Dallas to Houston High-Speed Rail
Draft Environmental Impact Statement

Appendix F

TEXAS CENTRAL

Dallas to Houston High-Speed Rail
Draft Environmental Impact Statement

Appendix F:
Dallas to Houston High-Speed Rail
Final Draft Conceptual Engineering Report – FDCEv7
Set 1 of 2

TEXAS CENTRAL

ARUP TEXAS CENTRAL FREESE AND NICHOLS

Transmittal

To	Megan Inman, AECOM	Date	November 17, 2017
Copies	FRA: K. Wright AECOM: J. Smiley TCRR: A. Greer File: HOU TCR	TRA Number	00211
From	Christopher Taylor, Arup		
Subject	FINAL DRAFT CONCEPTUAL ENGINEERING DESIGN DOCUMENTATION – FDCE v7 Transmittal Final Version for Publication with Draft Environmental Impact Statement (DEIS) FDCE for Public Release		

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Date of Document	DEIS Appendix	Set # of #	Title of Document or Drawing Title
11/17/17	-	-	234180-AFN-TRA-00211 FDCEv7.PDF (this transmittal)
REPORTS			
9/15/17	F	1 of 2	TCRR FDCE v7 REPORT.PDF *(Final Draft Conceptual Engineering Report v7 – Project Definition for publication with Draft EIS)*
9/15/17	F	2 of 2	TCRR CONSTRUCTABILITY v4 REPORT.PDF
TCRR FDCE v7 DWGS VOLUME 1 *(General Sheets and Typical Sections)*			
9/15/17	G	1 of 21	TCRR FDCE v7 DWGS VOLUME 1.PDF *(General Sheets and Typical Sections)*
TCRR FDCE v7 DWGS VOLUME 2 *(Railway Alignment Plan and Profile Sheets)*			
9/15/17	G	2 of 21	TCRR FDCE v7 DWGS VOLUME 2-1.PDF *(Houston Segment)*
9/15/17	G	3 of 21	TCRR FDCE v7 DWGS VOLUME 2-2.PDF *(West of Teague Segment)*
9/15/17	G	4 of 21	TCRR FDCE v7 DWGS VOLUME 2-3.PDF *(IH-45 Segment)*
9/15/17	G	5 of 21	TCRR FDCE v7 DWGS VOLUME 2-4.PDF *(Navarro West Segment)*
9/15/17	G	6 of 21	TCRR FDCE v7 DWGS VOLUME 2-5.PDF *(Navarro East Segment)*
9/15/17	G	7 of 21	TCRR FDCE v7 DWGS VOLUME 2-6.PDF *(Ellis West Segment)*
9/15/17	G	8 of 21	TCRR FDCE v7 DWGS VOLUME 2-7.PDF *(Ellis East Segment)*
9/15/17	G	9 of 21	TCRR FDCE v7 DWGS VOLUME 2-8.PDF *(Dallas Segment)*
TCRR FDCE v7 DWGS VOLUME 3 *(Stations, Maintenance Facilities, and Railway Systems Sheets)*			
9/15/17	G	10 of 21	TCRR FDCE v7 DWGS VOLUME 3-1.PDF *(Stations)*
9/15/17	G	11 of 21	TCRR FDCE v7 DWGS VOLUME 3-2.PDF *(Maintenance Facilities, Yards and Shops)*
9/15/17	G	12 of 21	TCRR FDCE v7 DWGS VOLUME 3-3.PDF *(Rail Systems)*
TCRR FDCE v7 DWGS VOLUME 4 *(Roadway Plan Sheets)*			
9/15/17	G	13 of 21	TCRR FDCE v7 DWGS VOLUME 4-1.PDF *(Houston Segment)*
9/15/17	G	14 of 21	TCRR FDCE v7 DWGS VOLUME 4-2.PDF *(West of Teague Segment)*
9/15/17	G	15 of 21	TCRR FDCE v7 DWGS VOLUME 4-3.PDF *(IH-45 Segment)*
9/15/17	G	16 of 21	TCRR FDCE v7 DWGS VOLUME 4-4.PDF *(Navarro West Segment)*
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TCRR FDCE v7 DWGS VOLUME 5 *(Wildlife Crossing Sheets)*			
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REMARKS:

The files transmitted herewith represent a final submittal of the Final Draft Conceptual Engineering (FDCE) design report and drawings for the Dallas to Houston High-Speed Rail Project. This v7 submittal of the FDCE report is intended for distribution on the FRA website with the Draft EIS (DEIS) for public review.

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PREPARED BY: Christopher Taylor **Date**: November 17, 2017

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Texas Central

Dallas to Houston High-Speed Rail

Final Draft Conceptual Engineering Report – FDCEv7

234180-AFN-REP-FDCE-Final Draft

Issue | 15 September 2017

ISSUE FOR INFORMATION
Not Intended for
Permit or construction

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FREESE AND NICHOLS

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Acronyms

Acronym	Meaning
AASHTO	American Association of State Highway Transportation Officials
ADA	Americans with Disabilities Act
AF	Audio Frequency
AP	Additional Permanent
AT	Additional Temporary
ATC	Automatic Train Control
ATP	Auto Transformer Post
AZGFD	Arizona Game and Fish Department
BCC	Bridge-Class Culvert
BCS	Bryan-College Station
BEG	Bureau of Economic Geology
BMP	Best Management Practice
BNSF	Burlington Northern Santa Fe Railway
BOD	Basis Of Design
BVC	Brazos Valley Connection
Caltrans	California Department of Transportation
CCTV	Closed-Circuit Television
CD	Conceptual Design
CEQ	Council on Environmental Quality
cfs	Cubic Feet per Second
CH	Communication House
CFR	Code of Federal Regulations
COD	City of Dallas
CTC	Centralized Traffic Control
CWR	Continuously Welded Rail
CWWTP	Central Wastewater Treatment Plant
DART	Dallas Area Rapid Transit
DAS	Distributed Antenna System
DCE	Draft Conceptual Engineering
DEIS	Draft Environmental Impact Statement
DEM	Digital Elevation Model
DFIRM	Digital Flood Insurance Rate Map
DFW	Dallas-Fort Worth
DHS	Department of Homeland Security
DP	Direct Permanent
DT	Direct Temporary
DTM	Digital Terrain Model
E.O.	Executive Order
EC	Engineering Circular
EIS	Environmental Impact Statement
EMU	Electric Multiple Unit
EPA	Environmental Protection Agency
FDCE	Final Draft Conceptual Engineering – Project Definition for DEIS
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FFRMS	Federal Flood Risk Management Standard
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration
FSL	Future Service Level

Acronym	Meaning
GCD	Groundwater Conservation District
GCRD	Gulf Coast Rail District
gpm	Gallons Per Minute
HCFCD	Harris County Flood Control District
HGAC	Houston-Galveston Area Council
HGSD	Harris-Galveston Subsidence District
HSR	High-Speed Rail
HV	High-Voltage
HVAC	Heating, Ventilation and Air Conditioning
IBC	International Building Code
IH	Interstate Highway
IP	Internet Protocol
ISH	Intermediate Signal House
ISL	Initial Service Level
ITM	Inspection, Testing, and Maintenance
JIS	Japanese Industrial Standards
JRC	Central Japan Railway Company
LEDPA	Least Environmentally Damaging and Practicable Alternative
LEED	Leadership in Energy and Environmental Design
LID	Low Impact Development
LiDAR	Light Detection and Ranging
LOD	Limit Of Disturbance
LOS	Level Of Service
LRFD	Load-and-Resistance Factor Design
MAS	Maximum Authorized Speed
MOW	Maintenance Of Way
MSE	Mechanically Stabilized Earth
MSH	Main Signal House
NEPA	National Environmental Policy Act
NFPA	National Fire Protection Association
NHD	National Hydrography Dataset
NIST	National Institute of Standards and Technology
NLCD	National Land Cover Database
NPRM	Notice of Proposed Rule-Making
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
O&M	Operations and Maintenance
OCC	Operations Control Center
OCS	Overhead Catenary System
OHWM	Ordinary High Water Mark
OSHA	Occupational Safety and Health Administration
PGMA	Priority Groundwater Management Area
PSL	Peak Service Level
RC	Reinforced Concrete
RF	Radio Frequency
ROD	Record of Decision
ROW	Right Of Way
RPA	Rule of Particular Applicability
RWP	Regional Water Plan
S&I	Service And Inspection
SDH	Synchronous Digital Hierarchy
SH	State Highway

Acronym	Meaning
SONET	Synchronous Optical Networking
SP	Sectioning Post
SPCC	Spill Prevention, Containment, and Control
SSH	Sub-Signal House
SSP	System Security Plan
SSP	Sub-Sectioning Post
SWP	State Water Plan
SWPPP	Stormwater Pollution Prevention Plan
TCEQ	Texas Commission on Environmental Quality
TCRR	Texas Central Railroad
THC	Texas Historical Commission
TMF	Trainset Maintenance Facility
TNRIS	Texas Natural Resource Information System
TNW	Traditionally Navigable Waters
TOD	Transit-Oriented Development
TOR	Top Of Rail
TPDES	Texas Pollutant Discharge Elimination System
TPH	Trains Per Hour
TPSS	Traction Power Substation
TRWD	Tarrant Regional Water District
TSA	Transportation Security Administration
TUEX	TU Electric Big Brown Steam Electric Station Rail
TWDB	Texas Water Development Board
TxDOT	Texas Department of Transportation
UPRR	Union Pacific Railroad
URS	Unique Reservoir Site
USACE	US Army Corps of Engineers
USGS	United States Geological Survey
zCE	Central Zone (Texas State Plane Coordinates)
zNC	North Central Zone (Texas State Plane Coordinates)
zSC	South Central Zone (Texas State Plane Coordinates)

1 Introduction

Texas Central Railroad, LLC ("TCRR"), a private Texas-based company, plans to operate and maintain a reliable, safe, and profitable passenger rail transportation system between Houston and Dallas, Texas using proven Japanese high-speed rail ("HSR") technology (hereafter the "Project"). TCRR and its Affiliates (see paragraph below) are seeking multiple regulatory approvals, including a favorable Record of Decision (ROD) resulting from an Environmental Impact Statement (EIS) as required under the National Environmental Policy Act (NEPA). The Federal Railroad Administration ("FRA") is preparing the Environmental Impact Statement (EIS) for the Project.

TCRR is a wholly-owned subsidiary of Texas Central Rail Holdings, LLC ("TCRH") which, in turn, is a subsidiary of Texas Central Partners, LLC ("TCP") a Delaware limited liability company. Other Affiliates of TCRR including Texas Central Railroad & Infrastructure, Inc. ("TCRI") and Texas Central High-Speed Railway, LLC ("TCR") are collectively referred to as "Texas Central." TCRI would be responsible for constructing the tracks, stations, platforms and other infrastructure along the route. When completed, the Project would be operated and maintained by TCRR and TCRI. Within this report, the various Texas Central entities (TCP, TCRH, TCRI, TCRR and TCR) are collectively referred to as "TCRR."

This Final Draft Conceptual Engineering Report (FDCE) documents the key requirements, considerations, design criteria, and approaches that formed the basis of the Project Draft Conceptual Engineering (DCE) design that was provided to the FRA study team for environmental analysis to be documented in the Draft Environmental Impact Statement, the DEIS. The DCE would continue to evolve based on the results of ongoing environmental and engineering surveys, stakeholder engagement, design development, and in response to the findings of the environmental analyses. This report is a companion document to the Final Draft Conceptual Engineering Plans and Details, which define the physical limit of disturbance (LOD) and conceptual details for infrastructure configuration, systems, and facilities for the proposed Project construction.

1.1 Project Alternatives Development

Following the FRA's proposed two-step approach for alternatives development, a Step 1 Screening of Alternatives Report was created to document TCRR's analysis of alternative corridors as input to the EIS effort. The Step 1 Screening of Alternatives (hereafter referred to as the Step 1 Screening) effort served as the first step in the alternatives development and analysis process and established criteria for the corridor analysis based on the Project's Purpose and Need. The goal was to identify reasonable corridor alternatives in which to develop the proposed HSR system.

Consistent with the Purpose and Need of this Project, alternative HSR alignments were developed to minimize impacts to the environment and to existing development. Alignment objectives that every potential route alternative must meet in order to be financially feasible and constructible would include:

- Configure alignments as a dedicated, fully grade-separated interchanges, two-track alignment to meet safety, service planning, and travel time goals, without shared use of track. Alignments must support operating speeds that would achieve a 90 minute or less travel time to generate ridership and be competitive with air travel.
- Maximize adjacency opportunities with transportation and utility corridors.
- Minimize relocation of any existing roadways or freight railroad tracks.
- Optimize the alignment to allow for the desired maximum operating speed, operational efficiency, and design best practices.
- Minimize crossings of existing freight tracks, major roadways, and transmission line corridors.
- Minimize expected impacts of construction to traffic and freight operations.
- Minimize expected environmental impacts and constructability concerns.
- Minimize expected right-of-way (ROW) and construction costs associated with heavy infrastructure requirements.

More specifically, the Step 1 Screening of Alternatives Report evaluated nine alternative HSR routes within four HSR corridors to screen out those corridors found to be unreasonable from an engineering, environmental, safety, or financial viability perspective. The preferred corridor resulting from the Step 1 Screening analysis and documented within the Step 1 Screening of Alternatives Report was found to be the Utility Corridor as shown in Figure 1. Development of the HSR system within the Utility Corridor was determined to be more constructible, to have less environmental impact, and to minimize construction costs, thereby allowing for accelerated project delivery and greater financial viability.

The FRA then independently evaluated the corridors in the Dallas to Houston High-Speed Rail Project Corridor Alternatives Analysis Technical Report dated August 10, 2015. The FRA concurred with selection of the Utility Corridor stating:

"It has the potential to meet TCR's purpose and technical requirements for high-speed passenger rail service between the Dallas and Houston metropolitan regions. There are no physical characteristics, operational feasibility, or environmental constraints at this first planning stage that would result in the FRA eliminating the Utility Corridor from further consideration."

After the Step 1 Screening, a more detailed assessment of 21 alignment alternatives within the Utility Corridor was undertaken in the Step 2 Screening of Alignment Alternatives (hereafter referred to as the Step 2 Screening). The Step 1 Screening of Alternatives Report method and framework for environmental and engineering analysis of competing alternatives was used in the Step 2 analysis to ensure use of a clear and consistent approach to alternatives screening and decision making by TCRR.

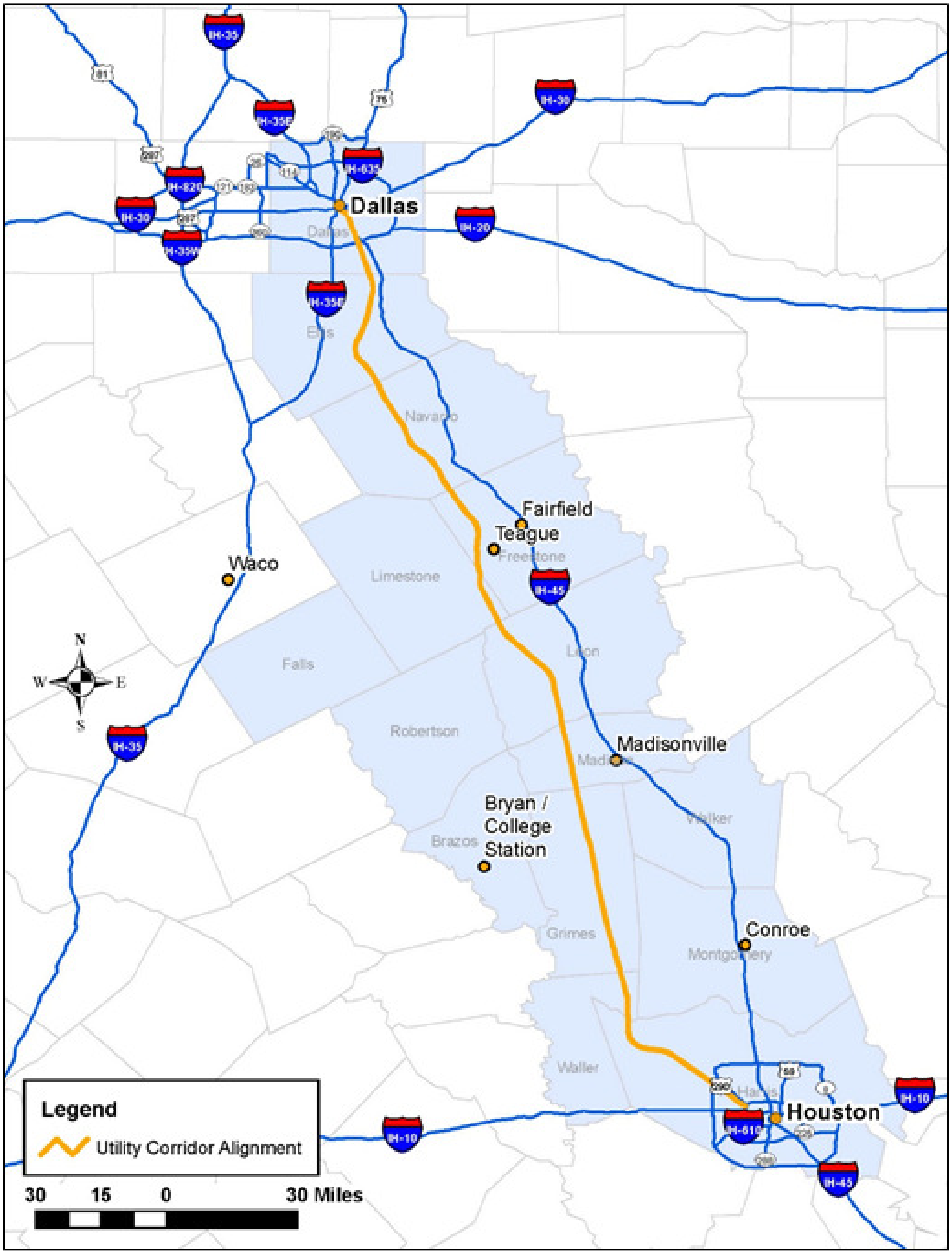


Figure 1: Preferred Step 1 Screening Utility Corridor "Base Alignment"

Additionally, a Last Mile Analysis was undertaken to evaluate alternative terminal station locations within the Houston and Dallas markets to analyze the marginal benefits and impacts associated with reaching incrementally further into the urban core to access each station site. The Last Mile Analysis Report concluded that proposed Project termini should be the Downtown Dallas station and US 290/Loop 610 Houston station locations.

This progressively refined step-by-step alternatives analysis by TCRR identified recommended HSR alignments linking Dallas and Houston for further study by the FRA through the NEPA process as shown in Figure 2. The four end-to-end alignment alternatives identified through this process, and proposed for further study in the Step 2 Screening Report, were determined by TCRR to best meet the overall Project Purpose and Need.

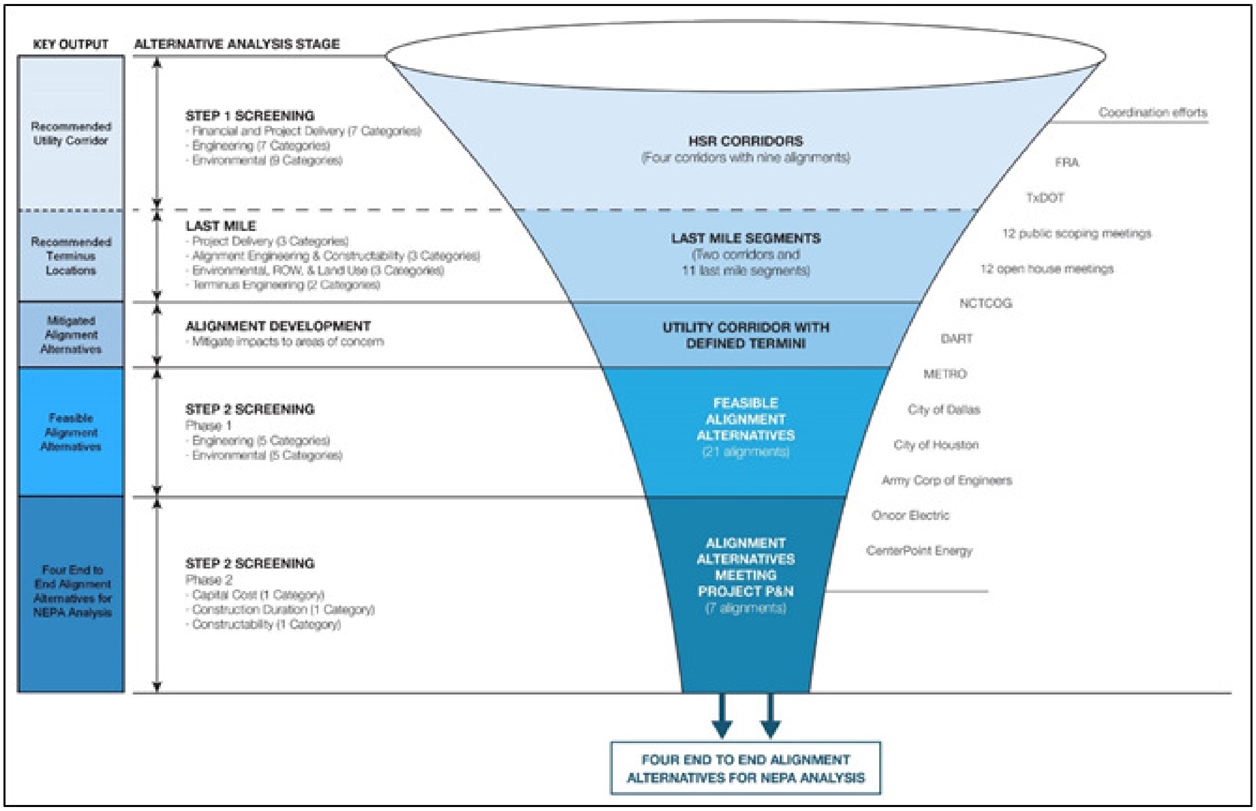


Figure 2: Alternatives TCRR Screening Process

The FRA then independently evaluated the alignments and determined that six end-to-end alignments should be studied in the Dallas to Houston High-Speed Rail Project Alignment Alternatives Analysis Report dated November 6, 2015. The FRA's responsibility was to evaluate the alternatives that TCRR developed and proposed. TCRR proposed potential route alternatives in six geographic groups – Corsicana, Bardwell, IH-45, Middle, Hockley and downtown Houston – to help avoid known environmental or engineering constraints. The FRA determined several common segments along the TCRR proposed potential route alternatives:

- Dallas Segment: Dallas to the north end of the Bardwell geographic group
- Houston Segment: The south end of the IH-45 geographic group to the north end of the downtown Houston geographic group

These common segments did not contain known environmental and/or engineering constraints. Therefore, TCRR did not propose potential route alternatives in these areas. Houston Segment contains three options for Houston terminal locations:

- Houston Terminal Northwest Transit Center Location (HT1)
- Houston Terminal Northwest Mall Location (HT2)
- Houston Terminal Industrial Site Location (HT3)

Based on further evaluation outlined in the November 2015 report, the FRA determined six route alternatives between the north end of the Bardwell geographic group and the south end of the IH-45 geographic group. These potential route alternatives were broken into six alternative segments.

- Ellis West Segment
- Ellis East Segment
- Navarro West Segment
- Navarro East Segment
- IH-45 Segment
- West of Teague Segment

The FRA recommended that the common and alternative segments be *"pieced together to create potential end-to-end alignment alternatives, or alignment alternatives from downtown Dallas to the Houston terminus at the intersection of US 290/Loop 610. To create the end-to-end alignment alternatives, each draft alignment alternative was broken into… segments made up of the potential route alternatives and common segments"*. The individual segments and the alternative routes are shown in Figure 3.

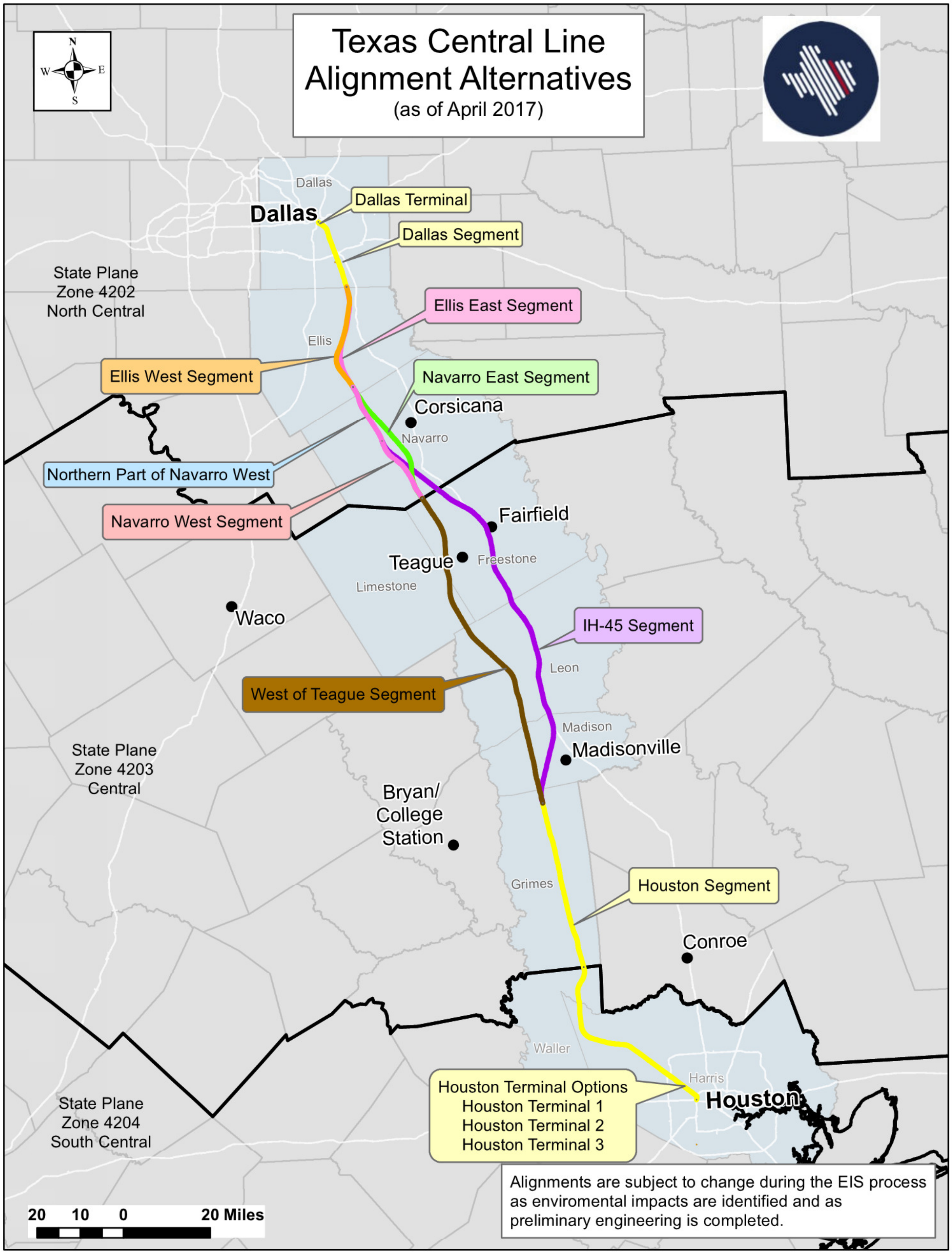


Figure 3: Segment and Alignment Alternatives

In various reports and memos, and in some appendices, the segments have different names. All of the names refer to the same lengths and locations; the difference is in nomenclature. Throughout this report, segments are referred to by their "segment names" (as shown above). The table below shows what different segments may be called. A description of each segment is provided in Section 1.1.1.

Table 1: Segment Nomenclature

FRA Segment ID	Segment Name	Segment Abbreviation	Section Name	Section Abbreviation
1	Dallas Segment	DS	Dallas Terminal	DT
			Dallas zNC	DS
2A	Ellis West Segment	EW	Ellis West zNC	EW
2B	Ellis East Segment	EE	Ellis East zNC	EE
3A	Navarro West Segment	NW	Navarro West zNC	NW
3B	Navarro East Segment	NE	Navarro East zNC	NE
3C	IH-45 Segment	IH	IH-45 zNC	IH2
			IH-45 zCE	IH1
			Northern Part of Navarro West	NWIH
4	West of Teague Segment	WT	West of Teague zCE	WT
5	Houston Segment	HN	Houston zCE	HN2
			Houston zSC	HN1
			Houston Terminal Options (collectively referred to as "HT")	HT1, HT2, or HT3

1.1.1 Approach to Alignment Development

The proposed alternative HSR alignments and infrastructure configuration, and the design of associated improvements like roadway configurations, were driven by the Project Purpose and Need, environmental concerns, constructability considerations, and stakeholder input. Comments and guidance received through coordination with various Project stakeholders and TCRR initiated public meetings has led to revisions and refinement of the alignments and associated LOD in every segment since the initial alternative alignments were identified by the FRA in its Alignment Alternatives Analysis Report released in November of 2015.

TCRR's efforts included coordination with USACE regarding fee lands, streams, wetlands, and flood plains. Through coordination with utility infrastructure owners TCRR has identified expected approaches to maintenance and protection of utilities along the alignments. Through coordination with electrical supply and transmission providers such as Oncor and CenterPoint, TCRR has also developed proposed modifications to electrical transmission infrastructure along the alignments and proposed connections with existing power grid to serve the traction power demand of the Project. Early coordination with TxDOT and other agencies, utility suppliers, community groups, and private property owners has also allowed TCRR to design the alignment and LOD in coordination with other planned projects, such as CenterPoint's Brazos Valley Connection in Grimes, Waller, and Harris Counties; the Dallas Floodway Extension and Trinity River Parkway projects in Dallas County; the Loop 9 project in Ellis and Dallas Counties; construction of Interstate 14; extension of SH 249; and, the Hwy 290 project in Harris County. Coordination with other municipalities, businesses, and community groups along the alternative alignments has also allowed TCRR to consider and coordinate the design with future corridor development plans. For example, the alignment and profile in Dallas County was designed to fully allow for future long-term plans identified in the Lancaster Regional Airport Master Plan, and the alignment and associated roadway works were closely coordinated with the development along the corridor. TCRR has also coordinated design development with various transportation providers within the corridor, such as with DART in Dallas, and with the Gulf Coast Rail District and METRO in Houston.

Specific approaches to design taken to minimize impacts to the natural world included increased use of viaduct configurations rather than embankments to facilitate access across the HSR alignment. Overall, the TCRR design approach includes use of viaducts over approximately 60% of the alternative alignments. Alignments also follow existing transportation or utility rights-of-way over approximately 50% of their length to minimize impacts to environmentally sensitive areas, wildlife habitats, and private property owners. TCRR's proposed design also includes provision of wildlife crossings based on species specific considerations as discussed in Section 16. Overall, TCRR's approach to design was specifically intended to minimize impacts to the built and natural environments as discussed in Section 3.14, which has resulted in an approximate 20% reduction of project footprint from that estimated for the alignment alternatives as studied in the FRA's 2015 analysis.

1.2 Segment Descriptions

The following sections describe each alignment segment.

1.2.1 Houston Segment

Each of the Houston terminal location options would have a unique alignment approach. A common point was selected along Hempstead Road where all three alignments alternatives would be identical as the start of the Houston zSC section and the end of each of the three Houston Terminal sections. That common point is located at approximately at the intersection of Hempstead Road and Dacoma Road.

HT1: The alignment for Houston Terminal Northwest Transit Center Location option (HT1) would be the longest and would start farthest to the south, just north of the Northwest Transit Center. It would parallel US 290 until crossing over the Union Pacific Railroad (UPRR) track near Northwest Mall. It would then run between Hempstead Road and the UPRR ROW until joining with Houston zSC section.

HT2: The alignment for the Houston Terminal Northwest Mall Location option (HT2) would start on the Northwest Mall property. It would then run between Hempstead Road and the UPRR ROW until joining with Houston zSC section. As the mall is to the north of Hempstead Road and the UPRR tracks, crossings would not be required.

HT3: The alignment for the Houston Terminal Industrial Site Location option (HT3) would be the shortest and would start near North Post Oak Road. The station would parallel UPRR and Hempstead Road to the south. The alignment would cross over the UPRR ROW, and run parallel between Hempstead Road and the UPRR ROW until joining with Houston zSC section.

Houston zSC: This alignment would start just north of the Industrial Station Site, between Hempstead Road and the UPRR ROW. The HSR would cross under Beltway 8, curve over to the southwest side of the UPRR ROW, and continue northwest. The alignment would curve west at Cypress, crossing over the Grand Parkway (SH 99), before curving north towards Hockley. The HSR would cross over the UPRR and over US 290 before curving northeast toward the existing transmission line. After running north to FM 1488, the alignment would curve east, crossing to the east of the transmission line.

Houston zCE: From Todd until Plantersville, this alignment would continue to run north adjacent to the transmission line ROW on the east. Near Plantersville, it moves slightly to the east for approximately nine miles to avoid a conflict with the CenterPoint K3 Brazos Valley Connection (BVC). North of the BVC, the HSR would continue to run adjacent to the transmission line ROW until Bedias.

1.2.2 West of Teague Segment

This segment would start adjacent to the transmission line just north of Bedias. The alignment would run north on the east side of the transmission line. Just south of Concord, the alignment would curve away from the transmission line to pass through the dense oil and gas well fields west of Donie, east of Lake Limestone. Continuing north out of the oil and gas fields, the alignment would pass to the east of Browns Lake and realign with the electrical transmission line ROW south of Teague. The proposed alignment would remain adjacent to the transmission line (on the west side) until the Freestone/Navarro county line, northeast of Wortham.

1.2.3 IH-45 Segment

IH-45 zCE: This segment would start adjacent to the transmission line just north of Bedias. At this point, the alignment alternative would curve away from the transmission line and run northeast until it aligns with the IH-45 corridor, passing to the west of Madisonville. The alignment would follow along the west of the IH-45 corridor past Fairfield before curving northwest toward the existing transmission line. The alignment would then run northwest adjacent to the east side of the transmission line to Streetman.

IH-45 zNC: The alignment would continue to run northwest adjacent to the east side of the transmission line past Streetman. It would cross to the west side of the transmission before ending northwest of Corbet, just north of TX-31.

Northern Part of Navarro West: IH-45 zNC intersects with the Navarro West Segment. Because of this, a portion of the Navarro West Segment (from the intersection station of NW 880+02 to northern ending station of NW 1637+09) is included in the IH Segment. This overlapping section is referred to as the Northern Part of Navarro West.

This section would follow on the western side of the transmission line, starting just north of TX-31, passing east of Barry, and ending near Rankin.

1.2.4 Navarro West Segment

This segment would start on the western side of the utility corridor near Wortham. Running north to Rankin, the alignment would continue to follow on the western side of the transmission line, passing west of Oak Valley and east of Barry.

1.2.5 Navarro East Segment

This segment would start near Wortham on the western side of the transmission line and run north until Currie, where it would curve northeast, crossing the electrical utility ROW. The alignment would cross the floodplain at a narrow section just north of Richland and curve northwest, passing west of Pickett. The alignment would pass southwest of Oak Valley and northeast of Barry crossing the electrical utility ROW and joining Navarro West Segment near Rankin.

1.2.6 Ellis West Segment

This segment would begin near Rankin on the western side of the transmission line. Running north, it would follows the electrical utility ROW, requiring multiple curves. The horizontal offset (distance between the Utility Corridor and rail alignment) was increased to reduce areas where the alignment would run parallel to streams. The alignment would continue alongside the Utility Corridor, curving northeast at Bardwell around Bardwell Lake and multiple utility lines. Near Palmer, the alignment would deviate from the utility line and curve to pass west of Ferris and avoid properties in Red Oak.

1.2.7 Ellis East Segment

This segment would begin near Rankin on the western side of the transmission line. Near Bardwell, it would cross the electrical transmission line and curve northeast at Bardwell to avoid multiple utility lines, but stay west of Bardwell Lake. Starting near Boyce, the alignment would closely follow the eastern side of the transmission line until Palmer. Near Palmer, the alignment would deviate from the utility line and curve to pass west of Ferris and avoid properties in Red Oak.

1.2.8 Dallas Segment

This segment would begin near Ferris and head northwest, west of Lancaster Airport. The alignment would head north, crossing under a raised Belt Line Road and Pleasant Run Road, and over Lancaster Hutchins Road and IH-20 before reaching the UPRR ROW. The segment would continue north between the UPRR ROW and IH-45 crossing over Loop 12. The segment would turn northwest toward Downtown Dallas, crossing over the Trinity River and terminating just south of IH-30.

1.3 Buildup of EIS Alignment Alternatives

The alignments that passed the Step 2 Screening process were further refined for inclusion in the EIS. Alignment refinements were performed to identify engineering, environmental, constructability, and property constraints and the alignment was optimized to avoid or minimize impacts. Considerations included, but were not limited to, locations of:

- Adverse topography.
- Stream, floodplains, and wetlands.
- Significant utility or roadway crossings.
- Developed parcels including schools and cemeteries.

Localized alignment modification studies were performed to determine whether each impact identified could be avoided or minimized. A qualitative analysis of the impacts of alternative alignments against the engineering, environmental, constructability, and land impacts was undertaken to determine the proposed alignments carried forward into the EIS alternatives. TCRR then developed the conceptual design drawings for each segment that make up the six end-to-end alternatives.

1.3.1 End-to-End Alignments

The combination of segments within each end-to-end alignment alternative being studied in the EIS are shown in Table 2. The table locations refer to Texas State Plane Coordinate Zones: South Central (zSC), Central (zCE) and North Central (zNC). Table 2 provides the segment and alignment details. The stationing includes the segment abbreviation. Total length assumes HT1, as that Houston Terminal option is the longest.

Alignment Alternatives C and F contain part of the Navarro West Segment. The IH-45 Segment intersects with the Navarro West Segment. From the point of intersection north to the Ellis East Segment or Ellis West Segment, the routes are identical. Rather than having duplicate drawings, a portion of the Navarro West Segment (from the intersection station of NW 880+02 to northern ending station of NW 1637+09) is included in IH-45 Segment. This overlapping section is referred to as the Northern Part of Navarro West

Table 2: Summary of Segment and End-to-End Alignment Details FRA

Segment Name (ID; abbreviation)	Section Name (and ID)	Start	End	Length		FRA Alignment Alternatives					
				mi	km	A	B	C	D	E	F
Dallas (1, DS)	Dallas zNC (DT)	DT 10+00	DT 217+02	3.9	6.3	X	X	X	X	X	X
	Dallas zNC (DS)	DS 10+00	DS 770+78	14.4	23.2	X	X	X	X	X	X
Ellis West (2A, EW)	Ellis West zNC (EW)	EW 10+00	EW 1242+50	23.3	37.6	X	X	X			
Ellis East (2B, EE)	Ellis East zNC (EE)	EE 10+00	EE 1208+15	22.7	36.5				X	X	X
Navarro West (3A, NW)	Navarro West zNC (NW)	NW 10+00	NW 1637+09	30.8	49.6	X			X		
Navarro East (3B, NE)	Navarro East zNC (NE)	NE 10+00	NE 1654+02	31.1	50.1		X			X	
IH-45 (3C, IH)	Navarro West zNC (NWIH)	NW 880+02	NW 1637+09	14.3	23.1			X			X
	IH-45 zNC (IH2)	IH2 10+00	IH2 913+96	17.1	27.6			X			X
	IH-45 zCE (IH1)	IH1 10+00	IH1 4329+69	81.8	131.7			X			X
West of Teague (4, WT)	West of Teague zCE (WT)	WT 10+00	WT 4118+87	77.8	125.2	X	X		X	X	
Houston (5, HN)	Houston zCE (HN2)	HN2 10+00	HN2 2073+80	39.1	62.9	X	X	X	X	X	X
	Houston zSC (HN1)	HN1 10+00	HN1 2387+62	45.0	72.4	X	X	X	X	X	X
	Houston Terminal Industrial Site (HT3)	HT3 10+00	HT3 54+21	0.8	1.3						
	Houston Terminal Northwest Mall Site (HT2)	HT2 10+00	HT2 68+24	1.1	1.8						
	Houston Terminal Northwest Transit Center Site (HT1)	HT1 11+00	HT1 110+00	1.9	3.0	X	X	X	X	X	X
Total Length in miles assuming HT1 (miles)						236	237	241	236	236	240
Total Length in miles assuming HT1 (km)						380	381	388	379	380	387

1.4 Coordination with USACE 404/408

Coordination with U.S. Army Corps of Engineers (USACE) raised concerns that affected development of the alignment alternatives. In particular, these included concerns over USACE regulated waterways in Dallas, impacts to the existing Lamar Levee, impacts to planned USACE levee projects, and impacts to federally owned lands.

The design and construction of drainage features would potentially impact numerous water bodies (waters) that are jurisdictional under Section 404 of the Clean Water Act. Where these impacts include placement of fill material into a jurisdictional water, authorization under Section 404 would be required.

TCRR is pursuing two individual Section 404 permits for the Project, one for each USACE District in which the Project corridor is located: Galveston and Fort Worth. The Section 404 permits are being developed in parallel with the FRA EIS process. In this way, the USACE would have an opportunity to review the analyses leading to selection of the Least Environmentally Damaging and Practicable Alternative (LEDPA) and at the same time an opportunity to review of the FRA EIS analysis, which would lead to selection of the "Agency Preferred Alternative" through the EIS analyses. As a cooperating agency to the EIS, this would help ensure that USACE specific concerns are properly integrated into the EIS analyses. Further, this would help ensure that measures to mitigate impacts to jurisdictional waters required to secure the Section 404 permit would be included in the EIS Record of Decision (ROD) and ultimately into detailed design being prepared for construction.

The Section 404 permits would also trigger other regulatory requirements, such as the need for a Section 401 Water Quality Certification from the Texas Commission on Environmental Quality (TCEQ). The USACE would normally coordinate with the TCEQ regarding the required Section 401 water quality certification requirements as part of the Section 404 permit process. These requirements or conditions would be appended to the Section 404 permit.

Compliance with the Section 401 water quality certification requirements and Section 404 permit conditions is mandatory. Regulatory approval and construction permit approval during the later stages of design development would help ensure that best management practices (BMPs) and environmentally responsible design and construction approaches are employed. The Project would also require a Stormwater Pollution Prevention Plan (SWPPP) during construction and would have to comply with the TCEQ's general stormwater permit for construction, TXR150000.

Coordination meetings are being held regularly with the USACE and other regulatory agencies to help address the concerns of these agencies in design development. As an example, in a meeting held with the TCEQ earlier in project development, the TCEQ specified culvert design preferences, including the use of open-bottom culverts that allow sediments to pass through, or culverts at different elevations to pass the low flow up to the 1.5-year event with higher-elevation culverts for higher flows. These preferences would be incorporated into performance and technical requirements being prepared to guide final design efforts. During more detailed design, BMPs typically used for linear projects would be included to satisfy other TCEQ requirements. These would include measures for erosion control, sediment control, and post-construction total suspended solids control.

Coordination with the USACE Fort Worth District raised concerns that affected development of the alignment alternatives, particularly in the Trinity River area and across the Lake Bardwell flowage easements, as they relate to 33 USC Section 408 authorization. A pre-coordination meeting was held with USACE and the City of Dallas to discuss potential Section 408 issues. As a result of the meeting, it was determined by the USACE that the crossing of Lake Bardwell would be considered a USACE real estate action and require a flowage easement rather than a 408 Permission request. Crossing of the Dallas Floodway and the Dallas Floodway Extension Project associated with the Trinity River in Dallas, however, would require a 408 Permission request. In accordance with Engineering Circular (EC) 1165-2-216, Policy and Procedural Guidance for Processing Requests to Alter US Army Corps of Engineers Civil Works Projects Pursuant to 33 USC 408, a written request for Project review was submitted. This request included the proposed elements of the Section 408 submittal and a draft Review Management Plan to comply with the USACE Civil Works Review Policy (EC 1165-2-209). Technical requirements for Section 408 continue to be coordinated with both the USACE and the City of Dallas.

Section 408 coordination with the USACE, Galveston District, started with an initial evaluation of any Section 408 issues. Although there did not appear to be any Section 408 issues, Harris County Flood Control District (HCFCD) distributed updated guidance clarifying the boundaries of any coordination required under Section 408. Using this updated guidance, the Project features were discussed with HCFCD on April 6, 2016, which resulted in confirmation that there were no Section 408 issues within Harris County. Subsequent to this meeting, coordination was considered complete when the USACE Galveston District notified the Project that the alignment did not cross any Section 408-regulated locations in Harris County, and that there were no additional USACE projects near the rail alignment alternatives within their geographic footprint.

1.5 Conceptual Design Drawing Organization

The Final Draft Conceptual Engineering Plans and Details drawing package includes the following components:

- Volume 1: General Sheets (.pdf)
    - 1-1 General
    - 1-2 Railway Typical Sections
    - 1-3 Roadway and Grade Separations Typical Sections
    - 1-4 Civil Structures Typical Details
    - 1-5 Civil Utilities Typical Details
- Volume 2: Railway Alignment Plan and Profile (.pdf)
    - 2-1 Houston Segment (HN1, HN2, HT1, HT2, & HT3)
    - 2-2 West of Teague Segment (WT)
    - 2-3 IH-45 Segment (IH1 & IH2)
    - 2-4 Navarro West Segment (NW)

  - 2-5 Navarro East Segment (NE)
  - 2-6 Ellis West Segment (EW)
  - 2-7 Ellis East Segment (EE)
  - 2-8 Dallas Segment (DS & DT)
- Volume 3: Stations Maintenance Facilities and Railway Systems Sheets (.pdf)
  - 3-1 Stations
  - 3-2 Maintenance Facilitates, Yards and Shops
  - 3-3 Railway Systems
- Volume 4: Roadway Plan Sheets (.pdf)
  - 4-1 Houston Segment
  - 4-2 West of Teague Segment
  - 4-3 IH-45 Segment
  - 4-4 Navarro West Segment
  - 4-5 Navarro East Segment
  - 4-6 Ellis West Segment
  - 4-7 Ellis East Segment
  - 4-8 Dallas Segment
- Volume 5: Wildlife Crossing Treatments

In addition to the FDCE report and accompanying drawing volumes, the FRA's environmental analysis teams were provided Roll Plots of the various alignment segments and Classified Civil Limit of Disturbance GIS Files (.mdb) to support their efforts.

2 Operations Information

This section describes key operational information about the proposed Texas Central HSR system, including the proposed HSR fleet and service plans. This section also includes the results of travel time and operational analyses completed to support project planning. Estimated staffing to support operations and maintenance of the system is also addressed.

Infrastructure required to support the proposed operations is covered in various sections of the report, but generally includes the following:

- A two track mainline designed to support 330 km/h (205 mph) operations. The criteria used in development of the alignments are covered in the Basis of Design in Section 3.2. Infrastructure would be configured in various forms as described in Section 5.
- Three passenger stations, including two terminal stations at Dallas and Houston and one intermediate station serving the Brazos Valley. As described in this section, service would include both express trains from Houston to Dallas and local trains that stop at the Brazos Valley Station. Design of the Dallas Terminal would not preclude future extensions to Fort Worth. For more information see Section 6.
- Various traction power, signals, and communications facilities along the alignments. For more information see Section 7.
- Two trainset maintenance facilities (TMFs) for the maintenance of the rolling stock. The TMFs would be capable of inspection, maintenance, cleaning, and overhaul tasks. For more information see Section 11.
- Seven typical Maintenance of Way (MOW) facilities, two of which are collocated with TMF locations. (Two smaller MOW facilities may be required based on which TMF sites are identified as preferred through the environmental analyses.) These are used for the maintenance of the infrastructure and right-of-way. MOW facilities would be used for staging of staff, materials and equipment and would be spaced out along the alignment as required to perform maintenance during the overnight hours when no passenger service is operating. For more information, see Section 10.

2.1 HSR Trainset

The “N700-series” trainset is proposed for use on the Dallas to Houston HSR service. The N700 trainset and its derivatives refers to the latest version of the rolling stock that operates on the Tokaido Shinkansen system. The N700 design would be adapted for the regulatory and environmental conditions on the proposed corridor. The proposed system would provide a holistic approach based upon accident-avoidance principles at the core of the Shinkansen system. The system would have the same safe properties developed through the experience and achievements of operation of the Shinkansen.

The specifications and standards used for the proposed Dallas to Houston HSR rolling stock would be based upon the specifications and standards of N700-series rolling stock currently operated on Tokaido Shinkansen.

The N700-series trainset design and aerodynamic features and car layout have evolved from the original Tokaido Shinkansen design, especially with respect to provisions for passengers with disabilities. The highlights are as follows:

- Each trainset would be an eight-car electric multiple unit (EMU) fixed-consist trainset. The configuration of trainset consists would be finalized during more the detailed design and procurement efforts. For conservative purposes the consist was assumed to be configured with six powered motor cars and two unpowered trailer cars (6M2T) for travel time simulations and with eight powered motor cars (8M) for traction power demand studies during conceptual engineering.
- The front and back car would be 89.7ft (27.35m) in length and the middle cars would be 82.0ft (25m) in length measured from couplers. The total trainset length would be 671.6ft (204.7m). Every car carries passengers. Front and back cars have operating compartments for drivers.
- Each trainset would hold approximately 400 passengers.
- The width of the rolling stock gauge is 11.2ft (3.4m). The rolling stock construction gauge is 14.4ft (4.4m), which includes a margin of 1.7ft (0.5m) for the dynamic displacement of rolling stock on each side of the rolling stock gauge.
- High-level platforms would be used at every station, with level boarding provided for every train car.
- Maximum vertical gap: 5/8in (approx. 16mm). See Section 3.2.6 and Section 3.13 for more information.
- Maximum horizontal gap: 3in (approx. 76mm). See Section 3.2.6 and Section 3.13 for more information.
- Each car in the trainset would meet or exceed the requirements of the Americans with Disabilities Act (ADA).

Central Japan Railway Company (JRC) has paid significant attention to design of the N700-series trainset to minimize the impact of operations on the communities through which the Shinkansen travels and to reduce general noise levels and energy demand. Key elements of the N700-series trainset used on some operations of the JRC system that help to mitigate sound impacts include:

- Nose shape.
- Insulator covers and soundproof walls at pantograph. See Section 17 and Appendix M for more information.
- Electrically connected pantographs to reduce sparking from the gap between wire and pantograph.
- Aerodynamic covers between adjacent car bodies.
- Bogie shroud to reduce rolling and aerodynamic noise.

The specific noise mitigation elements included in the trainset design used for the TCRR system would depend upon the results of the EIS analyses and the specific noise impacts requiring mitigation. More detailed analysis would be required to determine if the impacts identified would require site-specific noise mitigation measures such as sound barriers or trainset borne noise mitigation measures.

2.2 Service Planning

Basic service planning was undertaken to support development of conceptual engineering for the Project. Three levels of service were defined: an Initial Service Level (ISL), a Future Service Level (FSL), and a Peak Service Level (PSL). For planning purposes, it was assumed that consistent and regular service at each of these levels would be provided seven days a week, every day of the year. Descriptions of the three levels of service used in project planning are:

- The Initial Service Level (ISL) represents the proposed service level for the 2024 EIS Initial Build. Passenger service would commence at 2 trains per hour (TPH) during both peak and off-peak periods at a maximum authorized speed (MAS) of 300 km/h (186 mph). Service at 2 TPH would equate to a train every 30 minutes in each direction between Dallas and Houston.
- The Future Service Level (FSL) represents increased service levels and MAS for analysis as the operating plan for the EIS analysis Future Year of 2040. Timing for increases in service frequency would be based upon demand, but regular service is currently expected to be 3 TPH during peak periods and 2 TPH during off-peak periods by 2040. Timing for increases in MAS would require FRA approval based on system performance, but could reach 330 km/h (205 mph) by 2040. Service at 3 TPH would equate to a train every 20 minutes in each direction between Dallas and Houston.
- The Peak Service Level (PSL) is defined as the likely practicable maximum service level based on demand studied by TCRR to "stress test" the infrastructure design. The PSL studied was 6 TPH during peak periods and 4 TPH during off-peak periods. Service at 6 TPH would equate to a train every ten minutes in each direction between Dallas and Houston.

2.2.1 Use of Service Plan Scenarios in Design and Environmental Impact Analysis

A summary of how the service level scenarios were used in the design process, and recommendations regarding how they should be used in the environmental impact analysis is as follows:

- As noted, increases in MAS would require FRA approval, but, since the HSR alignment is designed to support 330 km/h (205 mph), assuming operations at that speed by 2040 is a conservative approach to environmental analysis of potential noise and vibration and power demand impacts.
- PSL were used to undertake traction power load flow studies to identify requirements for substations and other traction power facilities. This ensures that the environmental analyses conservatively evaluate the infrastructure and power demands of the Project.

- PSL were also used in operational analyses to validate the design of interlocking configurations at terminals and connections to trainset maintenance facilities.
- While not the expected service level in the EIS Future Year of 2040, the PSL was proposed for use in the EIS noise and vibration and power demand analyses to support a conservative approach to estimating impacts that could result from some demand-responsive service levels during special events or holiday periods. See Section 17 for more information on noise and vibration.
- Parking facility sizes incorporated into the design for station locations was based on TCRR ridership analyses for the maximum parking demand identified through 2050. See Section 6.5 for more information on parking demand.
- Traffic information provided to AECOM for use in the EIS traffic impact analysis used estimated arrivals and departures at terminal stations based upon FSL peak period service level and using the TCRR mode split and vehicle occupancy factors. This ensures consistency in EIS traffic analyses with other regional planning studies for 2040. See Section 6.4 for more information on traffic demand.
- TMF facilities included in the DCE design assumed FSL peak service levels. See Section 11 for more information on TMFs.
- Signals, power, and communication facilities were sized for PSL peak service levels based on traction power load flow studies. See Section 7 for more information on systems facilities.

2.3 Fleet Requirements

Fleet size assumptions were developed for each service level to support maintenance facility planning. Conservative fleet estimates were used to size trainset maintenance facilities required for initial operations and to ensure that potential future service growth would not be constrained by the footprint cleared through the EIS for maintenance facilities. Given trainset procurement schedules, it is likely that fleet procurements would exceed the strict trainset requirements to meet regular operations. The spare trainsets would allow flexibility for demand responsive service planning. As such, the following trainset fleet requirements were estimated for each identified service level to ensure a conservative environmental impact assessment. For more information on maintenance facility planning, see Section 10 and 11.

- Operational analyses completed indicate that an eight trainsets would be in operation to deliver the ISL. For environmental analysis when developing the DCE for trainset maintenance facilities, it was conservatively assumed that the ISL would require 15 trainsets. This conservative assumption under the ISL provides for crew and maintenance training during the early years of service ramp up, growth in response to demand from the initial ISL plan of two trains per hour until a second fleet procurement could be completed, and spare capacity.
- Operational analyses completed indicate that 13 trainsets would be in operation to deliver the FSL. For environmental analysis when developing the DCE for trainset maintenance facilities, it was conservatively assumed that the FSL fleet size would require 20 trainsets. This conservative assumption under the FSL for trainset maintenance facilities planning

would ensure that the system is not ultimately capacity constrained by TMF and shop expansion possibilities under the EIS.

- Operational analyses completed indicate that 24 trainsets would be in operation to deliver the PSL. Estimated fleet requirements for PSL would be 30 trainsets allowing for spare capacity. Maintenance facilities were not planned for this fleet size; but, with the conservative assumptions used, and the ability to store as many as four trains in each terminal overnight, this fleet size could be accommodated within the LOD included in the conceptual engineering.

2.4 Service Planning Summary

Exact timing of when service levels would ramp up from the ISL to the FSL, and whether they would ultimately reach the PSL level would depend upon demand. Based on ridership forecasting completed to date, it is expected that the regular service at the FSL would be required to meet demand by 2040. Service growth would occur over time in response to peak and off-peak demands for business and recreational travel. Initial growth would likely include higher service levels during focused time periods and in response to special events, but is unlikely to exceed the PSL. Additional service levels would be studied during more advanced service planning and would include study of demand for weekend, holiday, special event, and peak/off-peak periods.

The PSL represent a practicable long-term peak service level for planning purposes. Development of conceptual engineering for infrastructure, systems, stations, and facilities using the PSL ensures that the HSR system provides a conservative project footprint for environmental analysis purposes. Use of PSL for conceptual engineering ensures that excess capacity is being planned for and designed into the system so as not to limit the ability to:

- Increase the service levels well into the future.
- Allow for alternative service plans to respond to demand over time.
- Allow for operation of demand responsive service during special events, holiday periods, or emergency evacuation events.
- Allow for movement of the HSR fleet to and from TMF facilities as required without impact to planned service.

The service plans studied and associated key design requirements and performance information are shown in Table 3. Travel times provided in Table 3 are nominal travel times based on approximate average for the six alignment alternatives studied and include schedule margin. See Section 2.6 for more information on travel times.

Table 3: Service Plans and Key Assumptions

	ISL	FSL
TPH (Peak/Off Peak)	2/2	3/2
Speed	300km/h (186 mph)	330km/h (205mph)
Years	Commencing in 2024	By 2040
Trainsets	15	20
Revenue Train Trips per Day	68	80
Trainset Passenger Capacity	400	400
Terminal Station Tracks	4	
Brazos Valley Service	1 TPH	2 TPH
Nominal Travel Time – Express Service	84 mins	78 mins
Nominal Travel Time – Local Service	90 mins	85 mins
Scheduled Terminal Turnaround Time	30 minutes	
Brazos Valley Dwell Time	3 minutes	
Hours of Operation	05:30-23:30 final trains departing early enough to arrive by 23:30	
Trainset Storage in Terminals Overnight	2 – 4	
Dallas Parking Spaces	5,500	
Houston Parking Spaces	6,500	
Brazos Valley Parking Spaces	1,200	
Trainset Maintenance Facilities	2	

2.4.1 Station Configurations

Preliminary operational analyses indicate that the Dallas and Houston terminals could readily satisfy the FSL demands with two island platforms serving four platform tracks as proposed in the initial build. Operational analyses further indicate that the four platform tracks could support the PSL when using the assumption of the 30-minute turnaround time, but at those service levels there would be very little flexibility to recover from delays. Table 4 is the result of operational analyses at the 6 TPH PSL, with various speeds and terminal turnaround time assumptions. Table 4 shows:

- Assumed scheduled turnaround time.
- Average turnaround time with margin dependent on speed.
- Process time per trip: The track time needed for processing a trip is the turnaround time plus terminal replacement time. Terminal replacement time is the time from when the departing train clears the interlocking until the approaching train clears the interlocking.
- Total time per hour: Process time per trip multiplied by six TPH (for PSL). This is the total track time needed per hour at both Dallas and Houston.

- Minimum terminal tracks required is total time per hour divided by 60 minutes (in an hour) and rounded up.
- The minutes of flexibility per trip calculates how much time is available between a train's departure and the time when a following train would be delayed.

Table 4: Minimum Terminal Track Requirements

Speed (mph)	Sch. Turn-around Time (min)	Average Turn-around Time with 6 TPH (min)	Processing Time Per Trip (min)	Total Time Per Hour (min)	Minimum Terminal Tracks Required	Minutes of Flexibility Per Trip (4 Tracks)	4 Track Util. Pct.	Minutes of Flexibility Per Trip (6 Tracks)	6 Track Util. Pct.
186	20	22.5	27.5	165	3	12.5	68.8%	32.5	46%
186	30	32.5	37.5	225	4	2.5	93.8%	22.5	63%
186	40	42.5	47.5	285	5	N.A.	118.8%	12.5	79%
186	60	62.5	67.5	405	7	N.A.	168.8%	N.A.	113%
205	20	24	29	174	3	11	72.5%	31	48%
205	30	34	39	234	4	1	97.5%	21	65%
205	40	44	49	294	5	N.A.	122.5%	11	82%
205	60	64	69	414	7	N.A.	172.5%	N.A.	115%

As can be seen from the table above, 4 track terminals with 30 minute turnaround time serving 6 TPH leaves almost no margin for error, with only one minute of scheduling flexibility for recovery. In other words, the schedule that can be run is dictated by the capacity of the station, and the station tracks are operating at 97.5% capacity, almost continuous utilization. Operating a terminal above 90% of the maximum capacity is not recommended since scheduling close to maximum capacity greatly increases the probability of cascading delays on the system, makes rescheduling trips difficult, and limits new schedules/routes. Common terminal operating issues, such as on-board passenger medical emergencies and equipment failures can quickly consume the little available track capacity, which will in turn delay the next trip, and eventually trains at the opposite terminal.

To increase flexibility the scheduled turnaround time can be reduced, the operating speed can be reduced, or the number of terminal tracks can be increased. For the purposes of project planning, a five or six station track terminal would support regularly operating the PSL at 205 mph (330 km/h) at 30 minute scheduled turnaround times. Based on operating performance, a practical scheduled turnaround time of less than 30 minutes might be achievable over time.

Given that only the ISL and FSL operating levels are currently proposed as regular service levels, and that PSL service volumes would likely be operated at 186 mph (300 km/h) should they be required for special events through 2040, the project currently proposes building only four terminal tracks. Nonetheless, the FDCE design of the station area plans and associated roadways, and the alignment, profile, and interlocking configuration designs do not preclude a future expansion to a six-track terminal. The potential need for phased development of the additional terminal capacity is currently being studied in more detail; however, the six track PSL configuration is being used for the LOD provided in the conceptual engineering drawings for environmental documentation. This provides a conservative footprint for environmental analyses and ensures that adequate terminal capacity would be available to address recovery, train cleaning, special event staging of trains and other potential needs that might be identified during more detailed planning and design.

The intermediate station serving the Brazos Valley would be configured with two mainline tracks and two "siding" tracks serving side platforms. System design would support up to three intermediate stations in the future, with only one intermediate station (Brazos Valley) developed as part of the initial build. No additional stations are currently envisioned through 2040.

2.4.2 Hours of Operation

For planning purposes and environmental analyses, the hours of operation were assumed to be 05:30-23:30, with final trains departing each terminal early enough to arrive at the distant terminal by 23:30. Peak periods defined as 0700-1000 and 1600-1900. The allowable time for maintenance operations would vary by location and would depend upon the schedule for passenger operations over that particular segment. Maintenance of Way (MOW) equipment movements on the HSR line would be prohibited during times when passenger movements are scheduled. Likewise, passenger operations would be prohibited during times when maintenance operations are scheduled for the trackway. Once the line has been inspected in accordance with FRA requirements following maintenance operations, passenger trains would be permitted to operate. Hence, maintenance operations could be scheduled to allow for overnight passenger operations outside of the 05:30-23:30 time period in response to special demands.

2.5 Operating Speed

The initial maximum operating speed of the equipment would be 186 mph (300 km/h), with subsequent increases in speed up to the maximum allowable as described in the Rule-of-Particular-Applicability of 205 mph (330 km/h). After gaining operational experience at 186 mph (300 km/h) TCRR would work with the FRA to qualify the equipment for operation at increasing speeds up to the maximum allowed.

2.6 Travel Times

Travel times were simulated by LTK using the HSR trainset characteristics of the N700 Tokaido Shinkansen trainset for each alignment alternative at 186 mph (300 km/h) and 205 mph (330 km/h). These travel times were provided to AECOM to support their alternatives analysis. The simulated results for the Houston-to-Dallas and Dallas-to-Houston runs are shown in Table 5 to Table 8.

2.6.1 Travel Times – 205 mph (330km/h) Maximum Operating Speed

Under best case conditions known as "golden runs," the run times range between just under 80 minutes to just under 82 minutes. In Table 6, a 5% schedule margin is applied to produce realistic travel times that would be achievable in daily real-world operations. The addition of a schedule margin produces travel times between just under 84 minutes to just under 86 minutes.

These run times use the maximum authorized speed (MAS) of 205mph (330 km/h) and take into account civil speed restrictions due to alignment geometry along each alternative.

These run times include a stop in Brazos Valley.

Table 5: "Golden Run" Travel Times (205 MPH Maximum Speed, Without Schedule Margin)

Alignment	Houston to Dallas	Dallas to Houston
A	80:02	79:53
B	80:07	79:58
C	81:51	81:41
D	79:50	79:42
E	79:56	79:46
F	81:39	81:29

Table 6: Scheduled Travel Times (205 MPH Maximum Speed, With Schedule Margin)

Alignment	Houston to Dallas	Dallas to Houston
A	84:02	83:53
B	84:07	83:58
C	85:57	85:46
D	83:50	83:41
E	83:56	83:45
F	85:44	85:33

The speed distance trip graph for Alignment A in Figure 4 shows the civil maximum speed limit in red and the train's speed in green, plotted against the trip distance in miles from Houston to Dallas. In the lower plot the grade is plotted against the trip distance. For each of the alignments, there are very limited locations with civil speed restrictions outside of the common segments at the Dallas and Houston approaches and within the terminal areas. As a result, the differences in trip times are driven largely by the overall lengths of the alignments.

In addition, in segments with steeper grades, slight decreases in the train speed would occur for short time periods as the train is unable to maintain the 205 mph (330 km/h) speed. In each of the segments considered, the grades are usually below this value, with the few instances of higher grades standing out in the speed distance graphs. The full set of speed-distance trip graphs for travel time simulations at 205 mph (330 km/h) is provided in Appendix A.

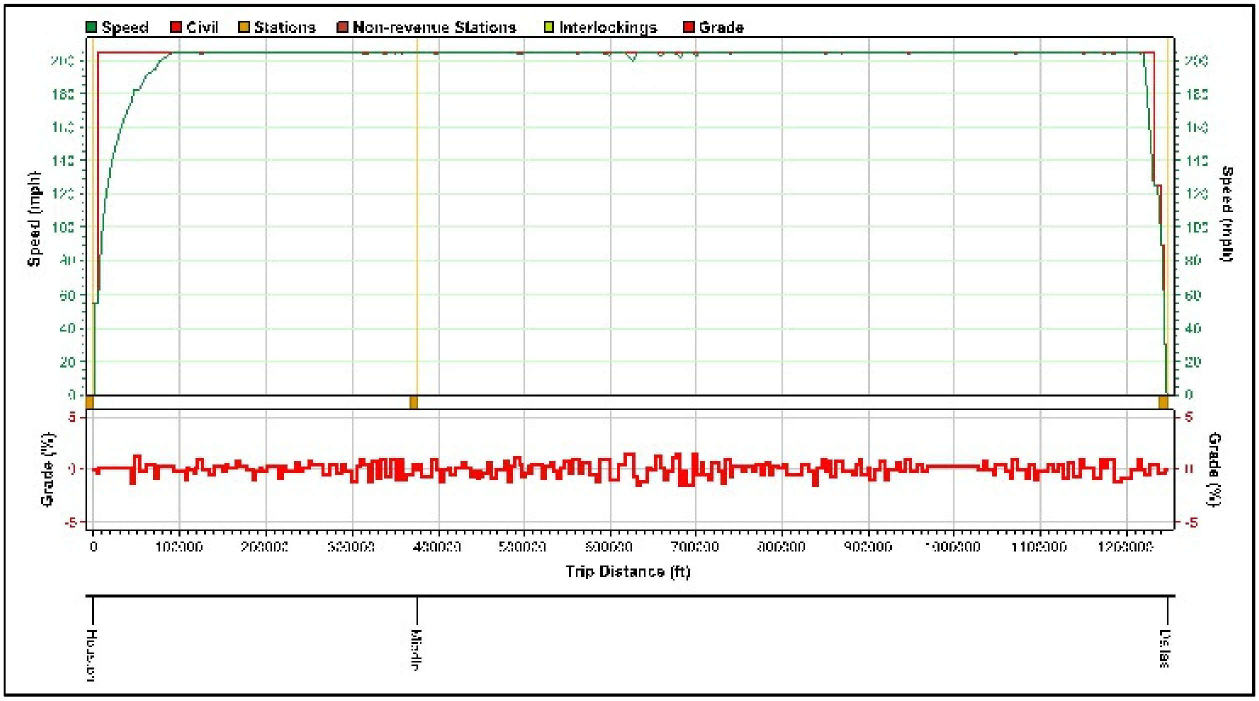


Figure 4: Speed Distance Trip Graph Houston to Dallas Alignment A (205 mph)

2.6.2 Travel Times - 186 mph (300 km/h) Maximum Operating Speed

The initial operating speed on the alignment would be 186 mph (300km/h), which would allow the TCRR to begin operations and eventually certify its rolling stock for the planned maximum line speed of 205 MPH. To assist with scheduling and planning for initial operations, a simulation was performed over each of the alignment alternatives with a maximum speed of 186 mph (300km/h). The speed of the train was restricted in this simulation to 186 mph (300km/h), but curves and grades would be constructed for 205 mph (330km/h) alignments. (The curve tables provided in Volume 2 of the FDCE drawings identifies curve speed restrictions along the various alignments and the superelevation values associated with both the 186 mph and 205 mph operating speeds.) Table 7 provides simulated 186 mph (300km/h) travel times for each alignment. These run times include a stop in Brazos Valley.

Table 7: "Golden Run" Travel Times (186 MPH Maximum Speed, Without Schedule Margin)

Alignment	Houston to Dallas	Dallas to Houston
A	85:54	85:47
B	86:00	85:53
C	87:53	87:47
D	85:41	85:34
E	85:47	85:40
F	87:40	87:33

The same results with a 5% schedule margin applied are shown in Table 8. Even when speeds are limited to 186 mph (300km/h), four of the six alignments are able to achieve travel times of less than 91 minutes when stopping at the middle station for three minutes. Alignment C and

Alignment F have the longest travel times, with simulated run times that are over a full minute longer than each of the other four alternatives.

Table 8: Scheduled Travel Times (186 MPH Maximum Speed, With Schedule Margin)

Alignment	Houston to Dallas	Dallas to Houston
A	90:12	90:04
B	90:18	90:11
C	92:17	92:10
D	89:58	89:51
E	90:04	89:57
F	92:03	91:56

Figure 5 shows a plot of speed versus distance for a northbound train operating on Alignment Alternative A. In red is the maximum speed for the alignment, which remains at 205 mph (330km/h). The train operates between Houston and Dallas without encountering any speed restrictions other than those imposed at the stations. At 186 mph (300km/h), the train is better able to maintain a constant speed and is less affected by the small changes in grade. The full set of speed-distance trip graphs for travel time simulations at 186 mph (300km/h) is provided in Appendix A.

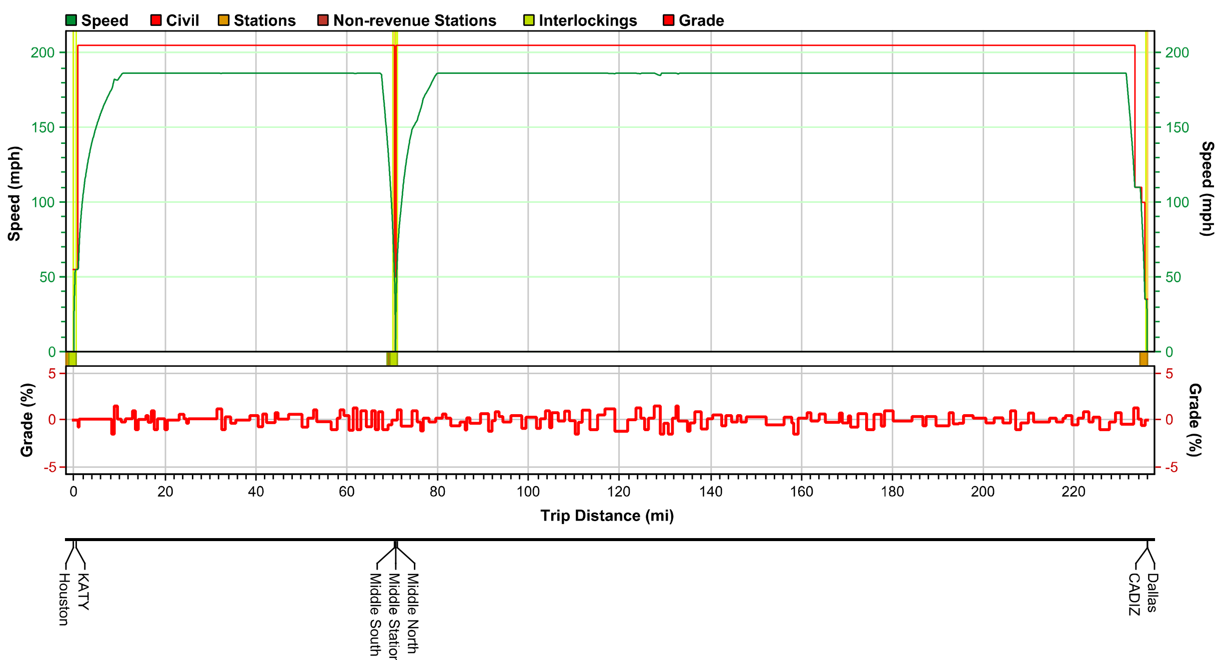


Figure 5: Speed Distance Trip Graph Houston to Dallas Alignment A (186 mph)

2.6.3 Travel Time Simulation Conclusions

Each proposed alignment alternative would support nominal end-to-end travel times of 90 minutes, even at the reduced initial operating speed of 186 mph (300 km/h). The trip times for the alignments vary by two minutes or less, an insignificant difference with respect to travel time, energy consumption or fleet size. The train performance is well matched to the terrain and is capable of maintaining the maximum speed in almost all areas on all segments. The alignments were created with curve radii that support 205 mph (330 km/h) for the majority of the alignment, with civil speed restrictions largely limited to the terminal areas and in select locations to minimize property and environmental impacts. As a result, the differences in trip times almost entirely attributed to the total alignment length.

2.7 TCRR Staffing

The Project would require skilled service jobs for TMFs, MOWs, and systems in every county along the corridor. Staffing estimates were developed based on existing high speed rail systems and stations and account for updates to technology and efficiency. Staffing estimates by location are provided in Table 9 on the following page.

At facilities, total staff numbers account for the number of staff at the station at any given time as well as the number of shifts per day.

Table 9: Staffing Assumptions

Staff Assumptions	No. of Positions	Shifts	Full Time Equivalents	Notes
Dallas Station Staff				
TCRR Staff	90	1	90	
Railway Operations & Station Operations and Maintenance	241	1	241	Assumed all staff and crew on site, multiple shifts consolidated to (1) one for this estimate
Concessions	60	2	120	2 restaurants, 2 bars, 5 fast food, 2 coffee stand, 2 newsstand
Car Rental / Parking / Valet	28	2	56	4 rental companies
Subtotal (1 station)	419		507	
Brazos Valley Station Staff				
Station Operations and Maintenance	50	1	50	Assumed staff and crew on site
Concessions	18	2	36	1 restaurant, 1 fast food, 1 bar, 1 coffee stand, 1 newsstand
Car Rental / Parking / Valet	12	2	24	2 rental companies
Subtotal (1 station)	80		110	
Houston Station Staff				
TCRR Staff	90	1	90	
Railway Operations & Station Operations and Maintenance	241	1	241	Assumed staff and crew on site
Concessions	60	2	120	2 restaurants, 2 bars, 5 fast food, 2 coffee stand, 2 newsstand
Car Rental / Parking / Valet	28	2	56	4 rental companies
Subtotal (1 station)	419		507	
Maintenance Facilities				
Trainset Maintenance Facility (TMF) Staff (all included at each)	30	2	60	
Subtotal (2 TMFs)	60		120	
Maintenance of Way (MOW) Staff				
Staff (Nighttime Crew)	30	1	30	
Staff (Daytime Crew)	5	2	10	
Subtotal (7 MOWs)	245		280	
Total Staff	**1,223**		**1,524**	

3 Basis of Design

This section identifies key design criteria and performance requirements, the Basis of Design (BOD), used in development of the DCE for the Project.

The BOD would be updated as the Project design is further developed in close coordination with the separate Rule of Particular Applicability (RPA) and USACE Section 404 and Section 408 permit efforts. Requirements identified through these separate efforts would be incorporated into future updates to the DCE engineering documentation for the EIS, and would be coordinated with the preliminary engineering efforts supporting more advanced Project definition, including development of more detailed design criteria that would guide final engineering efforts and fully define technical and performance requirements for Project infrastructure and systems.

The DCE was developed in support of the EIS and intended to support project planning and environmental analyses. During more advanced project development, the final design would be developed in accordance with the EIS Record of Decision commitments, USACE permit requirements, and all applicable local, state, and federal requirements. Final design would be used for construction and property purchase.

The following are the key goals and objectives of the Project that underpinned the development of the DCE and the BOD, and that support the Project Purpose and Need of the Project:

- Economic: Achieve a favorable return on investment when weighing expected ridership and revenue against estimated project capital investments, real estate requirements, project delivery schedule, and long-term operations and maintenance expenses.
- Technological: Deploy a state-of-the-art HSR system for service based upon the Tokaido Shinkansen. TCRR would adapt the rolling stock, systems, and operating and maintenance procedures as required to comply with applicable regulatory, environmental, and operational conditions of the Project corridor.
- Operational: Achieve a travel time of 90 minutes or less between Dallas and Houston.
- Environmental: Minimize impacts to the natural and built environment along the corridor and at stations through context-sensitive design, adjacency to existing infrastructure ROW, and stakeholder coordination as appropriate.

3.1 Survey and Mapping

The sources used and key characteristics of the conceptual design include:

- All mapping used in development of the DCE was developed from existing data sources. Mapping was secured from light detection and ranging (LiDAR) data from Texas Natural Resource Information System (TNRIS) and Houston-Galveston Area Council (HGAC), and aerial imagery from ArcGIS Online services.
- DCE of civil infrastructure in units of US Survey Feet.
- Key dimensions for systems infrastructure design, including track geometry key dimensions such as gauge and superelevation limits, are provided in metric units to allow for

coordination with RPA efforts to achieve regulatory approval for transferring Shinkansen technology to the Project.

- All project mapping and DCE are based on Texas State Plane Coordinates. The corridor spans across three separate state plane coordinate systems; North Central (TX NC 4202), Central (TX C 4203), and South Central (TX SC 4204).
- Horizontal datum of NAD 83.
- Vertical datum of NAVD 1988.
- A Digital Elevation Model (DEM) / Digital Terrain Model (DTM) was prepared from LiDAR data from TNRIS and HGAC. LiDAR sources were filtered to show only bare earth and supplemented by contour data where LiDAR sources were not available. The DEM/DTM was prepared in a format compatible with Microstation, Inroads, and ArcGIS design and mapping tools and used as the basis for vertical alignments, preparation of cross-sections, design of hydrology and hydraulics, and the generation of earthwork quantities.

3.2 Track and Alignment Design

The following sections describe the key design characteristics and considerations used in development of the DCE for DEIS documentation. In many cases, such as maximum grades and minimum curve radii criteria, strict requirements are identified and based upon Central Japan Railway Company (JRC) design criteria. The DCE used more conservative criteria to provide greater flexibility during design development to mitigate impacts and to address constructability or ROW concerns.

3.2.1 Track

Key criteria used for the track were as follows (metric units are provided as the primary units for rail system and track specific values to ensure consistency with JRC design criteria and RPA):

- The Project would include two mainline tracks.
- Typical mainline track spacing would be 4.5m (14ft 9in).
- Standard track gauge would be 1435mm (4ft 8 1/2 inches).
- Within stations and TMFs where trains come to a stop, track spacing between adjacent tracks would be minimum of 4.6m (15ft 1in) to accommodate a stopping point sign between the tracks.
- At tight curves used in TMFs, track spacing would be as required to accommodate car body center excess and end overhang, systems infrastructure, personnel clearance, superelevation, or other requirements at each location as appropriate.
- Track spacing within yards and in TMFs would support level boarding platforms wherever train crew members would be required to gain access to the equipment.
- Each of the two mainline tracks would be normally operated in one direction only. No high-speed crossovers to support routine bidirectional operations would be provided; bidirectional

operations would normally be limited to station approaches and at TMF connection areas. Low-speed crossovers would be provided at limited and strategic locations to support MOW and emergency operations.

3.2.2 Horizontal Alignment

Key criteria used for the horizontal alignment were as follows (rail system and track-specific values are provided in metric units as the primary units to ensure consistency with JRC design criteria and RPA):

- The DCE only includes an alignment for a centerline of the two tracks. An alignment for each individual track is not provided. Track layouts for station configurations and trainset maintenance facilities do include layouts for individual tracks since track spacing and special trackwork configurations for those facilities were required to evaluate the Project LOD.
- The track alignment was designed to accommodate an operating speed of 330 km/h (205 mph) except at station approaches and where required to minimize impacts. Alignment development at the planning stage is a critical concern since once built it is almost impossible to change the alignment during operations. As such, the geometric design of the alignment was developed to not preclude a future increase in train speed of up to 350 km/h (218 mph) or more should technological advances in rolling stock and systems make doing so feasible. Much of the Texas Central alignment would support future train speeds up to 400 km/h (250 mph) without violating superelevation or transition curve length requirements.
- The absolute minimum horizontal curve radius for use in mainline tracks (for operations at 205 mph operations) by JRC standards is 5,200m (17,100ft). The DCE used a minimum radius of 5,700m (18,700ft) to limit the actual superelevation at 205 mph. In low speed locations, and when it cannot be avoided, the minimum radius is 400m (1312ft). The minimum curve radius used in the DCE was 427m (1,400ft) at certain locations on the terminal station approaches, and 200m (660ft) minimum in TMFs and MOW facilities.
- The maximum actual superelevation would be limited to 200 mm (7 7/8 inches), as established in the RPA petition, or as limited by applicable FRA regulations. The DCE used a maximum superelevation of 150 mm (6 inches) and a superelevation deficiency of 75 mm (3 inches). Using these values, a minimum radius of 5,700 m (18,700ft) was used to achieve 330 km/h (205 mph) operations in the DCE.
- Curves on the mainline would be connected by transition curves. Cosine transition elements with lengths that exceed JRC requirements were used in the DCE. This allowed for use of design tools available at the time of development and provided a conservative approach. During more detailed design half sine wave spiral transition curves would be used, consistent with JRC practice.
- The minimum desirable element length for mainline high speed operations at 330 km/h (205 mph) is 150m (492ft) for passenger comfort. Due to alignment constraints, a minimum element length of 100m (328ft) was used for curves or tangents in select locations. A minimum separation length of 100m (328ft) was used between transition curves and vertical curves on main lines. In low speed locations and where the alignment is constrained the element length and separation requirements were reduced to suit the site specific constraints.

3.2.3 Vertical Alignment

Key criteria used for the vertical alignment were:

- Grades were designed to be as low as practicable within the topographical constraints. The vertical alignment was designed to typically follow the existing topography to the extent practicable. Impact to existing infrastructure and other features was considered and minimized where practicable through elevating the alignment on a viaduct.
- For the DCE the maximum grade was limited to 1.5%. Where practicable, a desired maximum of 1.0% was used. These values were more conservative than the JRC design guidelines which provide for the following:
  - A maximum grade of 1.8% for segments shorter than 1.5 miles (approximately 2.5km).
  - An absolute maximum grade of 2.0% for segments shorter than 0.6 miles (approximately 1km).
- The DCE used a maximum grade of 1.5% for lead tracks at approaches to TMFs, and 2.0% for MOW facilities. JRC guidelines allow for an absolute maximum grade for lead tracks and non-service lines of 3.0%, but only for lengths less than 800ft (approximately 250m).
- Where trains would be stored, a maximum grade of 0.25% was used.
- The DCE used 0.0% grade within stations. JRC guidelines allow for a maximum grade of 0.3% within stations, where parked, or where decoupled.
- A minimum grade of 0.2% was generally used where the HSR would be in a cut infrastructure configuration. This nominal grade is provided to aid drainage and avoid low spots for water to pond.
- The minimum vertical curve radius is defined by limiting the vertical acceleration. Consistent with JRC guidelines, circular curves were used for vertical curves with a minimum vertical curve radius of 30,000m (98,424ft). The DCE typically used 130,000ft (39600m) as a conservative approach.
- For the DCE, overlap between vertical curves and horizontal curves was minimized to the extent practicable, and overlap with transition elements was avoided where possible.

3.2.4 Clearances and Track Spacing

Key clearance and spacing assumptions and requirements used in development of DCE horizontal and vertical alignments include:

- Road Over HSR: A minimum overhead clearance from the track of 21ft 2in (6.45m) was used for this level of conceptual design. Typical road structure depth was assumed to be 5ft 6in (1.7m) deep. A minimum separation of 30ft (9.1m) from top of proposed HSR rail to road surface was provided. Therefore, a typical vertical clearance above the HSR track to the underside of the road structure of 24ft 6in (7.5m) was provided.

- HSR Over Freight Rail: A minimum vertical clearance above freight rail to the underside of the HSR structure of 24ft 6in (7.5m) was used for this level of conceptual design. The HSR structure was assumed to be 15ft 6in (4.7m) deep to allow for longer spans over freight line; therefore, a minimum separation of 40ft (12.2m) from top of proposed HSR rail to top of existing freight rail was provided.
- HSR Over Road: A vertical clearance to the underside of the HSR structure of 16ft 6in (5.0m) over a local and state roadway and 22ft (6.7m) over interstates was used, in accordance with the current version of Texas Department of Transportation (TxDOT) Highway Design Standards. The HSR structure was assumed to typically be 13ft 6in (4.1m) deep. Therefore, a minimum typical separation of 30ft (9.1m) for local and state roadway and 35.5ft (10.8m) from top of proposed HSR track to top of existing pavement at roadway crossings was assumed.
- Vertical clearance for private driveways and roadways was site-specific and in most cases not used to dictate HSR profile design. Access requirements would be coordinated with private property owners during more detailed design and may require reconfiguration of existing property access or provision of HSR bridge structures.
- Identification of infrastructure configuration as a viaduct required a minimum clearance of 4ft (1.2m) between the existing grade and the underside of the viaduct. Where less than 4ft (1.2m) was provided the infrastructure configuration was assumed to be embankment. This assumption allowed for assessment of potential environmental impacts, such as wildlife crossings. During more detailed design site specific conditions such as geotechnical conditions would be assessed to determine infrastructure configuration and structures may be used to support the HSR track where less than 4ft (1.2m) of clearance is provided or embankments used where more than 4ft (1.2m) is provided.
- ROW mapping for existing transmission lines was not available in all locations. To advance design, it was assumed that existing transmission line ROWs were approximately 215ft wide.
- A minimum offset of approx. 200ft (70m) to the transmission line corridor was used where the HSR alignment would run parallel to the utility. Adjustments to this offset were made as required to limit intrusion of embankment side slopes and other Project elements into utility easements. The offset between the HSR and the transmission lines varies based on site-specific conditions and HSR alignment geometry.
- Track spacing within TMFs and shops was developed in the DCE to support:
  - Safe operations of trainsets and maintenance equipment, including non-rail-based equipment used within facilities.
  - Safety of maintenance workers in accordance with planned operations and applicable regulatory requirements.
  - Space for lighting and overhead catenary system (OCS) poles, equipment cabinets, service aisles, and materials storage as required.
  - Level boarding for trainset crew and maintenance staff.

3.2.5 Barrier Separation

Barrier separation would be included in final design as required to ensure the safe movement of trainsets and to protect HSR structures from freight or roadway traffic adjacent to or crossing over or under the HSR line. Barrier separation requirements would be defined during more detailed design development and would take into account site-specific conditions and a risk-based hazards analysis. Development of barrier protection and intrusion protection systems and infrastructure would be closely coordinated with requirements identified through the RPA efforts, and through coordination with the freight railroads, roadway authorities, and other project stakeholders as appropriate at each location.

3.2.6 Station Platforms

Key considerations used in development of DCE for station platforms included:

- High-level platforms would be used at each station, with level boarding provided for each train car.
- Terminal stations would have 30ft (9.1m) wide island platforms.
- Brazos Valley Station would have 20ft (6.1m) wide side platforms. Consistent with JRC guidelines, the intermediate station was designed with side platforms on “passing siding” tracks accessed via mainline turnouts.
- Platforms would be 705ft (214.9m) long, which is 35ft (10.7m) longer than the proposed eight-car trainsets.
- All platforms would be on tangent level track.
- Platform height and offset would be confirmed during more detailed design and fleet procurement efforts to ensure platform edge offset complies with ADA requirements. The intent would be to provide a maximum horizontal gap of 3in (76mm) and an approximate maximum vertical gap of 5/8in (16mm). The following values were considered for alignment development for the DCE:
    - Platform offset from track centerline of 5ft 10in (1.78m).
    - Platform height above top of rail of 4ft 3in (1.30m).
- Direct fixation track would be used in stations to ensure tolerances can be met for level boarding and ADA compliance.
- Consistent with JRC practice, overrun tracks would be provided beyond terminal station platform limits. The DCE includes 100ft (30.5m) long overrun tracks beyond terminal platforms in Houston and Dallas to decrease the length of pedestrian connections. These lengths have been used by JRC on the Shinkansen system. Overrun protection coils and trainset speed detection systems would be provided in accordance with JRC requirements.
- The length of the siding tracks and position of the mainline turnouts used in the DCE was consistent with JRC practices to allow for consistent systems design and operational practices.

3.2.7 Track Structure and Components

Key characteristics of the Project track structure and configuration that were incorporated into the DCE, or that could impact the environmental analyses, include the following:

- Track components including, but not limited to, the rail, concrete ties, ballast, fasteners, expansion joints, glued insulated joints, and turnouts would be based upon those used on the Tokaido Shinkansen and would satisfy JRC/JIS (Japanese Industrial Standards) specifications except as required to meet regulatory requirements.
- Ballasted track with concrete ties would be used, except at stations where direct fixation track would be used to achieve the tight horizontal and vertical clearances to platform edge required for handicapped accessibility.
- Composite ties would be used at locations such as turnouts, transitions between aerial structure and embankment, and on non-ballasted steel bridges as required to provide increased track support and durability.
- A minimum ballast depth of 12in (305mm) below the tie within embankment infrastructure configurations and a minimum ballast depth of 10in (254mm) below the tie on viaduct structures would be used.
- Continuously Welded Rail (CWR) would be used in mainlines and TMFs. A minimum of joints would be used, with signal block circuits separated with impedance bonds and insulated joints.

Special trackwork components used for conceptual design were based upon JRC specifications. More detailed analysis of trackwork layouts at station approaches, at MOW bases, and at TMF locations would be performed during design development to determine the best balance between alignment geometry, operating speeds, and interlocking occupancy time concerns and associated ROW, structural, and maintenance requirements. Key special trackwork criteria and considerations included:

- No.18 turnouts with diverging move speeds of 43.5 mph (70 km/h) were primarily used for switches on mainline tracks. This includes turnouts used to access siding tracks at Brazos Valley Station.
- No.16 turnouts with 43.5 mph (70 km/h) diverging move speeds were used in the DCE at the approach to constrained terminal stations, where location-specific constraints require a more compact arrangement.
- No.14, No.12, and No.9 turnouts would be used within TMF, stations, and other facilities as required.

3.3 Right of Way (ROW)

Key characteristics of the Project ROW are as follows:

- The Project intends to acquire and maintain the minimum permanent ROW required to operate and maintain the system.

- The ROW would be fully access-controlled. This would include all ROW used for infrastructure, systems, and facilities including dedicated maintenance areas or access routes. Access control would be achieved either through grade separation, fencing, or intrusion protection barriers or systems as determined by the risk-based hazard analysis for the ROW barrier plan as required by the RPA.
- The LOD shown on the FDCE drawings represents the outermost physical LOD for that location considering related works, including infrastructure and systems and related roadways, utilities, drainage works and construction access and staging areas.
- The LOD does not necessarily represent limits of ROW purchase or the limits of proposed permanent TCRR ROW, for example:
    - In some locations, negotiations with the property owner may result in the Project acquiring a full parcel when only a portion of the parcel is directly impacted by the actual construction works.
    - Roadway works would be completed by the Project and transferred to authorities or adjacent properties owners, as appropriate.
    - Drainage facilities, including swales and retention basins, may be transferred to adjacent property owners or appropriate authorities.
    - Ownership and maintenance responsibilities for new roads constructed for the purpose of HSR maintenance or private property access may be retained by the Project or transferred to an adjacent property owner or to an appropriate roadway authority. In some cases, the Project would secure access easements from adjacent property owners for maintenance works. Close coordination with Project stakeholders during more advanced design would be undertaken to finalize public roadway, emergency access, HSR maintenance access, and private property access. See Section 8 for more information on roadway and access design approach.
    - In many cases, construction staging and access areas would be completed within temporary construction easements, and properties would be returned to current owners upon Project completion. In other cases, the Project would secure ownership of these properties to support construction and then transfer ownership for other uses. For the purposes of the environmental analysis, all properties impacted were identified as temporary or permanent uses.
    - Portions of utilities works would likely become utility easements within adjacent properties. Some LOD areas for utilities works are likely already within utility easements.
    - The Project may pursue slope easements, access easements, or maintenance easements on adjacent properties.

3.4 Civil Site Work

The DCE LOD represents conceptual site grading required for infrastructure, including drainage features, embankments, facilities, and roadway works. Most elements of civil infrastructure design approach for the DCE are covered in the various discipline specific sections of this report, e.g. roadway design is addressed in Section 8. The following key guidelines and considerations regarding civil site works were used in development of the DCE:

- Final design for civil site work would be in accordance with the most current specifications and design guidelines of the applicable regulatory authority (city, county, and/or TxDOT standards).
- Use of TxDOT right-of-way for permanent improvements will required appropriate approvals from TxDOT.
- Sidewalks, pavement, curbing and other features would comply with ADA requirements and be sloped to facilitate stormwater management.
- Final design would include development of a soil erosion and sedimentation control plan, a maintenance and protection of traffic plan, and all other plans required to comply with applicable regulations.
- Side slopes on HSR or roadway embankments were conservatively limited to 4:1. This would be revisited on a site-specific basis during more detailed design based on findings of geotechnical analyses and as required to mitigate impacts.

3.5 Roadway Design

Roadway works would be required by the Project to accommodate reconfiguration of the existing public roadway network and to ensure maintenance, emergency response, and private property access along the HSR ROW. This section describes the approach to roadway works along the proposed HSR line and key design requirements used in development of the DCE.

The Project goals are to:

- Provide the same or improved connectivity and safety along the HSR line via public roadways for not only the public, but also emergency providers.
- Provide the same or improved access to private properties along the HSR line.
- Provide access along the HSR line for maintenance and emergency response.

The following key guidelines and considerations regarding roadway works were used in development of the DCE:

- The HSR system would be fully grade-separated at all crossings.
- Final design for roadways would be in accordance with the most current specifications and design guidelines of the applicable regulatory authority (city, county, and/or TxDOT standards) appropriate for the intended use in effect during design development. For those cases where the local jurisdictions have no design guidelines, the latest American Association of State Highway Transportation Officials (AASHTO) design criteria would be used.
- For the DCE, all roadways were designed using TxDOT functional classification and the TxDOT Roadway Design Manual. The functional classification for each roadway evaluated was used to select the design speed. The roadway design manual provided the geometric requirements for any proposed modifications.

3.5.1 Public Roadways

The following guidelines were used for the conceptual design of improvements, reconfiguration, or rerouting of existing public roads.

- The typical section for roadway modifications would match the existing roadway section and be constructed to handle any required construction loading for the Project.
- For preliminary estimating purposes, typical sections were assumed to match existing pavement sections. Pavement details will be developed during detailed design in accordance with TxDOT or applicable agency requirements. Final pavement design will be based on geotechnical reports.
- Roadways would incorporate bike paths/shared use lanes where detailed on City/County transportation plans.
- In some cases, existing public roads are rerouted along the HSR alignment to achieve grade separation. Section 8.3 has more information on roadway separations.

3.5.2 Access Along HSR ROW

Access along the corridor has been addressed in the conceptual engineering efforts and is reflected in the LOD provided with the FDCE drawings (Volume 2 and 4). Access to the HSR ROW, to properties along the HSR line, and within those that may be partitioned by the HSR line is an important concern that is addressed by the DCE. Construction of the HSR infrastructure and related roadway works and associated facilities would impact existing public roadways and private access roads. During design development, existing public and private road crossings were evaluated to develop a proposed design that avoided or minimized impacts to property access along the HSR ROW. Close coordination with property owners along the HSR line would be undertaken during more detailed design to address concerns and mitigate impacts.

Development of the DCE was completed to ensure that private property access via public roads would be maintained, either in the existing locations, or by re-routing of existing roads; however, use of viaducts and bridge structure for existing private access roads crossing the proposed alignments was not always practicable. In many cases, these private access roads serve properties that would be purchased for the Project and, as such, are no longer needed. In many other cases, new private access roads were proposed in the DCE to maintain connectivity. More information on road crossings can be found in Section 8.

The following guidelines were used for the conceptual design of access roads.

- Where required, dedicated HSR MOW Access Roads that run parallel to the HSR line were included in the DCE that would allow access by emergency vehicles and TCRR maintenance equipment. These would be private roads owned and maintained by TCRR.
- Close coordination with emergency response providers would be undertaken during more detailed design to confirm design requirements for both public roads and HSR MOW Access Roads intended to serve as access to HSR ROW.

- Entrance to HSR MOW Access Roads from the public roadway network would be provided at convenient locations along the ROW.
- The Project would include an appropriate level of secure access points along HSR MOW Access Roads. Intrusion protection requirements and systems would be developed during more detailed design.
- The alignment for HSR MOW Access Roads was designed for 40 mph (64 km/h) speeds when parallel to the HSR alignment, and decreased to 25 mph (40 km/h) at road crossing connections.
- HSR MOW Access Roads would be permitted to be designed at-grade through low-water crossings. Emergency access would be provided at required intervals outside flood zones to ensure emergency response during high-water events.
- All HSR MOW Access Roads would be designed to facilitate a tractor trailer truck (WB-67) design vehicle.
- A drainage swale would generally be provided along roads to convey water away from the roadway surface and into drainage basins and or streams.
- Where existing public roadways would be rerouted along the HSR ROW, the design criteria for public roadways would be used and the rerouted Proposed Public Road would also be used for maintenance and emergency response access, with secure access points from these roadways to the HSR ROW provided as required.
- Design requirements for proposed Private Roads would be closely coordinated with private property owners during more detailed design.

3.6 Structures

This section outlines the general design requirements that were used in development of structural concepts for structures that would carry HSR operations. Refer to typical sections provided in the FDCE drawings (Volume 1). It is important to note that detailed structural design was not required for each structure for the DCE supporting the EIS. At the conceptual level of design, key guidelines and requirements were outlined to permit development of typical sections and typical span lengths to inform alignment and profile for each alternative. Where unique conditions exist along the alignment, such as long spans or skewed crossing, sufficient conceptual engineering design was developed to inform development of the LOD, the Project footprint, for environmental analyses.

3.6.1 Structural Design Requirements

Key design requirements that would guide final design would include the following:

- Structures would be designed in accordance with the live load requirements of the N700-series trainset (modified to the TCRR passenger loads) and/or the live load requirements of the maintenance train, whichever load governs, as provided by, or optimized based on design standards developed by the Japanese Railway Technical Research Institute.

- The design of the structural elements, including concrete and steel bridges, foundations, culverts, and transition structures, would conform to the AASHTO Load-and-Resistance Factor Design (LRFD) Bridge Design Specification. The TxDOT Bridge Design Manual would be used for the design of structures within TxDOT's jurisdiction.
- To ensure HSR running safety and passenger comfort, the structural deflections would need to comply with the design standards developed by the Japanese Railway Technical Research Institute.
- The design of building structures would conform to the International Building Code (IBC), adopted by Texas Local Government Code 214.216 and 16 Texas Administrative Code 10.100.
- Station platforms, concourse areas, and emergency walkways would be designed for a floor live load based on the local building code.
- Seismic loads would be considered based on AASHTO LRFD Bridge Design Specification, Article 3.10 Earthquake Effects. Seismic risk would be assessed through a formal hazard analysis.

3.6.2 Structure Types

Various structure types would be utilized to carry the HSR mainline. Where the use of a standard viaduct infrastructure configuration would not be feasible or appropriate, alternative structure types would be proposed, each with their own merits, as appropriate for the specific site conditions.

3.6.2.1 Standard Viaduct

The typical overall width of this infrastructure configuration for the purposes of the DCE was determined to be approximately 45ft 6in (13.9m) wide for a double-track structure. As shown in the FDCE drawings (Volume 1) the typical viaduct design proposed would be a box girder structure.

A prestressed I-girder structure was also investigated. It was found that this structure type could be a viable alternative to the box girder structure; however, the torsional rigidity of this structure is generally lower than that of a box girder structure. Therefore, if a prestressed I-girder structure is used, special provisions (e.g. closely spaced girders) would be considered to ensure that such structure could support eccentric high speed train loads within the performance limits if they are adopted for the final design.

For the HSR viaduct, a 2ft 6in (762mm) distance was assumed between the top of rail and the top of bridge deck, and would accommodate ballasted track with concrete cross ties and CWR. The depth of the standard box section was determined to be approximately 8ft (2.4m) based on preliminary calculations. For the purposes of the DCE, a total depth of approximately 12ft 6in (3.81m) from top-of-rail to box soffit was assumed to provide a contingency of 2ft (610mm) for design development at this level of planning. The depth of the girder was assumed to be constant throughout the span. The typical span length assumed for viaduct was estimated at 120ft (36.6m). For the purposes of construction, a consistent span length would be desired and was assumed for the DCE; however, site-specific considerations would be incorporated into more detailed design, and some locations would likely have unique span lengths and section depths.

For this type of structure, design would need to ensure that thermal stresses would be limited to avoid excessive rail stress during the most unfavorable loading condition. Rail joints would be avoided in order to ensure HSR safety, and to minimize inspection and maintenance efforts.

3.6.2.2 Haunched Girder Structure

In locations where there would be constraints on column positions, and spans in excess of 120ft (36.6m) would be required, haunched concrete girder structures could be proposed. These structures are composed of prestressed single-cell concrete box girders, similar in section to the standard viaduct; however, the depth is varied to more closely match the flexural capacity to the demand. This is seen as deeper sections over the integral columns.

The minimum depth of the section remains at 8ft (2.4m), matching the standard viaduct infrastructure configuration, with the maximum depth of the haunched sections varied depending on the length of the main spans.

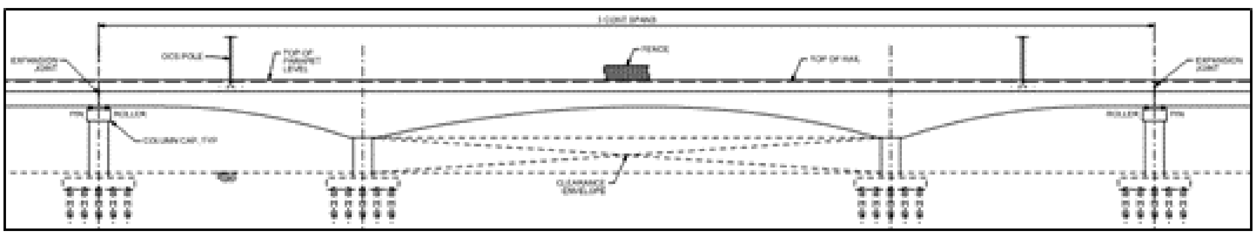


Figure 6: Haunched Girder Structure Section

3.6.2.3 Steel Truss

Truss structures would be specified for spans that are significantly longer than 120ft (36.6m), where a haunched concrete girder structure would no longer be suitable. They offer a much smaller structural depth in terms of the distance between top-of-rail and bridge soffit and, therefore, may also be desirable in areas where the alignment profile is constrained by vertical clearance over obstacles.

These structures are made up of two steel-trussed girders, connected at the top and bottom chords by transverse steel members. A reinforced concrete (RC) deck, supporting the HSR tracks, would be cast on the lower transverse girders.

3.6.2.4 Crossover Structure

Where the viaduct would cross over a railway or highway at extremely high skew, a crossover structure would be adopted to support the viaduct sections to ensure that the supporting foundations lay outside of the given horizontal clearance envelopes.

The crossover structure would consist of a concrete slab supported on precast concrete beams spanning approximately perpendicular to the railway or highway. The precast beams would be supported on concrete cap beams running parallel to the railway or highway.

Due to the clearance constraints near to the railway or roadway, the concrete cap beams would be supported on concrete columns or walls supported on small piled foundation.

3.6.2.5 Straddle Bent

Where the viaduct would cross over a highway or railway at high skew, straddle bents may be adopted to support the viaduct infrastructure configurations to ensure that the supporting foundations lay outside of the given horizontal clearance envelopes.

Straddle bent configurations may be traditionally used for the HSR structure where the standard viaduct box section is seated upon the concrete bent using bearings. Alternatively, in situations where vertical clearances to the infrastructure below have significant impact, integral straddles may be used. In these cases, the viaduct box sections would be cast integrally into the bent, forming a monolithic connection.

3.6.2.6 Box Culvert and Animal Crossing

Culverts below the HSR were specified in a variety of locations where the alignment would be at-grade or on embankment, principally at streams or where proposed longitudinal drainage swales would need to cross the HSR line. Typically, culverts would be reinforced concrete (RC) boxes. Flow depths were estimated during conceptual engineering to approximate culvert sizes at each location. The DCE includes details for culverts to provide not only for passage of water, but also for animal crossings. The drawing set (Volume 1) shows the typical 2-cell crossing section for small animals.

Special structure fills with varying depths would be used adjacent to these structures to provide smooth transitions in track modulus across these locations.

For large water or animal crossings by culvert, a concrete girder or slab bridge would be proposed to achieve the required vertical and horizontal clearances. Viaduct or bridge sections would be used in many locations for these crossings as well to provide desired clearances or to maintain consistency in infrastructure configuration. The wildlife typical crossings in the drawing (Volume 5) set show the typical large animal crossing.

3.6.2.7 Transition Structure

Bridge abutments would be constructed with reinforced concrete. Abutments would be aligned normal to the HSR to comply with dynamic performance requirements. Structure backfills with varying depths would be used behind the abutments to provide a smooth transition in track modulus from embankments infrastructure configurations to aerial structures.

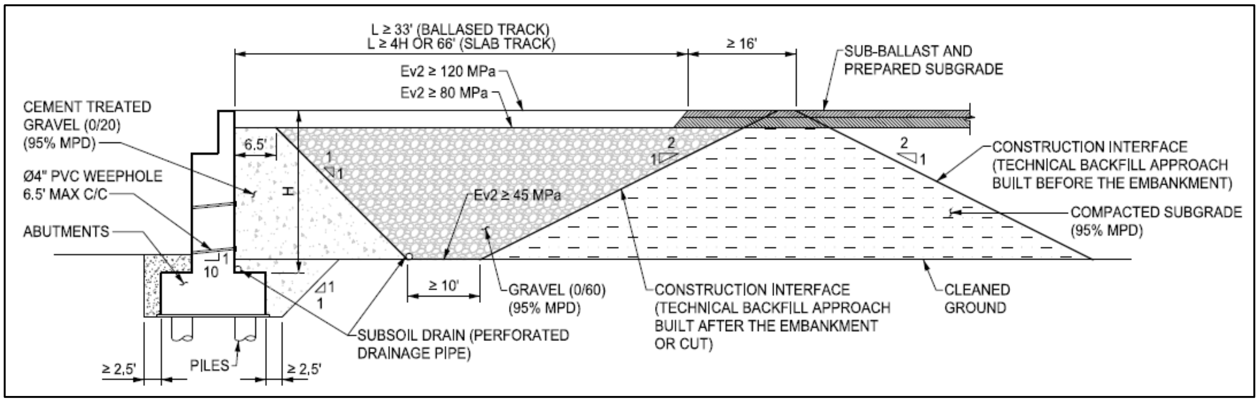


Figure 7: Transition Structure Crossing

3.6.2.8 Retained Fill

Retained fills were proposed where constructing slope embankments would have excessive impacts due to site constraints. The retaining wall type assumed and included in the DCE was a mechanically stabilized earth (MSE) wall, which uses reinforcing strips placed between layers of fill to anchor the outer retaining panels.

The recommended maximum height of retained fill was about 25ft (7.62m), measured from the top of rail to ground level, at the approaches of a HSR elevated structure. Above this height, the HSR mainline would be supported on a structure for improved accessibility below the HSR system.

3.6.2.9 Retained Cut

In some areas it would be preferable to depress the HSR alignment below grade, often to avoid excessively high viaduct or retained fill. To estimate the LOD during conceptual design, the structure was assumed to be a soldier pile wall with RC facing and tied-back anchors as shown below.

3.7 Hydrology, Hydraulics, and Drainage

The LOD represents conceptual design of site work required for drainage features and associated limit of grading within adjacent parcels. This includes the design of on-site facilities required for the drainage of the Project (swales and drainage basins, etc.), and off-site or cross-drainage facilities required to maintain connectivity for water courses impacted by the Project (culverts and stream diversions, etc. The following key guidelines and considerations regarding drainage works were used in development of the DCE.

- Final design for drainage facilities would be in accordance with the most current specifications and design guidelines of the applicable regulatory authority (city, county, state, or federal) in effect during design development. Drainage works during DCE were planned in close coordination with preparation of design works for the USACE Section 404 permit as discussed in Section 1.4. Final design would fully comply with requirements of the permit.

- For the purposes of the DCE structures were set to ensure that a minimum of 3ft (0.91m) of clearance between the low chord of bridge structure and the 100–year flood level.
- DCE involved location and sizing of swales, culverts, and retention basins for development of conceptual grading and drainage requirements and resulting LOD. Detailed design including determination of the elevations, sizes, slopes, inlet and outlet types and locations, and erosion protections for individual drainage facilities would be conducted in the next design stage based on detailed drainage analysis and geotechnical information.
- DCE for grading and drainage was developed to ensure that existing off-site cross-drainage patterns would not be changed where practicable.
- DCE for drainage was developed to ensure that new on-site runoff would be appropriately captured, detained, and conveyed.
- DCE for drainage was developed to ensure that the Project design would not create negative impacts to flooding upstream or downstream.
- The findings and evaluations of the hydrology and hydraulics analyses, including drainage area analysis and design, flood elevations, flow velocities, and drainage structure locations and sizes, are included in Section 13, Appendix G, Appendix H, and Appendix I.

3.8 Geotechnical and Foundation Design

Construction of the Project would require several structure types including HSR bridges, highway and roadway bridges, crash walls, retaining walls, noise walls, and fences. The HSR bridges would primarily be viaducts to carry the high-speed trains over waterways, flood plains, freight railway crossings, and roadway crossings. Where the HSR alignment remains at-grade, road bridges would be used to carry streets and highways over or under the alignment in accordance with TxDOT standards.

In addition to structural elements, sections of the HSR would require the construction of embankments and cuts into existing subsurface materials. The embankment and cut slopes would need to be engineered for stability in accordance with applicable transportation criteria.

The size, location, and bearing foundation of the HSR structures would be impacted by the site subsurface soil and rock profiles and the properties and constraints associated with each. The presence of widespread, highly expansive soil is a primary consideration in the development of recommendations for these items. A secondary consideration is the potential for foundation settlement of embankments where less consolidated materials are present, particularly along the southern half of the corridor.

It is important to note that detailed geotechnical and foundation design for each structure was not required for the DCE supporting the EIS. At the conceptual level of design, existing conditions information was gathered from a variety of sources and analyzed to determine the expected foundation requirements for typical viaduct structures.

A more detailed geotechnical analysis can be found in Section 14. See also Section 3.6 for discussion of analysis performed for foundation of typical viaduct structures.

3.8.1 Geotechnical Design Requirements

Key design requirements that would guide final design of foundations and earthworks would include the following:

- Existing subsurface information along the HSR corridor would be collected and reviewed using available sources as specified by Federal Highway Administration (FHWA) Circular 5.
- Drilling and boring would be performed according to FHWA and AASHTO Subsurface Investigation Manuals.
- Laboratory testing would be performed to evaluate soil and rock physical and engineering properties according to applicable ASTM standards.
- Viaduct and bridge foundations would be designed according to AASHTO LRFD specifications.
- Embankments and cut slopes would be designed according to FHWA-Soil Slope and Embankment Design, FHWA-Soil and Foundation Reference Manual, and TxDOT Geotechnical Manual.
- Earth-retaining structures would be designed in conformance with the AASHTO LRFD specifications.
- The geotechnical site investigation results, as well as the geotechnical and foundation design and analyses recommendations, would be documented in the form of geotechnical interpretative reports and geotechnical design reports.

