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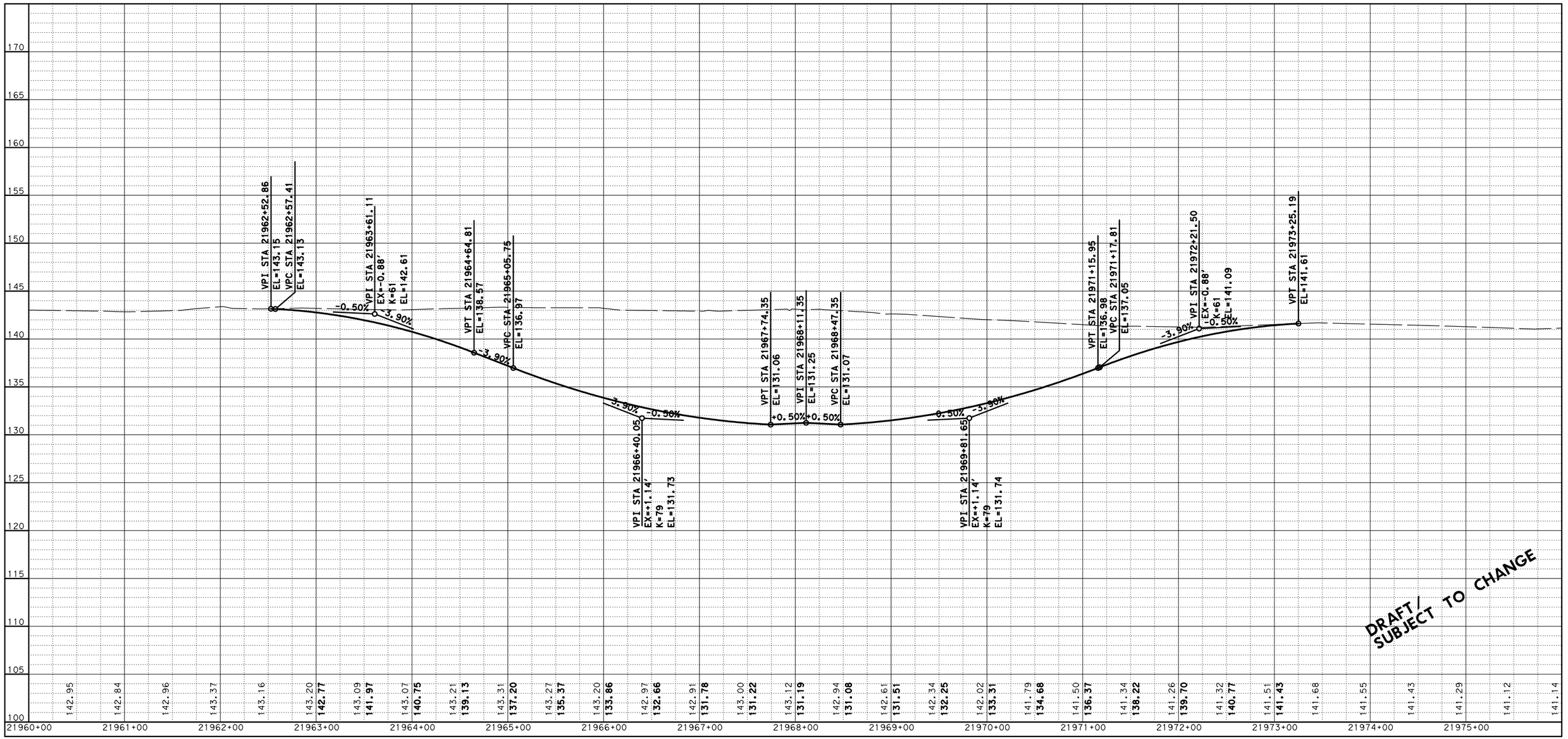
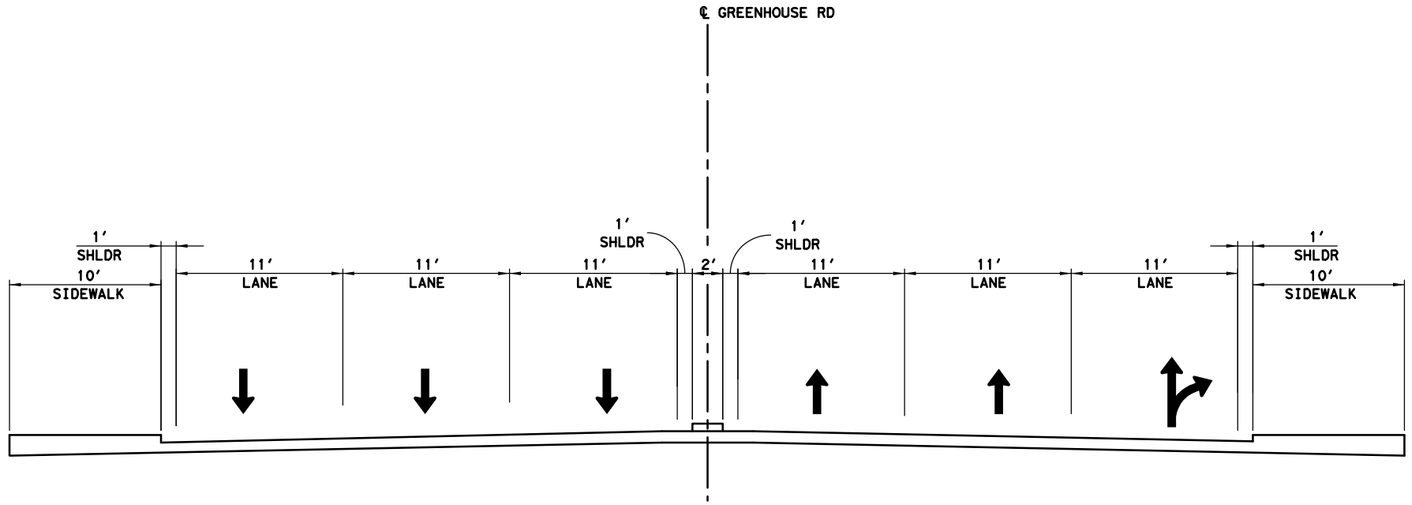


US 290 EASTBOUND FRONTAGE ROAD PROFILE

HORIZ SCALE: 1"=100'
VERT SCALE: 1"=10'

EHRA
10555 Westoffice Drive
Houston, Texas 77042
713.784.4500
EHRAinc.com
TBPE No. F-726



TYPICAL SECTION ENTERING UPRR UNDERPASS

0 25 50 100 200

SCALE: 1"=100′

EHRA
10555 Westoffice Drive
Houston, Texas 77042
713.784.4500
EHRAinc.com
TBPE No. F-726

DRAFT/ SUBJECT TO CHANGE

...\References\TYP_SECTIONS.dgn

GREENHOUSE/SKINNER RD AT US 290

GREENHOUSE RD
TYPICAL SECTION

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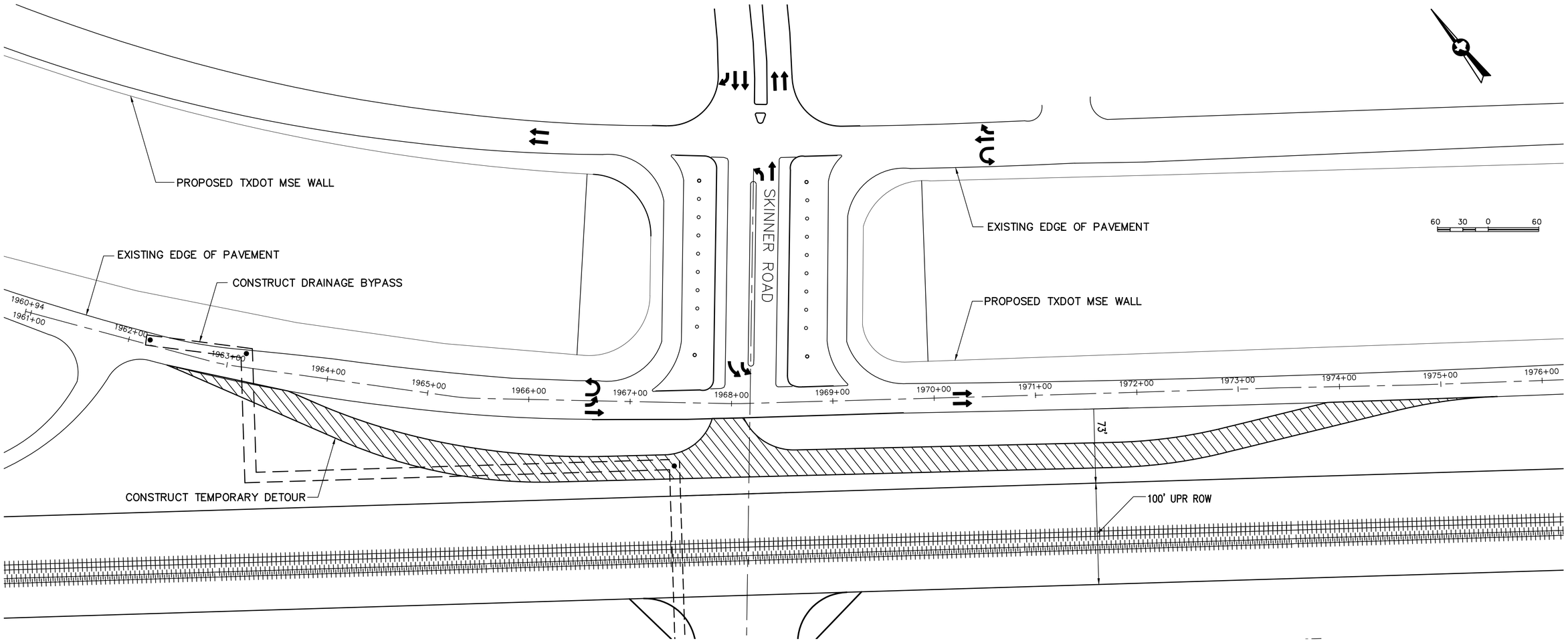

TCP - PHASE 1

- REROUTE EXISTING 10X10 BOX CULVERT (DRAIN TO CYPRESS CREEK)
- BUILD DETOUR ROAD
- NO OPERATION CHANGES TO US290

EHRA
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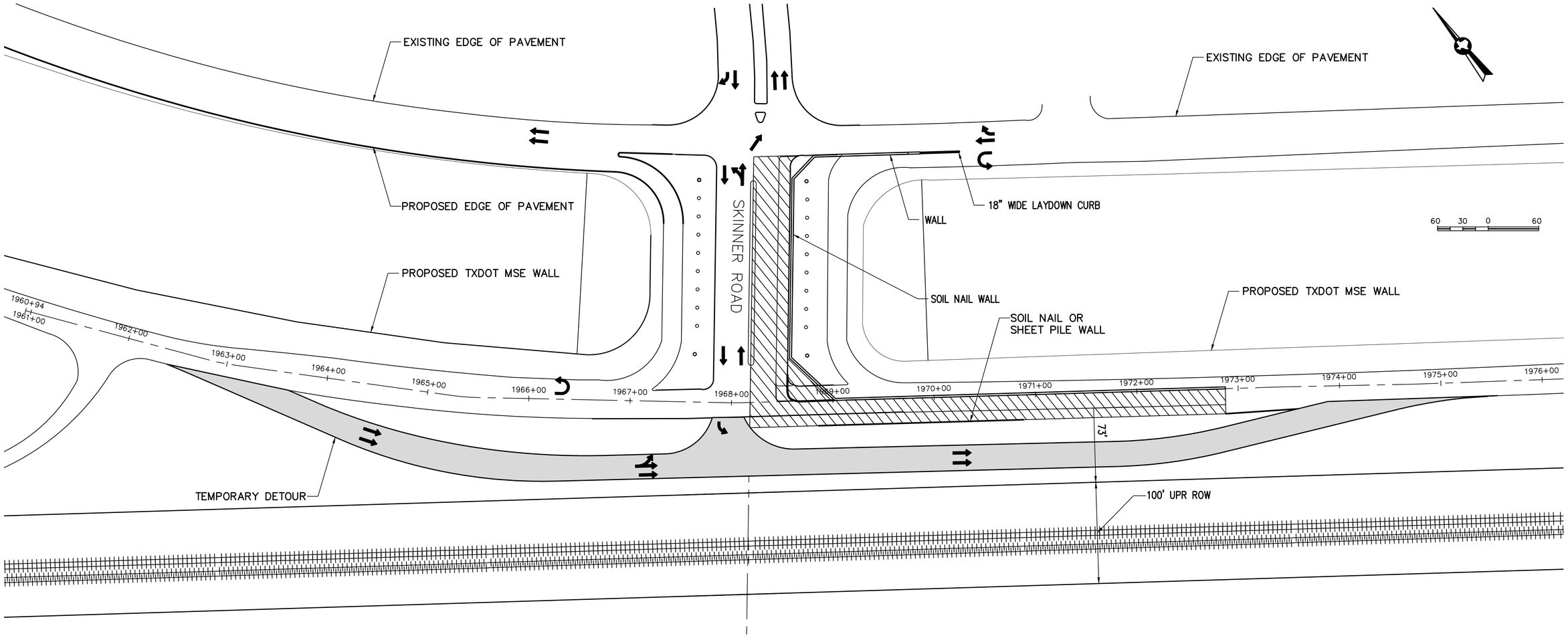
Houston, Texas 77042
713.784.4500
EHRAinc.com
TBPE No. F-726

US 290 EBFR
AT SKINNER/GREENHOUSE ROAD
TCP PHASE 1



TCP - PHASE 2

- DETOUR US290 EBFR TRAFFIC TO TEMPORARY PAVEMENT
- CLOSE EAST SIDE OF SKINNER UNDERPASS

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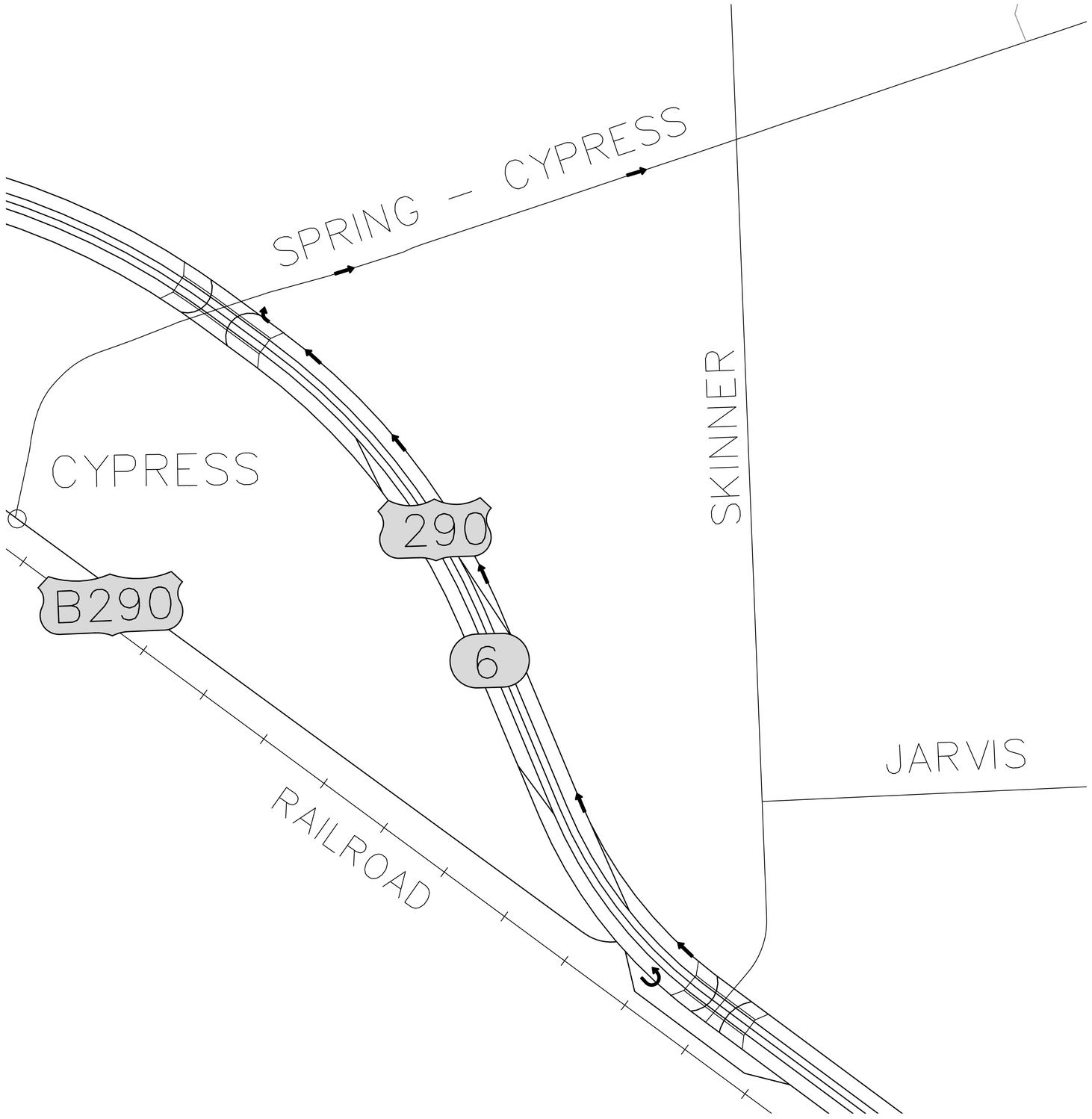
10555 Westoffice Drive
Houston, Texas 77042
713.784.4500
EHRAinc.com
TBPE No. F-726

US 290 EBFR
AT SKINNER/GREENHOUSE ROAD
TCP PHASE 2



250 125 0 250

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10555 Westoffice Drive
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EHRAinc.com
TBPE No. F-726

US 290 EBFR
AT SKINNER/GREENHOUSE ROAD
PLAN & CROSS SECTION

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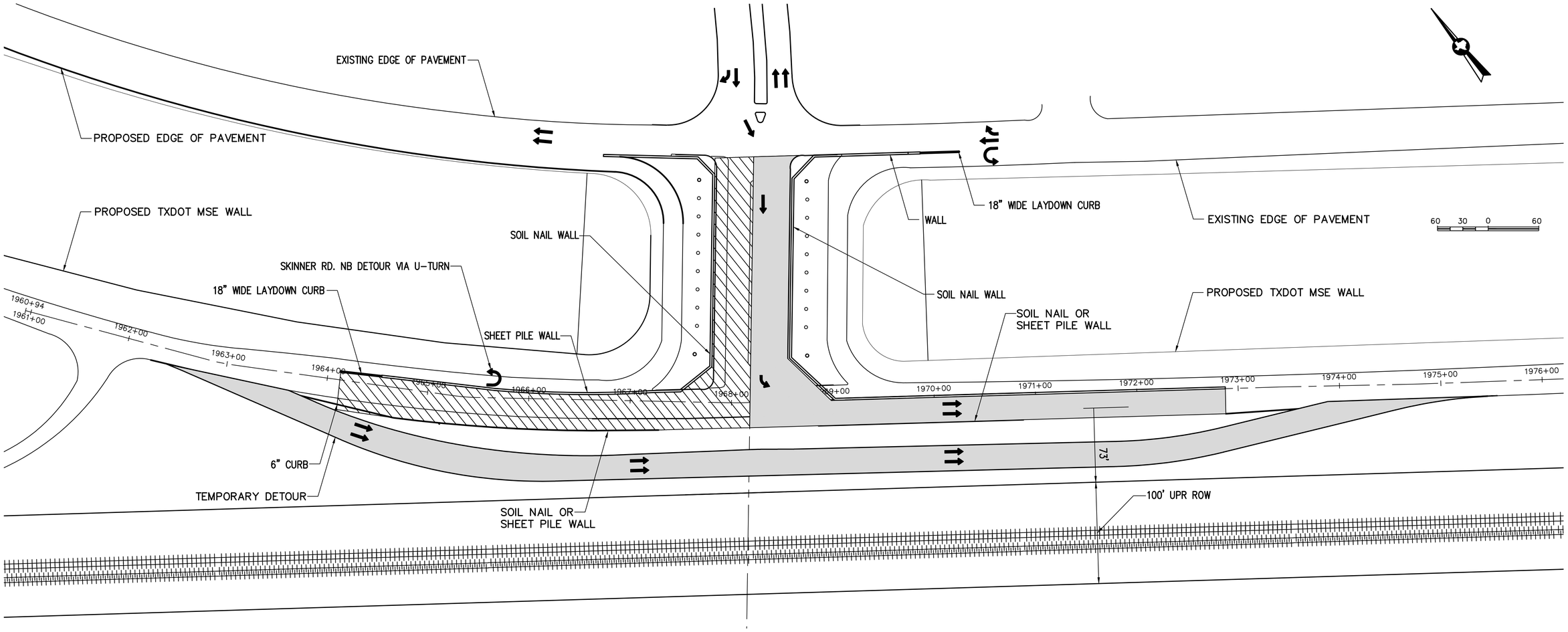
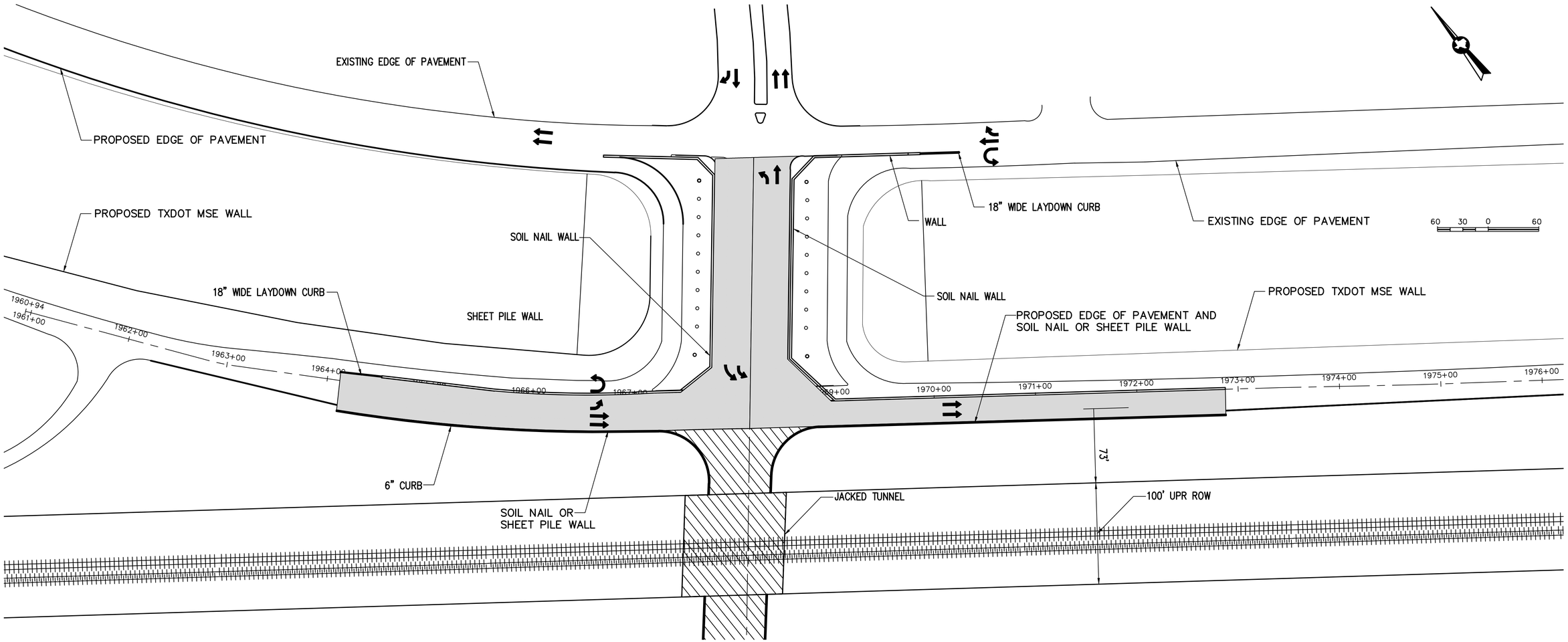


TCP - PHASE 3

- CLOSE WEST SIDE OF SKINNER UNDERPASS
- NO NORTHBOUND TRAFFIC
- NORTHBOUND TRAFFIC DETOURS VIA U-TURN

EHRA
10555 Westoffice Drive
Houston, Texas 77042
713.784.4500
EHRAinc.com
TBPE No. F-726

US 290 EBFR
AT SKINNER/GREENHOUSE ROAD
TCP PHASE 3



TCP - PHASE 4

- CONNECT SKINNER TO NEW GREENHOUSE ROAD

EHRA
10555 Westoffice Drive
Houston, Texas 77042
713.784.4500
EHRAinc.com
TBPE No. F-726

US 290 EBFR
AT SKINNER/GREENHOUSE ROAD
TCP PHASE 4

WETLAND ASSESSMENT
DETERMINATION AND DELINEATION

4.28 ± ACRES
U.S. HIGHWAY 290 & HEMPSTEAD ROAD
HARRIS COUNTY, TEXAS

PREPARED FOR
HARRIS COUNTY MUD #500
C/O ALLEN BOONE HUMPHRIES ROBINSON LLP

BERG◆OLIVER ASSOCIATES, INC.
ENVIRONMENTAL SCIENCE AND LAND USE CONSULTANTS
HOUSTON, TEXAS
REPORT NO: 10322N-WD
OCTOBER 2016

TABLE OF CONTENTS

SUMMARY

A Wetland Assessment Determination and Delineation was performed for Harris County MUD #500 c/o Allen Boone Humphries Robinson LLP, on a 4.28 ± acre tract of land, located southeast of U.S. Highway 290 and Hempstead Road, in Harris County, Texas.

