119)**	**F (83)**	**F (125)**	**F (89)**	**Y**

Table 8: Industrial Site Terminal Impacts LOS (Delay in Seconds per Vehicle)						
Map ID	Intersection	AM No Build	PM No Build	AM Build	PM Build	Impact
1	NB US 290/Mangum Rd	D (43)	**E (76)**	**E (70)**	**F (123)**	**Y**
2	SB US 290/Mangum Rd	D (39)	D (54)	**E (54)**	D (52)	**N**
3	Mangum Rd/Dacoma St	D (46)	**E (62)**	**F (105)**	**F (121)**	**Y**
4	SB US 290/Dacoma St	**F (141)**	**F (104)**	**F (108)**	**F (127)**	**Y**
5	NB US 290/Dacoma St	**F (89)**	**F (97)**	**F (89)**	**F (94)**	**N**
6	WB IH-610/TC Jester Blvd	**F (329)**	**F (188)**	**F (329)**	**F (188)**	**N**
7	EB IH-610/TC Jester Blvd	**F (110)**	**F (202)**	**F (110)**	**F (193)**	**N**
8	EB IH-610/E TC Jester Blvd	**F (122)**	**F (121)**	**F (122)**	**F (121)**	**N**
9	WB IH-610/E TC Jester Blvd	**F (315)**	**F (128)**	**F (315)**	**F (128)**	**N**
10	Long Point Rd/Hempstead Rd	**F (81)**	**F (92)**	**F (87)**	**F (81)**	**Y**
11	18th St/Hempstead Rd (unsignalized)	**F (61)**	**F (184)**	**F (69)**	**F (194)**	**Y**
12	Mangum Rd/18th St	D (41)	**E (67)**	**F (99)**	**F (177)**	**Y**
13	SB IH-610/18th St	D (52)	**F (124)**	**F (112)**	**F (236)**	**Y**
14	NB IH-610/18th St	E (67)	**F (106)**	**F (123)**	**F (142)**	**Y**
15	Mangum Rd/Hempstead Rd	C (24)	C (32)	**E (74)**	**F (122)**	**Y**
16	Post Oak Rd/Hempstead Rd	**F (96)**	**F (102)**	**F (375)**	**F (374)**	**Y**
17	SB IH-610/Hempstead Rd	**E (63)**	**F (99)**	**F (139)**	**F (112)**	**Y**
18	NB IH-610/Hempstead Rd	C (27)	**F (107)**	D (36)	**F (126)**	**Y**
19	Post Oak Rd/Westview Dr	**F (92)**	**E (77)**	**F (452)**	**F (292)**	**Y**
20	Post Oak Rd/Old Katy Rd	**F (179)**	**F (354)**	**F (272)**	**F (452)**	**Y**
21	Post Oak Rd/EB IH-10	**F (123)**	**F (95)**	**F (141)**	**F (119)**	**Y**
22	SB IH-610/Old Katy Rd	D (35)	**F (145)**	D (36)	**F (141)**	**N**
23	NB IH-610/Old Katy Rd	**E (56)**	**F (143)**	**F (131)**	**F (206)**	**Y**
24	WB IH-10/Silber Rd	D (51)	**F (132)**	**E (63)**	**F (151)**	**Y**
25	EB IH-10/Silber Rd	**E (74)**	**F (253)**	**F (84)**	**F (251)**	**Y**
26	WB IH-10/Antoine Dr	**F (119)**	**F (83)**	**F (140)**	**F (84)**	**Y**

Intersection Mitigation

For the Dallas station, the recommended mitigation for the substantial impacts include:

2 – Riverfront Boulevard/Commerce Street

- Add right-turn bay to northbound approach to provide dual-right turn bays

7 – Riverfront Boulevard/Cadiz Street

- Add one right-turn bay to provide dual right turns for south westbound approach
- Add one left-turn bay to northeast approach to provide dual left-turn bays

9 – Lamar Street/Cadiz Street

- Add one right-turn bay to southwestbound approach (IH-30 exit ramp)
- Add right-turn bay to south eastbound approach

17 – Canton Street/Akard Street

- Add a protected left phase and signal head for north westbound approach

21 – Belleview Street/S Akard Street

- Provide stop control on both approaches of Akard Street to make the intersection four-way stop-controlled

The resulting, mitigated LOS and delays are provided in **Table 9**.

Table 9: Dallas Terminal with Mitigation LOS (Delay in Seconds per Vehicle)			
Map ID	**Intersection**	**AM**	**PM**
		Mitigated	**Mitigated**
1	Woodall Rodgers Fwy/Riverfront Blvd	**F (128)**	E (76)
2	Riverfront Blvd/Commerce St	**F (116)**	**F (100)**
3	Reunion Blvd/Riverfront Blvd	C (28)	B (17)
4	WB IH-30/Riverfront Blvd	A (9)	C (20)
5	EB IH-30/Riverfront Blvd	C (35)	D (35)
6	IH-35E/Riverfront Blvd	B (14)	B (15)
7	Riverfront Blvd/Cadiz St	**F (259)**	**F (210)**
8	Cadiz St/Hotel St (unsignalized)	A (1)	A (3)
9	Cadiz St/Lamar St	**D (52)**	**F (88)**
10	Canton St/Lamar St	B (13)	B (15)
11	Hotel St/Memorial Dr (unsignalized)	A (9)	B (10)
13	Lamar St/Memorial Dr	B (17)	B (15)
14	Griffin St/Memorial Dr	C (27)	C (30)
15	Canton St/Griffin St	B (16)	C (22)
16	Cadiz St/Griffin St	C (26)	C (25)
17	Canton St/Akard St	B (16)	C (24)
18	Cadiz St/Akard St	D (36)	C (29)
19	Griffin St W/Akard St	C (26)	B (17)
20	Griffin St E/Akard St	B (11)	C (32)
21	Belleview St/Akard St (unsignalized)	**F (73)**	**F (69)**
22	Griffin St W/Ervay St	C (25)	A (4)
23	Griffin St E/Ervay St	C (29)	B (15)
24	Griffin St E/St Paul St	A (8)	D (47)
25	Griffin St W/St Paul St	B (15)	C (28)
26	Lamar St/Belleview St	**F (145)**	D (48)
27	Lamar St/Corinth St	D (45)	**E (62)**
28	Corinth St/Riverfront Blvd	**F (214)**	**F (193)**

For the Brazos Valley Station, the recommended mitigation for the substantial impacts include:

1 – SH 30 at SH 90

- Add eastbound and westbound left turn bays

The resulting LOS and delay are provided in **Table 10**.

Table 10: Brazos Valley Station with Mitigation LOS (Delay in Seconds per Vehicle)			
Map ID	**Intersection**	**AM**	**PM**
		Mitigated	**Mitigated**
1	SH 30/SH 90	**E (45)**	D (27)

For the Houston Northwest Transit Center Terminal Option, the recommended mitigation for the substantial impacts include:

1 − Mangum Road/US 290 NBFR

- Add one left-turn bay to northbound approach
- Add one through lane to southbound approach

2 − Mangum Road/US 290 SBFR

- Add one through lane to northbound approach

3 − Mangum Road/Dacoma Street

- Add one right-turn bay to northbound approach

7 − West T C Jester Boulevard/LP 610 Eastbound FR

- Convert north eastbound shared through/left-turn lane to through-only lane

8 – Jester Boulevard/LP 610 EBFR

- Convert southeastbound center lane from through to shared through/left

10 − Hempstead Road/Long Point Road

- Prohibit left turns from south eastbound approach

11 − W 18th Street/Hempstead Road

- Prohibit left turns at westbound approach

12 − Mangum Road/18th Street

- Add one right-turn bay to westbound approach
- Convert the left turns at all approaches to protected then permissive

13 − W 18th Street/Loop 610 SBFR

- Add one right-turn bay to eastbound approach

16 − Post Oak Road/Hempstead Road

- Add one right-turn bay to eastbound approach
- Convert northwestbound approach to dual left-turn bays, a shared through and right-turn lane, and one right-turn bay
- Convert southeastbound approach outside through lane to a shared through/right-turn lane, providing two lanes permitting right-turns

19 − Post Oak Road/Westview Drive

- Add one right-turn bay to southbound approach
- Convert the left turns at all approaches to protected then permissive

20 − Post Oak Road/Old Katy Road

- Add one right-turn bay to each approach
- Add one left-turn bay to the northbound and southbound approaches

21 – Post Oak Road/IH-10 EBFR
- Add one through lane to northbound approach

22 – Old Katy Road/Loop 610 SBFR
- Convert southbound approach shared through/left-turn lane to through-only
- Add one left-turn bay to southbound approach
- Add one through lane to the westbound approach

23 – Old Katy Road/Loop 610 NBFR
- Convert northbound approach to dual left-turn bays and a shared through/right-turn lane
- Add one through lane to westbound approach
- Add one left-turn bay to eastbound approach

24 – Silber Road/IH-10 WBFR
- Convert southbound approach to two through lanes and one right-turn lane

25 – Silber Road at IH-10 EBFR
- Convert eastbound approach shared through/left-turn lane to a through-only lane

26 – Antoine Drive at IH-10 WBFR
- Convert westbound approach shared through/left-turn lane to a through-only lane
- Add one right-turn bay to southbound approach

The peak period LOS and delay resulting from these mitigations are provided in **Table 11**.

Table 11: Northwest Transit Center Terminal Option with Mitigation LOS (Delay in Seconds per Vehicle)			
Map ID	**Intersection**	**AM**	**PM**
		Mitigated	**Mitigated**
1	NB US 290/Mangum Rd	D (45)	D (52)
2	SB US 290/Mangum Rd	D (45)	D (51)
3	Mangum Rd/Dacoma St	D (53)	**F (80)**
4	SB US 290/Dacoma St	**F (154)**	**F (139)**
5	NB US 290/Dacoma St	**F (98)**	**F (134)**
6	WB IH-610/TC Jester Blvd	**F (196)**	**F (167)**
7	EB IH-610/TC Jester Blvd	**F (97)**	**F (177)**
8	EB IH-610/E TC Jester Blvd	**F (112)**	**E (69)**
9	WB IH-610/E TC Jester Blvd	**F (367)**	**F (132)**
10	Long Point Rd/Hempstead Rd	**E (78)**	**F (88)**
11	18th St/Hempstead Rd (unsignalized)	**F (54)**	**F (175)**
12	Mangum Rd/18th St	D (41)	D (52)
13	SB IH-610/18th St	**F (86)**	**F (106)**
14	NB IH-610/18th St	**F (108)**	**F (130)**
15	Mangum Rd/Hempstead Rd	C (31)	D (48)
16	Post Oak Rd/Hempstead Rd	**F (119)**	**F (148)**

Table 11: Northwest Transit Center Terminal Option with Mitigation LOS (Delay in Seconds per Vehicle)			
Map ID	**Intersection**	**AM**	**PM**
		Mitigated	**Mitigated**
17	SB IH-610/Hempstead Rd	**E (55)**	**F (114)**
18	NB IH-610/Hempstead Rd	C (27)	**F (74)**
19	Post Oak Rd/Westview Dr	**F (109)**	**E (63)**
20	Post Oak Rd/Old Katy Rd	**F (261)**	**F (388)**
21	Post Oak Rd/EB IH-10	**F (85)**	**D (47)**
22	SB IH-610/Old Katy Rd	D (48)	**F (107)**
23	NB IH-610/Old Katy Rd	**D (52)**	**F (139)**
24	WB IH-10/Silber Rd	**E (71)**	**E (65)**
25	EB IH-10/Silber Rd	**F (83)**	**F (197)**
26	WB IH-10/Antoine Dr	**E (74)**	**F (106)**

For the Northwest Mall Terminal Option, the recommended mitigation for the substantial impacts include:

1 – Mangum Road/US 290 NBFR
- Add one left-turn bay to northbound approach to provide dual left-turn bays
- Add one through lane to southbound approach

2 – Mangum Road/US 290 SBFR
- Add one through lane to northbound approach

3 – Mangum Road/Dacoma Street
- Add one right-turn bay to northbound approach
- Convert the left turns at all approaches to protected then permissive

4 – Dacoma Street/US 290 SBFR
- Add a one right-turn bay to the north eastbound and south eastbound approaches

8 – E T C Jester Boulevard/LP 610 EBFR
- Convert the center lane of the south eastbound approach from a through lane to a shared through and left-turn lane

10 – Hempstead Road/Long Point Road
- Prohibit left turns at south eastbound approach

11 – W 18th Street/Hempstead Road
- Prohibit left turns at westbound approach

12 – Mangum Road/18th Street
- Add one right-turn bay to westbound approach
- Convert the left turns at all approaches to protected then permissive

13 – W 18th Street/Loop 610 SBFR
- Add two right-turn bays and one through lane on the eastbound approach

14 – W 18th Street/Loop 610 NBFR
- Add one right-turn bay and one through lane to westbound approach
- Add one right-turn bay to northbound approach

16 – Post Oak Road/Hempstead Road

- Add one right-turn bay to south eastbound approach
- Convert southwestbound approach center left-through lane to through lane
- Add one lane to north eastbound approach and convert to dual lefts, one through/right, and one right-turn lane

19 – Post Oak Road/Westview Drive
- Add one right-turn bay to southbound approach
- Convert the left turns at all approaches to protected then permissive

20 – Post Oak Road/Old Katy Road
- Add one right-turn bay to the northbound and eastbound approaches

21 – Post Oak Road/IH-10 EBFR
- Add one through lane to northbound approach

24 – Silber Road/IH-10 WBFR
- Convert the northbound approach center through/left-turn lane to a through-only lane
- Convert southbound approach to two through lanes and one right-turn lane

26 – Antoine Drive/IH-10 WBFR
- Convert the westbound approach shared through/left-turn lane to a through-only lane

The resulting LOS and delay are provided in **Table 12**.

Table 12: Northwest Mall Terminal with Mitigation LOS (Delay in Seconds per Vehicle)

Map ID	Intersection	AM	PM
		Mitigated	Mitigated
1	NB US 290/Mangum Rd	D (43)	**D (41)**
2	SB US 290/Mangum Rd	D (47)	E (78)
3	Mangum Rd/Dacoma St	D (44)	**E (59)**
4	SB US 290/Dacoma St	**F (161)**	**F (96)**
5	NB US 290/Dacoma St	**F (107)**	**D (51)**
6	WB IH-610/TC Jester Blvd	**F (220)**	**F (181)**
7	EB IH-610/TC Jester Blvd	**F (109)**	**F (239)**
8	EB IH-610/E TC Jester Blvd	**F (144)**	**E (73)**
9	WB IH-610/E TC Jester Blvd	**F (393)**	**F (141)**
10	Long Point Rd/Hempstead Rd	**E (78)**	**F (88)**
11	18th St/Hempstead Rd (unsignalized)	**F (54)**	**F (175)**
12	Mangum Rd/18th St	D (42)	**D (52)**
13	SB IH-610/18th St	F (81)	**F (124)**
14	NB IH-610/18th St	**E (70)**	**F (81)**
15	Mangum Rd/Hempstead Rd	C (27)	D (36)
16	Post Oak Rd/Hempstead Rd	**F (118)**	**F (163)**
17	SB IH-610/Hempstead Rd	**E (80)**	**F (134)**
18	NB IH-610/Hempstead Rd	D (36)	**F (87)**
19	Post Oak Rd/Westview Dr	**E (65)**	**E (68)**
20	Post Oak Rd/Old Katy Rd	**F (186)**	**F (280)**

Table 12: Northwest Mall Terminal with Mitigation LOS (Delay in Seconds per Vehicle)			
Map ID	**Intersection**	**AM**	**PM**
		Mitigated	**Mitigated**
21	Post Oak Rd/EB IH-10	**E (69)**	**D (38)**
22	SB IH-610/Old Katy Rd	D (48)	**F (133)**
23	NB IH-610/Old Katy Rd	**D (51)**	**F (154)**
24	WB IH-10/Silber Rd	F (81)	**E (72)**
25	EB IH-10/Silber Rd	**F (94)**	**F (259)**
26	WB IH-10/Antoine Dr	**F (114)**	**F (87)**

For the Industrial Site Terminal Option, the recommended mitigation for the substantial impacts include:

1 – Mangum Road/US 290 NBFR
- Add one left-turn bay to northbound approach
- Add one through lane to southbound approach

3 – Mangum Road/Dacoma Street
- Add one right-turn bay to northbound approach
- Convert the left turns of all approaches to protected then permissive

4 – Dacoma Street/US 290 SBFR
- Add one right-turn bay to the south eastbound approach and north eastbound approaches

10 – Hempstead Road/Long Point Road
- Prohibit left turns for south eastbound approach

11 – W 18th Street/Hempstead Road
- Prohibit left turns at westbound approach

12 – Mangum Road/18th Street
- Add one right-turn aby to westbound and northbound approaches
- Convert the left turns of all approaches to protected then permissive

13 – W 18th Street/Loop 610 SBFR
- Add one right-turn bay and one through lane to eastbound approach

14 – W 18th Street/Loop 610 NBFR
- Add one through lane to westbound approach

15 – Hempstead Road/Mangum Road
- Add one right-turn bay to northwestbound approach on Hempstead Road

16 – Post Oak Road/Hempstead Road
- Add one right-turn bay to south eastbound approach
- Add one left-turn bay to north westbound approach
- Convert southwest bound approach center left/through lane to through lane
- Add one lane to northeast bound approach and convert to dual lefts, one through/right and one right-turn lane

17 – Hempstead Road/IH-610 SBFR
- Add one through lane to northwest bound approach to provide three through lanes

18 – Hempstead Road/IH-610 NBFR

- Convert northwest bound approach right-turn lane to a shared through/right-turn lane

19 – Post Oak Road/Westview Drive

- Add one right-turn bay to southbound approach
- Add one right-turn bay to eastbound approach to provide two right-turn bays

20 – Post Oak Road/Old Katy Road

- Add one right-turn bay and one left-turn bay to northbound approach
- Add one right-turn bay to the southbound, eastbound, and westbound approaches

21 – Post Oak Road/IH-10 EBFR

- Add one through lane to northbound approach

23 – Old Katy Road/Loop 610 NBFR

- Convert northbound approach center lane from through lane to shared through/left-turn lane

24 – Silber Road/IH-10 WBFR

- Convert northbound approach center lane from a shared through/left-turn lane to a through-only lane
- Convert southbound approach to two through lanes and one right-turn lane

25 – Silber Road/IH-10 EBFR

- Convert eastbound approach shared through/left to through-only lane

26 – Antoine Drive/IH-10 WBFR

- Convert westbound approach shared through/left lane to through-only lane
- Add one right-turn bay to southbound approach

Table 13 shows the mitigated LOS and delay at each intersection under the Houston Industrial Site Terminal Option.

Table 13: Industrial Site Terminal With Mitigation LOS (Delay in Seconds per Vehicle)

Map ID	Intersection	AM	PM
		Mitigated	Mitigated
1	NB US 290/Mangum Rd	**E (57)**	D (40)
2	SB US 290/Mangum Rd	**E (61)**	**E (79)**
3	Mangum Rd/Dacoma St	**E (56)**	**E (60)**
4	SB US 290/Dacoma St	**F (107)**	**F (147)**
5	NB US 290/Dacoma St	**E (76)**	**F (162)**
6	WB IH-610/TC Jester Blvd	**F (220)**	**F (182)**
7	EB IH-610/TC Jester Blvd	**F (109)**	**F (239)**
8	EB IH-610/E TC Jester Blvd	**F (144)**	**E (67)**
9	WB IH-610/E TC Jester Blvd	**F (393)**	**F (144)**
10	Long Point Rd/Hempstead Rd	**E (79)**	**F (87)**
11	18th St/Hempstead Rd (unsignalized)	**F (84)**	**F (251)**
12	Mangum Rd/18th St	**E (62)**	**E (64)**
13	SB IH-610/18th St	D (46)	**F (109)**
14	NB IH-610/18th St	D (50)	**E (65)**
15	Mangum Rd/Hempstead Rd	C (28)	D (37)

Table 13: Industrial Site Terminal With Mitigation LOS (Delay in Seconds per Vehicle)			
Map ID	Intersection	AM	PM
		Mitigated	Mitigated
16	Post Oak Rd/Hempstead Rd	**F (118)**	**F (118)**
17	SB IH-610/Hempstead Rd	**F (115)**	**E (79)**
18	NB IH-610/Hempstead Rd	**E (73)**	**E (70)**
19	Post Oak Rd/Westview Dr	**F (118)**	**F (113)**
20	Post Oak Rd/Old Katy Rd	**F (145)**	**F (213)**
21	Post Oak Rd/EB IH-10	**E (76)**	D (42)
22	SB IH-610/Old Katy Rd	D (46)	**F (126)**
23	NB IH-610/Old Katy Rd	D (52)	**F (149)**
24	WB IH-10/Silber Rd	**E (73)**	**E (73)**
25	EB IH-10/Silber Rd	**F (86)**	**F (241)**
26	WB IH-10/Antoine Dr	**E (74)**	**F (106)**

AECOM

TECHNICAL MEMORANDUM
LAND USE

To: Jerry Smiley, AICP, AECOM

From: Jason Aprill, AICP, AECOM
Kristen Lueken, AECOM

Date: November 1, 2017

RE: **DALLAS TO HOUSTON HSR EIS – LAND USE**

This technical memorandum summarizes the structural displacements that would occur along the limits of disturbance (LOD) of the Dallas to Houston High-speed Rail Project. A structural displacement would occur when an impact with the LOD, either directly or indirectly, necessitates the removal of a structure.

Structural displacements would be based on a myriad of factors, including the proximity of the structure to the LOD (within the LOD or within 50 feet), the percentage of the overall structure's parcel impacted by the LOD and the permanent disruption of access to the structure caused by the LOD. A structure directly within the LOD or within 50 feet is referred to as a displaced structure while a structure on an acquired parcel is referred to as an acquired structure (or acquisition).

The following scenarios were developed to be used during the extensive analysis of all parcels and structures along the extension of the Project. If a structure was located on a parcel or portion of a parcel that was deemed a take by the following scenarios, the structure would be considered a displaced structure.

- Any structure located within the LOD or within 50 feet of the LOD was classified as a potential displacement of that structure
- Any parcel in which the primary structure was displaced was classified as a potential acquisition of the entire parcel, regardless of size
- If the LOD impacted more than 30 percent of a parcel, regardless of size, it was classified as a potential acquisition of the entire parcel and a potential displacement of all structures on the parcel
- If access to a parcel or a remnant would be blocked or impassable because the Project would not be on viaduct in that location, the portion of the parcel without access would be classified as a potential acquisition and all structures located on the remnant or impassable portion were classified as potential displacements
- If the cumulative impact from the LOD and remnant parcel would be greater than 30 percent, it was classified as a potential acquisition of the entire parcel and displacement of all structures on the parcel
- If the LOD impacted less than 30 percent of a parcel and no primary structures, potential acquisition was limited to the impacted area

The structural displacements and acquisitions, both commercial and residential, were documented using GIS analysis of ARUP parcel survey data, land use classification, county appraisal information and aerial and planar photography. Displacements were initially categorized as residential, commercial, community facilities, civic, oil/gas, agricultural, transportation, or utility. This technical memorandum presents the value and acreage of residential displacements and the business use and estimated employment for commercial displacements. All other categories of displacement are discussed collectively as miscellaneous displacements. A scan of comparable residential properties and businesses was conducted to gauge the effect of the displacements within the community. The findings and summaries are presented in the following memorandum.

Residential Displacements and Acquisitions

Residential structures include both single-family and multi-family buildings. Multi-family buildings within the LOD contain multiple dwelling units within a single building and each unit would be a single displacement. This analysis uses real estate information available from Zillow.com to ascertain the availability of comparable housing stock. **Table 1** provides a thorough analysis of the residential displacements and acquisitions in each county (broken out by segments) and a summary of the comparable residential properties in the surrounding areas.

Table 1: Primary Residential Displacements and Acquisitions									
Segment	Displaced Units	Improvement Value			County	Type	Comparable Residential Property in County (Price)		
		Low	High	Avg.			#	Low	High
1	56	$0[1]	$199,050	$30,040	Dallas	Urban	12*	$71,000	$165,000
1	7	$0[2]	$59,760	$19,587	Ellis	Suburban	6*	$192,000	$315,000
2A & 2B	47	$1,336	$307,365	$103,093	Ellis	Suburban	10*	$119,000	$585,000
3A and 3C	1	$107,460	$107,460	$107,460	Ellis	Suburban	0*	$0	$0
3A, 3B, & 3C	61	$2	$240,090	$66,573	Navarro	Suburban	20*	$45,000	$918,750
3C	9	$0[4]	$292,893	$84,666	Freestone	Rural	5*	$220,500	349000
4	9	$0[4]	$147,973	$48,293	Freestone	Rural	4*	$289,000	$699,950
4	8	$0[5]	$94,320	$30,915	Limestone	Rural	10*	$40,000	$529,000
3C	5	$22,890	$205,790	$70,882	Madison	Rural	6*	$179,500	$1,128,500
3C	13	$3,270	$ 265,299.43	$ 77,653.86	*Leon*	*Rural*	*31**	*$26,000*	*$599,500*
4	11	$3,270	$ 265,299.43	$ 77,653.86	*Leon*	*Rural*	*31**	*$26,000*	*$599,500*
4	19	$0[6]	$473,410	$139,860	Madison	Rural	4*	$179,500	$390,000
5	41	$0[7]	$342,090	$93,155	Grimes	Rural	24*	$167,500	$1,485,000
5	38	*$18,355*	*$200,357*	*$76,191*	*Waller*	*Suburban*	5*	$275,000	$861,190
5	95	$0[8]	$638,592	$136,021	Harris	Urban	340*	$116,900	$2,000,000
5	10 (1 apartment building)[9]	$25,983,362	$25,983,362	$25,983,362	Harris	Urban	340*	$116,900	$2,000,000
5: Northwest Transit Center	124 (1 apartment building)[10]	$14,127,971	$14,127,971	$14,127,971	Harris	Urban	163*	$82,500	$1,500,000

NOTES: Text in RED indicates counties where complete county appraisal data was unavailable; therefore, the average of the county is based on its type (i.e. urban, suburban, rural)

Source: Zillow.com; Dallas CAD 2016, Ellis CAD 2015, Navarro CAD 2015, Freestone CAD 2015, Limestone CAD 2015, Leon CAD 2015, Madison CAD 2016, Grimes CAD 2016, Waller CAD 2015, Harris CAD 2016

**Zillow Accessed on 10/26/2017*

[1] Improvement value for residential structure was $0, according to the Dallas Central Appraisal District

[2] Improvement value for residential structure was $0, according to the Ellis Central Appraisal District

[3] Improvement value for residential structure was $0, according to the Navarro Central Appraisal District

[4] Improvement value for residential structure was $0, according to the Freestone Central Appraisal District

[5] Improvement value for residential structure was $0, according to the Limestone Central Appraisal District

[6] Improvement value for residential structure was $0, according to the Madison Central Appraisal District

[7] Improvement value for residential structure was $0, according to the Grimes Central Appraisal District

[8] Improvement value for residential structure was $0, according to the Harris Central Appraisal District

[9] This apartment is called North Haven Apartments. The total units in this complex are 310 and one of the 31 buildings would be removed, with an estimated remaining number of units of 300. The building removed has 10 units.

[10] This apartment is called 1300 North Post Oak. The total units in the complex are 247 and one of 2 buildings would be removed, with an estimated remaining number of units of 124.

Averages of Rural Counties

The appraisal district data for Leon County was not accurate or complete. Leon County has been defined as a rural county. It was determined in the analysis for the *Land Use Technical Memorandum* that the averages of rural counties would be used and transferred for Leon County data. The averages of Navarro, Freestone, Limestone, Madison and Grimes counties were used to fill in data for Leon County. **Table 2**, below, illustrates the averages of Navarro, Freestone, Limestone, Madison, and Grimes Counties.

Table 2: Averages of Rural Counties					
Segment	Displaced Units	Improvement Value			County
		Low	High	Avg.	
3A, 3B & 3C	61	$2	$240,090	$66,573	Navarro
3C	9	$4	$292,893	$84,666	Freestone
4	9	$4	$147,973	$48,293	Freestone
4	9	$5	$94,320	$30,915	Limestone
3C	5	$22,890	$205,790	$70,882	Madison
4	19	$6	$473,410	$139,860	Madison
5	41	$7	$342,090	$93,155	Grimes
3C	13	*$3,274*	*$256,652*	*$76,335*	*Leon*
4	11	*$3,274*	*$256,652*	*$76,335*	*Leon*

NOTES: Text in RED indicates counties where complete county appraisal data was unavailable; therefore, the average of the county is based on its type (i.e. urban, suburban, rural)

[1] Improvement value for the oil/gas structures was $0, according to the Navarro Central Appraisal District[2] Improvement value for the oil/gas structures was $0, according to the Freestone Central Appraisal District

[3] Improvement value for the oil/gas structures was $0, according to the Limestone Central Appraisal District

[4] Improvement value for the oil/gas structures was $0, according to the Madison Central Appraisal District

[5] Improvement value for the oil/gas structures was $0, according to the Grimes Central Appraisal District

Averages for Suburban Counties

Similar to Leon County, the appraisal district data for Waller County was not accurate or complete. Waller County is located just north of Harris County and is deemed a suburban county for this study. The data from Ellis County (the other suburban county) was used to fill in data gaps for Waller County. **Table 3** illustrates the averages of Ellis County segments.

Table 3: Averages of Suburban Counties					
Segment	Displaced Units	Improvement Value			County
		Low	High	Avg.	
1	7	$2	$59,760	$19,587	Ellis
2A & 2B	47	$1,336	$307,365	$103,093	Ellis
3A & 3C	1	$107,460	$107,460	$107,460	Ellis
5	38	*$36,266*	*$158,195*	*$91,503*	*Waller*

NOTES: Text in RED indicates counties where complete county appraisal data was unavailable; therefore, the average of the county is based on its type (i.e. urban, suburban, rural)

Miscellaneous Primary Structure Displacements and Acquisitions

The structural displacements that could potentially result from the Build Alternatives include some structures that are neither residential nor commercial. A summary of potential impacts to primary structures including oil/gas, community facilities, civic and cultural resource is presented in **Table 4**.

Table 4: Miscellaneous Displacements and Acquisitons of Primary Structures						
Segment	Type	#	Improvement Value			County
			Low	High	Avg.	
1	Civic [1]	1	$4,614,210	$4,614,210	$4,614,210	Dallas
2B	Oil/Gas	1	7,000	7,000	-	Ellis
3C	Oil/Gas[2]	9	$0	$ 120,863	$ 12,086	Freestone
3C	Community Facilities[3]	1	$905,298	$905,298	$905,298	Freestone
4	Community Facilities[4]	1	$0	$0	$0	Madison
4	Oil/Gas[5]	8	$0	$155,810	$67,953	Madison
4	Cultural Resource[6]	1	$0	$0	$0	Madison
4	Utilities	1	$96,490	$96,490	$96,490	Madison
4	Oil/Gas[7]	9	$0	$167,040	$42,205	Limestone
5	Oil/Gas	2	$2,330	$342,090	$69,054	Grimes
5	Civic[8]	2	$0	$0	$0	Harris
5	Oil/Gas[9]	1	$0	$0	$0	Harris
5	Community Facilities[10]	1	$0	$0	$0	Harris

Source: Dallas CAD 2016, Ellis CAD 2015, Navarro CAD 2015, Freestone CAD 2015, Limestone CAD 2015, Leon CAD 2015, Madison CAD 2016, Grimes CAD 2016, Waller CAD 2015, Harris CAD 2016

[1] Property is a vacant warehouse building owned by the City of Dallas

[2] Improvement value for the oil/gas structures was $0, according to the Freestone Central Appraisal District

[3] Community Facility is Mount Zion Missionary Baptist Church.

[4] Community Facility is Union Church. It has no improvement value according to the Madison Central Appraisal District

[5] Improvement value for an oil/gas structure was $0, according to the Madison Central Appraisal District

[6] Cultural Resource is a structure located on a cemetery. It has no improvement value according to the Madison Central Appraisal District. While the property containing the cemetery would likely be purchased, the cemetery burials would not likely have to be relocated as a result of this project.

[7] Improvement value for the oil/gas structures was $0, according to the Limestone Central Appraisal District

[8] Improvement value includes a concrete batch plant for TxDOT. Improvement value is $0, according to the Harris Central Appraisal District

[9] Improvement value for the oil/gas structures was $0, according to the Harris Central Appraisal District

[10] This is part of the Connection School of Houston. The improvement value is $0, according to the Harris Central Appraisal District

Primary Commercial Structure Displacements and Acquisitions

Displaced commercial structures were identified through survey data, where available, and supplemented with listed businesses available through a standard Google search. In cases of limited data availability (where noted in **Tables 5-9** below), the business type was ascertained through examination of aerial, planar and street-level photography. All businesses were classified according to their nearest North American Industry Classification System (NAICS) code in order to determine the average number of employees per firm and the number of similar businesses operating within the county. Employment per firm and similar business were determined using the US Census Bureau (USCB)'s County Business Pattern (CBP) tables for 2014, by detailed industry. All averages are taken at the county level, unless otherwise noted in the tables. No commercial displacements were found for Ellis, Navarro, Madison, Limestone or Waller counties.

Table 5: Dallas County Commercial Displacements and Acquisitons (Primary)					
Segment	**Business Type**	**Nearest NAICS**	**NAICS Industry**	**Estimated Employees**	**Similar Businesses within Dallas County**
1	Rodeo Arena	711212	Racetracks	107	3
1	Shipping Warehouse[1]	484121	General freight trucking, long-distance, truckload	33	252
1	Recycling Center	562920	Materials recovery facilities	16	17
1	PVC, Resin, Chlorine Manufacturer	325211	Plastics material and resin manufacturing	20	6
1	Vocational Training Center	611519	Other technical and trade schools	14	43
1	Steel Plate Manufacturer[2]	332313	Plate work manufacturing	0	8
1	Structural Engineer	541330	Engineering services	21	536
1	Steel Construction Specialist	238120	Structural steel and precast concrete contractors	37	34
1	Used Tire Services	441320	Tire dealers	8	159
1	Data Center[2]	517911	Telecommunications resellers	0	25
1	Gas Station	447110	Gasoline stations with convenience stores	7	731
1	Portable Toilet Supplier	562991	Septic tank and related services	21	6
1	Concrete Plant[1]	327320	Ready-mix concrete manufacturing	17	20
1	Millwork/Retail Display Manufacturer	337215	Showcase, partition, shelving and locker manufacturing	26	10
1	Concrete Recycling/Infrastructure Materials Supplier	327390	Other concrete product manufacturing	30	13
1	Concrete Plant	327320	Ready-mix concrete manufacturing	17	20
1	Liquor Store	445310	Beer, wine and liquor stores	4	202
1	Building Material Supplier	327390	Other concrete product manufacturing	30	13
1	Used Auto Sales[1]	441120	Used car dealers	9	275
1	Liquor store	445310	Beer, wine and liquor stores	4	202

Source: North American Industry Classification System (NAICS), 2016; AECOM, 2016.
[1]Unlisted business, based on visual imagery
[2]Structure represents an offsite storage or utility location to a larger business located elsewhere, assuming no dedicated employment at this location.

Table 6: Freestone County Commercial Displacements and Acquisitions (Primary)					
Segment	**Business Type**	**Nearest NAICS**	**NAICS Industry**	**Estimated Employees**	**Similar Businesses within Freestone County**
3C	Chicken Farm[1]	424440	Poultry and poultry product merchant wholesalers	10	1
3C	Nursery[1]	444220	Nursery, garden center and farm supply stores	7	4
3C	Gas station	447110	Gasoline stations with convenience stores	4	13
3C	Private medical Air Transportation	621910	Ambulance services	17	3
3C	Distribution shed[1,2]	N/A	N/A	7	N/A
3C	Gas Station/Truck Stop	447190	Other gasoline stations	14	3
3C	Trailer Sales	441310	Automotive parts and accessories stores	10	1
3C	Distribution shed[1,2]	N/A	N/A	8	N/A
3C	RV Park Office	721211	RV (recreational vehicle) parks and campgrounds	10	1

Source: North American Industry Classification System (NAICS), 2016; AECOM, 2016.
[1] Unlisted business, based on visual imagery
[2] Insufficient detail to classify, employment estimate is based on vehicle activity at site

Table 7: Leon County Commercial Displacements and Acquisitions (Primary)					
Segment	**Business Type**	**Nearest NAICS**	**NAICS Industry**	**Estimated Employees**	**Similar Businesses within Leon County**
3C	Freight Trucking[1]	484121	General freight trucking, long-distance, truckload	3	4
3C	Gas Station	447110	Gasoline stations with convenience stores	11	15
3C	Vacant Gas Station[2]	447110	Gasoline stations with convenience stores	0	15
3C	Sand/Gravel Quarry[1,3]	212321	Construction sand and gravel mining	12	N/A
3C	Animal Production/Farm[1]	115210	Support activities for animal production	25	2
3C	Fast Food Restaurant	722513	Limited-service restaurants	17	10
3C	Concrete Plant[3]	327320	Ready-mix concrete manufacturing	14	N/A
3C	Sand/Gravel Pit[1,3]	212321	Construction sand and gravel mining	12	N/A

Source: North American Industry Classification System (NAICS), 2016; AECOM, 2016.
[1] Unlisted business, based on visual imagery
[2] Vacant Structure therefore no employment
[3] Employment estimates based on state-level NAICS data

Table 8: Grimes County Commercial Displacements and Acquisitions (Primary)					
Segment	**Business Type**	**Nearest NAICS**	**NAICS Industry**	**Estimated Employees**	**Similar Businesses within Grimes County**
5	Rail Yard[1]	488210	Support activities for rail transportation	0	2

Source: North American Industry Classification System (NAICS), 2016; AECOM, 2016.
[1] Structure represents an offsite storage or utility location to a larger business located elsewhere, assuming no dedicated employment at this location.

Table 9: Harris County Commercial Displacements and Acquisitions (Primary)					
Segment	**Business Type**	**Nearest NAICS**	**NAICS Industry**	**Estimated Employees**	**Similar Businesses within Harris County**
5	Used Auto Sales	441120	Used car dealers	9	275
5	Warehousing and distribution	484121	General freight trucking, long-distance, truckload	14	367
5	Machine Manufacturer	333249	Other industrial machinery manufacturing	17	14
5	Motel	721110	Hotels (except casino hotels) and motels	25	667
5	Auto Repair Shop	811111	General automotive repair	5	968
5	Adult Club	711120	Dance companies	46	7
5	Record Retention/Document Storage	493190	Other warehousing and storage	29	75
5	Filtration Equipment Manufacturer	333413	Industrial and commercial fan and blower and air purification equipment manufacturing	30	9
5	Lab	541380	Testing laboratories	42	209
5	Drilling Contractor	213111	Drilling oil and gas wells	124	100
5	Pipe, Sprinkler and Plumbing Supplier	423720	Plumbing and heating equipment and supplies (hydronic) merchant wholesalers	19	87
5	Cabinet Maker	337110	Wood kitchen cabinet and countertop manufacturing	4	20
5	Storage Facility	531130	Lessors of mini warehouses and self-storage units	2	350
5	Rice Milling	311212	Rice milling	25	2

Table 9: Harris County Commercial Displacements and Acquisitions (Primary)					
Segment	**Business Type**	**Nearest NAICS**	**NAICS Industry**	**Estimated Employees**	**Similar Businesses within Harris County**
5	Pipeline	486910	Pipeline transportation of refined petroleum products	26	17
5	Freight Trucking	484121	General freight trucking, long-distance, truckload	14	367
5	Roofing and Siding Contractor	238160	Roofing contractors	9	167
5	Granite Supplier	327991	Cut stone and stone product manufacturing	14	17
5	Oil well Machinery and Parts Manufacturer, Vendor and Rental	333132	Oil and gas field machinery and equipment manufacturing	143	149
5	Fast Food Restaurant	722513	Limited-service restaurants	17	10
5	Recycling Center	562920	Materials recovery facilities	16	20
5	Gas Station	447110	Gasoline stations with convenience stores	5	1,537
NWTC	Flat rolled steel manufacturing and distribution	331221	Rolled steel shape manufacturing	10	1
NWTC	Wire fabric/fence Manufacturer	332618	Other fabricated wire product manufacturing	57	15
NWTC	Wire fabric/fence Manufacturer	332618	Other fabricated wire product manufacturing	57	15
NWTC	Fitness Gym	713940	Fitness and recreational sports centers	24	342
NWTC	Oil/Gas/Mining Tool Manufacturer	333517	Machine tool manufacturing	10	15
NWTC	Office Supply Store	453210	Office supplies and stationery stores	7	91
NWTC	Office Equipment Wholesaler	423420	Office equipment merchant wholesalers	14	138
NWTC	Hydraulic Equipment Supplier	333911	Pump and pumping equipment manufacturing	63	35
NWTC	Capital Investment Services	523930	Investment advice	7	304
NWTC	Communications Provider (non-retail)	517911	Telecommunications resellers	7	31
NWTC	Picture Frame Shop	423220	Home furnishing merchant wholesalers	15	117
NWTC	Senior Computing Services	561439	Other business service centers (including copy	12	93

Table 9: Harris County Commercial Displacements and Acquisitions (Primary)					
Segment	**Business Type**	**Nearest NAICS**	**NAICS Industry**	**Estimated Employees**	**Similar Businesses within Harris County**
			shops)		
NWTC	Urgent Care Facility	621493	Freestanding ambulatory surgical and emergency centers	18	108
NWTC	Warehouse and local freight	484110	General freight trucking, local	7	321
NWTC	Warehouse and local freight	484110	General freight trucking, local	7	321
NWM	Parking Garage	812930	Parking lots and garages	16	225
NWM	Granite and Marble Supplier	327991	Cut stone and stone product manufacturing	14	17
IND	Plumbing Contractor	238220	Plumbing, heating and air-conditioning contractors	17	964

Source: North American Industry Classification System (NAICS), 2016; AECOM, 2016.

TECHNICAL MEMORANDUM
SOCIOECONOMIC AND COMMUNITY FACILITIES

To: Jerry Smiley, AICP, AECOM

From: Peggy Roberts, AECOM

Date: November 1, 2017

RE: DALLAS TO HOUSTON HSR EIS – SOCIOECONOMIC AND COMMUNITY FACILITIES

The enclosed documentation supports the Socioeconomic impact analyses for the Dallas to Houston HSR EIS. The following data tables are enclosed:

- Selected Demographic Characteristics for Block Groups along Each Segment Table

Data shown in this table includes the demographic characteristics for each block group by county along the Build Alternatives. Information includes the block group number, census tract, county, 2010 population, percent minority population, percent Hispanic origin, percent individuals below poverty level and median household income. Project segments have been identified for each block group/census tract listed.

The following files contain census data by population, race, ethnicity, low income, median income and children under 18 for the entire study area as well as a summary table.

- Census Data – 5 year – Total Population within the Study Area by Block Group, County
- Census Data – 5 Year – Race within the Study Area by Block Group and Census Track, County
- Census Data – 5 Year – Ethnicity within the Study Area by Block Group and Census Track, County
- Census Data – 5 Year – Low Income within the Study Area by Block Group and Census Track, County
- Census Data – Summary – Percent Minority, Percent Hispanic, Percent Poverty, Median Income by Block Group and Census Track, County
- Census Data – 2014 Total and Percent of Children under 18 Years Old – by Block, Census Tract, and County

In addition, economic data files from various sources are provided. These data support the economic impact analyses.

- Economics – Project Cost[1] by Alternative, Source: ARUP
- Economics – HSR Construction Cost[2] Estimate, Source: TCRR
- Economics – TCR Summary Schedule, Source: TCRR
- Economics – 2015 Occupational Employment Statistics (OES), Source: Bureau of Labor Statistics, U.S. Department of Labor
- Economics – Staffing Assumptions

[1] Excludes Systems, Rolling Stock and ROW costs
[2] Includes Systems and Rolling Stock

- Economics – 1940 – 2009 Deflator – Source: Whitehouse.gov
- Economics – Project Costs by Geography

Socioeconomic:
Total Population within the Study Area by
Block Group and Census Tract, County:

Geography	Total Population
Block Group 2, Census Tract 20, Dallas County, Texas	652
Block Group 1, Census Tract 34, Dallas County, Texas	653
Block Group 2, Census Tract 34, Dallas County, Texas	730
Block Group 1, Census Tract 40, Dallas County, Texas	397
Block Group 2, Census Tract 40, Dallas County, Texas	587
Block Group 2, Census Tract 41, Dallas County, Texas	535
Block Group 1, Census Tract 86.03, Dallas County, Texas	912
Block Group 1, Census Tract 86.04, Dallas County, Texas	1671
Block Group 2, Census Tract 86.04, Dallas County, Texas	1334
Block Group 1, Census Tract 87.01, Dallas County, Texas	1192
Block Group 2, Census Tract 87.01, Dallas County, Texas	727
Block Group 4, Census Tract 87.01, Dallas County, Texas	501
Block Group 5, Census Tract 87.01, Dallas County, Texas	1089
Block Group 1, Census Tract 89, Dallas County, Texas	1267
Block Group 1, Census Tract 100, Dallas County, Texas	9511
Block Group 1, Census Tract 114.01, Dallas County, Texas	1783
Block Group 3, Census Tract 115, Dallas County, Texas	228
Block Group 4, Census Tract 115, Dallas County, Texas	789
Block Group 1, Census Tract 167.03, Dallas County, Texas	1091
Block Group 2, Census Tract 168.02, Dallas County, Texas	1651
Block Group 1, Census Tract 169.02, Dallas County, Texas	3294
Block Group 2, Census Tract 169.02, Dallas County, Texas	1965
Block Group 3, Census Tract 169.03, Dallas County, Texas	1542
Block Group 5, Census Tract 169.03, Dallas County, Texas	778
Block Group 1, Census Tract 202, Dallas County, Texas	433
Block Group 2, Census Tract 202, Dallas County, Texas	2175
Block Group 3, Census Tract 202, Dallas County, Texas	1417
Block Group 1, Census Tract 204, Dallas County, Texas	1336
Block Group 3, Census Tract 204, Dallas County, Texas	2226
Block Group 1, Census Tract 601.01, Ellis County, Texas	2571
Block Group 2, Census Tract 601.01, Ellis County, Texas	1381
Block Group 1, Census Tract 601.02, Ellis County, Texas	3017
Block Group 3, Census Tract 601.02, Ellis County, Texas	3140
Block Group 1, Census Tract 602.10, Ellis County, Texas	893
Block Group 1, Census Tract 611, Ellis County, Texas	1584
Block Group 1, Census Tract 612, Ellis County, Texas	756
Block Group 2, Census Tract 612, Ellis County, Texas	1203
Block Group 1, Census Tract 613, Ellis County, Texas	924
Block Group 2, Census Tract 613, Ellis County, Texas	1496
Block Group 1, Census Tract 1, Freestone County, Texas	2781
Block Group 2, Census Tract 1, Freestone County, Texas	2700
Block Group 1, Census Tract 3, Freestone County, Texas	1031
Block Group 2, Census Tract 4, Freestone County, Texas	1476
Block Group 1, Census Tract 6, Freestone County, Texas	671
Block Group 2, Census Tract 6, Freestone County, Texas	930
Block Group 3, Census Tract 6, Freestone County, Texas	2907

Geography	Total Population
Block Group 1, Census Tract 1801.02, Grimes County, Texas	1788
Block Group 2, Census Tract 1801.02, Grimes County, Texas	1669
Block Group 5, Census Tract 1802, Grimes County, Texas	1250
Block Group 1, Census Tract 1803.01, Grimes County, Texas	1425
Block Group 2, Census Tract 1803.01, Grimes County, Texas	1254
Block Group 1, Census Tract 1803.02, Grimes County, Texas	1848
Block Group 2, Census Tract 1803.02, Grimes County, Texas	1595
Block Group 1, Census Tract 4301, Harris County, Texas	813
Block Group 2, Census Tract 4301, Harris County, Texas	1658
Block Group 5, Census Tract 4301, Harris County, Texas	1104
Block Group 4, Census Tract 5108, Harris County, Texas	865
Block Group 2, Census Tract 5109, Harris County, Texas	3703
Block Group 1, Census Tract 5110.01, Harris County, Texas	1551
Block Group 2, Census Tract 5110.01, Harris County, Texas	1005
Block Group 1, Census Tract 5201, Harris County, Texas	2439
Block Group 1, Census Tract 5203, Harris County, Texas	2264
Block Group 1, Census Tract 5204, Harris County, Texas	1383
Block Group 2, Census Tract 5204, Harris County, Texas	2156
Block Group 1, Census Tract 5205, Harris County, Texas	1439
Block Group 2, Census Tract 5205, Harris County, Texas	3471
Block Group 3, Census Tract 5205, Harris County, Texas	1691
Block Group 4, Census Tract 5205, Harris County, Texas	1732
Block Group 1, Census Tract 5206.01, Harris County, Texas	2331
Block Group 1, Census Tract 5206.02, Harris County, Texas	1024
Block Group 1, Census Tract 5214, Harris County, Texas	1203
Block Group 2, Census Tract 5214, Harris County, Texas	1566
Block Group 3, Census Tract 5214, Harris County, Texas	1660
Block Group 4, Census Tract 5214, Harris County, Texas	2727
Block Group 4, Census Tract 5215, Harris County, Texas	2204
Block Group 1, Census Tract 5216, Harris County, Texas	2400
Block Group 2, Census Tract 5216, Harris County, Texas	1173
Block Group 1, Census Tract 5217, Harris County, Texas	1414
Block Group 2, Census Tract 5217, Harris County, Texas	2387
Block Group 3, Census Tract 5217, Harris County, Texas	1822
Block Group 4, Census Tract 5217, Harris County, Texas	1401
Block Group 1, Census Tract 5218, Harris County, Texas	2459
Block Group 3, Census Tract 5301, Harris County, Texas	819
Block Group 1, Census Tract 5342.03, Harris County, Texas	1772
Block Group 1, Census Tract 5401, Harris County, Texas	7658
Block Group 3, Census Tract 5401, Harris County, Texas	1653
Block Group 2, Census Tract 5408, Harris County, Texas	3294
Block Group 2, Census Tract 5409.02, Harris County, Texas	2428
Block Group 1, Census Tract 5410.01, Harris County, Texas	8473
Block Group 1, Census Tract 5410.02, Harris County, Texas	7007
Block Group 2, Census Tract 5410.02, Harris County, Texas	1493
Block Group 1, Census Tract 5410.03, Harris County, Texas	4913

Geography	Total Population
Block Group 1, Census Tract 5430.01, Harris County, Texas	5848
Block Group 1, Census Tract 5430.02, Harris County, Texas	9606
Block Group 2, Census Tract 5430.02, Harris County, Texas	3680
Block Group 1, Census Tract 5431, Harris County, Texas	2785
Block Group 6, Census Tract 5517.01, Harris County, Texas	2279
Block Group 1, Census Tract 5518, Harris County, Texas	2540
Block Group 3, Census Tract 5518, Harris County, Texas	1055
Block Group 1, Census Tract 5519, Harris County, Texas	1023
Block Group 2, Census Tract 5519, Harris County, Texas	2305
Block Group 3, Census Tract 5519, Harris County, Texas	2823
Block Group 3, Census Tract 5520.01, Harris County, Texas	2491
Block Group 1, Census Tract 5520.02, Harris County, Texas	1926
Block Group 1, Census Tract 5521.01, Harris County, Texas	3842
Block Group 1, Census Tract 5521.03, Harris County, Texas	1071
Block Group 2, Census Tract 5522, Harris County, Texas	1620
Block Group 3, Census Tract 5522, Harris County, Texas	2412
Block Group 2, Census Tract 5544.01, Harris County, Texas	9344
Block Group 2, Census Tract 5544.02, Harris County, Texas	6573
Block Group 1, Census Tract 5544.03, Harris County, Texas	9721
Block Group 2, Census Tract 5557.01, Harris County, Texas	4213
Block Group 1, Census Tract 5560, Harris County, Texas	1284
Block Group 3, Census Tract 9501, Leon County, Texas	2679
Block Group 1, Census Tract 9502, Leon County, Texas	607
Block Group 2, Census Tract 9502, Leon County, Texas	735
Block Group 3, Census Tract 9502, Leon County, Texas	617
Block Group 5, Census Tract 9502, Leon County, Texas	1083
Block Group 2, Census Tract 9503, Leon County, Texas	1320
Block Group 3, Census Tract 9503, Leon County, Texas	1138
Block Group 4, Census Tract 9503, Leon County, Texas	1886
Block Group 1, Census Tract 9707, Limestone County, Texas	673
Block Group 2, Census Tract 9707, Limestone County, Texas	977
Block Group 1, Census Tract 2, Madison County, Texas	862
Block Group 1, Census Tract 3, Madison County, Texas	1001
Block Group 1, Census Tract 9703, Navarro County, Texas	1418
Block Group 3, Census Tract 9704, Navarro County, Texas	1301
Block Group 4, Census Tract 9709, Navarro County, Texas	2567
Block Group 5, Census Tract 9709, Navarro County, Texas	1769
Block Group 1, Census Tract 9710, Navarro County, Texas	1896
Block Group 1, Census Tract 6806, Waller County, Texas	2472
Block Group 2, Census Tract 6806, Waller County, Texas	2443