3.9 Utilities

Evaluation of major utility locations and potential impacts along the TCRR alignment have been incorporated into the DCE. The overall approach to mitigate utility impacts would rely upon protecting the existing utilities in place, working with utility companies to relocate utilities where feasible, and shifting the alignment in cases of major impacts where relocating the utility would not be feasible.

The preferred approach in most utility conflicts would be to protect-in-place. By keeping the existing utility in place, environmental impacts and impacts to adjacent landowners would be minimized. In addition, this would reduce the additional costs of relocating utilities: property purchase, design and construction. Other costs of relocating would include any utility owner downtime penalties, temporary facilities while relocation would be competed, and costs due to extended schedule impacts.

Utility limits of disturbances (LOD) defining the footprint of utilities work were developed for environmental evaluation. Significant utilities along each of the alternatives alignments were identified and the expected impacts were noted for the environmental analysis team as discussed in Section 15 of this report. Ultimately the respective utility owner would perform the design, and would complete permitting and environmental reviews with the applicable regulating agencies.

For any utilities work required by utility companies, each utility owner would develop the design as part of their regulating agency review process. The LOD evaluated at that stage for utility work would include area for temporary construction. This would include staging, equipment storage, and access. In areas where a utility would be relocated, the new LOD would include the permanent right-of-way of the relocated utility plus a temporary right-of-way for construction.

Based on meetings and correspondence with several utility companies, the following guidelines for utility relocation have been developed. The work for elevating transmission lines over a HSR crossing or where a roadway is raised to pass above the HSR would generally extend over a length of approximately 2,000ft (609.6m). In most cases, temporary utility poles would be installed to carry the transmission lines to minimize any disruption to service while the higher permanent poles are erected. For relocation of below-ground utilities, the utility work would include easements for the permanent utility location and temporary construction. These easements would be secured by the owning utility.

To support the conceptual design efforts, existing conditions information was gathered from a variety of sources and analyzed to determine the expected utilities requirements for typical viaduct structures.

- Third-party utilities would be relocated, abandoned, or protected in place during construction. It would be addressed whether this would be done by the Contractor or by the utility owner during detailed design
- Final design of utilities work would be in accordance with the most current specifications and design guidelines of the applicable regulatory authority (city, county, state, or federal).
- New construction and the protection, support, restoration, and rearrangement of utilities would be in conformance with the latest technical specifications and practices of the respective utility owner. In many cases, the affected utility would advance portions of the design work and may complete construction of the work.
- It is expected that each utility power company would lead their own environmental process and engineering design for high-voltage (HV) lines and supporting facilities and connections.
- Allowing third party utilities and supporting facilities within the HSR ROW would be reviewed during more detailed design.

3.10 Environmental Design

The following guidelines were used in development of the DCE and would be included in the more detailed design documentation under development for the USACE Section 404 permit.

- The spacing of viaduct sections and placement of individual piers would be set to minimize and avoid impacts to waters of the U.S.
- The placement of drainage swales in waters of the U.S. would be avoided and, if unavoidable, minimized and constructed to not drain waters of the U.S.

- In wetland areas disturbed by construction, a minimum of 12 inches of topsoil material from the wetland would be stockpiled and used as backfill material to restore preconstruction contours.
- Embankment infrastructure configuration water crossings would be adequately sized to maintain normal downstream flows and prevent ponding upstream.
- Hard armoring of streams for the construction of embankment infrastructure configurations would be limited to the minimum necessary and restricted to the immediate vicinity of the Project.
- Where practicable, the footprint of permanent facilities would be placed to avoid and minimize impacts to waters of the U.S. Facilities include train stations; maintenance and power generation facilities; parking areas; stormwater retention/detention facilities; lighting and communications towers; and any other infrastructure required for operation of the railroad.
- All crossings of water bodies would be designed and constructed to maintain low flows, when present, to sustain the movement of aquatic species.
- Stream relocations would be avoided and, if unavoidable, minimized.
- All fill and borrow sites used in constructing elements of the HSR line must be located in areas that have been verified as being upland areas (not jurisdictional under Section 404 of the Clean Water Act). Proof of verification by a qualified biologist would be provided in writing for borrow and fill site.
- All fill material used in constructing elements of the Project would meet all local, state and federal regulatory standards and criteria as "clean fill" including uncontaminated soil, dirt, rock, and sand or other uncontaminated natural or man-made inert solid material.

3.11 Fire Life Safety

The FDCE drawings do not include detailed design of individual facilities; instead, estimated facility sizes were used to inform Project LOD. Final design for facilities would be in accordance with the most current specifications and design guidelines of the applicable regulatory authority (city, county, state, or federal) in effect during design development. The following general guidelines would apply to final design development for facilities. Equipment-specific fire safety requirements would be addressed through FRA reviews and requirements including the RPA.

- Design would follow the National Fire Protection Association (NFPA) 130 Standard for Fixed Guideway Transit and Passenger Rail Systems, as deemed applicable by TCRR, for passenger stations and infrastructure. (See equipment specific fire safety requirements in RPA 2xx.103 and 2xx.413.)
- Chapter 6 of NFPA 130 would be applied as appropriate to provide prescriptive requirements for:
    - Construction/materials
    - Emergency access

- Emergency egress
- Fire safety systems (including standpipes, water supplies, fire extinguishers, fire detection, ventilation and emergency power)

- Design would follow Occupational Safety and Health Administration (OSHA) law and regulations for passenger and/or worker safety.
- During the construction process, the safeguards required by NFPA 241 would apply to the guideway (see NFPA 130, Section 6.2).
- Access to viaducts would be provided at a distance to be determined by TCRR and consistent with the requirements of the RPA.
- Spacing and design of emergency access would be determined during more detailed design and be consistent with all applicable regulatory requirements, including the RPA. Provision for access to the ROW for emergency response would be developed in close coordination with project stakeholders along the corridor.

For stations, the provisions of NFPA 130 (see RPA 2xx.13(b)(8)) would be applied in conjunction with applicable building codes such as the International Building Code (IBC) to provide for fire and life safety. This includes prescriptive requirements for:

- Fire Department access to the site and building.
- Provisions for Manual Intervention including portable fire extinguishers installed in accordance with NFPA 10 and modified by NFPA 130; standpipe/hose systems installed in accordance with NFPA 14 and modified by NFPA 130; and a Fire Command Center in accordance with NFPA 72 in enclosed stations.
- The fire resistance rating and combustibility of materials (see IBC as modified by NFPA 130 and as described in NFPA 220).
- Compartmentation as required by IBC and NFPA 130.
- Automatic sprinkler systems consistent with the installation standard NFPA 13 and NFPA 130.
- Alternative automatic extinguishing systems to be installed in accordance with the recognized standard (i.e., NFPA 2001 for Clean Agent Fire Extinguishing Systems).
- A fire alarm system consistent with the installation standard NFPA 72 and NFPA 130 as well as associated approved emergency voice/alarm communication system and emergency voice alarm reporting devices.
- Enclosed stations would provide emergency ventilation based on the emergency ventilation requirements of Chapter 7 of NFPA 130.
- Where NFPA 130 requires a mechanical smoke control system, such systems would be in compliance with Chapter 7 of NFPA 130 and NFPA 92.
- Where specific systems and equipment of the building requires emergency and/or standby power per 2012 IBC, 2012 IFC, or NFPA 130 and their referenced standards, such systems would be provided in the form of either: (1) Emergency Generator Systems consistent with

NFPA 70 and NFPA 110 or (2) Stored Electrical Energy (battery) Systems consistent with NFPA 70 and NFPA 111.

3.12 Safety and Security

Safety and security considerations would be included in the design of infrastructure, systems, facilities, and stations for the proposed HSR system. The following are key guidelines that would be incorporated during detailed design.

- The design, construction, testing, and start-up of the HSR would comply with applicable safety and security laws (for persons and property), regulations, requirements and railroad industry practices.
- Facilities and infrastructure design would provide capacity for safe emergency evacuation and compliance with emergency procedures.
- Perimeter fencing would be installed on embankment infrastructure configurations with a footing to resist ingress from digging or burrowing animals.
- Fencing, barrier separation, intrusion detection, and technological devices would be used to secure the right of way.
- The HSR system would be equipped with an integrated system for detecting, monitoring, and responding to environmental conditions and emergency events.
- Refer to Section 4 for more information.

3.13 Accessibility for People with Disabilities

The design of infrastructure, systems, and facilities for the proposed HSR system would comply with the requirements of the ADA and Texas Accessibility Standards as applicable. The following are key guidelines that would be incorporated during detailed design.

- Final design of facilities and site improvements would address the needs of people with disabilities, as applicable, including provisions for parking, access, safety, accommodation, and welfare.
- Final design efforts would assume that ADA accessibility guidelines for buildings and facilities and for transportation vehicles take precedence over any other standards or specifications, provided that the ADA guidelines are more stringent.
- All stations would have high-level platforms with level boarding for every train car to accommodate the needs of people with disabilities.
- Direct fixation track would be used in stations to ensure that tolerances can be met for level boarding.

Special attention has been paid during planning and design development to provide ease of circulation for people with disabilities.

- At least two ADA compliant side entrance doors per train car (one entrance per side). Doors would have a clear width 32.3in (820mm). Doorway illumination of a minimum of 2 foot-candles would be provided at thresholds.
- Minimum aisle width of 34.2in (870mm).
- 52.2in (1326mm) clearance for 90 degree turn from vestibule into passenger compartment. (Note that this exceeds the ADA requirement of 42in (1067mm).)
- 34.2in (870mm) aisle width throughout passenger compartment in all train cars. (Note that this is not required to meet ADA requirements.)
- Gangways between train cars would be meet ADA requirements (see Figure 8).

Figure 8: Gangway Between Train Cars

Special attention has also been paid to people with disabilities during planning and designing for rider comfort. Each train car would have one wheelchair location that is a minimum of 32in by 63.4in (813mm by 1610mm). (Note that this exceeds the ADA required 30in x 48in space.) Additional provisions at each wheelchair location include:

- 1 regular coach transfer seat with pivoting armrest
- 1 wheelchair storage location (16in by 48in; 406mm by 1219mm)
- Located near window
- Accessible call button

Eight restrooms would be provided in each trainset. Four would by ADA compliant restrooms, and four would be conventional washrooms in each trainset. ADA compliant restrooms would include:

- Restroom door width of 36.5in (928mm).
- Minimum passageway width from wheelchair location to restroom of 32.3in (820mm). (Note that this exceeds the ADA requirement of 32in (813mm).)

- Distance travelled from wheelchair to restroom (see Figure 9):
  - 10.5ft (3,214.8mm) train cars 1, 3, 5, 7
  - 19.4ft (5,906mm) train cars 2, 4, 6, 8

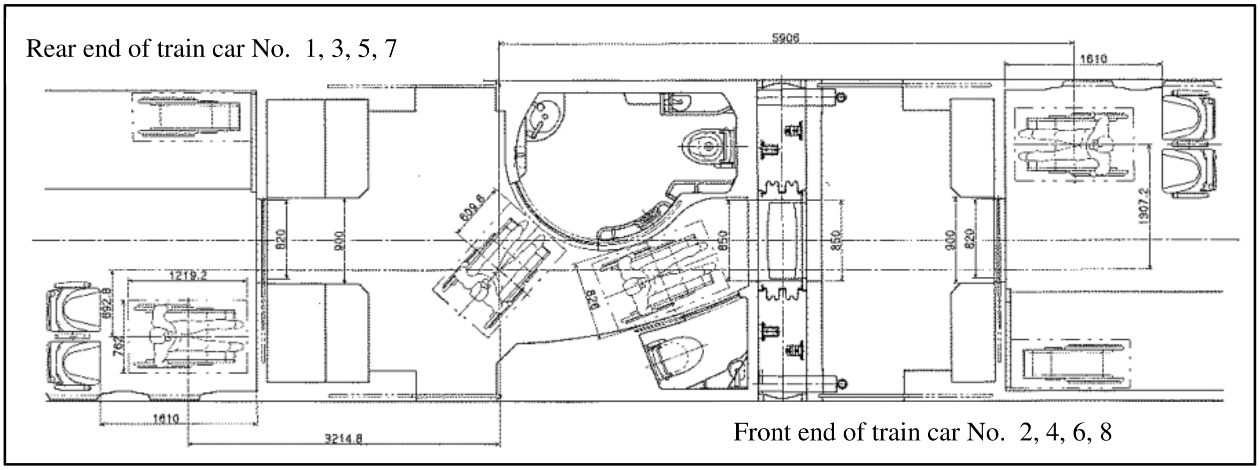


Figure 9: Distance travelled to Restrooms

Figure 10: ADA Compliant Restroom and Passageway

3.14 Low Impact Development (LID)

The DCE design incorporates a Low Impact Development (LID) design approach. This section outlines LID concepts in general, including criteria and approaches adopted to minimize environmental impacts of the Project on the built and natural environment. Using LID guidelines, the TCRR HSR design approach would result in a project that:

- Complies with federal, state and local regulations.
- Minimizes the environmental footprint of the Project.

- Minimizes impacts to wetlands, water bodies and natural streams.
- Uses construction techniques that minimize impacts to properties.
- Restores disturbed land back to the original condition.
- Protects natural and cultural resources.
- Mitigates impacts.

The Project design approach was developed to protect, preserve, and enhance properties and host communities along the proposed HSR corridor (from Dallas to Houston).

Per the Environmental Protection Agency (EPA), LID refers to “systems and practices that use or mimic natural processes that result in the infiltration, evapotranspiration or use of stormwater in order to protect water quality and associated aquatic habitat”. LID is an approach to land development (or re-development) that works with nature to manage stormwater as close to its source as possible.

3.14.1 Rating Systems

There are several standards and rating systems that can provide LID guidance. The Leadership in Energy and Environmental Design (LEED) approach evaluates LID integration in the design and construction of buildings. The ISO 14001 standard assesses environmental management systems. The Global Reporting Initiative approach allows business to communicate and understand their operational impacts on a global scale. The Institute of Sustainable Infrastructure’s Envision® Rating System (hereinafter referred to as Envision®) is applicable to linear infrastructure projects such as pipelines, gas lines, roads, and railroads. Two rating systems, Envision® and LEED, are described in more detail below.

3.14.1.1 Envision® Sustainable Infrastructure Rating System

The Envision® rating system is composed of 60 sustainability related objectives, or “credits”, organized into five main categories: Quality of Life, Leadership, Resource Allocation, Natural World, and Climate and Risk. The categories are divided into subcategories, as shown below. By grouping the credits into broader categories of impact, Envision® allows designers to navigate the complex trade-offs or synergies across subcategories.

- Quality of Life: Purpose, Community, Wellbeing
- Leadership: Collaboration, Management, Planning
- Resource Allocation: Materials, Energy, Water
- Natural World: Siting, Land and Water, Biodiversity
- Climate and Risk: Emissions, Resilience

Envision® credits can be awarded for up to five levels of achievement: Improved, Enhanced, Superior, Conserving, and Restorative. An independent third party project verification process confirms that the Project meets the Envision® evaluation criteria. Projects can receive Bronze, Silver, Gold or Platinum awards.

More information on Envision® can be found at http://sustainableinfrastructure.org/envision.

3.14.1.2 Leadership in Energy and Environmental Design (LEED)

Under LEED, projects can be awarded 100 base points in six categories: Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, Indoor Environmental Quality, and Innovation in Design. Up to 10 additional points may be earned: four additional points may be received for Regional Priority Credits, and six additional points for Innovation in Design. Based on the number of points earned, buildings can qualify for four levels of certification: Certified, Silver, Gold, or Platinum.

To participate in LEED, a building must comply with environmental laws and regulations, occupancy scenarios, building permanence and pre-rating completion, site boundaries, and area-to-site ratios. Its owner must share data on the building's energy and water use for five years. Each of the performance categories also have mandatory measures in each category, which receive no points.

Points are weighed using the environmental impact categories of the EPA's Tools for the Reduction and Assessment of Chemical and Other Environmental Impacts and the environmental-impact weighting scheme developed by the National Institute of Standards and Technology (NIST). The weighting process takes into account reference buildings to estimate impacts, NIST information to judge the relative importance of these impact, and data regarding actual impacts on environmental and human health. LEED results in a weighted average based upon actual impacts and the relative importance of those impacts to human health and environmental quality.

More information on LEED can be found at http://www.usgbc.org/LEED/.

3.14.1.3 Evaluating TCRR LID Approach

TCRR's goal is to incorporate sustainability and resiliency above and beyond industry standards in accordance with its environmental, financial, and social initiatives during final design and construction. This section identifies the various rating systems categories that TCRR's planning and design efforts are considering to evaluate the effectiveness of the LID approach.

As the Envision® rating system is best suited for linear infrastructure projects, TCRR has chosen to use the Envision® rating system as a guide to evaluate its efforts to incorporate LID into planning and design for the HSR system, from planning through to construction and ultimately operations. The table below shows those Envision® evaluation subcategories that TCRR is focusing on in its planning and design of alignment, infrastructure configuration, and roadways. As appropriate, the planning and design of facilities and stations would also incorporate the goals of these subcategories. How the goals of these subcategories are applied in the planning and design of the system are described in the sections below.

Table 10: Envision® Categories

Category	Subcategory	Description
Quality of Life	Purpose	Improve community quality of life
		Stimulate sustainable growth and development
		Develop local skills and capabilities
	Community	Enhance Public Health and Safety
		Improve Community Mobility and Access
		Encourage Alternative Modes of Transportation
		Improve Site Accessibility, Safety and Wayfinding
Natural World	Siting	Preserve Prime Habitat
		Protect Wetlands and Surface Water
		Preserve Prime Farmland
		Avoid Adverse Geology
		Preserve Floodplain Functions
		Avoid Unsuitable Development on Steep Slopes
		Preserve Greenfields
	Land and Water	Manage Stormwater
		Reduce Pesticide and Fertilizer Impacts
		Prevent Surface and Groundwater Contamination
	Biodiversity	Preserve Species Biodiversity
		Control Invasive Species
		Restore Disturbed Soils
		Maintain Wetland and Surface Water Functions
Climate	Emission	Reduce Greenhouse Gas Emissions
		Reduce Air Pollutant Emissions

As the LEED rating system is better suited for facilities projects, TCRR would use this system as a guide to evaluate its efforts to incorporate LID into planning and design for the Project building facilities. TCRR would monitor the integration of sustainability into the design of the three HSR stations and various facilities, including trainset and ROW maintenance and systems facilities using LEED criteria as a framework. The table below shows those LEED evaluation subcategories in the LEED framework that TCRR is focusing on in its planning and design of facilities. How the goals of these subcategories are applied in the design for the facilities required by the Project are described in the sections below.

Table 11: LEED Categories

Category	Credit
Sustainable Sites	Construction Activity Pollution Prevention
	Site Selection
	Development Density & Community Connectivity
	Alternative Transportation (Public Transportation Access; or Bicycle Storage & Changing Rooms; or Low-Emitting and Fuel-Efficient Vehicles; or Parking Capacity)
	Heat Island Effect (Non-Roof; or Roof)
	Water Efficient Landscaping (Reduce by 50%; or No Potable Use or No Irrigation)

Category	Credit
Water Efficiency	Innovative Wastewater Technologies
	Water Use Reduction (20% Reduction; or 30% Reduction)
	Minimum (or Optimized) Energy Performance
	On-Site Renewable Energy
	Measurement & Verification
Materials & Resources	Storage & Collection of Recyclables
	Building Reuse, Maintain 75% (or 100%) of Existing Walls, Floors & Roof
	Building Reuse, Maintain 50% of Interior Non-Structural Elements
	Construction Waste Management, Divert 50% (or 75%) from Disposal
	Materials Reuse (5%, or 10%)
	Recycled Content, post-consumer + ½ pre-consumer (10%, or 20%)
	Regional Materials, Extracted, Processed & Manufactured Regionally (10%, or 20%)
Indoor Environmental Quality	Minimum IAQ Performance
	Environmental Tobacco Smoke Control
	Outdoor Air Delivery Monitoring
	Increased Ventilation
	Low-Emitting Materials (Adhesives & Sealants; or Paints & Coatings; or Carpet Systems; or Composite Wood & Agrifiber Products)
	Indoor Chemical & Pollutant Source Control
	Controllability of Systems (Lighting; or Thermal Comfort)
	Thermal Comfort (Design; or Verification)
	Daylight & Views (Daylight 75% of Spaces; or Views for 90% of Spaces)

Early adoption of these Envision® and LEED evaluation criteria into the planning and design of the Project would help ensure that the Project would meet environmental impact avoidance and impact mitigation requirements that would be enforced through the FRA's Environmental Impact Statement (EIS) and United States Army Corps of Engineers' (USACE) permitting processes.

3.14.2 Incorporating an LID Approach

Overall, the Project aims to minimize impacts to the environment. This philosophy has been an essential part of the planning, design, and permitting process, and would continue through construction and operations. Through TCRR's Corporate Social Responsibility policy, design has focused on stewardship of resources and minimizing environmental footprint. This section describes how LID concepts could be implemented through the Envision® and LEED rating systems framework.

3.14.2.1 Quality of Life

TCRR's goal for the Project is to improve quality of life, from the health and wellbeing of individuals to the wellbeing of the larger social fabric as a whole, while stimulating development. The intent is to incorporate the Project into and improve existing community networks and benefit communities in the long term. As such, stakeholder input has been incorporated into design throughout the Project and drives the decision-making process.

System Wide Employment Opportunities

The Project would generate significant employment during both construction and operations. Because the Project is pioneering a new field of US work crews, workers would go through extensive training, as well as cross training labor for maintenance and operational jobs. In order to maintain a safe and secure system, emergency responders along the corridor would also be trained in response protocols for HSR conditions. This job creation and training would encourage sustainable growth and support development.

Terminal and Intermediate Stations

The stations would become a destination for residents, employees, customers, and visitors. The stations would enable the Project to contribute to the areas' economic activity, creating a model for future development. The Dallas station is placed on parcels that are not efficiently used in their existing conditions, but that are part of an established community. There is potential for a significant amount of new transit-oriented development (TOD) around the stations for retail, office and residential. TOD would stimulate sustainable growth and development around the three station locations. By increasing access to shopping, dining, and entertainment, TOD would increase quality of life around the stations.

Infrastructure Configuration

The infrastructure for the Project would be configured in several general infrastructure configuration types, including viaduct structures, embankments, and retained fills and cut. No tunnel structures are proposed. Every infrastructure configuration except viaduct structures would include fencing on the ground. (Viaduct structures would include fencing on the viaduct structure.) Therefore, the entire system right of way (ROW) would be safely separated from the surrounding environment to protect wildlife, livestock, and the public from HSR operations.

Selection of infrastructure configuration is dependent on the relationship of the HSR alignment and profile to the existing topography and environmental conditions. To minimize impacts on land, natural streams, wildlife, roadways, existing development, and landowners, elevated viaduct structures are proposed along more than half the alignment. (See below for infrastructure configuration types and more information on HSR impacts on the natural environment.) During design development, the selection of infrastructure type carefully considered how the surrounding community currently uses the area. For example, if road crossings in the area are elevated on viaduct, the HSR would go under them, reducing impacts to the road network. Where practicable, elevated viaducts were used to allow the HSR to pass over roadways without the need to impact existing traffic during construction. Where the HSR passes through areas used for farming or cattle, the design incorporated crossings large enough for equipment and animals, often by designing an elevated profile on viaduct structures. In many locations where the topography requires the HSR to be on an embankment through these types of existing land uses, TCRR has incorporated stakeholder input and wildlife considerations to strategically locate bridges, culverts, and other structures to facilitate movement across the alignment.

Roadway Networks

The HSR system would be fully grade separated along its entire length, meaning there would be no at-grade crossings with freight railroads or roadways. This approach ensures that the Project would not bring with it one of the major safety concerns that existing light rail and freight rail systems have to manage. To ensure full grade separating for safety, some existing roads would need to be rerouted or profiled to accommodate the HSR. New sections of roads, and new public roads constructed by the Project would be designed to current regulations and, in many cases, would bring safety and accessibility improvements to the communities they serve. The design of roadway works was developed to support access along and across the corridor.

Given that the construction of road crossing improvements to carry existing roads over the proposed HSR system or rerouting of existing roads would involve additional construction and associated impacts, the design minimizes the need for these works. The design approach used carries the HSR system over most roadways to maintain existing roadways and ensure that construction minimizes impacts to traffic. Moreover, the design approach ensured that there would be no closures of existing public roadways.

Temporary Construction

Construction would bring with it the transport of significant materials and construction equipment, and the movement of the as many as 10,000 new construction related workers per year. To minimize construction related traffic impacts and emissions, construction laydown areas and precast yards have been designed adjacent to the proposed HSR line. Where practicable, these laydown areas have also been located adjacent to major roadways and freight lines to minimize construction traffic through communities. When construction is complete, construction sites would be restored to pre-existing conditions, or improved. For example, if the temporary construction area is adjacent to a station, the site could be repurposed for development. If the site is adjacent to forested lands, it would be restored to existing conditions or improved by planting native plants and trees.

3.14.2.2 Natural World

In order to comply with the EIS and USACE permitting requirements, the conceptual engineering for the Project must be developed to protect, preserve, and enhance the natural world. The HSR alignment and associated facilities were located and designed to minimize direct and indirect impacts on important ecological areas, including land cover, wildlife habitat, and natural resources.

The Project would impact the natural world, but in each phase of design, planning, construction, operations, and maintenance, efforts would be made to protect and enhance the existing natural world. The permit processes themselves require adequate mitigation for potential impacts including resodding, introducing native plants, and replanting trees. In those areas where impacts are unavoidable, mitigation banking and Permitee Responsible Mitigation would be utilized to minimize disruption of systems.

System Wide

Minimizing and mitigating impacts to water bodies, wetlands, prime farm land and other geological conditions was a primary consideration in the development of alignments. The alignments were designed to be adjacent to existing utilities and highways in order to limit impacts to undeveloped areas and avoid wildlife habitat fragmentation. Following existing utility or highway corridors where practicable also reduced prime farmland and habitat impacts. Areas with threatened and endangered species' habitats were identified and avoided when possible.

Development of the HSR corridor would use native species ground cover, where appropriate, to reduce the long-term need for water, pesticides and fertilizer. Viaduct infrastructure configurations would have drainage running under the ballast and down the columns, while the other infrastructure configurations include roadbed drainage to control stormwater runoff from the track and drainage swales for the associated earth work runoff, as required.

Facilities and Stations

Mitigating impacts to water bodies, wetlands, prime farm land, and other geological conditions was a key consideration in locating project facilities. For example, terminal stations were located on previously developed or disturbed land, to prevent further damage and improving land value. Signals and communication facilities were located to avoid sensitive areas, including floodplains, wetlands, historic buildings, and adverse geology. In accordance with Project requirements, ancillary facilities were situated to avoid areas with known or potential threatened and endangered species habitat to the maximum extent practicable. Any potential impacts to threatened and endangered species habitat would be reduced through design and mitigated further during construction.

Maintaining the natural world after construction is important. In areas with landscaping, plants would be carefully selected and native species used to the extent practicable. Along with maintaining or increasing biodiversity, using native species should reduce the need for water, pesticides, and fertilizer. Design of stations and other facilities would offer opportunities for concepts such as bioswales, rain gardens, and earthen swale design. Facilities along the alignment that require buildings could have vegetated rooftops, rain barrels, or permeable pavers. Detention ponds with water quality features located along the alignment would help to manage stormwater.

The design of stations in particular would allow TCRR to promote green building design approaches and help educate the Project patrons and others about the value of sustainability. TCRR recently sponsored a design competition to engage architectural students from within the proposed HSR corridor to help develop an inspiring vision for stations in Dallas, the Brazos Valley, and Houston. In accordance with TCRR's goal to incorporate LID, three design awards were provided, one for architectural design, one for urban design, and one for sustainable design.

Infrastructure Configuration

The Project is being designed to maximize the use of viaducts where practicable. Use of elevated viaducts is a more environmentally sensitive and sustainable approach for various reasons.

- Since protection against intrusion into the ROW is critical to ensure that safe movement of trains and to ensure the safety of the residents of the communities through with the system passes, the entire ROW must be fenced where it is at-grade. As such, increased use of viaduct would ensure that the HSR design would facilitate movement across the ROW.
- Since the entire HSR alignment must be fully grade separated from roads and freight rail lines, increased use of viaduct would mean there is less need to raise roadways to pass over the HSR line. This means less roadway reconstruction work and less associated community disruption and construction impacts.
- The need for pesticide and fertilizer would be reduced, as there is no ground cover to maintain on viaduct sections. Although culverts in berm infrastructure configurations have been designed to limits impacts to wetlands and surface water functions, viaduct maintains existing wetlands and surface water functions.

Wildlife Crossings

The HSR system is being planned and designed to mitigate negative impacts to wildlife, including animal movements, landscape connectivity, and ecological functions such as energy and genetic flows, predator-prey dynamics, and biodiversity. Providing means for wildlife to cross the HSR ROW is not only critical to integrating the Project into the surrounding environment, it also eliminates the risk of HSR collisions with wildlife crossing the corridor.

At this time, general considerations for wildlife crossings have been incorporated into the preliminary design. During more detailed design, development of specific wildlife crossing provisions would be based upon field studies and close coordination with local land owners, wildlife agencies, and species-specific experts to determine the types and numbers of domestic livestock, native wildlife, and exotic wildlife present in the Project corridor. Frequent and varied crossings would maintain biodiversity and minimize impacts to prime habitat along the corridor.

More information on wildlife crossings can be found in Section 16.

3.14.2.3 Climate

The Tokaido Shinkansen system is a very energy efficient system and has extremely low pollutant emissions. The system is six (6) times more efficient than a car, and emits about 8% the amount of carbon as a commercial jet. Regenerative braking system and renewable energy opportunities would be used to increase energy efficiency and reduce pollutants.

Strategically planned construction staging areas adjacent to the ROW, and along freight railroad lines where practicable, were incorporated into the planning for the Project to reduce construction impacts, including emissions from construction vehicles. The approach taken by TCRR would reduce impacts relative to those that would result if selection and permitting of staging areas was left to more detailed design and construction documentation.

The counties of Dallas, Ellis, Harris, and Waller are in non-attainment zones for 8 hr-ozone. Utilizing HSR technology to provide an alternative mode of passenger travel between Dallas and Houston would help these counties in their efforts to comply with TCEQ clean air standards.

3.14.2.4 Station Development

Opportunities for sustainable and low impact approaches would be incorporated into the design of station buildings. The concepts above, in addition to the strategies described below, are intended to minimize energy and water usage, promote indoor air quality, and improve quality of life in and around the three station locations.

Many of the financial and operational goals of the stations coincide with LID approaches with respect to station site selection. The station location options were selected to allow for integration with the built environment and to support connectivity with the communities they would serve. The terminal station location options were located close to existing mass transit and would build on and encourage further development of the existing transit networks to support station access rather than foster driving to the station. The station design would include bike storage to make the system even more accessible and design of transit and pedestrian plazas to support multimodal accessibility. Selection of station sites in areas with existing utility and street networks was intended to reduce the construction, community, and environmental impacts of bringing this infrastructure to the site.

The stations would be designed to directly and indirectly reduce the need for electricity and potable water. By incorporating intelligent building approaches, design of station buildings would reduce the need for energy and water by:

- Reducing energy demand through use of elements such as motion sensitive lights in maintenance hall walls.
- Increased energy efficiency through the use of energy efficient lighting and appliances.
- Monitoring energy use.
- Use of renewable energy sources such as solar panels.
- Painting the roofs and creating green spaces to reduce heat gain and retention and to save energy.
- Reusing water in innovative ways such as including reclaimed wastewater, condensation, and rainwater, for irrigation, or toilet flushing.
- Installing efficient water fixtures and appliances in the station.
- Planting native vegetation with less need for irrigation.

Construction and operation of the station buildings would limit materials and resources used in a number of ways. Environmental, social and health impacts would be considered during design the entire life-cycle of the building, from manufacturing, to transport, to construction, to maintenance. An integrated team of engineers, designer, and architects would right-size the station to develop the most efficient design and use only materials needed. The design would encourage the use or reuse of recycled, renewable, regional, or sustainable materials, and would integrate existing buildings already on the proposed site, where practicable, to reduce waste and demand for building materials. Where existing buildings or structures must be removed, environmentally sensitive approaches for deconstruction and recycling would be encouraged. In construction and operations, waste management procedures, such as storage and collection of recyclables, would reduce the environmental impact of materials. TCRR would continue to encourage transparency and designers would use reporting tools to find information on the contents in products and the manufacturing process.

The stations would be designed as inviting, safe, and comfortable places. Attention would be paid to indoor air quality during design through the use of control processes for tobacco smoke, outdoor air delivery, and pollutants. The design would exceed requirements for indoor environmental quality performance through increased ventilation and use of low emitting materials. Comfortable and energy efficient lighting would be optimized through architectural design that encourages natural sunlight and an adaptable, controllable systems for lighting. These attributes, as well as temperature controls and pleasant views, not only improve each building’s value, but would encourage station use by more than just passengers.

4 Safety and Security

The goal of the TCRR project is to transfer the Shinkansen state-of-the-art HSR technology to the Dallas to Houston corridor and provide a new transportation alternative with proven performance and safety. JRC's commitment to safety and the highest standards of performance permeate every aspect of the Shinkansen system design, operation, and maintenance. This commitment has resulted in an unparalleled record of safety and on-time performance during more than 50 years of operations. Underpinning the regulatory approval to operate the N700 based HSR technology in this corridor would be the transfer of the seamlessly integrated JRC system of signaling, communications, and rolling stock design with Texas-designed and -constructed infrastructure that would be operated and maintained in a manner that combines JRC experience and innovation to meet or exceed FRA requirements for safe operations.

Safety and security are two separate but related issues. Each would be addressed in the design of infrastructure, systems, and facilities for the proposed HSR system. This section outlines some key issues and proposed approaches.

4.1 Safety Regulations

TCRR submitted the Rule of Particular Applicability (RPA) petition to the Federal Railroad Administration on April 15, 2016. The RPA petition would result in the issuance of a set of federal safety regulations, customized for TCRR's operations and the operating environment, which would be required to facilitate the safe operation of the Project system.

The RPA administrative process is a form of federal rulemaking that would be used by TCRR to develop safety regulations specifically applicable to the HSR operations between Dallas and Houston. The RPA petition would be submitted to the FRA Office of Safety to initiate the rulemaking process. Following a careful review of the RPA petition, the FRA would issue a Notice of Proposed Rule-Making (NPRM), soliciting public comment and discussion. Following a further review and consideration of public comment, the FRA would issue a Final Rule codifying the new safety regulations.

The rule-making authority is governed by US Code of Federal Regulations (CFR) Title 49 § 211.9: Content of rulemaking and waiver petitions, which states:

Each petition for rulemaking or waiver must:

1. *Set forth the text or substance of the rule, regulation, standard or amendment proposed, or specify the rule, regulation or standard that the petitioner seeks to have repealed or waived, as the case may be;*
2. *Explain the interest of the petitioner, and the need for the action requested; in the case of a petition for waiver, explain the nature and extent of the relief sought, and identify and describe the persons, equipment, installations and locations to be covered by the waiver;*
3. *Contain sufficient information to support the action sought including an evaluation of anticipated impacts of the action sought; each evaluation shall include an estimate of resulting costs to the private sector, to consumers, and to Federal, State and local*

governments as well as an evaluation of resulting benefits, quantified to the extent practicable. Each petition pertaining to safety regulations must also contain relevant safety data.

TCRR's RPA petition addresses all of the regulatory requirements cited above and provides the FRA with a thorough explanation as to how safety would be ensured and delivered.

Many of the current federal regulations governing passenger rail operations are codified at 49 CFR §200-299, wherein the FRA mandates specific and general standards regarding train movements and train control, equipment, communications and signaling, track, operating rules and practices, emergency preparedness, certification of equipment engineers, drug and alcohol and use, and other facets of passenger rail operations.

A number of these regulations, called Rules of General Applicability, would also apply to TCRR; however, given that TCRR's operations would be the first true HSR service in the United States, other existing regulations would have to be modified and some new regulations must be developed.

By following the administrative rulemaking process, TCRR would ensure that all applicable safety regulations are thoroughly reviewed and appropriately adopted and modified for the TCRR's operating environment.

4.2 Maintaining Security on HSR

TCRR intends to provide high levels of security to safeguard its passengers, employees, and property. TCRR's security strategies and policies are being developed to ensure that foreseeable threats and vulnerabilities are identified and properly mitigated or eliminated.

To advance and inform it's planning and design, TCRR would work closely with local, state, and federal law enforcement and emergency response officials. TCRR has had preliminary meetings with the Department of Homeland Security (DHS) and the Transportation Security Administration (TSA) to discuss their recommendations and guidance in these planning efforts. Additionally, TCRR would coordinate security planning with state, county, and city authorities along the entire right-of-way.

Unlike security that is provided at airports, passenger rail security must be designed to fit the passenger rail environment. TCRR would follow a number of the best practice guidelines currently used by other rail carriers and would incorporate security counter-measures into the design of its infrastructure and supporting systems. TCRR would also implement additional strategies that incorporate proven security systems and new technologies used by other high-speed rail and large transit systems.

TCRR would comply with all applicable rules and regulations. In compliance with federal regulations, TCRR would prepare a System Security Plan (SSP) that would:

- Identify the policies, goals, and objectives of the security program.
- Document TCRR's processes for mitigating and/or eliminating the security threats, vulnerabilities, and risks identified.

- Include the results of TCRR's Preliminary Hazards Analysis and Final Hazards Analysis in its threat and vulnerability assessments.
- Identify the controls that would be in place to safeguard the personal security of passengers and employees.
- Identify the internal processes used to evaluate and improve the effectiveness of the security processes.

Given the sensitivity of the planning, design, and implementation of the security program, the specific details of TCRR's security plans would only be shared with law enforcement and designated security and emergency response personnel.

4.3 Intrusion Protection

TCRR recognizes that a key component of its security plan would involve a robust intrusion protection program. TCRR plans to completely fence and secure the trackway between Dallas and Houston with security fencing and barriers to prevent unauthorized access or intrusions onto railway property.

TCRR's design approach for intrusion protection would generally follow federal and industry guidelines for fencing and barrier systems that emphasize prevention, detection, and deterrence of unwanted or illegal trespass onto TCRR's right-of-way and properties. Where feasible and effective, TCRR would employ multiple, layered technologies for monitoring its properties and providing for timely response to any intrusions.

TCRR's intrusion protection system would:

- Prevent unauthorized/unintended access onto TCRR property by active and passive control systems.
- Allow controlled and monitored access by authorized personnel.
- Provide effective physical barriers near highways and roadways to prevent vehicle access onto the right-of-way.
- Provide fencing of sufficient height to protect the right-of-way.
- Provide fall prevention for elevated structures.

TCRR's Intrusion Protection Plan would be an important part of the System Security Plan and would be continuously reviewed for effectiveness and suitability to address any threats to TCRR's operations.

4.4 Accident Avoidance Principles

The principle of accident avoidance is a safety system that is designed to prevent even the possibility of a collision. For a background in accident avoidance see the following website: http://www.ihra-hsr.org/cap/.

The key elements of accident avoidance are:

- Exclusively dedicated tracks for passenger HSR service, which completely exclude freight and commuter rail being on the same tracks.
- No at-grade crossings.
- An Automatic Train Control (ATC) system, which automatically detects train positions and controls the operation of the system.

The Project's safety plan would be based upon the same principles used for the Tokaido Shinkansen. The Tokaido Shinkansen system was the first dedicated high-speed rail system in the world. In over five decades of operations, the Tokaido Shinkansen has had an impeccable safety record. In developing the basic core system of the high-speed operation, JRC adopted a holistic approach in its design of an integrated system and sub-systems. The systems approach enabled JRC to design out serious hazards from the earliest stages, such as requiring fully grade separated dedicated right-of-way for the exclusive use of the high-speed trainsets.

Accident avoidance principles are the foundation for the Tokaido Shinkansen's service proven system. The accident avoidance principles cover all aspects of the high speed rail operation: system design, operations, inspection, testing, and maintenance, and personnel qualification and training. These key elements to an integrated systems approach to safety have been refined over time as a result of the safety culture of the railroad and continued monitoring.

A critical component of accident avoidance is collision avoidance. Collision avoidance includes mitigations to prevent collisions. The Tokaido Shinkansen is operated on a completely dedicated right-of-way. There is complete grade-separation and perimeter fencing is used as required to prevent unauthorized access. JRC has identified hazards through many years of operations and put appropriate intrusion detection system along the right-of-way and along highway overpasses to ensure the integrity of the right-of-way from external hazards.

Strict temporal separation of right-of-way maintenance-of-way activities to prevent collisions with passenger trainsets is another crucial collision avoidance feature. Temporal separation of maintenance-of-way activities also eliminates the potential for roadway worker injury or fatality from incidents with the trainsets. The daily use of a sweeper vehicle prior to initiating revenue service assures that no hazards are present on the tracks and confirms the safety of the right-of-way.

The rolling stock used on the Tokaido Shinkansen is optimized with track design details, providing a safe dynamic performance of the trainset. JRC has stringent track safety standards that are optimized for the rolling stock. Additionally, the implementation of the proven digital advanced signaling system in mainlines and yards prevents collisions at every allowable speed down to zero km/h. From the inception of service, JRC has invested in a signal system using Automatic Train Control to prevent train-to-train collisions, overspeed derailments, and the movement of trainsets through misaligned switches.

In addition to system designs, cultivating a safety culture among the workforce is crucial to ensure reliability and integrity of all safety-critical components of the system and to minimize the need for unusual or emergency operations including passenger rescue operations. JRC has a comprehensive and rigorous training and qualification program for all employees or contractors that perform safety-related duties. JRC has a state-of-the-art general training center, equipped with track, overhead catenary system, and simulators. To further prevent accidents/incidents and ensure reliable operations, JRC has a comprehensive inspection, testing, and maintenance program, which covers all aspects of the system. For example, after maintenance operations, sweeper vehicles would operate over the line to ensure that the ROW is clear of obstacles within the clearance envelope; then daily revenue service would be allowed to begin. Protocols and procedures are periodically updated and refined to ensure safe operations.

5 Infrastructure Configuration

Section 3 of this report outlined the approach used for conceptual engineering level of design for specific disciplines and the general guidelines that would be followed during more detailed development. Site-specific design of individual structures and facilities was not undertaken during the conceptual engineering effort, but typical infrastructure configurations were developed and applied along the corridor to determine the site-specific LOD. Development of these typical infrastructure configurations is described in this section.

The typical cross-sections (included in the FDCE drawing set Volume 1) reflect a conceptual level of design development. The key elements of the typical infrastructure configurations are summarized below. Note that site-specific requirements for certain elements, such as intrusion protection barriers or sound barriers, are not shown. Typical details for these types of specific elements would be documented separately.

The typical embankment cross-section used to develop the LOD included:

- The railway embankment, which would have a variable width based on profile height above surrounding grade.
- An access road on at least one side of the embankment. The location of the access road and the proximity of the access road to the embankment may vary since the road must follow alignment geometry that permits use by maintenance and emergency response vehicles. This geometry would not necessarily follow the variable embankment toe of slope position.
- A drainage swale on either side of the embankment and a further drainage swale beyond the roadway. Swale sizes would vary based on location-specific requirements.
- An allowance for construction and future maintenance access beyond the swales on each side of the cross-section.

The typical retained embankment cross-section used to develop the LOD included:

- An earthen embankment supported by retaining walls.
- An access road on at least one side, adjacent to the retained embankment. The location compared to the HSR alignment would be site specific. In some cases, a local roadway may provide access.
- Two drainage swales, one beyond the roadway and the other on the opposite side of the retained embankment. Both would collect surface water, including any runoff toward the corridor from beyond the site limits.
- An allowance for construction and future maintenance access beyond the swales on each side of the cross-section.

The typical cut cross-section used to develop the LOD included:

- A railway cut below grade including drainage swales on either side. The width of the cut would vary with depth relative to surrounding grade.

- An access road on at least one side of the cut. The location of the access road and proximity to the cut may vary since the road must follow alignment geometry that permits use by maintenance and emergency response vehicles. This geometry would not necessarily follow the variable top of slope position.
- A drainage swale beyond the roadway to collect surface water, including any runoff toward the corridor from beyond the site limits.
- An allowance for construction and future maintenance access beyond the outer swales on each side of the cross-section.

The typical retained cut cross-section used to develop the LOD included:

- A retained cut width, including soldier pile wall and sub-surface wall anchors where required. The width between the walls would accommodate drainage requirements. The width outside the retained cut would include requirements for an access roadway and drainage swales. The typical section shows the need for tie back anchors, which have been included in the LOD; however, low-height retained cuts may not need anchors, and deeper cuts with more extensive anchors may be installed through drilling and grouting without surface disturbance.
- An access road on at least one side of the retained cut.
- Two drainage swales, one beyond the roadway and the other on the opposite side of the retained cut. Both would collect surface water, including any runoff toward the corridor from beyond the site limits.
- An allowance for construction and future maintenance access beyond the swales on each side of the cross-section.

The typical viaduct cross-section used to develop the LOD included:

- A typical viaduct structure width of 45ft 6in (13.97m).
- An access road on at least one side of the viaduct structure. In more developed areas, it is expected that this access road would be an adjacent roadway.
- Two drainage swales, with one beyond the roadway and the other on the opposite side of the viaduct. Both would collect surface water, including any runoff toward the corridor from beyond the site limits. Drainage swale size and location would be based on local constraints, topography, and drainage analysis. The placement of drainage swales in waters of the U.S. would be avoided and, if unavoidable, minimized and constructed to not drain waters of the U.S.
- An allowance for construction and future maintenance access beyond the swales on each side of the cross-section.

6 Stations

The purpose and function of the Project is to provide a convenient alternative to interurban travel between the Dallas and Houston metropolitan areas, and to address mobility- and congestion-related issues in the IH-45 corridor. To meet this need, three stations are proposed along the corridor, including two terminal stations at Dallas and Houston and one intermediate station serving the Brazos Valley in Grimes County.

This section describes the proposed station locations and the design of each station. Also addressed is the projected ridership for the HSR system, the parking capacity proposed and expected traffic generation at station locations based on proposed service levels and estimated mode split for station access. Roadway improvements proposed at each station location were developed based upon these estimated traffic volumes as described herein. More detailed ridership analyses are underway and would be used in combination with the results of the independent EIS traffic analysis to refine the design of roadway improvements during more detailed design in close coordination with local, county, and state roadway authorities as appropriate.

6.1 Station Locations

Station locations were investigated that were accessible to both the highway network and, where available, public transportation. As a privately developed project, station locations that would generate ridership and revenue were advanced. Stations were strategically located to minimize impacts, maximize multi-modal connectivity, optimize ridership with respect to revenue, and optimize adjacent land-uses to provide long-term local development opportunities.

Key criteria used in the selection of the proposed station locations were:

- Availability of property
- Access to the rail alignment corridors being studied
- Access to the public transportation network
- Access to the highway and roadway network
- Annual ridership and revenue potential
- Relative "last mile" costs
- Station area development potential

First-class station facilities would provide a premium experience from the moment of getting out of a car to boarding the train. Station designs would incorporate sufficient customer capacity to handle customer volumes associated with the frequency of service. Platforms would have the capability to accommodate customers on the platform waiting to board, while passengers alight from an arriving train and move off the platform.

The Dallas Terminal station would be located just to the southwest of the Dallas Convention Center lying between Riverfront Boulevard and the existing Union Pacific Railroad. Design of the Dallas Terminal would not preclude future extensions to Fort Worth.

Three options are being studied as potential Houston Terminal station locations, each providing good access to the IH-10, US 290, and Loop 610 highway network.

- Houston Terminal Option 1 (HT1): North of Katy Road opposite the Northwest Transit Center.
- Houston Terminal Option 2 (HT2): Northwest Mall along the northeast side of Hempstead Road.
- Houston Terminal Option 3 (HT3): Industrial site opposite Northwest Mall along the southwest side of Hempstead Road.

6.2 Station Drawings

The FDCE drawings (Volume 3) provide conceptual, site-specific track, roadway, and architectural design for the Dallas terminal, the Brazos Valley station, and each of the Houston terminal locations options.

Site-specific plan and profile layouts and access plans are provided in the DCE for each station location. The plan and profile sheets show track geometry, interlockings, and station elevations. The access plan sheets show parking facilities, roadway circulation, and total station LOD. These drawings represent a generally conservative approach to the documentation of the potential LOD for the station infrastructure and surrounding elements.

6.3 Station Facilities

The terminal and intermediate stations were sized to accommodate HSR operations and maintenance, and the needs of the traveling public.

The program and staffing requirements identified for each station addresses engineering, operations, maintenance, and real estate needs. The “bubble diagram” provided in the drawing (Volume 3) demonstrates key adjacencies between the various public areas, secure passenger areas, and back-of-house/operations areas. Appendix B is a corresponding listing of various program spaces that must be included in the base station program.

The station program includes space for:

- The public: The stations would house information kiosks, baggage storage, public restrooms, public concourses, bars, restaurants, coffee and newsstands, public parking, and rental car facilities.
- Ticketed passengers: Final locations for separating passengers moving from public concourses to platforms remains to be determined. Allowances were included in sizing stations for first-class lounges, meeting rooms, private work areas, bar, and kitchen.

- Office facilities for both the running of the trains and the stations, including training and conference rooms
- Security (CCTV control rooms, security offices, etc.)
- Staff welfare (employee parking, lockers, break rooms, staff cafeteria, etc.)
- Operations (custodial equipment, loading dock and yard, kitchen for trains, service corridor, vehicle staging, storage, and laundry, etc.)

6.4 Traffic Demand at Station Locations

The following section summarizes the approach used to estimate traffic demand and to propose roadway improvements at each of the proposed stations. The approach used estimates for mode split for access to station, trip generation, and trip distribution assumptions derived from the ridership and parking studies undertaken by TCRR during the Project planning efforts. The estimates provide the necessary input to inform design requirements for roadway improvements and to support multimodal connectivity and pick up and drop off queue capacity for car share, taxi, shuttle, and Transportation Network Companies such as Uber and Lyft.

6.4.1 Ridership Forecasts and Passenger Profiles

As estimated by the proprietary market demand study undertaken by TCRR, the build year forecast for HSR ridership in 2026 is 4.4 million passengers per year. The long-term forecast for HSR ridership in the 2040 analysis year is 7.2 million passengers per year.

According to the travel survey undertaken by TCRR, the majority of people travelling between Dallas and Houston currently travel by car. The profile of passengers traveling between the two cities is predominately non-business users. Based on the travel survey conducted as part of the market demand assessment, non-business journeys was projected to be 76% in year 2040.

6.4.2 Mode Split Assumptions

The estimates for the mode of access to the stations were derived from the travel survey undertaken by TCRR. The means of access to a particular station would vary depending on whether the passenger is local or a visitor. For the purpose of traffic analysis, assuming 50% of passengers accessing the station are visitors, and 50% are locals, the following station access mode share percentages were estimated for Dallas and Houston stations.

Table 12: Mode Split Assumptions for Terminal Stations

Station	Drive and Park	Rental Car	Pickup/Dropoff	Taxi	Bus/Shuttle	Walk/Bike/Other
Dallas	25%	14%	32%	21%	4%	4%
Houston	32%	13%	31%	18%	2.5%	3.5%

6.4.3 Vehicle Trip Generation and Distribution Assumptions

The critical periods for traffic analysis would be the morning and evening peak hours, when both the HSR ridership and adjacent roadway traffic would be at their peak. Driver mode choice and route selection would reflect the peak hour roadway congestion conditions during this period. Ridership projections were not used to calculate trip generation at each of the stations. Rather, a conservative approach to estimating trip generation was taken, based on the capacity of the trains at the service level proposed in 2040.

The analysis below reflects the maximum potential peak hour demand. This level of activity is not expected to take place on a daily basis.

6.4.3.1 Peak Period Trip Generation Assumptions

Given that HSR operations would be operating at three trains per hour (TPH) under the FSL, and with a 400 passengers per train capacity during the peak periods of analyses, the passenger capacity of the system would be 1,200 passengers per hour in each direction, for a combined total of 2,400 inbound and outbound passengers at each terminal. The calculations and diagrams that follow focus on inbound trips for clarity. Additional operational characteristics and assumptions included in the analysis are provided.

Non-passenger related activities occur during off-peak hours

To prepare for servicing passengers during peak hours, associated service employees would arrive at and depart from their work shifts during non-peak hours of the day, when traffic operations are less critical.

95% practicable capacity departing/arriving at station

It can be expected that some inefficiencies would keep the trains from running fully loaded at each departure, so some reduction in train capacity is appropriate. To be conservative, only a 5% reduction was assumed; therefore, the practicable capacity was reduced to 1,140 passengers per hour per direction (inbound & outbound).

1,200 x 95% = 1,140 passengers

Reduction due to passenger trips to station not generating new vehicle trips

Passengers arriving at and departing from the stations choosing to ride the available rail transit service would not generate any additional ground trips to the roadway network. Shuttle or bus trips would generate additional trips; however, these are calculated at a different passenger per vehicle rate than private vehicle trips (see Table 13 and Table 14 below). The passengers biking or walking to or from the station are assumed to generate negligible vehicular trips to the roadway network. These rates for each station are based on Table 12 above.

Reduction due to multiple occupancy vehicles

Passengers arriving or departing by car (drive alone, rental car, pickup/drop off, or taxi) were assumed to occupy vehicles at a rate of 1.2 passengers per vehicle in Dallas and Houston. For the purposes of these initial estimates, shuttle buses (from nearby hotels, etc.) were considered to average twice the passenger occupancy as the cars (2.4 passengers per vehicle).

Dallas Terminal

At the Dallas terminal, the ground transportation vehicles generated by passenger activity during the peak hour were estimated as follows:

Table 13: Vehicles Generated by Access/Egress Mode, Dallas

Mode	% of Practicable Capacity	Passengers per Vehicle
Drive and Park	25%	1.2
Rental Car	14%	1.2
Pick up/Drop Off*	32%	1.2
Taxi*	21%	1.2
Shuttle Bus*	4%	2.4
Rail, walking and biking	4%	N/A

*Vehicle driver not included, trips generated are doubled to incorporate reverse empty trips to/from the station.

According to this analysis, there would be 1,415 vehicle trips per hour generated to/from the station.

Houston Terminal

At the Houston terminal, the ground transportation vehicles generated by passenger activity during the peak hour were estimated as follows:

Table 14: Vehicles Generated by Access/Egress Mode, Houston

Mode	% of Practicable Capacity	Passengers per Vehicle
Drive and Park	32%	1.2
Rental Car	13%	1.2
Pick up/Drop Off*	31%	1.2
Taxi*	18%	1.2
Shuttle Bus*	2.5%	2.4
Rail, walking and biking	3.5%	N/A

*Vehicle driver not included, trips generated are doubled to incorporate reverse empty trips to/from the station.

According to this analysis, there would be 1,381 vehicle trips per hour generated to/from the station.

6.4.3.2 Trip Distribution

The number of ground transportation vehicles arriving and departing the station during the peak hour were then distributed onto the street network according to the logical path that travelers would take to and from their origins/destinations shown in Figure 11 (Dallas) and Figure 12 (Houston). The percentage distributions take into account these distributions of trips from the TCRR ridership and revenue report and major arrival roadways that passengers from each direction would choose.

According to the TCRR ridership and revenue report: "The majority of Dallas ridership starts/ends in the Downtown area, which is where many businesses are located, and Tarrant [County], which is one of the largest residential zones." Dallas County is shown in dark grey below. The detailed distribution of trips is presented below. The TCRR ridership and revenue report also notes that this opening day distribution "stays reasonably constant through time."

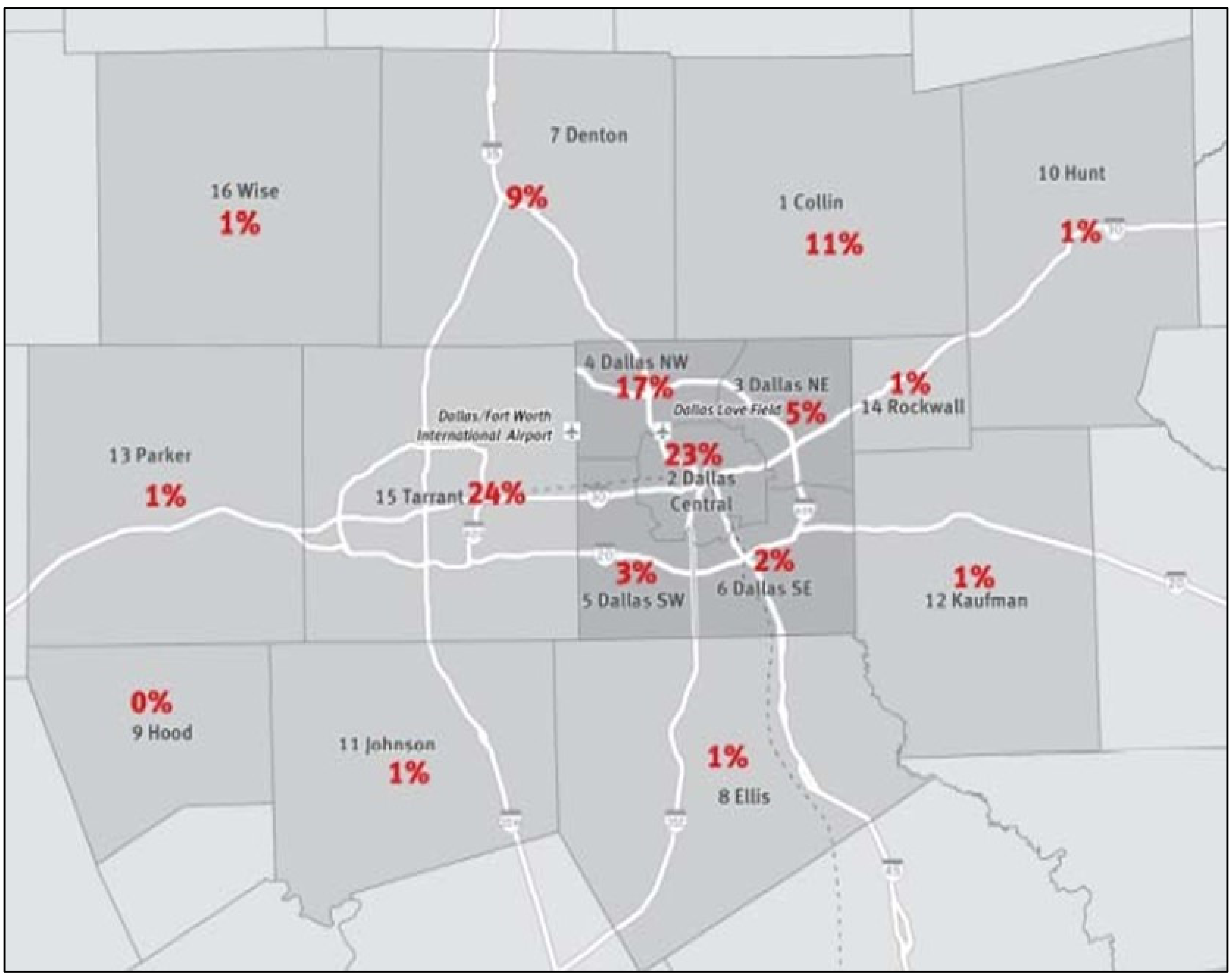


Figure 11: Trip Distribution in Dallas

According to the TCRR ridership and revenue report, the majority of Houston demand would be to/from Harris County, which is shown in dark grey in Figure 12 below. This demand is focused particularly in the central, north, and west zones.

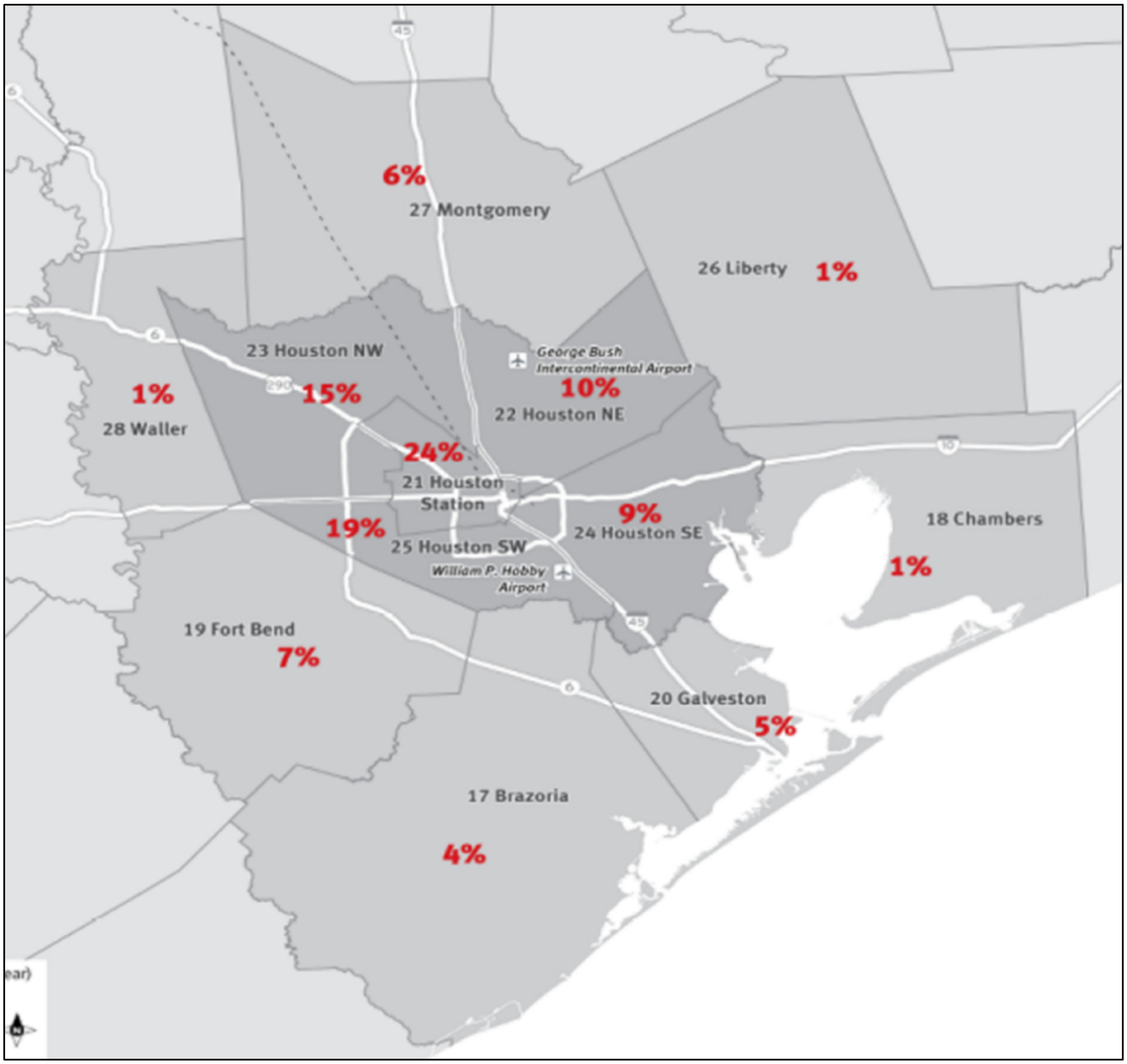


Figure 12: Trip Distribution in Houston

The resulting distribution of traffic for vehicles traveling to the HSR stations in Dallas and Houston during the peak hour are shown in Figure 13 (Dallas) and Figure 14 (Houston) on the following page. It is assumed that the same volumes would be expected for the reverse direction, namely vehicles departing the station.

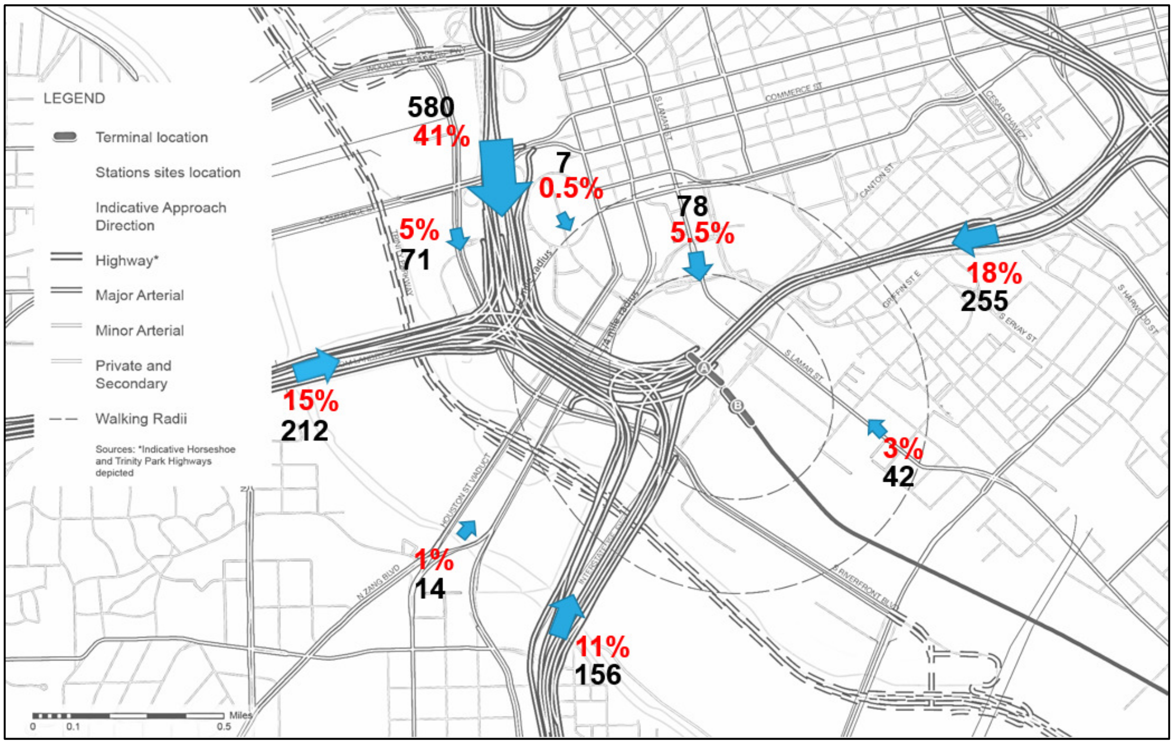


Figure 13: Trip Distribution for inbound trips in Dallas Station Area. Outbound trips would generate the same amount of traffic in the opposing direction.

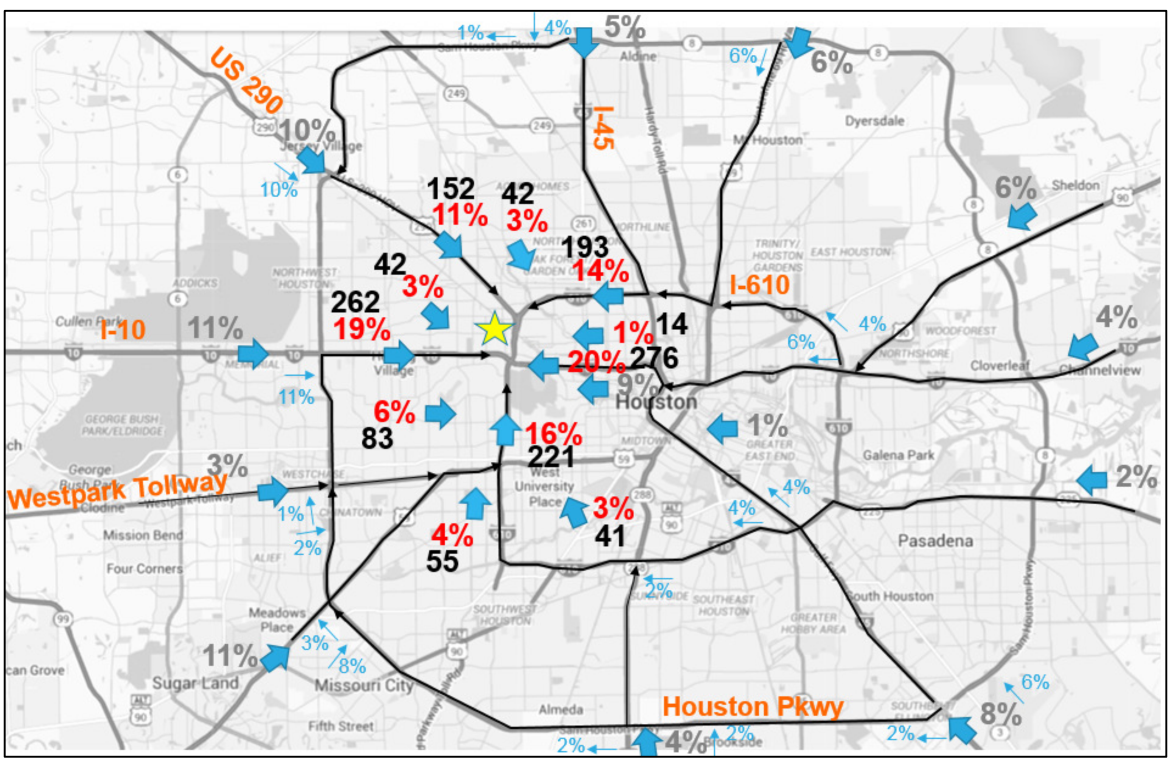


Figure 14: Trip Distribution for inbound trips in Houston Station Area. Outbound trips would generate the same amount of traffic in the opposing direction.

The analysis above demonstrates that in the morning and evening peak hours, the number of ground transportation vehicles arriving and departing the station would be 1415 vehicles/hr (each direction) for Dallas and 1381 vehicles/hr (each direction) for Houston. These numbers were based on the mode splits noted in the previous section, the trip distributions from the TCRR ridership and revenue report, and the following key assumptions:

- Non-passenger related travel: Non-passenger travel generates no peak hour trips
- Practicable Capacity: Each train operates at 95% of full capacity
- Passengers per vehicle: Rental cars, pick-up/drop-off and taxi trips contain 1.2 passengers per vehicle. Shuttle buses contain 2.4 passengers per vehicle
- Reverse trips: Taxi, pick-up/drop-off and shuttle bus trips generate reverse trips and are counted twice.

6.4.3.3 Trip Generation and Distribution for Brazos Valley Station

The TCRR ridership and revenue report referenced above did not provide estimated ridership numbers at the intermediate station. An updated ridership study is in progress and would provide this information. In the absence of available ridership forecasts for the Brazos Valley station at this time, assumptions were made based on peak hour ridership and parking supply characteristics for the Houston Station. A ridership of 171 peak hour passengers (15% of the peak hour ridership of 1,140 for Houston) was assumed for Brazos Valley station. Given the existing rural character of the area surrounding the Brazos Valley Station, a higher percentage of drive and park trips were assumed (70%) with the remaining trips assumed to be split between taxi, shuttle, rental car, and pick up/drop off modes.

The resulting distribution of traffic for vehicles traveling to the HSR station in Brazos Valley during the peak hour are shown in Figure 15 on the following page. It is assumed that the same volumes would be expected for the reverse direction, namely vehicles departing the station.

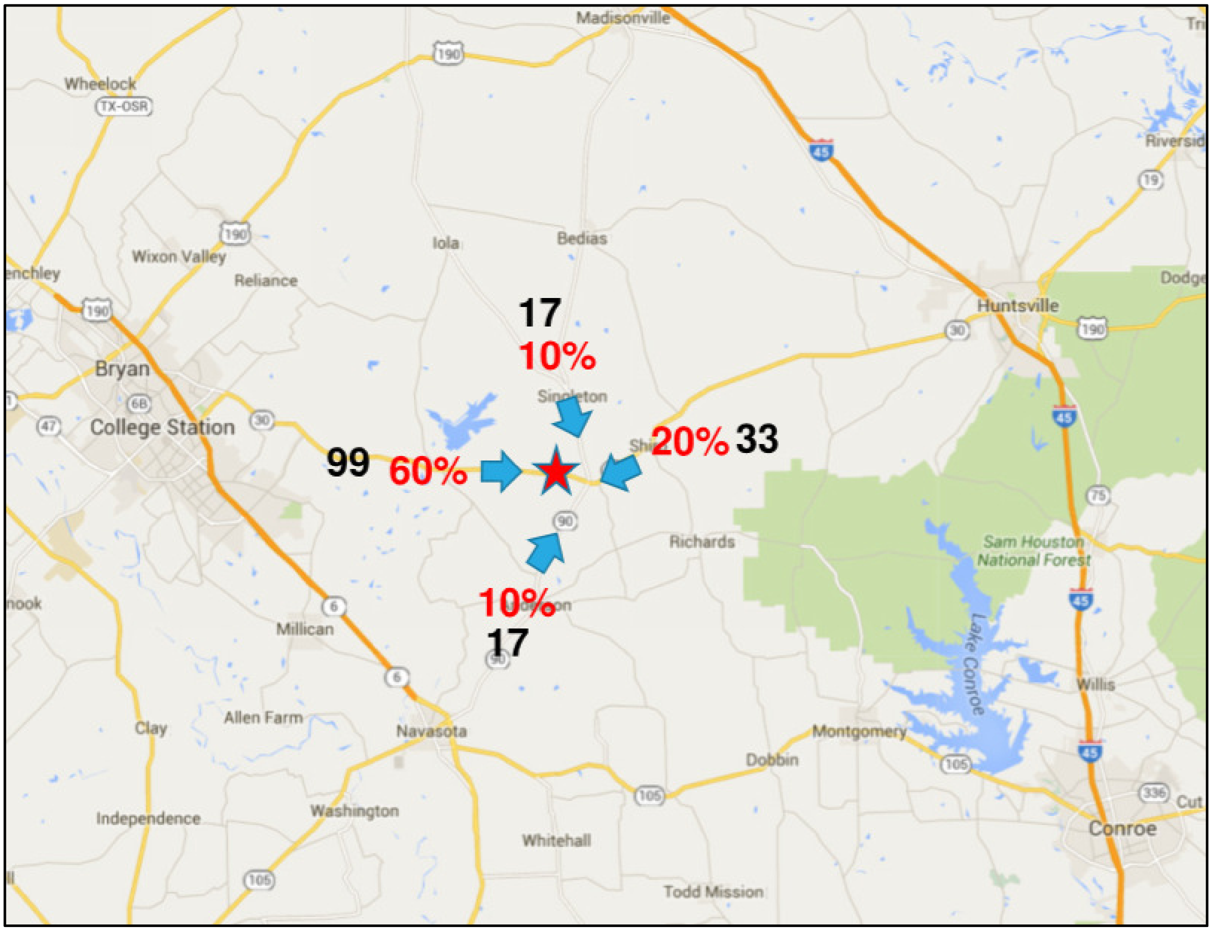


Figure 15: Trip Distribution for inbound trips to the Brazos Valley Station. Outbound trips would generate the same amount of traffic in the opposing direction.

6.5 Parking Demand at Station Locations

TCRR undertook a parking requirements study to estimate parking demand at each of the proposed terminal stations. The approach taken included the following considerations:

- Ridership.
- Mode share distribution for station access and egress.
- Trip durations and resulting hourly vehicle entrances and exits.
- Valet parking.
- Rental car storage and cycling.
- Operations, stations, and associated facilities staffing.
- Change in mode preferences due to trends in ride share services like Lyft and Uber.
- Predicted growth in autonomous vehicle technologies.

Through this analysis a maximum parking demand through 2050 was estimated using a "stock and flow" method to estimate vehicle accumulation. The analysis estimated that 25% of passengers would make a short journey of one night or fewer, while the remainder would make a journey of three days on average. The analysis revealed that demand for parking would continue to grow until the mid-2040s, due to increase in ridership, before declining, as share loss to AVs and taxi and ride share services would more than offset increases in ridership.

The parking demand for the rental cars was also estimated using the stock and flow method. The study estimates there would be, on average, 1,200 and 1,100 vehicles rented out at once in Dallas and Houston respectively during the year of peak demand. Parking requirements for rental cars was then estimated by determining the required vehicle stock at the start of each day to address daily demand.

The parking demand study did not include an analysis for the Brazos Valley Station. For the purposes of estimating the space requirements for parking at Brazos Valley, it was estimated that the parking needs would be approximately 20% of that at the terminal stations.

Based on the analysis completed, parking zones were established in the development of the station area plans to allow development of structured parking to accommodate the following demands. Further analysis would be completed during more detailed design to better estimate parking requirements. This additional effort would incorporate considerations identified through continued stakeholder engagement, including coordination with local development plans, rental car providers, transit agencies, emergency responders, and others.

Table 15: Parking Allowances at Terminal Stations

Station	Use	Estimated Parking Capacity Required (No. of spaces)
Dallas	Car Park (including valet)	4,500
	Rental Car	500
	Staff	500
	Total	5,500
Houston	Car Park (including valet)	5,500
	Rental Car	500
	Staff	500
	Total	6,500
Brazos Valley	Car Park (including valet)	750
	Rental Car	200
	Staff	250
	Total	1,200

6.6 Houston Terminal

The Last Mile Analysis determined that the preferred terminal location to serve Houston would be in the area of the intersection of US 290 and Loop 610 in central-northwest Houston. The location is at the south end of the US 290 corridor and would provide direct access to growing development in both northwest and central Houston. It would offer the following benefits:

- Convenient highway access from US 290 and Loop 610
- Proximity to key employment centers
- Proximity to central and Downtown Houston
- Development potential for the station area
- Transit connectivity to downtown and the METRO light rail network via Northwest Transit Center
- Additional transportation modal choices to relieve highway congestion
- Both Houston METRO and the Gulf Coast Rail District (GCRD) have planning studies underway for further improvements that would offer possible direct transit connectivity.

Given the dense urban development in the area, three potential Houston terminal locations were identified, providing flexibility to further study the environmental and engineering efforts of each location. Each of the three options for the Houston terminal would provide opportunities for economic redevelopment and connectivity with the region's major transit and roadway systems.

6.6.1 Northwest Transit Center Terminal Option (HT1)

The EIS Team studied alignment alternatives for the approach to the Houston Northwest Transit Center terminal option. These alternatives took into consideration two projects underway during the planning effort: the US 290 Expansion Project, and a new residential development under construction just north of the proposed Northwest Transit Center. The selected alignment would minimize impacts to this new residential development and preserve the "Area Reserved for High Capacity Transit Corridor" shown on the on US 290 improvement plans. This site would require the HSR viaduct to cross over the UPRR line.

This site would offer good connectivity with METRO services provided at the Northwest Transit Center.

6.6.1.1 Station Configuration

The station would be located north of Old Katy Road, between North Post Oak Road and US 290 with primary site access from Old Katy Road and North Post Oak and secondary access from the US 290 service road. The station would consist of three main levels: at-grade; an elevated second level; and the platforms at the third level. The tracks would be elevated approximately 51 feet above grade. The station would include two island platforms with tracks on both sides for a total of four tracks. Additional space would be provided to the east for the potential expansion of an additional island platform with two tracks. The elevated platforms and tracks would be open at each end and covered the full width and length of the station providing, shade and weather protection.

Passenger drop-off and pick-up would occur at-grade either northbound or southbound from the main road between the station and the parking facility to the west. Passengers accessing the site from Old Katy Road would travel northbound and would be dropped off adjacent to the main entry concourse at-grade. This concourse would contain public areas such as restaurants, bars, seating areas, fast food, newsstands, and restrooms. From the grade level concourse, passengers would circulate vertically via elevators, escalators, and stairs to the concourse at the second level. The second level concourse would include additional restaurants, bars, newsstands, concessions, rental car counters and queuing, and restrooms. The second level concourse would have a direct connection to the parking facility to the west via pedestrian bridges. Vehicular traffic from North Post Oak entering the site and proceeding south would drop off passengers next to the parking facility. Passengers would proceed vertically in the parking facility, cross over the internal road through the pedestrian bridges into the second concourse level. The first-class lounge, bar, and meeting facilities would be located at the south end of the second level of the station below the tracks and platforms. First-class passengers would be able to move directly vertical to their boarding areas on the platforms above.

Immediately below each platform would be service corridors spanning the length of each platform for servicing the trains. Back-of-house operations would be located at the grade and second levels at the north end of the station below the trackway. These areas would include crew and staff areas, security, station offices, signal and communications, food preparation areas (for the trains), vehicle staging, physical plant, and loading dock.

West of the station would be a five-level parking facility for as many as 6,500 vehicles including personal cars, rental cars, valet service, and employee parking. The parking facility would connect via the station by enclosed, elevated pedestrian bridges spanning across the roadway. From the elevated bridges, passengers would move vertically via escalators, elevators, and stairs either down into the grade level concourse or up to the platforms above. Similarly, an optional enclosed, elevated bridge could extend south from the public concourse across Old Katy Road to the Northwest Transit Center, connecting passengers with Houston's public transportation center.

6.6.1.2 Roadway Access Improvements

2026 Access Improvements

- Post Oak Road at Hempstead Road: To mitigate the high delay at the intersection, change the configuration at the eastbound Hempstead Road approach from L/T/T/T/R to L/T/T/R/R. This would help improve the intersection level of service (LOS) to D (as defined in the Highway Capacity Manual and AASHTO Geometric Design of Highways and Streets, "Green Book") without taking additional right-of-way.
- Post Oak Road at Old Katy Road: This intersection experiences high traffic demand and already has multilane approaches. Several mitigation measures were evaluated including the addition of northbound right turn and left turn lanes, southbound left turn lane, eastbound

right turn lane, and westbound right turn lane. These combined improvements would help reduce the intersection delay by over 50% and improve the intersection LOS to E.

- Old Katy Road at Loop 610 Northbound Frontage Road: The high delay at the northbound approach can be mitigated by converting the middle lane from though lane to shared through and left turn lane. This would improve the intersection LOS from F to B.
- West 18th Street at Hempstead Road: The intersection LOS could be improved to LOS C by prohibiting the westbound left turns from West 18th Street. The demand for this left turn movement is only five vehicles per hour, which could alternatively use Mangum Road to access southbound Hempstead Road.

2040 Access Improvements

- Post Oak Road at Hempstead Road: In addition to the proposed mitigation measures for year 2026, reassigning lanes at the northbound and southbound approaches would help reduce the intersection delay in 2040, so the intersection would continue to operate at LOS D. These improvements include changing the northbound lane configuration from L/LT/TR to L/L/TR and southbound lane configuration from L/LT/TR to L/T/TR.
- Post Oak Road at Old Katy Road: This intersection experiences high traffic demand and already has multilane approaches. The mitigation measures proposed for year 2026 would help reduce the intersection delay by over 50% to 94 seconds per vehicle. However, the intersection would continue to operate at LOS F in year 2040.
- Old Katy Road at Loop 610 Northbound Frontage Road: The proposed mitigation measures for year 2026 would help improve the intersection LOS from F to C.
- Silber Road at IH-10 Westbound Frontage Road: Restriping the northbound approach from L/LT/T to L/T/T would help improve the intersection LOS from E to C.
- West 18th Street at Hempstead Road: This intersection would need to be signalized to avoid excessive delay for the southbound left-turn movement. As discussed under 2026 mitigations, the westbound left turn from West 18th Street could be prohibited due to very low demand (about five vehicles per hour). In addition, overlapping the westbound right-turn movements with the protected southbound left-turn movements would help improve the intersection LOS to B.
- West T.C. Jester Boulevard at Loop 610 Northbound Frontage Road: This intersection would experience high delay for the southbound left turns from T.C. Jester Boulevard. Restriping this approach from L/T/T to L/L/T would improve the intersection LOS from E to C.

6.6.2 Northwest Mall Terminal Option (HT2)

Another option for the Houston terminal is a site along the northeast side of Hempstead Road at US 290 and Loop 610 at the Northwest Mall site, which is currently the subject of alternative redevelopment plans. This location would offer good highway access and possible connectivity with GCRD plans for commuter rail along Hempstead Road. This site would require the HSR viaduct to cross over Hempstead Road.

6.6.2.1 Station Configuration

The station would be located on the Northwest Mall site with access from Hempstead Road, North Post Oak Road, and West 18th Street. The station would consist of three main levels: at-grade, an elevated second level, and the platforms at the third level. The tracks would be elevated approximately 51 feet above grade. The station would include two island platforms with tracks on both sides for a total of four tracks. A future expansion of one platform and two tracks could occur to the south between the station and Hempstead Road. The elevated platforms and tracks would be open at each end and covered the full width and length of the station, providing shade and weather protection.

Passenger drop-off and pick-up would occur at-grade on both sides of the road between the station and the parking facility north of the station. The main concourse at-grade would consist of public areas such as restaurants, bars, seating areas, fast foods, concessions, newsstands, and restrooms. Above, a second level concourse with elevated pedestrian connections into the adjacent parking facility would also contain seating areas, restaurants, bars, concessions, rental car counters with queuing, and restrooms. The first-class lounge with a seating area, bar, meeting rooms, and restrooms would be located at the west end of the second level concourse. First class passengers would be able to move directly to their boarding areas on the platforms above.

Immediately below the upper level platforms would be service corridors the length and width of each platform for servicing the trains. Back-of-house operations would be located on the at-grade level and the second level at the west end of the station below the trackway. These areas would include crew and staff areas, security, station offices, signal and communications, food preparation areas (for the trains), vehicle staging, physical plant, and loading dock.

On the north side of the station, adjacent to West 18th Street, would be a five-level parking facility for as many as 6,500 vehicles, including personal cars, rental cars, valet service, and employee parking. The parking facilities would be connected to the station's upper level concourse by enclosed, elevated pedestrian bridges.

6.6.2.2 Roadway Access Improvements

2026 Access Improvements

- Post Oak Road at Hempstead Road: Adding a right turn lane at the northbound Post Oak Road approach would help improve the intersection to LOS to D.
- Post Oak Road at Old Katy Road: This intersection experiences high traffic demand and already has multilane approaches. Several mitigation measures were evaluated including the addition of northbound right turn and left turn lanes, southbound left turn lane, eastbound right turn lane, and westbound right turn lane. Combined these improvements would help reduce the intersection delay and the intersection operation would improve to LOS D.
- West 18th Street at Hempstead Road: The intersection LOS could be improved to LOS C by prohibiting the westbound left turns from West 18th Street. The demand for this left turn

movement is only about five vehicles per hour which could alternatively use Mangum Road to access southbound Hempstead Road.

- West 18th Street at Loop 610 Southbound Frontage Road: This intersection would operate at LOS E due to high westbound left turn demand, and could be improved to LOS D by adding a westbound left turn lane.

2040 Access Improvements

- Post Oak Road at Hempstead Road: The proposed mitigation measures for year 2026 would not help improve the intersection LOS. Improvements proposed to mitigate impacts in year 2040 include converting the lane allocation at the eastbound Hempstead Road approach from L/T/T/T/R to L/T/T/TR/R, the westbound Hempstead Road approach to L/L/T/T/R, and the northbound Post Oak Road approach to L/L/TR/R, and changing the lane allocation to L/T/R for the southbound station access road. These changes, in addition to protecting all the left turn movements, would improve intersection LOS to D.
- Post Oak Road at Old Katy Road: This intersection experiences high traffic demand and already has multilane approaches. The mitigation measures proposed for year 2026 would help improve the intersection LOS to E in year 2040.
- West 18th Street at Hempstead Road: This intersection would need to be signalized to avoid excessive delays for southbound left-turn movement. As discussed under 2026 mitigations, the westbound left turn from West 18th Street could be prohibited due to very low demand (about five vehicles per hour). In addition, overlapping the westbound right-turn movements with the protected southbound left-turn movements would help improve the intersection LOS to B.
- West 18th Street at Loop 610 southbound Frontage Road: The mitigation measures proposed for year 2026 would help maintain LOS to D at the intersection in year 2040.

6.6.3 Industrial Site Terminal Option (HT3)

An industrial site along the southwest side of Hempstead Road, just west of Loop 610, was also identified as a possible Houston terminal location. Highway access to this location would not be as good as the other two options; however, the site would minimize property requirements. This site would require the HSR viaduct to cross over the UPRR line. Several historic buildings are located on the site. Efforts to minimize any negative impacts to these buildings while developing future enhancements would be encouraged. Station site planning assumes adaptive re-use of the historic features and uses. The design would be developed in close coordination with the Texas Historical Commission (THC), City of Houston, local community, and key stakeholders.

6.6.3.1 Station Configuration

The station would be located south of Hempstead Highway, west of North Post Oak Road. Access would be from North Post Oak at the east, Westview Drive at the south, and from Hempstead Road at the west. The station would consist of three main levels: at-grade, an elevated second level, and the platforms at the third level. The tracks would be elevated approximately 51 feet above grade. The station would include two island platforms with tracks on both sides of each platform for a total of four tracks. A future expansion of one platform and two tracks could occur to the north between the station and Hempstead Road. The elevated platforms and tracks would be open at each end and covered the full width and length of the station, providing shade and weather protection.

Passenger drop-off and pick-up would occur at-grade on both sides of the road between the station and the parking facility to the south. Passengers dropped off on the parking facility side of the road would move into the parking facility, circulate vertically to the second level, and enter the station at the second level via enclosed pedestrian bridges. The at-grade concourse would consist of public areas such as restaurants, bars, fast food, seating areas, concessions, newsstands, and restrooms. From the grade level concourse, passengers would circulate vertically via elevators, escalators, and stairs to the second level concourse. This concourse would also contain seating areas, restaurants and bars, concessions, newsstands, rental car counters and queuing, and restrooms. The first-class lounge with its amenities would be located at the north end of the second level concourse.

Immediately below the platforms would be service corridors the length and width of each platform for servicing the trains. Back-of-house operations would be located at-grade and second levels at the north end of the station. These areas would include staff areas, security, station offices, signal and communications, food preparation areas (for the trains), vehicle staging, physical plant, and loading dock.

The station would be served by two five-level parking facilities, providing parking for as many as 6,500 vehicles including personal cars, rental cars, valet service, and employee parking. The parking capacity would be split between two facilities, one located adjacent to the station and one northwest of the station as shown on the station location plan.

6.6.3.2 Roadway Access Improvements

2026 Access Improvements

- Post Oak Road at Hempstead Road: To mitigate the high delay at the intersection, reallocation and addition of lanes at multiple approaches were tested. The proposed mitigation measures include adding an eastbound right turn lane and a westbound left turn lane along the Hempstead Road approaches, and converting the northbound Post Oak Road approach from L/LT/TR to L/L/TR/R. These changes would help reduce the intersection delay by over 50%, allowing the intersection to operate at LOS D.
- Post Oak Road at 12th Street: Converting the intersection to a signalized intersection would help reduce delay for the westbound approach and improve the LOS to B.
- Post Oak Road at Old Katy Road: This intersection experiences high traffic demand and already has multilane approaches. Several mitigation measures were evaluated including addition of northbound right turn and left turn lanes, southbound right turn lane, eastbound right turn lane, and westbound right turn lane. Combined these improvements would help reduce the intersection delay and help the intersection operate at a LOS D.

- Old Katy Road at Loop 610 Northbound Frontage Road: The high delay at the northbound approach can be mitigated by converting the middle lane from though lane to shared through and left turn lane. This would improve the intersection LOS from F to B.
- West 18th Street at Hempstead Road: The intersection could be improved to LOS C by providing a traffic signal and prohibiting westbound left turns from West 18th Street. The demand for this left turn movement is only about five vehicles per hour, which could alternatively use Mangum Road to access southbound Hempstead Road.

2040 Access Improvements

- Post Oak Road at Hempstead Road: In addition to the proposed mitigation measures for year 2026, changing the southbound approach to L/T/TR would help reduce the delay, and the intersection would continue to operate at LOS D.
- Post Oak Road at Westview Drive: Addition of a northbound left turn lane along Post Oak Road would help improve the intersection operations to LOS D in year 2040.
- Post Oak Road at 12th Street: The proposed mitigation measures for year 2026 would help improve the intersection operations to LOS B in year 2040.
- Post Oak Road at Old Katy Road: This intersection experiences high traffic demand and already has multilane approaches. The mitigation measures proposed for year 2026 would help improve the intersection LOS to E in year 2040.
- Old Katy Road at Loop 610 Northbound Frontage Road: The proposed mitigation measures for year 2026 would help improve the intersection operations to LOS B in year 2040.
- West 18th Street at Hempstead Road: The proposed mitigation measures for year 2026 would help maintain the intersection operations at LOS C in year 2040.
- West 18th Street at Mangum Road: Addition of an eastbound left turn lane would help improve the intersection operations to LOS D in year 2040.
- West 18th Street at Loop 610 Southbound Frontage Road: Addition of a westbound left turn lane would help improve the intersection operations to LOS C in year 2040.
- West T.C. Jester Boulevard at Loop 610 Northbound Frontage Road: This intersection would experience high delay for the southbound left turns from T.C. Jester Boulevard. Restriping this approach from L/T/T to L/L/T would improve the intersection LOS from E to C.

6.7 Brazos Valley Station

An intermediate station is proposed to serve the Bryan-College Station (BCS) population. The proposed station location lies east of BCS near Roans Prairie. The intermediate station would be served by side platforms to allow express trains to bypass the station. The station location would provide the following benefits:

- Provide for good access to State Highway 30 and State Highway 90
- Undeveloped property availability

- Proximity to Bryan-College Station and Huntsville
- Access to the existing roadway and highway network
- Development potential for the station area

6.7.1 Station Configuration

The station would be located northwest of the intersection of SH 30 and SH 90, in Roans Prairie. Site access would be provided by SH 30. The station would have two elevated side platforms along siding tracks, with the two mainline tracks separating the siding tracks. The elevated platforms and tracks, varying between 5 and 25 feet above grade due to grade changes, would be open at each end and covered the full width and length of the station providing, shade and weather protection.

Passenger drop-off and pick-up would occur at-grade on the west side of the station, adjacent to the concourse. The at-grade level would consist of public areas such as seating areas, fast food, and restrooms. From the grade level concourse, passengers would move horizontally under the tracks to the concourse below the east platform before circulating vertically via elevators, escalators, and stairs to the east platform above on the upper level. Passengers entering the station at the upper level concourse via the enclosed pedestrian bridges from the parking facility to the west would be able to move directly onto the west platform at the same level. The upper level would contain seating areas, restaurant and bar, newsstand, concessions, rental car counters and queuing, and restrooms. The first-class lounge with seating area, bar, meeting rooms, and restrooms would be located at the north end of the second level concourse.

West of the station would be a five-level parking facility for 1,200 vehicles including rental car and valet service. The parking facility would connect to the station's upper level concourse by enclosed, elevated pedestrian bridges.

Back-of-house operations would be located on one level at the south end of the station below the trackway. This area would include crew and staff areas, security, station offices, signal and communications, and loading dock.

6.7.2 Roadway Access Improvements

2026 Access Improvements

- Acceleration and deceleration lanes provided on SH 30

2040 Access Improvements

- None

6.8 Dallas Terminal

The Last Mile Analysis determined that the preferred terminal location to serve Dallas would be the downtown area. The Downtown Dallas area is approximately bounded by IH-45 to the southeast, Woodall-Rodgers Freeway to the north, and the Trinity River to the west and southwest. The area is heavily developed, but has good access to the highway network.

The proposed terminal location lies just to the southeast of IH-30 on vacant land between the UPRR line and South Riverfront Boulevard. The station location provides the following benefits:

- Access to the existing public transportation network and not preclude connectivity to the potential Dallas – Fort Worth system as envisioned by NCTCOG.
- Access to Amtrak passenger railway services at Union Station.
- Property availability.
- Development potential for the station area.
- Access to the existing roadway and highway network.
- Access to rail rights-of-way.
- Proximity to Metroplex employment centers.
- Heavy traffic congestion during peak hours.

6.8.1 Station Configuration

The station's tracks would be elevated approximately 70 feet above grade, extending over Cadiz Street. The station would include two island platforms with tracks on both sides, for a total of four tracks. Additional space would be provided to west for the potential expansion of an additional island platform with two tracks. The elevated platforms and tracks would be open at each end and covered the full width and length of the station providing, shade and weather protection.

The station would consist of three main levels: at-grade, an elevated second level, and the platforms at the third level. The main level concourse would be at-grade, south of Cadiz Street, and adjacent to the passenger drop-off and pick-up areas. The concourse would contain public areas such as restaurants, bars, seating areas, fast food, newsstands, and restrooms.

From the at-grade concourse, passengers would move vertically via escalators and elevators to the second level concourse. The second level concourse would contain additional restaurants and bars, seating, concessions, newsstands, rental car counters and queuing, and restrooms. From the second level concourse, passengers would move up to the boarding platforms at the third level. The first-class lounge would be located at the north end of the second-level concourse and would contain a seating area, bar, meeting rooms, and restrooms. First class passengers would be able to move vertically via escalators and elevators to their boarding areas above.

Immediately below the platforms would be service corridors the length and width of each platform for servicing the trains. Back-of-house operations would be located at the south end of the station. At the south end of the at-grade level would be the staff entry, security, staff training area, signal and communications, storage area, physical plant, and loading dock. A smaller, separate loading dock and service area to serve restaurants and bars at the north end of the station would be located across the street at-grade level. Vehicle staging would be located at the south end of the second level. A mezzanine level, between the first and second levels, would provide additional back-of-house areas consisting of station offices, headquarters work stations, staff areas, food preparation areas (for the trains), and staff cafeteria.

Passenger drop-off would occur on both sides of an extended Hotel Street, located on the east side of the station. Southbound passengers dropped off adjacent to the station would enter at a mezzanine level, half way between the lower at-grade concourse and the upper level concourse. From this mezzanine level, passengers could circulate down to the at-grade level or up to the second level via escalators and elevators. Passengers dropped off on the northbound side of Hotel Street could move down to a tunnel under Hotel Street, connecting to the at-grade level concourse, or could move up to a pedestrian bridge over Hotel Street, connecting to the upper level concourse. Passenger drop-off would also occur on the new Proposed Street 1, south of Cadiz Street on the west side of the station These passengers would enter the station at the at-grade level.

The station would be served by two five-level parking facilities for as many as 5,500 vehicles including personal cars, rental cars, valet service, and employee parking. The parking capacity would be split between two facilities, one located adjacent to the station, south of Cadiz Street, and one located east of the station on the other side of the UPRR tracks, along Austin Street. Both the Cadiz Street and the Austin Street facilities would be connected to the station by enclosed, elevated pedestrian bridges. The pedestrian bridges would enter the station at the second level. From there, passengers could circulate down into the concourse at-grade level or move directly to the platforms above.

Connectivity of the station would be vital to Downtown Dallas and the adjacent neighborhoods. Hotel Street would be rebuilt from IH-30 to connect to Belleview Street, which would be extended to South Riverfront Boulevard. A potential future enclosed pedestrian bridge could extend north from the station, crossing IH-30, leading to a new passenger drop-off plaza at Hotel Street. The pedestrian bridge could then be extended east across Hotel Street and the UPRR tracks to a new plaza at Lamar Street, providing additional pedestrian connectivity into Downtown. Both Lamar Street and Hotel Street could be enhanced for encouraging pedestrian movement between the station, Downtown, and DART light rail. The pedestrian bridge from the station to the Austin Street parking facility would terminate at Austin Street with vertical circulation and a plaza connecting the station to the Cedars neighborhood north of the UPRR tracks. Bus drop-off would also occur at this Austin Street plaza. The Project would continue coordination with NCTCOG to support connectivity to the potential future Dallas-Fort Worth system.

6.8.2 Roadway Access Improvements

2026 Access Improvements

- Riverfront Boulevard at Cadiz Street: The addition of a southbound right turn lane would provide dual right turn lanes to accommodate heavy right turn movement from southbound

Cadiz Street to westbound Riverfront Boulevard, reducing overall intersection delay and improve the intersection LOS from F to C.

- Riverfront Boulevard at Corinth Street: This intersection operates at LOS F even without the addition of station traffic due to high delays, primarily along Riverfront Boulevard approaches. The addition of a second southeast bound left turn pocket along Riverfront Boulevard and a new traffic signal that allows protected movements would improve the overall operation to LOS C in 2026.
- Belleview Street at S. Akard Street: This intersection experiences high delay for the stop-controlled northbound Belleview Street approach. Converting the intersection to an all-way stop-controlled intersection would reduce overall delay and improve the LOS from F to C in 2026.

2040 Access Improvements

- Riverfront Boulevard at Cadiz Street: Similar to the mitigation proposed in 2026, the addition of a southbound right turn lane would result in the improvement from LOS F to D in 2040.
- Riverfront Boulevard at Corinth Street: In addition to the mitigation proposed in 2026, adding a northeast bound right turn lane along Riverfront Boulevard would improve the overall operation to LOS D in 2040.
- Lamar Street at Corinth Street: Providing an additional northeast bound right turn lane on Corinth Street would be needed to reduce the overall delay and improve the LOS from F to C in 2040.
- Belleview Street at S. Austin Street: The addition of an eastbound right turn lane on Austin Street would improve the intersection LOS from E to D in year 2040.
- Belleview Street at S. Akard Street: Similar to the mitigation proposed in 2026, converting the intersection to an all-way stop-controlled intersection would result in the improvement from LOS F to C in 2040.

7 Power Supply, Signals and Communications Systems

The goal of the TCRR project is to transfer the Shinkansen state-of-the-art HSR technology to the Dallas to Houston. Underpinning the regulatory approval to operate the N700 based HSR technology in this corridor would be the transfer of the seamlessly integrated JRC system of signaling and communications with Texas-designed and -constructed infrastructure that would be operated and maintained in a manner that combines JRC experience and innovation to meet or exceed FRA requirements for safe operations.

This section outlines the specific elements of the proposed HSR systems infrastructure to support FRA environmental analyses. A general description of the traction power, signaling and communication systems is included, with a focus on the physical infrastructure and facilities that would house those systems. This section also addresses the expected electrical power demands of the proposed system and operations. All quantities and measurements are approximate and derived from assumptions identified herein.

7.1 Components of Systems

Systems of the proposed Project consist of the following three components:

- Traction Power Supply System
- Signaling System
- Communication System

7.2 Traction Power Supply System

The Traction Power Supply System provides the electric power to the trains and is composed of the following components:

- Connections to electrical transmission line utilities.
- Traction Power Substation (TPSS): A TPSS is the place in the electrical network where the incoming 138kV incoming utility service is converted to the 25kV utilization voltage required by the trains to operate. A TPSS is required approximately every 25 miles (40km) along the alignment.
- Sectioning Post (SP): A SP is the location where the Overhead Catenary System (OCS) circuits are split between adjacent TPSS and are located approximately 12 miles (20km) from a TPSS.
- Sub-Sectioning Post (SSP): A SSP is used to split the OCS circuit between TPSS and SP and are located approximately six miles (10km) apart.
- Auto Transformer Post (ATP): An ATP is used to boost the catenary voltage at the terminal ends of the line in lieu of providing an additional TPSS.
- Overhead Catenary System (OCS): The OCS is mounted above the track on catenary poles and distributes power from the TPSS to the trains.

7.2.1 Utility Connections

Power to each TPSS would be supplied from a connection to a 138kV transmission line from the local utility near each TPSS. In general, each TPSS would be located adjacent to, or within one mile of existing 138kV transmission lines. There are instances, however, where the connection would be greater than one mile. These connections to the transmission line have been included in the conceptual engineering limit of disturbance (LOD).

The transmission line connection at each TPSS would terminate on utility circuit breakers in either a loop-in or radial connection. The configuration would depend on the requirements of each utility and the redundancy requirements of the traction power system.

7.2.2 Traction Power Substation

The TPSS would consist of four distinct functions:

- Incoming utility circuit breakers
- Traction power transformers
- 25kV 60 cycle electrical distribution
- Controls for the traction power system

The utility equipment would consist of 138kV three-phase AC circuit breakers, disconnecting switches, load break switches, current and voltage transformers for metering, surge arresters, and any additional equipment required by the utility to provide the connection.

The traction power transformers would be 138kV to 25kV Scott connection transformers. As shown in Figure 16, this type of transformer produces two single-phase power circuits from a three-phase input. The single-phase circuits are designated M side and T side, which are electrically 90 degrees out of phase with each other. The TPSS system would require two transformers in the final operating system.

A decision to include one or two transformers in the initial system and the individual size of the transformers would be determined through detailed traction power modeling for the preferred alignment. Nonetheless, the LOD included in the conceptual engineering would be more than adequate for final electrical equipment selection and layout design.

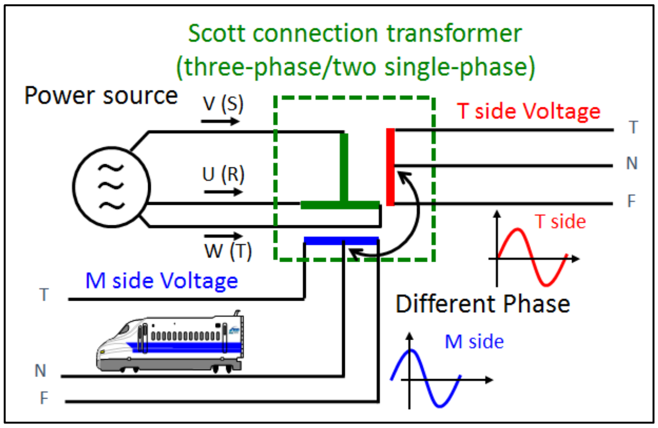


Figure 16: Scott Connection Transformer Diagram

Figure 17: Typical Traction Power Transformers

The transformers would feed 25kV single-phase distribution equipment, which would provide four circuits to the overhead catenary system: two for each track, and two in each direction. The distribution equipment would be installed inside or outside a building (depending on equipment requirements) on the TPSS site, which would provide system security, noise reduction, and aesthetic treatments as appropriate for each site. The building would be equipped with a heating, ventilation and air conditioning (HVAC) system for climate control.

The distribution equipment would include single-phase AC circuit breakers, disconnecting switches, load break switches, auto transformer, change-over switch, current and voltage transformers for metering, discharge panel and surge arresters.

The switchboards and controls would be housed within the same building. The switchboards would include control and relay panels, fault locators, an interlinked breaking panel, remote monitoring and control devices, and a DC battery system. The DC battery system would allow for control voltages to all high- and low-voltage distribution switchgear and for monitoring voltages to all power equipment condition. These remote monitoring and control devices would allow remote control and monitoring of the traction power system from a centralized Operations Control Center (OCC).

The secondary utility service would supply required voltage power to the TPSS facility to provide power while the traction power system is off during maintenance hours. This additional utility service would be derived from the 138kV via a separate step-down transformer or from the local 15kV utility network.

7.2.2.1 TPSS Facility Size

A TPSS is the largest of the electric traction power system's facilities and typically would have a footprint of 1,000ft (304.8m) by 500ft (152.4m), covering approximately 11 acres (44515m²), including allowance for utility substations, required traction power distribution equipment, parking, and other site features. The conceptual footprint shown for the LOD in the conceptual design drawings (Volume 3) varies given that there is some flexibility for layout and each site was configured based on environmental constraints and property limits. The site specific arrangement of equipment could be adjusted to minimize environmental impacts during more detailed design. Figure 18 and Figure 19 illustrate typical TPSSs.

Figure 18: Photo of Typical Traction Power Substation on Tokaido Shinkansen in Rural Area

Figure 19: Photo of Typical Traction Power Substation on Tokaido Shinkansen in Developed Area

7.2.3 Overhead Catenary System

The OCS is the system that provides electric power from the TPSS to trains. The OCS would consist of the wires that run above each track and the associated support equipment. The train would be connected to the OCS by a mechanism known as a pantograph. Each trainset would have two pantographs, as shown in Figure 20, which are used to collect power from the OCS at operating speeds and supply that power to the electric motors mounted in the bogies of the trainset. The two pantographs in a trainset would be electrically connected to reduce sparking from the gap between wire and pantograph via cable on the roof of the train. The power transmission system would be designed to prevent phase faults when a trainset traverses between adjacent tracks.

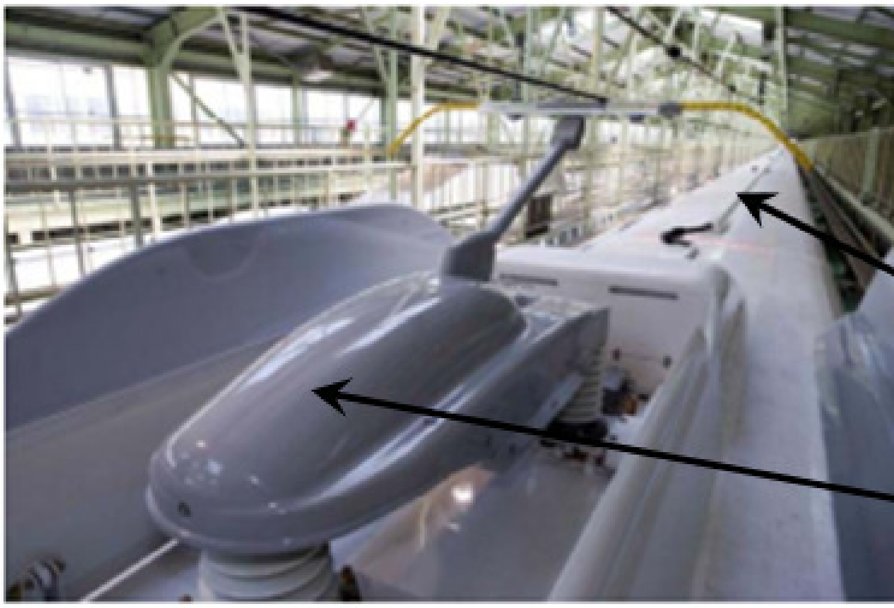


Figure 20: Electrical Interconnection of Pantographs

In addition, the pantographs have been designed to be aerodynamically efficient in order to achieve a stable current collection between the pantographs and OCS. In addition to the aerodynamic design of the pantograph, insulator covers around the pantograph would further assist in reducing noise created by the train at high speeds. The insulator covers can be seen in Figure 20 and Figure 21.

Figure 21: Shinkansen HSR Aerodynamic Pantograph

A simple catenary system, which is based upon the OCS on Tokaido Shinkansen, has been chosen as the OCS for the Houston to Dallas line.

The components of the OCS are illustrated in Figure 22.

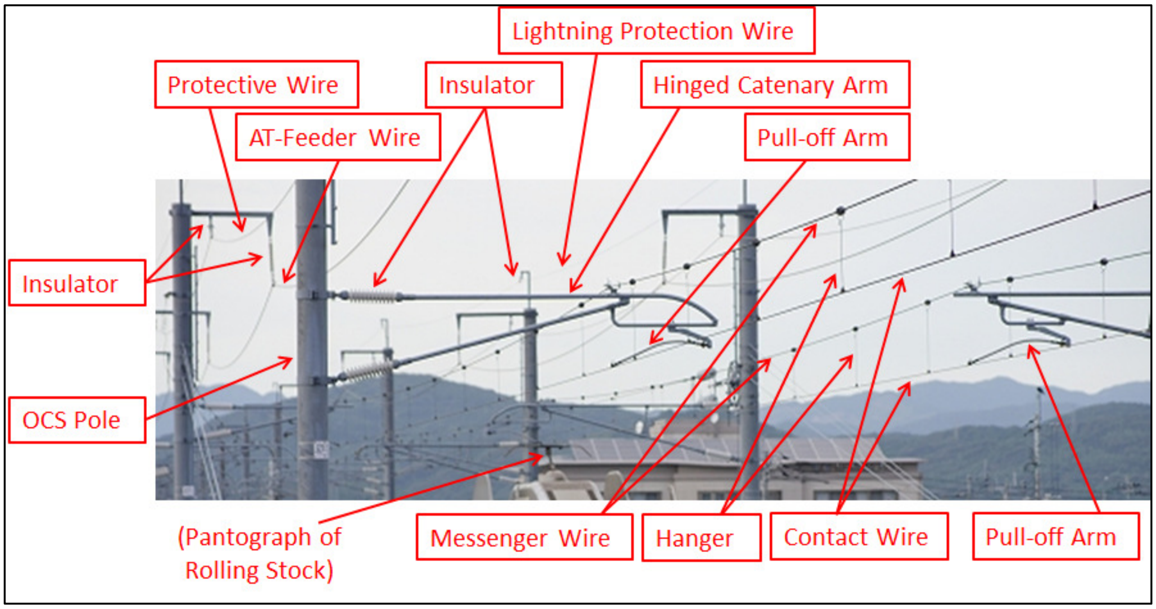


Figure 22: Typical OCS components (Simple Catenary System)

The OCS is designed to have a constant tension on the contact wire by tension balancers on the OCS poles as shown in Figure 23. This system would provide great performance and reliability for high-speed operations.