The subject property was evaluated for its content of jurisdictional wetlands, based on criteria set forth in the 2010 Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region (v.2). Wetlands were identified and delineated using interpretation of historical aerial photography, topographic maps, hydrology indicators, and field evaluation of hydric soils, hydrology, and hydrophytic vegetation.

Topographical information published by the United States Geological Survey (USGS) indicates a gently sloping landscape with storm-water runoff flowing southeast off the subject property into Cypress Creek. The FEMA floodplain maps indicate that the entire subject property lies outside of any mapped 100-year FEMA floodplain.

The United States Department of Agriculture (USDA), Web Soil Survey of Harris County was, for the most part, reasonably accurate in identifying the basic soil types on the property as Addicks loam (Ad) and Gessner fine sandy loam (Ge).

Vegetation communities were evaluated and documented to delineate wetland and upland boundaries. In upland areas, the subject property was dominated by Bermuda grass (*Cynodon dactylon*), Kleberg's bluestem (*Dichanthium annulatum*), annual ragweed (*Ambrosia artemisiifolia*), bushy bluestem (*Andropogon glomeratus*), and fringed windmill grass (*Chloris ciliata*). No wetland areas were identified on the subject property.

Based on the wetland delineation presented in this report and the survey data collected using Global Positioning System (GPS) satellite equipment, it is the professional opinion of Berg♦Oliver Associates, Inc. (BOA) that there are no areas within the subject property that would meet the technical criteria to be classified as a jurisdictional wetland set forth by the USACE.

However, it is the professional opinion of BOA that the subject property contains approximately 0.02 acre (200 ± linear feet) of man-made upland ditches. Based on historic aerial photography and site reconnaissance, it appears that these man-made ditches were created entirely out of uplands. Therefore, it is the opinion of BOA that the 0.02 acres (200 ± linear feet) of man-made upland ditches would likely be considered non-jurisdictional by the USACE.

The USACE and the Environmental Protection Agency (EPA) are the final authority over the jurisdictional status of both wetlands and Waters of the U.S. per Section 404 of the Clean Water Act. The findings discussed in this report are solely the opinion of BOA and have not been verified by the aforementioned regulatory governmental agencies.

On June 29, 2015, the EPA and the USACE published a final rule defining the scope of waters protected under the Clean Water Act (CWA) known as the Clean Water Rule: Definition of "Waters of the United States" (Final Rule) in the Congressional Federal Register (CFR § 37053 (2015)). The Final Rule became effective on August 28, 2015.

However, in response to petitions filed by eighteen (18) separate states, the United States Sixth (6th) Circuit Court of Appeals issued a nationwide Order of Stay for the Final Rule on October 9, 2015, pending completion of judicial review (Sixth Circuit I.O.P. 32.1(b)). Petitioners contend that the Final Rule expands the regulatory jurisdiction originally defined in the CWA by the Supreme Court without satisfying the requirements of the Administrative Procedures Act (APA). This Order of Stay restores regulation nationwide to the pre-Final Rule regime, pending judicial review. At this point, we are not aware of when, if ever, the Final Rule will be re-instated. All aquatic resources on the tract were evaluated under the pre-Final Rule guidance and regulations. Should the Order of Stay be lifted and the Final Rule be re-instated, the findings of this report may need to be re-evaluated under the Final Rule.

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(281) 589-0898 fax: (281) 589-0007

WETLAND ASSESSMENT DETERMINATION AND DELINEATION

4.28 ± ACRES U.S. HIGHWAY 290 & HEMPSTEAD ROAD HARRIS COUNTY, TEXAS

INTRODUCTION

The study reported herein is a Wetland Assessment Determination and Delineation Study for Harris County MUD #500 c/o Allen Boone Humphries Robinson LLP, on a 4.28 ± acre tract of land, located southeast of U.S. Highway 290 and Hempstead Road, in Harris County, Texas.

AUTHORIZATION

This study was performed as authorized by Ms. Alia Vinson of Allen Boone Humphries Robinson LLP.

SITE LOCATION

The subject property is located southeast of U.S. Highway 290 and Hempstead Road, in Harris County, Texas. The subject property is depicted more specifically in the site maps located in **Attachment A**.

SCOPE OF WORK

The objective of this Wetland Assessment Determination and Delineation Study was to evaluate the subject property for jurisdictional wetlands in accordance with Section 404 of the Clean Water Act and current regulations and policies of the U. S. Army Corps of Engineers (USACE). The following evaluations were performed for this project:

1. Vegetation Indicators: Evaluation for the presence or absence of hydrophytic vegetation (waterplants) that is typically adapted to wetlands and determination of the vegetative patterns that are prevalent within the site, or specific areas within the site.

2. Soil Indicators: Determination for the presence or absence of soils that would be classified as hydric.

3. Hydrology Indicators: Evaluation of the hydrological features of the site with respect to water accumulation and wetland development.

4. Historical Characteristics: Evaluation of historical information to determine the existence and development of wetland features over extended periods of time.

METHODOLOGY/INVESTIGATIVE WORK

The Wetland Assessment Determination and Delineation work consisted of reviewing published historical information and detailed site reconnaissance, to evaluate the subject property for the presence or absence of jurisdictional wetlands according to criteria set forth in the 2010 Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region (v.2). The following activities were undertaken to perform the wetland delineation: 1) review county soil maps; 2) review FEMA floodplain maps; 3) review USGS topographic maps; 4) interpret current and historical aerial photography; and 5) perform site reconnaissance to evaluate and document soil, hydrology, and vegetation indicators.

1. Soil Survey Evaluation:

Prior to site reconnaissance activities, the USDA Web Soil Survey of Harris County, Texas was reviewed to determine the types of soils that would most likely be present on the subject property (**Attachment B**). Specifically, these soils were identified as Addicks loam (Ad) and Gessner fine sandy loam (Ge).

Given the criteria and techniques employed by the Natural Resources Conservation Service (NRCS), formerly known as the Soil Conservation Service, for the survey process, it was considered probable that the boundaries depicted on the survey could contain certain inaccuracies. The minimum mapping area for any given soil in the NRCS survey is ten (10) acres, with the probability of imprecise boundary delineation being relatively high. Therefore, as part of site reconnaissance activities, on-site soil evaluations were performed to describe, classify, and document the hydric, or non-hydric, characteristics of the primary soils on the subject property.

2. Floodplain Evaluation:

To assess the hydrological characteristics of the site, current published FEMA maps were evaluated to determine if the property lies within, or adjacent to, the 100 and/or 500-year floodplain (**Attachment B**). Due to the low topographic grades found on the Gulf Coast, periodic floods are common along rivers, creeks and bayous. These floods, along with rainfall and subsurface flow, are the primary sources of hydrology for wetlands located inland of immediate coastal areas. In addition to FEMA maps, probable flow patterns and evidence of inundation and/or periods of saturation in potential wetland areas were evaluated on-site.

3. Topography Evaluation:

Investigative activities also included observations of the property's general topography and the location of landscape features such as depressions, ridges, and levees. These features could determine wetland patterns and their associated hydrological functions. Topography was evaluated by reviewing: 1) topographical information published by the USGS; 2) aerial photography; and 3) on-site observations.

4. Aerial Photography:

Wetlands generally occur as historical features on the landscape and usually maintain their basic configurations and appearances over a long period of time. However, vegetation communities naturally progress through several stages of predominance as wetlands age and mature. Additionally, topographical and hydrological characteristics may be changed by natural processes or by man-induced alterations in or near wetland areas. While field verification remains essential to wetland identification and delineation, historical aerial photography can play a vital role in the evaluation of wetland features and the variations, which may occur over extended periods of time. Aerial photography was used extensively in the evaluations made on the subject property. A variety of sources were used to provide photographic coverage of the area, including large-scale infrared photographs, color photographs, and black and white photographs (**Attachment C**).

1. Infrared Photography: High-altitude infrared photographs provide views of the subject property as a complete unit where areas and systems of high water content become more easily defined. Such areas are slightly cooler than the surrounding areas and will appear on the false color imagery as variations in shading.

2. Color Photography: Color photographs provide contrasts in shading from lower altitudes that can assist in the identification of vegetation patterns and development that should be verified in the field.

3. Methodology of Interpretation: A color photograph from 2015 was analyzed for vegetation patterns that might distinguish wetland areas. This photograph was compared with infrared photography from 2009 and 1995. Areas which consistently appeared as possible wetlands were marked for field confirmation. The same process also identified areas that appeared as marginal or upland. From these photographic interpretations, a preliminary "rough" delineation pattern was established and incorporated into planned field reconnaissance.

5. Transects:

Based upon methodology described in the 2010 Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region (v.2) transects must be performed on properties greater than five (5) acres in size. As the subject property's total acreage is less than 5 acres (4.28 acres), transects were not used to evaluate this property. Rather, the entire subject property was surveyed.

6. Site Reconnaissance:

The primary method of wetland identification and delineation was site reconnaissance activity that would identify and document the conditions that existed on the subject property as related to jurisdictional wetlands. The site visit was performed to target the following specific areas: 1) soil surveys and geology; 2) topography and hydrology; and 3) vegetation.

The site was visited in October 2016 by personnel from BOA. Using the diagnostic criteria set forth in the 2010 Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region (v.2) for sampling hydrology, soils and vegetation, the site was evaluated for the presence of wetlands that would be classified as Jurisdictional Waters of the United States. As part of a comprehensive assessment of the property, upland (non-wetland) areas were also identified and sampled according to the 2010 Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region (v.2).

Soil samples were documented and fully described according to NRCS staff (1991) criteria and were classified as either hydric or non-hydric. Numerous additional undocumented observations were made to define and establish trends or to verify aerial photo interpretation and/or NRCS mappings.

During site survey activities for soil identification, dominant plant life and vegetation communities were sampled, identified and documented for correlation with soil and hydrology data. As each soil description was made, dominant vegetation was recorded and photographed for the respective area (**Attachment D**). Representative samples were collected and identified as necessary for specific sites. Attempts were made to comprehensively observe and document plant communities and species for all areas of the property, with special focus on those plants that would be considered associated with wetlands.

Site reconnaissance activities also included observations of the general topography of the property and the landscape positions of depressions, ridges, levees, and other features that could determine wetland patterns and their associated hydrological features. A total of nine (9) upland samples and zero (0) wetland samples were documented and fully described according to the 2010 Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region (v.2).

FINDINGS

1. Geology and Soils:

Geologically, the subject property is underlain by the Lissie Formation. Formed during the Pleistocene era, this formation crops out extensively throughout Harris County. The Lissie Formation is characterized by a gently sloping relief and punctuated by shallow, undrained depressions of varying sizes. Hydric soils on the Lissie Formation are generally confined to these depressions and other large, less frequently occurring depressional flats.

The USDA Web Soil Survey of Harris County was, for the most part, reasonably accurate in identifying the basic soil types on the property as Addicks loam (Ad) and Gessner fine sandy loam (Ge).

Addicks loam (Ad) slopes 0 to 1 percent. This soil type is typically found on flats of flat coastal plains. The parent material consists of loamy fluviomarine deposits of Early Pleistocene age. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is very high. Shrink-swell potential is low. This soil is not flooded or ponded. A seasonal zone of water saturation is at 21 inches during January and February. Organic matter content in the surface horizon is about 2 percent. There are no saline horizons within 30 inches of the soil surface. Addicks loam (Ad) is classified as a hydric soil in Harris County, and therefore may be associated with a 'wetland habitat.'

Gessner fine sandy loam (Ge) slopes 0 to 1 percent. This soil type is typically found on depressions of coastal plains. The parent material consists of loamy fluviomarine deposits derived from igneous, metamorphic and sedimentary rock. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is moderately low. Available water to a depth of 60 inches (or restricted depth) is moderate. Shrink-swell potential is low. This soil is not flooded, but is occasionally ponded. A seasonal zone of water saturation is at 0 inches during January, February, March, April, May, June, November, and December. Organic matter content in the surface horizon is about 1 percent. There are no saline horizons within 30 inches of the soil surface. Gessner fine sandy loam (Ge) is classified as a hydric soil in Harris County, and therefore may be associated with a 'wetland habitat.'

Documentation of soil descriptions and classifications from each of the sample areas are presented in the Data Forms (**Attachment E**).

2. Topography and Hydrology:

Topographical information published by the United States Geological Survey (USGS) indicates a gently sloping landscape with storm-water runoff flowing southeast off the subject property into Cypress Creek. The FEMA floodplain maps indicate that the entire subject property lies outside of any mapped 100-year FEMA floodplain.

3. Vegetation:

Vegetation communities were evaluated and documented to delineate wetland and upland boundaries. In upland areas, the subject property was dominated by Bermuda grass (*Cynodon dactylon*), Kleberg's bluestem (*Dichanthium annulatum*), annual ragweed (*Ambrosia artemisiifolia*), bushy bluestem (*Andropogon glomeratus*), and fringed windmill grass (*Chloris ciliata*). No wetland areas were identified on the subject property.

As with the methods employed during soil survey activities, specific documentation was made in order to identify representative vegetation patterns within certain areas. Records of plant descriptions and classifications from each of the sample areas are presented in the Data Forms (**Attachment E**).

CONCLUSIONS

Based on the wetland delineation presented in this report and the survey data collected using GPS satellite equipment, it is the professional opinion of BOA that there are no areas within the subject property that would meet the technical criteria to be classified as a jurisdictional wetland set forth by the USACE.

However, it is the professional opinion of BOA that the subject property contains approximately 0.02 acre (200 ± linear feet) of man-made upland ditches. Based on historic aerial photography and site reconnaissance, it appears that these man-made ditches were created entirely out of uplands. Therefore, it is the opinion of BOA that the 0.02 acre (200 ± linear feet) of man-made upland ditches would likely be considered non-jurisdictional by the USACE.

The USACE and the EPA are the final authority over the jurisdictional status of both wetlands and Waters of the U.S. per Section 404 of the Clean Water Act. The findings discussed in this report are solely the opinion of BOA and have not been verified by the aforementioned regulatory governmental agencies.

On June 29, 2015, the EPA and the USACE published a final rule defining the scope of waters protected under the CWA known as the Clean Water Rule: Definition of "Waters of the United States" (Final Rule) in the Congressional Federal Register (CFR § 37053 (2015)). The Final Rule became effective on August 28, 2015.

However, in response to petitions filed by eighteen (18) separate states, the United States Sixth (6th) Circuit Court of Appeals issued a nationwide Order of Stay for the Final Rule on October 9, 2015, pending completion of judicial review (Sixth Circuit I.O.P. 32.1(b)). Petitioners contend that the Final Rule expands the regulatory jurisdiction originally defined in the CWA by the Supreme Court without satisfying the requirements of the APA. This Order of Stay restores regulation nationwide to the pre-Final Rule regime, pending judicial review. At this point, we are not aware of when, if ever, the Final Rule will be re-instated. All aquatic resources on the tract were evaluated under the pre-Final Rule guidance and regulations. Should the Order of Stay be lifted and the Final Rule be re-instated, the findings of this report may need to be re-evaluated under the Final Rule.

Respectfully,

Natalie Hall
Project Manager
Berg♦Oliver Associates, Inc.

Keith Morgan
Natural Resource Group Manager
Berg♦Oliver Associates, Inc.

REFERENCES

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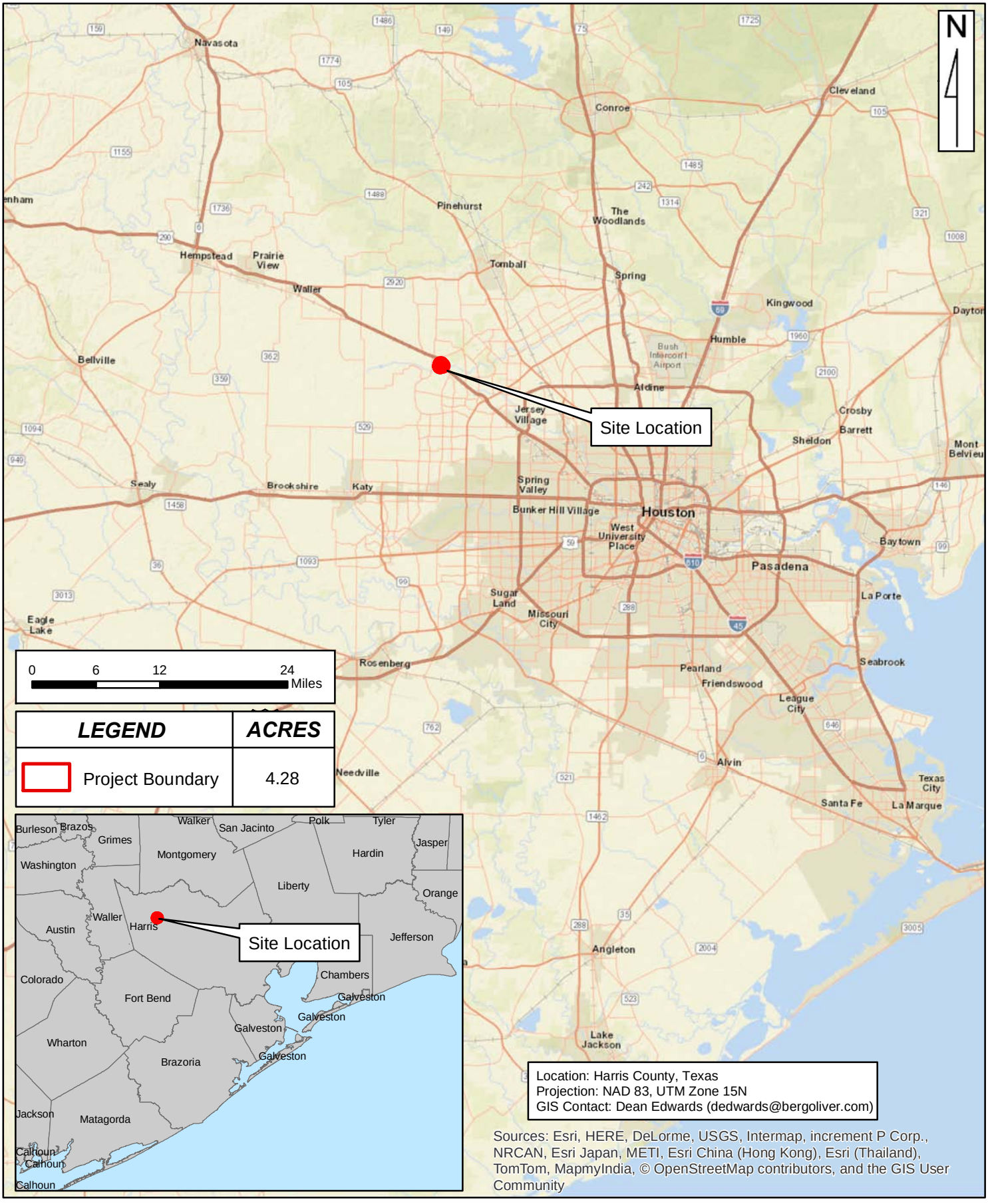
ATTACHMENT A

LOCATION MAPS



SITE VICINITY MAP

Project #: 10322N-WD
For: Allen Boone Humphries Robinson LLP
Location: South of US 290 & Hempstead Rd
Harris County, Texas

REVISIONS
10/17/16 by DBE

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ENVIRONMENTAL SCIENCE & LAND USE CONSULTANTS
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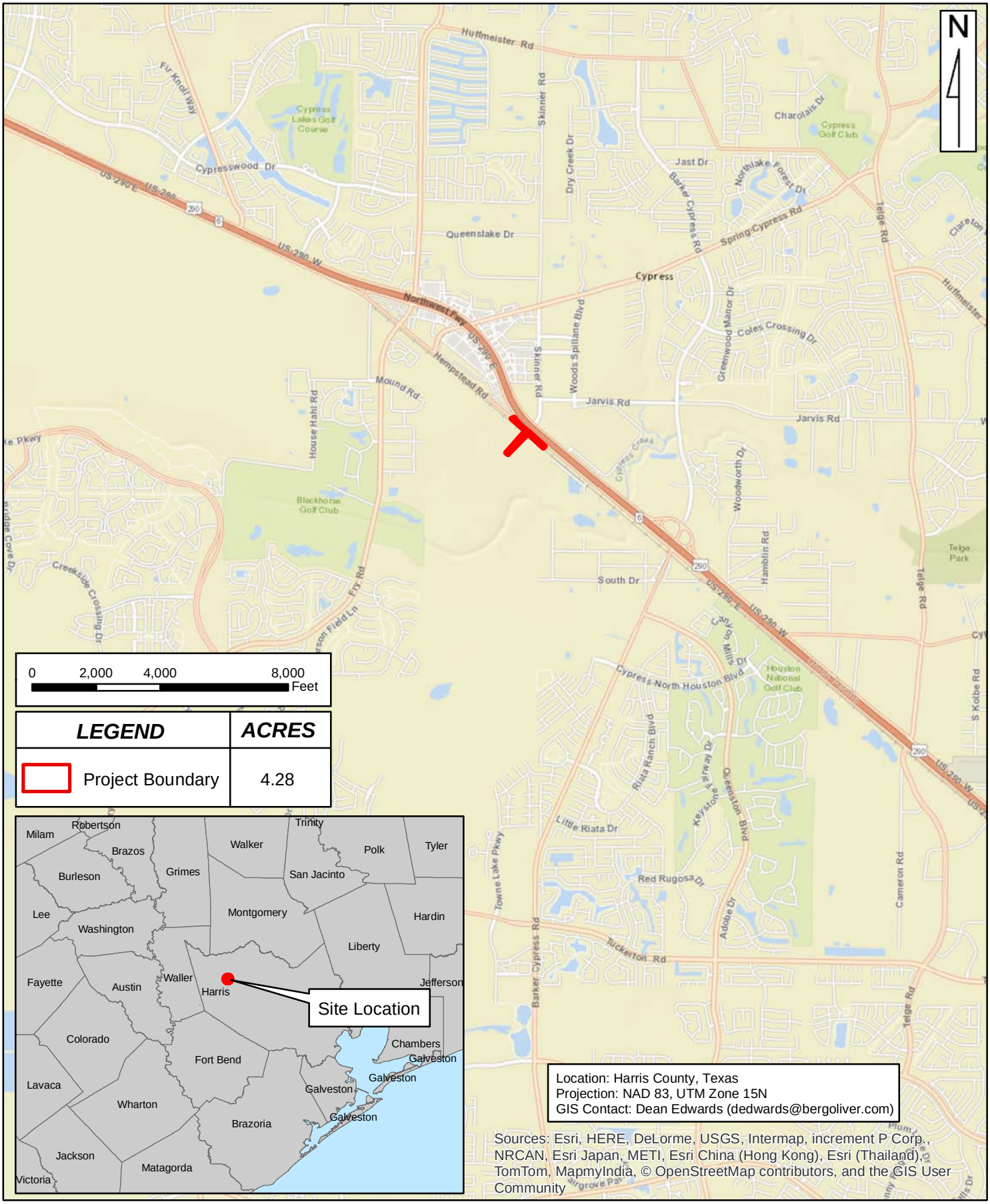

SITE LOCATION MAP

Project #: 10322N-WD
For: Allen Boone Humphries Robinson LLP
Location: South of US 290 & Hempstead Rd
Harris County, Texas