Socioeconomic:
Race within the Study Area by
Block Group and Census Tract, County:

Geography	Total	White Alone	Black or African American alone	American Indian and Alaska Native alone	Asian alone	Native Hawaiian and Other Pacific Islander alone	Some other race alone	Two or more races:	Two or more races: Two races including Some other race	Two or more races: Two races excluding Some other race, and three or more races
Block Group 2, Census Tract 20, Dallas County, Texas	652	345	229	0	19	0	0	59	59	0
Block Group 1, Census Tract 34, Dallas County, Texas	653	47	571	0	0	0	35	0	0	0
Block Group 2, Census Tract 34, Dallas County, Texas	730	237	426	3	21	0	43	0	0	0
Block Group 1, Census Tract 40, Dallas County, Texas	397	109	288	0	0	0	0	0	0	0
Block Group 2, Census Tract 40, Dallas County, Texas	587	77	510	0	0	0	0	0	0	0
Block Group 2, Census Tract 41, Dallas County, Texas	535	240	251	0	13	0	19	12	0	12
Block Group 1, Census Tract 86.03, Dallas County, Texas	912	243	657	0	0	0	0	12	12	0
Block Group 1, Census Tract 86.04, Dallas County, Texas	1671	553	1081	0	0	0	0	37	0	37
Block Group 2, Census Tract 86.04, Dallas County, Texas	1334	124	1167	0	0	18	25	0	0	0
Block Group 1, Census Tract 87.01, Dallas County, Texas	1192	0	1192	0	0	0	0	0	0	0
Block Group 2, Census Tract 87.01, Dallas County, Texas	727	30	697	0	0	0	0	0	0	0
Block Group 4, Census Tract 87.01, Dallas County, Texas	501	0	501	0	0	0	0	0	0	0
Block Group 5, Census Tract 87.01, Dallas County, Texas	1089	37	991	0	0	0	40	21	11	10

Geography	Total	White Alone	Black or African American alone	American Indian and Alaska Native alone	Asian alone	Native Hawaiian and Other Pacific Islander alone	Some other race alone	Two or more races:	Two or more races: Two races including Some other race	Two or more races: Two races excluding Some other race, and three or more races
Block Group 1, Census Tract 89, Dallas County, Texas	1267	523	744	0	0	0	0	0	0	0
Block Group 1, Census Tract 100, Dallas County, Texas	9511	4958	3989	88	52	18	250	156	32	124
Block Group 1, Census Tract 114.01, Dallas County, Texas	1783	187	1570	11	0	0	0	15	0	15
Block Group 3, Census Tract 115, Dallas County, Texas	228	149	79	0	0	0	0	0	0	0
Block Group 4, Census Tract 115, Dallas County, Texas	789	478	307	0	0	0	4	0	0	0
Block Group 1, Census Tract 167.03, Dallas County, Texas	1091	893	175	0	0	0	5	18	18	0
Block Group 2, Census Tract 168.02, Dallas County, Texas	1651	588	963	0	0	0	93	7	0	7
Block Group 1, Census Tract 169.02, Dallas County, Texas	3294	1788	1377	18	0	20	78	13	0	13
Block Group 2, Census Tract 169.02, Dallas County, Texas	1965	1239	453	43	0	54	160	16	16	0
Block Group 3, Census Tract 169.03, Dallas County, Texas	1542	980	481	22	1	0	52	6	5	1
Block Group 5, Census Tract 169.03, Dallas County, Texas	778	503	239	0	0	0	36	0	0	0
Block Group 1, Census Tract 202, Dallas County, Texas	433	0	375	0	0	0	55	3	3	0
Block Group 2, Census Tract 202, Dallas County, Texas	2175	18	2145	0	0	0	0	12	0	12

Geography	Total	White Alone	Black or African American alone	American Indian and Alaska Native alone	Asian alone	Native Hawaiian and Other Pacific Islander alone	Some other race alone	Two or more races:	Two or more races: Two races including Some other race	Two or more races: Two races excluding Some other race, and three or more races
Block Group 3, Census Tract 202, Dallas County, Texas	1417	281	1091	0	0	0	0	45	0	45
Block Group 1, Census Tract 204, Dallas County, Texas	1336	717	555	0	0	11	53	0	0	0
Block Group 3, Census Tract 204, Dallas County, Texas	2226	1007	753	6	171	0	88	201	25	176
Block Group 1, Census Tract 601.01, Ellis County, Texas	2571	2180	224	0	13	0	0	154	0	154
Block Group 2, Census Tract 601.01, Ellis County, Texas	1381	865	243	148	11	0	46	68	34	34
Block Group 1, Census Tract 601.02, Ellis County, Texas	3017	2128	41	0	20	0	709	119	0	119
Block Group 3, Census Tract 601.02, Ellis County, Texas	3140	2488	114	146	0	0	240	152	9	143
Block Group 1, Census Tract 602.10, Ellis County, Texas	893	829	33	0	0	0	25	6	0	6
Block Group 1, Census Tract 611, Ellis County, Texas	1584	1423	81	0	0	0	6	74	57	17
Block Group 1, Census Tract 612, Ellis County, Texas	756	716	11	25	0	0	1	3	0	3
Block Group 2, Census Tract 612, Ellis County, Texas	1203	920	124	30	0	0	40	89	0	89
Block Group 1, Census Tract 613, Ellis County, Texas	924	872	0	25	0	0	9	18	0	18
Block Group 2, Census Tract 613, Ellis County, Texas	1496	1378	34	7	0	0	51	26	0	26

Geography	Total	White Alone	Black or African American alone	American Indian and Alaska Native alone	Asian alone	Native Hawaiian and Other Pacific Islander alone	Some other race alone	Two or more races:	Two or more races: Two races including Some other race	Two or more races: Two races excluding Some other race, and three or more races
Block Group 1, Census Tract 1, Freestone County, Texas	2781	2259	340	65	19	0	73	25	0	25
Block Group 2, Census Tract 1, Freestone County, Texas	2700	2450	195	0	10	0	33	12	0	12
Block Group 1, Census Tract 3, Freestone County, Texas	1031	608	419	0	0	0	0	4	0	4
Block Group 2, Census Tract 4, Freestone County, Texas	1476	1119	313	6	0	0	0	38	0	38
Block Group 1, Census Tract 6, Freestone County, Texas	671	671	0	0	0	0	0	0	0	0
Block Group 2, Census Tract 6, Freestone County, Texas	930	882	27	9	0	0	0	12	0	12
Block Group 3, Census Tract 6, Freestone County, Texas	2907	2262	470	54	0	0	109	12	6	6
Block Group 1, Census Tract 1801.02, Grimes County, Texas	1788	1466	78	0	0	0	162	82	0	82
Block Group 2, Census Tract 1801.02, Grimes County, Texas	1669	1440	19	0	0	0	174	36	0	36
Block Group 5, Census Tract 1802, Grimes County, Texas	1250	887	257	0	0	0	11	95	0	95
Block Group 1, Census Tract 1803.01, Grimes County, Texas	1425	1006	86	187	0	0	96	50	0	50
Block Group 2, Census Tract 1803.01, Grimes County, Texas	1254	1181	5	5	0	0	17	46	0	46
Block Group 1, Census Tract 1803.02, Grimes County, Texas	1848	1591	126	19	0	0	15	97	0	97

Geography	Total	White Alone	Black or African American alone	American Indian and Alaska Native alone	Asian alone	Native Hawaiian and Other Pacific Islander alone	Some other race alone	Two or more races:	Two or more races: Two races including Some other race	Two or more races: Two races excluding Some other race, and three or more races
Block Group 2, Census Tract 1803.02, Grimes County, Texas	1595	1399	186	0	0	0	7	3	0	3
Block Group 1, Census Tract 4301, Harris County, Texas	813	728	0	0	49	0	14	22	10	12
Block Group 2, Census Tract 4301, Harris County, Texas	1658	1452	64	0	103	0	0	39	0	39
Block Group 5, Census Tract 4301, Harris County, Texas	1104	1001	43	0	60	0	0	0	0	0
Block Group 4, Census Tract 5108, Harris County, Texas	865	719	0	30	53	0	0	63	0	63
Block Group 2, Census Tract 5109, Harris County, Texas	3703	2988	140	0	253	0	166	156	0	156
Block Group 1, Census Tract 5110.01, Harris County, Texas	1551	1416	51	15	45	0	10	14	0	14
Block Group 2, Census Tract 5110.01, Harris County, Texas	1005	916	31	0	24	0	34	0	0	0
Block Group 1, Census Tract 5201, Harris County, Texas	2439	1932	53	0	121	0	239	94	0	94
Block Group 1, Census Tract 5203, Harris County, Texas	2264	1524	116	0	15	0	533	76	41	35
Block Group 1, Census Tract 5204, Harris County, Texas	1383	795	16	0	15	0	522	35	10	25
Block Group 2, Census Tract 5204, Harris County, Texas	2156	1535	42	0	29	0	482	68	7	61
Block Group 1, Census Tract 5205, Harris County, Texas	1439	1180	37	0	0	0	222	0	0	0

Geography	Total	White Alone	Black or African American alone	American Indian and Alaska Native alone	Asian alone	Native Hawaiian and Other Pacific Islander alone	Some other race alone	Two or more races:	Two or more races: Two races including Some other race	Two or more races: Two races excluding Some other race, and three or more races
Block Group 2, Census Tract 5205, Harris County, Texas	3471	2354	608	91	0	0	418	0	0	0
Block Group 3, Census Tract 5205, Harris County, Texas	1691	1384	0	0	0	0	307	0	0	0
Block Group 4, Census Tract 5205, Harris County, Texas	1732	1441	133	0	0	0	158	0	0	0
Block Group 1, Census Tract 5206.01, Harris County, Texas	2331	1593	0	62	84	0	592	0	0	0
Block Group 1, Census Tract 5206.02, Harris County, Texas	1024	542	0	0	0	0	482	0	0	0
Block Group 1, Census Tract 5214, Harris County, Texas	1203	315	0	69	0	0	727	92	75	17
Block Group 2, Census Tract 5214, Harris County, Texas	1566	401	33	0	0	0	1116	16	16	0
Block Group 3, Census Tract 5214, Harris County, Texas	1660	1181	0	0	14	17	361	87	73	14
Block Group 4, Census Tract 5214, Harris County, Texas	2727	990	0	89	0	0	1648	0	0	0
Block Group 4, Census Tract 5215, Harris County, Texas	2204	1437	44	0	22	0	627	74	0	74
Block Group 1, Census Tract 5216, Harris County, Texas	2400	1937	26	17	7	0	358	55	55	0
Block Group 2, Census Tract 5216, Harris County, Texas	1173	670	393	0	0	0	110	0	0	0
Block Group 1, Census Tract 5217, Harris County, Texas	1414	995	331	0	0	0	88	0	0	0

Geography	Total	White Alone	Black or African American alone	American Indian and Alaska Native alone	Asian alone	Native Hawaiian and Other Pacific Islander alone	Some other race alone	Two or more races:	Two or more races: Two races including Some other race	Two or more races: Two races excluding Some other race, and three or more races
Block Group 2, Census Tract 5217, Harris County, Texas	2387	1060	534	219	49	0	525	0	0	0
Block Group 3, Census Tract 5217, Harris County, Texas	1822	1004	385	0	102	0	308	23	23	0
Block Group 4, Census Tract 5217, Harris County, Texas	1401	591	548	0	10	0	207	45	0	45
Block Group 1, Census Tract 5218, Harris County, Texas	2459	1424	408	0	536	0	91	0	0	0
Block Group 3, Census Tract 5301, Harris County, Texas	819	716	14	0	0	0	89	0	0	0
Block Group 1, Census Tract 5342.03, Harris County, Texas	1772	802	524	13	202	0	231	0	0	0
Block Group 1, Census Tract 5401, Harris County, Texas	7658	4514	391	0	2175	0	399	179	33	146
Block Group 3, Census Tract 5401, Harris County, Texas	1653	1089	0	0	0	0	528	36	0	36
Block Group 2, Census Tract 5408, Harris County, Texas	3294	2098	467	128	307	0	219	75	75	0
Block Group 2, Census Tract 5409.02, Harris County, Texas	2428	1306	778	0	230	0	0	114	0	114
Block Group 1, Census Tract 5410.01, Harris County, Texas	8473	4561	1797	41	1479	0	421	174	73	101
Block Group 1, Census Tract 5410.02, Harris County, Texas	7007	3948	1197	17	1089	0	353	403	55	348
Block Group 2, Census Tract 5410.02, Harris County, Texas	1493	1149	80	0	100	0	45	119	0	119

Geography	Total	White Alone	Black or African American alone	American Indian and Alaska Native alone	Asian alone	Native Hawaiian and Other Pacific Islander alone	Some other race alone	Two or more races:	Two or more races: Two races including Some other race	Two or more races: Two races excluding Some other race, and three or more races
Block Group 1, Census Tract 5410.03, Harris County, Texas	4913	2369	1251	0	427	0	360	506	0	506
Block Group 1, Census Tract 5430.01, Harris County, Texas	5848	4144	661	132	800	0	20	91	0	91
Block Group 1, Census Tract 5430.02, Harris County, Texas	9606	6370	1305	0	1293	0	336	302	130	172
Block Group 2, Census Tract 5430.02, Harris County, Texas	3680	2607	413	0	252	0	283	125	0	125
Block Group 1, Census Tract 5431, Harris County, Texas	2785	2354	165	0	11	0	188	67	35	32
Block Group 6, Census Tract 5517.01, Harris County, Texas	2279	1509	14	0	508	0	119	129	27	102
Block Group 1, Census Tract 5518, Harris County, Texas	2540	2196	101	0	201	0	7	35	7	28
Block Group 3, Census Tract 5518, Harris County, Texas	1055	1008	0	10	37	0	0	0	0	0
Block Group 1, Census Tract 5519, Harris County, Texas	1023	744	126	0	12	0	0	141	23	118
Block Group 2, Census Tract 5519, Harris County, Texas	2305	965	753	0	187	0	333	67	0	67
Block Group 3, Census Tract 5519, Harris County, Texas	2823	1441	989	0	180	0	180	33	33	0
Block Group 3, Census Tract 5520.01, Harris County, Texas	2491	1302	468	52	41	0	628	0	0	0
Block Group 1, Census Tract 5520.02, Harris County, Texas	1926	1269	494	30	130	0	3	0	0	0

Geography	Total	White Alone	Black or African American alone	American Indian and Alaska Native alone	Asian alone	Native Hawaiian and Other Pacific Islander alone	Some other race alone	Two or more races:	Two or more races: Two races including Some other race	Two or more races: Two races excluding Some other race, and three or more races
Block Group 1, Census Tract 5521.01, Harris County, Texas	3842	2047	775	0	689	0	172	159	50	109
Block Group 1, Census Tract 5521.03, Harris County, Texas	1071	844	94	106	11	0	0	16	12	4
Block Group 2, Census Tract 5522, Harris County, Texas	1620	1382	33	44	32	0	129	0	0	0
Block Group 3, Census Tract 5522, Harris County, Texas	2412	857	735	0	562	0	148	110	87	23
Block Group 2, Census Tract 5544.01, Harris County, Texas	9344	8658	59	0	351	0	0	276	108	168
Block Group 2, Census Tract 5544.02, Harris County, Texas	6573	4886	609	0	872	0	115	91	0	91
Block Group 1, Census Tract 5544.03, Harris County, Texas	9721	8091	1006	0	484	0	19	121	0	121
Block Group 2, Census Tract 5557.01, Harris County, Texas	4213	3086	836	11	19	0	150	111	0	111
Block Group 1, Census Tract 5560, Harris County, Texas	1284	1051	215	0	18	0	0	0	0	0
Block Group 3, Census Tract 9501, Leon County, Texas	2679	2199	229	45	0	0	202	4	0	4
Block Group 1, Census Tract 9502, Leon County, Texas	607	601	0	0	0	0	6	0	0	0
Block Group 2, Census Tract 9502, Leon County, Texas	735	651	0	0	0	0	84	0	0	0
Block Group 3, Census Tract 9502, Leon County, Texas	617	610	0	0	0	0	0	7	0	7

Geography	Total	White Alone	Black or African American alone	American Indian and Alaska Native alone	Asian alone	Native Hawaiian and Other Pacific Islander alone	Some other race alone	Two or more races:	Two or more races: Two races including Some other race	Two or more races: Two races excluding Some other race, and three or more races
Block Group 5, Census Tract 9502, Leon County, Texas	1083	861	143	0	0	0	53	26	0	26
Block Group 2, Census Tract 9503, Leon County, Texas	1320	1239	36	0	0	0	30	15	0	15
Block Group 3, Census Tract 9503, Leon County, Texas	1138	886	252	0	0	0	0	0	0	0
Block Group 4, Census Tract 9503, Leon County, Texas	1886	1718	91	10	19	0	16	32	0	32
Block Group 1, Census Tract 9707, Limestone County, Texas	673	613	0	0	51	0	9	0	0	0
Block Group 2, Census Tract 9707, Limestone County, Texas	977	973	4	0	0	0	0	0	0	0
Block Group 1, Census Tract 2, Madison County, Texas	862	809	14	0	0	0	39	0	0	0
Block Group 1, Census Tract 3, Madison County, Texas	1001	978	0	10	1	0	3	9	0	9
Block Group 1, Census Tract 9703, Navarro County, Texas	1418	1257	78	0	63	0	20	0	0	0
Block Group 3, Census Tract 9704, Navarro County, Texas	1301	1218	49	27	0	0	3	4	1	3
Block Group 4, Census Tract 9709, Navarro County, Texas	2567	1973	416	0	0	75	99	4	0	4
Block Group 5, Census Tract 9709, Navarro County, Texas	1769	1708	47	2	0	0	12	0	0	0
Block Group 1, Census Tract 9710, Navarro County, Texas	1896	1799	21	24	9	0	31	12	0	12

Geography	Total	White Alone	Black or African American alone	American Indian and Alaska Native alone	Asian alone	Native Hawaiian and Other Pacific Islander alone	Some other race alone	Two or more races:	Two or more races: Two races including Some other race	Two or more races: Two races excluding Some other race, and three or more races
Block Group 1, Census Tract 6806, Waller County, Texas	2472	2314	58	17	83	0	0	0	0	0
Block Group 2, Census Tract 6806, Waller County, Texas	2443	2225	0	12	23	0	183	0	0	0

Socioeconomic:
Ethnicity within the Study Area by
Block Group and Census Tract, County:

Geography	Total	Not Hispanic or Latino	Not Hispanic or Latino: White alone	Not Hispanic or Latino: Black or African American alone	Not Hispanic or Latino: American Indian and Alaska Native alone	Not Hispanic or Latino: Asian alone	Not Hispanic or Latino: Native Hawaiian and Other Pacific Islander alone	Not Hispanic or Latino: Some other race alone	Not Hispanic or Latino: Two or more races:
Block Group 2, Census Tract 20, Dallas County, Texas	652	436	188	229	0	19	0	0	0
Block Group 1, Census Tract 34, Dallas County, Texas	653	594	23	571	0	0	0	0	0
Block Group 2, Census Tract 34, Dallas County, Texas	730	581	131	426	3	21	0	0	0
Block Group 1, Census Tract 40, Dallas County, Texas	397	380	92	288	0	0	0	0	0
Block Group 2, Census Tract 40, Dallas County, Texas	587	510	0	510	0	0	0	0	0
Block Group 2, Census Tract 41, Dallas County, Texas	535	274	10	251	0	13	0	0	0
Block Group 1, Census Tract 86.03, Dallas County, Texas	912	666	9	657	0	0	0	0	0
Block Group 1, Census Tract 86.04, Dallas County, Texas	1671	1145	55	1081	0	0	0	0	9
Block Group 2, Census Tract 86.04, Dallas County, Texas	1334	1205	20	1167	0	0	18	0	0
Block Group 1, Census Tract 87.01, Dallas County, Texas	1192	1155	0	1155	0	0	0	0	0
Block Group 2, Census Tract 87.01, Dallas County, Texas	727	668	0	668	0	0	0	0	0
Block Group 4, Census Tract 87.01, Dallas County, Texas	501	501	0	501	0	0	0	0	0
Block Group 5, Census Tract 87.01, Dallas County, Texas	1089	1010	9	991	0	0	0	0	10
Block Group 1, Census Tract 89, Dallas County, Texas	1267	806	62	744	0	0	0	0	0
Block Group 1, Census Tract 100, Dallas County, Texas	9511	7830	3616	3963	49	52	4	22	124
Block Group 1, Census Tract 114.01, Dallas County, Texas	1783	1650	56	1570	9	0	0	0	15
Block Group 3, Census Tract 115, Dallas County, Texas	228	79	0	79	0	0	0	0	0
Block Group 4, Census Tract 115, Dallas County, Texas	789	339	32	307	0	0	0	0	0

Geography	Total	Not Hispanic or Latino	Not Hispanic or Latino: White alone	Not Hispanic or Latino: Black or African American alone	Not Hispanic or Latino: American Indian and Alaska Native alone	Not Hispanic or Latino: Asian alone	Not Hispanic or Latino: Native Hawaiian and Other Pacific Islander alone	Not Hispanic or Latino: Some other race alone	Not Hispanic or Latino: Two or more races:
Block Group 1, Census Tract 167.03, Dallas County, Texas	1091	443	268	175	0	0	0	0	0
Block Group 2, Census Tract 168.02, Dallas County, Texas	1651	1328	338	963	0	0	0	20	7
Block Group 1, Census Tract 169.02, Dallas County, Texas	3294	2341	941	1367	6	0	20	0	7
Block Group 2, Census Tract 169.02, Dallas County, Texas	1965	846	388	404	0	0	54	0	0
Block Group 3, Census Tract 169.03, Dallas County, Texas	1542	1074	574	481	17	1	0	0	1
Block Group 5, Census Tract 169.03, Dallas County, Texas	778	513	295	207	0	0	0	11	0
Block Group 1, Census Tract 202, Dallas County, Texas	433	375	0	375	0	0	0	0	0
Block Group 2, Census Tract 202, Dallas County, Texas	2175	2175	18	2145	0	0	0	0	12
Block Group 3, Census Tract 202, Dallas County, Texas	1417	1136	0	1091	0	0	0	0	45
Block Group 1, Census Tract 204, Dallas County, Texas	1336	1067	501	555	0	0	11	0	0
Block Group 3, Census Tract 204, Dallas County, Texas	2226	1876	793	753	6	171	0	0	153
Block Group 1, Census Tract 601.01, Ellis County, Texas	2571	1797	1406	224	0	13	0	0	154
Block Group 2, Census Tract 601.01, Ellis County, Texas	1381	855	582	228	0	11	0	0	34
Block Group 1, Census Tract 601.02, Ellis County, Texas	3017	992	898	41	0	20	0	0	33
Block Group 3, Census Tract 601.02, Ellis County, Texas	3140	1924	1662	114	75	0	0	0	73
Block Group 1, Census Tract 602.10, Ellis County, Texas	893	706	673	33	0	0	0	0	0
Block Group 1, Census Tract 611, Ellis County, Texas	1584	1328	1230	81	0	0	0	0	17
Block Group 1, Census Tract 612, Ellis County, Texas	756	521	502	11	5	0	0	0	3

Geography	Total	Not Hispanic or Latino	Not Hispanic or Latino: White alone	Not Hispanic or Latino: Black or African American alone	Not Hispanic or Latino: American Indian and Alaska Native alone	Not Hispanic or Latino: Asian alone	Not Hispanic or Latino: Native Hawaiian and Other Pacific Islander alone	Not Hispanic or Latino: Some other race alone	Not Hispanic or Latino: Two or more races:
Block Group 2, Census Tract 612, Ellis County, Texas	1203	742	563	114	14	0	0	0	51
Block Group 1, Census Tract 613, Ellis County, Texas	924	710	692	0	0	0	0	0	18
Block Group 2, Census Tract 613, Ellis County, Texas	1496	907	847	34	0	0	0	0	26
Block Group 1, Census Tract 1, Freestone County, Texas	2781	2114	1665	340	65	19	0	0	25
Block Group 2, Census Tract 1, Freestone County, Texas	2700	2274	2057	195	0	10	0	0	12
Block Group 1, Census Tract 3, Freestone County, Texas	1031	822	399	419	0	0	0	0	4
Block Group 2, Census Tract 4, Freestone County, Texas	1476	1412	1055	313	6	0	0	0	38
Block Group 1, Census Tract 6, Freestone County, Texas	671	659	659	0	0	0	0	0	0
Block Group 2, Census Tract 6, Freestone County, Texas	930	895	847	27	9	0	0	0	12
Block Group 3, Census Tract 6, Freestone County, Texas	2907	2448	1966	470	6	0	0	0	6
Block Group 1, Census Tract 1801.02, Grimes County, Texas	1788	1567	1407	78	0	0	0	0	82
Block Group 2, Census Tract 1801.02, Grimes County, Texas	1669	1404	1349	19	0	0	0	0	36
Block Group 5, Census Tract 1802, Grimes County, Texas	1250	1157	805	257	0	0	0	0	95
Block Group 1, Census Tract 1803.01, Grimes County, Texas	1425	1120	984	86	0	0	0	0	50
Block Group 2, Census Tract 1803.01, Grimes County, Texas	1254	1110	1059	5	0	0	0	0	46
Block Group 1, Census Tract 1803.02, Grimes County, Texas	1848	1810	1571	126	19	0	0	0	94

Geography	Total	Not Hispanic or Latino	Not Hispanic or Latino: White alone	Not Hispanic or Latino: Black or African American alone	Not Hispanic or Latino: American Indian and Alaska Native alone	Not Hispanic or Latino: Asian alone	Not Hispanic or Latino: Native Hawaiian and Other Pacific Islander alone	Not Hispanic or Latino: Some other race alone	Not Hispanic or Latino: Two or more races:
Block Group 2, Census Tract 1803.02, Grimes County, Texas	1595	1313	1124	186	0	0	0	0	3
Block Group 1, Census Tract 4301, Harris County, Texas	813	742	681	0	0	49	0	0	12
Block Group 2, Census Tract 4301, Harris County, Texas	1658	1604	1398	64	0	103	0	0	39
Block Group 5, Census Tract 4301, Harris County, Texas	1104	1057	954	43	0	60	0	0	0
Block Group 4, Census Tract 5108, Harris County, Texas	865	865	719	0	30	53	0	0	63
Block Group 2, Census Tract 5109, Harris County, Texas	3703	2665	2141	115	0	253	0	0	156
Block Group 1, Census Tract 5110.01, Harris County, Texas	1551	1170	1056	40	15	45	0	0	14
Block Group 2, Census Tract 5110.01, Harris County, Texas	1005	722	667	31	0	24	0	0	0
Block Group 1, Census Tract 5201, Harris County, Texas	2439	1386	1118	53	0	121	0	0	94
Block Group 1, Census Tract 5203, Harris County, Texas	2264	537	419	76	0	15	0	0	27
Block Group 1, Census Tract 5204, Harris County, Texas	1383	237	196	16	0	15	0	0	10
Block Group 2, Census Tract 5204, Harris County, Texas	2156	587	455	42	0	29	0	0	61
Block Group 1, Census Tract 5205, Harris County, Texas	1439	188	151	37	0	0	0	0	0
Block Group 2, Census Tract 5205, Harris County, Texas	3471	969	361	608	0	0	0	0	0

Geography	Total	Not Hispanic or Latino	Not Hispanic or Latino: White alone	Not Hispanic or Latino: Black or African American alone	Not Hispanic or Latino: American Indian and Alaska Native alone	Not Hispanic or Latino: Asian alone	Not Hispanic or Latino: Native Hawaiian and Other Pacific Islander alone	Not Hispanic or Latino: Some other race alone	Not Hispanic or Latino: Two or more races:
Block Group 3, Census Tract 5205, Harris County, Texas	1691	297	297	0	0	0	0	0	0
Block Group 4, Census Tract 5205, Harris County, Texas	1732	654	521	133	0	0	0	0	0
Block Group 1, Census Tract 5206.01, Harris County, Texas	2331	345	247	0	14	84	0	0	0
Block Group 1, Census Tract 5206.02, Harris County, Texas	1024	0	0	0	0	0	0	0	0
Block Group 1, Census Tract 5214, Harris County, Texas	1203	24	24	0	0	0	0	0	0
Block Group 2, Census Tract 5214, Harris County, Texas	1566	43	43	0	0	0	0	0	0
Block Group 3, Census Tract 5214, Harris County, Texas	1660	290	245	0	0	14	17	0	14
Block Group 4, Census Tract 5214, Harris County, Texas	2727	69	69	0	0	0	0	0	0
Block Group 4, Census Tract 5215, Harris County, Texas	2204	1098	958	44	0	22	0	0	74
Block Group 1, Census Tract 5216, Harris County, Texas	2400	482	449	26	0	7	0	0	0
Block Group 2, Census Tract 5216, Harris County, Texas	1173	393	0	393	0	0	0	0	0
Block Group 1, Census Tract 5217, Harris County, Texas	1414	397	66	331	0	0	0	0	0
Block Group 2, Census Tract 5217, Harris County, Texas	2387	999	416	534	0	49	0	0	0
Block Group 3, Census Tract 5217, Harris County, Texas	1822	724	214	385	0	102	0	0	23
Block Group 4, Census Tract 5217, Harris County, Texas	1401	928	271	531	0	10	0	71	45
Block Group 1, Census Tract 5218, Harris County, Texas	2459	1375	454	408	0	513	0	0	0
Block Group 3, Census Tract 5301, Harris County, Texas	819	166	152	14	0	0	0	0	0
Block Group 1, Census Tract 5342.03, Harris County, Texas	1772	1085	346	524	13	202	0	0	0

Geography	Total	Not Hispanic or Latino	Not Hispanic or Latino: White alone	Not Hispanic or Latino: Black or African American alone	Not Hispanic or Latino: American Indian and Alaska Native alone	Not Hispanic or Latino: Asian alone	Not Hispanic or Latino: Native Hawaiian and Other Pacific Islander alone	Not Hispanic or Latino: Some other race alone	Not Hispanic or Latino: Two or more races:
Block Group 1, Census Tract 5401, Harris County, Texas	7658	6586	3891	369	0	2137	0	53	136
Block Group 3, Census Tract 5401, Harris County, Texas	1653	298	298	0	0	0	0	0	0
Block Group 2, Census Tract 5408, Harris County, Texas	3294	1825	1051	467	0	307	0	0	0
Block Group 2, Census Tract 5409.02, Harris County, Texas	2428	2127	1005	778	0	230	0	0	114
Block Group 1, Census Tract 5410.01, Harris County, Texas	8473	6211	2793	1797	41	1479	0	0	101
Block Group 1, Census Tract 5410.02, Harris County, Texas	7007	5764	3147	1197	0	1089	0	0	331
Block Group 2, Census Tract 5410.02, Harris County, Texas	1493	790	524	80	0	100	0	0	86
Block Group 1, Census Tract 5410.03, Harris County, Texas	4913	3570	1702	1251	0	427	0	0	190
Block Group 1, Census Tract 5430.01, Harris County, Texas	5848	4846	3293	635	41	786	0	0	91
Block Group 1, Census Tract 5430.02, Harris County, Texas	9606	7920	5143	1305	0	1293	0	17	162
Block Group 2, Census Tract 5430.02, Harris County, Texas	3680	2411	1621	413	0	252	0	0	125
Block Group 1, Census Tract 5431, Harris County, Texas	2785	1589	1381	165	0	11	0	0	32
Block Group 6, Census Tract 5517.01, Harris County, Texas	2279	1536	912	14	0	508	0	0	102
Block Group 1, Census Tract 5518, Harris County, Texas	2540	2323	1979	101	0	201	0	7	35
Block Group 3, Census Tract 5518, Harris County, Texas	1055	1034	987	0	10	37	0	0	0
Block Group 1, Census Tract 5519, Harris County, Texas	1023	648	498	126	0	0	0	0	24

Geography	Total	Not Hispanic or Latino	Not Hispanic or Latino: White alone	Not Hispanic or Latino: Black or African American alone	Not Hispanic or Latino: American Indian and Alaska Native alone	Not Hispanic or Latino: Asian alone	Not Hispanic or Latino: Native Hawaiian and Other Pacific Islander alone	Not Hispanic or Latino: Some other race alone	Not Hispanic or Latino: Two or more races:
Block Group 2, Census Tract 5519, Harris County, Texas	2305	1425	418	753	0	187	0	0	67
Block Group 3, Census Tract 5519, Harris County, Texas	2823	1759	592	954	0	180	0	0	33
Block Group 3, Census Tract 5520.01, Harris County, Texas	2491	1241	732	468	0	41	0	0	0
Block Group 1, Census Tract 5520.02, Harris County, Texas	1926	1538	884	494	30	130	0	0	0
Block Group 1, Census Tract 5521.01, Harris County, Texas	3842	2813	1340	765	0	689	0	0	19
Block Group 1, Census Tract 5521.03, Harris County, Texas	1071	872	657	94	106	11	0	0	4
Block Group 2, Census Tract 5522, Harris County, Texas	1620	1069	960	33	44	32	0	0	0
Block Group 3, Census Tract 5522, Harris County, Texas	2412	1806	486	735	0	562	0	0	23
Block Group 2, Census Tract 5544.01, Harris County, Texas	9344	8282	7596	59	0	351	0	0	276
Block Group 2, Census Tract 5544.02, Harris County, Texas	6573	5968	4400	579	0	872	0	26	91
Block Group 1, Census Tract 5544.03, Harris County, Texas	9721	7560	5989	966	0	484	0	0	121
Block Group 2, Census Tract 5557.01, Harris County, Texas	4213	3616	2673	836	0	19	0	0	88
Block Group 1, Census Tract 5560, Harris County, Texas	1284	1169	936	215	0	18	0	0	0
Block Group 3, Census Tract 9501, Leon County, Texas	2679	2145	1914	182	45	0	0	0	4
Block Group 1, Census Tract 9502, Leon County, Texas	607	421	421	0	0	0	0	0	0
Block Group 2, Census Tract 9502, Leon County, Texas	735	644	644	0	0	0	0	0	0
Block Group 3, Census Tract 9502, Leon County, Texas	617	617	610	0	0	0	0	0	7

Geography	Total	Not Hispanic or Latino	Not Hispanic or Latino: White alone	Not Hispanic or Latino: Black or African American alone	Not Hispanic or Latino: American Indian and Alaska Native alone	Not Hispanic or Latino: Asian alone	Not Hispanic or Latino: Native Hawaiian and Other Pacific Islander alone	Not Hispanic or Latino: Some other race alone	Not Hispanic or Latino: Two or more races:
Block Group 5, Census Tract 9502, Leon County, Texas	1083	1013	844	143	0	0	0	0	26
Block Group 2, Census Tract 9503, Leon County, Texas	1320	1245	1194	36	0	0	0	0	15
Block Group 3, Census Tract 9503, Leon County, Texas	1138	1138	886	252	0	0	0	0	0
Block Group 4, Census Tract 9503, Leon County, Texas	1886	1677	1518	91	10	19	0	7	32
Block Group 1, Census Tract 9707, Limestone County, Texas	673	525	474	0	0	51	0	0	0
Block Group 2, Census Tract 9707, Limestone County, Texas	977	977	973	4	0	0	0	0	0
Block Group 1, Census Tract 2, Madison County, Texas	862	766	752	14	0	0	0	0	0
Block Group 1, Census Tract 3, Madison County, Texas	1001	957	937	0	10	1	0	0	9
Block Group 1, Census Tract 9703, Navarro County, Texas	1418	1117	976	78	0	63	0	0	0
Block Group 3, Census Tract 9704, Navarro County, Texas	1301	1238	1156	49	27	0	0	3	3
Block Group 4, Census Tract 9709, Navarro County, Texas	2567	1963	1469	416	0	0	75	0	3
Block Group 5, Census Tract 9709, Navarro County, Texas	1769	1334	1285	47	2	0	0	0	0
Block Group 1, Census Tract 9710, Navarro County, Texas	1896	1445	1394	21	9	9	0	0	12
Block Group 1, Census Tract 6806, Waller County, Texas	2472	1677	1519	58	17	83	0	0	0
Block Group 2, Census Tract 6806, Waller County, Texas	2443	1947	1912	0	12	23	0	0	0

Geography	Not Hispanic or Latino: Two or more races - Two races including Some other race	Not Hispanic or Latino: Two or more races - Two races excluding Some other race, and three or more races	Hispanic or Latino:	Hispanic or Latino: White alone	Hispanic or Latino: Black or African American alone	Hispanic or Latino: American Indian and Alaska Native alone	Hispanic or Latino: Asian alone	Hispanic or Latino: Native Hawaiian and Other Pacific Islander alone	Hispanic or Latino: Some other race alone
Block Group 2, Census Tract 20, Dallas County, Texas	0	0	216	157	0	0	0	0	0
Block Group 1, Census Tract 34, Dallas County, Texas	0	0	59	24	0	0	0	0	35
Block Group 2, Census Tract 34, Dallas County, Texas	0	0	149	106	0	0	0	0	43
Block Group 1, Census Tract 40, Dallas County, Texas	0	0	17	17	0	0	0	0	0
Block Group 2, Census Tract 40, Dallas County, Texas	0	0	77	77	0	0	0	0	0
Block Group 2, Census Tract 41, Dallas County, Texas	0	0	261	230	0	0	0	0	19
Block Group 1, Census Tract 86.03, Dallas County, Texas	0	0	246	234	0	0	0	0	0
Block Group 1, Census Tract 86.04, Dallas County, Texas	0	9	526	498	0	0	0	0	0
Block Group 2, Census Tract 86.04, Dallas County, Texas	0	0	129	104	0	0	0	0	25
Block Group 1, Census Tract 87.01, Dallas County, Texas	0	0	37	0	37	0	0	0	0
Block Group 2, Census Tract 87.01, Dallas County, Texas	0	0	59	30	29	0	0	0	0
Block Group 4, Census Tract 87.01, Dallas County, Texas	0	0	0	0	0	0	0	0	0
Block Group 5, Census Tract 87.01, Dallas County, Texas	0	10	79	28	0	0	0	0	40
Block Group 1, Census Tract 89, Dallas County, Texas	0	0	461	461	0	0	0	0	0
Block Group 1, Census Tract 100, Dallas County, Texas	0	124	1681	1342	26	39	0	14	228
Block Group 1, Census Tract 114.01, Dallas County, Texas	0	15	133	131	0	2	0	0	0
Block Group 3, Census Tract 115, Dallas County, Texas	0	0	149	149	0	0	0	0	0
Block Group 4, Census Tract 115, Dallas County, Texas	0	0	450	446	0	0	0	0	4

Geography	Not Hispanic or Latino: Two or more races - Two races including Some other race	Not Hispanic or Latino: Two or more races - Two races excluding Some other race, and three or more races	Hispanic or Latino:	Hispanic or Latino: White alone	Hispanic or Latino: Black or African American alone	Hispanic or Latino: American Indian and Alaska Native alone	Hispanic or Latino: Asian alone	Hispanic or Latino: Native Hawaiian and Other Pacific Islander alone	Hispanic or Latino: Some other race alone
Block Group 1, Census Tract 167.03, Dallas County, Texas	0	0	648	625	0	0	0	0	5
Block Group 2, Census Tract 168.02, Dallas County, Texas	0	7	323	250	0	0	0	0	73
Block Group 1, Census Tract 169.02, Dallas County, Texas	0	7	953	847	10	12	0	0	78
Block Group 2, Census Tract 169.02, Dallas County, Texas	0	0	1119	851	49	43	0	0	160
Block Group 3, Census Tract 169.03, Dallas County, Texas	0	1	468	406	0	5	0	0	52
Block Group 5, Census Tract 169.03, Dallas County, Texas	0	0	265	208	32	0	0	0	25
Block Group 1, Census Tract 202, Dallas County, Texas	0	0	58	0	0	0	0	0	55
Block Group 2, Census Tract 202, Dallas County, Texas	0	12	0	0	0	0	0	0	0
Block Group 3, Census Tract 202, Dallas County, Texas	0	45	281	281	0	0	0	0	0
Block Group 1, Census Tract 204, Dallas County, Texas	0	0	269	216	0	0	0	0	53
Block Group 3, Census Tract 204, Dallas County, Texas	0	153	350	214	0	0	0	0	88
Block Group 1, Census Tract 601.01, Ellis County, Texas	0	154	774	774	0	0	0	0	0
Block Group 2, Census Tract 601.01, Ellis County, Texas	0	34	526	283	15	148	0	0	46
Block Group 1, Census Tract 601.02, Ellis County, Texas	0	33	2025	1230	0	0	0	0	709
Block Group 3, Census Tract 601.02, Ellis County, Texas	0	73	1216	826	0	71	0	0	240
Block Group 1, Census Tract 602.10, Ellis County, Texas	0	0	187	156	0	0	0	0	25
Block Group 1, Census Tract 611, Ellis County, Texas	0	17	256	193	0	0	0	0	6
Block Group 1, Census Tract 612, Ellis County, Texas	0	3	235	214	0	20	0	0	1

Geography	Not Hispanic or Latino: Two or more races - Two races including Some other race	Not Hispanic or Latino: Two or more races - Two races excluding Some other race, and three or more races	Hispanic or Latino:	Hispanic or Latino: White alone	Hispanic or Latino: Black or African American alone	Hispanic or Latino: American Indian and Alaska Native alone	Hispanic or Latino: Asian alone	Hispanic or Latino: Native Hawaiian and Other Pacific Islander alone	Hispanic or Latino: Some other race alone
Block Group 2, Census Tract 612, Ellis County, Texas	0	51	461	357	10	16	0	0	40
Block Group 1, Census Tract 613, Ellis County, Texas	0	18	214	180	0	25	0	0	9
Block Group 2, Census Tract 613, Ellis County, Texas	0	26	589	531	0	7	0	0	51
Block Group 1, Census Tract 1, Freestone County, Texas	0	25	667	594	0	0	0	0	73
Block Group 2, Census Tract 1, Freestone County, Texas	0	12	426	393	0	0	0	0	33
Block Group 1, Census Tract 3, Freestone County, Texas	0	4	209	209	0	0	0	0	0
Block Group 2, Census Tract 4, Freestone County, Texas	0	38	64	64	0	0	0	0	0
Block Group 1, Census Tract 6, Freestone County, Texas	0	0	12	12	0	0	0	0	0
Block Group 2, Census Tract 6, Freestone County, Texas	0	12	35	35	0	0	0	0	0
Block Group 3, Census Tract 6, Freestone County, Texas	6	0	459	296	0	48	0	0	109
Block Group 1, Census Tract 1801.02, Grimes County, Texas	0	82	221	59	0	0	0	0	162
Block Group 2, Census Tract 1801.02, Grimes County, Texas	0	36	265	91	0	0	0	0	174
Block Group 5, Census Tract 1802, Grimes County, Texas	0	95	93	82	0	0	0	0	11
Block Group 1, Census Tract 1803.01, Grimes County, Texas	0	50	305	22	0	187	0	0	96
Block Group 2, Census Tract 1803.01, Grimes County, Texas	0	46	144	122	0	5	0	0	17
Block Group 1, Census Tract 1803.02, Grimes County, Texas	0	94	38	20	0	0	0	0	15

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Block Group 2, Census Tract 1803.02, Grimes County, Texas	0	3	282	275	0	0	0	0	7
Block Group 1, Census Tract 4301, Harris County, Texas	0	12	71	47	0	0	0	0	14
Block Group 2, Census Tract 4301, Harris County, Texas	0	39	54	54	0	0	0	0	0
Block Group 5, Census Tract 4301, Harris County, Texas	0	0	47	47	0	0	0	0	0
Block Group 4, Census Tract 5108, Harris County, Texas	0	63	0	0	0	0	0	0	0
Block Group 2, Census Tract 5109, Harris County, Texas	0	156	1038	847	25	0	0	0	166
Block Group 1, Census Tract 5110.01, Harris County, Texas	0	14	381	360	11	0	0	0	10
Block Group 2, Census Tract 5110.01, Harris County, Texas	0	0	283	249	0	0	0	0	34
Block Group 1, Census Tract 5201, Harris County, Texas	0	94	1053	814	0	0	0	0	239
Block Group 1, Census Tract 5203, Harris County, Texas	0	27	1727	1105	40	0	0	0	533
Block Group 1, Census Tract 5204, Harris County, Texas	0	10	1146	599	0	0	0	0	522
Block Group 2, Census Tract 5204, Harris County, Texas	0	61	1569	1080	0	0	0	0	482
Block Group 1, Census Tract 5205, Harris County, Texas	0	0	1251	1029	0	0	0	0	222
Block Group 2, Census Tract 5205, Harris County, Texas	0	0	2502	1993	0	91	0	0	418

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Block Group 3, Census Tract 5205, Harris County, Texas	0	0	1394	1087	0	0	0	0	307
Block Group 4, Census Tract 5205, Harris County, Texas	0	0	1078	920	0	0	0	0	158
Block Group 1, Census Tract 5206.01, Harris County, Texas	0	0	1986	1346	0	48	0	0	592
Block Group 1, Census Tract 5206.02, Harris County, Texas	0	0	1024	542	0	0	0	0	482
Block Group 1, Census Tract 5214, Harris County, Texas	0	0	1179	291	0	69	0	0	727
Block Group 2, Census Tract 5214, Harris County, Texas	0	0	1523	358	33	0	0	0	1116
Block Group 3, Census Tract 5214, Harris County, Texas	0	14	1370	936	0	0	0	0	361
Block Group 4, Census Tract 5214, Harris County, Texas	0	0	2658	921	0	89	0	0	1648
Block Group 4, Census Tract 5215, Harris County, Texas	0	74	1106	479	0	0	0	0	627
Block Group 1, Census Tract 5216, Harris County, Texas	0	0	1918	1488	0	17	0	0	358
Block Group 2, Census Tract 5216, Harris County, Texas	0	0	780	670	0	0	0	0	110
Block Group 1, Census Tract 5217, Harris County, Texas	0	0	1017	929	0	0	0	0	88
Block Group 2, Census Tract 5217, Harris County, Texas	0	0	1388	644	0	219	0	0	525
Block Group 3, Census Tract 5217, Harris County, Texas	23	0	1098	790	0	0	0	0	308
Block Group 4, Census Tract 5217, Harris County, Texas	0	45	473	320	17	0	0	0	136
Block Group 1, Census Tract 5218, Harris County, Texas	0	0	1084	970	0	0	23	0	91
Block Group 3, Census Tract 5301, Harris County, Texas	0	0	653	564	0	0	0	0	89
Block Group 1, Census Tract 5342.03, Harris County, Texas	0	0	687	456	0	0	0	0	231

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Block Group 1, Census Tract 5401, Harris County, Texas	33	103	1072	623	22	0	38	0	346
Block Group 3, Census Tract 5401, Harris County, Texas	0	0	1355	791	0	0	0	0	528
Block Group 2, Census Tract 5408, Harris County, Texas	0	0	1469	1047	0	128	0	0	219
Block Group 2, Census Tract 5409.02, Harris County, Texas	0	114	301	301	0	0	0	0	0
Block Group 1, Census Tract 5410.01, Harris County, Texas	0	101	2262	1768	0	0	0	0	421
Block Group 1, Census Tract 5410.02, Harris County, Texas	41	290	1243	801	0	17	0	0	353
Block Group 2, Census Tract 5410.02, Harris County, Texas	0	86	703	625	0	0	0	0	45
Block Group 1, Census Tract 5410.03, Harris County, Texas	0	190	1343	667	0	0	0	0	360
Block Group 1, Census Tract 5430.01, Harris County, Texas	0	91	1002	851	26	91	14	0	20
Block Group 1, Census Tract 5430.02, Harris County, Texas	0	162	1686	1227	0	0	0	0	319
Block Group 2, Census Tract 5430.02, Harris County, Texas	0	125	1269	986	0	0	0	0	283
Block Group 1, Census Tract 5431, Harris County, Texas	0	32	1196	973	0	0	0	0	188
Block Group 6, Census Tract 5517.01, Harris County, Texas	0	102	743	597	0	0	0	0	119
Block Group 1, Census Tract 5518, Harris County, Texas	7	28	217	217	0	0	0	0	0
Block Group 3, Census Tract 5518, Harris County, Texas	0	0	21	21	0	0	0	0	0
Block Group 1, Census Tract 5519, Harris County, Texas	0	24	375	246	0	0	12	0	0

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Block Group 2, Census Tract 5519, Harris County, Texas	0	67	880	547	0	0	0	0	333
Block Group 3, Census Tract 5519, Harris County, Texas	33	0	1064	849	35	0	0	0	180
Block Group 3, Census Tract 5520.01, Harris County, Texas	0	0	1250	570	0	52	0	0	628
Block Group 1, Census Tract 5520.02, Harris County, Texas	0	0	388	385	0	0	0	0	3
Block Group 1, Census Tract 5521.01, Harris County, Texas	0	19	1029	707	10	0	0	0	172
Block Group 1, Census Tract 5521.03, Harris County, Texas	0	4	199	187	0	0	0	0	0
Block Group 2, Census Tract 5522, Harris County, Texas	0	0	551	422	0	0	0	0	129
Block Group 3, Census Tract 5522, Harris County, Texas	0	23	606	371	0	0	0	0	148
Block Group 2, Census Tract 5544.01, Harris County, Texas	108	168	1062	1062	0	0	0	0	0
Block Group 2, Census Tract 5544.02, Harris County, Texas	0	91	605	486	30	0	0	0	89
Block Group 1, Census Tract 5544.03, Harris County, Texas	0	121	2161	2102	40	0	0	0	19
Block Group 2, Census Tract 5557.01, Harris County, Texas	0	88	597	413	0	11	0	0	150
Block Group 1, Census Tract 5560, Harris County, Texas	0	0	115	115	0	0	0	0	0
Block Group 3, Census Tract 9501, Leon County, Texas	0	4	534	285	47	0	0	0	202
Block Group 1, Census Tract 9502, Leon County, Texas	0	0	186	180	0	0	0	0	6
Block Group 2, Census Tract 9502, Leon County, Texas	0	0	91	7	0	0	0	0	84
Block Group 3, Census Tract 9502, Leon County, Texas	0	7	0	0	0	0	0	0	0

Geography	Not Hispanic or Latino: Two or more races - Two races including Some other race	Not Hispanic or Latino: Two or more races - Two races excluding Some other race, and three or more races	Hispanic or Latino:	Hispanic or Latino: White alone	Hispanic or Latino: Black or African American alone	Hispanic or Latino: American Indian and Alaska Native alone	Hispanic or Latino: Asian alone	Hispanic or Latino: Native Hawaiian and Other Pacific Islander alone	Hispanic or Latino: Some other race alone
Block Group 5, Census Tract 9502, Leon County, Texas	0	26	70	17	0	0	0	0	53
Block Group 2, Census Tract 9503, Leon County, Texas	0	15	75	45	0	0	0	0	30
Block Group 3, Census Tract 9503, Leon County, Texas	0	0	0	0	0	0	0	0	0
Block Group 4, Census Tract 9503, Leon County, Texas	0	32	209	200	0	0	0	0	9
Block Group 1, Census Tract 9707, Limestone County, Texas	0	0	148	139	0	0	0	0	9
Block Group 2, Census Tract 9707, Limestone County, Texas	0	0	0	0	0	0	0	0	0
Block Group 1, Census Tract 2, Madison County, Texas	0	0	96	57	0	0	0	0	39
Block Group 1, Census Tract 3, Madison County, Texas	0	9	44	41	0	0	0	0	3
Block Group 1, Census Tract 9703, Navarro County, Texas	0	0	301	281	0	0	0	0	20
Block Group 3, Census Tract 9704, Navarro County, Texas	0	3	63	62	0	0	0	0	0
Block Group 4, Census Tract 9709, Navarro County, Texas	0	3	604	504	0	0	0	0	99
Block Group 5, Census Tract 9709, Navarro County, Texas	0	0	435	423	0	0	0	0	12
Block Group 1, Census Tract 9710, Navarro County, Texas	0	12	451	405	0	15	0	0	31
Block Group 1, Census Tract 6806, Waller County, Texas	0	0	795	795	0	0	0	0	0
Block Group 2, Census Tract 6806, Waller County, Texas	0	0	496	313	0	0	0	0	183