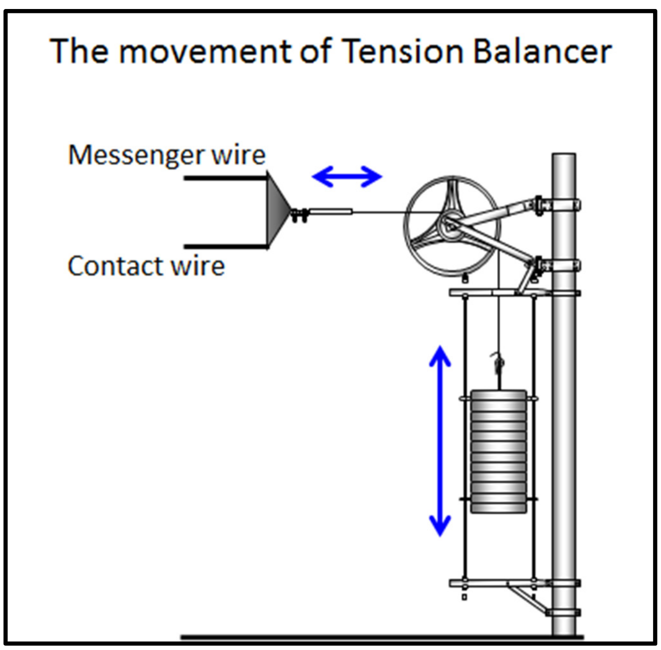


Figure 23: Tension Balancer installed on OCS Pole

Poles supporting the OCS would be located on each side of the HSR trackway and would be approximately 42ft (13m) above top of rail to the lightning protection wire, the highest element. The OCS and associated supports would generally be positioned between the pantograph (located 16.4ft (5m) above TOR) and the feeder wire (located 30ft (9.1m) above TOR). Catenary pole spacing would vary by location and would be influenced by infrastructure configuration, alignment curvature, speed and other site-specific conditions. Catenary pole spacing could range from approximately 35m (115ft) to 60m (197ft), with a typical catenary pole spacing of approximately 165 feet (50m). Typical track configuration, including catenary spacing, can be found in FDCE drawings (Volume 1).

7.2.4 Additional Traction Power Facilities

In addition to the TPSS there would be smaller facilities required for distribution and regulation of power to the OCS. These include the Sectioning Posts (SP), Sub-Sectioning Posts (SSP), and Auto Transformer Posts (ATP). Each of these facilities are described in this section.

7.2.4.1 Sectioning and Sub-Sectioning Posts

Sectioning Posts (SP) would be located between adjacent TPSSs and have several important functions in the traction power system. These include:

- High speed AC switching
- Reduction in voltage drops
- Detection of failures or faults
- Minimizing the length of failure sections during feeding faults

The SPs would be the junction point where the traction power circuits from adjacent TPSSs meet and would allow the train to seamlessly transition between adjacent circuits with minimal interruption in power supply to the train's pantographs. The circuit transition would be provided by a change-over switch system for the OCS made up of high-speed vacuum switches and a control panel for the switches.

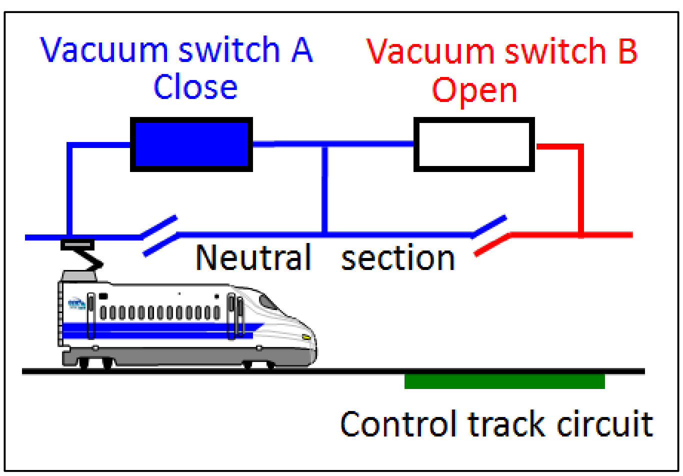


Figure 24: Change-over Switch System Diagram

As shown in Figure 24, the train would enter the neutral section of the OCS that is powered by circuit A. As the train is detected by the track circuit, the two vacuum switches operate, opening

A and closing B. The neutral section is then powered by circuit B and the train would continue with minimal interruption in power supply.

Figure 25: Typical Building of Sectioning Post (SP), Sub-Sectioning Post (SSP), Auto Transformer Post (ATP)

Sub-Sectioning Posts (SSP) would be placed between TPSSs and SPs where the distance is long, but not long enough to demand an additional TPSS. Similar to the SPs, the SSPs would reduce voltage drops and minimize the length of failure sections during feeding faults.

Under normal operating conditions, the SP and SSP would be powered by the OCS. However, a secondary power source would be required during traction power outages and maintenance hours. This secondary power source would be provided from a local utility source, likely to be a pole-mounted transformer on a local 15kV utility line.

In TPSSs, SPs, SSPs, and ATPs, auto-transformers would be provided to reduce voltage drops and electromagnetic interference in the OCS. Current flow in the case of using auto-transformers is shown in Figure 26.

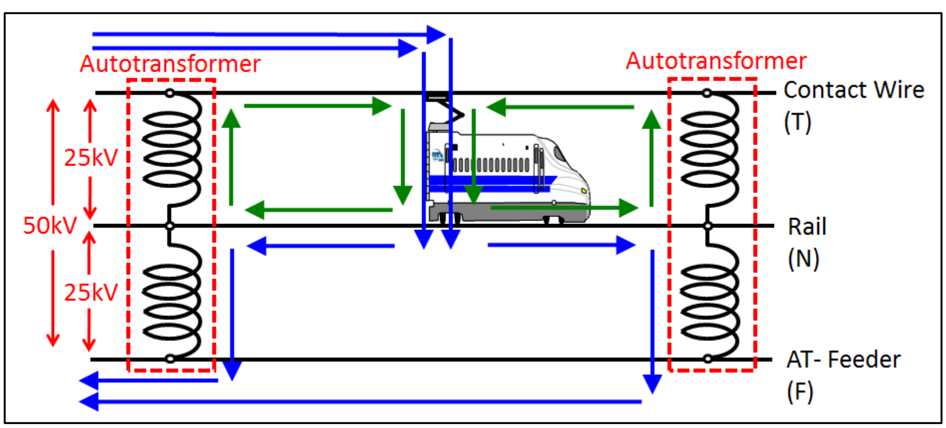


Figure 26: Current Flow Diagram (Autotransformers)

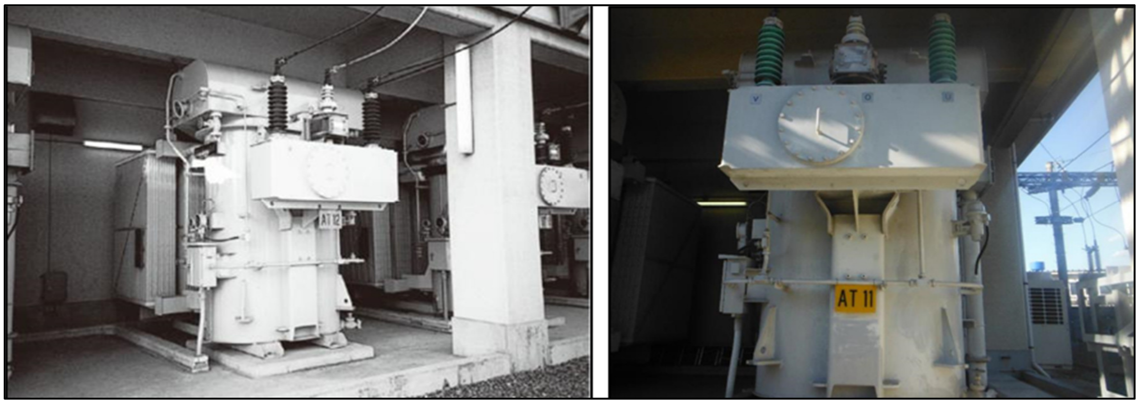


Figure 27: Typical Auto Transformers

A typical linear layout of the TPSSs, SPs and SSPs is shown in Figure 28.

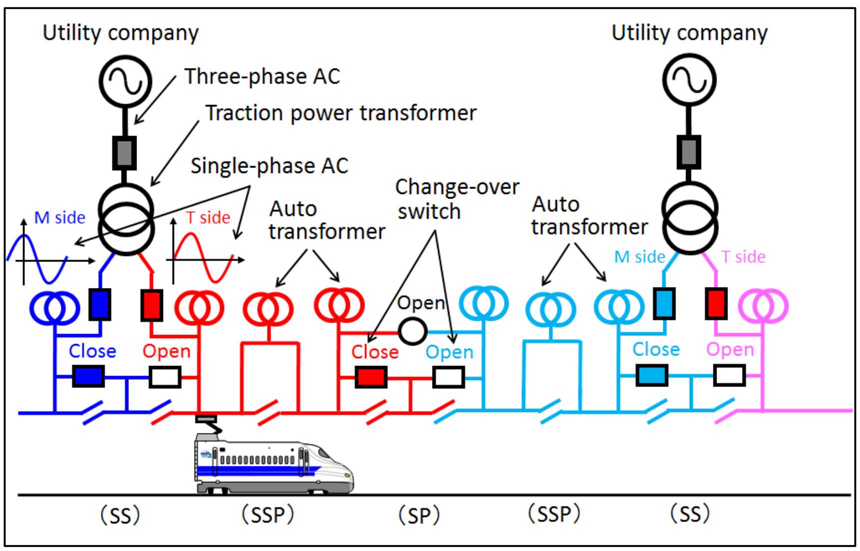


Figure 28: Typical TPSS, SP, SSP Layout

All traction power facilities, including the OCS, would be provided with a lightning protection and grounding system for safety.

7.2.4.2 Auto-Transformer Posts

Auto-Transformer Posts (ATP) would be required at the end points of the line to eliminate low voltage conditions near the two terminal stations. The auto-transformer in the ATP would have an electrical arrangement similar to that shown in Figure 26.

7.2.4.3 ATP, SP and SSP Facility Size

The secondary traction power facilities, the ATP, SP and SSP, would all have similar footprints, covering approximately 0.5 acres (2023m²) each, including allowance for parking, a small electrical building and other site features.

Facilities would vary in size depending on the complexity of the track location being controlled and the amount of equipment required at each location. Individual facility sizes and site specific designs would be developed during more advanced design. The below table provides the estimated sizes for each facility used for the DCE design to establish the Project LOD. The exact size and configuration shown on the LOD in the conceptual design drawings (Volume 2) varies by location, given site constraints and property limits. The configuration could be adjusted to minimize environmental impacts during more detailed design.

Table 16: Power Facility Size Table

Facility	Yard Size		Building Size	
SP	130ft x 200ft	39.6m x 61.0m	65.5ft x 33ft	20m x 10m
SSP	100ft x 200ft	30.5m x 61.0m	65.5ft x 33ft	20m x 10m
ATP	100ft x 130ft	30.5m x 39.6m	65.5ft x 33ft	20m x 10m

7.2.5 Traction Power Facility Locations

The traction power facilities were spaced out along the alignment as required to support estimated power demand and possible connection points to the electrical transmission system. This resulted in distances provided in Table 17 below. The distances between traction power facilities vary based on optimizing the locations of TPSSs.

Table 17: Typical Separation Distances for Traction Power Facilities

Facilities	Distance	
	Miles	Km
TPSS to TPSS	20-25	32-40
TPSS to SP	8-12	12-20
SP to SSP	4-9	7-15

Based on the separation distances shown in Table 17, each of the six end-to-end alignments have the following number of electrical facilities.

Table 18: Number of Traction Power Facilities

Facility	Alignment A	Alignment B	Alignment C	Alignment D	Alignment E	Alignment F
SP	11	11	11	11	11	11
SSP	11	12	10	11	12	10
ATP	2	2	2	2	2	2
TPSS	14	13	14	14	13	14

The number of traction power facilities shown in Table 18 includes requirement based on spacing, maintenance facilities, and stations. Each of the facilities currently expected to support operations, including TMFs and stations, are located on a track schematic for each alignment alternative in the FDCE drawings package (Volume 3).

7.3 Signaling and Communication System Infrastructure Requirements

To allow the safe operation of the train along the ROW, signaling and communication systems components need to be located in various small structures along the right of way. These facilities would be located close to the ROW to support connections to the track and to facilitate radio communications with crew and control systems within the train and maintenance crew operating along the ROW or in close proximity.

The location of each of these facilities would be flexible enough to allow for site-specific layouts that minimize environmental impacts and to maximize the use of ROW requirements for multiple purposes. Where practicable, the signaling and communication systems facilities would be integrated into proposed stations or collocated with other trackside based facilities such as MOW, TMF, or traction power facilities.

Where systems facilities cannot be integrated or collocated with other facility buildings, they would be housed in independent structures. These smaller facilities would range from freestanding system cabinets to buildings of varying sizes that would be architecturally sensitive to the surrounding context. In all cases, secure fencing would enclose systems facilities. The design of systems facilities structures, spacing, and locations would be advanced during the next stages of project planning and design.

Cable troughs installed on each side of the ROW, as shown in the typical sections in the FDCE drawings (Volume 1), would provide for routing of Ground Equipment for signals, communications, and power supply cables from the connected Signaling House or control facility.

7.3.1 Signal System

The signaling system has three housing types Main Signal Houses (MSH), Intermediate Signal Houses (ISH), and Sub-Signal Houses (SSH).

Signal houses would enclose equipment such as monitoring systems, electric interlocking devices, interlocking management devices, Centralized Traffic Control (CTC) devices, Automatic Train Control (ATC) ground devices, ATC management devices, signaling cables, surge protection, insulation transformers, insulation alarm devices, train counters, distribution panels, automatic voltage regulators, rectifiers, batteries, and power supply devices for signal equipment.

MSHs would be located close to each interlocking (controlled switching locations) such as at MOW bases, TMF sites, and stations. ISHs would be located such that the distance between signal houses would be less than 25 miles (40km). Because there are many switches at stations and TMFs, SSHs are smaller signal houses located at stations and TMFs to provide additional signal power to the many switches. Each MSH would:

- Support Automatic Train Control for an approximately 60 mile (100km) long section of track.

- House signal system computer equipment.
- Communicate with adjacent signal houses to provide uninterrupted control along the line.
- Support security of the track through integration of signaling and intrusion protection systems.
- Monitor speed of operation and distance through the cab signaling system.

The ISHs and SSHs between the MSHs contain the equipment that interfaces to the actual track for detection of the train position and integrity of the track, including broken rail detection.

7.3.1.1 Signal System Approximate Locations

For the signaling system to operate safely these houses have a fixed relationship to each other with a maximum allowable distance between them and be adjacent to the ROW. Due to the functional characteristics of the technology, the Signal Houses cannot have a distance of greater than 25 miles (40km) between them. MSHs are also provided at each station, TMF, and MOW facility. The ISH are located between the MSHs where MSH facilities are greater than 25 miles apart. SSHs are smaller signal houses located at stations and TMFs.

The physical distance constraints outlined above provide the guidelines for the number of facilities and their approximate locations. Table 19 shows the number and type of signaling facilities along each alignment. Each of the signaling facilities expected to support operations, including TMFs and stations, are located on a track schematic for each alignment alternative in the FDCE drawings package (Volume 3).

Table 19: Number of Signals and Communications Facilities

	Alignment						**Additional Facilities Required with Smaller MOWs with**	
Facility	**A**	**B**	**C**	**D**	**E**	**F**	**Houston North TMF**	**Dallas South TMF**
SSH	5	5	5	5	5	5	0	0
MSH	10	10	10	10	10	10	1	1
ISH	6	6	6	6	6	6	0	0

Additional small signal bungalows or cabinets would be located close to each interlocking (controlled switching locations) along the HSR line, at MOW bases, TMF sites, and stations where required.

7.3.1.2 Signal System Facility Size

Signal houses would vary in size depending on the complexity of the track location that is being controlled and the amount of equipment required at each location. The table below provides the estimated sizes for each facility used for the DCE design to establish the Project LOD.

Table 20: Signal and Communication Facility Size Table

Facility	Yard Size		Building Size	
SSH	60ft x 80ft	18.3m x 24.4m	50ft x 50ft	15.2m x 15.2m
MSH	130ft x 100ft	39.6m x 30.5m	100ft x 40ft	30.5m x 12.2m
ISH	130ft x 130ft	39.6m x 39.6m	100ft x 40ft	30.5m x 12.2m

7.3.2 Communications System

The communication system has two types of communications systems along the ROW, fixed and mobile.

The fixed communications network would provide voice and data along entire ROW with connection points at stations, MOW, Traffic Control center, and along the track at 6 mile (10km) intervals. The connection points are Communication Houses (CH). The CHs would support the operational systems required along the track, such as Traction Power Control (via SCADA), Security and Access Control, telephone, WiFi, and environmental condition monitoring (including seismic and rail temperature). CH yard and building size would be approximately as shown below:

- Yard size: 25ft x 30ft (7.6m x 9.1m)
- Building size: 16ft x16ft (4.9m x 4.9m)

The fixed communications system would also support the radio system that provides mobile communication for on board train systems, train crew, and maintenance workers. Radio towers would enable the mobile communications network. The final design of tower heights and locations would consider existing topography and ensure continuous communications with the train when operating along the line and enable maintenance workers to communicate using a handheld radio along the line. Where the track is elevated, coverage is required under the structure as well as above the train.

Using Radio Frequency (RF) software modeling techniques, the distance between radio towers was determined to be approximately 6 miles (10km) assuming a typical at-grade section of alignment and with the antenna located 50ft (15m) above TOR. In areas where the track is elevated, the height of the antenna would be increased to ensure coverage. Figure 29 shows the principle for train based communications with the handoff zone being sufficient to continue communications. For purposes of environmental planning 49 CHs were located along each alignment. CHs are located for each alignment alternative in the FDCE drawings (Volume 2).

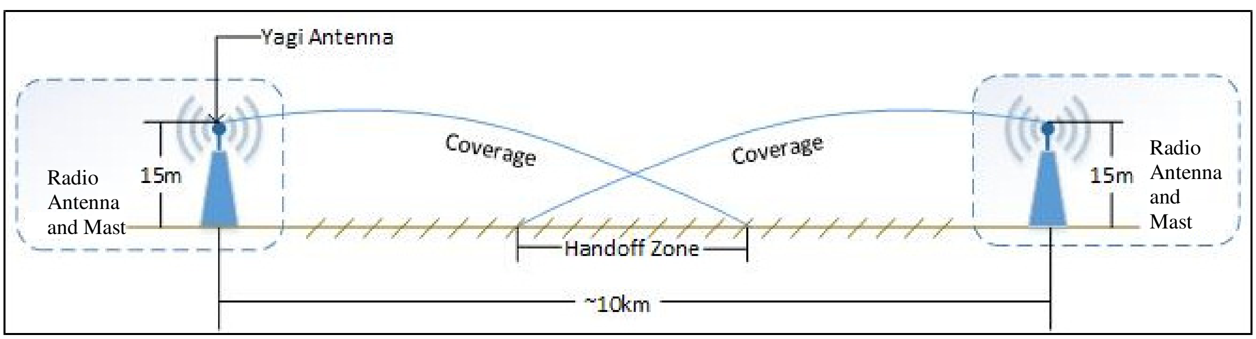


Figure 29: Typical Mast Spacing with Antenna Mounting Height of 50ft (15m) above TOR

The antenna masts could be either monopole or lattice type construction as shown in the typical tower configurations in Figure 30. These images are typical of those used by other railways for radio communications, but the antenna at the top of mast shown in the figure is a Panel type used for GSM-R. The final choice of antenna used for this Project would be determined by the RF analysis, but is likely to be a more open form rather than a solid object and have less visual impact.

Figure 30: Typical Monopole and Lattice Mast and Antenna at Grade

Public communications for passengers on the trains or at stations would use the existing public communication infrastructure. Within the train on board equipment would be used to relay and strengthen public communications systems, including:

- On-board passenger Wi-Fi
- On-board passenger information systems
- On-board mobile coverage

There is no planned associated trackside equipment for support of public communications systems as all augmentation equipment would be located in the trainset.

8 Roadway Works and Grade Separations

The LOD provided in the DCE represents proposed roadway works and associated limit of grading within adjacent parcels. Roadway works are required for:

- Access to the HSR ROW.
- Roadway grade separation where the roadway is reprofiled to cross above or below the proposed HSR.
- Rerouting of existing public roadways or private property access roads to facilitate full grade separation of all vehicular roads from the HSR line.

This section describes the various roadway works and grade separations between existing transportation infrastructure required for the Project alignment alternatives. The intent of the DCE was to provide equivalent or improved access where practicable.

8.1 Roadway Categories

Roadways included in the Project and as shown on the FDCE drawings (Volume 4) are generally considered as either “Private” or “Public” and fall into four general categories as defined below:

- Private Roads – Roads used solely for HSR operations and maintenance work or for private property access. Private Roads are categorized as either:
    - Proposed HSR MOW Access – New private access roads used by TCRR personnel to support maintenance and operations efforts along the HSR ROW. No public access would be permitted on these roadways. These roads would be accessible to emergency response providers to ensure full access along the ROW for emergency response. Intrusion protection infrastructure and systems would be developed during more advanced design. Design criteria, access, and security requirements would be closely coordinated with Project stakeholders.
    - Proposed Private Roads – New, realigned, or reconfigured private roads providing access to properties along the HSR ROW.
- Public Roads – Roads that would be accessible to the general public. Ownership and responsibility for maintenance of these roads would be by the appropriate local, municipal, county, state, or federal authority. Design details, ownership, and maintenance responsibilities for these roads would be closely coordinated with the appropriate Project stakeholders during more advanced design.
    - Proposed Public Roads – New public roadways. In many cases proposed roads were designed to facilitate ROW access for TCRR and emergency access needs, but would also improve connectivity or provide access to properties along the ROW. As such, they were not designated as HSR MOW Access roads.
    - Realigned Public Roads – Realignment or reconfiguration of existing public roadways. In some cases, public roads are rerouted along the HSR alignment to achieve grade separation and would also serve to provide access to the HSR ROW.

The FDCE design also shows where segments of existing private or public roadways are proposed to be removed for construction of the Project. This was classified on the drawings as Roadway Removals.

8.2 Parallel Access Roads

Where new roads were proposed, the general approach was to follow HSR alignment to minimize LOD and impacts. Roads were generally aligned to run parallel to the rail corridor and join existing roadways. Where the intersecting roadway is reprofiled to achieve grade separation with the HSR, the proposed parallel roadway would diverge from the HSR alignment and follow the grade separation embankment until joining with the crossing roadway. Keeping the access road next to the grade separation embankment would reduce the ROW required.

8.3 Roadway Grade Separations

Combined, the alternative Project alignments intersect with 629 public and private roads. All roads would be fully grade separated from the HSR alignment.

Roadway treatments for each crossing, public and private, are proposed in the DCE and fall into the following general categories:

- Road Under Rail – HSR is designed to pass above existing or proposed roads.
- Road Over Rail – Proposed new, reconfigured, or rerouted roads are designed to pass above the proposed HSR.
- Reroute – Proposed rerouting of an existing road to eliminate the crossing. Rerouted roads would generally cross either above or below the HSR in a different location, or would be connected to another existing or proposed roadway to maintain connectivity.
- Road Closure – Proposed closure of a roadway to eliminate the crossing. No public roads are proposed for closure by the Project. Private road closures are proposed where private properties served by the private road would be purchased to construct the Project or where new access to private properties adjacent to the HSR ROW is proposed. Proposed changes in access to all private properties impacted would be closely coordinated with the property owner.

A detailed table of road grade separations, including site specific clearances and roadway classifications based on TxDOT guidance, is provided in Appendix C. Each road crossing is identified on the FDCE drawings (Volume 4) with a crossing ID that can be found in Appendix C.

8.3.1 Roadway Treatments

Designing road grade separations can be rather complex depending on the number of site-specific issues and affected Project stakeholders. In addition, a multitude of roadway network alternatives could be evaluated for each unique location. The design team developed guidelines to make the process more uniform and efficient. These guidelines narrowed the options evaluated so that a recommended alternative could be selected objectively and without bias. The narrowed list of designed road grade separation options is shown below. The design team determined which road treatment to propose at each road separation using the criteria listed. The counts in Table 21 and Table 22 reflect the current proposed treatments as shown in the FDCE drawings (Volume 2 and 4).

During more detailed design development, the results of environmental analyses, field investigations, and input received from stakeholder coordination would be incorporated into the review of impact mitigation methods and roadway crossing treatments. This could result in improvements to the proposed roadway network. Additionally, site specific grade separation treatments and road modification strategies may change based upon this coordination. The following considerations and stakeholder coordination efforts would be factored into site specific approaches during more detailed design.

- When the property purchase process begins, parcels that were previously believed to need access may no longer need it. This could change the location and width of access roads, as well as the treatments of roads leading to those parcels.
- Exceptions to the general design guidelines in specific areas may be incorporated to reduce impacts and improve constructability.
- Dirt or gravel roads proposed to be closed might be designated for improvement.
- Additional viaduct lengths may be considered. While viaduct construction is generally costlier, it may prove to be more cost-effective during further design development when roadway works and impact mitigation measures are coordinated with Project stakeholders.

Road Under Rail

- When HSR track is on viaduct passing above the roadway, this treatment is preferred as it minimizes impacts to the roads below. In some cases, the road is proposed to be lowered to allow enough clearance to the bottom of the HSR structure. If the road is proposed to be lowered, it is noted in Appendix C.
- For roads that would be reconstructed to cross under the rail, a standard approach was taken. Each grade separation was aligned and profiled using corridor modeling software. This produced a grading model with toe of slope and LOD lines.
- Site-specific issues that could be created in cases where existing roads are proposed to be lowered to achieve adequate clearance are outlined below:
    - If road is lowered, roadway approach embankments would impact properties where houses and other structures are often located.
    - Lowering roads in their current locations would limit or require modifications to property access. Additional access roads would often be required to maintain connectivity, which would result in additional impacts and costs.
    - Lowering roads below grade may cause ponding and be a nuisance during rain events. Additional drainage swales may be needed to carry water to distant low points. These additional drainage needs have been incorporated into the conceptual design.

- Nearby properties would likely be impacted from roadway approach embankments that can extend over 100ft (30.5m) from edge of pavement to the toe of slope.

Road Over Rail

- In other areas, due to HSR profile elevation relative to existing ground, the roadway is proposed to be reconstructed to go over the rail.
- For roads that would be reconstructed to cross over the rail, a standard approach was taken. Each grade separation was aligned and profiled using corridor modeling software. This produced a grading model with toe of slope and limit of disturbance lines.
- Site-specific issues that could be created in cases where roads are proposed to be reprofiled to pass above the proposed HSR line are outlined below:
  - Roadway approach embankments could impact adjacent properties and require slopes, drainage swales, retaining walls, or reconfigured access.
  - Elevating roads in their current locations would limit or require modifications to property access. Additional access roads would often be required to maintain connectivity, which would result in additional impacts and costs.
  - Building a bridge over the HSR alignment would create a new structure that a local entity must maintain, inspect, and repair. Counties may not want this additional responsibility and would prefer an alternative access road. For example, the construction cost of a five-mile 24ft (7.3m) rural roadway is comparable to the construction cost of a road grade separation over the rail. The cost of maintaining the five-mile roadway could be significantly less than the bridge. The costs and maintenance would be weighed against the impacts associated with each approach.
  - Adding bridges over HSR alignment would create additional points of overhead grade separations and safety and security concerns that must be addressed.
  - Nearby properties would likely be impacted from roadway approach embankments that can extend over 100ft (30.5m) from edge of pavement to the toe of slope.

Reroute

- As noted, no public roadways would be closed by the Project, but in many locations the approach to eliminate the crossing was accomplished by proposing a rerouting of the roadway. In many areas, due to HSR profile elevation relative to existing ground, roads would be rerouted to locations where the roads could pass below proposed viaduct sections.
- Lateral relocation of a frontage road along existing highways, particularly along the IH-45 segment, are tabulated separately in Appendix C but are counted as reroutes.
- Existing roadway crossings within 1.5 miles (2.4km) of each other were often combined into one crossing, with at least one road being rerouted. This usually improved connectivity and provided a more efficient roadway network.
- Roadways that could be reconnected with a detour of less than one mile were generally rerouted rather than providing a grade separation over the HSR alignment. Longer reroutes were considered when grade separations impacted sensitive properties. This could be for environmental reasons or other specific property impacts.

Road Closure

- No public roads are proposed for closure by the Project.
- Private road closures are proposed where private properties served by the private road would be purchased to construct the Project, or where new access to private properties adjacent to the HSR ROW is proposed. Driveways and private roads were not usually provided grade separations and alternative access was proposed.
- Local roads that terminate or "dead end" within the Project LOD were not usually rerouted or grade separated. In the FDCE drawings (Volume 4), these roads are labeled as "Road Removal" and are essentially "roadway shortenings". These are classified as Road Closures in Appendix C.

8.3.2 Public Roads

Examples of public roads include County Roads, Farm to Market Roads, Interstates, and frontage roads. Frontage roads are typically two-lane roads parallel to the highway that provide access to properties adjacent to the highway or provide access to the local roadway network. Treatments are explained in Section 8.3.1.

Table 21: Public Road Crossing Treatment Summary

Segment	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
HN	101	16	63	22	0
WT	52	13	25	14	0
IH	157	21	54	82	0
NW	26	9	14	3	0
NE	31	8	16	7	0
EW	28	4	19	5	0
EE	22	5	12	5	0
DS	46	3	41	2	0
Total	463	79	244	140	0

8.3.3 Private Roads

Examples of private roads include driveways, utility access roads, unimproved/dirt access roads or trails within private properties, and roads providing access to businesses or oil/gas well sites. Treatments are explained in Section 8.3.1.

Table 22: Private Road Crossing Treatment Summary

Segment	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
HN	44	1	14	27	2
WT	79	0	18	6	55
IH	17	0	10	2	5
NW	2	0	0	1	1
NE	5	0	3	2	0
EW	7	0	3	2	2
EE	6	0	2	3	1
DS	2	0	1	0	1
Total	162	1	51	43	67

8.4 Comparison of Highway Impacts Amongst HSR Alternatives

Each of the HSR alignment alternatives would require work along existing highways, ranging from minor lane closures to facilitate construction, to complete roadway realignments and reconstruction to ensure full grade separation of HSR and roadway traffic. Work along existing highways has the potential to impact a significant number of roadways users. Further, limiting the amount of work required along highways would also reduce overall Project costs, shorten construction schedules, and limit impact to surrounding communities. Given these considerations, a supplemental analysis of the roadway works required for each HSR alignment alternative was undertaken to help compare the alignment alternatives currently.

Three roadway work categories were quantified for each alignment alternative: interchanges, overpasses, and frontage roads. To clarify terminology:

- A highway interchange is a location where entrance and exit ramps from the highway provide access to and from a frontage road parallel to the highway. In many locations an interchange includes multiple overpass structures.
- An overpass is typically a two-lane roadway that passes over the highway. In several locations existing highway overpasses must be reconstructed to facilitate HSR construction, in several other locations new overpasses would be required to bridge over the HSR.
- Frontage roads are typically two-lane access roads parallel to the highway that provide access to properties adjacent to the highway or provide access to the local roadway network.

A comparison of roadway works required along segments common to all alignment alternatives were not tabulated since that work would not help to differentiate between competing alternatives. The Houston and Dallas Segments are identical for all alternatives; therefore, they were not included in the analysis. The analysis was performed for those corridor segments where alternatives exist, namely:

- Navarro West (NW) and Navarro East (NE)
- Ellis West (EW) and Ellis East (EE)
- IH-45 (IH) and West of Teague (WT)

Table 23: Roadway Works Required by Alignment alternative Segments

Roadway Works Category	WT Segment	IH Segment	NW Segment	NE Segment	EW Segment	EE Segment
Interchanges	--	6	--	--	--	--
Overpasses	14	7	9	10	7	8
Frontage Road Lane-mile	--	82	--	--	--	--

As shown in Table 23, there are very slight differences between the NW and NE and between the EW and EE Segments; however, there are major differences between the WT and IH Segments. There are many more interchanges and frontage road reconstruction works associated with the IH Segment. Each of these additional roadway work activities would translate to transportation impacts including significant construction activities, materials movements, lane closures, and possible interruption of access to residential and commercial properties. These impacts would be in addition to transportation impacts that result from construction of the HSR infrastructure along the IH Segment.

The additional roadway works would also translate to increased capital costs, schedule durations, and risk. Based upon a preliminary assessment, the costs for additional roadway works along IH Segment would be more than twice that for the WT alignment. In addition to the direct costs for the associated roadway works, the design and construction of the overall Project and all of its elements along the IH-45 corridor would be significantly more complicated and costly, and would carry much greater risks. Work would require extensive coordination with various project stakeholders and traffic would need to be maintained through extended construction schedules and various temporary works not required along the WT Segment.

Assessing the potential schedule implications associated with these additional roadway works was not undertaken at this level of design development. However, construction schedules would be significantly impacted by these additional works. Combined with the need to carefully phase work along IH-45, and to very closely coordinate all work through TxDOT to minimize impacts, construction of the IH Segment would be expected to take significantly longer to complete. The longer construction schedule would increase costs for all project elements, not just for the associated roadway works. Moreover, the extended construction schedule would also extend the duration of construction related traffic impacts to surrounding communities along IH-45.

9 Railroad Grade Separations

All segments of the HSR line would cross existing railroad lines. Portions of the alignment also cross through existing yards and run along existing track. Appendix D shows locations of existing railroad crossings. In all cases, the DCE includes full grade separation of the proposed HSR and existing freight rail lines.

Most interfaces with existing freight rail lines occur near Houston and Dallas. The HSR alignment intersects with active, inactive, and abandoned spurs and main lines of private and public railroad companies belonging to:

- Union Pacific Railroad Company (UPRR)
- Private Railroads
- Burlington Northern Santa Fe Railway (BNSF)
- Dallas Area Rapid Transit (DART)
- TU Electric Big Brown Steam Electric Station Rail (TUEX)

Each crossing location was evaluated to develop a proposed HSR alignment and profile that minimized impacts to existing lines while meeting design objectives. Alternatives to divert the HSR route around existing tracks and yards were considered. The alignment alternative evaluation process considered alignment characteristics and complexities in regards to viaduct structures, railroad and roadway interaction, land access issues, environmental and floodplain interaction, and project delivery risk.

10 Maintenance of Way Facilities

This section outlines the proposed program requirements for the Maintenance of Way (MOW) facilities. The MOW facilities store and service the equipment required for routine inspections and maintenance of the system. Based upon the length of the alignment, system operations, and maintenance requirements, seven typical MOW facilities would be located along the alignment, including two MOW facilities which would be located within TMFs. A typical MOW equipment yard on the Tokaido Shinkansen is shown in Figure 31 and Figure 32.

Figure 31: Typical Staging of Equipment and Materials within a Tokaido Shinkansen MOW

Figure 32: Typical MOW Track and Shop Layout on the Tokaido Shinkansen

As discussed in Sections 10.4, additional smaller MOW facilities would be required with selection of the Houston North and Dallas South TMF facilities, given their more distant locations from the terminals. The FDCE drawing (Volume 3) set includes site layouts for each of the MOW facilities being proposed, including these two smaller MOW bases.

10.1 MOW Facilities Conceptual Design Development Approach

The development of MOW facilities conceptual design was based on the following steps:

- Identification of maintenance activities required along the proposed HSR line.
- Identification of maintenance equipment required to perform those activities. This included understanding the size of the equipment, the working speed of the equipment, and the non-working travel speed of equipment.
- Identification of the approximate maximum spacing of MOW facilities that would allow for work to be performed within the limited overnight work window when revenue service is not operated. Equipment would need to leave the MOW base, perform the work, and return to the MOW base between 23:30 and 05:30.
- Definition of the program for a typical MOW site. The program includes the list of equipment that could need to be staged at any MOW site, as well as the activities, space requirements, and staffing.
- Development of a prototypical layout that defined the general overall site space required. Note that it assumed that MOW equipment would move from one location to another, so the prototypical layout would need to accommodate the largest potential grouping of MOW equipment that could be required at any location.
- Analysis of alternative sites to evaluate engineering feasibility and expected environmental impacts of accommodating prototypical layout.
- Development of the conceptual design for each selected site that identified civil infrastructure requirements and property purchase needs.

Based on the program parameters, site-specific layouts were developed and included in the Project conceptual design drawings (Volume 3). It would likely be necessary to modify certain program elements during more detailed engineering to accommodate site-specific constraints. Further, TCRR is advancing the Rule of Particular Applicability (RPA) efforts with the FRA and has also established a Railroad O&M team that is coordinating with the EIS and RPA efforts to develop an O&M Plan. This O&M plan would influence the infrastructure and systems program; however, it is expected that the approach outlined herein is conservative with respect to the "environmental footprint" identified and that future refinements would reduce the overall project footprint required for MOW facilities. Based on the conservative MOW facility spacing assumptions, it is not expected that the number or location of MOW facilities would change, but that individual locations may be reduced in size or configuration to meet O&M needs and mitigate any environmental impacts identified.

10.2 MOW Spacing Requirements

The final O&M plan would dictate spacing, layout, and equipment requirements at each individual MOW location and would be influenced by the infrastructure configuration and systems facilities within each section of the HSR line. For the purposes of the conceptual engineering and environmental assessment, preliminary analyses were undertaken to estimate the length of track that could be served by typical MOW equipment within the overnight maintenance window to determine required spacing of MOW facilities. This effort was informed by preliminary conversations with MOW equipment manufacturers regarding the types of equipment available and the travel speed of the various equipment types. The effort was also informed by the experience of the Tokaido Shinkansen regarding the maintenance time required for various activities and the spacing of MOW facilities on the Tokaido system. The Tokaido Shinkansen is a HSR system 320 miles (515km) in length from Shin-Osaka to Tokyo, approximately 80 miles (129km) longer than the proposed alignment for the TCRR HSR line. Along the alignment, there are 20 track maintenance depots, 12 of which also have a MOW equipment yard. The track maintenance depots range from 6.2 miles (10km) to 31 miles (50km) apart, with an average spacing of 17 miles (27km). Depots containing a MOW equipment yard range from 15 miles (24km) to 48 miles (77km) apart, with an average spacing of 29 miles (46km). On the Tokaido system, siding-off areas are also provided between more distant MOW bases for staging of MOW equipment storage in advance of planned maintenance activities. Provision for siding-off facilities have also been included in the conceptual engineering and are discussed in Section 10.5.

Based on analysis of alignment lengths, and considering environmental constraints along the corridor, five standalone MOW facilities were located along the alternative HSR alignments under review, with two additional MOW facilities located in the TMFs, one in Houston and one in Dallas. As noted earlier, two smaller MOW facilities were also designed and would be required with the more distant TMF locations to support terminal maintenance. The FDCE drawing package (Volume 3) includes track schematics that illustrate the layout of the HSR infrastructure for each alternative, including locations for each MOW facility and the siding-off locations.

10.3 MOW Facility Sizing

The MOW equipment stored at each facility was estimated through review of the Tokaido Shinkansen Track Maintenance plans and associated MOW facility information provided by JRC. The Tokaido Shinkansen Track Maintenance plans contain 22 different inspection items with several different inspection methods and frequencies, ranging from once every 10 days to once per year. The inspection frequencies required for the TCRR system would be developed separately as part of the O&M plan and would be done in close coordination with the RPA effort.

In the conceptual design of the MOW facilities, the following key inputs were assumed to determine the number and type of equipment stored at each MOW facility:

- Maintenance would occur daily during hours when trains are not in operation, generally between the hours of 23:30 and 05:30; however, the allowable time for maintenance operations would vary by location and would depend upon the schedule for daily operations over that particular segment.
- The length of time available for maintenance work each night would depend upon the specific work location and would be determined by the time needed for MOW equipment to leave the facility, reach the work site, and re-enter the facility. After maintenance operations,

sweeper vehicles would operate over the line to ensure that the ROW is clear of obstacles within the clearance envelope; then daily revenue service would be allowed to begin.

- Maintenance facility track quantities, lengths, and areas were designed with some margin for operational flexibility as to not constrain design or operations during future stages of detailed design.

A variety of maintenance equipment would be required to satisfy the maintenance requirements for the TCRR system. The types of equipment that would generally be required to maintain the overall system is listed below, and more specific requirements for each location would be determined during future stages of design and development of the O&M plan. As noted, equipment and staff would move from one location to another as determined by the O&M plan and routine inspections of the line.

The assumed size of each MOW facility for the DCE was based on the amount of equipment that could be mobilized to, or stored at each location. The railroad would likely own a single unit of certain equipment, such as the New Ballast Carrier, and move that equipment from location to location as work requires. Other pieces of equipment would be required at each MOW location, such as Sweeper Vehicles. The below is a listing of the maintenance equipment that could be mobilized to each of the MOW facilities.

- Motor Platform, Tower, and Inspection Car
- Wire Restringer
- Dynamic Track Stabilizer
- Ballast Regulator
- Tamper
- Multiple Tie Tamper
- Ballast Bed Cleaner KVP-S
- Motor-car
- Electricity Facility Maintenance Vehicle
- Sweeper Vehicle
- Rail-grinding machine
- Ballast replacement machine
- Ultrasonic Rail Inspector
- Hopper Car
- Shunting Equipment
- Long-rail Carrier
- Welder
- Used Ballast Carrier

- New Ballast Carrier
- Rescue Train – for MOW or ROW Train
- Trolley – 15 ton type
- Trolley – Backhoe Shovel Carrier type

The maintenance equipment needed at each specific MOW location would be dependent on the infrastructure requiring maintenance within the reach of that MOW base. The quantity and location of equipment required at each specific location, and to maintain the system overall, would ultimately be based upon the final infrastructure design and the final O&M plan. To facilitate environmental analyses and conceptual engineering of the HSR alignment and infrastructure, one prototypical MOW facility layout was developed based on a preliminary assessment of the grouping of equipment that could be required at any one location and the lengths of the maintenance equipment.

The development of the prototypical layout also incorporated key operational, maintenance, and safety considerations. For example, the MOW layout would need to be arranged so that equipment would be able to access materials storage area and to enter and leave the MOW facility without disruption to other equipment being stored or in use.

The prototypical MOW facility site layout includes the following:

- One track at least 1,500ft (457.2m) long with catenary to handle disabled trains.
- A minimum of three tracks for inspections of MOW equipment with a workshop (200ft x 85ft) (61m x 26m).
- Accommodation for fueling MOW equipment stored on any track.
- A minimum of one track for loading and unloading of material.
- An employee welfare facility (85ft x 100ft) (26m x 30.5m) that includes offices, bathrooms, storage, and other maintenance staff needs.
- Additional elements include laydown areas, interior roadways, drainage basins, and fencing.

Table 24: MOW Track Types, Quantities, and Lengths Included in Prototypical Layouts

Track Type	Quantity	Min Length (ft)	Min Length (m)
Relay	2	765	233
Safety Siding	2	455	139
Materials Loading/unloading	1	758	231
Storage	4	645	196
Ballasted loading/unloading	1	1145	349
Inspection	3	890	271
MOW Total	13		

The minimum MOW track offset from the mainline used in design was 40ft (12.2m). A minimum of 30ft (9.1m) was used between tracks within the MOW facility to support maintenance operations such as loading of equipment and materials. Additional offsets of 35ft (13.7m) were added in some areas to allow MOW activities to occur between tracks.

All special trackwork used in development of the prototypical MOW facility layout were No.9 turnouts. Some variations were used in particular locations due to site-specific constraints. The DCE includes No.12 turnouts to access the MOW facilities off the HSR mainline tracks and No. 12 crossovers located on either side of the MOW facility to provide for flexibility of operations.

The prototypical MOW facility layout is approximately 20 acres (80937m²) in area. This prototypical layout was used as the basis for site specific layouts at each location to determine the limit of disturbance (LOD) for environmental analysis. Space requirements at each location vary based on site-specific constraints, including connections to HSR tracks, roadway access, grading, drainage, and electrical facilities.

10.4 Additional Smaller MOW Facilities

Given that the TMF also includes a MOW facility, which would be used for maintenance of the HSR infrastructure between the TMF and terminal, the location of the TMF would influence requirements for MOW spacing. If the TMF is located further than 10 miles (16.1km) from the terminal, an additional MOW would be required between the TMF and the terminal.

The additional MOW facility required with selection of either the Houston North or Dallas South TMFs required since these facilities are too far from the terminals as noted in Section 11.3 would include provisions for storage of two sweeper vehicles, a small MOW inspection workshop, and employee welfare facilities.

The track types and facilities included at these locations are listed in Table 25 below. For track lengths and facility sizes see Table 30 and Table 34, facility sizes can be found in Table 27.

Table 25: Allowances for Additional MOW Facilities Included with Houston North and Dallas South TMF

Track Type	**Quantity**
MOW Base Track	2
MOW Inspection Track	2
MOW Safety Siding and Relay	2
Facilities	**Description**
Employee Welfare Facility	Cafeteria, lockers
MOW workshop	Maintenance building for MOW equipment

10.5 Siding-Off Facilities

Siding-off facilities would be constructed on both sides of the mainline at locations between MOW bases that are more than 34 miles (54.7km) apart. The siding-off facilities are a proven component of the JRC maintenance approach, consisting of a unique mechanical piece of track off to the side of the mainline tracks that slides over the tracks and drops down onto the rails to create a temporary connection. This track component, shown in Figure 33, provides access to the mainline HSR tracks without the insertion of a track switch into the mainline tracks. This eliminates the possibility of a switch failure, reduces systems requirements, and enhances safety. The mechanically operated switch would connect to two offline tracks, approximately 700ft (213.4m) in length (capable of storing the largest routinely utilized MOW equipment). When not engaged, the mechanical switch would keep equipment from moving from the siding-off tracks onto the mainline tracks.

The siding-off facilities would be used for staging of equipment close to work sites in advance of maintenance activities. Equipment would be moved to these locations overnight and stored locally during system operating hour, allowing for rapid mobilization during maintenance windows. This provides for quick mobilization of MOW equipment to work sites between distant MOW bases. Siding-off facilities allow maintenance work to be conducted for longer durations since equipment would not have to travel long distances at the beginning and end of every maintenance work shift.

Figure 33: Mechanical Siding-off Temporary Track Connection

Figure 34 shows a schematic of the siding-off facilities. The design drawings (Volume 2 and 4) show the location of the siding-off locations along the TCRR system.

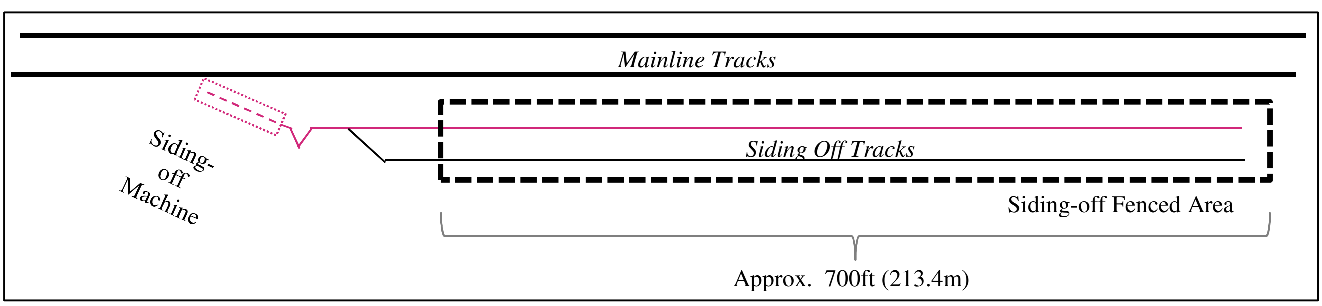


Figure 34: Schematic of Siding-off Facility

11 Trainset Maintenance Facilities

This section documents the approach for trainset maintenance facility (TMF) sizing and expected program requirements for the TMF facilities for the Project. The TMFs are critical elements of the proposed HSR system where inspections and maintenance of the train fleet help to ensure safe operations. The assumed fleet size under both the ISL and FSL stages, key considerations, and the approach taken to size and develop the TMF conceptual design and program requirements are outlined.

Site specific designs were developed for four alternative TMF sites; two alternative TMF locations at each end of the HSR alignment. Development of designs for two alternatives in both Dallas and Houston were developed to provide flexibility in the environmental analyses.

11.1 Fleet Maintenance Facility Requirements

Rail transit systems generally include either 1) a TMF with both Service and Inspection (S&I) and overhaul facilities near one end of the line and a TMF with only S&I facilities near the opposite end, or 2) two TMFs with S&I facilities, with one on each end, and a TMF with only overhaul facilities elsewhere.

The proposed system under the ISL has a relatively small fleet, and locating all maintenance activities and crew facilities would provide efficiencies with respect to capital costs and operations and maintenance (O&M) costs. However, there are downsides with a single facility, including the need to move empty trains, known as "dead-heading," before or after service hours; the potential that a disabled/out-of-service train must be moved a long distance to a facility for service; and, the need to provide storage and light repair capabilities at the remote terminal. Initial operations review has demonstrated that the FSL would likely require two facilities due to its larger fleet. Moreover, planning for full S&I and overhaul facilities at each location is the most conservative approach to analysis of environmental impacts and provides flexibility for more advanced fleet maintenance planning during later stages of design development and O&M planning. As such, the FDCE drawings (Volume 3) developed for the DEIS includes the following:

- A conceptual design and associated LOD for two TMFs, one on each end of the line. The LOD and program for all four TMF locations studied included consideration of train storage, S&I, and overhaul facilities.
- Trainset storage and servicing infrastructure requirements are shown for the FSL in the conceptual design and the resulting LOD provides for a conservative environmental analysis. Additionally, the required expansion for future storage and servicing capacity to accommodate the FSL fleet requirements is indicated in the conceptual design and included within the LOD.
- At this early level of planning, adequate space at each TMF has been provided in the conceptual design to accommodate overhaul facilities. However, it is expected that overhaul capabilities would only be needed at one TMF site. The preferred location of trainset

overhaul capabilities would be determined through more detailed operational and infrastructure planning analyses currently underway.

More advanced planning, design, and operational analysis would be required to determine the distribution of activities at each site over time, in close coordination with ridership analyses and financial planning regarding service growth. The TMF facility planning and site design has been developed to support phasing so that during the ISL phase, either facility can be built out initially as a TMF with combined S&I and overhaul facilities. Under this approach, the environmental process would “clear” the maximum LOD that may be required so that each facility could ultimately be expanded to serve as a TMF that would meet the complete range of fleet maintenance and train storage needs for the FSL.

Site-specific layouts for each TMF facility are included in the FDCE drawing package (Volume 3) provided to support EIS documentation.

The figures below illustrate typical TMF facility and storage yard arrangements.

Figure 35: Typical Storage of Trainsets within a Tokaido Shinkansen Yard

Figure 36: Interior of Typical Maintenance Shop on the Tokaido Shinkansen

Figure 37: Exterior of Typical Maintenance Shop on the Tokaido Shinkansen

11.2 Proposed Fleet Maintenance Conceptual Design Development Approach

The development of TMF conceptual design documentation for the EIS was based on the following steps:

- Estimation of the fleet size for the ISL and FSL.
- Estimation of maintenance facilities and storage capacity required for the overall system at ISL and FSL.
- Definition of the program of activities that would occur at each TMF location – listing of activities, space requirements, staffing, etc.
- Development of a prototypical layout that defines the general overall site space required.
- Analysis of alternative sites in both Dallas and Houston to evaluate engineering feasibility and expected environmental impacts of accommodating the prototypical layout.
- Selection of feasible sites.
- Development of the conceptual design for each selected site that identifies civil infrastructure requirements and LOD. Two optional TMF locations at each end of the alignment were proposed.

11.3 Key Assumptions and Considerations

The key assumptions and considerations underlying the conceptual engineering design of TMF facilities include the following:

- Timing of service growth from the ISL to the PSL is uncertain, but would respond to demand, to the extent practicable given fleet procurement schedules. Greater certainty would be achieved through ridership, operational, and fleet procurement studies currently underway.

- For the purposes of EIS documentation, it is assumed that the ISL would require 15 trainsets and the FSL would require 20 trainsets.
- Conceptual design and development of the associated LOD at both Dallas and Houston would provide for fleet storage, S&I, and trainset overhaul capabilities that would, in combination, meet the full system needs for the FSL. Ultimately, trainset overhaul facilities may only be constructed at one end. This conservative approach would provide the greatest flexibility in planning and design development by securing environmental approval for two full service locations through the EIS.
- At the ISL stage, in the early years of operations, the maintenance and storage requirements at the TMFs would be limited as described herein. However, the site selection effort was based upon the full buildout design for the FSL.
- The conceptual engineering for the EIS identifies the LOD for the full buildout for the assumed FSL fleet size.
- TMFs should be located as close as practicable to either terminal. If the facilities are too far from the terminals, it would require dead-head moves (movement of empty trains), which would increase O&M demands and create excess train movements, limiting long-term system capacity. For the purposes of planning and site selection, a maximum distance of 10 miles (16.1km) between the terminal and the TMF is recommended to minimize deadhead operations.
- The program, layout, and facility sizing was informed by the Kumamoto General Depot facility on the Kyushu Shinkansen system. Adjustments were made for Project operations based on operational modeling and guidance received from JRC.

11.3.1 Key TMF Design Criteria

The following yard planning and design criteria are assumed for each site specific TMF. These were developed with guidance from JRC and the O&M team.

- The track layout should minimize any single points of failure.
- Each trainset would be an eight-car fixed-consist bi-directional (train can operate in both directions without turning around) trainset. All trainsets would be single level.
- Access to the TMF would be via a “flat junction” at the connection to the mainline HSR tracks. This would require “reverse running” on the mainline HSR tracks for moves to and from the yard from one direction, but is not expected to create any operational capacity limitations given current service plan assumptions. No. 16 turnouts limited to 43.5 mph (70 km/h) would be used for the mainline connections.
- Designs include track and special trackwork layouts that allow for changing from ATC mainline mode to ATC Shunting Mode (operations limited to 18.6 mph (30 km/h)) on the departure and arrival tracks. A dedicated area where trains can stop to switch between ATC mainline mode and ATC Shunting Mode is required before entering S&I tracks. The minimum length of the ATC switchover track was set at 1000ft (300m).

- Layouts allow for two dedicated track segments and associated crossovers between the TMF and the HSR mainline to support parallel moves to and from the yard without conflict on the mainline HSR tracks.
- Layouts provide sufficient segments of track to support “sectionalizing” between the mainline HSR traction power circuit and the TMF circuit. The OCS Changeover track length was determined by JRC to be 2,625ft (800m) and includes 656ft (200m) of tangent track on each end to support required air gaps in the overhead catenary system (OCS).
- The separation between mainline HSR operational control and yard operational control would be just beyond the limits of the OCS Changeover segment, and ahead of the ATC switchover track. In the event that a HSR train is “held” at the limits of yard control, the design provides a full train length of track between the OCS Changeover segment and the ATC switchover track. This would avoid the need to restart a held train within the OCS Changeover limits, which could cause arcing between the pantograph and OCS if the pantograph of the held train falls within the required 656ft (200m) air gap section.
- The TMF layouts support safe separation of the facility from the HSR service tracks through the use of overrun protection coils, fencing, and other means in accordance with JRC design standards and operating practices.

Layouts within the TMF footprint include:

- A train car wash location and associated trackwork arrangement that would provide full flexibility to access or bypass the carwash by moves to and from either the shop or the yard.
- Traction power substations (TPSS) for the TMFs were located near to the OCS Changeover area to limit lengths of high voltage connections.
- One track adjacent to the trainset maintenance shop to support both wheel truing and unscheduled repairs. This track would be a minimum of 1700ft (518m) long. A small dedicated shop building of sufficient length to install necessary equipment for unscheduled repair and wheel truing would be centered on this track and would allow the full train to move back and forth through this shop building so that wheel truing or unscheduled repairs can be made on any car in the trainset.
- One of the tracks for general overhaul would need to be without overhead catenary. Small equipment would be used to move trains in and out of this track. As such, the TMF layouts include a full train length relay track from which this equipment would operate. In this way, equipment coupled to a trainset, or to train cars, ready for general overhaul would only operate between this relay track and the two general overhaul tracks to minimize the potential for collisions between the equipment and trainsets.
- Track spacing in the yard was designed in accordance with JRC Standards to be operationally feasible and support OCS structures and level boarding platforms.
- Each yard stabling track was designed to have only one trainset so that no storage of multiple trainsets on a single track would be required. The approximate train storage length on each stabling track was designed to be a minimum of 955ft (291m) to allow for derail protection and bumping posts.

- Each TMF was designed to include a maintenance of way (MOW) base with a track connection and safety sidings designed that would protect against MOW equipment collisions with the trainsets.
- Yard and shop facilities would ultimately be designed to comply with JRC Standards and all applicable federal, state, and local building and fire codes.

The ATC switchover track and OCS Changeover requirements drive the design of connections back to the mainline HSR. These lengthy connections also made it impracticable to develop a double-ended yard layout, which would allow a trainset to enter from one end, pass through the TMF, and exit the TMF, continuing in the same direction without any relays. The space requirements and associated capital costs of a double ended layout were determined to far exceed the benefits to afford direct access from the remote terminal, which would be undesirable given the long dead-head movements required. As such, double ended yard layouts were not developed and a relay track was included in the revised layouts for access from the distant terminal without the need to relay on the mainline. Given the expected frequency of the need for TMF access from the more remote terminal, and given service plan assumptions, this layout is not expected to create any operational capacity limitations.

11.4 Program for Trainset Maintenance Facilities

The "Program" can be generally described as the space, equipment, and maintenance requirements to operate the facility and to perform the functions intended. Based on the TMF program parameters, site-specific layouts have been developed and included in the DCE design. These designs would be modified as planning and design advances to accommodate site-specific constraints.

11.4.1 TMF Inspection Types and Frequencies

The projected inspection types and frequencies performed are listed in Table 26 below.

Note that inspection requirements would be fully detailed during development of the Inspection, Testing, and Maintenance (ITM) Program required under the RPA. The ITM program is currently under development and would ultimately require FRA approval.

Table 26: TMF Inspection Types and Assumed Frequencies

Activity	Description	Nominal Frequency
Pre-Service Inspection	Pre-service inspection with inspection of parts, pantograph, bogie, braking system, door opening and closing device, and other important safety equipment.	Every 2 Days
Regular Inspection	Regular inspection of pantograph, bogie, cab equipment, underfloor equipment, door opening and closing device, braking system, interior inspection, and function testing.	Every 35 days
ATC Inspection	Inspection of on-board ATC function (such as braking patterns) and related monitors	Every 90 Days
Bogie Inspection*	Bogie inspection including wheel check, flaw detection by magnetic particle probe and ultrasonic testing.	Every 18 months, or 600,000km (whichever occurs first)
General Overhaul*	General inspection to restore the trainset to its original condition with new parts, detailed inspection of the vehicle body and equipment, and safety inspection by testing ATC equipment.	Every 24 months
*Indicates inspections associated with general overhaul. Adequate space is provided for these inspections in both TMF sites for general overhaul operations.		

11.4.2 Servicing and Maintenance Activities Performed in the TMF

The servicing and maintenance activities performed in the TMF are listed below:

- Pre-Service Inspection
- Regular Inspection
- Train Washing
- Toilet Servicing and Watering
- Wheel Truing
- Unscheduled Inspection/Special Repairs (e.g. pantograph carbons, windscreen wipers)
- ATC Inspection

11.4.3 Overhaul Activities Performed in the TMF

- The layout and LOD of each TMF would allow for the possible construction of overhaul facilities. The servicing and maintenance activities performed at these overhaul facilities are listed below. Large Component Replacement (e.g. motor, windscreen, roof equipment)
- Bogie Inspection
- General Overhaul
  - Carbody Inspection
  - Train Testing – Static and Dynamic
  - Painting
  - Bogie Overhaul

11.4.4 TMF Facilities and Tracks

The general track and building facilities required at the TMF are listed in Table 27 below.

Table 27: General Description of TMF Facilities

Facility	Description	Footprint Size (SF)	Footprint Size (m^2)
General or Administrative			
Administration/General Office	General administrative office; employee training facilities	39,100	3,633
Employee Welfare Facility	Cafeteria, lockers	8,600	798
Traction Power Substation	Area allowed for TMF TPSS (building and yard)	330,000	30,658
Facility Substation	Electrical substation	15,000	1,394
Operations Control Center	Center for controlling/monitoring system operations Note that the location of the OCC to be determined through more detailed planning. It is expected that the OCC may be included in one of the TMF locations, but it could potentially be located in an independent location.	TBD	TBD
Trainset Maintenance Facilities			
Chemical Washing Machine	Rolling stock chemical washing area	1,500	139
Washing Machine	Rolling stock washing area	1,500	139
Maintenance Inspection Workshop	Maintenance building for MOW equipment	17,200	1,598
Wheel truing workshop		12,000	1,115
Overhaul Facilities			
Bogie Inspection, Inspection, and General Overhaul	Removal of bogie-related equipment and inspection; general overhaul; check the status and function of equipment	200,000	18,581
Painting Shop	Painting area (not specified in drawing layouts)	64,000	5,946
Facilities needed at Additional MOWs			
Employee Welfare Facility	Cafeteria, lockers	2,818	261
MOW workshop	Maintenance building for MOW equipment	7,540	700

11.5 Trainset Servicing and Stabling Requirements

The conceptual layout for the two facilities, in combination, provides for the full range of storage and maintenance needs. Table 28 and Table 29 below summarize the total capacity requirements of the TMFs.

Table 28: Trainset Maintenance Facility – Maintenance Capacity Requirements

TRAINSETS	FSL
Number of Trainsets in Fleet	20
INSPECTION SHOP	
Trainsets requiring Regular Inspections per Day (Assume trainsets undergo Regular Inspection every 35 days.)	0.6
Regular Inspections Possible per shop track per day (Regular Inspections take 140 mins depending on staff levels.)	3.4
Tracks Needed for Regular Inspections	*ALLOW 1*
Trainsets requiring Pre-Service Inspections per Day (Pre-service inspections occur every other day.)	10
Pre-Service Inspections Possible per Track per Day (Pre-service inspections take 50 mins depending on staff level.)	9.6
Tracks Needed for Pre-Service Inspections	*ALLOW 2*
Additional Tracks (Margin for maintenance operations)	*ALLOW 1*
TOTAL INSPECTION TRACKS REQUIRED FOR FLEET *(Tracks with pits for undercarriage access and walkways for roof access)*	*4* *(Provide 2 per TMF location)*
GENERAL OVERHAUL SHOP	
Bogie Inspection (600KI) – 5 days of inspection time (Although bogie inspection would happen every 12 months based on assumed annual travel per trainset, during alternate years, bogie inspection would take place concurrent with General Overhaul and does not require separate track time.) General Overhaul Inspection (1.2M GO) – 15 days of inspection time (Inspection requirements would be detailed in the Inspection, Testing, and Maintenance Program, which would require FRA approval. An estimate of 12- and 24-month cycles used here to calculate track requirements.)	5 + 15 = 20 days per trainset in 2-year period 20 trainset x 20 days per trainset = 400 days in 2-year period
Total inspection days per year	200 days per year
Overhaul Shop Tracks Required	*1 track*
Painting Tracks Required	*ALLOW 1*
TOTAL GENERAL OVERHAUL TRACKS REQUIRED FOR FLEET	*2* *(Provide 2 per TMF location)*
OTHER MAINTENANCE TRACKS	
Wheel Truing/Unscheduled Repairs	*ALLOW 2* *(Provide 1 per TMF location)*

Table 29: Trainset Maintenance Facility – Storage Capacity Requirements

TRAINSET STORAGE CAPACITY / STABLING TRACKS	
Number of Trainsets	20
Stabling Margin Required for Shunting (Tracks left open to support movement of trainsets.)	ALLOW 4 (2 per TMF location)
TOTAL REQUIRED TRAINSET STORAGE FOR FLEET	*24*
Trainset Storage Capacity at Terminal Stations (As many as 4 trainsets stored in each terminal overnight, but allow for storage/staging of only 2 in each terminal for conservative footprint.)	4
Trainsets Undergoing Service (Assume 1 trainset per inspection track)	4
TOTAL TRAINSET STORAGE REQUIRED FOR FLEET	*16* *(Provide 8 per TMF location)*

11.6 Houston Trainset Maintenance Facility

The TMF located in the vicinity of Houston would be required to serve as stabling, S&I, and potentially overhaul for the rolling stock. The TMF would provide for periodic inspections, scheduled maintenance, and unexpected repairs for out of service trainsets. The TMF could also potentially serve as the location for delivery and assembly of the trainsets.

The alternative TMF site locations evaluated in Houston are listed below.

- Houston North Location (south of US 290, west of Katy Hockley Road)
- Houston South Location (south of Hempstead Road, east of Beltway 8)

11.6.1 Houston North Location

Site Location

This location is about 27 miles (43km) from the Houston terminal. The location is just west of Katy Hockley Road and south of US 290. An additional MOW is required between this TMF site and the Houston terminal. The additional MOW is approximately 11.7 miles (18.8km) from the terminal, between Jones Road and West Road.

Site Environmental Constraints

As shown in Appendix E, the TMF site is located on primarily agricultural land. Based on available data, there are two emergent wetlands and three agricultural ditches on this site that could be impacted by the TMF alternative along the south side of the HSR mainline.

There appear to be few residential relocations required for the development of this alternative.

There is a potential recycling facility located to the east of this site; however, it does not appear active based on aerial imagery. There is also one EPA registered facility to the west of this alternative.

This location has not been surveyed previously for cultural resources. There is a moderate potential to find surficial and/or buried cultural material.

Site Layout Overview

The northern portion of Parcel TX-HA-172.000 is being bisected by the HSR mainline. The TMF layout is shifted to the east as much as possible to be within this one large parcel; however, some additional space would be needed for the fence and access to storage tracks. The additional Parcel TX-HA-O1-001.000, is currently being bisected by the HSR mainline and would be required for the current TMF layout.

At the southeast portion of the site, there is a clear space of about 65ft (19.8m) between the mainline embankment and Katy Hockley Road. This area prevents the facility from being closer to the HSR mainline without impacting the existing roadway or proposed embankment. This area also requires the TPSS location to be reconfigured on a separate parcel to avoid impacts to Katy Hockley Road. Parcels TX-HA-169.000 and TX-HA-170.900 are currently being bisected by the HSR mainline and would only require the northern portion of the parcel for the TPSS site.

Access to the facility shall be via Katy-Hockley Road. The first access point would be an upgraded existing private dirt road to allow for truck deliveries to TMF. The second access point would be a completely new road running along the MOW facility. The access roads within the TMF site would provide access to the storage tracks, shop, and MOW, and provide access to the administration building, facility substation, and parking lots. A separate access point would be required for the TPSS location off of Katy-Hockley Road for this TMF layout.

This site does not preclude a freight connection to the MOW site since there is an existing UPRR freight line to the north of the TMF along US-290. However, a freight connection was not included in the design since adequate freight connections are included to construction staging areas to support initial system construction. There is a planned freight connection to an MOW base in the middle of the line that could support deliveries. Following initial construction, it is unlikely that significant materials delivery by freight rail would be required. Additionally, the following elements would be required to make the connection, which would increase environmental impacts:

- About 2 miles (3.2km) of new freight track
- 1 roadway crossing
- 2 parcel impacts
- Multiple wetland and stream crossings

Track Characteristics

The track types, quantities, and lengths in the Houston North TMF for the FSL are listed in Table 30 below.

Table 30: Houston North TMF Location Track Types, Quantities, and Lengths for the FSL

Track Type	Quantity	Min. Length Provided (ft)	Min. Length Provided (m)
Stabling Track	8	1300	396
Inspection Track	4	1293	394
Wheel Truing/Unscheduled Repairs	1	2718	828
Car Wash	1	737	225
Relay off Mainline	1	1101	336
Inspection Shop Relay	1	767	234
MOW at TMF			
MOW S&I Tracks	7	808	246
MOW Safety Siding and Relay	2	942	287
MOW Ballast Loading/Unloading Track	1	608	185
MOW Materials Loading/Unloading Track	1	758	231
Additional MOW			
MOW S&I Tracks	4	952	290
MOW Safety Siding and Relay	2	799	244

11.6.2 Houston South Location

Site Location

This location is about 8.5 miles (13.7km) from the Houston terminal. The location is just east of Beltway 8 and south of Hempstead Road.

Site Environmental Constraints

As shown in Appendix E, the site is located on a commercially developed area with several EPA registered facilities. The site borders a landfill to the southeast. Additionally, there are two petroleum storage tanks that could require remediation or removal.

Available waterbody and wetland datasets for this area are no longer accurate due to extensive land use changes; however, one stream (Cole Creek) with a mapped 100-year floodplain bisects the property.

Desktop analysis shows two churches in the footprint of this alternative: Covenant Church of Houston and Houston Faith Church. However, site visits performed in March 2016 indicate that there are no church buildings present at these locations. Additional investigation is still required to determine if property is owned by these churches.

Data from the Texas Historic Commission reveals no archeological sites and historic properties within the proposed study area. The majority of the site has either been previously developed or utilized as a quarry. The majority of the area has low integrity for buried cultural resources.

Site Layout Overview

The Houston South TMF is located in a densely developed commercial area and impacts buildings southeast of the Beltway8/US290 connection and along the northbound Beltway 8 frontage road. Additionally, the TMF is constrained by a landfill directly north of Tanner Road and east of the proposed TMF site.

Due to the constraints of Beltway 8, the TMF is designed as a single-ended facility that connects to the mainline adjacent to Hempstead Road southeast of Beltway 8. The TMF connection requires the reverse curve in the proposed HSR mainline alignment (and crossing over the existing freight line along Hempstead Road) to be shifted to the southeast (towards the Houston terminus) so there is adequate tangent length for the crossover and turnouts to the TMF site.

To minimize impacts to the development, the TPSS site proposed at this location was limited and irregular in shape to follow the proposed lead track connections to the HSR main line. If a larger and more regularly shaped TPSS site is required, additional property impacts would be required.

It is also noted that the current aerial imagery on the Houston South TMF layout drawing does not include the following recent development:

- Additional Beltway 8 ramp to the east
- New building construction north of Okanella Street
- Building demolition on the southeast corner of the Beltway 8/US290 connection

Access to the facility would be via Okanella Street and Tanner Road. The TMF lead tracks and site would require the rerouting of Okanella Road to Tanner Road as shown on the design drawings. A new access road would be constructed to connect both access points together and to connect to various parts of the TMF. The access road would run along the yard to give access to storage tracks, shop, and MOW, and provide access to administration building, facility substation, and parking lots.

To minimize traffic and business impacts, the design for the TMF connecting tracks was conceptually designed to maintain the W. Little York crossing beneath Beltway 8. This would complicate grading of the TMF facility and additional viaduct structure along these connecting tracks, but closure of W. Little York would be considered a fatal flaw. All traffic from Beltway 8 or the Beltway 8 frontage roadways accessing the area east of the proposed TMF would have to use W Little York Road to access the commercial development area.

This site would not permit a freight connection to the MOW site without closure of W. Little York Road. This was not considered a fatal flaw since adequate freight connections are included to construction staging areas to support initial system construction. Moreover, the Conceptual Design (CD) includes a proposed freight connection to an MOW base in the middle of the line that could support deliveries. Following initial construction, it is unlikely that significant materials delivery by freight rail would be required.

Track Characteristics

The track types, quantities, and lengths in the Houston South TMF for the FSL are listed in Table 31 below.

Table 31: Houston South TMF Location Track Types, Quantities, and Lengths for the FSL

Track Type	Quantity	Min. Length Provided (ft)	Min. Length Provided (m)
Stabling Tracks	8	1439	439
S&I and Bogie Tracks	4	1111	339
Wheel Truing/Unscheduled Repairs	1	2647	807
Car Wash	1	734	224
Relay off Mainline	1	1000	305
Inspection Shop Relay	3	742	226
MOW at TMF			
MOW S&I Tracks	7	638	194
MOW Safety Siding and Relay	2	942	287
MOW Ballast Loading/Unloading Track	1	605	184
MOW Materials Loading/Unloading Track	1	758	231

11.6.3 Comparison of Houston TMF Alternatives

The Houston North TMF location has numerous advantages compared to the Houston South TMF location, including no major constraints or constructability concerns, a location along a tangent area of mainline, good local roadway access, no impacts to existing infrastructure and development, and minimal environmental impacts. Conversely, access to the Houston South TMF requires a large curve, crossing of the existing UPRR line, significant impacts to commercial development and to the local roadway network, and potential environmental impacts including an adjacent landfill and several registered EPA facilities. While the Houston South TMF has a much shorter (18.5 miles less) deadhead mileage, the large impacts to existing infrastructure make the Houston North TMF the recommended Houston TMF.

Selection of the Houston North TMF would require development of an additional MOW base near to the Houston South location to satisfy maintenance requirements. The combined cost and impact of the Houston North TMF and the additional MOW base near the Houston South TMF location would need to be weighed against the development of the Houston South TMF location.

Designs and LOD for each location were included in the FDCE so that a comparative analysis of environmental impacts could be performed by the FRA environmental analysis team.

Table 32 on the following page provides a comparison of the Houston TMF alternative locations.

Table 32: Houston TMF Site Engineering Analysis

	Houston North Location	Houston South Location
Lead tracks	No major constraints; mainline alignment mostly tangent adjacent to TMF	Mainline alignment on viaduct crossing over UPRR tracks; large curve required to enter TMF site
Deadhead Distance	~27 miles (43km)	~8.5 miles (13.7km)
Site	Yard proposed elevation located at existing ground level	Yard proposed elevation located at existing ground level
Access	Local access from Katy Hockley Rd.	Local access from Okanella St.
Freight Access	Not adjacent to freight access; UPRR line located along US-290 to north	UPRR line located along Hempstead Rd, however site constraints preclude freight access
ROW	Farm and undeveloped land – little expected impacts to existing infrastructure development	Commercial and industrial land – expected impacts to existing infrastructure development
Waters of the U.S.	2 emergent wetlands and 3 agricultural ditches	Outdated information; in 100-year flood plain, 1 stream
EPA Registered Industrial Facilities	2 potential near (not impacted)	3
Cultural Resources	Moderate potential	None
Threatened and Endangered Species	None	None
Public Facilities	None	Potentially 2
Environmental Justice Populations	None	None

11.7 Dallas Trainset Maintenance Facility

A TMF located in the vicinity of Dallas would be required and serve as stabling, S&I, and potentially overhaul for rolling stock. The TMF would provide for all periodic inspections, scheduled maintenance, and unexpected repairs for out of service trainsets. The TMF could also potentially serve as the location for delivery and assembly of the trainsets.

Two alternative locations were studied for the Dallas TMF facility as listed below.

- Dallas North Location (North of IH-20)
- Dallas South Location (North of Belt Line Road)

11.7.1 Dallas North Location

Site Location

This location is about 7.9 miles (12.7km) from the Dallas terminal. The location is just north of IH-20 and to the west of IH-45. The majority of the proposed TMF area falls within the City of Dallas (COD) parcels. The design for the TMF approach tracks (OCS Changeover limits) were developed to avoid the corner of TX-DA-063.000 and stay within the adjacent COD parcels where practicable.

Site Environmental and Topographical Constraints

The layout in this area was predominately driven by topography and flood zones.

A marker for the McCommas Bluff Landfill (shown in Appendix E) was identified in the Texas Commission on Environmental Quality's GIS database for municipal solid waste landfills. After further investigation of COD permit documents, it was determined that the actual landfill site is northwest of the proposed TMF location near the intersection of Youngblood Road and State Hwy 310. Consequently, no impacts from McCommas Bluff landfill activities are anticipated within the proposed boundary for the Dallas North TMF Location.

Previously recorded archeological sites are located within and adjacent to this site based on records from the restricted Texas Archeological Sites Atlas, which is maintained by the Texas Historical Commission (THC); however, field survey would be required to determine their significance. The sites below are shown in Appendix E. Each site is described briefly below.

- Site 41DL218 – Historic / Prehistoric site. Field survey required to delineate site boundaries.
- Site 41DL219 – Historic structure was documented in 1981 with unique pentagonal room. Field survey is needed to determine whether the structure still exists and potential eligibility for listing in the National Register of Historic Places (NRHP); at present it looks to have low integrity.
- Site 41DL214 – Historic Burnt house with cistern. Site is known as Langdon Plantation. Field survey is needed to evaluate the site, but it appears to have low integrity.
- Site 41DL504 – Historic windmill, well house, and feeder. The THC online database did not include any recommendations for further study. This site is located several hundred feet outside of the proposed TMF boundary. As presently designed, the Dallas North location should not impact this site.
- Site 41DL506 – Brick-lined cistern that is associated with historic building materials. No further investigation was recommended. Site has low integrity. This site is located outside of the proposed TMF boundary. As presently designed, the Dallas North location should not impact this site.
- Site 41DL505 – Historic Cistern associated with structures on historic maps. Structures are no longer present. Previously recorded investigations recommended the site be further investigated to determine the sites eligibility to be listed in the NRHP. It is unknown if the site has integrity or not. This site is located outside of the proposed TMF boundary. As presently designed, the Dallas North location should not impact this site.

Site Layout Overview

As shown, the HSR mainline passes through the flood zone, which extends to about elevation 425. As required by design requirements, proposed HSR infrastructure must be designed to be a minimum of three feet (one meter) above the 100 year floodplain, requiring that the main elements of the TMF (yard, shop, MOW) be located out of the flood zone. As shown in Dallas North Attachment A1, the area near the intersection of IH-45 and IH-20 is the only area large enough to locate the main TMF elements out of the flood zone, but this area is at the top of a hill at about elevation 500.

Given capital cost and maintenance concerns associated with tall retaining walls, and given concerns about potential impacts to IH-45, which lies atop this hill, a target of 480ft (146m) was set as the desired TMF elevation to avoid a retaining wall greater than 20ft (6m) that would generally support the IH-45 / IH-20 interchange. The profile of the TMF connecting tracks was developed to reach this height. Given that the "air gap" sections of the OCS Changeover area must be on tangents, and given the complexity of special trackwork on the connecting tracks, reaching the desired TMF elevation required placing vertical curves within horizontal curves. Because of the slow operating speeds within the TMF, we have confirmed with JRC that this is allowable provided superelevation is included on the horizontal curves if required to address the combined effect of centripetal forces.

Although the main elements of the TMF are out of the flood zones, the connections back to the mainline HSR tracks pass through areas that present a high potential for impacts to forested wetland, streams, and floodplains. To mitigate potential environmental impacts, and to elevate the HSR infrastructure above the floodplain, about 0.9 miles (1.4km) of the TMF approach tracks (OCS Changeover area) is on viaduct.

Access to the facility is proposed to be via JJ Lemmon Road. The tracks were designed to be a minimum of 20ft (6m) from the access roads where parallel. The roads run along the perimeter of the proposed yard for access to the train car wash, shop, MOW, administration building, facility substation, parking lots, and TPSS. Two points of access were provided to the TMF to ensure emergency response. Both entries would be controlled for security.

A freight connection would be the preferred method of delivery for materials and ballast to the MOW. Unfortunately, this site cannot support a freight connection because:

- The grade of the connection would need to be greater than 1.5%, which is the maximum preferred grade for a freight line. Even with this grade, much of the connection would be at risk for flooding.
- The utility line between the BNSF tracks and the mainline tracks would make moving materials and construction difficult.
- The connecting tracks would require additional stream and road crossings and increase impacts to wetlands.
- The possibility of connecting a MOW track to a cleared area adjacent to the freight line was also reviewed, but a cleared area could not be accommodated above flood plain or without significant environmental impacts.

Track Characteristics

The track types, quantities, and lengths in the Dallas North TMF location for the FSL are listed in Table 33 below.

Table 33: Dallas North TMF Location Track Types, Quantities, and Lengths for the FSL

Track Type	Quantity	Min. Length Provided (ft)	Min. Length Provided (m)
Stabling Tracks	8	1279	390
S&I and Bogie Tracks	4	1461	445
Wheel Truing/Unscheduled Repairs	1	2043	623
Car Wash	1	796	243
Relay off Mainline	1	1000	305
Inspection Shop Relay	1	741	226
MOW at TMF			
MOW S&I Tracks	7	653	199
MOW Safety Siding and Relay	2	760	232
MOW Ballast Loading/Unloading Track	1	608	185
MOW Materials Loading/Unloading Track	1	758	231

11.7.2 Dallas South Location

Site Location

The Dallas South TMF location is about 13.8 miles (22.2 km) from the Dallas terminal. The location is just north of Belt Line Road and east of Lancaster Hutchins Road. Because of the distance, an additional MOW is required between this TMF site and the Dallas terminal. The additional MOW is approximately 4.2 miles (6.8km) from the terminal, just north of East Illinois Avenue.

Site Environmental and Topographical Constraints

This relatively flat site is located on agricultural and undeveloped land.

The Dynamax facility, an elevated water storage tank, and a potential school facility (see Appendix E) are located in the vicinity of this site. None of these facilities would impacted by the current layout.

Development of this site would have the potential to impact a pond and wetlands near the intersection of Cornell Road and Greene Road.

Based on historic topographic and aerial imagery, this site crosses the potential remnants of two historic structures (see Appendix E). These structures are not visible on current aerial imagery. Further field study would be required to determine whether these structures still exist.

Site Layout Overview

The mainline geometry for the alignment is mostly made up of large curves, which constrain the location for placement of the flat junction on the mainline HSR tracks to the TMF, which must be on tangent track. The mainline tangent used for access to the TMF layout is only long enough to support a single entry and exit location, prohibiting a double-ended layout.

The alignment passes through multiple large parcels in this location, so the design layout uses the remaining portions of these impacted parcels to benefit the land acquisition process.

TMF and MOW workers would access the facility for be via Belt Line Road. A second access point from Pleasant Run Road could be provided to meet emergency response requirements and could also serve as the primary access to the TPSS site. The mainline alignment is on embankment adjacent to the TMF layout and would require Belt Line Road to be elevated over the HSR. This would require either an elevated roadway viaduct structure or an embankment structure to raise the roadway profile. If an embankment is used for the roadway, a retaining wall on the south side of the TMF site would be required to allow space for the TMF shop and storage tracks.

This site does not preclude a freight connection to the MOW site since there is an existing BNSF freight line to the east of the TMF, near E. Lancaster Hutchins Road. However, a freight connection was not included in the design since adequate freight connections are included to construction staging areas to support initial system construction. In addition, there is a planned freight connection to an MOW base in the middle of the line that could support deliveries and, following initial construction, it is unlikely that significant materials delivery by freight rail would be required. Additionally, the following elements would be required to make the connection, which would increase environmental impacts:

- About 1.5 miles (2.4km) of new freight track
- 3 roadway crossings
- 3 parcel impacts
- 1 stream crossing

Track Characteristics

The track types, quantities, and lengths in the Dallas South TMF location for the FSL are listed in Table 34 below.

Table 34: Dallas South TMF Location Track Types, Quantities, and Lengths for the FSL

Track Type	Quantity	Min. Length (ft)	Min. Length (m)
Stabling Track	8	1268	386
Inspection Track	4	1194	364
Wheel Truing/Unscheduled Repairs	1	2566	782
Car Wash	1	716	218
Relay off Mainline	1	1100	335
Inspection Shop Relay	1	751	229
MOW at TMF			
MOW S&I Tracks	7	910	277
MOW Safety Siding and Relay	2	766	233
MOW Ballast Loading/Unloading Track	1	608	185
MOW Materials Loading/Unloading Track	1	758	231
Additional MOW			
MOW S&I Tracks	4	952	290
MOW Safety Siding and Relay	2	657	200

11.7.3 Comparison of Dallas TMF Alternatives

The Dallas North TMF alternative would be the most problematic to construct due to its location in the Newton Creek floodplain and its high potential to impact streams, wetlands, and cultural resources. The Dallas South TMF alternative is primarily located in upland, agricultural areas that have been previously disturbed and have a lower potential to impact streams, wetlands, and cultural resources. Nonetheless, the Dallas South TMF alternative would require further coordination with resource specialists to confirm that undocumented cultural resources do not lie within the Area of Potential Effect.

The Dallas North TMF location is closer to the Dallas terminal, which would reduce deadhead miles and therefore be operationally preferred. However, the Dallas South TMF location is only a few miles further from the terminal. The higher number of deadhead miles and non-revenue moves would not be expected to significantly increase operations and maintenance costs or cause undue operational impacts, given the service levels proposed relative to overall line capacity.

While the Dallas North TMF location has operational benefits and is on land that the City of Dallas would like to see repurposed to bring jobs to the City, the significant topographical issues would lead to greatly increased capital costs relative to the Dallas South TMF location. Further, development of a TMF on the Dallas North site would also raise significant environmental concerns related to wetlands and floodplain impacts. Due to reduced potential for impacts to environmental resources and greatly reduced capital costs and constructability concerns, the Dallas South TMF location would be recommended for advancement.

Selection of the Dallas South TMF would require development of an additional MOW base near to the Dallas North TMF location to satisfy maintenance requirements. The combined cost and impact of the Dallas South TMF and the additional MOW base near the Dallas North TMF location would need to be weighed against the development of the Dallas North TMF location.

Designs for each location were included in the FDCE and a LOD for each location was provided to the FRA environmental analysis team so that a comparative analysis of environmental impacts could be performed.

Table 35 on the following page provides a comparison of the Dallas TMF alternative locations.

Table 35: Dallas TMF Site Engineering Analysis

	Dallas North Location	Dallas South Location
Lead tracks	Constrained by IH-20, JJ Lemmon Road, and Stuart Simpson Road	Constrained by horizontal geometry
Distance from Dallas Terminal	~7.9 miles (12.7km)	~13.8 miles (22.2km)
Site	Significant topographic concerns and flooding concerns. Significant cut and fill would be required but earthworks could likely be balanced on site.	Yard proposed elevation located at relatively flat existing ground level
Access	Via JJ Lemmon Road	Via Belt Line Road
Freight Access	BNSF located on opposite side of the HSR mainline with transmission line between.	BNSF runs to the west of HSR
ROW	Undeveloped land – limited to no impacts to existing development. Incorporates parcels owned by COD, which they proposed for TMF use. Within City limits.	Undeveloped land – limited to no impacts to existing development
Waters of the U.S.	High potential for impacts to forested wetland, streams, and floodplains on lead tracks	Potential to impact a pond and potential wetlands
EPA Registered Industrial Facilities	None	Near Dynamax facility (but does not impact)
Cultural Resources	Potentially 3 (another 3 are located nearby)	Potentially 2
Threatened and Endangered Species	None	None
Public Facilities	None	Near water tower and potential school facility (but does not impact)
Environmental Justice Populations	None	None

12 Water Demand

This section provides a conceptual level estimate of water demands (potable and industrial), wastewater discharge volumes and treatment approaches at ancillary facilities for the Project. The estimates include stations and maintenance facilities as follows:

- Stations
  - Dallas Terminal
  - Brazos Valley Station
  - Houston Terminal (3 options)
- Maintenance Facilities
  - Trainset Maintenance Facility (TMF) in Dallas (2 options)
  - Trainset Maintenance Facility (TMF) in Houston (2 options)
  - Maintenance of Way (MOW) facilities

The daily water demand estimates account for facility staff, passengers and other activities occurring at each location such as food and beverage service, passenger meal preparation and train washing. The estimated water demands reflect the FSL level of service to ensure a conservative approach for environmental analyses.

12.1 General Assumptions

Generalized assumptions made to assess baseline water demands include:

- Efficiency measures which might affect water demands are not considered.
- Although strategies to provide alternative water supplies, such as rainwater harvesting or on-site greywater reuse, may be considered at a later stage of the Project, this section conservatively assumes no alternative water supplies would be used.
- Landscape irrigation requirements at the facilities have not been included in this analysis.
- Municipal non-potable water is not available or considered for toilet and urinal flushing or other non-potable demands.
- While some minor losses are expected, sewer flow is assumed to equal water demand.
- This section does not intend to provide an assessment for the method, cost or feasibility of connecting to municipal water and sanitary sewer services.

Staffing assumptions provided in Section 2.7 were used to estimate water demand by staff at stations, TMFs, and MOWs. Assumptions used to estimate the number of passengers including train capacity and number of trains per day are provided in Table 36. Other general assumptions used in the calculations are provided in either Table 36 or in the notes section of the water demand table in Appendix F.

Table 36: Passenger Assumptions

Passenger Assumptions	FSL	Unit	Notes
Trainset Passenger Capacity	400	passengers/train	Ref Section 2.4
Train Operation Capacity (for water demand)	95%		Ref Section 6.4.3.1
Scheduled Terminal Turnaround Time	30	minutes	
Operation Hours	18	hours	
Train Trips/Day	80		
Trains Arriving/Day	40	trains/day	
Trains Departing/Day	40	trains/day	
Assumed Passengers/Day (Urban Station)	30,400	passengers/day	Assumed peak day, average daily ~20k, average annual 7.2M
Assumed Passengers/Day (Rural Station)	1,600	passengers/day	Based on 1,200 parking spaces (18% of spaces at Houston station) and average 1.3 people per vehicle
% Passengers Embarking and Disembarking at Rural Stations	5%		

Table 37: Other Assumptions

Other Assumptions	Value	Other Assumptions
Number of Trainsets	20	Number of Trainsets
Number of Train Cars per Trainset	8	Number of Train Cars per Trainset
Number of Train Cars Including Engines	160	Number of Train Cars Including Engines
Washes/Month for 1 Trainset	15	Washes/Month for 1 Trainset
Total number of Train Car Washes per Day	80	Total number of Train Car Washes per Day
% of Passengers in First Class	15%	% of Passengers in First Class
First-Class Meals Prepared	50%	First-Class Meals Prepared (% of 1st class passengers)
% Passengers Using Restroom	25%	% Passengers Using Restroom

12.2 Water Demands

The total daily water demand for Project facilities is estimated to be about 287,850 gallons/day for the base system, as summarized in Table 38. It is recommended that a peaking factor of 1.3 be applied to the maximum day water demand for a peak hourly demand. Details can be found in Appendix F.

Table 38: Daily Water Demand Summary

Facility	Max Demand (g/d)
Dallas Station	110,700
Brazos Valley Station	27,200
Houston Station	100,900
Trainset Maintenance Facilities (2 Locations)	42,190
Maintenance of Way Facilities (7 Locations)	6,860
Total	287,850

13 Hydrology, Hydraulics, and Drainage

This section provides an overview of the approach used by the TCRR design team to analyze hydrology and hydraulics and to perform conceptual design of the Project's drainage features. Satisfying drainage requirements, both on-site runoff and off-site cross-drainage, is a critical element of the design of any linear transportation project. Aside from meeting the various federal, state, and local regulatory requirements involved, providing for adequate drainage is absolutely critical to protecting the infrastructure from damage during extreme weather events and to safely provide the planned HSR services.

Since the design team is completing the USACE Section 404 individual permit application in parallel with the Environmental Impact Statement (EIS), the team is paying special attention to this aspect of the work. As such, a greater level of detail regarding wetland and stream impacts was available than is normally available during the Draft EIS (DEIS) stage.

TCRR would continue to coordinate with relevant local, state, and federal agencies as required to ensure that the Project meets all applicable requirements. Drainage performance and environmental impact mitigation requirements identified through the EIS process would be incorporated by the designer and the Design-Build contractor into the final drainage design and construction of the Project. Any changes driven by constructability concerns and value engineering would be carefully evaluated against performance and environmental commitments, and be coordinated with permitting requirements and schedules across various agencies.

The following approach outlines basic steps which were completed in support of the preliminary drainage design.

13.1 Drainage Approach Overview

Key goals of the drainage analyses performed for the conceptual engineering design were:

- To ensure that existing off-site cross-drainage patterns would be maintained where practicable.
- To ensure that new on-site runoff would be appropriately captured, detained, and conveyed as necessary.
- To ensure that, where appropriate, the Project design mitigated any potential impacts to flooding upstream or downstream.

Initially, during the early stage of project planning, several high-level drainage assessments were completed to help develop alignment alternatives by identifying "problem areas" and potential significant environmental impacts or constructability concerns. These initial assessments were also helpful to screen proposed alignment alternatives during the Step 1 and Step 2 Screening efforts.

To meet the expedited schedule for preliminary alternative screening activities, a simplified approach for determining anticipated drainage crossing impacts was used. This approach used existing datasets such as Federal Emergency Management Agency (FEMA) floodplains (Digital

Flood Insurance Rate Map (DFIRM) and Q3 data) and the National Hydrography Dataset (NHD) streams. The FEMA and NHD information was used to quantify the number and anticipated extent of crossings for each alignment as part of the screening process. With this information, some preliminary guidance was provided to the design team to develop the initial horizontal and vertical alignments and associated construction types (retained cut, cut, embankment, retained embankment, or viaduct). However, this preliminary approach did not produce hydrologic-based flow determinations necessary for input into the sizing of cross-drainage infrastructure.

Following the Step 2 Screening of Alignment Alternatives, more detailed hydrologic and hydraulic data were developed for preliminary (5-percent design) sizing of cross-drainage structures and bridges, and development of rail-side and access road-side detention basins, swales, and conveyance facilities. The more detailed analysis helped to inform development of the vertical alignment and infrastructure type selection (viaducts, bridges, culverts, embankments, etc.) based on required cross-drainage capacities and floodplain clearances. As such, the hydrologic and hydraulic input to the design process was a key determinant of the consolidated LOD associated with the Project.

13.2 Resiliency

On any project, an assessment of the desired levels of service/levels of protection (LOS) and drainage design criteria for the Project must be developed; they must consider not only regulatory requirements and design guidelines, but also the risk profile of the Project. As noted, TCRR must ensure the highest practicable LOS given the critical importance of safe operations, and the critical commercial importance of infrastructure protection. In accordance with this desire, and the preliminary planning stage of the work, the Project's conceptual design approach was to exceed expected requirements.

Guidelines that were considered during design development included the recently revised guidance associated with Executive Order (E.O.) 11988 and E.O. 13690. While typical planning studies often utilize the 100-year event, or 1 percent annual exceedance probability, to determine the size of all off-site drainage structures, these E.O.'s necessitate a higher level of protection. With the advent of the new Federal Flood Risk Management Standard (FFRMS), there is additional uncertainty as to which required level of flood protection the Project would fall under, specifically with the unknown level of future agency involvement. With the new FFRMS, there is the desire to design facilities to protect from not only existing 100-year flooding, but also from increased flooding risk due to future development. While a future condition 100-year floodplain is a desirable quantification of risk, it can be difficult to approximate due to the unknowns concerning how future development and drainage would occur. As such, the guidance allows for proxies to be used to approximate future risk, including the 500-year floodplain, as well as the existing 100-year floodplain plus appropriate freeboard (2ft to 3ft (0.6m to 0.9m)). Given the uncertainty in requirements, the approach used for the conceptual design was to provide 3ft (0.9m) of freeboard above the current estimated 100-year floodplain as the minimum elevation for viaducts and bridge sections, thus providing a LOS greater than the 100-year storm event.

13.3 Drainage Area Delineation

Contributing drainage areas were delineated to develop hydrologic flows crossing the proposed alignment. LiDAR data was obtained for the Project to delineate the catchment areas to points representing the intersection of alignment alternatives with anticipated stream crossings identified in previous phases of work. A combination of GIS-based hydrologic automation tools, existing NHD catchment delineations, and visual interpretation of elevation data were used to delineate the drainage areas. The following process was automated and distributed among multiple users and computers as applicable:

1. Project alignments were intersected with NHD and FEMA streams from the previous phase of analysis. Alignment crossings of drainage channels and floodplains were identified and named with a unique naming convention based on alignment, watershed, and state plane zone.
2. 10 acre (40468m²) resolution stream networks and catchments were generated using ArcHydro, and hydrologic watershed areas specific to each drainage crossing were developed. These areas were used in the development of hydrology described in the next section.

   Remaining corridor drainage areas, or areas which do not contribute to larger stream crossings but may contribute overland sheet flow or shallow concentrated flow to the corridor ROW were subsequently identified. This drainage is proposed to be collected by rail-side ditches and conveyed to larger crossings or passed through cross-culverts.
3. Viaduct segments were specified at all floodplain crossings based upon FEMA Zone AE and Approximate Zone A mapped areas. The floodplain limits along the alignments were identified, and the floodplain was then fully designated as a viaduct crossing with three feet (0.9m) of freeboard based on FEMA elevations. Additionally, since FEMA Approximate Zone A boundaries are only assumed representations of the floodplain and not based on hydraulic models, a conservative approach was taken to ensure viaduct limits extended beyond estimated floodplain extents, based on LiDAR elevation data.

   For this level of conceptual engineering, use of the available FEMA data and conservative freeboard allowance is appropriate. However, each crossing would ultimately be modeled hydraulically for the final design. Permitting requirements would depend on the local Floodplain Administrator and can vary significantly. Obtaining stormwater drainage and detention permitting through local jurisdictions or through FEMA, which is anticipated to occur during final design, is typically a requirement which must be satisfied prior to construction activities commencing. FEMA crossings identified using the information described above are included within Appendix G and Appendix H.
4. Structural elevations for viaduct crossings above existing drainage crossings and floodplains were determined by analyses described herein. During more detailed design, hydraulic modeling would be required to:
   - Confirm minimum viaduct low-chord elevations.
   - Ensure that the proposed bridge foundations within the floodplain would not significantly raise the water surface elevations outside of the TCRR right-of-way.

- Assess scour envelopes for bridge and viaduct piers and abutments per the latest FHWA HEC No. 18 procedure.

Further analysis would be undertaken during more detailed design to confirm conceptual design approach. Where viaduct sections could impinge directly on a stream and potentially cause an impact below the ordinary high water mark (OHWM) or in an adjacent jurisdictional area, the future spacing of viaduct sections and placement of individual piers would be set to minimize and avoid impacts to waters of the U.S. No pier would be placed in a stream unless the width of the stream requires a pier for support. Bank armoring would be a possible tool in protecting the railway or access road and would be designed in accordance with the conditions of Nationwide Permit 14 wherever possible.

13.4 Watershed Hydrology

Using the contributing drainage areas developed as described above and the Kirpich and Natural Resources Conservation Service (NRCS) Curve Number methodologies, TCRR developed watershed characteristics and peak flows. The Composite Curve Number for each drainage area was computed based on the NRCS Soil Survey Geographic Database (SSURGO v2.2) and the 2011 National Land Cover Database (NLCD). Contributing watersheds were determined to be mostly undeveloped.

1. Developed peak flows for the 24-hour, 100-year return event using hydrologic software.
2. Used the Rational Method for on-site drainage areas along the ROW.

13.5 Stream Crossings

The initial analysis simplified the categorization of drainage crossings based on the anticipated magnitude of flows and the extent of floodplains based on best available data. Once crossing-specific hydrologic flows were developed, more detailed analysis was undertaken as follows:

- Crossings were categorized by magnitude of flow to help determine the type of structure (such as culvert, bridge-class culvert (BCC), or bridge span) required to adequately pass the contributed flow without causing impacts upstream or downstream of the alignment.
- Opportunities to co-locate drainage features and wildlife crossings were investigated by the Environmental Team (See Section 16.3.3). Considerations for wildlife crossings were included in the development of typical crossing details for culverts in the drawing set (Volume 1).
- Typical depths available for culvert crossings were determined through coordination with the structural engineering and alignment teams when developing typical embankment infrastructure configurations to maintain minimum cover requirements.
- Hydraulic analysis software was used to determine flow capacities for an array of culverts and combination of culverts such that a wide range of flows could be accommodated by identified culvert configurations based on available depth under the embankment infrastructure configuration and head-loss requirements. A matrix was developed for various

structural configurations (type and size) based on available depth at the location of the crossing and the computed flow.

- Threshold peak flows, which were developed using NRCS and Kirpich Methods for development of hydrology, were identified for bridge or BCC crossings and large viaduct crossings. They were also used to categorize the crossings by type, based on ranges in the magnitude of flows. Generally, culvert crossings were assigned at peak flows less than 300 cfs, BCC crossings were assigned between 300 and 1,000 cfs, and viaduct/bridge crossings were assigned for peak flows greater than 1,000 cfs, depending on site conditions.

The following approach was used to select culvert requirements at each location:

- LiDAR data was used to determine the minimum flowline of the existing drainage feature across the corridor ROW for all crossings determined to fall under the culvert or BCC type. This elevation was assumed to equal the culvert flowline and, when compared to the vertical profile, determined the available depth for culvert configurations. This conservative assumption allows for the use of open-bottom culverts during more detailed design, if desired.
- The most appropriate culvert array to convey the flow with required head-loss at each crossing location was selected.
- The alignment team was provided crossing locations, flowline elevations, and culvert selection to determine embankment elevation at each crossing. The depth available for the culvert(s) was computed using the Top of Rail elevation, the LiDAR elevation, and the rail subgrade thickness and freeboard.

For the rail crossings, the cross culverts have been aligned to be perpendicular to the rail alignment as much as possible, or to have a skew angle not larger than 30 degrees from the normal direction of the rail alignment. For roadway crossings, the cross culverts have been aligned to have a skew angle not larger than 45 degrees.

In some instances, the available depth resulted in an excessive width of culverts due to the limited height available. The preliminary LOD used the selected culvert array and provides a conservative approach for the environmental analysis of potential impacts. However, wide culvert arrays exceeding defined channels should be avoided during more detailed design. Such a design approach creates difficulties for returning the flow to the natural drainage course within the available ROW downstream of the rail. Culvert configurations should be designed to align well with the natural configuration of channels upstream or downstream of the alignment to minimize transition zones and erosion control requirements.

Crossing locations that did not have a well-defined channel wide enough to accommodate the necessary width of culverts were flagged for further analysis during more advanced design. Mitigation of this issue could be accomplished through adjustments to the vertical alignment to provide more flow depth or use of a viaduct segment or bridge to accommodate the crossing.

For large crossings determined to exceed the capacity of culverts or BCC, a viaduct segment was incorporated into the design. In many cases these crossings were within FEMA-delineated floodplains where viaduct segments were already assumed. Many of these crossings were studied further to determine not only the necessary width of conveyance, but also to approximate water surface elevations so that structure heights could be determined to ensure at least 3 feet of freeboard below the viaduct low chord.

- A simple hydraulic model was developed using hydraulic calculation software consisting of a single representative cross-section to approximate existing conditions flow at each crossing location.
- The existing water surface profile and total flow width were estimated using the hydraulic software. At this level of design, all bridge and viaduct sections were assumed to span the entire approximated floodplain width in addition to the FEMA identified floodplains.
- The estimated water surface elevation dataset was used in coordination with the structural engineering and alignment teams' data to set viaduct elevations and limits.

In some instances where selection of viaduct configurations were driven by factors other than cross-drainage, it was determined that there was likely more than sufficient depth available for flow (typically twenty feet or greater between the channel flowline and the bottom of the viaduct structure). In these cases, hydraulic analysis was not performed for the crossing. Appendix G shows proposed culvert crossings and Appendix H shows proposed bridge crossing locations.

13.6 Detention Basins

The development of the proposed railway infrastructure could increase stormwater runoff peak flows and total runoff volumes. As such, detention mitigation may be required and has been included in the LOD to ensure detention mitigation can be provided as necessary, to minimize adverse impacts to downstream receiving streams and properties. To limit potential environmental impacts, use of adequate detention measures in accordance with applicable local and state guidelines and criteria, and consistent with BMPs, would be incorporated into more advanced design. Coordination with applicable local, state, and federal entities to identify relevant regulations and criteria regarding the use of mitigating detention would be incorporated into future design development.

Preliminary estimates of detention requirements for mitigation and conveyance of stormwater for on-site drainage were developed as follows:

- The engineering team defined typical sections for different infrastructure configurations. Each typical section was evaluated for increased impervious area per linear foot. Section types included roadway improvements associated with grade separations.
- Relationships of detention rate and total detention volume were developed for different lengths of each section type using standard methodologies.
- Total lengths of various infrastructure configuration types were determined to estimate increases in runoff due to the proposed project section.
- The detention volume for each drainage area segment was determined so that post-project peak flows would not exceed pre-project flows, and that excess runoff would be detained to ensure no increase in peak flows.

- The design parameters used to calculate the required detention basin volume were determined following the TxDOT Hydraulic Design Manual dated May 2014.
- The 100-year, 24-hour storm event was used for the detention basin design. The runoff coefficient for the pre-project condition was determined based on soil map from Geology_N83, surface slope, storage and vegetation coverage, with conservative selections from the parameter ranges provided in Section 4 of the manual. The runoff coefficient for the post-project condition used is 0.8. Basin areas are included in the volume calculations and assume 100% impervious (Runoff Coefficient = 1).
- No detention basins would be provided for bridges and viaducts in the rural areas, where no significant impact on the soil condition is expected. If there are any impacts, they could be managed using small detention basins or oversized ditches under the bridges or viaducts.
- The total basin footprint needed for each drainage area segment was determined. Based on the flowline identified for each crossing and using conservative estimates of available gravity outfall depth, the team approximated a basin footprint assuming a reasonable maximum depth for each location. 30-foot wide footprint strips were designed along the outside edge of the basins to cover an assumed maintenance assess road and potential cut and fill grading needs.
- Detention basins would be located adjacent to the railway in coordination with access roadway and rail-side ditch design. The detention basins would be close to natural streams or existing storm drain trunk lines that could serve as outfalls wherever feasible.
- A range of ditch sizes and configurations was developed to convey on-site runoff from the railway to the detention facilities within the ROW. A ditch top width of 25ft (7.6m) was assumed within the typical section. Peak flows were calculated for each segment using the Rational Method. In instances where the peak flow exceeded the capacity of the typical ditch section, a larger ditch was incorporated into the design and LOD.

The resulting requirements were included in the consolidated LOD. The initial approach taken with respect to sizing and location of detention basins was a conservative approach developed to provide initial input into the environmental analyses and property requirements assessment. The initial approach of sizing and location detention basins was developed as follows:

- Detention basins were sized separately for the O&M needs of railway and roadway impacts, assuming that the roadway basins would be under jurisdiction of local agencies in the future, after construction is complete. Adjacent railway and roadway basins may be consolidated during more advanced design to mitigate environmental or property impacts.
- The depth of detention basins was assumed to be no more than four feet (3-feet maximum water depth plus 1-foot freeboard), to accommodate shallow groundwater and outfall requirements. During the detailed design stage, when geotechnical investigations for each basin are completed, deeper basins may be designed, which would reduce the overall footprint.
- The rail side ditches (swales) would serve as drainage conveyance facility for both on-site drainage and a portion of off-site drainage that sheet flows towards the rail alignment (rather than in a confined stream channel). It is assumed that the rail side ditches would not serve as

retention or detention ponds; therefore they are not included in detention requirement calculation.

During more detailed design, the above assumptions may be revisited and detention basin locations would be refined to minimize property impacts and to maximize use of land acquired for other project purposes. The locations and volumes of detention basins are shown in Appendix I.

13.7 Ancillary Facilities

In addition to the HSR track infrastructure, the Project would require numerous ancillary facilities such as traction power facilities, maintenance facilities, and stations. These features would also increase impervious areas, and would therefore also require detention volume to reduce increases in peak runoff and limit project impacts.

Detention basin requirements were estimated for each facility and were included in the consolidated LOD. Given that detailed site plans have not yet been developed for each of these facilities, conceptual characteristics of site developments were developed to estimate required detention volumes.

Any discharges of stormwater runoff or wastewater discharges from ancillary facilities to a water of the State would likely require an industrial wastewater discharge permit from TCEQ. The Project trainset maintenance facilities and MOW facilities would involve industrial operations that would include hazardous materials use and discharges. These operations would include cleaning, fueling, painting, and various maintenance activities. All hazardous materials handling and discharge methods would be in full compliance with all applicable regulatory requirements. During more detailed design, discharge design and impact mitigation would be developed in compliance with all applicable regulatory requirements.

13.8 BMPs for Water Quality Protection

Best management practices (BMPs) for the protection of water quality would be developed in accordance with state, federal, and local laws, regulations, ordinances, Executive Orders, Federal Railroad Administration requirements and various permit or certification provisions for the construction of the Project. As the specific compliance requirements of these permits are unknown at this time, the contents of this section are intended as a basic outline for agency consideration in the Draft Environmental Impact Statement (DEIS). The Applicant's Contractor would select site appropriate water quality protection BMPs, further advance the design of permanent water quality BMPs, and prepare site plans detailing the location of temporary and permanent BMPs prior to construction and the issuance of the Final Environmental Impact Statement (FEIS).

13.8.1 Project Activities with Potential Impacts to Water Quality

The proposed HSR infrastructure would be constructed at, above, or below natural grade in various configurations including on viaduct structures, on embankments, on retained fills, or within cuts. The Project would also include stations, ancillary facilities, access roads, and storm water control features. Surface water management features would include ditches, swales, detention basins, and open grassy areas.

During construction of the rail system components, potential water quality impacts could result where the Project crosses hydrological features, such as floodplains, oxbows, meanders, wetlands, streams, ponds, and small reservoirs. Design of the Project would be developed to minimize adverse impacts to water quality.

To the maximum extent practicable, the pre-construction course, condition, capacity and location of hydrological features would be maintained during each construction activity, including during stream channelization and stormwater management. As presently designed, all structures of the proposed Project rail system would be designed to be a minimum of three feet above the 100-year floodplain of streams and surface water resources.

13.8.2 Crossings of Waters of the United States, including Wetlands

Many of the hydrological features crossed by the Project would be considered waters of the U.S. The USACE regulates the discharge of dredged and fill material into waters of the U.S., including wetlands, under Section 404 of the Clean Water Act. Within the context of the proposed project, jurisdictional waters would include streams that display ordinary high water marks (OHWMs) and have hydrologic connectivity with traditionally navigable waters (TNW) of the U.S., ponds constructed on jurisdictional waters, and wetlands adjacent to jurisdictional waters.

The Project would cross the USACE Galveston and Fort Worth Districts. A separate Section 404 Individual Permit application is being prepared for each district to address unavoidable impacts to waters of the U.S. associated with the Project. The Contractor would be required to comply with the specific water quality protection provisions issued by each district, including compensatory mitigation.

13.8.2.1 Requirements for Construction Activities in Waters of the U.S.

Avoidance and Minimization

In accordance with Section 404 (b) (1) guidelines and pursuant to the Final Mitigation Rule (40 CFR 230.91), all Individual Permit applicants are required to take all appropriate and practicable steps to avoid and minimize adverse impacts to waters of the U.S. This applies to all Project crossings of waters of the U.S.

General Project-Wide Construction Requirements

All construction works would be performed in full accordance with all applicable regulatory requirements. The following general requirements would apply to all construction activities:

- Contractor would comply with the terms, conditions, and specific design criteria required in the final Individual Permit issued by the USACE, including construction best management practices required by the Texas Commission on Environmental Quality (TCEQ), the U.S. Fish and Wildlife Service, and other cooperating state and federal agencies.

- Contractor would comply with all landowner stipulations in ROW and easement agreements.
- Contractor would restrict all construction activities to permanent and temporary workspaces and easements.
- Contractor would obtain and dispose of fill materials from and within approved locations specified in the construction contract documents.

Temporary vs. Permanent Impacts to Waters of the U.S.

A Section 404 permit application and mitigation plan would be provided to the USACE for impacts to waters of the U.S. Permanent impacts occur where construction activity results in a permanent loss of waters of the U.S.; or where pre-construction contours would not be restored due to placement of fill in waters of the U.S. Temporary impacts result in no permanent loss to waters of the U.S.; or where pre-construction contours would be restored and all temporary fills would be removed in their entirety after construction is complete. The following general crossing criteria are applicable to areas that would be temporarily impacted during construction of the Project.

General Crossing Criteria for All Waters of the U.S.

- Appropriate measures would be taken to maintain the passage of normal or high downstream flows to the maximum extent practicable.
- Heavy equipment working in wetlands or mudflats would be placed on mats, or other measures must be taken to minimize soil disturbance.
- Temporary fills would consist of materials that would not be eroded by expected high flows.
- Temporary fills would be removed in their entirety and the affected areas returned to pre-construction elevations as soon as practicable after construction.
- No activity would be permitted to use unsuitable material (e.g. trash, debris, car bodies, asphalt, etc.). Material used for construction or discharged must be free from toxic pollutants in toxic amounts.
- The areas affected by temporary fills would be revegetated as soon as practicable after construction.
- Access roads would be constructed so that the length of each road crossing minimizes adverse effects on waters of the U.S. (e.g. is the shortest distance across the water body) and would be as near as possible to pre-construction contours and elevations.
- The placement of drainage swales in waters of the U.S. would be avoided and, if unavoidable, minimized and constructed to not drain waters of the U.S.
- In wetland areas disturbed by construction, a minimum of 12 inches of topsoil material from the wetland would be stockpiled and used as backfill material to restore preconstruction contours.