REVISIONS
10/17/16 by DBE

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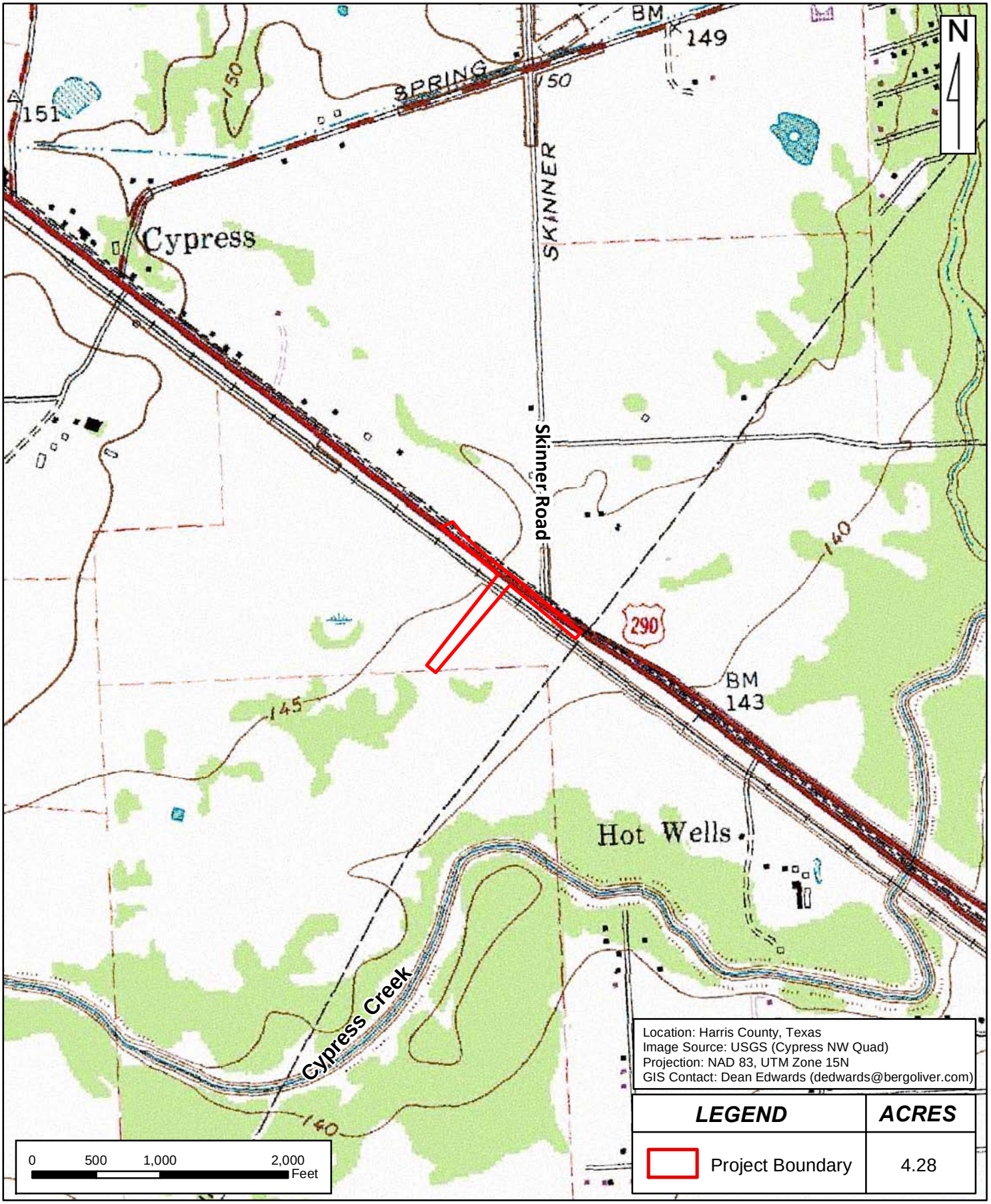
ATTACHMENT B

GEOLOGICAL MAPS



Location: Harris County, Texas
Image Source: USGS (Cypress NW Quad)
Projection: NAD 83, UTM Zone 15N
GIS Contact: Dean Edwards (dedwards@bergoliver.com)

LEGEND	ACRES
Project Boundary	4.28

USGS TOPOGRAPHIC MAP- Cypress NW Quad

Project #: 10322N-WD
For: Allen Boone Humphries Robinson LLP
Location: South of US 290 & Hempstead Rd
Harris County, Texas

REVISIONS
10/17/16 by DBE
10/25/16 by ADY

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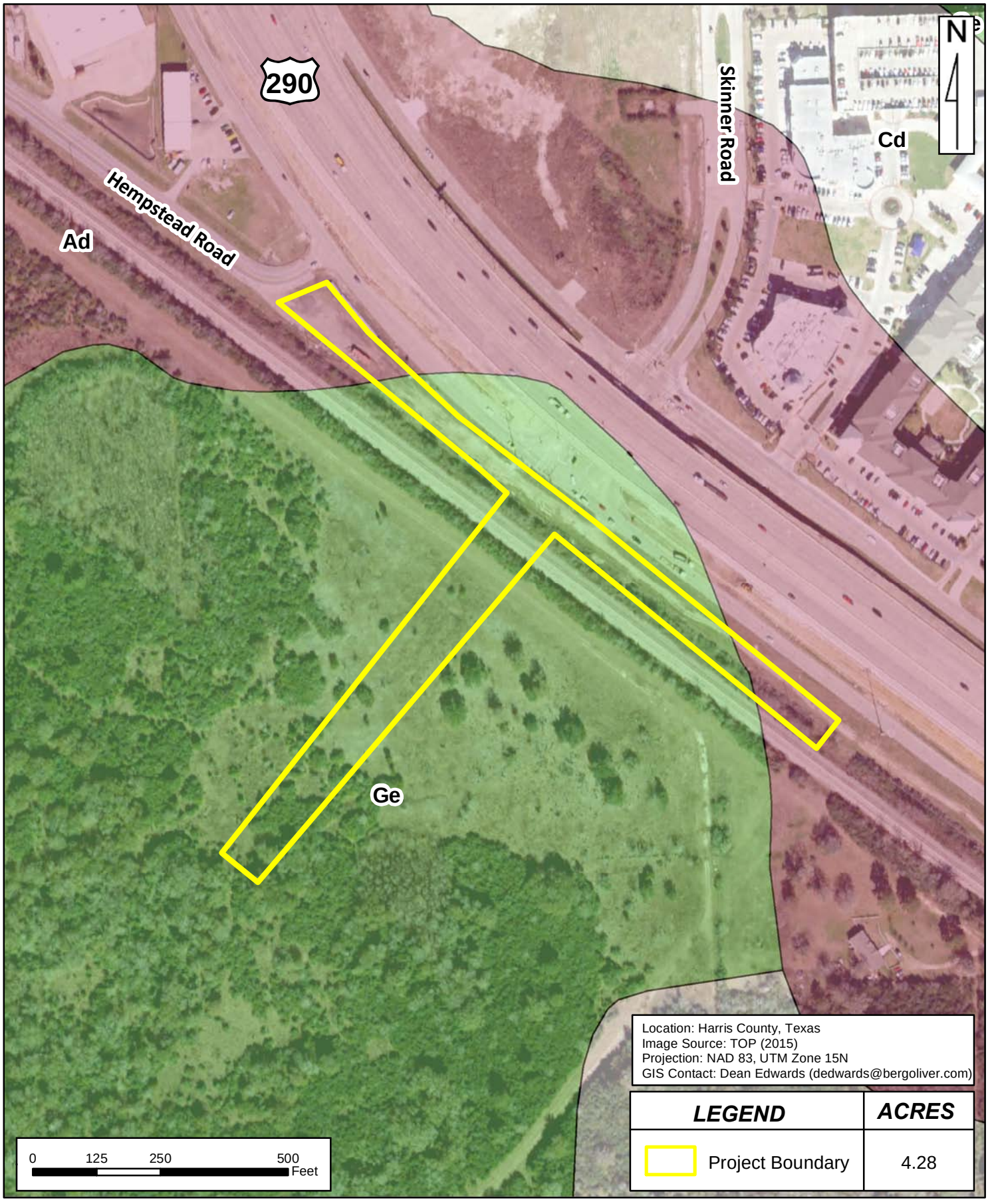

NRCS COUNTY SOILS ON TOP 2015 AERIAL

Project #: 10322N-WD
For: Allen Boone Humphries Robinson LLP
Location: South of US 290 & Hempstead Rd
Harris County, Texas

REVISIONS
10/17/16 by DBE

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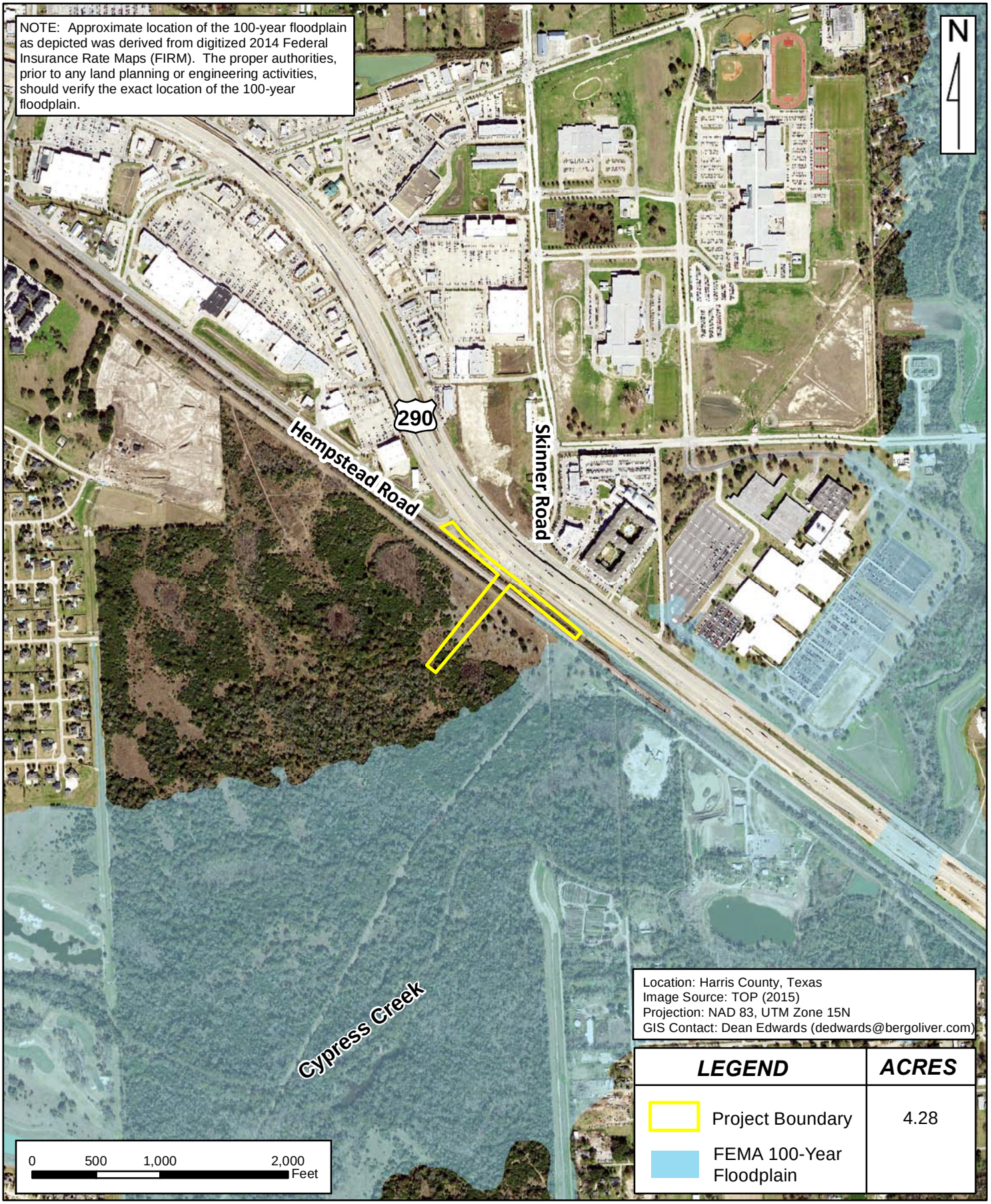

FEMA 100-YEAR FLOODPLAIN ON 2015 TOP AERIAL

Project #: 10322N-WD
For: Allen Boone Humphries Robinson LLP
Location: South of US 290 & Hempstead Rd
Harris County, Texas

REVISIONS
10/17/16 by DBE
10/25/16 by ADY

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ATTACHMENT C

AERIAL PHOTOGRAPHY

2015 TOP AERIAL

Project #: 10322N-WD
For: Allen Boone Humphries Robinson LLP
Location: South of US 290 & Hempstead Rd
Harris County, Texas

REVISIONS
10/17/16 by DBE

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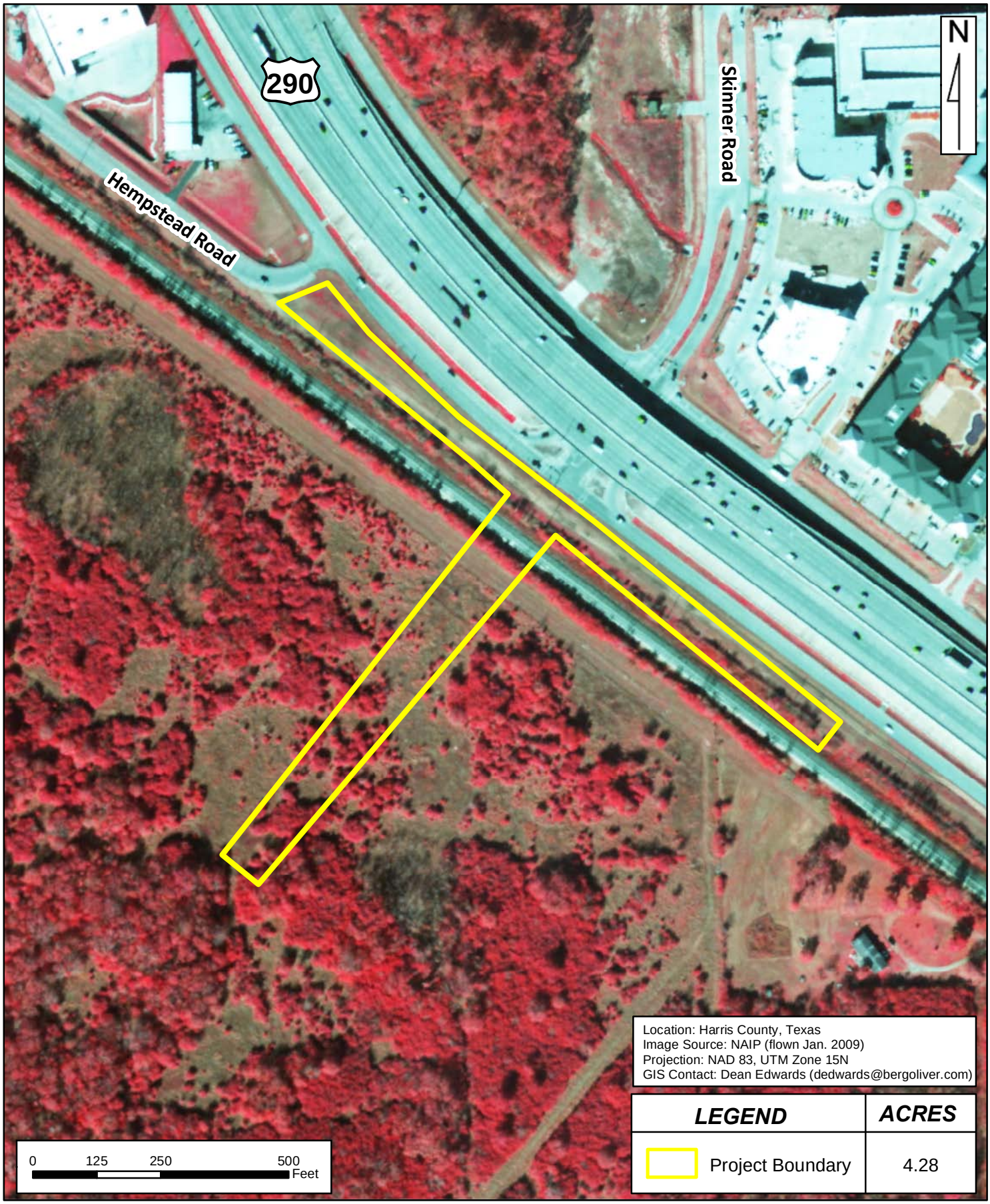

2009 NAIP INFRARED AERIAL

Project #: 10322N-WD
For: Allen Boone Humphries Robinson LLP
Location: South of US 290 & Hempstead Rd
Harris County, Texas

REVISIONS
10/17/16 by DBE

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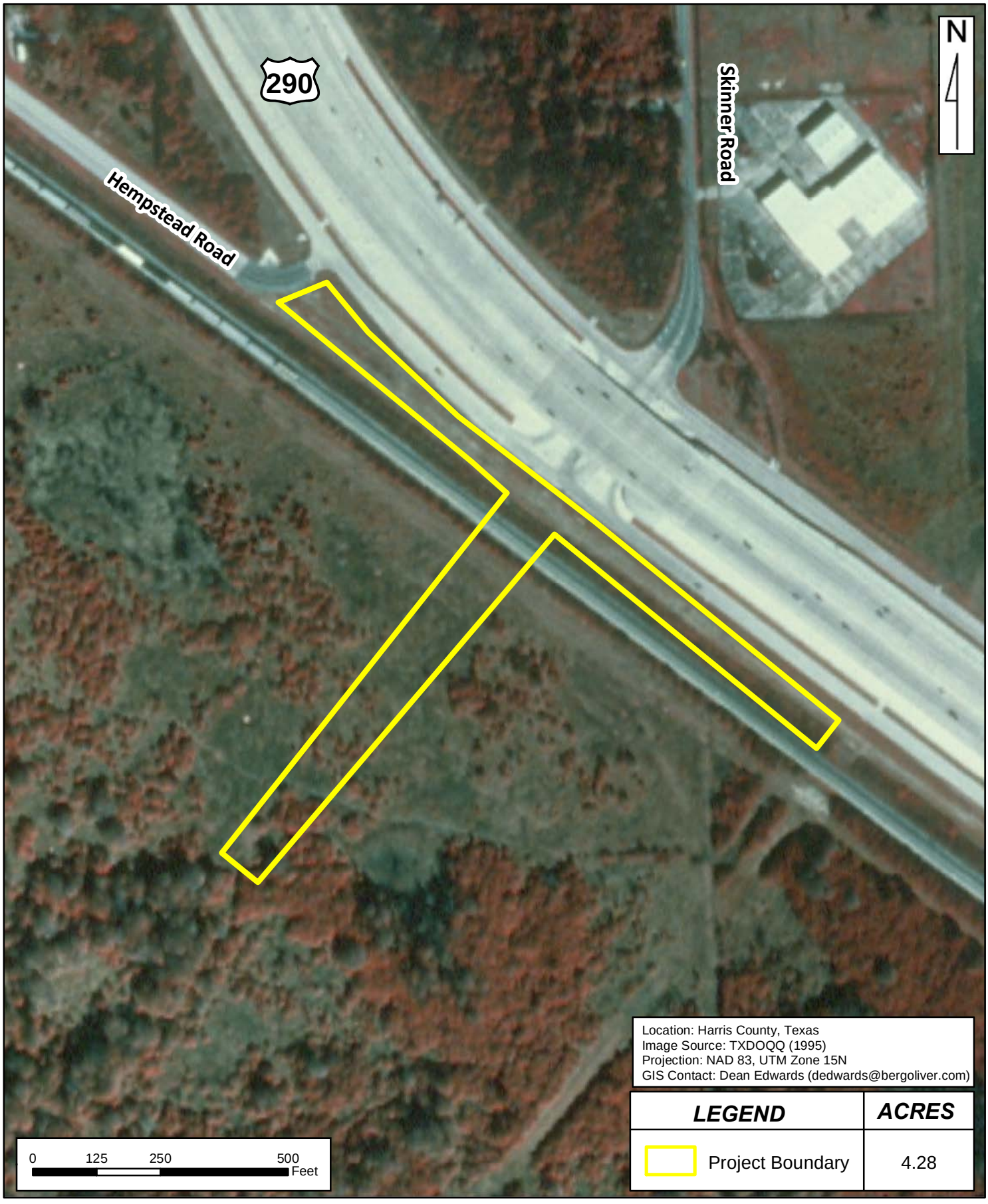

TXDOQQ 1995 INFRARED AERIAL

Project #: 10322N-WD
For: Allen Boone Humphries Robinson LLP
Location: South of US 290 & Hempstead Rd
Harris County, Texas

REVISIONS
10/17/16 by DBE

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ATTACHMENT D

SITE PHOTOGRAPHY

View of uplands near Up 1 dominated by Bermuda grass (*Cynodon dactylon*).

View of uplands near Up 3 dominated by Bermuda grass (*Cynodon dactylon*).

View of uplands near Up 5 dominated by Kleberg's bluestem (*Dichanthium annulatum*).

View of uplands near Up 6 dominated by annual ragweed (*Ambrosia artemisiifolia*), bushy bluestem (*Andropogon glomeratus*), and fringed windmill grass (*Chloris ciliata*).

View of uplands near Up 8 dominated by annual ragweed (*Ambrosia artemisiifolia*), yaupon (*Ilex vomitoria*), fringed windmill grass (*Chloris ciliata*), and bushy bluestem (*Andropogon glomeratus*).

Typical view of man-made ditch in the southern portion of the subject property.

ATTACHMENT E

U.S. ARMY CORPS OF ENGINEERS ROUTINE DATA FORMS

Up 1

BERG-OLIVER ASSOCIATES, INC.

ROUTINE WETLAND DETERMINATION DATA FORM

Project Site: 10322N-WD | City/County: Harris County | Sampling Date: 10/21/2016
Applicant/Owner: Harris County MUD #500 c/o ABHR | State: Texas | Sampling Point: Up 1
Investigator: Berg-Oliver Associates, Inc. | Section/Range: | Slope (%):
Landform (hillslope, terrace, etc.): | Local relief (concave, convex, none): | Datum: NAD 83
Subregion (LRR or MLRA): LRR T | Lat: 29.96368988 | Long: -95.68951419
Soil Map Unit Name: Addicks loam (Ad) | NWI classification:
Are climatic/hydrologic conditions on the site typical for this time of year? Yes X No (If no, explain in Remarks)
Are Vegetation ____ Soil ____ Hydrology ____ significantly disturbed?
Are Vegetation ____ Soil ____ Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks)
Are "Normal Circumstances" present? Yes X No

SUMMARY OF FINDINGS- Attach site map showing sampling point locations, transects, important features, ect.

Hydrophytic Vegetation Present?	Yes	No **X**		
Hydric Soils Present?	Yes	No **X**	**Is the Sample Area within a Wetland?**	Yes
Wetland Hydrology Present?	Yes	No **X**		No **X**

Remarks: Based on the absence of hydrophytic vegetation, hydric soils, and wetland hydrology, this location does not meet the criteria for a wetland.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required: check all that apply)

Surface Water (A1)	Water-Stained Leaves (B9)	Surface Soil Cracks (B6)
High Water Table (A2)	Aquatic Fauna (B13)	Sparsely Vegetated Concave Surface (B8)
Saturation (A3)	Marl Deposits (B15) **(LLR U)**	Drainage Patterns (B10)
Water Marks (B1)	Hydrogen Sulfide Odor (C1)	Moss Trim Lines (B16)
Sediment Deposits (B2)	Oxidized Rhizospheres on Living Roots (C3)	Dry-Season Water Table (C2)
Drift Deposits (B3)	Presence of Reduced Iron (C4)	Crayfish Burrows (C8)
Algal Mat or Crust (B4)	Recent Iron Reduction in Tilled Soils (C6)	Saturation Visible on Aerial Imagery (C9)
Iron Deposits (B5)	Thin Muck Surface (C7)	Geomorphic Position (D2)
Inundation Visible on Aerial Imagery (B7)	Other (Explain in Remarks)	Shallow Aquitard (D3)
		FAC-Neutral Test (D5)
		Sphagnum moss (D8) (LRR T, U)

Field Observations:

Surface Water Present?	Yes	No **X**	Depth (inches)	
Water Table Present?	Yes	No **X**	Depth (inches)	**Wetland Hydrology Present?**
Saturation Present?	Yes	No **X**	Depth (inches)	Yes
(include cappillary fringe)				No **X**

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Hydrologic indicators were not observed at this location.