Geography	Hispanic or Latino: Two or more races:	Hispanic or Latino: Two or more races - Two races including Some other race	Hispanic or Latino: Two or more races - Two races excluding Some other race, and three or more races
Block Group 2, Census Tract 20, Dallas County, Texas	59	59	0
Block Group 1, Census Tract 34, Dallas County, Texas	0	0	0
Block Group 2, Census Tract 34, Dallas County, Texas	0	0	0
Block Group 1, Census Tract 40, Dallas County, Texas	0	0	0
Block Group 2, Census Tract 40, Dallas County, Texas	0	0	0
Block Group 2, Census Tract 41, Dallas County, Texas	12	0	12
Block Group 1, Census Tract 86.03, Dallas County, Texas	12	12	0
Block Group 1, Census Tract 86.04, Dallas County, Texas	28	0	28
Block Group 2, Census Tract 86.04, Dallas County, Texas	0	0	0
Block Group 1, Census Tract 87.01, Dallas County, Texas	0	0	0
Block Group 2, Census Tract 87.01, Dallas County, Texas	0	0	0
Block Group 4, Census Tract 87.01, Dallas County, Texas	0	0	0
Block Group 5, Census Tract 87.01, Dallas County, Texas	11	11	0
Block Group 1, Census Tract 89, Dallas County, Texas	0	0	0
Block Group 1, Census Tract 100, Dallas County, Texas	32	32	0
Block Group 1, Census Tract 114.01, Dallas County, Texas	0	0	0
Block Group 3, Census Tract 115, Dallas County, Texas	0	0	0
Block Group 4, Census Tract 115, Dallas County, Texas	0	0	0

Geography	Hispanic or Latino: Two or more races:	Hispanic or Latino: Two or more races - Two races including Some other race	Hispanic or Latino: Two or more races - Two races excluding Some other race, and three or more races
Block Group 1, Census Tract 167.03, Dallas County, Texas	18	18	0
Block Group 2, Census Tract 168.02, Dallas County, Texas	0	0	0
Block Group 1, Census Tract 169.02, Dallas County, Texas	6	0	6
Block Group 2, Census Tract 169.02, Dallas County, Texas	16	16	0
Block Group 3, Census Tract 169.03, Dallas County, Texas	5	5	0
Block Group 5, Census Tract 169.03, Dallas County, Texas	0	0	0
Block Group 1, Census Tract 202, Dallas County, Texas	3	3	0
Block Group 2, Census Tract 202, Dallas County, Texas	0	0	0
Block Group 3, Census Tract 202, Dallas County, Texas	0	0	0
Block Group 1, Census Tract 204, Dallas County, Texas	0	0	0
Block Group 3, Census Tract 204, Dallas County, Texas	48	25	23
Block Group 1, Census Tract 601.01, Ellis County, Texas	0	0	0
Block Group 2, Census Tract 601.01, Ellis County, Texas	34	34	0
Block Group 1, Census Tract 601.02, Ellis County, Texas	86	0	86
Block Group 3, Census Tract 601.02, Ellis County, Texas	79	9	70
Block Group 1, Census Tract 602.10, Ellis County, Texas	6	0	6
Block Group 1, Census Tract 611, Ellis County, Texas	57	57	0
Block Group 1, Census Tract 612, Ellis County, Texas	0	0	0

Geography	Hispanic or Latino: Two or more races:	Hispanic or Latino: Two or more races - Two races including Some other race	Hispanic or Latino: Two or more races - Two races excluding Some other race, and three or more races
Block Group 2, Census Tract 612, Ellis County, Texas	38	0	38
Block Group 1, Census Tract 613, Ellis County, Texas	0	0	0
Block Group 2, Census Tract 613, Ellis County, Texas	0	0	0
Block Group 1, Census Tract 1, Freestone County, Texas	0	0	0
Block Group 2, Census Tract 1, Freestone County, Texas	0	0	0
Block Group 1, Census Tract 3, Freestone County, Texas	0	0	0
Block Group 2, Census Tract 4, Freestone County, Texas	0	0	0
Block Group 1, Census Tract 6, Freestone County, Texas	0	0	0
Block Group 2, Census Tract 6, Freestone County, Texas	0	0	0
Block Group 3, Census Tract 6, Freestone County, Texas	6	0	6
Block Group 1, Census Tract 1801.02, Grimes County, Texas	0	0	0
Block Group 2, Census Tract 1801.02, Grimes County, Texas	0	0	0
Block Group 5, Census Tract 1802, Grimes County, Texas	0	0	0
Block Group 1, Census Tract 1803.01, Grimes County, Texas	0	0	0
Block Group 2, Census Tract 1803.01, Grimes County, Texas	0	0	0
Block Group 1, Census Tract 1803.02, Grimes County, Texas	3	0	3

Geography	Hispanic or Latino: Two or more races:	Hispanic or Latino: Two or more races - Two races including Some other race	Hispanic or Latino: Two or more races - Two races excluding Some other race, and three or more races
Block Group 2, Census Tract 1803.02, Grimes County, Texas	0	0	0
Block Group 1, Census Tract 4301, Harris County, Texas	10	10	0
Block Group 2, Census Tract 4301, Harris County, Texas	0	0	0
Block Group 5, Census Tract 4301, Harris County, Texas	0	0	0
Block Group 4, Census Tract 5108, Harris County, Texas	0	0	0
Block Group 2, Census Tract 5109, Harris County, Texas	0	0	0
Block Group 1, Census Tract 5110.01, Harris County, Texas	0	0	0
Block Group 2, Census Tract 5110.01, Harris County, Texas	0	0	0
Block Group 1, Census Tract 5201, Harris County, Texas	0	0	0
Block Group 1, Census Tract 5203, Harris County, Texas	49	41	8
Block Group 1, Census Tract 5204, Harris County, Texas	25	10	15
Block Group 2, Census Tract 5204, Harris County, Texas	7	7	0
Block Group 1, Census Tract 5205, Harris County, Texas	0	0	0
Block Group 2, Census Tract 5205, Harris County, Texas	0	0	0

Geography	Hispanic or Latino: Two or more races:	Hispanic or Latino: Two or more races - Two races including Some other race	Hispanic or Latino: Two or more races - Two races excluding Some other race, and three or more races
Block Group 3, Census Tract 5205, Harris County, Texas	0	0	0
Block Group 4, Census Tract 5205, Harris County, Texas	0	0	0
Block Group 1, Census Tract 5206.01, Harris County, Texas	0	0	0
Block Group 1, Census Tract 5206.02, Harris County, Texas	0	0	0
Block Group 1, Census Tract 5214, Harris County, Texas	92	75	17
Block Group 2, Census Tract 5214, Harris County, Texas	16	16	0
Block Group 3, Census Tract 5214, Harris County, Texas	73	73	0
Block Group 4, Census Tract 5214, Harris County, Texas	0	0	0
Block Group 4, Census Tract 5215, Harris County, Texas	0	0	0
Block Group 1, Census Tract 5216, Harris County, Texas	55	55	0
Block Group 2, Census Tract 5216, Harris County, Texas	0	0	0
Block Group 1, Census Tract 5217, Harris County, Texas	0	0	0
Block Group 2, Census Tract 5217, Harris County, Texas	0	0	0
Block Group 3, Census Tract 5217, Harris County, Texas	0	0	0
Block Group 4, Census Tract 5217, Harris County, Texas	0	0	0
Block Group 1, Census Tract 5218, Harris County, Texas	0	0	0
Block Group 3, Census Tract 5301, Harris County, Texas	0	0	0
Block Group 1, Census Tract 5342.03, Harris County, Texas	0	0	0

Geography	Hispanic or Latino: Two or more races:	Hispanic or Latino: Two or more races - Two races including Some other race	Hispanic or Latino: Two or more races - Two races excluding Some other race, and three or more races
Block Group 1, Census Tract 5401, Harris County, Texas	43	0	43
Block Group 3, Census Tract 5401, Harris County, Texas	36	0	36
Block Group 2, Census Tract 5408, Harris County, Texas	75	75	0
Block Group 2, Census Tract 5409.02, Harris County, Texas	0	0	0
Block Group 1, Census Tract 5410.01, Harris County, Texas	73	73	0
Block Group 1, Census Tract 5410.02, Harris County, Texas	72	14	58
Block Group 2, Census Tract 5410.02, Harris County, Texas	33	0	33
Block Group 1, Census Tract 5410.03, Harris County, Texas	316	0	316
Block Group 1, Census Tract 5430.01, Harris County, Texas	0	0	0
Block Group 1, Census Tract 5430.02, Harris County, Texas	140	130	10
Block Group 2, Census Tract 5430.02, Harris County, Texas	0	0	0
Block Group 1, Census Tract 5431, Harris County, Texas	35	35	0
Block Group 6, Census Tract 5517.01, Harris County, Texas	27	27	0
Block Group 1, Census Tract 5518, Harris County, Texas	0	0	0
Block Group 3, Census Tract 5518, Harris County, Texas	0	0	0
Block Group 1, Census Tract 5519, Harris County, Texas	117	23	94

Geography	Hispanic or Latino: Two or more races:	Hispanic or Latino: Two or more races - Two races including Some other race	Hispanic or Latino: Two or more races - Two races excluding Some other race, and three or more races
Block Group 2, Census Tract 5519, Harris County, Texas	0	0	0
Block Group 3, Census Tract 5519, Harris County, Texas	0	0	0
Block Group 3, Census Tract 5520.01, Harris County, Texas	0	0	0
Block Group 1, Census Tract 5520.02, Harris County, Texas	0	0	0
Block Group 1, Census Tract 5521.01, Harris County, Texas	140	50	90
Block Group 1, Census Tract 5521.03, Harris County, Texas	12	12	0
Block Group 2, Census Tract 5522, Harris County, Texas	0	0	0
Block Group 3, Census Tract 5522, Harris County, Texas	87	87	0
Block Group 2, Census Tract 5544.01, Harris County, Texas	0	0	0
Block Group 2, Census Tract 5544.02, Harris County, Texas	0	0	0
Block Group 1, Census Tract 5544.03, Harris County, Texas	0	0	0
Block Group 2, Census Tract 5557.01, Harris County, Texas	23	0	23
Block Group 1, Census Tract 5560, Harris County, Texas	0	0	0
Block Group 3, Census Tract 9501, Leon County, Texas	0	0	0
Block Group 1, Census Tract 9502, Leon County, Texas	0	0	0
Block Group 2, Census Tract 9502, Leon County, Texas	0	0	0
Block Group 3, Census Tract 9502, Leon County, Texas	0	0	0

Geography	Hispanic or Latino: Two or more races:	Hispanic or Latino: Two or more races - Two races including Some other race	Hispanic or Latino: Two or more races - Two races excluding Some other race, and three or more races
Block Group 5, Census Tract 9502, Leon County, Texas	0	0	0
Block Group 2, Census Tract 9503, Leon County, Texas	0	0	0
Block Group 3, Census Tract 9503, Leon County, Texas	0	0	0
Block Group 4, Census Tract 9503, Leon County, Texas	0	0	0
Block Group 1, Census Tract 9707, Limestone County, Texas	0	0	0
Block Group 2, Census Tract 9707, Limestone County, Texas	0	0	0
Block Group 1, Census Tract 2, Madison County, Texas	0	0	0
Block Group 1, Census Tract 3, Madison County, Texas	0	0	0
Block Group 1, Census Tract 9703, Navarro County, Texas	0	0	0
Block Group 3, Census Tract 9704, Navarro County, Texas	1	1	0
Block Group 4, Census Tract 9709, Navarro County, Texas	1	0	1
Block Group 5, Census Tract 9709, Navarro County, Texas	0	0	0
Block Group 1, Census Tract 9710, Navarro County, Texas	0	0	0
Block Group 1, Census Tract 6806, Waller County, Texas	0	0	0
Block Group 2, Census Tract 6806, Waller County, Texas	0	0	0

Socioeconomic:
Low Income within the Study Area by
Block Group and Census Tract, County:

Geography	Total:	Income in the past 12 months below poverty level:	Income in the past 12 months below poverty level: - In family households:	Income in the past 12 months below poverty level: - In family households: - In married couple families:	Income in the past 12 months below poverty level: - In family households: - In married couple families: - All relatives	Income in the past 12 months below poverty level: - In family households: - In married couple families: - Non-relatives	Income in the past 12 months below poverty level: - In family households: - In other families:	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present:	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present: - All relatives
Block Group 2, Census Tract 20, Dallas County, Texas	633	115	20	0	0	0	20	20	0
Block Group 1, Census Tract 34, Dallas County, Texas	631	210	131	35	35	0	96	25	25
Block Group 2, Census Tract 34, Dallas County, Texas	717	328	216	103	103	0	113	10	10
Block Group 1, Census Tract 40, Dallas County, Texas	397	209	184	92	92	0	92	0	0
Block Group 2, Census Tract 40, Dallas County, Texas	587	262	195	77	77	0	118	23	0
Block Group 2, Census Tract 41, Dallas County, Texas	535	295	263	118	118	0	145	11	0
Block Group 1, Census Tract 86.03, Dallas County, Texas	912	495	478	30	30	0	448	115	103
Block Group 1, Census Tract 86.04, Dallas County, Texas	1671	785	742	58	58	0	684	98	81
Block Group 2, Census Tract 86.04, Dallas County, Texas	1334	870	517	0	0	0	517	63	47
Block Group 1, Census Tract 87.01, Dallas County, Texas	1192	972	957	11	11	0	946	33	26

Geography	Total:	Income in the past 12 months below poverty level:	Income in the past 12 months below poverty level: - In family households:	Income in the past 12 months below poverty level: - In family households: - In married couple families:	Income in the past 12 months below poverty level: - In family households: - In married couple families: - All relatives	Income in the past 12 months below poverty level: - In family households: - In married couple families: - Non-relatives	Income in the past 12 months below poverty level: - In family households: - In other families:	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present:	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present: - All relatives
Block Group 2, Census Tract 87.01, Dallas County, Texas	727	305	199	22	22	0	177	0	0
Block Group 4, Census Tract 87.01, Dallas County, Texas	501	114	96	0	0	0	96	0	0
Block Group 5, Census Tract 87.01, Dallas County, Texas	1034	521	286	38	38	0	248	44	44
Block Group 1, Census Tract 89, Dallas County, Texas	1267	553	525	0	0	0	525	389	270
Block Group 1, Census Tract 100, Dallas County, Texas	1572	140	16	16	16	0	0	0	0
Block Group 1, Census Tract 114.01, Dallas County, Texas	1676	842	720	286	258	28	434	84	84
Block Group 3, Census Tract 115, Dallas County, Texas	228	81	81	81	81	0	0	0	0
Block Group 4, Census Tract 115, Dallas County, Texas	789	322	287	24	24	0	263	96	69
Block Group 1, Census Tract 167.03, Dallas County, Texas	1091	0	0	0	0	0	0	0	0
Block Group 2, Census Tract 168.02, Dallas County, Texas	1651	118	110	0	0	0	110	0	0

Geography	Total:	Income in the past 12 months below poverty level:	Income in the past 12 months below poverty level: - In family households:	Income in the past 12 months below poverty level: - In family households: - In married couple families:	Income in the past 12 months below poverty level: - In family households: - In married couple families: - All relatives	Income in the past 12 months below poverty level: - In family households: - In married couple families: - Non-relatives	Income in the past 12 months below poverty level: - In family households: - In other families:	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present:	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present: - All relatives
Block Group 1, Census Tract 169.02, Dallas County, Texas	1387	193	141	141	141	0	0	0	0
Block Group 2, Census Tract 169.02, Dallas County, Texas	1912	607	537	359	359	0	178	69	58
Block Group 3, Census Tract 169.03, Dallas County, Texas	1122	287	287	256	256	0	31	0	0
Block Group 5, Census Tract 169.03, Dallas County, Texas	778	80	74	0	0	0	74	38	38
Block Group 1, Census Tract 202, Dallas County, Texas	433	174	130	0	0	0	130	55	55
Block Group 2, Census Tract 202, Dallas County, Texas	2175	744	659	0	0	0	659	21	21
Block Group 3, Census Tract 202, Dallas County, Texas	1363	667	485	33	33	0	452	21	21
Block Group 1, Census Tract 204, Dallas County, Texas	1336	458	98	0	0	0	98	0	0
Block Group 3, Census Tract 204, Dallas County, Texas	2226	390	0	0	0	0	0	0	0
Block Group 1, Census Tract 601.01, Ellis County, Texas	2571	100	38	0	0	0	38	38	0

Geography	Total:	Income in the past 12 months below poverty level:	Income in the past 12 months below poverty level: - In family households:	Income in the past 12 months below poverty level: - In family households: - In married couple families:	Income in the past 12 months below poverty level: - In family households: - In married couple families: - All relatives	Income in the past 12 months below poverty level: - In family households: - In married couple families: - Non-relatives	Income in the past 12 months below poverty level: - In family households: - In other families:	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present:	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present: - All relatives
Block Group 2, Census Tract 601.01, Ellis County, Texas	1374	202	163	126	126	0	37	8	0
Block Group 1, Census Tract 601.02, Ellis County, Texas	2893	418	375	170	170	0	205	0	0
Block Group 3, Census Tract 601.02, Ellis County, Texas	3121	356	323	237	233	4	86	7	7
Block Group 1, Census Tract 602.10, Ellis County, Texas	893	14	6	6	6	0	0	0	0
Block Group 1, Census Tract 611, Ellis County, Texas	1584	233	230	19	19	0	211	18	0
Block Group 1, Census Tract 612, Ellis County, Texas	751	102	83	30	30	0	53	0	0
Block Group 2, Census Tract 612, Ellis County, Texas	1203	174	151	74	74	0	77	0	0
Block Group 1, Census Tract 613, Ellis County, Texas	924	150	125	68	68	0	57	57	57
Block Group 2, Census Tract 613, Ellis County, Texas	1496	449	446	252	228	24	194	172	172
Block Group 1, Census Tract 1, Freestone County, Texas	2781	530	465	113	89	24	352	0	0

Geography	Total:	Income in the past 12 months below poverty level:	Income in the past 12 months below poverty level: - In family households:	Income in the past 12 months below poverty level: - In family households: - In married couple families:	Income in the past 12 months below poverty level: - In family households: - In married couple families: - All relatives	Income in the past 12 months below poverty level: - In family households: - In married couple families: - Non-relatives	Income in the past 12 months below poverty level: - In family households: - In other families:	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present:	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present: - All relatives
Block Group 2, Census Tract 1, Freestone County, Texas	2636	555	493	332	332	0	161	14	0
Block Group 1, Census Tract 3, Freestone County, Texas	1005	161	120	26	26	0	94	0	0
Block Group 2, Census Tract 4, Freestone County, Texas	1447	143	101	15	13	2	86	10	10
Block Group 1, Census Tract 6, Freestone County, Texas	671	49	42	42	42	0	0	0	0
Block Group 2, Census Tract 6, Freestone County, Texas	898	38	0	0	0	0	0	0	0
Block Group 3, Census Tract 6, Freestone County, Texas	1613	89	53	6	6	0	47	5	0
Block Group 1, Census Tract 1801.02, Grimes County, Texas	1788	477	424	278	278	0	146	0	0
Block Group 2, Census Tract 1801.02, Grimes County, Texas	1669	311	213	33	33	0	180	77	77
Block Group 5, Census Tract 1802, Grimes County, Texas	1249	48	19	0	0	0	19	19	19
Block Group 1, Census Tract 1803.01, Grimes County, Texas	1425	52	49	0	0	0	49	49	40

Geography	Total:	Income in the past 12 months below poverty level:	Income in the past 12 months below poverty level: - In family households:	Income in the past 12 months below poverty level: - In family households: - In married couple families:	Income in the past 12 months below poverty level: - In family households: - In married couple families: - All relatives	Income in the past 12 months below poverty level: - In family households: - In married couple families: - Non-relatives	Income in the past 12 months below poverty level: - In family households: - In other families:	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present:	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present: - All relatives
Block Group 2, Census Tract 1803.01, Grimes County, Texas	1251	82	44	39	39	0	5	0	0
Block Group 1, Census Tract 1803.02, Grimes County, Texas	1848	388	330	32	32	0	298	90	83
Block Group 2, Census Tract 1803.02, Grimes County, Texas	1595	200	91	35	35	0	56	10	0
Block Group 1, Census Tract 4301, Harris County, Texas	813	25	25	0	0	0	25	0	0
Block Group 2, Census Tract 4301, Harris County, Texas	1597	16	0	0	0	0	0	0	0
Block Group 5, Census Tract 4301, Harris County, Texas	974	73	0	0	0	0	0	0	0
Block Group 4, Census Tract 5108, Harris County, Texas	865	21	0	0	0	0	0	0	0
Block Group 2, Census Tract 5109, Harris County, Texas	3688	657	576	485	485	0	91	91	78
Block Group 1, Census Tract 5110.01, Harris County, Texas	1551	85	0	0	0	0	0	0	0
Block Group 2, Census Tract 5110.01, Harris County, Texas	1005	38	0	0	0	0	0	0	0

Geography	Total:	Income in the past 12 months below poverty level:	Income in the past 12 months below poverty level: - In family households:	Income in the past 12 months below poverty level: - In family households: - In married couple families:	Income in the past 12 months below poverty level: - In family households: - In married couple families: - All relatives	Income in the past 12 months below poverty level: - In family households: - In married couple families: - Non-relatives	Income in the past 12 months below poverty level: - In family households: - In other families:	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present:	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present: - All relatives
Block Group 1, Census Tract 5201, Harris County, Texas	2416	396	358	141	124	17	217	217	217
Block Group 1, Census Tract 5203, Harris County, Texas	2258	358	305	280	280	0	25	25	25
Block Group 1, Census Tract 5204, Harris County, Texas	1363	651	496	336	336	0	160	0	0
Block Group 2, Census Tract 5204, Harris County, Texas	2156	818	763	343	343	0	420	179	155
Block Group 1, Census Tract 5205, Harris County, Texas	1422	343	286	239	239	0	47	0	0
Block Group 2, Census Tract 5205, Harris County, Texas	3471	1098	933	490	490	0	443	96	81
Block Group 3, Census Tract 5205, Harris County, Texas	1691	469	431	431	431	0	0	0	0
Block Group 4, Census Tract 5205, Harris County, Texas	1732	408	392	0	0	0	392	288	219
Block Group 1, Census Tract 5206.01, Harris County, Texas	2331	989	878	188	163	25	690	37	26
Block Group 1, Census Tract 5206.02, Harris County, Texas	1024	558	558	273	273	0	285	39	0

Geography	Total:	Income in the past 12 months below poverty level:	Income in the past 12 months below poverty level: - In family households:	Income in the past 12 months below poverty level: - In family households: - In married couple families:	Income in the past 12 months below poverty level: - In family households: - In married couple families: - All relatives	Income in the past 12 months below poverty level: - In family households: - In married couple families: - Non-relatives	Income in the past 12 months below poverty level: - In family households: - In other families:	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present:	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present: - All relatives
Block Group 1, Census Tract 5214, Harris County, Texas	1203	297	297	162	162	0	135	59	0
Block Group 2, Census Tract 5214, Harris County, Texas	1494	782	749	254	254	0	495	0	0
Block Group 3, Census Tract 5214, Harris County, Texas	1660	494	485	485	485	0	0	0	0
Block Group 4, Census Tract 5214, Harris County, Texas	2669	1186	1127	710	710	0	417	132	0
Block Group 4, Census Tract 5215, Harris County, Texas	2204	174	164	127	116	11	37	37	18
Block Group 1, Census Tract 5216, Harris County, Texas	2400	350	334	130	130	0	204	124	38
Block Group 2, Census Tract 5216, Harris County, Texas	1171	254	245	88	88	0	157	20	20
Block Group 1, Census Tract 5217, Harris County, Texas	1414	445	382	293	293	0	89	30	0
Block Group 2, Census Tract 5217, Harris County, Texas	2387	1274	1134	486	486	0	648	173	128
Block Group 3, Census Tract 5217, Harris County, Texas	1822	669	484	198	198	0	286	224	224

Geography	Total:	Income in the past 12 months below poverty level:	Income in the past 12 months below poverty level: - In family households:	Income in the past 12 months below poverty level: - In family households: - In married couple families:	Income in the past 12 months below poverty level: - In family households: - In married couple families: - All relatives	Income in the past 12 months below poverty level: - In family households: - In married couple families: - Non-relatives	Income in the past 12 months below poverty level: - In family households: - In other families:	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present:	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present: - All relatives
Block Group 4, Census Tract 5217, Harris County, Texas	1401	144	112	0	0	0	112	0	0
Block Group 1, Census Tract 5218, Harris County, Texas	2451	518	305	140	140	0	165	107	107
Block Group 3, Census Tract 5301, Harris County, Texas	819	230	189	0	0	0	189	0	0
Block Group 1, Census Tract 5342.03, Harris County, Texas	1647	132	57	24	24	0	33	14	14
Block Group 1, Census Tract 5401, Harris County, Texas	7582	337	249	205	189	16	44	44	44
Block Group 3, Census Tract 5401, Harris County, Texas	1653	20	0	0	0	0	0	0	0
Block Group 2, Census Tract 5408, Harris County, Texas	3294	504	304	274	274	0	30	0	0
Block Group 2, Census Tract 5409.02, Harris County, Texas	2428	0	0	0	0	0	0	0	0
Block Group 1, Census Tract 5410.01, Harris County, Texas	8473	1134	1019	710	710	0	309	13	0
Block Group 1, Census Tract 5410.02, Harris County, Texas	6966	485	420	340	311	29	80	0	0

Geography	Total:	Income in the past 12 months below poverty level:	Income in the past 12 months below poverty level: - In family households:	Income in the past 12 months below poverty level: - In family households: - In married couple families:	Income in the past 12 months below poverty level: - In family households: - In married couple families: - All relatives	Income in the past 12 months below poverty level: - In family households: - In married couple families: - Non-relatives	Income in the past 12 months below poverty level: - In family households: - In other families:	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present:	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present: - All relatives
Block Group 2, Census Tract 5410.02, Harris County, Texas	1493	0	0	0	0	0	0	0	0
Block Group 1, Census Tract 5410.03, Harris County, Texas	4913	574	540	476	476	0	64	0	0
Block Group 1, Census Tract 5430.01, Harris County, Texas	5848	111	86	86	86	0	0	0	0
Block Group 1, Census Tract 5430.02, Harris County, Texas	9606	182	127	67	67	0	60	0	0
Block Group 2, Census Tract 5430.02, Harris County, Texas	3646	419	397	149	149	0	248	32	0
Block Group 1, Census Tract 5431, Harris County, Texas	2702	558	553	461	461	0	92	51	21
Block Group 6, Census Tract 5517.01, Harris County, Texas	2279	0	0	0	0	0	0	0	0
Block Group 1, Census Tract 5518, Harris County, Texas	2539	34	0	0	0	0	0	0	0
Block Group 3, Census Tract 5518, Harris County, Texas	1055	68	0	0	0	0	0	0	0
Block Group 1, Census Tract 5519, Harris County, Texas	1023	55	0	0	0	0	0	0	0

Geography	Total:	Income in the past 12 months below poverty level:	Income in the past 12 months below poverty level: - In family households:	Income in the past 12 months below poverty level: - In family households: - In married couple families:	Income in the past 12 months below poverty level: - In family households: - In married couple families: - All relatives	Income in the past 12 months below poverty level: - In family households: - In married couple families: - Non-relatives	Income in the past 12 months below poverty level: - In family households: - In other families:	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present:	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present: - All relatives
Block Group 2, Census Tract 5519, Harris County, Texas	2264	442	396	187	187	0	209	0	0
Block Group 3, Census Tract 5519, Harris County, Texas	2823	769	547	262	262	0	285	0	0
Block Group 3, Census Tract 5520.01, Harris County, Texas	2491	74	30	0	0	0	30	0	0
Block Group 1, Census Tract 5520.02, Harris County, Texas	1926	114	107	63	49	14	44	44	0
Block Group 1, Census Tract 5521.01, Harris County, Texas	3842	316	136	10	0	10	126	51	0
Block Group 1, Census Tract 5521.03, Harris County, Texas	1071	0	0	0	0	0	0	0	0
Block Group 2, Census Tract 5522, Harris County, Texas	1620	242	129	0	0	0	129	0	0
Block Group 3, Census Tract 5522, Harris County, Texas	2412	678	616	0	0	0	616	0	0
Block Group 2, Census Tract 5544.01, Harris County, Texas	9344	167	167	167	111	56	0	0	0
Block Group 2, Census Tract 5544.02, Harris County, Texas	6573	356	340	146	126	20	194	0	0

Geography	Total:	Income in the past 12 months below poverty level:	Income in the past 12 months below poverty level: - In family households:	Income in the past 12 months below poverty level: - In family households: - In married couple families:	Income in the past 12 months below poverty level: - In family households: - In married couple families: - All relatives	Income in the past 12 months below poverty level: - In family households: - In married couple families: - Non-relatives	Income in the past 12 months below poverty level: - In family households: - In other families:	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present:	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present: - All relatives
Block Group 1, Census Tract 5544.03, Harris County, Texas	9629	623	459	21	0	21	438	61	45
Block Group 2, Census Tract 5557.01, Harris County, Texas	4213	34	34	34	0	34	0	0	0
Block Group 1, Census Tract 5560, Harris County, Texas	1284	86	78	0	0	0	78	78	78
Block Group 3, Census Tract 9501, Leon County, Texas	2644	282	257	37	37	0	220	0	0
Block Group 1, Census Tract 9502, Leon County, Texas	607	173	148	0	0	0	148	140	140
Block Group 2, Census Tract 9502, Leon County, Texas	733	130	49	0	0	0	49	49	49
Block Group 3, Census Tract 9502, Leon County, Texas	617	103	29	29	29	0	0	0	0
Block Group 5, Census Tract 9502, Leon County, Texas	1083	174	146	61	61	0	85	0	0
Block Group 2, Census Tract 9503, Leon County, Texas	1290	154	147	0	0	0	147	0	0
Block Group 3, Census Tract 9503, Leon County, Texas	1138	105	33	23	6	17	10	0	0

Geography	Total:	Income in the past 12 months below poverty level:	Income in the past 12 months below poverty level: - In family households:	Income in the past 12 months below poverty level: - In family households: - In married couple families:	Income in the past 12 months below poverty level: - In family households: - In married couple families: - All relatives	Income in the past 12 months below poverty level: - In family households: - In married couple families: - Non-relatives	Income in the past 12 months below poverty level: - In family households: - In other families:	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present:	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present: - All relatives
Block Group 4, Census Tract 9503, Leon County, Texas	1850	122	56	52	52	0	4	4	2
Block Group 1, Census Tract 9707, Limestone County, Texas	673	58	48	0	0	0	48	0	0
Block Group 2, Census Tract 9707, Limestone County, Texas	977	162	127	64	64	0	63	0	0
Block Group 1, Census Tract 2, Madison County, Texas	851	128	98	22	22	0	76	14	14
Block Group 1, Census Tract 3, Madison County, Texas	1001	153	111	31	31	0	80	0	0
Block Group 1, Census Tract 9703, Navarro County, Texas	1418	97	79	35	28	7	44	2	0
Block Group 3, Census Tract 9704, Navarro County, Texas	1301	171	81	24	22	2	57	0	0
Block Group 4, Census Tract 9709, Navarro County, Texas	2476	638	622	213	213	0	409	22	7
Block Group 5, Census Tract 9709, Navarro County, Texas	1769	259	206	20	20	0	186	0	0
Block Group 1, Census Tract 9710, Navarro County, Texas	1896	381	289	218	214	4	71	0	0

Geography	Total:	Income in the past 12 months below poverty level:	Income in the past 12 months below poverty level: - In family households:	Income in the past 12 months below poverty level: - In family households: - In married couple families:	Income in the past 12 months below poverty level: - In family households: - In married couple families: - All relatives	Income in the past 12 months below poverty level: - In family households: - In married couple families: - Non-relatives	Income in the past 12 months below poverty level: - In family households: - In other families:	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present:	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present: - All relatives
Block Group 1, Census Tract 6806, Waller County, Texas	2472	378	328	217	217	0	111	0	0
Block Group 2, Census Tract 6806, Waller County, Texas	2443	107	85	23	0	23	62	32	32

Geography	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present: - Non-relatives	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present:	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present: - All relatives	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present: - Non-relatives	Income in the past 12 months below poverty level: - In non-family households and other living arrangement:	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder:	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder: - Living alone	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder: - Not living alone
Block Group 2, Census Tract 20, Dallas County, Texas	20	0	0	0	95	82	82	0
Block Group 1, Census Tract 34, Dallas County, Texas	0	71	59	12	79	35	20	15
Block Group 2, Census Tract 34, Dallas County, Texas	0	103	98	5	112	72	68	4
Block Group 1, Census Tract 40, Dallas County, Texas	0	92	85	7	25	25	21	4
Block Group 2, Census Tract 40, Dallas County, Texas	23	95	83	12	67	47	38	9
Block Group 2, Census Tract 41, Dallas County, Texas	11	134	110	24	32	32	32	0
Block Group 1, Census Tract 86.03, Dallas County, Texas	12	333	333	0	17	17	17	0
Block Group 1, Census Tract 86.04, Dallas County, Texas	17	586	571	15	43	43	43	0
Block Group 2, Census Tract 86.04, Dallas County, Texas	16	454	454	0	353	311	279	32
Block Group 1, Census Tract 87.01, Dallas County, Texas	7	913	900	13	15	15	15	0

Geography	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present: - Non-relatives	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present:	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present: - All relatives	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present: - Non-relatives	Income in the past 12 months below poverty level: - In non-family households and other living arrangement:	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder:	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder: - Living alone	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder: - Not living alone
Block Group 2, Census Tract 87.01, Dallas County, Texas	0	177	177	0	106	70	61	9
Block Group 4, Census Tract 87.01, Dallas County, Texas	0	96	94	2	18	18	18	0
Block Group 5, Census Tract 87.01, Dallas County, Texas	0	204	204	0	235	167	146	21
Block Group 1, Census Tract 89, Dallas County, Texas	119	136	117	19	28	28	28	0
Block Group 1, Census Tract 100, Dallas County, Texas	0	0	0	0	124	61	26	35
Block Group 1, Census Tract 114.01, Dallas County, Texas	0	350	350	0	122	109	109	0
Block Group 3, Census Tract 115, Dallas County, Texas	0	0	0	0	0	0	0	0
Block Group 4, Census Tract 115, Dallas County, Texas	27	167	167	0	35	35	35	0
Block Group 1, Census Tract 167.03, Dallas County, Texas	0	0	0	0	0	0	0	0
Block Group 2, Census Tract 168.02, Dallas County, Texas	0	110	103	7	8	8	8	0

Geography	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present: - Non-relatives	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present:	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present: - All relatives	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present: - Non-relatives	Income in the past 12 months below poverty level: - In non-family households and other living arrangement:	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder:	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder: - Living alone	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder: - Not living alone
Block Group 1, Census Tract 169.02, Dallas County, Texas	0	0	0	0	52	19	19	0
Block Group 2, Census Tract 169.02, Dallas County, Texas	11	109	109	0	70	60	60	0
Block Group 3, Census Tract 169.03, Dallas County, Texas	0	31	31	0	0	0	0	0
Block Group 5, Census Tract 169.03, Dallas County, Texas	0	36	36	0	6	6	6	0
Block Group 1, Census Tract 202, Dallas County, Texas	0	75	72	3	44	44	44	0
Block Group 2, Census Tract 202, Dallas County, Texas	0	638	638	0	85	67	56	11
Block Group 3, Census Tract 202, Dallas County, Texas	0	431	404	27	182	104	26	78
Block Group 1, Census Tract 204, Dallas County, Texas	0	98	98	0	360	15	15	0
Block Group 3, Census Tract 204, Dallas County, Texas	0	0	0	0	390	15	15	0
Block Group 1, Census Tract 601.01, Ellis County, Texas	38	0	0	0	62	62	62	0

Geography	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present: - Non-relatives	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present:	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present: - All relatives	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present: - Non-relatives	Income in the past 12 months below poverty level: - In non-family households and other living arrangement:	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder:	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder: - Living alone	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder: - Not living alone
Block Group 2, Census Tract 601.01, Ellis County, Texas	8	29	29	0	39	39	39	0
Block Group 1, Census Tract 601.02, Ellis County, Texas	0	205	205	0	43	0	0	0
Block Group 3, Census Tract 601.02, Ellis County, Texas	0	79	76	3	33	19	4	15
Block Group 1, Census Tract 602.10, Ellis County, Texas	0	0	0	0	8	8	8	0
Block Group 1, Census Tract 611, Ellis County, Texas	18	193	193	0	3	2	0	2
Block Group 1, Census Tract 612, Ellis County, Texas	0	53	39	14	19	3	3	0
Block Group 2, Census Tract 612, Ellis County, Texas	0	77	63	14	23	10	10	0
Block Group 1, Census Tract 613, Ellis County, Texas	0	0	0	0	25	18	18	0
Block Group 2, Census Tract 613, Ellis County, Texas	0	22	22	0	3	3	3	0
Block Group 1, Census Tract 1, Freestone County, Texas	0	352	352	0	65	65	61	4

Geography	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present: - Non-relatives	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present:	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present: - All relatives	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present: - Non-relatives	Income in the past 12 months below poverty level: - In non-family households and other living arrangement:	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder:	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder: - Living alone	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder: - Not living alone
Block Group 2, Census Tract 1, Freestone County, Texas	14	147	147	0	62	62	62	0
Block Group 1, Census Tract 3, Freestone County, Texas	0	94	70	24	41	26	5	21
Block Group 2, Census Tract 4, Freestone County, Texas	0	76	72	4	42	35	35	0
Block Group 1, Census Tract 6, Freestone County, Texas	0	0	0	0	7	7	7	0
Block Group 2, Census Tract 6, Freestone County, Texas	0	0	0	0	38	38	38	0
Block Group 3, Census Tract 6, Freestone County, Texas	5	42	42	0	36	26	26	0
Block Group 1, Census Tract 1801.02, Grimes County, Texas	0	146	133	13	53	43	37	6
Block Group 2, Census Tract 1801.02, Grimes County, Texas	0	103	103	0	98	24	24	0
Block Group 5, Census Tract 1802, Grimes County, Texas	0	0	0	0	29	28	28	0
Block Group 1, Census Tract 1803.01, Grimes County, Texas	9	0	0	0	3	3	3	0

Geography	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present: - Non-relatives	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present:	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present: - All relatives	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present: - Non-relatives	Income in the past 12 months below poverty level: - In non-family households and other living arrangement:	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder:	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder: - Living alone	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder: - Not living alone
Block Group 2, Census Tract 1803.01, Grimes County, Texas	0	5	5	0	38	34	29	5
Block Group 1, Census Tract 1803.02, Grimes County, Texas	7	208	192	16	58	29	29	0
Block Group 2, Census Tract 1803.02, Grimes County, Texas	10	46	46	0	109	109	109	0
Block Group 1, Census Tract 4301, Harris County, Texas	0	25	25	0	0	0	0	0
Block Group 2, Census Tract 4301, Harris County, Texas	0	0	0	0	16	0	0	0
Block Group 5, Census Tract 4301, Harris County, Texas	0	0	0	0	73	68	68	0
Block Group 4, Census Tract 5108, Harris County, Texas	0	0	0	0	21	0	0	0
Block Group 2, Census Tract 5109, Harris County, Texas	13	0	0	0	81	54	54	0
Block Group 1, Census Tract 5110.01, Harris County, Texas	0	0	0	0	85	0	0	0
Block Group 2, Census Tract 5110.01, Harris County, Texas	0	0	0	0	38	13	13	0

Geography	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present: - Non-relatives	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present:	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present: - All relatives	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present: - Non-relatives	Income in the past 12 months below poverty level: - In non-family households and other living arrangement:	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder:	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder: - Living alone	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder: - Not living alone
Block Group 1, Census Tract 5201, Harris County, Texas	0	0	0	0	38	10	0	10
Block Group 1, Census Tract 5203, Harris County, Texas	0	0	0	0	53	35	26	9
Block Group 1, Census Tract 5204, Harris County, Texas	0	160	160	0	155	73	45	28
Block Group 2, Census Tract 5204, Harris County, Texas	24	241	241	0	55	55	55	0
Block Group 1, Census Tract 5205, Harris County, Texas	0	47	30	17	57	41	18	23
Block Group 2, Census Tract 5205, Harris County, Texas	15	347	347	0	165	63	0	63
Block Group 3, Census Tract 5205, Harris County, Texas	0	0	0	0	38	15	0	15
Block Group 4, Census Tract 5205, Harris County, Texas	69	104	104	0	16	16	16	0
Block Group 1, Census Tract 5206.01, Harris County, Texas	11	653	653	0	111	85	63	22
Block Group 1, Census Tract 5206.02, Harris County, Texas	39	246	246	0	0	0	0	0

Geography	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present: - Non-relatives	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present:	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present: - All relatives	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present: - Non-relatives	Income in the past 12 months below poverty level: - In non-family households and other living arrangement:	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder:	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder: - Living alone	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder: - Not living alone
Block Group 1, Census Tract 5214, Harris County, Texas	59	76	76	0	0	0	0	0
Block Group 2, Census Tract 5214, Harris County, Texas	0	495	495	0	33	33	33	0
Block Group 3, Census Tract 5214, Harris County, Texas	0	0	0	0	9	9	9	0
Block Group 4, Census Tract 5214, Harris County, Texas	132	285	285	0	59	30	0	30
Block Group 4, Census Tract 5215, Harris County, Texas	19	0	0	0	10	10	10	0
Block Group 1, Census Tract 5216, Harris County, Texas	86	80	69	11	16	16	16	0
Block Group 2, Census Tract 5216, Harris County, Texas	0	137	130	7	9	9	9	0
Block Group 1, Census Tract 5217, Harris County, Texas	30	59	59	0	63	14	14	0
Block Group 2, Census Tract 5217, Harris County, Texas	45	475	457	18	140	71	46	25
Block Group 3, Census Tract 5217, Harris County, Texas	0	62	62	0	185	85	71	14

Geography	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present: - Non-relatives	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present:	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present: - All relatives	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present: - Non-relatives	Income in the past 12 months below poverty level: - In non-family households and other living arrangement:	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder:	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder: - Living alone	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder: - Not living alone
Block Group 4, Census Tract 5217, Harris County, Texas	0	112	112	0	32	32	32	0
Block Group 1, Census Tract 5218, Harris County, Texas	0	58	58	0	213	78	63	15
Block Group 3, Census Tract 5301, Harris County, Texas	0	189	112	77	41	41	41	0
Block Group 1, Census Tract 5342.03, Harris County, Texas	0	19	19	0	75	0	0	0
Block Group 1, Census Tract 5401, Harris County, Texas	0	0	0	0	88	71	71	0
Block Group 3, Census Tract 5401, Harris County, Texas	0	0	0	0	20	20	20	0
Block Group 2, Census Tract 5408, Harris County, Texas	0	30	30	0	200	106	106	0
Block Group 2, Census Tract 5409.02, Harris County, Texas	0	0	0	0	0	0	0	0
Block Group 1, Census Tract 5410.01, Harris County, Texas	13	296	296	0	115	35	35	0
Block Group 1, Census Tract 5410.02, Harris County, Texas	0	80	80	0	65	65	65	0

Geography	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present: - Non-relatives	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present:	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present: - All relatives	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present: - Non-relatives	Income in the past 12 months below poverty level: - In non-family households and other living arrangement:	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder:	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder: - Living alone	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder: - Not living alone
Block Group 2, Census Tract 5410.02, Harris County, Texas	0	0	0	0	0	0	0	0
Block Group 1, Census Tract 5410.03, Harris County, Texas	0	64	64	0	34	34	0	34
Block Group 1, Census Tract 5430.01, Harris County, Texas	0	0	0	0	25	0	0	0
Block Group 1, Census Tract 5430.02, Harris County, Texas	0	60	60	0	55	35	35	0
Block Group 2, Census Tract 5430.02, Harris County, Texas	32	216	216	0	22	0	0	0
Block Group 1, Census Tract 5431, Harris County, Texas	30	41	41	0	5	5	5	0
Block Group 6, Census Tract 5517.01, Harris County, Texas	0	0	0	0	0	0	0	0
Block Group 1, Census Tract 5518, Harris County, Texas	0	0	0	0	34	14	14	0
Block Group 3, Census Tract 5518, Harris County, Texas	0	0	0	0	68	9	9	0
Block Group 1, Census Tract 5519, Harris County, Texas	0	0	0	0	55	9	9	0

Geography	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present: - Non-relatives	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present:	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present: - All relatives	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present: - Non-relatives	Income in the past 12 months below poverty level: - In non-family households and other living arrangement:	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder:	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder: - Living alone	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder: - Not living alone
Block Group 2, Census Tract 5519, Harris County, Texas	0	209	209	0	46	29	29	0
Block Group 3, Census Tract 5519, Harris County, Texas	0	285	285	0	222	163	163	0
Block Group 3, Census Tract 5520.01, Harris County, Texas	0	30	30	0	44	44	44	0
Block Group 1, Census Tract 5520.02, Harris County, Texas	44	0	0	0	7	7	7	0
Block Group 1, Census Tract 5521.01, Harris County, Texas	51	75	75	0	180	131	131	0
Block Group 1, Census Tract 5521.03, Harris County, Texas	0	0	0	0	0	0	0	0
Block Group 2, Census Tract 5522, Harris County, Texas	0	129	129	0	113	25	12	13
Block Group 3, Census Tract 5522, Harris County, Texas	0	616	616	0	62	62	62	0
Block Group 2, Census Tract 5544.01, Harris County, Texas	0	0	0	0	0	0	0	0
Block Group 2, Census Tract 5544.02, Harris County, Texas	0	194	194	0	16	13	0	13

Geography	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present: - Non-relatives	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present:	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present: - All relatives	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present: - Non-relatives	Income in the past 12 months below poverty level: - In non-family households and other living arrangement:	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder:	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder: - Living alone	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder: - Not living alone
Block Group 1, Census Tract 5544.03, Harris County, Texas	16	377	377	0	164	22	22	0
Block Group 2, Census Tract 5557.01, Harris County, Texas	0	0	0	0	0	0	0	0
Block Group 1, Census Tract 5560, Harris County, Texas	0	0	0	0	8	8	8	0
Block Group 3, Census Tract 9501, Leon County, Texas	0	220	220	0	25	25	25	0
Block Group 1, Census Tract 9502, Leon County, Texas	0	8	6	2	25	25	25	0
Block Group 2, Census Tract 9502, Leon County, Texas	0	0	0	0	81	30	13	17
Block Group 3, Census Tract 9502, Leon County, Texas	0	0	0	0	74	33	0	33
Block Group 5, Census Tract 9502, Leon County, Texas	0	85	84	1	28	15	12	3
Block Group 2, Census Tract 9503, Leon County, Texas	0	147	147	0	7	7	7	0
Block Group 3, Census Tract 9503, Leon County, Texas	0	10	10	0	72	72	65	7

Geography	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present: - Non-relatives	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present:	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present: - All relatives	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present: - Non-relatives	Income in the past 12 months below poverty level: - In non-family households and other living arrangement:	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder:	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder: - Living alone	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder: - Not living alone
Block Group 4, Census Tract 9503, Leon County, Texas	2	0	0	0	66	61	54	7
Block Group 1, Census Tract 9707, Limestone County, Texas	0	48	48	0	10	10	10	0
Block Group 2, Census Tract 9707, Limestone County, Texas	0	63	63	0	35	35	35	0
Block Group 1, Census Tract 2, Madison County, Texas	0	62	58	4	30	21	15	6
Block Group 1, Census Tract 3, Madison County, Texas	0	80	80	0	42	7	0	7
Block Group 1, Census Tract 9703, Navarro County, Texas	2	42	26	16	18	11	6	5
Block Group 3, Census Tract 9704, Navarro County, Texas	0	57	51	6	90	73	62	11
Block Group 4, Census Tract 9709, Navarro County, Texas	15	387	352	35	16	2	1	1
Block Group 5, Census Tract 9709, Navarro County, Texas	0	186	186	0	53	53	48	5
Block Group 1, Census Tract 9710, Navarro County, Texas	0	71	56	15	92	56	30	26

Geography	Income in the past 12 months below poverty level: - In family households: - In other families: - Male householder, no wife present: - Non-relatives	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present:	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present: - All relatives	Income in the past 12 months below poverty level: - In family households: - In other families: - Female householder, no husband present: - Non-relatives	Income in the past 12 months below poverty level: - In non-family households and other living arrangement:	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder:	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder: - Living alone	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Householder: - Not living alone
Block Group 1, Census Tract 6806, Waller County, Texas	0	111	86	25	50	15	15	0
Block Group 2, Census Tract 6806, Waller County, Texas	0	30	30	0	22	22	22	0

Geography	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Other living arrangement	Income in the past 12 months at or above poverty level:	Income in the past 12 months at or above poverty level: - In family households:	Income in the past 12 months at or above poverty level: - In family households: - In married couple families:	Income in the past 12 months at or above poverty level: - In family households: - In married couple families: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In married couple families: - Non-relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present: - Non-relatives
Block Group 2, Census Tract 20, Dallas County, Texas	13	518	339	84	84	0	255	53	35	18
Block Group 1, Census Tract 34, Dallas County, Texas	44	421	333	171	162	9	162	73	73	0
Block Group 2, Census Tract 34, Dallas County, Texas	40	389	182	133	133	0	49	34	34	0
Block Group 1, Census Tract 40, Dallas County, Texas	0	188	90	27	27	0	63	0	0	0
Block Group 2, Census Tract 40, Dallas County, Texas	20	325	204	31	31	0	173	58	37	21
Block Group 2, Census Tract 41, Dallas County, Texas	0	240	224	88	88	0	136	62	62	0
Block Group 1, Census Tract 86.03, Dallas County, Texas	0	417	361	205	205	0	156	0	0	0
Block Group 1, Census Tract 86.04, Dallas County, Texas	0	886	773	277	277	0	496	172	156	16
Block Group 2, Census Tract 86.04, Dallas County, Texas	42	464	271	111	111	0	160	82	82	0
Block Group 1, Census Tract 87.01, Dallas County, Texas	0	220	174	33	33	0	141	20	20	0

Geography	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Other living arrangement	Income in the past 12 months at or above poverty level:	Income in the past 12 months at or above poverty level: - In family households:	Income in the past 12 months at or above poverty level: - In family households: - In married couple families:	Income in the past 12 months at or above poverty level: - In family households: - In married couple families: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In married couple families: - Non-relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present: - Non-relatives
Block Group 2, Census Tract 87.01, Dallas County, Texas	36	422	367	130	130	0	237	50	50	0
Block Group 4, Census Tract 87.01, Dallas County, Texas	0	387	348	63	63	0	285	14	14	0
Block Group 5, Census Tract 87.01, Dallas County, Texas	68	513	393	100	100	0	293	29	29	0
Block Group 1, Census Tract 89, Dallas County, Texas	0	714	689	153	153	0	536	189	171	18
Block Group 1, Census Tract 100, Dallas County, Texas	63	1432	319	178	178	0	141	106	106	0
Block Group 1, Census Tract 114.01, Dallas County, Texas	13	834	680	251	251	0	429	99	99	0
Block Group 3, Census Tract 115, Dallas County, Texas	0	147	139	97	97	0	42	42	42	0
Block Group 4, Census Tract 115, Dallas County, Texas	0	467	419	150	150	0	269	95	95	0
Block Group 1, Census Tract 167.03, Dallas County, Texas	0	1091	1074	473	473	0	601	467	467	0
Block Group 2, Census Tract 168.02, Dallas County, Texas	0	1533	1412	1115	1115	0	297	45	45	0

Geography	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Other living arrangement	Income in the past 12 months at or above poverty level:	Income in the past 12 months at or above poverty level: - In family households:	Income in the past 12 months at or above poverty level: - In family households: - In married couple families:	Income in the past 12 months at or above poverty level: - In family households: - In married couple families: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In married couple families: - Non-relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present: - Non-relatives
Block Group 1, Census Tract 169.02, Dallas County, Texas	33	1194	1004	651	651	0	353	102	102	0
Block Group 2, Census Tract 169.02, Dallas County, Texas	10	1305	1160	970	970	0	190	162	131	31
Block Group 3, Census Tract 169.03, Dallas County, Texas	0	835	747	624	624	0	123	43	34	9
Block Group 5, Census Tract 169.03, Dallas County, Texas	0	698	598	403	403	0	195	195	186	9
Block Group 1, Census Tract 202, Dallas County, Texas	0	259	226	71	71	0	155	0	0	0
Block Group 2, Census Tract 202, Dallas County, Texas	18	1431	1272	681	681	0	591	219	219	0
Block Group 3, Census Tract 202, Dallas County, Texas	78	696	622	296	296	0	326	76	76	0
Block Group 1, Census Tract 204, Dallas County, Texas	345	878	490	408	408	0	82	0	0	0
Block Group 3, Census Tract 204, Dallas County, Texas	375	1836	609	470	470	0	139	119	104	15
Block Group 1, Census Tract 601.01, Ellis County, Texas	0	2471	2354	2003	2003	0	351	152	152	0