13.8.3 TCEQ 401 Water Quality Certification and BMPs

TCEQ Section 401 Water Quality Certification, including the use of appropriate BMPs, would be required for approval of the Project Section 404 Individual Permit Applications. A list of BMPs commonly employed for Section 404 Nationwide Permits, which may be used to satisfy Water Quality Certification, as well as stormwater pollution prevention are provided below. Ultimately, the Contractor would be required to evaluate site-specific conditions, develop a BMP site plan, and implement the appropriate BMPs necessary for the protection of water quality during construction of the Project.

Erosion Control Measures

- Temporary Vegetation
- Blankets/Matting
- Mulch
- Sod
- Interceptor Swale
- Diversion Dike
- Erosion Control Compost
- Mulch Filter Socks
- Compost Filter Socks

Sedimentation Control Measures

- Sand Bag Berm
- Silt Fence
- Triangular Filter Dike
- Rock Berm
- Hay Bale Dike
- Brush Berms
- Stone Outlet Sediment Traps
- Erosion Control Compost
- Compost Filter Socks
- Sediment Basins
- Mulch Filter Socks

Post-Construction TSS Control Measures

- Retention/Irrigation Systems
- Extended Detention Basin
- Vegetative Filter Strips
- Grassy Swales
- Erosion Control Compost
- Compost Filter Socks
- Sedimentation Chambers
- Constructed Wetlands
- Wet Basins
- Compost Filter Socks
- Vegetation lined drainage ditches
- Sand Filter Systems
- Mulch Filter Socks

13.8.4 Temporary Erosion and Sedimentation Control for Water Quality

The TCEQ regulates stormwater discharges associated with construction activities under the Texas Pollutant Discharge Elimination System (TPDES), Permit No. TXR150000. The Contractor for the Project and all subcontractors meeting the definition of an “Operator” under TXR150000 would be required to comply with the terms and conditions of the permit, including the preparation of a Stormwater Pollution Prevention Plan (SWPPP) for all construction activities with disturbance areas equal to or greater than five acres, including temporary erosion and sedimentation controls.

The implementation and development of SWPPPs for all construction activities regulated under TXR150000 would be developed by the Contractor prior to construction and the final issuance of the FEIS.

13.8.5 Permanent Erosion and Sedimentation Control for Water Quality

Conceptual design of the Project includes the use of permanent detention basins along the length of the proposed railway, some of which would be collocated with ancillary facilities (e.g. maintenance of way facilities, stations, and trainset maintenance facilities). Basins would mitigate potential impacts from flooding resulting from increased impervious area associated with the new railway and facilities. Additional design information related to permanent erosion and sedimentation controls for water quality can be referenced in Section 13.8.3 of this report.

13.8.6 Local Coordination

Requirements of the City of Houston, City of Dallas, and other municipalities for water quality protection related to development and attenuation of flood waters would be identified prior to construction and would be implemented in the final construction plans and permit applications for the FEIS.

13.8.7 Material Handling Practices

The following list outlines some key measures that may be used to ensure that material handling practices comply with environmental requirements:

Source

- Fill material brought into the ROW from external source areas and used for the construction of any of the features listed would be from known sources with verified chemical properties.
- Proper source documentation would be obtained by the Contractor and provided to regulatory agencies as required.
- The use of fill material or soil from non-approved sources, including private landowners, would be in compliance with environmental and other applicable regulatory requirements.

Storage

- Overburden, excavated materials, and stockpiled construction materials, including but not limited to dirt, sand, gravel, and other base materials, would only be stored in approved locations as indicated in the final construction contract documents.
- No material would be stored outside of the Project ROW or temporary construction workspace easements.

Disposal

- The removal of unused excess cut and fill material from the Project ROW or temporary construction workspace easements would be disposed of at an approved location with all applicable permits.
- The transfer and use of excess cut soils to different areas of the alignment for use and/or disposal would be prohibited without additional site-specific evaluation and documentation.
- Any excavated materials suspected to contain elevated chemicals of concern, whether due to odor, staining, or other field observations, would be segregated and stockpiled for proper waste characterization prior to offsite disposal.
- Proper waste characterization documentation, including final waste manifests from the disposal facility, shall be obtained by the Contractor and regulatory agencies when requested.

13.8.7.1 Hazardous Materials and Waste Management

During construction, the contractor would be required to develop a site-specific Contractor's Hazardous Materials and Waste Management Plan for the Project that identifies the hazardous materials that the Contractor would use and the wastes that the Contractor may generate during project activities. This would include Material Data Safety Sheets or waste designation information, quantities, locations of storage and use, container, or tank, secondary containment, and inspection procedures.

Spill Prevention, Containment, and Control

A Spill Prevention, Containment, and Control Plan (SPCC Plan) would be prepared and implemented during construction of the Project to comply with 40 CFR 112. The SPCC Plan would include specific preventive measures and practices to reduce the likelihood of an accidental release of a hazardous or regulated liquid and, in the event such a release occurs, to expedite the response to and remediation of the release.

13.8.8 NEPA Required Construction Plans for Water Quality Protection

A number of additional construction management and control plans would be required for compliance with NEPA Council on Environmental Quality (CEQ), SWPPP, and TCEQ guidelines for water quality protection. These plans would be developed in close coordination with Contractor and are expected to include:

- Soil Erosion and Sediment Control Plan (including Construction Inspection)
- Storm Water Management and Storm Water Pollution Prevention Plan
- Section 404 Mitigation Plans for permanent impacts to waters of the U.S. in the USACE Fort Worth and Galveston Districts
- Dust and Erosion Control Plan
- Temporary Erosion and Sediment Control Plan

- Construction Management Plan, including
- Trenching Plan
- Road and Railroad Crossing Plan
- Work and Staging Areas Plan
- Utility Relocation Plan
- Dewatering Plan
- Site Restoration and Re-Vegetation Plan
- Solid and Hazardous Waste Management and Disposal Plan
- Spill Prevention, Containment and Control Plan (SPCC)

13.9 Subsidence and Groundwater Regulation

This section provides a brief overview of land surface subsidence and groundwater regulations relevant to the evaluation of alignment alternatives.

Land surface subsidence, which can result from prolonged or heavy pumping of groundwater, has historically occurred in the area surrounding the southern portion of the Project alignment and has resulted in extensive regulatory requirements. Additionally, much of the alignment passes through areas under the jurisdiction of Groundwater Conservation Districts (GCDs) which have regulatory authority over groundwater supplies.

13.9.1 Subsidence

Land surface subsidence is a concern in infrastructure development due to the potential for differential elevation changes and increased flood risk. The potential for subsidence is dependent on a number of factors including subsurface geology and patterns of groundwater production. Most of the alignment alternatives are located in rural areas without a history of concentrated, high intensity groundwater production where subsidence has been of minimal concern. Subsidence issues have been particularly pronounced near the southern end of the Project alignment, where prolonged and intensive pumping of the Gulf Coast Aquifer in the greater Houston area has caused subsidence ranging from under a foot in less-developed areas to as much as 10 feet in areas of heavy historical use. In order to combat this problem, the Texas Legislature has created Subsidence Districts: special purpose districts with authority to regulate groundwater withdrawal in order to prevent land surface subsidence and a corresponding increased flooding risk. Segment HN is located within the Harris-Galveston Subsidence District (HGSD), as illustrated in Figure 38. Because Segment HN is common to every alignment alternative, water supply for the Project would be developed in accordance with HGSD rules. .

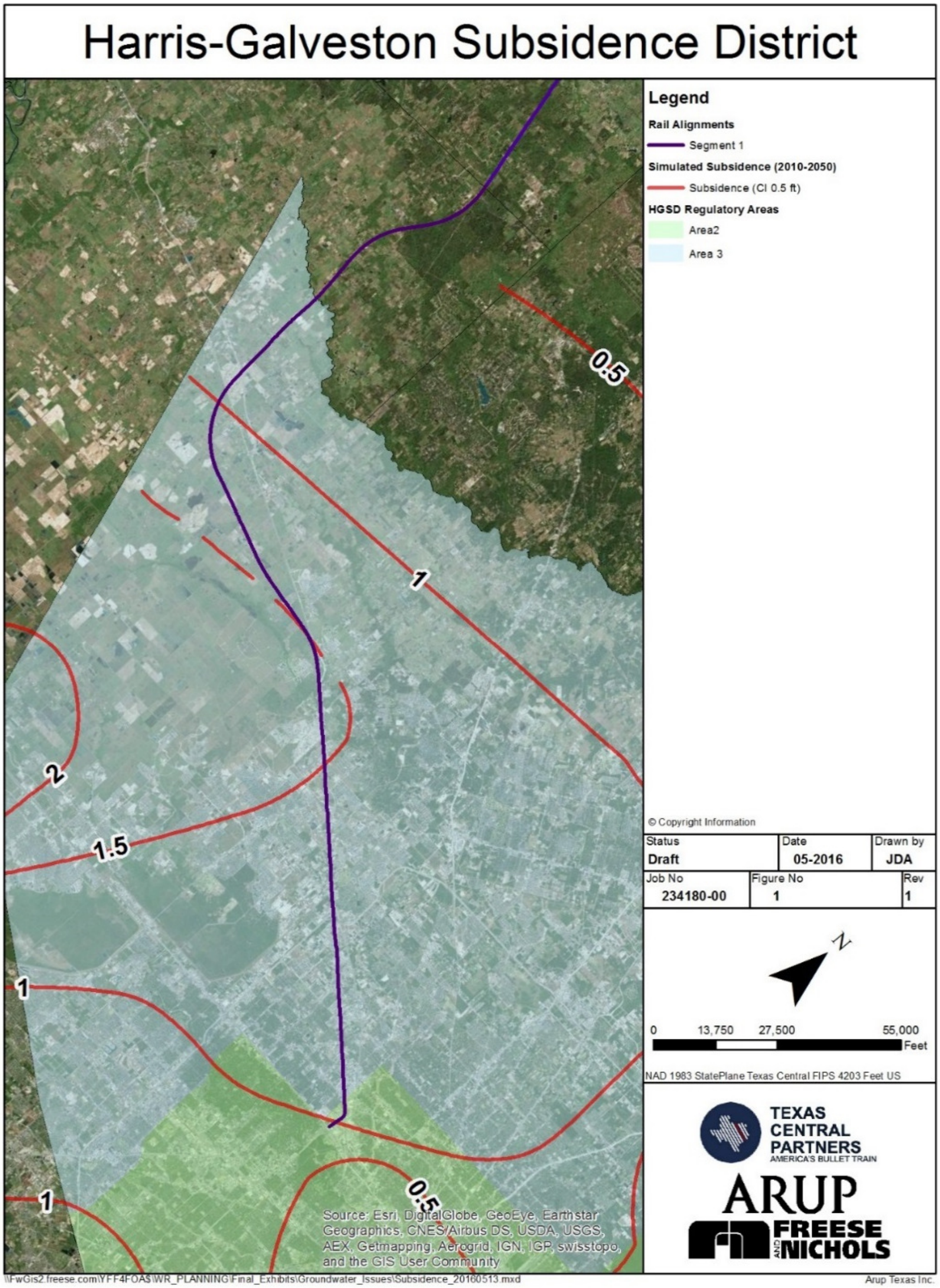


Figure 38: Harris-Galveston Subsidence District

13.9.2 Subsidence in Project Alignment Vicinity

Land surface subsidence near the Project alignment is primarily a concern at the southern portion of the alignment in the greater Houston area. As part of efforts to evaluate the efficacy of regulatory plans, HGSD partnered with Fort Bend Subsidence District and Lone Star GCD in developing a Regional Groundwater Update Project. This study incorporated available scientific data, detailed population projections, and detailed water demand projections to model projected impacts of local groundwater regulations on water level declines and subsidence. Contours of projected feet of subsidence through 2050 are shown in red in Figure 38, with maximum projected subsidence near the alignment of approximately 1.5 feet, driven in part by rapid growth in and around the City of Katy. The northernmost contour reflects modeled drawdown in southern Montgomery County, suggesting that future levels of subsidence along the Project alignment reduce considerably for the rural areas immediately north of Harris County. The issue of subsidence is also one of a number of items considered by GCDs in the development of their management plans. Bluebonnet GCD, which is crossed by the alignment in Waller and Grimes Counties, includes goals for both aquifer drawdown and subsidence. For Grimes County, the goal is a maximum subsidence of approximately 0.12 feet of subsidence, for a timeframe from 1890 to 2070. The goal for Waller County for the same timeframe is a maximum of 4.73 feet. It should be noted that these goals do not represent a county-wide average but rather a maximum value.

13.9.3 Groundwater

Groundwater Conservation Districts (GCDs) are local regulatory entities created by the Texas Legislature or Texas Commission on Environmental Quality (TCEQ) to provide a mechanism for the protection of groundwater resources, prevention of waste, and the control of subsidence. The measures applied in meeting these goals vary widely among GCDs based on the characteristics of their jurisdictions. Registration or permitting of wells are generally required, and many GCDs also regulate other factors, including well spacing, metering, production quantities, use, and export. The GCDs crossed by the Project alignment are shown in Figure 39. Detailed design development and construction documentation would meet the requirements of each of these GCDs.

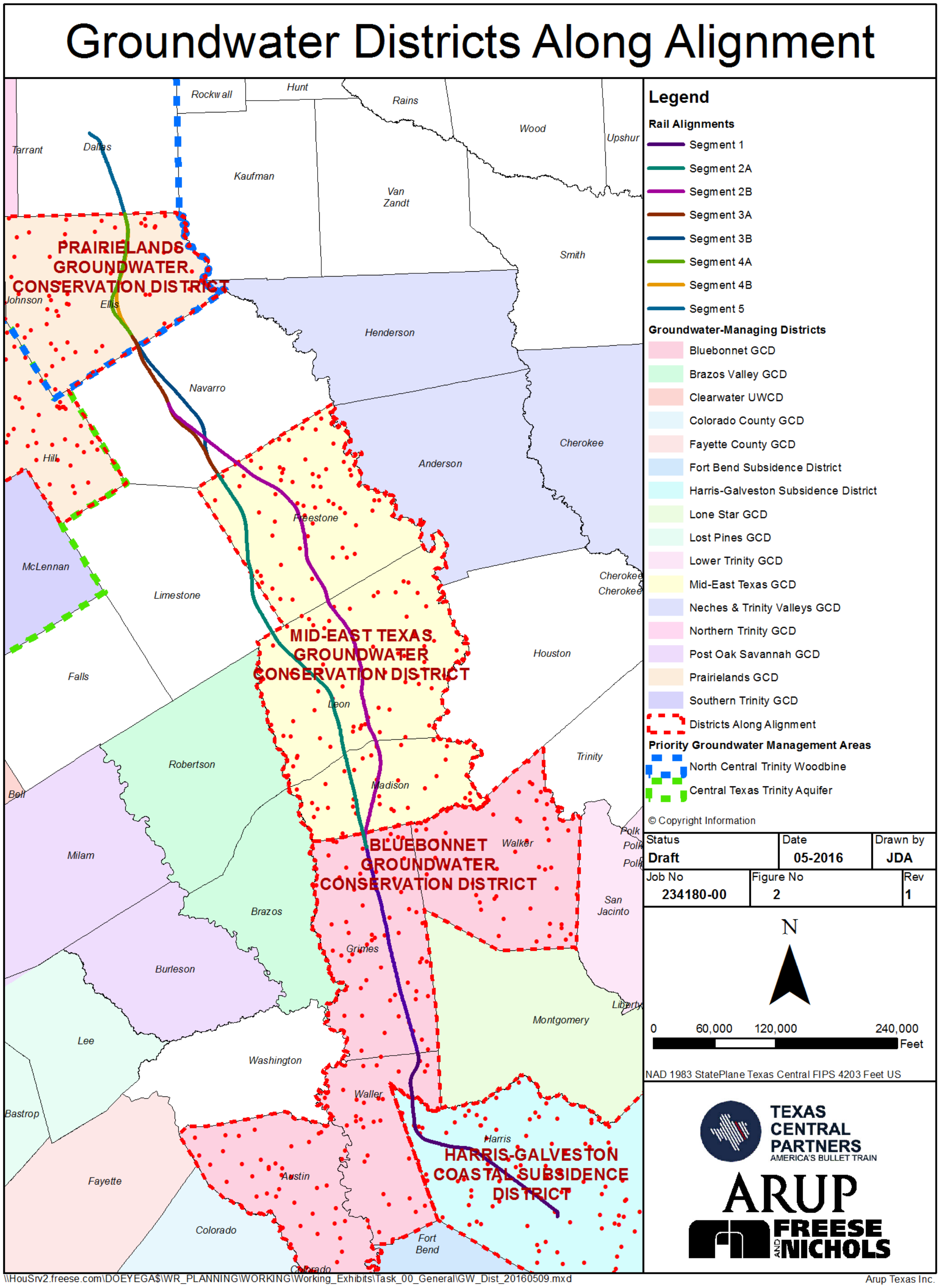


Figure 39: Groundwater Districts Along Alignment

Priority Groundwater Management Areas (PGMAs) have also been designated by the Texas Commission on Environmental Quality (TCEQ) as areas experiencing or expected to experience critical groundwater problems related to supply shortages, land surface subsidence, or water quality. The Project alignment alternatives fall within the boundary of the North-Central Trinity Woodbine PGMA in Ellis and Dallas Counties. TCEQ requirements for work within the PGMAs would be incorporated into construction documentation. Where the Project falls within the urbanized area, water supply would be through connection to a municipality or other utility rather than depending solely on groundwater to minimize environmental impact.

13.10 Existing and Potential Reservoir Sites

Surface water reservoirs are a major component of the water supply infrastructure for Texas, and are particularly numerous in the northern and eastern portions of the state. Large flood control reservoirs are also present in the greater Houston area, near the southern end of the Project. New surface water reservoirs are anticipated to be a major component of meeting future water demands associated with strong population growth in Texas. Hence, consideration of potential reservoir sites in addition to existing water supply infrastructure is required in the evaluation of alignment alternatives.

For purposes of this section, two key criteria were used to identify potential future reservoir sites. The first criterion includes reservoir sites listed as recommended projects in the Draft 2017 State Water Plan (SWP), which is the most recent SWP available and integrates data from the 2016 Regional Water Plans (RWPs). This listing carries significant weight, as inclusion in the SWP is a prerequisite to secure funding through a number of Texas Water Development Board (TWDB) financial programs. The second criterion includes reservoirs designated by the Texas Legislature as Unique Reservoir Sites (URS) or recommended in the RWPs for designation. URS designation is intended to provide protection to sites of unique value for reservoir construction and prevents state agencies and political subdivisions of the state from obtaining easements or fee titles which would significantly prevent reservoir construction. This does not directly limit private development but could impact construction permitting or use of eminent domain. Any anticipated crossing of a URS should be discussed with state regulatory and permitting agencies.

The locations of existing and potential reservoir sites along the alignment alternatives are shown in Figure 40.

13.10.1 Existing Reservoir Sites

Footprints of existing reservoirs are shaded in light blue on Figure 40. The proposed alignment alternatives do not cross the footprint of any existing reservoir and are generally a mile or more away from reservoir boundaries. The closest point identified was on Segment WT, which is in close proximity to the extreme end of a tributary arm of Lake Limestone and crosses multiple streams flowing into the lake. The portion of the alignment in close proximity to the lake is currently anticipated to be constructed on viaduct, which would minimize impacts.

13.10.2 Potential Reservoir Sites

General locations of potential reservoir sites are shown in Figure 40. Sites listed as recommended in the Draft 2017 SWP are represented with small blue symbols. Previously identified Unique Reservoir Sites (URS) are represented with larger red symbols. The URS designations for Allens Creek Reservoir and Lake Columbia sites were enacted without an expiration date, with URS designation for the remaining sites shown expiring on September 1, 2015. However, Brushy Creek Reservoir, Lake Fastrill, and Tehuacana Reservoir are among the sites recommended by the 2016 RWPs for URS designation by Texas Legislature and could regain URS status in the next legislative session. The 2B alignment alternative, which runs along IH-45, is located near two potential reservoir sites, Bedias Reservoir and Tehuacana Reservoir.

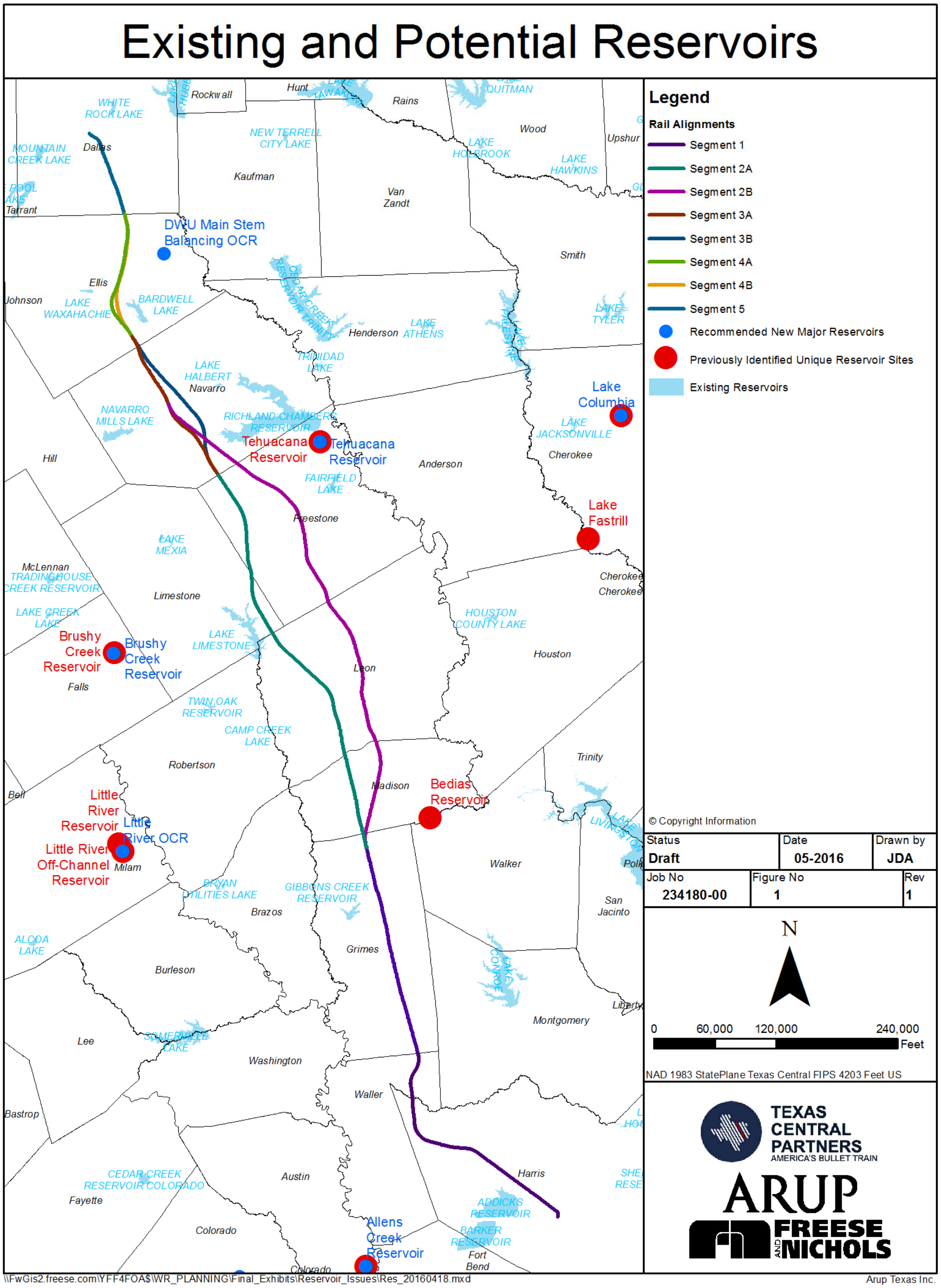


Figure 40: Existing and Potential Reservoir Sites

14 Geotechnical

The initial geotechnical study for the Project involved gathering existing geotechnical information through an enhanced desktop study to develop an understanding of geotechnical-related conditions along the alignment and their general impact on design and planning.

The collected geotechnical information was used to support the conceptual design and analysis of HSR structures, providing inputs for typical foundation, retaining wall, embankment, and cut designs. The desktop study did not include specific geotechnical design recommendations. Additional analysis and recommendations would need to be developed as part of an in-depth, discrete geotechnical investigation.

14.1 Geotechnical Data Sources

Geotechnical data was obtained from a variety of sources; both publicly available information and data purchased or made available by private entities. The data sources included:

- Freese and Nichols available data from design projects in their database;
- TxDOT boring data routinely obtained as part of bridge and roadway design;
- Oncor Delivery Services borings drilled at intermittent tower locations;
- Texas Water Development Board (TWDB) database of water wells installed in Texas;
- National Resource Conservation Service (NRCS) database of surficial soil units;
- Bureau of Economic Geology (BEG) maps, University of Texas at Austin;
- United States Geological Survey (USGS) maps and databases.

The geotechnical-related data was compiled into a GIS-based database. The database includes shapefiles from the reference sources and georeferenced borelogs and/or plan sheets (in the case of TxDOT data).

14.2 Topography

The HSR alignments are located wholly within the Gulf Coastal Plains physiographic province. The Gulf Coastal Plains include three subprovinces described as the Coastal Prairies, the Interior Coastal Plains, and the Blackland Prairies. The southern terminus of the alignment is within the Coastal Prairies. The Coastal Prairies are described as nearly flat prairies formed by deposition of young deltaic soils that have eroded to nearly flat grasslands, sloping almost imperceptibly to the southeast. Typical elevations for this subprovince range from 0 to 300 feet above mean sea level (ft-msl) and a similar range can be expected along the HSR alignment in this region.

The surface elevations rise gradually, moving north along the corridor and transitioning into the Interior Coastal Plains subprovince. The Interior Coastal Plains comprise parallel ridges and valleys resulting from erosion of the weaker shales within alternating belts of resistant uncemented sand and soft shale. Typical elevations for this subprovince range from 300 to

800ft-msl, though along the HSR alignment, the maximum elevation is anticipated to be no more than 550ft-msl.

The northern part of the HSR corridor is contained within the Blackland Prairies subprovince, characterized as a gently undulating terrain formed by weathering of the subsurface chalks and marls. Typical elevations for this subprovince range from 450 to 1,000ft-msl, though along the HSR alignment, the maximum elevation is expected to be no more than 600ft-msl in this region.

Overall, the elevation generally varies from about 50ft-msl in Houston to 550ft-msl in Dallas. Variations in surface elevations due to erosion, faulting, and subsidence can be expected but should not deviate significantly from the aforementioned elevation ranges.

14.3 Geologic Formations

The proposed HSR alignments span several geologic formations ascending in age, from the younger Quaternary deposits at the southern terminus to older Cretaceous deposits at the northern terminus. The age of these deposits and the processes contributing to their formation have a direct impact on their structure and consequent engineering properties, which are discussed in further detail in the following sections.

Active mining, oil wells, gas wells, and storage tanks are identified in the area between Jewett and Teague close to the proposed alignment (approximately 200 km to 250 km from Houston). (Surface well counts can be found in Section 15.5.) The more detailed structural design should account for potential seismic events, where applicable.

14.4 Earthwork and Borrow for Embankment Option

The geotechnical desktop study provided critical input to the conceptual design for the typical embankment infrastructure configuration. The findings are presented for three generalized zones based on the findings of the 2015 geotechnical desktop study. Specific items that are defined include:

- Limits of the three zones
- Reasonable average depths of excavate and replace for each zone
- Expected percentage of suitable for excavated materials in each zone for both the case of using lime stabilization, and without stabilization
- Initial assessment, given risks described above, whether lime stabilization has fatal flaws, or should be kept in consideration

The presence of widespread, highly-expansive soil is a primary consideration in the development of recommendations for these items. A secondary consideration is the potential for foundation settlement of embankments along the southern end of the alignment where less consolidated materials are present.

14.4.1 Geotechnical Zones Along Alignments

The HSR corridor was subdivided into three zones for the purpose of geotechnical discussion in this section. The zones and their limits are presented in Table 39 on the following page.

Table 39: Geotechnical Zones

Zone	Description	Section Name	Begin Station	Approx. End Station
3	Northern End, geologically older deposits (Cretaceous), primarily over-consolidated, high plasticity clays over limestone and shale	Dallas zNC	DT 10+00	DT 217+02
		Dallas zNC	DS 10+00	DS 770+78
		Ellis West zNC	EW 10+00	EW 1242+50
		Ellis East zNC	EE 10+00	EE 1208+15
		Northern Part of Navarro West	NW 880+02	NW 1637+09
		Navarro West zNC	NW 710+00	NW 1637+09
		Navarro East zNC	NE 610+00	NE 1654+02
		IH-45 zNC	IH2 710+00	IH2 913+96
2	Middle, geologically mature deposits (Miocene to Paleocene), primarily moderate-to-high plasticity clays over shale and marl	Navarro West zNC	NW 10+00	NW 610+00
		Navarro East zNC	NE 10+00	NE 510+00
		IH-45 zNC	IH2 10+00	IH2 610+00
		IH-45 zCE	IH1 10+00	IH1 4329+69
		West of Teague zCE	WT 10+00	WT 4118+86
		Houston zCE	HN2 1611+40	HN2 2073+80
1	Southern End, geologically younger deposits (Holocene to Pliocene), primarily consolidated, moderate-to-high plasticity clays	Houston zCE	HN2 10+00	HN2 1511+40
		Houston zSC	HN1 10+00	HN1 2383+15
		Houston Terminal Industrial Site	HT3 10+00	HT3 58+00
		Houston Terminal Northwest Mall Site	HT2 10+00	HT2 68+23
		Houston Terminal Northwest Transit Center Site	HT1 11+00	HT1 110+00

14.4.2 Expected Average Depths of Excavation and Replacement for Each Zone

Due to highly plastic clay considerations, embankment infrastructure configurations would require either 1) modification of the foundation subgrade to limit expansive soil movement and/or consolidation settlement (depending on zone), or 2) the use of a “non-expansive” embankment core to limit shrink/swell movements at the track level. Material used outside of the core (shells) may be a random material.

The following table summarizes the estimated average depth, below the base of the embankment, of excavation and replacement of soil for the foundation. The excavation depth is a function of soil conditions as well as height of embankment. The table values are preliminary in nature, and the amount of excavation and replacement of the foundation below the embankment would depend on the consistency and plasticity of the foundation soil and the height of the embankment. In particular, the surcharge from taller embankment infrastructure configurations would limit expansive soil movement, but would also increase the potential for consolidation in areas with softer foundation materials. Swell conditions control for shorter embankment sections, while consolidation conditions control for the taller embankment sections. This is most pronounced in Zone 1 because of the coastal clays in the Houston area. Other methodologies, such as deep soil mixing, may achieve the desired result, but would require site specific evaluation.

Table 40: Estimated Average Depth of Foundation Excavation and Replacement of the Foundation Soil Below the Base of the Embankment

Zone	Embankment Height up to 5ft	Embankment Height Between 5ft to 10ft	Embankment Height Between 10ft to 15ft
1	6 ft	4 ft	6 ft
2	6 ft	4 ft	4 ft
3	8 ft	4 ft	3 ft

For the purposes of this discussion, consolidation behavior is neglected in all rock materials (limestone, shale, and marl), and in clays that are from geologic epochs older than the Pliocene. Based on these assumptions, consolidation is most likely in portions of Zone 1. Note that consolidation is also possible for alluvial deposits that cross older deposits, but they are not considered or quantified for this discussion.

14.4.3 Expected Suitable Percentages of Excavated Materials in Each Zone

Materials excavated along the alignment are likely to be overwhelmingly high plasticity clays. These materials are commonly used for the construction of roadway and dam embankments in Texas due to the limited availability of higher strength and/or less expansive material, but their use does require special consideration with regard to construction and slope stability. Because the high-speed track has limited movement criteria, highly plastic clays would have limited suitability.

For the purposes of this discussion, it is assumed that the embankment would be zoned to include a core of "non-expansive" material with 1:1 side slopes, and that the shell on both sides may be a "random" material with 4:1 side slopes. For a typical large embankment infrastructure configuration 15ft (4.6m) tall with a 60ft (18.3m) wide crest, this configuration results in roughly two-thirds of the fill volume in the core and one-third of the volume in the shell. The following criteria was used to estimate the amount of suitable material:

- Soils with less than 25 % fine content and PI<15 are considered as material suitable for core without modification.
- Soils with 15<PI<50 are considered as material suitable for core with lime modification.

- Any other soil types are considered suitable for shell
- Segments of soil within the Freestone, Ellis and Dallas counties are mapped by TxDOT as containing appreciable sulfate content, and are excluded for use with lime modification. The occurrence of sulfates would not be continuous in these areas, but could be widespread.

The existing desktop database was queried for these criteria. The data source used was the USGS Soil Web, which characterizes soil in the upper 5ft to 7ft (1.5m to 2.1m) of the ground surface. The following table summarizes the proportion of suitable materials based on these selection criteria. Note that the values are approximated based on the analysis and experience.

Table 41: Suitability of Excavated Materials

Zone	Desktop Segment	Approx. Length (miles)	County	Suitable for Core Material (Unmodified)	Suitable for Core Material (Modified)	Generally Unsuitable Material	Suitable for Random Shell
Reach 1	1	2.2 (3.5km)	Harris	10%	50%	10%	80%
	2	20.2 (32.5km)	Harris				
	3	30.5 (49.1km)	Harris/ Waller				
	4	14.6 (23.5km)	Grimes				
Reach 2	5	5.6 (9km)	Grimes	15%	50%	10%	75%
	6	11.7 (18.8km)	Grimes				
	7	15.2 (24.5km)	Grimes/ Madison				
	8	31.9 (51.3km)	Madison/ Leon				
	9	40.7 (65.5km)	Freestone*/ Navarro				
Reach 3	10	47.7 (76.8km)	Ellis*/ Navarro	0%	20%	5%	95%
	11	14.7 (23.7km)	Dallas*				
* Counties with mapped as containing soluble sulfates (TxDOT)							

14.4.4 Initial Assessment of Stabilization

The use of lime treatment to “stabilize” expansive clays has a long history in Texas and is a proven technology. Because of this, contractors and equipment to perform the modification process should be readily available.

However, the majority of the application of lime modification has been for roadways with only limited application to deep fills. Lime treatment is considered a viable option with the following caveats:

- There is some uncertainty regarding the long-term effectiveness of lime-modified clays. A limited review of published research indicates that the movement of water through the treated material can reduce the effectiveness of the modification over time. For this consideration, the use of lime modified materials is likely more appropriate for the embankment core, and potentially less so for foundation modification (particularly in areas with shallow groundwater).

- The lime modification can be amended with Portland cement or other pozzolanic-forming additives to increase their effectiveness and durability.
- Lime, Portland cement, and other calcium-based modifiers can react negatively with soluble sulfates in soil to form highly hydrophilic minerals (sulfate-induced heave). This is a well-documented process for roadways, and can be highly damaging for a shallow treatment depth. Because lime modification of the core or replaced subgrade is much thicker that used for roadways, the threshold level for the sulfate concentration would likely need to be more stringent than used by TxDOT for roadways. The impacts of this mechanism can be significantly reduced if the minerals form and are hydrated before compaction occurs.
- Lime modification may have limited applicability in Zone 3 because of the presence of sulfates in many of the Cretaceous-aged materials.
- Lime modification requires a hydration period during treatment and curing. This period is critical for the effectiveness of the modification. An added benefit is that this period can be extended during the batch process to allow for the formation and hydration of sulfate induced heave minerals before compaction.

If used, the modification process would likely be more efficient if applied to a “batch” process where the material to be modified is delivered to centralized locations, is treated in lay-down areas and then stockpiled and/or removed for transport. An important consideration is that this approach would promote material consistency and can also provide more time for hydration during the lime modification process.

15 Utilities and Power

15.1 Sources of Data

The majority of the preliminary electric transmission line GIS data was obtained from the Platts commercial GIS service.

Oncor Electric Delivery provided the following data:

- GIS maps of 138kV and 345kV transmission lines for Watermill to Limestone
- Borelogs of 345kV line to Watermill substation
- Easement documents for Watermill to Limestone 345kV line
- Oncor Service Area in Navarro and Ellis counties

CenterPoint Energy provided the following data:

- GIS maps of 138kV and 345kV transmission lines for CenterPoint Service Area
- GIS maps of natural gas transmission and distribution pipelines for CenterPoint Service Area

Cross Texas Transmission provided GIS data for their new Limestone to Gibbons Creek 345-kv transmission line project.

The majority of the preliminary pipeline data was received from the Texas Railroad Commission public GIS database.

Enterprise Product Partners also shared their GIS data for the twin Seaway 30in (762mm) crude pipelines

The following municipalities provided data on water, sanitary sewer, and storm drains for their respective jurisdictions:

- City of Houston
- City of Dallas
- City of Lancaster

The following companies provided map and GIS data for above and below grade communication and fiber locations:

- AT&T

15.2 Utilities Considered

Major utilities along the HSR alignments and potential impacts were considered in development of the DCE. At this preliminary level of Project planning and conceptual design, it was not practicable to identify all third-party utilities along the corridor. Ultimately, detailed coordination with utility owners would be required to complete mapping, which would involve test pits and other subsurface investigations. Accordingly, the following criteria were used to determine what major utilities were incorporated in the utilities investigation supporting the conceptual design efforts.

- Water and Wastewater: 18in (457mm) diameter and larger
- Storm drain: 36in (914mm) diameter and larger
- Oil and Natural Gas Piping: 12in (305mm) diameter and larger; high pressure (500 psi)
- Electrical Transmission Lines: 69kV and above
- Communication/Fiber: 100 Pair or larger (copper); 144 Fiber or larger

As the alignment and utility coordination process continues, the need to evaluate impacts to smaller-diameter utilities may be identified to support site-specific design or impact mitigation issues.

Subsequent to development of the DCE a more detailed utilities investigation involving close coordination with utility owners was commenced to support final design efforts. The results of these ongoing utility investigations would be incorporated into more advanced design development.

Appendix J provides major utility crossings and expected impacts along each of the HSR alignments.

15.3 General Utility Considerations

Simply stated, the design and construction of the HSR line would need to protect in place or relocate (temporarily or permanently) utilities impacted by the Project. Crossings of pipelines would generally be handled with a “protect-in-place” approach where practicable. Protect-in-place requires structural bridging over the pipeline to minimize any additional loads transmitted to the existing pipeline. In some cases work would involve excavating around the existing pipeline and install casing around pipeline to support additional loads. In most areas, water, sanitary sewer, and storm drain utilities would be protected in place.

Most of the pressurized gas and petroleum product pipelines along the alignment would be protected in place. Most of the gas and petroleum pipelines in place across the alignment today were not designed and installed to meet regulations for crossings. Therefore, where the alignment crosses any existing pipeline, the assumption is that the pipeline would need to be “protected in place” by the addition of encasement pipe, or structural slabs and bridges to support any additional load. This is directly applicable to areas of the alignment where embankment, cut, or retained fill is utilized along the alignment. In addition, in areas where viaduct is used, the protection of gas and oil pipelines would still be required due to the new access road which would cross the pipeline. The use of viaduct structures would also place an additional load on the existing pipeline if the pipeline were near the new structure, requiring the pipeline to be protected.

Where protect-in-place is not feasible, pipeline relocation or rerouting would be required. Due to the extensive work along Hempstead Road in Houston, many of the utilities in this segment of the corridor would be relocated. Close coordination with the City of Houston and with the various utility owners impacted would be required.

The decision to protect in place or relocate utilities would vary based on many factors, including but not limited to the location, the type of utility, the age of the utility, the accessibility of the utility post construction for maintenance, and the risk to HSR operations and the utility of leaving the utility in place. Some utilities are more difficult to relocate, such as gravity sewers. Others such as utilities under pressure are much more easily rerouted. Depending on depth, it is expected that many communications utilities can be protected in place, or perhaps left in their current alignment but moved to a deeper location.

Clearance provided to transmission line crossings must be a minimum of 25ft (7.6m). Determining existing heights of transmission lines requires further detailed surveys and utilities coordination, but it is expected that existing transmission lines would need to be raised where either the HSR crosses below the transmission lines, or where roadways that cross below transmission lines are raised to achieve grade separation with the HSR.

It is desirable to have transmission lines cross over the HSR alignment as close to a 90 degree angle as possible. This would minimize induction effects and minimize impacts to the existing transmission line ROW and utility access requirements. Further design development and coordination with utility owners is required to determine locations where transmission line realignments are required at crossings.

Large diameter water transmission lines owned by Tarrant Regional Water District (TRWD) are crossed by the alignment. Careful consideration of these utilities would be undertaken during more detailed design to ensure no interruption in service. It is expected that some sections of the existing pipelines would not allow for any work or additional weight on or near the pipeline. These sections may have to be replaced and rerouted under the rail alignment.

Mitigation of utilities impacts would require direct utility owner involvement in design development, construction coordination, and sequencing of work. Each utility owner has its own requirements and compliance specifications. Each utility is also regulated by a government entity where the utility owners' assets are tightly regulated. As such, and as is common practice, the utilities would generally either participate in or complete the final design for utilities protection, relocation, or provision. During construction detailed coordination of relocations and outages would be required and scheduled months in advance with the corresponding utility. In some cases, the utility owner would either self-perform or separately contract the utility works. Utility relocation in the area of construction works would be timed to minimize the potential for any unexpected impacts during infrastructure construction operations. Temporary utilities would be provided as required to minimize any service interruptions.

15.4 Coordination of Utility Impacts Underway

Existing utility information is provided in Appendix J. Coordination with utility owners along the entirety of the preferred HSR alignment would be required during detailed design. The below coordination efforts are currently underway.

15.4.1 Enterprise Products Seaway Pipeline

A conflict with a recently constructed 30in (762mm) diameter Enterprise Product Partners Seaway crude pipeline was identified along sections of alignment Segments WT and IH during the course of the utility assessment and investigation

EW Segment

The overall area of conflict begins near Station WT 130+00 (near the Madison/Grimes county line) and continues to Station WT 1030+00. This is approximately a 17-mile (27km) long stretch where the HSR alignment either crosses, runs along the utility line, or follows too closely to the pipeline. However, within this 17-mile (27km) stretch there are only seven (7) cumulative miles (11km cumulative) that have actual conflicts with the Seaway Pipeline easement. The seven miles of conflicts are not contiguous, but occur intermittently through the 17-mile (27km) section.

IH Segment

The overall area of interaction between the HSR alignment and the pipeline begins near Station IH1 3925+00 and continues to Station IH2 820+00, approximately 12 miles (19km). Within this zone, the main area of alignment and pipeline conflict happens between Station IH1 4150+00 and Station IH2 245+00, approximately 9 miles (14km).

As a part of our due diligence process, we have continued to review the alignment of both the HSR and Seaway pipeline internally, and with Enterprise Product Partners. One of the primary conclusions based on discussions with EPP, is that the amount of right-of-way (ROW) overlap between HSR and Seaway should be kept to a minimum. If a repair is required on the Seaway pipeline in an area where the HSR LOD and the Seaway easement overlap, there is a potential that the HSR service would have to be temporarily halted until the repair is complete. This scenario is particularly valid if the construction type of the HSR is embankment and the slope extends into the Seaway ROW.

As the design has developed, coordination with Enterprise Products has been ongoing. Several options have been discussed to mitigate the conflict between HSR and the Seaway pipeline. The options discussed with Enterprise included:

- Relocating the pipeline outside of the HSR LOD
- Protecting the pipeline in place where feasible
- Using viaduct to span and avoid pipeline crossings

As the engineering and design of the alignment progresses, we would continue to coordinate with Enterprise Product Partners and their team. In addition, cost estimates for the different options would be refined as more design data is developed and assessed. Selection of the preferred option would strive to minimize cost, scheduling, and environmental impact.

15.4.2 Dallas Water Utilities

The City of Dallas has several water, wastewater, and storm lines that cross the alignment. As a part of the conceptual engineering process, the design team has identified the major DWU utility line crossings. For a majority of the utility crossings, the alignment would be on viaduct. This would allow the spacing and layout of the viaduct structures to be coordinated to avoid the utility lines. At the Dallas HSR station, the sanitary, storm and water lines would be evaluated and modified as the station design and footprint are developed.

Dallas Water Utilities has a wastewater lift station facility called Cadiz Pump Station near the intersection of IH-30 and IH-35 on Cadiz Street. The facility serves the north and northwest corridor of Dallas to the Central Wastewater Treatment Plant (CWWTP), located 4 miles (6km) south of the downtown area. The City of Dallas is currently working on large sewer projects in the vicinity to ultimately decommission the Cadiz Pump Station over the next few years. The current alignment and station is designed to not impact the Lift Station itself and minimize impacts to surrounding sanitary sewer lines. Coordination is ongoing with Dallas Water Utilities to fully understand any additional sewer infrastructure that may be impacted.

15.4.3 City of Houston Utilities – Hempstead Road

Due to the high amount of existing development along the Hempstead Road corridor, record drawings and detailed utility information for this area have been obtained. Team staff also visited the site to identify utility line markers, cable boxes, electric risers, manholes, and other utility infrastructure and owners within the Hempstead Road corridor. The site visit identified 25 utility companies with infrastructure that includes fiber duct, internet and telecom, cable, electric, oil and gas pipelines, natural gas service, and City of Houston water and wastewater pipelines within the Hempstead Road Corridor.

The major utilities that have been identified along Hempstead Road include approximately 11,000 LF (3.3km) of 54-inch (1.3m) City of Houston water transmission line that runs between Hempstead Road and the existing UPRR line and 20-, 24-, and 36-inch (50cm, 61cm, 91cm) water mains crossing Hempstead Road. Other major utilities along Hempstead Road include 36-inch and 42-inch (91cm and 107cm) sanitary sewer mains that cross Hempstead Road and three petroleum gathering lines. In addition to the major water, sanitary sewer and petroleum pipelines, there are fiber optic, cable, natural gas and power lines that run between the edge of pavement and existing rail.

At a conceptual level, it is anticipated that many of these utilities would be relocated into a dedicated “utility corridor” or right-of-way space on one or both sides of the reconfigured roadway as required.

15.5 Oil and Gas Field Impacts

All alignment alternatives pass through natural gas and oil fields. This segment of the corridor, within the counties of Freestone, Limestone, and Leon, includes dense well spacing, a large number of mineral leases, and several large operators.

Along each of the alignment alternatives, there a number of existing natural gas production facilities and supporting pipelines, gathering systems, and roadway networks to operate and maintain those facilities. Based upon review of existing documentation and outreach to operators and landowners along the alignment alternatives, the facilities in the corridor are a mixture of active, inactive, and abandoned wells. Approximately one third of wells impacted are expected to be active. Of the active wells, most are handled by major industry operators, but some are managed by smaller operators.

TCRR would seek to purchase and abandon all wells within the LOD through private negotiations with operators and land owners, based upon existing investment and future production potential. Where continued production is desired along the corridor, TCRR may work with operators, land owners, and lease holders to relocate production and supporting facilities. Newly abandoned well heads within the LOD would be closed in full accordance with applicable regulatory requirements for Plug and Abandonment (P&A). Formerly abandoned well heads would be investigated as required to confirm proper P&A. Existing roadway networks serving well field facilities would be reconfigured as required to provide uninterrupted access to active wells.

Further investigation of natural gas, oil facilities, pipelines, and mineral rights would be undertaken during more detailed project planning. At this stage of development, TCRR has investigated potential impacts using spatial data for surface well locations from the Texas Railroad Commission, which possesses regulatory authority in the oil and gas industry. The data was spatially queried against the LOD for each of the six (6) end-to-end alignments. For the purposes of a comparative analysis of competing alternatives, records were selected that were within the boundaries of the LOD data.

Table 42 provides surface well counts within each alignment's LOD. Further study of regulatory requirements and an assessment of risk is required to determine if any additional facilities would be impacted, given proximity to the proposed HSR system. While less facilities are located along Alternatives C and F, which follow IH-45, there would be less opportunity to relocate impacted facilities along those alignments, given existing development.

Table 42: Surface Well Count

Alignment	Surface Well Count
Alignment A	32
Alignment B	29
Alignment C	20
Alignment D	32
Alignment E	29
Alignment F	20

Oil and gas pipelines provided in Appendix J fall under the criteria of being 12" diameter or larger. Existing collection and distribution pipe networks with diameters smaller than 12" were not identified, but would be investigated in detail during more advanced design. Any existing or newly abandoned lines would be removed. Operating utilities and pipe networks would be protected, relocated, or consolidated as required to facilitate continued well field operations and long term maintainability of the utility network. Foundations of proposed HSR and roadway structures would be designed and constructed to safeguard utilities and either place outside the influence line or properly protect as required.

15.6 Energy Consumption

This section provides a general description of the energy consumption related to the operation of trains and facilities on the Project to support FRA environmental analyses.

15.6.1 Traction Power Energy Consumption

This section addresses traction power energy consumption and regenerative breaking.

The Shinkansen N700 trainset is an electrically powered, high-capacity, and high-performance rolling stock technology that has a low energy consumption per passenger mile. Electric power would be supplied via overhead catenary system to an eight-car electric multiple unit (EMU) fixed-consist trainset that delivers high performance acceleration and braking and can be operated bi-directionally. The trainset represents over 50 years of design innovation that has resulted in an aerodynamic design that increases efficiency and reduces sound generated by operations. The system would also include an advanced regenerative braking system that conserves natural resources by converting kinetic energy into electric power to slow the train. The N700 trainset achieves low energy consumption levels through:

- Reduced aerodynamic resistance.
- Design standards and maintenance practices.
- Reduced rolling stock weight.
- Efficient use of an innovative regenerative braking system.

The proposed HSR system is being designed for a maximum speed of 330km/h (205mph), with initial operations limited to 300km/h (186mph) as described in Section 2. To determine sizing and locations of TPSS facilities, traction power load flow simulations were performed that incorporated consideration of alignment grades, speeds, and train volumes. These simulations identified the power consumption at each point along the alignment. Figure 41 provides a typical traction power demand graph illustrating the relationship between power demand for a single trainset, train speed and altitude of alignment for a train traveling 205mph (330km/h) along from Houston to Dallas. Note that during deceleration, kinematic energy is captured for regeneration.

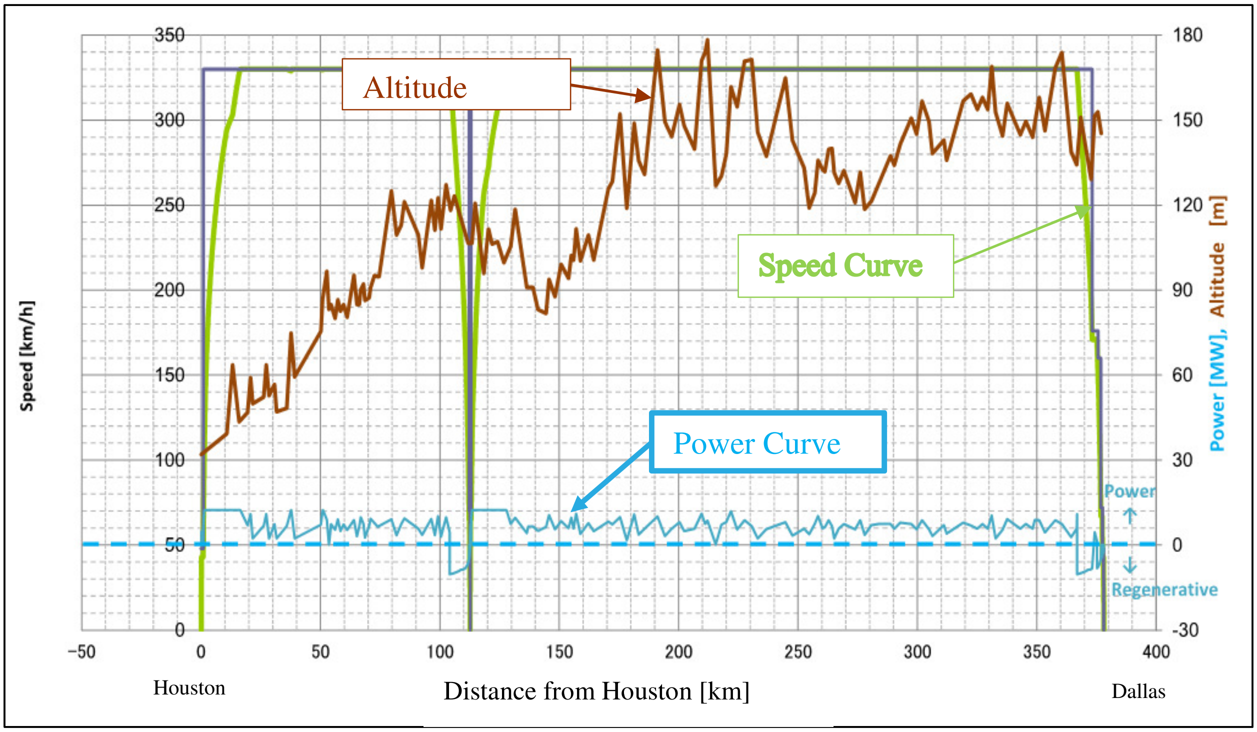


Figure 41: Graph of Speed and Power Consumption vs Distance

The PSL level of service was used in project planning for systems facilities, as described in Section 2.2.

Using the N700 trainset operational data and the PSL planning service levels, the power demand for train operations was identified, as shown in Table 43. Load flow simulation were developed in February 2016 based on all six October 2015 alternative alignments. This analysis included only the energy demands for traction power consumption and incorporates the N700 trainset regenerative braking capability. The power demand between alternatives varied by approximately 9%. While minor revisions were made in alternative alignments since October 2015, the power demand from these simulations has been proposed for use in environmental analyses. To be conservative, the maximum power demand has been used. Note that the Maximum Demand and Amperage values are for the complete end-to-end alignment, not for an individual TPSS. As noted, these values do not account for auxiliary power consumption, such as lights or air conditioning in the trainset, which is considered to be minor in comparison to traction power demand.

As the PSL is being studied for infrastructure planning and an assessment of potential environmental impacts, the traction power demand during operation (ISL and FSL) would be less. More likely power demands during ISL and FSL are also provided in Table 43.

Table 43: Power Consumption and Demand of N700-series Rolling Stock on a Daily Basis

Service Level		Tractive Effort Load (MWh)	Number of Trains per day	Demand Load per Day (MWh)	Average Maximum Demand (MW)	Amperage at 138KV (A)
ISL	186mph (300 km/h)	6.619	68	419	32.63	136
FSL	205 mph (330km/h)	7.731	80	618	48.10	201
PSL	205 mph (330km/h)	7.731	158	1,221	95.01	397

The above tractive effort loads do not account for auxiliary power consumption, such as lights or air conditioning in the trainset. It is estimated that these additional loads would add 0.9 MW per train.

Power to each TPSS would be supplied from a connection to the nearest 138kV transmission line. During more advanced design, detailed coordination with utility providers would be undertaken to refine connection routes to the existing utility grid. The points of connection and the alignments of the utility connections would ultimately be determined by the utility owner and designs developed by the utility would be approved through their standard regulatory and environmental review processes and procedures.

The average current drawn from the utility connection at any TPSS would be in the range of 40-50A at 138kV for loading conditions of the ISL, and 50-60A range for the PSL. While these represent large demands, they would be expected to have a minor impact on the utility circuits that feed them, as those circuits are typically rated in the 800-1600A range.

15.6.2 Facility Power Energy Consumption

The HSR system would have approximately 70 facilities along the alignment to support rail operations, depending on which alignment alternative is advanced following the EIS analyses. These facilities include:

- Stations.
- Parking Garages.
- Maintenance of Way (MOW).
- Train Maintenance Facilities (TMF).
- Communications and Signaling Houses.
- Traction Power Distribution.

These facilities would comprise a mixture of areas falling into the following categories:

- Covered air conditioned spaces.
- Covered ventilated (not heated or cooled, but provided ventilation with fans) spaces.
- Uncovered unconditioned areas (e.g. yards and parking).

The areas of each type of facility would vary with the operational requirements of each facility, ranging from the small communications building to the large station complexes. For every space category within each facility, industry recognized load allowances or energy code allowances, as shown in Appendix K, were used to estimate energy demands. The areas of each facility and assumed hours of operation of each space are described in Appendix K. Based on these allowances and the areas of each program, the total energy usage requirements of all of the facilities would be approximately 515MWh per day. The component parts of this load are shown in Appendix K.

15.6.2.1 Utility Connections

The utility connections for each facility would vary depending on the available utility voltage at each location. For the larger facilities with loads >1 MW, TCRR would seek medium voltage utility connections, probably 15kV, while for the smaller loads a low voltage service a 208 or 480V commercial service would be requested.

It is possible that in some instances, the utility connection would require network reinforcement, but that would be determined through more detailed analyses by the local utility companies.

15.6.3 Summary

Based on the loads described in Appendix K, the estimated maximum daily energy usage of the HSR system and associated facilities for each alignment at the PSL is provided in Table 44. As the PSL is being studied for infrastructure planning and an assessment of potential environmental impacts, the traction power demand during operation (ISL and FSL) would be less. As such, the PSL Total Demand shown in Table 44 is a conservative estimate for assessment of potential environmental impacts. More likely total demands, including train operations and facilities, during ISL and FSL are also provided in Table 44. Note that the energy usage below assumes includes the Houston Northwest Transit Site (HT1), Houston North TMF, and Dallas South TMF, as these are expected to use the most energy of the various alternatives.

Table 44: Maximum Daily Energy Usage for Facilities and Traction Power

	Alignment A (MWh)	Alignment B (MWh)	Alignment C (MWh)	Alignment D (MWh)	Alignment E (MWh)	Alignment F (MWh)
Facilities and Stations	520.4	512.7	519.9	520.4	512.7	519.9
Traction Power (ISL)	419.5 (expected maximum possible demand load at ISL levels)					
Traction Power (FSL)	618.5 (expected maximum possible demand load at FSL levels)					
Traction Power (PSL)	1,221.5 (expected maximum possible demand load at PSL levels)					
Total Demand (ISL)	939.9	932.2	939.4	939.9	932.2	939.4
Total Demand (FSL)	1,138.8	1,131.2	1,138.3	1,138.8	1,131.2	1,138.3
Total Demand (PSL)	1,741.9	1,734.2	1,741.4	1,741.9	1,734.2	1,741.4

16 Wildlife Crossings

The Project is being planned and designed to mitigate negative impacts to wildlife, including animal movements, landscape connectivity, and ecological functions (e.g. energy and genetic flows, predator-prey dynamics, and biodiversity). Providing means for wildlife to cross the HSR ROW would not only be critical to integrating the Project into the surrounding environment, but it would also help address stakeholder concerns and minimize the risk of HSR collisions with wildlife crossing the corridor.

This section outlines corridor-specific wildlife concerns and current best practices for mitigating impacts. This section also provides a general overview of wildlife crossing designs being used for linear transportation projects, and outlines specific considerations being incorporated into the conceptual engineering for the Project. While each crossing would be unique, Figure 42 illustrates a recently completed highway overpass for wildlife use.

Figure 42: Example of recently constructed wildlife highway overpass crossing.

16.1 General Considerations

To mitigate impacts to wildlife movements and landscape connectivity, it is important to understand wildlife and associated habitats along the overall corridor and the specific characteristics of individual wildlife crossing locations. Corridor-wide, landscape scale considerations include locations of threatened or endangered species, migration corridors, existing unfragmented areas of wildlife habitat, watersheds, and other similar concerns. Frequency and placement of wildlife crossings should support landscape-scale habitat connectivity and be tailored to the species present. The design of a wildlife crossing can be just as important as the crossing location.

At the conceptual engineering level intended to support the DEIS, only general considerations are being incorporated into the design. During more detailed design, development of specific wildlife crossing provisions would be based upon field studies and close coordination with local land owners, wildlife agencies, and species-specific experts to determine the types and numbers of domestic livestock, native wildlife, and exotic wildlife present in the Project corridor. At specific crossing locations, selection of crossing type would consider the species present and the surrounding habitat. As the design develops, the Project would incorporate the findings from the FRA's environmental analysis team to further inform design and mitigate impacts. Fencing and natural vegetation buffers along wildlife crossings would have to meet the safety requirements of the HSR system and address site-specific topographic and wildlife considerations.

Specific wildlife crossings. Provisions would be incorporated into more detailed design as appropriate, and as required to mitigate impacts identified by the FRA analyses. These provisions include:

- Include key project stakeholders, along with researchers and professionals familiar with project corridor wildlife and ecology, in design development to address local concerns.
- Integrate wildlife crossings into the natural landscape and take advantage of existing wildlife corridors when deciding on the placement of wildlife crossings.
- 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.
- Locate crossings away from highways and other hazard areas to prevent wildlife mortality due to exposure to traffic or other threats.
- Ensure adequate provision and effective design of wildlife crossings to prevent wildlife from crossing adjacent roadways and threatening driver safety after project implementation.
- Protect both sides of wildlife crossings with long-term conservation easements, particularly at larger, more important crossings.
- Place crossings in a straight line of sight for wildlife, which works better than placements below or above the wildlife's approach levels.
- Consider long-term maintenance requirements of passages to ensure effectiveness of crossings, especially the bottom of passages in riparian areas and holes in fencing.

16.2 Project Specific Considerations

16.2.1 Embankment Sections

Crossings would be integrated along embankment infrastructure configurations at sufficient intervals along the track in order to allow animal movement. At this level of design development, it is assumed that these crossings would most often be integrated with culvert crossings for drainage. Typical details for culverts and wildlife crossings have been included in conceptual design documents.

Figure 43: Example of a multifunctional wildlife crossing in a road embankment. Note clear line of sight, vegetated entrance, and large opening to accommodate cattle and wildlife.

During field investigations in support of environmental analyses and more detailed design, coordination with local land owners and trained biologists would help identify the need for any additional wildlife crossings at specific locations.

Crossings would be located in areas with sufficient wildlife cover to encourage the use of these crossings. This is 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.

16.2.2 Viaduct Sections

Corridor segments with viaducts would not require many special considerations other than preventing access by wildlife to the viaduct. Security fences or other barriers would be designed to prevent access to the ROW by livestock or wildlife except at designated crossings.

Figure 44: Example of security fence along transition from embankment to viaduct (Courtesy of the Ministry of the Environmental of Spain). Note that the area beneath the viaduct can be traversed freely by wildlife or cattle.

The use of viaducts would provide wildlife crossings in floodplains where there are significant wildlife habitats. Expanded use of viaducts would be investigated as an infrastructure approach in critical wildlife habitat areas or within areas with significant populations of large animals to mitigate any impacts.

16.2.3 Species-Specific Differences

Acceptance of crossings would differ by species, especially enclosed crossings such as culverts. Ungulates (hoofed animals) may prefer overpasses while certain carnivores may prefer underpasses. Some species would more readily go through enclosed culverts while others would be wary of culverts, especially small openings.

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 Federal Highway Administration (FHWA). Guidance from these and similar sources would be adapted to create successful design approaches for species specific to the Project corridor.

16.2.4 Land Use and Ownership

Land use and property ownership would be considered when determining the placement and design of wildlife crossings. Urban areas would generally require less frequent wildlife crossings when compared to rural areas. In rural farm and ranch areas, fences, in addition to those protecting the HSR ROW, would be incorporated into the design to control livestock movement and to direct livestock to desired crossing locations. As appropriate to mitigate impacts, existing rural fences that would allow wildlife species to pass through would be improved.

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.

Figure 45: Example of large parcel (green) along the proposed HSR alignment (red) where placement of a wildlife crossing could be contained to a single landowner.

16.2.5 Riparian Corridors and Culvert Crossing Considerations

Studies show that wildlife pathways in riparian crossings are effective and regularly used by wildlife. Many natural wildlife crossing areas would be along creeks within the Project corridor. These creek corridors are often the only vegetated areas in otherwise predominantly agricultural or developed areas and frequently serve as wildlife travel corridors and as foraging and resting habitat for wildlife. Stream channels can provide a natural crossing point for animals even with flowing water. Large ungulates, such as feral hogs, can be exceptional swimmers and easily traverse medium to large size rivers.

Where the HSR line is on an embankment, creeks would be carried through culverts below the HSR line. Appendix G provides proposed culvert crossings; Appendix H provides proposed bridge crossing locations. These culverts would be used by some species during dry periods to cross the railroad, but during flood events these crossings may be flooded. As such, the design team would review the need for additional crossings at higher elevations near frequently flooded creek corridors.

Figure 46: A sounder (family) of Feral hogs crossing the road

The following BMPs related to culvert crossings would be considered during more advanced design development.

- Culverts for wildlife crossings could 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 and should have appropriate cover.
- Even in riparian zones, culverts should be built with dry ledges for use by water-shy organisms, and ledges should be located above the design flood elevation.
- Where culvert crossings are required, design must consider the Openness Ratio (the culvert cross sectional area divided by the culvert length) shown to be an important consideration for different species.
- Most mammals prefer to see through to habitat on the opposite side of the culvert so that the culvert does not appear as a cave or burrow. Other species such as weasels and amphibians do not require such line of sight through the culvert.
- Box culverts, used in conjunction with fencing to guide (or "funnel") animals into the culvert, would be used for both riparian and upland situations.
- The substrate in the floor of the culvert, should be the same substrate as the surrounding habitat is ideal.
- Routine maintenance of culverts can be essential to maintain wildlife connectivity for species depending upon these culverts for safe crossing. "Hanging culverts" are often created

following periods of intense precipitation. Appropriate monitoring and maintenance would be required to ensure access to and through the culvert.

- Boulders, riprap, or other coarse materials should not be used to maintain the aprons at the ends culverts used for passage by small-bodied animals since rough materials may be difficult to negotiate for small bodied and hoofed animals.

16.2.6 Overpasses

Overpasses are typically employed along roadways to reduce traffic mortality for wildlife, to provide safe passage for large-bodied mammals, and to 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.

Figure 47: Example of a wildlife overpass crossing of highway.

The following BMPs related to overpasses for wildlife crossings would be considered during more advanced design development.

- Fencing and vegetation can be used to direct animals to the overpass.
- Substrate and vegetation on the overpass should match that of surrounding landscapes.
- 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.

16.2.7 Fencing

In order to ensure the safe operation of the HSR system, risks of wildlife collisions must be prevented. As such, fencing for the entire ROW and for all crossings would be securely designed and tamper-proof so that animals cannot burrow, chew, climb, or otherwise access the HSR line. Typical details are included in the conceptual design for potential fencing types that could be employed at different locations along the proposed HSR alignment are included in the FDCE drawings (Volume 1).

Figure 48: Juvenile feral hog rooting (digging) in the soil for food.

16.2.8 Frequency of Wildlife Crossings

Determining the correct frequency and spacing of wildlife crossings for the Project would require consideration of habitat types and target species (e.g. feral hogs [*Sus scrofa*], white-tailed deer [*Odocoileus virginianus*], Houston Toad [*Anaxyrus houstonensis*]) in the Project corridor. Spacing would also be largely dependent on the biology of the target species. The typical approach cited in the literature is to determine the typical home range of the target species and to space crossings accordingly. As such, the number and types of wildlife crossings would be based upon the results of the environmental analyses and coordination with relevant agencies and local subject matter experts during more detailed design development.

Specific information related to the frequency of wildlife crossings required for HSR projects is limited. 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 size of the target animals (small vs. big), habitat type (human impacted vs. high value) 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.

16.2.9 Feral Hogs in Texas

The feral hog is a non-native, highly adaptive, ungulate with an extensive population in Texas in the area of the Project.

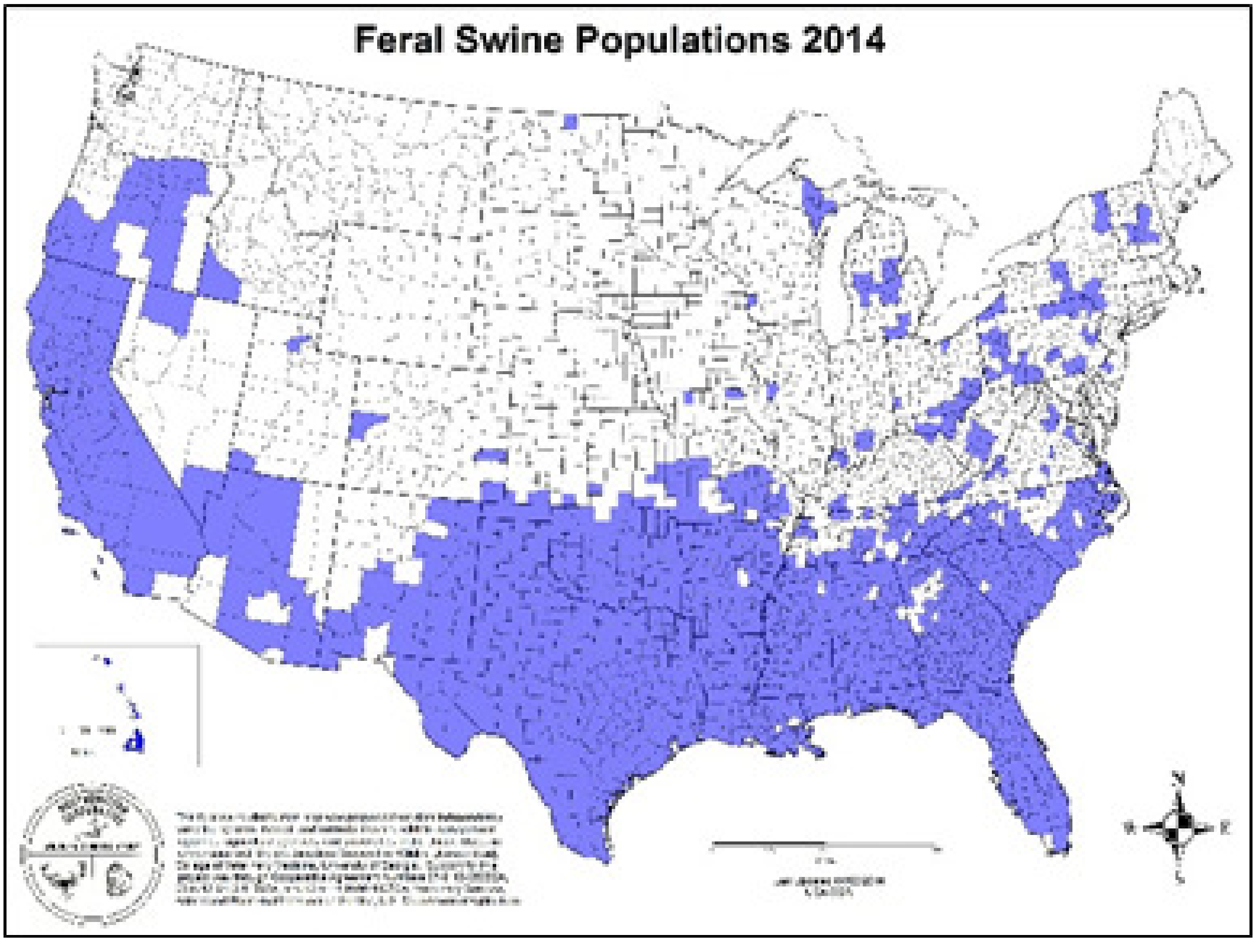


Figure 49: Distribution of Feral Hogs in the United States in 2014 (Courtesy of Southeastern Cooperative Wildlife Disease Study, University of Georgia)

Given the propensity of the feral hog for cursorial (digging/rooting) behavior, protection of the HSR ROW from these animals would be a key consideration. High-strength, buried fencing, or other barriers would be required in areas with established hog populations and where the grade separation of the tracks and the natural ground is minimal.

16.3 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. Example typical details and proposed approaches to mitigation of impacts have been provided with the DCE design to support the DEIS. Location-specific treatments and more advanced typical details would be provided in support of the FEIS following input from the FRA and natural resource agencies, including the 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 proposed HSR corridor. The planning level efforts completed to date are detailed in the following sections and include:

- Drainage Design – Identified existing creek corridors along the alignment 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 alignment profile and by constructability considerations, but identifies opportunities for wildlife crossing locations.
- Species List for Wildlife Crossings– Developed a list of species within the Project corridor that may 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, typical spacing for white tailed deer were followed [1 crossing per 0.5 mile].)
    - Areas with special crossing considerations for the Houston toad based on recognized species-soil type associations.
    - Typical Sections for Wildlife Crossings and Fencing – Identified typical wildlife crossing and fencing details that could be modified for the Project to meet the requirements of target species (i.e. white-tailed deer and Houston toad) and HSR safety needs.

16.3.1 Review of Rail Drainage and Infrastructure Design

The project team used GIS, design plans, and aerial photography to analyze existing creek corridors along the alignment and bridge underpasses or culvert crossings required to meet drainage needs. This information was compared against the proposed infrastructure type to identify and compare those locations where wildlife migration across the HSR corridor 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. Conversely, embankment sections with culverted drainage crossings were considered "constricted" by the project team in terms of wildlife movement, thus requiring special design treatments, in the form of specialized culvert design and separate wildlife crossings in upland areas, to facilitate passage across the HSR corridor. Presently, approximately 60% of the alignment alternatives would be on viaduct with the DCE design to increase permeability of the corridor for wildlife crossings.

16.3.2 Wildlife Species along the HSR Corridor

The project team developed a list of potential species that may occur in the HSR corridor and could require special consideration for wildlife crossings during the FEIS stage of the Project.

Appendix L includes suggested wildlife crossing treatments and fencing size. As the design of wildlife crossings and associated fencing is a new and evolving science, information for certain species is not available at this time. Furthermore, although various wildlife crossings may be suitable for a particular species, the DCE has focused on concrete box culverts for the development of typical wildlife crossing sections due to the limited application of other technologies on HSR projects. The additional wildlife crossings treatments, such as multi-plate steel arches and overpasses, would be considered for species-specific application based on FRA review and input from natural resource agencies.

16.3.3 GIS Analysis of Proposed Crossing Locations and Frequency

To identify opportunities for detailed design of wildlife crossings for the FEIS 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. These preliminary locations were identified and mapped in GIS and consider the following basic assumptions:

- Viaduct sections would allow "free movement" and would not require wildlife crossings.
- Embankment sections, stations, and large maintenance facilities would hinder wildlife movement.
- Wildlife crossings would be provided where the alignment is not on viaduct and wildlife migration would be otherwise impeded. For the purposes of preliminary planning during the conceptual engineering effort an average spacing of 0.5 miles (0.8 km) was assumed along embankment sections outside of urban areas and is shown on the Wildlife Crossings sheets (Vol 5).
- If environmental analyses indicate presence of the Houston Toad, adequate crossings would be included in the design in those areas to mitigate impacts. Potential crossing locations are indicated on the wildlife crossing maps based on soil types preferred by Houston Toad.
- 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 Dallas and Harris counties, would be limited due to anticipated low wildlife populations.

Maps of the preliminary locations can be found in the drawing set (Volume 5).

16.3.4 Next Steps in Design Development

For the FEIS, mitigation measures to address impacts identified in the DEIS would be developed, including site-specific crossing treatments. The level of detail required would be refined through coordination with regulatory agencies and project stakeholders. The following actions would be taken during more detailed design development:

- Field Survey – The alternative alignments were surveyed by qualified biologists on the environmental analysis team and additional focused surveys would be undertaken to determine habitat suitability of crossings proposed in the planning-level design. Where habitat for sensitive species is identified through the EIS efforts, additional studies would be conducted to determine site specific details and locations for crossings.

- Develop Site-Specific Requirements for Fencing – Further refine typical details for fencing based on species-specific requirements. Identify locations along preferred alignment for each fencing type. Where field survey and consultation with local resource agencies and subject matter experts indicate the presence of established feral hog populations, detailed design of specialized fencing would be advanced. This is critical, 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 a HSR train.
- Develop Site-Specific Crossing Treatments – Document requirements for wildlife treatments (fencing and crossings) based on site-specific habitats and species. Identify treatments proposed at each location along the preferred alignment.
- 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 crossings 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 final design, as appropriate.

17 Noise and Vibration

17.1 Mitigation Options

The Project team understands that the FRA team is undertaking a noise and vibration assessment of the Project, and this section is intended to support the FRA's efforts. TCRR is interested in working collaboratively with the FRA to mitigate noise and vibration impacts along the operating alignment and in the vicinities of stations, yards, shops, and ancillary facilities, as identified through the assessment.

At this stage of project development, TCRR has not designed site-specific noise mitigation measures along the alignment. The design of these measures would be dependent upon the noise and vibration assessment being undertaken by the FRA, which would be informed by various field visits and ambient noise measurements made by the FRA team. Nonetheless, this section does provide a general overview of noise and vibration mitigation designs being used for linear transportation projects, and outlines general considerations being incorporated into the conceptual engineering for the Project.

17.2 Project Specific Considerations

17.2.1 Rolling Stock

JRC provided confidential and proprietary performance data and physical characteristics for the proposed HSR trainset as described in Section 2.1, including all those assumed to be relevant to the environmental analyses.

17.2.2 Noise Level Data

Technical noise level data was gathered in Japan for the Tokaido N700A Shinkansen to support TCRR analysis of potential noise impacts and stakeholder engagement efforts.

The recordings in Japan took place just south of Nagoya, at a stretch of straight track on an embankment with no noise barrier. This location was chosen because it is flat and unobstructed, with relatively quiet surroundings. Recordings were made at 82, 164, 328, 656, and 1312 feet (25, 50, 100, 200, and 400 meters) from the track. Arup's engineers used highly-specialized microphones and sound level meters, and a Canon 5D camera to record both audio and video of more than 140 train passings. The same types of recordings (audio, video, sound level) were made at several locations near TCRR's proposed alignment, approximately midway between Dallas and Houston. These locations were selected based on representative existing noise sources: vehicle traffic from highways, noise from industrial plants and freight trains. Measurements were made at the same distances away from these noise sources as were made in Japan with the same equipment.

The recordings from Japan and Texas were compiled into a demonstration at each of the Public Open Houses hosted by TCRR in December of 2015. Each recording was played back in the

Arup NY SoundLab using a technical process to recreate a sound scene in three dimensions—and calibrated to match what was measured in the field with the sound level meter. The sound scenes were then translated to a format that would allow for listening to 3D sound over headphones.

The sound recordings were provided separately to support the FRA's independent analyses of potential noise impacts. The technical details of the noise recording effort are as follows:

- Measurements were made on 8/19/2015 of Tokaido Shinkansen N700A train pass-bys at 25m from the center of tracks, at a height of 1.5m above the track. Because the section of track was on an embankment, this meant that the measurement microphone was positioned 6.5m above ground level. The ground was flat and planted with rice. The coordinates of the location are as follows: 35°00'52.1"N 137°00'04.9"E.
- Data was gathered independently by both JRC and Arup. Audio recordings taken by the Arup team were by a Brüel & Kjær Type 2250 Type 1 Sound Level Meter. JRC data was captured with a Rion NL-32 Type 1 Sound Level Meter.

17.3 General Noise and Vibration Mitigation Considerations

This section provides a general summary of noise and vibration mitigation design options, based on a review of available literature and project experience. These mitigation strategies and technologies would be incorporated into more detailed design as appropriate, and as required to mitigate expected impacts identified by the FRA analyses.

17.3.1 Mitigation Options: Effectiveness

The following table drawn from the FRA's own noise impact analysis guidance document outlines some of the available mitigation measures that could be used in the Project, along with each measure's anticipated effectiveness. Some of these measures are already incorporated into the design of the N700 series Shinkansen trainset planned for use on this Project, given the sensitivity to noise and vibration impacts in the dense Japanese urban areas. The table also notes where specific noise and vibration mitigation measures are either integrated in the trainset design or are considered for inclusion in the design of the TCRR HSR infrastructure.

Table 45: Mitigation Measures

<table>
<tr><th>Application</th><th colspan="2">Mitigation Measure</th><th>Effectiveness</th><th>Incorporated into N700 Trainset or Considered for Use as Mitigation Method?</th></tr>
<tr><td rowspan="14">Source</td><td colspan="2">Stringent vehicle and equipment noise specifications</td><td>Varied</td><td>Yes. Train fleet would be based on Japanese Shinkansen standard specifications</td></tr>
<tr><td colspan="2">Sound-absorptive duct lining for air intake / exhaust</td><td>Varied</td><td>No</td></tr>
<tr><td colspan="2">Operational restrictions</td><td>Varied</td><td>Yes: Operating hours restricted to 05:30-23:30</td></tr>
<tr><td rowspan="2">Resilient or damped wheels</td><td>For rolling noise on tangent track</td><td>2 dB</td><td>No</td></tr>
<tr><td>For curving noise on curved track</td><td>10-20 dB</td><td>No</td></tr>
<tr><td colspan="2">Vehicle/Bogie Skirts</td><td>6-10 dB</td><td>Yes</td></tr>
<tr><td colspan="2">Under-car Absorption</td><td>5 dB</td><td>No</td></tr>
<tr><td colspan="2">Wheel slide protection (prevents flats)</td><td>Varied</td><td>Yes</td></tr>
<tr><td colspan="2">Wheel truing</td><td>Varied</td><td>Yes</td></tr>
<tr><td colspan="2">Rail Grinding</td><td>Varied</td><td>Yes</td></tr>
<tr><td colspan="2">Turn radii greater than 1,000ft</td><td>Avoids curving noise</td><td>Yes</td></tr>
<tr><td colspan="2">Rail lubrication on sharp curves</td><td>Reduces curving noise</td><td>N/A for majority of alignments due to large radii. Rail lubricators to be considered at station approaches and within maintenance facilities.</td></tr>
<tr><td colspan="2">Elimination of surface discontinuities/edges on vehicle</td><td>3-6 dB</td><td>Yes</td></tr>
<tr><td colspan="2">Pantograph well or shroud</td><td>5 dB</td><td>Yes</td></tr>
<tr><td rowspan="6">Path</td><td colspan="2">Sound barriers close to vehicles</td><td>6-10 dB</td><td>Where required, sound barriers would be located at the minimum distance from track centerline still providing safe maintenance and emergency access.</td></tr>
<tr><td colspan="2">Sound barriers at ROW line</td><td>≥ 5-8 dB</td><td>TBD</td></tr>
<tr><td colspan="2">Alterations of horizontal and vertical alignments</td><td>Varied</td><td>TBD</td></tr>
<tr><td colspan="2">Purchase of buffer zones</td><td>Varied</td><td>TBD</td></tr>
<tr><td colspan="2">Ballast on at-grade guideway</td><td>3 dB</td><td>Yes</td></tr>
<tr><td colspan="2">Ballast on aerial guideway</td><td>5 dB</td><td>Yes</td></tr>
<tr><td rowspan="2">Receiver</td><td colspan="2">Purchase of property rights for barrier construction</td><td>5-10 dB</td><td>TBD</td></tr>
<tr><td colspan="2">Building noise insulation</td><td>5-15 dB</td><td>TBD</td></tr>
</table>

17.3.2 Design Aims

The design aims of the Project's noise and vibration mitigation approach are as follows:

- Minimize potential impacts of noise and vibration from the HSR system.
- Design noise and vibration mitigation technologies and measures to control noise and vibration generation to be as close to the source as possible.
- Integrate noise and vibration mitigation into the engineering specification and design for trains, rail systems, stations, alignment, track and structures.
- For the operational railway, specify and design the track to avoid potential severe impacts caused by ground borne noise and vibration within the requirements for a safe, reliable, available and maintainable railway, per FRA guidance
- Specify and design the railway infrastructure to avoid adverse acoustic effects on passenger comfort.
- For the operational railway, where further control at the source is not practicable, specify and design noise barriers and landscape modifications to remove or reduce likely moderate and severe impacts, integrating:
    - Noise barriers as close to the railway as practicable
    - Consistent specification and design vocabulary along the alignment
    - Engineering, acoustic, landscape and other environmental discipline design
    - Stakeholder input
- Include noise and vibration mitigation requirements into the operations and maintenance (O&M) plan.
- The condition of wheel/rail interface where sound and vibration are commonly generated should be kept properly by conducting periodic maintenance of wheel set and track based on JRC's practices.
- Rigorous maintenance of overhead catenary system (OCS) and trainset pantograph. Note that JRC's OCS design and maintenance practices result in industry leading OCS performance and extraordinarily low incidence of OCS failures.
- MOW equipment selection and practices focused on minimizing noise and vibration impacts due to overnight maintenance operations.
- For MOW equipment and facilities, reduce noise and vibration levels as far as is reasonably practicable by locating the source away from sensitive receptors and/or reducing the source noise and vibration itself though specification and design. Provide appropriate additional mitigation measures to equipment to remove likely impacts to the extent practicable.

17.4 Preferred Mitigation Options by Construction Type

If the noise and vibration cannot be sufficiently controlled at the source and additional measures are required to mitigate impacts, there are a host of other measures available. These measures are described in this section in the following tables and illustrated in Appendix M.

Table 46: Embankment

Rural	Urban
Close-in noise barrier (low height, absorbent)	Close-in noise barrier (low height, absorbent)
Conventional noise barrier (absorbent, reflective)	Conventional noise barrier (absorbent, reflective)

Table 47: Viaduct and Retained Fill

Rural	Urban
Close-in noise barrier (low height, absorbent)	Close-in noise barrier (low height, absorbent)
Conventional noise barrier (absorbent)	Conventional noise barrier (absorbent)

Table 48: Retained Cuttings

Rural	Urban
Absorbent wall treatment	Absorbent wall treatment

Table 49: Typical Cutting

Rural	Urban
Landscaping (increase height of bunding)	Close-in noise barrier (low height, absorbent)
Short noise barrier on top of cutting edge; Close-in noise barrier (low height, absorbent)	Conventional noise barrier (absorbent, reflective)
Conventional noise barrier (absorbent, reflective)	-

17.5 Anticipated Impacts

The FRA defines noise impact criteria in terms of human annoyance arising from exposure to the cumulative existing noise plus Project noise. The FRA criteria were developed to apply to a wide variety of surface transportation modes, not just rail. These criteria respond to increased community concerns regarding the impacts of late-night or early-morning operations, and they respond to the individual sensitivities of communities with different ambient noise conditions. Impacts on wildlife (mammals and birds) and domestic animals (livestock and poultry) are also addressed by the FRA.

Noise impacts depend on the combined effects of the existing noise environment and the anticipated project noise levels: those communities already exposed to high levels of ambient noise are said to be more prone to annoyance due to a small increase in overall noise level; to create equivalent levels of increased annoyance in communities with relatively low background noise levels requires a greater change in the overall noise level.

Noise and vibration impacts would also depend greatly on the configuration of the HSR infrastructure, and of the community through which it passes. For example, if the HSR is on an elevated structure adjacent to residential communities, the HSR may be directly “in the line of sight” of sensitive receptors, e.g. the bedroom level of homes. On the other hand, if the HSR is at-grade and separated by a berm from an industrial park the impacts could be minimal.

The TCRR HSR would pass through both densely- and sparsely-populated areas, and some impacts can be expected. In general terms, the design team would expect general impacts along the elevated viaduct entering into Houston, through the Hockley area where there are dense residential areas, and along the approach into Dallas. Over the middle of the route, the team expects more isolated areas of impact that would need to be individually addressed as the design progresses.

18 ROW Requirements

The LOD required for the project is illustrated on the FDCE drawings. Utility LOD, Rail Systems Sites, Temporary Construction Areas, TMF and MOW facilities, and other works are also identified. For the purposes of the environmental analysis GIS files were developed and provided to the FRA analysis team that further categorized the Project LOD as Direct Permanent (DP), Direct Temporary (DT), Additional Permanent (AP), and Additional Temporary (AT). These LOD categories are defined below.

- Direct Permanent LOD describes LOD that would be permanently impacted by the infrastructure configuration, structures, and facilities directly required for the operation of the HSR. This includes LOD for rail, systems (traction power, communications, and signals), MOWs, TMFs, access road (emergency/maintenance), drainage basins, and stations. It is equivalent to the final HSR Right-of-Way.
- Direct Temporary LOD describes LOD that would be temporarily impacted during the construction of the infrastructure configuration, structures, and facilities directly required for the operation of the HSR. This includes temporary construction areas and laydown areas for HSR construction.
- Additional Permanent LOD describes LOD that would be permanently impacted by the infrastructure configuration, structures, and facilities that are not directly required for the operation of the HSR. This includes area for public road realignments and grade separations, associated road drainage basins, new electric transmission line connections, and relocated utilities.
- Additional Temporary LOD describes LOD that would be temporarily impacted by the infrastructure configuration, structures, and facilities that are not directly required for the operation of the HSR. This includes area for utility diversions within existing utility easements, utility protect in place, and electric transmission line crossings.

Appendix A

Speed Distance Trip Graphs

Appendix A: Speed Distance Trip Graphs

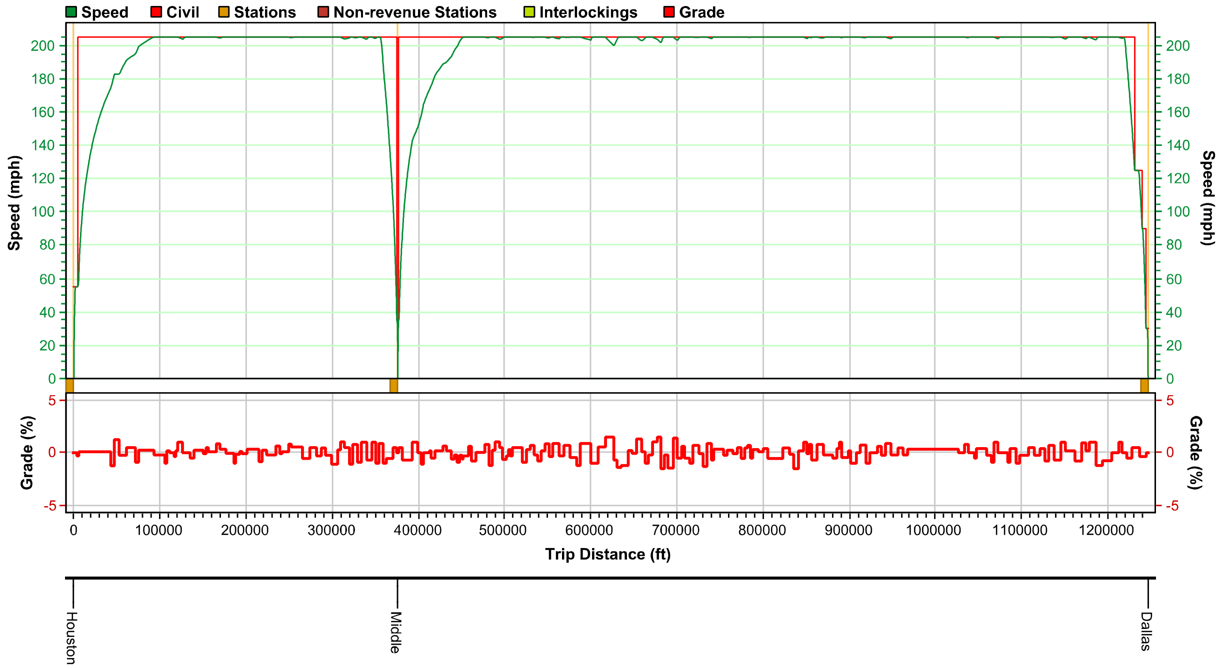


Figure 1: Speed Distance Trip Graph Houston to Dallas Alignment A (205 MPH)

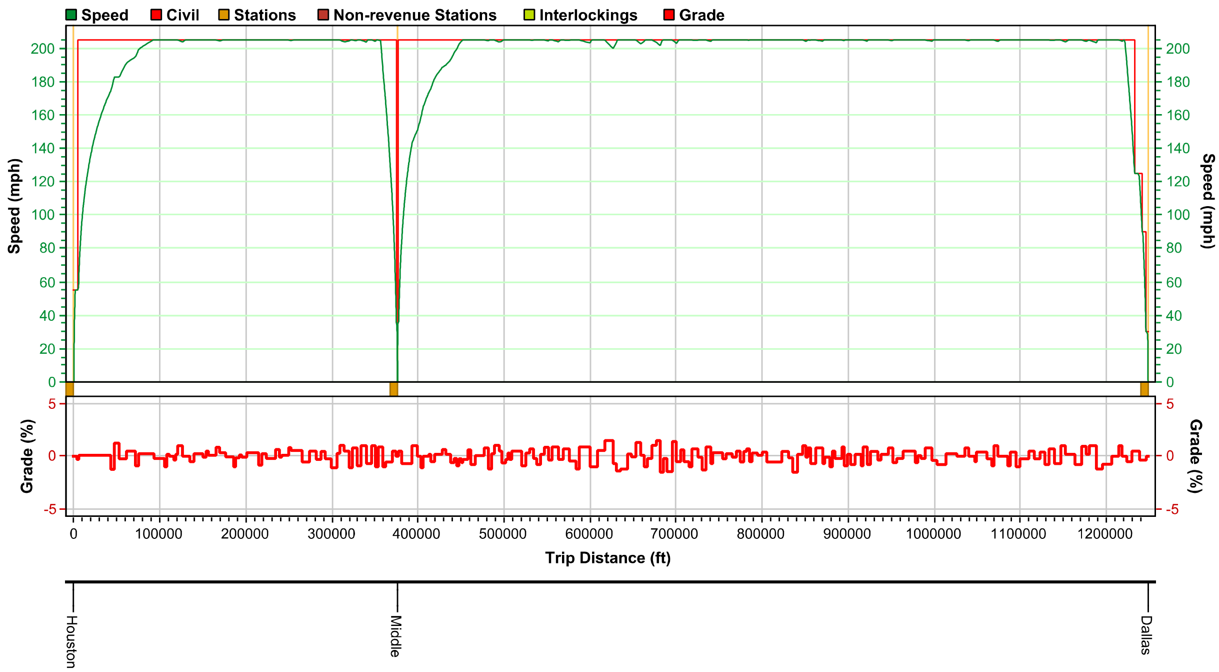


Figure 2: Speed Distance Trip Graph Houston to Dallas Alignment B (205 MPH)

Appendix A: Speed Distance Trip Graphs

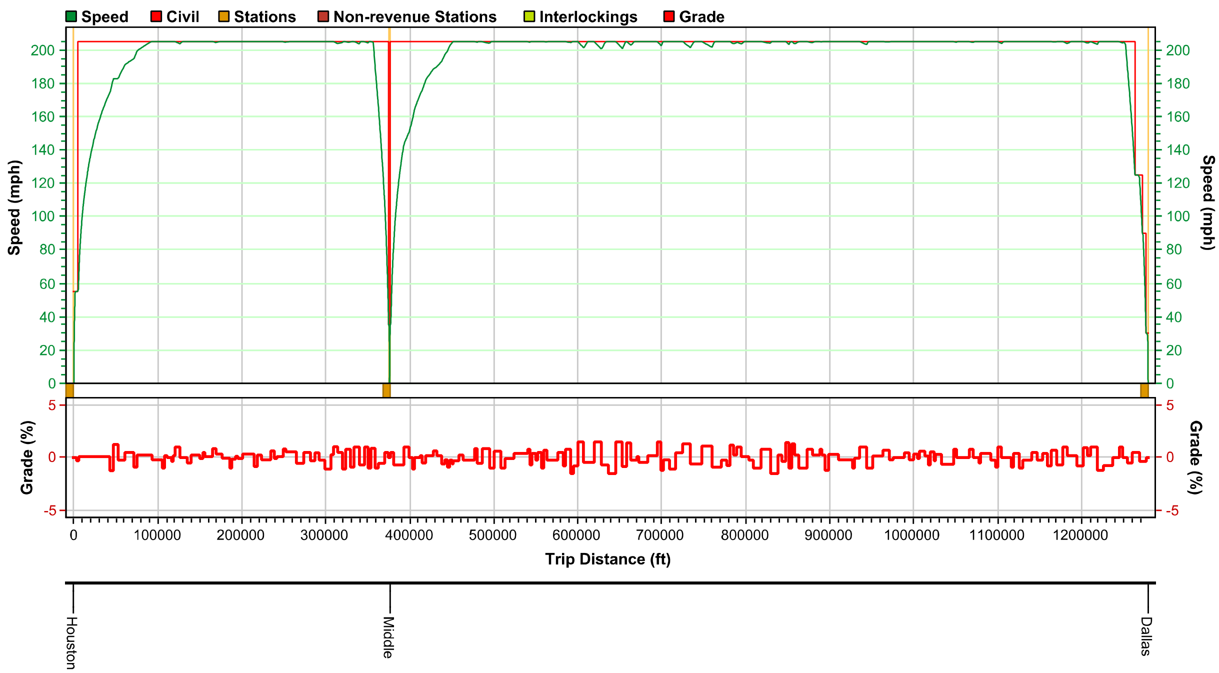


Figure 3: Speed Distance Trip Graph Houston to Dallas Alignment C (205 MPH)

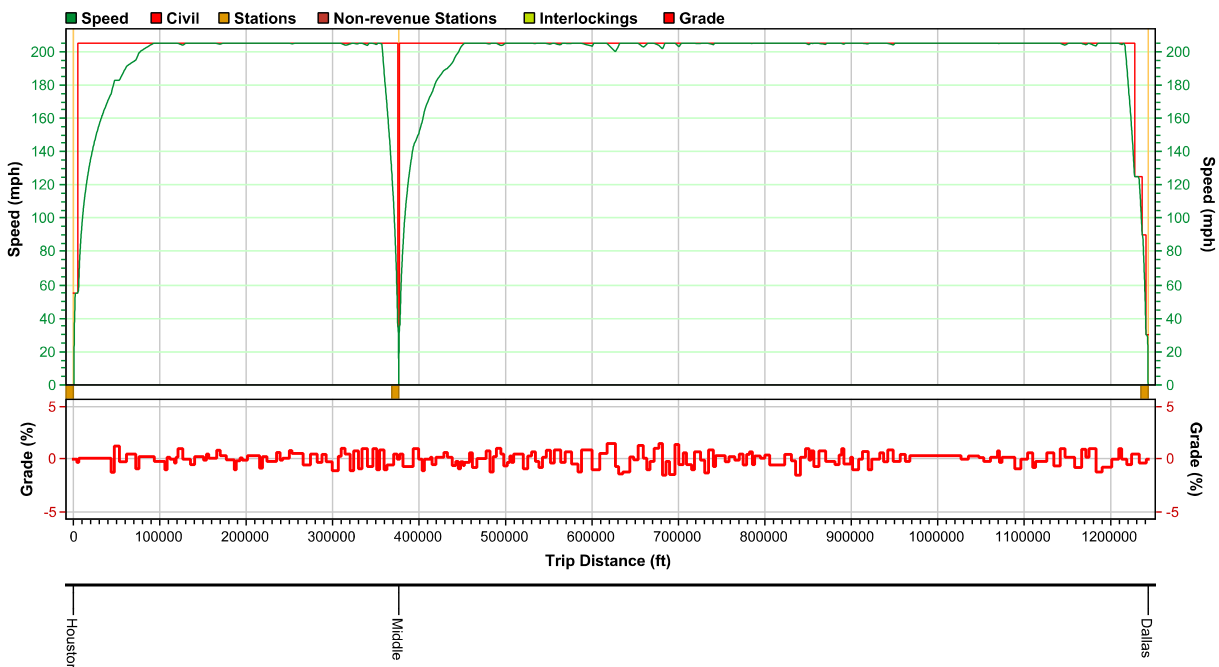


Figure 4: Speed Distance Trip Graph Houston to Dallas Alignment D (205 MPH)

Appendix A: Speed Distance Trip Graphs

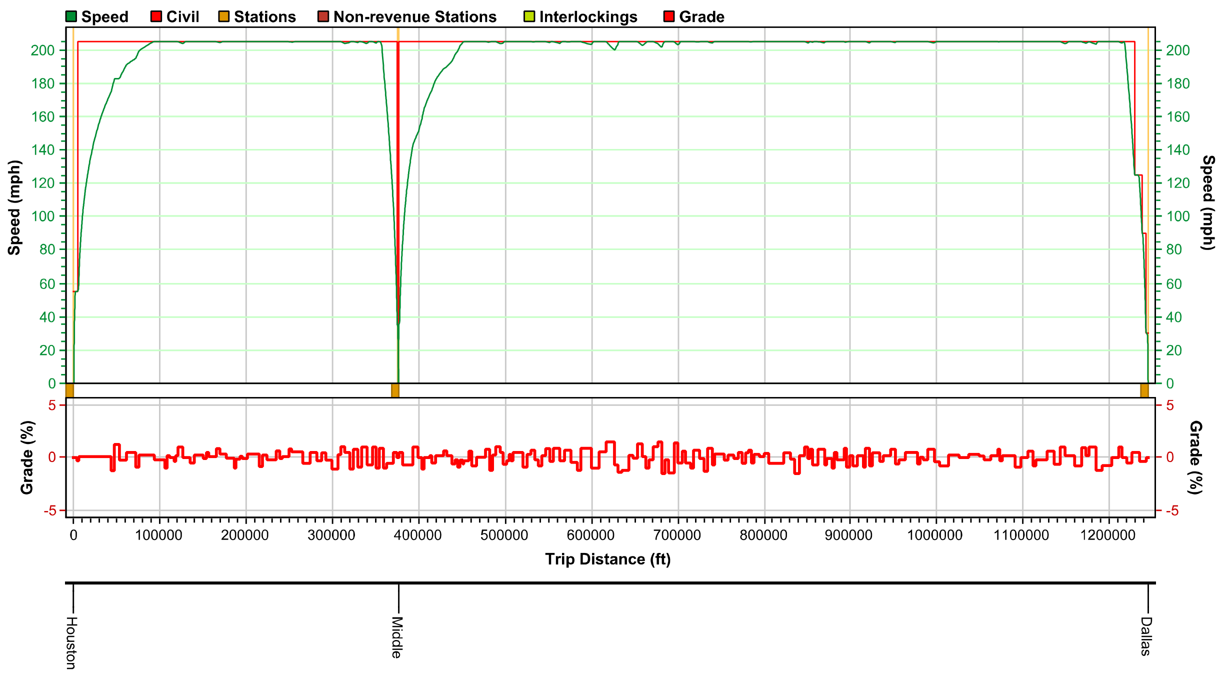


Figure 5: Speed Distance Trip Graph Houston to Dallas Alignment E (205 MPH)

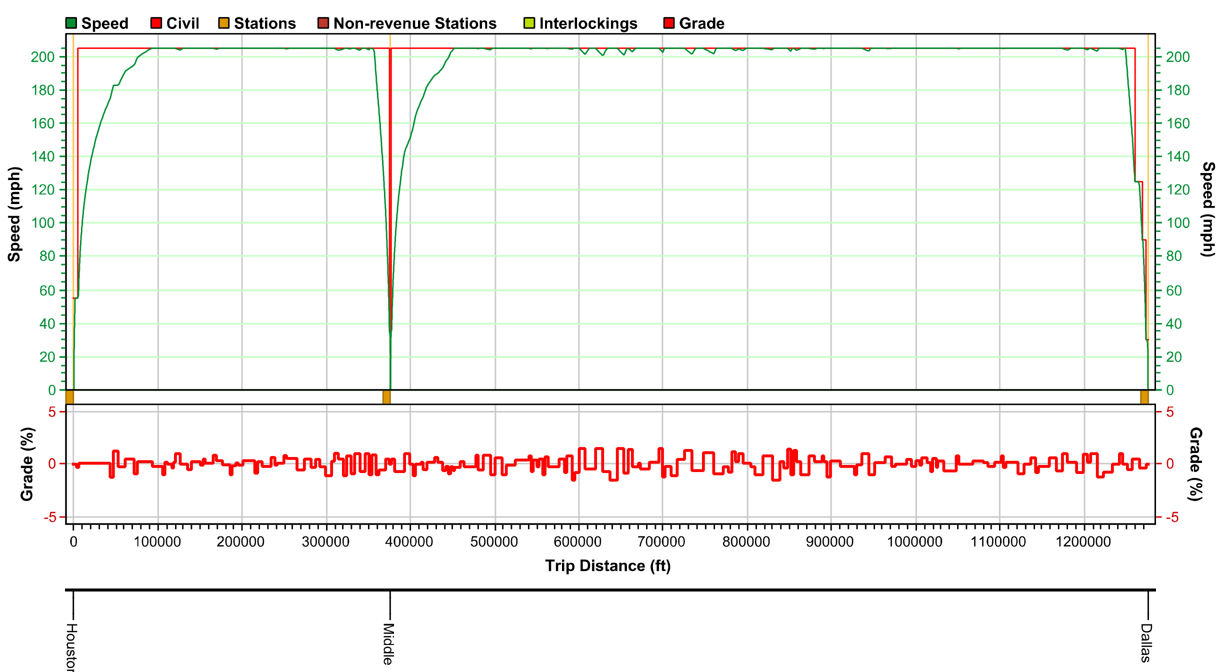


Figure 6: Speed Distance Trip Graph Houston to Dallas Alignment F (205 MPH)

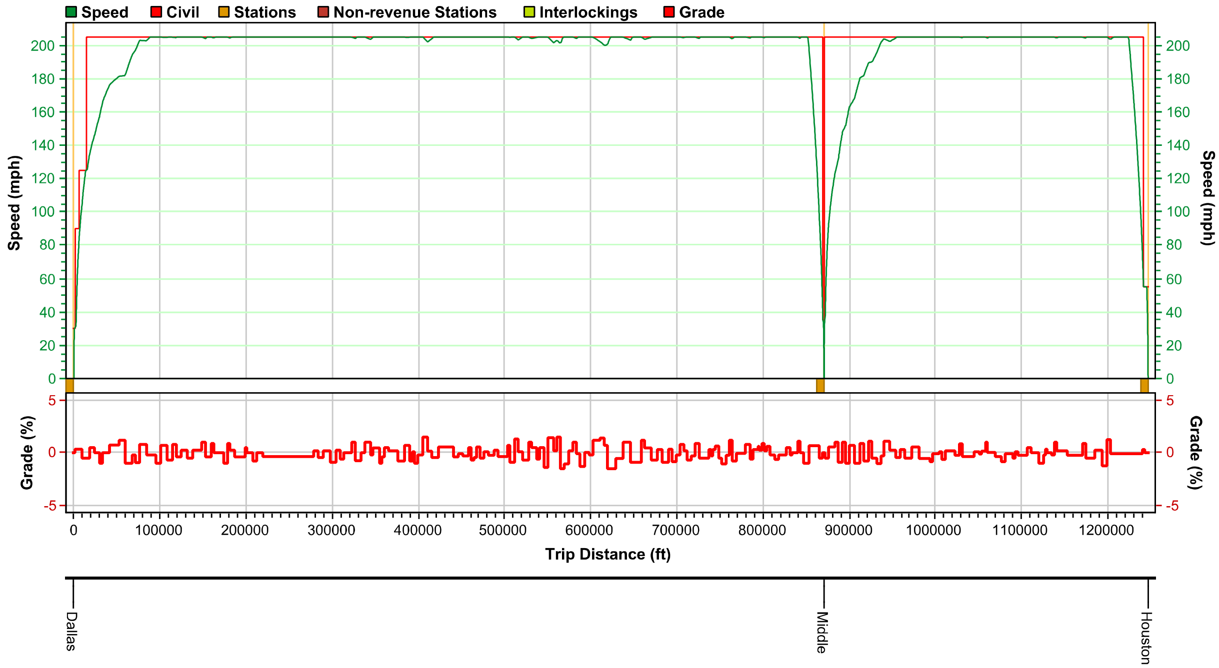


Figure 7: Speed Distance Trip Graph Dallas to Houston Alignment A (205 MPH)

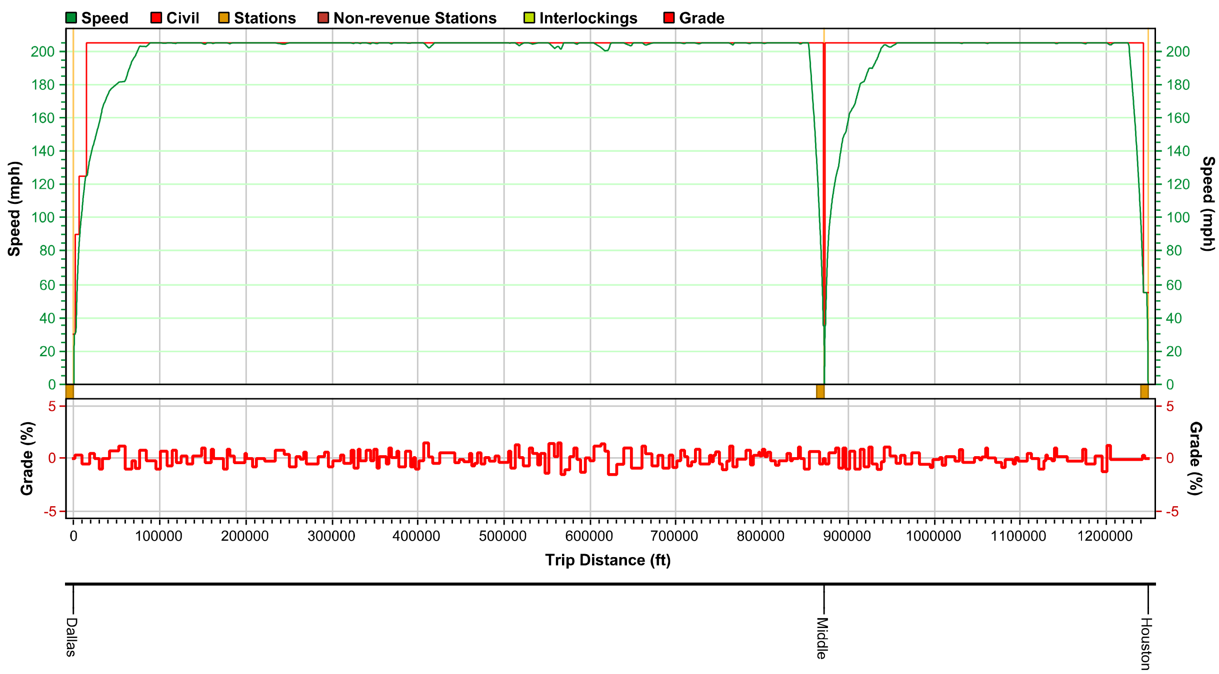


Figure 8: Speed Distance Trip Graph Dallas to Houston Alignment B (205 MPH)

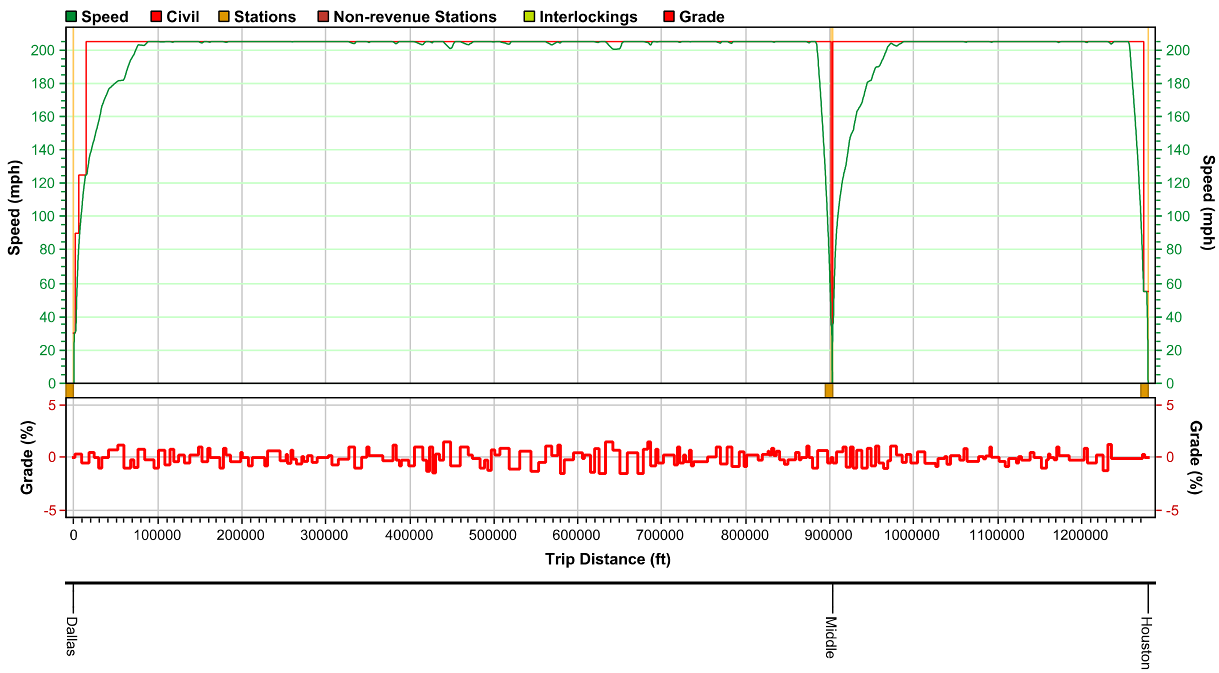


Figure 9: Speed Distance Trip Graph Dallas to Houston Alignment C (205 MPH)