Vegetation- Use scientific names of plants

Texas

Tree Stratum (Plot Sizes: 30')		Absolute % Cover	Dominant Species?	Indicator Status
1				
2				
3				
4				
5				
6				
7				
	Total Cover	0		

Sapling Stratum (30')		Absolute % Cover	Dominant Species?	Indicator Status
1				
2				
3				
4				
5				
6				
7				
	Total Cover	0		

Shrub Stratum (30')		Absolute % Cover	Dominant Species?	Indicator Status
1				
2				
3				
4				
5				
6				
7				
	Total Cover	0		

Herb Stratum (30')		Absolute % Cover	Dominant Species?	Indicator Status
1	Cynodon dactylon	90	YES	FACU
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
	Total Cover	90		

Woody Vine Stratum (30')		Absolute % Cover	Dominant Species?	Indicator Status
1				
2				
3				
4				
5				
	Total Cover	0		

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0% (A/B)

Prevalance Index Worksheet:

Total % Cover of:		Multiply by:	
OBL species	**0**	x 1 =	**0**
FACW species	**0**	x 2 =	**0**
FAC species	**0**	x 3 =	**0**
FACU species	**90**	x 4 =	**360**
UPL species	**0**	x 5 =	**0**
Column Totals:	**90** (A)	(B)	**360**
Prevalence Index = B/A =			4

Hydrophytic Vegetation Indicators:

_____ Rapid Test for Hydrophytic Vegetation

_____ Dominance Test is >50%

_____ Prevalence Index $\leq$ 3.0[1]

_____ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present.

Definitions for Four Vegetation Strata:

Tree - Woody plants, excluding woody vines, greater than 20 feet in height and 3 inches or more in diameter at breast height (DBH).

Sapling - Woody plants, excluding vines, greater than or equal to 20 feet in height and less than 3 inch DBH.

Shrub - Woody plants, excluding vines, approximately 3-20 feet in height.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 1 meter tall.

Woody vine - All woody vines greater than 1 meter in height.

Hydrophytic Vegetation Present?

YES	NO
	X

Remarks: Hydrophytic vegetation was not observed at this location.

SOIL Up 1

Profile Desription: (Describe to the depth needed to document the indicator or confirm the absence of indicators.) **Texas**

	Matrix		Redox Features					
Depth (inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-18	10YR 4/2	100					clay loam	

[1]Type: C= Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains [2]Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

- Histol (A1)
- Histic Epipedon (A2)
- Black Histic (A3)
- Hydrogen Sulfide (A4)
- Stratified Layers (A5)
- Organic Bodies (A6) **(LRR P, T, U)**
- 5 cm Mucky Mineral (A7) **(LRR P, T, U)**
- Muck Presence (A8) **(LRR U)**
- 1 cm Muck (A9) **(LRR P, T)**
- Depleted Below Dark Surface (A11)
- Thick Dark Surface (A12)
- Coastal Prarie Redox (A16) **(MLRA 150A)**
- Sandy Mucky Mineral (S1) **(LRR O, S)**
- Sandy Gleyed Matrix (S4)
- Sandy Redox (S5)
- Stripped Matrix (S6)
- Dark Surface (S7) **(LRR p, S, T, U)**
- Polyvalue Below Surface (S8) **(LRR S, T, U)**
- Thin Dark Surface (S9) **(LRR S, T, U)**
- Loamy Mucky Mineral (F1) **(LRR**
- Loamy Gleyed Matrix (F2)
- Depleted Matrix (F3)
- Redox Dark Surface (F6)
- Depleted Dark Surface (F7)
- Redox Depressions (F8)
- Marl (F10) **(LRR U)**
- Depleted Ochric (F11) **(MLRA 151)**
- Iron-Manganese Masses (F12) **(LRR O, P, T)**
- Umbric Surface (F13) **(LRR P, T, U)**
- Delta Ochric (F17) **(MLRA 151)**
- Reduced Vertic (F18) **(MLRA 150A, 150B)**
- Piedmont Floodplain Soils (F19) **(MLRA 149A)**
- Anomalous Bright Loamy Soils (F20) **(MLRA 149A, 153C, 153D)**

Indicator for Problematic Hydric Soils[3]:

- 1 cm Muck (A9) **(LRR O)**
- 2 cm Muck (A10) **(LRR S)**
- Reduced Vertic (F18) **(outside MLRA 150A, B)**
- Piedmont Floodplain Soils (F19) **(LRR P, S, T)**
- Anomalous Bright Loamy Soils (F20) **MLRA 153 B)**
- Red Parent Material (TF2)
- Very Shallow Dark Surface (TF12)
- Other (Explain in Remarks)

[3]Indicators of hydrolophytic vegetation and wetland hydrology must be present.

Restrictive Layer (if observed):

Type:

Depth (inches):

Hydric Soil Present?

Yes | **No** X

Remarks: Hydric soil indicators were not observed at this location.

Up 2

BERG-OLIVER ASSOCIATES, INC.

ROUTINE WETLAND DETERMINATION DATA FORM

Project Site: 10322N-WD City/County: Harris County Sampling Date: 10/21/2016
Applicant/Owner: Harris County MUD #500 c/o ABHR State: Texas Sampling Point: Up 2
Investigator: Berg-Oliver Associates, Inc. Section/Range: Slope (%):
Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): Datum: NAD 83
Subregion (LRR or MLRA): LRR T Lat: 29.96310052 Long: -95.68891505
Soil Map Unit Name: Gessner fine sandy loam (Ge) NWI classification:
Are climatic/hydrologic conditions on the site typical for this time of year? Yes X No (If no, explain in Remarks)
Are Vegetation Soil Hydrology significantly disturbed?
Are Vegetation Soil Hydrology naturally problematic? (If needed, explain any answers in Remarks)
Are "Normal Circumstances" present? Yes X No

SUMMARY OF FINDINGS- Attach site map showing sampling point locations, transects, important features, ect.

Hydrophytic Vegetation Present?	Yes	No **X**		
Hydric Soils Present?	Yes	No **X**	**Is the Sample Area within a Wetland?**	Yes
Wetland Hydrology Present?	Yes	No **X**		No **X**

Remarks: Based on the absence of hydrophytic vegetation, hydric soils, and wetland hydrology, this location does not meet the criteria for a wetland.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required: check all that apply)

	Surface Water (A1)		Water-Stained Leaves (B9)		Surface Soil Cracks (B6)
	High Water Table (A2)		Aquatic Fauna (B13)		Sparsely Vegetated Concave Surface (B8)
	Saturation (A3)		Marl Deposits (B15) **(LLR U)**		Drainage Patterns (B10)
	Water Marks (B1)		Hydrogen Sulfide Odor (C1)		Moss Trim Lines (B16)
	Sediment Deposits (B2)		Oxidized Rhizospheres on Living Roots (C3)		Dry-Season Water Table (C2)
	Drift Deposits (B3)		Presence of Reduced Iron (C4)		Crayfish Burrows (C8)
	Algal Mat or Crust (B4)		Recent Iron Reduction in Tilled Soils (C6)		Saturation Visible on Aerial Imagery (C9)
	Iron Deposits (B5)		Thin Muck Surface (C7)		Geomorphic Position (D2)
	Inundation Visible on Aerial Imagery (B7)		Other (Explain in Remarks)		Shallow Aquitard (D3)
					FAC-Neutral Test (D5)
					Sphagnum moss (D8) (LRR T, U)

Field Observations:

				Wetland Hydrology Present?
Surface Water Present?	Yes	No **X**	Depth (inches)	Yes
Water Table Present?	Yes	No **X**	Depth (inches)	No **X**
Saturation Present? (include cappillary fringe)	Yes	No **X**	Depth (inches)	

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Hydrologic indicators were not observed at this location.

Vegetation- Use scientific names of plants

Texas

Tree Stratum (Plot Sizes: 30')		Absolute % Cover	Dominant Species?	Indicator Status
1				
2				
3				
4				
5				
6				
7				
	Total Cover	0		

Sapling Stratum (30')		Absolute % Cover	Dominant Species?	Indicator Status
1				
2				
3				
4				
5				
6				
7				
	Total Cover	0		

Shrub Stratum (30')		Absolute % Cover	Dominant Species?	Indicator Status
1				
2				
3				
4				
5				
6				
7				
	Total Cover	0		

Herb Stratum (30')		Absolute % Cover	Dominant Species?	Indicator Status
1	Cynodon dactylon	90	YES	FACU
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
	Total Cover	90		

Woody Vine Stratum (30')		Absolute % Cover	Dominant Species?	Indicator Status
1				
2				
3				
4				
5				
	Total Cover	0		

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0% (A/B)

Prevalance Index Worksheet:

Total % Cover of:		Multiply by:	
OBL species	**0**	x 1 =	**0**
FACW species	**0**	x 2 =	**0**
FAC species	**0**	x 3 =	**0**
FACU species	**90**	x 4 =	**360**
UPL species	**0**	x 5 =	**0**
Column Totals:	**90**	(A) (B)	**360**
Prevalence Index = B/A =			4

Hydrophytic Vegetation Indicators:

_____ Rapid Test for Hydrophytic Vegetation

_____ Dominance Test is >50%

_____ Prevalence Index $\leq$ 3.0[1]

_____ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present.

Definitions for Four Vegetation Strata:

Tree - Woody plants, excluding woody vines, greater than 20 feet in height and 3 inches or more in diameter at breast height (DBH).

Sapling - Woody plants, excluding vines, greater than or equal to 20 feet in height and less than 3 inch DBH.

Shrub - Woody plants, excluding vines, approximately 3-20 feet in height.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 1 meter tall.

Woody vine - All woody vines greater than 1 meter in height.

Hydrophytic Vegetation Present?

YES	NO
	X

Remarks: Hydrophytic vegetation was not observed at this location.

SOIL Up 2

Profile Desription: (Describe to the depth needed to document the indicator or confirm the absence of indicators.) **Texas**

	Matrix		Redox Features					
Depth (inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-18	10YR 4/2	100					clay loam	

[1]Type: C= Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains [2]Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

- Histol (A1)
- Histic Epipedon (A2)
- Black Histic (A3)
- Hydrogen Sulfide (A4)
- Stratified Layers (A5)
- Organic Bodies (A6) **(LRR P, T, U)**
- 5 cm Mucky Mineral (A7) **(LRR P, T, U)**
- Muck Presence (A8) **(LRR U)**
- 1 cm Muck (A9) **(LRR P, T)**
- Depleted Below Dark Surface (A11)
- Thick Dark Surface (A12)
- Coastal Prarie Redox (A16) **(MLRA 150A)**
- Sandy Mucky Mineral (S1) **(LRR O, S)**
- Sandy Gleyed Matrix (S4)
- Sandy Redox (S5)
- Stripped Matrix (S6)
- Dark Surface (S7) **(LRR p, S, T, U)**
- Polyvalue Below Surface (S8) **(LRR S, T, U)**
- Thin Dark Surface (S9) **(LRR S, T, U)**
- Loamy Mucky Mineral (F1) **(LRR**
- Loamy Gleyed Matrix (F2)
- Depleted Matrix (F3)
- Redox Dark Surface (F6)
- Depleted Dark Surface (F7)
- Redox Depressions (F8)
- Marl (F10) **(LRR U)**
- Depleted Ochric (F11) **(MLRA 151)**
- Iron-Manganese Masses (F12) **(LRR O, P, T)**
- Umbric Surface (F13) **(LRR P, T, U)**
- Delta Ochric (F17) **(MLRA 151)**
- Reduced Vertic (F18) **(MLRA 150A, 150B)**
- Piedmont Floodplain Soils (F19) **(MLRA 149A)**
- Anomalous Bright Loamy Soils (F20) **(MLRA 149A, 153C, 153D)**

Indicator for Problematic Hydric Soils[3]:

- 1 cm Muck (A9) **(LRR O)**
- 2 cm Muck (A10) **(LRR S)**
- Reduced Vertic (F18) **(outside MLRA 150A, B)**
- Piedmont Floodplain Soils (F19) **(LRR P, S, T)**
- Anomalous Bright Loamy Soils (F20) **MLRA 153 B)**
- Red Parent Material (TF2)
- Very Shallow Dark Surface (TF12)
- Other (Explain in Remarks)

[3]Indicators of hydrolophytic vegetation and wetland hydrology must be present.

Restrictive Layer (if observed):

Type:

Depth (inches):

Hydric Soil Present?

Yes | **No** X

Remarks: Hydric soil indicators were not observed at this location.

Up 3

BERG-OLIVER ASSOCIATES, INC.

ROUTINE WETLAND DETERMINATION DATA FORM

Project Site: 10322N-WD City/County: Harris County Sampling Date: 10/21/2016
Applicant/Owner: Harris County MUD #500 c/o ABHR State: Texas Sampling Point: Up 3
Investigator: Berg-Oliver Associates, Inc. Section/Range: Slope (%):
Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): Datum: NAD 83
Subregion (LRR or MLRA): LRR T Lat: 29.96257795 Long: -95.68818938
Soil Map Unit Name: Gessner fine sandy loam (Ge) NWI classification:
Are climatic/hydrologic conditions on the site typical for this time of year? Yes X No (If no, explain in Remarks)
Are Vegetation Soil Hydrology significantly disturbed?
Are Vegetation Soil Hydrology naturally problematic? (If needed, explain any answers in Remarks)
Are "Normal Circumstances" present? Yes X No

SUMMARY OF FINDINGS- Attach site map showing sampling point locations, transects, important features, ect.

Hydrophytic Vegetation Present?	Yes	No **X**		
Hydric Soils Present?	Yes	No **X**	**Is the Sample Area within a Wetland?**	Yes
Wetland Hydrology Present?	Yes	No **X**		No **X**

Remarks: Based on the absence of hydrophytic vegetation, hydric soils, and wetland hydrology, this location does not meet the criteria for a wetland.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required: check all that apply)

	Surface Water (A1)		Water-Stained Leaves (B9)		Surface Soil Cracks (B6)
	High Water Table (A2)		Aquatic Fauna (B13)		Sparsely Vegetated Concave Surface (B8)
	Saturation (A3)		Marl Deposits (B15) **(LLR U)**		Drainage Patterns (B10)
	Water Marks (B1)		Hydrogen Sulfide Odor (C1)		Moss Trim Lines (B16)
	Sediment Deposits (B2)		Oxidized Rhizospheres on Living Roots (C3)		Dry-Season Water Table (C2)
	Drift Deposits (B3)		Presence of Reduced Iron (C4)		Crayfish Burrows (C8)
	Algal Mat or Crust (B4)		Recent Iron Reduction in Tilled Soils (C6)		Saturation Visible on Aerial Imagery (C9)
	Iron Deposits (B5)		Thin Muck Surface (C7)		Geomorphic Position (D2)
	Inundation Visible on Aerial Imagery (B7)		Other (Explain in Remarks)		Shallow Aquitard (D3)
					FAC-Neutral Test (D5)
					Sphagnum moss (D8) (LRR T, U)

Field Observations:

				Wetland Hydrology Present?
Surface Water Present?	Yes	No **X**	Depth (inches)	
Water Table Present?	Yes	No **X**	Depth (inches)	
Saturation Present? (include cappillary fringe)	Yes	No **X**	Depth (inches)	Yes / No **X**

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Hydrologic indicators were not observed at this location.

Vegetation- Use scientific names of plants

Texas

Tree Stratum (Plot Sizes: 30')		Absolute % Cover	Dominant Species?	Indicator Status
1				
2				
3				
4				
5				
6				
7				
	Total Cover	0		

Sapling Stratum (30')		Absolute % Cover	Dominant Species?	Indicator Status
1				
2				
3				
4				
5				
6				
7				
	Total Cover	0		

Shrub Stratum (30')		Absolute % Cover	Dominant Species?	Indicator Status
1				
2				
3				
4				
5				
6				
7				
	Total Cover	0		

Herb Stratum (30')		Absolute % Cover	Dominant Species?	Indicator Status
1	Cynodon dactylon	90	YES	FACU
2	Paspalum notatum	10	NO	FACU
3	Cyperus entrerianus	5	NO	FACW
4				
5				
6				
7				
8				
9				
10				
11				
12				
	Total Cover	105		

Woody Vine Stratum (30')		Absolute % Cover	Dominant Species?	Indicator Status
1				
2				
3				
4				
5				
	Total Cover	0		

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0% (A/B)

Prevalance Index Worksheet:

Total % Cover of:		Multiply by:	
OBL species	**0**	x 1 =	**0**
FACW species	**5**	x 2 =	**10**
FAC species	**0**	x 3 =	**0**
FACU species	**100**	x 4 =	**400**
UPL species	**0**	x 5 =	**0**
Column Totals:	**105**	(A) (B)	**410**
Prevalence Index = B/A =			4

Hydrophytic Vegetation Indicators:

_____ Rapid Test for Hydrophytic Vegetation

_____ Dominance Test is >50%

_____ Prevalence Index $\leq$ 3.0[1]

_____ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present.

Definitions for Four Vegetation Strata:

Tree - Woody plants, excluding woody vines, greater than 20 feet in height and 3 inches or more in diameter at breast height (DBH).

Sapling - Woody plants, excluding vines, greater than or equal to 20 feet in height and less than 3 inch DBH.

Shrub - Woody plants, excluding vines, approximately 3-20 feet in height.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 1 meter tall.

Woody vine - All woody vines greater than 1 meter in height.

Hydrophytic Vegetation Present?

YES	NO
	X

Remarks: Hydrophytic vegetation was not observed at this location.

SOIL Up 3

Profile Desription: (Describe to the depth needed to document the indicator or confirm the absence of indicators.) **Texas**

	Matrix		Redox Features					
Depth (inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-18	10YR 4/2	90					sandy loam	
	5YR 8/3	10					sandy loam	potential fill

[1]Type: C= Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains [2]Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

- Histol (A1)
- Histic Epipedon (A2)
- Black Histic (A3)
- Hydrogen Sulfide (A4)
- Stratified Layers (A5)
- Organic Bodies (A6) **(LRR P, T, U)**
- 5 cm Mucky Mineral (A7) **(LRR P, T, U)**
- Muck Presence (A8) **(LRR U)**
- 1 cm Muck (A9) **(LRR P, T)**
- Depleted Below Dark Surface (A11)
- Thick Dark Surface (A12)
- Coastal Prarie Redox (A16) **(MLRA 150A)**
- Sandy Mucky Mineral (S1) **(LRR O, S)**
- Sandy Gleyed Matrix (S4)
- Sandy Redox (S5)
- Stripped Matrix (S6)
- Dark Surface (S7) **(LRR p, S, T, U)**
- Polyvalue Below Surface (S8) **(LRR S, T, U)**
- Thin Dark Surface (S9) **(LRR S, T, U)**
- Loamy Mucky Mineral (F1) **(LRR**
- Loamy Gleyed Matrix (F2)
- Depleted Matrix (F3)
- Redox Dark Surface (F6)
- Depleted Dark Surface (F7)
- Redox Depressions (F8)
- Marl (F10) **(LRR U)**
- Depleted Ochric (F11) **(MLRA 151)**
- Iron-Manganese Masses (F12) **(LRR O, P, T)**
- Umbric Surface (F13) **(LRR P, T, U)**
- Delta Ochric (F17) **(MLRA 151)**
- Reduced Vertic (F18) **(MLRA 150A, 150B)**
- Piedmont Floodplain Soils (F19) **(MLRA 149A)**
- Anomalous Bright Loamy Soils (F20) **(MLRA 149A, 153C, 153D)**

Indicator for Problematic Hydric Soils[3]:

- 1 cm Muck (A9) **(LRR O)**
- 2 cm Muck (A10) **(LRR S)**
- Reduced Vertic (F18) **(outside MLRA 150A, B)**
- Piedmont Floodplain Soils (F19) **(LRR P, S, T)**
- Anomalous Bright Loamy Soils (F20) **MLRA 153 B)**
- Red Parent Material (TF2)
- Very Shallow Dark Surface (TF12)
- Other (Explain in Remarks)

[3]Indicators of hydrolophytic vegetation and wetland hydrology must be present.

Restrictive Layer (if observed):

Type:

Depth (inches):

Hydric Soil Present?

Yes | **No** X

Remarks: Hydric soil indicators were not observed at this location.

Up 4

BERG-OLIVER ASSOCIATES, INC.

ROUTINE WETLAND DETERMINATION DATA FORM

Project Site: 10322N-WD City/County: Harris County Sampling Date: 10/21/2016
Applicant/Owner: Harris County MUD #500 c/o ABHR State: Texas Sampling Point: Up 4
Investigator: Berg-Oliver Associates, Inc. Section/Range: Slope (%):
Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): Datum: NAD 83
Subregion (LRR or MLRA): LRR T Lat: 29.96206751 Long: -95.68749144
Soil Map Unit Name: Gessner fine sandy loam (Ge) NWI classification:
Are climatic/hydrologic conditions on the site typical for this time of year? Yes X No (If no, explain in Remarks)
Are Vegetation Soil Hydrology significantly disturbed?
Are Vegetation Soil Hydrology naturally problematic? (If needed, explain any answers in Remarks)
Are "Normal Circumstances" present? Yes X No

SUMMARY OF FINDINGS- Attach site map showing sampling point locations, transects, important features, ect.

Hydrophytic Vegetation Present?	Yes	No **X**		
Hydric Soils Present?	Yes	No **X**	**Is the Sample Area within a Wetland?**	Yes
Wetland Hydrology Present?	Yes	No **X**		No **X**

Remarks: Based on the absence of hydrophytic vegetation, hydric soils, and wetland hydrology, this location does not meet the criteria for a wetland.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required: check all that apply)

	Surface Water (A1)		Water-Stained Leaves (B9)		Surface Soil Cracks (B6)
	High Water Table (A2)		Aquatic Fauna (B13)		Sparsely Vegetated Concave Surface (B8)
	Saturation (A3)		Marl Deposits (B15) **(LLR U)**		Drainage Patterns (B10)
	Water Marks (B1)		Hydrogen Sulfide Odor (C1)		Moss Trim Lines (B16)
	Sediment Deposits (B2)		Oxidized Rhizospheres on Living Roots (C3)		Dry-Season Water Table (C2)
	Drift Deposits (B3)		Presence of Reduced Iron (C4)		Crayfish Burrows (C8)
	Algal Mat or Crust (B4)		Recent Iron Reduction in Tilled Soils (C6)		Saturation Visible on Aerial Imagery (C9)
	Iron Deposits (B5)		Thin Muck Surface (C7)		Geomorphic Position (D2)
	Inundation Visible on Aerial Imagery (B7)		Other (Explain in Remarks)		Shallow Aquitard (D3)
					FAC-Neutral Test (D5)
					Sphagnum moss (D8) (LRR T, U)

Field Observations:

Surface Water Present?	Yes	No **X**	Depth (inches)	
Water Table Present?	Yes	No **X**	Depth (inches)	**Wetland Hydrology Present?**
Saturation Present?	Yes	No **X**	Depth (inches)	Yes
(include cappillary fringe)				No **X**

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Hydrologic indicators were not observed at this location.

Vegetation- Use scientific names of plants

Texas

Tree Stratum (Plot Sizes: 30')		Absolute % Cover	Dominant Species?	Indicator Status
1				
2				
3				
4				
5				
6				
7				
	Total Cover	0		

Sapling Stratum (30')		Absolute % Cover	Dominant Species?	Indicator Status
1				
2				
3				
4				
5				
6				
7				
	Total Cover	0		

Shrub Stratum (30')		Absolute % Cover	Dominant Species?	Indicator Status
1				
2				
3				
4				
5				
6				
7				
	Total Cover	0		

Herb Stratum (30')		Absolute % Cover	Dominant Species?	Indicator Status
1	Dichanthium annulatum	80	YES	NI
2	Cynodon dactylon	25	NO	FACU
3	Ambrosia artemisifolia	15	NO	FACU
4	Rubus trivialis	5	NO	FACU
5	Eupatorium serotinum	5	NO	FAC
6				
7				
8				
9				
10				
11				
12				
	Total Cover	130		

Woody Vine Stratum (30')		Absolute % Cover	Dominant Species?	Indicator Status
1				
2				
3				
4				
5				
	Total Cover	0		

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0% (A/B)

Prevalance Index Worksheet:

Total % Cover of:		Multiply by:	
OBL species	**0**	x 1 =	**0**
FACW species	**0**	x 2 =	**0**
FAC species	**5**	x 3 =	**15**
FACU species	**45**	x 4 =	**180**
UPL species	**0**	x 5 =	**0**
Column Totals:	**50**	(A) (B)	**195**
Prevalence Index = B/A =			4

Hydrophytic Vegetation Indicators:

_____ Rapid Test for Hydrophytic Vegetation

_____ Dominance Test is >50%

_____ Prevalence Index $\leq$ 3.0[1]

_____ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present.

Definitions for Four Vegetation Strata:

Tree - Woody plants, excluding woody vines, greater than 20 feet in height and 3 inches or more in diameter at breast height (DBH).