Geography	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Other living arrangement	Income in the past 12 months at or above poverty level:	Income in the past 12 months at or above poverty level: - In family households:	Income in the past 12 months at or above poverty level: - In family households: - In married couple families:	Income in the past 12 months at or above poverty level: - In family households: - In married couple families: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In married couple families: - Non-relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present: - Non-relatives
Block Group 2, Census Tract 601.01, Ellis County, Texas	0	1172	1156	952	952	0	204	79	68	11
Block Group 1, Census Tract 601.02, Ellis County, Texas	43	2475	2226	2088	2070	18	138	36	36	0
Block Group 3, Census Tract 601.02, Ellis County, Texas	14	2765	2599	2049	2049	0	550	175	155	20
Block Group 1, Census Tract 602.10, Ellis County, Texas	0	879	847	667	667	0	180	18	18	0
Block Group 1, Census Tract 611, Ellis County, Texas	1	1351	1243	1063	1063	0	180	74	74	0
Block Group 1, Census Tract 612, Ellis County, Texas	16	649	583	465	465	0	118	27	27	0
Block Group 2, Census Tract 612, Ellis County, Texas	13	1029	967	840	840	0	127	14	14	0
Block Group 1, Census Tract 613, Ellis County, Texas	7	774	721	570	570	0	151	25	9	16
Block Group 2, Census Tract 613, Ellis County, Texas	0	1047	915	739	739	0	176	69	52	17
Block Group 1, Census Tract 1, Freestone County, Texas	0	2251	2004	1389	1389	0	615	42	42	0

Geography	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Other living arrangement	Income in the past 12 months at or above poverty level:	Income in the past 12 months at or above poverty level: - In family households:	Income in the past 12 months at or above poverty level: - In family households: - In married couple families:	Income in the past 12 months at or above poverty level: - In family households: - In married couple families: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In married couple families: - Non-relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present: - Non-relatives
Block Group 2, Census Tract 1, Freestone County, Texas	0	2081	1824	1479	1479	0	345	168	168	0
Block Group 1, Census Tract 3, Freestone County, Texas	15	844	719	366	366	0	353	189	189	0
Block Group 2, Census Tract 4, Freestone County, Texas	7	1304	1158	835	835	0	323	19	16	3
Block Group 1, Census Tract 6, Freestone County, Texas	0	622	553	338	338	0	215	29	29	0
Block Group 2, Census Tract 6, Freestone County, Texas	0	860	779	750	750	0	29	0	0	0
Block Group 3, Census Tract 6, Freestone County, Texas	10	1524	1314	1134	1134	0	180	76	76	0
Block Group 1, Census Tract 1801.02, Grimes County, Texas	10	1311	1256	1077	1077	0	179	37	37	0
Block Group 2, Census Tract 1801.02, Grimes County, Texas	74	1358	1211	1014	1014	0	197	22	22	0
Block Group 5, Census Tract 1802, Grimes County, Texas	1	1201	1040	822	822	0	218	25	25	0
Block Group 1, Census Tract 1803.01, Grimes County, Texas	0	1373	1257	1173	1173	0	84	41	41	0

Geography	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Other living arrangement	Income in the past 12 months at or above poverty level:	Income in the past 12 months at or above poverty level: - In family households:	Income in the past 12 months at or above poverty level: - In family households: - In married couple families:	Income in the past 12 months at or above poverty level: - In family households: - In married couple families: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In married couple families: - Non-relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present: - Non-relatives
Block Group 2, Census Tract 1803.01, Grimes County, Texas	4	1169	1060	869	869	0	191	140	130	10
Block Group 1, Census Tract 1803.02, Grimes County, Texas	29	1460	1220	1075	1068	7	145	42	40	2
Block Group 2, Census Tract 1803.02, Grimes County, Texas	0	1395	1275	544	544	0	731	169	169	0
Block Group 1, Census Tract 4301, Harris County, Texas	0	788	467	222	222	0	245	0	0	0
Block Group 2, Census Tract 4301, Harris County, Texas	16	1581	1373	1239	1239	0	134	0	0	0
Block Group 5, Census Tract 4301, Harris County, Texas	5	901	527	456	456	0	71	0	0	0
Block Group 4, Census Tract 5108, Harris County, Texas	21	844	615	589	589	0	26	0	0	0
Block Group 2, Census Tract 5109, Harris County, Texas	27	3031	1743	1111	1111	0	632	480	389	91
Block Group 1, Census Tract 5110.01, Harris County, Texas	85	1466	976	918	918	0	58	22	22	0
Block Group 2, Census Tract 5110.01, Harris County, Texas	25	967	699	466	466	0	233	54	54	0

Geography	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Other living arrangement	Income in the past 12 months at or above poverty level:	Income in the past 12 months at or above poverty level: - In family households:	Income in the past 12 months at or above poverty level: - In family households: - In married couple families:	Income in the past 12 months at or above poverty level: - In family households: - In married couple families: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In married couple families: - Non-relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present: - Non-relatives
Block Group 1, Census Tract 5201, Harris County, Texas	28	2020	1596	1348	1318	30	248	86	86	0
Block Group 1, Census Tract 5203, Harris County, Texas	18	1900	1700	1139	1139	0	561	0	0	0
Block Group 1, Census Tract 5204, Harris County, Texas	82	712	477	266	266	0	211	190	164	26
Block Group 2, Census Tract 5204, Harris County, Texas	0	1338	1081	871	871	0	210	21	21	0
Block Group 1, Census Tract 5205, Harris County, Texas	16	1079	914	848	848	0	66	0	0	0
Block Group 2, Census Tract 5205, Harris County, Texas	102	2373	1622	1229	1227	2	393	0	0	0
Block Group 3, Census Tract 5205, Harris County, Texas	23	1222	1131	1011	1011	0	120	25	18	7
Block Group 4, Census Tract 5205, Harris County, Texas	0	1324	1276	753	753	0	523	130	130	0
Block Group 1, Census Tract 5206.01, Harris County, Texas	26	1342	1095	679	679	0	416	86	86	0
Block Group 1, Census Tract 5206.02, Harris County, Texas	0	466	466	96	96	0	370	126	126	0

Geography	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Other living arrangement	Income in the past 12 months at or above poverty level:	Income in the past 12 months at or above poverty level: - In family households:	Income in the past 12 months at or above poverty level: - In family households: - In married couple families:	Income in the past 12 months at or above poverty level: - In family households: - In married couple families: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In married couple families: - Non-relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present: - Non-relatives
Block Group 1, Census Tract 5214, Harris County, Texas	0	906	663	563	563	0	100	100	100	0
Block Group 2, Census Tract 5214, Harris County, Texas	0	712	491	246	246	0	245	131	131	0
Block Group 3, Census Tract 5214, Harris County, Texas	0	1166	1092	951	931	20	141	63	63	0
Block Group 4, Census Tract 5214, Harris County, Texas	29	1483	1383	254	254	0	1129	571	529	42
Block Group 4, Census Tract 5215, Harris County, Texas	0	2030	1889	1433	1417	16	456	151	151	0
Block Group 1, Census Tract 5216, Harris County, Texas	0	2050	1922	1274	1274	0	648	548	530	18
Block Group 2, Census Tract 5216, Harris County, Texas	0	917	811	643	630	13	168	109	109	0
Block Group 1, Census Tract 5217, Harris County, Texas	49	969	427	168	168	0	259	70	70	0
Block Group 2, Census Tract 5217, Harris County, Texas	69	1113	850	376	376	0	474	0	0	0
Block Group 3, Census Tract 5217, Harris County, Texas	100	1153	826	502	502	0	324	80	37	43

Geography	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Other living arrangement	Income in the past 12 months at or above poverty level:	Income in the past 12 months at or above poverty level: - In family households:	Income in the past 12 months at or above poverty level: - In family households: - In married couple families:	Income in the past 12 months at or above poverty level: - In family households: - In married couple families: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In married couple families: - Non-relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present: - Non-relatives
Block Group 4, Census Tract 5217, Harris County, Texas	0	1257	920	553	553	0	367	45	45	0
Block Group 1, Census Tract 5218, Harris County, Texas	135	1933	1539	1231	1231	0	308	0	0	0
Block Group 3, Census Tract 5301, Harris County, Texas	0	589	558	181	181	0	377	89	58	31
Block Group 1, Census Tract 5342.03, Harris County, Texas	75	1515	1330	751	751	0	579	4	0	4
Block Group 1, Census Tract 5401, Harris County, Texas	17	7245	6736	5981	5981	0	755	136	97	39
Block Group 3, Census Tract 5401, Harris County, Texas	0	1633	1495	1254	1254	0	241	0	0	0
Block Group 2, Census Tract 5408, Harris County, Texas	94	2790	2583	2169	2169	0	414	71	42	29
Block Group 2, Census Tract 5409.02, Harris County, Texas	0	2428	1815	1636	1636	0	179	0	0	0
Block Group 1, Census Tract 5410.01, Harris County, Texas	80	7339	6491	4951	4951	0	1540	259	214	45
Block Group 1, Census Tract 5410.02, Harris County, Texas	0	6481	6241	4890	4863	27	1351	877	836	41

Geography	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Other living arrangement	Income in the past 12 months at or above poverty level:	Income in the past 12 months at or above poverty level: - In family households:	Income in the past 12 months at or above poverty level: - In family households: - In married couple families:	Income in the past 12 months at or above poverty level: - In family households: - In married couple families: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In married couple families: - Non-relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present: - Non-relatives
Block Group 2, Census Tract 5410.02, Harris County, Texas	0	1493	1424	1402	1402	0	22	0	0	0
Block Group 1, Census Tract 5410.03, Harris County, Texas	0	4339	4044	3560	3552	8	484	0	0	0
Block Group 1, Census Tract 5430.01, Harris County, Texas	25	5737	5538	5436	5436	0	102	58	58	0
Block Group 1, Census Tract 5430.02, Harris County, Texas	20	9424	9026	8585	8585	0	441	40	40	0
Block Group 2, Census Tract 5430.02, Harris County, Texas	22	3227	2968	2344	2344	0	624	97	97	0
Block Group 1, Census Tract 5431, Harris County, Texas	0	2144	2041	1787	1787	0	254	156	117	39
Block Group 6, Census Tract 5517.01, Harris County, Texas	0	2279	1956	1566	1548	18	390	0	0	0
Block Group 1, Census Tract 5518, Harris County, Texas	20	2505	2310	2095	2095	0	215	128	128	0
Block Group 3, Census Tract 5518, Harris County, Texas	59	987	823	731	731	0	92	0	0	0
Block Group 1, Census Tract 5519, Harris County, Texas	46	968	793	724	680	44	69	0	0	0

Geography	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Other living arrangement	Income in the past 12 months at or above poverty level:	Income in the past 12 months at or above poverty level: - In family households:	Income in the past 12 months at or above poverty level: - In family households: - In married couple families:	Income in the past 12 months at or above poverty level: - In family households: - In married couple families: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In married couple families: - Non-relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present: - Non-relatives
Block Group 2, Census Tract 5519, Harris County, Texas	17	1822	1136	583	578	5	553	215	215	0
Block Group 3, Census Tract 5519, Harris County, Texas	59	2054	1356	757	757	0	599	75	75	0
Block Group 3, Census Tract 5520.01, Harris County, Texas	0	2417	2032	1311	1311	0	721	352	332	20
Block Group 1, Census Tract 5520.02, Harris County, Texas	0	1812	1566	1138	1138	0	428	204	204	0
Block Group 1, Census Tract 5521.01, Harris County, Texas	49	3526	3097	2154	2143	11	943	589	565	24
Block Group 1, Census Tract 5521.03, Harris County, Texas	0	1071	1048	797	797	0	251	143	143	0
Block Group 2, Census Tract 5522, Harris County, Texas	88	1378	1077	991	991	0	86	24	24	0
Block Group 3, Census Tract 5522, Harris County, Texas	0	1734	1567	1405	1405	0	162	13	13	0
Block Group 2, Census Tract 5544.01, Harris County, Texas	0	9177	8708	8181	8181	0	527	212	212	0
Block Group 2, Census Tract 5544.02, Harris County, Texas	3	6217	5771	5018	5018	0	753	180	180	0

Geography	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Other living arrangement	Income in the past 12 months at or above poverty level:	Income in the past 12 months at or above poverty level: - In family households:	Income in the past 12 months at or above poverty level: - In family households: - In married couple families:	Income in the past 12 months at or above poverty level: - In family households: - In married couple families: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In married couple families: - Non-relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present: - Non-relatives
Block Group 1, Census Tract 5544.03, Harris County, Texas	142	9006	8547	7401	7401	0	1146	22	22	0
Block Group 2, Census Tract 5557.01, Harris County, Texas	0	4179	4088	3077	3061	16	1011	298	298	0
Block Group 1, Census Tract 5560, Harris County, Texas	0	1198	1124	1089	1089	0	35	35	35	0
Block Group 3, Census Tract 9501, Leon County, Texas	0	2362	2154	1406	1383	23	748	310	310	0
Block Group 1, Census Tract 9502, Leon County, Texas	0	434	390	311	311	0	79	79	77	2
Block Group 2, Census Tract 9502, Leon County, Texas	51	603	439	439	439	0	0	0	0	0
Block Group 3, Census Tract 9502, Leon County, Texas	41	514	491	491	491	0	0	0	0	0
Block Group 5, Census Tract 9502, Leon County, Texas	13	909	833	474	474	0	359	228	222	6
Block Group 2, Census Tract 9503, Leon County, Texas	0	1136	1042	894	883	11	148	95	95	0
Block Group 3, Census Tract 9503, Leon County, Texas	0	1033	958	646	580	66	312	85	66	19

Geography	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Other living arrangement	Income in the past 12 months at or above poverty level:	Income in the past 12 months at or above poverty level: - In family households:	Income in the past 12 months at or above poverty level: - In family households: - In married couple families:	Income in the past 12 months at or above poverty level: - In family households: - In married couple families: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In married couple families: - Non-relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present: - Non-relatives
Block Group 4, Census Tract 9503, Leon County, Texas	5	1728	1478	877	877	0	601	347	347	0
Block Group 1, Census Tract 9707, Limestone County, Texas	0	615	552	506	506	0	46	0	0	0
Block Group 2, Census Tract 9707, Limestone County, Texas	0	815	754	565	565	0	189	47	47	0
Block Group 1, Census Tract 2, Madison County, Texas	9	723	631	528	528	0	103	46	46	0
Block Group 1, Census Tract 3, Madison County, Texas	35	848	754	615	615	0	139	9	9	0
Block Group 1, Census Tract 9703, Navarro County, Texas	7	1321	1285	1001	1001	0	284	10	10	0
Block Group 3, Census Tract 9704, Navarro County, Texas	17	1130	1081	853	853	0	228	27	27	0
Block Group 4, Census Tract 9709, Navarro County, Texas	14	1838	1558	748	748	0	810	219	202	17
Block Group 5, Census Tract 9709, Navarro County, Texas	0	1510	1471	1205	1205	0	266	155	155	0
Block Group 1, Census Tract 9710, Navarro County, Texas	36	1515	1263	947	947	0	316	94	94	0

Geography	Income in the past 12 months below poverty level: - In non-family households and other living arrangement: - Other living arrangement	Income in the past 12 months at or above poverty level:	Income in the past 12 months at or above poverty level: - In family households:	Income in the past 12 months at or above poverty level: - In family households: - In married couple families:	Income in the past 12 months at or above poverty level: - In family households: - In married couple families: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In married couple families: - Non-relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Male householder, no wife present: - Non-relatives
Block Group 1, Census Tract 6806, Waller County, Texas	35	2094	1953	1677	1677	0	276	129	115	14
Block Group 2, Census Tract 6806, Waller County, Texas	0	2336	2108	1992	1992	0	116	38	38	0

Geography	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present: - Non-relatives	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement:	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder:	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder: - Living alone	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder: - Not living alone	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Other living arrangement
Block Group 2, Census Tract 20, Dallas County, Texas	202	188	14	179	179	179	0	0
Block Group 1, Census Tract 34, Dallas County, Texas	89	89	0	88	76	60	16	12
Block Group 2, Census Tract 34, Dallas County, Texas	15	10	5	207	168	127	41	39
Block Group 1, Census Tract 40, Dallas County, Texas	63	63	0	98	81	72	9	17
Block Group 2, Census Tract 40, Dallas County, Texas	115	115	0	121	109	93	16	12
Block Group 2, Census Tract 41, Dallas County, Texas	74	60	14	16	16	16	0	0
Block Group 1, Census Tract 86.03, Dallas County, Texas	156	156	0	56	56	56	0	0
Block Group 1, Census Tract 86.04, Dallas County, Texas	324	324	0	113	113	113	0	0
Block Group 2, Census Tract 86.04, Dallas County, Texas	78	78	0	193	170	143	27	23
Block Group 1, Census Tract 87.01, Dallas County, Texas	121	121	0	46	46	46	0	0

Geography	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present: - Non-relatives	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement:	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder:	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder: - Living alone	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder: - Not living alone	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Other living arrangement
Block Group 2, Census Tract 87.01, Dallas County, Texas	187	159	28	55	55	55	0	0
Block Group 4, Census Tract 87.01, Dallas County, Texas	271	251	20	39	39	39	0	0
Block Group 5, Census Tract 87.01, Dallas County, Texas	264	264	0	120	120	94	26	0
Block Group 1, Census Tract 89, Dallas County, Texas	347	344	3	25	25	25	0	0
Block Group 1, Census Tract 100, Dallas County, Texas	35	35	0	1113	833	569	264	280
Block Group 1, Census Tract 114.01, Dallas County, Texas	330	272	58	154	154	144	10	0
Block Group 3, Census Tract 115, Dallas County, Texas	0	0	0	8	8	8	0	0
Block Group 4, Census Tract 115, Dallas County, Texas	174	174	0	48	42	36	6	6
Block Group 1, Census Tract 167.03, Dallas County, Texas	134	134	0	17	17	17	0	0
Block Group 2, Census Tract 168.02, Dallas County, Texas	252	225	27	121	121	121	0	0

Geography	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present: - Non-relatives	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement:	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder:	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder: - Living alone	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder: - Not living alone	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Other living arrangement
Block Group 1, Census Tract 169.02, Dallas County, Texas	251	237	14	190	145	99	46	45
Block Group 2, Census Tract 169.02, Dallas County, Texas	28	21	7	145	126	97	29	19
Block Group 3, Census Tract 169.03, Dallas County, Texas	80	65	15	88	88	88	0	0
Block Group 5, Census Tract 169.03, Dallas County, Texas	0	0	0	100	88	75	13	12
Block Group 1, Census Tract 202, Dallas County, Texas	155	155	0	33	33	33	0	0
Block Group 2, Census Tract 202, Dallas County, Texas	372	372	0	159	122	89	33	37
Block Group 3, Census Tract 202, Dallas County, Texas	250	230	20	74	42	33	9	32
Block Group 1, Census Tract 204, Dallas County, Texas	82	82	0	388	264	197	67	124
Block Group 3, Census Tract 204, Dallas County, Texas	20	20	0	1227	937	768	169	290
Block Group 1, Census Tract 601.01, Ellis County, Texas	199	187	12	117	102	87	15	15

Geography	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present: - Non-relatives	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement:	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder:	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder: - Living alone	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder: - Not living alone	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Other living arrangement
Block Group 2, Census Tract 601.01, Ellis County, Texas	125	125	0	16	16	16	0	0
Block Group 1, Census Tract 601.02, Ellis County, Texas	102	52	50	249	149	62	87	100
Block Group 3, Census Tract 601.02, Ellis County, Texas	375	369	6	166	150	135	15	16
Block Group 1, Census Tract 602.10, Ellis County, Texas	162	124	38	32	32	32	0	0
Block Group 1, Census Tract 611, Ellis County, Texas	106	80	26	108	104	104	0	4
Block Group 1, Census Tract 612, Ellis County, Texas	91	85	6	66	66	53	13	0
Block Group 2, Census Tract 612, Ellis County, Texas	113	108	5	62	55	37	18	7
Block Group 1, Census Tract 613, Ellis County, Texas	126	119	7	53	40	36	4	13
Block Group 2, Census Tract 613, Ellis County, Texas	107	75	32	132	132	132	0	0
Block Group 1, Census Tract 1, Freestone County, Texas	573	573	0	247	220	199	21	27

Geography	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present: - Non-relatives	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement:	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder:	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder: - Living alone	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder: - Not living alone	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Other living arrangement
Block Group 2, Census Tract 1, Freestone County, Texas	177	177	0	257	233	217	16	24
Block Group 1, Census Tract 3, Freestone County, Texas	164	149	15	125	125	125	0	0
Block Group 2, Census Tract 4, Freestone County, Texas	304	282	22	146	127	115	12	19
Block Group 1, Census Tract 6, Freestone County, Texas	186	186	0	69	55	39	16	14
Block Group 2, Census Tract 6, Freestone County, Texas	29	29	0	81	60	40	20	21
Block Group 3, Census Tract 6, Freestone County, Texas	104	104	0	210	210	202	8	0
Block Group 1, Census Tract 1801.02, Grimes County, Texas	142	137	5	55	55	55	0	0
Block Group 2, Census Tract 1801.02, Grimes County, Texas	175	175	0	147	147	95	52	0
Block Group 5, Census Tract 1802, Grimes County, Texas	193	193	0	161	154	146	8	7
Block Group 1, Census Tract 1803.01, Grimes County, Texas	43	43	0	116	93	78	15	23

Geography	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present: - Non-relatives	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement:	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder:	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder: - Living alone	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder: - Not living alone	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Other living arrangement
Block Group 2, Census Tract 1803.01, Grimes County, Texas	51	46	5	109	87	62	25	22
Block Group 1, Census Tract 1803.02, Grimes County, Texas	103	100	3	240	213	147	66	27
Block Group 2, Census Tract 1803.02, Grimes County, Texas	562	562	0	120	120	120	0	0
Block Group 1, Census Tract 4301, Harris County, Texas	245	208	37	321	282	245	37	39
Block Group 2, Census Tract 4301, Harris County, Texas	134	134	0	208	208	208	0	0
Block Group 5, Census Tract 4301, Harris County, Texas	71	71	0	374	351	351	0	23
Block Group 4, Census Tract 5108, Harris County, Texas	26	26	0	229	229	208	21	0
Block Group 2, Census Tract 5109, Harris County, Texas	152	152	0	1288	808	394	414	480
Block Group 1, Census Tract 5110.01, Harris County, Texas	36	36	0	490	447	370	77	43
Block Group 2, Census Tract 5110.01, Harris County, Texas	179	179	0	268	242	193	49	26

Geography	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present: - Non-relatives	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement:	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder:	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder: - Living alone	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder: - Not living alone	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Other living arrangement
Block Group 1, Census Tract 5201, Harris County, Texas	162	162	0	424	332	263	69	92
Block Group 1, Census Tract 5203, Harris County, Texas	561	549	12	200	200	190	10	0
Block Group 1, Census Tract 5204, Harris County, Texas	21	16	5	235	96	39	57	139
Block Group 2, Census Tract 5204, Harris County, Texas	189	151	38	257	170	127	43	87
Block Group 1, Census Tract 5205, Harris County, Texas	66	66	0	165	51	40	11	114
Block Group 2, Census Tract 5205, Harris County, Texas	393	393	0	751	486	228	258	265
Block Group 3, Census Tract 5205, Harris County, Texas	95	95	0	91	91	91	0	0
Block Group 4, Census Tract 5205, Harris County, Texas	393	393	0	48	48	48	0	0
Block Group 1, Census Tract 5206.01, Harris County, Texas	330	290	40	247	158	112	46	89
Block Group 1, Census Tract 5206.02, Harris County, Texas	244	244	0	0	0	0	0	0

Geography	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present: - Non-relatives	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement:	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder:	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder: - Living alone	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder: - Not living alone	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Other living arrangement
Block Group 1, Census Tract 5214, Harris County, Texas	0	0	0	243	157	98	59	86
Block Group 2, Census Tract 5214, Harris County, Texas	114	0	114	221	106	15	91	115
Block Group 3, Census Tract 5214, Harris County, Texas	78	78	0	74	63	53	10	11
Block Group 4, Census Tract 5214, Harris County, Texas	558	504	54	100	100	100	0	0
Block Group 4, Census Tract 5215, Harris County, Texas	305	305	0	141	119	96	23	22
Block Group 1, Census Tract 5216, Harris County, Texas	100	100	0	128	93	85	8	35
Block Group 2, Census Tract 5216, Harris County, Texas	59	59	0	106	106	106	0	0
Block Group 1, Census Tract 5217, Harris County, Texas	189	159	30	542	516	470	46	26
Block Group 2, Census Tract 5217, Harris County, Texas	474	424	50	263	212	169	43	51
Block Group 3, Census Tract 5217, Harris County, Texas	244	244	0	327	191	102	89	136

Geography	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present: - Non-relatives	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement:	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder:	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder: - Living alone	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder: - Not living alone	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Other living arrangement
Block Group 4, Census Tract 5217, Harris County, Texas	322	306	16	337	251	189	62	86
Block Group 1, Census Tract 5218, Harris County, Texas	308	280	28	394	312	217	95	82
Block Group 3, Census Tract 5301, Harris County, Texas	288	288	0	31	31	31	0	0
Block Group 1, Census Tract 5342.03, Harris County, Texas	575	543	32	185	174	133	41	11
Block Group 1, Census Tract 5401, Harris County, Texas	619	580	39	509	382	260	122	127
Block Group 3, Census Tract 5401, Harris County, Texas	241	208	33	138	123	108	15	15
Block Group 2, Census Tract 5408, Harris County, Texas	343	333	10	207	191	104	87	16
Block Group 2, Census Tract 5409.02, Harris County, Texas	179	179	0	613	572	535	37	41
Block Group 1, Census Tract 5410.01, Harris County, Texas	1281	1236	45	848	684	496	188	164
Block Group 1, Census Tract 5410.02, Harris County, Texas	474	422	52	240	213	187	26	27

Geography	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present: - Non-relatives	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement:	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder:	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder: - Living alone	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder: - Not living alone	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Other living arrangement
Block Group 2, Census Tract 5410.02, Harris County, Texas	22	22	0	69	69	69	0	0
Block Group 1, Census Tract 5410.03, Harris County, Texas	484	360	124	295	240	224	16	55
Block Group 1, Census Tract 5430.01, Harris County, Texas	44	33	11	199	180	147	33	19
Block Group 1, Census Tract 5430.02, Harris County, Texas	401	362	39	398	314	214	100	84
Block Group 2, Census Tract 5430.02, Harris County, Texas	527	476	51	259	259	242	17	0
Block Group 1, Census Tract 5431, Harris County, Texas	98	93	5	103	67	34	33	36
Block Group 6, Census Tract 5517.01, Harris County, Texas	390	390	0	323	274	225	49	49
Block Group 1, Census Tract 5518, Harris County, Texas	87	87	0	195	181	162	19	14
Block Group 3, Census Tract 5518, Harris County, Texas	92	92	0	164	155	105	50	9
Block Group 1, Census Tract 5519, Harris County, Texas	69	69	0	175	175	137	38	0

Geography	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present: - Non-relatives	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement:	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder:	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder: - Living alone	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder: - Not living alone	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Other living arrangement
Block Group 2, Census Tract 5519, Harris County, Texas	338	313	25	686	632	580	52	54
Block Group 3, Census Tract 5519, Harris County, Texas	524	485	39	698	670	611	59	28
Block Group 3, Census Tract 5520.01, Harris County, Texas	369	323	46	385	385	385	0	0
Block Group 1, Census Tract 5520.02, Harris County, Texas	224	213	11	246	175	126	49	71
Block Group 1, Census Tract 5521.01, Harris County, Texas	354	330	24	429	357	284	73	72
Block Group 1, Census Tract 5521.03, Harris County, Texas	108	97	11	23	23	23	0	0
Block Group 2, Census Tract 5522, Harris County, Texas	62	62	0	301	296	245	51	5
Block Group 3, Census Tract 5522, Harris County, Texas	149	124	25	167	118	85	33	49
Block Group 2, Census Tract 5544.01, Harris County, Texas	315	315	0	469	339	229	110	130
Block Group 2, Census Tract 5544.02, Harris County, Texas	573	504	69	446	308	223	85	138

Geography	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present: - Non-relatives	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement:	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder:	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder: - Living alone	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder: - Not living alone	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Other living arrangement
Block Group 1, Census Tract 5544.03, Harris County, Texas	1124	1018	106	459	424	302	122	35
Block Group 2, Census Tract 5557.01, Harris County, Texas	713	713	0	91	91	91	0	0
Block Group 1, Census Tract 5560, Harris County, Texas	0	0	0	74	74	74	0	0
Block Group 3, Census Tract 9501, Leon County, Texas	438	417	21	208	183	157	26	25
Block Group 1, Census Tract 9502, Leon County, Texas	0	0	0	44	44	44	0	0
Block Group 2, Census Tract 9502, Leon County, Texas	0	0	0	164	138	113	25	26
Block Group 3, Census Tract 9502, Leon County, Texas	0	0	0	23	23	23	0	0
Block Group 5, Census Tract 9502, Leon County, Texas	131	131	0	76	56	49	7	20
Block Group 2, Census Tract 9503, Leon County, Texas	53	45	8	94	94	94	0	0
Block Group 3, Census Tract 9503, Leon County, Texas	227	221	6	75	57	57	0	18

Geography	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present: - Non-relatives	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement:	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder:	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder: - Living alone	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder: - Not living alone	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Other living arrangement
Block Group 4, Census Tract 9503, Leon County, Texas	254	254	0	250	176	132	44	74
Block Group 1, Census Tract 9707, Limestone County, Texas	46	38	8	63	63	63	0	0
Block Group 2, Census Tract 9707, Limestone County, Texas	142	142	0	61	61	61	0	0
Block Group 1, Census Tract 2, Madison County, Texas	57	46	11	92	92	88	4	0
Block Group 1, Census Tract 3, Madison County, Texas	130	117	13	94	88	67	21	6
Block Group 1, Census Tract 9703, Navarro County, Texas	274	260	14	36	36	36	0	0
Block Group 3, Census Tract 9704, Navarro County, Texas	201	193	8	49	47	41	6	2
Block Group 4, Census Tract 9709, Navarro County, Texas	591	508	83	280	247	216	31	33
Block Group 5, Census Tract 9709, Navarro County, Texas	111	105	6	39	32	31	1	7
Block Group 1, Census Tract 9710, Navarro County, Texas	222	200	22	252	207	146	61	45

Geography	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present:	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present: - All relatives	Income in the past 12 months at or above poverty level: - In family households: - In other families: - Female householder, no husband present: - Non-relatives	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement:	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder:	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder: - Living alone	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Householder: - Not living alone	Income in the past 12 months at or above poverty level: - In non-family households and other living arrangement: - Other living arrangement
Block Group 1, Census Tract 6806, Waller County, Texas	147	125	22	141	103	79	24	38
Block Group 2, Census Tract 6806, Waller County, Texas	78	78	0	228	115	76	39	113

Socioeconomic:
Percent Minority, Percent Hispanic, Percent Poverty, Median Income within the Study Area by Block Group and Census Tract, County:

Selected Demographic Characteristics for Block Groups along Each Segment						
Geography	2014 Population	Percent Minority Population	Percent Hispanic Origin	Percent Individuals Below Poverty Level	Median Household Income	Segment
Block Group 2, Census Tract 20, Dallas County, Texas	652	47%	33%	18%	17,737	Segment 1
Block Group 1, Census Tract 34, Dallas County, Texas	653	93%	9%	33%	32,292	Segment 1
Block Group 2, Census Tract 34, Dallas County, Texas	730	68%	20%	46%	25,425	Segment 1
Block Group 1, Census Tract 40, Dallas County, Texas	397	73%	4%	53%	21,042	Segment 1
Block Group 2, Census Tract 40, Dallas County, Texas	587	87%	13%	45%	25,069	Segment 1
Block Group 2, Census Tract 41, Dallas County, Texas	535	55%	49%	55%	18,036	Segment 1
Block Group 1, Census Tract 86.03, Dallas County, Texas	912	73%	27%	54%	17,120	Segment 1
Block Group 1, Census Tract 86.04, Dallas County, Texas	1,671	67%	31%	47%	20,913	Segment 1
Block Group 2, Census Tract 86.04, Dallas County, Texas	1,334	91%	10%	65%	10,641	Segment 1
Block Group 1, Census Tract 87.01, Dallas County, Texas	1,192	100%	3%	82%	8,933	Segment 1
Block Group 2, Census Tract 87.01, Dallas County, Texas	727	96%	8%	42%	19,665	Segment 1
Block Group 4, Census Tract 87.01, Dallas County, Texas	501	100%	0%	23%	23,988	Segment 1
Block Group 5, Census Tract 87.01, Dallas County, Texas	1,089	97%	7%	50%	14,663	Segment 1
Block Group 1, Census Tract 89, Dallas County, Texas	1,267	59%	36%	44%	27,353	Segment 1
Block Group 1, Census Tract 100, Dallas County, Texas	9,511	48%	18%	9%	79,063	Segment 1
Block Group 1, Census Tract 114.01, Dallas County, Texas	1,783	90%	7%	50%	19,767	Segment 1
Block Group 3, Census Tract 115, Dallas County, Texas	228	35%	65%	36%	18,438	Segment 1
Block Group 4, Census Tract 115, Dallas County, Texas	789	39%	57%	41%	32,829	Segment 1
Block Group 1, Census Tract 167.03, Dallas County, Texas	1,091	18%	59%	0%	61,146	Segment 1

Selected Demographic Characteristics for Block Groups along Each Segment						
Geography	2014 Population	Percent Minority Population	Percent Hispanic Origin	Percent Individuals Below Poverty Level	Median Household Income	Segment
Block Group 2, Census Tract 168.02, Dallas County, Texas	1,651	64%	20%	7%	65,068	Segment 1
Block Group 1, Census Tract 169.02, Dallas County, Texas	3,294	46%	29%	14%	50,821	Segment 1
Block Group 2, Census Tract 169.02, Dallas County, Texas	1,965	37%	57%	32%	30,972	Segment 1
Block Group 3, Census Tract 169.03, Dallas County, Texas	1,542	36%	30%	26%	52,344	Segment 1
Block Group 5, Census Tract 169.03, Dallas County, Texas	778	35%	34%	10%	50,784	Segment 1
Block Group 1, Census Tract 202, Dallas County, Texas	433	100%	13%	40%	21,618	Segment 1
Block Group 2, Census Tract 202, Dallas County, Texas	2,175	99%	0%	34%	26,083	Segment 1
Block Group 3, Census Tract 202, Dallas County, Texas	1,417	80%	20%	49%	23,214	Segment 1
Block Group 1, Census Tract 204, Dallas County, Texas	1,336	46%	20%	34%	80,921	Segment 1
Block Group 3, Census Tract 204, Dallas County, Texas	2,226	55%	16%	18%	59,355	Segment 1
Block Group 1, Census Tract 601.01, Ellis County, Texas	2,571	15%	30%	4%	66,373	Segment 1
Block Group 2, Census Tract 601.01, Ellis County, Texas	1,381	37%	38%	15%	55,306	Segment 1, 2A, 2B
Block Group 1, Census Tract 601.02, Ellis County, Texas	3,017	29%	67%	14%	53,276	Segment 2A, 2B
Block Group 3, Census Tract 601.02, Ellis County, Texas	3,140	21%	39%	11%	53,125	Segment 2A, 2B
Block Group 1, Census Tract 602.10, Ellis County, Texas	893	7%	21%	2%	82,275	Segment 2A, 2B
Block Group 1, Census Tract 611, Ellis County, Texas	1,584	10%	16%	15%	58,250	Segment 2A, 2B
Block Group 1, Census Tract 612, Ellis County, Texas	756	5%	31%	14%	55,481	Segment 2A, 2B, 3A, 3B, 3C
Block Group 2, Census Tract 612, Ellis County, Texas	1,203	24%	38%	14%	40,735	Segment 2A, 2B, 3A, 3B, 3C
Block Group 1, Census Tract 613, Ellis County, Texas	924	6%	23%	16%	44,638	Segment 2A, 2B

Selected Demographic Characteristics for Block Groups along Each Segment						
Geography	2014 Population	Percent Minority Population	Percent Hispanic Origin	Percent Individuals Below Poverty Level	Median Household Income	Segment
Block Group 2, Census Tract 613, Ellis County, Texas	1,496	8%	39%	30%	47,031	Segment 2A, 2B
Block Group 1, Census Tract 1, Freestone County, Texas	2,781	19%	24%	19%	42,500	Segment 3C
Block Group 2, Census Tract 1, Freestone County, Texas	2,700	9%	16%	21%	45,903	Segment 3C
Block Group 1, Census Tract 3, Freestone County, Texas	1,031	41%	20%	16%	35,200	Segment 3C
Block Group 2, Census Tract 4, Freestone County, Texas	1,476	24%	4%	10%	39,886	Segment 3A, 3B, 3C, 4
Block Group 1, Census Tract 6, Freestone County, Texas	671	0%	2%	7%	51,324	Segment 4
Block Group 2, Census Tract 6, Freestone County, Texas	930	5%	4%	4%	51,130	Segment 3C, 4
Block Group 3, Census Tract 6, Freestone County, Texas	2,907	22%	16%	6%	52,184	Segment 3C
Block Group 1, Census Tract 1801.02, Grimes County, Texas	1,788	18%	12%	27%	60,352	Segment 5
Block Group 2, Census Tract 1801.02, Grimes County, Texas	1,669	14%	16%	19%	43,050	Segment 5
Block Group 5, Census Tract 1802, Grimes County, Texas	1,250	29%	7%	4%	40,813	Segment 5
Block Group 1, Census Tract 1803.01, Grimes County, Texas	1,425	29%	21%	4%	44,107	Segment 5
Block Group 2, Census Tract 1803.01, Grimes County, Texas	1,254	6%	11%	7%	66,307	Segment 3C, 4, 5
Block Group 1, Census Tract 1803.02, Grimes County, Texas	1,848	14%	2%	21%	58,387	Segment 3C, 4, 5
Block Group 2, Census Tract 1803.02, Grimes County, Texas	1,595	12%	18%	13%	49,583	Segment 5
Block Group 1, Census Tract 4301, Harris County, Texas	813	10%	9%	3%	90,417	Northwest Transit Center Terminal Option
Block Group 2, Census Tract 4301, Harris County, Texas	1,658	12%	3%	1%	106,731	Northwest Transit Center Terminal Option
Block Group 5, Census Tract 4301, Harris County, Texas	1,104	9%	4%	7%	59,712	Northwest Transit Center Terminal Option
Block Group 4, Census Tract 5108, Harris County, Texas	865	17%	0%	2%	220,119	Northwest Transit Center Terminal Option

Selected Demographic Characteristics for Block Groups along Each Segment						
Geography	2014 Population	Percent Minority Population	Percent Hispanic Origin	Percent Individuals Below Poverty Level	Median Household Income	Segment
Block Group 2, Census Tract 5109, Harris County, Texas	3,703	19%	28%	18%	119,462	Industrial Site Terminal Option, Northwest Mall Terminal Option, Northwest Transit Center Terminal Option
Block Group 1, Census Tract 5110.01, Harris County, Texas	1,551	9%	25%	5%	80,186	Northwest Mall Terminal Option, Northwest Transit Center Terminal Option
Block Group 2, Census Tract 5110.01, Harris County, Texas	1,005	9%	28%	4%	56,471	Industrial Site Terminal Option, Northwest Mall Terminal Option, Northwest Transit Center Terminal Option
Block Group 1, Census Tract 5201, Harris County, Texas	2,439	21%	43%	16%	75,417	Segment 5, Industrial Site Terminal Option, Northwest Mall Terminal Option, Northwest Transit Center Terminal Option
Block Group 1, Census Tract 5203, Harris County, Texas	2,264	33%	76%	16%	36,540	Segment 5, Industrial Site Terminal Option, Northwest Mall Terminal Option, Northwest Transit Center Terminal Option
Block Group 1, Census Tract 5204, Harris County, Texas	1,383	43%	83%	48%	36,250	Segment 5
Block Group 2, Census Tract 5204, Harris County, Texas	2,156	29%	73%	38%	30,625	Segment 5, Industrial Site Terminal Option, Northwest Mall Terminal Option, Northwest Transit Center Terminal Option
Block Group 1, Census Tract 5205, Harris County, Texas	1,439	18%	87%	24%	31,163	Segment 5, Industrial Site Terminal Option, Northwest Mall Terminal Option, Northwest Transit Center Terminal Option
Block Group 2, Census Tract 5205, Harris County, Texas	3,471	32%	72%	32%	33,643	Segment 5
Block Group 3, Census Tract 5205, Harris County, Texas	1,691	18%	82%	28%	49,457	Segment 5
Block Group 4, Census Tract 5205, Harris County, Texas	1,732	17%	62%	24%	29,201	Segment 5
Block Group 1, Census Tract 5206.01, Harris County, Texas	2,331	32%	85%	42%	31,538	Segment 5
Block Group 1, Census Tract 5206.02, Harris County, Texas	1,024	47%	100%	54%	19,620	Segment 5
Block Group 1, Census Tract 5214, Harris County, Texas	1,203	74%	98%	25%	26,915	Segment 5
Block Group 2, Census Tract 5214, Harris County, Texas	1,566	74%	97%	52%	34,614	Segment 5

Selected Demographic Characteristics for Block Groups along Each Segment						
Geography	2014 Population	Percent Minority Population	Percent Hispanic Origin	Percent Individuals Below Poverty Level	Median Household Income	Segment
Block Group 3, Census Tract 5214, Harris County, Texas	1,660	29%	83%	30%	52,625	Segment 5
Block Group 4, Census Tract 5214, Harris County, Texas	2,727	64%	97%	44%	24,577	Segment 5
Block Group 4, Census Tract 5215, Harris County, Texas	2,204	35%	50%	8%	59,773	Segment 5
Block Group 1, Census Tract 5216, Harris County, Texas	2,400	19%	80%	15%	56,250	Segment 5
Block Group 2, Census Tract 5216, Harris County, Texas	1,173	43%	66%	22%	37,083	Segment 5
Block Group 1, Census Tract 5217, Harris County, Texas	1,414	30%	72%	31%	27,334	Segment 5
Block Group 2, Census Tract 5217, Harris County, Texas	2,387	56%	58%	53%	29,340	Segment 5
Block Group 3, Census Tract 5217, Harris County, Texas	1,822	45%	60%	37%	25,389	Segment 5
Block Group 4, Census Tract 5217, Harris County, Texas	1,401	58%	34%	10%	42,328	Segment 5
Block Group 1, Census Tract 5218, Harris County, Texas	2,459	42%	44%	21%	48,807	Segment 5
Block Group 3, Census Tract 5301, Harris County, Texas	819	13%	80%	28%	27,212	Industrial Site Terminal Option, Northwest Mall Terminal Option, Northwest Transit Center Terminal Option
Block Group 1, Census Tract 5342.03, Harris County, Texas	1,772	55%	39%	8%	63,353	Segment 5
Block Group 1, Census Tract 5401, Harris County, Texas	7,658	41%	14%	4%	123,771	Segment 5
Block Group 3, Census Tract 5401, Harris County, Texas	1,653	34%	82%	1%	66,444	Segment 5
Block Group 2, Census Tract 5408, Harris County, Texas	3,294	36%	45%	15%	45,500	Segment 5
Block Group 2, Census Tract 5409.02, Harris County, Texas	2,428	46%	12%	0%	42,378	Segment 5
Block Group 1, Census Tract 5410.01, Harris County, Texas	8,473	46%	27%	13%	72,836	Segment 5
Block Group 1, Census Tract 5410.02, Harris County, Texas	7,007	44%	18%	7%	95,665	Segment 5

Selected Demographic Characteristics for Block Groups along Each Segment						
Geography	2014 Population	Percent Minority Population	Percent Hispanic Origin	Percent Individuals Below Poverty Level	Median Household Income	Segment
Block Group 2, Census Tract 5410.02, Harris County, Texas	1,493	23%	47%	0%	157,500	Segment 5
Block Group 1, Census Tract 5410.03, Harris County, Texas	4,913	52%	27%	12%	107,941	Segment 5
Block Group 1, Census Tract 5430.01, Harris County, Texas	5,848	29%	17%	2%	142,747	Segment 5
Block Group 1, Census Tract 5430.02, Harris County, Texas	9,606	34%	18%	2%	119,185	Segment 5
Block Group 2, Census Tract 5430.02, Harris County, Texas	3,680	29%	34%	11%	126,934	Segment 5
Block Group 1, Census Tract 5431, Harris County, Texas	2,785	15%	43%	21%	70,951	Segment 5
Block Group 6, Census Tract 5517.01, Harris County, Texas	2,279	34%	33%	0%	78,468	Segment 5
Block Group 1, Census Tract 5518, Harris County, Texas	2,540	14%	9%	1%	126,000	Segment 5
Block Group 3, Census Tract 5518, Harris County, Texas	1,055	4%	2%	6%	80,104	Segment 5
Block Group 1, Census Tract 5519, Harris County, Texas	1,023	27%	37%	5%	42,212	Segment 5
Block Group 2, Census Tract 5519, Harris County, Texas	2,305	58%	38%	20%	40,286	Segment 5
Block Group 3, Census Tract 5519, Harris County, Texas	2,823	49%	38%	27%	36,478	Segment 5
Block Group 3, Census Tract 5520.01, Harris County, Texas	2,491	48%	50%	3%	49,005	Segment 5
Block Group 1, Census Tract 5520.02, Harris County, Texas	1,926	34%	20%	6%	74,219	Segment 5
Block Group 1, Census Tract 5521.01, Harris County, Texas	3,842	47%	27%	8%	60,820	Segment 5
Block Group 1, Census Tract 5521.03, Harris County, Texas	1,071	21%	19%	0%	87,639	Segment 5
Block Group 2, Census Tract 5522, Harris County, Texas	1,620	15%	34%	15%	59,000	Segment 5
Block Group 3, Census Tract 5522, Harris County, Texas	2,412	64%	25%	28%	52,593	Segment 5
Block Group 2, Census Tract 5544.01, Harris County, Texas	9,344	7%	11%	2%	137,900	Segment 5

Selected Demographic Characteristics for Block Groups along Each Segment						
Geography	2014 Population	Percent Minority Population	Percent Hispanic Origin	Percent Individuals Below Poverty Level	Median Household Income	Segment
Block Group 2, Census Tract 5544.02, Harris County, Texas	6,573	26%	9%	5%	106,859	Segment 5
Block Group 1, Census Tract 5544.03, Harris County, Texas	9,721	17%	22%	6%	85,030	Segment 5
Block Group 2, Census Tract 5557.01, Harris County, Texas	4,213	27%	14%	1%	99,359	Segment 5
Block Group 1, Census Tract 5560, Harris County, Texas	1,284	18%	9%	7%	34,699	Segment 5
Block Group 3, Census Tract 9501, Leon County, Texas	2,679	18%	20%	11%	53,320	Segment 3C
Block Group 1, Census Tract 9502, Leon County, Texas	607	1%	31%	29%	52,232	Segment 4
Block Group 2, Census Tract 9502, Leon County, Texas	735	11%	12%	18%	44,932	Segment 4
Block Group 3, Census Tract 9502, Leon County, Texas	617	1%	0%	17%	135,294	Segment 4
Block Group 5, Census Tract 9502, Leon County, Texas	1,083	20%	6%	16%	35,972	Segment 4
Block Group 2, Census Tract 9503, Leon County, Texas	1,320	6%	6%	12%	44,955	Segment 3C
Block Group 3, Census Tract 9503, Leon County, Texas	1,138	22%	0%	9%	41,776	Segment 3C
Block Group 4, Census Tract 9503, Leon County, Texas	1,886	9%	11%	7%	53,448	Segment 3C
Block Group 1, Census Tract 9707, Limestone County, Texas	673	9%	22%	9%	42,679	Segment 4
Block Group 2, Census Tract 9707, Limestone County, Texas	977	0%	0%	17%	43,571	Segment 4
Block Group 1, Census Tract 2, Madison County, Texas	862	6%	11%	15%	42,321	Segment 3C, 4
Block Group 1, Census Tract 3, Madison County, Texas	1,001	2%	4%	15%	47,266	Segment 3C, 4
Block Group 1, Census Tract 9703, Navarro County, Texas	1,418	11%	21%	7%	42,500	Segment 3A, 3B, 3C
Block Group 3, Census Tract 9704, Navarro County, Texas	1,301	6%	5%	13%	48,882	Segment 3A, 3B, 3C
Block Group 4, Census Tract 9709, Navarro County, Texas	2,567	23%	24%	26%	33,709	Segment 3A, 3B, 3C

Selected Demographic Characteristics for Block Groups along Each Segment						
Geography	2014 Population	Percent Minority Population	Percent Hispanic Origin	Percent Individuals Below Poverty Level	Median Household Income	Segment
Block Group 5, Census Tract 9709, Navarro County, Texas	1,769	3%	25%	15%	56,667	Segment 3A, 3B, 3C
Block Group 1, Census Tract 9710, Navarro County, Texas	1,896	5%	24%	20%	37,281	Segment 3A, 3B, 3C, 4
Block Group 1, Census Tract 6806, Waller County, Texas	2,472	6%	32%	15%	65,375	Segment 5
Block Group 2, Census Tract 6806, Waller County, Texas	2,443	9%	20%	4%	67,453	Segment 5

Socioeconomic:
2014 Total and Percent of Children under 18 Years Old –
by Block Group and Census Tract, County

Geography	Total	Total Under 18 Years of Age	Percent Under 18 Years of Age
Block Group 2, Census Tract 20, Dallas County, Texas	589	109	19%
Block Group 1, Census Tract 34, Dallas County, Texas	656	172	26%
Block Group 2, Census Tract 34, Dallas County, Texas	757	172	23%
Block Group 1, Census Tract 40, Dallas County, Texas	420	41	10%
Block Group 2, Census Tract 40, Dallas County, Texas	560	147	26%
Block Group 2, Census Tract 41, Dallas County, Texas	632	255	40%
Block Group 1, Census Tract 86.03, Dallas County, Texas	750	317	42%
Block Group 1, Census Tract 86.04, Dallas County, Texas	1657	706	43%
Block Group 2, Census Tract 86.04, Dallas County, Texas	1203	171	14%
Block Group 1, Census Tract 87.01, Dallas County, Texas	1301	671	52%
Block Group 2, Census Tract 87.01, Dallas County, Texas	615	200	33%
Block Group 4, Census Tract 87.01, Dallas County, Texas	526	77	15%
Block Group 5, Census Tract 87.01, Dallas County, Texas	1249	543	43%
Block Group 1, Census Tract 89, Dallas County, Texas	1123	493	44%
Block Group 1, Census Tract 100, Dallas County, Texas	8977	171	2%
Block Group 1, Census Tract 114.01, Dallas County, Texas	1602	496	31%
Block Group 3, Census Tract 115, Dallas County, Texas	397	125	31%
Block Group 4, Census Tract 115, Dallas County, Texas	902	418	46%
Block Group 1, Census Tract 167.03, Dallas County, Texas	1255	582	46%
Block Group 2, Census Tract 168.02, Dallas County, Texas	1904	594	31%
Block Group 1, Census Tract 169.02, Dallas County, Texas	3060	622	20%
Block Group 2, Census Tract 169.02, Dallas County, Texas	1797	695	39%
Block Group 3, Census Tract 169.03, Dallas County, Texas	1625	337	21%
Block Group 5, Census Tract 169.03, Dallas County, Texas	730	206	28%
Block Group 1, Census Tract 202, Dallas County, Texas	705	238	34%
Block Group 2, Census Tract 202, Dallas County, Texas	1715	215	13%
Block Group 3, Census Tract 202, Dallas County, Texas	1576	555	35%
Block Group 1, Census Tract 204, Dallas County, Texas	1574	231	15%
Block Group 3, Census Tract 204, Dallas County, Texas	2692	31	1%
Block Group 1, Census Tract 601.01, Ellis County, Texas	2980	902	30%
Block Group 2, Census Tract 601.01, Ellis County, Texas	1276	394	31%
Block Group 1, Census Tract 601.02, Ellis County, Texas	2998	1174	39%
Block Group 3, Census Tract 601.02, Ellis County, Texas	3034	1238	41%
Block Group 1, Census Tract 602.10, Ellis County, Texas	935	257	27%
Block Group 1, Census Tract 611, Ellis County, Texas	1548	356	23%
Block Group 1, Census Tract 612, Ellis County, Texas	692	168	24%
Block Group 2, Census Tract 612, Ellis County, Texas	1268	399	31%
Block Group 1, Census Tract 613, Ellis County, Texas	906	229	25%
Block Group 2, Census Tract 613, Ellis County, Texas	1644	622	38%
Block Group 1, Census Tract 1, Freestone County, Texas	2885	903	31%
Block Group 2, Census Tract 1, Freestone County, Texas	2446	535	22%
Block Group 1, Census Tract 3, Freestone County, Texas	1090	307	28%
Block Group 2, Census Tract 4, Freestone County, Texas	1485	434	29%
Block Group 1, Census Tract 6, Freestone County, Texas	642	236	37%
Block Group 2, Census Tract 6, Freestone County, Texas	1068	260	24%
Block Group 3, Census Tract 6, Freestone County, Texas	2958	350	12%
Block Group 1, Census Tract 1801.02, Grimes County, Texas	1457	455	31%
Block Group 2, Census Tract 1801.02, Grimes County, Texas	1699	581	34%
Block Group 5, Census Tract 1802, Grimes County, Texas	1588	337	21%
Block Group 1, Census Tract 1803.01, Grimes County, Texas	1354	348	26%
Block Group 2, Census Tract 1803.01, Grimes County, Texas	985	297	30%
Block Group 1, Census Tract 1803.02, Grimes County, Texas	1562	453	29%
Block Group 2, Census Tract 1803.02, Grimes County, Texas	1752	498	28%
Block Group 1, Census Tract 4301, Harris County, Texas	933	181	19%
Block Group 2, Census Tract 4301, Harris County, Texas	1695	380	22%
Block Group 5, Census Tract 4301, Harris County, Texas	1305	284	22%
Block Group 4, Census Tract 5108, Harris County, Texas	849	156	18%