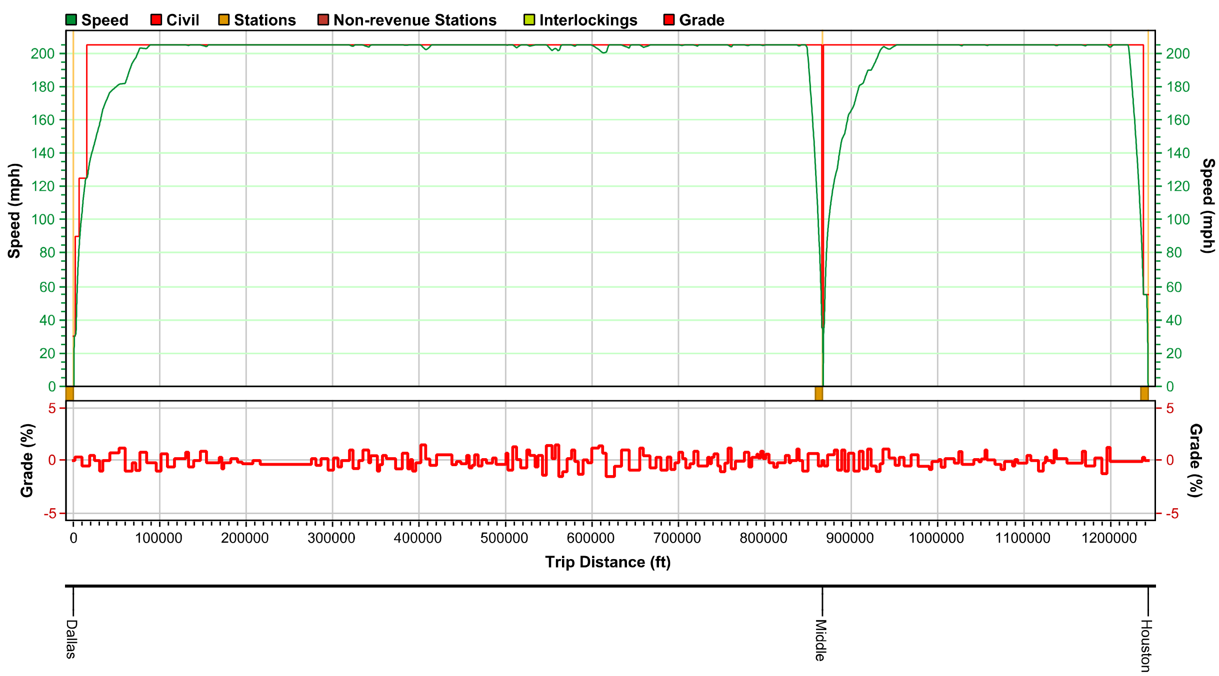


Figure 10: Speed Distance Trip Graph Dallas to Houston Alignment D (205 MPH)

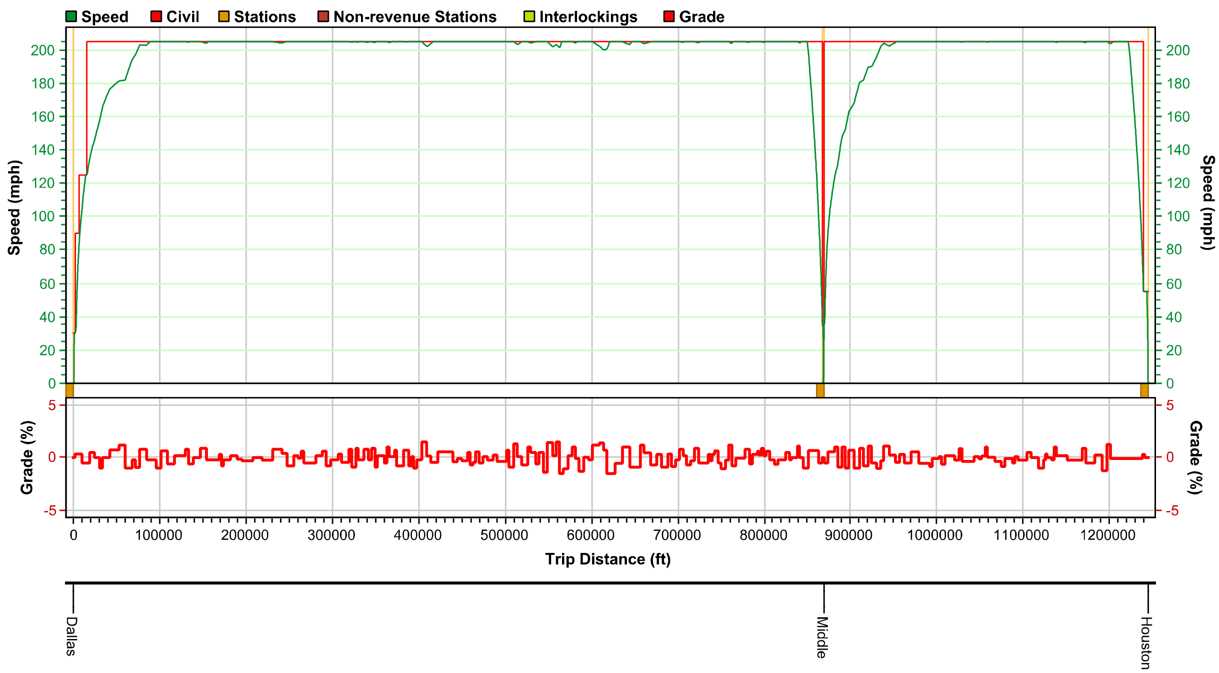


Figure 11: Speed Distance Trip Graph Dallas to Houston Alignment E (205 MPH)

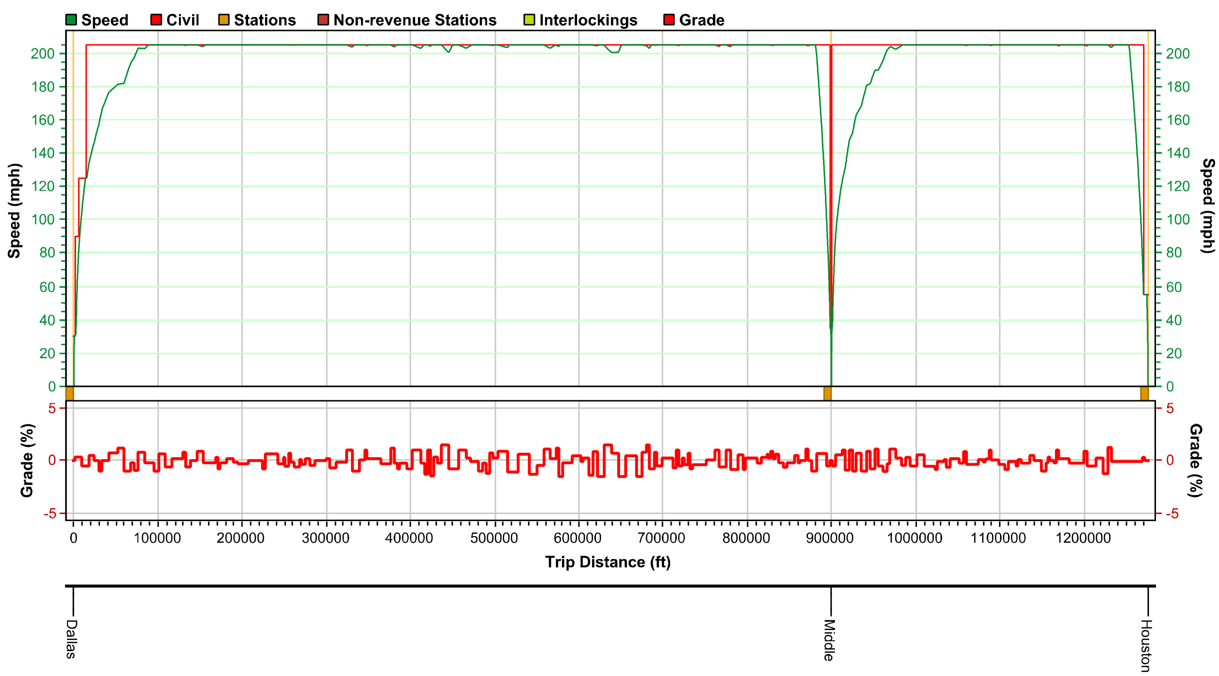


Figure 12: Speed Distance Trip Graph Dallas to Houston Alignment F (205 MPH)

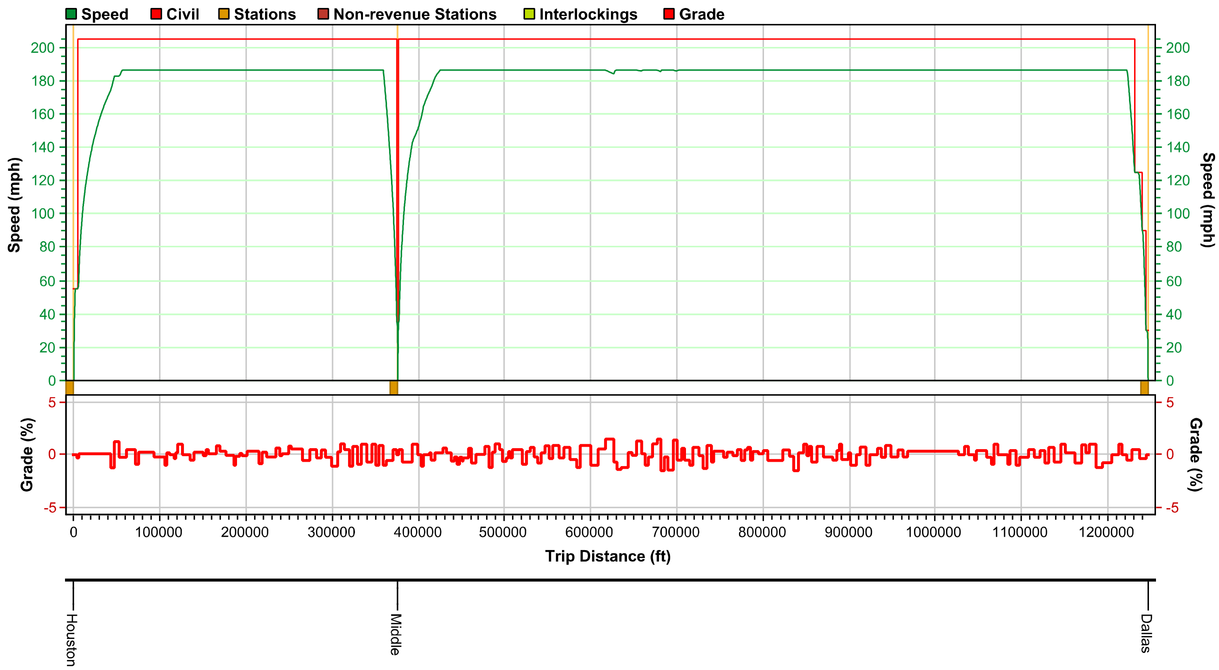


Figure 13: Speed Distance Trip Graph Houston to Dallas Alignment A (186 MPH)

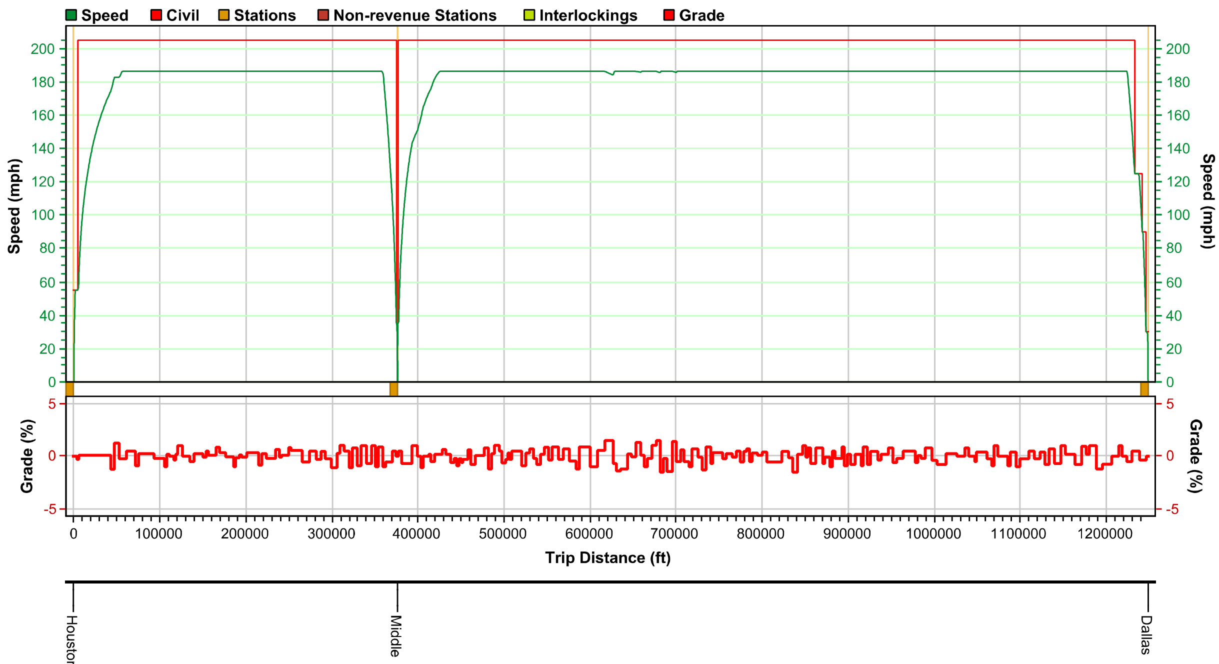


Figure 14: Speed Distance Trip Graph Houston to Dallas Alignment B (186 MPH)

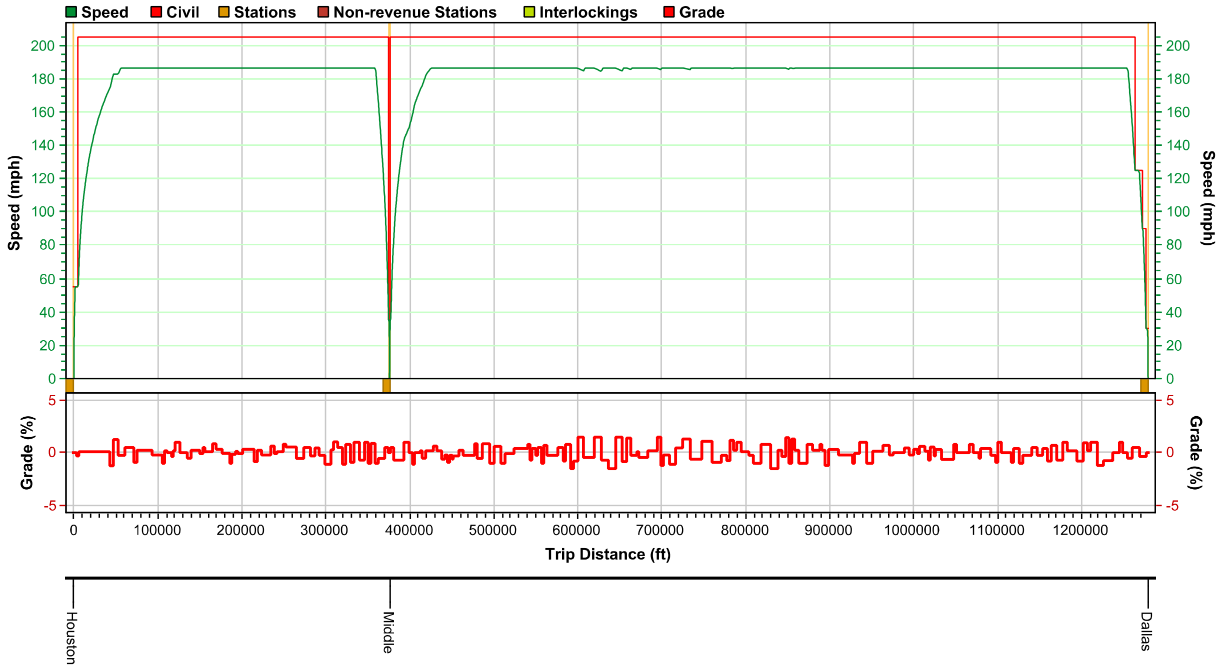


Figure 15: Speed Distance Trip Graph Houston to Dallas Alignment C (186 MPH)

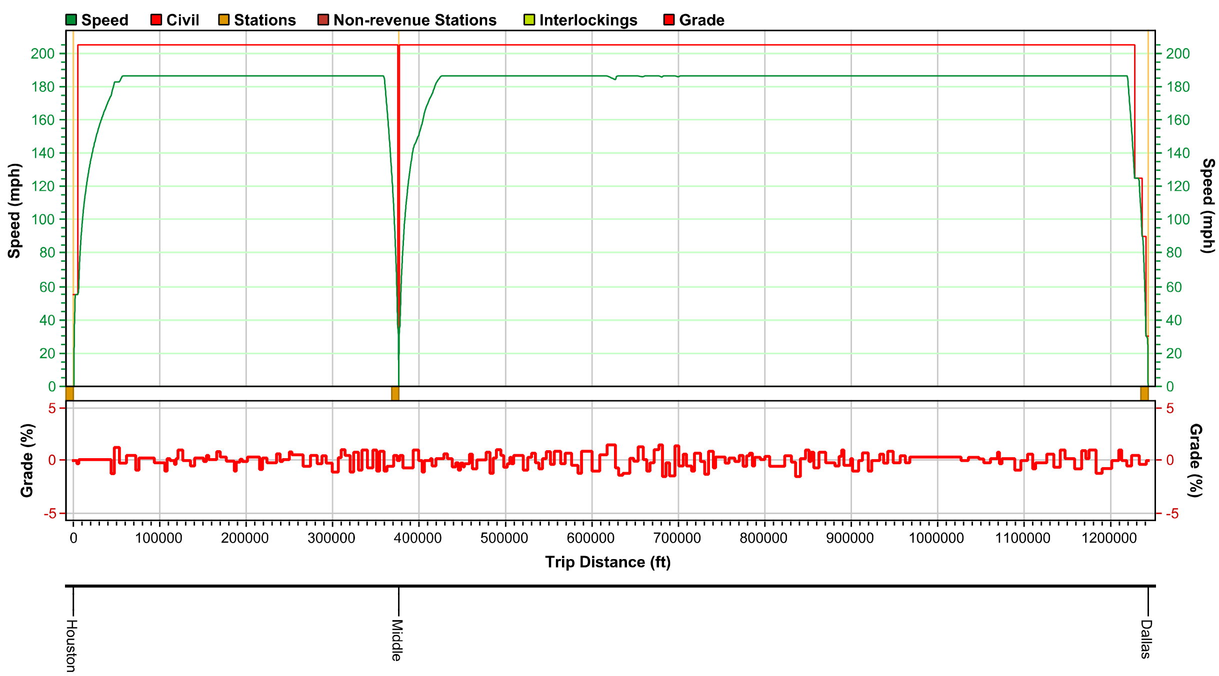


Figure 16: Speed Distance Trip Graph Houston to Dallas Alignment D (186 MPH)

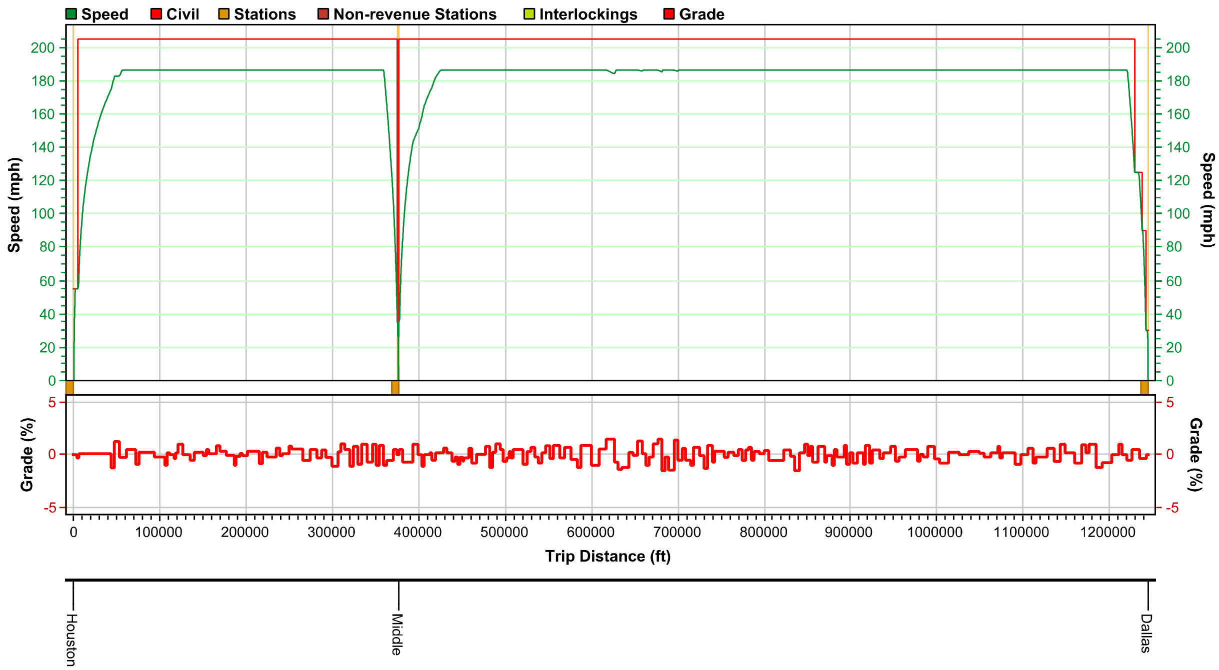


Figure 17: Speed Distance Trip Graph Houston to Dallas Alignment E (186 MPH)

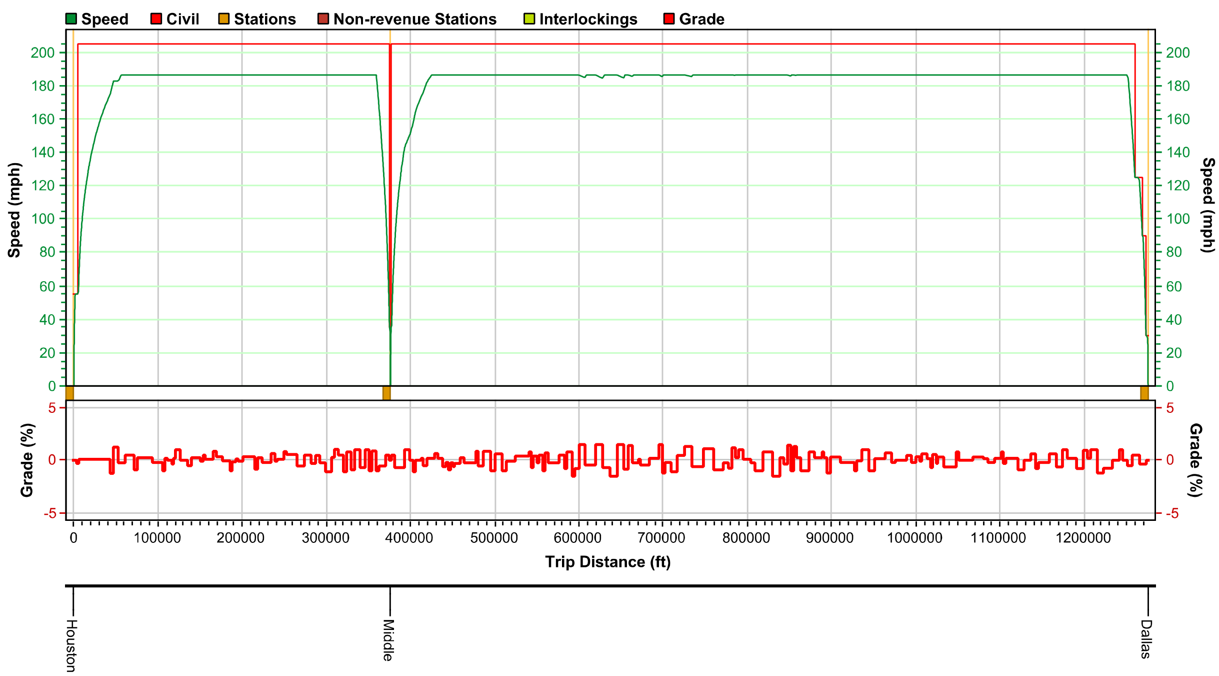


Figure 18: Speed Distance Trip Graph Houston to Dallas Alignment F (186 MPH)

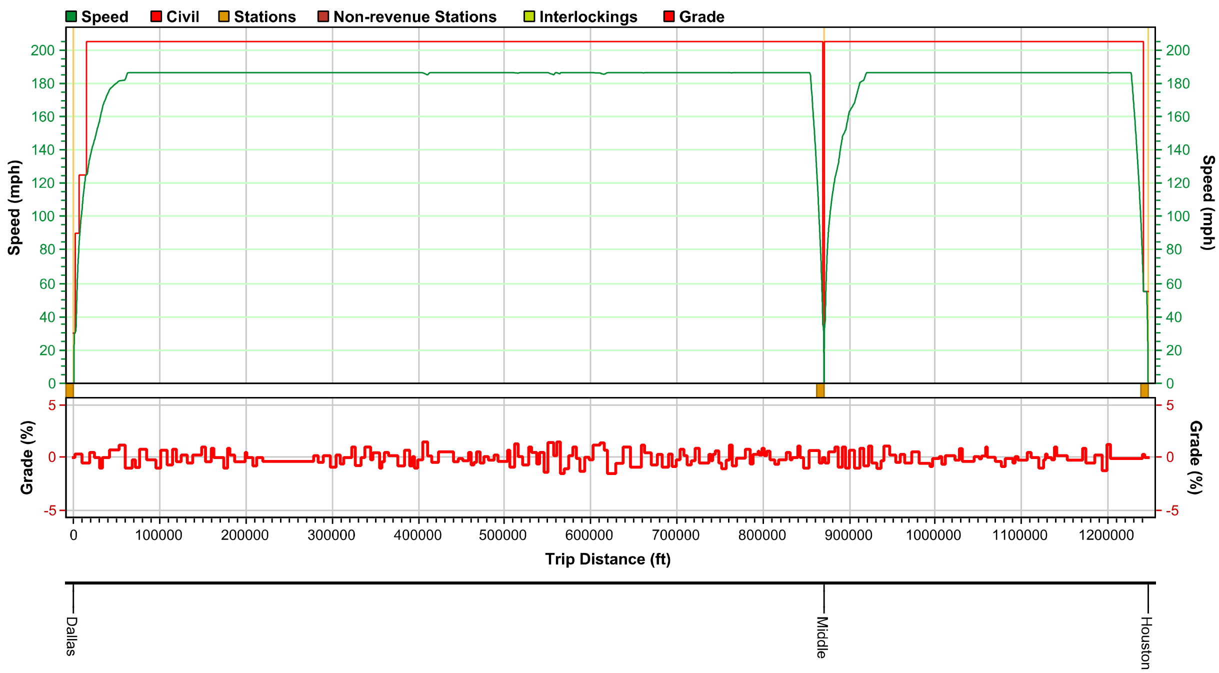


Figure 19: Speed Distance Trip Graph Dallas to Houston Alignment A (186 MPH)

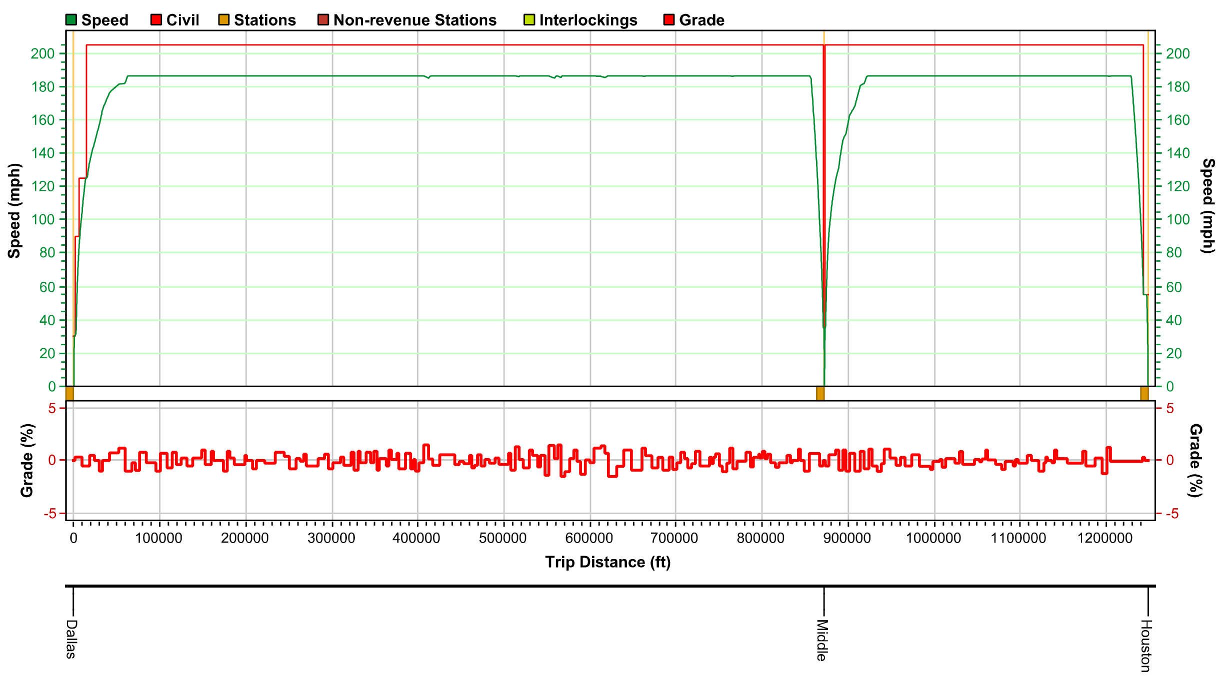


Figure 20: Speed Distance Trip Graph Dallas to Houston Alignment B (186 MPH)

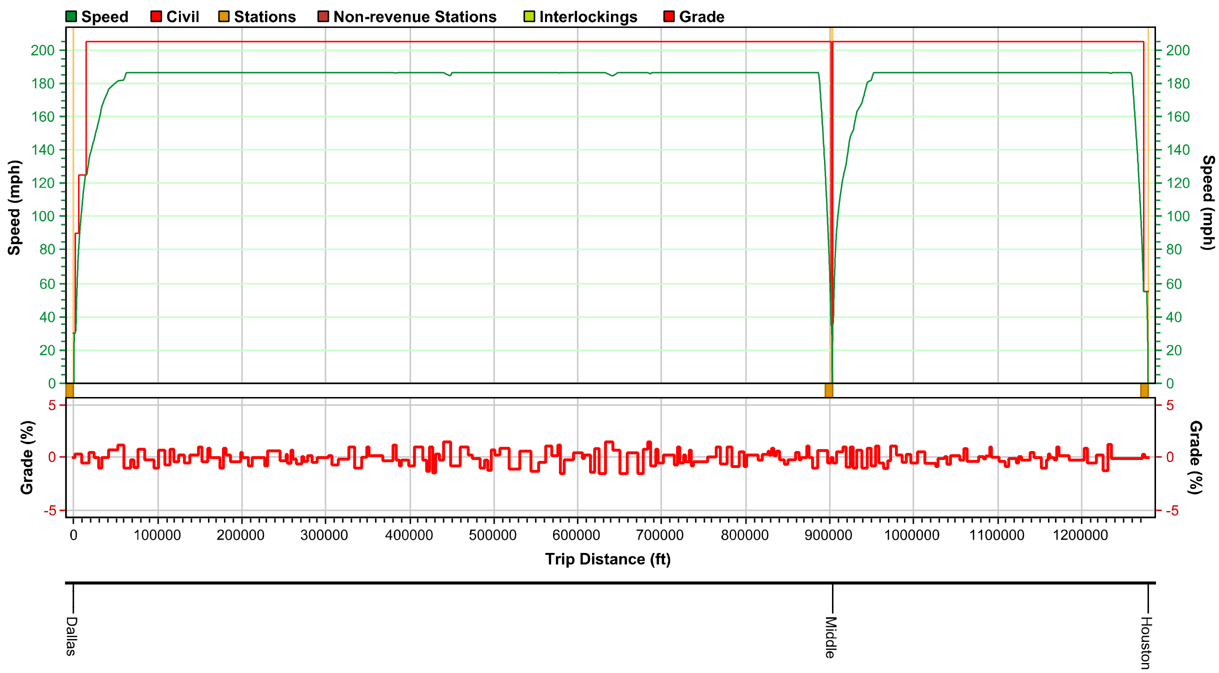


Figure 21: Speed Distance Trip Graph Dallas to Houston Alignment C (186 MPH)

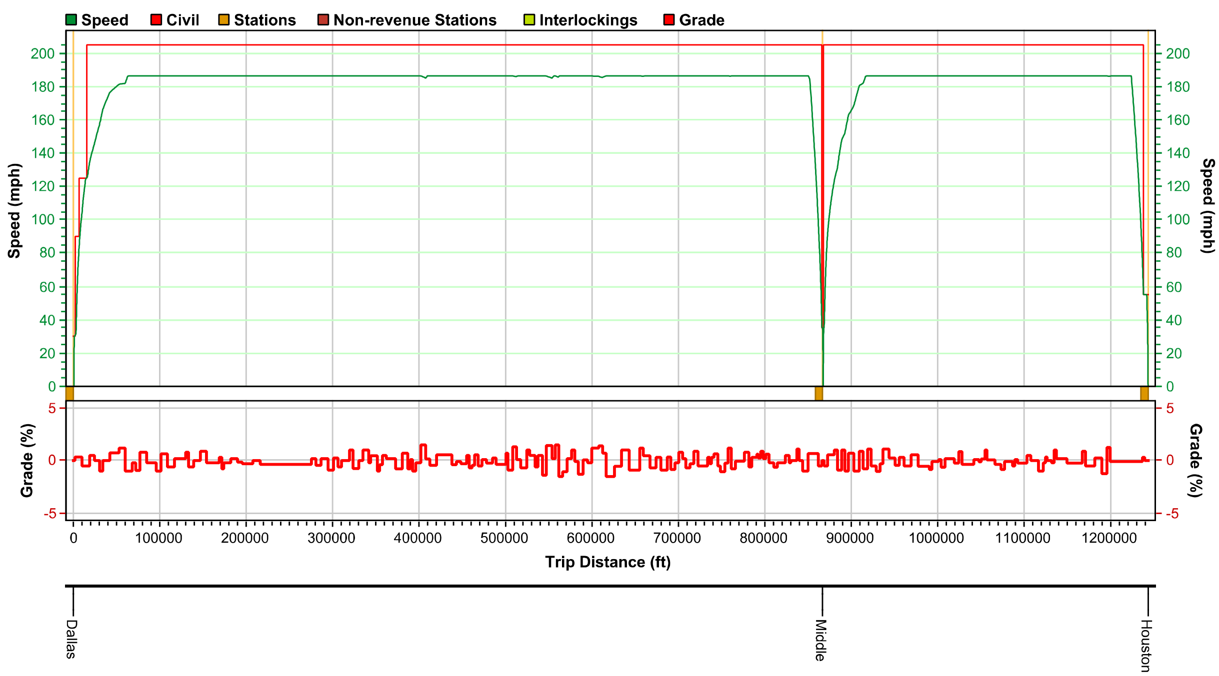


Figure 22: Speed Distance Trip Graph Dallas to Houston Alignment D (186 MPH)

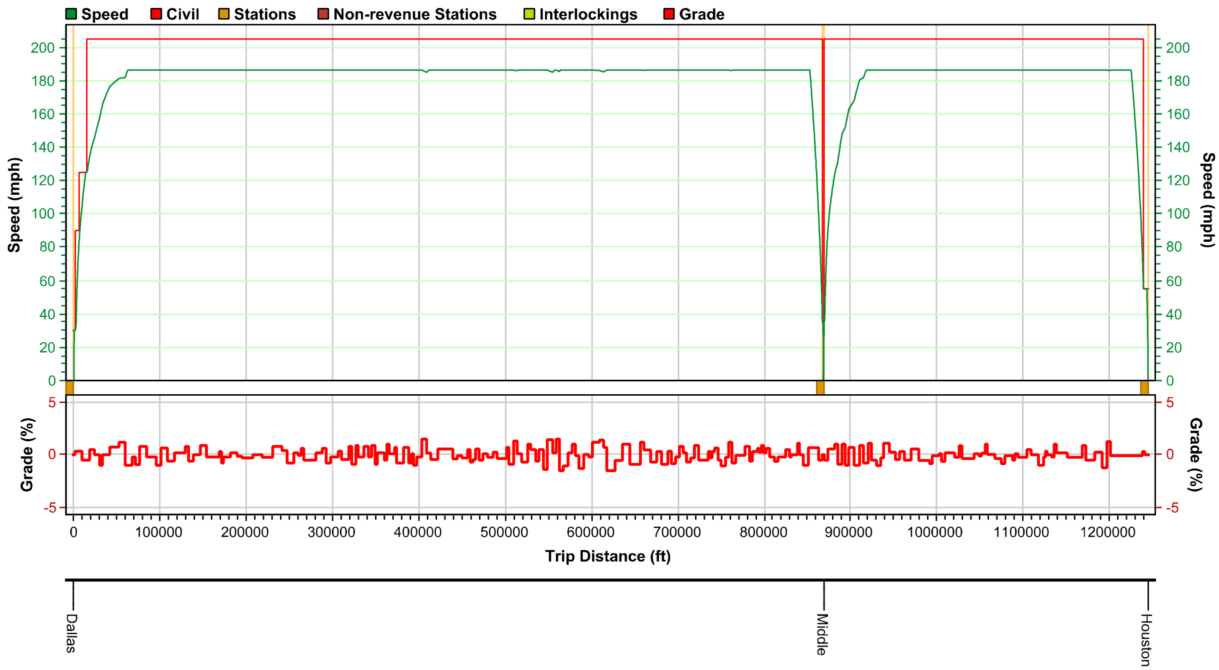


Figure 23: Speed Distance Trip Graph Dallas to Houston Alignment E (186 MPH)

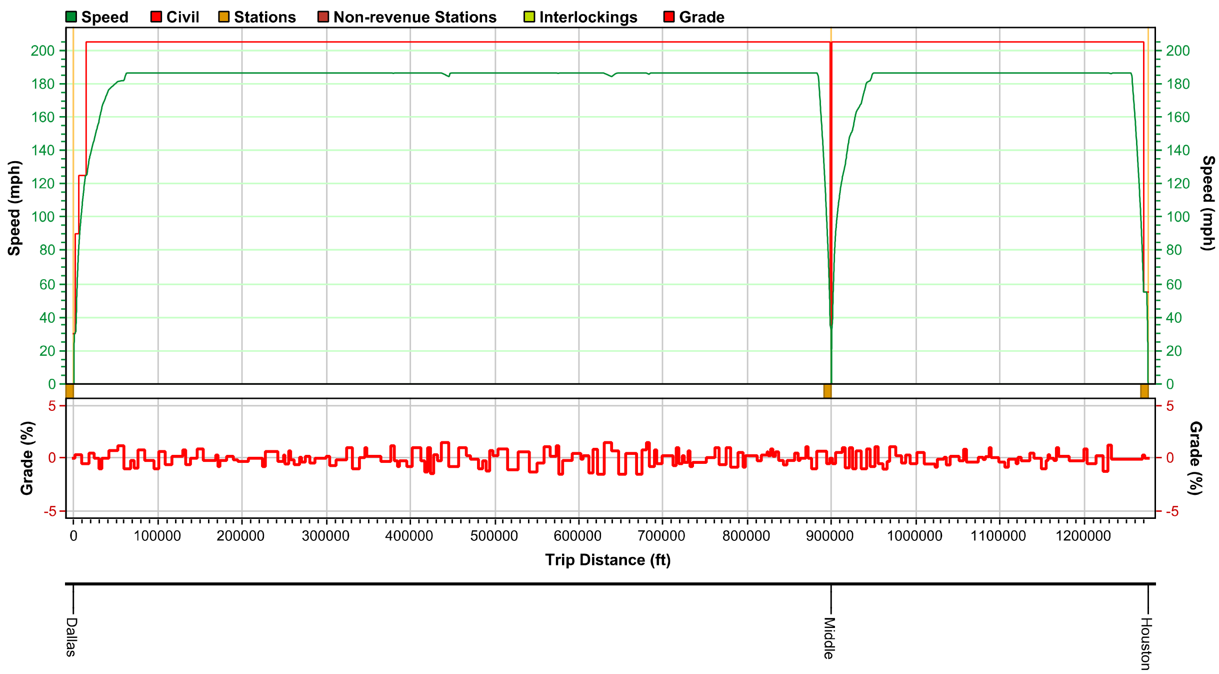


Figure 24: Speed Distance Trip Graph Dallas to Houston Alignment F (186 MPH)

Appendix B

Station Programs

Texas Central Railroad - Preliminary Dallas Terminal Station Program			
PUBLIC AREAS - PARKING & PEDESTRIAN CIRCULATION	SF		Notes
Parking Spaces			
Public Parking including rental cars and valet (5,000 cars)	1,875,000	Uncovered/Parking	Assume 375 sf per space; valet staff at 4 per shift
Employee Parking (500 cars)	187,500	Uncovered/Parking	Assume 375 sf per space
Subtotal parking (5,500 cars)	***2,062,500***		Total of 5,500 spaces assumed
Rental car Maintenance/ service	8,000	Uncovered/Parking	4 rental companies @ 2,000 sf each; assume most maintenance, fueling, washing off site; total staff 12 per shift
Enclosed conditioned walkway	80,000	Conditioned	1,600 lf x 50' wide, length of parking facilities
Subtotal Parking	***2,150,500***		
Surface area required	*430,100*		Assume five level parking - Say 9.9 acres
			9.9
Parking Facilities in Station			
Consolidated Car Rental Counters/ Offices	2,000	Conditioned	4 rental companies @ 500 sf each; Total staff 12 per shift
Car Rental Queuing	2,000	Conditioned	80 lf x 25' deep
Subtotal Parking Facilities in Station	***4,000***		Located in Station Public Area
Total Parking and Parking Facilities		**2,154,500**	
Pedestrian Circulation			
Enclosed, conditioned pedestrain bridges	28,000	Conditioned	560 lf x 50' wide with 2 directional moving sidewalks to Austin Street Parking Facility
Enclosed, conditioned pedestrain bridges	2,500	Conditioned	100 lf x 25' wide to Cadiz Street Parking Facility
Enclosed, conditioned pedestrain bridges	85,000	Conditioned	1,700 lf x 50' wide with 2 directional moving sidewalks to Lamar Street
Enclosed, condtioned pedestrian tunnel under Hotel St.	5,000	Conditioned	100 lf x 50' wide
Vertical circulation lobbies at ground level	4,500	Conditioned	Three lobbies at 1,500 sf each
Subtotal Pedestrian Circulation	***125,000***		
Total Parking & Pedestrian Circulation		**2,279,500**	
PUBLIC AREAS			
Public Areas			
Entry Vestibule	960	Conditioned	12' x 20' x 4
Information/ Ticketing Counter	500	Conditioned	Ticket vending machines located throughout concourse areas; 250 sf per concourse
Baggage Storage	500	Ventilated	250 sf per level
Public Restrooms	4,000	Conditioned	2,000 sf per clevel
At Grade Level Concourse	35,000	Conditioned	388' x 123' circulation area minus concessions, fast food, restaurant/ bar, etc.
Hotel Street Mezzanine	2,000	Conditioned	40' x 50'
Second Level Concourse	42,610	Conditioned	480' x 123' circulation area minus concessions, restaurant/ bar, rental car, service corridor, etc.
Subtotal Public Areas	***85,570***		
Concessions			
Restaurants	6,000	Conditioned	2 restaurants @ 3,000 sf each; Total staff 20 per shift (10 per restaurant)
Bars	2,000	Conditioned	2 bars @ 1,000 sf each; Total staff 8 per shift (4 per bar)
Coffee/ Donut Stands	500	Conditioned	2 @ 250 sf each, 1 per level; Total staff 6 per shift (3 per stand);
News stands	1,000	Conditioned	2 @ 500 sf each, 1 per level; Total staff 6 per shift (3 per stand)
Fast Food	3,500	Conditioned	5 @ 700 sf each; Total staff 20 per shift (4 per stand)
Fast Food Common Seating	2,400	Conditioned	150 seats @ 16 sf each
Subtotal Concessions	***15,400***		
First Class			
First Class Check-in	1,000	Conditioned	
Lounge	6,000	Conditioned	300 seats @ 20 sf
Bar	1,000	Conditioned	
Meeting Rooms	2,000	Conditioned	2 large @ 400 sf each; 2 medium @ 300 sf each; 3 small @ 200 sf each
Private huddle/ work areas	1,000	Conditioned	10 @ 100 sf each
Restrooms	500	Conditioned	
Subtotal First Class	***11,500***		
Circulation @ 15%	16,871	Conditioned	
Mechanical/ electrical @ 10%	12,934	Ventilated	
Subtotal Allowances	***29,805***		
Total Public Areas		**146,275**	Includes 4,000 sf rental car in station
TOTAL PUBLIC AREAS		**2,296,775**	Station and Parking (Excludes Pedestrian Circulation)
TICKETED PASSENGER AREAS			
Platforms and Tracks			
Platforms and tracks	86,715	Ventilated	705' x 123' (assumes four tracks, two 30' wide island platforms, island platforms include 10' x 10' area for platform staff)
Mechanical/ electrical @10%	8,672	Ventilated	Assumes platforms ventilated, partially conditioned
Subtotal Platforms and Tracks		**95,387**	
TOTAL TICKETED PASSENGER AREAS		**95,387**	
BACK-OF-HOUSE/ OPERATIONS			
Security			
Station Control Room, CCTV, and Server	250	Conditioned	
Security offices	500	Conditioned	
Conference Room	200	Conditioned	
Open Area	200	Conditioned	
Internal circulation @ 20%	230	Conditioned	
Subtotal Security	***1,380***		
Staff Welfare			
Crew & Staff Facilities restrooms/ lockers/ changing area	5,000	Conditioned	Assume 241 staff on site; multiple shifts consolidated to one shift
Overnite rooms	0		Removed from Program
Driver/ conductor waiting area	400	Conditioned	20 chairs at 20 sf
Staff Breakroom	1,200	Conditioned	60 seats at 20 sf
Staff Cafeteria	3,000	Conditioned	
Subtotal Staff Welfare	***9,600***		
General Offices			
Staff entry	250	Conditioned	
Station Offices	5,605	Conditioned	Station master @ 450 sf, controller @ 325 sf, administration @ 500 sf; external affais @ 200 sf, reception @ 250 sf, meeting room @1,200 sf; training room @ 400 sf, ticket sales @ 1,280 sf, storeroom @ 1,000 sf
Headquarters work stations	3,200	Conditioned	50 8' x 8' cubicles
First Class Offices	500	Conditioned	2 @ 150 sf, 2 @ 100 sf
Training Facility	7,500	Conditioned	75' x 100'
Internal circulation @ 20%	3,411	Conditioned	
Subtotal General Offices	***20,466***		
Operations			
Custodial Equipment	2,000	Ventilated	1,000 sf per concourse level
Loading Dock, Receiving, Trash	4,000	Ventilated	
Storage	2,000	Ventilated	40' x 50'
Receiving/ Storage Area at North End	5,600	Ventilated	Separate Service Area to serve northend of station
Kitchen (Food prep for Trains)	2,000	Conditioned	
Kitchen (First class)	1,000	Conditioned	
Laundry	1,000	Conditioned	25' x 40'- commercial
Vehicle Cleaning/ Staging	5,000	Ventilated	
Service corridor at Level 2	7,500	Conditioned	705' x 10'
Train Service corridor	42,300	Conditioned	Below each platform 30' x 705' x 2
Signals and Communications	4,000	Conditioned	
Subtotal Operations	***76,400***		
Circulation @ 15%	16,177	Conditioned	
Mechanical/electrial @10%	12,402	Ventilated	Includes Physical Plant
Subtotal Allowances	***28,579***		
TOTAL BACK-OF-HOUSE/ OPERATIONS		**136,425**	
Total Facilities		**282,700**	
Platforms and Tracks		**95,387**	
TOTAL STATION (Excluding Parking & Pedestrian Circulation)		**378,086**	
TOTAL STATION (Including Parking & Pedestrian Circulation)		**2,653,586**	

Texas Central Railroad - Preliminary Brazos Valley Station Program			
PUBLIC AREAS - PARKING	**SF**		**Notes**
Parking Spaces			
Public Parking including rental cars and valet (950 cars)	356,250	Uncovered/Parking	Assume 375 sf per space; valet staff 2 per shift
Employee Parking (250 cars)	93,750	Uncovered/Parking	Assume 375 sf per space
Subtotal parking spaces (1,200)	***450,000***		Total of 1,200 spaces assumed
Rental car Maintenance/ service	500	Uncovered/Parking	2 rental car companies @ 250 sf each; assume most maintenance, fueling, washing off site; total staff 4 per shift
Enclosed conditioned walkway	0		
Subtotal parking	***450,500***		
Surface area required	*90,100*		Assume five level parking - Say 2.2 acres
			2.1
Parking Facilities in Station			
Consolidated Car Rental Counters/ Offices	500	Conditioned	2 rental companies @ 250 sf each; Total staff 4 per shift
Car Rental Queuing	500	Conditioned	40 lf x 12.5' deep
Subtotal Parking Facilities in Station	***1,000***		Located in Station
Total Parking and Parking Facilities		**451,500**	
Pedestrian Circulation			
Enclosed, Conditioned Pedestrian Bridges	5,000	**Conditioned**	Two at 100 lf x 25' wide
Subtotal Pedestrian Circulation	***5,000***		
Total Parking & Pedestrian Circulation		**456,500**	
PUBLIC AREAS			
Public Areas			
Entry Vestibule	960	Conditioned	12' x 20' x 4
Information/ Ticketing Counter	400	Ventilated	200 sf per level
Baggage Storage	300	Conditioned	150 sf per level
Public Restrooms	1,200	Conditioned	
At Grade Level Concourse	21,470	Conditioned	570 lf x 50' minus restaurant/ bar, fast food, concessions, etc.
Concourse below platforms and tracks	26,850	Conditioned	
Second Level Concourse	19,470	Conditioned	440 lf x 50' minus restaurant/bar, rental cars, concessions, etc.
Subtotal Public Areas	***70,650***		
Concessions			
Restaurants	2,500	Conditioned	1 restaurant @ 2,500 sf; Total staff 8 per shift
Bars	500	Conditioned	1 bar @ 500 sf; Total staff 2 per shift
Coffee/ Donut Stands	250	Conditioned	1 @ 250 sf each; Total staff 2 per shift
News stands	250	Conditioned	1 @ 250 sf; Total staff 2 per shift
Fast Food	500	Conditioned	1 @ 500 sf each; Total staff 4 per shift
Fast Food Common Seating	1,200	Conditioned	75 seats @ 16 sf each
Subtotal Concessions	***5,200***		
First Class			
First Class Check-in	500	Conditioned	
Lounge	3,000	Conditioned	150 seats @ 20 sf
Bar	500	Conditioned	
Meeting Rooms	1,100	Conditioned	1 large @ 400 sf ; 1 medium @ 300 sf; 2 small @ 200 sf each
Private huddle/ work areas	400	Conditioned	4 @ 100 sf each
Restrooms	500	Conditioned	
Subtotal First Class	***6,000***		
Circulation @ 20%	16,370	Conditioned	
Mechanical/ electrical @ 15%	14,733	Ventilated	
Subtotal Allowances	***31,103***		
Total Public Facilities		**113,953**	Includes 1,000 sf rental car in station
TOTAL PUBLIC AREAS		**564,453**	Station and Parking (Excludes Pedestrian Circulation)
TICKETED PASSENGER AREAS			
Platforms and Tracks			
Platforms and tracks	67,680	Ventilated	705 lf x 96'
Mechanical/ electrical @10%	6,768	Ventilated	Assumes platforms ventilated, partially conditioned
Subtotal Platforms and Tracks		**74,448**	
TOTAL TICKETED PASSENGER AREAS		**74,448**	
BACK-OF-HOUSE/ OPERATIONS			
Security			
Station Control Room, CCTV, and Server	200	Conditioned	
Security offices	250	Conditioned	
Conference Room	200	Conditioned	
Open Area	150	Conditioned	
Internal circulation @ 20%	160	Conditioned	
Subtotal Security	***960***		
Staff Welfare			
Crew & Staff Facilities restrooms/ lockers	2,000	Conditioned	Assume 50 staff on site; multiple shifts consolidated to one shift
Driver/ conductor waiting area	200	Conditioned	10 chairs at 20 sf
Staff Breakroom	400	Conditioned	20 seats at 20 sf
Staff cafeteria	1,800	Conditioned	
Subtotal Staff Welfare	***4,400***		
General Office			
Staff entry	150	Conditioned	
Station Offices	3,095	Conditioned	Station master @ 220 sf, controller @ 175 sf, administration @ 250 sf; external affais @ 100 sf, reception @ 150 sf, meeting @ 600 sf, training @ 600 sf, ticket sales @ 500 sf, storeroom @ 500 sf
Headquarters work stations	0		None at mid-point station
First Class offices	250	Conditioned	1 @ 150 sf, 1 @ 100 sf
Training Facility	0		None at mid-point station
Internal circulation @ 20%	699	Conditioned	
Subtotal General Office	***4,194***		
Operations			
Custodial Equipment	500	Ventilated	20' x 25'
Loading Dock, Receiving, Trash	2,500	Ventilated	
Storage	1,200	Ventilated	40' x 30'
Kitchen (Food prep for Trains)	0		None at mid-point station
Kitchen (First class)	0		None at mid-point station
Laundry	200	Conditioned	10' x 20' commercial
Vehicle Cleaning/ Staging	0		None at mid-point station
Train Service corridor	0		None at mid-point station
Signals and Communications	4,000	Conditioned	
Subtotal Operations	***8,400***		
Circulation @ 15%	2,693	Conditioned	
Mechanical/electrial @10%	2,065	Ventilated	Includes Physical Plant
Subtotal Allowances	***4,758***		
TOTAL BACK-OF-HOUSE/ OPERATIONS		**22,712**	
Total Facilities		**136,665**	
Platforms and Tracks		**74,448**	
TOTAL STATION (Excluding Parking & Pedestrian Circulation)		**211,113**	
TOTAL STATION (Including Parking & Pedestrian Circulation)		**666,613**	

Texas Central Railroad - Preliminary Houston Terminal Station Program - (Northwest Transit Center, Northwest Mall, Industrial Site)

PUBLIC AREAS - PARKING & PEDESTRIAN CIRCULATION	SF		Notes
Parking Spaces			
Public Parking including rental cars and valet (6,000 cars)	2,250,000	Uncovered/Parking	Assume 375 sf per space; valet staff at 4 per shift
Employee Parking (500 cars)	187,500	Uncovered/Parking	Assume 375 sf per space
Subtotal parking spaces (6,500 cars)	***2,437,500***		Total of 6,500 spaces assumed
Rental car Maintenance/ service	2,000	Uncovered/Parking	4 rental companies @ 2,000 sf each; assume most maintenance, fueling, washing off site; total staff 12 per shift
Enclosed conditioned walkway	65,000	Conditioned	1,300 lf x 50' wide @ Transit Center; 850 lf x 50' @ NW Mall; 1,500 lf x 50' retail concourse @ Industrial Site
Subtotal parking	***2,504,500***		
Surface area required	*500,900*		Assume five level parking - Say 12 acres
			11.5
Parking Facilities in Station			
Consolidated Rental Car Counters/ Offices	2,000	Conditioned	4 rental companies @ 500 sf each; Total staff 12 per shift
Car Rental Queuing	2,000	Conditioned	80 lf x 25' deep
Subtotal Parking Facilities in Station	***4,000***		Located in Station Public Area
Total Parking and Parking Facilities		**2,508,500**	
Pedestrian Circulation			
Enclosed, conditioned pedestrain bridges	35,000	Conditioned	700 lf x 50' wide with 2 directional moving sidewalks @ Transit Center Station to NW Transit Center (Optional).
Enclosed, conditioned pedestrain bridges	5,000	Conditioned	100 lf x 25' wide (2 bridges at Transit Center, NW Mall Station, Industrial Station)
Verical circulation lobbies at ground level	1,500	Conditioned	Lobby at Transit Center Station only
Subtotal Pedestrian Circulation	***41,500***		At Transit Center Station. Subtotal 5,000 sf at NW Mall Station and at Industrial Station
Total Parking & Pedestrian Circulation		**2,550,000**	At Transit Center Station. Total 2,326,000 sf at NW Mall Station and at Industrial Station
PUBLIC AREAS			
Public Areas			
Entry Vestibule	960	Conditioned	12' x 20' x 4
Information/ Ticketing Counter	500	Conditioned	Ticket vending machines located throughout concourse areas; 250 sf per concourse
Baggage Storage	500	Conditioned	250 sf per level
Public Restrooms	4,000	Conditioned	2,000 sf per clevel
At Grade Level Concourse	51,780	Conditioned	570' x 123' circulation area minus concessions, restaurant/ bar, service corridor, etc.
Second Level Concourse	41,070	Conditioned	570' x 123' circulation area minus concessions, restaurant/ bar, rental car, service corridor, etc.
Subtotal Public Areas	***98,810***		
Concessions			
Restaurants	6,000	Conditioned	2 restaurants @ 3,000 sf each; Total staff 20 per shift (10 per restaurant)
Bars	2,000	Conditioned	2 bars @ 1,000 sf each; Total staff 8 per shift (4 per bar)
Coffee/ Donut Stands	500	Conditioned	2 @ 250 sf each, 1 per level; Total staff 6 per shift (3 per stand);
News stands	1,000	Conditioned	2 @ 500 sf each, 1 per level; Total staff 6 per shift (3 per stand)
Fast Food	3,500	Conditioned	5 @ 700 sf each; Total staff 20 per shift (4 per stand)
Fast Food Common Seating	2,400	Conditioned	150 seats @ 16 sf each
Subtotal Concessions	***15,400***		
First Class			
First Class Check-in	1,000	Conditioned	
Lounge	6,000	Conditioned	300 seats @ 20 sf
Bar	1,000	Conditioned	
Meeting Rooms	2,000	Conditioned	2 large @ 400 sf each; 2 medium @ 300 sf each; 3 small @ 200 sf each
Private huddle/ work areas	1,000	Conditioned	10 @ 100 sf each
Restrooms	500	Conditioned	
Subtotal First Class	***11,500***		
Circulation @ 15%	18,857	Conditioned	
Mechanical/ electrical @ 10%	14,457	Ventilated	
Subtotal Allowances	***33,313***		
Total Public Facilities		**163,023**	Includes 4,000 sf rental car in station
TOTAL PUBLIC AREAS		**2,667,523**	Station and Parking (Excludes Pedestrian Circulation)
TICKETED PASSENGER AREAS			
Platforms and Tracks			
Platforms and tracks	86,715	Ventilated	705' x 123' (assumes four tracks, two 30' wide island platforms, island platforms include 10' x 10' area for platform staff)
Mechanical/ electrical @10%	8,672	Ventilated	Assumes platforms ventilated, partially conditioned
Subtotal Platforms and Tracks		**95,387**	
TOTAL TICKETED PASSENGER AREAS		**95,387**	
BACK-OF-HOUSE/ OPERATIONS			
Security			
Station Control Room, CCTV, and Server	250	Conditioned	
Security offices	500	Conditioned	
Conference Room	200	Conditioned	
Open Area	200	Conditioned	
Internal circulation @ 20%	230	Conditioned	
Subtotal Security	***1,380***		
Staff Welfare			
Crew & Staff Facilities restrooms/ lockers/ changing area	5,000	Conditioned	Assume 241 staff on site; multiple shifts consolidated to one shift
Overnite rooms	0		Removed from Program
Driver/ conductor waiting area	400	Conditioned	20 chairs at 20 sf
Staff Breakroom	1,200	Conditioned	60 seats at 20 sf
Staff cafeteria	3,000	Conditioned	
Subtotal Staff Welfare	***9,600***		
General Offices			
Staff entry	250	Conditioned	
Station Offices	5,605	Conditioned	Station master @ 450 sf, controller @ 325 sf, administration @ 500 sf; external affais @ 200 sf, reception @ 250 sf, meeting room @1,200 sf; training room @ 400 sf, ticket sales @ 1,280 sf, storeroom @ 1,000 sf
Headquarters work stations	3,200	Conditioned	50 8' x 8' cubicles
First Class Offices	500	Conditioned	2 @ 150 sf, 2 @ 100 sf
Internal circulation @ 20%	1,271	Conditioned	
Subtotal General Offices	***10,826***		
Operations			
Custodial Equipment	2,000	Ventilated	1,000 sf per concourse level
Loading Dock, Receiving, Trash	4,000	Ventilated	
Storage	2,000	Ventilated	40' x 50'
Kitchen (Food prep for Trains)	2,000	Conditioned	
Kitchen (First class)	1,000	Conditioned	
Laundry	1,000	Conditioned	25' x 40'- commercial
Vehicle Cleaning/ Staging	5,000	Ventilated	
Service corridors at each level	14,100	Conditioned	705' x 10' x 2
Train Service corridor	42,300	Conditioned	Below each platform 30' x 705' x 2
Signals and Communications	4,000	Conditioned	
Subtotal Operations	***77,400***		
Circulation @ 15%	14,881	Conditioned	
Mechanical/electrial @10%	11,409	Ventilated	Includes Physical Plant
Subtotal Allowances	***26,290***		
TOTAL BACK-OF-HOUSE/ OPERATIONS		**125,496**	
Total Facilities		**288,519**	
Platforms and Tracks		**95,387**	
TOTAL STATION (Excluding Parking & Pedestrian Circulation)		**383,905**	
TOTAL STATION (Including Parking & Pedestrian Circulation)		**2,929,905**	(NW Transit Center Station)

Appendix C

Roadway Grade Separation Database

Road Grade Separation Database - Summary by County

Updated September 2017

All Alignments

Segment	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	**Public**	**Public**	**Public**	**Public**	**Public**
Harris	61	8	48	5	*0*
Waller	7	1	2	4	*0*
Grimes	35	7	15	13	*0*
Madison	33	7	14	11	1
Leon	76	6	21	49	*0*
Limestone	7	2	5	*0*	*0*
Freestone	65	12	23	30	*0*
Navarro	67	15	40	12	*0*
Ellis	54	12	31	11	*0*
Dallas	46	3	41	2	*0*
Total	**451**	**73**	**240**	**137**	**1**

Segment	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	**Private**	**Private**	**Private**	**Private**	**Private**
Harris	27	1	10	16	*0*
Waller	4	*0*	*0*	4	*0*
Grimes	16	*0*	8	7	1
Madison	17	*0*	7	3	7
Leon	21	*0*	5	3	13
Limestone	26	*0*	8	*0*	18
Freestone	27	*0*	4	2	21
Navarro	7	*0*	3	3	1
Ellis	13	*0*	5	5	3
Dallas	2	*0*	1	*0*	1
Total	**160**	**1**	**51**	**43**	**65**

Harris

Classification	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	**Public**	**Public**	**Public**	**Public**	**Public**
Interstate	*0*	*0*	*0*	*0*	*0*
Principal Arterial	19	4	15	*0*	*0*
Minor Arterial	12	*0*	12	*0*	*0*
Major Collector	4	1	3	*0*	*0*
Minor Collector	2	*0*	2	*0*	*0*
Local Road	24	3	16	5	*0*
Total	**61**	**8**	**48**	**5**	*0*

Classification	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	**Private**	**Private**	**Private**	**Private**	**Private**
Interstate	*0*	*0*	*0*	*0*	*0*
Principal Arterial	*0*	*0*	*0*	*0*	*0*
Minor Arterial	*0*	*0*	*0*	*0*	*0*
Major Collector	*0*	*0*	*0*	*0*	*0*
Minor Collector	*0*	*0*	*0*	*0*	*0*
Local Road	27	1	10	16	*0*
Total	**27**	**1**	**10**	**16**	*0*

Waller

Classification	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	**Public**	**Public**	**Public**	**Public**	**Public**
Interstate	*0*	*0*	*0*	*0*	*0*
Principal Arterial	*0*	*0*	*0*	*0*	*0*
Minor Arterial	*0*	*0*	*0*	*0*	*0*
Major Collector	2	*0*	1	1	*0*
Minor Collector	1	*0*	*0*	1	*0*
Local Road	4	1	1	2	*0*
Total	**7**	**1**	**2**	**4**	*0*

Classification	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	**Private**	**Private**	**Private**	**Private**	**Private**
Interstate	*0*	*0*	*0*	*0*	*0*
Principal Arterial	*0*	*0*	*0*	*0*	*0*
Minor Arterial	*0*	*0*	*0*	*0*	*0*
Major Collector	*0*	*0*	*0*	*0*	*0*
Minor Collector	*0*	*0*	*0*	*0*	*0*
Local Road	4	*0*	*0*	4	*0*
Total	**4**	*0*	*0*	**4**	*0*

Grimes

Classification	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	Public	Public	Public	Public	Public
Interstate	0	0	0	0	0
Principal Arterial	1	0	1	0	0
Minor Arterial	2	0	2	0	0
Major Collector	4	2	2	0	0
Minor Collector	2	1	1	0	0
Local Road	26	4	9	13	0
Total	**35**	**7**	**15**	**13**	0

Classification	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	Private	Private	Private	Private	Private
Interstate	0	0	0	0	0
Principal Arterial	0	0	0	0	0
Minor Arterial	0	0	0	0	0
Major Collector	0	0	0	0	0
Minor Collector	0	0	0	0	0
Local Road	16	0	8	7	1
Total	**16**	0	**8**	**7**	**1**

Madison

Classification	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	Public	Public	Public	Public	Public
Interstate	0	0	0	0	0
Principal Arterial	2	0	2	0	0
Minor Arterial	0	0	0	0	0
Major Collector	6	1	2	3	0
Minor Collector	7	3	3	1	0
Local Road	18	3	7	7	1
Total	**33**	**7**	**14**	**11**	**1**

Classification	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	Private	Private	Private	Private	Private
Interstate	0	0	0	0	0
Principal Arterial	0	0	0	0	0
Minor Arterial	0	0	0	0	0
Major Collector	0	0	0	0	0
Minor Collector	0	0	0	0	0
Local Road	17	0	7	3	7
Total	**17**	0	**7**	**3**	**7**

Leon

Classification	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	Public	Public	Public	Public	Public
Interstate	0	0	0	0	0
Principal Arterial	4	0	4	0	0
Minor Arterial	2	1	1	0	0
Major Collector	53	3	9	41	0
Minor Collector	6	0	4	2	0
Local Road	11	2	3	6	0
Total	**76**	**6**	**21**	**49**	0

Classification	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	Private	Private	Private	Private	Private
Interstate	0	0	0	0	0
Principal Arterial	0	0	0	0	0
Minor Arterial	0	0	0	0	0
Major Collector	0	0	0	0	0
Minor Collector	0	0	0	0	0
Local Road	21	0	5	3	13
Total	**21**	0	**5**	**3**	**13**

Limestone

Classification	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	Public	Public	Public	Public	Public
Interstate	0	0	0	0	0
Principal Arterial	0	0	0	0	0
Minor Arterial	0	0	0	0	0
Major Collector	2	0	2	0	0
Minor Collector	1	0	1	0	0
Local Road	4	2	2	0	0
Total	**7**	**2**	**5**	0	0

Classification	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	Private	Private	Private	Private	Private
Interstate	0	0	0	0	0
Principal Arterial	0	0	0	0	0
Minor Arterial	0	0	0	0	0
Major Collector	0	0	0	0	0
Minor Collector	0	0	0	0	0
Local Road	26	0	8	0	18
Total	**26**	0	**8**	0	**18**

Freestone

Classification	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	Public	Public	Public	Public	Public
Interstate	0	0	0	0	0
Principal Arterial	0	0	0	0	0
Minor Arterial	2	1	1	0	0
Major Collector	40	2	12	26	0
Minor Collector	5	2	1	2	0
Local Road	18	7	9	2	0
Total	**65**	**12**	**23**	**30**	0

Classification	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	Private	Private	Private	Private	Private
Interstate	0	0	0	0	0
Principal Arterial	0	0	0	0	0
Minor Arterial	0	0	0	0	0
Major Collector	0	0	0	0	0
Minor Collector	0	0	0	0	0
Local Road	27	0	4	2	21
Total	**27**	0	**4**	**2**	**21**

Navarro

Classification	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	Public	Public	Public	Public	Public
Interstate	0	0	0	0	0
Principal Arterial	6	0	6	0	0
Minor Arterial	7	2	5	0	0
Major Collector	5	3	2	0	0
Minor Collector	8	2	5	1	0
Local Road	41	8	22	11	0
Total	**67**	**15**	**40**	**12**	0

Classification	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	Private	Private	Private	Private	Private
Interstate	0	0	0	0	0
Principal Arterial	0	0	0	0	0
Minor Arterial	0	0	0	0	0
Major Collector	0	0	0	0	0
Minor Collector	0	0	0	0	0
Local Road	7	0	3	3	1
Total	**7**	0	**3**	**3**	**1**

Ellis

Classification	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	**Public**	**Public**	**Public**	**Public**	**Public**
Interstate	*0*	*0*	*0*	*0*	*0*
Principal Arterial	4	*0*	4	*0*	*0*
Minor Arterial	2	1	1	*0*	*0*
Major Collector	4	*0*	4	*0*	*0*
Minor Collector	10	4	4	2	*0*
Local Road	34	7	18	9	*0*
Total	**54**	**12**	**31**	**11**	*0*

Classification	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	**Private**	**Private**	**Private**	**Private**	**Private**
Interstate	*0*	*0*	*0*	*0*	*0*
Principal Arterial	*0*	*0*	*0*	*0*	*0*
Minor Arterial	*0*	*0*	*0*	*0*	*0*
Major Collector	*0*	*0*	*0*	*0*	*0*
Minor Collector	*0*	*0*	*0*	*0*	*0*
Local Road	13	*0*	5	5	3
Total	**13**	*0*	**5**	**5**	**3**

Dallas

Classification	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	**Public**	**Public**	**Public**	**Public**	**Public**
Interstate	4	*0*	4	*0*	*0*
Principal Arterial	14	1	13	*0*	*0*
Minor Arterial	4	*0*	4	*0*	*0*
Major Collector	8	1	6	1	*0*
Minor Collector	1	*0*	*0*	1	*0*
Local Road	15	1	14	*0*	*0*
Total	**46**	**3**	**41**	**2**	*0*

Classification	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	**Private**	**Private**	**Private**	**Private**	**Private**
Interstate	*0*	*0*	*0*	*0*	*0*
Principal Arterial	*0*	*0*	*0*	*0*	*0*
Minor Arterial	*0*	*0*	*0*	*0*	*0*
Major Collector	*0*	*0*	*0*	*0*	*0*
Minor Collector	*0*	*0*	*0*	*0*	*0*
Local Road	2	*0*	1	*0*	1
Total	**2**	*0*	**1**	*0*	**1**

Road Grade Separation Database - Summary by Segment

Updated September 2017

All Alignments

Segment	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	Public	Public	Public	Public	Public
1 (HN)	101	16	63	22	0
2A (WT)	52	13	25	13	1
2B (IH45)	157	21	54	82	0
3A (NW)	26	9	14	3	0
3B (NE)	31	8	16	7	0
4A (EW)	28	4	19	5	0
4B (EE)	22	5	12	5	0
5 (DS)	46	3	41	2	0
Total	**463**	**79**	**244**	**139**	**1**

Segment	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	Private	Private	Private	Private	Private
1 (HN)	43	1	14	27	1
2A (WT)	79	0	18	6	55
2B (IH45)	17	0	10	2	5
3A (NW)	2	0	0	1	1
3B (NE)	5	0	3	2	0
4A (EW)	7	0	3	2	2
4B (EE)	6	0	2	3	1
5 (DS)	2	0	1	0	1
Total	**161**	**1**	**51**	**43**	**66**

Segment 1

Classification	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	Public	Public	Public	Public	Public
Interstate	0	0	0	0	0
Principal Arterial	20	4	16	0	0
Minor Arterial	14	0	14	0	0
Major Collector	10	3	6	1	0
Minor Collector	5	1	3	1	0
Local Road	52	8	24	20	0
Total	**101**	**16**	**63**	**22**	0

Classification	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	Private	Private	Private	Private	Private
Interstate	0	0	0	0	0
Principal Arterial	0	0	0	0	0
Minor Arterial	0	0	0	0	0
Major Collector	0	0	0	0	0
Minor Collector	0	0	0	0	0
Local Road	43	1	14	27	1
Total	**43**	**1**	**14**	**27**	**1**

Segment 2A

Classification	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	Public	Public	Public	Public	Public
Interstate	0	0	0	0	0
Principal Arterial	2	0	2	0	0
Minor Arterial	2	1	1	0	0
Major Collector	7	3	4	0	0
Minor Collector	11	3	5	3	0
Local Road	30	6	13	10	1
Total	**52**	**13**	**25**	**13**	**1**

Classification	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	Private	Private	Private	Private	Private
Interstate	0	0	0	0	0
Principal Arterial	0	0	0	0	0
Minor Arterial	0	0	0	0	0
Major Collector	0	0	0	0	0
Minor Collector	0	0	0	0	0
Local Road	79	0	18	6	55
Total	**79**	0	**18**	**6**	**55**

Segment 2B

Classification	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	**Public**	**Public**	**Public**	**Public**	**Public**
Interstate	*0*	*0*	*0*	*0*	*0*
Principal Arterial	6	*0*	6	*0*	*0*
Minor Arterial	5	2	3	*0*	*0*
Major Collector	96	4	22	70	*0*
Minor Collector	12	4	5	3	*0*
Local Road	38	11	18	9	*0*
Total	**157**	**21**	**54**	**82**	*0*

Classification	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	**Private**	**Private**	**Private**	**Private**	**Private**
Interstate	*0*	*0*	*0*	*0*	*0*
Principal Arterial	*0*	*0*	*0*	*0*	*0*
Minor Arterial	*0*	*0*	*0*	*0*	*0*
Major Collector	*0*	*0*	*0*	*0*	*0*
Minor Collector	*0*	*0*	*0*	*0*	*0*
Local Road	17	*0*	10	2	5
Total	**17**	*0*	**10**	**2**	**5**

Segment 3A

Classification	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	**Public**	**Public**	**Public**	**Public**	**Public**
Interstate	*0*	*0*	*0*	*0*	*0*
Principal Arterial	2	*0*	2	*0*	*0*
Minor Arterial	3	1	2	*0*	*0*
Major Collector	2	2	*0*	*0*	*0*
Minor Collector	6	3	2	1	*0*
Local Road	13	3	8	2	*0*
Total	**26**	**9**	**14**	**3**	*0*

Classification	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	**Private**	**Private**	**Private**	**Private**	**Private**
Interstate	*0*	*0*	*0*	*0*	*0*
Principal Arterial	*0*	*0*	*0*	*0*	*0*
Minor Arterial	*0*	*0*	*0*	*0*	*0*
Major Collector	*0*	*0*	*0*	*0*	*0*
Minor Collector	*0*	*0*	*0*	*0*	*0*
Local Road	2	*0*	*0*	1	1
Total	**2**	*0*	*0*	**1**	**1**

Segment 3B

Classification	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	**Public**	**Public**	**Public**	**Public**	**Public**
Interstate	*0*	*0*	*0*	*0*	*0*
Principal Arterial	2	*0*	2	*0*	*0*
Minor Arterial	3	1	2	*0*	*0*
Major Collector	2	1	1	*0*	*0*
Minor Collector	3	*0*	2	1	*0*
Local Road	21	6	9	6	*0*
Total	**31**	**8**	**16**	**7**	*0*

Classification	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	**Private**	**Private**	**Private**	**Private**	**Private**
Interstate	*0*	*0*	*0*	*0*	*0*
Principal Arterial	*0*	*0*	*0*	*0*	*0*
Minor Arterial	*0*	*0*	*0*	*0*	*0*
Major Collector	*0*	*0*	*0*	*0*	*0*
Minor Collector	*0*	*0*	*0*	*0*	*0*
Local Road	5	*0*	3	2	*0*
Total	**5**	*0*	**3**	**2**	*0*

Segment 4A

Classification	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	**Public**	**Public**	**Public**	**Public**	**Public**
Interstate	*0*	*0*	*0*	*0*	*0*
Principal Arterial	2	*0*	2	*0*	*0*
Minor Arterial	1	1	*0*	*0*	*0*
Major Collector	4	*0*	4	*0*	*0*
Minor Collector	3	1	1	1	*0*
Local Road	18	2	12	4	*0*
Total	**28**	**4**	**19**	**5**	*0*

Classification	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	**Private**	**Private**	**Private**	**Private**	**Private**
Interstate	*0*	*0*	*0*	*0*	*0*
Principal Arterial	*0*	*0*	*0*	*0*	*0*
Minor Arterial	*0*	*0*	*0*	*0*	*0*
Major Collector	*0*	*0*	*0*	*0*	*0*
Minor Collector	*0*	*0*	*0*	*0*	*0*
Local Road	7	*0*	3	2	2
Total	**7**	*0*	**3**	**2**	**2**

Segment 4B

Classification	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	**Public**	**Public**	**Public**	**Public**	**Public**
Interstate	*0*	*0*	*0*	*0*	*0*
Principal Arterial	2	*0*	2	*0*	*0*
Minor Arterial	1	*0*	1	*0*	*0*
Major Collector	*0*	*0*	*0*	*0*	*0*
Minor Collector	5	2	3	*0*	*0*
Local Road	14	3	6	5	*0*
Total	**22**	**5**	**12**	**5**	*0*

Classification	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	**Private**	**Private**	**Private**	**Private**	**Private**
Interstate	*0*	*0*	*0*	*0*	*0*
Principal Arterial	*0*	*0*	*0*	*0*	*0*
Minor Arterial	*0*	*0*	*0*	*0*	*0*
Major Collector	*0*	*0*	*0*	*0*	*0*
Minor Collector	*0*	*0*	*0*	*0*	*0*
Local Road	6	*0*	2	3	1
Total	**6**	*0*	**2**	**3**	**1**

Segment 5

Classification	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	**Public**	**Public**	**Public**	**Public**	**Public**
Interstate	4	*0*	4	*0*	*0*
Principal Arterial	14	1	13	*0*	*0*
Minor Arterial	4	*0*	4	*0*	*0*
Major Collector	8	1	6	1	*0*
Minor Collector	1	*0*	*0*	1	*0*
Local Road	15	1	14	*0*	*0*
Total	**46**	**3**	**41**	**2**	*0*

Classification	Road Crossings	Road over Rail	Road under Rail	Reroute	Road Closure
Type	**Private**	**Private**	**Private**	**Private**	**Private**
Interstate	*0*	*0*	*0*	*0*	*0*
Principal Arterial	*0*	*0*	*0*	*0*	*0*
Minor Arterial	*0*	*0*	*0*	*0*	*0*
Major Collector	*0*	*0*	*0*	*0*	*0*
Minor Collector	*0*	*0*	*0*	*0*	*0*
Local Road	2	*0*	1	*0*	1
Total	**2**	*0*	**1**	*0*	**1**

Segment	Crossing ID	Existing Road Station	Street Name	TxDOT Classification	Public or Private	County	Treatment	Proposed Rail Elevation	Existing Road Elevation	Elevation Difference
HN	CH-HT-001	HT1 27+22	Houston Station Internal St	Minor Collector	Public	Harris	Road under Rail	117.0000	64.26	52.74
HN	CH-HT-002	HT1 35+13	12th St	Major Collector	Public	Harris	Road under Rail	117.0000	64.77	52.23
HN	CH-HT-003	HT1 60+00	Hempstead Rd	Principal Arterial	Public	Harris	Road under Rail	114.1051	70.1706	43.93
HN	CH-HT-004	HT1 63+88	Post Oak Rd	Minor Arterial	Public	Harris	Road under Rail	113.5410	70.92	42.62
HN	CH-HT-005	HT1 91+56	Long Point Rd	Major Collector	Public	Harris	Road under Rail	111.1726	69.56	41.61
HN	CH-HN-006	HN1 40+87	Antoine Dr	Minor Arterial	Public	Harris	Road under Rail	116.0580	74.59	41.47
HN	CH-HN-007	HN1 62+00	Central Coast Crest / Wirtcrest Ln	Local Road	Public	Harris	Road under Rail	118.17	77.19	40.98
HN	CH-HN-008	HN1 77+40	W 34th / Kempwood Dr	Minor Arterial	Public	Harris	Road under Rail	119.7110	77.85	41.86
HN	CH-HN-010	HN1 120+00	Bingle Rd	Principal Arterial	Public	Harris	Road under Rail	123.97	75.18	48.79
HN	CH-HN-010a	HN1 126+45	Rayson Rd	Local Road	Public	Harris	Road under Rail	124.6160	76.38	48.24
HN	CH-HN-011	HN1 165+35	W 43rd / Clay Rd	Principal Arterial	Public	Harris	Road under Rail	128.5060	82.69	45.82
HN	CH-HN-013	HN1 207+70	Pinemont Dr	Minor Arterial	Public	Harris	Road under Rail	131.7410	86.06	45.68
HN	CH-HN-014	HN1 244+80	Blalock Rd / Fairbanks N Houston Rd	Minor Arterial	Public	Harris	Road under Rail	136.4510	89.04	47.42
HN	CH-HN-015a	HN1 276+45	Campbell Rd	Minor Arterial	Public	Harris	Road under Rail	139.6160	92.29	47.33
HN	CH-HN-015b	HN1 302+55	Private Road	Local Road	Private	Harris	Road under Rail	142.2260	95.01	47.22
HN	CH-HN-016	HN1 326+67	N Gessner Rd	Principal Arterial	Public	Harris	Road under Rail	144.6380	95.49	49.15
HN	CH-HN-017	HN1 361+88	W Little York Rd	Principal Arterial	Public	Harris	Road under Rail	130.7710	100.29	30.49
HN	CH-HN-018	HN1 382+21	Perimeter Park Dr	Local Road	Public	Harris	Reroute	105.4901	101.58	3.91
HN	CH-HN-019	HN1 387+38	Sam Houston Pkwy	Principal Arterial	Public	Harris	Road over Rail	102.2278	148.00	45.77
HN	CH-HN-020	HN1 388+50	Sam Houston Pkwy	Principal Arterial	Public	Harris	Road over Rail	102.10	125.67	23.57
HN	CH-HN-021	HN1 389+05	Sam Houston Pkwy	Principal Arterial	Public	Harris	Road over Rail	102.1146	135.98	33.86
HN	CH-HN-022	HN1 390+30	Sam Houston Pkwy	Principal Arterial	Public	Harris	Road over Rail	102.3458	138.00	35.65
HN	CH-HN-023	HN1 405+20	Senate Ave	Local Road	Public	Harris	Road under Rail	118.1210	82.04	36.08
HN	CH-HN-025	HN1 421+10	Britmoore Rd	Local Road	Public	Harris	Road under Rail	137.9960	107.71	30.28
HN	CH-HN-026	HN1 432+30	FM 529	Principal Arterial	Public	Harris	Road under Rail	150.9335	85.71	65.22
HN	CH-HN-027	HN1 437+64	Spencer Rd	Minor Collector	Public	Harris	Road under Rail	158.6705	107.66	51.01
HN	CH-HN-030	HN1 454+80	Private Road	Local Road	Private	Harris	Reroute	166.4546	107.27	59.19
HN	CH-HN-031	HN1 492+50	Jones Rd	Local Road	Public	Harris	Road under Rail	156.9210	111.08	45.84
HN	CH-HN-032	HN1 511+00	Wright Rd	Local Road	Public	Harris	Reroute	152.8950	113.27	39.63
HN	CH-HN-032a	HN1 511+80	Wright Rd	Local Road	Public	Harris	Road under Rail	152.5000	113.27	39.23
HN	CH-HN-032b	HN1 513+00	Taylor Rd	Local Road	Public	Harris	Reroute	151.9264	113.26	38.67
HN	CH-HN-033	HN1 534+52	Private Road	Local Road	Private	Harris	Road under Rail	150.8284	114.15	36.67
HN	CH-HN-034	HN1 551+85	West Rd	Minor Arterial	Public	Harris	Road under Rail	159.4852	116.79	42.69
HN	CH-HN-035	HN1 552+52	West Rd	Minor Arterial	Public	Harris	Road under Rail	159.8199	116.56	43.26
HN	CH-HN-036	HN1 564+56	N Eldridge Pkwy	Principal Arterial	Public	Harris	Road under Rail	165.8342	119.13	46.71
HN	CH-HN-037	HN1 565+18	N Eldridge Pkwy	Principal Arterial	Public	Harris	Road under Rail	166.1439	119.15	46.99
HN	CH-HN-038	HN1 590+05	Daniel Dr	Local Road	Public	Harris	Road under Rail	178.5670	121.69	56.88
HN	CH-HN-039	HN1 604+38	HPL Co. Maintenance Rd.	Local Road	Private	Harris	Road under Rail	185.7252	122.70	63.03
HN	CH-HN-039a	HN1 614+25	Private Road	Local Road	Private	Harris	Reroute	190.0311	123.83	66.20
HN	CH-HN-040	HN1 635+30	TX-6	Principal Arterial	Public	Harris	Road under Rail	198.5070	155.58	42.93
HN	CH-HN-041	HN1 670+35	Huffmiester Rd	Minor Arterial	Public	Harris	Road under Rail	170.0521	131.19	38.86
HN	CH-HN-041a	HN1 717+20	Private Road	Local Road	Private	Harris	Road under Rail	177.8988	132.40	45.50
HN	CH-HN-041b	HN1 719+20	Private Road	Local Road	Private	Harris	Road under Rail	178.6975	132.83	45.87
HN	CH-HN-042	HN1 723+60	Berwick Dr	Local Road	Public	Harris	Road under Rail	179.7958	135.85	43.95
HN	CH-HN-043	HN1 757+00	Telge Rd	Minor Arterial	Public	Harris	Road under Rail	188.1328	139.11	49.02
HN	CH-HN-043a	HN1 775+90	Private Road	Local Road	Private	Harris	Road under Rail	192.8504	140.47	52.38
HN	CH-HN-044	HN1 853+16	Barker Cypress Rd	Minor Arterial	Public	Harris	Road under Rail	210.7150	143.31	67.40
HN	CH-HN-045	HN1 887+00	Spring Blvd	Local Road	Public	Harris	Road under Rail	203.9010	138.46	65.45
HN	CH-HN-045b	HN1 949+00	Josey Ranch Rd	Local Road	Public	Harris	Road under Rail	191.5458	148.12	43.43
HN	CH-HN-046	HN1 964+13	Fry Rd	Minor Arterial	Public	Harris	Road under Rail	188.6157	149.81	38.80
HN	CH-HN-047	HN1 973+00	House Hahl Rd	Local Road	Public	Harris	Road under Rail	185.8783	149.61	36.27
HN	CH-HN-047a	HN1 975+00	Private Road	Local Road	Private	Harris	Reroute	184.5843	149.85	34.73
HN	CH-HN-047b	HN1 978+00	Private Road	Local Road	Private	Harris	Road under Rail	182.0903	150.30	31.79
HN	CH-HN-047c	HN1 1056+42	Private Road	Local Road	Private	Harris	Reroute	167.6702	152.97	14.70
HN	CH-HN-050	HN1 1103+78	Private Road	Local Road	Private	Harris	Road over Rail	161.5796	152.81	8.77
HN	CH-HN-050a	HN1 1136+35	Private Road	Local Road	Private	Harris	Reroute	178.0017	155.13	22.87
HN	CH-HN-050b	HN1 1165+00	Private Road	Local Road	Private	Harris	Road under Rail	206.6200	161.14	45.48
HN	CH-HN-051	HN1 1184+25	SH 99	Principal Arterial	Public	Harris	Road under Rail	222.3057	180.33	41.97
HN	CH-HN-052	HN1 1185+05	SH 99	Principal Arterial	Public	Harris	Road under Rail	222.4894	180.11	42.38
HN	CH-HN-053	HN1 1186+05	SH 99	Principal Arterial	Public	Harris	Road under Rail	222.6490	180.12	42.53
HN	CH-HN-054	HN1 1187+70	SH 99	Principal Arterial	Public	Harris	Road under Rail	222.7458	180.46	42.28
HN	CH-HN-055	HN1 1268+46	House Rd	Local Road	Public	Harris	Road under Rail	222.2819	189.59	32.69
HN	CH-HN-056	HN1 1317+24	Katy Hockley Rd	Major Collector	Public	Harris	Road over Rail	200.4810	196.45	4.03
HN	CH-HN-058	HN1 1391+90	Private Road	Local Road	Private	Harris	Reroute	218.8723	202.69	16.18
HN	CH-HN-059	HN1 1405+10	Private Road	Local Road	Private	Harris	Reroute	222.1712	202.20	19.97
HN	CH-HN-060	HN1 1447+59	Warren Ranch Rd	Local Road	Public	Harris	Road over Rail	223.0132	211.97	11.04
HN	CH-HN-060a	HN1 1473+00	Private Road	Local Road	Private	Harris	Reroute	231.2722	215.17	16.10
HN	CH-HN-064	HN1 1510+00	Private Road	Local Road	Private	Harris	Reroute	238.1722	222.06	16.11
HN	CH-HN-062	HN1 1521+00	Private Road	Local Road	Private	Harris	Reroute	239.2722	224.31	14.97
HN	CH-HN-063	HN1 1534+36	Private Road	Local Road	Private	Harris	Reroute	240.6082	227.31	13.30
HN	CH-HN-065	HN1 1554+20	Betka Rd	Local Road	Public	Harris	Road over Rail	242.5922	233.03	9.56
HN	CH-HN-067	HN1 1614+62	Burton Cemetery Rd	Local Road	Public	Harris	Road under Rail	279.6852	244.11	35.57
HN	CH-HN-068	HN1 1634+18	Old Washington County Rd	Local Road	Public	Harris	Road under Rail	286.6352	244.33	42.31
HN	CH-HN-069	HN1 1636+24	Hempstead Hwy	Principal Arterial	Public	Harris	Road under Rail	287.3562	248.48	38.88
HN	CH-HN-069a	HN1 1659+48	Private Road	Local Road	Private	Harris	Road under Rail	295.4902	251.93	43.56
HN	CH-HN-070	HN1 1686+15	US 290	Principal Arterial	Public	Harris	Road under Rail	304.1870	261.94	42.25
HN	CH-HN-070a	HN1 1694+86	Private Road	Local Road	Private	Harris	Road under Rail	303.9117	263.40	40.52
HN	CH-HN-071	HN1 1721+00	FM 2920	Major Collector	Public	Harris	Road under Rail	302.5926	271.78	30.81
HN	CH-HN-072	HN1 1729+00	Jaime Ln	Local Road	Public	Harris	Road under Rail	302.1889	271.50	30.69
HN	CH-HN-073	HN1 1742+00	Kari Ln	Local Road	Public	Harris	Reroute	301.5329	275.05	26.48
HN	CH-HN-074	HN1 1776+00	Waller Spring Creek Rd.	Local Road	Public	Harris	Road under Rail	298.8422	267.63	31.21
HN	CH-HN-074a	HN1 1783+48	St. Nicholas Dr.	Local Road	Public	Harris	Reroute	293.3420	264.74	28.60
HN	CH-HN-075	HN1 1786+85	Private Road	Local Road	Private	Harris	Reroute	289.9792	263.42	26.56
HN	CH-HN-075a	HN1 1790+20	Private Road	Local Road	Private	Harris	Reroute	286.6364	261.09	25.55
HN	CH-HN-076	HN1 1802+12	Private Road	Local Road	Private	Harris	Reroute	278.4910	257.71	20.78
HN	CH-HN-077	HN1 1819+00	Private Road	Local Road	Private	Harris	Reroute	275.8457	262.28	13.57
HN	CH-HN-079	HN1 1868+85	Private Road	Local Road	Private	Harris	Reroute	275.3225	267.92	7.41
HN	CH-HN-080	HN1 1882+30	Castle Rd.	Local Road	Public	Harris	Road over Rail	274.3922	271.17	3.23
HN	CH-HN-081	HN1 1950+50	Private Road	Local Road	Private	Waller	Closure	277.2400	270.00	7.24
HN	CH-HN-081a	HN1 1967+40	Private Road	Local Road	Private	Waller	Reroute	283.1553	260.00	23.16
HN	CH-HN-082	HN1 2011+25	Private Road	Local Road	Private	Waller	Reroute	298.4949	271.93	26.57
HN	CH-HN-083	HN1 2030+00	Private Road	Local Road	Private	Waller	Reroute	305.0541	290.00	15.05
HN	CH-HN-084	HN1 2042+65	Joseph Rd.	Local Road	Public	Waller	Reroute	309.4793	300.00	9.48
HN	CH-HN-085	HN1 2063+90	Hegar Rd.	Major Collector	Public	Waller	Reroute	316.1510	296.18	19.97
HN	CH-HN-086	HN1 2073+70	FM 1488	Major Collector	Public	Waller	Road under Rail	312.5297	277.09	35.44
HN	CH-HN-087	HN1 2075+00	Bowler Rd.	Minor Collector	Public	Waller	Reroute	312.3046	276.45	35.85
HN	CH-HN-088	HN1 2130+00	Murphy Rd. (Residential)	Local Road	Public	Waller	Road under Rail	294.4461	258.93	35.52

Segment	Crossing ID	Existing Road Station	Street Name	TxDOT Classification	Public or Private	County	Treatment	Proposed Rail Elevation	Existing Road Elevation	Elevation Difference
HN	CH-HN-088a	HN1 2152+75	Private Road	Local Road	Private	Waller	Reroute	300.1200	289.51	10.61
HN	CH-HN-090	HN1 2304+80	Foxwood Dr.	Local Road	Public	Waller	Reroute	305.5246	296.96	8.57
HN	CH-HN-091	HN1 2363+20	Riley Rd.	Local Road	Public	Waller	Road over Rail	307.5227	301.10	6.42
HN	CH-HN-092	HN2 20+03	Bronco Ln	Local Road	Public	Grimes	Reroute	310.9710	306.37	4.60
HN	CH-HN-093	HN2 58+44	Clark Rd	Local Road	Public	Grimes	Road under Rail	330.7489	298.69	32.06
HN	CH-HN-094	HN2 122+90	County Road 302	Local Road	Public	Grimes	Road over Rail	367.8839	349.73	18.15
HN	CH-HN-096	HN2 219+45	Private Road	Local Road	Private	Grimes	Road under Rail	392.3532	355.97	36.38
HN	CH-HN-097	HN2 269+85	Pavlock Rd	Local Road	Public	Grimes	Reroute	364.6334	345.91	18.73
HN	CH-HN-098	HN2 275+58	Private Road	Local Road	Private	Grimes	Reroute	361.9510	338.85	23.11
HN	CH-HN-099b	HN2 316+70	Private Road	Local Road	Private	Grimes	Reroute	378.2171	369.45	8.77
HN	CH-HN-100	HN2 363+49	TX-105	Principal Arterial	Public	Grimes	Road under Rail	397.5724	338.82	58.76
HN	CH-HN-101	HN2 385+64	Private Road	Local Road	Private	Grimes	Road under Rail	391.0878	341.74	49.35
HN	CH-HN-102	HN2 431+57	County Road 311	Local Road	Public	Grimes	Road under Rail	391.6044	359.29	32.32
HN	CH-HN-103	HN2 467+28	High Oaks Dr	Local Road	Public	Grimes	Reroute	404.4471	377.91	26.54
HN	CH-HN-104	HN2 533+10	County Road 313	Local Road	Public	Grimes	Road over Rail	386.0609	374.15	11.91
HN	CH-HN-105	HN2 574+87	Private Road	Local Road	Private	Grimes	Reroute	341.0131	341.63	0.62
HN	CH-HN-107	HN2 635+29	FM 2445	Minor Collector	Public	Grimes	Road under Rail	321.7873	291.10	30.68
HN	CH-HN-108	HN2 658+00	Chisum Trail	Local Road	Public	Grimes	Reroute	344.4982	337.88	6.61
HN	CH-HN-109	HN2 692+50	Rolling Hills	Local Road	Public	Grimes	Reroute	374.6600	388.61	13.95
HN	CH-HN-110	HN2 806+05	County Road 215	Local Road	Public	Grimes	Road under Rail	378.5628	347.15	31.41
HN	CH-HN-111	HN2 833+90	FM 1774	Major Collector	Public	Grimes	Road over Rail	396.0553	410.54	14.49
HN	CH-HN-115	HN2 946+62	FM 2819	Minor Collector	Public	Grimes	Road over Rail	419.8738	410.70	9.17
HN	CH-HN-115b	HN2 1044+00	Private Road	Local Road	Private	Grimes	Reroute	418.7804	418.39	0.39
HN	CH-HN-116	HN2-1047+41	FM 149	Major Collector	Public	Grimes	Road over Rail	418.7431	419.95	1.21
HN	CH-HN-117	HN2 1136+20	County Road 220	Local Road	Public	Grimes	Reroute	426.5412	402.17	24.37
HN	CH-HN-117a	HN2 1142+12	County Road 220	Local Road	Public	Grimes	Road under Rail	422.2518	385.91	36.34
HN	CH-HN-119	HN2 1195+10	County Road 219	Local Road	Public	Grimes	Road under Rail	381.9505	352.08	29.87
HN	CH-HN-120a	HN2 1237+90	Private Road	Local Road	Private	Grimes	Reroute	358.5255	342.90	15.63
HN	CH-HN-120b	HN2 1240+50	Private Road	Local Road	Private	Grimes	Reroute	357.2960	344.14	13.16
HN	CH-HN-121	HN2 1251+50	TX-90	Minor Arterial	Public	Grimes	Road under Rail	358.3265	327.32	31.01
HN	CH-HN-122	HN2 1291+69	TX-30	Minor Arterial	Public	Grimes	Road under Rail	374.8903	344.60	30.29
HN	CH-HN-123	HN2 1335+72	County Road 226	Local Road	Public	Grimes	Reroute	386.6601	389.68	3.02
HN	CH-HN-124	HN2 1345+00	County Road 279	Local Road	Public	Grimes	Reroute	391.2893	400.29	9.00
HN	CH-HN-124a	HN2 1351+75	County Road 279	Local Road	Public	Grimes	Reroute	392.3862	387.22	5.17
HN	CH-HN-125	HN2 1373+75	Luthe Road	Local Road	Public	Grimes	Road over rail	379.7188	372.35	7.37
HN	CH-HN-126	HN2 1382+58	High Star Lane	Local Road	Public	Grimes	Reroute	373.7226	371.24	2.48
HN	CH-HN-127	HN2 1447+36	Private Road	Local Road	Private	Grimes	Road under Rail	329.7324	298.30	31.43
HN	CH-HN-128	HN2 1514+21	County Road 176	Local Road	Public	Grimes	Reroute	358.0487	350.57	7.48
HN	CH-HN-129	HN2 1541+00	County Road 178	Local Road	Public	Grimes	Road under rail	375.3698	335.75	39.62
HN	CH-HN-130	HN2 1570+35	FM 39	Major Collector	Public	Grimes	Road under rail	374.6999	320.38	54.32
HN	CH-HN-131	HN2 1610+80	County Road 155	Local Road	Public	Grimes	Reroute	347.8698	337.98	9.89
HN	CH-HN-132	HN2 1648+72	Neff Ln	Local Road	Public	Grimes	Reroute	347.8698	341.47	6.40
HN	CH-HN-133	HN2 1672+32	Private Road	Local Road	Private	Grimes	Road Closure	348.7379	324.26	24.48
HN	CH-HN-134	HN2 1690+65	County Road 150	Local Road	Public	Grimes	Road under Rail	350.8681	320.57	30.30
HN	CH-HN-135	HN2 1831+14	Private Road	Local Road	Private	Grimes	Reroute	352.8523	337.50	15.36
HN	CH-HN-137	HN2 1926+00	County Road 123	Local Road	Public	Grimes	Road over rail	383.3388	379.93	3.40
HN	CH-HN-138	HN2 1989+30	Private Road	Local Road	Private	Grimes	Road under Rail	356.5562	324.55	32.01
HN	CH-HN-139	HN2 2046+56	FM 1696	Major Collector	Public	Grimes	Road under Rail	325.0332	294.85	30.18
WT	CH-WT-002	WT 88+48	County Road 114	Local Road	Public	Grimes	Road under Rail	315.3699	283.63	31.74
WT	CH-WT-003	WT 160+36	Private Road	Local Road	Private	Grimes	Road under Rail	276.8596	244.87	31.99
WT	CH-WT-003a	WT 196+00	Maintenance Rd.	Local Road	Private	Grimes	Road under Rail	278.6402	238.20	40.44
WT	CH-WT-003b	WT 202+83	Private Road	Local Road	Private	Grimes	Road under Rail	278.9817	238.04	40.94
WT	CH-WT-006	WT 240+22	Private Road	Local Road	Private	Madison	Road under Rail	280.8591	250.94	29.92
WT	CH-WT-007	WT 289+68	FM 1372	Minor Collector	Public	Madison	Road Over Rail	312.4191	299.63	12.79
WT	CH-WT-008	WT 297+40	Private Road	Local Road	Private	Madison	Road Closure	311.7301	320.91	9.18
WT	CH-WT-009	WT 326+29	W Production Rd	Local Road	Public	Madison	Road Closure	282.0891	268.67	13.42
WT	CH-WT-010	WT 379+35	Strawther Rd	Local Road	Public	Madison	Road under Rail	295.8394	263.62	32.21
WT	CH-WT-011	WT 416+86	Moss Ln	Local Road	Public	Madison	Road under Rail	335.1994	298.55	36.65
WT	CH-WT-012	WT 429+20	Clark Rd	Local Road	Public	Madison	Road under Rail	343.2276	312.49	30.74
WT	CH-WT-013	WT 430+50	Private Road	Local Road	Private	Madison	Road under Rail	343.8776	315.80	28.08
WT	CH-WT-014	WT 451+72	US 190	Principal Arterial	Public	Madison	Road under Rail	352.6066	322.42	30.18
WT	CH-WT-015	WT 477+80	Private Road	Local Road	Private	Madison	Reroute	338.1358	325.91	12.22
WT	CH-WT-016	WT 479+20	Oxford Cemetery Rd	Local Road	Public	Madison	Reroute	337.2258	323.74	13.49
WT	CH-WT-017	WT 479+91	Oxford Cemetery Rd	Local Road	Public	Madison	Reroute	336.7643	323.66	13.11
WT	CH-WT-018	WT 480+00	Private Road	Local Road	Private	Madison	Reroute	336.7058	323.68	13.03
WT	CH-WT-019	WT 524+34	Private Road	Local Road	Private	Madison	Road Closure	319.1178	300.71	18.41
WT	CH-WT-020	WT 527+82	Private Road	Local Road	Private	Madison	Road Closure	319.8383	302.07	17.77
WT	CH-WT-021	WT 529+00	Private Road	Local Road	Private	Madison	Road Closure	320.1859	300.86	19.32
WT	CH-WT-023	WT 542+21	FM 1452	Minor Collector	Public	Madison	Road under Rail	323.5230	293.23	30.29
WT	CH-WT-026	WT 669+15	Private Road	Local Road	Private	Madison	Road Closure	367.0949	357.76	9.34
WT	CH-WT-027	WT 671+50	FM 978	Minor Collector	Public	Madison	Road Over Rail	368.2697	361.58	6.69
WT	CH-WT-029	WT 688+00	FM 978	Minor Collector	Public	Madison	Reroute	366.1189	358.35	7.77
WT	CH-WT-030	WT 695+00	Poteet Rd	Local Road	Public	Madison	Reroute	359.9369	351.15	8.79
WT	CH-WT-032	WT 752+87	Poteet Rd	Local Road	Public	Madison	Road Over Rail	335.7853	342.40	6.62
WT	CH-WT-034	WT 807+66	FM 2289	Minor Collector	Public	Madison	Road under Rail	365.8187	335.19	30.63
WT	CH-WT-035	WT 863+60	Dawkins Rd	Local Road	Public	Madison	Road under Rail	363.3797	333.04	30.34
WT	CH-WT-036A	WT 929+84	Dawkins Rd	Local Road	Public	Madison	Reroute	336.8520	333.00	3.85
WT	CH-WT-037	WT 937+26	Metzler Ln	Local Road	Public	Madison	Reroute	338.3314	333.66	4.67
WT	CH-WT-038	WT 977+40	Skains Ln	Local Road	Public	Madison	Reroute	366.5713	350.86	15.71
WT	CH-WT-039	WT 981+10	SH OSR County Line Rd	Major Collector	Public	Leon	Road over Rail	369.7148	355.63	14.09
WT	CH-WT-040	WT 986+36	Private Road	Local Road	Private	Leon	Reroute	374.1837	358.60	15.58
WT	CH-WT-044	WT 1134+30	County Road 408	Local Road	Public	Leon	Reroute	427.2391	423.44	3.80
WT	CH-WT-045	WT 1182+60	County Road 408	Local Road	Public	Leon	Reroute	430.5915	415.71	14.88
WT	CH-WT-046	WT 1206+10	FM 977	Major Collector	Public	Leon	Road Over Rail	447.0402	430.17	16.87
WT	CH-WT-048	WT 1310+00	Private Road	Local Road	Private	Leon	Road under Rail	435.8965	396.35	39.54
WT	CH-WT-049	WT 1338+80	Private Road	Local Road	Private	Leon	Road under Rail	404.0870	368.00	36.08
WT	CH-WT-050	WT 1442+22	Private Road 4255	Local Road	Private	Leon	Road Closure	467.3610	453.54	13.83
WT	CH-WT-051	WT 1454+00	Private Road	Local Road	Private	Leon	Road Closure	477.9630	467.37	10.59
WT	CH-WT-052	WT 1463+00	Private Road	Local Road	Private	Leon	Road Closure	486.0264	475.85	10.18
WT	CH-WT-053	WT 1481+10	Private Road	Local Road	Private	Leon	Road Closure	491.2730	481.39	9.88
WT	CH-WT-054a	WT 1615+88	Private Road	Local Road	Private	Leon	Reroute	439.4545	434.45	5.01
WT	CH-WT-056	WT 1727+46	FM 39	Major Collector	Public	Leon	Road under Rail	576.6730	540.57	36.11
WT	CH-WT-057	WT 1738+35	SH 7 W	Minor Arterial	Public	Leon	Road under Rail	590.6048	560.87	29.73
WT	CH-WT-059	WT 1815+32	County Road 391	Local Road	Public	Leon	Road under Rail	529.7136	475.86	53.85
WT	CH-WT-063	WT 1953+45	Private Road	Local Road	Private	Leon	Road Closure	419.9656	405.42	14.55
WT	CH-WT-064	WT 1957+00	County Road 347	Local Road	Public	Leon	Road under Rail	420.4529	389.59	30.86
WT	CH-WT-065	WT 2011+27	Private Road	Local Road	Private	Leon	Road Closure	421.8539	416.19	5.66
WT	CH-WT-066	WT 2079+87	US 79	Principal Arterial	Public	Leon	Road under Rail	492.1322	448.58	43.55
WT	CH-WT-067	WT 2102+77	County Road 344	Local Road	Public	Leon	Reroute	494.1181	494.56	0.44