Sapling - Woody plants, excluding vines, greater than or equal to 20 feet in height and less than 3 inch DBH.

Shrub - Woody plants, excluding vines, approximately 3-20 feet in height.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 1 meter tall.

Woody vine - All woody vines greater than 1 meter in height.

Hydrophytic Vegetation Present?

YES	NO
	X

Remarks: Hydrophytic vegetation was not observed at this location.

SOIL Up 4

Profile Desription: (Describe to the depth needed to document the indicator or confirm the absence of indicators.) **Texas**

	Matrix		Redox Features					
Depth (inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-18	10YR 4/2	90					clay loam	
	5YR 8/3	10					clay loam	potential fill

[1]Type: C= Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains [2]Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

- Histol (A1)
- Histic Epipedon (A2)
- Black Histic (A3)
- Hydrogen Sulfide (A4)
- Stratified Layers (A5)
- Organic Bodies (A6) **(LRR P, T, U)**
- 5 cm Mucky Mineral (A7) **(LRR P, T, U)**
- Muck Presence (A8) **(LRR U)**
- 1 cm Muck (A9) **(LRR P, T)**
- Depleted Below Dark Surface (A11)
- Thick Dark Surface (A12)
- Coastal Prarie Redox (A16) **(MLRA 150A)**
- Sandy Mucky Mineral (S1) **(LRR O, S)**
- Sandy Gleyed Matrix (S4)
- Sandy Redox (S5)
- Stripped Matrix (S6)
- Dark Surface (S7) **(LRR p, S, T, U)**
- Polyvalue Below Surface (S8) **(LRR S, T, U)**
- Thin Dark Surface (S9) **(LRR S, T, U)**
- Loamy Mucky Mineral (F1) **(LRR**
- Loamy Gleyed Matrix (F2)
- Depleted Matrix (F3)
- Redox Dark Surface (F6)
- Depleted Dark Surface (F7)
- Redox Depressions (F8)
- Marl (F10) **(LRR U)**
- Depleted Ochric (F11) **(MLRA 151)**
- Iron-Manganese Masses (F12) **(LRR O, P, T)**
- Umbric Surface (F13) **(LRR P, T, U)**
- Delta Ochric (F17) **(MLRA 151)**
- Reduced Vertic (F18) **(MLRA 150A, 150B)**
- Piedmont Floodplain Soils (F19) **(MLRA 149A)**
- Anomalous Bright Loamy Soils (F20) **(MLRA 149A, 153C, 153D)**

Indicator for Problematic Hydric Soils[3]:

- 1 cm Muck (A9) **(LRR O)**
- 2 cm Muck (A10) **(LRR S)**
- Reduced Vertic (F18) **(outside MLRA 150A, B)**
- Piedmont Floodplain Soils (F19) **(LRR P, S, T)**
- Anomalous Bright Loamy Soils (F20) **MLRA 153 B)**
- Red Parent Material (TF2)
- Very Shallow Dark Surface (TF12)
- Other (Explain in Remarks)

[3]Indicators of hydrolophytic vegetation and wetland hydrology must be present.

Restrictive Layer (if observed):

Type:

Depth (inches):

Hydric Soil Present?

Yes | **No** X

Remarks: Hydric soil indicators were not observed at this location.

Up 5

BERG-OLIVER ASSOCIATES, INC.

ROUTINE WETLAND DETERMINATION DATA FORM

Project Site: 10322N-WD City/County: Harris County Sampling Date: 10/21/2016
Applicant/Owner: Harris County MUD #500 c/o ABHR State: Texas Sampling Point: Up 5
Investigator: Berg-Oliver Associates, Inc. Section/Range: Slope (%):
Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): Datum: NAD 83
Subregion (LRR or MLRA): LRR T Lat: 29.96157166 Long: -95.6868332
Soil Map Unit Name: Addicks loam (Ad) NWI classification:
Are climatic/hydrologic conditions on the site typical for this time of year? Yes X No (If no, explain in Remarks)
Are Vegetation Soil Hydrology significantly disturbed?
Are Vegetation Soil Hydrology naturally problematic? (If needed, explain any answers in Remarks)
Are "Normal Circumstances" present? Yes X No

SUMMARY OF FINDINGS- Attach site map showing sampling point locations, transects, important features, ect.

Hydrophytic Vegetation Present?	Yes	No **X**		
Hydric Soils Present?	Yes	No **X**	**Is the Sample Area within a Wetland?**	Yes
Wetland Hydrology Present?	Yes	No **X**		No **X**

Remarks: Based on the absence of hydrophytic vegetation, hydric soils, and wetland hydrology, this location does not meet the criteria for a wetland.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required: check all that apply)

Surface Water (A1)	Water-Stained Leaves (B9)	Surface Soil Cracks (B6)	
High Water Table (A2)	Aquatic Fauna (B13)	Sparsely Vegetated Concave Surface (B8)	
Saturation (A3)	Marl Deposits (B15) **(LLR U)**	Drainage Patterns (B10)	
Water Marks (B1)	Hydrogen Sulfide Odor (C1)	Moss Trim Lines (B16)	
Sediment Deposits (B2)	Oxidized Rhizospheres on Living Roots (C3)	Dry-Season Water Table (C2)	
Drift Deposits (B3)	Presence of Reduced Iron (C4)	Crayfish Burrows (C8)	
Algal Mat or Crust (B4)	Recent Iron Reduction in Tilled Soils (C6)	Saturation Visible on Aerial Imagery (C9)	
Iron Deposits (B5)	Thin Muck Surface (C7)	Geomorphic Position (D2)	
Inundation Visible on Aerial Imagery (B7)	Other (Explain in Remarks)	Shallow Aquitard (D3)	
		FAC-Neutral Test (D5)	
		Sphagnum moss (D8) (LRR T, U)	

Secondary Indicators (minimum of two required)

Field Observations:

Surface Water Present?	Yes	No **X**	Depth (inches)	
Water Table Present?	Yes	No **X**	Depth (inches)	**Wetland Hydrology Present?**
Saturation Present?	Yes	No **X**	Depth (inches)	Yes
(include cappillary fringe)				No **X**

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Hydrologic indicators were not observed at this location.

Vegetation- Use scientific names of plants

Texas

Tree Stratum (Plot Sizes: 30')		Absolute % Cover	Dominant Species?	Indicator Status
1				
2				
3				
4				
5				
6				
7				
	Total Cover	0		

Sapling Stratum (30')		Absolute % Cover	Dominant Species?	Indicator Status
1	Diospyros virginiana	20	YES	FAC
2	Morus rubra	10	YES	FACU
3	Ulmus americana	5	NO	FAC
4	Triadica sebifera	2	NO	FAC
5				
6				
7				
	Total Cover	37		

Shrub Stratum (30')		Absolute % Cover	Dominant Species?	Indicator Status
1	Ilex vomitoria	15	YES	FAC
2				
3				
4				
5				
6				
7				
	Total Cover	15		

Herb Stratum (30')		Absolute % Cover	Dominant Species?	Indicator Status
1	Rubus trivialis	50	YES	FACU
2	Ampelopsis arborea	20	YES	FAC
3	Toxicodendron radicans	10	NO	FAC
4				
5				
6				
7				
8				
9				
10				
11				
12				
	Total Cover	80		

Woody Vine Stratum (30')		Absolute % Cover	Dominant Species?	Indicator Status
1	Vitis mustangensis	25	YES	UPL
2	Lonicera japonica	5	NO	FACU
3				
4				
5				
	Total Cover	30		

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50% (A/B)

Prevalance Index Worksheet:

Total % Cover of:		Multiply by:	
OBL species	**0**	x 1 =	**0**
FACW species	**0**	x 2 =	**0**
FAC species	**72**	x 3 =	**216**
FACU species	**65**	x 4 =	**260**
UPL species	**25**	x 5 =	**125**
Column Totals:	**162**	(A) (B)	**601**
Prevalence Index = B/A =			4

Hydrophytic Vegetation Indicators:

_____ Rapid Test for Hydrophytic Vegetation

_____ Dominance Test is >50%

_____ Prevalence Index $\leq$ 3.0[1]

_____ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present.

Definitions for Four Vegetation Strata:

Tree - Woody plants, excluding woody vines, greater than 20 feet in height and 3 inches or more in diameter at breast height (DBH).

Sapling - Woody plants, excluding vines, greater than or equal to 20 feet in height and less than 3 inch DBH.

Shrub - Woody plants, excluding vines, approximately 3-20 feet in height.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 1 meter tall.

Woody vine - All woody vines greater than 1 meter in height.

Hydrophytic Vegetation Present?

YES	NO
	X

Remarks: Hydrophytic vegetation was not observed at this location.

SOIL Up 5

Profile Desription: (Describe to the depth needed to document the indicator or confirm the absence of indicators.) **Texas**

	Matrix		Redox Features					
Depth (inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-18	10YR 4/2	100					clay loam	

[1]Type: C= Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains [2]Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

- Histol (A1)
- Histic Epipedon (A2)
- Black Histic (A3)
- Hydrogen Sulfide (A4)
- Stratified Layers (A5)
- Organic Bodies (A6) **(LRR P, T, U)**
- 5 cm Mucky Mineral (A7) **(LRR P, T, U)**
- Muck Presence (A8) **(LRR U)**
- 1 cm Muck (A9) **(LRR P, T)**
- Depleted Below Dark Surface (A11)
- Thick Dark Surface (A12)
- Coastal Prarie Redox (A16) **(MLRA 150A)**
- Sandy Mucky Mineral (S1) **(LRR O, S)**
- Sandy Gleyed Matrix (S4)
- Sandy Redox (S5)
- Stripped Matrix (S6)
- Dark Surface (S7) **(LRR p, S, T, U)**
- Polyvalue Below Surface (S8) **(LRR S, T, U)**
- Thin Dark Surface (S9) **(LRR S, T, U)**
- Loamy Mucky Mineral (F1) **(LRR**
- Loamy Gleyed Matrix (F2)
- Depleted Matrix (F3)
- Redox Dark Surface (F6)
- Depleted Dark Surface (F7)
- Redox Depressions (F8)
- Marl (F10) **(LRR U)**
- Depleted Ochric (F11) **(MLRA 151)**
- Iron-Manganese Masses (F12) **(LRR O, P, T)**
- Umbric Surface (F13) **(LRR P, T, U)**
- Delta Ochric (F17) **(MLRA 151)**
- Reduced Vertic (F18) **(MLRA 150A, 150B)**
- Piedmont Floodplain Soils (F19) **(MLRA 149A)**
- Anomalous Bright Loamy Soils (F20) **(MLRA 149A, 153C, 153D)**

Indicator for Problematic Hydric Soils[3]:

- 1 cm Muck (A9) **(LRR O)**
- 2 cm Muck (A10) **(LRR S)**
- Reduced Vertic (F18) **(outside MLRA 150A, B)**
- Piedmont Floodplain Soils (F19) **(LRR P, S, T)**
- Anomalous Bright Loamy Soils (F20) **MLRA 153 B)**
- Red Parent Material (TF2)
- Very Shallow Dark Surface (TF12)
- Other (Explain in Remarks)

[3]Indicators of hydrolophytic vegetation and wetland hydrology must be present.

Restrictive Layer (if observed):

Type:

Depth (inches):

Hydric Soil Present?

Yes | **No** X

Remarks: Hydric soil indicators were not observed at this location.

BERG-OLIVER ASSOCIATES, INC.

ROUTINE WETLAND DETERMINATION DATA FORM

Project Site: 10322N-WD | City/County: Harris County | Sampling Date: 10/21/2016
Applicant/Owner: Harris County MUD #500 c/o ABHR | State: Texas | Sampling Point: Up 6
Investigator: Berg-Oliver Associates, Inc. | Section/Range: | Slope (%):
Landform (hillslope, terrace, etc.): | Local relief (concave, convex, none): | Datum: NAD 83
Subregion (LRR or MLRA): LRR T | Lat: 29.96202448 | Long: -95.68875424
Soil Map Unit Name: Gessner fine sandy loam (Ge) | NWI classification:
Are climatic/hydrologic conditions on the site typical for this time of year? Yes X No (If no, explain in Remarks)
Are Vegetation ____ Soil ____ Hydrology ____ significantly disturbed?
Are Vegetation ____ Soil ____ Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks)
Are "Normal Circumstances" present? Yes X No

SUMMARY OF FINDINGS- Attach site map showing sampling point locations, transects, important features, ect.

Hydrophytic Vegetation Present?	Yes		No	X	
Hydric Soils Present?	Yes	X	No		**Is the Sample Area within a Wetland?** Yes
Wetland Hydrology Present?	Yes		No	X	No X

Remarks: Based on the absence of hydrophytic vegetation and wetland hydrology, this location does not meet the criteria for a wetland.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required: check all that apply)

	Surface Water (A1)		Water-Stained Leaves (B9)
	High Water Table (A2)		Aquatic Fauna (B13)
	Saturation (A3)		Marl Deposits (B15) **(LLR U)**
	Water Marks (B1)		Hydrogen Sulfide Odor (C1)
	Sediment Deposits (B2)		Oxidized Rhizospheres on Living Roots (C3)
	Drift Deposits (B3)		Presence of Reduced Iron (C4)
	Algal Mat or Crust (B4)		Recent Iron Reduction in Tilled Soils (C6)
	Iron Deposits (B5)		Thin Muck Surface (C7)
	Inundation Visible on Aerial Imagery (B7)		Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

	Surface Soil Cracks (B6)
	Sparsely Vegetated Concave Surface (B8)
	Drainage Patterns (B10)
	Moss Trim Lines (B16)
	Dry-Season Water Table (C2)
	Crayfish Burrows (C8)
	Saturation Visible on Aerial Imagery (C9)
	Geomorphic Position (D2)
	Shallow Aquitard (D3)
	FAC-Neutral Test (D5)
	Sphagnum moss (D8) (LRR T, U)

Field Observations:

Surface Water Present?	Yes		No	X	Depth (inches)
Water Table Present?	Yes		No	X	Depth (inches)
Saturation Present? (include cappillary fringe)	Yes		No	X	Depth (inches)

Wetland Hydrology Present? Yes ____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Hydrologic indicators were not observed at this location.

Vegetation- Use scientific names of plants

Texas

Tree Stratum (Plot Sizes: 30')		Absolute % Cover	Dominant Species?	Indicator Status
1				
2				
3				
4				
5				
6				
7				
	Total Cover	0		

Sapling Stratum (30')		Absolute % Cover	Dominant Species?	Indicator Status
1				
2				
3				
4				
5				
6				
7				
	Total Cover	0		

Shrub Stratum (30')		Absolute % Cover	Dominant Species?	Indicator Status
1	Baccharis halimifolia	2	YES	FAC
2				
3				
4				
5				
6				
7				
	Total Cover	2		

Herb Stratum (30')		Absolute % Cover	Dominant Species?	Indicator Status
1	Ambrosia artemisifolia	70	YES	FACU
2	Paspalum urvillei	15	NO	FAC
3	Helenium amarum	10	NO	FACU
4	Andropogon glomeratus	7	NO	FACW
5	Setaria parviflora	5	NO	FACW
6	Juncus roemerianus	5	NO	OBL
7	Tridens strictus	2	NO	FACW
8	Eupatorium serotinum	2	NO	FAC
9	Cyperus entrerianus	2	NO	FACW
10				
11				
12				
	Total Cover	118		

Woody Vine Stratum (30')		Absolute % Cover	Dominant Species?	Indicator Status
1				
2				
3				
4				
5				
	Total Cover	0		

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50% (A/B)

Prevalance Index Worksheet:

Total % Cover of:		Multiply by:	
OBL species	**5**	x 1 =	**5**
FACW species	**16**	x 2 =	**32**
FAC species	**19**	x 3 =	**57**
FACU species	**80**	x 4 =	**320**
UPL species	**0**	x 5 =	**0**
Column Totals:	**120** (A)	(B)	**414**
Prevalence Index = B/A =			3

Hydrophytic Vegetation Indicators:

_____ Rapid Test for Hydrophytic Vegetation

_____ Dominance Test is >50%

_____ Prevalence Index $\leq$ 3.0[1]

_____ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present.

Definitions for Four Vegetation Strata:

Tree - Woody plants, excluding woody vines, greater than 20 feet in height and 3 inches or more in diameter at breast height (DBH).

Sapling - Woody plants, excluding vines, greater than or equal to 20 feet in height and less than 3 inch DBH.

Shrub - Woody plants, excluding vines, approximately 3-20 feet in height.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 1 meter tall.

Woody vine - All woody vines greater than 1 meter in height.

Hydrophytic Vegetation Present?

YES	NO
	X

Remarks: Hydrophytic vegetation was not observed at this location.

SOIL Up 6

Profile Desription: (Describe to the depth needed to document the indicator or confirm the absence of indicators.) **Texas**

	Matrix		Redox Features					
Depth (inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-18	10YR 6/1	100					silty loam	

[1]Type: C= Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains [2]Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

	Histol (A1)		Polyvalue Below Surface (S8) **(LRR S, T, U)**
	Histic Epipedon (A2)		Thin Dark Surface (S9) **(LRR S, T, U)**
	Black Histic (A3)		Loamy Mucky Mineral (F1)**(LRR**
	Hydrogen Sulfide (A4)		Loamy Gleyed Matrix (F2)
	Stratified Layers (A5)	X	Depleted Matrix (F3)
	Organic Bodies (A6) **(LRR P, T, U)**		Redox Dark Surface (F6)
	5 cm Mucky Mineral (A7) **(LRR P, T, U)**		Depleted Dark Surface (F7)
	Muck Presence (A8) **(LRR U)**		Redox Depressions (F8)
	1 cm Muck (A9) **(LRR P, T)**		Marl (F10) **(LRR U)**
	Depleted Below Dark Surface (A11)		Depleted Ochric (F11) **(MLRA 151)**
	Thick Dark Surface (A12)		Iron-Manganese Masses (F12) **(LRR O, P, T)**
	Coastal Prarie Redox (A16) **(MLRA 150A)**		Umbric Surface (F13) **(LRR P, T, U)**
	Sandy Mucky Mineral (S1) **(LRR O, S)**		Delta Ochric (F17) **(MLRA 151)**
	Sandy Gleyed Matrix (S4)		Reduced Vertic (F18) **(MLRA 150A, 150B)**
	Sandy Redox (S5)		Piedmont Floodplain Soils (F19) **(MLRA 149A)**
	Stripped Matrix (S6)		Anomalous Bright Loamy Soils (F20)**(MLRA 149A, 153C, 153D)**
	Dark Surface (S7) **(LRR p, S, T, U)**		

Indicator for Problematic Hydric Soils[3]:

	1 cm Muck (A9) **(LRR O)**
	2 cm Muck (A10) **(LRR S)**
	Reduced Vertic (F18) **(outside MLRA 150A, B)**
	Piedmont Floodplain Soils (F19) **(LRR P, S, T)**
	Anomalous Bright Loamy Soils (F20) **MLRA 153 B)**
	Red Parent Material (TF2)
	Very Shallow Dark Surface (TF12)
	Other (Explain in Remarks)

[3]Indicators of hydrolophytic vegetation and wetland hydrology must be present.

Restrictive Layer (if observed):

Type:

Depth (inches):

Hydric Soil Present?

Yes X **No**

Remarks: Hydric soil indicators were observed at this location.

BERG-OLIVER ASSOCIATES, INC.

ROUTINE WETLAND DETERMINATION DATA FORM

Project Site: 10322N-WD | City/County: Harris County | Sampling Date: 10/21/2016
Applicant/Owner: Harris County MUD #500 c/o ABHR | State: Texas | Sampling Point: Up 7
Investigator: Berg-Oliver Associates, Inc. | Section/Range: | Slope (%):
Landform (hillslope, terrace, etc.): | Local relief (concave, convex, none): | Datum: NAD 83
Subregion (LRR or MLRA): LRR T | Lat: 29.96170171 | Long: -95.68918273
Soil Map Unit Name: Gessner fine sandy loam (Ge) | NWI classification:
Are climatic/hydrologic conditions on the site typical for this time of year? Yes X No (If no, explain in Remarks)
Are Vegetation ____ Soil ____ Hydrology ____ significantly disturbed?
Are Vegetation ____ Soil ____ Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks)
Are "Normal Circumstances" present? Yes X No

SUMMARY OF FINDINGS- Attach site map showing sampling point locations, transects, important features, ect.

Hydrophytic Vegetation Present?	Yes		No	X	
Hydric Soils Present?	Yes	X	No		**Is the Sample Area within a Wetland?** Yes
Wetland Hydrology Present?	Yes		No	X	No X

Remarks: Based on the absence of hydrophytic vegetation and wetland hydrology, this location does not meet the criteria for a wetland.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required: check all that apply)

Surface Water (A1)	Water-Stained Leaves (B9)		Surface Soil Cracks (B6)
High Water Table (A2)	Aquatic Fauna (B13)		Sparsely Vegetated Concave Surface (B8)
Saturation (A3)	Marl Deposits (B15) **(LLR U)**		Drainage Patterns (B10)
Water Marks (B1)	Hydrogen Sulfide Odor (C1)		Moss Trim Lines (B16)
Sediment Deposits (B2)	Oxidized Rhizospheres on Living Roots (C3)		Dry-Season Water Table (C2)
Drift Deposits (B3)	Presence of Reduced Iron (C4)		Crayfish Burrows (C8)
Algal Mat or Crust (B4)	Recent Iron Reduction in Tilled Soils (C6)		Saturation Visible on Aerial Imagery (C9)
Iron Deposits (B5)	Thin Muck Surface (C7)		Geomorphic Position (D2)
Inundation Visible on Aerial Imagery (B7)	Other (Explain in Remarks)		Shallow Aquitard (D3)
			FAC-Neutral Test (D5)
			Sphagnum moss (D8) (LRR T, U)

Field Observations:

Surface Water Present?	Yes		No X	Depth (inches)	
Water Table Present?	Yes		No X	Depth (inches)	**Wetland Hydrology Present?** Yes
Saturation Present? (include cappillary fringe)	Yes		No X	Depth (inches)	No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Hydrologic indicators were not observed at this location.

Vegetation- Use scientific names of plants

Texas

Tree Stratum (Plot Sizes: 30')		Absolute % Cover	Dominant Species?	Indicator Status
1				
2				
3				
4				
5				
6				
7				
	Total Cover	0		

Sapling Stratum (30')		Absolute % Cover	Dominant Species?	Indicator Status
1				
2				
3				
4				
5				
6				
7				
	Total Cover	0		

Shrub Stratum (30')		Absolute % Cover	Dominant Species?	Indicator Status
1	Ilex vomitoria	15	YES	FAC
2				
3				
4				
5				
6				
7				
	Total Cover	15		

Herb Stratum (30')		Absolute % Cover	Dominant Species?	Indicator Status
1	Ambrosia artemisifolia	40	YES	FACU
2	Chloris ciliata	20	NO	UPL
3	Dicanthelium scabriusculum	15	NO	OBL
4	Solidago sempervirens	10	NO	FACW
5	Eragrostis spectabilis	10	NO	FACU
6	Tridens strictus	5	NO	FACW
7	Helenium amarum	2	NO	FACU
8				
9				
10				
11				
12				
	Total Cover	102		

Woody Vine Stratum (30')		Absolute % Cover	Dominant Species?	Indicator Status
1				
2				
3				
4				
5				
	Total Cover	0		

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50% (A/B)

Prevalance Index Worksheet:

Total % Cover of:		Multiply by:	
OBL species	**15**	x 1 =	**15**
FACW species	**15**	x 2 =	**30**
FAC species	**15**	x 3 =	**45**
FACU species	**52**	x 4 =	**208**
UPL species	**20**	x 5 =	**100**
Column Totals:	**117** (A)	(B)	**398**
Prevalence Index = B/A =			3

Hydrophytic Vegetation Indicators:

_____ Rapid Test for Hydrophytic Vegetation

_____ Dominance Test is >50%

_____ Prevalence Index $\leq$ 3.0[1]

_____ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present.

Definitions for Four Vegetation Strata:

Tree - Woody plants, excluding woody vines, greater than 20 feet in height and 3 inches or more in diameter at breast height (DBH).

Sapling - Woody plants, excluding vines, greater than or equal to 20 feet in height and less than 3 inch DBH.

Shrub - Woody plants, excluding vines, approximately 3-20 feet in height.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 1 meter tall.

Woody vine - All woody vines greater than 1 meter in height.

Hydrophytic Vegetation Present?

YES	NO
	X

Remarks: Hydrophytic vegetation was not observed at this location.