Geography	Total	Total Under 18 Years of Age	Percent Under 18 Years of Age
Block Group 2, Census Tract 5109, Harris County, Texas	3705	907	24%
Block Group 1, Census Tract 5110.01, Harris County, Texas	1475	201	14%
Block Group 2, Census Tract 5110.01, Harris County, Texas	1197	181	15%
Block Group 1, Census Tract 5201, Harris County, Texas	2222	501	23%
Block Group 1, Census Tract 5203, Harris County, Texas	2505	985	39%
Block Group 1, Census Tract 5204, Harris County, Texas	1251	359	29%
Block Group 2, Census Tract 5204, Harris County, Texas	1760	480	27%
Block Group 1, Census Tract 5205, Harris County, Texas	1637	594	36%
Block Group 2, Census Tract 5205, Harris County, Texas	4060	1678	41%
Block Group 3, Census Tract 5205, Harris County, Texas	1359	407	30%
Block Group 4, Census Tract 5205, Harris County, Texas	1929	604	31%
Block Group 1, Census Tract 5206.01, Harris County, Texas	2543	1056	42%
Block Group 1, Census Tract 5206.02, Harris County, Texas	1024	625	61%
Block Group 1, Census Tract 5214, Harris County, Texas	1130	221	20%
Block Group 2, Census Tract 5214, Harris County, Texas	2213	988	45%
Block Group 3, Census Tract 5214, Harris County, Texas	1569	393	25%
Block Group 4, Census Tract 5214, Harris County, Texas	2491	766	31%
Block Group 4, Census Tract 5215, Harris County, Texas	2226	540	24%
Block Group 1, Census Tract 5216, Harris County, Texas	2191	779	36%
Block Group 2, Census Tract 5216, Harris County, Texas	1480	493	33%
Block Group 1, Census Tract 5217, Harris County, Texas	1477	373	25%
Block Group 2, Census Tract 5217, Harris County, Texas	2288	809	35%
Block Group 3, Census Tract 5217, Harris County, Texas	1586	531	33%
Block Group 4, Census Tract 5217, Harris County, Texas	1373	336	24%
Block Group 1, Census Tract 5218, Harris County, Texas	2523	461	18%
Block Group 3, Census Tract 5301, Harris County, Texas	1122	160	14%
Block Group 1, Census Tract 5342.03, Harris County, Texas	1857	638	34%
Block Group 1, Census Tract 5401, Harris County, Texas	7628	2231	29%
Block Group 3, Census Tract 5401, Harris County, Texas	1601	542	34%
Block Group 2, Census Tract 5408, Harris County, Texas	3338	1217	36%
Block Group 2, Census Tract 5409.02, Harris County, Texas	2367	954	40%
Block Group 1, Census Tract 5410.01, Harris County, Texas	8497	2729	32%
Block Group 1, Census Tract 5410.02, Harris County, Texas	6939	2454	35%
Block Group 2, Census Tract 5410.02, Harris County, Texas	1722	456	26%
Block Group 1, Census Tract 5410.03, Harris County, Texas	4713	1283	27%
Block Group 1, Census Tract 5430.01, Harris County, Texas	7142	2881	40%
Block Group 1, Census Tract 5430.02, Harris County, Texas	11156	4042	36%
Block Group 2, Census Tract 5430.02, Harris County, Texas	3796	1461	38%
Block Group 1, Census Tract 5431, Harris County, Texas	2985	1136	38%
Block Group 6, Census Tract 5517.01, Harris County, Texas	2498	791	32%
Block Group 1, Census Tract 5518, Harris County, Texas	2286	447	20%
Block Group 3, Census Tract 5518, Harris County, Texas	1105	248	22%
Block Group 1, Census Tract 5519, Harris County, Texas	917	235	26%
Block Group 2, Census Tract 5519, Harris County, Texas	2354	499	21%
Block Group 3, Census Tract 5519, Harris County, Texas	2837	949	33%
Block Group 3, Census Tract 5520.01, Harris County, Texas	2714	820	30%
Block Group 1, Census Tract 5520.02, Harris County, Texas	1747	444	25%
Block Group 1, Census Tract 5521.01, Harris County, Texas	3823	923	24%
Block Group 1, Census Tract 5521.03, Harris County, Texas	1143	352	31%
Block Group 2, Census Tract 5522, Harris County, Texas	1661	208	13%
Block Group 3, Census Tract 5522, Harris County, Texas	2610	848	32%
Block Group 2, Census Tract 5544.01, Harris County, Texas	9390	3749	40%
Block Group 2, Census Tract 5544.02, Harris County, Texas	7262	2471	34%
Block Group 1, Census Tract 5544.03, Harris County, Texas	10272	3689	36%
Block Group 2, Census Tract 5557.01, Harris County, Texas	4834	2030	42%
Block Group 1, Census Tract 5560, Harris County, Texas	1531	476	31%
Block Group 3, Census Tract 9501, Leon County, Texas	2482	697	28%

Geography	Total	Total Under 18 Years of Age	Percent Under 18 Years of Age
Block Group 1, Census Tract 9502, Leon County, Texas	574	186	32%
Block Group 2, Census Tract 9502, Leon County, Texas	830	109	13%
Block Group 3, Census Tract 9502, Leon County, Texas	754	53	7%
Block Group 5, Census Tract 9502, Leon County, Texas	915	200	22%
Block Group 2, Census Tract 9503, Leon County, Texas	1069	426	40%
Block Group 3, Census Tract 9503, Leon County, Texas	1233	258	21%
Block Group 4, Census Tract 9503, Leon County, Texas	2110	390	18%
Block Group 1, Census Tract 9707, Limestone County, Texas	974	360	37%
Block Group 2, Census Tract 9707, Limestone County, Texas	915	161	18%
Block Group 1, Census Tract 2, Madison County, Texas	981	209	21%
Block Group 1, Census Tract 3, Madison County, Texas	1141	228	20%
Block Group 1, Census Tract 9703, Navarro County, Texas	1467	351	24%
Block Group 3, Census Tract 9704, Navarro County, Texas	1303	340	26%
Block Group 4, Census Tract 9709, Navarro County, Texas	3053	895	29%
Block Group 5, Census Tract 9709, Navarro County, Texas	1854	580	31%
Block Group 1, Census Tract 9710, Navarro County, Texas	2034	595	29%
Block Group 1, Census Tract 6806, Waller County, Texas	2370	564	24%
Block Group 2, Census Tract 6806, Waller County, Texas	2748	818	30%

Economics:
Project Cost by Alternative,
Source: ARUP

Prof. Svcs. Assumption	Alternative	Capital Low*	Capital High*	Construction Low	Construction High
15%	A Low	$ 10,000,000,000	$ 12,000,000,000	$ 8,500,000,000	$ 10,200,000,000
	B Low	$ 10,000,000,000	$ 12,000,000,000	$ 8,500,000,000	$ 10,200,000,000
Tot. Direct Project Employment	C Low	$ 11,000,000,000	$ 13,000,000,000	$ 9,350,000,000	$ 11,050,000,000
1086	D Low	$ 10,000,000,000	$ 12,000,000,000	$ 8,500,000,000	$ 10,200,000,000
	E Low	$ 10,000,000,000	$ 12,000,000,000	$ 8,500,000,000	$ 10,200,000,000
	F Low	$ 11,000,000,000	$ 13,000,000,000	$ 9,350,000,000	$ 11,050,000,000

* Capital Costs Exlude Systems, ROW and Rolling Stock

Source: ARUP

Economics:
HSR Construction Cost Estimate
Source: TCRR

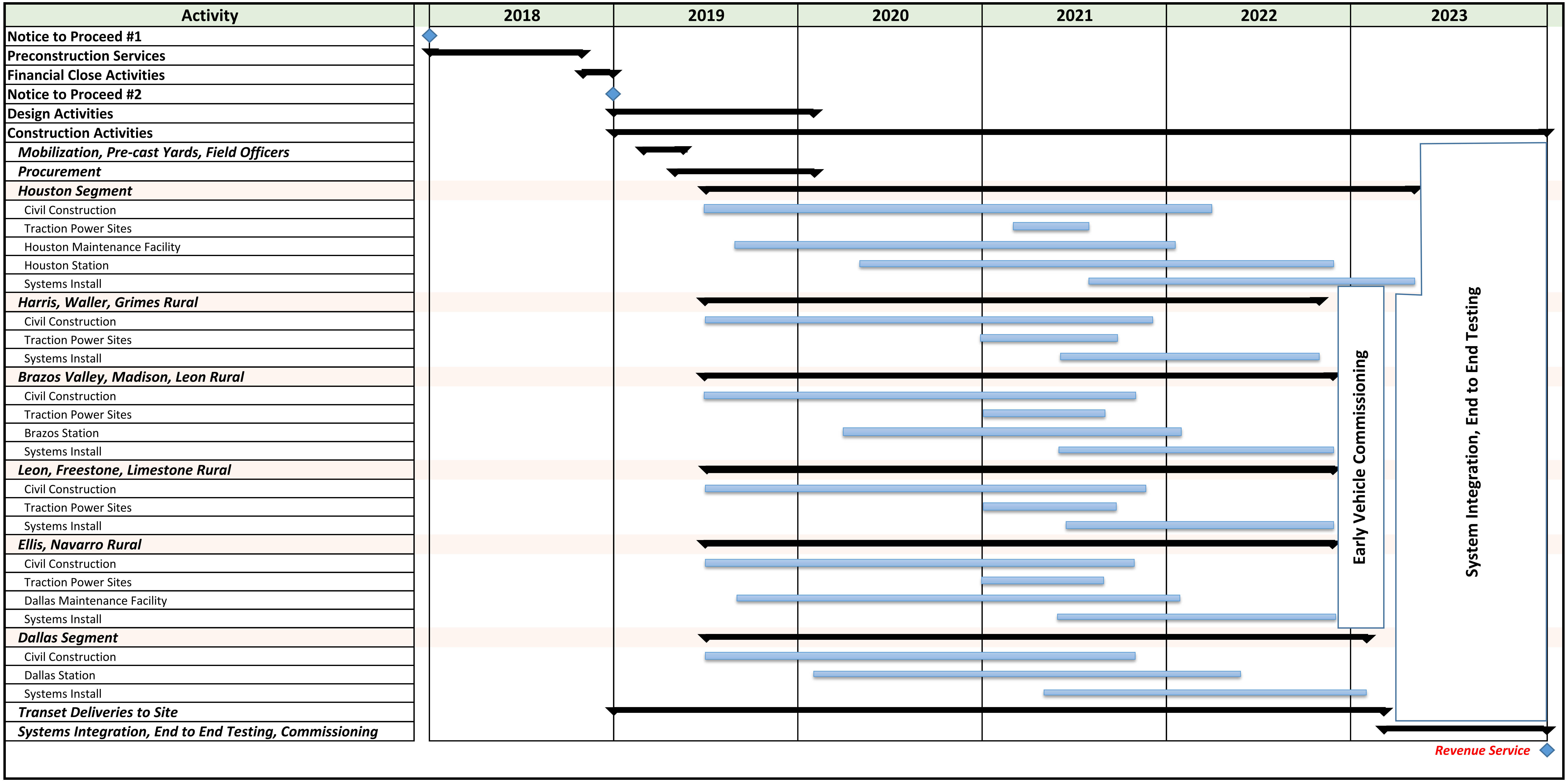
HSR Construction Cost Estimate, May 2017

Direct Labor Costs (28%)	$2.4B
Direct Materials & Equipment Costs (72%)	$6.1B
Total Direct Costs[1] (61%)	$8.5B
Total Indirect Costs[2] (39%)	$5.5B
Total Civil Infrastructure & Fixed Facilities	**$14B +/- $1B**
Systems & Rolling Stock[3]	**$2.5B +/- $.5B**
Total Construction Cost Estimate	**$16.5B +/- $1.5B**

[1]Includes Labor, Material, Equipment, and Subcontractors to perform the specific civil work items
[2]Includes OH & P, Design Services, Safety, QA/QC, Project Administration, etc.
[3]Includes Signals, Power Distribution, Communications, Train Control, Fare Collection, and Rolling Stock

Economics:
TCRR Summary Schedule
Source: TCRR

TCRR Summary Schedule



Economics:

2015 Occupational Employment Statistics (OES),

Source: Bureau of Labor Statistics, U.S. Department of Labor

May 2015 OES Estimates

Occupational Employment Statistics (OES) Survey
Bureau of Labor Statistics, Department of Labor
website: www.bls.gov/oes
phone: 202-691-6569

nat4d_M2015_dl.xlsx National, 4-digit NAICS, cross-ownership estimates

NAICS	NAICS_TITLE	OCC_CODE	OCC_TITLE	OCC_GROUP	TOT_EMP	A_MEAN
482100	Rail Transportation	00-0000	Industry Total	total	215,090	$61,680.00
482100	Rail Transportation	11-0000	Management Occupations	major	13,670	$108,680.00
482100	Rail Transportation	11-1000	Top Executives	minor	2,340	$134,450.00
482100	Rail Transportation	11-1010	Chief Executives	broad	100	$201,470.00
482100	Rail Transportation	11-1011	Chief Executives	detailed	100	$201,470.00
482100	Rail Transportation	11-1020	General and Operations Managers	broad	2,240	$131,380.00
482100	Rail Transportation	11-1021	General and Operations Managers	detailed	2,240	$131,380.00
482100	Rail Transportation	11-2000	Advertising, Marketing, Promotions, Public Relations, and Sales Managers	minor	620	$115,860.00
482100	Rail Transportation	11-2020	Marketing and Sales Managers	broad	540	$113,910.00
482100	Rail Transportation	11-2021	Marketing Managers	detailed	270	$120,620.00
482100	Rail Transportation	11-2022	Sales Managers	detailed	270	$106,980.00
482100	Rail Transportation	11-2030	Sales Managers	broad	70	$128,380.00
482100	Rail Transportation	11-2031	Public Relations and Fundraising Managers	detailed	70	$128,380.00
482100	Rail Transportation	11-3000	Operations Specialties Managers	minor	7,110	$102,000.00
482100	Rail Transportation	11-3010	Administrative Services Managers	broad	920	$96,830.00
482100	Rail Transportation	11-3011	Administrative Services Managers	detailed	920	$96,830.00
482100	Rail Transportation	11-3020	Computer and Information Systems Managers	broad	380	$130,580.00

NAICS	NAICS_TITLE	OCC_CODE	OCC_TITLE	OCC_GROUP	TOT_EMP	A_MEAN
482100	Rail Transportation	11-3021	Computer and Information Systems Managers	detailed	380	$130,580.00
482100	Rail Transportation	11-3030	Financial Managers	broad	380	$125,650.00
482100	Rail Transportation	11-3031	Financial Managers	detailed	380	$125,650.00
482100	Rail Transportation	11-3060	Purchasing Managers	broad	140	$110,990.00
482100	Rail Transportation	11-3061	Purchasing Managers	detailed	140	$110,990.00
482100	Rail Transportation	11-3070	Transportation, Storage, and Distribution Managers	broad	4,770	$97,110.00
482100	Rail Transportation	11-3071	Transportation, Storage, and Distribution Managers	detailed	4,770	$97,110.00
482100	Rail Transportation	11-3110	Compensation and Benefits Managers	broad	40	$109,900.00
482100	Rail Transportation	11-3111	Compensation and Benefits Managers	detailed	40	$109,900.00
482100	Rail Transportation	11-3120	Human Resources Managers	broad	310	$117,670.00
482100	Rail Transportation	11-3121	Human Resources Managers	detailed	310	$117,670.00
482100	Rail Transportation	11-3130	Training and Development Managers	broad	170	$112,030.00
482100	Rail Transportation	11-3131	Training and Development Managers	detailed	170	$112,030.00
482100	Rail Transportation	11-9000	Other Management Occupations	minor	3,600	$103,860.00
482100	Rail Transportation	11-9020	Construction Managers	broad	1,350	$94,390.00
482100	Rail Transportation	11-9021	Construction Managers	detailed	1,350	$94,390.00
482100	Rail Transportation	11-9040	Architectural and Engineering Managers	broad	360	$121,520.00
482100	Rail Transportation	11-9041	Architectural and Engineering Managers	detailed	360	$121,520.00
482100	Rail Transportation	11-9140	Property, Real Estate, and Community Association Managers	broad	130	$115,120.00
482100	Rail Transportation	11-9141	Property, Real Estate, and Community Association Managers	detailed	130	$115,120.00
482100	Rail Transportation	11-9160	Emergency Management Directors	broad	30	$103,200.00
482100	Rail Transportation	11-9161	Emergency Management Directors	detailed	30	$103,200.00
482100	Rail Transportation	11-9190	Miscellaneous Managers	broad	1,710	$106,860.00
482100	Rail Transportation	11-9199	Managers, All Other	detailed	1,710	$106,860.00
482100	Rail Transportation	13-0000	Business and Financial Operations Occupations	major	5,000	$78,670.00
482100	Rail Transportation	13-1000	Business Operations Specialists	minor	3,870	$77,570.00

NAICS	NAICS_TITLE	OCC_CODE	OCC_TITLE	OCC_GROUP	TOT_EMP	A_MEAN
482100	Rail Transportation	13-1020	Buyers and Purchasing Agents	broad	200	$72,640.00
482100	Rail Transportation	13-1023	Purchasing Agents, Except Wholesale, Retail, and Farm Products	detailed	200	$72,650.00
482100	Rail Transportation	13-1030	Claims Adjusters, Appraisers, Examiners, and Investigators	broad	310	$72,830.00
482100	Rail Transportation	13-1031	Claims Adjusters, Examiners, and Investigators	detailed	310	$72,830.00
482100	Rail Transportation	13-1040	Compliance Officers	broad	150	$86,460.00
482100	Rail Transportation	13-1041	Compliance Officers	detailed	150	$86,460.00
482100	Rail Transportation	13-1070	Human Resources Workers	broad	470	$80,210.00
482100	Rail Transportation	13-1071	Human Resources Specialists	detailed	370	$78,120.00
482100	Rail Transportation	13-1075	Labor Relations Specialists	detailed	100	$87,730.00
482100	Rail Transportation	13-1080	Logisticians	broad	170	$77,780.00
482100	Rail Transportation	13-1081	Logisticians	detailed	170	$77,780.00
482100	Rail Transportation	13-1110	Management Analysts	broad	510	$83,430.00
482100	Rail Transportation	13-1111	Management Analysts	detailed	510	$83,430.00
482100	Rail Transportation	13-1140	Compensation, Benefits, and Job Analysis Specialists	broad	70	$75,040.00
482100	Rail Transportation	13-1141	Compensation, Benefits, and Job Analysis Specialists	detailed	70	$75,040.00
482100	Rail Transportation	13-1150	Training and Development Specialists	broad	560	$71,410.00
482100	Rail Transportation	13-1151	Training and Development Specialists	detailed	560	$71,410.00
482100	Rail Transportation	13-1160	Market Research Analysts and Marketing Specialists	broad	450	$76,760.00
482100	Rail Transportation	13-1161	Market Research Analysts and Marketing Specialists	detailed	450	$76,760.00
482100	Rail Transportation	13-1190	Miscellaneous Business Operations Specialists	broad	960	$79,010.00
482100	Rail Transportation	13-1199	Business Operations Specialists, All Other	detailed	960	$79,010.00
482100	Rail Transportation	13-2000	Financial Specialists	minor	1,120	$82,480.00
482100	Rail Transportation	13-2010	Accountants and Auditors	broad	650	$83,220.00
482100	Rail Transportation	13-2011	Accountants and Auditors	detailed	650	$83,220.00

NAICS	NAICS_TITLE	OCC_CODE	OCC_TITLE	OCC_GROUP	TOT_EMP	A_MEAN
482100	Rail Transportation	13-2030	Budget Analysts	broad	130	$80,500.00
482100	Rail Transportation	13-2031	Budget Analysts	detailed	130	$80,500.00
482100	Rail Transportation	13-2050	Financial Analysts and Advisors	broad	240	$84,200.00
482100	Rail Transportation	13-2051	Financial Analysts	detailed	240	$84,200.00
482100	Rail Transportation	13-2090	Miscellaneous Financial Specialists	broad	60	$83,200.00
482100	Rail Transportation	13-2099	Financial Specialists, All Other	detailed	60	$83,200.00
482100	Rail Transportation	15-0000	Computer and Mathematical Occupations	major	2,580	$88,730.00
482100	Rail Transportation	15-1100	Computer Occupations	minor	2,530	$88,820.00
482100	Rail Transportation	15-1120	Computer and Information Analysts	broad	290	$82,410.00
482100	Rail Transportation	15-1121	Computer Systems Analysts	detailed	250	$79,260.00
482100	Rail Transportation	15-1122	Information Security Analysts	detailed	50	$99,560.00
482100	Rail Transportation	15-1130	Software Developers and Programmers	broad	1,070	$94,970.00
482100	Rail Transportation	15-1131	Computer Programmers	detailed	50	$82,270.00
482100	Rail Transportation	15-1132	Software Developers, Applications	detailed	890	$94,690.00
482100	Rail Transportation	15-1140	Database and Systems Administrators and Network Architects	broad	790	$86,300.00
482100	Rail Transportation	15-1141	Database Administrators	detailed	90	$86,390.00
482100	Rail Transportation	15-1142	Network and Computer Systems Administrators	detailed	570	$81,680.00
482100	Rail Transportation	15-1143	Computer Network Architects	detailed	130	$106,730.00
482100	Rail Transportation	15-1150	Computer Support Specialists	broad	150	$70,900.00
482100	Rail Transportation	15-1151	Computer User Support Specialists	detailed	90	$68,240.00
482100	Rail Transportation	15-1152	Computer Network Support Specialists	detailed	60	$75,070.00
482100	Rail Transportation	15-1190	Miscellaneous Computer Occupations	broad	240	$88,420.00
482100	Rail Transportation	15-1199	Computer Occupations, All Other	detailed	240	$88,420.00
482100	Rail Transportation	15-2000	Mathematical Science Occupations	minor	50	$83,690.00
482100	Rail Transportation	15-2030	Operations Research Analysts	broad	40	$79,960.00
482100	Rail Transportation	15-2031	Operations Research Analysts	detailed	40	$79,960.00
482100	Rail Transportation	17-0000	Architecture and Engineering Occupations	major	2,270	$84,260.00

NAICS	NAICS_TITLE	OCC_CODE	OCC_TITLE	OCC_GROUP	TOT_EMP	A_MEAN
482100	Rail Transportation	17-2000	Engineers	minor	2,100	$85,830.00
482100	Rail Transportation	17-2050	Civil Engineers	broad	440	$87,570.00
482100	Rail Transportation	17-2051	Civil Engineers	detailed	440	$87,570.00
482100	Rail Transportation	17-2070	Electrical and Electronics Engineers	broad	**	$96,320.00
482100	Rail Transportation	17-2071	Electrical Engineers	detailed	160	$90,540.00
482100	Rail Transportation	17-2080	Environmental Engineers	broad	40	$91,090.00
482100	Rail Transportation	17-2081	Environmental Engineers	detailed	40	$91,090.00
482100	Rail Transportation	17-2110	Industrial Engineers, Including Health and Safety	broad	220	$88,470.00
482100	Rail Transportation	17-2111	Health and Safety Engineers, Except Mining Safety Engineers and Inspectors	detailed	150	$84,320.00
482100	Rail Transportation	17-2112	Industrial Engineers	detailed	60	$98,350.00
482100	Rail Transportation	17-2140	Mechanical Engineers	broad	280	$83,780.00
482100	Rail Transportation	17-2141	Mechanical Engineers	detailed	280	$83,780.00
482100	Rail Transportation	17-2190	Miscellaneous Engineers	broad	660	$76,720.00
482100	Rail Transportation	17-2199	Engineers, All Other	detailed	660	$76,720.00
482100	Rail Transportation	17-3000	Drafters, Engineering Technicians, and Mapping Technicians	minor	150	$62,180.00
482100	Rail Transportation	17-3010	Drafters	broad	40	$67,410.00
482100	Rail Transportation	17-3020	Engineering Technicians, Except Drafters	broad	120	$60,490.00
482100	Rail Transportation	19-0000	Life, Physical, and Social Science Occupations	major	110	$91,040.00
482100	Rail Transportation	19-3000	Social Scientists and Related Workers	minor	60	$106,600.00
482100	Rail Transportation	19-4000	Life, Physical, and Social Science Technicians	minor	40	$68,350.00
482100	Rail Transportation	19-4090	Miscellaneous Life, Physical, and Social Science Technicians	broad	40	$68,350.00
482100	Rail Transportation	23-0000	Legal Occupations	major	470	$117,320.00
482100	Rail Transportation	23-1000	Lawyers, Judges, and Related Workers	minor	290	$150,860.00
482100	Rail Transportation	23-1010	Lawyers and Judicial Law Clerks	broad	290	$150,860.00
482100	Rail Transportation	23-1011	Lawyers	detailed	290	$150,860.00
482100	Rail Transportation	23-2000	Legal Support Workers	minor	180	$63,110.00

NAICS	NAICS_TITLE	OCC_CODE	OCC_TITLE	OCC_GROUP	TOT_EMP	A_MEAN
482100	Rail Transportation	23-2010	Paralegals and Legal Assistants	broad	100	$62,970.00
482100	Rail Transportation	23-2011	Paralegals and Legal Assistants	detailed	100	$62,970.00
482100	Rail Transportation	23-2090	Miscellaneous Legal Support Workers	broad	80	$63,280.00
482100	Rail Transportation	23-2099	Legal Support Workers, All Other	detailed	70	$65,520.00
482100	Rail Transportation	27-0000	Arts, Design, Entertainment, Sports, and Media Occupations	major	200	$94,940.00
482100	Rail Transportation	27-3000	Media and Communication Workers	minor	150	$101,040.00
482100	Rail Transportation	27-3030	Public Relations Specialists	broad	140	$102,430.00
482100	Rail Transportation	27-3031	Public Relations Specialists	detailed	140	$102,430.00
482100	Rail Transportation	29-0000	Healthcare Practitioners and Technical Occupations	major	160	$77,210.00
482100	Rail Transportation	29-1000	Health Diagnosing and Treating Practitioners	minor	90	$76,990.00
482100	Rail Transportation	29-1140	Registered Nurses	broad	90	$71,790.00
482100	Rail Transportation	29-1141	Registered Nurses	detailed	90	$71,790.00
482100	Rail Transportation	29-9000	Other Healthcare Practitioners and Technical Occupations	minor	70	$77,500.00
482100	Rail Transportation	29-9010	Occupational Health and Safety Specialists and Technicians	broad	70	$77,500.00
482100	Rail Transportation	29-9011	Occupational Health and Safety Specialists	detailed	60	$76,130.00
482100	Rail Transportation	33-0000	Protective Service Occupations	major	900	$68,220.00
482100	Rail Transportation	33-1000	Supervisors of Protective Service Workers	minor	70	$78,630.00
482100	Rail Transportation	33-1090	Miscellaneous First-Line Supervisors, Protective Service Workers	broad	70	$78,630.00
482100	Rail Transportation	33-1099	First-Line Supervisors of Protective Service Workers, All Other	detailed	70	$78,630.00
482100	Rail Transportation	33-3000	Law Enforcement Workers	minor	570	$63,280.00
482100	Rail Transportation	33-3050	Police Officers	broad	570	$63,280.00
482100	Rail Transportation	33-3052	Transit and Railroad Police	detailed	570	$63,280.00
482100	Rail Transportation	33-9000	Other Protective Service Workers	minor	250	$76,380.00
482100	Rail Transportation	33-9030	Security Guards and Gaming Surveillance Officers	broad	110	$51,290.00

NAICS	NAICS_TITLE	OCC_CODE	OCC_TITLE	OCC_GROUP	TOT_EMP	A_MEAN
482100	Rail Transportation	33-9032	Security Guards	detailed	110	$51,290.00
482100	Rail Transportation	33-9090	Miscellaneous Protective Service Workers	broad	110	$100,960.00
482100	Rail Transportation	33-9093	Transportation Security Screeners	detailed	110	$102,830.00
482100	Rail Transportation	35-0000	Food Preparation and Serving Related Occupations	major	400	$38,740.00
482100	Rail Transportation	35-2000	Cooks and Food Preparation Workers	minor	170	$39,230.00
482100	Rail Transportation	35-2010	Cooks	broad	170	$39,230.00
482100	Rail Transportation	35-2019	Cooks, All Other	detailed	**	$32,170.00
482100	Rail Transportation	35-3000	Food and Beverage Serving Workers	minor	40	$40,420.00
482100	Rail Transportation	35-9000	Other Food Preparation and Serving Related Workers	minor	**	$35,630.00
482100	Rail Transportation	35-9090	Miscellaneous Food Preparation and Serving Related Workers	broad	80	$36,830.00
482100	Rail Transportation	35-9099	Food Preparation and Serving Related Workers, All Other	detailed	80	$36,830.00
482100	Rail Transportation	37-0000	Building and Grounds Cleaning and Maintenance Occupations	major	460	$31,680.00
482100	Rail Transportation	37-2000	Building Cleaning and Pest Control Workers	minor	410	$29,840.00
482100	Rail Transportation	37-2010	Building Cleaning Workers	broad	410	$29,840.00
482100	Rail Transportation	37-2011	Janitors and Cleaners, Except Maids and Housekeeping Cleaners	detailed	410	$29,840.00
482100	Rail Transportation	39-0000	Personal Care and Service Occupations	major	260	$48,090.00
482100	Rail Transportation	39-6000	Baggage Porters, Bellhops, and Concierges	minor	250	$47,320.00
482100	Rail Transportation	39-6010	Baggage Porters, Bellhops, and Concierges	broad	250	$47,320.00
482100	Rail Transportation	39-6011	Baggage Porters and Bellhops	detailed	250	$47,320.00
482100	Rail Transportation	41-0000	Sales and Related Occupations	major	550	$76,210.00
482100	Rail Transportation	41-1000	Supervisors of Sales Workers	minor	30	$100,230.00
482100	Rail Transportation	41-1010	First-Line Supervisors of Sales Workers	broad	30	$100,230.00
482100	Rail Transportation	41-2000	Retail Sales Workers	minor	70	$44,200.00
482100	Rail Transportation	41-2010	Cashiers	broad	50	$50,180.00
482100	Rail Transportation	41-2011	Cashiers	detailed	50	$50,180.00

NAICS	NAICS_TITLE	OCC_CODE	OCC_TITLE	OCC_GROUP	TOT_EMP	A_MEAN
482100	Rail Transportation	41-3000	Sales Representatives, Services	minor	320	$80,920.00
482100	Rail Transportation	41-3090	Miscellaneous Sales Representatives, Services	broad	310	$81,500.00
482100	Rail Transportation	41-3099	Sales Representatives, Services, All Other	detailed	310	$81,500.00
482100	Rail Transportation	41-4000	Sales Representatives, Wholesale and Manufacturing	minor	50	$72,430.00
482100	Rail Transportation	41-4010	Sales Representatives, Wholesale and Manufacturing	broad	50	$72,430.00
482100	Rail Transportation	41-4012	Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products	detailed	50	$72,430.00
482100	Rail Transportation	41-9000	Other Sales and Related Workers	minor	80	$79,620.00
482100	Rail Transportation	41-9020	Real Estate Brokers and Sales Agents	broad	80	$79,620.00
482100	Rail Transportation	41-9022	Real Estate Sales Agents	detailed	70	$80,010.00
482100	Rail Transportation	43-0000	Office and Administrative Support Occupations	major	14,620	$51,160.00
482100	Rail Transportation	43-1000	Supervisors of Office and Administrative Support Workers	minor	1,220	$69,600.00
482100	Rail Transportation	43-1010	First-Line Supervisors of Office and Administrative Support Workers	broad	1,220	$69,600.00
482100	Rail Transportation	43-1011	First-Line Supervisors of Office and Administrative Support Workers	detailed	1,220	$69,600.00
482100	Rail Transportation	43-3000	Financial Clerks	minor	1,040	$46,910.00
482100	Rail Transportation	43-3020	Billing and Posting Clerks	broad	170	$45,220.00
482100	Rail Transportation	43-3021	Billing and Posting Clerks	detailed	170	$45,220.00
482100	Rail Transportation	43-3030	Bookkeeping, Accounting, and Auditing Clerks	broad	600	$44,470.00
482100	Rail Transportation	43-3031	Bookkeeping, Accounting, and Auditing Clerks	detailed	600	$44,470.00
482100	Rail Transportation	43-3050	Payroll and Timekeeping Clerks	broad	160	$59,200.00
482100	Rail Transportation	43-3051	Payroll and Timekeeping Clerks	detailed	160	$59,200.00
482100	Rail Transportation	43-3060	Procurement Clerks	broad	90	$42,470.00
482100	Rail Transportation	43-3061	Procurement Clerks	detailed	90	$42,470.00
482100	Rail Transportation	43-4000	Information and Record Clerks	minor	4,260	$48,050.00

NAICS	NAICS_TITLE	OCC_CODE	OCC_TITLE	OCC_GROUP	TOT_EMP	A_MEAN
482100	Rail Transportation	43-4050	Customer Service Representatives	broad	1,300	$46,040.00
482100	Rail Transportation	43-4051	Customer Service Representatives	detailed	1,300	$46,040.00
482100	Rail Transportation	43-4160	Human Resources Assistants, Except Payroll and Timekeeping	broad	60	$48,400.00
482100	Rail Transportation	43-4161	Human Resources Assistants, Except Payroll and Timekeeping	detailed	60	$48,400.00
482100	Rail Transportation	43-4170	Receptionists and Information Clerks	broad	100	$50,600.00
482100	Rail Transportation	43-4171	Receptionists and Information Clerks	detailed	100	$50,600.00
482100	Rail Transportation	43-4180	Reservation and Transportation Ticket Agents and Travel Clerks	broad	2,570	$49,070.00
482100	Rail Transportation	43-4181	Reservation and Transportation Ticket Agents and Travel Clerks	detailed	2,570	$49,070.00
482100	Rail Transportation	43-4190	Miscellaneous Information and Record Clerks	broad	120	$47,910.00
482100	Rail Transportation	43-4199	Information and Record Clerks, All Other	detailed	120	$47,910.00
482100	Rail Transportation	43-5000	Material Recording, Scheduling, Dispatching, and Distributing Workers	minor	4,620	$56,010.00
482100	Rail Transportation	43-5010	Cargo and Freight Agents	broad	180	$46,900.00
482100	Rail Transportation	43-5011	Cargo and Freight Agents	detailed	180	$46,900.00
482100	Rail Transportation	43-5030	Dispatchers	broad	2,640	$58,020.00
482100	Rail Transportation	43-5032	Dispatchers, Except Police, Fire, and Ambulance	detailed	2,640	$58,020.00
482100	Rail Transportation	43-5060	Production, Planning, and Expediting Clerks	broad	910	$61,400.00
482100	Rail Transportation	43-5061	Production, Planning, and Expediting Clerks	detailed	910	$61,400.00
482100	Rail Transportation	43-5070	Shipping, Receiving, and Traffic Clerks	broad	330	$52,370.00
482100	Rail Transportation	43-5071	Shipping, Receiving, and Traffic Clerks	detailed	330	$52,370.00
482100	Rail Transportation	43-5080	Stock Clerks and Order Fillers	broad	550	$42,520.00
482100	Rail Transportation	43-5081	Stock Clerks and Order Fillers	detailed	550	$42,520.00
482100	Rail Transportation	43-6000	Secretaries and Administrative Assistants	minor	1,320	$49,180.00
482100	Rail Transportation	43-6010	Secretaries and Administrative Assistants	broad	1,320	$49,180.00
482100	Rail Transportation	43-6011	Executive Secretaries and Executive Administrative Assistants	detailed	490	$57,950.00

NAICS	NAICS_TITLE	OCC_CODE	OCC_TITLE	OCC_GROUP	TOT_EMP	A_MEAN
482100	Rail Transportation	43-6012	Legal Secretaries	detailed	50	$60,780.00
482100	Rail Transportation	43-6014	Secretaries and Administrative Assistants, Except Legal, Medical, and Executive	detailed	780	$42,900.00
482100	Rail Transportation	43-9000	Other Office and Administrative Support Workers	minor	2,130	$39,720.00
482100	Rail Transportation	43-9020	Data Entry and Information Processing Workers	broad	70	$49,560.00
482100	Rail Transportation	43-9022	Word Processors and Typists	detailed	70	$49,380.00
482100	Rail Transportation	43-9060	Office Clerks, General	broad	1,800	$38,410.00
482100	Rail Transportation	43-9061	Office Clerks, General	detailed	1,800	$38,410.00
482100	Rail Transportation	43-9110	Statistical Assistants	broad	50	$54,480.00
482100	Rail Transportation	43-9111	Statistical Assistants	detailed	50	$54,480.00
482100	Rail Transportation	43-9190	Miscellaneous Office and Administrative Support Workers	broad	**	$42,530.00
482100	Rail Transportation	43-9199	Office and Administrative Support Workers, All Other	detailed	**	$42,530.00
482100	Rail Transportation	47-0000	Construction and Extraction Occupations	major	18,480	$57,720.00
482100	Rail Transportation	47-1000	Supervisors of Construction and Extraction Workers	minor	3,340	$71,480.00
482100	Rail Transportation	47-1010	First-Line Supervisors of Construction Trades and Extraction Workers	broad	3,340	$71,480.00
482100	Rail Transportation	47-1011	First-Line Supervisors of Construction Trades and Extraction Workers	detailed	3,340	$71,480.00
482100	Rail Transportation	47-2000	Construction Trades Workers	minor	6,060	$60,170.00
482100	Rail Transportation	47-2010	Boilermakers	broad	300	$60,880.00
482100	Rail Transportation	47-2011	Boilermakers	detailed	300	$60,880.00
482100	Rail Transportation	47-2030	Carpenters	broad	580	$58,580.00
482100	Rail Transportation	47-2031	Carpenters	detailed	580	$58,580.00
482100	Rail Transportation	47-2060	Construction Laborers	broad	120	$46,890.00
482100	Rail Transportation	47-2061	Construction Laborers	detailed	120	$46,890.00
482100	Rail Transportation	47-2070	Construction Equipment Operators	broad	930	$58,060.00

NAICS	NAICS_TITLE	OCC_CODE	OCC_TITLE	OCC_GROUP	TOT_EMP	A_MEAN
482100	Rail Transportation	47-2071	Paving, Surfacing, and Tamping Equipment Operators	detailed	80	$50,140.00
482100	Rail Transportation	47-2073	Operating Engineers and Other Construction Equipment Operators	detailed	840	$58,860.00
482100	Rail Transportation	47-2110	Electricians	broad	2,530	$61,960.00
482100	Rail Transportation	47-2111	Electricians	detailed	2,530	$61,960.00
482100	Rail Transportation	47-2150	Pipelayers, Plumbers, Pipefitters, and Steamfitters	broad	270	$59,350.00
482100	Rail Transportation	47-2152	Plumbers, Pipefitters, and Steamfitters	detailed	270	$59,350.00
482100	Rail Transportation	47-2210	Sheet Metal Workers	broad	1,240	$59,310.00
482100	Rail Transportation	47-2211	Sheet Metal Workers	detailed	1,240	$59,310.00
482100	Rail Transportation	47-2220	Structural Iron and Steel Workers	broad	**	$76,950.00
482100	Rail Transportation	47-2221	Structural Iron and Steel Workers	detailed	**	$76,950.00
482100	Rail Transportation	47-4000	Other Construction and Related Workers	minor	9,060	$51,040.00
482100	Rail Transportation	47-4010	Construction and Building Inspectors	broad	40	$68,280.00
482100	Rail Transportation	47-4011	Construction and Building Inspectors	detailed	40	$68,280.00
482100	Rail Transportation	47-4060	Rail-Track Laying and Maintenance Equipment Operators	broad	7,830	$52,260.00
482100	Rail Transportation	47-4061	Rail-Track Laying and Maintenance Equipment Operators	detailed	7,830	$52,260.00
482100	Rail Transportation	47-4090	Miscellaneous Construction and Related Workers	broad	1,140	$42,150.00
482100	Rail Transportation	47-4099	Construction and Related Workers, All Other	detailed	1,140	$42,150.00
482100	Rail Transportation	49-0000	Installation, Maintenance, and Repair Occupations	major	32,190	$60,470.00
482100	Rail Transportation	49-1000	Supervisors of Installation, Maintenance, and Repair Workers	minor	4,170	$74,130.00
482100	Rail Transportation	49-1010	First-Line Supervisors of Mechanics, Installers, and Repairers	broad	4,170	$74,130.00
482100	Rail Transportation	49-1011	First-Line Supervisors of Mechanics, Installers, and Repairers	detailed	4,170	$74,130.00
482100	Rail Transportation	49-2000	Electrical and Electronic Equipment Mechanics, Installers, and Repairers	minor	5,340	$60,410.00

NAICS	NAICS_TITLE	OCC_CODE	OCC_TITLE	OCC_GROUP	TOT_EMP	A_MEAN
482100	Rail Transportation	49-2020	Radio and Telecommunications Equipment Installers and Repairers	broad	**	$64,120.00
482100	Rail Transportation	49-2021	Radio, Cellular, and Tower Equipment Installers and Repairers	detailed	**	$72,110.00
482100	Rail Transportation	49-2022	Telecommunications Equipment Installers and Repairers, Except Line Installers	detailed	60	$58,180.00
482100	Rail Transportation	49-2090	Miscellaneous Electrical and Electronic Equipment Mechanics, Installers, and Repairers	broad	**	$60,330.00
482100	Rail Transportation	49-2093	Electrical and Electronics Installers and Repairers, Transportation Equipment	detailed	5,170	$60,280.00
482100	Rail Transportation	49-2094	Electrical and Electronics Repairers, Commercial and Industrial Equipment	detailed	30	$69,260.00
482100	Rail Transportation	49-3000	Vehicle and Mobile Equipment Mechanics, Installers, and Repairers	minor	14,470	$57,270.00
482100	Rail Transportation	49-3030	Bus and Truck Mechanics and Diesel Engine Specialists	broad	2,170	$55,760.00
482100	Rail Transportation	49-3031	Bus and Truck Mechanics and Diesel Engine Specialists	detailed	2,170	$55,760.00
482100	Rail Transportation	49-3040	Heavy Vehicle and Mobile Equipment Service Technicians and Mechanics	broad	12,300	$57,540.00
482100	Rail Transportation	49-3042	Mobile Heavy Equipment Mechanics, Except Engines	detailed	380	$54,910.00
482100	Rail Transportation	49-3043	Rail Car Repairers	detailed	11,910	$57,620.00
482100	Rail Transportation	49-9000	Other Installation, Maintenance, and Repair Occupations	minor	8,210	$59,190.00
482100	Rail Transportation	49-9020	Heating, Air Conditioning, and Refrigeration Mechanics and Installers	broad	60	$67,830.00
482100	Rail Transportation	49-9021	Heating, Air Conditioning, and Refrigeration Mechanics and Installers	detailed	60	$67,830.00
482100	Rail Transportation	49-9040	Industrial Machinery Installation, Repair, and Maintenance Workers	broad	360	$54,340.00
482100	Rail Transportation	49-9041	Industrial Machinery Mechanics	detailed	90	$68,080.00
482100	Rail Transportation	49-9043	Maintenance Workers, Machinery	detailed	260	$48,690.00
482100	Rail Transportation	49-9050	Line Installers and Repairers	broad	100	$62,200.00

NAICS	NAICS_TITLE	OCC_CODE	OCC_TITLE	OCC_GROUP	TOT_EMP	A_MEAN
482100	Rail Transportation	49-9051	Electrical Power-Line Installers and Repairers	detailed	100	$62,580.00
482100	Rail Transportation	49-9070	Maintenance and Repair Workers, General	broad	850	$50,770.00
482100	Rail Transportation	49-9071	Maintenance and Repair Workers, General	detailed	850	$50,770.00
482100	Rail Transportation	49-9090	Miscellaneous Installation, Maintenance, and Repair Workers	broad	6,840	$60,380.00
482100	Rail Transportation	49-9097	Signal and Track Switch Repairers	detailed	6,010	$61,200.00
482100	Rail Transportation	49-9099	Installation, Maintenance, and Repair Workers, All Other	detailed	740	$55,820.00
482100	Rail Transportation	51-0000	Production Occupations	major	10,320	$50,530.00
482100	Rail Transportation	51-1000	Supervisors of Production Workers	minor	150	$74,820.00
482100	Rail Transportation	51-1010	First-Line Supervisors of Production and Operating Workers	broad	150	$74,820.00
482100	Rail Transportation	51-1011	First-Line Supervisors of Production and Operating Workers	detailed	150	$74,820.00
482100	Rail Transportation	51-4000	Metal Workers and Plastic Workers	minor	9,610	$50,250.00
482100	Rail Transportation	51-4040	Machinists	broad	5,920	$51,000.00
482100	Rail Transportation	51-4041	Machinists	detailed	5,920	$51,000.00
482100	Rail Transportation	51-4120	Welding, Soldering, and Brazing Workers	broad	3,630	*
482100	Rail Transportation	51-4121	Welders, Cutters, Solderers, and Brazers	detailed	3,610	$48,950.00
482100	Rail Transportation	51-8000	Plant and System Operators	minor	50	$63,890.00
482100	Rail Transportation	51-9000	Other Production Occupations	minor	480	$46,380.00
482100	Rail Transportation	51-9060	Inspectors, Testers, Sorters, Samplers, and Weighers	broad	60	$53,650.00
482100	Rail Transportation	51-9061	Inspectors, Testers, Sorters, Samplers, and Weighers	detailed	60	$53,650.00
482100	Rail Transportation	51-9120	Painting Workers	broad	80	$50,140.00
482100	Rail Transportation	51-9122	Painters, Transportation Equipment	detailed	**	$48,230.00
482100	Rail Transportation	51-9190	Miscellaneous Production Workers	broad	350	$44,280.00
482100	Rail Transportation	51-9198	Helpers--Production Workers	detailed	340	$44,200.00
482100	Rail Transportation	53-0000	Transportation and Material Moving Occupations	major	112,440	$57,610.00

NAICS	NAICS_TITLE	OCC_CODE	OCC_TITLE	OCC_GROUP	TOT_EMP	A_MEAN
482100	Rail Transportation	53-1000	Supervisors of Transportation and Material Moving Workers	minor	4,340	$68,230.00
482100	Rail Transportation	53-1020	First-Line Supervisors of Helpers, Laborers, and Material Movers, Hand	broad	290	$58,300.00
482100	Rail Transportation	53-1021	First-Line Supervisors of Helpers, Laborers, and Material Movers, Hand	detailed	290	$58,300.00
482100	Rail Transportation	53-1030	First-Line Supervisors of Transportation and Material-Moving Machine and Vehicle Operators	broad	4,050	$68,950.00
482100	Rail Transportation	53-1031	First-Line Supervisors of Transportation and Material-Moving Machine and Vehicle Operators	detailed	4,050	$68,950.00
482100	Rail Transportation	53-3000	Motor Vehicle Operators	minor	1,360	$47,380.00
482100	Rail Transportation	53-3030	Driver/Sales Workers and Truck Drivers	broad	990	$46,740.00
482100	Rail Transportation	53-3032	Heavy and Tractor-Trailer Truck Drivers	detailed	440	$51,570.00
482100	Rail Transportation	53-3033	Light Truck or Delivery Services Drivers	detailed	550	$42,910.00
482100	Rail Transportation	53-3090	Miscellaneous Motor Vehicle Operators	broad	**	$44,560.00
482100	Rail Transportation	53-3099	Motor Vehicle Operators, All Other	detailed	**	$44,560.00
482100	Rail Transportation	53-4000	Rail Transportation Workers	minor	96,530	$57,760.00
482100	Rail Transportation	53-4010	Locomotive Engineers and Operators	broad	39,540	$59,440.00
482100	Rail Transportation	53-4011	Locomotive Engineers	detailed	35,860	$59,800.00
482100	Rail Transportation	53-4012	Locomotive Firers	detailed	1,590	$54,580.00
482100	Rail Transportation	53-4013	Rail Yard Engineers, Dinkey Operators, and Hostlers	detailed	2,100	$57,000.00
482100	Rail Transportation	53-4020	Railroad Brake, Signal, and Switch Operators	broad	17,010	$55,250.00
482100	Rail Transportation	53-4021	Railroad Brake, Signal, and Switch Operators	detailed	17,010	$55,250.00
482100	Rail Transportation	53-4030	Railroad Conductors and Yardmasters	broad	38,440	$56,810.00
482100	Rail Transportation	53-4031	Railroad Conductors and Yardmasters	detailed	38,440	$56,810.00
482100	Rail Transportation	53-4090	Miscellaneous Rail Transportation Workers	broad	1,540	$66,170.00
482100	Rail Transportation	53-4099	Rail Transportation Workers, All Other	detailed	1,540	$66,170.00
482100	Rail Transportation	53-6000	Other Transportation Workers	minor	5,830	$61,610.00

NAICS	NAICS_TITLE	OCC_CODE	OCC_TITLE	OCC_GROUP	TOT_EMP	A_MEAN
482100	Rail Transportation	53-6010	Bridge and Lock Tenders	broad	270	*
482100	Rail Transportation	53-6011	Bridge and Lock Tenders	detailed	270	*
482100	Rail Transportation	53-6050	Transportation Inspectors	broad	3,520	$73,190.00
482100	Rail Transportation	53-6051	Transportation Inspectors	detailed	3,520	$73,190.00
482100	Rail Transportation	53-6060	Transportation Attendants, Except Flight Attendants	broad	1,710	$43,150.00
482100	Rail Transportation	53-6061	Transportation Attendants, Except Flight Attendants	detailed	1,710	$43,150.00
482100	Rail Transportation	53-6090	Miscellaneous Transportation Workers	broad	330	*
482100	Rail Transportation	53-6099	Transportation Workers, All Other	detailed	330	*
482100	Rail Transportation	53-7000	Material Moving Workers	minor	4,370	$41,330.00
482100	Rail Transportation	53-7020	Crane and Tower Operators	broad	420	$50,520.00
482100	Rail Transportation	53-7021	Crane and Tower Operators	detailed	420	$50,520.00
482100	Rail Transportation	53-7030	Dredge, Excavating, and Loading Machine Operators	broad	110	$53,640.00
482100	Rail Transportation	53-7032	Excavating and Loading Machine and Dragline Operators	detailed	110	$53,640.00
482100	Rail Transportation	53-7050	Industrial Truck and Tractor Operators	broad	430	$50,640.00
482100	Rail Transportation	53-7051	Industrial Truck and Tractor Operators	detailed	430	$50,640.00
482100	Rail Transportation	53-7060	Laborers and Material Movers, Hand	broad	3,180	$38,230.00
482100	Rail Transportation	53-7061	Cleaners of Vehicles and Equipment	detailed	1,670	$38,370.00
482100	Rail Transportation	53-7062	Laborers and Freight, Stock, and Material Movers, Hand	detailed	1,510	$38,080.00
482100	Rail Transportation	53-7190	Miscellaneous Material Moving Workers	broad	190	$43,810.00
482100	Rail Transportation	53-7199	Material Moving Workers, All Other	detailed	190	$43,810.00

Economics:

Staffing Assumptions

Staff Assumptions	# of positions	Shifts	Full Time Equivalent	Annual Mean Wage	Ocupation Title EOS	Ocupation Title EOS
Urban Station Staff						
Station attendees(ticketing/ information/baggage)	10	2	20	$49,070	Reservation and Transportation Ticket Agents and Travel Clerks	$981,400
Maintenance/clearing	4	3	12	$29,840	Janitors and Cleaners, Except Maids and Housekeeping Cleaners	$358,080
Security	4	3	12	$51,290	Security Guards	$615,480
Concession	33	2	66	$40,420	Food and Beverage Serving Workers	$2,667,720
Station Manager and assistance manager	3	2	6	$66,170	Rail Transportation Workers, All Other	$397,020
Rental Car Staff	32	2	64	$51,160	Office and Administrative Support Occupations	$3,274,240
Rental Car - car wash	6	2	12	$31,680	Building and Grounds Cleaning and Maintenance Occupations	$380,160
First Class lounge and bar	6	2	12	$40,420	Food and Beverage Serving Workers	$485,040
First Class kitchen	2	2	4	$39,230	Cooks and Food Preparation Workers	$156,920
Train Operations	4	2	8	$56,810	Railroad Conductors and Yardmasters	$454,480
Subtotal (1 station)	**104**		**216**			**$9,770,540**
Subtotal (2 stations)	**208**		**432**			**$19,541,080**
Rural Station Staff						
Station attendees	4	2	8	$49,070	Reservation and Transportation Ticket Agents and Travel Clerks	$392,560
Maintenance/clearing	2	3	6	$29,840	Janitors and Cleaners, Except Maids and Housekeeping Cleaners	$179,040
Security	2	3	6	$51,290	Security Guards	$307,740
Concession	18	2	36	$40,420	Food and Beverage Serving Workers	$1,455,120
Station Manager and assistance manager	2	2	4	$66,170	Rail Transportation Workers, All Other	$264,680
Rental Car Staff	24	2	48	$51,160	Office and Administrative Support Occupations	$2,455,680
Rental Car - car wash	4	2	8	$31,680	Building and Grounds Cleaning and Maintenance Occupations	$253,440
First Class lounge and bar	4	2	8	$40,420	Food and Beverage Serving Workers	$323,360
Subtotal (1 station)	**60**		**124**			**$5,631,620**
Maintenance Facilities						
TMF 1 (all staff)	120	2	240	$60,470	Installation, Maintenance, and Repair Occupations	$14,512,800

Staff Assumptions	# of positions	Shifts	Full Time Equivalent		Annual Mean Wage	Ocupation Title EOS		Ocupation Title EOS
Maintenance Facilities								
TMF 2 (all staff)	120	2	240		$60,470	Installation, Maintenance, and Repair Occupations		$14,512,800
Dallas MOW - Staff (night time crew)	10	1	10		$60,470	Installation, Maintenance, and Repair Occupations		$604,700
Dallas MOW - Staff (day time crew)	5	2	10		$60,470	Installation, Maintenance, and Repair Occupations		$604,700
Houston MOW - Staff (night time crew)	10	1	10		$60,470	Installation, Maintenance, and Repair Occupations		$604,700
Houston MOW - Staff (day time crew)	5	2	10		$60,470	Installation, Maintenance, and Repair Occupations		$604,700
Intermeiate MOW - Staff (night time crew)	50	1	50		$60,470	Installation, Maintenance, and Repair Occupations		$3,023,500
Intermediate MOW - Staff (day time crew)	25	2	50		$60,470	Installation, Maintenance, and Repair Occupations		$3,023,500
Subtotal (HMF, LMF, MOW)	**345**		**620**					**$37,491,400**
Total staff			**1176**					
Total staff (Calculated)			**1176**					
Average Pay 2015								**$53,285.80**
Median Pay 2015								**$60,470.00**
Average Pay 2016								**$54,129.45**
Median Pay 2016								**$61,427.40**
					$45,416			
Direct Earnings Estimate								
All					$54,129.45			**$63,656,234.07**
Dallas					$54,404.11			**$25,896,355.72**
Harris					$54,404.11	62932		**$25,896,355.72**
Rural					$52,962.15	41567		**$11,863,522.63**
Texas					$54,129.45			**$63,656,234.07**
Note:					$46,135			$5,720,783.05

Subtotal from the client that does not match the sum of cells unders rural stations staff, this analysis relies on individual staff projections

One one rural station carried forward

	for analysis
	Calculated Total based on geographic projections

Quick Facts: Railroad Workers	
2015 Median Pay	$55,180 per year $26.53 per hour

Source: http://www.bls.gov/ooh/transportation-and-material-moving/railroad-occupations.htm#tab-5

Economics:
1940— 2009 Deflator
Source: Whitehouse.gov

Fiscal Year	GDP (in billions of dollars)	GDP (Chained) Price Index	Composite Outlay Deflators												
			Total	Total Defense	Total Non-defense	Payment for Individuals			Other Grants	Net Interest	Undis-tributed Offsetting Receipts	All Other	Addendum: Direct Capital		
						Total	Direct	Grants					Total	Defense	Non-defense
1940	98.2	0.0809	0.0697	0.0651	0.0707	0.0788	0.0788	0.0788	0.0493	0.0809	0.0477	0.0674	0.1448	0.1484	0.1433
1941	116.2	0.0840	0.0769	0.0801	0.0743	0.0815	0.0815	0.0815	0.0446	0.0840	0.0474	0.0688	0.1548	0.1573	0.1490
1942	147.7	0.0902	0.0872	0.0976	0.0678	0.0892	0.0892	0.0892	0.0437	0.0902	0.0509	0.0595	0.1614	0.1616	0.1581
1943	184.6	0.0961	0.0964	0.1045	0.0671	0.0988	0.0988	0.0988	0.0469	0.0961	0.0557	0.0584	0.1582	0.1582	0.1585
1944	213.8	0.0995	0.0887	0.0918	0.0726	0.1061	0.1061	0.1061	0.0498	0.0995	0.0614	0.0624	0.1536	0.1536	0.1625
1945	226.4	0.1019	0.0834	0.0835	0.0831	0.1115	0.1116	0.1113	0.0503	0.1019	0.0647	0.0663	0.1433	0.1432	0.1668
1946	228.0	0.1097	0.0842	0.0801	0.1019	0.1176	0.1176	0.1174	0.0555	0.1097	0.0673	0.0719	0.1455	0.1451	0.1643
1947	238.9	0.1216	0.0956	0.0866	0.1019	0.1264	0.1264	0.1263	0.1309	0.1216	0.0713	0.0741	0.1624	0.1616	0.1670
1948	262.4	0.1331	0.0994	0.0812	0.1103	0.1380	0.1380	0.1379	0.0751	0.1331	0.0771	0.0816	0.1800	0.1773	0.1903
1949	276.8	0.1375	0.0958	0.0810	0.1056	0.1417	0.1418	0.1416	0.0791	0.1375	0.0749	0.0795	0.1902	0.1868	0.1985
1950	279.0	0.1355	0.1005	0.0818	0.1127	0.1399	0.1400	0.1395	0.0750	0.1355	0.0789	0.0848	0.1867	0.1860	0.1879
1951	327.4	0.1428	0.1009	0.0866	0.1226	0.1478	0.1479	0.1473	0.0894	0.1428	0.0778	0.0866	0.1998	0.2003	0.1978
1952	357.5	0.1485	0.1006	0.0901	0.1339	0.1537	0.1537	0.1532	0.0899	0.1485	0.0838	0.0944	0.2094	0.2094	0.2098
1953	382.5	0.1512	0.1080	0.0993	0.1349	0.1559	0.1560	0.1555	0.0941	0.1512	0.0887	0.0993	0.2122	0.2118	0.2177
1954	387.7	0.1530	0.1112	0.1009	0.1450	0.1580	0.1580	0.1578	0.0904	0.1530	0.0918	0.1061	0.2103	0.2099	0.2163
1955	407.0	0.1542	0.1151	0.1043	0.1390	0.1579	0.1579	0.1578	0.0921	0.1542	0.0943	0.1028	0.2162	0.2165	0.2126
1956	439.0	0.1582	0.1202	0.1105	0.1386	0.1598	0.1598	0.1597	0.0936	0.1582	0.0954	0.1024	0.2275	0.2280	0.2186
1957	464.2	0.1641	0.1261	0.1161	0.1441	0.1644	0.1644	0.1643	0.1019	0.1641	0.0976	0.1060	0.2401	0.2409	0.2291
1958	474.3	0.1691	0.1335	0.1216	0.1533	0.1692	0.1692	0.1691	0.1128	0.1691	0.1044	0.1150	0.2478	0.2487	0.2367
1959	505.6	0.1717	0.1391	0.1298	0.1513	0.1716	0.1716	0.1715	0.1199	0.1717	0.1097	0.1191	0.2521	0.2532	0.2402
1960	535.1	0.1741	0.1411	0.1286	0.1579	0.1747	0.1748	0.1746	0.1204	0.1741	0.1088	0.1229	0.2540	0.2552	0.2439
1961	547.6	0.1765	0.1443	0.1309	0.1612	0.1772	0.1772	0.1771	0.1184	0.1765	0.1142	0.1295	0.2554	0.2566	0.2462
1962	586.9	0.1783	0.1445	0.1312	0.1603	0.1789	0.1789	0.1788	0.1190	0.1783	0.1164	0.1315	0.2576	0.2588	0.2484
1963	619.3	0.1805	0.1507	0.1369	0.1661	0.1810	0.1810	0.1809	0.1231	0.1805	0.1202	0.1396	0.2617	0.2632	0.2508
1964	662.9	0.1827	0.1531	0.1388	0.1679	0.1835	0.1835	0.1834	0.1251	0.1827	0.1241	0.1462	0.2621	0.2634	0.2542
1965	710.7	0.1859	0.1553	0.1386	0.1707	0.1861	0.1862	0.1860	0.1286	0.1859	0.1311	0.1523	0.2627	0.2641	0.2564

Fiscal Year	GDP (in billions of dollars)	GDP (Chained) Price Index	Composite Outlay Deflators												
			Total	Total Defense	Total Non-defense	Payment for Individuals			Other Grants	Net Interest	Undis-tributed Offsetting Receipts	All Other	Addendum: Direct Capital		
						Total	Direct	Grants					Total	Defense	Non-defense
1966	781.9	0.1899	0.1596	0.1451	0.1727	0.1895	0.1895	0.1894	0.1255	0.1899	0.1356	0.1566	0.2648	0.2662	0.2576
1967	838.2	0.1957	0.1632	0.1498	0.1763	0.1946	0.1946	0.1945	0.1274	0.1957	0.1390	0.1589	0.2687	0.2698	0.2615
1968	899.3	0.2024	0.1691	0.1568	0.1813	0.2006	0.2006	0.2005	0.1319	0.2024	0.1441	0.1625	0.2746	0.2755	0.2673
1969	982.3	0.2117	0.1798	0.1657	0.1932	0.2091	0.2091	0.2090	0.1400	0.2117	0.1541	0.1747	0.2850	0.2858	0.2775
1970	1,049.1	0.2231	0.1899	0.1742	0.2030	0.2191	0.2191	0.2190	0.1494	0.2231	0.1668	0.1855	0.2998	0.3005	0.2930
1971	1,119.3	0.2344	0.2030	0.1853	0.2155	0.2289	0.2289	0.2288	0.1601	0.2344	0.1837	0.2031	0.3185	0.3196	0.3113
1972	1,219.5	0.2455	0.2165	0.2031	0.2242	0.2377	0.2377	0.2376	0.1679	0.2455	0.1979	0.2164	0.3417	0.3448	0.3259
1973	1,356.0	0.2562	0.2266	0.2176	0.2309	0.2466	0.2466	0.2465	0.1719	0.2562	0.2094	0.2289	0.3637	0.3692	0.3396
1974	1,486.2	0.2743	0.2454	0.2325	0.2512	0.2664	0.2664	0.2663	0.1878	0.2743	0.2222	0.2422	0.3863	0.3912	0.3661
1975	1,610.6	0.3027	0.2695	0.2533	0.2758	0.2940	0.2940	0.2939	0.2084	0.3027	0.2389	0.2586	0.4197	0.4234	0.4061
1976	1,790.3	0.3237	0.2888	0.2696	0.2955	0.3132	0.3132	0.3131	0.2246	0.3237	0.2588	0.2814	0.4485	0.4528	0.4331
TQ	472.6	0.3334	0.2961	0.2749	0.3032	0.3230	0.3230	0.3229	0.2327	0.3334	0.2666	0.2877	0.4651	0.4722	0.4435
1977	2,028.4	0.3470	0.3098	0.2906	0.3163	0.3366	0.3367	0.3365	0.2408	0.3470	0.2791	0.3023	0.4838	0.4913	0.4578
1978	2,278.2	0.3703	0.3292	0.3102	0.3353	0.3594	0.3595	0.3593	0.2562	0.3703	0.2966	0.3192	0.5134	0.5238	0.4806
1979	2,570.0	0.4001	0.3576	0.3355	0.3649	0.3892	0.3893	0.3891	0.2795	0.4001	0.3153	0.3436	0.5474	0.5581	0.5120
1980	2,796.8	0.4349	0.3951	0.3709	0.4028	0.4302	0.4303	0.4301	0.3107	0.4349	0.3414	0.3683	0.5909	0.5996	0.5584
1981	3,138.4	0.4775	0.4391	0.4133	0.4476	0.4720	0.4720	0.4718	0.3462	0.4775	0.3751	0.4038	0.6426	0.6507	0.6090
1982	3,313.9	0.5103	0.4721	0.4491	0.4803	0.5011	0.5011	0.5009	0.3759	0.5103	0.3930	0.4233	0.6966	0.7045	0.6554
1983	3,541.1	0.5327	0.4957	0.4720	0.5045	0.5241	0.5241	0.5239	0.3950	0.5327	0.4077	0.4371	0.7325	0.7410	0.6765
1984	3,952.8	0.5515	0.5184	0.4944	0.5278	0.5444	0.5444	0.5442	0.4155	0.5515	0.4173	0.4593	0.7594	0.7700	0.6939
1985	4,270.4	0.5698	0.5372	0.5128	0.5467	0.5637	0.5637	0.5634	0.4331	0.5698	0.4345	0.4782	0.7674	0.7773	0.7087
1986	4,536.1	0.5828	0.5486	0.5242	0.5585	0.5783	0.5784	0.5781	0.4486	0.5828	0.4407	0.4796	0.7621	0.7686	0.7174
1987	4,781.9	0.5958	0.5643	0.5325	0.5777	0.5930	0.5931	0.5928	0.4712	0.5958	0.4425	0.4894	0.7549	0.7592	0.7263
1988	5,155.1	0.6151	0.5835	0.5455	0.5991	0.6155	0.6156	0.6150	0.4890	0.6151	0.4566	0.5082	0.7560	0.7575	0.7473
1989	5,570.0	0.6396	0.6058	0.5647	0.6222	0.6425	0.6426	0.6415	0.5098	0.6396	0.4670	0.5163	0.7701	0.7698	0.7722
1990	5,914.6	0.6627	0.6237	0.5844	0.6371	0.6682	0.6684	0.6667	0.5341	0.6627	0.4797	0.5189	0.7851	0.7839	0.7921

Fiscal Year	GDP (in billions of dollars)	GDP (Chained) Price Index	Composite Outlay Deflators												
			Total	Total Defense	Total Non-defense	Payment for Individuals			Other Grants	Net Interest	Undis-tributed Offsetting Receipts	All Other	Addendum: Direct Capital		
						Total	Direct	Grants					Total	Defense	Non-defense
1991	6,110.1	0.6862	0.6526	0.6159	0.6629	0.6943	0.6946	0.6926	0.5557	0.6862	0.5124	0.5493	0.8067	0.8054	0.8135
1992	6,434.7	0.7030	0.6771	0.6231	0.6936	0.7122	0.7126	0.7102	0.5725	0.7030	0.5257	0.5906	0.8185	0.8179	0.8208
1993	6,794.9	0.7197	0.6972	0.6302	0.7171	0.7306	0.7310	0.7280	0.5909	0.7197	0.5560	0.6362	0.8359	0.8366	0.8332
1994	7,197.8	0.7354	0.7100	0.6366	0.7301	0.7459	0.7466	0.7425	0.6066	0.7354	0.5815	0.6449	0.8549	0.8570	0.8469
1995	7,583.4	0.7510	0.7306	0.6498	0.7511	0.7618	0.7626	0.7584	0.6271	0.7510	0.6001	0.6851	0.8766	0.8788	0.8701
1996	7,978.3	0.7650	0.7459	0.6641	0.7652	0.7771	0.7778	0.7735	0.6442	0.7650	0.6282	0.7057	0.8885	0.8925	0.8779
1997	8,483.2	0.7785	0.7612	0.6740	0.7817	0.7927	0.7934	0.7890	0.6559	0.7785	0.6431	0.7203	0.8858	0.8888	0.8778
1998	8,954.8	0.7881	0.7679	0.6866	0.7860	0.7999	0.8005	0.7973	0.6650	0.7881	0.6583	0.7101	0.8865	0.8887	0.8786
1999	9,510.5	0.7981	0.7777	0.7015	0.7943	0.8092	0.8097	0.8069	0.6816	0.7981	0.6774	0.7292	0.8951	0.8992	0.8846
2000	10,148.2	0.8147	0.7970	0.7235	0.8133	0.8283	0.8289	0.8256	0.7074	0.8147	0.7093	0.7551	0.9079	0.9108	0.9017
2001	10,564.6	0.8342	0.8183	0.7494	0.8333	0.8468	0.8473	0.8444	0.7301	0.8342	0.7310	0.7816	0.9114	0.9115	0.9113
2002	10,876.9	0.8477	0.8319	0.7761	0.8446	0.8568	0.8573	0.8547	0.7444	0.8477	0.7702	0.8084	0.9061	0.9041	0.9107
2003	11,332.4	0.8639	0.8554	0.8239	0.8630	0.8740	0.8745	0.8719	0.7672	0.8639	0.8057	0.8380	0.9130	0.9118	0.9160
2004	12,088.6	0.8853	0.8778	0.8552	0.8836	0.8930	0.8934	0.8912	0.7979	0.8853	0.8468	0.8680	0.9260	0.9250	0.9292
2005	12,888.9	0.9131	0.9081	0.8963	0.9111	0.9180	0.9183	0.9167	0.8458	0.9131	0.8867	0.9006	0.9437	0.9423	0.9484
2006	13,684.7	0.9428	0.9395	0.9350	0.9406	0.9457	0.9459	0.9446	0.8892	0.9428	0.9229	0.9326	0.9601	0.9593	0.9626
2007	14,322.9	0.9684	0.9643	0.9648	0.9642	0.9659	0.9660	0.9655	0.9354	0.9684	0.9562	0.9633	0.9749	0.9744	0.9766
2008	14,752.4	0.9885	0.9980	1.0019	0.9970	0.9999	1.0000	0.9996	0.9811	0.9885	0.9879	0.9893	0.9929	0.9921	0.9956
2009	14,414.6	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2010	14,798.5	1.0088	1.0157	1.0183	1.0151	1.0162	1.0163	1.0159	1.0150	1.0088	1.0320	1.0152	1.0070	1.0052	1.0127
2011	15,379.2	1.0293	1.0395	1.0496	1.0371	1.0377	1.0378	1.0374	1.0432	1.0293	1.0686	1.0466	1.0278	1.0249	1.0361
2012	16,027.2	1.0481	1.0603	1.0647	1.0592	1.0597	1.0597	1.0596	1.0693	1.0481	1.0839	1.0683	1.0394	1.0373	1.0459
2013	16,498.1	1.0661	1.0742	1.0714	1.0748	1.0757	1.0757	1.0757	1.0915	1.0661	1.0930	1.0663	1.0447	1.0411	1.0547
2014	17,183.5	1.0843	1.0902	1.0890	1.0904	1.0913	1.0913	1.0913	1.1146	1.0843	1.1320	1.0798	1.0563	1.0519	1.0704
2015	17,803.4	1.0990	1.1056	1.1042	1.1058	1.1055	1.1054	1.1056	1.1379	1.0990	1.1473	1.1184	1.0711	1.0661	1.0849
2016 estim	18,472.0	1.1164	1.1268	1.1218	1.1277	1.1265	1.1264	1.1266	1.1707	1.1164	1.1655	1.1404	1.0883	1.0831	1.1021

Fiscal Year	GDP (in billions of dollars)	GDP (Chained) Price Index	Composite Outlay Deflators												
			Total	Total Defense	Total Non-defense	Payment for Individuals			Other Grants	Net Interest	Undis-tributed Offsetting Receipts	All Other	Addendum: Direct Capital		
						Total	Direct	Grants					Total	Defense	Non-defense
ate															
2017 estimate	19,302.8	1.1364	1.1499	1.1420	1.1513	1.1501	1.1500	1.1503	1.2044	1.1364	1.1864	1.1638	1.1076	1.1025	1.1219
2018 estimate	20,129.6	1.1584	1.1745	1.1641	1.1762	1.1754	1.1753	1.1757	1.2407	1.1584	1.2093	1.1863	1.1291	1.1238	1.1436
2019 estimate	21,012.6	1.1816	1.2005	1.1875	1.2025	1.2024	1.2023	1.2028	1.2776	1.1816	1.2335	1.2100	1.1518	1.1463	1.1665
2020 estimate	21,921.4	1.2053	1.2275	1.2112	1.2299	1.2301	1.2300	1.2305	1.3190	1.2053	1.2582	1.2343	1.1748	1.1693	1.1898
2021 estimate	22,875.2	1.2294	1.2551	1.2355	1.2578	1.2584	1.2583	1.2589	1.3610	1.2294	1.2834	1.2590	1.1983	1.1927	1.2137

Note: Constant dollar research and development outlays are based on the GDP (chained) price index.

Source: Table 10.1 White House

https://www.whitehouse.gov/sites/default/files/omb/budget/fy2017/assets/hist10z1.xls

Downloaded: March 21 2016

Economics:
Project Costs by Geography

	Construction Allocation	Prof. Services Allocation	Regional Jobs	Jobs Allocation	Systems Allocation
All	100%	100%	1086	100.0%	100%
Dallas	33%	50%	456	42.0%	4%
Harris	33%	50%	456	42.0%	10%
Rural	34%	0%	224	20.6%	86%
Texas	100%	100%	1086	100.0%	100%

Notes:

Construction cost detail is insufficient to allocate by geography. This allocation assumes that longer mileage in rural counties will be offset by higher grade separation and station costs in urban counties for a roughly even split.

Professional Services include engineering and environmental analysis. To date, the primary offices for this work are located in Dallas and Harris County, with an assumed 50/50 split.

Locational job estimates are based on staffing assumptions prepared for purposes of water usage estimates (not a final number). 20 MOW staff allocated to rural geography (unknown county). 30 staff unaccounted for in water analysis to reach estimated employment of 1086, not allocated to any-sub geography.

Systems Costs are allocated by milage of track in each geography

AECOM

TECHNICAL MEMORANDUM
ENVIRONMENTAL JUSTICE

To: Jerry Smiley, AICP, AECOM

From: Matthew Ables, AICP, AECOM

Date: November 1, 2017

RE: **DALLAS TO HOUSTON HSR EIS – ENVIRONMENTAL JUSTICE**

This technical memorandum summarizes the data analyzed to determine disproportionately high or adverse impacts to EJ communities. That data below is represented in tables that display potential impacts by county, segment and Build Alternative for EJ communities. A comparison of impacts to EJ communities and the non-EJ communities is calculated to determine if highly disproportionate or adverse impacts would exist.

Identification of EJ Block Groups by Segments

Definitions and methods used to identify EJ block groups can be found in the Methodology section of the EIS (**Section 3.18.3, Methodology**). The following tables identify the block groups that are classified as minority, Hispanic and/or low-income, and would be intersected by the Build Alternatives' study area. In **Table 2**, Segment 1 ends and Segments 2A and 2B begin in the same block group. Additionally, Segments 2A and 2B end in the same block group where Segments 3A, 3B and 3C begin. For the purpose of this analysis, any instance of a segment intersecting a block group is counted, and a footnote is added. However, in **Table 3,** for the calculation of total block groups intersected per Build Alternative, if a block group is intersected by multiple segments of the LOD the block group is only counted once.

Table 1: Number of EJ Block Groups By County

County	EJ Block Groups Intersected by the LOD	EJ Block Groups Intersected by the Study Area	Total Block Groups Intersected by the LOD	Total Block Groups Intersected by the Study Area
Dallas	11	25	14	29
Ellis	9	9	9	9
Navarro	0	0	4	5
Freestone	1	2	6	7
Limestone	0	0	2	2
Leon	5	5	8	8
Madison	0	0	2	2
Grimes	1	1	7	7
Waller	0	0	2	2
Harris	12	29	27	60
Total	**37**	**69**	**80**	**131**

Source: AECOM, 2017

Table 2: Number of EJ Block Groups By Segment				
Segment	**EJ Block Groups Intersected by the LOD**	**EJ Block Groups Intersected by the Study Area******	**Total Block Groups Intersected by the LOD**	**Total Block Groups Intersected by the Study Area*******
Segment 1	12*	27	14*	32
Segment 2A	7*	17	9*	21
Segment 2B	7*	16	9*	19
Segment 3A	1**	7	5**	21
Segment 3B	1**	7	6**	18
Segment 3C	4**	9	17**	36
Segment 4	3	3	12****	21
Segment 5	12	32	30	66
Industrial Site Terminal***	2	7	6	13
Northwest Mall Terminal***	2	9	3	19
Northwest Transit Center Terminal***	2	8	6	24

* The terminus of Segment 1 and the beginning of Segments 2A and 2B overlap in the same block group in Ellis County
**Segments 3A, 3B and 3C begin in the same EJ block group in Ellis County.
***Station options intersect the same block groups found on Segment 5.
***** Block groups can be intersected by multiple segments due to overlapping Study Area.
Source: AECOM, 2017

Table 3: Number of Block Groups By Build Alternative Within the LOD									
Resource	**Build Alternative**						**Houston Station Option**		
	ALT A	**ALT B**	**ALT C**	**ALT D**	**ALT E**	**ALT F**	**Industrial Site Terminal***	**Northwest Mall Terminal***	**Northwest Transit Center Terminal***
Number of EJ Block Groups intersected by the LOD	34	34	34	34	34	34	2	2	2
Number of EJ Block Groups intersected by the Study Area	86	86	85	85	85	84	7	9	8
Total number of Block Groups intersected by the LOD	66	67	67	66	67	67	6	3	6
Total number of Block Groups intersected by the Study Area	161	158	155	159	156	153	6	10	16

*Station options intersect the same block groups found on Segment 5.
Source: AECOM, 2017

Identification of Potential Impacts by Resource Area

Air Quality

Across all Build Alternatives, there would be no disproportionately high or adverse air quality impacts to EJ populations.

Water Quality

Across all Build Alternatives, there would be no disproportionately high or adverse water quality impacts to EJ populations.

Noise and Vibration

Noise and vibration impacts would occur at various locations along the Build Alternatives where sensitive receptors are present. Generally these are locations that include residences, commercial businesses that would be sensitive to noise, locations where people gather and recreational areas where ambient noise levels are generally low. Sources of noise would be due to the construction and operation of the Build Alternatives. Therefore, a noise and vibration analysis was conducted by FRA. Noise impacts that were noted as severe are represented in the tables below. **Tables 4-6** show the number of impacts in EJ communities and total impacts within the LOD by county, segment and Build Alternative. Across all Build Alternatives there would be no vibration impacts in EJ communities. Data in the tables show that by quantity of noise impacts there would not be a disproportionately high or adverse number in EJ communities based on the selected Build Alternative.

Table 4: Severe and Moderate Noise Impacts by County

County	Severe (EJ)	Severe (Total)	Moderate (EJ)	Moderate (Total)
Dallas	0	0	4	9
Ellis	2	2	33	35
Navarro	0	3	0	24
Freestone	0	6	0	8
Limestone	0	0	0	3
Leon	1	1	6	8
Madison	0	0	0	7
Grimes	1	1	5	15
Waller	0	1	0	24
Harris	8	8	175	206
Total	12	22	223	339

Source: AECOM, 2017

Table 5: Severe and Moderate Noise Impacts by Segment

Segment	Severe (EJ)	Severe (Total)	Moderate (EJ)	Moderate (Total)
Segment 1	2	2	21	26
Segment 2A	0	0	12	14
Segment 2B	0	0	4	4
Segment 3A	0	0	0	4
Segment 3B	0	2	0	17
Segment 3C	0	3	4	15
Segment 4	1	5	2	14
Segment 5	9	10	180	245
Industrial Site Terminal	0	0	0	0
Northwest Mall Terminal	0	0	0	0
Northwest Transit Center Terminal	0	0	0	0
Total	12	22	223	339

Source: AECOM, 2017

Table 6: Severe and Moderate Noise Impacts and Vibration Impacts By Build Alternative									
Resource	Build Alternative						Houston Station Option		
	ALT A	ALT B	ALT C	ALT D	ALT E	ALT F	Industrial Site Terminal	Northwest Mall Terminal	Northwest Transit Center Terminal
Severe (EJ)	12	12	11	12	12	11	0	0	0
Severe (Total)	17	19	15	17	19	15	0	0	0
Moderate (EJ)	215	215	217	207	207	209	0	0	0
Moderate (Total)	303	316	300	293	306	290	0	0	0

Source: AECOM, 2017

<u>Hazardous Materials</u>

Primary producers of hazardous materials for the Build Alternatives would be the construction of the HST System, TMFs, MOWs and station areas. TCRR conducted an analysis regarding quantities of hazardous materials generated by all aspects of the project. For EJ purposes, it is important to note that the Dallas County TMF would be located in EJ communities and the Harris County TMF would not be located in an EJ community. However, hazardous materials would be controlled in accordance with state and federal laws. The locations of these facilities would not represent a disproportionately high or adverse impact to EJ communities.

Additionally, the hazardous materials analysis included site specific research relating to potential hazardous sites that would potentially be encountered by each Build Alternative. **Tables 7-9** show the number of potentially high and moderate risk sites for each county, segment, and Build Alternatives. The data shows that a disproportionately high or adverse impact would not occur to EJ communities. It is possible that the selected Build Alternative would encounter high risk sites during construction that would require remediation. Remediation of hazardous sites could be a beneficial impact for an EJ community.

Table 7: High and Moderate Risk HAZMAT Impacts by County				
County	High (EJ)	High (Total)	Moderate (EJ)	Moderate (Total)
Dallas	3	3	25	41
Ellis	1	1	0	1
Navarro	0	0	0	0
Freestone	0	0	3	8
Limestone	0	0	0	0
Leon	0	0	0	4
Madison	0	0	0	0
Grimes	0	0	0	0
Waller	0	0	0	1
Harris	0	4*	65	121
Total	4	6	93	176

*Includes sites at potential station areas.

Source: AECOM, 2017

Table 8: High and Moderate Risk HAZMAT Impacts by Segment				
Segment	**High (EJ)**	**High (Total)**	**Moderate (EJ)**	**Moderate (Total)**
Segment 1	3	3	34	34
Segment 2A	1	1	0	0
Segment 2B	0	0	0	0
Segment 3A	0	0	0	0
Segment 3B	0	0	0	0
Segment 3C	0	0	6	9
Segment 4	0	0	0	0
Segment 5	0	2	62	101*
Industrial Site Terminal	0	2	0	3**
Northwest Mall Terminal	0	0	3	3**
Northwest Transit Center Terminal	0	0	0	8**
Total	4	8	105	144

*Includes sites at potential station areas.

**Resources at station area may be counted multiple times.

Source: AECOM, 2017

Table 9: High and Moderate HAZMAT Impacts By Build Alternative									
Resource	**Build Alternative**						**Houston Station Option**		
	ALT A	**ALT B**	**ALT C**	**ALT D**	**ALT E**	**ALT F**	**Industrial Site Terminal**	**Northwest Mall Terminal**	**Northwest Transit Center Terminal**
High (EJ)	4	4	4	3	3	3	0	0	0
High (Total)	7	7	7	6	6	6	2	0	0
Moderate (EJ)	87	87	90	87	87	90	0	3	0
Moderate (Total)	135	135	144	135	135	144	3	3	8

Source: AECOM, 2017

<u>Aesthetic and Scenic Resources</u>

Across all Build Alternatives, there would be no disproportionately high or adverse Aesthetic and Scenic Resource impacts to EJ populations. **Tables 10-12** show the numbers of construction sites and MOW sites by county, segment and by Build Alternatives in EJ communities and total. These sites would cause temporary and permanent impacts that would be mitigated through measures covered in **Section 3.10.7, Avoidance, Minimization and Mitigation.**

Table 10: Temporary Construction Sites and MOWF by County				
County	Temporary Construction Sites (EJ)	Temporary Construction Sites (Total)	MOWF (EJ)	MOWF (Total)
Dallas	17	19	1	1
Ellis	9	9	2	2
Navarro	0	11	0	0
Freestone	0	3	0	2
Limestone	0	1	0	0
Leon	11	11	1	2
Madison	0	2	0	0
Grimes	0	3	0	1
Waller	0	1	0	1
Harris	2	9	1	1
Total	23*	69*	5	10

Source: AECOM, 2017

*Some temporary construction sites are double counted as some sites are used for multiple segments.

Table 11: Temporary Construction Sites and MOWF by Segment				
Segment	Temporary Construction Sites (EJ Acreage)	Temporary Construction Sites (Total Acreage)	MOWF (EJ)	MOWF (Total)
Segment 1	324	373	1	1
Segment 2A	219	219	1	1
Segment 2B	203	203	1	1
Segment 3A	0	218	0	1
Segment 3B	0	229	0	1
Segment 3C	87	576	1	3
Segment 4	173	500	1	4
Segment 5	16	833	0	4
Industrial Site Terminal	0		0	0
Northwest Mall Terminal	0		0	0
Northwest Transit Center Terminal	0	6	0	0
Total	1,022**	3,157**	5	16

Source: AECOM, 2017

**Some temporary construction sites are double counted as some sites are used for multiple segments.

Table 12: Temporary Construction Sites and MOWF By Build Alternative									
Resource	Build Alternative						Houston Station Option		
	ALT A	ALT B	ALT C	ALT D	ALT E	ALT F	Industrial Site Terminal	Northwest Mall Terminal	Northwest Transit Center Terminal
Temporary Construction Sites (EJ Acreage)	641	641	554	625	625	538	0	0	0
Temporary Construction Sites(Total Acreage)	2,143	2,154	2,001	2,127	2,138	1,985	0	0	6
MOWF (EJ)	3	3	3	3	3	3	0	0	0
MOWF(Total)	11	11	9	11	11	9	0	0	0

Source: AECOM, 2017

Transportation

Transportation impacts caused as a result of the Build Alternatives would primarily affect EJ communities through roadway modifications. TCRR has designed the Build Alternatives to avoid and minimize impacts to the maximum extent. The HSR System avoids roadway impacts through the use of viaduct, road over and under rail, relocation, rerouting and closure. Permanent changes to roadways occur when roadways are relocated, rerouted or closed. Road closure is only considered when an alternate route serving traffic in a similar manner is nearby. **Tables 13-16** show roadway modifications across the all Build Alternatives, and roadway modifications in EJ communities by county, segment, and Build Alternative. The data shows that EJ communities are not disproportionately affected by permanent roadway modifications, and there would not be a disproportionately high or adverse impact to EJ communities.

Tables 17-20 show roadway modifications in EJ communities at station locations. These modifications would include only infrastructure changes or improvements and not represent a disproportionately high or adverse impact to EJ communities.

Table 13: Roadway Modifications by County				
County	All Modifications # (EJ)	All Modifications # (Total)	Relocations, Reroutes, Closures (EJ)	Relocations, Reroutes, Closures (Total)
Dallas	10	10	7	7
Ellis	26	27	10	11
Navarro	0	45	0	28
Freestone	0	40	0	27
Limestone	0	23	0	21
Leon	34	47	29	41
Madison	0	37	0	30
Grimes	2	46	1	38
Waller	0	10	0	8
Harris	0	31	0	26
Total	72	316	47	237

Source: AECOM, 2017

Table 14: Roadway Modifications by Segment				
County	**All Modifications # (EJ)**	**All Modifications # (Total)**	**Relocations, Reroutes, Closures (EJ)**	**Relocations, Reroutes, Closures (Total)**
Segment 1	10	10	7	7
Segment 2A	11	12	6	7
Segment 2B	11	11	4	4
Segment 3A	2	19	0	10
Segment 3B	2	25	0	14
Segment 3C	10	40	7	25
Segment 4	24	113	22	99
Segment 5	2	86	1	71
Industrial Site Terminal	12	19	0	0
Northwest Mall Terminal	10	16	0	0
Northwest Transit Center Terminal	10	11	0	0
Total	104	362	47	237

Source: AECOM, 2017

Table 15: Summary of Transportation Impacts						
Resource	**Build Alternative**					
	A	**B**	**C**	**D**	**E**	**F**
Roads Permanently Impacted (Closed, Relocated or Rerouted) in EJ Communities	36	36	21	34	34	19
Roads Permanently Impacted (Closed, Relocated or Rerouted)	194	198	110	191	195	107
Transit Services	All alternatives would have the same impacts on transit services. All alternatives could increase ridership on local transit systems, particularly in Dallas or where local rail connections would be most accessible from the station.					
Rail Facilities and Operations	There would be no permanent or long-term operational impacts associated with any of rail crossings as the Build Alternative would be fully grade separated.					
On-Road Pedestrian & Bicycle Facilities	None of the segments would permanently impact on-road pedestrian or bicycle facilities.					
Impacts to airports	1	2	1	1	2	1

Source: AECOM, 2017

Table 16: Roadways Impacted In EJ Communities		
Roadway Name	**Roadway Modification**	**Segment**
Dallas County		
Private Drive	Closure	1
Cleveland Road	Reroute	1
Private Drive	Reroute	1
Private Drive	Reroute	1
Private Drive	Closure	1
Private Drive	Closure	1
Cornell Road	Reroute	1
E. Pleasant Run Road	Road Under Rail	1
Greene Road	Road Over Rail	1
Beltline Road	Road Over Rail	1
Ellis County		
Ewing Road	Reroute	2A
Dirt Road	Reroute	2A
FM 878	Road Over Rail	2A
Wilson Road	Road Over Rail	2A
Bacak Road	Road Over Rail	2A
East B Lane	Reroute	2A
SH 34	Road Over Rail	2A
Private Drive	Closure	2A
Farmer Road	Reroute	2A
Dirt Road	Reroute	2A
Hodge Road	Road Over Rail	2A
Ewing Road	Reroute	2B
Epps Road	Reroute	2B
Almand Road	Road Under Rail	2B
Wilson Road	Road Over Rail	2B
Private Driveway	Reroute	2B
Private Driveway	Reroute	2B
Old Boyce Road	Reroute	2B
Old Church Road	Road Over Rail	2B
Old Waxahachie Road / Getzendaner Road	Road Over Rail	2B
FM 984	Road Over Rail	2B
FM 984	Road Over Rail	2B
FM 985	Road Over Rail	3A
Sullivan Road	Road Over Rail	3A
FM 985	Road Over Rail	3B
Sullivan Road	Road Over Rail	3B
Leon County		
IH-45 Frontage	Relocation	3C
Industrial	Relocation	3C
IH-45 Frontage	Relocation	3C
County Road 3051	Reroute	3C
County Road 314	Road Over Rail	3C
County Road 477	Reroute	3C
IH-45	Relocation	3C
FM 977	Road Over Rail	3C
IH-45	Relocation	3C
CR 400	Road Over Rail	3C
Private Road	Closure	4
Private Road	Closure	4
Private Road	Closure	4

Table 16: Roadways Impacted In EJ Communities		
Roadway Name	**Roadway Modification**	**Segment**
Private Road	Closure	4
Private Road	Closure	4
Private Road	Closure	4
FM 1512	Road Under Rail	4
Private Road	Closure	4
Private Road	Reroute	4
Private Road	Closure	4
Private Road	Closure	4
County Road 344	Reroute	4
Private Road	Closure	4
Private Road	Closure	4
Private Road 4255	Closure	4
Private Road	Closure	4
County Road 408	Reroute	4
Private Road	Closure	4
County Road 408	Reroute	4
Private Road	Closure	4
Private Road	Closure	4
Private Road	Closure	4
Private Road	Reroute	4
County Line Road	Road Over Rail	4
Grimes County		
County Road 302	Road Over Rail	5
Bronco Lane	Reroute	5
Harris County		
None		

Source: AECOM, 2017

Table 17: Dallas Terminal Intersection Design Modifications	
Intersection	**Improvement**
Riverfront Boulevard/ Commerce Street	• Add right-turn bay to northbound approach to provide dual-right turn bays.
Riverfront Boulevard/ Cadiz Street	• Add one right-turn bay to provide dual right turns for southwest bound approach. • Add one left-turn bay to northeast approach to provide dual left-turn bays.
Lamar Street/ Cadiz Street	• Add one right-turn bay to southwest bound approach (IH-30 exit ramp). • Add right-turn bay to southeast bound approach.
Canton Street/Akard Street	• Add a protected left phase and signal head for northwest bound approach.
Belleview Street/South Akard Street	• Provide stop control on both approaches of Akard Street to make the intersection four-way stop-controlled.

Source: AECOM, 2017

Table 18: Northwest Mall Terminal Intersection Design Modifications	
Intersection	**Improvement**
Mangum Road/US 290 NBFR	• Add one left-turn bay to northbound approach to provide dual left-turn bays. • Add one through lane to southbound approach.
Mangum Road/US 290 SBFR	• Add one through lane to northbound approach.
Mangum Road/Dacoma Street	• Add one right-turn bay to northbound approach. • Convert the left turns at all approaches to protected then permissive.
Dacoma Street/US 290 SBFR	• Add a one right-turn bay to the northeast bound and southeast bound approaches.
Hempstead Road/Long Point Road	• Prohibit left turns at southeast bound approach.
W 18th Street/ Hempstead Road	• Prohibit left turns at westbound approach.

Table 18: Northwest Mall Terminal Intersection Design Modifications	
Intersection	**Improvement**
Mangum Road/18th Street	• Add one right-turn bay to westbound approach. • Convert the left turns at all approaches to protected then permissive.
W 18th Street/IH-610 SBFR	• Add two right-turn bays and one through lane on the eastbound approach.
W 18th Street/IH-610 NBFR	• Add one right-turn bay and one through lane to westbound approach. • Add one right-turn bay to northbound approach.
Post Oak Road/Hempstead Road	• Add one right-turn bay to southeast bound approach. • Convert southwest bound approach center left-through lane to through lane. • Add one lane to northeast bound approach and convert to dual lefts, one through/right and one right-turn lane.

Source: AECOM, 2017

Table 19: Industrial Site Intersection Design Modifications	
Intersection	**Improvement**
Mangum Road/US 290 NBFR	• Add one left-turn bay to northbound approach. • Add one through lane to southbound approach.
Mangum Road/Dacoma Street	• Add one right-turn bay to northbound approach. • Convert the left turns of all approaches to protected then permissive.
Dacoma Street/US 290 SBFR	• Add one right-turn bay to the southeast bound approach and northeast bound approaches.
Hempstead Road/Long Point Road	• Prohibit left-turns for southeast bound approach.
W 18th Street/Hempstead Road	• Prohibit left turns at westbound approach.
Mangum Road/18th Street	• Add one right-turn aby to westbound and northbound approaches. • Convert the left turns of all approaches to protected then permissive.
W 18th Street/IH-610 SBFR	• Add one right-turn bay and one through lane to eastbound approach.
W 18th Street/IH-610 NBFR	• Add one through lane to westbound approach.
Hempstead Road/ Mangum Road	• Add one right-turn bay to northwest bound approach on Hempstead Road.
Post Oak Road/ Hempstead Road	• Add one right-turn bay to southeast bound approach. • Add one left-turn bay to northwest bound approach. • Convert southwest bound approach center left/through lane to through lane. • Add one lane to northeast bound approach and convert to dual lefts, one through/right and one right-turn lane.
Hempstead Road/IH-610 SBFR	• Add one through lane to northwest bound approach to provide three through lanes.
Hempstead Road/IH-610 NBFR	• Convert northwest bound approach right-turn lane to a shared through/right-turn lane.

Source: AECOM, 2017

Table 20: Northwest Transit Center Terminal Intersection Design Modifications	
Intersection	**Improvement**
Mangum Road/US 290 NBFR	• Add one left-turn bay to northbound approach. • Add one through lane to southbound approach.
Mangum Road/US 290 SBFR	• Add one through lane to northbound approach.
Mangum Road/Dacoma Street	• Convert northeast bound shared through/left-turn lane to through-only lane.
West T C Jester Boulevard/IH-610 Eastbound FR	• Convert northeast bound shared through/left-turn lane to through-only lane.
Jester Boulevard/IH-610 EBFR	• Convert southeast bound center lane from through to shared through/left.
Hempstead Road/Long Point Road	• Prohibit left turns from southeast bound approach.
W 18th Street/Hempstead Road	• Prohibit left turns at westbound approach.
Mangum Road/18th Street	• Add one right-turn bay to westbound approach. • Convert the left turns at all approaches to protected then permissive.
W 18th Street/IH-610 SBFR	• Add one right-turn bay to eastbound approach.

Table 20: Northwest Transit Center Terminal Intersection Design Modifications	
Intersection	**Improvement**
Post Oak Road/Hempstead Road	• Add one right-turn bay to eastbound approach. • Convert northwest bound approach to dual left-turn bays, a shared through and right-turn lane and one right-turn bay. • Convert southeast bound approach outside through lane to a shared through/right-turn lane, providing two lanes permitting right-turns.

Source: AECOM, 2017

Displacements, Acquisitions and Relocations

Table 21 details primary structures (residences, commercial, and community facilities) that are located within the LOD based on the structure displacement and land use acquisition analysis in **Section 3.13, Land Use**. The results were then analyzed to determine if structures were in EJ Communities or not. Depending on the Build Alternative selected, these primary structures would be displaced by the Project. Details regarding the determination of displacements can be found in **Section 3.13, Land Use** and the Land Use Technical Memorandum. **Table 22** shows displaced structures by Build Alternative. The table shows that EJ communities would not experience a disproportionately high or adverse impact related to displacement of structures by the selected Build Alternative.

Table 21: Primary Structure Displacements within LOD and Within 50' of the LOD

County/Segment	Residential (EJ)	Residential (Total)	Commercial (EJ)	Commercial (Total)	Community Facilities (EJ)	Community Facilities (Total)
Dallas						
Segment 1	32	40	23	23	--	--
Ellis						
Segment 1	7	7	--	--	--	--
Segment 2A	14	18	--	--	--	--
Segment 2B	21	23	--	--	--	--
Segment 3A	1	1	--	--	--	--
Segment 3B	0	0	--	--	--	--
Segment 3C	1	1	--	--	--	--
Navarro						
Segment 3A	0	18	--	--	--	--
Segment 3B	0	29	--	--	--	--
Segment 3C	0	19	--	--	--	--
Freestone						
Segment 3A	--	--	--	--	--	--
Segment 3B	--	--	--	--	--	--
Segment 3C	0	6	0	10	0	1
Segment 4	0	6	--	--	--	--
Limestone						
Segment 4	0	6	--	--	--	--
Leon						
Segment 3C	13	17	6	9	--	1
Segment 4	10	12	--	--	--	--
Madison						
Segment 3C	0	5	--	--	--	--
Segment 4	0	16	--	--	0	1
Grimes						
Segment 3C	--	--	--	--	--	--
Segment 4	--	--	--	--	--	--
Segment 5	11	38	0	1	--	--

Table 21: Primary Structure Displacements within LOD and Within 50' of the LOD						
County/Segment	**Residential (EJ)**	**Residential (Total)**	**Commercial (EJ)**	**Commercial (Total)**	**Community Facilities (EJ)**	**Community Facilities (Total)**
Waller						
Segment 5	0	35	--	--	--	--
Harris						
Segment 5	0	86	4	25	--	--
Houston Terminal Options						
Industrial Site	0	0	3	9	--	--
Northwest Mall	--	--	9	9	--	--
Northwest Transit Center	0	1	4	16	--	--
Total	110	384	49	102	0	3

Source: AECOM, 2017

Table 22: Displaced Structures within EJ Communities by Build Alternative									
Resource	**Build Alternative**						**Houston Terminal Options**		
	ALT A	**ALT B**	**ALT C**	**ALT D**	**ALT E**	**ALT F**	**Industrial Site**	**Northwest Mall**	**Northwest Transit Center**
Residential (EJ)	75	74	78	82	81	85	0	0	0
Commercial (EJ)	27	27	33	27	27	33	3	9	4
Community Features (EJ)	0	0	0	0	0	0	0	0	0
Total	102	101	111	109	108	118	3	9	4
Residential (Total)	283	293	272	288	298	277	0	0	1
Commercial (Total)	49	49	68	49	49	68	9	9	16
Community Features (Total)	1	1	2	1	1	2	0	0	0
Total	333	343	342	338	348	347	18	19	23

Source: AECOM, 2017

Table 22: Estimated Parcel Acquisition by County				
Segment	**Temporary Parcels (EJ)***	**Temporary Parcels (Total)***	**Permanent Parcels (EJ)***	**Permanent Parcels (Total)***
Dallas	21	35	233	265
Ellis	57	65	321	360
Navarro	0	73	8	559
Freestone	0	40	3	367
Limestone	0	5	1	67
Leon	26	29	195	286
Madison	0	22	1	176
Grimes	0	18	52	428
Waller	0	5	2	124
Harris	10	25	155	468
Total	114	312	975	3,100

Source: AECOM, 2017

*Counts include acquisitions which may only acquire a portion of a parcel.

Table 23: Estimated Parcel Acquisition by Segment				
Segment	Temporary Parcels (EJ)*	Temporary Parcels (Total)*	Permanent Parcels (EJ)*	Permanent Parcels (Total)*
Segment 1	21	35	247	279
Segment 2A	35	40	135	160
Segment 2B	22	25	131	145
Segment 3A	0	15	17	183
Segment 3B	0	24	15	238
Segment 3C	6	59	114	644
Segment 4	20	66	107	451
Segment 5	1	35	174	897
Industrial Site Terminal	3	3	11	40
Northwest Mall Terminal	3	3	14	15
Northwest Transit Center Terminal	3	7	10	48
Total	114	312	975	3100

Source: AECOM, 2017
*Counts include acquisitions which may only acquire a portion of a parcel.

Table 24: Estimated Parcel Acquisition By Build Alternative									
Resource	Build Alternative						Houston Station Option		
	ALT A	ALT B	ALT C	ALT D	ALT E	ALT F	Industrial Site Terminal	Northwest Mall Terminal	Northwest Transit Center Terminal
Temporary Parcels (EJ)*	77	77	63	64	64	50	3	3	3
Temporary Parcels (Total)*	191	200	169	176	185	154	3	3	7
Permanent Parcels (EJ)*	680	678	670	676	674	666	11	14	10
Permanent Parcels (Total)*	1,970	2,025	1,980	1,955	2,010	1,965	40	15	48

Source: AECOM, 2017 *Counts include acquisitions which may only acquire a portion of a parcel.

Community Cohesion

Table 23 shows communities identified in **Section 3.14, Socioeconomic.** Each of the communities would be impacted by all Build Alternatives. Two of the communities would be located in EJ communities. The Downtown Dallas area would be enhanced by the Build Alternative and would potentially increase community cohesion, employment and quality of life in the neighborhood. The LeMay and LeForge community would have numerous homes displaced by Segment 1 of all Build Alternatives. This would represent a severe impact to an EJ community; however across the entirety of the Build Alternatives EJ communities would not suffer the majority of impacts to community cohesion. Therefore, there would not be a disproportionately high or adverse impact to EJ Communities.

Table 25: Impacted Neighborhoods by Segment

Community Name	Segment	EJ Community
Dallas County		
Downtown Dallas	1	Minority/Low-Income
LeMay and LeForge	1	Minority/Low-Income
Harris		
Saddle Creek Forest Development	5	No
Plantation Drive Neighborhood	5	No
White Oak Falls Neighborhood	5	No
Houston Terminus Station Options	5	No

Source: AECOM, 2017

Population and Employment

Effects from business displacements overall would be distributed throughout the Build Alternatives and would not be predominantly borne by minority or low-income groups. Overall, the Build Alternatives would create a beneficial impact for employment opportunities to EJ communities.

Community Facilities

Only one community facility would be impacted by the Build Alternatives. Honey Springs Cemetery would be spanned via viaduct for all Build Alternatives.

Table 26: Impacted Community Facilities by County

County	Impacted Community Facilities (EJ)	Impacted Community Facilities (Total)
Dallas	1	1
Ellis	0	0
Navarro	0	0
Freestone	0	3
Limestone	0	0
Leon	0	0
Madison	0	1
Grimes	0	0
Waller	0	0
Harris	0	1
Total	1	6

Source: AECOM, 2017

Table 27: Impacted Community Facilities by Segment		
Segment	**Impacted Community Facilities (EJ)**	**Impacted Community Facilities (Total)**
Segment 1	1	1
Segment 2A	0	0
Segment 2B	0	0
Segment 3A	0	0
Segment 3B	0	0
Segment 3C	0	2
Segment 4	0	1
Segment 5	0	2
Industrial Site Terminal	0	0
Northwest Mall Terminal	0	0
Northwest Transit Center Terminal	0	0
Total	1	6

Source: AECOM, 2017

Table 28: Community Facility Impacts in EJ Communities By Build Alternative									
Resource	**Build Alternative**						**Houston Station Option**		
	ALT A	**ALT B**	**ALT C**	**ALT D**	**ALT E**	**ALT F**	**Industrial Site Terminal**	**Northwest Mall Terminal**	**Northwest Transit Center Terminal**
Community Facilities	1	1	1	1	1	1	0	0	0

Source: AECOM, 2017

<u>Recreational Facilities</u>

Tables 27-29 show reactional facilities impacted by county, segment and Build Alternative. Bardwell Lake and Fort Boggy State Park are the main impacts located on Segment 2B and 3C, respectively. A disproportionately high or adverse impact would not occur to use of these two resources by EJ communities.