Segment	Crossing ID	Existing Road Station	Street Name	TxDOT Classification	Public or Private	County	Treatment	Proposed Rail Elevation	Existing Road Elevation	Elevation Difference
WT	CH-WT-068	WT 2120+68	Private Road	Local Road	Private	Leon	Road Closure	481.3739	456.78	24.60
WT	CH-WT-068b	WT 2159+20	Private Road	Local Road	Private	Leon	Reroute	454.4341	426.59	27.84
WT	CH-WT-069	WT 2161+44	Private Road	Local Road	Private	Leon	Road under Rail	453.9916	424.10	29.90
WT	CH-WT-070	WT 2205+15	FM 1469	Minor Collector	Public	Leon	Road under Rail	459.0649	426.54	32.53
WT	CH-WT-071	WT 2234+52	Private Road	Local Road	Private	Leon	Road Closure	489.9020	467.03	22.88
WT	CH-WT-072	WT 2300+95	FM 1512	Minor Collector	Public	Leon	Reroute	551.5512	530.21	21.34
WT	CH-WT-073A	WT 2319+18	Private Road	Local Road	Private	Leon	Road Closure	528.2492	507.34	20.91
WT	CH-WT-074	WT 2347+39	Private Road	Local Road	Private	Leon	Road Closure	507.2266	484.97	22.25
WT	CH-WT-075	WT 2372+67	Private Road	Local Road	Private	Leon	Road Closure	497.9613	489.30	8.66
WT	CH-WT-076	WT 2387+42	Private Road	Local Road	Private	Leon	Road Closure	477.8693	456.61	21.26
WT	CH-WT-077	WT 2393+01	Private Road	Local Road	Private	Leon	Road Closure	469.7650	455.58	14.19
WT	CH-WT-078	WT 2470+65	Private Road	Local Road	Private	Limestone	Road under Rail	458.2668	423.20	35.07
WT	CH-WT-079	WT 2479+05	County Road 879	Local Road	Public	Limestone	Road under Rail	465.2201	434.01	31.21
WT	CH-WT-080	WT 2484+00	FM 1512	Minor Collector	Public	Limestone	Road under Rail	466.7999	436.36	30.44
WT	CH-WT-081	WT 2505+25	County Road 884	Local Road	Public	Limestone	Road under Rail	458.7353	428.09	30.64
WT	CH-WT-082	WT 2511+32	Private Road	Local Road	Private	Limestone	Road under Rail	455.7106	415.12	40.59
WT	CH-WT-083	WT 2532+25	Private Road	Local Road	Private	Limestone	Road Closure	448.1509	436.86	11.29
WT	CH-WT-084	WT 2542+22	Private Road	Local Road	Private	Limestone	Road Closure	452.9167	441.09	11.83
WT	CH-WT-085	WT 2563+25	County Road 882	Local Road	Public	Limestone	Road Over Rail	464.8757	453.35	11.52
WT	CH-WT-087	WT 2575+46	Private Road	Local Road	Private	Limestone	Road Closure	462.9286	453.63	9.30
WT	CH-WT-088	WT 2588+78	Private Road	Local Road	Private	Limestone	Road under Rail	456.2686	413.92	42.35
WT	CH-WT-089	WT 2605+20	Private Road	Local Road	Private	Limestone	Road Closure	448.0586	425.55	22.51
WT	CH-WT-090	WT 2615+70	Private Road	Local Road	Private	Limestone	Road Closure	442.8086	430.94	11.87
WT	CH-WT-091	WT 2623+02	Private Road	Local Road	Private	Limestone	Road Closure	439.1473	427.14	12.01
WT	CH-WT-092	WT 2680+60	Private Road	Local Road	Private	Limestone	Road Closure	416.7084	393.29	23.42
WT	CH-WT-093	WT 2711+76	Private Road	Local Road	Private	Limestone	Road Closure	438.4580	426.22	12.24
WT	CH-WT-094	WT 2713+53	Private Road	Local Road	Private	Limestone	Road Closure	439.6970	428.99	10.71
WT	CH-WT-095	WT 2722+95	Private Road	Local Road	Private	Limestone	Road Closure	446.2910	435.87	10.42
WT	CH-WT-096	WT 2734+00	Private Road	Local Road	Private	Limestone	Road Closure	451.5597	445.50	6.06
WT	CH-WT-097	WT 2742+18	County Road 828	Local Road	Public	Limestone	Road Over Rail	450.9618	441.23	9.73
WT	CH-WT-099	WT 2785+31	Private Road	Local Road	Private	Limestone	Road Closure	440.5706	432.24	8.33
WT	CH-WT-100	WT 2793+15	Private Road	Local Road	Private	Limestone	Road Closure	430.7414	404.44	26.30
WT	CH-WT-101	WT 2800+96	Private Road	Local Road	Private	Limestone	Road Closure	420.5884	405.83	14.75
WT	CH-WT-102	WT 2864+73	Private Road	Local Road	Private	Limestone	Road under Rail	428.8415	390.00	38.84
WT	CH-WT-103	WT 2869+34	Private Road	Local Road	Private	Limestone	Road under Rail	432.9332	400.00	32.93
WT	CH-WT-104	WT 2877+54	TX-164	Major Collector	Public	Limestone	Road under Rail	437.0637	400.76	36.30
WT	CH-WT-105	WT 2880+45	FM 39	Major Collector	Public	Limestone	Road under Rail	437.3038	407.07	30.23
WT	CH-WT-106	WT 2886+77	Private Road	Local Road	Private	Limestone	Road under Rail	435.5405	404.86	30.68
WT	CH-WT-107	WT 2904+30	Private Road	Local Road	Private	Limestone	Road Closure	425.8048	410.00	15.80
WT	CH-WT-108	WT 2906+60	Private Road	Local Road	Private	Limestone	Road Closure	425.7804	410.00	15.78
WT	CH-WT-109	WT 2926+75	Private Road	Local Road	Private	Limestone	Road Closure	432.3139	412.37	19.94
WT	CH-WT-110	WT 2941+93	Private Road	Local Road	Private	Limestone	Road Closure	437.6251	420.00	17.63
WT	CH-WT-111	WT 2964+00	Private Road	Local Road	Private	Limestone	Road under Rail	445.3470	403.15	42.20
WT	CH-WT-112	WT 2969+00	Private Road	Local Road	Private	Limestone	Road under Rail	447.0965	400.00	47.10
WT	CH-WT-113	WT 3056+37	Private Road	Local Road	Private	Freestone	Road under Rail	453.7287	400.00	53.73
WT	CH-WT-114	WT 3057+97	Private Road	Local Road	Private	Freestone	Road under Rail	453.4264	398.82	54.61
WT	CH-WT-115	WT 3067+84	Private Road	Local Road	Private	Freestone	Road Closure	454.9646	430.00	24.96
WT	CH-WT-116	WT 3073+00	Private Road	Local Road	Private	Freestone	Road Closure	456.2546	447.92	8.34
WT	CH-WT-117	WT 3083+72	Private Road	Local Road	Private	Freestone	Road Closure	458.9346	460.00	1.07
WT	CH-WT-118	WT 3113+48	Private Road	Local Road	Private	Freestone	Road Closure	466.3746	464.90	1.47
WT	CH-WT-119	WT 3119+55	Private Road	Local Road	Private	Freestone	Road Closure	467.8876	460.00	7.89
WT	CH-WT-120	WT 3129+65	Private Road	Local Road	Private	Freestone	Road Closure	469.7315	460.00	9.73
WT	CH-WT-121	WT 3137+26	Private Road	Local Road	Private	Freestone	Road Closure	469.0508	460.00	9.05
WT	CH-WT-122	WT 3146+44	Private Road	Local Road	Private	Freestone	Road Closure	468.1329	460.00	8.13
WT	CH-WT-124	WT 3190+61	County Road 844	Local Road	Public	Freestone	Road under Rail	470.8847	440.00	30.88
WT	CH-WT-125	WT 3262+12	County Road 890	Local Road	Public	Freestone	Road under Rail	465.8508	430.00	35.85
WT	CH-WT-126	WT 3300+83	Private Road	Local Road	Private	Freestone	Road Closure	481.7732	460.00	21.77
WT	CH-WT-127	WT 3317+18	FM 1365	Major Collector	Public	Freestone	Road under Rail	493.2182	463.16	30.06
WT	CH-WT-128	WT 3351+66	Private Road	Local Road	Private	Freestone	Road Closure	490.9552	470.00	20.96
WT	CH-WT-129	WT 3378+15	Private Road	Local Road	Private	Freestone	Road Closure	493.6385	481.57	12.07
WT	CH-WT-130	WT 3387+48	Private Road	Local Road	Private	Freestone	Road Closure	496.4375	488.02	8.42
WT	CH-WT-131	WT 3394+48	FM 2777	Minor Collector	Public	Freestone	Reroute	498.5375	490.00	8.54
WT	CH-WT-132	WT 3446+84	US 84	Minor Arterial	Public	Freestone	Road Over Rail	509.8788	493.63	16.25
WT	CH-WT-133	WT 3506+10	County Road 930	Local Road	Public	Freestone	Road Over Rail	524.4820	510.00	14.48
WT	CH-WT-134	WT 3532+13	Private Road	Local Road	Private	Freestone	Road Closure	531.9065	520.00	11.91
WT	CH-WT-135	WT 3604+40	County Road 963	Local Road	Public	Freestone	Reroute	492.9480	500.00	7.05
WT	CH-WT-136	WT 3629+00	County Road 964	Local Road	Public	Freestone	Road under Rail	479.4180	450.02	29.40
WT	CH-WT-137	WT 3644+93	County Road 961	Local Road	Public	Freestone	Road Over Rail	470.6565	466.27	4.39
WT	CH-WT-138	WT 3687+10	Private Road	Local Road	Private	Freestone	Road Closure	447.4630	444.36	3.11
WT	CH-WT-139	WT 3744+67	County Road 960	Local Road	Public	Freestone	Road Over Rail	455.9054	446.45	9.46
WT	CH-WT-140	WT 3789+26	Private Road	Local Road	Private	Freestone	Road Closure	472.3521	443.94	28.41
WT	CH-WT-141	WT 3805+06	FM 1366	Minor Collector	Public	Freestone	Road Over Rail	469.9829	460.00	9.98
WT	CH-WT-142	WT 3850+15	FM 27	Major Collector	Public	Freestone	Road Over Rail	438.2114	428.46	9.75
WT	CH-WT-143	WT 3884+68	Private Road	Local Road	Private	Freestone	Road Closure	388.8975	360.76	28.14
WT	CH-WT-144	WT 3931+66	Private Road	Local Road	Private	Freestone	Road Closure	390.5453	380.46	10.09
WT	CH-WT-145	WT 3937+79	Private Road	Local Road	Private	Freestone	Road Closure	391.7713	400.00	8.23
WT	CH-WT-146	WT 3973+27	Private Road	Local Road	Private	Freestone	Road Closure	420.1552	400.00	20.16
WT	CH-WT-147	WT 3987+60	County Road 995	Local Road	Public	Freestone	Road under Rail	430.6630	400.00	30.66
WT	CH-WT-148	WT 4029+12	FM 246	Minor Collector	Public	Freestone	Road under Rail	445.7533	395.31	50.44
WT	CH-WT-148a	WT 4062+91	Private Road	Local Road	Private	Freestone	Reroute	439.4687	430.00	9.47
IH	CH-IH-002	IH1 142+00	County Road 119	Local Road	Public	Grimes	Road under Rail	301.9659	268.13	33.84
IH	CH-IH-003	IH1 162+30	Private Road	Local Road	Private	Grimes	Road under Rail	296.8909	266.15	30.75
IH	CH-IH-005	IH1 204+80	Bethel Cemetery Rd	Local Road	Public	Madison	Road under Rail	286.2659	235.41	50.85
IH	CH-IH-006	IH1 224+95	Private Road	Local Road	Private	Madison	Road under Rail	281.2284	245.06	36.17
IH	CH-IH-007	IH1 277+35	FM 1372	Minor Collector	Public	Madison	Road under Rail	294.3537	263.50	30.86
IH	CH-IH-009	IH1 347+23	Private Road	Local Road	Private	Madison	Road under Rail	271.5638	240.07	31.50
IH	CH-IH-011	IH1 427+19	Cottonwood Rd.	Local Road	Public	Madison	Road under Rail	334.4787	301.37	33.11
IH	CH-IH-012	IH1 440+78	US 190	Principal Arterial	Public	Madison	Road under Rail	327.2876	287.11	40.18
IH	CH-IH-013	IH1 475+26	Private Road	Local Road	Private	Madison	Road under Rail	293.2392	258.67	34.57
IH	CH-IH-014	IH1 490+18	Private Road	Local Road	Private	Madison	Road Closure	290.4665	262.42	28.05
IH	CH-IH-015	IH1 556+00	FM 1452	Minor Collector	Public	Madison	Road over Rail	329.2749	319.47	9.81
IH	CH-IH-017	IH1 646+17	FM 978	Major Collector	Public	Madison	Road under Rail	282.1826	251.08	31.11
IH	CH-IH-018	IH1 671+80	Private Road	Local Road	Private	Madison	Road under Rail	280.2521	250.14	30.11
IH	CH-IH-019	IH1 688+00	Private Road	Local Road	Private	Madison	Road under Rail	279.0318	246.59	32.44
IH	CH-IH-021	IH1 909+13	Greenbriar Rd	Local Road	Public	Madison	Road under Rail	360.6816	329.28	31.40
IH	CH-IH-022	IH1 937+40	Private Road	Local Road	Private	Madison	Reroute	350.3670	355.81	5.44
IH	CH-IH-023	IH1 947+67	Waldrip	Local Road	Public	Madison	Road over Rail	354.1807	347.50	6.68
IH	CH-IH-024	IH1 984+76	Private Road	Local Road	Private	Madison	Road Closure	365.1103	361.33	3.78
IH	CH-IH-025	IH1 994+50	IH 45 Frontage Rd	Major Collector	Public	Madison	Road over Rail	362.6753	346.99	15.68

Segment	Crossing ID	Existing Road Station	Street Name	TxDOT Classification	Public or Private	County	Treatment	Proposed Rail Elevation	Existing Road Elevation	Elevation Difference
IH	CH-IH-026	IH1 1026+15	IH 45 Frontage Rd	Major Collector	Public	Madison	Reroute	372.4319	365.11	7.32
IH	CH-IH-027	IH1 1028+62	Hendrix Ln	Local Road	Public	Madison	Road over Rail	373.6671	385.32	11.66
IH	CH-IH-028	IH1 1032+68	IH 45 Frontage Rd	Major Collector	Public	Madison	Reroute	375.6902	369.87	5.82
IH	CH-IH-028a	IH1 1080+80	Quail Ln	Local Road	Public	Madison	Reroute	359.8100	333.08	26.73
IH	CH-IH-029	IH1 1100+90	IH 45 Frontage Rd	Major Collector	Public	Madison	Reroute	373.2004	334.53	38.67
IH	CH-IH-030	IH1 1108+68	IH 45 Ramp	Major Collector	Public	Madison	Road under Rail	378.3848	332.06	46.33
IH	CH-IH-031	IH1 1112+96	SH OSR	Major Collector	Public	Leon	Road under Rail	379.8213	348.07	31.75
IH	CH-IH-032	IH1 1117+00	IH 45 Frontage Rd	Major Collector	Public	Leon	Road under Rail	380.0218	326.09	53.93
IH	CH-IH-033	IH1 1126+00	IH 45 Frontage Rd & Ramps	Major Collector	Public	Leon	Reroute	377.8411	321.69	56.15
IH	CH-IH-033a	IH1 1192+10	IH 45 Frontage Rd	Major Collector	Public	Leon	Reroute	361.35	314.39	46.96
IH	CH-IH-033b	IH1 1197+10	IH 45 Frontage Rd	Major Collector	Public	Leon	Reroute	360.1	316.81	43.29
IH	CH-IH-033c	IH1 1236+20	IH 45 Frontage Rd	Major Collector	Public	Leon	Reroute	350.23	356.47	6.24
IH	CH-IH-034	IH1 1238+37	County Road 400	Local Road	Public	Leon	Road over Rail	349.7849	357.6571	7.87
IH	CH-IH-034A	IH1 1240+60	IH 45 Frontage Rd	Major Collector	Public	Leon	Reroute	349.44	348.21	1.23
IH	CH-IH-035	IH1 1329+50	IH 45 Frontage Rd & Ramps	Major Collector	Public	Leon	Reroute	349.6347	349.88	0.25
IH	CH-IH-036	IH1 1334+25	FM 977	Major Collector	Public	Leon	Road over Rail	364.1260	367.47	3.34
IH	CH-IH-036A	IH1 1340+10	IH 45 Frontage Rd	Major Collector	Public	Leon	Reroute	565.7400	546.29	19.45
IH	CH-IH-037	IH1 1364+00	IH 45 Frontage Rd	Major Collector	Public	Leon	Reroute	584.2900	557.80	26.49
IH	CH-IH-038	IH1 1497+50	IH 45 Ramp	Major Collector	Public	Leon	Reroute	345.0900	310.00	35.09
IH	CH-IH-038a	IH1 1505+75	IH 45 Ramp	Major Collector	Public	Leon	Reroute	357.4600	316.78	40.68
IH	CH-IH-039	IH1 1562+65	IH 45 Frontage Rd	Major Collector	Public	Leon	Reroute	413.1300	393.24	19.89
IH	CH-IH-041	IH1 1609+20	County Road 477	Minor Collector	Public	Leon	Reroute	392.2700	381.49	10.78
IH	CH-IH-042	IH1 1644+36	County Road 413	Minor Collector	Public	Leon	Road under Rail	376.4459	331.57	44.87
IH	CH-IH-043	IH1 1680+18	County Road 423	Local Road	Public	Leon	Road under Rail	372.1951	340.78	31.41
IH	CH-IH-044	IH1 1730+78	TX-7	Minor Arterial	Public	Leon	Road over Rail	447.1559	446.39	0.77
IH	CH-IH-045	IH1 1750+40	County Road 318	Local Road	Public	Leon	Reroute	472.9585	482.75	9.79
IH	CH-IH-046	IH1 1799+40	County Road 317	Local Road	Public	Leon	Reroute	462.4578	451.44	11.01
IH	CH-IH-047	IH1 1874+00	IH 45 Frontage Rd	Major Collector	Public	Leon	Reroute	385.5400	353.27	32.27
IH	CH-IH-47a	IH1 1905+00	IH 45 Frontage Rd	Major Collector	Public	Leon	Reroute	339.0400	294.98	44.06
IH	CH-IH-47b	IH1 1913+50	IH 45 Frontage Rd	Major Collector	Public	Leon	Reroute	326.2900	284.78	41.51
IH	CH-IH-47c	IH1 1981+75	IH 45 Frontage Rd	Major Collector	Public	Leon	Reroute	373.7200	345.73	27.99
IH	CH-IH-048	IH1 2149+00	IH 45 Frontage Rd	Major Collector	Public	Leon	Reroute	388.8400	380.10	8.74
IH	CH-IH-48a	IH1 2055+80	IH 45 Frontage Rd	Major Collector	Public	Leon	Reroute	375.6000	365.26	10.34
IH	CH-IH-48b	IH1 2078+50	IH 45 Frontage Rd	Major Collector	Public	Leon	Reroute	392.8000	389.59	3.21
IH	CH-IH-48c	IH1 2089+30	IH 45 Frontage Rd	Major Collector	Public	Leon	Reroute	407.9200	410.93	3.01
IH	CH-IH-049	IH1 2102+31	County Road 314	Local Road	Public	Leon	Road over Rail	426.1100	436.39	10.28
IH	CH-IH-049a	IH1 2123+00	IH 45 Frontage Rd	Major Collector	Public	Leon	Reroute	434.8600	413.27	21.59
IH	CH-IH-049b	IH1 2130+00	IH 45 Frontage Rd	Major Collector	Public	Leon	Reroute	433.1100	409.50	23.61
IH	CH-IH-049c	IH1 2142+00	IH 45 Frontage Rd	Major Collector	Public	Leon	Reroute	430.1100	403.72	26.39
IH	CH-IH-049d	IH1 2149+60	IH 45 Frontage Rd	Major Collector	Public	Leon	Reroute	428.2100	418.58	9.63
IH	CH-IH-049e	IH1 2155+25	IH 45 Frontage Rd	Major Collector	Public	Leon	Reroute	426.8000	417.55	9.25
IH	CH-IH-050	IH1 2192+00	County Road 3051	Local Road	Public	Leon	Reroute	421.1500	396.61	24.54
IH	CH-IH-050a	IH1 2215+80	IH 45 Frontage Rd	Major Collector	Public	Leon	Reroute	417.8100	414.49	3.32
IH	CH-IH-050b	IH1 2238+00	IH 45 Frontage Rd	Major Collector	Public	Leon	Reroute	407.8200	393.60	14.22
IH	CH-IH-050c	IH1 2248+75	IH 45 Frontage Rd	Major Collector	Public	Leon	Reroute	402.9900	375.41	27.58
IH	CH-IH-050d	IH1 2268+50	IH 45 Frontage Rd	Major Collector	Public	Leon	Reroute	394.1000	369.48	24.62
IH	CH-IH-050e	IH1 2273+00	IH 45 Frontage Rd	Major Collector	Public	Leon	Reroute	392.0800	383.60	8.48
IH	CH-IH-050f	IH1 2281+20	IH 45 Frontage Rd	Major Collector	Public	Leon	Reroute	388.3900	377.55	10.84
IH	CH-IH-050g	IH1 2286+75	IH 45 Frontage Rd	Major Collector	Public	Leon	Reroute	385.8900	377.00	8.89
IH	CH-IH-051	IH1 2316+50	IH 45 Frontage Rd	Major Collector	Public	Leon	Road under Rail	375.6478	313.24	62.41
IH	CH-IH-051a	IH1 2334+00	IH 45 Frontage Rd	Major Collector	Public	Leon	Reroute	379.1400	349.15	29.99
IH	CH-IH-051b	IH1 2361+00	IH 45 Frontage Rd	Major Collector	Public	Leon	Reroute	384.5400	340.34	44.20
IH	CH-IH-051c	IH1 2398+00	IH 45 Frontage Rd	Major Collector	Public	Leon	Reroute	391.9400	337.17	54.77
IH	CH-IH-051d	IH1 2417+50	IH 45 Frontage Rd	Major Collector	Public	Leon	Reroute	395.8300	347.83	48.00
IH	CH-IH-051e	IH1 2422+15	IH 45 Frontage Rd	Major Collector	Public	Leon	Reroute	397.2300	362.99	34.24
IH	CH-IH-051f	IH1 2435+75	IH 45 Frontage Rd	Major Collector	Public	Leon	Reroute	413.2100	385.54	27.67
IH	CH-IH-052	IH1 2453+00	IH 45 Frontage Rd	Major Collector	Public	Leon	Reroute	439.0800	360.19	78.89
IH	CH-IH-052a	IH1 2466+00	Private Road	Local Road	Private	Leon	Road under Rail	453.5943	395.42	58.17
IH	CH-IH-053	IH1 2476+60	County Road 306	Minor Collector	Public	Leon	Road under Rail	454.7500	414.49	40.26
IH	CH-IH-054	IH1 2482+75	S Craig Dr	Major Collector	Public	Leon	Road under Rail	447.9486	380.15	67.80
IH	CH-IH-055	IH1 2487+30	IH 45 Ramp	Major Collector	Public	Leon	Road under Rail	442.5119	377.75	64.76
IH	CH-IH-056	IH1 2495+18	US 79	Principal Arterial	Public	Leon	Road under Rail	433.0962	352.37	80.72
IH	CH-IH-057	IH1 2495+48	US 79	Principal Arterial	Public	Leon	Road under Rail	432.7377	352.37	80.37
IH	CH-IH-058	IH1 2495+70	US 79	Principal Arterial	Public	Leon	Road under Rail	432.4749	351.93	80.54
IH	CH-IH-059	IH1 2502+60	IH 45 Frontage Rd, Ramps, Driveways, Road Tie-Ins	Major Collector	Public	Leon	Road under Rail	427.0600	358.73	68.33
IH	CH-IH-060	IH1 2512+35	IH 45 Frontage Rd, Ramps, Driveways, Road Tie-Ins	Major Collector	Public	Leon	Reroute	424.8500	394.41	30.44
IH	CH-IH-060a	IH1 2532+50	IH 45 Frontage Rd	Major Collector	Public	Leon	Road under Rail	420.82	372.4700	48.35
IH	CH-IH-061	IH1 2543+00	IH 45 Frontage Rd	Major Collector	Public	Leon	Reroute	418.5200	352.12	66.40
IH	CH-IH-061a	IH1 2552+00	County Road 331	Minor Collector	Public	Leon	Road under Rail	416.9200	387.25	29.67
IH	CH-IH-062	IH1 2571+75	IH 45 Frontage Rd	Major Collector	Public	Leon	Reroute	411.5169	392.16	19.35
IH	CH-IH-063	IH1 2574+19	TX 164	Major Collector	Public	Leon	Road under Rail	408.6845	377.70	30.99
IH	CH-IH-065	IH1 2693+50	Private Road	Local Road	Private	Leon	Road under Rail	355.0677	323.97	31.10
IH	CH-IH-066	IH1 2696+67	County Road 691	Local Road	Public	Freestone	Road under Rail	356.4947	323.16	33.33
IH	CH-IH-067	IH1 2730+50	IH 45 Frontage Rd, Ramps, Driveways, Road Tie-Ins	Major Collector	Public	Freestone	Road under Rail	374.9100	333.63	41.28
IH	CH-IH-067a	IH1 2735+25	IH 45 Frontage Rd	Major Collector	Public	Freestone	Reroute	379.3300	342.63	36.70
IH	CH-IH-067b	IH1 2743+50	IH 45 Frontage Rd	Major Collector	Public	Freestone	Reroute	390.3200	390.65	0.33
IH	CH-IH-067c	IH1 2780+50	IH 45 Frontage Rd	Major Collector	Public	Freestone	Reroute	438.4200	407.10	31.32
IH	CH-IH-067d	IH1 2794+25	IH 45 Frontage Rd	Major Collector	Public	Freestone	Reroute	456.2900	425.39	30.90
IH	CH-IH-067e	IH1 2798+50	IH 45 Frontage Rd	Major Collector	Public	Freestone	Reroute	461.8200	449.28	12.54
IH	CH-IH-067f	IH1 2857+15	IH 45 Frontage Rd	Major Collector	Public	Freestone	Reroute	463.4300	438.52	24.91
IH	CH-IH-067g	IH1 2887+50	IH 45 Frontage Rd	Major Collector	Public	Freestone	Reroute	442.2200	437.11	5.11
IH	CH-IH-067h	IH1 2902+00	IH 45 RAMP	Major Collector	Public	Freestone	Reroute	436.5200	446.78	10.26
IH	CH-IH-067i	IH1 2912+40	IH 45 RAMP	Major Collector	Public	Freestone	Reroute	430.2800	435.29	5.01
IH	CH-IH-067j	IH1 2948+00	IH 45 Frontage Rd	Major Collector	Public	Freestone	Reroute	409.6600	404.41	5.25
IH	CH-IH-067k	IH1 2995+00	IH 45 Frontage Rd	Major Collector	Public	Freestone	Reroute	450.4100	421.93	28.48
IH	CH-IH-068	IH1 3041+06	FM 489	Major Collector	Public	Freestone	Road under Rail	501.0799	461.40	39.68
IH	CH-IH-069	IH1 3063+20	Private road	Local Road	Private	Freestone	Road under Rail	524.4726	466.16	58.31
IH	CH-IH-070	IH1 3078+75	County Road 675	Local Road	Public	Freestone	Road under Rail	530.7142	474.25	56.47
IH	CH-IH-071	IH1 3086+50	IH 45 Frontage Rd & Ramps	Major Collector	Public	Freestone	Road under Rail	529.8182	484.62	45.20
IH	CH-IH-072	IH1 3090+78	TX 179	Major Collector	Public	Freestone	Road under Rail	527.2447	494.87	32.37
IH	CH-IH-074	IH1 3117+00	IH-45 Frontage Rd	Major Collector	Public	Freestone	Reroute	516.6367	493.80	22.84
IH	CH-IH-074a	IH1 3201+30	IH 45 Frontage Rd	Major Collector	Public	Freestone	Reroute	436.0200	400.00	36.02
IH	CH-IH-074b	IH1 3220+75	IH 45 Frontage Rd	Major Collector	Public	Freestone	Reroute	431.1600	420.00	11.16
IH	CH-IH-075	IH1 3228+17	County Road 660	Local Road	Public	Freestone	Road over Rail	429.3068	420.00	9.31
IH	CH-IH-076	IH1 3235+50	IH 45 Frontage Rd	Major Collector	Public	Freestone	Reroute	429.2243	420.00	9.22

Segment	Crossing ID	Existing Road Station	Street Name	TxDOT Classification	Public or Private	County	Treatment	Proposed Rail Elevation	Existing Road Elevation	Elevation Difference
IH	CH-IH-076a	IH1 3261+00	IH 45 Frontage Rd	Major Collector	Public	Freestone	Reroute	416.3500	380.00	36.35
IH	CH-IH-076b	IH1 3370+00	IH 45 Frontage Rd	Major Collector	Public	Freestone	Reroute	452.6300	435.02	17.61
IH	CH-IH-076c	IH1 3409+00	IH 45 Frontage Rd	Major Collector	Public	Freestone	Reroute	489.2300	455.54	33.69
IH	CH-IH-076d	IH1 3413+50	RD 610	Major Collector	Public	Freestone	Reroute	492.4400	460.59	31.85
IH	CH-IH-077	IH1 3458+15	IH 45 Frontage Rd	Minor Collector	Public	Freestone	Reroute	508.0043	480.00	28.00
IH	CH-IH-078	IH1 3474+82	Church Street	Local Road	Public	Freestone	Reroute	509.3213	499.78	9.54
IH	CH-IH-078a	IH1 3486+00	IH 45 Frontage Rd	Major Collector	Public	Freestone	Reroute	510.4400	491.27	19.17
IH	CH-IH-080	IH1 3514+78	IH 45 Ramp	Major Collector	Public	Freestone	Road under Rail	513.2864	473.19	40.09
IH	CH-IH-081	IH1 3521+00	Teague St	Minor Arterial	Public	Freestone	Road under Rail	512.5369	473.92	38.62
IH	CH-IH-082	IH1 3526+32	IH 45 Ramp	Major Collector	Public	Freestone	Road under Rail	511.2086	480.00	31.21
IH	CH-IH-082a	IH1 3550+00	IH 45 Frontage Rd	Major Collector	Public	Freestone	Reroute	505.2400	470.00	35.24
IH	CH-IH-083	IH1 3564+00	IH 45 Frontage Rd	Major Collector	Public	Freestone	Reroute	500.9140	470.00	30.91
IH	CH-IH-084	IH1 3569+35	IH 45 Ramp	Major Collector	Public	Freestone	Road under Rail	497.8019	467.41	30.39
IH	CH-IH-085	IH1 3571+20	FM 27	Major Collector	Public	Freestone	Road under Rail	496.5081	460.92	35.59
IH	CH-IH-086	IH1 3573+00	IH 45 Frontage Rd & Ramp	Major Collector	Public	Freestone	Road under Rail	495.1339	459.08	36.05
IH	CH-IH-087	IH1 3587+95	Private Road	Local Road	Private	Freestone	Road Closure	480.8386	457.27	23.56
IH	CH-IH-089	IH1 3604+55	Private Road	Local Road	Private	Freestone	Reroute	464.2380	439.04	25.20
IH	CH-IH-090	IH1 3610+70	Private Road	Local Road	Private	Freestone	Road under Rail	458.0878	430.00	28.09
IH	CH-IH-091	IH1 3627+00	IH 45 Frontage Rd	Major Collector	Public	Freestone	Reroute	441.7900	429.00	12.79
IH	CH-IH-091a	IH1 3655+00	IH 45 Frontage Rd	Major Collector	Public	Freestone	Reroute	415.0800	392.07	23.01
IH	CH-IH-092	IH1 3720+50	IH 45 Frontage Rd	Major Collector	Public	Freestone	Reroute	455.5700	420.00	35.57
IH	CH-IH-092a	IH1 3773+00	IH 45 Frontage Rd	Major Collector	Public	Freestone	Reroute	491.6400	420.00	71.64
IH	CH-IH-093	IH1 3780+00	County Road 1080	Local Road	Public	Freestone	Road under Rail	488.6215	418.09	70.53
IH	CH-IH-094	IH1 3782+56	IH 45 Frontage Rd	Major Collector	Public	Freestone	Road under Rail	486.5968	420.04	66.56
IH	CH-IH-095	IH1 3787+90	Private Road	Local Road	Private	Freestone	Road Closure	480.7606	418.01	62.76
IH	CH-IH-097	IH1 3885+46	County Road 1090	Local Road	Public	Freestone	Road under Rail	375.6345	340.00	35.63
IH	CH-IH-100	IH1 3987+75	FM 833W	Major Collector	Public	Freestone	Road over Rail	406.9263	405.26	1.67
IH	CH-IH-101	IH1 4013+22	County Road 1101	Local Road	Public	Freestone	Road over Rail	396.6612	382.93	13.74
IH	CH-IH-102	IH1 4087+40	County Road 1100	Local Road	Public	Freestone	Road over Rail	432.0572	420.00	12.06
IH	CH-IH-103	IH1 4106+19	FM 80	Major Collector	Public	Freestone	Road under Rail	433.4666	400.00	33.47
IH	CH-IH-104a	IH1 4127+15	County Road 1051	Local Road	Public	Freestone	Road under Rail	419.3087	386.74	32.57
IH	CH-IH-108	IH1 4288+76	County Road 1041	Local Road	Public	Freestone	Road over Rail	394.3203	384.72	9.60
IH	CH-IH-109	IH1 4314+00	FM 246	Minor Collector	Public	Freestone	Road over Rail	400.6307	387.71	12.93
IH	CH-IH-110	IH2 68+40	County Road 2380	Local Road	Public	Navarro	Road over Rail	430.8413	428.40	2.44
IH	CH-IH-112	IH2 188+44	County Road 2348	Local Road	Public	Navarro	Reroute	404.7877	400.00	4.79
IH	CH-IH-114	IH2 224+14	County Road 2344	Local Road	Public	Navarro	Reroute	415.4970	409.00	6.49
IH	CH-IH-115	IH2 268+80	SH 14	Minor Arterial	Public	Navarro	Road under Rail	425.7486	370.00	55.75
IH	CH-IH-116	IH2 298+55	County Road 2130	Local Road	Public	Navarro	Road under Rail	419.8020	380.00	39.80
IH	CH-IH-117	IH2 317+80	County Road 2120	Local Road	Public	Navarro	Road under Rail	415.9542	372.03	43.93
IH	CH-IH-118	IH2 352+88	FM 1394	Minor Collector	Public	Navarro	Road under Rail	408.9422	375.54	33.40
IH	CH-IH-120	IH2 426+12	County Road 40	Local Road	Public	Navarro	Reroute	394.2823	381.39	12.90
IH	CH-IH-122	IH2 600+14	FM 709	Major Collector	Public	Navarro	Road under Rail	442.8938	411.44	31.45
IH	CH-IH-123	IH2 733+36	County Road 3120	Local Road	Public	Navarro	Road under Rail	389.4792	351.45	38.03
IH	CH-IH-124	IH2 772+00	County Road 5127	Local Road	Public	Navarro	Road under Rail	395.2752	355.08	40.20
IH	CH-IH-125	IH2 878+35	County Road 3030	Local Road	Public	Navarro	Road under Rail	450.1195	411.04	39.08
IH	CH-IH-125a	IH2 891+24	SH 31E	Principal Arterial	Public	Navarro	Road under Rail	447.5805	416.66	30.92
IH	CH-IH-126	IH2 891+24	SH 31W	Principal Arterial	Public	Navarro	Road under Rail	447.5805	416.66	30.92
NW	CH-NW-001	NW 25+00	County Road 2420	Local Road	Public	Navarro	Road Under Rail	439.2091	401.50	37.70
NW	CH-NW-002	NW 68+41	County Road 2380	Local Road	Public	Navarro	Road Under Rail	472.7820	441.91	30.87
NW	CH-NW-003	NW 118+91	SH 14	Minor Arterial	Public	Navarro	Road Under Rail	464.8837	413.35	51.53
NW	CH-NW-004	NW 153+59	FM 641	Minor Collector	Public	Navarro	Road Under Rail	457.9477	423.94	34.01
NW	CH-NW-005	NW 208+90	County Road 2190	Local Road	Public	Navarro	Road under Rail	437.4635	404.88	32.58
NW	CH-NW-006	NW 283+23	County Road 2110	Local Road	Public	Navarro	Road Under Rail	464.6711	430.05	34.62
NW	CH-NW-007	NW 314+00	FM 1394	Minor Collector	Public	Navarro	Road Under Rail	452.8080	420.83	31.98
NW	CH-NW-008	NW 380+31	FM 3194	Minor Collector	Public	Navarro	Road Over Rail	435.7850	429.15	6.64
NW	CH-NW-008b	NW 507+00	Private Road	Local Road	Private	Navarro	Reroute	377.5251	391.60	14.07
NW	CH-NW-009	NW 517+05	County Road 2010	Local Road	Public	Navarro	Reroute	385.0626	383.40	1.67
NW	CH-NW-010	NW 553+84	FM 709	Major Collector	Public	Navarro	Road Over Rail	412.4215	423.94	11.51
NW	CH-NW-011	NW 732+23	County Road 5127	Local Road	Public	Navarro	Road Over Rail	398.6038	392.73	5.87
NW	CH-NW-011a	NW 844+19	County Road 3030	Local Road	Public	Navarro	Road under Rail	440.8428	411.11	29.73
NW	CH-NW-012	NW 857+29	SH 31	Principal Arterial	Public	Navarro	Road Under Rail	447.2696	416.64	30.63
NW	CH-NW-013	NW 858+13	SH 31	Principal Arterial	Public	Navarro	Road Under Rail	447.2191	414.49	32.73
NW	CH-NW-014	NW 890+74	Private Road	Local Road	Private	Navarro	Road Closure	440.8913	426.07	14.82
NW	CH-NW-015	NW 911+80	FM 1126	Minor Collector	Public	Navarro	Reroute	436.6805	446.74	10.06
NW	CH-NW-016	NW 950+90	FM 744	Minor Arterial	Public	Navarro	Road Over Rail	440.7276	441.23	0.50
NW	CH-NW-017	NW 1162+65	County Road 2070	Local Road	Public	Navarro	Road Under Rail	492.1259	458.97	33.15
NW	CH-NW-018	NW 1186+93	TX 22	Minor Arterial	Public	Navarro	Road Under Rail	502.9716	472.34	30.63
NW	CH-NW-019	NW 1232+20	County Road 1220	Local Road	Public	Navarro	Road Over Rail	499.4742	487.24	12.23
NW	CH-NW-020	NW 1285+32	County Road 1230	Local Road	Public	Navarro	Road Under Rail	514.4236	480.57	33.85
NW	CH-NW-021	NW 1325+26	FM 1126	Major Collector	Public	Navarro	Road Over Rail	518.3409	523.66	5.32
NW	CH-NW-022	NW 1392+93	County Road 1300	Minor Collector	Public	Navarro	Road Over Rail	520.9617	505.45	15.52
NW	CH-NW-023	NW 1417+38	County Road 1320	Local Road	Public	Navarro	Reroute	505.0692	495.90	9.17
NW	CH-NW-024	NW 1447+00	NW County Road 1320	Local Road	Public	Navarro	Road under Rail	485.8163	433.87	51.95
NW	CH-NW-025	NW 1543+65	Sullivan Rd	Local Road	Public	Ellis	Road Over Rail	453.8580	448.07	5.79
NW	CH-NW-026	NW 1601+76	FM 985	Minor Collector	Public	Ellis	Road Over Rail	463.0000	453.26	9.74
NE	CH-NE-001	NE 25+00	County Road 2420	Local Road	Public	Navarro	Road under Rail	439.2084	401.50	37.70
NE	CH-NE-001a	NE 68+45	County Road 2380	Local Road	Public	Navarro	Road under Rail	465.9647	424.66	41.30
NE	CH-NE-002	NE 118+95	SH 14	Minor Arterial	Public	Navarro	Road under Rail	458.3983	413.32	45.08
NE	CH-NE-003	NE 153+58	FM 641	Minor Collector	Public	Navarro	Road under Rail	454.3532	423.86	30.49
NE	CH-NE-004	NE 209+00	County Road 2190	Local Road	Public	Navarro	Road under Rail	438.8689	406.37	32.50
NE	CH-NE-004a	NE 230+00	County Road 2210	Local Road	Public	Navarro	Reroute	437.9280	424.54	13.39
NE	CH-NE-005	NE 285+61	County Road 2110	Local Road	Public	Navarro	Road over Rail	426.8060	421.29	5.52
NE	CH-NE-006	NE 324+27	FM 1394	Minor Collector	Public	Navarro	Road under Rail	442.6489	412.47	30.18
NE	CH-NE-007	NE 417+38	County Road 30	Local Road	Public	Navarro	Road under Rail	404.7325	372.23	32.51
NE	CH-NE-008	NE 553+20	County Road 30	Local Road	Public	Navarro	Road under Rail	381.8795	329.17	52.71
NE	CH-NE-009	NE 556+30	County Road 30	Local Road	Public	Navarro	Road under Rail	384.6209	340.75	43.87
NE	CH-NE-010	NE 557+80	County Road 5159	Local Road	Public	Navarro	Road under Rail	385.9709	351.38	34.59
NE	CH-NE-010a	NE 578+18	Private Road	Local Road	Private	Navarro	Reroute	404.3129	378.61	25.70
NE	CH-NE-010b	NE 585+50	Private Road	Local Road	Private	Navarro	Road under Rail	409.1750	378.79	30.39

Segment	Crossing ID	Existing Road Station	Street Name	TxDOT Classification	Public or Private	County	Treatment	Proposed Rail Elevation	Existing Road Elevation	Elevation Difference
NE	CH-NE-010c	NE 590+00	Private Road	Local Road	Private	Navarro	Road Under Rail	410.1080	379.67	30.44
NE	CH-NE-011	NE 591+00	County Road 30	Local Road	Public	Navarro	Road under Rail	410.1273	379.84	30.29
NE	CH-NE-011a	NE 592+49	Private Road	Local Road	Private	Navarro	Road under Rail	409.9832	379.54	30.44
NE	CH-NE-011b	NE 601+00	Private Road	Local Road	Private	Navarro	Reroute	405.8975	380.50	25.40
NE	CH-NE-012	NE 623+78	FM 709	Major Collector	Public	Navarro	Road over Rail	389.4626	381.04	8.42
NE	CH-NE-013	NE 658+15	County Road 1140	Local Road	Public	Navarro	Reroute	401.4232	389.98	11.44
NE	CH-NE-014	NE 701+80	County Road 5149	Local Road	Public	Navarro	Road over Rail	421.1323	411.73	9.40
NE	CH-NE-014a	NE 788+75	Oak Valley Lane	Local Road	Public	Navarro	Reroute	419.9979	433.73	13.73
NE	CH-NE-015	NE 804+37	Red Oak Lane	Local Road	Public	Navarro	Road over Rail	423.1355	420.89	2.25
NE	CH-NE-015a	NE 813+12	County Road 1090	Local Road	Public	Navarro	Reroute	424.8931	410.71	14.19
NE	CH-NE-016	NE 888+00	SH 31	Principal Arterial	Public	Navarro	Road under Rail	469.5481	439.13	30.41
NE	CH-NE-017	NE 888+84	SH 31	Principal Arterial	Public	Navarro	Road under Rail	469.6996	438.12	31.58
NE	CH-NE-018	NE 973+43	FM 744	Minor Arterial	Public	Navarro	Road over Rail	438.6671	439.82	1.15
NE	CH-NE-019	NE 1061+80	County Road 4865	Local Road	Public	Navarro	Reroute	455.9299	444.44	11.49
NE	CH-NE-020	NE 1141+95	SH 22	Minor Arterial	Public	Navarro	Road under Rail	499.7624	469.02	30.75
NE	CH-NE-021	NE 1208+85	County Road 1160	Local Road	Public	Navarro	Reroute	486.0069	470.68	15.33
NE	CH-NE-022	NE 1251+72	County Road 1220	Local Road	Public	Navarro	Road over Rail	478.7292	470.26	8.47
NE	CH-NE-023	NE 1305+67	County Road 1230	Local Road	Public	Navarro	Road under Rail	509.9282	476.88	33.05
NE	CH-NE-024	NE 1342+61	FM 1126	Major Collector	Public	Navarro	Road under Rail	536.8594	506.86	30.00
NE	CH-NE-025	NE 1398+89	CR 4777	Local Road	Public	Navarro	Road over Rail	516.3491	507.04	9.31
NE	CH-NE-026	NE 1559+35	Sullivan	Local Road	Public	Ellis	Road over Rail	445.2228	449.50	4.28
NE	CH-NE-027	NE 1618+68	FM 985	Minor Collector	Public	Ellis	Reroute	460.0402	453.30	6.74
EW	CH-EW-001	EW 21+80	Hodge Rd	Local Road	Public	Ellis	Reroute	463.0000	459.61	3.39
EW	CH-EW-001b	EW 120+40	FM 984	Minor Collector	Public	Ellis	Road under Rail	495.7561	459.85	35.90
EW	CH-EW-001c	EW 160+00	Farmer Road	Local Road	Public	Ellis	Reroute	499.2864	475.41	23.87
EW	CH-EW-001d	EW 169+70	Private Road	Local Road	Private	Ellis	Reroute	499.2794	473.66	25.62
EW	CH-EW-002	EW 193+06	SH 34	Minor Arterial	Public	Ellis	Road over Rail	499.1624	488.22	10.94
EW	CH-EW-003	EW 233+29	E B Lane	Local Road	Public	Ellis	Reroute	496.1767	489.79	6.38
EW	CH-EW-004	EW 255+44	Bacak Rd	Local Road	Public	Ellis	Road over Rail	505.0360	498.26	6.77
EW	CH-EW-005	EW 340+61	Walker Rd	Local Road	Public	Ellis	Road under Rail	536.0424	503.03	33.02
EW	CH-EW-006	EW 360+41	FM 984	Minor Collector	Public	Ellis	Reroute	531.0924	489.86	41.23
EW	CH-EW-007	EW 390+69	Getzendaner Rd	Local Road	Public	Ellis	Road under Rail	522.9864	490.84	32.15
EW	CH-EW-008	EW 451+10	Old Waxahachie Rd	Local Road	Public	Ellis	Road under Rail	529.7012	496.36	33.34
EW	CH-EW-009	EW 480+72	US 287	Principal Arterial	Public	Ellis	Road under Rail	542.7842	495.18	47.60
EW	CH-EW-010	EW 481+84	US 287	Principal Arterial	Public	Ellis	Road under Rail	542.7842	494.23	48.56
EW	CH-EW-011	EW 526+03	Old Church Rd	Local Road	Public	Ellis	Road under Rail	542.7842	505.64	37.14
EW	CH-EW-012	EW 537+10	Mustang Rd	Local Road	Public	Ellis	Road under Rail	542.7842	512.24	30.55
EW	CH-EW-013	EW 575+09	Old Boyce Rd	Local Road	Public	Ellis	Road under Rail	542.6909	506.94	35.75
EW	CH-EW-014	EW 643+62	Private Road	Local Road	Private	Ellis	Road under Rail	533.6159	495.98	37.64
EW	CH-EW-014a	EW 668+52	Rail Access Rd	Major Collector	Public	Ellis	Road under Rail	543.3383	501.01	42.32
EW	CH-EW-015	EW 670+00	New Public Rd.	Local Road	Public	Ellis	Road under Rail	543.5646	503.17	40.40
EW	CH-EW-016	EW 676+64	FM 879	Major Collector	Public	Ellis	Road under Rail	542.5685	499.97	42.59
EW	CH-EW-017	EW 768+67	Wilson Rd	Local Road	Public	Ellis	Road over Rail	490.5443	481.57	8.98
EW	CH-EW-018	EW 818+40	Ebenezer Rd	Local Road	Public	Ellis	Road under Rail	478.1842	443.24	34.95
EW	CH-EW-019	EW 853+27	FM 878	Minor Collector	Public	Ellis	Road over Rail	492.7734	483.25	9.52
EW	CH-EW-019b	EW 931+96	FM 813	Major Collector	Public	Ellis	Road under Rail	498.9840	465.74	33.24
EW	CH-EW-020	EW 988+24	Epps Rd	Local Road	Public	Ellis	Road under Rail	506.2964	474.24	32.06
EW	CH-EW-020a	EW 1020+00	Private Road	Local Road	Private	Ellis	Road under Rail	508.5295	474.77	33.76
EW	CH-EW-021	EW 1028+75	Palmyra Rd	Local Road	Public	Ellis	Road under Rail	501.5400	467.72	33.82
EW	CH-EW-021a	EW 1032+93	Private Road	Local Road	Private	Ellis	Reroute	498.1960	475.41	22.78
EW	CH-EW-022	EW 1056+74	Risinger Rd	Local Road	Public	Ellis	Road under Rail	482.2593	439.18	43.08
EW	CH-EW-022a	EW 1114+76	Private Road	Local Road	Private	Ellis	Road under Rail	518.1236	486.73	31.40
EW	CH-EW-022b	EW 1119+34	Wester Rd.	Local Road	Public	Ellis	Road under Rail	519.2740	487.13	32.15
EW	CH-EW-023	EW 1159+00	Ewing Rd.	Local Road	Public	Ellis	Reroute	495.4273	487.88	7.55
EW	CH-EW-024	EW 1192+66	FM 983	Major Collector	Public	Ellis	Road under Rail	474.6351	431.54	43.09
EW	CH-EW-025	EW 1201+59	Private Road	Local Road	Private	Ellis	Road Closure	477.2722	451.96	25.32
EW	CH-EW-026	EW 1207+57	Private Road	Local Road	Private	Ellis	Road Closure	482.3945	466.82	15.57
EE	CH-EE-001	EE 20+76	Hodge Rd.	Local Road	Public	Ellis	Road over Rail	463.0000	461.07	1.93
EE	CH-EE-002	EE 120+04	FM 984	Minor Collector	Public	Ellis	Road over Rail	470.5815	456.21	14.37
EE	CH-EE-003	EE 192+07	SH 34	Minor Arterial	Public	Ellis	Road under Rail	492.1897	461.04	31.15
EE	CH-EE-004	EE 264+18	FM 984	Minor Collector	Public	Ellis	Road over Rail	507.0660	507.49	0.42
EE	CH-EE-005	EE 343+63	Walker Rd.	Local Road	Public	Ellis	Road under Rail	494.3603	451.66	42.70
EE	CH-EE-006a	EE 402+86	Old Waxahachie Rd/Getzendander Rd.	Local Road	Public	Ellis	Reroute	502.5278	490.30	12.23
EE	CH-EE-007	EE 455+42	US 287	Principal Arterial	Public	Ellis	Road under Rail	524.9108	494.51	30.40
EE	CH-EE-008	EE 456+42	US 287	Principal Arterial	Public	Ellis	Road under Rail	525.1573	494.45	30.71
EE	CH-EE-010	EE 510+44	Old Church Rd.	Local Road	Public	Ellis	Road over Rail	524.0436	516.99	7.06
EE	CH-EE-011	EE 526+36	Old Boyce Rd.	Local Road	Public	Ellis	Reroute	527.2277	518.24	8.99
EE	CH-EE-011a	EE 528+31	Private Road	Local Road	Private	Ellis	Reroute	527.6177	517.00	10.62
EE	CH-EE-011b	EE 537+61	Private Road	Local Road	Private	Ellis	Reroute	529.4777	522.02	7.46
EE	CH-EE-011c	EE 602+07	Private Road	Local Road	Private	Ellis	Road under Rail	542.3673	492.67	49.70
EE	CH-EE-012	EE 639+66	FM 879	Minor Collector	Public	Ellis	Road under Rail	541.7749	504.74	37.04
EE	CH-EE-013	EE 731+80	Wilson Rd.	Local Road	Public	Ellis	Road over Rail	485.3396	480.68	4.66
EE	CH-EE-014	EE 774+68	Ebenezer N. Rd.	Local Road	Public	Ellis	Road under Rail	485.3396	449.78	35.56
EE	CH-EE-015	EE 820+16	FM 878	Local Road	Public	Ellis	Road under Rail	508.4757	478.32	30.15
EE	CH-EE-017	EE 888+83	FM 813	Minor Collector	Public	Ellis	Road under Rail	489.8933	424.15	65.75
EE	CH-EE-018	EE 897+34	Almand Rd.	Local Road	Public	Ellis	Reroute	488.1912	461.69	26.50
EE	CH-EE-019	EE-954+21	Epps Rd.	Local Road	Public	Ellis	Reroute	476.8167	471.76	5.06
EE	CH-EE-020	EE 985+57	Palmyra Rd.	Local Road	Public	Ellis	Road under Rail	470.5444	437.86	32.68
EE	CH-EE-021	EE 1018+23	Risinger Rd.	Local Road	Public	Ellis	Road under Rail	475.9163	446.50	29.41
EE	CH-EE-021a	EE 1075+71	Maintenance Rd.	Local Road	Private	Ellis	Reroute	510.4032	483.13	27.28
EE	CH-EE-022	EE 1086+32	Wester Rd.	Local Road	Public	Ellis	Road under Rail	513.0825	480.50	32.58
EE	CH-EE-023	EE 1125+19	Ewing Rd.	Local Road	Public	Ellis	Reroute	489.4350	490.82	1.39
EE	CH-EE-024	EE 1160+00	FM 983	Minor Collector	Public	Ellis	Road under Rail	472.4947	420.52	51.97
EE	CH-EE-025	EE 1166+00	Private Road	Local Road	Private	Ellis	Road under Rail	475.9445	451.73	24.22
EE	CH-EE-026	EW 1171+80	Private Road	Local Road	Private	Ellis	Road Closure	482.3945	466.82	15.57
DS	CH-DS-001	DS 20+63	Bluff Springs Road	Local Road	Public	Dallas	Road under Rail	524.5225	489.19	35.34
DS	CH-DS-001a	DS 26+67	FM 664	Minor Arterial	Public	Dallas	Road under Rail	525.7922	489.47	36.33
DS	CH-DS-001b	DS 79+47	Stainback	Major Collector	Public	Dallas	Road under Rail	536.3604	495.80	40.56
DS	CH-DS-001c	DS 90+00	Prop. Loop 9	Principal Arterial	Public	Dallas	Road under Rail	538.4680	493.72	44.74
DS	CH-DS-001d	DS 98+73	Raintree Dr.	Local Road	Public	Dallas	Road under Rail	540.2154	501.04	39.18
DS	CH-DS-001e	DS 107+35	Lake Trail Dr.	Local Road	Public	Dallas	Road under Rail	541.9408	501.41	40.53
DS	CH-DS-001f	DS 131+38	Hash Rd.	Local Road	Public	Dallas	Road under Rail	542.1301	511.60	30.53
DS	CH-DS-002	DS 153+07	Watermill Rd.	Local Road	Public	Dallas	Road under Rail	524.9657	481.38	43.59
DS	CH-DS-004	DS 246+02	E. Beltline Rd.	Principal Arterial	Public	Dallas	Road over Rail	519.7280	514.16	5.57
DS	CH-DS-004a	DS 279+37	Greene Rd.	Local Road	Public	Dallas	Road over Rail	533.5030	521.27	12.23
DS	CH-DS-005	DS 311+36	Pleasant Run Rd.	Major Collector	Public	Dallas	Road over Rail	553.4051	548.38	5.03
DS	CH-DS-006	DS 322+03	Cornell Rd.	Minor Collector	Public	Dallas	Reroute	564.0756	552.11	11.97
DS	CH-DS-007	DS 364+76	Wintergreen Rd.	Minor Arterial	Public	Dallas	Road under Rail	606.6099	575.65	30.96

Segment	Crossing ID	Existing Road Station	Street Name	TxDOT Classification	Public or Private	County	Treatment	Proposed Rail Elevation	Existing Road Elevation	Elevation Difference
DS	CH-DS-008	DS 380+75	Lancaster-Hutchins Rd	Minor Arterial	Public	Dallas	Road under Rail	607.7806	561.42	46.36
DS	CH-DS-008a	DS 402+28	Blanco Rd.	Major Collector	Public	Dallas	Road under Rail	583.2283	543.63	39.60
DS	CH-DS-010	DS 448+34	Cleveland Rd	Major Collector	Public	Dallas	Reroute	529.0826	524.31	4.77
DS	CH-DS-011	DS 495+97	Langdon Rd	Major Collector	Public	Dallas	Road under Rail	493.2218	443.40	49.82
DS	CH-DS-013	DS 506+53	IH 20	Interstate	Public	Dallas	Road under Rail	485.3018	442.75	42.56
DS	CH-DS-014	DS 507+33	IH 20	Interstate	Public	Dallas	Road under Rail	484.7018	448.14	36.56
DS	CH-DS-016	DS 508+39	IH 20	Interstate	Public	Dallas	Road under Rail	483.9068	446.84	37.06
DS	CH-DS-017	DS 509+41	IH 20	Interstate	Public	Dallas	Road under Rail	483.1418	442.06	41.08
DS	CH-DS-018	DS 526+31	JJ Lemon Rd	Major Collector	Public	Dallas	Road under Rail	470.4668	422.62	47.85
DS	CH-DS-020	DS 596+67	Simpson Stuart Rd	Principal Arterial	Public	Dallas	Road under Rail	449.0267	410.25	38.78
DS	CH-DS-021	DS 667+48	SL 12	Principal Arterial	Public	Dallas	Road under Rail	480.1862	444.71	35.48
DS	CH-DS-022	DS 668+79	SL 12	Principal Arterial	Public	Dallas	Road under Rail	481.3000	436.68	44.62
DS	CH-DS-024	DS 672+45	SL 12	Principal Arterial	Public	Dallas	Road under Rail	483.9324	452.36	31.58
DS	CH-DS-025	DS 672+90	SL 12	Principal Arterial	Public	Dallas	Road under Rail	484.1429	452.46	31.68
DS	CH-DS-026	DS 673+00	SL 12	Principal Arterial	Public	Dallas	Road under Rail	484.1873	452.25	31.94
DS	CH-DS-027	DS 674+00	SL 12	Principal Arterial	Public	Dallas	Road under Rail	484.6314	448.67	35.96
DS	CH-DS-028	DS 676+28	SL 12	Principal Arterial	Public	Dallas	Road under Rail	485.5090	437.75	47.76
DS	CH-DS-029	DS 677+70	SL 12	Principal Arterial	Public	Dallas	Road under Rail	485.7996	439.93	45.87
DS	CH-DS-030	DS 681+20	Mayforge Dr	Local Road	Public	Dallas	Road under Rail	485.9793	423.04	62.94
DS	CH-DS-030a	DS 711+28	Le Forge Ave	Local Road	Public	Dallas	Road under Rail	486.0000	427.73	58.27
DS	CH-DS-030b	DS 714+00	Le Forge Ave	Local Road	Public	Dallas	Road under Rail	486.0000	437.09	48.91
DS	CH-DS-031	DS 723+36	Illinois	Principal Arterial	Public	Dallas	Road under Rail	486.0000	436.65	49.35
DS	CH-DS-031a	S 735+64 to DS 737+0	Private Road	Local Road	Private	Dallas	Road Closure	483.0322	441.12	41.91
DS	CH-DS-031b	DS 743+46	Overton Ct	Local Road	Public	Dallas	Road under Rail	479.1222	431.36	47.76
DS	CH-DS-031c	DS 749+14	Shindoll St	Local Road	Public	Dallas	Road under Rail	476.2822	429.14	47.14
DS	CH-DS-031d	DS 753+25	Cotton Ln	Local Road	Public	Dallas	Road under Rail	474.2272	426.53	47.70
DS	CH-DS-031e	DS 754+75	Bulova St	Local Road	Public	Dallas	Road under Rail	473.4772	424.99	48.49
DS	CH-DS-032	DS 762+95	E. Overton Rd.	Major Collector	Public	Dallas	Road under Rail	469.3772	413.23	56.15
DS	CH-DS-035	DT 119+16	Private Plant Maintenance Rd.	Local Road	Private	Dallas	Road under Rail	499.6042	404.62	94.98
DS	CH-DS-036	DT 125+32	Lenway St.	Local Road	Public	Dallas	Road under Rail	497.6406	407.45	90.19
DS	CH-DS-037	DT 133+00	Cedar Crest	Minor Arterial	Public	Dallas	Road under Rail	494.9526	409.36	85.59
DS	CH-DS-038	DT 140+92	Forest Ave.	Local Road	Public	Dallas	Road under Rail	492.1806	408.27	83.91
DS	CH-DS-039	DT 176+85	Corinth St.	Principal Arterial	Public	Dallas	Road under Rail	479.6051	394.53	85.08
DS	CH-DS-041	DT 216+00	Hotel St.	Major Collector	Public	Dallas	Road under Rail	473.0000	401.04	71.96
DS	CH-DS-042	DT 214+52	Cadiz St.	Principal Arterial	Public	Dallas	Road under Rail	473.0000	397.54	75.46

Appendix D

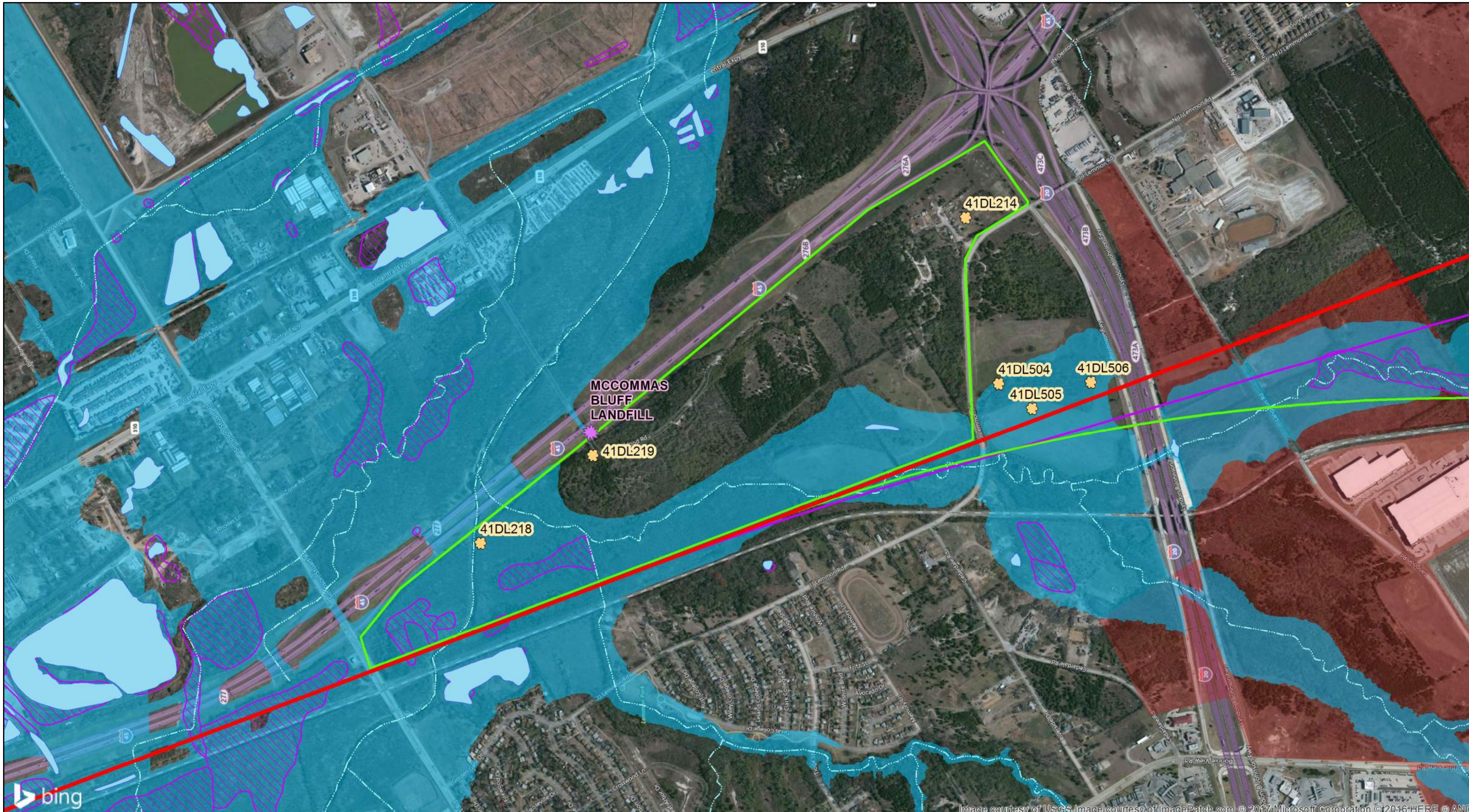
Existing Railroad Crossing Locations

Crossing ID	Approx TCRR Stationing	Railroad Company Name	Railroad Company Abbreviation	Railroad Line Type	Line Status	Number of Crossings	Approx Exisiting Freight Elevation	TOR at Crossing	Proposed Separation (TOR to TOR)	Proposed Treatment
FR-HN-1	HT1 43+96	Union Pacific Railroad Company	UPRR	Spur Line	Active	1	66.2	117.0	50.8	Assumed Inactive
FR-HN-2	HT1 48+86	Union Pacific Railroad Company	UPRR	Spur Line	Active	1	65.1	116.3	51.1	Assumed Inactive
FR-HN-3	HT1 49+69	Union Pacific Railroad Company	UPRR	Spur Line	Active	1	67.5	116.1	48.6	Assumed Inactive
FR-HN-4	HT1 58+62	Union Pacific Railroad Company	UPRR	Main Line	Active	1	68.5	114.8	46.4	Freight Under HSR
FR-HN-5	HN1 346+11	Union Pacific Railroad Company	UPRR	Main Line	Active	3	98.5	146.4	47.9	Freight Under HSR
FR-HN-6	HN1 402+99	Private Railroad	Private	Spur Line	Inactive/Abandoned	1	104.4	115.4	11.0	Assumed Inactive
FR-HN-7	HN1 451+63	Union Pacific Railroad Company	UPRR	Spur Line	Active	1	107.5	167.2	59.7	Freight Under HSR
FR-HN-8	HN1 570+47	Union Pacific Railroad Company	UPRR	Spur Line	Active	1	118.8	168.8	50.0	Assumed Inactive
FR-HN-9	HN1 782+11	Union Pacific Railroad Company	UPRR	Spur Line	Active	1	138.8	194.4	55.6	Freight Under HSR
FR-HN-10	HN1 1635+16	Union Pacific Railroad Company	UPRR	Main Line	Active	1	246.4	287.0	40.6	Freight Under HSR
FR-HN-11	HN2 357+09	BNSF Railway	BNSF	Main Line	Active	1	354.7	397.5	42.8	Freight Under HSR
FR-HN-12	HN2 361+87	Union Pacific Railroad Company	UPRR	Main Line	Active	1	339.0	397.8	58.8	Freight Under HSR
FR-HN-13	HN2 1572+43	BNSF Railway	BNSF	Main Line	Active	1	323.3	373.9	50.6	Freight Under HSR
FR-WT-1	WT 1814+18	BNSF Railway	BNSF	Main Line	Active	1	488.0	531.3	43.3	Freight Under HSR
FR-WT-2	WT 2063+87	Union Pacific Railroad Company	UPRR	Main Line	Active	1	445.0	486.8	41.8	Freight Under HSR
FR-WT-3	WT 4036+42	TU Electric Big Brown Steam Electric Station Rail Spur	TUEX	Main Line	Active	1	396.3	450.5	54.2	Freight Under HSR
FR-IH-1	IH1 2469+42	Union Pacific Railroad Company	UPRR	Main Line	Active	1	411.3	454.7	43.4	Freight Under HSR
FR-IH-2	IH1 3779+20	TU Electric Big Brown Steam Electric Station Rail Spur	TUEX	Main Line	Active	1	417.1	489.2	72.1	Freight Under HSR
FR-IH-3	IH1 4170+01	BNSF Railway	BNSF	Main Line	Active	1	330.0	376.5	46.5	Freight Under HSR
FR-NW-1	NW 117+18	Union Pacific Railroad Company	UPRR	Main Line	Active	1	414.3	465.2	50.9	Freight Under HSR
FR-NE-1	NE 117+18	Union Pacific Railroad Company	UPRR	Main Line	Active	1	414.3	458.6	44.2	Freight Under HSR
FR-IH-4	IH1 277+81	Union Pacific Railroad Company	UPRR	Main Line	Active	1	380.0	423.9	43.9	Freight Under HSR
FR-EW-1	EW 434+02	BNSF Railway	BNSF	Main Line	Active	1	445.0	512.6	67.6	Freight Under HSR
FR-EW-2	EW 670+10	Union Pacific Railroad Company	UPRR	Main Line	Active	1	502.0	543.6	41.6	Freight Under HSR
FR-EE-1	EE 347+52	BNSF Railway	BNSF	Main Line	Active	1	446.0	493.6	47.6	Freight Under HSR
FR-EE-2	EE 632+45	Union Pacific Railroad Company	UPRR	Main Line	Active	1	503.2	546.4	43.2	Freight Under HSR
FR-DS-1	DS 731+27	Union Pacific Railroad Company	UPRR	Spur Line	Pulled	1	442.6	485.1	42.5	Assumed Closure
FR-DS-2	DT 123+07	BNSF Railway	BNSF	Main Line	Active	1	410.4	498.4	88.1	Freight Under HSR
FR-DS-3	DT 125+71	Union Pacific Railroad Company	BNSF	Spur Line	Active	2	407.0	497.5	90.5	Freight Under HSR
FR-DS-4	DT 160+02	Dallas Area Rapid Transit	DART	Main Line	Active	2	423.3	485.5	62.2	Freight Under HSR

Segment	Approx THSR Stationing	Railroad Company Name	Railroad Company	Railroad Line Type	Line Status	Interface
HN	HT1 60+00 to HT 950+00	Union Pacific Railroad Company	UPRR	Main Line	Active	Parallel outside ROW
DS	DS 540+00 to DS 750+00	BNSF Railway	BNSF	Main Line	Active	Parallel outside ROW
DS	DT 90+00 to DT 217+02	Union Pacific Railroad Company	UPRR	Main Line	Active	Parallel inside ROW

Appendix E

TMF Environmental Constraints



- Dallas North Location
- Base Alignment
- West Airport Option
- Critical IIPOD Parcels
- Controlled Parcels
- Previously Recorded Archeological Sites
- Municipal Solid Waste Sites
- NHD Streams
- NHD Waterbodies
- NWI Wetlands
- 100-yr Floodplain

N

0 500 1,000 2,000 Feet

TEXAS CENTRAL

1601 Elm Street, Suite 4343, Dallas, Texas 75201

ARUP
www.arup.com
Texas Registered Engineering Firm: F-1990

FREESE AND NICHOLS
www.freese.com
Texas Registered Engineering Firm: F-2144

Title

Dallas Maintenance Facility Alternative - Dallas North Location

Status	Date	Drawn by
oDrawingStatus	01-16-2017	JT

Job No	Figure No	Rev
234180-00	001	P1

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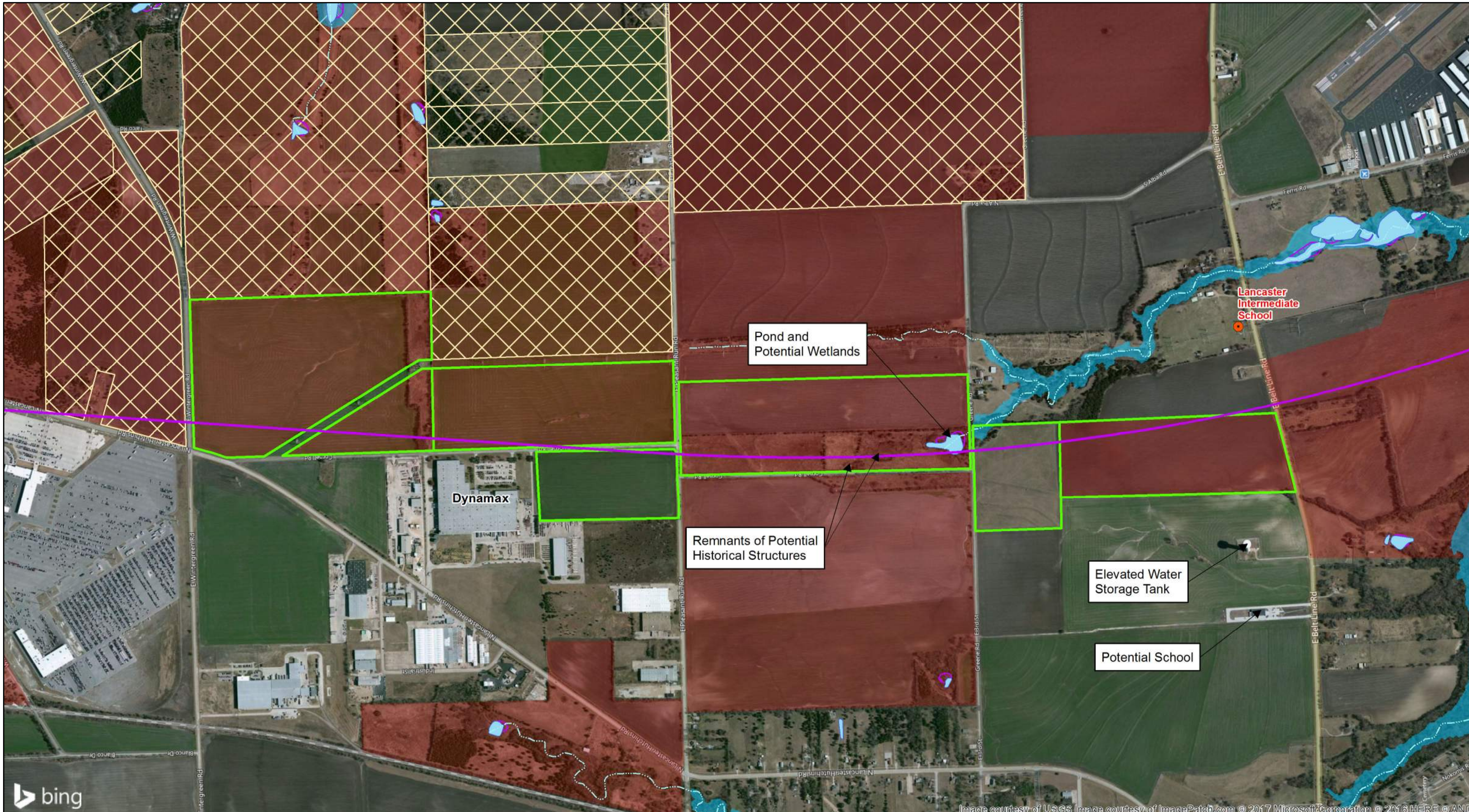
Arup Texas Inc.



West Airport Alternative MF Parcels
West Airport Alignment Option
Critical IIPOD Parcels
Controlled Parcels
NHD Streams
NHD Waterbodies
NWI Wetlands
100-yr Floodplain

N

0 500 1,000 2,000 Feet

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Texas Registered Engineering Firm: F-1990

FREESE NICHOLS
www.freese.com
Texas Registered Engineering Firm: F-2144

Title
Dallas Maintenance Facility Alternative - West Airport South Location

Status	Date	Drawn by
oDrawingStatus	01-16-2017	JT
Job No	Figure No	Rev
234180-00	002	P1

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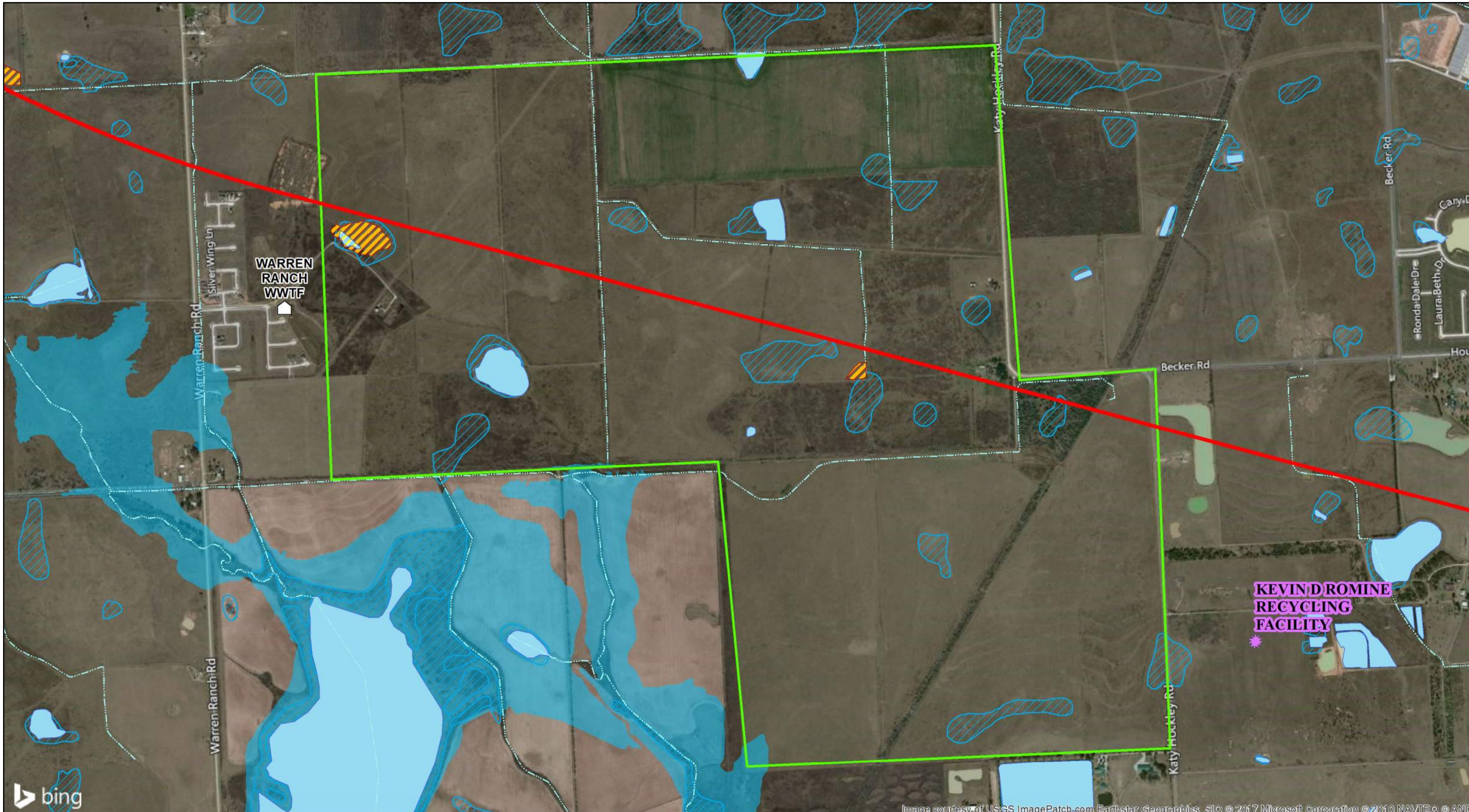
NAD 1983 StatePlane Texas Central FIPS 4203 Feet US

Arup Texas Inc.



Base Alignment
Houston North Location
EPA Registered Facilities
Municipal Solid Waste Sites
NHD Streams
NHD Waterbodies
Emergent Wetland
Scrub/Shrub Wetland
NWI Wetlands
100-yr Floodplain

N

0 600 1,200 2,400 Feet

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Texas Registered Engineering Firm: F-1990

FREESE AND NICHOLS
www.freese.com
Texas Registered Engineering Firm: F-2144

Title
Houston Maintenance Facility Alternative - Houston North Location

Status	Date	Drawn by
oDrawingStatus	01-16-2017	JT

Job No	Figure No	Rev
234180-00	004	P1

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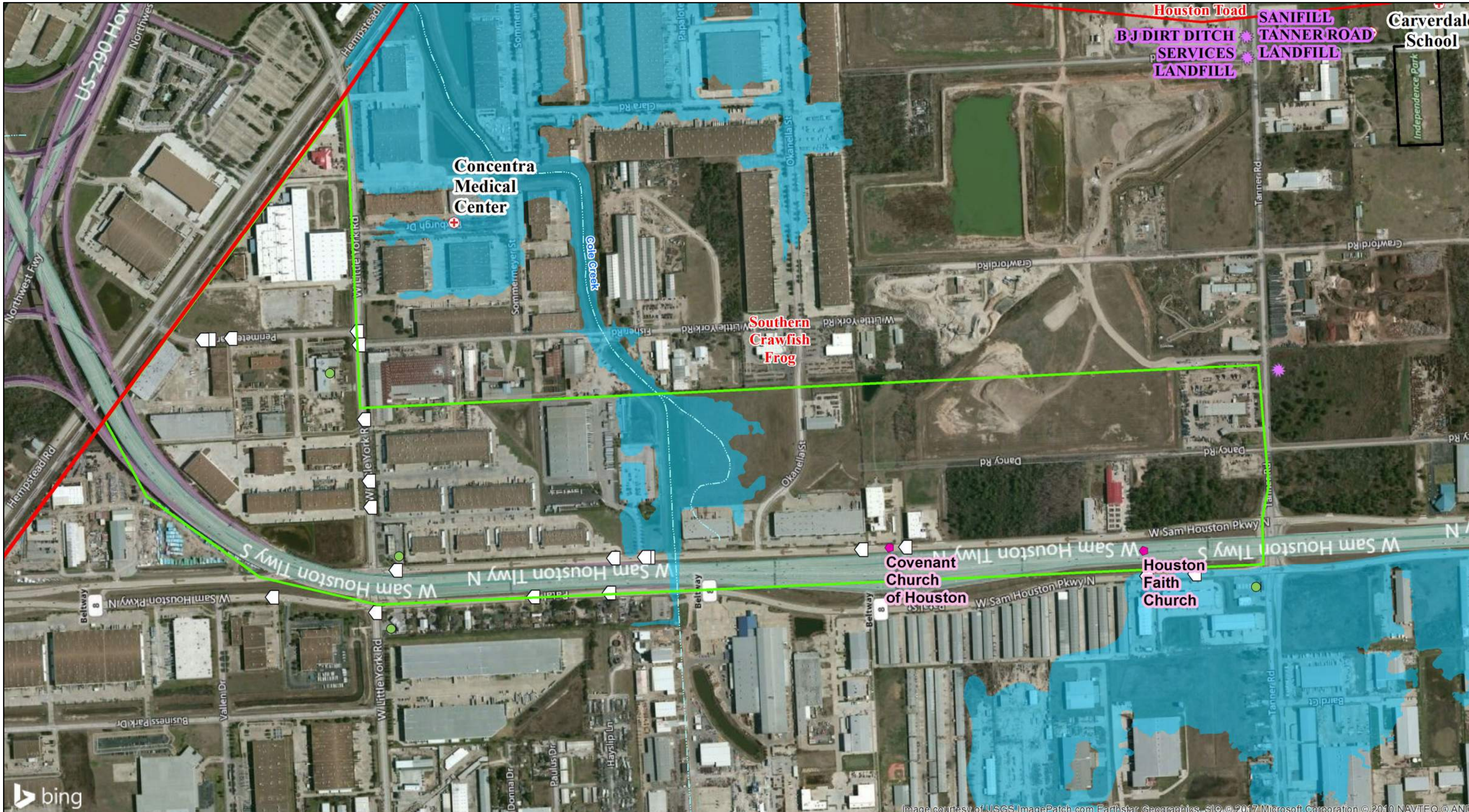
Arup Texas Inc.



- Base Alignment
- Houston South Location
- Municipal Solid Waste Sites
- EPA Registered Facilities
- Petroleum Storage Tank
- Church
- Public Facilities
- NHD Streams
- 100-yr Floodplain

N

0 315 630 1,260 Feet

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Texas Registered
Engineering Firm: F-2144

Title
Houston Maintenance Facility Alternative - Houston South Location

Status	Date	Drawn by
oDrawingStatus	01-16-2017	JT
Job No	Figure No	Rev
234180-00	005	P1

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NAD 1983 StatePlane Texas Central FIPS 4203 Feet US

Arup Texas Inc.

Appendix F

Water Demand

Demand Element	Units	Units/d	Demand Factor g/Unit-d	Total Demand @ FSL (g/d)	Notes
Stations					
Dallas Terminal					
Staff (all staff)	Total work shifts	507	12	6,084	EPA Onsite Wastewater Treatment Systems Manual - February 2002 EPA/625/R-00/008
Station Restrooms	Passengers using restroom	7,600	3	22,800	Assume passenger consumption is primarily for restrooms. Other consumption accounted for elsewhere. Assume about 25% of passengers use restroom at station @ 1.5 gallons per use for flushing and faucet. Other passengers are through traffic.
Concessions	1000 sqft	15.4	300	4,620	SFPUC - Water Supply Assessment - Stadium Project (2014)
Laundry	lbs fabric cleaned	800	3.5	2,800	For washing staff uniforms, First Class linens etc, assume 800 lbs/day, Ref Alliance for Water Efficiency
First class lounge (inc. Kitchen & restrooms)	1000 sqft	11.5	500	5,750	Ref LA CEQA Thresholds Guide
Food preparation for train	Meals prepared	0	2	0	Assume minimal on-site preparation - some washing and cleaning
Cooling demand	1000 sqft cooled	440	140	61,600	All conditioned area in the station and parking structures
Rental Car washing	Cars washed	500	14	7,000	Assume 1500 cars - 1/3 washed per day - 50 gallons per wash and 72% recycled - http://www.carwashmag.com/issues/march-2013/water-treatment.cfm
Dallas Terminal Subtotal				***110,700***	Equivalent to 3.6-gpd/passenger
Brazos Valley					
Staff (all staff)	Total work shifts	110	12	1,320	EPA Onsite Wastewater Treatment Systems Manual - February 2002 EPA/625/R-00/008
Station Restrooms	Passengers using restroom	800	3	2,400	Assume passenger consumption is primarily for restrooms. Other consumption accounted for elsewhere. Assume about 50% of passengers use restroom at station @ 1.5 gallons per use for flushing and faucet. Other passengers are through traffic.
Concessions	1000 sqft	5.2	300	1,560	SFPUC - Water Supply Assessment - Stadium Project (2014)
Laundry	lbs fabric cleaned	200	3.5	700	For washing staff uniforms, First Class linens etc, assume 200 lbs/day, Ref Alliance for Water Efficiency
First class lounge (inc. Kitchen & restrooms)	1000 sqft	6.0	500	3,000	Ref LA CEQA Thresholds Guide, and assume no meal prep for trains at rural stations
Cooling demand	1000 sqft cooled	120	140	16,800	All conditioned area in the station and parking structures
Rental Car washing	Cars washed	100	14	1,400	Assume 300 cars - 1/3 washed per day - 50 gallons per wash and 72% recycled - http://www.carwashmag.com/issues/march-2013/water-treatment.cfm
Brazos Valley Subtotal				***27,200***	Equivalent to 17-gpd/passenger
Houston Terminal (Transit, NW Mall or Industrial Options)					
Staff (all staff)	Total work shifts	507	12	6,084	EPA Onsite Wastewater Treatment Systems Manual - February 2002 EPA/625/R-00/008
Station Restrooms	Passengers using restroom	7,600	3	22,800	Assume passenger consumption is primarily for restrooms. Other consumption accounted for elsewhere. Assume about 25% of passengers use restroom at station @ 1.5 gallons per use for flushing and faucet. Other passengers are through traffic.
Concessions	1000 sqft	15.4	300	4,620	SFPUC - Water Supply Assessment - Stadium Project (2014)
Laundry	lbs fabric cleaned	800	3.5	2,800	For washing staff uniforms, First Class linens etc, assume 800 lbs/day, Ref Alliance for Water Efficiency
First class lounge (inc. Kitchen & restrooms)	1000 sqft	11.5	500	5,750	Ref LA CEQA Thresholds Guide
Food preparation for train	Meals prepared	0	2	0	Assume minimal on-site preparation - some washing and cleaning
Cooling demand	1000 sqft cooled	360	140	50,400	All conditioned area in the station and parking structures
Rental Car washing	Cars washed	600	14	8,400	Assume 1800 cars - 1/3 washed per day - 50 gallons per wash and 72% recycled - http://www.carwashmag.com/issues/march-2013/water-treatment.cfm
Houston Terminal Subtotal				***100,900***	Equivalent to 3.3-gpd/passenger

Demand Element	Units	Units/d	Demand Factor g/Unit-d	Total Demand @ FSL (g/d)	Notes
Maintenance Facilities					
Dallas Train Maintenance Facility (TMF)					
Staff	work shifts/day	60	12	720	EPA Onsite Wastewater Treatment Systems Manual - February 2002 EPA/625/R-00/008
Cafeteria	# seats	120	30	3,600	LA CEQA Threshold Guide
Showers/Locker	staff using full shower facilities	30	12.5	375	Assume 50% of Maintenance Facility staff using shower/locker room daily (2.5 gallons per minute for 5 minutes/shower)
Cooling demand	1000 sqft cooled	15	140	2,100	Assumed conditioned area in office and workshop structures
Trainset Washing	train car washes/day	10	55	550	Assume cars washed every day, 56 gallons per train car based on 200 gallon per wash & 72% water savings by recycling - http://www.carwashmag.com/issues/march-2013/water-treatment.cfm
Water for trains	trains sets/day	10	1,225	12,250	Source: TCRR
Overhaul shop	process flow/day	1,500	1	1,500	
Houston Train Maintenance Facility (TMF)					
Staff	work shifts/day	60	12	720	EPA Onsite Wastewater Treatment Systems Manual - February 2002 EPA/625/R-00/008
Cafeteria	# seats	120	30	3,600	LA CEQA Threshold Guide
Showers/Locker	staff using full shower facilities	30	12.5	375	Assume 50% of Maintenance Facility staff using shower/locker room daily (2.5 gallons per minute for 5 minutes/shower)
Cooling demand	1000 sqft cooled	15	140	2,100	Assumed conditioned area in office and workshop structures
Trainset Washing	train car washes/day	10	55	550	Assume cars washed every day, 56 gallons per train car based on 200 gallon per wash & 72% water savings by recycling - http://www.carwashmag.com/issues/march-2013/water-treatment.cfm
Water for trains	trains sets/day	10	1,225	12,250	Source: TCRR
Overhaul shop	process flow/day	1,500	1	1,500	
TMF Subtotal				***42,190***	
Each Maintenance of Way Facility (MOW)					
Night Time Staff	work shifts/day	30	12	360	EPA Onsite Wastewater Treatment Systems Manual - February 2002 EPA/625/R-00/008
Day-time Staff	work shifts/day	10	12	120	EPA Onsite Wastewater Treatment Systems Manual - February 2002 EPA/625/R-00/009
Staff showers		40	12.5	500	Assume 100% of MOW staff use showers/lockers (2.5 gallons per minute for 5 minutes)
Maintenance of Way Facilities Subtotal				***6,860***	For 7 MOWs
TOTAL				***287,850***	

Appendix G

Culvert Crossings

GENERAL INFORMATION			PROPOSED HYDRAULIC STRUCTURE				HYDROLOGY INFORMATION	
STATION	**CROSSING NAME ID**	**COUNTY NAME**	**TYPE**	**NUMBER**	**HEIGHT**	**WIDTH**	**DRAINAGE AREA**	**100-YR PEAK FLOW[1]**
							(ac.)	(cfs)
HN1 999+05	HN1-CyC-03B	Harris	CULVERT-RCB	2	3	5	23.1	106
HN1 1012+73	HN1-CyC-03C	Harris	CULVERT-RCB	2	2	6	23.3	102
HN1 1041+63	HN1-CyC-03D	Harris	CULVERT-RCB	2	4	6	12.4	79
HN1 1046+61	HN1-CyC-03E	Harris	CULVERT-RCB	2	4	6	22.4	134
HN1 1073+69	HN1-CyC-04A	Harris	CULVERT-RCB	4	5	5	134.3	422
HN1 1086+98	HN1-CyC-04B	Harris	CULVERT-RCB	3	6	10	228.3	787
HN1 1120+69	HN1-CyC-05	Harris	CULVERT-RCB	3	6	7	106.4	442
HN1 1298+23	HN1-CyC-09	Harris	CULVERT-RCB	2	5	9	81.7	350
HN1 1331+57	HN1-CyC-10A	Harris	CULVERT-RCB	8	4	11	424.3	1,450
HN1 1336+76	HN1-CyC-10	Harris	CULVERT-RCB	8	3	7	64.6	675
HN1 1363+37	HN1-CyC-10B	Harris	CULVERT-RCB	3	4	12	32.4	560
HN1 1374+34	HN1-CyC-10C	Harris	CULVERT-RCB	2	6	12	24.4	625
HN1 1381+60	HN1-CyC-10D	Harris	CULVERT-RCB	2	6	12	22.9	620
HN1 1391+93	HN1-CyC-11	Harris	CULVERT-RCB	4	8	12	448.9	1,700
HN1 1424+85	HN1-CyC-12F	Harris	CULVERT-RCB	5	4	7	201.6	502
HN1 1439+41	HN1-CyC-12G	Harris	CULVERT-RCB	3	4	8	97.9	371
HN1 1451+24	HN1-CyC-13	Harris	CULVERT-RCB	6	9	12	1627.5	3,482
HN1 1475+27	HN1-CyC-14	Harris	CULVERT-RCB	4	10	10	788.5	1,851
HN1 1507+09	HN1-CyC-15	Harris	CULVERT-RCB	5	4	6	75.5	352
HN1 1518+39	HN1-CyC-15A	Harris	CULVERT-RCB	5	7	7	264.3	1,061
HN1 1559+92	HN1-CyC-15B	Harris	CULVERT-RCB	3	4	5	41.6	244
HN1 1577+55	HN1-CyC-15C	Harris	CULVERT-RCB	4	4	4	41.0	235
HN1 1939+85	HN1-WSC-03B	Harris	CULVERT-RCB	3	3	4	19.5	120
HN1 2049+37	HN1-WSC-06A	Waller	CULVERT-RCB	1	2	5	8.4	44
HN1 2302+85	HN1-WSC-11B	Waller	CULVERT-RCB	4	2	6	41.0	218
HN1 2365+52	HN1-WSC-11C	Waller	CULVERT-RCB	1	2	4	28.4	34
HN1 2373+80	HN1-WSC-11D	Waller	CULVERT-RCB	1	3	8	52.1	89
HN2 101+69	HN2-WSC-02B	Grimes	CULVERT-RCB	2	2	3	28.9	41
HN2 120+14	HN2-WSC-03	Grimes	CULVERT-RCB	2	2	4	40.5	66
HN2 139+05	HN2-WSC-03A	Grimes	CULVERT-RCB	1	2	3	13.3	25
HN2 147+28	HN2-WSC-04	Grimes	CULVERT-RCB	2	3	3	41.2	53
HN2 168+36	HN2-WSC-04A	Grimes	CULVERT-RCB	1	2	3	14.1	20
HN2 172+77	HN2-WSC-04B	Grimes	CULVERT-RCB	1	3	3	29.3	47
HN2 680+49	HN2-CLC-04A	Grimes	CULVERT-RCB	1	4	5	21.8	130
HN2 966+13	HN2-CLC-11A	Grimes	CULVERT-RCB	2	3	7	30.1	234
HN2 992+09	HN2-CLC-11	Grimes	CULVERT-RCB	2	3	7	31.4	245
HN2 1034+76	HN2-CLC-12A	Grimes	CULVERT-RCB	2	2	4	10.9	85
HN2 1213+99	HN2-RNR-02	Grimes	CULVERT-RCB	1	2	7	23.7	60

GENERAL INFORMATION			PROPOSED HYDRAULIC STRUCTURE				HYDROLOGY INFORMATION	
STATION	CROSSING NAME ID	COUNTY NAME	TYPE	NUMBER	HEIGHT	WIDTH	DRAINAGE AREA	100-YR PEAK FLOW[1]
							(ac.)	(cfs)
HN2 1233+33	HN2-RNR-03	Grimes	CULVERT-RCB	4	2	6	21.4	159
HN2 1325+09	HN2-RNR-06	Grimes	CULVERT-RCB	5	2	7	44.0	335
HN2 1498+86	HN2-GNR-05	Grimes	CULVERT-RCB	3	2	6	26.9	174
HN2 1642+35	HN2-GNR-11	Grimes	CULVERT-RCB	6	2	6	60.9	383
HN2 1830+29	HN2-SBC-01A	Grimes	CULVERT-RCB	6	2	4	32.3	207
HN2 1851+86	HN2-SBC-01	Grimes	CULVERT-RCB	5	4	5	97.6	570
WT 34+61	WT-CBC-02A	Grimes	CULVERT-RCB	2	2	6	16.9	95
WT 63+89	WT-CBC-03	Grimes	CULVERT-RCB	6	2	7	62.7	407
WT 76+47	WT-CBC-03A	Grimes	CULVERT-RCB	4	2	6	25.3	198
WT 292+30	WT-CBC-10A	Madison	CULVERT-RCB	3	2	5	14.4	98
WT 330+80	WT-CBC-12A	Madison	CULVERT-RCB	2	8	8	146.6	884
WT 591+42	WT-CBC-20	Madison	CULVERT-RCB	3	6	9	107.8	668
WT 1065+03	WT-CBC-31C	Leon	CULVERT-RCB	2	2	7	18.5	124
WT 1122+70	WT-CBC-31D	Leon	CULVERT-RCB	2	2	4	10.2	87
WT 1194+54	WT-CBC-33A	Leon	CULVERT-RCB	2	2	7	34.7	133
WT 1209+14	WT-CBC-33B	Leon	CULVERT-RCB	6	2	6	90.3	347
WT 1232+32	WT-BoC-01A	Leon	CULVERT-RCB	6	2	7	104.0	386
WT 1425+98	WT-BoC-07A	Leon	CULVERT-RCB	1	5	5	89.8	118
WT 1452+00	WT-BoC-07B	Leon	CULVERT-RCB	2	2	4	23.9	69
WT 1580+28	WT-BoC-09A	Leon	CULVERT-RCB	2	4	5	28.2	215
WT 1583+59	WT-BoC-09B	Leon	CULVERT-RCB	2	3	6	40.4	171
WT 1593+64	WT-BoC-09C	Leon	CULVERT-RCB	2	4	5	37.2	203
WT 2024+14	WT-DNR-11	Leon	CULVERT-RCB	3	4	6	100.3	389
WT 2109+09	WT-SNR-01C	Leon	CULVERT-RCB	1	4	4	17.9	74
WT 2370+99	WT-SNR-08A	Leon	CULVERT-RCB	3	3	7	58.0	207
WT 3032+30	WT-SNR-28A	Limestone	CULVERT-RCB	3	3	5	24.6	200
WT 3135+84	WT-SNR-29A	Limestone	CULVERT-RCB	4	3	5	36.2	275
WT 3395+80	WT-SNR-33B	Limestone	CULVERT-RCB	2	2	6	12.1	101
WT 3509+25	WT-SNR-35B	Freestone	CULVERT-RCB	4	3	8	50.0	418
WT 3522+08	WT-SNR-35A	Freestone	CULVERT-RCB	6	5	6	104.5	724
WT 3560+61	WT-CTC-01	Freestone	CULVERT-RCB	4	4	4	47.1	320
WT 3585+94	WT-CTC-02	Freestone	CULVERT-RCB	4	4	5	54.1	386
WT 3592+63	WT-CTC-02A	Freestone	CULVERT-RCB	3	3	3	13.6	112
WT 3665+27	WT-CTC-05	Freestone	CULVERT-RCB	6	5	5	139.8	869
WT 3693+42	WT-CTC-06	Freestone	CULVERT-RCB	4	4	4	43.1	324
WT 3754+61	WT-CTC-09	Freestone	CULVERT-RCB	4	2	3	14.4	107
IH1 34+80	IH1-CBC-02A	Grimes	CULVERT-RCB	2	2	5	16.9	95
IH1 63+87	IH1-CBC-03	Grimes	CULVERT-RCB	4	3	8	71.6	460

GENERAL INFORMATION			PROPOSED HYDRAULIC STRUCTURE				HYDROLOGY INFORMATION	
STATION	CROSSING NAME ID	COUNTY NAME	TYPE	NUMBER	HEIGHT	WIDTH	DRAINAGE AREA	100-YR PEAK FLOW[1]
							(ac.)	(cfs)
IH1 76+14	IH1-CBC-03A	Grimes	CULVERT-RCB	3	2	7	26.1	199
IH1 717+11	IH1-CBC-22C	Madison	CULVERT-RCB	5	2	7	68.5	307
IH1 736+48	IH1-CBC-22D	Madison	CULVERT-RCB	2	3	6	28.2	188
IH1 747+81	IH1-CBC-22E	Madison	CULVERT-RCB	4	2	6	33.1	209
IH1 899+72	IH1-CBC-27A	Madison	CULVERT-RCB	2	2	7	13.6	110
IH1 978+84	IH1-SBC-01A	Madison	CULVERT-RCB	4	2	6	24.0	164
IH1 1000+21	IH1-SBC-02	Madison	CULVERT-RCB	6	4	8	285.0	1,013
IH1 1054+37	IH1-BoC-01A	Madison	CULVERT-RCB	3	4	8	34.9	300
IH1 1325+29	IH1-BoC-06B	Leon	CULVERT-RCB	4	3	4	36.5	156
IH1 1713+15	IH1-LKC-01A	Leon	CULVERT-RCB	2	5	5	56.2	275
IH1 1735+55	IH1-LKC-02A	Leon	CULVERT-RCB	1	4	4	18.6	75
IH1 1849+15	IH1-LKC-04A	Leon	CULVERT-RCB	2	4	4	19.4	139
IH1 2059+73	IH1-LKC-09	Leon	CULVERT-RCB	2	7	7	152.1	655
IH1 2063+54	IH1-LKC-10	Leon	CULVERT-RCB	2	6	11	236.1	697
IH1 2226+12	IH1-BuC-01A	Leon	CULVERT-RCB	2	3	7	31.3	199
IH1 2282+55	IH1-BuC-02A	Leon	CULVERT-RCB	2	4	5	61.2	203
IH1 2567+50	IH1-BuC-09A	Leon	CULVERT-RCB	2	2	6	15.4	105
IH1 2891+12	IH1-BuC-15	Freestone	CULVERT-RCB	1	4	10	37.5	237
IH1 2894+93	IH1-BuC-15A	Freestone	CULVERT-RCB	1	4	10	37.5	237
IH1 3360+36	IH1-UKC-06A	Freestone	CULVERT-RCB	1	3	6	11.7	91
IH1 3852+80	IH1-CTC-05A	Freestone	CULVERT-RCB	5	2	6	34.2	281
IH1 3954+53	IH1-CTC-07A	Freestone	CULVERT-RCB	4	4	4	35.0	292
IH1 3963+78	IH1-CTC-07B	Freestone	CULVERT-RCB	4	4	4	42.8	352
IH1 3996+34	IH1-CTC-08	Freestone	CULVERT-RCB	3	4	4	33.5	269
IH1 4064+64	IH1-CTC-12	Freestone	CULVERT-RCB	4	4	4	45.7	332
NW 222+01	NW-ARC-05	Navarro	CULVERT-RCB	6	3	7	84.8	500
NW 514+05	NW-POC-07A	Navarro	CULVERT-RCB	3	2	4	14.3	96
NW 521+38	NW-POC-07	Navarro	CULVERT-RCB	5	7	7	384.6	1,305
NW 922+34	NW-PRC-09A	Navarro	CULVERT-RCB	2	2	7	16.6	127
NW 931+34	NW-PRC-09B	Navarro	CULVERT-RCB	1	5	4	13.2	102
NW 936+41	NW-PRC-09	Navarro	CULVERT-RCB	1	5	10	45.4	306
NW 962+44	NW-PRC-10	Navarro	CULVERT-RCB	3	5	10	131.0	661
NW 992+89	NW-PRC-11	Navarro	CULVERT-RCB	6	2	7	34.5	283
NW 1016+13	NW-PRC-11A	Navarro	CULVERT-RCB	5	2	7	38.6	263
NW 1018+50	NW-PRC-11B	Navarro	CULVERT-RCB	5	2	7	35.6	285
NW 1043+30	NW-PRC-11C	Navarro	CULVERT-RCB	6	3	8	109.7	683
NW 1051+17	NW-PRC-11D	Navarro	CULVERT-RCB	2	3	6	24.4	188
NW 1238+04	NW-LCC-01	Navarro	CULVERT-RCB	6	4	8	126.8	720

GENERAL INFORMATION			PROPOSED HYDRAULIC STRUCTURE				HYDROLOGY INFORMATION	
STATION	CROSSING NAME ID	COUNTY NAME	TYPE	NUMBER	HEIGHT	WIDTH	DRAINAGE AREA	100-YR PEAK FLOW[1]
							(ac.)	(cfs)
NW 1306+10	NW-LCC-02C	Navarro	CULVERT-RCB	3	2	6	22.3	170
NW 1397+47	NW-UCC-01	Navarro	CULVERT-RCB	3	4	8	58.2	431
NW 1403+67	NW-UCC-01C	Navarro	CULVERT-RCB	2	2	7	17.3	135
NW 1416+37	NW-UCC-01D	Navarro	CULVERT-RCB	2	3	4	10.2	80
NW 1428+98	NW-UCC-01E	Navarro	CULVERT-RCB	2	4	7	40.3	284
NW 1615+21	NW-UCC-05A	Ellis	CULVERT-RCB	4	2	4	23.7	155
NE 445+30	NE-POC-01	Navarro	CULVERT-RCB	2	4	4	17.1	133
NE 481+50	NE-ARC-08A	Navarro	CULVERT-RCB	1	9	12	109.9	833
NE 645+98	NE-PRC-02A	Navarro	CULVERT-RCB	2	4	11	63.3	495
NE 677+09	NE-PRC-02	Navarro	CULVERT-RCB	4	5	10	291.1	1,266
NE 715+88	NE-PRC-03	Navarro	CULVERT-RCB	5	3	8	119.5	467
NE 769+17	NE-PRC-05	Navarro	CULVERT-RCB	6	3	7	200.0	666
NE 969+11	NE-PRC-10	Navarro	CULVERT-RCB	3	2	7	24.8	196
NE 1175+01	NE-PRC-18	Navarro	CULVERT-RCB	6	2	6	39.4	318
NE 1190+03	NE-PRC-19	Navarro	CULVERT-RCB	4	4	9	82.6	572
NE 1206+54	NE-PRC-20	Navarro	CULVERT-RCB	5	2	7	27.5	221
NE 1243+72	NE-LCC-01	Navarro	CULVERT-RCB	3	3	4	24.3	188
NE 1607+13	NE-UCC-04	Navarro	CULVERT-RCB	6	5	10	753.4	1,849
IH2 31+15	IH2-CTC-01A	Navarro	CULVERT-RCB	3	4	9	57.4	418
IH2 53+29	IH2-ARC-01	Navarro	CULVERT-RCB	2	6	9	136.4	722
IH2 118+24	IH2-ARC-03A	Navarro	CULVERT-RCB	5	2	7	32.0	242
IH2 181+28	IH2-ARC-05A	Navarro	CULVERT-RCB	2	7	7	49.1	384
IH2 393+07	IH2-ARC-11	Navarro	CULVERT-RCB	1	3	4	7.4	60
IH2 403+25	IH2-ARC-11A	Navarro	CULVERT-RCB	3	3	6	36.6	286
IH2 417+49	IH2-ARC-11B	Navarro	CULVERT-RCB	3	6	6	102.7	578
EW 217+48	EW-WaC-03B	Ellis	CULVERT-RCB	5	3	7	67.4	393
EW 223+65	EW-WaC-03	Ellis	CULVERT-RCB	2	4	7	50.4	333
EW 258+95	EW-WaC-03E	Ellis	CULVERT-RCB	3	2	6	27.2	204
EW 277+61	EW-WaC-04A	Ellis	CULVERT-RCB	6	2	6	66.8	344
EW 725+15	EW-RoC-02A	Ellis	CULVERT-RCB	4	4	4	61.0	266
EW 748+73	EW-RoC-02B	Ellis	CULVERT-RCB	5	4	4	60.3	299
EW 870+81	EW-RoC-05A	Ellis	CULVERT-RCB	4	3	7	16.7	94
EW 940+41	EW-RoC-06B	Ellis	CULVERT-RCB	2	4	8	67.9	244
EW 956+82	EW-RoC-06C	Ellis	CULVERT-RCB	3	2	6	20.9	124
EE 124+70	EE-WaC-04B	Ellis	CULVERT-RCB	4	3	6	45.3	259
EE 137+18	EE-WaC-05A	Ellis	CULVERT-RCB	3	2	7	24.0	184
EE 427+96	EE-WaC-14A	Ellis	CULVERT-RCB	5	2	6	59.5	251
EE 484+26	EE-WaC-14B	Ellis	CULVERT-RCB	4	3	5	65.2	313

GENERAL INFORMATION			PROPOSED HYDRAULIC STRUCTURE				HYDROLOGY INFORMATION	
STATION	CROSSING NAME ID	COUNTY NAME	TYPE	NUMBER	HEIGHT	WIDTH	DRAINAGE AREA	100-YR PEAK FLOW[1]
							(ac.)	(cfs)
EE 498+83	EE-WaC-14C	Ellis	CULVERT-RCB	5	2	6	30.1	209
EE 710+60	EE-RoC-04A	Ellis	CULVERT-RCB	3	3	7	62.9	307
EE 726+35	EE-RoC-04B	Ellis	CULVERT-RCB	3	2	6	21.3	116
EE 917+89	EE-RoC-12B	Ellis	CULVERT-RCB	2	4	9	85.2	398
EE 939+98	EE-RoC-13A	Ellis	CULVERT-RCB	4	3	7	77.7	307
EE 1030+50	EE-RoC-13B	Ellis	CULVERT-RCB	2	5	5	37.4	273
EE 1040+90	EE-RoC-13C	Ellis	CULVERT-RCB	1	4	4	13.5	84
DS 225+75	DS-TTR-02A	Dallas	CULVERT-RCB	2	2	5	14.6	96
DS 279+00	DS-TTR-02B	Dallas	CULVERT-RCB	3	7	9	280.0	1,100
DS 340+00	DS-TTR-02C	Dallas	CULVERT-RCB	1	3	7	13.0	90

NOTES:
1. All peak flows shown are approximate.