SOIL Up 7

Profile Desription: (Describe to the depth needed to document the indicator or confirm the absence of indicators.) **Texas**

	Matrix		Redox Features					
Depth (inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-18	10YR 6/2	40	7.5YR 4/6	3	C	M	sandy loam	
	10YR 5/2	57						

[1]Type: C= Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains [2]Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

	Histol (A1)		Polyvalue Below Surface (S8) **(LRR S, T, U)**		
	Histic Epipedon (A2)		Thin Dark Surface (S9) **(LRR S, T, U)**		1 cm Muck (A9) **(LRR O)**
	Black Histic (A3)		Loamy Mucky Mineral (F1)**(LRR**		2 cm Muck (A10) **(LRR S)**
	Hydrogen Sulfide (A4)		Loamy Gleyed Matrix (F2)		Reduced Vertic (F18) **(outside MLRA 150A, B)**
	Stratified Layers (A5)	X	Depleted Matrix (F3)		
	Organic Bodies (A6) **(LRR P, T, U)**		Redox Dark Surface (F6)		Piedmont Floodplain Soils (F19) **(LRR P, S, T)**
	5 cm Mucky Mineral (A7) **(LRR P, T, U)**		Depleted Dark Surface (F7)		
	Muck Presence (A8) **(LRR U)**		Redox Depressions (F8)		Anomalous Bright Loamy Soils (F20) **MLRA 153 B)**
	1 cm Muck (A9) **(LRR P, T)**		Marl (F10) **(LRR U)**		
	Depleted Below Dark Surface (A11)		Depleted Ochric (F11) **(MLRA 151)**		Red Parent Material (TF2)
	Thick Dark Surface (A12)		Iron-Manganese Masses (F12) **(LRR O, P, T)**		
	Coastal Prarie Redox (A16) **(MLRA 150A)**		Umbric Surface (F13) **(LRR P, T, U)**		Very Shallow Dark Surface (TF12)
	Sandy Mucky Mineral (S1) **(LRR O, S)**		Delta Ochric (F17) **(MLRA 151)**		Other (Explain in Remarks)
	Sandy Gleyed Matrix (S4)		Reduced Vertic (F18) **(MLRA 150A, 150B)**		
	Sandy Redox (S5)		Piedmont Floodplain Soils (F19) **(MLRA 149A)**		
	Stripped Matrix (S6)		Anomalous Bright Loamy Soils (F20)**(MLRA 149A, 153C, 153D)**		
	Dark Surface (S7) **(LRR p, S, T, U)**				

Indicator for Problematic Hydric Soils[3]:

[3]Indicators of hydrolophytic vegetation and wetland hydrology must be present.

Restrictive Layer (if observed):

Type:

Depth (inches):

Hydric Soil Present?

Yes X **No**

Remarks: Hydric soil indicators were observed at this location.

Up 8

BERG-OLIVER ASSOCIATES, INC.

ROUTINE WETLAND DETERMINATION DATA FORM

Project Site: 10322N-WD | City/County: Harris County | Sampling Date: 10/21/2016
Applicant/Owner: Harris County MUD #500 c/o ABHR | State: Texas | Sampling Point: Up 8
Investigator: Berg-Oliver Associates, Inc. | Section/Range: | Slope (%):
Landform (hillslope, terrace, etc.): | Local relief (concave, convex, none): | Datum: NAD 83
Subregion (LRR or MLRA): LRR T | Lat: 29.96113641 | Long: -95.6897968
Soil Map Unit Name: Gessner fine sandy loam (Ge) | NWI classification:
Are climatic/hydrologic conditions on the site typical for this time of year? Yes X No (If no, explain in Remarks)
Are Vegetation ____ Soil ____ Hydrology ____ significantly disturbed?
Are Vegetation ____ Soil ____ Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks)
Are "Normal Circumstances" present? Yes X No

SUMMARY OF FINDINGS- Attach site map showing sampling point locations, transects, important features, ect.

Hydrophytic Vegetation Present?	Yes	No **X**		
Hydric Soils Present?	Yes **X**	No	**Is the Sample Area within a Wetland?**	Yes
Wetland Hydrology Present?	Yes	No **X**		No **X**

Remarks: Based on the absence of hydrophytic vegetation and wetland hydrology, this location does not meet the criteria for a wetland.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required: check all that apply)

Surface Water (A1)	Water-Stained Leaves (B9)	Surface Soil Cracks (B6)
High Water Table (A2)	Aquatic Fauna (B13)	Sparsely Vegetated Concave Surface (B8)
Saturation (A3)	Marl Deposits (B15) **(LLR U)**	Drainage Patterns (B10)
Water Marks (B1)	Hydrogen Sulfide Odor (C1)	Moss Trim Lines (B16)
Sediment Deposits (B2)	Oxidized Rhizospheres on Living Roots (C3)	Dry-Season Water Table (C2)
Drift Deposits (B3)	Presence of Reduced Iron (C4)	Crayfish Burrows (C8)
Algal Mat or Crust (B4)	Recent Iron Reduction in Tilled Soils (C6)	Saturation Visible on Aerial Imagery (C9)
Iron Deposits (B5)	Thin Muck Surface (C7)	Geomorphic Position (D2)
Inundation Visible on Aerial Imagery (B7)	Other (Explain in Remarks)	Shallow Aquitard (D3)
		FAC-Neutral Test (D5)
		Sphagnum moss (D8) (LRR T, U)

Secondary Indicators (minimum of two required)

Field Observations:

Surface Water Present?	Yes	No **X**	Depth (inches)	
Water Table Present?	Yes	No **X**	Depth (inches)	**Wetland Hydrology Present?**
Saturation Present?	Yes	No **X**	Depth (inches)	Yes
(include cappillary fringe)				No **X**

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Hydrologic indicators were not observed at this location.

Vegetation- Use scientific names of plants

Texas

Tree Stratum (Plot Sizes: 30')		Absolute % Cover	Dominant Species?	Indicator Status
1				
2				
3				
4				
5				
6				
7				
	Total Cover	0		

Sapling Stratum (30')		Absolute % Cover	Dominant Species?	Indicator Status
1				
2				
3				
4				
5				
6				
7				
	Total Cover	0		

Shrub Stratum (30')		Absolute % Cover	Dominant Species?	Indicator Status
1	Ilex vomitoria	20	YES	FAC
2				
3				
4				
5				
6				
7				
	Total Cover	20		

Herb Stratum (30')		Absolute % Cover	Dominant Species?	Indicator Status
1	Ambrosia artemisifolia	50	YES	FACU
2	Chloris ciliata	10	NO	UPL
3	Croton capitatus	20	NO	NI
4	Andropogon glomeratus	12	NO	FACW
5	Helenium amarum	5	NO	FACU
6	Eragrostis spectabilis	2	NO	FACU
7	Solidago sempervirens	2	NO	FACW
8	Ambrosia artemisifolia	2	NO	FACU
9				
10				
11				
12				
	Total Cover	103		

Woody Vine Stratum (30')		Absolute % Cover	Dominant Species?	Indicator Status
1				
2				
3				
4				
5				
	Total Cover	0		

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50% (A/B)

Prevalance Index Worksheet:

Total % Cover of:		Multiply by:	
OBL species	**0**	x 1 =	**0**
FACW species	**14**	x 2 =	**28**
FAC species	**20**	x 3 =	**60**
FACU species	**59**	x 4 =	**236**
UPL species	**10**	x 5 =	**50**
Column Totals:	**103** (A)	(B)	**374**
Prevalence Index = B/A =			4

Hydrophytic Vegetation Indicators:

- ____ Rapid Test for Hydrophytic Vegetation
- ____ Dominance Test is >50%
- ____ Prevalence Index $\leq$ 3.0[1]
- ____ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present.

Definitions for Four Vegetation Strata:

Tree - Woody plants, excluding woody vines, greater than 20 feet in height and 3 inches or more in diameter at breast height (DBH).

Sapling - Woody plants, excluding vines, greater than or equal to 20 feet in height and less than 3 inch DBH.

Shrub - Woody plants, excluding vines, approximately 3-20 feet in height.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 1 meter tall.

Woody vine - All woody vines greater than 1 meter in height.

Hydrophytic Vegetation Present?

YES	NO
	X

Remarks: Hydrophytic vegetation was not observed at this location.

SOIL Up 8

Profile Desription: (Describe to the depth needed to document the indicator or confirm the absence of indicators.) **Texas**

	Matrix		Redox Features					
Depth (inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-18	10YR 6/2	40	7.5YR 4/6	3	C	M	sandy loam	
	10YR 5/2	57						

[1]Type: C= Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains [2]Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

- ___ Histol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Organic Bodies (A6) **(LRR P, T, U)**
- ___ 5 cm Mucky Mineral (A7) **(LRR P, T, U)**
- ___ Muck Presence (A8) **(LRR U)**
- ___ 1 cm Muck (A9) **(LRR P, T)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Coastal Prarie Redox (A16) **(MLRA 150A)**
- ___ Sandy Mucky Mineral (S1) **(LRR O, S)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) **(LRR p, S, T, U)**
- ___ Polyvalue Below Surface (S8) **(LRR S, T, U)**
- ___ Thin Dark Surface (S9) **(LRR S, T, U)**
- ___ Loamy Mucky Mineral (F1) **(LRR**
- ___ Loamy Gleyed Matrix (F2)
- X Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) **(LRR U)**
- ___ Depleted Ochric (F11) **(MLRA 151)**
- ___ Iron-Manganese Masses (F12) **(LRR O, P, T)**
- ___ Umbric Surface (F13) **(LRR P, T, U)**
- ___ Delta Ochric (F17) **(MLRA 151)**
- ___ Reduced Vertic (F18) **(MLRA 150A, 150B)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 149A)**
- ___ Anomalous Bright Loamy Soils (F20) **(MLRA 149A, 153C, 153D)**

Indicator for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) **(LRR O)**
- ___ 2 cm Muck (A10) **(LRR S)**
- ___ Reduced Vertic (F18) **(outside MLRA 150A, B)**
- ___ Piedmont Floodplain Soils (F19) **(LRR P, S, T)**
- ___ Anomalous Bright Loamy Soils (F20) **MLRA 153 B)**
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrolophytic vegetation and wetland hydrology must be present.

Restrictive Layer (if observed):

Type: ___

Depth (inches): ___

Hydric Soil Present?

Yes X **No** ___

Remarks: Hydric soil indicators were observed at this location.

BERG-OLIVER ASSOCIATES, INC.

ROUTINE WETLAND DETERMINATION DATA FORM

Project Site: 10322N-WD | City/County: Harris County | Sampling Date: 10/21/2016
Applicant/Owner: Harris County MUD #500 c/o ABHR | State: Texas | Sampling Point: Up 9
Investigator: Berg-Oliver Associates, Inc. | Section/Range: | Slope (%):
Landform (hillslope, terrace, etc.): | Local relief (concave, convex, none): | Datum: NAD 83
Subregion (LRR or MLRA): LRR T | Lat: 29.96075553 | Long: -95.69006821
Soil Map Unit Name: Gessner fine sandy loam (Ge) | NWI classification:
Are climatic/hydrologic conditions on the site typical for this time of year? Yes X No (If no, explain in Remarks)
Are Vegetation | Soil | Hydrology | significantly disturbed?
Are Vegetation | Soil | Hydrology | naturally problematic? (If needed, explain any answers in Remarks)
Are "Normal Circumstances" present? Yes X No

SUMMARY OF FINDINGS- Attach site map showing sampling point locations, transects, important features, ect.

Hydrophytic Vegetation Present?	Yes **X**	No		
Hydric Soils Present?	Yes **X**	No	**Is the Sample Area within a Wetland?**	Yes
Wetland Hydrology Present?	Yes	No **X**		No **X**

Remarks: Based on the absence of wetland hydrology, this location does not meet the criteria for a wetland.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required: check all that apply)

- Surface Water (A1)
- High Water Table (A2)
- Saturation (A3)
- Water Marks (B1)
- Sediment Deposits (B2)
- Drift Deposits (B3)
- Algal Mat or Crust (B4)
- Iron Deposits (B5)
- Inundation Visible on Aerial Imagery (B7)
- Water-Stained Leaves (B9)
- Aquatic Fauna (B13)
- Marl Deposits (B15) **(LLR U)**
- Hydrogen Sulfide Odor (C1)
- Oxidized Rhizospheres on Living Roots (C3)
- Presence of Reduced Iron (C4)
- Recent Iron Reduction in Tilled Soils (C6)
- Thin Muck Surface (C7)
- Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- Surface Soil Cracks (B6)
- Sparsely Vegetated Concave Surface (B8)
- Drainage Patterns (B10)
- Moss Trim Lines (B16)
- Dry-Season Water Table (C2)
- Crayfish Burrows (C8)
- Saturation Visible on Aerial Imagery (C9)
- Geomorphic Position (D2)
- Shallow Aquitard (D3)
- FAC-Neutral Test (D5)
- Sphagnum moss (D8) (LRR T, U)

Field Observations:

Surface Water Present?	Yes	No **X**	Depth (inches)	
Water Table Present?	Yes	No **X**	Depth (inches)	**Wetland Hydrology Present?**
Saturation Present? (include cappillary fringe)	Yes	No **X**	Depth (inches)	Yes / No **X**

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Hydrologic indicators were not observed at this location.

Vegetation- Use scientific names of plants

Texas

	Tree Stratum (Plot Sizes: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1				
2				
3				
4				
5				
6				
7				
	Total Cover	0		

	Sapling Stratum (30')	Absolute % Cover	Dominant Species?	Indicator Status
1				
2				
3				
4				
5				
6				
7				
	Total Cover	0		

	Shrub Stratum (30')	Absolute % Cover	Dominant Species?	Indicator Status
1	Sesbania vesicaria	2	YES	FAC
2				
3				
4				
5				
6				
7				
	Total Cover	2		

	Herb Stratum (30')	Absolute % Cover	Dominant Species?	Indicator Status
1	Panicum coloratum	90	YES	FACW
2	Setaria parviflora	10	NO	FACW
3	Croton capitatus	10	NO	NI
4	Chloris ciliata	5	NO	UPL
5	Cynodon dactylon	2	NO	FACU
6	Tridens strictus	2	NO	FACW
7	Cyperus entrerianus	2	NO	FACW
8	Ambrosia artemisifolia	2	NO	FACU
9				
10				
11				
12				
	Total Cover	123		

	Woody Vine Stratum (30')	Absolute % Cover	Dominant Species?	Indicator Status
1				
2				
3				
4				
5				
	Total Cover	0		

Dominance Test Worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100% (A/B)

Prevalance Index Worksheet:

Total % Cover of:		Multiply by:	
OBL species	**0**	x 1 =	**0**
FACW species	**104**	x 2 =	**208**
FAC species	**2**	x 3 =	**6**
FACU species	**4**	x 4 =	**16**
UPL species	**5**	x 5 =	**25**
Column Totals:	**115** (A)	(B)	**255**
Prevalence Index = B/A =			2

Hydrophytic Vegetation Indicators:

- ____ Rapid Test for Hydrophytic Vegetation
- **X** Dominance Test is >50%
- ____ Prevalence Index $\leq$ 3.0[1]
- ____ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present.

Definitions for Four Vegetation Strata:

Tree - Woody plants, excluding woody vines, greater than 20 feet in height and 3 inches or more in diameter at breast height (DBH).

Sapling - Woody plants, excluding vines, greater than or equal to 20 feet in height and less than 3 inch DBH.

Shrub - Woody plants, excluding vines, approximately 3-20 feet in height.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 1 meter tall.

Woody vine - All woody vines greater than 1 meter in height.

Hydrophytic Vegetation Present?

YES	NO
X	

Remarks: Hydrophytic vegetation was observed at this location.

SOIL Up 9

Profile Desription: (Describe to the depth needed to document the indicator or confirm the absence of indicators.) **Texas**

	Matrix		Redox Features					
Depth (inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-18	10YR 7/1	100					silty loam	potential fill material

[1]Type: C= Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains [2]Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

	Histol (A1)		Polyvalue Below Surface (S8) **(LRR S, T, U)**		
	Histic Epipedon (A2)		Thin Dark Surface (S9) **(LRR S, T, U)**		1 cm Muck (A9) **(LRR O)**
	Black Histic (A3)		Loamy Mucky Mineral (F1)**(LRR**		2 cm Muck (A10) **(LRR S)**
	Hydrogen Sulfide (A4)		Loamy Gleyed Matrix (F2)		Reduced Vertic (F18) **(outside MLRA 150A, B)**
	Stratified Layers (A5)	X	Depleted Matrix (F3)		
	Organic Bodies (A6) **(LRR P, T, U)**		Redox Dark Surface (F6)		Piedmont Floodplain Soils (F19) **(LRR P, S, T)**
	5 cm Mucky Mineral (A7) **(LRR P, T, U)**		Depleted Dark Surface (F7)		
	Muck Presence (A8) **(LRR U)**		Redox Depressions (F8)		Anomalous Bright Loamy Soils (F20) **MLRA 153 B)**
	1 cm Muck (A9) **(LRR P, T)**		Marl (F10) **(LRR U)**		
	Depleted Below Dark Surface (A11)		Depleted Ochric (F11) **(MLRA 151)**		Red Parent Material (TF2)
	Thick Dark Surface (A12)		Iron-Manganese Masses (F12) **(LRR O, P, T)**		
	Coastal Prarie Redox (A16) **(MLRA 150A)**		Umbric Surface (F13) **(LRR P, T, U)**		Very Shallow Dark Surface (TF12)
	Sandy Mucky Mineral (S1) **(LRR O, S)**		Delta Ochric (F17) **(MLRA 151)**		Other (Explain in Remarks)
	Sandy Gleyed Matrix (S4)		Reduced Vertic (F18) **(MLRA 150A, 150B)**		
	Sandy Redox (S5)		Piedmont Floodplain Soils (F19) **(MLRA 149A)**		
	Stripped Matrix (S6)		Anomalous Bright Loamy Soils (F20)**(MLRA 149A, 153C, 153D)**		
	Dark Surface (S7) **(LRR p, S, T, U)**				

Indicator for Problematic Hydric Soils[3]:

[3]Indicators of hydrolophytic vegetation and wetland hydrology must be present.

Restrictive Layer (if observed):

Type:

Depth (inches):

Hydric Soil Present?

Yes X **No**

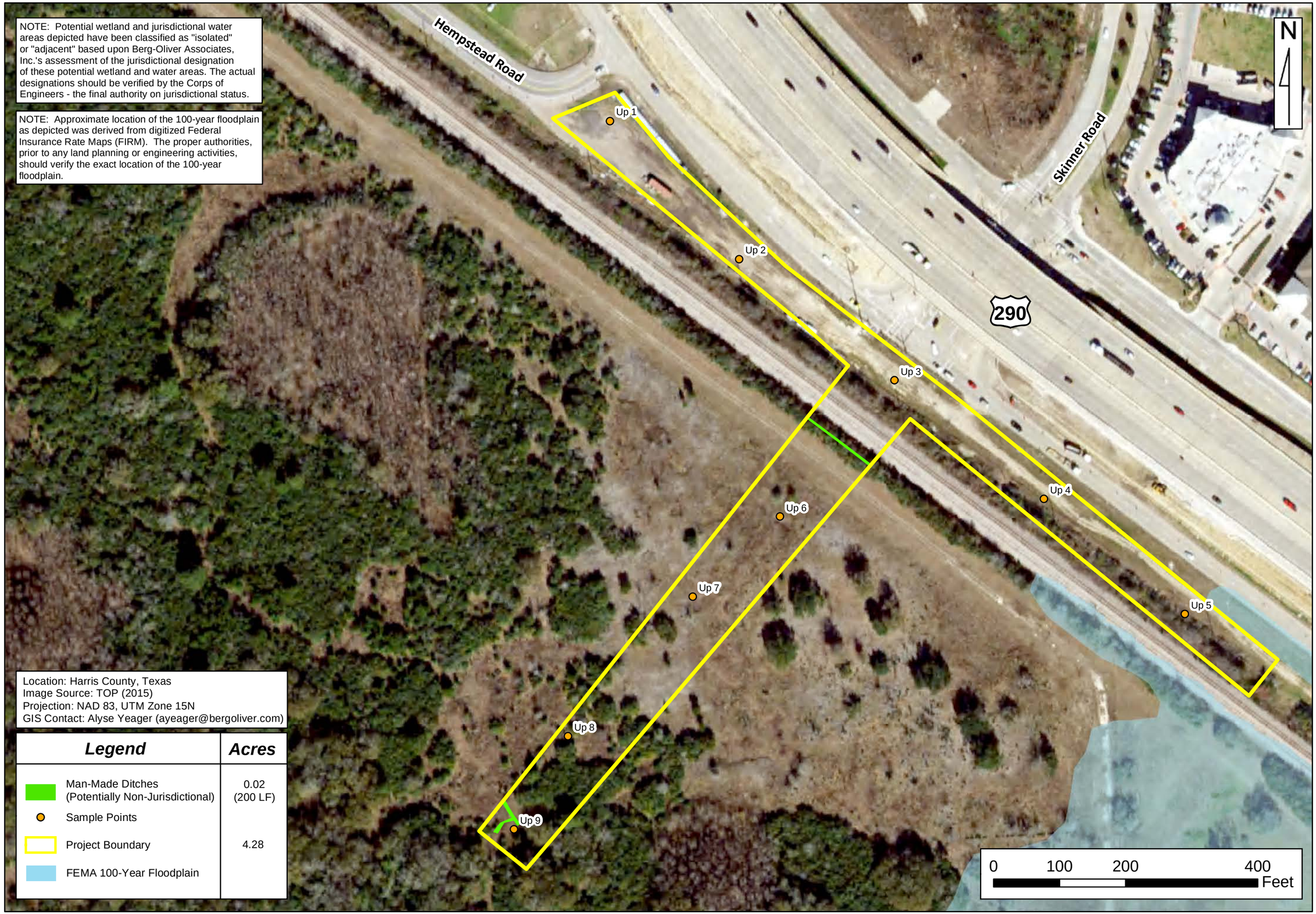
Remarks: Hydric soil indicators were observed at this location.

ATTACHMENT F

WETLAND DELINEATION MAP

NOTE: Potential wetland and jurisdictional water areas depicted have been classified as "isolated" or "adjacent" based upon Berg-Oliver Associates, Inc.'s assessment of the jurisdictional designation of these potential wetland and water areas. The actual designations should be verified by the Corps of Engineers - the final authority on jurisdictional status.

NOTE: Approximate location of the 100-year floodplain as depicted was derived from digitized Federal Insurance Rate Maps (FIRM). The proper authorities, prior to any land planning or engineering activities, should verify the exact location of the 100-year floodplain.



Location: Harris County, Texas
Image Source: TOP (2015)
Projection: NAD 83, UTM Zone 15N
GIS Contact: Alyse Yeager (ayeager@bergoliver.com)

Legend	Acres
Man-Made Ditches (Potentially Non-Jurisdictional)	0.02 (200 LF)
Sample Points	
Project Boundary	4.28
FEMA 100-Year Floodplain	

WETLAND DETERMINATION AND CLASSIFICATION
SITE LOCATION MAP

BERG•OLIVER ASSOCIATES, INC.
ENVIRONMENTAL SCIENCE & LAND USE CONSULTANTS
14701 ST. MARY'S LANE, SUITE 400
HOUSTON, TEXAS 77079 PHONE (281)589-0898 http://www.bergoliver.com

REVISIONS
10/24/16 by DBE

Project #: 10322N-WD
For: Allen Boone Humphries Robinson LLP
Location: South of US 290 & Hempstead Rd
Harris County, Texas

Cultural Resources Survey for the Proposed Hempstead Road 4.28-Acre Project in Harris County, Texas

Prepared for:

Harris County M.U.D. 500
c/o Allen Boone Humphries Robinson, LLP
3200 Southwest Freeway, Suite 2600
Houston, Texas 77027

Prepared by:

Gray & Pape, Inc.
110 Avondale Street
Houston, Texas 77006

GRAY & PAPE
HERITAGE MANAGEMENT

March 7, 2017

GRAY & PAPE
HERITAGE MANAGEMENT

Project No. 16-70740.001

Cultural Resources Survey for the Proposed Hempstead Road 4.28-Acre Project in Harris County, Texas

Prepared for:
Harris County M.U.D. 500
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3200 Southwest Freeway, Suite 2600
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Prepared by:
Jacob Hilton
and
T. Arron Kotlensky, RPA

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T. Arron Kotlensky, RPA
Principal Investigator
March 7, 2017

ABSTRACT

Gray & Pape Inc. of Houston, Texas conducted an intensive pedestrian cultural resources survey of property subsuming a total of approximately 1.73 hectares (4.28 acres) proposed for a development project in Harris County, Texas. This project was done for the Harris County Municipal Utility District 500. The proposed development is on privately-owned property; therefore, a Texas Antiquities Permit was not required. No Lead Federal Agency has been identified with the current project.