Table 29: Impacted Recreational Facilities by County		
County	**Impacted Recreational Facilities (EJ)**	**Impacted Recreational Facilities (Total)**
Dallas	0	0
Ellis	1	1
Navarro	0	0
Freestone	0	0
Limestone	0	0
Leon	1	1
Madison	0	0
Grimes	0	0
Waller	0	0
Harris	0	0
Total	2	2

Source: AECOM, 2017

Table 30: Recreational Facility Impacts by Segment		
Segment	**Impacted Facilities (EJ)**	**Impacted Facilities (Total)**
Segment 1	0	0
Segment 2A	0	0
Segment 2B	1	1
Segment 3A	0	0
Segment 3B	0	0
Segment 3C	1	1
Segment 4	0	0
Segment 5	0	0
Industrial Site Terminal	0	0
Northwest Mall Terminal	0	0
Northwest Transit Center Terminal	0	0
Total	2	3

Source: AECOM, 2017

Table 31: Recreational Facility Impacts in EJ Communities By Build Alternative									
Resource	**Build Alternative**						**Houston Station Option**		
	ALT A	**ALT B**	**ALT C**	**ALT D**	**ALT E**	**ALT F**	**Industrial Site Terminal**	**Northwest Mall Terminal**	**Northwest Transit Center Terminal**
Recreational Facilities	0	0	1	1	1	2	0	0	0
Trails	0	0	0	0	0	0	0	0	0

Source: AECOM, 2017

AECOM

TECHNICAL MEMORANDUM
SOILS AND GEOLOGY

To: Jerry Smiley, AICP, AECOM

From: Jennifer Oakley, AECOM

Date: November 1, 2017

RE: Dallas to Houston HSR –Soils and Geology

This technical memorandum identifies the individual soil associations, soil units and geologic formations that comprise the Dallas to Houston EIS Study Area. The tables provided in this technical memorandum include soil associations, geologic formations descriptions and acreages within each county and project segment. For each table, the Study Area refers to each respective segment along the project corridor within each county. For additional information on soil and geologic conditions refer to **Chapter 3.0, Section 3.20, Soils and Geology**.

Dallas County

Soils

In Dallas County, the Study Area is comprised of five soil associations. Descriptions of these soil associations and the area in acres of each segment are provided in **Table 1. Table 2** includes the soils units that comprise the Study Areas with associated characteristics including shrink-swell potential, erosion potential, corrosion potential and prime farmland designation and the area in acres of each segment. Please note that the soil map units in **Table 2** for Dallas County are represented by numbers.

Table 1. Soil Associations within the Study Area – Dallas County

Soil Association	STATSGO code	Description	Segment 1 (acres)
Houston Black-Heiden-Austin	s7184	• Nearly level to strongly sloping • Moderately well drained and well drained • Clayey soils • Associated with uplands • Used mainly as pasture, urban or cropland	94.5
Stephen-Houston Black-Heiden-Eddy-Austin	s7185	• Nearly level to moderately steep • Moderately well drained and well drained • Loamy and clayey soils • Associated with uplands • Used mainly as pasture, range or cropland	41.6
Houston Black-Heiden-Altoga	s7377	• Nearly level to strongly sloping • Moderately well drained and well drained • Clayey soils • Associated with uplands • Used mainly as pasture, urban or cropland	557.6

Table 1. Soil Associations within the Study Area – Dallas County			
Soil Association	**STATSGO code**	**Description**	**Segment 1 (acres)**
Trinity-Kaufman	s7697	• Nearly level to gently sloping • Somewhat poorly drained; very slowly permeable • Clayey soils • Associated with floodplains • Used mainly as pasture or cropland	306.1
Silstid-Silawa-Bastsil	s7644	• Nearly level to sloping • Well drained • Loamy and sandy soils • Associated with stream terraces • Used mainly as pasture and urban	1.3

Source: NRCS, 2006

Table 2: Soil Units within the Study Area – Dallas County						
Soil Unit Name	**Soil Unit**	**Shrink/Swell Potential**	**Erosion Potential**	**Corrosion Potential**	**Area of Segment 1 (acres)**	**Prime Farmland Designation**
Arents, loamy, gently undulating	2	Low	Moderate	High	7.5	None
Arents, loamy, hilly	3		Moderate	High	22.7	None
Eddy clay loam, 3 to 8 percent slopes	27		Moderate	Moderate	12.4	None
Eddy-Whitewright complex, 8 to 20 percent slopes	28		Moderate	Moderate	32.5	None
Eddy-Stephen complex, 1 to 5 percent slopes	30		Moderate	Moderate	86.1	None
Pits and Dumps	56		NA	NA	2.3	None
Silstid-Urban land complex, 0 to 6 percent slopes	65		Low	Moderate	0.5	None
Urban Land	75		NA	NA	58.8	None
Stephen silty clay, 1 to 4 percent slopes	67	Moderate	Low	High	5.4	None
Sunev clay loam, 3 to 8 percent slopes	71		Low	Moderate	13.4	None
Austin silty clay, 1 to 3 percent slopes	5		Low	High	28.3	Farmland of Statewide Importance
Austin silty clay, 2 to 5 percent slopes, eroded	6		Low	High	1.1	None
Frio silty clay, occasionally flooded	36		Low	High	17.7	None
Frio silty clay, frequently flooded	37		Low	High	40.4	None
Altoga silty clay, 5 to 12 percent slopes, eroded	1	High	Low	High	3.3	None

Table 2: Soil Units within the Study Area – Dallas County

Soil Unit Name	Soil Unit	Shrink/Swell Potential	Erosion Potential	Corrosion Potential	Area of Segment 1 (acres)	Prime Farmland Designation
Axtell-Urban land complex, 1 to 5 percent slopes	13		Moderate	High	21.1	None
Lewisville silty clay, 1 to 3 percent slopes	46		Low	High	10.9	Prime Farmland
Lewisville silty clay, 3 to 5 percent slopes, eroded	47		Low	High	8.4	None
Austin-Lewisville complex, 5 to 8 percent slopes	7		Moderate	High	2.9	None
Wilson-Urban land complex, 0 to 2 percent slopes	80		Moderate	High	4.9	None
Houston Black clay, 0 to 1 percent slopes	43		Low	High	54.9	Prime Farmland
Houston black clay, 1 to 3 percent slopes	44		Moderate	High	371.7	Prime Farmland
Burleson clay, 0 to 1 percent slopes	18		Low	High	10.7	Prime Farmland
Burleson clay, 1 to 3 percent slopes	19		Low	High	10.3	Prime Farmland
Ferris-Heiden complex, 5 to 12 percent slopes	34		Low	High	4.7	None
Ferris-Urban land complex 5 to 12 percent slopes	35	Very High	Low	High	4.2	None
Houston Black-Urban land complex 0 to 4 percent slopes	45		Low	High	27.5	None
Trinity clay, occasionally flooded	72		Low	High	2.1	None
Trinity clay, frequently flooded	73		Low	High	41.4	None
Trinity-Urban land complex	74		Low	High	87.7	None

Source: NRCS, 2013

Geology

In Dallas County, the Study Area is comprised of four geologic formations. Descriptions of the formations and the area in acres in each segment are provided in **Table 3.**

Table 3: Predominant Geological Formations within the Study Area – Dallas County				
Formation	**ID**	**Period/ Epoch Series/ Group**	**Characteristics**	**Area of Segment 1 (acres)**
Austin Chalk	Kau	Cretaceous/ Gulfian/ Austin/ None listed	Upper and lower parts, chalk, mostly microgranular calcite, massive, some interbeds and partings of calcareous clay, thin bentonitic locally in lower part, lower part forms westward-facing scarp; light gray. Middle part, mostly thin-bedded marl with interbeds of massive chalk, locally burrowed, marcasite-pyrite modules common, light gray. Weathers white, marine megafossils scarce, thickness 300-500 feet, thins southward.	647.2
Alluvium	Qal	Quaternary/ Holocene/ None listed	Flood-plain deposits, includes indistinct low terrace deposits; gravel, sand, silt, silty clay and organic matter.	274.5
Ozan	Ko	Cretaceous/ Gulfian/ Taylor Group	Clay, calcareous, silt and sand content increases upward, montmorillonitic, blocky, conchoidal fracture, medium gray; some glauconite, phosphate pellets, hematitie nodules and pyrite nodules; some very thin limestone lenses locally in lower part; weathers light brownish gray with poor fissility, grades upward to Wolfe City Formation; marine megafossils; thickness 500 plus or minus feet.	15.9
Fluviatile terrace deposits	Qt	Quaternary/ Pleistocene/ None listed	Gravel, sand, silt and clay; contiguous terraces of different ages separated by solid line.	63.7

Source: BEG, 1996 and USGS, 2007

Ellis County

Soils

In Ellis County, the Study Area is comprised of three soil associations. Descriptions of these soil associations and the area in acres of each segment are provided in **Table 4. Table 5** includes the soils units that comprise the Study Areas with associated characteristics including shrink-swell potential, erosion potential, corrosion potential and prime farmland designation and the area in acres of each segment.

Table 4. Soil Associations within the Study Area – Ellis County

Soil Association	STATSGO code	Description	Segment 1 (acres)	Segment 2A (acres)	Segment 2B (acres)	Segment 3A (acres)	Segment 3B (acres)	Segment 3C (acres)
Houston Black-Heiden-Altoga	s7377	• Nearly level to strongly sloping • Moderately well drained and well drained • Clayey soils • Associated with uplands • Used mainly as pasture, urban or cropland	23.4	874.1	806.5	117.2	121.7	117.2
Trinity-Kaufman	s7697	• Nearly level to gently sloping • Somewhat poorly drained; very slowly permeable • Clayey soils • Associated with floodplains • Used mainly as pasture or cropland	--	83.4	133.9	1.5	--	1.5
Wilson-Crockett-Burleson	s7732	• Nearly level to gently sloping • Somewhat poorly drained and moderately well drained; very slowly permeable • Loamy and clayey soils • Associated with uplands • Used mainly as pasture or cropland	--	17.9	18.0	--	--	--

'Source: NRCS, 2006
'--' - not present

Table 5: Soil Units within the Study Area – Ellis County											
Soil Unit Name	**Soil Unit**	**Shrink/Swell Potential**	**Erosion Potential**	**Corrosion Potential**	**Area of Segment 1 (acres)**	**Area of Segment 2A (acres)**	**Area of Segment 2B (acres)**	**Area of Segment 3A (acres)**	**Area of Segment 3B (acres)**	**Area of Segment 3C (acres)**	**Prime Farmland Designation**
Frio silty clay, 0 to 1 percent slopes, frequently flooded	Fr	Moderate	Low	High	--	3.0	3.0	--	--	--	None
Lamar clay loam, 3 to 8 percent slopes	LaD		Moderate	Moderate	--	--	--	--	0.5	--	None
Leson clay, 0 to 1 percent slopes	HuA	High	Low	High	--	16.8	10.9	--	--	--	Prime Farmland
Lewisville silty clay, 0 to 1 percent slopes	LeA		Low	High	--	4.2	--	--	--	--	Prime Farmland
Lewisville silty clay, 1 to 3 percent slopes	LeB		Low	High	--	1.1	0.3	--	--	--	Prime Farmland
Lewisville silty clay, 3 to 5 percent slopes, eroded	LeC 2		Low	High	--	3.2	1.8	3.1	4.2	3.1	None
Lewisville silty clay, 5 to 8 percent slopes, eroded	LeD 2		Low	High	--	13.5	4.1	--	--	--	None
Altoga soils, 5 to 8 percent slopes, severely eroded	LsD 3		Low	High	--	5.7	3.9	--	--	--	None
Wilson clay loam, 1 to 3 percent slopes	Wn B		Moderate	High	--	--	--	1.9	3.3	1.9	Farmland of Statewide Importance
Wilson clay loam, 1 to 3 percent slopes, eroded	WsB 2		Moderate	High	--	--	1.9	--	--	--	None
Wilson clay loam, terrace, 1 to 3 percent slopes	WtB		Moderate	High	--	2.7	2.0	1.5	2.4	1.4	Farmland of Statewide Importance
Crockett fine sandy loam, 1 to 3 percent slopes	CrB		High	High	--	--	--	0.7	--	0.7	Farmland of Statewide Importance
Leson clay, 1 to 3 percent slopes	LsB	Very High	Low	High	--	85.1	74.1	--	--	--	Prime Farmland
Houston Black clay, 1 to 3 percent slopes	HaB		Moderate	High	15.7	433.7	381333.3	--	--	--	Prime Farmland
Burleson clay, 1 to 3 percent slopes	BtB		Low	High	--	1.2	1.8	8.8	9.4	8.8	Prime Farmland
Burleson clay, 0 to 1 percent slopes	BuA		Low	High	--	23.0	41.6	9.1	7.9	9.1	Prime Farmland
Houston Black clay, 0 to 1 percent slopes	HaA		Low	High	0.1	84.4	6278.2	--	--	--	Prime Farmland

Table 5: Soil Units within the Study Area – Ellis County											
Soil Unit Name	**Soil Unit**	**Shrink/Swell Potential**	**Erosion Potential**	**Corrosion Potential**	**Area of Segment 1 (acres)**	**Area of Segment 2A (acres)**	**Area of Segment 2B (acres)**	**Area of Segment 3A (acres)**	**Area of Segment 3B (acres)**	**Area of Segment 3C (acres)**	**Prime Farmland Designation**
Branyon clay, terrace, 0 to 1 percent slopes	HbA	Very High	Low	High	--	63.6	115.0	69.8	65.4	69.8	Prime Farmland
Branyon clay, terrace, 1 to 3 percent slopes	HbB		Low	High	--	49.1	70.2	24.0	28.7	24.0	Prime Farmland
Heiden clay, 1 to 3 percent slopes	HcB		Low	High	--	12.9	19.1	--	--	--	Prime Farmland
Heiden clay, 3 to 5 percent slopes, eroded	HcC 2		Low	High	6.8	90.0	87.8	--	--	--	None
Heiden clay, 5 to 8 percent slopes, eroded	HcD 2		Low	High	--	22.8	30.5	--	--	--	None
Heiden-Ferris complex, 5 to 8 percent slopes, severely eroded	HsD 3		Low	High	--	15.6	25.1	--	--	--	None
Ferris clay, 5 to 12 percent slopes severely eroded	SuE 3		Low	High	--	8.7	18.8	--	--	--	None
Trinity clay, frequently flooded	Tc		Low	High	0.8	23.9	25.9	--	--	--	None
Trinity clay, occasionally flooded	To		Low	High	--	9.2	7.0	--	--	--	None

Source: NRCS, 2015
'--' - not present

Geology

In Ellis County, the Study Area is comprised of three geologic formations. Descriptions of the formations and the area in acres of each segment are provided in **Table 6.**

Table 6: Predominant Geological Formations within the Study Area – Ellis County									
Formation	**ID**	**Period/ Epoch Series/ Group**	**Characteristics**	**Area of Segment 1 (acres)**	**Area of Segment 2A (acres)**	**Area of Segment 2B (acres)**	**Area of Segment 3A (acres)**	**Area of Segment 3B (acres)**	**Area of Segment 3C (acres)**
Ozan	Ko	Cretaceous/ Gulfian/ Taylor Group	Previously described in **Table 3.**	23.3	976900.1	886.0	--	--	--
Wolfe City	Kwc	Cretaceous/ Gulfian/ Taylor Group	Marl, sand, sandstone and mudstone. In Navarro County, marl, candy and silty, interbedded with thin sandstone beds and massive sandstone; medium gray. Grades northward into an upper fine-grained sand and silt unit, calcareous, medium yellowish gray; and a lower mudstone unit, calcareous, dark gray, weathers medium gray. Marine megafossils. Thickness 75-300 feet, thins northward.	--	31.1	32.7	118.7	121.7	118.7
Alluvium	Qal	Quaternary/ Holocene/ None listed	Previously described in **Table 3**.	--	44.2	39.6	--	--	--

Source: BEG, 1996 and USGS, 2007
'--' - not present

Navarro County

Soils

In Navarro County, the Study Area is comprised of six soil associations. Descriptions of these soil associations and the area in acres of each segment are provided in **Table 7. Table 8** includes the soils units that comprise the Study Area with associated characteristics including shrink-swell potential, erosion potential, corrosion potential and prime farmland designation and the area in acres of each segment.

Table 7: Soil Associations within the Study Area – Navarro County					
Soil Association	**STATSGO code**	**Description**	**Area of Segment 3A (acres)**	**Area of Segment 3B (acres)**	**Area of Segment 3C (acres)**
Gredge-Crockett	s7354	• Nearly level to sloping • Moderately well drained; very slowly permeable • Moderately deep and very deep loamy soils • Associated with uplands • Used mainly as pasture or cropland	--	104.6	--
Houston Black-Heiden-Altoga	s7377	• Nearly level to strongly sloping • Moderately well drained and well drained • Clayey soils • Associated with uplands • Used mainly as pasture, urban or cropland	486.2	383.0	524.4
Tinn-Kaufman-Gladewater	s7392	• Nearly level • Somewhat poorly drained; very slowly permeable • Clayey soils • Associated with floodplains • Used mainly as pasture or cropland	71.3	17.8	74.9
Trinity-Kaufman	s7697	• Nearly level to gently sloping • Somewhat poorly drained; very slowly permeable • Clayey soils • Associated with floodplains • Used mainly as pasture or cropland	23.5	21.0	23.5
Wilson-Crockett	s7269	• Nearly level to sloping • Moderately well drained; very slowly permeable • Loamy and sandy soils • Associated with uplands • Used mainly as pasture or cropland	564.4	624.5	528.7
Wilson-Crockett-Burleson	s7732	• Nearly level to gently sloping • Somewhat poorly drained and moderately well drained; very slowly permeable • Loamy and clayey soils • Associated with uplands • Used mainly as pasture or cropland	--	85.1	--

Source: NRCS, 2006

'--' - not present

Table 8: Soil Units within the Study Area – Navarro County								
Soil Unit Name	**Soil Unit**	**Shrink/Swell Potential**	**Erosion Potential**	**Corrosion Potential**	**Area of Segment 3A (acres)**	**Area of Segment 3B (acres)**	**Area of Segment 3C (acres)**	**Prime Farmland Designation**
Bunyan loam, calcareous variant	Bn	Low	Moderate	Moderate	1.7	0.3	19.9	None
Chickasha fine sandy loam, 3 to 8 percent slopes	ChD		Low	Moderate	4.3	--	4.3	None
Gowen fine sandy loam	Gn	Moderate	Low	Moderate	1.5	1.6	1.4	None
Gowen fine sandy loam, frequently flooded	Go		Low	Moderate	2.3	1.2	--	None
Gowen clay loam	Gw		Moderate	Moderate	1.8	0.4	--	None
Gowen clay loam, frequently flooded	Gy		Moderate	Moderate	6.7	8.6	4.5	None
Lamar clay loam, 3 to 8 percent slopes	LaD		Moderate	Moderate	20.0	2.5	3.8	None
Pursley clay loam	Pr		Moderate	Low	11.0	12.9	10.0	None
Axtell fine sandy loam, 1 to 3 percent slopes	AxB	High	Moderate	High	39.5	100.5	21.0	Farmland of Statewide Importance
Axtell fine sandy loam, 3 to 5 percent slopes	AxC		Moderate	High	2.0	11.5	0.9	Farmland of Statewide Importance
Axtell fine sandy loam, 2 to 5 percent slopes, moderately eroded	AxC2		Moderate	High	1.4	--	--	None
Axtell fine sandy loam, 5 to 12 percent slopes	AxE		Moderate	High	--	--	1.0	None
Bonham loam, 1 to 3 percent slopes	BmB		Moderate	Moderate	22.4	0.9	7.3	Prime Farmland
Blum loam, 0 to 1 percent slopes	OkA		Moderate	High	--	2.5	--	Prime Farmland
Purves rocky clay, 1 to 5 percent slopes	PuC		Low	High	37.0	8.2	--	None
Tabor fine sandy loam, 0 to 1 percent slopes	TaA		Moderate	High	20.6	1.4	19.3	Farmland of Statewide Importance
Mabank very fine sandy loam, 0 to 1 percent slopes	WlA		High	High	37.7	18.1	30.3	Farmland of Statewide Importance
Mabank very fine sandy loam, 1 to 3 percent slopes	WlB		High	High	4.7	13.0	2.3	Farmland of Statewide Importance
Ellis clay, 3 to 12 percent slopes	ElE		Moderate	High	--	--	12.5	None
Wilson clay loam, 0 to 1 percent slopes	WnA		Moderate	High	71.9	149.1	62.3	Farmland of Statewide Importance
Wilson clay loam, 1 to 3 percent slopes	WnB		Moderate	High	74.5	77.1	57.9	Farmland of Statewide Importance

Table 8: Soil Units within the Study Area – Navarro County								
Soil Unit Name	**Soil Unit**	**Shrink/Swell Potential**	**Erosion Potential**	**Corrosion Potential**	**Area of Segment 3A (acres)**	**Area of Segment 3B (acres)**	**Area of Segment 3C (acres)**	**Prime Farmland Designation**
Wilson clay loam, 3 to 5 percent slopes	WnC	High	Moderate	High	6.6	15.2	5.0	Farmland of Statewide Importance
Wilson clay loam, 2 to 5 percent slopes, eroded	WnC2	High	Moderate	High	1.9	1.9	3.6	None
Crockett fine sandy loam, 0 to 1 percent slopes	CrA	High	High	High	4.1	71.0	24.6	Farmland of Statewide Importance
Crockett fine sandy loam, 1 to 3 percent slopes	CrB	High	High	High	137.0	48.6	106.6	Farmland of Statewide Importance
Crockett fine sandy loam, 3 to 5 percent slopes	CrC	High	High	High	2.9	1.3	8.7	Farmland of Statewide Importance
Crockett fine sandy loam, 5 to 10 percent slopes	CrD	High	High	High	11.6	--	3.5	None
Crockett soils, 2 to 5 percent slopes, eroded	CtC2	High	High	High	15.6	3.4	8.0	None
Crockett fine sandy loam, 3 to 8 percent slopes, severely eroded	CtD3	High	High	High	18.9	5.5	10.4	None
Houston Black clay, 1 to 3 percent slopes	HbB	Very High	Moderate	High	267.9	295.7	256.9	Prime Farmland
Houston Black clay, 3 to 5 percent slopes	HbC	Very High	Moderate	High	54.7	0.1	54.7	Prime Farmland
Heiden clay, 1 to 3 percent slopes	HaB	Very High	Moderate	High	19.8	6.8	25.2	Prime Farmland
Heiden clay, 3 to 5 percent slopes	HaC	Very High	Moderate	High	6.6	57.0	37.3	Prime Farmland
Heiden clay, 3 to 5 percent slopes, eroded	HaC2	Very High	Moderate	High	56.7	54.0	72.2	None
Heiden clay, 5 to 8 percent slopes	HaD	Very High	Moderate	High	2.5	10.4	29.1	None
Heiden clay, 5 to 8 percent slopes, eroded	HaD2	Very High	Moderate	High	20.7	1.4	1.6	None
Burleson clay, 0 to 1 percent slopes	BuA	Very High	Low	High	0.3	19.7	4.5	Prime Farmland
Burleson clay, 1 to 3 percent slopes	BuB	Very High	Low	High	16.7	82.1	53.6	None
Ferris clay, 3 to 8 percent slopes, eroded	FeD2	Very High	Low	High	--	8.3	7.4	None
Ferris and Heiden clays, 5 to 15 percent slopes, eroded	FhE2	Very High	Low	High	9.7	18.5	42.1	None
Ferris and Heiden stony clays, 8-15 percent slopes	FlE	Very High	Low	High	--	2.6	--	None
Houston Black clay, 2 to 5 percent slopes, eroded	HbC2	Very High	Low	High	32.6	78.1	32.6	None
Kaufman clay	Ka	Very High	Low	High	12.0	--	11.1	None
Kaufman clay, frequently flooded	Kc	Very High	Low	High	--	--	11.8	None

Table 8: Soil Units within the Study Area – Navarro County								
Soil Unit Name	**Soil Unit**	**Shrink/Swell Potential**	**Erosion Potential**	**Corrosion Potential**	**Area of Segment 3A (acres)**	**Area of Segment 3B (acres)**	**Area of Segment 3C (acres)**	**Prime Farmland Designation**
Lufkin fine sandy loam, 0 to 1 percent slopes	LuA	Very High	Moderate	Moderate	7.9	--	7.9	Farmland of Statewide Importance
Trinity clay	Tn		Low	High	37.7	10.9	45.8	None
Trinity clay, frequently flooded	Tr		Low	High	39.2	22.1	28.4	None

Source: NRCS, 2015
'--' - not present

Geology

In Navarro County, the Study Area is comprised of ten geologic formations. Descriptions of the formations and the area in acres of each segment are provided in **Table 9.**

Table 9: Predominant Geological Formations within the Study Area – Navarro County						
Formation	**ID**	**Period/ Epoch Series/ Group**	**Characteristics**	**Area of Segment 3A (acres)**	**Area of Segment 3B (acres)**	**Area of Segment 3C (acres)**
Hooper	Eh	Tertiary/ Eocene/ Wilcox Group	Mostly mudstone with various amounts of sandstone, minor lignite, ironstone concretions and locally glauconite in lowermost part. Mudstone medium to dark gray, weathers yellowish brown. Sandstone, in upper part-fine to medium grained, moderately well sorted, cross-bedded, units 5 to 30 feet thick, light gray to pale yellowish brown; in lower part-very fine grained, well sorted and in part argillaceous, cross-bedded, locally burrowed, units a few inches to 10 feet thick, yellowish brown to moderate brown. Average thickness 500 feet.	12.1	12.0	--
Pisgah and Littig Memebers of Kincaid	Ekpl	Tertiary/ Eocene/ Midway Group	Pisgah Member, sand and clay; sand, glauconitic, argillaceous, poorly sorted, greenish gray; clay, sandy, silty, medium gray to black. Littig Member, sand and clay; sand very glauconitic, greenish black; clay, sandy, phosphatic nodules and pebbles present; weathers to yellow and yellowish-brown soil. Thickness 10-120 feet, thins locally, forms mid-slope of cuesta formed by Tehuacana Member.	87.2	5.9	5.0
Tehuacana Member of Kincaid	Ekt	Tertiary/ Eocene/ Midway Group	Limestone, glauconitic, hard, indurated, grayish white, interbedded with gray marl, forms crest of prominent northwest-facing cuesta; thickness up to 30 feet, absent south of Brazos River.	40.9	33.9	--

Table 9: Predominant Geological Formations within the Study Area – Navarro County						
Formation	**ID**	**Period/ Epoch Series/ Group**	**Characteristics**	**Area of Segment 3A (acres)**	**Area of Segment 3B (acres)**	**Area of Segment 3C (acres)**
Kemp Clay	Kke	Cretaceous/ Gulfian/ Navarro Group	Calcareous, locally silty, massive, thinly laminated, conchoidal fracture, medium dark gray; weathers medium gray; thickness 80-200 feet, thins locally.	--	20.4	--
Nacatoch Sand	Kn	Cretaceous/ Gulfian/ Navarro Group	Quartz, fine to medium grained, glauconitic, poorly sorted, friable, greenish gray; local lenses of silty clay; calcite-cemented sandstone in thin hard beds in lower and upper parts; thickness up to 180 feet, feathers out southward near Rosebud.	107.3	275.2	38.2
Wolf City Formation	Kwc	Cretaceous/ Gulfian/ Taylor Group	Previously described in **Table 6.**	111.8	45.4	111.8
Alluvium	Qal	Quaternary/ Holocene/ None listed	Previously described in **Table 3.**	84.2	26.8	105.0
Fluviatile terrace deposits	Qt	Quaternary/ Pleistocene/ None listed	Gravel, sand, silt and clay.	125.2	3.1	96.8
Wills Point	Ewp	Tertiary/ Eocene/ Midway Group	Clay, silty, sandy, silt and sand more abundant upward, slightly glauconitic near base, 10-inch rosette limestone bed near middle, massive, poorly bedded, grades upward to mudstone and sand of Wilcox Group, light gray to dark bluish gray, topographically featureless; thickness 250-500 feet, thins southward.	123.1	251.1	367.1
Neylandville and Marlbrook Marl undivided	Knm	Cretaceous/ Gulfian/ Taylor Group	South of Rockwall County; where subdivided includes from the top down Neylandville Formation and Marlbrook Marl. Neylandville Formation, clay calcareous, silty, sandy, sand content increases upward, medium gray; weathers light gray, forms irregular topography; thickness 125 plus or minus feet. Marlbrook Marl ("upper Taylor marl"), clay, calcareous, variable amount of silt and glauconite, silt content increases upward, disseminated pyrite, locally phosphate nodules and phosphatized marine megafossils, blocky, conchoidal fracture, light to dark gray; weathers light gray with poor fissility; marine megafossils; thickness 350 plus or minus feet.	453.3	562.2	427.5

Source: BEG, 1996 and USGS, 2007

'--' - not present

Freestone County

Soils

In Freestone County, the Study Area is comprised of eight soil associations. Descriptions of these soil associations and the area in acres of each segment are provided in **Table 10. Table 11** includes the soils units that comprise the Study Area with associated characteristics including shrink-swell potential, erosion potential, corrosion potential and prime farmland designation and the area in acres of each segment.

Table 10: Soil Associations within the Study Area – Freestone County

Soil Association	STATSGO code	Description	Area of Segment 3A (acres)	Area of Segment 3B (acres)	Area of Segment 3C (acres)	Area of Segment 4 (acres)
Konsil-Gasil-Axtell	s7409	• Gently sloping • Moderately well drained; slowly permeable and moderately permeable • Loamy and sandy soils • Associated with stream terraces • Used mainly as pasture or wildlife habitat	--	--	--	38.9
Nahatche-Hatliff	s7364	• Nearly level • Somewhat poorly drained and moderately well drained; moderately permeable and moderately rapidly permeable • Loamy soils • Associated with floodplains and creek • Used mainly as pasture or wildlife habitat	--	--	71.7	--
Silstid-Padina	s7525	• Gently sloping to moderately sloping • Well drained; moderately permeable • Sandy soils • Associated with uplands • Used mainly as pasture or range	--	--	140.8	136.8
Tabor-Gredge-Edge	s7306	• Nearly level to strongly sloping • Well drained and moderately well drained • Loamy soils • Associated with uplands and high stream terraces • Used mainly as pasture, range or cropland	--	--	1006.9	227.0

Table 10: Soil Associations within the Study Area – Freestone County						
Soil Association	**STATSGO code**	**Description**	**Area of Segment 3A (acres)**	**Area of Segment 3B (acres)**	**Area of Segment 3C (acres)**	**Area of Segment 4 (acres)**
Tinn-Gowen	s7350	• Nearly level • Well drained • Loamy soils • Associated with floodplains • Used mainly as pasture, range or cropland	--	--	52.6	65.2
Uhland-Sandow-Kaufman-Kaman-Gowen	s7629	• Nearly level • Somewhat poorly drained; very slowly permeable • Clayey soils • Associated with floodplains • Used mainly as pasture or range	--	--	--	19.0
Wilson-Crockett	s7269	• Nearly level to sloping • Moderately well drained; very slowly permeable • Loamy and sandy soils • Associated with uplands • Used mainly as pasture or cropland	0.4	0.4	87.9	505.0
Wolfpen-Pickton-Cuthbert	s7550	• Gently sloping to steep • Well drained; moderately permeable to moderately slowly permeable • Loamy and sandy soils • Associated with uplands • Used mainly as pasture or wildlife habitat	--	--	5.3	--

Source: NRCS, 2006
'--' - not present

Table 11: Soil Units within the Study Area – Freestone County									
Soil Unit Name	**Soil Unit**	**Shrink/Swell Potential**	**Erosion Potential**	**Corrosion Potential**	**Area of Segment 3A (acres)**	**Area of Segment 3B (acres)**	**Area of Segment 3C (acres)**	**Area of Segment 4 (acres)**	**Prime Farmland Designation**
Arenosa fine sand, 1 to 8 percent slopes	ArC	Low	Low	Low	--	--	1.7	15.2	None
Gasil fine sandy loam, 1 to 5 percent slopes	GfB		Low	Moderate	--	--	96.2	95.8	Prime Farmland
Padina loamy fine sand, 1 to 5 percent slopes	PaB		Low	Moderate	--	--	55.8	31.7	None
Silawa fine sandy loam, 5 to 12 percent slopes	SaE		Low	Moderate	--	--	80.5	22.4	None
Silstid loamy fine sand, 1 to 5 percent slopes	SsB		Low	Moderate	--	--	60.2	33.7	None
Silstid loamy fine sand, 5 to 8 percent slopes	SsD		Low	Moderate	--	--	24.2	6.3	None
Lamar clay loam, 5 to 12 percent slopes	LaE	Moderate	Moderate	Moderate	--	--	--	27.9	None
Cuthbert fine sandy loam, 5 to 15 percent slopes	CtE		Moderate	High	--	--	2.7	--	None
Hearne fine sandy loam, 5 to 15 percent slopes	HeE		Moderate	High	--	--	4.6	--	None
Nahatche clay loam, frequently flooded	Na		Moderate	High	--	--	10.3	--	None
Nahatche-Hatliff association, frequently flooded	NH		Moderate	High	--	--	74.1	28.4	None
Pluck loam, frequently flooded	Pu		Moderate	High	--	--	6.2	1.5	None
Whitesboro fine sandy loam, occasionally flooded	Wh		Low	Moderate	--	--	--	31.8	None
Whitesboro clay loam, occasionally flooded	Wk		Moderate	Moderate	--	--	6.5	20.0	None
Whitesboro clay loam, frequently flooded	Wm		Moderate	Moderate	--	--	3.9	18.8	None
Crockett fine sandy loam, 3 to 5 percent slopes	CrC	High	Moderate	High	--	--	3.2	--	Farmland of Statewide Importance
Crockett fine sandy loam, 5 to 8 percent slopes	CrD		Moderate	High	--	--	1.8	--	None
Crockett fine sandy loam, 3 to 8 percent slopes, severely eroded	CrD4		Moderate	High	--	--	22.2	17.2	None

Table 11: Soil Units within the Study Area – Freestone County									
Soil Unit Name	**Soil Unit**	**Shrink/Swell Potential**	**Erosion Potential**	**Corrosion Potential**	**Area of Segment 3A (acres)**	**Area of Segment 3B (acres)**	**Area of Segment 3C (acres)**	**Area of Segment 4 (acres)**	**Prime Farmland Designation**
Edge fine sandy loam, 1 to 5 percent slopes	EgB	High	High	Moderate	--	--	240.2	124.2	Farmland of Statewide Importance
Edge fine sandy loam, 5 to 12 percent slopes	EgE		High	Moderate	--	--	339.7	19.2	None
Edge-Gullied land complex, 2 to 8 percent slopes	ErC		High	Moderate	--	--	0.6	6.9	None
Ellis clay, 3 to 12 percent slopes	EsE		Moderate	High	--	--	5.9	57.0	None
Leson clay, 3 to 5 percent slopes	LsC		Low	High	--	--	20.2	--	Prime Farmland
Mabank fine sandy loam, 0 to 1 percent slopes	MaA		Moderate	High	--	--	0.4	0.4	Farmland of Statewide Importance
Rader fine sandy loam, 0 to 3 percent slopes	RaB		Moderate	High	--	--	3.8	--	Prime Farmland
Robco loamy fine sand, 0 to 2 percent slopes	RoA		Low	High	--	--	0.3	--	None
Tabor fine sandy loam, 1 to 3 percent slopes	TaB		Moderate	High	--	--	209.5	95.5	Farmland of Statewide Importance
Tabor-Lufkin complex, 0 to 1 percent slopes	TfA		Moderate	Moderate	--	--	16.1	54.4	Farmland of Statewide Importance
Wilson silty clay loam, 1 to 3 percent slopes	WnB		High	High	--	--	1.9	50.0	Farmland of Statewide Importance
Wilson clay loam, 3 to 5 percent slopes	WnB		High	High	--	--	0.3	--	Farmland of Statewide Importance
Crockett fine sandy loam, 0 to 1 percent slopes	CrA		High	High	--	--	0.8	20.7	Farmland of Statewide Importance

Table 11: Soil Units within the Study Area – Freestone County									
Soil Unit Name	**Soil Unit**	**Shrink/Swell Potential**	**Erosion Potential**	**Corrosion Potential**	**Area of Segment 3A (acres)**	**Area of Segment 3B (acres)**	**Area of Segment 3C (acres)**	**Area of Segment 4 (acres)**	**Prime Farmland Designation**
Crockett fine sandy loam, 1 to 3 percent slopes	CrB	High	High	High	0.4	0.4	48.6	226.6	Farmland of Statewide Importance
Crockett fine sandy loam, 2 to 5 percent slopes, eroded	CrC3		High	High	--	--	9.4	43.3	None
Kaufman clay loam, overwash, occasionally flooded	Ka	Very High	Low	High	--	--	--	85.2	None
Kaufman clay, occasionally flooded	Kc		Low	High	--	--	4.9	--	None
Kaufman clay, frequently flooded	Kd		Low	High	--	--	8.7	--	None

Source: NRCS, 2013
'--' - not present

Geology

In Freestone County, the Study Area is comprised of nine geologic formations. Descriptions of the formations and the area in acres of each segment are provided in **Table 12.**

Table 12: Predominant Geological Formations within the Study Area – Freestone County							
Formation	**ID**	**Period/ Epoch Series/ Group**	**Characteristics**	**Area of Segment 3A (acres)**	**Area of Segment 3B (acres)**	**Area of Segment 3C (acres)**	**Area of Segment 4 (acres)**
Carrizo Sand	Ec	Tertiary/ Eocene/ Wilcox Group	Upper part-sand very fine grained, partings of silty clay, light to dark gray and carbonaceous clay, black; weathers yellowish brown to dark reddish brown, some beds of ironstone, dark brownish, red. Lower part-sand, fine to medium grained, thickly bedded, grayish brown, weathers gray to various reds and purples. Thickness 75-200 feet, characterized by ridges thickly forested with oak.	--	--	85.6	--
Calvert Bluff Formation	Ecb	Tertiary/ Eocene/ Wilcox Group	Mostly mudstone with various amounts of sandstone, lignite, ironstone concretions and in uppermost part locally glauconitic. Mudstone, massive to thin bedded with silt and very fine sand laminae, pale brown to yellowish brown, weathers yellowish brown. Sandstone, medium to fine grained, moderately well sorted, cross-bedded, lenticular, thin beds locally burrowed, light gray to pale yellowish brown, weathers to various shades of brown. Lignite, mostly in lower part of formation, seams 1 to 20 feet thick, brownish black. Average thickness 1,200 feet.	--	--	570.5	--
Hooper	Eh	Tertiary/ Eocene/ Wilcox Group	Previously described in **Table 9.**	--	--	374.5	541.1

Table 12: Predominant Geological Formations within the Study Area – Freestone County							
Formation	**ID**	**Period/ Epoch Series/ Group**	**Characteristics**	**Area of Segment 3A (acres)**	**Area of Segment 3B (acres)**	**Area of Segment 3C (acres)**	**Area of Segment 4 (acres)**
Queen City Sand	Eqc	Tertiary/ Eocene/ Claiborne Group	Sand, fine-grained quartz, locally carbonaceous, light gray to brown; thin interbeds of clay, sandy, silty, brownish gray; a few lentils of glauconitic quartz greensand; weathers red and white mottled; characterized by low ridges heavily forested; thickness up to 100 feet, thins southwestward.	--	--	0.3	--
Reklaw	Er	Tertiary/ Eocene/ Claiborne Group	Includes front top down Marquez and Newby Members not separately mapped. Marquez Member, clay and silt, carbonaceous, lentils of glauconitic clay ironstone, brownish black, reddish brown; weathers light brown to light gray. Newby Member, quartz sand and clay, glauconitic, grayish green, weathers moderate brown and dark yellowish orange, some clay ironstone ledges and rubble; forms low scarp. Thickness about 80 feet, forms fairly narrow prairie.	--	--	7.0	--
Simsboro	Esb	Tertiary/ Eocene/ Wilcox Group	Mostly sand, some mudstone, clay and mudstone conglomerate. Sand, locally indurated, ranges from moderately well-sorted fine sand to sandy mudstone-boulder conglomerate, typically medium to coarse grained, cross-bedded, light gray, commonly weathers reddish brown. In uppermost part thin lenses of clay and mudstone, medium to dark gray. Forms gently rolling hills covered by dense growth of oak. Thickness up to 300 feet, pinches out in northern Freestone County.	--	--	60.0	81.1
Wills Point	Ewp	Tertiary/ Eocene/ Midway Group	Previously described in **Table 9.**	0.4	0.4	128.3	229.0

Source: BEG, 1996 and USGS, 2007
'--' - not present

Limestone County

Soils

In Limestone County, the Study Area is comprised of three soil associations. Descriptions of these soil associations and the area in acres are provided in **Table 13. Table 14** includes the soils units that comprise the Study Area with associated characteristics including shrink-swell potential, erosion potential, corrosion potential and prime farmland designation and the area.

Table 13: Soil Associations within the Study Area – Limestone County

Soil Association	STATSGO code	Description	Area of Segment 4 (acres)
Silstid-Padina	s7525	Previously described in **Table 10**	2.4
Tabor-Gredge-Edge	s7306	Previously described in **Table 10**	337.1
Uhland-Sandow-Kaufman-Kaman-Gowen	s7629	Previously described in **Table 10**	18.2

Source: NRCS, 2006

Table 14: Soil Units within the Study Area – Limestone County

Soil Unit Name	Soil Unit	Shrink/Swell Potential	Erosion Potential	Corrosion Potential	Area of Segment 4 (acres)	Prime Farmland Designation
Gasil loamy fine sand, 1 to 5 percent slopes	GfB	Low	Low	Moderate	100.8	Prime Farmland
Hatliff fine sandy loam, frequently flooded	Ha		Low	High	0.4	None
Padina loamy fine sand, 1 to 5 percent slopes	PaC		Low	Moderate	1.4	None
Padina loamy fine sand, 5 to 12 percent slopes	PaE		Low	Moderate	5.7	None
Silawa fine sandy loam, 1 to 3 percent slopes	SaB		Low	Moderate	8.8	Prime Farmland
Silawa fine sandy loam, 5 to 12 percent slopes	SaD		Low	Moderate	15.2	None
Silstid loamy fine sand, 1 to 3 percent slopes	SsB		Low	Moderate	44.1	None
Silstid loamy fine sand, 3 to 8 percent slopes	SsD		Low	Moderate	5.2	None
Uhland fine sandy loam, frequently flooded	Uh		Low	Moderate	17.3	None
Hearne fine sandy loam, 5 to 20 percent slopes	HeE	Moderate	Moderate	High	0.3	None
Nahatche loam, frequently flooded	Na		Moderate	High	9.3	None
Axtell fine sandy loam, 1 to 3 percent slopes	AxB	High	Moderate	High	2.2	Farmland of Statewide Importance
Edge fine sandy loam, 1 to 5 percent slopes	EgB		High	Moderate	17.6	Farmland of Statewide Importance
Edge fine sandy loam, 2 to 5 percent slopes, moderately eroded	EgC2		High	Moderate	13.0	None
Edge fine sandy loam, 5 to 12 percent slopes	EgD		High	Moderate	49.8	None

Table 14: Soil Units within the Study Area – Limestone County						
Soil Unit Name	**Soil Unit**	**Shrink/Swell Potential**	**Erosion Potential**	**Corrosion Potential**	**Area of Segment 4 (acres)**	**Prime Farmland Designation**
Edge fine sandy loam, 5 to 12 percent slopes	EgE	High	High	Moderate	1.6	None
Edge-Gullied land complex, 3 to 8 percent slopes	EhC3	High	High	Moderate	5.0	None
Rader fine sandy loam, 0 to 2 percent slopes	RaA	High	Moderate	High	15.3	Prime Farmland
Robco loamy fine sand, 0 to 2 percent slopes	RoA	High	Low	High	9.6	None
Tabor fine sandy loam, 0 to 2 percent slopes	TaA	High	Moderate	High	26.1	Farmland of Statewide Importance
Lufkin fine sandy loam, 0 to 1 percent slopes	LuA	Very High	Moderate	Moderate	9.0	Farmland of Statewide Importance

Source: NRCS, 2015

Geology

In Limestone County, the Study Area is comprised of three geologic formations. Descriptions of the formations and the area in acres are provided in **Table 15.**

Table 15: Predominant Geological Formations within the Study Area – Limestone County				
Formation	**ID**	**Period/ Epoch Series/ Group**	**Characteristics**	**Area of Segment 4 (acres)**
Calvert Bluff Formation	Ecb	Tertiary/ Eocene/ Wilcox Group	Previously described in **Table 12**.	331.3
Simsboro	Esb	Tertiary/ Eocene/ Wilcox Group	Previously described in **Table 12**.	2.1
Alluvium	Qal	Quaternary/ Holocene/None listed	Previously described in **Table 3.**	24.4

Source: BEG, 1996 and USGS, 2007

Leon County

Soils

In Leon County, the Study Area is comprised of 10 soil associations. Descriptions of these soil associations and the area in acres of each segment are provided in **Table 16. Table 17** includes the soils units that comprise the Study Area with associated characteristics including shrink-swell potential, erosion potential, corrosion potential and prime farmland designation and the area in acres of each segment.

Table 16: Soil Associations within the Study Area – Leon County				
Soil Association	**STATSGO code**	**Description**	**Area of Segment 3C (acres)**	**Area of Segment 4 (acres)**
Margie-Lexton	s7454	• Gently sloping to steep • Well drained • Loamy soils • Associated with savannahs • Used mainly as pasture or range	199.4	133.5
Nahatche-Hatliff	s7364	Previously described in **Table 10**	104.9	--
Silstid-Padina	s7525	Previously described in **Table 10**	193.5	606.4
Silstid-Padina-Jedd-Arenosa	s7524	• Gently sloping to moderately steep • Moderately well drained and somewhat excessively drained • Sandy soils • Associated with savannahs • Used mainly as pasture or range	35.0	164.8
Silstid-Rader-Padina-Crockett-Axtell	s7187	• Nearly level to moderately steep • Moderately well drained and somewhat excessively drained • Sandy soils • Associated with savannahs • Used mainly as pasture or range	--	92.6
Tabor-Gredge-Edge	s7306	Previously described in **Table 10**	--	14.3
Tonkawa-Tenaha-Pickton	s7549	• Gently sloping to moderately steep • Well drained and excessively drained; moderately and rapidly permeable • Sandy and clayey soils • Associated with uplands • Used mainly as pasture or range	50.7	--
Trawick-Elrose-Bub	s7693	• Gently sloping to moderately steep • Well drained • Loamy soils • Associated with woodlands • Used mainly as pasture or woodland	69.3	--
Wilson-Luling-Crockett-Benchley	s7267	• Nearly level to gently sloping • Moderately well drained; slowly and very slowly permeable • Loamy and clayey soils • Associated with uplands and ancient terraces • Used mainly as pasture, range or hayland	106.0	134.9
Wolfpen-Pickton-Cuthbert	s7550	Previously described in **Table 10**	612.2	--

Source: NRCS, 2006
'--' - not present

Table 17: Soil Units within the Study Area – Leon County							
Soil Unit Name	**Soil Unit**	**Shrink/ Swell Potential**	**Erosion Potential**	**Corrosion Potential**	**Area of Segment 3C (acres)**	**Area of Segment 4 (acres)**	**Prime Farmland Designation**
Arenosa fine sand, 1 to 8 percent slopes	ArC	Low	Low	Low	15.3	34.9	None
Eufaula loamy fine sand, 1 to 5 percent slopes	EuB	Low	Low	Low	1.1	--	None
Tonkawa fine sand, 1 to 8 percent slopes	ToC	Low	Low	Low	13.8	--	None
Attoyac fine sandy loam, 0 to 3 percent slopes	AtB	Low	Low	Moderate	1.0	--	Prime Farmland
Dutek loamy fine sand, 1 to 8 percent slopes	DuC	Low	Low	Moderate	0.7	19.7	None
Flo loamy fine sand, 1 to 8 percent slopes	FoC	Low	Low	Low	11.9	--	None
Gasil fine sandy loam, 1 to 5 percent slopes	GfB	Low	Low	Moderate	52.5	103.8	Prime Farmland
Hatliff fine sandy loam, frequently flooded	Ha	Low	Low	High	34.0	17.1	None
Larue loamy, fine sand, 1 to 8 percent slopes	LaC	Low	Low	Low	20.3	--	Farmland of Statewide Importance
Gasil fine sandy loam, 5 to 8 percent slopes	GfD	Low	Low	Moderate	--	4.6	None
Melhomes loamy fine sand, 0 to 1 percent slopes	Ms	Low	Low	Moderate	2.5	3.4	None
Padina loamy fine sand, 1 to 8 percent slopes	PaC	Low	Low	Moderate	68.7	88.3	None
Padina loamy fine sand, 8 to 15 percent slopes	PaD	Low	Low	Moderate	40.3	14.5	None
Pickton loamy fine sand, 1 to 8 percent slopes	PkC	Low	Low	Moderate	180.1	--	None
Pickton loamy fine sand, 8 to 15 percent slopes	PkD	Low	Low	Moderate	36.4	--	None
Silawa fine sandy loam, 1 to 5 percent slopes	SaB	Low	Low	Moderate	--	14.9	Prime Farmland
Silstid loamy fine sand, 1 to 5 percent slopes	SdB	Low	Low	Moderate	152.8	201.0	None
Tenaha-Cuthbert complex, 8 to 20 percent slopes	TcE	Low	Low	Moderate	97.1	--	None
Wolfpen loamy fine sand, 1 to 8 percent slopes	WoC	Low	Low	Moderate	82.8	--	None
Flynn fine sandy loam, 3 to 8 percent slopes	FyC	Low	Moderate	Moderate	--	1.6	None
Cuthbert fine sandy loam, 5 to 15 percent slopes	CtE	Moderate	Moderate	High	0.1	--	None
Kirvin fine sandy loam, 1 to 5 percent slopes	KrB	Moderate	Low	High	31.8	--	None
Cuthbert fine sandy loam, 5 to 20 percent slopes	CuE	Moderate	Moderate	Moderate	65.2	--	None
Cuthbert fine sandy loam, 5 to 20 percent slopes, stony	CxE	Moderate	Moderate	High	4.6	--	None
Hearne fine sandy loam, 1 to 5 percent slopes	HeB	Moderate	Moderate	High	--	7.9	None
Hearne fine sandy loam, 5 to 20 percent slopes	HeE	Moderate	Moderate	High	61.4	101.0	None

Table 17: Soil Units within the Study Area – Leon County							
Soil Unit Name	**Soil Unit**	**Shrink/ Swell Potential**	**Erosion Potential**	**Corrosion Potential**	**Area of Segment 3C (acres)**	**Area of Segment 4 (acres)**	**Prime Farmland Designation**
Hearne fine sandy loam, graded, 5 to 20 percent slopes	HxE	Moderate	Moderate	High	0.6	3.9	None
Jedd-Margie complex, 5 to 25 percent slopes	JmE		Moderate	High	19.2	42.7	None
Lexton clay loam, 1 to 3 percent slopes	LeB		Moderate	High	4.0	5.9	Prime Farmland
Margie fine sandy loam, 1 to 5 percent slopes	MgB		Moderate	High	52.6	43.7	Prime Farmland
Margie fine sandy loam, 5 to 8 percent slopes	MgD		Moderate	High	24.7	43.3	None
Marquez very fine sandy loam, 1 to 5 percent slopes	MkB		High	High	20.0	33.2	None
Marquez gravelly fine sandy loam, 1 to 5 percent slopes	MrB		Moderate	High	--	1.5	None
Nahatche loam, frequently flooded	Na		Moderate	High	46.0	14.2	None
Trawick fine sandy loam, 1 to 5 percent slopes	TrB		Low	High	8.3	--	Prime Farmland
Trawick-Bub complex, 8 to 20 percent slopes	TxE		Moderate	High	51.3	--	None
Axtell fine sandy loam, 1 to 5 percent slopes	AxB	High	Moderate	High	--	3.9	Farmland of Statewide Importance
Bremond-Wilson complex, 0 to 2 percent slopes	BrA		High	High	0.5	1.8	Farmland of Statewide Importance
Crockett loam, 1 to 3 percent slopes	CrB		Moderate	High	6.9	48.1	Farmland of Statewide Importance
Crockett fine sandy loam, 5 to 10 percent slopes	CrD		Moderate	High	7.8	1.7	None
Crockett-Wilson complex, 1 to 3 percent slopes	CsB		Moderate	High	63.2	39.2	Farmland of Statewide Importance
Derly silt loam, 0 to 1 percent slopes	De		High	High	4.0	19.3	None
Lummus fine sandy loam, 1 to 5 percent slopes	LmB		Low	High	24.6	--	Prime Farmland
Rader fine sandy loam, 1 to 3 percent slopes	RaB		Moderate	High	27.2	65.7	Prime Farmland
Rader-Derly complex, gently undulating	Rd		Moderate	High	--	3.0	Prime Farmland
Robco loamy fine sand, 1 to 8 percent slopes	RoC		Low	High	1.5	24.1	None
Robco-Gullied land complex, 1 to 8 percent slopes	RxC		Low	High	--	5.9	None
Tabor fine sandy loam, 1 to 5 percent slopes	TaB		Moderate	High	--	6.2	Farmland of Statewide Importance
Woodtell fine sandy loam, 5 to 12 percent slopes	WtD		Moderate	High	0.5	--	None
Benchley clay loam, 1 to 3 percent slopes	BeB		Moderate	High	14.1	27.1	Prime Farmland

Table 17: Soil Units within the Study Area – Leon County							
Soil Unit Name	**Soil Unit**	**Shrink/ Swell Potential**	**Erosion Potential**	**Corrosion Potential**	**Area of Segment 3C (acres)**	**Area of Segment 4 (acres)**	**Prime Farmland Designation**
Crockett fine sandy loam, 1 to 5 percent slopes	CrB	High	High	High	6.9	47.4	Farmland of Statewide Importance
Dimebox silty clay, 0 to 1 percent slopes	DmA	Very High	Moderate	High	16.7	11.6	Prime Farmland
Kaufman clay, occasionally flooded	Ka		Low	High	1.5	--	None
Lufkin fine sandy loam, 0 to 1 percent slopes	LfA		Moderate	Moderate	1.7	7.5	Farmland of Statewide Importance

Source: NRCS, 2013
'--' - not present

Geology

In Leon County, the Study Area is comprised of ten geologic formations. Descriptions of the formations and the area in acres of each segment are provided in **Table 18.**

Table 18: Predominant Geological Formations within the Study Area – Leon County					
Formation	**ID**	**Period/ Epoch Series/ Group**	**Characteristics**	**Area of Segment 3C (acres)**	**Area of Segment 4 (acres)**
Carrizo Sand	Ec	Tertiary/ Eocene/ Wilcox Group	Previously described in **Table 12.**	--	85.4
Calvert Bluff Formation	Ecb	Tertiary/ Eocene/ Wilcox Group	Previously described in **Table 12**.	--	51.6
Cook Mountain	Ecm	Tertiary/ Eocene/ Claiborne Group	In western part of sheet includes from top down Mount Tabor, Spiller, Landrum and Wheelock Members not separately mapped. Mount Tabor Member, clay and marl, brown, marine megafossils, thickness 45-100 feet; Spiller Member, sand, argillaceous, lignitic thickness 100 feet; Landrum Member, marl and clay, glauconitic, limestone lentils, near base bentonitic with some glauconitic clay_ironstone containing marine megafossils, brown, thickness 100 feet; Wheelock Member, marl and clay, some glauconitic calcareous ironstone, gray, abundant marine megafossils, thickness 70 feet. Total thickness 100 feet in eastern part of sheet to 370 feet in western part.	82.5	115.0
Queen City Sand	Eqc	Tertiary/ Eocene/ Claiborne Group	Previously described in **Table 12**.	599.2	439.5
Reklaw	Er	Tertiary/ Eocene/ Claiborne Group	Previously described in **Table 12**.	3.9	31.3
Sparta Sand	Es	Tertiary/ Eocene/ Claiborne Group	Quartz sand, very fine to fine grained, commonly with lignitic clay and silt partings, soft to indurated, light gray to brownish gray; weathers yellowish brown to reddish brown, local beds and upper few feet cemented by limonite; thickness 200±feet.	274.0	187.8

Table 18: Predominant Geological Formations within the Study Area – Leon County					
Formation	**ID**	**Period/ Epoch Series/ Group**	**Characteristics**	**Area of Segment 3C (acres)**	**Area of Segment 4 (acres)**
Stone City	Esc	Tertiary/ Eocene/ Claiborne Group	Clay, silt and sand; clay, silty, sandy, fissile, brownish gray, interbedded with sand, argillaceous, glauconitic; weathers yellowish brown and orange red; thickness up to 80 feet.	180.8	113.5
Weches	Ew	Tertiary/ Eocene/ Claiborne Group	Greensand, sand and clay; greensand mostly glauconite in part marly, quartz sand common; interbedded with clay, silty, brown to gray; weathers light to dark reddish brown, locally forms layers of limonitic iron ore and clay ironstone concretions; thickness 2575 feet.	157.8	72.3
Alluvium	Qal	Quaternar/ Holocene/ None listed	Previously described in **Table 3.**	56.7	37.6
Fluviatile terrace deposits	Qt	Quaternar/ Pleistocene/ None listed	Gravel, sand, silt and clay.	16.0	12.5

Source: BEG, 1996 and USGS, 2007
'--' - not present

Madison County

Soils

In Madison County, the Study Area is comprised of six soil associations. Descriptions of these soil associations and the area in acres of each segment are provided in **Table 19. Table 20** includes the soils units that comprise the Study Area with associated characteristics including shrink-swell potential, erosion potential, corrosion potential and prime farmland designation and the area in acres of each segment.