Appendix H

Viaduct Crossings

GENERAL INFORMATION				FEMA INFORMATION			HYDROLOGY & HYDRAULICS INFORMATION			
					FEMA FLOODPLAIN EXTENTS			100-YR PEAK	100-YR	Approx. 100-
STATION	CROSSING NAME ID	STREAM NAME[1]	COUNTY	FEMA ZONE	FROM STA	TO STA	DRAINAGE AREA	FLOW[2]	FEMA BFE[3]	YR WSE[4]
							(ac.)	(cfs)	(ft.)	(ft.)
HN1 107+75	HN1-WBB-01	E115-00-00 (Brickhouse Gully)	Harris	AE	104+52	114+24	not calc.	not calc.	74.73	N/A
HN1 257+52	HN1-WBB-02	E117-06-00	Harris	None			not calc.	not calc.	N/A	not calc.
HN1 314+89	HN1-WBB-03	E117-07-00	Harris	None			not calc.	not calc.	N/A	not calc.
HN1 353+75	HN1-WBB-04	E117-00-00 (Cole Creek)	Harris	AE	332+31	361+23	not calc.	not calc.	98.00	N/A
HN1 477+58	HN1-WBB-05	E127-00-00 (Tributary 19.05 to White Oak Bayou)	Harris	AE	477+06	478+50	not calc.	not calc.	108.26	N/A
HN1 536+12	HN1-WBB-06	E135-00-00 (Tributary 19.82 to White Oak Bayou)	Harris	None			not calc.	not calc.	N/A	not calc.
HN1 973+13	HN1-CyC-03A	Unnamed Stream	Harris	None			27	150	N/A	not calc.
HN1 873+17	HN1-CyC-01	K100-00-00 (Cypress Creek)	Harris	AE	862+97	905+78	16,597	18,626	140.41	N/A
HN1 894+00	HN1-CyC-02	K148-00-00	Harris	AE	862+97	905+78	124	442	140.41	N/A
HN1 1029+00	HN1-CyC-03	K152-00-00 (Tributary 37.1 to Cypress Creek)	Harris	AE	1028+89	1029+39	25	125	151.00	not calc.
HN1 1051+20	HN1-CyC-04	K159-00-00 (Channel A to Cypress Creek)	Harris	AE	1050+54	1052+07	2,477	6,006	152.01	N/A
HN1 1137+20	HN1-CyC-05A	Unnamed Stream	Harris	None			366	1,127	N/A	not calc.
HN1 1155+87	HN1-CyC-06	Unnamed Stream	Harris	None			626	1,845	N/A	not calc.
HN1 1190+43	HN1-CyC-07	Unnamed Stream	Harris	None			54	244	N/A	not calc.
HN1 1228+37	HN1-CyC-08	K155-00-00 (Tributary 40.7 to Cypress Creek)	Harris	AE	1227+35	1229+23	1,224	2,864	182.85	N/A
HN1 1249+13	HN1-CyC-09A	Unnamed Stream	Harris	None			86	370	N/A	not calc.
HN1 1253+28	HN1-CyC-09B	Unnamed Stream	Harris	None			44	270	N/A	not calc.
HN1 1261+83	HN1-CyC-09C	Unnamed Stream	Harris	None			218	644	N/A	not calc.
HN1 1290+28	HN1-CyC-09D	Unnamed Stream	Harris	None			207	716	N/A	not calc.
HN1 1401+64	HN1-CyC-12D	Unnamed Stream	Harris	None			125	390	N/A	not calc.
HN1 1405+06	HN1-CyC-12E	Unnamed Stream	Harris	None			64	294	N/A	not calc.
HN1 1597+21	HN1-CyC-15D	Unnamed Stream	Harris	None			27	172	N/A	not calc.
HN1 1642+37	HN1-CyC-15F	Unnamed Stream	Harris	None			531	1,411	N/A	not calc.
HN1 1668+02	HN1-CyC-15H	Unnamed Stream	Harris	None			13	84	N/A	not calc.
HN1 1676+07	HN1-CyC-15I	Unnamed Stream	Harris	None			38	235	N/A	not calc.
HN1 1687+71	HN1-CyC-15J	Unnamed Stream	Harris	None			373	1,381	N/A	not calc.
HN1 1723+80	HN1-CyC-15K	Unnamed Stream	Harris	None			95	325	N/A	not calc.
HN1 1736+85	HN1-CyC-15L	Unnamed Stream	Harris	None			42	197	N/A	not calc.
HN1 1760+85	HN1-WSC-01B	Unnamed Stream	Harris	None			45	254	N/A	not calc.
HN1 1776+62	HN1-WSC-01C	Unnamed Stream	Harris	None			38	242	N/A	not calc.
HN1 1789+34	HN1-WSC-01D	Unnamed Stream	Harris	None			28	174	N/A	not calc.
HN1 1798+72	HN1-WSC-01	J158-01-00	Harris	None			1,292	3,488	N/A	259.45
HN1 1833+66	HN1-WSC-02	J158-00-00 (Kickapoo Creek)	Harris	AE	1830+69	1839+38	3,211	6,712	251.90	N/A
HN1 1915+79	HN1-WSC-03	J100-00-00 (Spring Creek)	Harris	AE	1909+00	1928+16	7,942	11,434	248.10	N/A
HN1 1926+36	HN1-WSC-04	J100-00-00 (Spring Creek)	Harris	AE	1909+00	1928+16	1,414	3,135	248.10	N/A
HN1 1965+19	HN1-WSC-05	Unnamed Stream	Waller	None			128	547	N/A	not calc.
HN1 2003+31	HN1-WSC-06	Unnamed Stream	Waller	None			280	1,074	N/A	not calc.
HN1 2076+33	HN1-WSC-07	Unnamed Stream	Waller	None			186	854	N/A	270.00
HN1 2107+97	HN1-WSC-08	Unnamed Stream	Waller	AE	2105+37	2127+98	139	640	259.00	N/A
HN1 2111+45	HN1-WSC-09	Threemile Creek	Waller	AE	2105+37	2127+98	10,251	13,009	259.00	N/A
HN1 2180+73	HN1-WSC-10	Brushy Creek	Waller	AE	2179+26	2189+85	4,517	5,802	273.00	N/A
HN1 2254+52	HN1-WSC-11	Walnut Creek	Waller	AE	2250+39	2260+85	10,138	4,611	253.00	N/A
HN2 40+14	HN2-WSC-01B	Unnamed Stream	Grimes	None			3,572	3,120	N/A	290.25
HN2 67+00	HN2-WSC-01	Unnamed Stream	Grimes	None			3,232	1,668	N/A	290.25

GENERAL INFORMATION				FEMA INFORMATION			HYDROLOGY & HYDRAULICS INFORMATION			
					FEMA FLOODPLAIN EXTENTS			100-YR PEAK	100-YR	Approx. 100-
STATION	CROSSING NAME ID	STREAM NAME[1]	COUNTY	FEMA ZONE	FROM STA	TO STA	DRAINAGE AREA	FLOW[2]	FEMA BFE[3]	YR WSE[4]
							(ac.)	(cfs)	(ft.)	(ft.)
HN2 67+89	HN2-WSC-02	Unnamed Stream	Grimes	None			3,232	1,645	N/A	299.19
HN2 184+74	HN2-WSC-04C	Unnamed Stream	Grimes	None			39	66	N/A	not calc.
HN2 222+74	HN2-WSC-05	Unnamed Stream	Grimes	None			154	533	N/A	not calc.
HN2 284+53	HN2-WSC-06	Unnamed Stream	Grimes	A	283+41	287+47	2,009	2,582	330.00	N/A
HN2 285+91	HN2-WSC-07	Kickapoo Creek	Grimes	A	283+41	287+47	2,009	2,582	330.00	N/A
HN2 339+49	HN2-WSC-08A	Unnamed Stream	Grimes	None			42	181	N/A	not calc.
HN2 369+33	HN2-WSC-08	Hurricane Creek	Grimes	A	367+06	372+65	1,639	3,340	332.00	N/A
HN2 432+94	HN2-WSC-09	Unnamed Stream	Grimes	None			190	761	N/A	not calc.
HN2 436+47	HN2-WSC-09B	Unnamed Stream	Grimes	None			139	751	N/A	not calc.
HN2 445+35	HN2-WSC-09C	Unnamed Stream	Grimes	None			32	204	N/A	not calc.
HN2 500+11	HN2-CLC-01	Sand Creek	Grimes	A	495+20	501+22	737	2,862	331.00	N/A
HN2 547+46	HN2-CLC-02B	Unnamed Stream	Grimes	None			35	267	N/A	not calc.
HN2 585+65	HN2-CLC-02	Unnamed Stream	Grimes	None			638	2,612	N/A	296.44
HN2 612+94	HN2-CLC-03	Unnamed Stream	Grimes	A	607+91	615+36	728	2,572	285.50	N/A
HN2 625+44	HN2-CLC-04	Caney Creek	Grimes	A	620+40	631+67	5,248	8,804	285.50	N/A
HN2 703+98	HN2-CLC-04B	Unnamed Stream	Grimes	None			36	264	N/A	not calc.
HN2 763+19	HN2-CLC-05	Unnamed Stream	Grimes	None			160	435	N/A	not calc.
HN2 783+44	HN2-CLC-06	Unnamed Stream	Grimes	A	783+18	784+27	135	351	323.00	N/A
HN2 788+24	HN2-CLC-07	Haynie Creek	Grimes	A	787+13	790+37	1,468	4,130	322.50	N/A
HN2 807+90	HN2-CLC-08	Unnamed Stream	Grimes	None			28	88	N/A	not calc.
HN2 849+88	HN2-CLC-09	Unnamed Stream	Grimes	None			94	606	N/A	not calc.
HN2 873+55	HN2-CLC-10	Bums Creek	Grimes	None			1,007	3,685	N/A	339.78
HN2 1002+37	HN2-CLC-12	Unnamed Stream	Grimes	None			1,063	3,735	N/A	354.12
HN2 1070+89	HN2-CLC-13	Unnamed Stream	Grimes	None			106	763	N/A	not calc.
HN2 1082+01	HN2-CLC-14	Unnamed Stream	Grimes	None			259	1,137	N/A	not calc.
HN2 1103+20	HN2-CLC-15	Unnamed Stream	Grimes	None			231	1,079	N/A	not calc.
HN2 1110+56	HN2-CLC-16	Unnamed Stream	Grimes	None			79	558	N/A	not calc.
HN2 1157+99	HN2-CLC-17	Unnamed Stream	Grimes	None			166	962	N/A	not calc.
HN2 1163+48	HN2-CLC-17A	Unnamed Stream	Grimes	None			19	137	N/A	not calc.
HN2 1193+90	HN2-RNR-01	Unnamed Stream	Grimes	None			129	746	N/A	not calc.
HN2 1252+03	HN2-RNR-04	Rocky Creek	Grimes	None			720	2,595	N/A	321.68
HN2 1285+03	HN2-RNR-05A	Unnamed Stream	Grimes	None			757	2,841	N/A	328.74
HN2 1374+02	HN2-GNR-01	Unnamed Stream	Grimes	None			25	99	N/A	not calc.
HN2 1424+29	HN2-GNR-02	Unnamed Stream	Grimes	None			26	147	N/A	not calc.
HN2 1446+41	HN2-GNR-03	Unnamed Stream	Grimes	A	1438+20	1447+18	1,172	1,727	306.00	N/A
HN2 1468+46	HN2-GNR-04	Sulphur Creek	Grimes	A	1460+12	1472+29	6,348	10,013	295.00	N/A
HN2 1543+39	HN2-GNR-06	Unnamed Stream	Grimes	None			83	431	N/A	not calc.
HN2 1559+22	HN2-GNR-07	Cat Creek	Grimes	A	1551+65	1562+40	1,708	3,686	317.50	N/A
HN2 1580+74	HN2-GNR-08	Unnamed Stream	Grimes	None			111	436	N/A	not calc.
HN2 1594+12	HN2-GNR-09	Unnamed Stream	Grimes	None			113	438	N/A	not calc.
HN2 1618+10	HN2-GNR-10	Unnamed Stream	Grimes	None			263	967	N/A	not calc.
HN2 1665+71	HN2-GNR-12	Unnamed Stream	Grimes	None			23	139	N/A	not calc.
HN2 1680+20	HN2-GNR-13	Unnamed Stream	Grimes	None			495	2,404	N/A	309.24

GENERAL INFORMATION				FEMA INFORMATION			HYDROLOGY & HYDRAULICS INFORMATION			
					FEMA FLOODPLAIN EXTENTS			100-YR PEAK	100-YR	Approx. 100-
STATION	CROSSING NAME ID	STREAM NAME[1]	COUNTY	FEMA ZONE	FROM STA	TO STA	DRAINAGE AREA	FLOW[2]	FEMA BFE[3]	YR WSE[4]
							(ac.)	(cfs)	(ft.)	(ft.)
HN2 1693+22	HN2-GNR-14	Unnamed Stream	Grimes	None			70	378	N/A	not calc.
HN2 1696+11	HN2-GNR-14A	Unnamed Stream	Grimes	None			19	67	N/A	not calc.
HN2 1738+31	HN2-GNR-15	Unnamed Stream	Grimes	None			416	1,688	N/A	not calc.
HN2 1748+95	HN2-GNR-16	Unnamed Stream	Grimes	None			142	726	N/A	not calc.
HN2 1757+92	HN2-GNR-16A	Unnamed Stream	Grimes	None			41	191	N/A	not calc.
HN2 1789+52	HN2-GNR-17	Unnamed Stream	Grimes	None			287	1,380	N/A	not calc.
HN2 1818+78	HN2-GNR-18	Unnamed Stream	Grimes	None			26	154	N/A	not calc.
HN2 1885+81	HN2-SBC-02A	Unnamed Stream	Grimes	None			14	104	N/A	not calc.
HN2 1888+94	HN2-SBC-02	Unnamed Stream	Grimes	None			64	397	N/A	not calc.
HN2 1894+40	HN2-SBC-03	Unnamed Stream	Grimes	None			40	290	N/A	not calc.
HN2 1917+28	HN2-SBC-03A	Unnamed Stream	Grimes	None			10	217	N/A	not calc.
HN2 1958+08	HN2-CBC-01	Unnamed Stream	Grimes	None			74	531	N/A	not calc.
HN2 1967+87	HN2-CBC-01A	Unnamed Stream	Grimes	None			79	522	N/A	not calc.
HN2 1988+20	HN2-CBC-01B	Unnamed Stream	Grimes	None			39	244	N/A	not calc.
HN2 1991+60	HN2-CBC-01C	Unnamed Stream	Grimes	None			12	89	N/A	not calc.
HN2 2052+04	HN2-CBC-02	Panky Creek	Grimes	A	2045+59	2063+34	2,068	5,652	294.00	N/A
HN2 2059+54	HN2-CBC-03	Panky Creek	Grimes	A	2045+59	2063+34	34	264	294.00	N/A
WT 17+89	WT-CBC-01	Unnamed Stream	Grimes	A	10+14	19+39	106	625	289.00	N/A
WT 42+94	WT-CBC-02	Unnamed Stream	Grimes	None			261	1,333	N/A	296.00
WT 90+85	WT-CBC-04	Unnamed Stream	Grimes	None			139	765	N/A	not calc.
WT 101+53	WT-CBC-05	Unnamed Stream	Grimes	None			57	318	N/A	not calc.
WT 120+83	WT-CBC-06A	Unnamed Stream	Grimes	None			16	109	N/A	not calc.
WT 143+02	WT-CBC-07	Unnamed Stream	Grimes	A	125+32	228+15	83	432	260.00	N/A
WT 189+01	WT-CBC-08	Bedias Creek	Madison	A	125+32	228+15	29,104	28,899	260.00	N/A
WT 250+91	WT-CBC-09	Unnamed Stream	Madison	None			1,284	3,568	N/A	not calc.
WT 269+69	WT-CBC-10	Unnamed Stream	Madison	None			44	320	N/A	not calc.
WT 311+22	WT-CBC-11	Unnamed Stream	Madison	None			46	339	N/A	not calc.
WT 340+05	WT-CBC-12	Unnamed Stream	Madison	None			163	984	N/A	not calc.
WT 354+39	WT-CBC-13	Kickapoo Creek	Madison	None			14,690	17,516	N/A	272.00
WT 384+13	WT-CBC-14A	Unnamed Stream	Madison	None			27	147	N/A	not calc.
WT 392+98	WT-CBC-14B	Unnamed Stream	Madison	None			56	296	N/A	not calc.
WT 397+61	WT-CBC-14	Unnamed Stream	Madison	None			40	271	N/A	not calc.
WT 487+17	WT-CBC-15A	Unnamed Stream	Madison	None			28	231	N/A	not calc.
WT 494+38	WT-CBC-15B	Unnamed Stream	Madison	None			19	158	N/A	not calc.
WT 508+55	WT-CBC-15	Unnamed Stream	Madison	None			28	207	N/A	not calc.
WT 512+33	WT-CBC-16	Unnamed Stream	Madison	None			421	1,701	N/A	not calc.
WT 541+54	WT-CBC-17	Unnamed Stream	Madison	None			75	531	N/A	not calc.
WT 549+74	WT-CBC-18	Iron Creek	Madison	None			10,391	11,395	N/A	300.17
WT 566+98	WT-CBC-19	Unnamed Stream	Madison	None			76	419	N/A	not calc.
WT 623+39	WT-CBC-21	Unnamed Stream	Madison	None			258	1,117	N/A	not calc.
WT 650+27	WT-CBC-22	Unnamed Stream	Madison	None			91	540	N/A	not calc.
WT 731+00	WT-CBC-23	Unnamed Stream	Madison	None			1,186	3,912	N/A	306.72
WT 776+31	WT-CBC-24	Brushy Creek	Madison	A	776+00	785+91	1,318	3,175	313.50	N/A

GENERAL INFORMATION				FEMA INFORMATION			HYDROLOGY & HYDRAULICS INFORMATION			
					FEMA FLOODPLAIN EXTENTS			100-YR PEAK	100-YR	Approx. 100-
STATION	CROSSING NAME ID	STREAM NAME[1]	COUNTY	FEMA ZONE	FROM STA	TO STA	DRAINAGE AREA	FLOW[2]	FEMA BFE[3]	YR WSE[4]
							(ac.)	(cfs)	(ft.)	(ft.)
WT 778+83	WT-CBC-25	Unnamed Stream	Madison	A	776+00	785+91	324	1,126	313.50	N/A
WT 808+17	WT-CBC-25A	Unnamed Stream	Madison	None			53	288	N/A	not calc.
WT 864+62	WT-CBC-26	Unnamed Stream	Madison	A	864+00	866+97	203	1,042	334.50	N/A
WT 900+21	WT-CBC-27	Caney Creek	Madison	A	894+87	906+67	8,448	10,229	310.00	N/A
WT 941+59	WT-CBC-28	Salt Creek	Madison	A	940+40	944+50	2,134	4,734	323.00	N/A
WT 955+52	WT-CBC-30	Unnamed Stream	Madison	None			192	828	N/A	not calc.
WT 1002+53	WT-CBC-30A	Unnamed Stream	Leon	None			97	592	N/A	not calc.
WT 1040+56	WT-CBC-31	East Caney Creek	Leon	None			9,076	9,969	N/A	349.18
WT 1155+79	WT-CBC-32	Unnamed Stream	Leon	None			282	936	N/A	not calc.
WT 1257+38	WT-BoC-01	Yellow Branch	Leon	None			108	541	N/A	not calc.
WT 1264+37	WT-BoC-02	Unnamed Stream	Leon	None			115	686	N/A	not calc.
WT 1285+79	WT-BoC-03	Unnamed Stream	Leon	None			13	89	N/A	310.40
WT 1306+76	WT-BoC-04	Unnamed Stream	Leon	None			126	645	N/A	not calc.
WT 1334+12	WT-BoC-05	Unnamed Stream	Leon	None			417	1,093	N/A	not calc.
WT 1364+55	WT-BoC-06	Unnamed Stream	Leon	None			1,128	2,500	N/A	341.30
WT 1371+19	WT-BoC-07	Boggy Creek	Leon	None			5,895	5,673	N/A	341.30
WT 1519+94	WT-BoC-08	Unnamed Stream	Leon	None			298	875	N/A	not calc.
WT 1553+20	WT-BoC-09	Spring Creek	Leon	None			5,187	6,514	N/A	371.70
WT 1605+08	WT-BoC-10	Unnamed Stream	Leon	None			128	601	N/A	not calc.
WT 1625+78	WT-BoC-11	Unnamed Stream	Leon	None			246	901	N/A	not calc.
WT 1629+64	WT-BoC-11A	Unnamed Stream	Leon	None			67	409	N/A	not calc.
WT 1658+90	WT-BoC-12A	Unnamed Stream	Leon	None			33	207	N/A	not calc.
WT 1664+49	WT-BoC-12	Spring Creek	Leon	None			1,164	3,172	N/A	not calc.
WT 1694+42	WT-BoC-12B	Unnamed Stream	Leon	None			29	213	N/A	not calc.
WT 1746+53	WT-DNR-01	Unnamed Stream	Leon	None			61	174	N/A	not calc.
WT 1771+26	WT-DNR-01A	Unnamed Stream	Leon	None			32	167	N/A	not calc.
WT 1802+71	WT-DNR-02	Unnamed Stream	Leon	None			101	482	N/A	not calc.
WT 1808+55	WT-DNR-03	Little Brushy Creek	Leon	None			238	1,397	N/A	not calc.
WT 1824+97	WT-DNR-04	Little Brushy Creek	Leon	None			368	1,641	N/A	not calc.
WT 1829+71	WT-DNR-05	Little Brushy Creek	Leon	None			379	1,714	N/A	not calc.
WT 1894+45	WT-DNR-06	Unnamed Stream	Leon	None			299	678	N/A	not calc.
WT 1917+18	WT-DNR-07	Little Brushy Creek	Leon	None			578	1,029	N/A	not calc.
WT 1925+06	WT-DNR-08	Unnamed Stream	Leon	None			4,438	6,592	N/A	384.62
WT 1964+98	WT-DNR-09	Unnamed Stream	Leon	A	1957+38	1979+78	105	58	390.00	N/A
WT 1973+96	WT-DNR-10	Brushy Creek	Leon	A	1957+38	1979+78	7,851	7,856	390.00	N/A
WT 2037+11	WT-DNR-12	Unnamed Stream	Leon	None			223	721	N/A	not calc.
WT 2058+48	WT-DNR-13	Cedar Creek	Leon	None			406	1,357	N/A	not calc.
WT 2075+56	WT-DNR-14	Unnamed Stream	Leon	None			151	584	N/A	not calc.
WT 2130+50	WT-SNR-01A	Unnamed Stream	Leon	None			33	242	N/A	not calc.
WT 2158+07	WT-SNR-01	Unnamed Stream	Leon	None			817	2,380	N/A	not calc.
WT 2184+37	WT-SNR-02	Birch Creek	Leon	A	2179+02	2185+96	2,842	4,436	408.65	N/A
WT 2207+87	WT-SNR-03	Unnamed Stream	Leon	None			145	499	N/A	not calc.
WT 2218+59	WT-SNR-04	Unnamed Stream	Leon	None			1,033	2,768	N/A	not calc.

GENERAL INFORMATION				FEMA INFORMATION			HYDROLOGY & HYDRAULICS INFORMATION			
					FEMA FLOODPLAIN EXTENTS			100-YR PEAK	100-YR	Approx. 100-
STATION	CROSSING NAME ID	STREAM NAME[1]	COUNTY	FEMA ZONE	FROM STA	TO STA	DRAINAGE AREA	FLOW[2]	FEMA BFE[3]	YR WSE[4]
							(ac.)	(cfs)	(ft.)	(ft.)
WT 2258+28	WT-SNR-05	Unnamed Stream	Leon	None			206	914	N/A	not calc.
WT 2333+77	WT-SNR-06	Mine Creek	Leon	None			440	512	N/A	not calc.
WT 2415+05	WT-SNR-09	Unnamed Stream	Leon	None			17	69	N/A	not calc.
WT 2432+90	WT-SNR-10	Lambs Creek	Limestone	A	2430+39	2442+11	14,617	12,795	370.50	N/A
WT 2434+55	WT-SNR-11	Unnamed Stream	Limestone	A	2430+39	2442+11	14,617	12,795	370.50	N/A
WT 2441+22	WT-SNR-12	Unnamed Stream	Limestone	A	2430+39	2442+11	14,617	12,795	370.50	N/A
WT 2491+40	WT-SNR-13	Unnamed Stream	Limestone	None			24	159	N/A	not calc.
WT 2513+49	WT-SNR-14	Unnamed Stream	Limestone	None			449	523	N/A	not calc.
WT 2587+17	WT-SNR-15	Unnamed Stream	Limestone	None			53	287	N/A	not calc.
WT 2598+42	WT-SNR-16	Unnamed Stream	Limestone	None			763	2,353	N/A	not calc.
WT 2653+36	WT-SNR-17	Unnamed Stream	Limestone	A	2641+56	2656+69	25,788	17,051	375.00	N/A
WT 2668+71	WT-SNR-18	Unnamed Stream	Limestone	A	2665+91	2678+09	25,788	17,051	380.5-381.5	N/A
WT 2702+12	WT-SNR-20	Unnamed Stream	Limestone	None			223	722	N/A	not calc.
WT 2767+85	WT-SNR-21	Unnamed Stream	Limestone	None			152	588	N/A	not calc.
WT 2822+59	WT-SNR-22	Big Elm Creek	Limestone	A	2814+12	2836+39	64,510	38,240	374.00	N/A
WT 2829+88	WT-SNR-23	Unnamed Stream	Limestone	A	2814+12	2836+39	64,510	38,240	374.00	N/A
WT 2861+75	WT-SNR-24	Unnamed Stream	Limestone	A	2858+76	2862+76	374	1,692	380.00	N/A
WT 2898+62	WT-SNR-25	Unnamed Stream	Limestone	None			72	512	N/A	not calc.
WT 2919+21	WT-SNR-26	Unnamed Stream	Limestone	A	2918+27	2921+60	941	2,523	393.40	N/A
WT 2920+49	WT-SNR-27	Unnamed Stream	Limestone	A	2918+27	2921+60	941	2,523	392.00	N/A
WT 2968+22	WT-SNR-27A	Unnamed Stream	Limestone	A	2964+79	2974+09	1,769	3,980	403.00	N/A
WT 2972+25	WT-SNR-27B	Unnamed Stream	Limestone	A	2964+79	2974+09	127	651	401.00	N/A
WT 2989+35	WT-SNR-27C	Unnamed Stream	Limestone	None			59	210	N/A	not calc.
WT 3019+61	WT-SNR-27D	Unnamed Stream	Limestone	None			60	170	N/A	not calc.
WT 3056+00	WT-SNR-28	Unnamed Stream	Limestone	A	3053+30	3054+99	3,445	5,118	410.70	N/A
WT 3164+43	WT-SNR-29	Unnamed Stream	Freestone	None			10,275	11,268	N/A	405.41
WT 3184+76	WT-SNR-30B	Unnamed Stream	Limestone	None			20	150	N/A	not calc.
WT 3220+00	WT-SNR-30C	Unnamed Stream	Limestone	None			48	317	N/A	not calc.
WT 3264+70	WT-SNR-31	Patton Creek	Freestone	None			13,348	16,994	N/A	423.35
WT 3267+13	WT-SNR-32	Patton Creek	Freestone	None			13,348	16,994	N/A	423.35
WT 3322+32	WT-SNR-32A	Unnamed Stream	Limestone	None			20	146	N/A	not calc.
WT 3338+30	WT-SNR-33A	Unnamed Stream	Limestone	None			32	253	N/A	not calc.
WT 3355+00	WT-SNR-33	Unnamed Stream	Limestone	None			153	999	N/A	485.81
WT 3417+15	WT-SNR-34	Unnamed Stream	Limestone	None			257	1,355	N/A	500.00
WT 3455+41	WT-SNR-35	Unnamed Stream	Freestone	None			687	2,330	N/A	not calc.
WT 3624+16	WT-CTC-03	Unnamed Stream	Freestone	None			1,030	2,762	N/A	not calc.
WT 3633+64	WT-CTC-04	Unnamed Stream	Freestone	None			186	1,062	N/A	not calc.
WT 3711+14	WT-CTC-07	Little Tehuacana Creek	Freestone	None			5,563	10,696	N/A	415.24
WT 3718+35	WT-CTC-08	Unnamed Stream	Freestone	None			276	1,261	N/A	415.24
WT 3770+52	WT-CTC-10	Unnamed Stream	Freestone	None			47	351	N/A	not calc.
WT 3778+76	WT-CTC-11	Unnamed Stream	Freestone	None			289	1,343	N/A	not calc.
WT 3796+59	WT-CTC-12	Unnamed Stream	Freestone	None			19	149	N/A	not calc.
WT 3827+85	WT-CTC-12A	Unnamed Stream	Freestone	None			19	150	N/A	not calc.

GENERAL INFORMATION				FEMA INFORMATION			HYDROLOGY & HYDRAULICS INFORMATION			
					FEMA FLOODPLAIN EXTENTS			100-YR PEAK	100-YR	Approx. 100-
STATION	CROSSING NAME ID	STREAM NAME[1]	COUNTY	FEMA ZONE	FROM STA	TO STA	DRAINAGE AREA	FLOW[2]	FEMA BFE[3]	YR WSE[4]
							(ac.)	(cfs)	(ft.)	(ft.)
WT 3884+73	WT-CTC-13	Unnamed Stream	Freestone	None			41,814	38,659	N/A	363.71
WT 3899+40	WT-CTC-14	Tehuacana Creek	Freestone	None			41,814	38,659	N/A	363.71
WT 3945+28	WT-CTC-15	Jackson Branch	Freestone	None			1,886	4,245	N/A	not calc.
WT 3980+57	WT-CTC-16	Unnamed Stream	Freestone	None			229	966	N/A	not calc.
WT 4002+30	WT-CTC-17	Unnamed Stream	Freestone	None			122	765	N/A	not calc.
WT 4013+06	WT-CTC-17A	Unnamed Stream	Freestone	None			31	248	N/A	not calc.
WT 4031+16	WT-CTC-18	Unnamed Stream	Freestone	None			89	576	N/A	not calc.
WT 4036+24	WT-CTC-18A	Unnamed Stream	Freestone	None			160	1,055	N/A	not calc.
WT 4087+16	WT-CTC-19	Unnamed Stream	Freestone	None			388	1,818	N/A	not calc.
WT 4092+08	WT-CTC-20	Cedar Creek	Freestone	None			9,598	13,798	N/A	not calc.
IH1 17+89	IH1-CBC-01	Unnamed Stream	Grimes	A	10+14	19+39	107	633	288.84	N/A
IH1 42+97	IH1-CBC-02	Unnamed Stream	Grimes	A	42+51	44+03	256	1,302	282.00	N/A
IH1 90+95	WT-CBC-04	Unnamed Stream	Grimes	None			139	765	N/A	not calc.
IH1 103+22	WT-CBC-05	Unnamed Stream	Grimes	None			57	318	N/A	not calc.
IH1 119+41	IH1-CBC-06	Panky Creek	Grimes	A	108+86	139+00	4,475	6,822	265.08	N/A
IH1 130+07	IH1-CBC-07	Unnamed Stream	Grimes	A	108+86	139+00	69	440	265.08	N/A
IH1 171+54	IH1-CBC-08	Unnamed Stream	Grimes	A	165+49	224+12	56	391	266.0-253.5	N/A
IH1 188+88	IH1-CBC-09	Unnamed Stream	Grimes	A	165+49	224+12	93	638	266.0-253.5	N/A
IH1 193+47	IH1-CBC-10	Bedias Creek	Madison	A	165+49	224+12	29,510	27,923	243.05	N/A
IH1 207+11	IH1-CBC-11	Unnamed Stream	Madison	A	165+49	224+12	1,940	4,238	243.05	N/A
IH1 247+21	IH1-CBC-12A	Unnamed Stream	Madison	None			24	155	N/A	not calc.
IH1 256+61	IH1-CBC-12	Unnamed Stream	Madison	None			470	1,765	N/A	247.75
IH1 282+16	IH1-CBC-13B	Unnamed Stream	Madison	None			18	139	N/A	not calc.
IH1 290+96	IH1-CBC-13	Unnamed Stream	Madison	None			34	260	N/A	not calc.
IH1 323+69	IH1-CBC-14	Kickapoo Creek	Madison	None			17,908	17,811	N/A	239.63
IH1 331+05	IH1-CBC-15	Unnamed Stream	Madison	None			34	245	N/A	not calc.
IH1 363+56	IH1-CBC-16A	Unnamed Stream	Madison	None			33	236	N/A	not calc.
IH1 377+62	IH1-CBC-16	Unnamed Stream	Madison	None			205	990	N/A	not calc.
IH1 406+20	IH1-CBC-16B	Unnamed Stream	Madison	None			31	237	N/A	not calc.
IH1 453+74	IH1-CBC-17	Iron Creek	Madison	None			14,587	11,925	N/A	not calc.
IH1 475+09	IH1-CBC-18A	Unnamed Stream	Madison	None			18	110	N/A	not calc.
IH1 482+70	IH1-CBC-18	Pooles Branch	Madison	None			3,255	5,094	N/A	263.12
IH1 589+85	IH1-CBC-19	Unnamed Stream	Madison	None			150	953	N/A	not calc.
IH1 624+91	IH1-CBC-20	Unnamed Stream	Madison	None			27	197	N/A	not calc.
IH1 629+60	IH1-CBC-21	Ferry Branch	Madison	None			1,622	4,461	N/A	not calc.
IH1 674+15	IH1-CBC-22	Caney Creek	Madison	None			56,095	33,797	N/A	249.42
IH1 687+70	IH1-CBC-22B	Unnamed Stream	Madison	None			80	400	N/A	not calc.
IH1 756+77	IH1-CBC-23	Greenbriar Creek	Madison	None			3,629	6,761	N/A	269.29
IH1 765+15	IH1-CBC-24	Unnamed Stream	Madison	None			441	1,691	N/A	274.95
IH1 800+57	IH1-CBC-25	Greenbriar Creek	Madison	None			1,965	4,083	N/A	280.74
IH1 840+00	IH1-CBC-26	Unnamed Stream	Madison	None			30	187	N/A	not calc.
IH1 848+00	IH1-CBC-27	Unnamed Stream	Madison	None			377	1,540	N/A	not calc.
IH1 908+62	IH1-CBC-27B	Unnamed Stream	Madison	None			26	181	N/A	not calc.

GENERAL INFORMATION				FEMA INFORMATION			HYDROLOGY & HYDRAULICS INFORMATION			
STATION	CROSSING NAME ID	STREAM NAME[1]	COUNTY	FEMA ZONE	FEMA FLOODPLAIN EXTENTS FROM STA	TO STA	DRAINAGE AREA (ac.)	100-YR PEAK FLOW[2] (cfs)	100-YR FEMA BFE[3] (ft.)	Approx. 100-YR WSE[4] (ft.)
IH1 910+38	IH1-CBC-28A	Unnamed Stream	Madison	None			98	448	N/A	not calc.
IH1 914+15	IH1-CBC-28B	Unnamed Stream	Madison	None			17	133	N/A	not calc.
IH1 922+41	IH1-CBC-28	Unnamed Stream	Madison	None			110	516	N/A	not calc.
IH1 955+99	IH1-SBC-01	Unnamed Stream	Madison	None			279	1,281	N/A	not calc.
IH1 1071+92	IH1-BoC-01	Unnamed Stream	Madison	None			570	1,582	N/A	not calc.
IH1 1085+07	IH1-BoC-02	Unnamed Stream	Madison	None			285	1,210	N/A	not calc.
IH1 1123+00	IH1-BoC-03	Unnamed Stream	Leon	None			748	3,063	N/A	319.57
IH1 1172+33	IH1-BoC-04A	Unnamed Stream	Leon	None			24	198	N/A	not calc.
IH1 1193+15	IH1-BoC-04	Unnamed Stream	Leon	A	1189+33	1198+04	1,263	3,659	318.81	N/A
IH1 1250+87	IH1-BoC-05	Mustang Creek	Leon	A	1248+69	1253+71	5,044	6,865	326.50	N/A
IH1 1292+95	IH1-BoC-06	Unnamed Stream	Leon	None			688	1,318	N/A	344.17
IH1 1343+59	IH1-BoC-06C	Unnamed Stream	Leon	None			195	752	N/A	not calc.
IH1 1365+26	IH1-BoC-07	Leona Branch	Leon	AE	1358+94	1366+33	287	1,077	356.00	N/A
IH1 1390+87	IH1-BoC-08	Unnamed Stream	Leon	None			122	869	N/A	not calc.
IH1 1435+19	IH1-BoC-09	Unnamed Stream	Leon	None			258	1,096	N/A	317.12
IH1 1465+02	IH1-BoC-10A	Unnamed Stream	Leon	A	1462+33	1483+62	370	1,203	283.21	N/A
IH1 1480+04	IH1-BoC-10	Boggy Creek	Leon	A	1462+33	1483+62	38,741	22,654	283.21	N/A
IH1 1510+53	IH1-BoC-11	Unnamed Stream	Leon	A	1509+90	1512+50	570	1,016	294.00	N/A
IH1 1573+10	IH1-BoC-12	Unnamed Stream	Leon	None			75	161	N/A	357.03
IH1 1664+60	IH1-LKC-01	Beaver Creek	Leon	A	1655+69	1671+88	7,347	12,524	304.80	N/A
IH1 1740+45	IH1-LKC-02	Unnamed Stream	Leon	None			60	165	N/A	not calc.
IH1 1781+45	IH1-LKC-03	Bain Branch	Leon	None			179	394	N/A	not calc.
IH1 1877+74	IH1-LKC-05	Unnamed Stream	Leon	None			72	493	N/A	not calc.
IH1 1901+33	IH1-LKC-06	Unnamed Stream	Leon	None			252	1,330	N/A	not calc.
IH1 1928+64	IH1-LKC-07	Lower Keechi Creek	Leon	A	1907+62	1948+97	36,787	22,015	283.66	N/A
IH1 2031+27	IH1-LKC-08	Unnamed Stream	Leon	None			179	933	N/A	not calc.
IH1 2115+33	IH1-LKC-11	Unnamed Stream	Leon	None			76	397	N/A	not calc.
IH1 2136+76	IH1-LKC-12	Unnamed Stream	Leon	None			149	677	N/A	not calc.
IH1 2165+54	IH1-LKC-13	Unnamed Stream	Leon	None			148	804	N/A	not calc.
IH1 2254+30	IH1-BuC-01	Unnamed Stream	Leon	None			959	2,525	N/A	373.00
IH1 2261+81	IH1-BuC-02	Right Branch	Leon	None			959	2,512	N/A	373.00
IH1 2312+24	IH1-BuC-03	Unnamed Stream	Leon	None			5,072	6,199	N/A	330.00
IH1 2316+86	IH1-BuC-04	Bliss Creek	Leon	None			5,072	6,182	N/A	330.00
IH1 2360+63	IH1-BuC-05	Unnamed Stream	Leon	None			186	1,164	N/A	not calc.
IH1 2408+02	IH1-BuC-06	Copper Creek	Leon	None			2,227	4,511	N/A	not calc.
IH1 2506+50	IH1-BuC-07	Unnamed Stream	Leon	AE	2504+28	2511+24	2,009	3,940	347.00	N/A
IH1 2537+94	IH1-BuC-08	Unnamed Stream	Leon	AE	2537+50	2539+01	189	908	348.00	N/A
IH1 2625+34	IH1-BuC-10	Buffalo Creek	Freestone	None			58,659	44,312	N/A	309.00
IH1 2685+21	IH1-BuC-11	Unnamed Stream	Freestone	None			156	692	N/A	309.00
IH1 2733+79	IH1-BuC-12	Whitney Branch	Freestone	None			703	1,612	N/A	330.00
IH1 2787+99	IH1-BuC-13	Fulks Dugout	Freestone	None			153	378	N/A	not calc.
IH1 2851+79	IH1-BuC-14	Wilkerson Spring Branch	Freestone	None			273	889	N/A	not calc.
IH1 2924+16	IH1-BuC-16	Unnamed Stream	Freestone	None			177	1,041	N/A	not calc.

GENERAL INFORMATION				FEMA INFORMATION			HYDROLOGY & HYDRAULICS INFORMATION			
					FEMA FLOODPLAIN EXTENTS			100-YR PEAK	100-YR	Approx. 100-
STATION	CROSSING NAME ID	STREAM NAME[1]	COUNTY	FEMA ZONE	FROM STA	TO STA	DRAINAGE AREA	FLOW[2]	FEMA BFE[3]	YR WSE[4]
							(ac.)	(cfs)	(ft.)	(ft.)
IH1 2936+17	IH1-BuC-17	Unnamed Stream	Freestone	None			108	757	N/A	not calc.
IH1 2956+76	IH1-BuC-18	Unnamed Stream	Freestone	None			376	1,914	N/A	366.00
IH1 2977+29	IH1-BuC-19	Caroline Creek	Freestone	None			1,224	3,956	N/A	387.00
IH1 3125+05	IH1-UKC-01	Unnamed Stream	Freestone	None			108	810	N/A	not calc.
IH1 3142+93	IH1-UKC-01A	Unnamed Stream	Freestone	None			74	568	N/A	not calc.
IH1 3166+29	IH1-UKC-01B	Unnamed Stream	Freestone	None			41	284	N/A	not calc.
IH1 3196+73	IH1-UKC-02	Hog Creek	Freestone	None			2,690	7,085	N/A	not calc.
IH1 3269+56	IH1-UKC-03	Upper Keechi Creek	Freestone	None			10,609	16,994	N/A	380.00
IH1 3279+79	IH1-UKC-04	Unnamed Stream	Freestone	None			4,120	8,986	N/A	not calc.
IH1 3325+02	IH1-UKC-05	Unnamed Stream	Freestone	None			87	686	N/A	not calc.
IH1 3367+93	IH1-UKC-06B	Unnamed Stream	Freestone	None			23	182	N/A	not calc.
IH1 3380+42	IH1-UKC-06	Unnamed Stream	Freestone	None			76	627	N/A	not calc.
IH1 3404+21	IH1-UKC-07	Unnamed Stream	Freestone	None			74	536	N/A	not calc.
IH1 3463+68	IH1-UKC-07A	Unnamed Stream	Freestone	None			43	340	N/A	not calc.
IH1 3500+58	IH1-UKC-08	Unnamed Stream	Freestone	None			116	802	N/A	not calc.
IH1 3505+49	IH1-UKC-08A	Unnamed Stream	Freestone	None			51	409	N/A	not calc.
IH1 3539+24	IH1-CTC-01A	Unnamed Stream	Freestone	None			50	423	N/A	not calc.
IH1 3543+55	IH1-CTC-01A1	Unnamed Stream	Freestone	None			50	423	N/A	not calc.
IH1 3553+83	IH1-CTC-01B	Unnamed Stream	Freestone	None			100	833	N/A	not calc.
IH1 3639+25	IH1-CTC-01	Unnamed Stream	Freestone	None			780	2,957	N/A	383.54
IH1 3654+95	IH1-CTC-01C	Unnamed Stream	Freestone	None			18	151	N/A	not calc.
IH1 3668+34	IH1-CTC-02	Cottonwood Creek	Freestone	None			4,007	8,077	N/A	381.63
IH1 3707+36	IH1-CTC-03	Unnamed Stream	Freestone	None			196	939	N/A	387.63
IH1 3798+88	IH1-CTC-04	Unnamed Stream	Freestone	None			150	882	N/A	392.38
IH1 3817+44	IH1-CTC-04C	Unnamed Stream	Freestone	None			150	1,064	N/A	392.63
IH1 3897+29	IH1-CTC-05	Caney Creek	Freestone	None			42,109	33,585	N/A	not calc.
IH1 3906+71	IH1-CTC-06	Unnamed Stream	Freestone	None			176	957	N/A	not calc.
IH1 3942+41	IH1-CTC-07	Cedar Creek	Freestone	None			1,657	4,964	N/A	335.57
IH1 4008+53	IH1-CTC-08A	Unnamed Stream	Freestone	None			23	187	N/A	not calc.
IH1 4020+59	IH1-CTC-09	Unnamed Stream	Freestone	None			60	409	N/A	358.08
IH1 4031+76	IH1-CTC-10	Dry Creek	Freestone	None			1,106	4,678	N/A	357.62
IH1 4035+39	IH1-CTC-11	Unnamed Stream	Freestone	None			157	895	N/A	357.62
IH1 4103+41	IH1-CTC-13	Unnamed Stream	Freestone	None			29	231	N/A	not calc.
IH1 4132+63	IH1-CTC-13A	Unnamed Stream	Freestone	None			47	374	N/A	not calc.
IH1 4145+27	IH1-CTC-14	Unnamed Stream	Freestone	None			638	2,518	N/A	346.33
IH1 4179+28	IH1-CTC-15	Unnamed Stream	Freestone	None			85,140	57,997	N/A	323.48
IH1 4185+56	IH1-CTC-16	Little Tehuacana Creek	Freestone	None			85,140	57,997	N/A	323.48
IH1 4207+81	IH1-CTC-17	Tehuacana Creek	Freestone	None			85,140	57,997	N/A	323.48
IH1 4302+54	IH1-CTC-19	Unnamed Stream	Freestone	None			163	949	N/A	366.49
IH1 4231+00	IH1-CTC-18	Unnamed Stream	Freestone	None			85,140	57,987	N/A	323.48
IH1 4317+68	IH1-CTC-20	Unnamed Stream	Freestone	None			38	223	N/A	366.49
NW 20+55	NW-CTC-01	Unnamed Stream	Freestone	None			209	895	N/A	not calc.
NW 104+39	NW-ARC-01	Unnamed Stream	Navarro	None			673	2,459	N/A	411.70

GENERAL INFORMATION				FEMA INFORMATION			HYDROLOGY & HYDRAULICS INFORMATION			
					FEMA FLOODPLAIN EXTENTS			100-YR PEAK	100-YR	Approx. 100-
STATION	CROSSING NAME ID	STREAM NAME[1]	COUNTY	FEMA ZONE	FROM STA	TO STA	DRAINAGE AREA	FLOW[2]	FEMA BFE[3]	YR WSE[4]
							(ac.)	(cfs)	(ft.)	(ft.)
NW 125+97	NW-ARC-02	Unnamed Stream	Navarro	A	120+81	130+57	797	2,659	412.17	N/A
NW 173+70	NW-ARC-03	Unnamed Stream	Navarro	None			1,594	4,155	N/A	406.62
NW 207+33	NW-ARC-04	Unnamed Stream	Navarro	None			807	2,988	N/A	403.32
NW 253+95	NW-ARC-06A	Unnamed Stream	Navarro	None			491	353	N/A	not calc.
NW 267+54	NW-ARC-06	Unnamed Stream	Navarro	None			78	2,383	N/A	not calc.
NW 303+87	NW-POC-01	Unnamed Stream	Navarro	None			665	2,606	N/A	422.71
NW 361+71	NW-POC-03	Unnamed Stream	Navarro	None			206	1,049	N/A	411.47
NW 427+34	NW-POC-04	Unnamed Stream	Navarro	A	418+96	496+91	1,800	3,726	346.00	N/A
NW 453+80	NW-POC-05	Pin Oak Creek	Navarro	A	418+96	496+91	102,217	38,826	346.00	N/A
NW 483+19	NW-POC-06	Unnamed Stream	Navarro	A	418+96	496+91	2,531	5,268	346.00	N/A
NW 598+37	NW-PRC-01	Unnamed Stream	Navarro	A	587+89	698+89	4,774	6,659	355.00	N/A
NW 618+22	NW-PRC-02	Richland Creek	Navarro	A	587+89	698+89	274,807	88,639	355.00	N/A
NW 696+91	NW-PRC-03	Unnamed Stream	Navarro	A	587+89	698+89	9,537	10,011	352.00	N/A
NW 763+35	NW-PRC-04	Rush Creek	Navarro	A	756+70	785+00	17,269	13,729	368.00	N/A
NW 768+45	NW-PRC-05	Unnamed Stream	Navarro	A	756+70	785+00	91	187	368.00	N/A
NW 782+27	NW-PRC-06	Unnamed Stream	Navarro	A	756+70	785+00	1,926	3,588	368.00	N/A
NW 794+86	NW-PRC-07	Unnamed Stream	Navarro	None			10	71	N/A	not calc.
NW 821+63	NW-PRC-08	Unnamed Stream	Navarro	None			40	265	N/A	not calc.
NW 860+65	NW-PRC-08A	Unnamed Stream	Navarro	None			83	419	N/A	not calc.
NW 880+69	NW-PRC-08B	Unnamed Stream	Navarro	None			50	322	N/A	not calc.
NW 1076+45	NW-PRC-12	Unnamed Stream	Navarro	None			244	993	N/A	not calc.
NW 1103+14	NW-PRC-13	Unnamed Stream	Navarro	None			56	398	N/A	not calc.
NW 1123+05	NW-PRC-14	Unnamed Stream	Navarro	A	1122+57	1127+83	136	587	435.60	N/A
NW 1124+97	NW-PRC-15	Unnamed Stream	Navarro	A	1122+57	1127+83	498	1,904	435.60	N/A
NW 1167+28	NW-PRC-16	Unnamed Stream	Navarro	A	1164+72	1177+52	118	608	464.50	N/A
NW 1172+87	NW-PRC-17	Briar Creek	Navarro	A	1164+72	1177+52	262	1,103	464.50	N/A
NW 1203+37	NW-PRC-18	Unnamed Stream	Navarro	None			18	152	N/A	not calc.
NW 1258+33	NW-LCC-02A	Unnamed Stream	Navarro	None			28	213	N/A	not calc.
NW 1265+59	NW-LCC-02	Unnamed Stream	Navarro	A	1264+85	1273+37	2,971	5,948	470.50	N/A
NW 1352+55	NW-LCC-03	Unnamed Stream	Navarro	None			336	1,546	N/A	490.15
NW 1369+53	NW-LCC-03A	Unnamed Stream	Navarro	None			35	257	N/A	not calc.
NW 1490+83	NW-UCC-02	Chambers Creek	Navarro	A	1459+97	1514+51	336,320	92,605	406.00	N/A
NW 1502+47	NW-UCC-03	Unnamed Stream	Navarro	A	1459+97	1514+51	336,320	92,605	406.00	N/A
NW 1590+34	NW-UCC-04	Unnamed Stream	Ellis	None			755	1,785	N/A	447.00
NW 1619+62	NW-UCC-05	Unnamed Stream	Ellis	None			645	1,693	N/A	444.50
NE 22+54	NE-CTC-01	Unnamed Stream	Navarro	None			235	890	N/A	not calc.
NE 105+15	NE-ARC-01	Unnamed Stream	Navarro	None			729	2,648	N/A	not calc.
NE 125+97	NE-ARC-02	Little Pin Oak Creek	Navarro	A	120+77	130+57	732	2,433	412.24	N/A
NE 174+00	NE-ARC-03	Unnamed Stream	Navarro	None			1,635	4,236	N/A	403.79
NE 206+19	NE-ARC-04	Unnamed Stream	Navarro	None			767	2,814	N/A	402.50
NE 221+49	NE-ARC-05	Unnamed Stream	Navarro	None			171	771	N/A	410.64
NE 265+75	NE-ARC-06	Unnamed Stream	Navarro	None			586	2,432	N/A	412.87
NE 334+02	NE-ARC-07	Unnamed Stream	Navarro	None			236	1,697	N/A	401.99

GENERAL INFORMATION				FEMA INFORMATION			HYDROLOGY & HYDRAULICS INFORMATION			
					FEMA FLOODPLAIN EXTENTS			100-YR PEAK	100-YR	Approx. 100-
STATION	CROSSING NAME ID	STREAM NAME[1]	COUNTY	FEMA ZONE	FROM STA	TO STA	DRAINAGE AREA	FLOW[2]	FEMA BFE[3]	YR WSE[4]
							(ac.)	(cfs)	(ft.)	(ft.)
NE 410+29	NE-ARC-08	Unnamed Stream	Navarro	None			148	760	N/A	not calc.
NE 537+07	NE-ARC-09	Richland Creek	Navarro	A	531+24	555+99	455,796	135,545	340.53	N/A
NE 552+79	NE-PRC-01	Unnamed Stream	Navarro	A	531+24	555+99	37	82	340.53	N/A
NE 736+17	NE-PRC-04	Unnamed Stream	Navarro	A	734+30	745+46	5,735	8,209	384.00	N/A
NE 819+92	NE-PRC-06	Unnamed Stream	Navarro	None			521	1,693	N/A	403.00
NE 870+62	NE-PRC-07	Unnamed Stream	Navarro	A	869+51	871+71	604	1,769	409.00	N/A
NE 911+95	NE-PRC-08	Unnamed Stream	Navarro	A	911+20	913+17	87	538	413.00	N/A
NE 922+52	NE-PRC-09	Cedar Creek	Navarro	A	920+39	925+01	2,381	4,784	413.00	N/A
NE 987+09	NE-PRC-11	Unnamed Stream	Navarro	A	986+75	987+70	71	429	411.00	N/A
NE 993+79	NE-PRC-12	Unnamed Stream	Navarro	A	992+62	994+23	56	385	417.00	N/A
NE 1000+33	NE-PRC-13	Unnamed Stream	Navarro	A	997+66	1004+23	1,004	2,697	410.00	N/A
NE 1014+43	NE-PRC-14	Unnamed Stream	Navarro	A	1010+69	1020+06	2,459	5,733	410.00	N/A
NE 1080+28	NE-PRC-15	Unnamed Stream	Navarro	None			32	263	N/A	not calc.
NE 1089+59	NE-PRC-16	Unnamed Stream	Navarro	None			33	260	N/A	not calc.
NE 1156+00	NE-PRC-17	Unnamed Stream	Navarro	None			26	205	N/A	not calc.
NE 1259+21	NE-LCC-02	Unnamed Stream	Navarro	A	1255+83	1265+63	4,411	7,105	453.60	N/A
NE 1319+60	NE-LCC-02A	Unnamed Stream	Navarro	None			51	391	N/A	not calc.
NE 1374+64	NE-LCC-03	Briar Creek	Navarro	A	1372+38	1380+12	807	2,500	476.97	N/A
NE 1418+34	NE-LCC-04	Unnamed Stream	Navarro	None			155	870	N/A	not calc.
NE 1469+26	NE-UCC-01	Unnamed Stream	Navarro	None			533	1,732	N/A	not calc.
NE 1517+00	NE-UCC-02	Chambers Creek	Navarro	A	1477+86	1532+79	337,365	92,434	405.00	N/A
NE 1520+45	NE-UCC-03	Chambers Creek	Navarro	A	1477+86	1532+79	337,365	92,434	405.00	N/A
NE 1636+70	NE-UCC-05	Unnamed Stream	Navarro	None			727	1,979	N/A	not calc.
IH2 10+83	IH2-CTC-01	Unnamed Stream	Navarro	None			155	882	N/A	not calc.
IH2 83+18	IH2-ARC-02	Unnamed Stream	Navarro	None			173	996	N/A	not calc.
IH2 124+52	IH2-ARC-03	Unnamed Stream	Navarro	None			56	399	N/A	not calc.
IH2 150+15	IH2-ARC-04	Mesquite Creek	Navarro	A	145+24	154+43	2,019	5,482	358.28	N/A
IH2 162+21	IH2-ARC-05	Unnamed Stream	Navarro	A	161+41	163+27	84	541	367.20	N/A
IH2 207+12	IH2-ARC-06	Unnamed Stream	Navarro	None			270	1,409	N/A	not calc.
IH2 256+16	IH2-ARC-07	Little Pin Oak Creek	Navarro	A	249+32	258+72	9,073	14,596	352.92	N/A
IH2 278+57	IH2-ARC-08	Unnamed Stream	Navarro	None			172	956	N/A	not calc.
IH2 312+86	IH2-ARC-09	Unnamed Stream	Navarro	None			839	2,715	N/A	not calc.
IH2 366+69	IH2-ARC-10	Unnamed Stream	Navarro	None			564	2,294	N/A	not calc.
IH2 482+58	IH2-POC-01	Unnamed Stream	Navarro	A	454+04	554+93	1,800	3,726	342.40	N/A
IH2 497+12	IH2-POC-02	Pin Oak Creek	Navarro	A	454+04	554+93	102,217	38,826	342.40	N/A
IH2 525+57	IH2-POC-03	Unnamed Stream	Navarro	A	454+04	554+93	2,531	5,268	342.40	N/A
IH2 546+82	IH2-POC-04	Unnamed Stream	Navarro	A	454+04	554+93	2,531	5,268	342.40	N/A
IH2 571+88	IH2-PRC-01	Unnamed Stream	Navarro	None			159	875	N/A	not calc.
IH2 621+21	IH2-PRC-02	Unnamed Stream	Navarro	A	620+88	815+98	156	822	355.2-364.2	N/A
IH2 648+92	IH2-PRC-03	Richland Creek	Navarro	A	620+88	815+98	324,263	118,894	355.2-364.2	N/A
IH2 772+06	IH2-PRC-04	Unnamed Stream	Navarro	A	620+88	815+98	58	340	355.2-364.2	N/A
IH2 832+93	IH2-PRC-05	Unnamed Stream	Navarro	None			14	96	N/A	not calc.
IH2 856+74	IH2-PRC-08	Unnamed Stream	Navarro	None			40	265	N/A	not calc.

GENERAL INFORMATION				FEMA INFORMATION			HYDROLOGY & HYDRAULICS INFORMATION			
					FEMA FLOODPLAIN EXTENTS			100-YR PEAK	100-YR	Approx. 100-
STATION	CROSSING NAME ID	STREAM NAME[1]	COUNTY	FEMA ZONE	FROM STA	TO STA	DRAINAGE AREA	FLOW[2]	FEMA BFE[3]	YR WSE[4]
							(ac.)	(cfs)	(ft.)	(ft.)
EW 44+27	EW-WaC-01	Onion Creek	Ellis	A	41+61	61+43	40,266	28,243	405.28	N/A
EW 72+96	EW-WaC-02	Unnamed Stream	Ellis	A	67+86	73+00	228	803	407.00	N/A
EW 106+51	EW-WaC-02A	Unnamed Stream	Ellis	None			71	409	N/A	408.50
EW 181+00	EW-WaC-02B	Unnamed Stream	Ellis	None			19	150	N/A	not calc.
EW 293+39	EW-WaC-04	Unnamed Stream	Ellis	None			127	676	N/A	not calc.
EW 362+04	EW-WaC-05	Unnamed Stream	Ellis	None			63	436	N/A	not calc.
EW 398+23	EW-WaC-06	Unnamed Stream	Ellis	None			156	697	N/A	not calc.
EW 431+55	EW-WaC-07	Waxahachie Creek	Ellis	A	403+95	439+40	68,948	36,074	449.30	N/A
EW 436+60	EW-WaC-08	Unnamed Stream	Ellis	A	403+95	439+40	41	264	449.30	N/A
EW 482+89	EW-WaC-09	Unnamed Stream	Ellis	A	482+46	483+97	1,601	3,549	490.74	N/A
EW 503+26	EW-WaC-10A	Unnamed Stream	Ellis	None			35	205	N/A	not calc.
EW 521+02	EW-WaC-10	Unnamed Stream	Ellis	None			194	894	N/A	not calc.
EW 537+61	EW-WaC-10D	Unnamed Stream	Ellis	None			79	457	N/A	not calc.
EW 547+21	EW-WaC-10E	Unnamed Stream	Ellis	None			20	157	N/A	not calc.
EW 579+44	EW-WaC-11	Unnamed Stream	Ellis	None			75	480	N/A	not calc.
EW 584+38	EW-WaC-12	Unnamed Stream	Ellis	A	581+41	584+62	372	1,567	481.56	N/A
EW 617+32	EW-WaC-13	Mustang Creek	Ellis	A	612+03	619+43	11,501	11,529	461.37	N/A
EW 623+90	EW-WaC-14	Unnamed Stream	Ellis	A	622+93	626+87	161	723	465.41	N/A
EW 672+17	EW-RoC-01	Unnamed Stream	Ellis	None			88	586	N/A	not calc.
EW 737+15	EW-RoC-02	Cottonwood Creek	Ellis	A	734+96	738+41	1,209	3,040	464.00	N/A
EW 790+23	EW-RoC-03	Grove Creek	Ellis	AE	781+67	802+82	18,454	14,621	437.00	N/A
EW 798+86	EW-RoC-03A	Unnamed Stream	Ellis	AE	781+67	802+82	41	301	437.00	N/A
EW 821+89	EW-RoC-04	Bone Branch	Ellis	A	817+94	825+90	2,794	4,272	447.00	N/A
EW 832+54	EW-RoC-04A	Unnamed Stream	Ellis	A	831+80	833+27	262	1,102	460.50	N/A
EW 905+89	EW-RoC-05	Red Oak Creek	Ellis	AE	898+85	922+25	38,293	22,198	421.00	N/A
EW 913+43	EW-RoC-06	Unnamed Stream	Ellis	AE	898+85	922+25	697	1,629	421.00	N/A
EW 932+11	EW-RoC-06A	Unnamed Stream	Ellis	None			59	269	N/A	not calc.
EW 969+72	EW-RoC-07A	Unnamed Stream	Ellis	None			54	249	N/A	not calc.
EW 992+72	EW-RoC-07	Unnamed Stream	Ellis	A	991+69	993+45	1,731	3,236	447.00	N/A
EW 1002+18	EW-RoC-07B	Unnamed Stream	Ellis	None			70	407	N/A	not calc.
EW 1026+77	EW-RoC-08	Unnamed Stream	Ellis	None			99	442	N/A	not calc.
EW 1046+42	EW-RoC-09	Brushy Creek	Ellis	AE	1042+73	1050+96	8,516	9,563	415.00	N/A
EW 1132+13	EW-RoC-10	Unnamed Stream	Ellis	None			497	1,467	N/A	not calc.
EW 1190+75	EW-RoC-11B	Unnamed Stream	Ellis	AE	1188+85	1197+44	981	2,601	436.0-437.0	N/A
EW 1195+10	EW-RoC-11	Bear Creek	Ellis	AE	1188+85	1197+44	981	2,601	427.00	N/A
EE 44+27	EE-WaC-01	Onion Creek	Ellis	A	41+61	61+27	38,234	26,891	406.70	N/A
EE 55+19	EE-WaC-02	Unnamed Stream	Ellis	AE	41+61	61+27	10,926	10,143	406.80	N/A
EE 58+79	EE-WaC-03	Unnamed Stream	Ellis	A	41+61	61+27	381	1,174	406.70	N/A
EE 72+03	EE-WaC-04	Unnamed Stream	Ellis	A	68+46	73+51	228	801	409.10	N/A
EE 104+83	EE-WaC-04A	Unnamed Stream	Ellis	None			47	294	N/A	not calc.
EE 156+18	EE-WaC-05B	Unnamed Stream	Ellis	None			26	200	N/A	not calc.
EE 179+80	EE-WaC-05	Unnamed Stream	Ellis	A	169+12	184+78	71	497	446.50	N/A
EE 214+37	EE-WaC-06	Elm Branch	Ellis	A	207+43	225+29	944	2,518	459.2-467.8	N/A

GENERAL INFORMATION				FEMA INFORMATION			HYDROLOGY & HYDRAULICS INFORMATION			
STATION	CROSSING NAME ID	STREAM NAME[1]	COUNTY	FEMA ZONE	FEMA FLOODPLAIN EXTENTS FROM STA	TO STA	DRAINAGE AREA (ac.)	100-YR PEAK FLOW[2] (cfs)	100-YR FEMA BFE[3] (ft.)	Approx. 100-YR WSE[4] (ft.)
EE 238+81	EE-WaC-07A	Unnamed Stream	Ellis	None			25	174	N/A	not calc.
EE 299+25	EE-WaC-08	Unnamed Stream	Ellis	None			148	769	N/A	not calc.
EE 304+31	EE-WaC-08A	Unnamed Stream	Ellis	None			32	225	N/A	not calc.
EE 316+13	EE-WaC-09	Unnamed Stream	Ellis	A	315+57	316+92	593	2,018	448.17	N/A
EE 326+32	EE-WaC-10	Unnamed Stream	Ellis	None			17	117	N/A	not calc.
EE 352+31	EE-WaC-11	Unnamed Stream	Ellis	A	348+29	379+07	186	901	438.59	N/A
EE 366+13	EE-WaC-12	Unnamed Stream	Ellis	A	348+29	379+07	71,931	35,914	438.59	N/A
EE 376+45	EE-WaC-13	Waxahachie Creek	Ellis	A	348+29	379+07	71,931	35,818	438.59	N/A
EE 443+74	EE-WaC-14D	Unnamed Stream	Ellis	None			61	309	N/A	not calc.
EE 456+62	EE-WaC-14	Unnamed Stream	Ellis	None			672	2,175	N/A	not calc.
EE 552+68	EE-WaC-15	Unnamed Stream	Ellis	A	550+55	557+51	422	1,565	476.50	N/A
EE 579+61	EE-WaC-16	Mustang Creek	Ellis	A	574+44	582+78	11,707	12,180	459.40	N/A
EE 688+63	EE-RoC-01	Unnamed Stream	Ellis	None			72	310	N/A	473.00
EE 699+84	EE-RoC-04	Cottonwood Creek	Ellis	A	699+08	702+08	1,311	3,198	460.58	N/A
EE 757+70	EE-RoC-05	Grove Creek	Ellis	AE	753+35	772+21	18,477	14,541	435.00	N/A
EE 770+23	EE-RoC-06	Unnamed Stream	Ellis	AE	753+35	772+21	82	481	435.00	N/A
EE 783+77	EE-RoC-07	Bone Branch	Ellis	A	781+68	791+34	2,816	4,208	444.77	N/A
EE 786+79	EE-RoC-08	Unnamed Stream	Ellis	A	781+68	791+34	282	1,098	444.77	N/A
EE 806+15	EE-RoC-09A	Unnamed Stream	Ellis	None			30	217	N/A	not calc.
EE 817+21	EE-RoC-09	Unnamed Stream	Ellis	None			30	227	N/A	not calc.
EE 827+84	EE-RoC-10A	Unnamed Stream	Ellis	None			39	188	N/A	not calc.
EE 874+66	EE-RoC-10	Red Oak Creek	Ellis	AE	862+69	885+57	38,318	22,008	419.00	N/A
EE 877+13	EE-RoC-11	Unnamed Stream	Ellis	AE	862+69	885+57	733	1,656	419.00	N/A
EE 881+53	EE-RoC-12	Unnamed Stream	Ellis	AE	862+69	885+57	252	1,003	419.00	N/A
EE 963+10	EE-RoC-13	Unnamed Stream	Ellis	A	962+40	965+09	1,867	3,380	427.00	N/A
EE 986+30	EE-RoC-14	Unnamed Stream	Ellis	None			151	685	N/A	not calc.
EE 1006+00	EE-RoC-15	Brushy Creek	Ellis	AE	1003+77	1011+35	8,675	9,645	413.00	not calc.
EE 1058+50	EE-RoC-15B	Unnamed Stream	Ellis	None			195	611	N/A	not calc.
EE 1062+15	EE-RoC-15C	Unnamed Stream	Ellis	None			112	460	N/A	not calc.
EE 1098+00	EE-RoC-16	Unnamed Stream	Ellis	None			489	1,448	N/A	not calc.
EE 1135+00	EE-RoC-17A	Unnamed Stream	Ellis	None			40	301	N/A	not calc.
EE 1154+92	EE-RoC-17	Unnamed Stream	Ellis	AE	1153+98	1157+39	976	2,605	433.00	not calc.
EE 1160+00	EE-RoC-18	Bear Creek	Ellis	AE	1157+39	1161+76	10,904	10,181	437.00	not calc.
DS 43+27	DS-TTR-01	Long Branch	Dallas	AE	41+22	44+35	1,954	4,500	456.00	not calc.
DS 200+00	DS-TTR-02	Tenmile Creek	Dallas	AE	183+87	205+49	38,803	25,000	450.00	not calc.
DS 398+45	DS-HTR-01A	Unnamed Stream	Dallas	None			51	279	N/A	not calc.
DS 415+10	DS-HTR-01B	Unnamed Stream	Dallas	None			131	681	N/A	not calc.
DS 438+35	DS-HTR-01C	Unnamed Stream	Dallas	None			61	307	N/A	not calc.
DS 486+00	DS-HTR-01	Whites Branch	Dallas	AE	475+80	505+50	1,709	4,400	436.0-450.0	not calc.
DS 540+00	DS-HTR-02	Newton Creek	Dallas	AE	511+61	543+24	5,741	10,000	420.0-430.0	not calc.
DS 570+00	DS-HTR-03	Wilson Branch	Dallas	AE	547+94	608+52	1,124	3,030	411.0-418.0	N/A
DS 587+52	DS-HTR-04	Fivemile Creek	Dallas	AE	547+94	608+52	28,014	26,666	411.00	N/A
DS 604+47	DS-HTR-05	Old Stream 5A1 Channel	Dallas	AE	547+94	608+52	28,014	26,666	411.00	N/A

Appendix H: VIADUCT CROSSINGS
(as of June 9, 2017)

GENERAL INFORMATION				FEMA INFORMATION			HYDROLOGY & HYDRAULICS INFORMATION			
					FEMA FLOODPLAIN EXTENTS			100-YR PEAK	100-YR	Approx. 100-
STATION	CROSSING NAME ID	STREAM NAME[1]	COUNTY	FEMA ZONE	FROM STA	TO STA	DRAINAGE AREA	FLOW[2]	FEMA BFE[3]	YR WSE[4]
							(ac.)	(cfs)	(ft.)	(ft.)
DS 624+40	DS-HTR-06	Fivemile Creek	Dallas	AE	611+01	630+00	28,014	26,666	411.0-413.0	N/A
DS 650+50	DS-HTR-07	Unnamed Stream	Dallas	AE	630+00	661+93	28,014	26,666	411.00	N/A
DS 707+71	DS-HTR-08	Honey Springs Branch	Dallas	AE	707+13	709+63	1,231	3,242	426.00	N/A
DS 770+78	DS-HTR-09	Trinity River	Dallas	AE	763+69	770+78	9,475	43,779	411.00	N/A
DT 60+84	DT-HTR-01	Trinity River	Dallas	AE	10+00	159+41	9,475	43,779	411.0-416.0	N/A

NOTES:

1. "Unnamed Streams" did not have assigned names per USGS National Hydrography Dataset.
2. All peak flows shown are approximate.
3. FEMA Base Flood Elevations (BFE) for Zone A are estimated from LIDAR. BFE is only available for FEMA streams.
4. Approximate 100-year Water Surface Elevations (WSE) not shown for FEMA crossings – reference “100-YR FEMA BFE” column. Crossings listed as "not calc" were not hydraulically modeled to determine water surface elevation due to assumed sufficient depth below viaduct low chord.

Appendix I

Detention Basin Database

Rail Road Basins

Segment	Basin ID	Basin Location	Required Volume (cf)	Depth (ft)	Bt Area (sf)	TW Area (sf)	Volume (cf)
HN1	RRB-HN1-12	518+00	379,513	5	66,000	88,800	385,593
HN1	RRB-HN1-15	600+00	112,749	5	13,940	33,300	114,642
HN1	RRB-HN1-16	667+00	222,238	5	36,481	53,361	223,272
HN1	RRB-HN1-17	700+00	151,983	3	36,600	67,176	153,361
HN1	RRB-HN1-19	787+00	256,667	5	41,640	61,920	257,229
HN1	RRB-HN1-21	955+00	178,168	5	20,720	53,040	178,185
HN1	RRB-HN1-23	1005+00	314,259	3	95,000	120,776	322,891
HN1	RRB-HN1-24	1032+00	290,718	3	101,761	117,649	328,827
HN1	RRB-HN1-25	1080+00	208,368	3	63,504	76,176	209,232
HN1	RRB-HN1-32	1360+00	186,187	3	61,740	78,948	210,504
HN1	RRB-HN1-33	1385+00	159,628	3	62,640	82,080	216,424
HN1	RRB-HN1-34	1430+00	351,671	3	105,210	132,354	355,568
HN1	RRB-HN1-36	1530+00	460,519	3	144,000	164,736	462,755
HN1	RRB-HN1-41	1808+00	145,818	3	43,681	54,289	146,667
HN1	RRB-HN1-42	1191+00	233,593	3	71,289	84,681	233,667
HN1	RRB-HN1-43	1962+00	145,151	3	43,264	53,824	145,344
HN1	RRB-HN1-44	2025+00	197,691	3	60,025	72,361	198,291
HN1	RRB-HN1-45	2150+00	118,607	3	34,969	44,521	118,947
HN1	RRB-HN1-45I	2236+00	270,677	3	83,160	97,608	270,863
HN1	RRB-HN1-46	2282+00	117,686	3	34,596	44,100	117,756
HN1	RRB-HN1-47	2305+00	204,916	3	61,200	76,896	206,697
HN1	RRB-HN1-48	2335+00	373,658	2	180,120	194,040	374,074
HN2	RRB-HN2-01	15+00	151,554	3	45,390	56,358	152,326
HN2	RRB-HN2-13	523+00	106,757	3	31,250	40,826	107,795
HN2	RRB-HN2-15	576+00	180,288	3	55,225	67,081	183,171
HN2	RRB-HN2-16	603+60	55,187	3	15,625	22,201	56,451
HN2	RRB-HN2-17	648+50	203,532	3	63,038	75,914	208,128
HN2	RRB-HN2-18	690+00	128,621	3	38,025	47,961	128,691
HN2	RRB-HN2-19	718+50	77,929	3	22,500	30,276	78,876
HN2	RRB-HN2-20	746+00	112,322	3	33,489	42,849	114,219
HN2	RRB-HN2-21	769+00	67,809	3	20,000	27,776	71,345
HN2	RRB-HN2-21a	820+00	152,950	3	44,800	57,664	153,291
HN2	RRB-HN2-22	853+00	40,391	6.1	4,640	9,042	40,990
HN2	RRB-HN2-23	894+00	218,790	3	66,720	79,728	219,383
HN2	RRB-HN2-23c	931+00	134,664	3	40,000	50,416	135,323
HN2	RRB-HN2-24	951+00	78,157	3	22,560	30,528	79,331
HN2	RRB-HN2-25	990+00	168,167	3	50,490	61,938	168,350
HN2	RRB-HN2-25c	1020+00	134,361	3	39,900	50,076	134,675
HN2	RRB-HN2-26	1057+00	117,351	3	34,440	43,992	117,356
HN2	RRB-HN2-27	1091+50	60,496	3	16,900	23,716	60,636
HN2	RRB-HN2-28	1134+00	72,477	3	21,025	28,561	74,091
HN2	RRB-HN2-28e	1173+60	127,623	3	38,025	47,961	128,691
HN2	RRB-HN2-30	1240+00	322,715	3	100,050	115,866	323,584
HN2	RRB-HN2-32	1297+50	120,816	3	35,420	45,428	120,961
HN2	RRB-HN2-33	1354+00	289,699	3	89,900	104,876	291,876
HN2	RRB-HN2-34	1416+00	345,262	3	105,600	125,856	346,740
HN2	RRB-HN2-35	1484+00	289,595	3	89,280	104,544	290,435
HN2	RRB-HN2-36	1603+50	110,317	3	32,400	41,616	110,736

Appendix I: Detention Basin Database
Rail Road Basins

Segment	Basin ID	Basin Location	Required Volume (cf)	Depth (ft)	Bt Area (sf)	TW Area (sf)	Volume (cf)
HN2	RRB-HN2-37	1623+00	271,455	3	83,000	98,336	271,679
HN2	RRB-HN2-38	1722+00	196,920	3	59,664	72,000	197,206
HN2	RRB-HN2-39	1761+50	168,422	3	50,784	62,400	169,477
HN2	RRB-HN2-40	1825+00	429,664	3	134,568	152,760	430,704
HN2	RRB-HN2-41	1900+00	134,200	3	39,894	50,094	134,692
HN2	RRB-HN2-42	1934+00	106,987	3	31,350	40,446	107,405
HN2	RRB-HN2-43	1948+00	147,833	3	44,250	55,074	148,690
HN2	RRB-HN2-45	2038+00	259,552	3	81,225	95,481	264,771
HN2	RRB-HN2-02	84+00	252,863	3	77,200	91,840	253,242
HN2	RRB-HN2-03	141+00	276,021	3	85,140	100,788	278,562
HN2	RRB-HN2-04	175+00	54,693	3	15,129	21,609	54,819
HN2	RRB-HN2-05	184+00	51,910	3	14,400	20,736	52,416
HN2	RRB-HN2-06	210+00	109,758	3	32,400	41,616	110,736
HN2	RRB-HN2-07	264+50	196,287	3	59,536	71,824	196,752
HN2	RRB-HN2-08	300+00	196,287	3	59,536	71,824	196,752
WT	RRB-WT-01	38+00	108,757	3	31,618	41,172	108,870
WT	RRB-WT-02	55+00	178,281	3	53,933	65,702	179,163
WT	RRB-WT-10	707+00	124,468	3	36,603	47,343	125,573
WT	RRB-WT-11	740+00	193,210	3	58,609	70,854	193,905
WT	RRB-WT-12	847+00	110,146	3	31,923	41,991	110,525
WT	RRB-WT-13	887+00	110,146	3	31,923	41,991	110,525
WT	RRB-WT-14	914+50	128,718	3	37,823	48,731	129,484
WT	RRB-WT-15	972+50	57,154	3	16,224	23,040	58,598
WT	RRB-WT-16	1032+00	118,923	3	35,574	45,390	121,147
WT	RRB-WT-17	1047+00	302,883	3	93,636	108,900	303,516
WT	RRB-WT-18	1150+00	198,132	3	60,025	72,361	198,291
WT	RRB-WT-19	1165+00	81,778	3	23,328	31,680	82,193
WT	RRB-WT-20	1181+00	270,569	3	82,810	98,674	271,879
WT	RRB-WT-21	1247+00	153,251	3	25,000	33,976	88,120
WT	RRB-WT-22	1299+00	102,256	3	29,703	39,435	103,361
WT	RRB-WT-23	1323+00	89,586	3	26,136	34,632	90,854
WT	RRB-WT-24	1393+00	353,677	3	109,500	126,588	353,822
WT	RRB-WT-25	1455+00	297,538	3	92,256	107,712	299,653
WT	RRB-WT-26	1550+50	132,099	3	39,366	49,662	133,243
WT	RRB-WT-27	1566+00	221,315	3	67,240	81,592	222,901
WT	RRB-WT-28	1609+50	87,536	3	25,350	33,726	88,316
WT	RRB-WT-29	1631+00	121,342	3	35,403	45,975	121,721
WT	RRB-WT-30	1687+00	71,653	3	20,250	28,386	72,611
WT	RRB-WT-31	1705+00	42,360	3	11,449	17,161	42,627
WT	RRB-WT-32	1730+00	53,612	3	14,785	21,222	53,721
WT	RRB-WT-33	1772+00	148,526	3	44,376	55,272	149,173
WT	RRB-WT-34	1846+00	54,204	3	14,823	21,867	54,692
WT	RRB-WT-35	1884+00	204,151	3	62,424	75,240	206,197
WT	RRB-WT-36	1910+00	126,962	3	37,210	48,034	127,521
WT	RRB-WT-37	1934+00	143,478	3	42,250	53,746	143,649
WT	RRB-WT-38	2017+00	276,264	3	84,640	100,672	277,621
WT	RRB-WT-39	2119+00	126,230	3	37,210	48,034	127,521
WT	RRB-WT-40	2145+00	59,535	3	16,562	23,690	60,060

Rail Road Basins

Segment	Basin ID	Basin Location	Required Volume (cf)	Depth (ft)	Bt Area (sf)	TW Area (sf)	Volume (cf)
WT	RRB-WT-41	2164+00	70,724	3	20,070	27,635	71,257
WT	RRB-WT-42	2195+00	54,481	3	14,823	21,867	54,692
WT	RRB-WT-43	2235+00	99,175	3	28,623	38,187	99,869
WT	RRB-WT-44	2275+00	86,193	3	24,503	33,395	86,502
WT	RRB-WT-45	2289+00	42,352	3	11,223	17,427	42,634
WT	RRB-WT-46	2369+00	151,344	3	44,890	56,722	152,072
WT	RRB-WT-47	2397+00	58,389	3	16,224	23,040	58,598
WT	RRB-WT-48	2420+00	38,712	3	10,334	15,890	39,037
WT	RRB-WT-49	2531+00	192,371	3	58,806	71,262	194,803
WT	RRB-WT-50	2580+00	248,264	3	76,614	90,750	250,747
WT	RRB-WT-51	2631+00	103,231	3	30,246	39,342	104,083
WT	RRB-WT-52	1710+00	190,433	3	57,624	69,960	191,077
WT	RRB-WT-53	2755+00	98,605	3	28,623	38,187	99,869
WT	RRB-WT-54	2775+00	152,656	3	46,208	57,728	155,584
WT	RRB-WT-55	2996+50	117,183	3	32,490	42,642	112,353
WT	RRB-WT-56	3028+00	151,132	3	44,890	56,722	152,072
WT	RRB-WT-57	3072+00	339,731	3	105,063	122,859	341,534
WT	RRB-WT-58	3135+00	147,729	3	43,560	55,224	147,830
WT	RRB-WT-59	3247+00	145,635	3	42,903	54,483	145,732
WT	RRB-WT-60	3384+00	237,717	3	72,250	87,106	238,687
WT	RRB-WT-61	3419+00	152,582	3	45,563	57,479	154,216
WT	RRB-WT-62	3482+00	303,978	3	93,123	109,911	304,202
WT	RRB-WT-63	3594+00	380,377	3	118,810	137,698	384,414
WT	RRB-WT-64	3705+00	285,107	3	87,423	103,707	286,346
WT	RRB-WT-65	3725+00	219,037	3	66,423	80,691	220,323
WT	RRB-WT-66	3823+00	138,187	3	40,960	52,288	139,527
WT	RRB-WT-67	3867+00	133,111	3	39,063	50,139	133,456
WT	RRB-WT-68	3915+00	156,127	3	46,240	58,240	156,374
WT	RRB-WT-69	4053+00	75,496	3	21,160	29,464	75,593
WT	RRB-WT-03	293+00	45,385	3	12,250	18,706	46,094
WT	RRB-WT-04	308+00	72,585	3	20,250	28,386	72,611
WT	RRB-WT-05	328+00	96,990	3	28,090	37,570	98,146
WT	RRB-WT-06	482+00	106,896	3	30,803	40,703	106,913
WT	RRB-WT-07	569+00	275,785	3	84,640	100,672	277,621
WT	RRB-WT-08	633+00	81,275	3	23,040	31,680	81,737
WT	RRB-WT-09	660+00	104,591	3	30,625	39,601	105,051
IH1	RRB-IH1-01	36+00	125,288	3	36,600	47,304	125,513
IH1	RRB-IH1-02	50+00	123,971	3	36,450	46,746	124,474
IH1	RRB-IH1-03	88+00	143,635	3	42,750	53,430	143,973
IH1	RRB-IH1-10	739+00	119,476	3	34,800	45,216	119,684
IH1	RRB-IH1-11	787+50	25,863	3	6,500	11,036	26,006
IH1	RRB-IH1-12	822+00	158,028	3	47,100	58,644	158,300
IH1	RRB-IH1-13	853+50	110,070	3	32,120	41,480	110,101
IH1	RRB-IH1-14	880+00	138,294	3	41,170	51,562	138,806
IH1	RRB-IH1-15	926+00	176,632	3	53,200	65,056	177,086
IH1	RRB-IH1-16	966+00	115,436	3	33,810	43,434	115,565
IH1	RRB-IH1-17	997+50	236,877	3	72,240	86,112	237,224
IH1	RRB-IH1-18	1034+00	136,829	3	40,500	51,156	137,173

Segment	Basin ID	Basin Location	Required Volume (cf)	Depth (ft)	Bt Area (sf)	TW Area (sf)	Volume (cf)
IH1	RRB-IH1-19	1060+00	73,292	3	20,470	28,702	73,411
IH1	RRB-IH1-20	1210+00	63,044	3	17,640	24,600	63,071
IH1	RRB-IH1-21	1243+00	129,388	3	38,280	48,312	129,596
IH1	RRB-IH1-22	1307+00	176,125	3	52,920	64,752	176,210
IH1	RRB-IH1-23	1373+00	77,092	3	21,960	29,784	77,319
IH1	RRB-IH1-24	1400+00	51,710	3	14,080	20,608	51,722
IH1	RRB-IH1-25	1448+00	37,104	3	9,840	15,264	37,360
IH1	RRB-IH1-26	1586+00	48,600	3	13,120	19,504	48,621
IH1	RRB-IH1-27	1624+00	198,507	3	60,200	72,656	198,991
IH1	RRB-IH1-28	1686+00	58,364	3	16,160	23,000	58,439
IH1	RRB-IH1-29	1700+00	168,926	3	50,880	62,304	169,487
IH1	RRB-IH1-30	1743+00	127,666	3	37,599	47,775	127,757
IH1	RRB-IH1-31	815+00	50,924	3	13,950	20,358	51,160
IH1	RRB-IH1-32	1830+00	70,623	3	19,980	27,540	70,977
IH1	RRB-IH1-33	1866+50	76,666	3	21,900	29,580	76,932
IH1	RRB-IH1-34	1895+00	50,924	3	13,950	20,358	51,160
IH1	RRB-IH1-35	1982+00	42,249	3	11,340	17,100	42,365
IH1	RRB-IH1-36	2000+00	93,104	3	26,840	35,624	93,386
IH1	RRB-IH1-37	2050+00	151,040	3	45,000	55,896	151,049
IH1	RRB-IH1-38	2063+00	162,446	3	48,600	60,264	162,983
IH1	RRB-IH1-39	2110+00	49,022	3	13,390	19,558	49,131
IH1	RRB-IH1-40	2163+00	89,983	3	26,010	34,338	90,233
IH1	RRB-IH1-41	2181+50	115,608	3	33,750	43,566	115,661
IH1	RRB-IH1-42	2202+00	104,327	3	30,380	39,524	104,556
IH1	RRB-IH1-43	2243+00	110,782	3	32,160	42,048	110,981
IH1	RRB-IH1-44	2283+00	88,098	3	25,340	33,620	88,148
IH1	RRB-IH1-45	2294+00	61,511	3	17,160	24,048	61,522
IH1	RRB-IH1-46	2352+00	48,368	3	13,260	19,404	48,704
IH1	RRB-IH1-47	2373+00	115,574	3	33,750	43,566	115,661
IH1	RRB-IH1-48	2434+00	39,547	3	10,530	16,074	39,614
IH1	RRB-IH1-49	2566+00	73,243	3	20,740	28,324	73,301
IH1	RRB-IH1-50	2726+00	81,606	3	23,400	31,416	81,929
IH1	RRB-IH1-51	2741+00	70,329	3	19,890	27,258	70,432
IH1	RRB-IH1-52	2757+50	59,673	3	16,660	23,452	59,878
IH1	RRB-IH1-53	2797+00	142,688	3	42,300	53,244	143,002
IH1	RRB-IH1-54	2835+00	39,588	3	10,560	16,080	39,671
IH1	RRB-IH1-55	2856+00	70,720	3	20,060	27,548	71,116
IH1	RRB-IH1-56	2898+00	114,372	3	33,600	43,008	114,622
IH1	RRB-IH1-57	2922+00	72,736	3	20,600	28,448	73,256
IH1	RRB-IH1-58	2938+00	52,230	3	14,400	20,880	52,620
IH1	RRB-IH1-59	2961+00	42,774	3	11,480	17,384	42,991
IH1	RRB-IH1-61	3211+00	94,788	3	27,400	36,064	94,899
IH1	RRB-IH1-62	3265+00	123,916	3	36,270	46,662	124,071
IH1	RRB-IH1-63	3349+00	119,230	3	34,680	45,072	119,288
IH1	RRB-IH1-64	3372+00	129,849	3	38,640	48,768	130,818
IH1	RRB-IH1-66	3486+00	80,489	3	23,000	31,136	80,897
IH1	RRB-IH1-67	3594+00	30,116	3	7,680	12,672	30,217
IH1	RRB-IH1-68	3631+00	65,755	3	18,480	25,632	65,876

Segment	Basin ID	Basin Location	Required Volume (cf)	Depth (ft)	Bt Area (sf)	TW Area (sf)	Volume (cf)
IH1	RRB-IH1-69	3704+00	75,633	3	21,400	29,344	75,803
IH1	RRB-IH1-70	3830+00	86,723	3	24,840	33,264	86,849
IH1	RRB-IH1-71	3850+00	104,072	3	30,120	39,600	104,256
IH1	RRB-IH1-72	3880+00	167,160	3	49,800	61,944	167,285
IH1	RRB-IH1-73	3911+00	24,968	3	6,200	10,664	24,995
IH1	RRB-IH1-74	3935+00	62,730	3	17,500	24,676	62,957
IH1	RRB-IH1-75	3947+00	190,621	3	57,570	69,978	191,020
IH1	RRB-IH1-76	3983+00	99,615	3	29,000	37,856	99,989
IH1	RRB-IH1-77	4017+00	30,116	3	7,680	12,672	30,217
IH1	RRB-IH1-78	4043+50	74,252	3	20,900	28,892	74,365
IH1	RRB-IH1-79	4096+00	147,751	3	43,800	54,984	147,858
IH1	RRB-IH1-80	4233+00	122,838	3	35,760	46,368	122,848
IH1	RRB-IH1-81	4260+00	195,587	3	58,800	71,808	195,587
IH1	RRB-IH1-82	4306+00	46,604	3	12,600	18,792	46,780
IH1	RRB-IH1-83	4326+00	46,789	3	12,460	18,988	46,829
IH1	RRB-IH1-04	297+00	161,377	3	48,480	59,664	161,926
IH1	RRB-IH1-05	491+50	128,832	3	37,960	48,280	129,050
IH1	RRB-IH1-06	522+00	236,632	3	72,300	85,860	236,949
IH1	RRB-IH1-07	577+00	72,816	3	20,640	28,224	73,000
IH1	RRB-IH1-08	617+50	109,114	3	32,000	41,216	109,533
IH1	RRB-IH1-09	700+00	144,169	3	42,500	54,236	144,747
IH2	RRB-IH2-01	17+01	132,042	3	39,063	50,139	133,456
IH2	RRB-IH2-02	44+27	180,631	3	54,023	66,947	181,107
IH2	RRB-IH2-03	85+99	86,513	3	24,819	33,945	87,789
IH2	RRB-IH2-04	123+99	99,726	3	28,623	38,187	99,869
IH2	RRB-IH2-10	446+99	237,282	3	72,944	87,344	240,108
IH2	RRB-IH2-05	143+82	82,775	3	23,523	32,247	83,310
IH2	RRB-IH2-06	166+99	131,294	3	38,440	49,432	131,463
IH2	RRB-IH2-07	215+99	120,621	3	35,721	45,369	121,347
IH2	RRB-IH2-08	348+99	50,168	3	13,690	20,482	50,917
IH2	RRB-IH2-09	397+99	63,142	3	17,640	25,272	64,026
NW	RRB-NW-01	201+00	49,525	3	13,500	19,836	49,700
NW	RRB-NW-02	232+00	138,295	3	40,800	51,840	138,630
NW	RRB-NW-03	370+00	147,051	3	43,750	54,526	147,118
NW	RRB-NW-04	499+00	53,643	3	14,580	21,420	53,672
NW	RRB-NW-05	529+00	190,505	3	57,078	70,350	190,795
NW	RRB-NW-10	931+00	194,194	3	57,600	72,576	194,832
NW	RRB-NW-11	964+00	139,711	3	41,500	52,060	140,041
NW	RRB-NW-12	996+00	57,752	3	16,000	22,816	57,922
NW	RRB-NW-13	1021+00	113,013	3	33,020	42,884	113,534
NW	RRB-NW-14	1045+00	177,625	3	53,400	65,448	177,966
NW	RRB-NW-15	1087+00	52,251	3	14,280	20,952	52,529
NW	RRB-NW-16	1111+00	44,519	3	12,000	18,096	44,832
NW	RRB-NW-17	1205+00	60,093	3	16,600	23,968	60,515
NW	RRB-NW-18	1236+00	120,976	3	35,280	45,600	120,989
NW	RRB-NW-19	1308+00	153,693	3	45,920	57,152	154,301
NW	RRB-NW-20	1343+00	63,547	3	17,760	24,840	63,604
NW	RRB-NW-21	1387+00	95,209	3	27,500	36,356	95,475

Rail Road Basins

Segment	Basin ID	Basin Location	Required Volume (cf)	Depth (ft)	Bt Area (sf)	TW Area (sf)	Volume (cf)
NW	RRB-NW-22	1403+00	95,306	3	27,360	36,432	95,364
NW	RRB-NW-23	1425+00	170,275	3	51,120	62,832	170,626
NW	RRB-NW-24	1525+00	138,420	3	40,880	51,680	138,524
NW	RRB-NW-25	1587+00	174,385	3	52,140	64,428	174,527
NW	RRB-NW-26	1612+00	82,272	3	23,580	31,620	82,506
NW	RRB-NW-27	1626+50	79,081	3	22,610	30,458	79,310
NW	RRB-NW-06	586+00	65,454	3	18,450	25,578	65,752
NW	RRB-NW-07	708+00	119,259	3	35,070	44,694	119,355
NW	RRB-NW-08	744+00	70,683	3	19,980	27,540	70,977
NW	RRB-NW-09	888+00	66,273	3	18,540	25,908	66,365
NE	RRB-NE-01	186+00	105,427	3	30,800	39,872	105,716
NE	RRB-NE-02	227+00	175,195	3	52,456	64,792	175,547
NE	RRB-NE-03	275+00	73,169	3	20,600	28,448	73,256
NE	RRB-NE-04	300+00	165,987	3	49,840	61,408	166,570
NE	RRB-NE-05	431+00	116,294	3	34,126	43,750	116,516
NE	RRB-NE-06	447+00	130,013	3	38,100	48,924	130,198
NE	RRB-NE-10	612+00	62,103	3	17,280	24,480	62,327
NE	RRB-NE-11	627+00	156,847	3	46,760	58,064	156,930
NE	RRB-NE-12	665+00	194,469	3	58,860	71,148	194,721
NE	RRB-NE-13	723+00	138,857	3	41,148	51,708	138,983
NE	RRB-NE-14	770+00	170,330	3	51,240	62,928	170,952
NE	RRB-NE-15	817+00	98,301	3	27,200	39,008	98,781
NE	RRB-NE-16	828+00	175,136	3	52,488	64,728	175,504
NE	RRB-NE-17	939+00	68,555	3	19,440	26,928	69,248
NE	RRB-NE-18	968+00	74,104	3	21,080	28,712	74,394
NE	RRB-NE-19	984+00	48,255	3	13,160	19,352	48,470
NE	RRB-NE-20	1032+00	120,850	3	35,500	45,484	121,167
NE	RRB-NE-21	1076+00	94,123	3	27,360	35,904	94,606
NE	RRB-NE-22	1109+00	120,659	3	35,600	45,248	120,983
NE	RRB-NE-23	1173+00	80,055	3	22,800	30,816	80,123
NE	RRB-NE-24	1209+00	150,094	3	44,800	55,936	150,795
NE	RRB-NE-25	1240+50	136,176	3	40,320	51,072	136,771
NE	RRB-NE-26	1416+00	75,083	3	21,420	29,100	75,486
NE	RRB-NE-27	1437+00	84,861	3	24,320	32,528	84,974
NE	RRB-NE-28	1453+00	110,391	3	32,340	41,724	110,798
NE	RRB-NE-29	1543+00	176,326	3	53,100	65,124	177,029
NE	RRB-NE-30	1609+00	166,203	3	50,176	61,504	167,232
NE	RRB-NE-31	1633+00	177,149	3	53,361	65,025	177,291
NE	RRB-NE-07	476+00	55,188	3	15,260	21,812	55,316
NE	RRB-NE-08	485+00	146,070	3	43,200	54,432	146,124
NE	RRB-NE-09	523+00	36,304	3	9,600	14,976	36,566
EW	RRB-EW-01	33+00	130,790	3	39,200	49,856	133,264
EW	RRB-EW-02	176+00	34,244	3	9,000	14,616	35,085
EW	RRB-EW-03	204+00	114,818	3	33,800	43,736	115,984
EW	RRB-EW-04	228+00	187,628	3	57,800	70,616	192,303
EW	RRB-EW-05	261+00	90,961	3	28,800	38,016	99,905
EW	RRB-EW-06	320+00	68,416	3	20,000	27,776	71,345
EW	RRB-EW-07	568+00	68,994	3	20,000	27,776	71,345

Rail Road Basins

Segment	Basin ID	Basin Location	Required Volume (cf)	Depth (ft)	Bt Area (sf)	TW Area (sf)	Volume (cf)
EW	RRB-EW-10	775+00	68,684	3	20,250	28,386	72,611
EW	RRB-EW-11	848+00	114,330	3	36,000	46,656	123,639
EW	RRB-EW-12	874+00	120,640	3	36,000	46,656	123,639
EW	RRB-EW-13	949+00	122,147	3	38,400	48,576	130,165
EW	RRB-EW-14	1060+00	129,955	3	39,200	49,856	133,264
EW	RRB-EW-15	1148+00	55,329	3	15,400	21,976	55,772
EW	RRB-EW-16	1205+00	59,475	3	16,380	23,484	59,477
EW	RRB-EW-08	724+00	66,066	3	20,000	27,776	71,345
EW	RRB-EW-09	746+50	88,677	3	28,800	38,016	99,905
EE	RRB-EE-01	32+00	130,244	3	38,144	48,944	130,296
EE	RRB-EE-02	137+00	166,670	3	50,085	61,557	167,168
EE	RRB-EE-03	253+00	99,973	3	28,994	37,994	100,178
EE	RRB-EE-04	280+00	75,868	3	21,340	29,524	75,965
EE	RRB-EE-05	330+00	43,024	3	11,640	17,424	43,305
EE	RRB-EE-06	395+00	59,601	3	16,380	23,652	59,715
EE	RRB-EE-07	433+50	90,728	3	26,010	35,154	91,402
EE	RRB-EE-08	497+00	128,667	3	37,800	48,600	129,261
EE	RRB-EE-10	673+00	104,280	3	30,130	39,754	104,493
EE	RRB-EE-11	712+00	152,344	3	45,500	56,516	152,726
EE	RRB-EE-12	917+00	112,100	3	32,780	42,212	112,190
EE	RRB-EE-13	950+00	128,073	3	37,840	47,824	128,204
EE	RRB-EE-14	980+00	59,667	3	16,400	23,744	59,877
EE	RRB-EE-15	994+00	25,007	3	6,250	11,026	25,577
EE	RRB-EE-16	1032+00	101,313	3	29,700	38,796	102,441
EE	RRB-EE-17	1106+50	107,972	3	31,460	40,748	108,012
EE	RRB-EE-09	516+00	119,363	3	35,200	44,800	119,711
DS	RRB-DS-01	149+00	34,259	3	9,000	14,256	34,583
DS	RRB-DS-02	213+00	157,912	3	47,700	58,956	159,686
DS	RRB-DS-03	267+00	163,626	3	49,500	60,996	165,444
DS	RRB-DS-04	294+00	99,110	3	28,980	37,908	100,033
DS	RRB-DS-05	320+00	117,750	3	34,800	45,216	119,684
DS	RRB-DS-06	434+00	36,264	3	9,600	15,456	37,237
DS	RRB-DS-07	454+00	72,716	3	21,000	29,016	74,701

Segment	Basin ID	Basin Location	Volume Required (ac-ft)	Depth (ft)	Bt Area (ac)	WS Area (ac)	Volume Provided (ac-ft)
HN1	CHB-HN1-01	1108+00	9.1	3.0	2.8	3.2	9.1
HN1	CHB-HN1-05	1320+00	8.5	3.0	2.6	3.0	8.5
HN1	CHB-HN1-06	1450+00	10.1	4.0	2.3	2.8	10.2
HN1	CHB-HN1-07	1450+00	6.9	4.5	1.3	1.8	7.0
HN1	CHB-HN1-11	1885+00	7.1	3.0	2.6	3.0	8.3
HN1	CHB-HN1-12	2363+00	6.9	5.0	1.2	1.6	6.9
HN2	CHB-HN2-01	121+00	7.2	3.0	2.2	2.6	7.2
HN2	CHB-HN2-02	537+00	5.2	3.0	1.6	1.9	5.2
HN2	CHB-HN2-04	828+00	4.7	3.0	1.4	1.7	4.7
HN2	CHB-HN2-05	940+00	13.6	3.0	4.3	4.8	13.6
HN2	CHB-HN2-06	1050+00	10.9	3.0	3.4	3.9	10.9
HN2	CHB-HN2-08	1370+00	8.9	3.0	2.8	3.2	8.9
HN2	CHB-HN2-09	1520+00	8.8	3.0	2.7	3.1	8.8
HN2	CHB-HN2-10	1920+00	10.4	3.0	3.3	3.7	10.5
WT	CHB-WT-01	285+00	12.7	3.0	4.0	4.5	12.7
WT	CHB-WT-02	679+00	16.9	3.0	5.3	5.9	16.9
WT	CHB-WT-03	750+00	7.1	3.0	2.2	2.6	7.2
WT	CHB-WT-04	917+00	10.2	3.0	3.2	3.6	10.3
WT	CHB-WT-05	985+00	16.8	3.0	5.3	5.9	16.8
WT	CHB-WT-06	1010+00	12.7	3.0	4.4	4.9	13.8
WT	CHB-WT-07	2557+00	8.1	3.0	2.5	2.9	8.1
WT	CHB-WT-08	2747+00	9.1	3.0	2.8	3.2	9.1
WT	CHB-WT-09	3455+00	18.1	3.0	5.7	6.4	18.1
WT	CHB-WT-10	3501+00	11.2	3.0	3.5	4.0	11.2
WT	CHB-WT-11	3654+00	7.7	3.0	2.4	2.8	7.7
WT	CHB-WT-12	3751+00	7.0	3.0	2.2	2.5	7.0
WT	CHB-WT-13	3795+00	12.2	3.0	3.8	4.3	12.2
WT	CHB-WT-14	3870+00	17.8	3.0	5.7	6.2	17.9
IH1	CHB-IH1-.5	4013+00	3.4	3.0	1.0	1.3	3.4
IH1	CHB-IH1-01A	4315+00	4.7	3.0	1.4	1.7	4.8
IH1	CHB-IH1-01B	4315+00	3.0	3.0	0.9	1.1	3.0
IH1	CHB-IH1-02A	4288+00	2.3	3.0	0.7	0.9	2.4
IH1	CHB-IH1-02B	4288+00	3.2	3.0	1.0	1.2	3.3
IH1	CHB-IH1-04	4080+00	7.8	3.0	2.4	2.8	7.8
IH1	CHB-IH1-05A	3980+00	3.2	3.0	1.0	1.2	3.3
IH1	CHB-IH1-05B	3980+00	3.0	3.0	0.9	1.1	3.0
IH1	CHB-IH1-08A	3461+50	5.1	3.0	1.6	1.9	5.2
IH1	CHB-IH1-08B	3461+50	3.6	3.0	1.1	1.4	3.7
IH1	CHB-IH1-09A	3220+00	2.9	3.0	0.9	1.1	2.9
IH1	CHB-IH1-09B	3220+00	3.4	3.0	1.0	1.2	3.4
IH1	CHB-IH1-10A	3090+00	3.7	3.0	1.7	2.0	5.5
IH1	CHB-IH1-10B	3090+00	5.9	3.0	2.3	2.7	7.5
IH1	CHB-IH1-11	3040+00	14.4	3.0	4.0	4.5	12.7
IH1	CHB-IH1-14	2110+00	5.6	3.0	1.7	2.0	5.6
IH1	CHB-IH1-15A	1710+00	0.9	3.0	0.2	0.4	0.9
IH1	CHB-IH1-15B	1710+00	3.9	3.0	1.2	1.5	4.0
IH1	CHB-IH1-16A	1340+00	4.3	3.0	1.4	1.7	4.6
IH1	CHB-IH1-16B	1340+00	5.5	3.0	1.8	2.2	6.0
IH1	CHB-IH1-17	1240+00	4.7	3.0	1.4	1.7	4.7
IH1	CHB-IH1-19	1010+00	6.8	3.0	2.1	2.5	6.8
IH1	CHB-IH1-20A	960+00	4.9	3.0	1.5	1.8	4.9

Segment	Basin ID	Basin Location	Volume Required (ac-ft)	Depth (ft)	Bt Area (ac)	WS Area (ac)	Volume Provided (ac-ft)
IH1	CHB-IH1-20B	960+00	3.0	3.0	0.9	1.1	3.0
IH1	CHB-IH1-21A	610+00	5.9	3.0	1.8	2.2	6.0
IH1	CHB-IH1-21B	610+00	7.1	3.0	2.2	2.6	7.2
IH1	CHB-IH1-22	555+00	10.2	3.0	3.2	3.6	10.2
IH2	CHB-IH2-01	63+00	4.7	3.0	1.4	1.7	4.7
IH2	CHB-IH2-02	210+00	0.8	3.0	0.5	0.7	1.9
NW	CHB-NW-05A	379+00	2.7	3.0	0.8	1.0	2.8
NW	CHB-NW-05B	380+00	4.0	3.0	1.2	1.5	4.0
NW	CHB-NW-06A	552+00	1.7	3.0	0.5	0.7	1.7
NW	CHB-NW-06B	555+00	1.7	3.0	0.5	0.7	1.7
NW	CHB-NW-07A	731+00	2.5	3.0	0.7	1.0	2.5
NW	CHB-NW-07B	731+50	4.3	3.0	1.3	1.6	4.3
NW	CHB-NW-09A	948+00	3.2	3.0	0.9	1.2	3.2
NW	CHB-NW-09B	954+00	4.7	3.0	1.4	1.7	4.7
NW	CHB-NW-11A	1228+50	3.6	5.0	0.6	0.9	3.6
NW	CHB-NW-11B	1235+00	3.3	5.0	0.5	0.8	3.3
NW	CHB-NW-13A	1327+00	2.4	3.0	0.7	0.9	2.4
NW	CHB-NW-13B	1329+00	5.5	3.0	1.7	2.0	5.5
NW	CHB-NW-14A	1395+00	4.2	3.0	1.3	1.5	4.2
NW	CHB-NW-14B	1397+00	4.1	3.0	1.2	1.5	4.1
NW	CHB-NW-15A	1544+00	2.9	3.0	0.8	1.1	2.9
NW	CHB-NW-15B	1547+50	3.9	3.0	1.2	1.4	3.9
NW	CHB-NW-16A	1598+00	4.3	3.0	1.3	1.6	4.3
NW	CHB-NW-16B	1599+00	3.6	3.0	1.1	1.3	3.6
NE	CHB-NE-01	288+00	6.9	3.0	2.1	2.5	6.9
NE	CHB-NE-02	626+50	3.9	3.0	1.2	1.5	3.9
NE	CHB-NE-03	628+00	4.4	3.0	1.3	1.6	4.4
NE	CHB-NE-04	701+00	4.1	3.0	1.2	1.5	4.1
NE	CHB-NE-05	705+00	4.1	3.0	1.2	1.5	4.1
NE	CHB-NE-06	802+00	2.9	3.0	0.8	1.1	2.9
NE	CHB-NE-07	807+50	3.5	3.0	1.0	1.3	3.5
NE	CHB-NE-08A	966+00	10.0	3.0	3.1	3.5	10.0
NE	CHB-NE-08B	969+00	4.4	3.0	1.3	1.6	4.4
NE	CHB-NE-09	1051+00	4.6	3.0	1.4	1.7	4.6
NE	CHB-NE-10	1059+00	4.6	3.0	1.4	1.7	4.6
NE	CHB-NE-11	1247+00	8.1	3.0	2.5	2.9	8.1
NE	CHB-NE-12	1396+00	4.2	3.0	1.3	1.5	4.2
NE	CHB-NE-13	1341+00	4.2	3.0	1.3	1.5	4.2
NE	CHB-NE-14	1564+00	6.1	3.0	1.9	2.2	6.1
NE	CHB-NE-15	1623+00	8.1	3.0	2.5	2.9	8.1
EW	CHB-EW-01	25+00	5.7	3.0	1.8	2.2	6.0
EW	CHB-EW-02A	188+00	6.9	3.0	2.2	2.6	7.1
EW	CHB-EW-02B	197+00	6.4	3.0	2.0	2.4	6.6
EW	CHB-EW-03	253+00	5.8	3.0	1.8	2.2	6.0
EW	CHB-EW-04	766+00	6.4	3.0	2.0	2.4	6.6
EW	CHB-EW-05A	850+00	6.1	3.0	2.0	2.3	6.5
EW	CHB-EW-05B	857+00	7.5	3.0	2.4	2.8	7.9
EW	CHB-EW-06A	1031+00	6.7	4.5	1.3	1.8	7.0
EW	CHB-EW-06B	1035+00	4.0	3.0	1.2	1.5	4.1
EW	CHB-EW-07	1160+00	3.4	3.0	1.0	1.3	3.5
EE	CHB-EE-01	23+00	6.1	3.0	1.9	2.2	6.1

Segment	Basin ID	Basin Location	Volume Required (ac-ft)	Depth (ft)	Bt Area (ac)	WS Area (ac)	Volume Provided (ac-ft)
EE	CHB-EE-02A	116+00	2.9	3.0	0.8	1.1	2.9
EE	CHB-EE-02B	117+00	2.7	3.0	0.8	1.0	2.8
EE	CHB-EE-03A	264+00	3.6	3.0	1.1	1.4	3.7
EE	CHB-EE-03B	266+00	3.3	3.0	1.0	1.2	3.4
EE	CHB-EE-04A	397+00	4.1	3.0	1.2	1.5	4.1
EE	CHB-EE-04B	405+00	4.1	3.0	1.2	1.5	4.1
EE	CHB-EE-05	503+00	5.0	3.0	1.5	1.8	5.0
EE	CHB-EE-06	735+00	3.9	3.0	1.2	1.5	3.9
EE	CHB-EE-07	1120+00	8.0	3.0	2.5	2.9	8.0
DS	CHB-DS-01	250+00	5.2	3.0	1.6	1.9	5.2
DS	CHB-DS-02	267+00	3.4	3.5	0.9	1.2	3.7
DS	CHB-DS-03	315+00	4.0	3.0	1.2	1.5	4.1

Appendix J

Utility Crossings

Crossing ID	Stationing	Utility Type	Size / Diameter (in)	Transmission Voltage	Utility Owner	System Name	Status	Length of Affected Utility (ft)	Parallel, Crossing, or Both
CU-HT1-1	HT1 10+00	STORMWATER	72		CITY OF HOUSTON		PROTECT	2200	PARALLEL
CU-HT1-2	HT1 10+00	WASTEWATER	42		CITY OF HOUSTON		PROTECT	2200	PARALLEL
CU-HT1-3	HT1 10+00	WATER	24		CITY OF HOUSTON		PROTECT	2200	PARALLEL
CU-HT1-4	HT1 16+64	COMMUNICATION - UG	300 Pr		AT&T TEXAS		RELOCATE	400	CROSS
CU-HT1-5	HT1 19+93	COMMUNICATION - UG	200 Pr		AT&T TEXAS		RELOCATE	350	CROSS
CU-HT1-6	HT1 21+88	COMMUNICATION - UG	300 Pr		AT&T TEXAS		RELOCATE	500	CROSS
CU-HT1-7	HT1 22+07	COMMUNICATION - UG	300 Pr		AT&T TEXAS		RELOCATE	100	CROSS
CU-HT1-8	HT1 24+77	COMMUNICATION - UG	300 Pr		AT&T TEXAS		RELOCATE	450	CROSS
CU-HT1-9	HT1 26+12	COMMUNICATION - OH	400 Pr		AT&T TEXAS		RELOCATE	600	CROSS
CU-HT1-10	HT1 32+24	COMMUNICATION - UG	300 Pr		AT&T TEXAS		RELOCATE	450	CROSS
CU-HT1-11	HT1 32+37	COMMUNICATION - UG	300 Pr		AT&T TEXAS		RELOCATE	550	CROSS
CU-HT1-12	HT1 35+09	SANITARY GRAVITY MAIN	48		CITY OF HOUSTON		NO IMPACT		CROSS
CU-HT1-13	HT1 35+28	STORMWATER	30		CITY OF HOUSTON		NO IMPACT		CROSS
CU-HT1-14	HT1 35+28	WATER	72		CITY OF HOUSTON		NO IMPACT		CROSS
CU-HT1-15	HT1 41+82	COMMUNICATION - UG	200 Pr		AT&T TEXAS		RELOCATE	350	CROSS
CU-HT1-16	HT1 45+00	STORMWATER	78		CITY OF HOUSTON		PROTECT	2000	PARALLEL
CU-HT1-17	HT1 45+00	STORMWATER	54		CITY OF HOUSTON		PROTECT	1500	PARALLEL
CU-HT1-18	HT1 45+00	WASTEWATER	48		CITY OF HOUSTON		PROTECT	1500	PARALLEL
CU-HT1-19	HT1 45+00	WATER	72		CITY OF HOUSTON		PROTECT	1500	PARALLEL
CU-HT1-20	HT1 48+67	ELECTRIC TRANSMISSION		115kV - 161kV	CENTERPOINT ENERGY		ELEVATE	2000	CROSS
CU-HT1-21	HT1 48+67	ELECTRIC TRANSMISSION		115kV - 161kV	CENTERPOINT ENERGY		ELEVATE	2000	CROSS
CU-HT1-22	HT1 60+00	WATER	24		CITY OF HOUSTON		PROTECT	4800	PARALLEL
CU-HT1-23	HT1 63+46	COMMUNICATION - UG	400 Pr		AT&T TEXAS		RELOCATE	500	CROSS
CU-HT1-24	HT1 63+56	STORMWATER	42		CITY OF HOUSTON		PROTECT	100	CROSS
CU-HT1-25	HT1 64+02	WATER	24		CITY OF HOUSTON		PROTECT	100	CROSS
CU-HT1-26	HT1 86+91	COMMUNICATION - UG	100 Pr		AT&T TEXAS		RELOCATE	150	CROSS
CU-HT1-27	HT1 89+90	COMMUNICATION - UG	100 Pr		AT&T TEXAS		RELOCATE	300	CROSS
CU-HT1-28	HT1 90+06	SANITARY GRAVITY MAIN	60		CITY OF HOUSTON		PROTECT	150	CROSS
CU-HT1-29	HT1 104+91	COMMUNICATION - UG	400 Pr		AT&T TEXAS		RELOCATE	150	CROSS
CU-HT2-1	HT2 20+00	WATER	24		CITY OF HOUSTON		PROTECT	4800	PARALLEL
CU-HT2-2	HT2 21+50	COMMUNICATION - UG	400 Pr		AT&T TEXAS		RELOCATE	500	CROSS
CU-HT2-3	HT2 21+50	STORMWATER	42		CITY OF HOUSTON		PROTECT	100	CROSS
CU-HT2-4	HT2 22+00	WATER	24		CITY OF HOUSTON		PROTECT	100	CROSS
CU-HT2-5	HT2 45+20	COMMUNICATION - UG	100 Pr		AT&T TEXAS		RELOCATE	150	CROSS
CU-HT2-6	HT2 48+20	COMMUNICATION - UG	100 Pr		AT&T TEXAS		RELOCATE	300	CROSS
CU-HT2-7	HT2 48+40	SANITARY GRAVITY MAIN	60		CITY OF HOUSTON		PROTECT	150	CROSS
CU-HT2-8	HT2 63+00	COMMUNICATION - UG	400 Pr		AT&T TEXAS		RELOCATE	150	CROSS
CU-HT3-1	HT3 10+00	STORMWATER	78		CITY OF HOUSTON		PROTECT	2000	PARALLEL
CU-HT3-2	HT3 10+00	STORMWATER	54		CITY OF HOUSTON		PROTECT	1500	PARALLEL
CU-HT3-3	HT3 10+00	WASTEWATER	48		CITY OF HOUSTON		PROTECT	1500	PARALLEL
CU-HT3-4	HT3 10+00	WATER	72		CITY OF HOUSTON		PROTECT	1500	PARALLEL
CU-HT3-5	HT3 10+00	WATER	24		CITY OF HOUSTON		PROTECT	4800	PARALLEL
CU-HT3-6	HT3 10+00	COMMUNICATION - UG	400 Pr		AT&T TEXAS		RELOCATE	500	CROSS
CU-HT3-7	HT3 10+00	STORMWATER	42		CITY OF HOUSTON		PROTECT	100	CROSS
CU-HT3-8	HT3 10+00	WATER	24		CITY OF HOUSTON		PROTECT	100	CROSS
CU-HT3-9	HT3 31+20	COMMUNICATION - UG	100 Pr		AT&T TEXAS		RELOCATE	150	CROSS
CU-HT3-10	HT3 34+30	COMMUNICATION - UG	100 Pr		AT&T TEXAS		RELOCATE	300	CROSS
CU-HT3-11	HT3 34+70	SANITARY GRAVITY MAIN	60		CITY OF HOUSTON		PROTECT	150	CROSS
CU-HT3-12	HT3 49+00	COMMUNICATION - UG	400 Pr		AT&T TEXAS		RELOCATE	150	CROSS
CU-HN-1	HN1 10+55	COMMUNICATION - UG	900 Pr		AT&T TEXAS		RELOCATE	550	CROSS
CU-HN-2	HN1 10+66	WATER	36		CITY OF HOUSTON		PROTECT	100	CROSS
CU-HN-3	HN1 41+45	COMMUNICATION - UG	100 Pr		AT&T TEXAS		RELOCATE	200	CROSS
CU-HN-4	HN1 45+00	WATER	24		CITY OF HOUSTON		PROTECT	13000	PARALLEL
CU-HN-5	HN1 71+17	ELECTRIC TRANSMISSION		115kV - 161kV	CENTERPOINT ENERGY		ELEVATE	2000	CROSS
CU-HN-6	HN1 71+17	ELECTRIC TRANSMISSION		115kV - 161kV	CENTERPOINT ENERGY		ELEVATE	2000	CROSS
CU-HN-7	HN1 71+69	ELECTRIC TRANSMISSION		345kV - 450kV	CENTERPOINT ENERGY		ELEVATE	2000	CROSS
CU-HN-8	HN1 74+33	CRUDE OIL	12.75		ENTERPRISE CRUDE PIPELINE LLC	TEPPCO SOUTH TEXAS CRUDE LINES	PROTECT	400	CROSS
CU-HN-9	HN1 75+00	STORMWATER	36.00		CITY OF HOUSTON		PROTECT	350	PARALLEL
CU-HN-10	HN1 76+54	COMMUNICATION - UG	900 Pr		AT&T TEXAS		RELOCATE	450	CROSS
CU-HN-11	HN1 99+84	COMMUNICATION - OH	200 Pr		AT&T TEXAS		RELOCATE	400	CROSS
CU-HN-12	HN1 100+00	WASTEWATER	18		CITY OF HOUSTON		PROTECT	1000	PARALLEL
CU-HN-13	HN1 100+00	STORMWATER	96		CITY OF HOUSTON		PROTECT	1200	PARALLEL
CU-HN-14	HN1 108+55	SANITARY FORCE MAIN	20		CITY OF HOUSTON		PROTECT	100	CROSS
CU-HN-15	HN1 109+73	SANITARY FORCE MAIN	18		CITY OF HOUSTON		PROTECT	100	CROSS
CU-HN-16	HN1 119+51	WATER	20		CITY OF HOUSTON		PROTECT	100	CROSS
CU-HN-17	HN1 130+18	SANITARY GRAVITY MAIN	18		CITY OF HOUSTON		PROTECT	100	CROSS
CU-HN-18	HN1 130+19	COMMUNICATION - OH	900 Pr		AT&T TEXAS		RELOCATE	400	CROSS
CU-HN-19	HN1 130+69	COMMUNICATION - UG	400 Pr		AT&T TEXAS		RELOCATE	650	CROSS
CU-HN-20	HN1 130+96	COMMUNICATION - OH	300 Pr		AT&T TEXAS		RELOCATE	100	CROSS
CU-HN-21	HN1 132+18	COMMUNICATION - UG	900 Pr		AT&T TEXAS		RELOCATE	500	CROSS