The goals of the survey were to determine whether or not intact soils or sediments were present within the south and west portion of the project area, also defined as the project's Area of Potential Effects, to establish whether or not previously identified or unidentified archaeological resources were located within the project area as a whole, and whether the proposed development would affect any identified cultural resources. All fieldwork and reporting activities were completed following accepted standards set forth by the Texas Historical Commission and the Council of Texas Archeologists and in accordance with Section 106 of the National Historic Preservation Act of 1966.

Fieldwork took place on December 29th, 2016 and required 16 person hours to complete. Field investigation consisted of intensive pedestrian inspection, subsurface shovel testing, photographic documentation, and mapping. A total of eight shovel tests were excavated, none of which yielded cultural materials.

The "crossbar" of the T-shaped project area (mapped as the "northern area") measures roughly1.13 hectares (2.78 acres) in area and had been previously surveyed and disturbed from the construction of United States Highway 290, adjacent the Frontage Road, and several above and below ground utilities. Shovel testing was therefore targeted in the "stem" of the project area (mapped as the "southern area") that measures 0.6 hectares (1.5 acres) in area where intact soils and sediments were anticipated. Construction and grading activities had been undertaken within the southern area prior to field investigations; consequently, very little of the project area was left undisturbed, with shovel tests concentrated in those areas exhibiting the most integrity. Of the eight shovel tests that were excavated at a 30-meter (100-foot) interval, only two presented evidence of intact soil stratigraphy. The remainder of the recently graded southern area of the overall project area was subject to visual inspection, with cultural materials observed.

No artifacts or cultural features were recovered or identified in the course of fieldwork for the current project and no new archaeological sites were identified. One previously recorded archaeological site, Site 41HR399 (the linear alignment of the former Houston & Texas Central Railway) intersects the project area northwest-southeast across the "stem" of the T-shaped project area immediately south and parallel to the existing two-track Union Pacific Railroad right-of-way (the "northern area"). No eligibility recommendations were made for this site at the time of its recordation in 1978 and no further work was recommended, per the Texas Archeological Sites Atlas. Additionally, no evidence of Site 41HR399 was identified within the project area in the course of the intensive pedestrian survey, such as surviving railroad structures or materials. Based on the results of the survey, Gray & Pape, Inc. recommends no further cultural resources investigations with respect to the current project design and that the project may proceed as currently planned.

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1.0 INTRODUCTION

Gray & Pape Inc. (Gray & Pape) of Houston, Texas, was contracted by Berg-Oliver Associates, Inc. (Berg Oliver) to conduct a cultural resources investigation consisting of a combination of reconnaissance survey and shovel test excavation on privately-owned property measuring approximately 1.73 hectares (4.28 acres), which defines the Area of Potential Effects (APE). This work was done for the Harris County Municipal Utility District (MUD) 500.

The goals of the cultural resources investigation were to determine whether or not intact soils or sediments were present within the south and west portion of the APE, to establish whether or not previously unidentified archaeological resources were located within the project area as a whole, and whether the proposed development would affect any previously identified cultural resources. All fieldwork and reporting activities were completed following accepted standards defined by Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended (36 CFR 800). The proposed development is on privately-owned property; therefore, a Texas Antiquities Permit was not required. No Lead Federal Agency was involved for this undertaking.

1.1 Project Overview

The project area is approximately 1.7 hectares (4.3 acres) in area, encompassing a "T"-shaped alignment at the intersection of Hempstead Road and United States (US) Highway 290 Frontage Road. The project area is within the Cypress, TX 7.5-minute US Geological Survey (USGS) topographic quadrangle (Quad # 2995-343) (Figure 1-1). Based on recent aerial imagery, the project area is largely undeveloped idle and wooded land but is intersected by an active, double-track Union Pacific Railroad (UPRR) right-of-way. No significant named natural waterbody is within or near the project area.

1.2 Report Organization

This report is organized into seven numbered chapters. Chapter 1.0 provides an overview of the project. Chapter 2.0 presents an overview of the environmental setting and geomorphology of the project area. Chapter 3.0 presents a discussion of the cultural context associated with the project area. Chapter 4.0 presents the methodology developed for this investigation. The results of this investigation are presented in Chapter 5.0. Chapter 6.0 presents a summary of the work conducted and provides management recommendations. A list of all work references throughout the report is presented in Chapter 7.0.

1.3 Acknowledgements

Fieldwork was conducted on December 29th, 2016 by Crew Chief Jacob Hilton and Field Technician Charles William Fee, working under the supervision of Principle Investigator T. Arron Kotlensky. Fieldwork required 16 person hours to complete. The report was prepared by Jacob Hilton with contributions by T. Arron Kotlensky. Graphics for this report were prepared by Duncan Hughey. Jessica Bludau edited and produced the report.

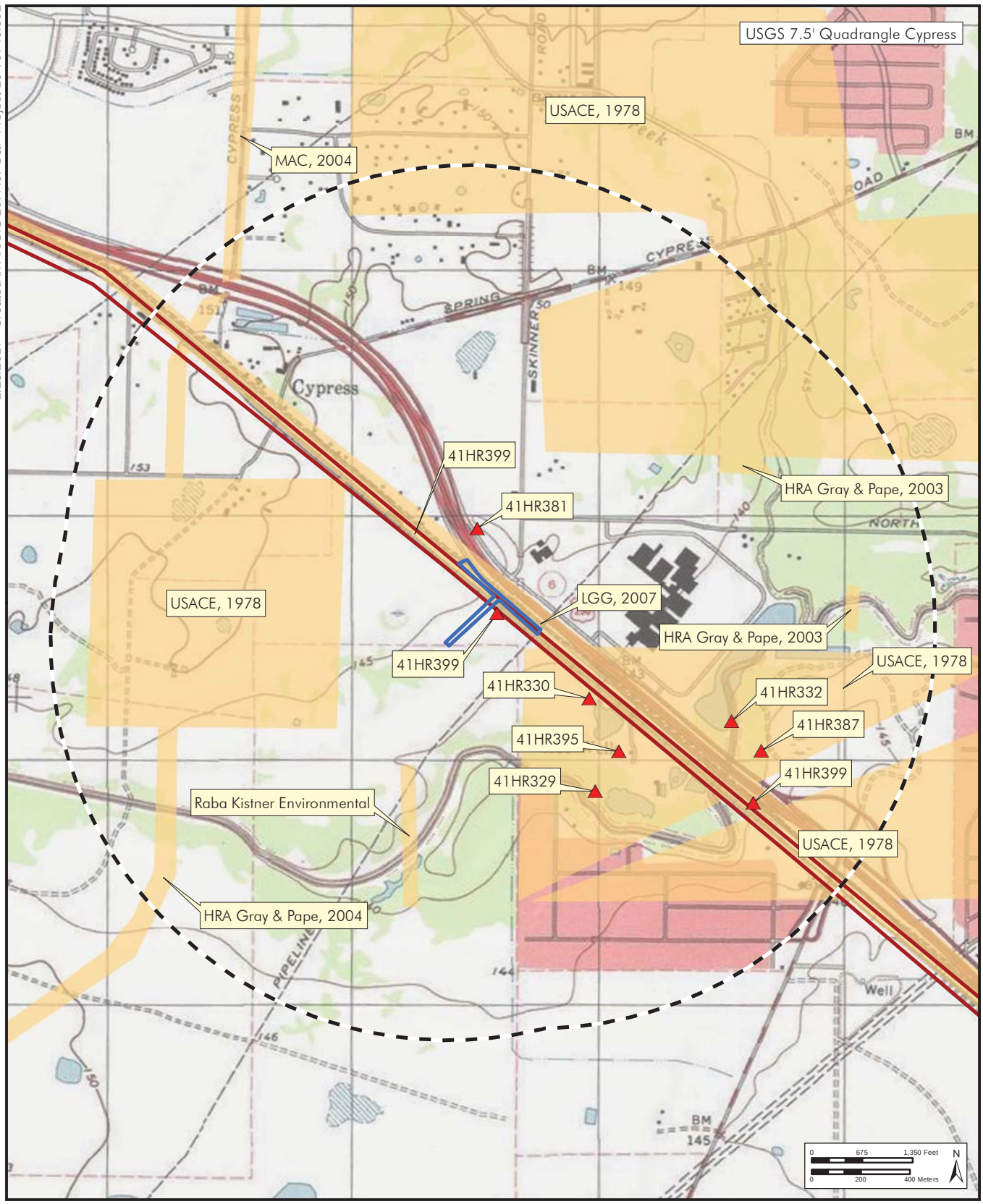
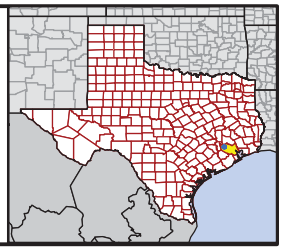


Figure 1-1
Project area location in Harris County, Texas.

GRAY & PAPE
HERITAGE MANAGEMENT

- Project Area
- Study Radius (1.6-km/1-mi.)
- Previously Recorded Site Boundary (41HR399)
- Previously Recorded Area Survey
- Previously Recorded Site Centroid



2.0 ENVIRONMENTAL CONTEXT

2.1 Physiography and Geomorphology

The project area is located in the Coastal Prairies which are situated within the Gulf Coast Plains physiographic province. The Coastal Prairies are underlain by nearly flat strata of deltaic sands and muds which form nearly flat level plains dissected by rivers and streams. Here, elevations range from sea level in the dunes and barrier islands estuarine zone to roughly 250 feet (76 meters) in the upland prairies and woodlands. The Coastal Prairies extend from the Rio Grande along the Gulf of Mexico to the Sabine. Inland, the sub-province transitions into the Interior Coastal Plains which, by contrast, are underlain by beds of unconsolidated sands and muds tilted toward the Gulf that form parallel ridges and valleys with elevations ranging from 300 feet (91 meters) to 800 feet (244 meters) above sea level (University of Texas, Bureau of Economic Geology [UT-BEG] 1997).

2.2 Surface Geology

Locally, the project area is underlain by the Lissie Formation which is composed of Holocene and Pleistocene fluvial sedimentary deposits of the Quaternary period. The upper part of this formation contains clay, silt, sand and minor siliceous gravel. Concretions of calcium carbonate, iron oxide and iron-manganese oxide are common in zones that have undergone substantial weathering. The landscape features nearly flat plains, shallow depressions and pimple mounds. The lower part of the Lissie Formation is made of similar sediments with slightly coarser gravel and more iron oxide concretions (UT-BEG 1992).

2.3 Soils

Soils within the project area are associated with the Gessner fine sandy loam (0 to 1 percent slopes, ponded) soil series and the Addicks loam soil series (Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture [SSS NRCS USDA] 2016).

The poorly drained Gessner fine sandy loam (0 to 1 percent slopes, ponded) soil series are typically composed of the following: an A horizon that extends from the surface to a depth of 10 centimeters (4 inches), composed of dark grayish brown (10YR 4/2) fine sandy loam and subsurface B horizon soils that extends from 10 centimeters (4 inches) below surface to approximately 231 centimeters (91 inches), composed of grayish brown (10YR 5/2) fine sandy loam and dark grayish brown (10YR 4.2) to light gray (10YR 7/2) sandy clay loam (SSS NRCS USDA 2016). The Gessner soil series have been characterized as having a low to moderate geoarchaeological potential and have been largely mapped within approximately 80 percent of the project area, from along the US Highway 290 Frontage Road extending to the southwest (Abbott 2001:22).

Addicks loam (Ad) soil series is made up of poorly drained soils that are typically composed of the following: an A horizon (Ap) that extends from the surface to a depth of 28 centimeters (11 inches) composed of black (10YR 2/1) loam and subsurface B horizon soils that typically extend from 28 centimeters (11 inches) below surface to 198 centimeters (78 inches) below surface, composed of dark gray (10YR 4/1) to light gray (10YR 7/1) loam (SSS NRCS USDA 2016). The Addicks soil series have been characterized as having a low geoarchaeological potential and have been mapped at the extreme northwestern and southeastern ends of the project area segment parallel to the US Highway 290 Frontage Road (Abbott 2001:22).

Texas Department of Transportation (TxDOT)-Houston District's Potential Archeological Liability Map (PALM) covers

Harris County and nearby counties in the Greater Houston area and is based on a combination of data including soil associations, landform types, known cultural and natural resource distribution, and historic and recent land use data (Abbott 2001; 2013). The PALM is a Cultural Resource Management tool that predicts the likelihood of detecting deeply buried intact prehistoric cultural resources in various topographic settings in the greater Houston area. The model also recommends the type of archaeological survey strategy that should be implemented for a given PALM unit, of which there are five major groupings:

- 0 - Water. No survey recommended;
- 1 - Surface Survey Recommended, Deep Reconnaissance Recommended if Deep Impacts are Anticipated;
- 2 - Surface Survey Recommended, No Deep Reconnaissance Recommended;
- 2a - Surface Survey of Mounds Only; No Deep Reconnaissance Recommended;
- 3 - No Surface Survey Recommended, Deep Reconnaissance Recommended if Deep Impacts are Anticipated;
    - 3a - No Surface Survey Recommended, Deep Reconnaissance Recommended only if Severe Deep Impacts are Anticipated; and
- 4 - No Survey Recommended.

Although the current project does not require TxDOT review, the PALM modeling units were referred to as part of the desktop assessment of the project area and was consulted in development of the field survey strategy. Roughly 80 percent of the project area, encompassing the northeast-southwest-oriented segment and most of the segment along the US Highway 290 Frontage Road, falls within Unit 2, which includes a recommendation of surface survey but no recommendation of deep reconnaissance. The remainder of the project area falls within Unit 4, which is not recommended for survey.

2.4 Natural Environment

The project area is situated in the Gulf Coast Prairies and Marshes ecoregion. The Gulf Coast Prairies and Marshes extend from the Sabine River along the Gulf of Mexico to the Rio Grande River and transition inland into the Piney Woods along the upper coast, the Blackland Prairies along the central coast and the South Texas Brush Country and the Coastal Sand Plains along the lower coast (UT-BEG 2010).

2.4.1 Flora and Fauna

The Gulf Coast Prairies and Marshes are inhabited by a high diversity of species due to the ecoregion's large number of habitats, temperate climate and relative abundance of rainfall. It is characterized by inland tallgrass prairies, riverine woodlands and coastal sedges, rushes and salt grass marshes. Common grasses include big bluestem, brownseed paspalum, little bluestem and yellow indiangrass. Common trees include live oak, sweetgum, water oak and yaupon (Hagerty and Meuth 2016).

The region is home to many resident and migratory birds and several species of furbearers and reptiles (Texas Parks and Wildlife 2016). Common birds include black skimmers, piping plovers and roseate spoonbills. Notable mammals include Gulf Coast kangaroo rats, marsh rice rats and river otters. Notable reptiles and amphibians include American alligators, diamond back terrapins and Gulf Coast toads (Hagerty and Meuth 2016).

2.4.2 Climate

The Gulf Coast Prairies and Marshes occupy the humid subtropical climate zone which is characterized by high levels of humidity and warm temperatures year-round. Throughout this ecoregion, average annual temperatures range from 85 Fahrenheit (F)° (29 Celsius [C]°) in the summer to 52 F° (11 C°) in the winter. Average annual precipitation ranges from 60 to 70 inches (152 to 178 centimeters) near the Sabine

River and from 24 to 28 inches (61 to 71 centimeters) near the Rio Grande River (Hagerty and Meuth 2016). In Houston, the average annual maximum temperature is 78 F° (26 C°) and the annual average minimum temperature is 60 F° (16 C°). The average annual rainfall in Harris County is 57 inches (145 centimeters) (National Oceanographic and Atmospheric Administration [NOAA] 2016).

2.5 Land Use

Today, much of the Gulf Coast Prairies and Marshes have been converted to use by industry, agriculture, and urbanization. Such land uses have resulted in fragmentation and massive habitat loss to many native plants and animals and the preservation status of the ecoregion is considered threatened or endangered (Henson 2010). Wild fires are a necessary component of this ecoregion that have been hindered and prevented by human intervention. As a result, species of thorn scrub such as mesquite and acacia have grown and spread in areas previously dominated by grasses. Controlled fires have been employed to reduce these plant populations and to help restore the native prairie grasses.

3.0 CULTURAL CONTEXT

3.1 Prehistoric Context

Most sites near the coast between the Brazos River and Sabine Lake consist of middens found in estuaries or exposed in cutbanks along streams (Aten 1983; Patterson 1995). These middens usually contain faunal material as well as cultural remains such as lithic tools and pottery. Inland sites are less likely to consist of middens and are more similar to generalized open campsites. In both areas, sites are found near stream channels.

Addicks Reservoir was one of the earliest projects conducted in the area (Wheat 1953). The research done during that project initialized the formation of the Galveston Bay Focus and the development of a cultural sequence of the region based on lithics and ceramics (Aten 1983). Aten (1983) and Story (1990) have aptly described the cultural context of the upper coastal region. This information is merged with the archaeological data here to give a complete picture of life on the Upper Texas Coast.

Along the Upper Texas Coast, the Paleo Indian period begins around 12,000 Before Present (BP) and ends near 9,000 BP (Aten 1983; Story 1990). This period is poorly represented in the archaeological evidence for the region (Aten 1983). Isolated artifacts include Clovis, Angostura, Scottsbluff, Meserve, Plainview, and Golondrina point types (Aten 1983). Sites from this stage would be either buried by alluvium or found in upland sites. Until recently, the oldest prehistoric sites in Harris County could be found around Clear Lake, and date to approximately 4,000 BP placing them in the latter part of the Early Archaic (Henson 2005). However, recent data recovery efforts at the Dimond Knoll Site (41HR796) have contributed to the knowledge of the Paleoindian and early Archaic occupation in the area of of Harris County in particular (Barrett and Weinstein 2013).

These early Native Americans practiced a nomadic hunter-gatherer lifestyle (Patterson 1995). These people traveled in small bands from resource to resource, depending on the time of year and availability and had only loose cultural affiliations with one another. Life was a constant journey to reach the next food or water supply, never staying at a single campsite for long. Resources such as lithic raw material for stone tools were also an important part of the seasonal mobility pattern (Patterson 1995). Tribal distinctions prior to the historic period are vague and cultural groups are classified primarily by age and technology (Story 1990).

The Transitional Archaic period begins about 9,000 BP and ends around 7,500 BP (Aten 1983; Story 1990). This stage is also poorly represented in the archaeological work in the area but isolated finds of Bell/Calf Creek, Early-Side Notched, and Early Expanding Stemmed dart points are attributed to this time period. The Archaic stage is thought to include a shift towards a diet more geared towards plant processing but still includes hunting. Plant processing technology seen during the entire Archaic period includes stone-lined hearths and baking pits as well as milling tools (Story 1990). Groups began to travel over less of the landscape and population density seems to have risen.

Beginning at 7,500 BP and spanning 2,500 years (Aten 1983), the Early Archaic period in this region has not been well documented. The sites may have been destroyed or deeply buried (Aten 1983; Story 1990). In situ, Early Archaic remains have been found at the Addicks Reservoir as well as other localities in the area (Story 1990). Points from this period include Bell, Carrollton, Trinity, Wells, and Early Stemmed. It is possible that the Carrollton, Trinity, and Wells points continued to be used into the middle Archaic (Patterson 1995).

The Middle Archaic period (5,000 to 3,000 BP) reveals the earliest surviving shell middens (Aten 1983). These middens often contain remains of shellfish, such as oysters and estuarine clams, faunal material from terrestrial and aquatic vertebrates, and the earliest known human burials in the region (Aten 1983). Characteristic projectile points include Bulverde, Williams, Lange, and Pedernales types.

The Late Archaic lasted from 3,000 to 2,000 BP and shows evidence for population increase (Aten 1983). By 2,500 BP, the climate in this area was essentially like the modern climate. Ground stone artifacts made from materials from southwestern Arkansas and found in context with human burials in cemeteries such as the Ernest Witte Site indicate the possibility of trade (Hall 1981). Projectile points differ from earlier periods in that they are corner-notched or expanding-stemmed forms, such as the Kent, Ellis, and Pontchartrain types. Other types can be found, such as the un-notched Pamillas. These types are thought to precede the Gary type, which can be found into the Late Prehistoric (Story 1990). During the Late Archaic, more utilitarian biface tools are prevalent as well as are bone tools. Late Archaic assemblages are very similar to the early part of the Late Prehistoric stage (Aten 1983).

The transition from the Late Archaic stage to the Late Prehistoric is indicated by the introduction of ceramics into the assemblage (Aten 1983). Cultural shifts during the Late Prehistoric include the possible adoption of a more sedentary lifestyle and major technological changes, such as sandy paste ceramics and late in the stage, the bow and arrow (Story 1990). The cultural tradition during the Late Prehistoric along the Upper Gulf Coast has been designated as Woodland. Story (1990) has suggested the use of the term Mossy Grove Tradition to define cultural patterns of the region. The Trinity River seems to be a dividing line in this tradition with cultures east of the river being more similar to those in Louisiana than to those west of Galveston Bay. The eastern tradition also seems to have begun earlier than that in the west, beginning about 2,000 BP and lasting 600 years (Aten 1983; Story 1990).

Story (1990) splits the Mossy Grove Tradition into five distinct time intervals on the coast, while noting that only two are found inland. Aten (1983) defined these intervals for the area between the Brazos River and Galveston Bay as the Clear Lake (1,850 to 1,525 BP), Mayes Island (1,525 to 1,300 BP), Turtle Bay (1,300 to 950 BP), Round Lake (950 to 600 BP), and Old River (600 to 250 BP) periods based on ceramic styles. Only the Round Lake period is recognized by Aten for the West Bay-Brazos Delta due to the low artifact class diversity compared to areas east of Galveston Bay as well as a time discrepancy in which equivalent periods are later in time than those to the east (Aten 1983).

Early ceramics from this area are similar to Tchefuncte period wares found near Sabine Lake and into Louisiana and include sandy paste varieties such as Mandeville Plain, Goose Creek Plain (Anahuac variety), and Tchefuncte Plain (Aten 1983; Story 1990). These early sites appear similar to pre-ceramic sites due to the low number of ceramic sherds found. The appearance of sandy paste and sand-tempering occurs about 1,900 BP with the O'Neal Plain (variety Conway) being a good example (Aten 1983). Rocker-stamped decorations, a distinctive marker for this period, are uncommon in the West Bay-Brazos Delta, as are incised wares (Aten 1983).

The Mayes Island period brought about the introduction of the bow and arrow, which was probably used along with the atlatl until the historic period (Aten 1983; Story 1990). The arrow points during this period included both notched and expanding-stemmed forms (Aten 1983; Story 1990).

Ceramic indicators for the Turtle Bay period include Goose Creek red-filmed along with other decorated ceramics, all of which are rare in the West Bay-Brazos Delta area. At the

beginning of the Round Lake period, the earliest use of grog or large crushed ceramic particles as tempering agents is seen. Typical varieties include Baytown Plain (variety San Jacinto) and San Jacinto Incised. Along with these types, a reduction in Goose Creek types is seen. Aten (1983) describes this period as having an increase in population due to the larger number of sites in more specialized locations.

During the Old River period, a resurgence of Goose Creek ceramics is seen as the Baytown types decrease in popularity. Contact with Europeans begins near the end of this period, but visible changes in material culture are not seen until about A.D. 1750 along with a rapid decline in population (Story 1990).

3.2 Historical Context

Harris County was formed as Harrisburg County on December 22, 1836. The county was renamed Harris in December 1839 to honor John Richardson Harris, an early pioneer who had established Harrisburg in 1826, the first town site in the county. Harrisburg was established at the confluence of Buffalo Bayou and Brays Bayou and by the 1830s had become the major port of entry for the region and a transportation hub. Roads ran northwest to the Brazos communities of San Felipe and Washington, east to the ferry landing that crossed the San Jacinto, and west paralleling Brays Bayou to the Oyster Creek Community near present day Stafford in Fort Bend County.

Under Mexican authority, the area surrounding Harrisburg was known as the San Jacinto District. The district stretched east from Lynchburg on the San Jacinto River, west to the location of present day Richmond, and from Clear Creek in the south to Spring Creek in the north. Harrisburg County encompassed this same territory with the addition of Galveston Island. The current boundaries of Harris County were established in 1838 (Henson 2016).