Table 19: Soil Association within the Study Area – Madison County				
Soil Association	**STATSGO code**	**Description**	**Area of Segment 3C (acres)**	**Area of Segment 4 (acres)**
Nahatche-Hatliff	s7364	Previously described in **Table 10**	68.2	39.6
Nahatche-Kaufman-Gowker	s7351	• Nearly level • Somewhat poorly drained and well drained • Loamy and clayey soils • Associated with broad, flat backswamps • Used mainly as pasture or range	19.2	11.0
Tabor-Robco-Chazos	s7605	• Very gently to gently sloping • Moderately well drained; slowly and very slowly permeable • Loamy and clayey soils • Associated with high stream terraces and uplands • Used mainly as pasture, range or cropland	98.7	--
Tabor-Spiller-Rader-Marquez-Gredge	s7585	• Very gently sloping to moderately sloping • Moderately well drained; slowly permeable • Loamy, sandy and clayey soils • Associated with high terraces and uplands • Used mainly as pasture, range or hayland	207.8	252.6

Table 19: Soil Association within the Study Area – Madison County				
Soil Association	**STATSGO code**	**Description**	**Area of Segment 3C (acres)**	**Area of Segment 4 (acres)**
Wilson-Luling-Crockett-Benchley	s7267	Previously described in **Table 16**	20.4	184.1
Zulch-Zack-Boonville	s7748	• Very gently sloping to moderately steep • Somewhat poorly drained and moderately well drained • Loamy soils • Associated with uplands • Used mainly as pasture, range or hayland	186.4	240.6

Source: NRCS, 2006
'--' - not present

Table 20: Soil Units within the Study Area – Madison County							
Soil Unit Name	**Soil Unit**	**Shrink/Swell Potential**	**Erosion Potential**	**Corrosion Potential**	**Area of Segment 3C (acres)**	**Area of Segment 4 (acres)**	**Prime Farmland Designation**
Dutek loamy fine sand, 1 to 5 percent slopes	DuC	Low	Low	Moderate	4.0	--	None
Eufaula loamy fine sand, 1 to 5 percent slopes	EuB	Low	Low	Low	6.3	--	None
Gasil fine sandy loam, 1 to 5 percent slopes	GaB	Low	Low	Moderate	<0.01	--	Prime Farmland
Padina loamy fine sand, 1 to 5 percent slopes	PaC	Low	Low	Moderate	10.9	--	None
Silawa fine sandy loam, 1 to 5 percent slopes	SaB	Low	Low	Moderate	7.3	6.9	Prime Farmland
Silstid loamy fine sand, 1 to 5 percent slopes	SdB	Low	Low	Moderate	30.9	--	None
Robco loamy fine sand, 1 to 5 percent slopes	RcB	Moderate	Low	High	20.7	42.6	None
Chazos loamy fine sand, 1 to 5 percent slopes	ChB	Moderate	Moderate	Moderate	29.4	38.1	Prime Farmland
Gowker clay loam, frequently flooded	Go	Moderate	Moderate	High	34.3	30.1	None
Gowker clay loam, frequently flooded	Gp	Moderate	Low	High	0.04	0.1	None
Nahatche loam, frequently flooded	Na	Moderate	Moderate	High	25.7	18.5	None
Rosanky fine sandy loam, 1 to 5 percent slopes	RoC	Moderate	Moderate	Moderate	14.6	9.7	None
Spiller fine sandy loam, 1 to 3 percent slopes	SpB	Moderate	Moderate	Moderate	3.1	--	Prime Farmland
Boonville fine sandy loam, 1 to 3 percent slopes	BfB	High	High	High	0.01	--	Farmland of Statewide Importance
Boonville fine sandy loam, 1 to 3 percent slopes	BoB	High	High	High	21.7	68.6	Farmland of Statewide Importance
Bremond-Wilson complex, 0 to 2 percent slopes	BrA	High	High	High	13.4	47.3	Farmland of Statewide Importance
Crockett loam, 1 to 3 percent slopes	CrB	High	High	High	--	97.1	Farmland of Statewide Importance
Crockett fine sandy loam, 5 to 10 percent slopes	CrD	High	Moderate	High	--	0.04	None
Derly silt loam, 0 to 1 percent slopes	DdA	High	High	High	4.3	--	None
Derly-Rader complex, 0 to 1 percent slopes	DeA	High	High	High	10.1	--	None
Ellis clay, 5 to 15 percent slopes	EeE	High	Moderate	High	--	0.3	None
Gredge fine sandy loam, 1 to 5 percent slopes	GrC	High	High	Moderate	31.2	87.3	Farmland of Statewide Importance
Gredge fine sandy loam, 5 to 8 percent slopes	GrD	High	High	Moderate	15.1	7.9	None
Kurten fine sandy loam, 1 to 5 percent slopes	KuC	High	Moderate	High	8.8	--	Farmland of Statewide Importance

Table 20: Soil Units within the Study Area – Madison County							
Soil Unit Name	**Soil Unit**	**Shrink/Swell Potential**	**Erosion Potential**	**Corrosion Potential**	**Area of Segment 3C (acres)**	**Area of Segment 4 (acres)**	**Prime Farmland Designation**
Mabank fine sandy loam, 0 to 1 percent slopes	MaA	High	Moderate	High	4.7	--	Farmland of Statewide Importance
Rader fine sandy loam, 1 to 3 percent slopes	RaB		Moderate	High	97.1	121.9	Prime Farmland
Rader-Derly complex, 0 to 2 percent slopes	RbA		High	High	37.1	4.2	Prime Farmland
Tabor fine sandy loam, 1 to 3 percent slopes	TaB		Moderate	High	49.7	7.6	Farmland of Statewide Importance
Wilson loam, 0 to 1 percent slopes	WcA		Moderate	High	2.8	--	Farmland of Statewide Importance
Zack fine sandy loam, 1 to 5 percent slopes	ZaB		High	Moderate	50.0	76.4	None
Zack fine sandy loam, 3 to 8 percent slopes, eroded	ZaC2		High	Moderate	14.8	4.1	None
Zack fine sandy loam, 5 to 8 percent slopes	ZaD		High	Moderate	9.2	--	None
Zulch fine sandy loam, 1 to 3 percent slopes	ZuB		High	High	38.2	44.5	None
Benchley clay loam, 1 to 3 percent slopes	BeB		Moderate	High	4.1	10.6	Prime Farmland

Source: NRCS, 2013
'--' - not present

Geology

In Madison County, the Study Area is comprised of three geologic formations. Descriptions of the dominant geologic formations and the area in acres of each segment are provided in **Table 21.**

Table 21: Predominant Geological Formations within the Study Area – Madison County					
Formation	**ID**	**Period/ Epoch Series/ Group**	**Characteristics**	**Area of Segment 3C (acres)**	**Area of Segment 4 (acres)**
Cook Mountain	Ecm	Tertiary/ Eocene/ Claiborne Group	Previously described in **Table 18**.	167.5	258.0
Yegua	Ey	Tertiary/ Eocene/ Claiborne Group	Sandstone, clay and lignite; sandstone mostly quartz, some chert, fine grained, subangular to subrounded, indurated to friable, calcareous, glauconitic, massive, locally crossbedded; clay, lignitic, bentonitic, sandy, silty, mostly well laminated, chocolate brown to reddish brown, lighter colored upward; lentils of lignite common; flat ironstone concretions and spherical calcareous concretions a foot or more in diameter common; some fossil wood; thickness 750-1,000 feet.	379.0	437.1
Alluvium	Qal	Quaternary/ Holocene/ None listed	Previously described in **Table 3.**	54.1	32.8

Source: BEG, 1996 and USGS, 2007

Grimes County

Soils

In Grimes County, the Study Area is comprised of eight soil associations. Descriptions of these soil associations and the area in acres of each segment are provided in **Table 22. Table 23** includes the soils units that comprise the Study Area with associated characteristics including shrink-swell potential, erosion potential, corrosion potential and prime farmland designation and the area in acres of each segment.

Table 22: Soil Associations within the Study Area – Grimes County					
Soil Association	**STATSGO code**	**Description**	**Area of Segment 3C (acres)**	**Area of Segment 4 (acres)**	**Area of Segment 5 (acres)**
Greenvine-Falba-Burleswash-Arol	s7324	• Gently sloping to moderately sloping • Moderately well drained and well drained • Loamy, sandy and clayey soils • Associated with ridgetops and slopes • Used mainly as pasture or range	--	--	259.9

Table 22: Soil Associations within the Study Area – Grimes County					
Soil Association	**STATSGO code**	**Description**	**Area of Segment 3C (acres)**	**Area of Segment 4 (acres)**	**Area of Segment 5 (acres)**
Huntsberg-Fetzer-Depcor-Boy-Annona	s7286	• Gently sloping to moderately sloping • Somewhat poorly drained and moderately well drained • Loamy and sandy soils • Associated with ridgetops, slopes, uplands and ancient terraces • Used mainly as pasture or woodland	--	--	577.6
Latium-Frelsburg-Crockett-Carbengle-Brenham-Bosque-Bleiblerville	s7333	• Gently sloping and moderately sloping • Moderately well drained and well drained • Loamy and clayey soils • Associated with ridges and side slopes • Used mainly as pasture, range or cropland	--	--	374.9
Nahatche-Kaufman-Gowker	s7351	Previously described in **Table 19**	1.1	8.4	--
Rader-Lufkin-Axtell	s7584	• Nearly level to strongly sloping • Somewhat poorly drained and moderately well drained • Loamy and clayey soils • Associated with ridges, slopes and terraces • Used mainly as pasture, range, or cropland	--	--	130.8
Singleton-Shiro-Burleswash	s7647	• Nearly level to strongly sloping • Well drained and moderately well drained • Loamy and sandy soils • Associated with broad flats and divides • Used mainly as pasture or range	--	--	223.2
Tonkavar-Shiro-Gomery-Elmina	s7349	• Gently sloping to moderately sloping • Somewhat poorly drained, moderately well drained and well drained • Sandy soils • Associated with broad ridgetops • Used mainly as pasture or range	--	--	245.8
Zulch-Zack-Boonville	s7748	Previously described in **Table 19**	88.8	71.4	50.9

Source: NRCS, 2006
'--' - not present

Table 23: Soil Units within the Study Area – Grimes County								
Soil Unit Name	**Soil Unit**	**Shrink/Swell Potential**	**Erosion Potential**	**Corrosion Potential**	**Area of Segment 3C (acres)**	**Area of Segment 4 (acres)**	**Area of Segment 5 (acres)**	**Prime Farmland Designation**
Boy loamy fine sand, 1 to 5 percent slopes	BgD	Low	Low	High	--	--	51.4	None
Boy loamy fine sand, 1 to 5 percent slopes	BoC		Low	High	--	--	0.5	None
Carbengle clay loam, 1 to 5 percent slopes	CaC		Moderate	Moderate	--	--	8.7	Prime Farmland
Depcor loamy fine sand, 1 to 5 percent slopes	DeC		Low	High	--	--	296.7	None
Depcor loamy fine sand, 5 to 8 percent slopes	DeD		Low	Moderate	--	--	12.0	None
Gomery loamy fine sand, 1 to 5 percent slopes	GmC		Low	Moderate	--	--	102.1	None
Hatliff fine sandy loam, frequently flooded	Ha		Low	High	--	--	17.4	None
Landman loamy fine sand, 1 to 5 percent slopes	LaC		Low	Moderate	--	--	1.9	Farmland of Statewide Importance
Padina loamy fine sand, 1 to 8 percent slopes	PaD		Low	Moderate	--	--	0.7	None
Robco loamy fine sand, 1 to 5 percent slopes	RoC	Moderate	Low	High	23.9	22.0	15.4	None
Brenham clay loam, 3 to 8 percent slopes	BrD		Moderate	High	--	--	26.1	None
Chazos loamy fine sand, 1 to 5 percent slopes	ChC		Moderate	Moderate	--	--	26.6	Prime Farmland
Fetzer loamy fine sand, 1 to 5 percent slopes	FeC		Low	High	--	--	80.4	None
Gowker loam, frequently flooded	Go		Moderate	High	--	--	1.5	None
Gowker clay loam, frequently flooded	Gp		Low	High	--	19.8	1.3	None
Nahatche clay loam, frequently flooded	Na		Moderate	High	10.9	5.1	69.4	None
Tonkavar fine sand, 1 to 8 percent slopes	ToD		Low	Moderate	--	--	6.9	None
Annona fine sandy loam, 1 to 5 percent slopes	AnC	High	Moderate	High	--	--	114.6	None
Annona fine sandy loam, 1 to 5 percent slopes, eroded	AnC2		Moderate	High	--	--	4.1	None
Annona fine sandy loam, 5 to 8 percent slopes	AnD		Moderate	High	--	--	19.3	None
Arol fine sandy loam, 0 to 1 percent slopes	ArA		High	High	--	--	0.3	None
Arol fine sandy loam, 1 to 5 percent slopes	ArC		High	High	--	--	18.6	None
Axtell fine sandy loam, 1 to 5 percent slopes	AxC		Moderate	High	--	--	33.3	Farmland of Statewide Importance
Axtell fine sandy loam, 2 to 5 percent slopes, moderately eroded	AxC2		Moderate	High	--	--	14.0	None
Boonville fine sandy loam, 1 to 3 percent slopes	BfB		High	High	5.2	4.2	14.8	Farmland of Statewide Importance
Burlewash fine sandy loam, 1 to 5 percent slopes	BuC		High	High	--	--	9.8	None

Table 23: Soil Units within the Study Area – Grimes County								
Soil Unit Name	**Soil Unit**	**Shrink/Swell Potential**	**Erosion Potential**	**Corrosion Potential**	**Area of Segment 3C (acres)**	**Area of Segment 4 (acres)**	**Area of Segment 5 (acres)**	**Prime Farmland Designation**
Burlewash-Gullied land complex, 5 to 15 percent slopes	BxE	High	High	High	--	1.9	--	None
Crockett fine sandy loam, 1 to 5 percent slopes	CrC	High	Moderate	Moderate	--	--	45.5	Farmland of Statewide Importance
Elmina loamy fine sand, 1 to 5 percent slopes	EmC	High	Low	High	--	--	45.5	None
Elmina loamy fine sand, 5 to 8 percent slopes	EmD	High	Low	High	--	--	9.7	None
Falba fine sandy loam, 1 to 5 percent slopes	FaC	High	Moderate	High	--	--	70.0	None
Flatonia clay loam, 1 to 4 percent slopes	FlB	High	Moderate	High	--	--	39.9	Prime Farmland
Gredge fine sandy loam, 1 to 5 percent slopes	GrC	High	High	Moderate	2.6	--	7.3	Farmland of Statewide Importance
Gredge fine sandy loam, 5 to 12 percent slopes	GrE	High	High	Moderate	3.5	--	--	None
Huntsburg loamy fine sand, 1 to 5 percent slopes	HuC	High	Moderate	High	--	--	28.8	Farmland of Statewide Importance
Huntsburg loamy fine sand, 5 to 8 percent slopes	HuD	High	Low	High	--	--	2.9	None
Shiro loamy fine sand, 1 to 5 percent slopes	ShC	High	Low	Moderate	--	--	247.9	Farmland of Statewide Importance
Singleton fine sandy loam, 1 to 5 percent slopes	SnC	High	Moderate	Moderate	--	--	95.4	None
Tabor fine sandy loam, 1 to 5 percent slopes	TaC	High	Moderate	High	--	--	22.6	Farmland of Statewide Importance
Wilson clay loam, 1 to 3 percent slopes	WlB	High	Moderate	High	--	--	9.6	Farmland of Statewide Importance
Zack fine sandy loam, 1 to 5 percent slopes	ZaC	High	High	High	37.0	26.9	12.7	None
Zulch fine sandy loam, 1 to 5 percent slopes	ZuC	High	High	High	6.7	--	13.6	None
Tinn clay, 0 to 1 percent slopes, frequently flooded	Tn	Very High	Low	High	--	--	13.5	None
Bleiblerville clay, 1 to 3 percent slopes	BcB	Very High	Moderate	High	--	--	7.3	Farmland of Statewide Importance
Frelsburg clay, 1 to 5 percent slopes	FrC	Very High	Low	High	--	--	132.0	Prime Farmland
Frelsburg clay, 1 to 5 percent slopes, eroded	FrC2	Very High	Low	High	--	--	0.01	None

Table 23: Soil Units within the Study Area – Grimes County								
Soil Unit Name	**Soil Unit**	**Shrink/Swell Potential**	**Erosion Potential**	**Corrosion Potential**	**Area of Segment 3C (acres)**	**Area of Segment 4 (acres)**	**Area of Segment 5 (acres)**	**Prime Farmland Designation**
Greenvine clay, 1 to 5 percent slopes	GvC	Very High	Low	High	--	--	12.3	Prime Farmland
Latium clay, 5 to 8 percent slopes	LtD		Low	High	--	--	7.5	None
Latium clay, 4 to 12 percent slopes, severely eroded	LtD3		Low	High	--	--	4.5	None
Lufkin fine sandy loam, 1 to 3 percent slopes	LuB		High	Moderate	--	--	31.8	Farmland of Statewide Importance
Lufkin-Rader complex, gently undulating	LxB		High	Moderate	--	--	43.7	Farmland of Statewide Importance

Source: NRCS, 2013
'--' - not present

Geology

In Grimes County, the Study Area is comprised of 10 geologic formations. Descriptions of the formations and the area in acres of each segment are provided in **Table 24.**

Table 24: Predominant Geological Formations within the Study Area – Grimes County						
Formation	**ID**	**Period/ Epoch Series/ Group**	**Characteristics**	**Area of Segment 3C (acres)**	**Area of Segment 4 (acres)**	**Area of Segment 5 (acres)**
Caddell	Eca	Tertiary/ Eocene/Jackson Group	Clay and quartz sand; clay sandy, lignitic, brown; sand, very fine grained, glauconitic, glauconitic ironstone concretions common; thickness 50-150 feet, thickens westward.	--	--	58.3
Catahoula	Mc	Tertiary/ Oligocene/ None Listed	Mudstone and sand. Upper part mudstone, tuffaceous, sandy, light gray; weathers dark gray. Lower 10-80 feet, quartz sand, coarse grained, grains polished, opal cement common; fossil wood abundant; forms cuesta; thickness 250-300 feet.	--	--	216.2
Fleming	Mf	Tertiary/ Miocene/ Fleming Group	Clay, silt and sand; mostly clay, commonly calcareous, calcareous concretions locally; silt and sand indurated, locally predominant; light gray to yellowish gray; weathers light gray to medium gray, locally red beneath Willis, forms brownish-black soil; thickness 1,300-1,450 feet.	--	--	458.0

Table 24: Predominant Geological Formations within the Study Area – Grimes County						
Formation	**ID**	**Period/ Epoch Series/ Group**	**Characteristics**	**Area of Segment 3C (acres)**	**Area of Segment 4 (acres)**	**Area of Segment 5 (acres)**
Manning	Em	Tertiary/ Eocene/ Jackson Group	Clay and sandstone; clay lignitic, chocolate brown, interbedded fine- to medium-grained sand, fossil wood common; sandstone, fine to medium grained, tuffaceous, indurated, brittle, thick bedded, some crossbedding; forms resistant ledges, light yellowish gray; thickness 250± feet.	--	--	361.1
Wellborn	Ewb	Tertiary/ Eocene/ Jackson Group	Quartz sand, fine to very fine grained, glauconitic, light gray, weathers dark gray; interbeds of brown lignitic clay and lignite; fossil wood abundant, imprints of marine megafossils common; thickness 50-150 feet, thickens westward.	--	--	188.7
Whitsett	EOw	Tertiary/ Oligocene/ None Listed	Quartz sand, fine to medium grained, tuffaceous, lignitic, argillaceous, locally silica cemented, light gray; weathers dark gray; fossil wood abundant; thickness 30-70 feet.	--	--	57.9
Willis Formation (coastward belt)	Qwc	Quaternary/ Pleistocene/ Jackson Group	Has a thickness of +/- 100 feet and is characterized by clay, silt, sand and siliceous gravel of granule to pebble size, including some petrified wood. It is mostly deeply weathered and lateritic, indurated by clay and cemented by iron oxide locally, with iron oxide concretions abundant.	--	--	393.2
Willis Formation (landward belt)	Qwl	Quaternary/ Pleistocene/ None Listed	Clay, silt, sand and siliceous gravel of granule to pebble size, including some petrified wood; sand coarser than in younger rocks, noncalcareous; mostly deeply weathered and lateritic, indurated by clay and cemented by iron oxide locally, iron oxide concretions abundant and locally used as road material in coastward belt of outcrop, Qwc, iron oxide concretions less abundant and amount of weathering decreases eastward in landward belt of outcrop, Qwl; coastward edge of base of Qwl outcrop is mostly at a lower elevation than base of landward edge of Qwc, indicating that the two outcrop belts may be of different ages; forms scarps on landward side; fluviatile; thickness ±100 feet.	--	--	102.5
Alluvium	Qal	Quaternary/ Holocene/None listed	Previously described in **Table 3.**	8.2	17.1	9.5

Table 24: Predominant Geological Formations within the Study Area – Grimes County						
Formation	**ID**	**Period/ Epoch Series/ Group**	**Characteristics**	**Area of Segment 3C (acres)**	**Area of Segment 4 (acres)**	**Area of Segment 5 (acres)**
Yegua	Ey	Tertiary/ Eocene/Claiborne Group	Previously described in **Table 21**.	81.7	62.8	15.8

Source: BEG, 1996 and USGS, 2007
'--' - not present

Waller County

Soils

In Waller County, the Study Area is comprised of three soil associations. Descriptions of these soil associations and the area in acres are provided in **Table 25. Table 26** includes the soils units that comprise the Study Area with associated characteristics including shrink-swell potential, erosion potential, corrosion potential and prime farmland designation and the area in acres.

Table 25: Soil Associations within the Study Area – Waller County

Soil Association	STATSGO code	Description	Area of Segment 5 (acres)
Huntsberg-Fetzer-Depcor-Boy-Annona	s7286	Previously described in **Table 22**	95.8
Splendora-Segno-Landman-Boy	s7217	• Nearly level to gently sloping • Somewhat poorly drained and moderately well drained • Loamy and sandy soils • Associated with uplands • Used mainly as pasture, range or cropland	70.2
Wockley-Segno-Monaville-Hockley	s7374	• Nearly level to gently sloping • Somewhat poorly drained and moderately well drained; moderately slowly permeable • Loamy and sandy soils • Associated with hillsides and ridges • Used mainly as pasture or cropland	140.0

Source: NRCS, 2006

Table 26: Soil Units within the Study Area – Waller County

Soil Unit Name	Soil Unit	Shrink/ Swell Potential	Erosion Potential	Corrosion Potential	Area of Segment 5 (acres)	Prime Farmland Designation
Boy loamy fine sand, 1 to 5 percent slopes	BoC	Low	Low	High	33.1	None
Depcor loamy fine sand, 1 to 5 percent slopes	DeC		Low	High	52.6	None
Segno fine sandy loam, 1 to 5 percent slopes	SgC		Moderate	High	15.3	Prime Farmland
Splendora fine sandy loam, 0 to 2 percent slopes	SpB		Moderate	High	42.6	None
Wockley fine sandy loam, 0 to 1 percent slopes	WoA		High	High	54.2	Prime Farmland
Hockley loamy fine sand, 1 to 3 percent slopes	HoB		Low	High	26.4	Prime Farmland
Wockley fine sandy loam, 1 to 3 percent slopes	WoB		High	High	14.3	Prime Farmland
Hatliff-Pluck-Kian complex, 0 to 1 percent slopes, frequently flooded	HatA		High	Moderate	0.2	None
Chazos loamy fine sand, 1 to 5 percent slopes	ChC	Moderate	Moderate	Moderate	0.6	Prime Farmland
Conroe loamy fine sand, 1 to 5 percent slopes	CoC		Moderate	High	10.2	None
Fetzer loamy fine sand, 1 to 5 percent slopes	FeC		Low	High	0.8	None

Table 26: Soil Units within the Study Area – Waller County						
Soil Unit Name	**Soil Unit**	**Shrink/ Swell Potential**	**Erosion Potential**	**Corrosion Potential**	**Area of Segment 5 (acres)**	**Prime Farmland Designation**
Hockley gravelly fine sandy loam, 1 to 5 percent slopes	HpC	Moderate	Low	High	10.0	Prime Farmland
Katy fine sandy loam, 0 to 1 percent slopes	KaA		High	High	2.3	Prime Farmland
Katy fine sandy loam, 1 to 3 percent slopes	KaB			High	2.5	Prime Farmland
Monaville loamy fine sand, 1 to 5 percent slopes	MvC		Low	Moderate	15.9	None
Nahatche loam, frequently flooded	Na		Moderate	High	10.1	None
Edna loam, 0 to 1 percent slopes	EdA	High	High	Moderate	6.2	Farmland of Statewide Importance
Annona fine sandy loam, 1 to 5 percent slopes	AnC		High	High	4.0	Farmland of Statewide Importance
Axtell fine sandy loam, 1 to 5 percent slopes	AxC		Moderate	High	2.6	Farmland of Statewide Importance
Verland clay loam, 1 to 3 percent slopes	MdB		Moderate	High	1.3	Farmland of Statewide Importance
Frelsburg clay, 1 to 3 percent slopes	FrB	Very High	Low	High	0.8	Prime Farmland

Source: NRCS, 2013

Geology

In Waller County, the Study Area is comprised of three geologic formations. Descriptions of the formations and the area in acres are provided in **Table 27.**

Table 27: Predominant Geological Formations within the Study Area – Waller County				
Formation	**ID**	**Period/ Epoch Series/ Group**	**Characteristics**	**Area of Segment 5 (acres)**
Alluvium	Qal	Quaternary/ Holocene/ None listed	Previously described in **Table 3.**	5.5
Lissie	Ql	Quaternary/ Holocene, Pleistocene/ None listed	Upper part, clay, slit, sand and very minor siliceous gravel of granule and small pebble size gravel more abundant northwestward, locally calcareous, concretions of calcium carbonate, iron oxide and iron-manganese oxides common in zone of weathering; fluviatile; surface fairly flat and featureless except for numerous rounded shallow depressions and pimple mounds, bower part, clay, silt, sand and minor amount of gravel; gravel slightly coarser than in upper part, noncalcareous, iron oxide concretions mare abundant than in upper part; fluviatile; very gently rolling; thickness ± 200 feet.	20.9
Willis (coastward belt)	Qw c	Quaternary/ Pleistocene/None Listed	Previously described in **Table 24**.	279.7

Source: BEG, 1996 and USGS, 2007

Harris County

Soils

In Harris County, the Study Area is comprised of five soil associations. Descriptions of these soil associations and the area in acres are provided in **Table 28. Table 29** includes the soils units that comprise the Study Area with associated characteristics including shrink-swell potential, erosion potential, corrosion potential and prime farmland designation and the area in acres of Segment 5 and the three terminal options.

Table 28: Soil Associations within the Study Area – Harris County

Soil Association	STATSGO code	Description	Segment 5 (acres)	Segment 5: Industrial Site Terminal Option (acres)	Segment 5: Northwest Mall Terminal Option (acres)	Segment 5: Northwest Transit Center Terminal (acres)
Gessner-Clodine-Addicks	S7249	• Nearly level • Poorly drained; moderately permeable • Loamy soils • Associated with prairies • Used mainly as pasture, range, or cropland	237.2	--	--	--
Katy-Clodine-Aris	S7389	• Nearly level • Somewhat poorly drained and poorly drained • Loamy soils • Associated with prairies • Used mainly as pasture, range, or cropland	61.7	97.1	80.2	87.3
Morey-Mocarey-Bernard	S7198	• Nearly level to gently sloping • Somewhat poorly drained; very slowly permeable • Loamy soils • Associated with uplands • Used mainly as pasture, range, or cropland	8.0	--	--	--
Wockley-Hockley-Gessner	S7740	• Nearly level to gently sloping • Somewhat poorly drained, moderately well drained and poorly drained; moderately slowly and moderately permeable Loamy soils • Associated with prairies • Used mainly as pasture, range, or cropland	730.1	--	--	--
Wockley-Segno-Monaville-Hockley	S7374	Previously described in **Table 25**	364.1	--	--	--

Source: NRCS, 2006

Table 29: Soil Units within the Study Area – Harris County

Soil Unit Name	Soil Unit	Shrink/ Swell Potential	Erosion Potential	Corrosion Potential	Area of Segment 5 (acres)	Industrial Site Terminal Option (acres)	Northwest Mall Terminal Option (acres)	Northwest Transit Center Terminal (acres)	Prime Farmland Designation
Segno fine sandy loam, 0 to 1 percent slopes	SeA	Low	Moderate	High	2.2	--	--	--	Prime Farmland
Hatliff-Pluck-Kian complex, 0 to 1 percent slopes, frequently flooded	HatA		High	Moderate	1.1	--	--	--	None
Wockley fine sandy loam, 0 to 1 percent slopes	Wo		High	High	666.9	--	--	--	Prime Farmland
Hockley loamy fine sand, 1 to 3 percent slopes	HoB		Low	High	295.2	--	--	--	Prime Farmland
Gessner fine sandy loam, 0 to 1 percent slopes, ponded	Ge	Moderate	High	High	163.8	--	--	--	None
Addicks loam	Ad		High	High	46.6	--	--	--	Farmland of Statewide Importance
Addicks-Urban land complex	Ak		High	High	50.1	2.8	2.7	2.4	None
Clodine-Urban land complex	Ce		High	High	27.4	--	--	--	None
Katy fine sandy loam, 0 to 1 percent slopes	Kf		High	High	7.0	--	--	--	Prime Farmland
Nahatche loam, frequently flooded	Na		Moderate	High	0.1	--	--	--	None
Clodine fine sandy loam, 0 to 1 percent slopes	Cd		High	High	83.4	--	--	--	None
Aris fine sandy loam	Ap	High	Moderate	High	3.0	--	--	--	Prime Farmland, if Drained
Aris-Gessner complex	Ar		Moderate	High	52.6	--	--	--	Prime Farmland, if Drained
Aris-Urban land complex	As		Moderate	High	--	8.1	0.6	41.6	None
Urban land	URLX	NA	N/A	NA	--	86.2	77.0	43.4	None

Source: NRCS, 2013

Geology

In Harris County, the Study Areas are comprised of four geologic formations. Descriptions of the formations and the area in acres of Segment 5 and the three terminal options are provided in **Table 30.**

Table 30: Predominant Geological Formations within the Study Area – Harris County							
Formation	**ID**	**Period/ Epoch Series/ Group**	**Characteristics**	**Area of Segment 5 (acres)**	**Industrial Site Terminal Option (acres)**	**Northwest Mall Terminal Option (acres)**	**Northwest Transit Center Terminal (acres)**
Beaumont	Qb-stipled	Quaternary/ Holocene, Pleistocene/None listed	Dominantly clay and mud of low permeability, high water-holding capacity, high compressibility, high to very high shrink-swell potential, poor drainage, level to depressed relief, low shear strength and high plasticity; geologic units include interdistributary muds, abandoned channel-fill muds and overbank fluvial muds.	--	7.0	--	69.1
Lissie	Ql	Quaternary/ Holocene, Pleistocene/None listed	Previously described in **Table 27**.	551.1	90.0	80.2	18.2
Willis	Qw	Tertiary/ Pliocene/ None listed	Clay, silt, sand and minor siliceous gravel of granule to pebble size including some petrified wood; sand coarser than in younger units. Deeply weathered and lateritic, indurated by clay and cemented by iron oxide locally, concretions of iron oxide numerous, noncalcareous; fluviatale; maximum thickness 75 feet.	421.1	--	--	--
Willis (coastward belt)	Qwc	Quaternary/ Pleistocene/None listed	Previously described in **Table 24**.	428.9	--	--	--

Source: BEG, 1996 and USGS, 2007

AECOM

TECHNICAL MEMORANDUM
IMPACTS TO USACE PROJECTS

To: Jerry Smiley, AICP, AECOM

From: Jennifer Oakley, AECOM

Date: November 1, 2017

RE: **DALLAS TO HOUSTON HSR – 408 Impacts to USACE Projects**

As noted in **Section 3.7, Waters of the U.S.**, impacts to U.S. Army Corps of Engineers (USACE)-Projects are documented and approved through separate Section 408 permission and Section 404 permit authorization processes with the Fort Worth and/or Galveston District. These authorization requests will be developed, reviewed and submitted by Texas Central Railroad (TCRR), not the Federal Railroad Administration (FRA), and are not part of this Environmental Impact Statement (EIS). However, the USACE is a cooperating agency on the Dallas to Houston High-Speed Rail (HSR) Project and will use the EIS and its appendices as a base document for their review and supplemental analysis of USACE impacts. As part of that analysis, the USACE has requested specific data from FRA detailing estimated potential impacts to resources within the USACE project boundaries. This technical memorandum focuses on Section 408 potential impacts.

Section 408

The authority to grant permission to alter USACE federally authorized civil works projects is contained in Section 14 of the Rivers and Harbors Act of 1899 and codified in Title 33 Section 408 (Section 408). Current Section 408 policy can be found within Engineer Circular (EC) 1165-2-216, *Policy and Procedural Guidance for Processing Requests to Alter US Army Corps of Engineers Civil Work Projects Pursuant to 33 USC 408.* Issuance of a Section 408 permission is a federal action and subject to NEPA and other environmental laws, executive orders, regulations, and policies. The approval under Section 408 is termed a *permission.* Non-USACE entities proposing to do the work are defined as *requesters*. An *alteration* is defined as, "…any action by any entity other than USACE that builds upon, alters, improves, moves, occupies, or otherwise affects the usefulness, or the structural or ecological integrity, of a USACE project." The proposed Dallas to Houston HSR Project would constitute an alteration of two USACE federally authorized civil works projects: the Dallas Floodway Extension (DFE) and the Dallas Floodway (DF). These USACE projects are described below.

Dallas County

Segment 1 is located in Dallas County (**Appendix D, Project Footprint Mapbook, Sheets 1-23**). The alignment begins on the south side of downtown Dallas near IH-30 and Lamar Street and parallels the existing Union Pacific Railroad (UPRR) freight line towards Interstate Highway (IH)-45. It parallels the west side of IH-45 as it crosses the Trinity River, running between the existing Burlington Northern Santa Fe (BNSF) freight line and the highway as it crosses East Illinois Avenue.

USACE federally authorized civil works projects subject to Section 408 approval located within Dallas County include:

- DFE-Central Wastewater Treatment Plant (CWWTP)
- DFE-Floodway
- DFE-Rochester Levee
- DFE-Future Levees (Lamar Street)
- DFE-Chain of Wetlands
- DFEIH-45 Realignment
- DF
- DF Levees (East, West, CWWTP Ring)
- DF-Sumps

The proposed Project corridor and affiliated structures will include alterations to two existing levees in the vicinity of the Trinity River, the existing DF East Levee, and the CWWTP Ring Levee.

The East Levee was completed in 1932 and provides protection along the north side of the Trinity River. This levee begins along the Elm Fork of the river and terminates at Santa Fe Avenue. In the 1950s, the DF reconstruction project modified the East Levee to flatten the levee slope to 3:1, widen the crest, and improve the interior drainage system. These improvements were completed in 1958. In 2012, the DF East and West Levees were updated to include a soil-bentonite cutoff wall to address seepage related concerns.

The CWWTP Ring Levee is located on the south side of the Trinity River and protects the CWWTP. The levee was constructed in the 1940s, encircles the facility, and provides protection from floodwaters – not directly providing protection to the public. These levee embankments were improved by the City of Dallas in 1994 to increase the crest height and flatten the slopes.

The DFE, an initiative jointly developed through the City of Dallas' partnership with the USACE, will eventually extend flood protection in the Trinity River corridor to the intersection of Interstate Highway 20 (IH-20) and Dowdy Ferry Road. Once completed, this Project will include the construction of new levee facilities, including the Lamar Street Levee (hereinafter the "Lamar Levee"), as well as a number of facilities providing recreational and environmental value.

The Lamar Levee will connect the DF East Levee system to the Rochester Levee system and is currently designed to a conceptual (35%) level. At this time, the Lamar Levee does not have a schedule for design completion nor does it have funding for construction.

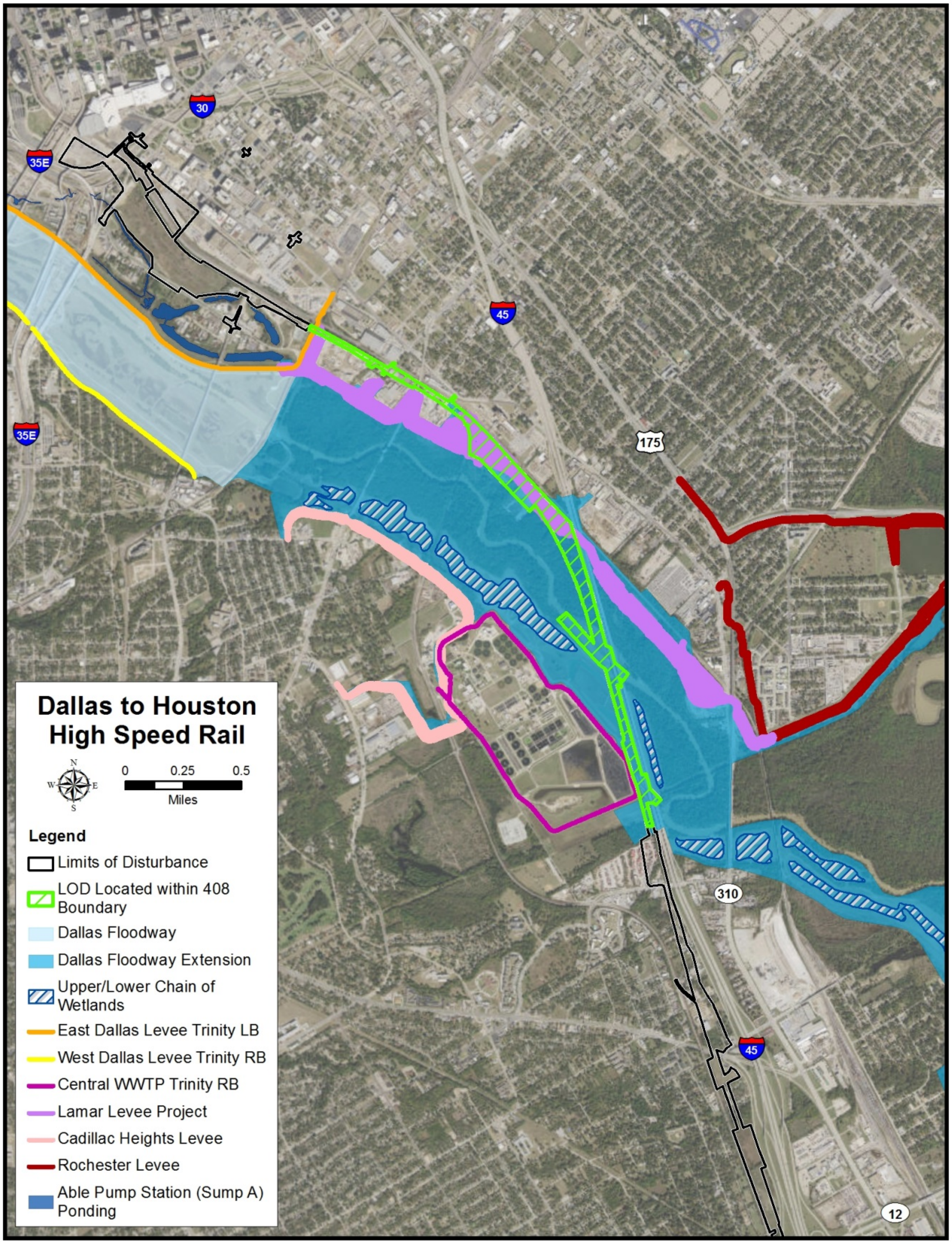
Along with crossing two existing levees and one proposed levee, the HSR Project also crosses between the Upper and Lower Chain of Wetlands, and near the Able Sump Pumps ponding areas.

The Upper and Lower Chain of Wetlands cells are interconnected ponds fed year-round by reclaimed water from the CWWTP. During flood events, the wetlands reduce flood risk by providing an efficient and second pathway to convey waters through the DF system. The wetlands project, which is part of the overall DFE, began in 2004 and is scheduled for completion in 2018.

The City of Dallas manages interior drainage by allowing stormwater runoff to pool in sumps in interior areas before pumping or draining to the Trinity River within the DF. The Able Pump Station manages stormwater in the Able Basin, which currently consists of nine sump ponds, two pump stations, and associated infrastructure. Although originally included as part of the DFE project, the City of Dallas expedited improvements due to safety concerns associated with flooding impacts. The HSR Project will not encroach on the Able Pump Station ponding areas and proposes no alterations to this system.

Figure 1 illustrates the Project footprint in association with these USACE Projects. It should be noted however, that there are additional mitigation lands not depicted on the figure as a part of the DFE. These areas are located to the southeast of the Project and outside of the LOD. Specifically, these mitigation lands are located to the east and southeast of the DFE-Lower Chain of Wetlands Cell G.

Figure 1: Project Footprint in Association with USACE Projects



Source: AECOM, 2017

Wetlands

Section 3.7.5.2.1, Waters of the U.S. outlines the estimated impacts to potential waters of the U.S. as a result of Segment 1 within Dallas County including impacts to USACE projects. As requested by the USACE, impacts to streams, wetlands and waterbodies within the USACE projects located within Segment 1 in Dallas County are provided in **Tables 1** through **3**.

Table 1: Estimated Stream Impacts – Dallas County

Classification	Crossing Type	USACE Projects		
		# of Crossings*	Temp	Perm
			linear feet	
Artificial	Bridge/Viaduct	5	43.5	0.00
	Excavation	1	0.00	449.5
Perennial	Bridge/Viaduct	2	0.00	0.00
	Excavation	1	0.00	165.1
	Total	**9**	**43.5**	**614.6**

Source: USGS, 2016; FNI, 2017

*Number of crossings was determined based on a combination of NHD and field collected data. Not all features have been field-verified. Each crossing is included by type, and includes where a single feature may be crossed multiple times within the LOD.

Table 2: Estimated Wetland Impacts – Dallas County

Wetland Type	Crossing Type	USACE Projects		
		# of Crossings*	Temp	Perm
			acres	
Emergent	Bridge/Viaduct	7	0.27	0.00
	Excavation	2	0.00	2.1
Forested	Conversion	11	0.05	0.56
	Excavation	5	0.00	1.9
	Fill	2	0.00	0.05
	Total	**27**	**0.32**	**4.6**

Source: USFWS, 2016; FNI, 2017

*Number of crossings was determined based on a combination of NWI and field collected data. Not all features have been field-verified. Each crossing is included by type, and includes where a single feature may be crossed multiple times within the LOD.

Table 3: Estimated Waterbody Impacts – Dallas County

Waterbody Type	Crossing Type	USACE Projects		
		# of Crossings*	Temp	Perm
			acres	
Freshwater Pond	Bridge/Viaduct	8	<0.01	0.00
	Excavation	3	0.00	1.0
	Fill	2	0.00	0.09
	Total	**13**	**<0.01**	**1.1**

Source: USGS, 2016; USFWS, 2016; FNI, 2017

*Number of crossings was determined based on a combination of NWI and field collected data. Not all features have been field-verified. Each crossing is included by type, and includes where a single feature may be crossed multiple times within the LOD

Vegetation

Section 3.6.5.2.1, Natural Ecological Systems and Protect Species, outlines impacts to vegetation in Dallas County, including impacts to USACE Projects. As requested by the USACE, **Table 4** identifies estimated impacts to vegetation within these USACE Projects based on Ecological Mapping System of Texas (EMST) data.

Table 4: Estimated Vegetation Impacts – Dallas County		
Vegetation Type	**USACE Projects**	
	Temp	**Perm**
	acres	
Urban Low Intensity	6.6	27.5
Central Texas: Floodplain Hardwood Forest	3.4	21.4
Urban High Intensity	8.2	15.2
Native Invasive: Deciduous Woodland	0.61	10.7
Open Water	0.05	2.7
Central Texas: Riparian Herbaceous Vegetation	0.00	0.02
Total	**18.9**	**77.5**

Source: Elliot et al., 2014

Cultural Resources

As noted in **Section 3.19, Cultural Resources**, there is one cultural resource site crossed by Segment 1 of the Project that requires coordination with the USACE. **Resource DA.072** is the Trinity River Floodway Historic District that encompasses 3,554.20 acres along the Trinity River. The DF, as a single engineering system for flood control and reclamation, is a historic and cultural resource with locally significant historical associations with flood control and the history of city planning and community development in Dallas, and is a significant statewide example of an engineering system designed for flood control and development enhancement. The period of significance of the DF spans from 1928, when floodway construction started, to 1959, when the project was completed. The essential physical features of the DF are the levees, diversion channels, and overbank. The DF retains all its essential physical features and its ability to convey its significance to the observer. The DF meets the NEPA definition of a significant historic and cultural resource that must be considered in assessment of environmental impacts as required under CEQ regulations Part 1502.16.

FRA has recommended this resource eligible for listing in the NRHP under Criterion A for community development. A narrow portion (approximately 140 feet wide) at the south end of the district crosses the LOD of Segment 1 in Dallas County, at the Santa Fe Railroad tracks. Previous coordination between the USACE and the THC determined that due to the type of resource, some changes in the setting of the historic district must be expected and that it is anticipated that the construction of additional bridges across the floodway would not adversely affect the historic floodway (THC Letter dated December 30, 2011). Therefore, it is recommended the Project would have no adverse effect on Resource DA.072.

It should be noted that Section 405 (a) of Public Law 111-212 and USACE guidance, directs the USACE to not to make any determinations under the NHPA for Resource DA.072, the DF, or resources within the DF. However, USACE must still consider impacts to cultural resources under NEPA. Additionally, the USACE Sections 404/10 permit evaluation covers actions impacting jurisdictional wetlands and waters of the U.S. Some of the actions of the Project in jurisdictional areas include compensatory mitigation areas and facilities built to support the high speed rail corridor, if the sites are located in wetlands or waters of the U.S. The USACE's Section 106 scope of analysis is established in accordance with 33 C.F.R. 325 Appendix C and is specifically identified and geographically defined for each crossing of a water of the U.S. and is not inclusive of the entire railway. In some instances FRA's Section 106 control and responsibility (area of potential effect (APE)) will be inclusive of the USACE's scope of analysis, while in other cases, where large expanses of uplands are present, the FRA 106 APE will be well outside of the USACE's scope of analysis.

Permission Request Process

In response to these impacts, TCRR shall submit a Section 408 request to the USACE Fort Worth District. All Build Alternatives (A through F) would require 408 authorizations from the USACE Fort Worth District.

Ellis County

In Ellis County, Segments 2A and 2B cross USACE-owned property near Bardwell Lake. Segment 2A crosses a flowage easement and would require coordination with USACE. However, a Section 408 permission would not be required to cross a flowage easement. Segment 2B crosses fee land and would require Section 408 authorization. Further coordination with the USACE determined that with two alternatives evaluated for crossings in and around Bardwell Lake, one crossing fee land and the other crossing land where the government retains a flowage easement, per USACE National Non-Recreation Outgrant Policy, the alternative proposed to cross fee land would be denied and not carried forward in the USACE evaluation criteria as there is a viable alternative off of federal property. This would result in the USACE's removal of Build Alternatives D, E and F from consideration. As noted above, Segment 2A (Build Alternatives A, B and C) would not require a Section 408 permission; therefore, impacts to streams, wetlands, waterbodies, vegetation and cultural resources in relation to Segment 2A in Ellis County are not outlined in this technical memorandum.