Crossing ID	Stationing	Utility Type	Size / Diameter (in)	Transmission Voltage	Utility Owner	System Name	Status	Length of Affected Utility (ft)	Parallel, Crossing, or Both
CU-HN-22	HN1 143+64	COMMUNICATION - UG	900 Pr		AT&T TEXAS		RELOCATE	450	CROSS
CU-HN-23	HN1 162+48	WATER	20		CITY OF HOUSTON		PROTECT	100	CROSS
CU-HN-24	HN1 186+11	COMMUNICATION - UG	100 Pr		AT&T TEXAS		RELOCATE	200	CROSS
CU-HN-25	HN1 190+20	COMMUNICATION - UG	200 Pr		AT&T TEXAS		RELOCATE	450	CROSS
CU-HN-26	HN1 197+78	COMMUNICATION - UG	200 Pr		AT&T TEXAS		RELOCATE	2300	CROSS
CU-HN-27	HN1 202+99	COMMUNICATION - UG	300 Pr		AT&T TEXAS		RELOCATE	500	CROSS
CU-HN-28	HN1 210+45	COMMUNICATION - UG	900 Pr		AT&T TEXAS		RELOCATE	150	CROSS
CU-HN-29	HN1 210+85	NATURAL GAS	14		NETCO PIPELINE, L.L.C.	NETCO PIPELINE	PROTECT	300	CROSS
CU-HN-30	HN1 242+95	COMMUNICATION - UG	900 Pr		AT&T TEXAS		RELOCATE	850	CROSS
CU-HN-31	HN1 244+06	COMMUNICATION - OH	100 Pr		AT&T TEXAS		RELOCATE	250	CROSS
CU-HN-32	HN1 263+60	SANITARY GRAVITY MAIN	21		CITY OF HOUSTON		PROTECT	200	CROSS
CU-HN-33	HN1 271+13	COMMUNICATION - UG	200 Pr		AT&T TEXAS		RELOCATE	200	CROSS
CU-HN-34	HN1 284+02	WATER	54		CITY OF HOUSTON		RELOCATE	6000	BOTH
CU-HN-35	HN1 289+16	WATER	54		CITY OF HOUSTON		RELOCATE	6000	BOTH
CU-HN-36	HN1 299+40	COMMUNICATION - UG	300 Pr		AT&T TEXAS		RELOCATE	750	CROSS
CU-HN-37	HN1 299+67	COMMUNICATION - OH	200 Pr		AT&T TEXAS		RELOCATE	750	CROSS
CU-HN-38	HN1 299+82	COMMUNICATION - UG	100 Pr		AT&T TEXAS		RELOCATE	250	CROSS
CU-HN-39	HN1 299+97	COMMUNICATION - OH	100 Pr		AT&T TEXAS		RELOCATE	100	CROSS
CU-HN-40	HN1 300+53	COMMUNICATION - UG	100 Pr		AT&T TEXAS		RELOCATE	550	CROSS
CU-HN-41	HN1 322+31	COMMUNICATION - UG	900 Pr		AT&T TEXAS		RELOCATE	750	CROSS
CU-HN-42	HN1 326+69	WATER	20		CITY OF HOUSTON		NO IMPACT		CROSS
CU-HN-43	HN1 361+08	WATER	24		CITY OF HOUSTON		NO IMPACT		CROSS
CU-HN-44	HN1 382+52	WATER	24		CITY OF HOUSTON		RELOCATE	4000	BOTH
CU-HN-45	HN1 386+08	COMMUNICATION - UG		400 Pr	AT&T TEXAS		RELOCATE	160	CROSS
CU-HN-46	HN1 406+45	STORMWATER+C414	42.00		CITY OF HOUSTON		NO IMPACT		CROSS
CU-HN-47	HN1 407+28	STORMWATER	36.00		CITY OF HOUSTON		NO IMPACT		CROSS
CU-HN-48	HN1 417+87	COMMUNICATION - UG		100 Pr	AT&T TEXAS		RELOCATE	400	CROSS
CU-HN-49	HN1 420+00	WATER	36.00		CITY OF HOUSTON		PROTECT	500	PARALLEL
CU-HN-50	HN1 420+00	WATER	48.00		CITY OF HOUSTON		PROTECT	500	PARALLEL
CU-HN-51	HN1 421+26	WATER	24.00		CITY OF HOUSTON		NO IMPACT		CROSS
CU-HN-52	HN1 423+22	WATER	24		CITY OF HOUSTON		NO IMPACT		CROSS
CU-HN-53	HN1 430+44	WATER	48.00		CITY OF HOUSTON		NO IMPACT		CROSS
CU-HN-54	HN1 431+24	WATER	36.00		CITY OF HOUSTON		NO IMPACT		CROSS
CU-HN-55	HN1 448+95	COMMUNICATION - OH	100 Pr		AT&T TEXAS		RELOCATE	600	CROSS
CU-HN-56	HN1 448+95	COMMUNICATION - UG		100 Pr	AT&T TEXAS		RELOCATE	500	CROSS
CU-HN-57	HN1 452+44	ELECTRIC TRANSMISSION		115kV - 161kV	CENTERPOINT ENERGY		ELEVATE	2000	CROSS
CU-HN-58	HN1 452+44	ELECTRIC TRANSMISSION		115kV - 161kV	CENTERPOINT ENERGY		ELEVATE	2000	CROSS
CU-HN-59	HN1 453+26	NATURAL GAS	36		KINDER MORGAN TEJAS PIPELINE LLC	TGPL MUSTANG	PROTECT	350	CROSS
CU-HN-60	HN1 453+92	ELECTRIC TRANSMISSION		345kV - 450kV	CENTERPOINT ENERGY		ELEVATE	2000	CROSS
CU-HN-61	HN1 457+85	COMMUNICATION - UG		1200 Pr	AT&T TEXAS		NO IMPACT		CROSS
CU-HN-62	HN1 510+05	COMMUNICATION - UG		600 Pr	AT&T TEXAS		RELOCATE	700	PARALLEL
CU-HN-63	HN1 510+10	COMMUNICATION - UG		300 Pr	AT&T TEXAS		RELOCATE	700	PARALLEL
CU-HN-64	HN1 541+33	COMMUNICATION - UG		100 Pr	AT&T TEXAS		RELOCATE	1100	PARALLEL
CU-HN-65	HN1 551+77	COMMUNICATION - UG	200 Pr		AT&T TEXAS		NO IMPACT		CROSS
CU-HN-66	HN1 576+40	NATURAL GAS	30.00		TRANSCONTINENTAL GAS P.L. CO,LLC	TRANSCO	PROTECT	200	CROSS
CU-HN-67	HN1 576+83	NATURAL GAS	30		TRANSCONTINENTAL GAS P.L. CO,LLC	TRANSCO	PROTECT	200	CROSS
CU-HN-68	HN1 603+62	CRUDE OIL	20.00		MAGELLAN PIPELINE COMPANY, L.P.	LONGHORN	PROTECT	400	CROSS
CU-HN-69	HN1 610+40	NATURAL GAS	24.00		HOUSTON PIPE LINE COMPANY LP	3040_4194 HOUSTON WEST LOOP TO HEMPSTEAD	PROTECT	400	CROSS
CU-HN-70	HN1 610+56	NATURAL GAS	12.75		HOUSTON PIPE LINE COMPANY LP	4007-01 CAMERON IRON WORKS	PROTECT	400	CROSS
CU-HN-71	HN1 611+01	NATURAL GAS	30.00		HOUSTON PIPE LINE COMPANY LP	3106 KATY - SATSUMA 30IN	PROTECT	4000	BOTH
CU-HN-72	HN1 622+00	CRUDE OIL	20		MAGELLAN PIPELINE COMPANY, L.P.	LONGHORN	PROTECT	400	CROSS
CU-HN-73	HN1 634+19	NATURAL GAS	12.75		HOUSTON PIPE LINE COMPANY LP	4007-01 CAMERON IRON WORKS	PROTECT	5500	BOTH
CU-HN-74	HN1 634+32	NATURAL GAS	30.00		HOUSTON PIPE LINE COMPANY LP	3106 KATY - SATSUMA 30IN	PROTECT	4000	BOTH
CU-HN-75	HN1 636+16	COMMUNICATION - OH	300		AT&T TEXAS		RELOCATE	150	CROSS
CU-HN-76	HN1 636+41	COMMUNICATION - UG		600	AT&T TEXAS		PROTECT	400	BOTH
CU-HN-77	HN1 644+11	NATURAL GAS	30.00		KINDER MORGAN TEXAS PIPELINE LLC	KATY TO BAYTOWN MAIN LINE	PROTECT	6000	BOTH
CU-HN-78	HN1 650+57	NATURAL GAS	30		HOUSTON PIPE LINE COMPANY LP	3111-000	PROTECT	4500	BOTH
CU-HN-79	HN1 650+98	ELECTRIC TRANSMISSION		115kV - 161kV	CENTERPOINT ENERGY		ELEVATE	2000	CROSS
CU-HN-80	HN1 650+98	ELECTRIC TRANSMISSION		115kV - 161kV	CENTERPOINT ENERGY		ELEVATE	2000	CROSS
CU-HN-81	HN1 652+18	ELECTRIC TRANSMISSION		345kV - 450kV	CENTERPOINT ENERGY		ELEVATE	2000	CROSS
CU-HN-82	HN1 652+18	ELECTRIC TRANSMISSION		345kV - 450kV	CENTERPOINT ENERGY		ELEVATE	2000	CROSS
CU-HN-83	HN1 652+61	NATURAL GAS LIQUIDS	14.00		ENTERPRISE PRODUCTS OPERATINGLLC	SEMINOLE LOOP	PROTECT	400	CROSS
CU-HN-84	HN1 669+16	NATURAL GAS	30		NATURAL GAS P/L CO OF AMER LLC	GULF COAST MAINLINE	PROTECT	400	CROSS
CU-HN-85	HN1 670+57	COMMUNICATION - UG		432 F	AT&T TEXAS		RELOCATE	1600	PARALLEL
CU-HN-86	HN1 678+69	NATURAL GAS	30		NATURAL GAS P/L CO OF AMER LLC	GULF COAST MAINLINE	PROTECT	400	CROSS
CU-HN-87	HN1 684+37	COMMUNICATION - UG		360 F	AT&T TEXAS		RELOCATE	3000	PARALLEL
CU-HN-88	HN1 697+45	NATURAL GAS	20.00		KINDER MORGAN TEJAS PIPELINE LLC	TGPL MUSTANG	PROTECT	400	CROSS
CU-HN-89	HN1 699+11	NATURAL GAS	30		GULF SOUTH PIPELINE COMPANY, LP	129	PROTECT	400	CROSS
CU-HN-90	HN1 723+75	COMMUNICATION - UG		200	AT&T TEXAS		NO IMPACT		CROSS
CU-HN-91	HN1 776+92	NATURAL GAS	12.75		HOUSTON PIPE LINE COMPANY LP	4007-01 CAMERON IRON WORKS	PROTECT	3500	BOTH

Crossing ID	Stationing	Utility Type	Size / Diameter (in)	Transmission Voltage	Utility Owner	System Name	Status	Length of Affected Utility (ft)	Parallel, Crossing, or Both
CU-HN-92	HN1 779+34	COMMUNICATION - UG		100	AT&T TEXAS		RELOCATE	300	PARALLEL
CU-HN-93	HN1 779+80	COMMUNICATION - UG		600	AT&T TEXAS		NO IMPACT		CROSS
CU-HN-94	HN1 780+33	NATURAL GAS	12.75		HOUSTON PIPE LINE COMPANY LP	4007-01 CAMERON IRON WORKS	PROTECT	3500	BOTH
CU-HN-95	HN1 834+06	ELECTRIC TRANSMISSION		115kV - 161kV	CENTERPOINT ENERGY		ELEVATE	3100	CROSS
CU-HN-96	HN1 834+95	NATURAL GAS	36		TENNESSEE GAS PIPELINE CO,L.L.C.	TENNESSEE GAS PIPELINE COMPANY	PROTECT	150	CROSS
CU-HN-97	HN1 835+20	NATURAL GAS	36		TENNESSEE GAS PIPELINE CO,L.L.C.	TENNESSEE GAS PIPELINE COMPANY	PROTECT	150	CROSS
CU-HN-98	HN1 854+06	COMMUNICATION - UG		600	AT&T TEXAS		NO IMPACT		CROSS
CU-HN-99	HN1 889+14	COMMUNICATION - UG		100	AT&T TEXAS		RELOCATE	850	CROSS
CU-HN-100	HN1 904+59	NATURAL GAS	24		TRUNKLINE GAS COMPANY, LLC	EDNA DISCHARGE	PROTECT	150	CROSS
CU-HN-101	HN1 963+29	COMMUNICATION - UG		900	AT&T TEXAS		NO IMPACT		CROSS
CU-HN-102	HN1 963+46	COMMUNICATION - UG		432 F	AT&T TEXAS		NO IMPACT		CROSS
CU-HN-103	HN1 966+01	CRUDE OIL	12.75		GENESIS PIPELINE TEXAS, L.P.	NAVASOTA/SATSUMA	PROTECT	750	CROSS
CU-HN-104	HN1 973+03	COMMUNICATION - UG	300		AT&T TEXAS		NO IMPACT		CROSS
CU-HN-105	HN1 1267+80	COMMUNICATION - UG		600	AT&T TEXAS		NO IMPACT		CROSS
CU-HN-106	HN1 1290+89	ELECTRIC TRANSMISSION		345kV - 450kV	CENTERPOINT ENERGY		ELEVATE	2000	CROSS
CU-HN-107	HN1 1290+89	ELECTRIC TRANSMISSION		345kV - 450kV	CENTERPOINT ENERGY		ELEVATE	2000	CROSS
CU-HN-108	HN1 1414+85	NATURAL GAS	12.75		SOUTHCROSS GULF COAST TRANS. LTD	MONCO GATHERING SYSTEM	PROTECT	350	CROSS
CU-HN-109	HN1 1439+58	ELECTRIC TRANSMISSION		115kV - 161kV	CENTERPOINT ENERGY		ELEVATE	2000	CROSS
CU-HN-110	HN1 1553+20	ELECTRIC TRANSMISSION		115kV - 161kV	CENTERPOINT ENERGY		ELEVATE	2000	CROSS
CU-HN-111	HN1 1553+20	ELECTRIC TRANSMISSION		Below 100kV	CENTERPOINT ENERGY		ELEVATE	2000	CROSS
CU-HN-112	HN1 1635+68	COMMUNICATION - UG		216	AT&T TEXAS		NO IMPACT		CROSS
CU-HN-113	HN1 1636+89	COMMUNICATION - UG		600	AT&T TEXAS		NO IMPACT		CROSS
CU-HN-114	HN1 1690+00	NATURAL GAS	30		ATMOS		PROTECT	100	PARALLEL
CU-HN-115	HN1 1720+68	COMMUNICATION - UG		616	AT&T TEXAS		NO IMPACT		CROSS
CU-HN-116	HN1 1721+39	COMMUNICATION - UG		600	AT&T TEXAS		NO IMPACT		CROSS
CU-HN-117	HN1 1721+47	COMMUNICATION - UG		144	AT&T TEXAS		NO IMPACT		CROSS
CU-HN-118	HN1 1885+00	NATURAL GAS	30		ATMOS		PROTECT	100	PARALLEL
CU-HN-119	HN1 1947+26	NATURAL GAS	24		TEXAS EASTERN TRANSMISSION, LP	HEMP-HUNT	PROTECT	350	CROSS
CU-HN-120	HN1 2020+18	ELECTRIC TRANSMISSION		115kV - 161kV	SAN BERNARD ELECTRIC COOP		ELEVATE	2000	CROSS
CU-HN-121	HN1 2072+94	COMMUNICATION - UG		100	AT&T TEXAS		NO IMPACT		CROSS
CU-HN-122	HN1 2072+98	COMMUNICATION - UG		100	AT&T TEXAS		NO IMPACT		CROSS
CU-HN-123	HN1 2073+62	COMMUNICATION - UG		216	AT&T TEXAS		NO IMPACT		PARALLEL
CU-HN-124	HN1 2073+96	COMMUNICATION - UG		158	AT&T TEXAS		NO IMPACT		CROSS
CU-HN-125	HN1 2074+01	COMMUNICATION - UG		600	AT&T TEXAS		NO IMPACT		CROSS
CU-HN-126	HN1 2074+41	COMMUNICATION - UG		100	AT&T TEXAS		NO IMPACT		PARALLEL
CU-HN-127	HN1 2078+47	COMMUNICATION - UG	300		AT&T TEXAS		RELOCATE	1200	CROSS
CU-HN-128	HN1 2078+47	COMMUNICATION - UG		300	AT&T TEXAS		NO IMPACT		CROSS
CU-HN-129	HN1 2079+63	COMMUNICATION - UG		100	AT&T TEXAS		NO IMPACT		CROSS
CU-HN-130	HN1 2080+58	COMMUNICATION - UG		100	AT&T TEXAS		NO IMPACT		CROSS
CU-HN-131	HN1 2082+09	COMMUNICATION - UG		106	AT&T TEXAS		NO IMPACT		PARALLEL
CU-HN-132	HN1 2122+26	CRUDE OIL	12.75		BLACKHAWK PIPELINE LP	NAVASOTA/SATSUMA	PROTECT	350	CROSS
CU-HN-133	HN1 2352+10	ELECTRIC TRANSMISSION		345kV - 450kV	CENTERPOINT ENERGY		ELEVATE	4500	CROSS
CU-HN-134	HN1 2352+10	ELECTRIC TRANSMISSION		345kV - 450kV	CENTERPOINT ENERGY		ELEVATE	4500	CROSS
CU-HN-135	HN1 2362+96	COMMUNICATION - UG		900	AT&T TEXAS		PROTECT	3000	BOTH
CU-HN-136	HN1 2363+19	COMMUNICATION - UG		900	AT&T TEXAS		PROTECT	3000	BOTH
CU-HN-137	HN2 125+00	ELECTRIC TRANSMISISON		345kV - 450kV	CENTERPOINT ENERGY		ELEVATE	2000	PARALLEL
CU-HN-138	HN2 455+82	REFINED PRODUCTS	12.75		SUNOCO PIPELINE L.P.	MPL-110 HEBERT-HEARNE PRODUCTS	PROTECT	500	CROSS
CU-HN-139	HN2 462+30	ELECTRIC TRANSMISSION		115kV - 161kV	ENTERGY TEXAS		ELEVATE	2000	CROSS
CU-HN-140	HN2 535+00	ELECTRIC TRANSMISISON		345kV - 450kV	CENTERPOINT ENERGY		ELEVATE	2000	PARALLEL
CU-HN-141	HN2 728+99	NATURAL GAS	16		ENERGY TRANSFER COMPANY	157600 ANDERSON TREATER PLT TO TEJAS DEL	PROTECT	350	CROSS
CU-HN-142	HN2 835+00	ELECTRIC TRANSMISISON		345kV - 450kV	CENTERPOINT ENERGY		ELEVATE	2000	PARALLEL
CU-HN-143	HN2 870+99	Y-GRADE NGL	12.75		ENTERPRISE PRODUCTS OPERATINGLLC	CHAPARRAL SYSTEM	PROTECT	400	CROSS
CU-HN-144	HN2 943+49	NATURAL GAS	12.75		ENERGY TRANSFER COMPANY	SOUTHEAST TEXAS PIPELINE SYSTEM	PROTECT	350	CROSS
CU-HN-145	HN2 950+00	ELECTRIC TRANSMISSION		345kV - 450kV	CENTERPOINT ENERGY		ELEVATE	2000	PARALLEL
CU-HN-146	HN2 994+57	NATURAL GAS	20		KINDER MORGAN TEJAS PIPELINE LLC	TGPL MUSTANG	PROTECT	350	CROSS
CU-HN-147	HN2 1050+00	ELECTRIC TRANSMISSION		345kV - 450kV	CENTERPOINT ENERGY		ELEVATE	2000	PARALLEL
CU-HN-148	HN2 1123+14	ELECTRIC TRANSMISSION		115kV - 161kV	ENTERGY TEXAS		ELEVATE	2000	CROSS
CU-HN-149	HN2 1124+74	NATURAL GAS	16		KINDER MORGAN TEJAS PIPELINE LLC	TGPL MUSTANG	PROTECT	400	CROSS
CU-HN-150	HN2 1140+00	ELECTRIC TRANSMISSION		345kV - 450kV	CENTERPOINT ENERGY		NO IMPACT		PARALLEL
CU-HN-151	HN2 1270+25	Y GRADE PRODUCTS	20		ENTERPRISE PRODUCTS OPERATINGLLC	TEXAS EXPRESS PIPELINE SYSTEM	PROTECT	350	CROSS
CU-HN-152	HN2 1290+00	ELECTRIC TRANSMISSION		345kV - 450kV	CENTERPOINT ENERGY		NO IMPACT		PARALLEL
CU-HN-153	HN2 1357+50	ELECTRIC TRANSMISSION		345kV - 450kV	CENTERPOINT ENERGY		ELEVATE	2000	CROSS
CU-HN-154	HN2 1360+00	ELECTRIC TRANSMISSION		115kV - 161kV			ELEVATE	2000	CROSS
CU-HN-155	HN2 1510+00	ELECTRIC TRANSMISSION		115kV - 161kV			ELEVATE	2000	CROSS
CU-HN-156	HN2 1540+00	ELECTRIC TRANSMISSION		345kV - 450kV	CENTERPOINT ENERGY		ELEVATE	2000	CROSS
CU-HN-157	HN2 1542+78	CRUDE OIL	20		MAGELLAN PIPELINE COMPANY, L.P.	BRIDGETEX CRUDE SYSTEM	PROTECT	400	CROSS
CU-HN-158	HN2 1570+30	ELECTRIC TRANSMISSION		115kV - 161kV	ENTERGY TEXAS		ELEVATE	2000	CROSS
CU-HN-159	HN2 1590+00	CRUDE OIL	20		MAGELLAN PIPELINE COMPANY, L.P.		NO IMPACT		PARALLEL
CU-HN-160	HN2 1922+90	NATURAL GAS	12.75		COPANO FLD SER/UP GULF COAST LLC	GRIMES GATHERING SYSTEM	PROTECT	350	CROSS
CU-HN-161	HN2 1923+76	NATURAL GAS	12.75		COPANO PIPELINES/UP GLFCOAST LLC	SAM HOUSTON SYSTEM	PROTECT	350	CROSS

Crossing ID	Stationing	Utility Type	Size / Diameter (in)	Transmission Voltage	Utility Owner	System Name	Status	Length of Affected Utility (ft)	Parallel, Crossing, or Both
CU-HN-162	HN2 1925+00	ELECTRIC TRANSMISSION		345kV - 450kV	CENTERPOINT ENERGY		ELEVATE	2000	PARALLEL
CU-WT-1	WT 150+00	CRUDE OIL	30		ENTERPRISE CRUDE PIPELINE LLC	SEAWAY	RELOCATE	90000	BOTH
CU-WT-2	WT 195+88	ELECTRIC TRANSMISSION		Below 100kV	MID-SOUTH SYNERGY		ELEVATE	2000	CROSS
CU-WT-3	WT 290+00	ELECTRIC TRANSMISSION		345kV - 450kV	CENTERPOINT ENERGY		ELEVATE	2000	PARALLEL
CU-WT-4	WT 440+00	ELECTRIC TRANSMISSION		345kV - 450kV	CENTERPOINT ENERGY		NO IMPACT		PARALLEL
CU-WT-5	WT 614+52	NATURAL GAS	12.75		ATMOS PIPELINE - TEXAS	VK	PROTECT	350	CROSS
CU-WT-6	WT 670+00	ELECTRIC TRANSMISSION		345kV - 450kV	CENTERPOINT ENERGY		ELEVATE	2000	PARALLEL
CU-WT-7	WT 737+00	ELECTRIC TRANSMISSION		345kV - 450kV	CENTERPOINT ENERGY		ELEVATE	2000	PARALLEL
CU-WT-8	WT 737+85	ELECTRIC TRANSMISSION		115kV - 161kV	MID-SOUTH SYNERGY		ELEVATE	2000	CROSS
CU-WT-9	WT 750+00	ELECTRIC TRANSMISSION		345kV - 450kV	CENTERPOINT ENERGY		NO IMPACT		PARALLEL
CU-WT-10	WT 920+00	ELECTRIC TRANSMISSION		345kV - 450kV	CENTERPOINT ENERGY		ELEVATE	2000	PARALLEL
CU-WT-11	WT 980+00	ELECTRIC TRANSMISSION		345kV - 450kV	CENTERPOINT ENERGY		ELEVATE	2000	PARALLEL
CU-WT-12	WT 1546+29	NATURAL GAS	24		ENBRIDGE PIPELINES (E. TX) L.P.	CLARITY SYSTEM	PROTECT	350	
CU-WT-13	WT 1602+61	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	2000	CROSS
CU-WT-14	WT 1602+61	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	2000	CROSS
CU-WT-15	WT 1715+03	ELECTRIC TRANSMISSION		115kV - 161kV	ONCOR		ELEVATE	2000	CROSS
CU-WT-16	WT 1737+69	COMMUNICATION - UG	300 Pr		AT&T TEXAS		NO IMPACT		CROSS
CU-WT-17	WT 1737+95	COMMUNICATION - OH	100 Pr		AT&T TEXAS		NO IMPACT		CROSS
CU-WT-18	WT 1738+94	COMMUNICATION - UG	400 Pr		AT&T TEXAS		NO IMPACT		CROSS
CU-WT-19	WT 1739+14	COMMUNICATION - UG	100 Pr		AT&T TEXAS		NO IMPACT		CROSS
CU-WT-20	WT 1739+26	COMMUNICATION - UG	100 Pr		AT&T TEXAS		NO IMPACT		CROSS
CU-WT-21	WT 1790+00	ELECTRIC TRANSMISSION			ONCOR		ELEVATE	2000	CROSS
CU-WT-22	WT 1956+97	COMMUNICATION - UG	100 Pr		AT&T TEXAS		NO IMPACT		CROSS
CU-WT-23	WT 2079+39	COMMUNICATION - UG	300 Pr		AT&T TEXAS		NO IMPACT		CROSS
CU-WT-24	WT 2117+19	NATURAL GAS	12.75		ENBRIDGE PIPELINES (E. TX) L.P.	EAST TEXAS SYSTEM	PROTECT	800	CROSS
CU-WT-25	WT 2174+93	NATURAL GAS	20		ENBRIDGE PIPELINES (E. TX) L.P.	EAST TEXAS SYSTEM	PROTECT	350	CROSS
CU-WT-26	WT 2176+06	NATURAL GAS	12.75		ENBRIDGE PIPELINES (E. TX) L.P.	EAST TEXAS SYSTEM	PROTECT	350	CROSS
CU-WT-27	WT 2300+00	NATURAL GAS	12.75		TREND GATHERING & TREATING, LLC	FREESTONE TREND	PROTECT	150	PARALLEL
CU-WT-28	WT 2303+21	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	2000	CROSS
CU-WT-29	WT 2303+21	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	2000	CROSS
CU-WT-30	WT 2303+93	ELECTRIC TRANSMISSION		115kV - 161kV	ONCOR		ELEVATE	2000	CROSS
CU-WT-31	WT 2328+10	NATURAL GAS	12.75		TREND GATHERING & TREATING, LLC	FREESTONE TREND	PROTECT	400	CROSS
CU-WT-32	WT 2346+29	COMMUNICATION - UG	600 Pr		AT&T TEXAS		NO IMPACT		CROSS
CU-WT-33	WT 2399+78	NATURAL GAS	20		TREND GATHERING & TREATING, LLC	FREESTONE TREND	PROTECT	400	CROSS
CU-WT-34	WT 2401+64	NATURAL GAS	30		ENERGY TRANSFER COMPANY	20040052 FARRAR STATION TO WORTHAM JUNC*	PROTECT	400	CROSS
CU-WT-35	WT 2423+22	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	2000	CROSS
CU-WT-36	WT 2423+22	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	2000	CROSS
CU-WT-37	WT 2468+05	NATURAL GAS	12.75		TREND GATHERING & TREATING, LLC	FREESTONE TREND	PROTECT	350	CROSS
CU-WT-38	WT 2526+47	NATURAL GAS	16		TREND GATHERING & TREATING, LLC	FREESTONE TREND	PROTECT	350	CROSS
CU-WT-39	WT 2872+25	NATURAL GAS	12.75		ENBRIDGE PIPELINES (E. TX) L.P.	EAST TEXAS SYSTEM	PROTECT	350	CROSS
CU-WT-40	WT 3137+85	NATURAL GAS	16		ATMOS PIPELINE - TEXAS	L8A (2ND)(EAST)	PROTECT	350	CROSS
CU-WT-41	WT 3137+97	NATURAL GAS	16		ATMOS PIPELINE - TEXAS	L8A (3RD)	PROTECT	350	CROSS
CU-WT-42	WT 3317+01	COMMUNICATION - UG	100 Pr		AT&T TEXAS		NO IMPACT		CROSS
CU-WT-43	WT 3394+91	NATURAL GAS LIQUIDS	18		DCP MIDSTREAM, LP	SOUTHERN HILLS PIPELINE	PROTECT	550	CROSS
CU-WT-44	WT 3410+00	ELECTRIC TRANSMISSION		115kV - 161kV	ONCOR		ELEVATE	2000	CROSS
CU-WT-45	WT 3410+00	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	6500	PARALLEL
CU-WT-46	WT 3445+00	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	2000	CROSS
CU-WT-47	WT 3505+00	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	2000	PARALLEL
CU-WT-48	WT 3581+51	NATURAL GAS	12.75		ENERGY TRANSFER COMPANY	9021 LINE F REED STATION-THELMA STATION*	PROTECT	400	CROSS
CU-WT-49	WT 3678+73	ELECTRIC TRANSMISSION		Below 100kV	ONCOR		ELEVATE	2000	CROSS
CU-WT-50	WT 3815+81	CRUDE OIL	26		SUNOCO PIPELINE L.P.	WEST TEXAS GULF	PROTECT	1800	CROSS
CU-WT-51	WT 3820+00	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		NO IMPACT		PARALLEL
CU-WT-52	WT 3820+00	NATURAL GAS	42		ENERGY TRANSFER COMPANY	20051001 CLEBURNE TO REED 42IN	PROTECT	150	PARALLEL
CU-WT-53	WT 3837+37	NATURAL GAS	42		ENERGY TRANSFER COMPANY	20051001 CLEBURNE TO REED 42IN	PROTECT	1000	CROSS
CU-WT-54	WT 3850+00	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	2000	PARALLEL
CU-WT-55	WT 3850+00	NATURAL GAS	42		ENERGY TRANSFER COMPANY	20051001 CLEBURNE TO REED 42IN	PROTECT	1100	PARALLEL
CU-WT-56	WT 3850+00	CRUDE OIL	26		SUNOCO PIPELINE L.P.	WEST TEXAS GULF	PROTECT	2300	PARALLEL
CU-WT-57	WT 3889+59	LIQUEFIED PETROLEUM GAS	14		ONEOK NGL PIPELINE, L.L.C.	WEST TEXAS LPG	PROTECT	250	CROSS
CU-WT-58	WT 3891+59	CRUDE OIL	20		SUNOCO PIPELINE L.P.	WEST TEXAS GULF	PROTECT	250	CROSS
CU-WT-59	WT 3931+78	CRUDE OIL	24		SUNOCO PIPELINE L.P.	SXL INTERSTATE	PROTECT	1100	CROSS
CU-WT-60	WT 4035+00	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		NO IMPACT		PARALLEL
CU-IH-1	IH1 176+28	ELECTRIC TRANSMISSION		Below 100kV	MID-SOUTH SYNERGY		ELEVATE	2000	CROSS
CU-IH-2	IH1 561+26	ELECTRIC TRANSMISSION		115kV - 161kV	ENTERGY TEXAS		ELEVATE	2000	CROSS
CU-IH-3	IH1 695+77	NATURAL GAS	12.75		ATMOS PIPELINE - TEXAS	VK	PROTECT	350	CROSS
CU-IH-4	IH1 1551+67	NATURAL GAS LIQUIDS	20		DCP MIDSTREAM, LP	SOUTHERN HILLS PIPELINE	PROTECT	500	CROSS
CU-IH-5	IH1 1577+10	NATURAL GAS	24		ENBRIDGE PIPELINES (E. TX) L.P.	CLARITY SYSTEM	PROTECT	500	CROSS
CU-IH-6	IH1 1589+71	GASOLINE/JET FUEL/DIESEL	16		MAGELLAN PIPELINE COMPANY, L.P.	MAGELLAN PIPE LINE	PROTECT	1200	CROSS
CU-IH-7	IH1 2082+00	ELECTRIC TRANSMISSION		115kV - 161kV	ONCOR		ELEVATE	2000	CROSS
CU-IH-8	IH1 2338+76	NATURAL GAS	42		ENERGY TRANSFER COMPANY	20063003-1 FARRAR TO GROVETON STA-SE BO*	PROTECT	350	CROSS
CU-IH-9	IH1 2369+44	ELECTRIC TRANSMISSION		115kV - 161kV	ONCOR		ELEVATE	2000	CROSS

Crossing ID	Stationing	Utility Type	Size / Diameter (in)	Transmission Voltage	Utility Owner	System Name	Status	Length of Affected Utility (ft)	Parallel, Crossing, or Both
CU-IH-10	IH1 2768+75	NATURAL GAS	12.75		ENBRIDGE PIPELINES (E. TX) L.P.	EAST TEXAS SYSTEM	PROTECT	350	CROSS
CU-IH-11	IH1 2769+47	NATURAL GAS	20		ENBRIDGE PIPELINES (E. TX) L.P.	EAST TEXAS SYSTEM	PROTECT	350	CROSS
CU-IH-12	IH1 2771+35	NATURAL GAS	12.75		PINNACLE GAS TREATING LLC	PINNACLE	PROTECT	350	CROSS
CU-IH-13	IH1 2823+83	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	2000	CROSS
CU-IH-14	IH1 2884+96	NATURAL GAS	12.75		ANADARKO GATHERING COMPANY LLC	DEW/MIMMS CREEK/DOWDY RANCH SYSTEM	PROTECT	2000	CROSS
CU-IH-15	IH1 3053+85	NATURAL GAS	12.75		ANADARKO GATHERING COMPANY LLC	DEW/MIMMS CREEK/DOWDY RANCH SYSTEM	PROTECT	350	CROSS
CU-IH-16	IH1 3055+56	NATURAL GAS	12.75		ENBRIDGE PIPELINES (E. TX) L.P.	EAST TEXAS SYSTEM	PROTECT	350	CROSS
CU-IH-17	IH1 3063+94	NATURAL GAS	12.75		ATMOS PIPELINE - TEXAS	L8A (2ND)(EAST)	PROTECT	350	CROSS
CU-IH-18	IH1 3064+11	NATURAL GAS	16		ATMOS PIPELINE - TEXAS	L8A (3RD)	PROTECT	350	CROSS
CU-IH-19	IH1 3142+06	CRUDE OIL	26		SUNOCO PIPELINE L.P.	WEST TEXAS GULF	PROTECT	350	CROSS
CU-IH-20	IH1 3312+67	NATURAL GAS	12.75		LINN OPERATING, INC.	MIMMS CREEK - NAN SU GAIL	PROTECT	350	CROSS
CU-IH-21	IH1 3338+55	NATURAL GAS LIQUIDS	16		ONEOK ARBUCKLE PIPELINE, L.L.C.	ARBUCKLE PIPELINE	PROTECT	350	CROSS
CU-IH-22	IH1 3403+91	NATURAL GAS	12.75		ENBRIDGE PIPELINES (E. TX) L.P.	EAST TEXAS SYSTEM	PROTECT	800	CROSS
CU-IH-23	IH1 3582+52	NATURAL GAS	12.75		TREND GATHERING & TREATING, LLC	FREESTONE TREND	PROTECT	400	CROSS
CU-IH-24	IH1 3582+74	NATURAL GAS	12.75		ENERGY TRANSFER COMPANY	9018 LINE F BETHEL-REED/BETHEL-LAKE CRE*	PROTECT	350	CROSS
CU-IH-25	IH1 3582+79	NATURAL GAS	42		ENERGY TRANSFER COMPANY	20051002 REED TO	PROTECT	350	CROSS
CU-IH-26	IH1 3587+29	ELECTRIC TRANSMISSION		115kV - 161kV	ONCOR		ELEVATE	2000	CROSS
CU-IH-27	IH1 3612+86	LIQUEFIED PETROLEUM GAS	14		ONEOK NGL PIPELINE, L.L.C.	WEST TEXAS LPG	PROTECT	350	CROSS
CU-IH-28	IH1 3923+96	CRUDE OIL	30		ENTERPRISE CRUDE PIPELINE LLC	SEAWAY	PROTECT	350	CROSS
CU-IH-29	IH1 3924+37	CRUDE OIL	30		ENTERPRISE CRUDE PIPELINE LLC	SEAWAY	RELOCATE	700	CROSS
CU-IH-30	IH1 3985+04	CRUDE OIL	30		ENTERPRISE CRUDE PIPELINE LLC	SEAWAY	RELOCATE	3000	CROSS
CU-IH-31	IH1 3985+76	CRUDE OIL	30		ENTERPRISE CRUDE PIPELINE LLC	SEAWAY	RELOCATE	3000	CROSS
CU-IH-32	IH1 4121+76	CRUDE OIL	20		SUNOCO PIPELINE L.P.	WEST TEXAS GULF	PROTECT	350	CROSS
CU-IH-33	IH1 4130+00	CRUDE OIL	20		SUNOCO PIPELINE L.P.	WEST TEXAS GULF	NO IMPACT		PARALLEL
CU-IH-34	IH1 4141+31	CRUDE OIL	30		ENTERPRISE CRUDE PIPELINE LLC	SEAWAY	PROTECT	700	CROSS
CU-IH-35	IH1 4142+64	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	2000	CROSS
CU-IH-36	IH1 4142+96	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	2000	CROSS
CU-IH-37	IH1 4150+00	GASOLINE/JET FUEL/DIESEL	16		MAGELLAN PIPELINE COMPANY, L.P.		NO IMPACT		PARALLEL
CU-IH-38	IH1 4219+59	GASOLINE/JET FUEL/DIESEL	16		MAGELLAN PIPELINE COMPANY, L.P.	MAGELLAN PIPE LINE	PROTECT	500	CROSS
CU-IH-39	IH1 4235+00	CRUDE OIL	30		ENTERPRISE CRUDE PIPELINE LLC	SEAWAY	PROTECT	400	PARALLEL
CU-IH-40	IH1 4235+00	CRUDE OIL	30		ENTERPRISE CRUDE PIPELINE LLC	SEAWAY	PROTECT	400	PARALLEL
CU-IH-41	IH1 4290+00	CRUDE OIL	30		ENTERPRISE CRUDE PIPELINE LLC	SEAWAY	PROTECT	300	PARALLEL
CU-IH-42	IH1 4290+00	CRUDE OIL	30		ENTERPRISE CRUDE PIPELINE LLC	SEAWAY	PROTECT	300	PARALLEL
CU-IH-43	IH1 4290+00	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	4500	PARALLEL
CU-IH-44	IH1 4315+00	CRUDE OIL	30		ENTERPRISE CRUDE PIPELINE LLC	SEAWAY	PROTECT	600	PARALLEL
CU-IH-45	IH1 4315+00	CRUDE OIL	30		ENTERPRISE CRUDE PIPELINE LLC	SEAWAY	PROTECT	600	PARALLEL
CU-IH-1	IH2 70+00	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		NO IMPACT		PARALLEL
CU-IH-2	IH2 70+00	CRUDE OIL	30		ENTERPRISE CRUDE PIPELINE LLC	SEAWAY	PROTECT	400	PARALLEL
CU-IH-3	IH2 70+00	CRUDE OIL	30		ENTERPRISE CRUDE PIPELINE LLC	SEAWAY	PROTECT	400	PARALLEL
CU-IH-4	IH2 117+32	NATURAL GAS	12.75		ENBRIDGE PIPELINES (E. TX) L.P.	EAST TEXAS SYSTEM	PROTECT	350	CROSS
CU-IH-5	IH2 190+00	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		NO IMPACT		PARALLEL
CU-IH-6	IH2 190+00	CRUDE OIL	30		ENTERPRISE CRUDE PIPELINE LLC	SEAWAY	PROTECT	2400	PARALLEL
CU-IH-7	IH2 190+00	CRUDE OIL	30		ENTERPRISE CRUDE PIPELINE LLC	SEAWAY	PROTECT	2400	PARALLEL
CU-IH-8	IH2 250+00	CRUDE OIL	30		ENTERPRISE CRUDE PIPELINE LLC	SEAWAY	PROTECT	1300	PARALLEL
CU-IH-9	IH2 250+00	CRUDE OIL	30		ENTERPRISE CRUDE PIPELINE LLC	SEAWAY	PROTECT	1300	PARALLEL
CU-IH-10	IH2 262+51	CRUDE OIL	24		SUNOCO PIPELINE L.P.	SXL INTERSTATE	PROTECT	400	CROSS
CU-IH-11	IH2 266+00	ELECTRIC TRANSMISSION		Below 100kV	ONCOR		ELEVATE	2000	CROSS
CU-IH-12	IH2 280+00	CRUDE OIL	24		SUNOCO PIPELINE L.P.	SXL INTERSTATE	NO IMPACT		PARALLEL
CU-IH-13	IH2 280+00	CRUDE OIL	30		ENTERPRISE CRUDE PIPELINE LLC	SEAWAY	NO IMPACT		PARALLEL
CU-IH-14	IH2 280+00	CRUDE OIL	30		ENTERPRISE CRUDE PIPELINE LLC	SEAWAY	NO IMPACT		PARALLEL
CU-IH-15	IH2 546+18	ELECTRIC TRANSMISSION		115kV - 161kV	ONCOR		ELEVATE	2000	CROSS
CU-IH-16	IH2 550+00	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	2000	PARALLEL
CU-IH-17	IH2 822+21	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	3000	CROSS
CU-IH-18	IH2 822+21	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	3000	CROSS
CU-IH-19	IH2 890+00	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	2000	PARALLEL
CU-NW-1	NW 81+27	NATURAL GAS	12.75		ENBRIDGE PIPELINES (E. TX) L.P.	EAST TEXAS SYSTEM	PROTECT	350	CROSS
CU-NW-2	NW 106+49	ELECTRIC TRANSMISSION		Below 100kV	ONCOR		ELEVATE	2000	CROSS
CU-NW-3	NW 313+16	NATURAL GAS LIQUIDS	16		ONEOK ARBUCKLE PIPELINE, L.L.C.	ARBUCKLE PIPELINE	PROTECT	250	CROSS
CU-NW-4	NW 380+00	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	2000	PARALLEL
CU-NW-5	NW 517+62	ELECTRIC TRANSMISSION		115kV - 161kV	ONCOR		ELEVATE	2000	CROSS
CU-NW-6	NW 769+63	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	2000	CROSS
CU-NW-7	NW 769+63	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	2000	CROSS
CU-NW-8	NW 860+00	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		NO IMPACT		PARALLEL
CU-NW-9	NW 950+00	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	2000	PARALLEL
CU-NW-10	NW 950+47	COMMUNICATION - UG	100 Pr		AT&T TEXAS		RELOCATE	2000	CROSS
CU-NW-11	NW 1093+53	GASOLINE/JET FUEL/DIESEL	20		MAGELLAN PIPELINE COMPANY, L.P.	MAGELLAN PIPE LINE	PROTECT	350	CROSS
CU-NW-12	NW 1093+66	NATURAL GAS LIQUIDS	16		ENERGY TRANSFER COMPANY	S109 TX NGL MERTENS TO CORSICANA	PROTECT	350	CROSS
CU-NW-13	NW 1094+66	CRUDE OIL	20		SUNOCO PIPELINE L.P.	PERMIAN EXPRESS II SYSTEM	PROTECT	350	CROSS
CU-NW-14	NW 1180+88	ELECTRIC TRANSMISSION		Below 100kV	ONCOR		ELEVATE	2000	CROSS
CU-NW-15	NW 1198+99	EMPTY	12.75		MAGELLAN PIPELINE COMPANY, L.P.	MAGELLAN PIPE LINE	PROTECT	2000	CROSS

Crossing ID	Stationing	Utility Type	Size / Diameter (in)	Transmission Voltage	Utility Owner	System Name	Status	Length of Affected Utility (ft)	Parallel, Crossing, or Both
CU-NW-16	NW 1230+00	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	2000	PARALLEL
CU-NW-17	NW 1330+00	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	2000	PARALLEL
CU-NW-18	NW 1464+14	ELECTRIC TRANSMISSION		Below 100kV	ONCOR		ELEVATE	2000	CROSS
CU-NW-19	NW 1600+00	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	2000	PARALLEL
CU-NE-1	NE 81+27	NATURAL GAS	12.75		ENBRIDGE PIPELINES (E. TX) L.P.	EAST TEXAS SYSTEM	PROTECT	350	CROSS
CU-NE-2	NE 106+49	ELECTRIC TRANSMISSION		Below 100kV	ONCOR		ELEVATE	2000	CROSS
CU-NE-3	NE 110+00	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	2000	PARALLEL
CU-NE-4	NE 263+52	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	2000	CROSS
CU-NE-5	NE 263+52	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	2000	CROSS
CU-NE-6	NE 303+93	NATURAL GAS LIQUIDS	16		ONEOK ARBUCKLE PIPELINE, L.L.C.	ARBUCKLE PIPELINE	PROTECT	300	CROSS
CU-NE-7	NE 395+26	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	2000	CROSS
CU-NE-8	NE 395+26	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	2000	CROSS
CU-NE-9	NE 531+66	ELECTRIC TRANSMISSION		115kV - 161kV	ONCOR		ELEVATE	2000	CROSS
CU-NE-10	NE 975+00	CRUDE OIL	20		SUNOCO PIPELINE L.P.	PERMIAN EXPRESS II SYSTEM	PROTECT	200	PARALLEL
CU-NE-11	NE 1040+96	GASOLINE/JET FUEL/DIESEL	20		MAGELLAN PIPELINE COMPANY, L.P.	MAGELLAN PIPE LINE	PROTECT	300	CROSS
CU-NE-12	NE 1042+00	NATURAL GAS LIQUIDS	16		ENERGY TRANSFER COMPANY	S109 TX NGL MERTENS TO CORSICANA	PROTECT	800	CROSS
CU-NE-13	NE 1042+73	CRUDE OIL	20		SUNOCO PIPELINE L.P.	PERMIAN EXPRESS II SYSTEM	PROTECT	800	CROSS
CU-NE-14	NE 1099+44	EMPTY	12.75		MAGELLAN PIPELINE COMPANY, L.P.	MAGELLAN PIPE LINE	PROTECT	300	CROSS
CU-NE-15	NE 1132+82	ELECTRIC TRANSMISSION		Below 100kV	ONCOR		ELEVATE	2000	CROSS
CU-NE-16	NE 1391+19	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	2000	CROSS
CU-NE-17	NE 1391+19	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	2000	CROSS
CU-NE-18	NE 1512+46	ELECTRIC TRANSMISSION		Below 100kV	ONCOR		ELEVATE	2000	CROSS
CU-NE-19	NE 1560+00	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	2000	PARALLEL
CU-NE-20	NE 1620+00	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	2000	PARALLEL
CU-EW-1	EW 126+63	CRUDE OIL	16		SUNOCO PIPELINE L.P.	SXL INTERSTATE	PROTECT	500	CROSS
CU-EW-2	EW 178+00	CRUDE OIL	16		SUNOCO PIPELINE L.P.	SXL INTERSTATE	PROTECT	100	PARALLEL
CU-EW-3	EW 193+00	CRUDE OIL	16		SUNOCO PIPELINE L.P.	SXL INTERSTATE	PROTECT	450	PARALLEL
CU-EW-4	EW 357+33	NATURAL GAS	42		ENERGY TRANSFER COMPANY	20081017 TEXAS INDEPENDENCE PIPELINE(TI*	PROTECT	350	CROSS
CU-EW-5	EW 365+27	NATURAL GAS	36		ENERGY TRANSFER COMPANY	BETHEL-HOWARD	PROTECT	650	CROSS
CU-EW-6	EW 384+79	NATURAL GAS	20		ENERGY TRANSFER COMPANY	WILLS POINT-HOWARD	PROTECT	350	CROSS
CU-EW-7	EW 386+54	ELECTRIC TRANSMISSION		Below 100kV	ONCOR		ELEVATE	2000	CROSS
CU-EW-8	EW 431+96	ELECTRIC TRANSMISSION		115kV - 161kV	ONCOR		ELEVATE	2000	CROSS
CU-EW-9	EW 459+63	NATURAL GAS	24		EMS USA, INC.	COKINOS SYSTEM	PROTECT	350	CROSS
CU-EW-10	EW 480+43	COMMUNICATION - UG			AT&T TEXAS		NO IMPACT		CROSS
CU-EW-11	EW 486+65	ELECTRIC TRANSMISSION		Below 100kV	ONCOR		ELEVATE	2000	CROSS
CU-EW-12	EW 526+87	COMMUNICATION - OH			AT&T TEXAS		NO IMPACT		CROSS
CU-EW-13	EW 676+55	COMMUNICATION - UG			AT&T TEXAS		NO IMPACT		CROSS
CU-EW-14	EW 765+00	WATER	72		TARRANT REGIONAL WATER DIST		PROTECT	1600	CROSS
CU-EW-15	EW 765+00	WATER	90		TARRANT REGIONAL WATER DIST		PROTECT	1600	CROSS
CU-EW-16	EW 869+91	ELECTRIC TRANSMISSION		Below 100kV	ONCOR		ELEVATE	2000	CROSS
CU-EW-17	EW 876+83	NATURAL GAS	30		ATMOS PIPELINE - TEXAS	V	PROTECT	400	CROSS
CU-EW-18	EW 946+13	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	2000	CROSS
CU-EW-19	EW 946+13	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	2000	CROSS
CU-EW-20	EW 1006+03	ELECTRIC TRANSMISSION		115kV - 161kV	ONCOR		ELEVATE	2000	CROSS
CU-EW-21	EW 1153+65	NATURAL GAS	20		ATMOS PIPELINE - TEXAS	S (3RD)	PROTECT	500	CROSS
CU-EW-22	EW 1154+05	NATURAL GAS	20		ATMOS PIPELINE - TEXAS	S	PROTECT	500	CROSS
CU-EW-23	EW 1179+00	ELECTRIC TRANSMISSION		Below 100kV	ONCOR		ELEVATE	2000	CROSS
CU-EE-1	EE 20+00	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	2000	PARALLEL
CU-EE-2	EE 108+09	CRUDE OIL	16		SUNOCO PIPELINE L.P.	SXL INTERSTATE	PROTECT	2100	CROSS
CU-EE-3	EE 120+00	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	2000	PARALLEL
CU-EE-4	EE 191+32	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	8500	CROSS
CU-EE-5	EE 191+32	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	8500	CROSS
CU-EE-6	EE 265+00	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	2000	PARALLEL
CU-EE-7	EE 265+00	NATURAL GAS	36		ENERGY TRANSFER COMPANY	BETHEL-HOWARD	PROTECT	150	PARALLEL
CU-EE-8	EE 265+00	NATURAL GAS	36		ENERGY TRANSFER COMPANY	BETHEL-HOWARD	PROTECT	150	PARALLEL
CU-EE-9	EE 265+00	NATURAL GAS	42		ENERGY TRANSFER COMPANY	20081017 TEXAS INDEPENDENCE PIPELINE(TI*	PROTECT	150	PARALLEL
CU-EE-10	EE 287+89	NATURAL GAS	36		ENERGY TRANSFER COMPANY	BETHEL-HOWARD	PROTECT	800	CROSS
CU-EE-11	EE 289+01	NATURAL GAS	42		ENERGY TRANSFER COMPANY	20081017 TEXAS INDEPENDENCE PIPELINE(TI*	PROTECT	800	CROSS
CU-EE-12	EE 363+79	NATURAL GAS	20		ENERGY TRANSFER COMPANY	WILLS POINT-HOWARD	PROTECT	350	CROSS
CU-EE-13	EE 368+79	ELECTRIC TRANSMISSION		Below 100kV	ONCOR		ELEVATE	2000	CROSS
CU-EE-14	EE 379+69	ELECTRIC TRANSMISSION		Below 100kV	ONCOR		ELEVATE	2000	CROSS
CU-EE-15	EE 379+69	ELECTRIC TRANSMISSION		Below 100kV	ONCOR		ELEVATE	2000	CROSS
CU-EE-16	EE 384+36	ELECTRIC TRANSMISSION		Below 100kV	ONCOR		ELEVATE	2000	CROSS
CU-EE-17	EE 391+63	ELECTRIC TRANSMISSION		115kV - 161kV	ONCOR		ELEVATE	2000	CROSS
CU-EE-18	EE 445+36	NATURAL GAS	24		EMS USA, INC.	COKINOS SYSTEM	PROTECT	350	CROSS
CU-EE-19	EE 455+00	COMMUNICATION - UG			AT&T TEXAS		NO IMPACT		CROSS
CU-EE-20	EE 511+00	COMMUNICATION - OH			AT&T TEXAS		NO IMPACT		CROSS
CU-EE-21	EE 640+00	COMMUNICATION - UG			AT&T TEXAS		NO IMPACT		CROSS
CU-EE-22	EE 726+00	WATER	72		TARRANT REGIONAL WATER DIST		PROTECT	500	CROSS
CU-EE-23	EE 726+00	WATER	90		TARRANT REGIONAL WATER DIST		PROTECT	500	CROSS

Crossing ID	Stationing	Utility Type	Size / Diameter (in)	Transmission Voltage	Utility Owner	System Name	Status	Length of Affected Utility (ft)	Parallel, Crossing, or Both
CU-EE-24	EE 827+09	ELECTRIC TRANSMISSION		Below 100kV	ONCOR		ELEVATE	2000	CROSS
CU-EE-25	EE 854+65	NATURAL GAS	30		ATMOS PIPELINE - TEXAS	V	PROTECT	500	CROSS
CU-EE-26	EE 963+96	ELECTRIC TRANSMISSION		115kV - 161kV	ONCOR		ELEVATE	2000	CROSS
CU-EE-27	EE 1114+10	NATURAL GAS	20		ATMOS PIPELINE - TEXAS	S (3RD)	PROTECT	500	CROSS
CU-EE-28	EE 1114+50	NATURAL GAS	20		ATMOS PIPELINE - TEXAS	S	PROTECT	500	CROSS
CU-EE-29	EE 1145+20	ELECTRIC TRANSMISSION		Below 100kV	ONCOR		ELEVATE	2000	CROSS
CU-DS-1	DS 136+90	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	2000	CROSS
CU-DS-2	DS 136+90	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	2000	CROSS
CU-DS-3	DS 138+20	ELECTRIC TRANSMISSION		115kV - 161kV	ONCOR		ELEVATE	2000	CROSS
CU-DS-4	DS 138+90	ELECTRIC TRANSMISSION		115kV - 161kV	ONCOR		ELEVATE	2000	CROSS
CU-DS-5	DS 193+20	ELECTRIC TRANSMISSION		115kV - 161kV	ONCOR		ELEVATE	2000	CROSS
CU-DS-6	DS 194+60	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	2000	CROSS
CU-DS-7	DS 200+00	SANITARY	36		CITY OF LANCASTER		NO IMPACT		CROSS
CU-DS-8	DS 350+00	ELECTRIC TRANSMISSION		345kV - 450kV	ONCOR		ELEVATE	2000	CROSS
CU-DS-9	DS 351+30	ELECTRIC TRANSMISSION		115kV - 161kV	ONCOR		ELEVATE	2000	CROSS
CU-DS-10	DS 447+90	COMMUNICATION - UG	600 Pr		AT&T TEXAS		PROTECT	800	CROSS
CU-DS-11	DS 529+00	SANITARY	48		CITY OF DALLAS		NO IMPACT		CROSS
CU-DS-12	DS 538+10	SANITARY	48		CITY OF DALLAS		NO IMPACT		CROSS
CU-DS-13	DS 539+75	SANITARY	48		CITY OF DALLAS		NO IMPACT		CROSS
CU-DS-14	DS 565+90	NATURAL GAS	24		ATMOS ENERGY CORP., MID-TEX DIVISION	DALLAS	PROTECT	350	CROSS
CU-DS-15	DS 570+90	SANITARY	21		CITY OF DALLAS		NO IMPACT		CROSS
CU-DS-16	DS 596+20	ELECTRIC TRANSMISSION		115kV - 161kV	ONCOR		ELEVATE	2000	CROSS
CU-DS-17	DS 596+50	WATER	72		CITY OF DALLAS		NO IMPACT		CROSS
CU-DS-18	DS 606+80	NATURAL GAS	18		GULF SOUTH PIPELINE COMPANY, LP	1	PROTECT	350	CROSS
CU-DS-19	DS 652+45	SANITARY	60		CITY OF DALLAS		PROTECT	400	CROSS
CU-DS-20	DS 652+90	ELECTRIC TRANSMISSION		115kV - 161kV	ONCOR		ELEVATE	2000	CROSS
CU-DS-21	DS 652+90	ELECTRIC TRANSMISSION		115kV - 161kV	ONCOR		ELEVATE	2000	CROSS
CU-DS-22	DS 706+60	SANITARY	21		CITY OF DALLAS		NO IMPACT		CROSS
CU-DS-23	DS 722+70	STORMWATER	24		CITY OF DALLAS		NO IMPACT		CROSS
CU-DS-24	DS 762+00	STORMWATER	18		CITY OF DALLAS		NO IMPACT		PARALLEL
CU-DS-25	DS 767+70	STORMWATER			CITY OF DALLAS		NO IMPACT		CROSS
CU-DS-1	DT 18+10	STORMWATER			CITY OF DALLAS		NO IMPACT		CROSS
CU-DS-2	DT 20+90	SANITARY	60		CITY OF DALLAS		NO IMPACT		CROSS
CU-DS-3	DT 21+29	WATER	72		CITY OF DALLAS		NO IMPACT		CROSS
CU-DS-4	DT 22+40	ELECTRIC TRANSMISSION		115kV - 161kV	ONCOR		ELEVATE	2000	CROSS
CU-DS-5	DT 22+40	ELECTRIC TRANSMISSION		115kV - 161kV	ONCOR		ELEVATE	2000	CROSS
CU-DS-6	DT 35+37	SANITARY	81		CITY OF DALLAS		NO IMPACT		CROSS
CU-DS-7	DT 65+00	SANITARY	24		CITY OF DALLAS		NO IMPACT		CROSS
CU-DS-8	DT 71+70	SANITARY	18		CITY OF DALLAS		NO IMPACT		CROSS
CU-DS-9	DT 85+30	SANITARY	24		CITY OF DALLAS		NO IMPACT		CROSS
CU-DS-10	DT 103+50	STORMWATER	27		CITY OF DALLAS		NO IMPACT		CROSS
CU-DS-11	DT 120+90	SANITARY	48		CITY OF DALLAS		NO IMPACT		CROSS
CU-DS-12	DT 121+30	SANITARY	18		CITY OF DALLAS		NO IMPACT		CROSS
CU-DS-13	DT 132+90	STORMWATER	84		CITY OF DALLAS		NO IMPACT		CROSS
CU-DS-14	DT 138+00	STORMWATER			CITY OF DALLAS		NO IMPACT		CROSS
CU-DS-15	DT 141+00	STORMWATER	27		CITY OF DALLAS		NO IMPACT		CROSS
CU-DS-16	DT 142+80	STORMWATER	72		CITY OF DALLAS		NO IMPACT		CROSS
CU-DS-17	DT 158+20	ELECTRIC TRANSMISSION		115kV - 161kV	ONCOR		ELEVATE	2000	CROSS
CU-DS-18	DT 158+20	ELECTRIC TRANSMISSION		Below 100kV	ONCOR		ELEVATE	2000	CROSS
CU-DS-19	DT 158+50	STORMWATER	66		CITY OF DALLAS		NO IMPACT		CROSS
CU-DS-20	DT 159+00	STORMWATER	60		CITY OF DALLAS		NO IMPACT		CROSS
CU-DS-21	DT 163+00	SANITARY	24		CITY OF DALLAS		RELOCATE	2700	CROSS
CU-DS-22	DT 176+90	STORMWATER	27		CITY OF DALLAS		NO IMPACT		CROSS
CU-DS-23	DT 177+00	SANITARY	60		CITY OF DALLAS		NO IMPACT		PARALLEL
CU-DS-24	DT 177+00	WATER	24		CITY OF DALLAS		NO IMPACT		PARALLEL
CU-DS-25	DT 177+00	WATER	20		CITY OF DALLAS		NO IMPACT		PARALLEL
CU-DS-26	DT 177+14	COMMUNICATION - OH	100 Pr		AT&T TEXAS		NO IMPACT		CROSS
CU-DS-27	DT 177+14	COMMUNICATION - OH	300 Pr		AT&T TEXAS		NO IMPACT		CROSS
CU-DS-28	DT 181+70	STORMWATER	30		CITY OF DALLAS		NO IMPACT		CROSS
CU-DS-29	DT 195+80	STORMWATER			CITY OF DALLAS		NO IMPACT		CROSS
CU-DS-30	DT 196+00	SANITARY	60		CITY OF DALLAS		NO IMPACT		PARALLEL
CU-DS-31	DT 196+00	STORMWATER			CITY OF DALLAS		NO IMPACT		PARALLEL
CU-DS-32	DT 197+00	WATER	24		CITY OF DALLAS		NO IMPACT		PARALLEL
CU-DS-33	DT 197+00	WATER	20		CITY OF DALLAS		NO IMPACT		PARALLEL
CU-DS-34	DT 198+70	STORMWATER	60		CITY OF DALLAS		NO IMPACT		PARALLEL
CU-DS-35	DT 198+70	STORMWATER	60		CITY OF DALLAS		NO IMPACT		PARALLEL
CU-DS-36	DT 204+00	SANITARY	24		CITY OF DALLAS		NO IMPACT		CROSS
CU-DS-37	DT 214+60	STORMWATER			CITY OF DALLAS		NO IMPACT		PARALLEL
CU-DS-38	DT 214+60	WATER	20		CITY OF DALLAS		NO IMPACT		PARALLEL
CU-DS-39	DT 214+60	WATER	24		CITY OF DALLAS		NO IMPACT		PARALLEL

Crossing ID	Stationing	Utility Type	Size / Diameter (in)	Transmission Voltage	Utility Owner	System Name	Status	Length of Affected Utility (ft)	Parallel, Crossing, or Both
CU-DS-40	DT 214+60	SANITARY	30		CITY OF DALLAS		NO IMPACT		PARALLEL
CU-DS-41	DT 214+60	SANITARY	60		CITY OF DALLAS		NO IMPACT		PARALLEL
CU-DS-42	DT 214+60	STORMWATER	24		CITY OF DALLAS		NO IMPACT		CROSS
CU-DS-43	DT 214+60	WATER	60		CITY OF DALLAS		NO IMPACT		PARALLEL
CU-DS-44	DT NORTH PARKING	SANITARY	90		CITY OF DALLAS		NO IMPACT		PARALLEL
CU-DS-45	DT NORTH PARKING	SANITARY	51		CITY OF DALLAS		NO IMPACT		PARALLEL
CU-DS-46	DT NORTH PARKING	STORMWATER	96		CITY OF DALLAS		NO IMPACT		PARALLEL
CU-DS-47	DT NORTH PARKING	STORMWATER	96		CITY OF DALLAS		NO IMPACT		PARALLEL

Appendix K

Breakdown of Electrical Load Requirements at Each Facility on Each Alignment

		Area				Power Use							Hours of Operation			Power
		Conditioned	Ventilated	Covered	Uncovered / Parking	Conditioned	Ventilated	Uncovered/ Parking	Conditioned	Ventilated	Uncovered/ Parking	Maximum Demand	Conditioned	Ventilated	Uncovered/ Parking	consumption per day
Facility		sq ft				Watts per sqft			Watts			KiloWatts	Hours of Operation			MWh/Day
Dallas Station	0	238,263	139,823	378,086	0	8	2	0.21	1,906,107	279,646	0	2,186	24	24	24	52.5
Dallas Parking	0	205,000	0	205,000	2,070,500	8	2	0.21	1,640,000	0	434,805	2,075	24	24	24	49.8
Houston Station (HT1)*	0	249,653	134,252	383,905	0	8	2	0.21	1,997,227	268,504	0	2,266	24	24	24	54.4
Houston Parking (HT1)*	0	106,500	0	106,500	2,293,250	8	2	0.21	852,000	0	481,583	1,334	24	24	24	32.0
Brazos Valley Station	0	115,267	95,846	211,113	0	8	2	0.21	922,137	191,691	0	1,114	24	24	24	26.7
Brazos Valley Parking	0	5,000	0	5,000	450,500	8	2	0.21	40,000	0	94,605	135	24	24	24	3.2
Houston South TMF	TMF	176,550	145,350	321,900	1,964,246	8	2	0.21	1,412,400	290,700	412,492	2,116	24	24	24	50.8
Houston North TMF and additional MOW	TMF	179,368	152,890	332,258	4,893,673	8	2	0.21	1,434,944	305,780	1,027,671	2,768	24	24	24	66.4
Dallas South TMF and additional MOW	TMF	179,368	152,890	332,258	4,199,906	8	2	0.21	1,434,944	305,780	881,980	2,623	24	24	24	62.9
Dallas North TMF	TMF	176,550	145,350	321,900	3,197,497	8	2	0.21	1,412,400	290,700	671,474	2,375	24	24	24	57.0
MOW	MOW	9,250	17,750	27,000	844,193	8	2	0.21	74,000	35,500	177,281	287	24	24	24	6.9
Sectioning Post	SP	2,148	0	2,148	23,852	8	0	0.21	17,187	0	5,009	22	24	24	24	0.5
Sub-Sectioning Post	SSP	2,148	0	2,148	17,852	8	0	0.21	17,187	0	3,749	21	24	24	24	0.5
Auto Transformer Post	ATP	2,148	0	2,148	10,852	8	0	0.21	17,187	0	2,279	19	24	24	24	0.5
Traction Power Substation	TPSS	30,000	0	30,000	470,000	8	0	0.21	240,000	0	98,700	339	24	24	24	8.1
Communication House	CH	256	0	256	494	15	0	0.21	3,840	0	104	4	24	24	24	0.1
Sub Signal House	SSH	2,500	0	2,500	2,300	15	0	0.21	37,500	0	483	38	24	24	24	0.9
Main Signal House	MSH	4,000	0	4,000	9,000	15	0	0.21	60,000	0	1,890	62	24	24	24	1.5
Intermediate Signal House	ISH	4,000	0	4,000	12,900	15	0	0.21	60,000	0	2,709	63	24	24	24	1.5

*HT1 analyzed as it is the longest Houston terminal option

		Alt Alignment A		Alt Alignment B		Alt Alignment C		Alt Alignment D		Alt Alignment E		Alt Alignment F	
		Number of Facilities	Demand Load per	Number of Facilities	Demand Load per	Number of Facilities	Demand Load per	Number of Facilities	Demand Load per day	Number of Facilities	Demand Load per	Number of Facilities	Demand Load per day
Facility		Number	(MWH)	Number	(MWH)	Number	(MWH)	Number	(MWH)	Number	(MWH)	Number	(MWH)
Dallas Station	0	1	52.5	1	52.5	1	52.5	1	52.5	1	52.5	1	52.5
Dallas Parking	0	1	49.8	1	49.8	1	49.8	1	49.8	1	49.8	1	49.8
Houston Station (HT1)*	0	1	54.4	1	54.4	1	54.4	1	54.4	1	54.4	1	54.4
Houston Parking (HT1)*	0	1	32.0	1	32.0	1	32.0	1	32.0	1	32.0	1	32.0
Brazos Valley Station	0	1	26.7	1	26.7	1	26.7	1	26.7	1	26.7	1	26.7
Brazos Valley Parking	0	1	3.2	1	3.2	1	3.2	1	3.2	1	3.2	1	3.2
Houston North TMF and additional MOW**	TMF	1	66.4	1	66.4	1	66.4	1	66.4	1	66.4	1	66.4
Dallas South TMF and additional MOW**	TMF	1	62.9	1	62.9	1	62.9	1	62.9	1	62.9	1	62.9
MOW	MOW	5	34.4	5	34.4	5	34.4	5	34.4	5	34.4	5	34.4
Sectioning Post	SP	11	5.9	11	5.9	11	5.9	11	5.9	11	5.9	11	5.9
Sub-Sectioning Post	SSP	11	5.5	12	6.0	10	5.0	11	5.5	12	6.0	10	5.0
Auto Transformer Post	ATP	2	0.9	2	0.9	2	0.9	2	0.9	2	0.9	2	0.9
Traction Power Substation	TPSS	12	97.5	11	89.4	12	97.5	12	97.5	11	89.4	12	97.5
Communication House	CH	47	4.4	47	4.4	47	4.4	47	4.4	47	4.4	47	4.4
Sub Signal House	SSH	3	2.7	3	2.7	3	2.7	3	2.7	3	2.7	3	2.7
Main Signal House	MSH	8	11.9	8	11.9	8	11.9	8	11.9	8	11.9	8	11.9
Intermediate Signal House	ISH	6	9.0	6	9.0	6	9.0	6	9.0	6	9.0	6	9.0
Total			520.4		512.7		519.9		520.4		512.7		519.9

*HT1 analyzed as it is the longest Houston terminal option

**Houston North TMF and additional MOW and Dallas South TMF and additional MOW analyzed as they use more power than the alternative TMF locations.

Appendix L

Species List and Suggested Wildlife Crossings Types and Fencing

Appendix L: Species list and Suggested
Wildlife Crossings Types and Fencing

Common Name	**Scientific Name**	**Round Culvert**	**Concrete Box Culvert**	**Multi-Plate Steel Arch**	**Open-Span Bridge, Bridge Extension**	**Over-pass**	**Fencing**
Mammalian Species							
American badger	*Taxidea taxus*	48"	48"h x 48"w	---	---	---	4' wire mesh
Beaver	*Castor canadensis*	36"	36"	---	---	---	4" x 2" page wire, small mesh
Black bear	*Ursus americanus*	10'	10'h x 20'w	10'h x 20'w	10'h x 20'w	75'w	8' page wire
Black-tailed jackrabbit	*Lepus californicus*	36"	36"	---	---	---	4" x 2" page wire, small mesh
Bobcat	*Lynx rufus*	48"	48"h x 48"w	---	---	---	4' wire mesh
Coyote	*Canis latrans*	48"	48"h x 48"w	---	---	---	4' wire mesh
Feral Pig	*Sus scrofa*	36"	36"	---	---	---	
Eastern cottontail	*Sylvilagus floridanus*	36"	36"	---	---	---	4" x 2" page wire, small mesh
Eastern flying squirrel	*Glaucomys volans*	36"	36"	---	---	---	4" x 2" page wire, small mesh
Eastern fox squirrel	*Sciurus niger*	36"	36"	---	---	---	4" x 2" page wire, small mesh
Eastern gray squirrel	*Sciurus carolinensis*	36"	36"	---	---	---	4" x 2" page wire, small mesh
Eastern spotted skunk	*Spilogale putorius*	36"	36"	---	---	---	4" x 2" page wire, small mesh
Grey fox	*Urocyon cinereo-argenteus*	36"	36"	---	---	---	4" x 2" page wire, small mesh
Hog-nosed skunk	*Conepatus mesoleucus*	36"	36"	---	---	---	4" x 2" page wire, small mesh
Long-tailed weasel	*Mustela frenata*	36"	36"	---	---	---	4" x 2" page wire, small mesh
American Mink	*Mustela vison*	36"	36"	---	---	---	4" x 2" page wire, small mesh

Common Name	Scientific Name	Round Culvert	Concrete Box Culvert	Multi-Plate Steel Arch	Open-Span Bridge, Bridge Extension	Over-pass	Fencing
Mountain lion	*Felis concolor*	10'	10'h x 20'w	10'h x 20'w	10'h x 20'w	75'w	8' page wire
Muskrat	*Ondatra zibethicus*	36"	36"	---	---	---	4" x 2" page wire, small mesh
Nine-banded armadillo	*Dasypus novemcinctus*	36"	36"	---	---	---	4" x 2" page wire, small mesh
Raccoon	*Procyon lotor*	36"	36"	---	---	---	4" x 2" page wire, small mesh
Red fox	*Vulpes fulva*	36"	36"	---	---	---	4" x 2" page wire, small mesh
Red wolf	*Canis rufus*	Not adequate	12'h x 23'w	12'h x 23'w	12'h x 50'w	150'w	8' page wire
Ringtailed Cat	*Bassariscus astutus*	36"	36"	---	---	---	4" x 2" page wire, small mesh
River otter	*Lontra canadensis*	36"	36"	---	---	---	4" x 2" page wire, small mesh
Striped skunk	*Mephitis mephitis*	36"	36"	---	---	---	4" x 2" page wire, small mesh
Swamp rabbit	*Sylvilagus aquaticus*	36"	36"	---	---	---	4" x 2" page wire, small mesh
Virginia opposum	*Didelphis virginiana*	36"	36"	---	---	---	4" x 2" page wire, small mesh
White-tailed deer	*Odocoileus virginianus*	10'	10'h x 20'w	10'h x 20'w	10'h x 20'w	75'w	8' page wire
Reptiles							
American Alligator	*Alligator mississippiensis*	24'w x 8'h	24'w x 8'h	---	---	---	8'h
Common Snapping Turtle	*Chelydra serpentina*	18"w	18"w	---	---	---	20"h

Appendix L: Species list and Suggested
Wildlife Crossings Types and Fencing

Common Name	**Scientific Name**	**Round Culvert**	**Concrete Box Culvert**	**Multi-Plate Steel Arch**	**Open-Span Bridge, Bridge Extension**	**Over-pass**	**Fencing**
Eastern Mud Turtle	*Kinosternon subrubrum*	23"w	23"w	---	---	---	20"h
Ornate Box Turtle	*Terrapene ornata*	23"w	23"w	---	---	---	20"h
Texas Map Turtle	*Graptemys versa*	23"w	23"w	---	---	---	20"h
Red Ear Slider	*Trachemys scripta elegans*	23"w	23"w	---	---	---	20"h
Common Kingsnake	*Lampropeltis getula*	18"w	18"w	---	---	---	---
Copperhead	*Agkistrodon contortrix*	18"w	18"w	---	---	---	---
Cottonmouth	*Agkistrodon piscivorus*	18"w	18"w	---	---	---	---
Diamond-backed Watersnake	*Nerodia rhombifer*	18"w	18"w	---	---	---	---
Eastern Hog-nosed Snake	*Heterodon platirhinos*	18"w	18"w	---	---	---	---
Eastern Racer	*Coluber constrictor*	18"w	18"w	---	---	---	---
Eastern Ratsnake	*Pantherophis alleghaniensis*	18"w	18"w	---	---	---	---
Prairie Kingsnake	*Lampropeltis calligaster*	18"w	18"w	---	---	---	---
Red-bellied mudsnake	*Farancia abacura*	18"w	18"w	---	---	---	---
Rough Green Snake	*Opheodrys aestivus*	18"w	18"w	---	---	---	---

Common Name	**Scientific Name**	**Round Culvert**	**Concrete Box Culvert**	**Multi-Plate Steel Arch**	**Open-Span Bridge, Bridge Extension**	**Over-pass**	**Fencing**
Timber Rattlesnake	*Crotalus horridus*	18"w	18"w	---	---	---	---
Amphibians							
Cajun Chorus Frog	*Pseudacris fouquettei*	18"w	18"w	---	---	---	12"h
East Texas Toad	*Bufo velatus*	18"w	18"w	---	---	---	12"h
Gray Treefrog	*Hyla versicolor*	18"w	18"w	---	---	---	12"h
Green Treefrog	*Hyla cinerea*	18"w	18"w	---	---	---	12"h
Hurter's Spadefoot	*Scaphiopus hurterii*	18"w	18"w	---	---	---	12"h
Southern Leopard Frog	*Rana sphenocephala*	18"w	18"w	---	---	---	12"h
Strecker's Chorus Frog	*Pseudacris streckeri*	18"w	18"w	---	---	---	12"h
Houston Toad	*Anaxyrus houstonensis*	18"w	18"w	---	---	---	12"h
Eastern Newt	*Notophthalamus viridescens*	18"w	18"w	---	---	---	---
Small Mouth Salamander	*Ambystoma texanum*	18"w	18"w	---	---	---	---
* Measurement information is not available for all species for all treatments. Measurements given are minimum recommended dimensions as reported in the literature. h = height, w = width							

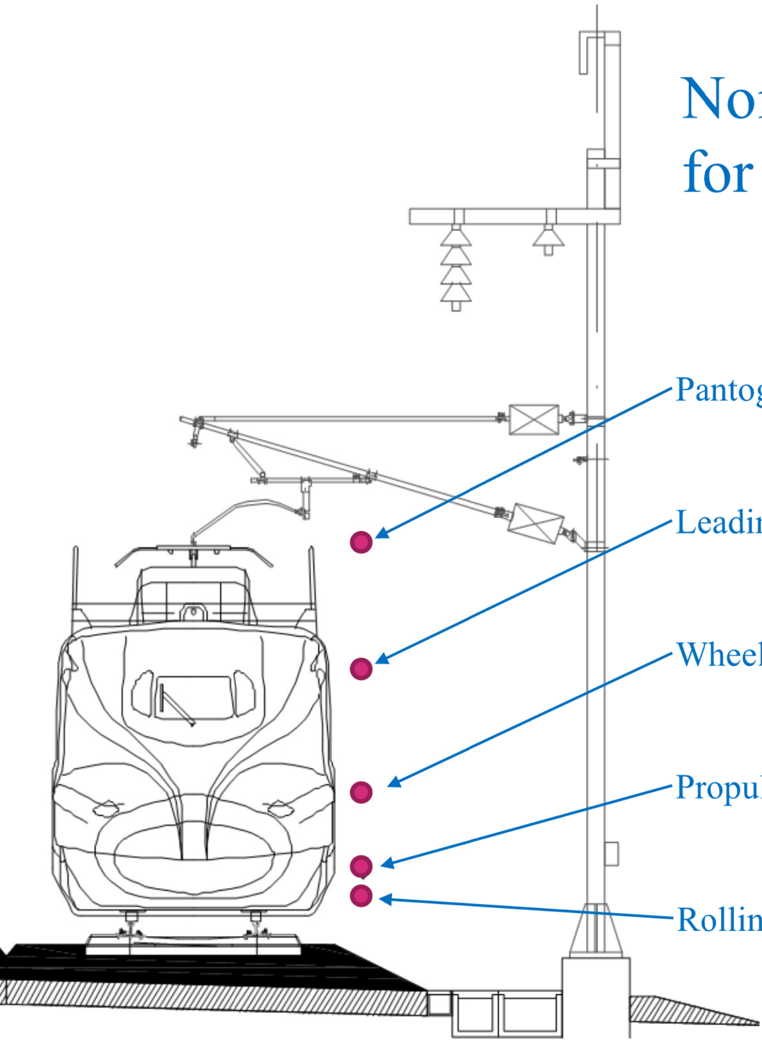
Appendix M

Noise and Vibration Mitigation Options

Noise and Vibration Mitigation Options

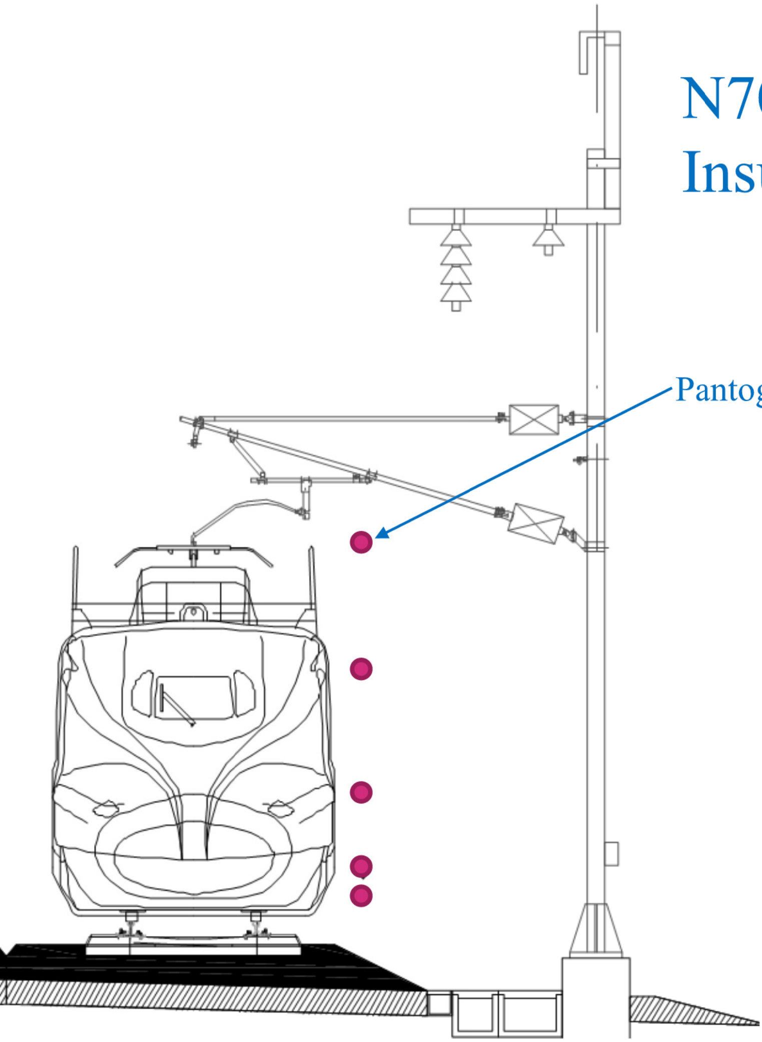
Typical HSR Infrastructure Section Types and N+V Mitigation Options for Each

Noise source types and their heights above rail for EMU trains running > 150 mph (FRA)



Noise mitigation effectiveness relies on breaking the line-of-sight between source(s) and receiver

N700-I source mitigation measures: Insulator covers and soundproof walls

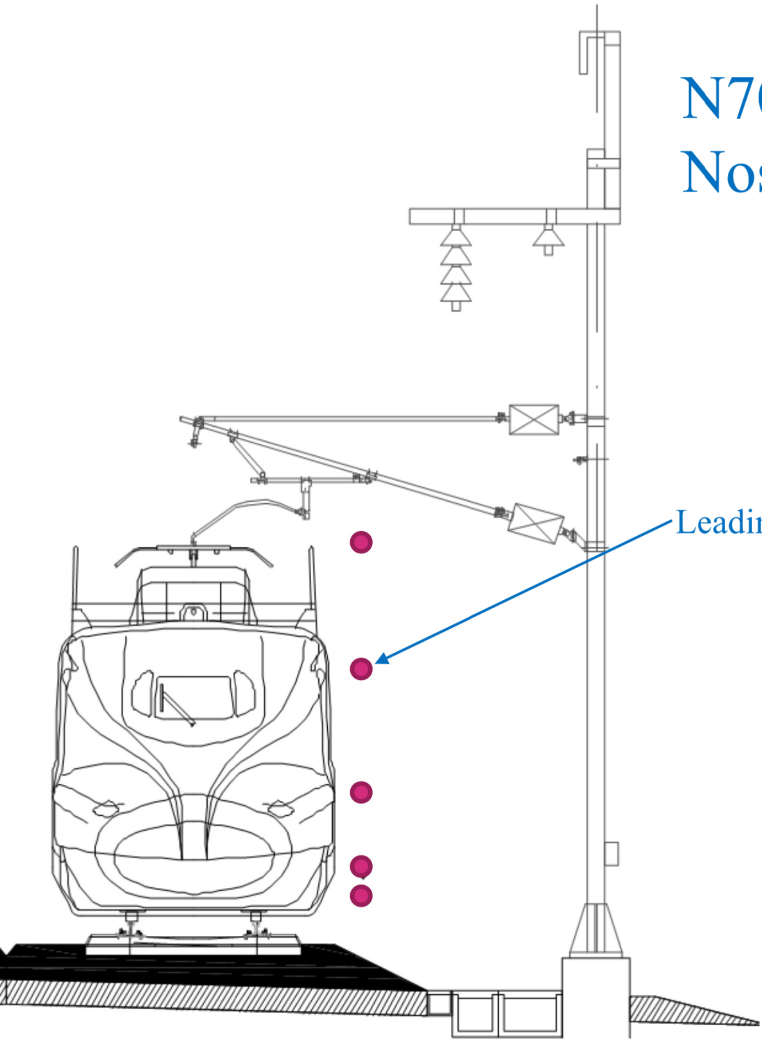


TEXAS CENTRAL RAILWAY
AMERICA'S BULLET TRAIN

FREESE NICHOLS
Celebrating 120 YEARS of Service

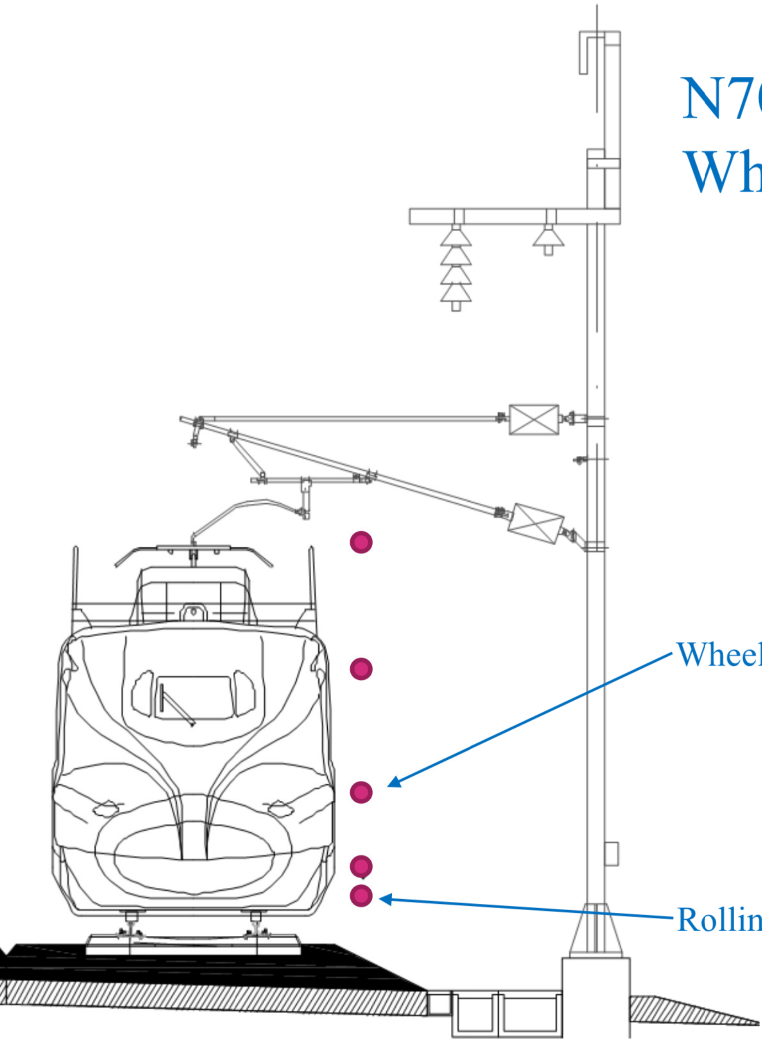
ARUP

N700-I source mitigation measures: Nose aerodynamic design



Leading/trailing car nose aerodynamic

N700-I source mitigation measures:
Wheel region / body aerodynamic + rolling noise



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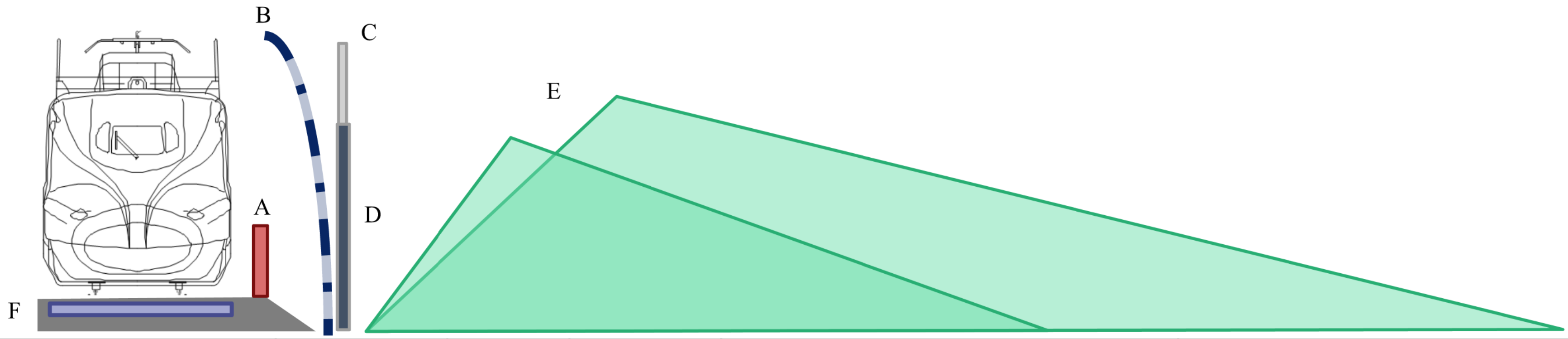
Wheel region/body aerodynamic

Rolling/wheel-rail noise

Circumferential diaphragm

Bogie shroud (aerodynamic + rolling noise)

Noise and vibration mitigation strategies: external to train



	Mitigation Technique	Groundborne Noise + Vibration	Rolling Noise	Aerodynamic Noise	Pros	Cons
A	Absorptive low-level barrier		✓		Reduced material cost / Reduced visual impact	Opportunities for close railway barriers are limited for trains running at > 186 mph
B	Transparent / cranked barrier		✓	✓*	Reduced visual impact	High Cost / Sustainability
C	Reflective barrier		✓	✓*	Wide range of materiality	Significant visual impact
D	Absorptive barrier (shorter than C)		✓	✓*	Wide range of materiality	Significant visual impact
E	Earthworks	✓§	✓	✓	Highly effective	Significant visual impact / require space
F	Lateral / sleeper pads	✓				High cost

** Effectiveness is height-dependent: must break line-of-sight to between subsource and receiver*
§ Effective by virtue of likely larger distances between alignment and receiver

Noise and vibration mitigation strategies: external to train
Reflective barriers

Material options: Wood, Metal, Concrete, Stone, Paraglass, etc.

Noise and vibration mitigation strategies: external to train
Absorptive barriers

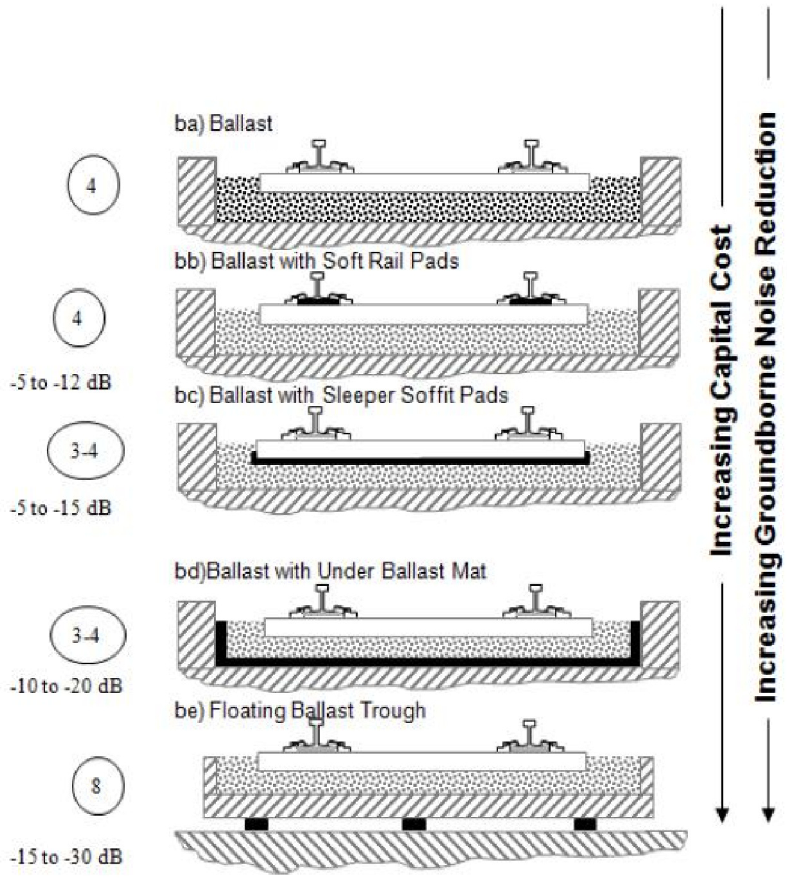
Example: wooden fence barrier
- 1-3/8 in. T&G panelling
- 1 in. depth T&G with seal
- Trapezoidal, perforated, galvanized steel inner cladding
- Mineral wool in void

Noise and vibration mitigation strategies: external to train
Transparent / cranked barriers

Noise and vibration mitigation strategies: external to train
Transparent barriers

Noise and vibration mitigation strategies: external to train
Low-level barriers

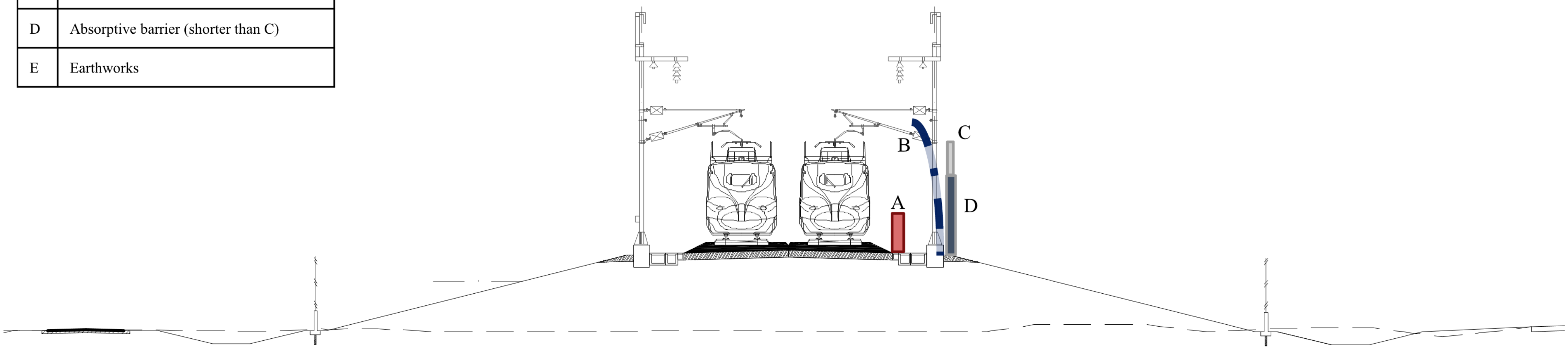
Noise and vibration mitigation strategies: external to train
Groundborne noise/vibration mitigation incorporated into ballast track-forms



TEXAS CENTRAL RAILWAY
FREESE NICHOLS
ARUP

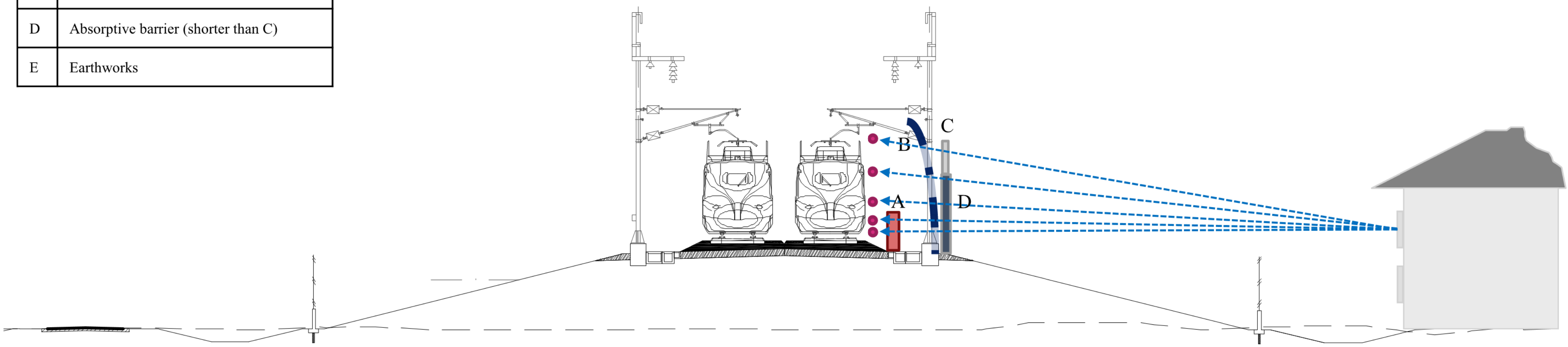
	Mitigation Technique
A	Absorptive low-level barrier
B	Transparent / cranked barrier
C	Reflective barrier
D	Absorptive barrier (shorter than C)
E	Earthworks

Embankment



	Mitigation Technique
A	Absorptive low-level barrier
B	Transparent / cranked barrier
C	Reflective barrier
D	Absorptive barrier (shorter than C)
E	Earthworks

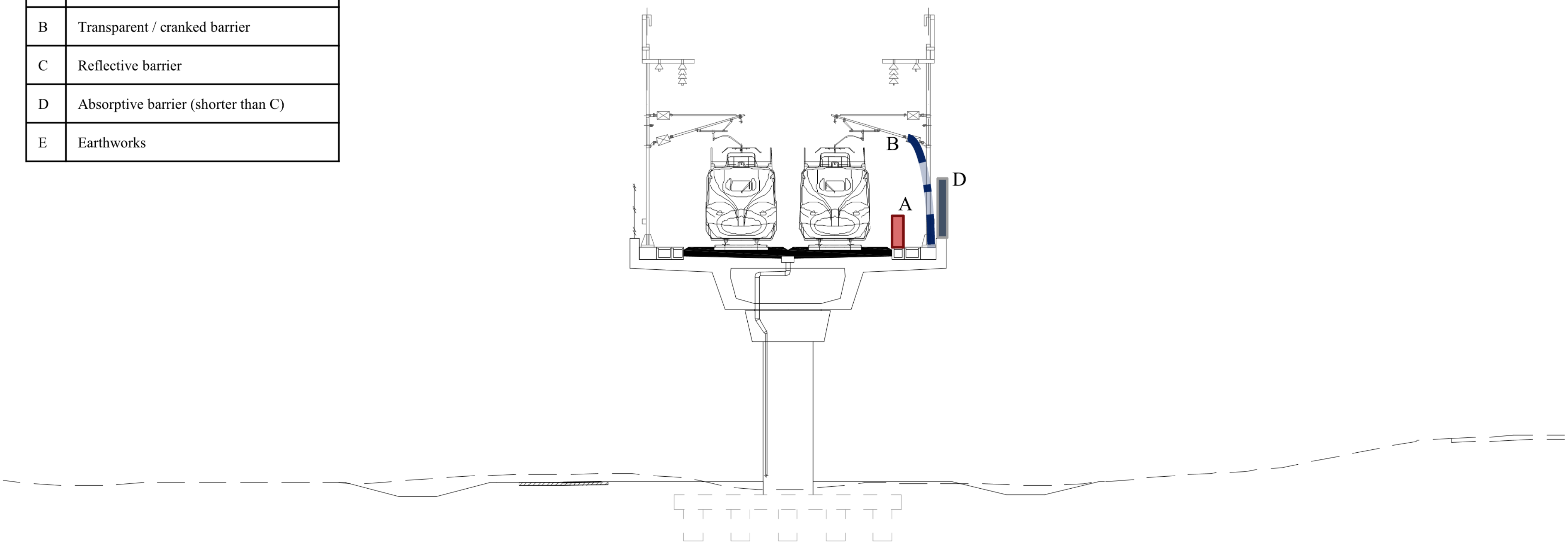
Embankment



Effectiveness of barriers is height-dependent – must break line-of-sight between source and receiver (i.e. the higher the receiver elevation above the subsource, the taller the barrier will need to be)

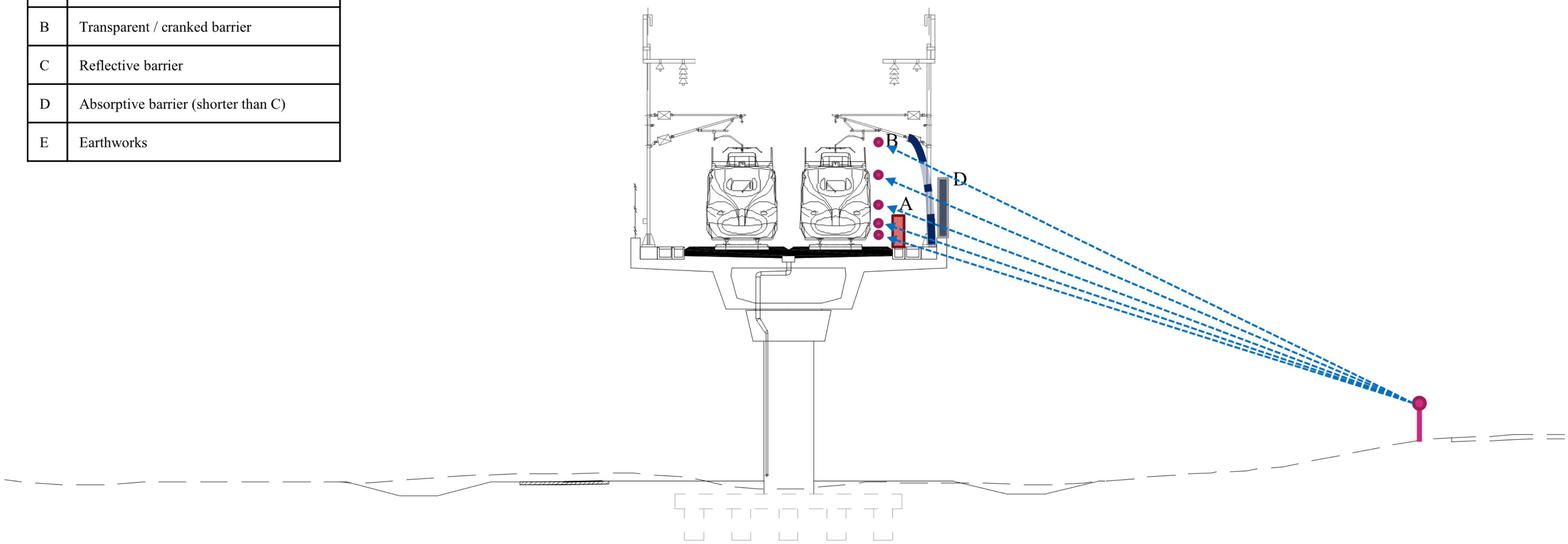
	Mitigation Technique
A	Absorptive low-level barrier
B	Transparent / cranked barrier
C	Reflective barrier
D	Absorptive barrier (shorter than C)
E	Earthworks

Viaduct



	Mitigation Technique
A	Absorptive low-level barrier
B	Transparent / cranked barrier
C	Reflective barrier
D	Absorptive barrier (shorter than C)
E	Earthworks

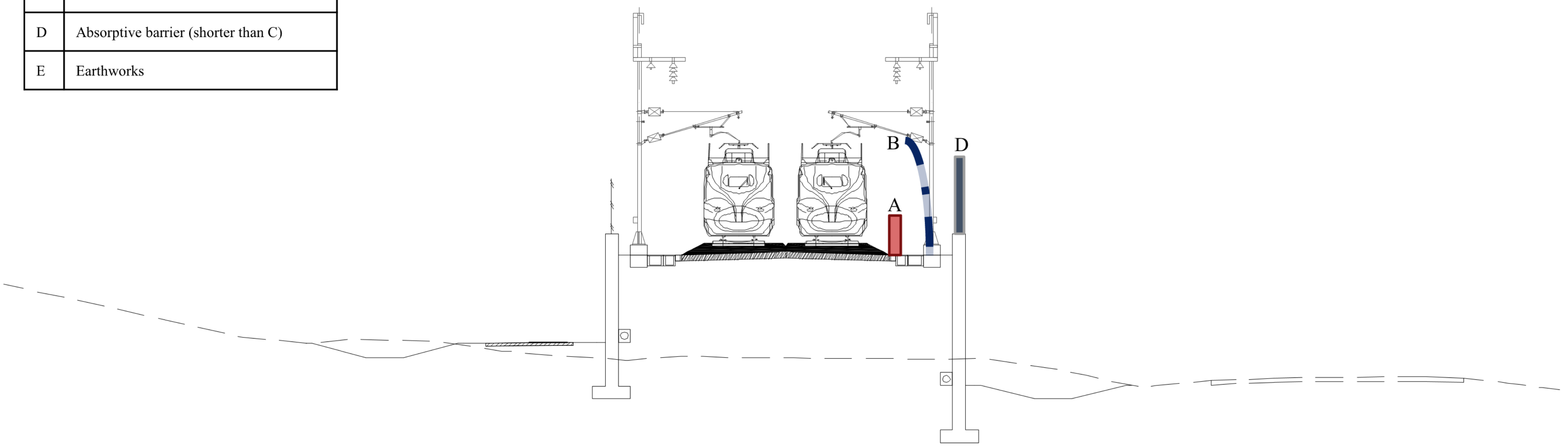
Viaduct



Effectiveness of barriers is height-dependent – must break line-of-sight between source and receiver. In general, viaducts allow for shorter noise barriers.

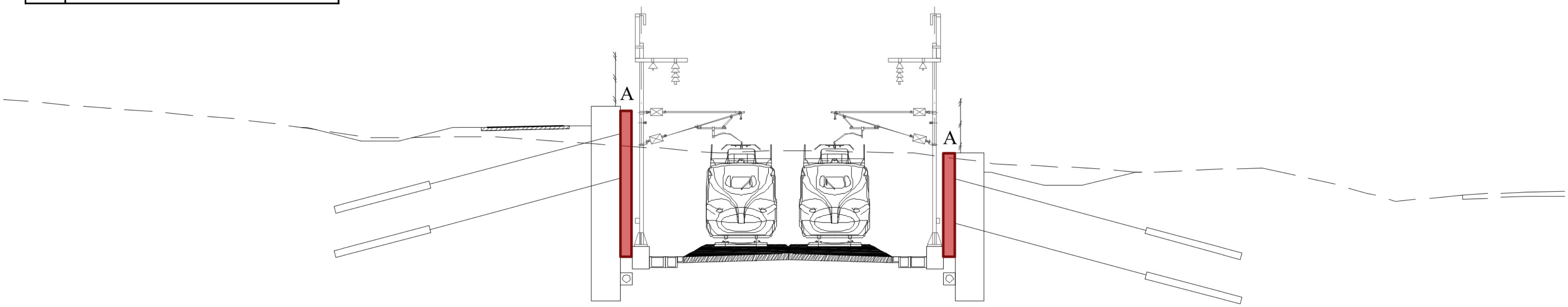
	Mitigation Technique
A	Absorptive low-level barrier
B	Transparent / cranked barrier
C	Reflective barrier
D	Absorptive barrier (shorter than C)
E	Earthworks

Retained Fill



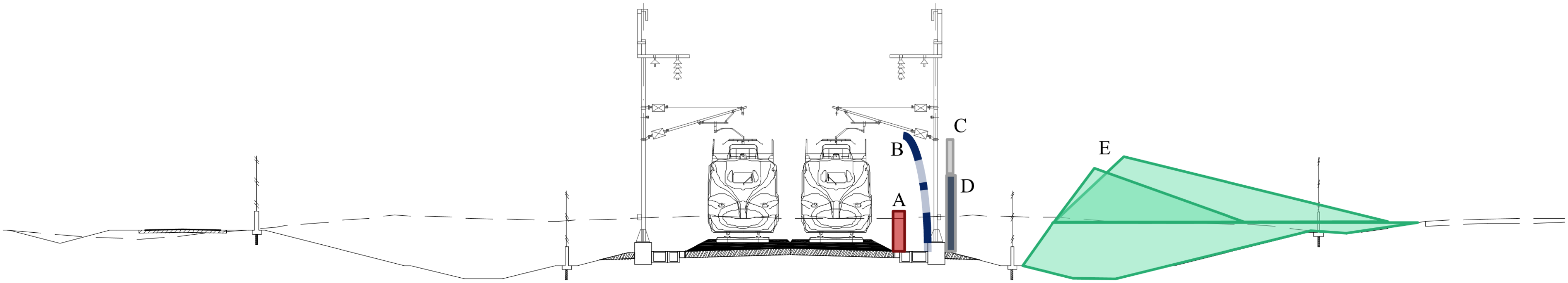
	Mitigation Technique
A	Absorptive low-level barrier
B	Transparent / cranked barrier
C	Reflective barrier
D	Absorptive barrier (shorter than C)
E	Earthworks

Retained Cutting



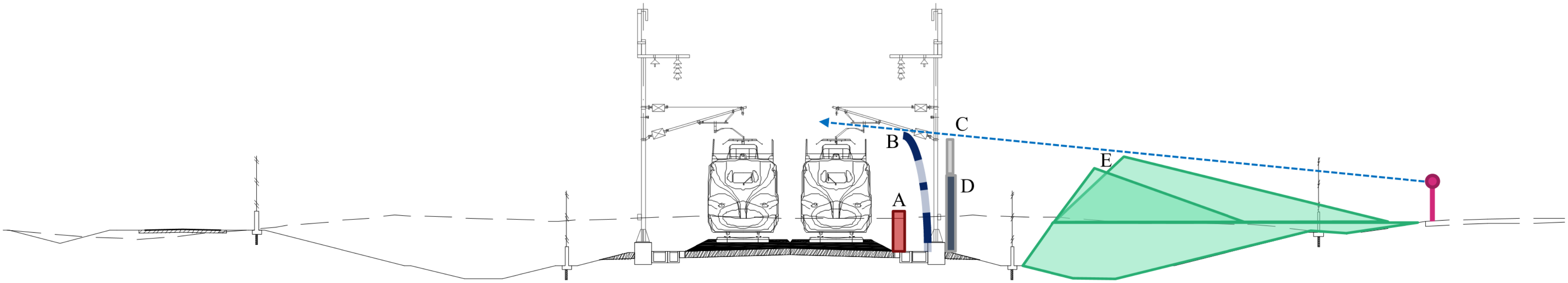
	Mitigation Technique
A	Absorptive low-level barrier
B	Transparent / cranked barrier
C	Reflective barrier
D	Absorptive barrier (shorter than C)
E	Earthworks

Typical Cutting



	Mitigation Technique
A	Absorptive low-level barrier
B	Transparent / cranked barrier
C	Reflective barrier
D	Absorptive barrier (shorter than C)
E	Earthworks

Typical Cutting



Effectiveness of barriers is height-dependent: must break line-of-sight between source and receiver