The lands that would become Harris County comprised the southeastern border of Austin's Colony. In July of 1824, 29 titles were granted to lands in future Harris County, with an additional 23 grants made between 1828 and 1833. These original grants concentrated mainly on the watercourses of the region (Henson 2016). The early settlers in the region were mostly from the southern United States, many of whom brought slaves with them. In the 1840s, large numbers of German and French immigrants settled in Harris County. The Hispanic presence in the region was relatively sparse prior to an influx of immigrants following the Mexican Revolution reflecting the ephemeral nature of Spanish and Mexican colonization of the overall region.

The founding of the city of Houston by Augustus and John Allen was announced in a newspaper advertisement in August 1836. The brothers managed to convince the delegates of the first Texas Congress to establish the yet-to-be-built Houston as the first, albeit temporary (1837-1840), capital of Texas. In 1837, Houston also became the seat of government of Harrisburg County. The town was laid out on a grid plan with streets running parallel and perpendicular to Buffalo Bayou near the confluence of White Oak Bayou. The town grew rapidly from just 12 inhabitants and one log house in January 1837 to over1,500 people and 100 houses four months later (Henson 2016).

By the mid-nineteenth century, Houston and Harris County had become a center of commerce. Products were imported into the Texas hinterland through Houston after being offloaded from ocean going ships in Galveston. Exports included agricultural products such as cotton, corn, and cow hides. The town became a rail hub with six railways spreading from 81 to 161 kilometers (50 to 100 miles) to the northwest, east, west, south, and southeast, including the Houston and Texas Central Railroad that intersected the current project area in the 1850s (Werner 2010). In 1873, Houston became linked to the nation's growing interstate rail network when the Houston and

Texas Central Railroad reached Denison, Texas (Henson 2016; Werner 2010).

The immigrants that came to the area following the American Civil War founded settlements along the rail lines that bisected the county. The Houston communities of Pasadena, Deer Park, Houston Heights, Bellaire, Webster, La Porte, South Houston, and Genoa developed in this manner and were eventually annexed into the city of Houston. By the 1930s, Harris County was the most populous county in Texas and Houston was the most populous city in the state as well (Henson 2016).

The expansion of Buffalo Bayou was essential to the commercial life of Houston and a number of private ventures were undertaken over the years to widen and deepen the channel. The United States Army Corps of Engineers took control of the project in 1881, eventually creating the 15.2-meter (50-foot) deep Houston Ship Channel from Galveston Bay to a turning basin above Brays Bayou, opening to ship traffic in the 1910s. Additional public works projects included the creation of the Lake Houston reservoir in 1954 to reduce the dependence on subsurface water, the use of which had caused up to 3 meters (9 feet) of subsidence surrounding the confluence of Buffalo Bayou and the San Jacinto River. In 1935, the Harris County Flood Control District was established and infrastructure such as the Addicks and Barker dams in western Harris County were constructed. Since this time, channelization projects completed along Houston area bayous have disturbed many archaeological sites. However, isolated and undisturbed areas along these watercourses may still contain intact deposits (Abbott 2001:101).

4.0 FIELD METHODOLOGY

This cultural resources investigation was designed to identify and assess new and already recorded cultural resources that may be impacted by the proposed project. Desktop assessment and modeling were performed prior to initiating field investigations in order to better understand cultural, environmental, and geological settings. Results of the desktop assessment then were used to develop the field methodology.

4.1 Site File and Literature Review

Site file research was initiated by reviewing records maintained by the Texas Archeological Research Laboratory (TARL) in Austin, Texas, and by consulting the online Texas Archeological and Historic Sites Atlases maintained by the Texas Historical Commission (THC). Site file research was performed in order to identify previously recorded archaeological sites within a 1.6-kilometer (1.0-mile) study area of the project APE and recorded sites and historic structures eligible for the National Register of Historic Places (NRHP) listing or as State Antiquities Landmarks (SALs) located adjacent to or within the APE.

Site file research was used to provide a historic context to the archaeological survey, and additional documentary research was conducted in order to provide an understanding of the development and history of the project area, the surrounding area, and the Southeast Texas region in general. This information was primarily obtained by reviewing records through the online Texas Archeological Sites Atlas, by reviewing available articles pertaining to the history of the area from the Handbook of Texas Online maintained by the Texas State Historical Association (TSHA), and by reviewing original land grant documents maintained by Texas General Land Office (TxGLO).

4.2 Field Methods

4.2.1 Intensive Pedestrian Survey

Gray & Pape field personnel completed the intensive pedestrian survey through pedestrian reconnaissance and shovel testing of the project area that measures approximately 1.73 hectares (4.28 acres) in area. Due to portions of the project area having already been surveyed and subsequently disturbed from construction (largely the northern area of the project area), shovel testing was concentrated in the southern area of the overall project area, encompassing approximately 0.6 hectares (1.5 acres) of level area and extending northeast-southwest. In accordance with THC archaeological survey standards, shovel testing was conducted along a single transect at a 30-meter (98-foot) interval.

Shovel tests measured approximately 30 centimeters (12 inches) in diameter and were excavated to a maximum depth of 100 centimeters (39 inches) below ground surface and no less than 50 centimeters (20 inches) below ground surface or 10 centimeters (4 inches) into B-horizon subsoils. Vertical control of each shovel test was maintained by excavating in arbitrary 10-centimeter (4-inch) levels with reference to the parent soil stratum. The profile of each shovel test was inspected for color and texture change potentially associated with the presence of cultural features. Descriptions of soil texture and color followed standard terminology and soil color charts (Munsell 2005). Additional information such as mottling, evidence of disturbance, and moisture level was also recorded. Field personnel screened excavated soils through 0.64-centimeter (0.25-inch) hardware cloth, while soils with high clay content were hand sorted. All shovel test data were recorded on standardized forms.

The locations of all shovel tests were recorded with a sub-meter accurate global positioning system (GPS) data collector and recorded on field maps. Digital photography aided documentation of the existing conditions of the project area and fieldwork methods, with photograph locations recorded on field maps and logged with a GPS unit.

4.2.2 Site Definition

If buried cultural resources would have been identified in the field, any such newly-identified archaeological sites would have been defined by excavating at least six radial shovel tests in cardinal directions outward from any positive shovel tests until two consecutive negative shovel tests were recorded, or the extents of the project area were reached, per standards established by the THC and Council of Texas Archeologists.

4.3 Curation

Gray & Pape pursued a non-collect survey in the field with the exception of temporally diagnostic artifacts. Furthermore, the survey was performed on privately owned property and a Texas Antiquities Permit was not required. Should such materials be collected, they would be temporarily housed at the Gray & Pape Houston office for analysis and be returned to the land owner following completion of the project and submission of a final report.

5.0 RESULTS OF INVESTIGATIONS

5.1 Result of Site File and Literature Review

Site file and literature review resulted in the identification of 10 previously recorded area and linear surveys (Table 5-1) and seven previously recorded archaeological sites (Table 5-2) located within 1.6 kilometers (1.0 mile) of the proposed project area (Figure 1-1). Research revealed that one previously-identified archaeological site has been mapped within the project area (Site 41HR399, the former Houston & Texas Central Railway right-of-way, which is largely encompassed by the existing UPRR right-of-way) (Figure 1-1). No mapped historic properties, state historic markers, properties listed on the NRHP, or Texas SALs are located within the current project area or within a 1.6-kilometer (1-mile) study area surrounding the project area. One unnamed historically African-American associated cemetery, recorded as archaeological Site 41HR381, is located within the study area, 425 meters (1,400 feet) northwest of the project area (discussed further below). The project area also intersects the area of one previous cultural resources survey, completed by the Lopez Garcia Group (LGG) in 2007, which did not identify any cultural resources within the current project area.

5.1.1 Previously Recorded Surveys

A total of 10 previous surveys have been undertaken within the study area of the project. (Figure 1-1; Table 5-1). The current project area intersects the area of one previous cultural resources survey, completed by LGG in 2007, which did not identify any cultural resources within the current project area.

Table 5-1. Previously Recorded Area and Linear Surveys within 1.6 kilometers of the Proposed Project Area, Harris County, Texas

Survey Type	Consulting Firm or Agency	Reported Year	Texas Antiquities Permit No.	Distance (meters/feet) and Direction from Project Area
Area	U.S. Army Corps of Engineers – Galveston District	1978	Not Applicable (N/A)	800/2,625 north
Area	U.S. Army Corps of Engineers – Galveston District	1978	(N/A)	130/425 southeast
Area	U.S. Army Corps of Engineers – Galveston District	1978	(N/A)	660/2,165 west
Area	U.S. Army Corps of Engineers – Galveston District	1978	(N/A)	1,160/3,805 southeast
Area	HRA Gray & Pape, LLC.	2003	3168	1,150/3,770 northeast
Area	HRA Gray & Pape, LLC.	2003	3168	1,425/4,675 east
Linear	HRA Gray & Pape, LLC.	2004	3320	1,340/4,395 west

Survey Type	Consulting Firm or Agency	Reported Year	Texas Antiquities Permit No.	Distance (meters/feet) and Direction from Project Area
Linear	Moore Archeological Consultants, Inc. (MAC, Inc.)	2004	(N/A)	1,720/5,640 northwest
Linear	LGG	2007	4681	Intersects current project area
Area	Raba Kistner Environmental	2015	7310	780/2,560 south

5.1.2 Previously Recorded Archaeological Sites

Site 41HR329 is a prehistoric lithic scatter recorded by M. and N. Morris in 1977 (THC 2016a). The site is located on a terrace above Cypress Creek. Recovered artifacts included two projectile points, a snapped biface, and five thinning flakes, which were found eroding out of the banks of a bulldozer cut which drains rainwater from the Hot Wells Shooting Range into Cypress Creek.

Site 41HR330 is a prehistoric light lithic scatter recorded by M. and N. Morris in 1977 (THC 2016b). Primary, secondary and tertiary flakes were found eroding out of the bank of a large man-made pond.

Site 41HR332 is a prehistoric light lithic scatter recorded by M. and N. Morris in 1977 (THC 2016c). One utilized tertiary flake and one primary flake were found pedestaled on a steep slope of an eroding cut bank along Cypress Creek that was created by dredging project.

Site 41HR381 is a twentieth century African-American cemetery recorded by Martha Doty Freeman in 1978 (THC 2016d). The cemetery was unfenced and some graves might have been unmarked. An attempt was made to relocate the cemetery in 1986, however, the area was described as completely overgrown with no sign of grave markers.

Site 41HR387, also known as the Knigge Homestead, is a nineteenth to twentieth century German-American homestead recorded by Martha Doty Freeman in 1978 (THC 2016e). The site is located immediately south of Big Cypress Creek on the edge of the woods which line the creek bottom. The site appears to be comprised of corrals, chutes, and numerous livestock sheds although nothing remains of the house. The site was revisited in 1986 and the corrals and sheds were described as being in very poor condition.

Site 41HR395, also called the Houston Hot Wells Hotel, is a twentieth century hotel and bathing spa recorded by Martha Doty Freeman (THC 2016f). The site is located southeast of Cypress on the southwest side of US Highway 290. At the time of survey, three hot water pools were the only portion of the resort remaining. The Hot Wells Hotel was burned within recent years, and the owners reported having found numerous railroad tokens and other artifacts when they bulldozed the area.

Site 41HR399, also referred to as the Houston and Texas Central Railroad, was a railroad line built in the 1850s and recorded by Martha Doty Freeman in 1978 (THC 2016g). The alignment of the former railroad follows parallel to the existing UPRR two-track right-of-way, with the existing boundary of the archaeological site intersecting the UPRR right-of-way (the existing UPRR right-of-way likely assumed much of the Texas and Central Railroad right-of-way as it expanded into its current two-track alignment).

Table 5-2. Previously Recorded Archaeological Sites within 1.6 kilometers of the Proposed Project Area, Harris County, Texas.

Site Number	Site Name (if provided)	Site Type/Period	Distance (meters/feet) and Direction from Project Area
41HR329	None provided	Low-density lithic and biface scatter/prehistoric	775/2,540 southeast
41HR330	None provided	Low-density lithic scatter/prehistoric	560/1,840 southeast
41HR332	None provided	Low-density lithic scatter/prehistoric	1,050/3,445 southeast
41HR381	None provided	Cemetery (African-American association), twentieth century	425/1,400 north
41HR387	Knigge Homestead	Home and farmstead (German-American association), nineteenth and twentieth century	1,200/3,940 southeast
41HR395	Houston Hot Well Sanitarium	Hotel/resort, twentieth century	690/2,260 southeast
41HR399	Houston and Texas Central Railroad	Former railroad right-of-way	Intersects current project area

5.2 Results of Field Investigations

Gray & Pape of Houston, Texas conducted an intensive pedestrian cultural resources survey of property subsuming a total of approximately 1.73 hectares (4.28 acres) proposed for an urban development project in Harris County, Texas. A total of eight shovel tests were excavated (Figure 5-1) and the results from the survey are discussed below. For organization purposes, Gray & Pape labeled the northwest/southeast aligned segment of the project area as the "northern area," and the southwest/northeast aligned segment of the project areas as the "southern area." The northern area measures 430 meters (1,410 feet) in length and 30 meters (98 feet) in width, while the southern area measures 275 meters (902 feet) in length and 20 meters (66 feet) in width.

The crew began the survey of the northern area near the intersection of Hempstead Road and the US Highway 290 East Frontage Road. From this point, the crew traversed the northern area to identify any areas of intact soils or other above-ground historic age structures or features. The northern area, measuring approximately 1.13 hectares (2.78 acres) in area, has been previously surveyed by LGG in 2007 and subsequently disturbed from the construction of US Highway 290, adjacent Frontage Road, and several above and below ground utilities (see inset Photo A in Figure 5-1). Consequently, no shovel tests were excavated in the northern area due to extensive and demonstrable disturbance. At the time of survey, the area was being used as a staging area for equipment and building materials, likely in support of ongoing construction projects for US Highway 290.

On the southwest side of the Union Pacific Railroad right-of-way, the crew continued pedestrian reconnaissance of the southern area of the overall project area and shovel tested the remaining 0.6 hectares (1.5 acres) of the APE along a single transect at a staggered 30-meter

A. Stockyard or staging area near Hempstead Rd. and US 290 E. Frontage Rd. View is to the southeast.

B. Buried utility crossing project area and underlying Site 41HR399. View is to the northwest.

C. Construction and disturbances within project area. View is to the southwest.

D. Push piles and artificial drainage ditch within project area. View is to the northeast.

Service Layer Credits: Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Project area with field survey results and photo locations and angles.

GRAY & PAPE HERITAGE MANAGEMENT

Figure 5-1

- Project Area
- Negative Shovel Test
- Photo Location and Camera Direction
- Previously Recorded Site Boundary (41HR399)
- Previously Recorded Area Survey

(98-foot) interval. The more northerly portion of this survey area crosses the existing UPRR two-track right-of-way, a narrow line of mature trees, and a buried utility corridor (see inset Photo B in Figure 5-1). Consequently, no shovel tests were excavated in this area but visual inspection of the area was undertaken to identify any extant above-ground features associated with past railroad development of the area by the former Texas and Central Railroad. Southwest of the buried utility corridor, two shovel tests (1 and 2) were excavated and disturbed soils were observed. Heavy machinery had recently excavated and graded much of the area encompassing Shovel Tests 1 and 2.

The remainder of the southern area had also recently been graded by heavy machinery (see inset Photo C in Figure 5-1). Vegetation had been cleared, soils and sediments had been displaced and gravel had been laid down along a road to accommodate heavy machinery access. A narrow strip along the northwest boundary of the project area appeared to be intact or minimally impacted, and the six remaining shovel tests (3 through 8), were offset and concentrated in the undisturbed portion of the southern area. Two large push piles of soils were located near the southwest end of the southern area where an artificial drainage ditch intersected the immediate property (see inset Photo D in Figure 5-1).

Of the eight shovel tests completed, only two shovel tests (4 and 8) presented evidence of intact soil stratigraphy. The soils profile of Shovel Test 4 consisted of three strata discernible on the basis of color and texture. Stratum I was a very dark grayish brown (10YR 3/2) fine sandy loam between 0 and 10 centimeters (0 and 4 inches) below surface. Stratum II was a dark gray (10YR 4/1) fine sandy loam between 20 and 80 centimeters (8 and 32 inches) in depth below surface. Stratum III was a dark gray (10YR 4/1) sandy clay with mottles of light gray (10YR 7/1) fine sand between 80 and 100 centimeters (32 and 39 inches) below surface. These soils are roughly consistent with Gessner fine sandy loam soils mapped in this area.

The soils profile of Shovel Test 8 consisted of three strata. Stratum I was a mottled grayish brown (10YR 5/2) with light gray (10YR 7/2) wet fine sandy loam. Stratum II was a gray (10YR 5/1) mottled soil with light gray (10YR 7/1) wet fine sandy loam. Stratum III was a gray (10YR 6/1) mottled soil with very pale brown (10YR 7/3) wet sandy clay with yellow (10YR 7/8) iron oxide concretions.

Despite the disturbance through grading observed in the southern area, Gray & Pape undertook pedestrian survey of the stripped areas to identify prehistoric or historic artifacts, deposits, or other features that may have been exposed through the recent grading activities but observed no such cultural materials. Overall, no artifacts or cultural features were observed or recovered in the course of sub-surface testing or through pedestrian reconnaissance of the overall project area, and therefore no new archaeological sites have been identified within the current project area.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Gray & Pape conducted an intensive pedestrian cultural resources survey of property subsuming a total of approximately 1.73 hectares (4.28 acres) proposed for development in Harris County, Texas. The proposed development is on privately-owned property; therefore, a Texas Antiquities Permit was not required prior to commencing the archaeological survey.

The goals of the survey were to determine whether or not intact soils or sediments were present within the project area, also defined as the project's APE, to establish whether or not previously identified or unidentified archaeological resources were located within the project area as a whole, and whether the proposed development would affect any identified cultural resources. All fieldwork and reporting activities were completed following accepted standards set forth by the THC and the Council of Texas Archeologists and in accordance with Section 106 of the NHPA.

Site file and literature review resulted in the identification of 10 previously recorded area and linear surveys and seven previously recorded archaeological sites located within 1.6 kilometers (1.0 mile) of the proposed project area. Research revealed that one previously-identified archaeological site has been mapped within the project area (Site 41HR399, the former Houston & Texas Central Railway right-of-way). No additional historic properties, state historic markers, properties listed on the NRHP, or Texas State SALs are located within the current project area or within a 1.6-kilometer (1-mile) study area surrounding the project area. The project area also intersects the area of one previous cultural resources survey, completed by LGG in 2007, which did not identify any cultural resources within the current project area.

Fieldwork took place on December 29th, 2016 and required 16 person hours to complete. Field investigation consisted of intensive pedestrian inspection, subsurface shovel testing, photographic documentation, and mapping. A total of eight shovel tests were excavated, none of which were positive for buried cultural materials.

The northern area of the overall project area, measuring roughly 1.13 hectares (2.78 acres) in area, had been previously surveyed by LGG in 2007 and was significantly disturbed from the construction of US Highway 290, adjacent Frontage Road, and several above and below ground utilities. Shovel testing was undertaken in the southern area of the overall project area, measuring 0.6 hectares (1.5 acres) in area, where intact soils and sediments were more likely to be encountered based on background research. The intensive pedestrian survey identified areas of recent grading within the southern area of the project area, with shovel testing undertaken in the northern margin of this area. Of the eight shovel tests that were excavated, only two presented evidence of intact soils (Shovel Tests 4 and 8). Pedestrian survey of the recently graded areas did not identify any cultural materials.

Overall, no artifacts or cultural features were observed or recovered in the course of the survey and therefore no new archaeological sites were identified. One previously recorded archaeological site, the linear Site 41HR399 (the former Houston and Texas Central Railroad alignment), intersects the project area, parallel to the existing UPRR two-track right-of-way. No eligibility recommendations were made for this site at the time of its recordation and no further investigations of the linear site are recommended, per the Texas Archeological Sites Atlas (1978). The intensive pedestrian attempted to identify structures and features associated with the former railroad alignment and identified no such resources within the current project area.

In consideration of the results presented in this report, Gray & Pape recommends that no further cultural resources investigations are necessary within the existing project area and that the project may proceed as currently designed.

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October 27, 2016

Harris County MUD #500
c/o Alia Vinson
Allen Boon Humphries Robinson LLP
3200 Southwest Freeway, Suite 2600
Houston, Texas 77027

Via email: Avinson@abhr.com

Re: Threatened & Endangered Species Survey
U.S. Highway 290 & Hempstead Road; Harris County, Texas
BOA Job No. 10322N-TE

Dear Ms. Vinson,

At your request, Berg♦Oliver Associates, Inc. (BOA) performed a Threatened and Endangered Species Survey for a proposed road crossing, located southeast of U.S. Highway 290 and Hempstead Road, in Harris County, Texas.

The objective of the Threatened and Endangered Species Survey is to evaluate the potential for the existence of habitat that is considered protected under the Endangered Species Act of 1973 and subsequent amendments and listings. Threatened and Endangered species located or having potential habitat in Harris County are the following: **bald eagle** (*Haliaeetus leucocephalus*), and **Texas prairie dawn** (*Hymenoxys texana*). Although the bald eagle has been delisted from the status of threatened or endangered, this species is still protected under the Bald and Golden Eagle Protection Act of 1940 and should be accounted for accordingly.

A review of the United States Fish and Wildlife Service (USFWS) database indicates that the following species have a possibility of occurring in the vicinity of the proposed project site, located within Harris County, Texas:

Group	Common Name (Species)	Status
Birds	Bald Eagle (*Haliaeetus leucocephalus*)	Protected
Plants	Texas Prairie Dawn (*Hymenoxys texana*)	Endangered

Bald Eagle (*Haliaeetus leucocephalus*) –The bald eagle is a large bird with a wingspan of six (6) to seven and a half (7.5) feet. Bald eagles have been known to nest in the Harris County area during December to March after which time they migrate to the northern United States and southern Canada. Nesting eagles prefer habitat in undisturbed coastal regions or along lake shores with large cliffs or tall trees, ranging forty (40) to one hundred and twenty (120) feet in height. These taller trees, of which are generally taller than the common forest canopy, provide an unobstructed flight path to the nest. The nest usually consists of bulky platforms of sticks and

other woody debris. Fish are the primary food source for nesting bald eagles; thus, nests are usually constructed three (3) km or less from an open body of water. Although the bald eagle species has been recovered and is no longer threatened according to USFWS, this species and its critical habitat are still protected under the Bald and Golden Eagle Protection Act of 1940.

Texas Prairie Dawn (*Hymenoxys texana*) **–** The Texas prairie dawn is a delicate annual herbaceous plant approximately one (1) to six (6) inches tall. It grows in sparsely vegetated areas that are poorly drained (slick spots) at the base of mima mounds (pimple mounds). They can also be found in nearly barren areas on slightly saline soils in coastal prairie grasslands. This suitable habitat is limited to a small geographic area, found in Fort Bend and Harris Counties, located in southeast Texas. Texas prairie dawn flowers in March through early April and disappears by mid-summer. The status of Texas prairie dawn is better known today, and much of its remaining habitat is protected on public lands administered by the U.S. Army Corps of Engineers. It has been identified in about 50 sites, many within Addicks and Barker Reservoirs in western Harris County.

A site survey was performed in October 2016 by personnel of BOA, to determine if the subject property contains habitat suitable for any of the above species. Based upon the site investigation, the subject property is undeveloped land. It is the professional opinion of BOA that no known endangered species or their critical habitat will be affected by the proposed work. Furthermore, while conducting the Wetland Assessment Determination and Delineation for the subject property, in October 2016, BOA personnel found no evidence of threatened or endangered individual species or their critical habitat within the subject property. The subject property is currently an undeveloped tract of land, bordered by U.S. Highway 290 to the north.

The Texas prairie dawn (*Hymenoxys texana*) prefers poorly drained soils in open areas; due to heavy vegetation cover and loamy soils, this subject property does not meet the habitat requirements to sustain the Texas prairie dawn (*Hymenoxys texana*). The bald eagle (*Haliaeetus leucocephalus*) prefers nesting and/or perching trees along large bodies of water for a food source; none of the existing trees within the subject property would be suitable for nesting or perching. No bodies of water are present on the subject property or on surrounding properties to sustain bald eagles. Additionally the traffic surrounding the subject property would likely deter any bald eagle individuals from nesting.

It is the opinion of BOA that no threatened or endangered species or their potential habitat will be affected by any future work on the subject property.

Thank you for allowing BOA to assist with the proposed project. If you have any questions please contact us at (281) 589-0898.

Sincerely,

Natalie Hall
Project Manager
Berg ♦ Oliver Associates, Inc.

Update To Assessment of Development Potential
Towne Lake Town Center

Prepared For:

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May 2018 **DRAFT**

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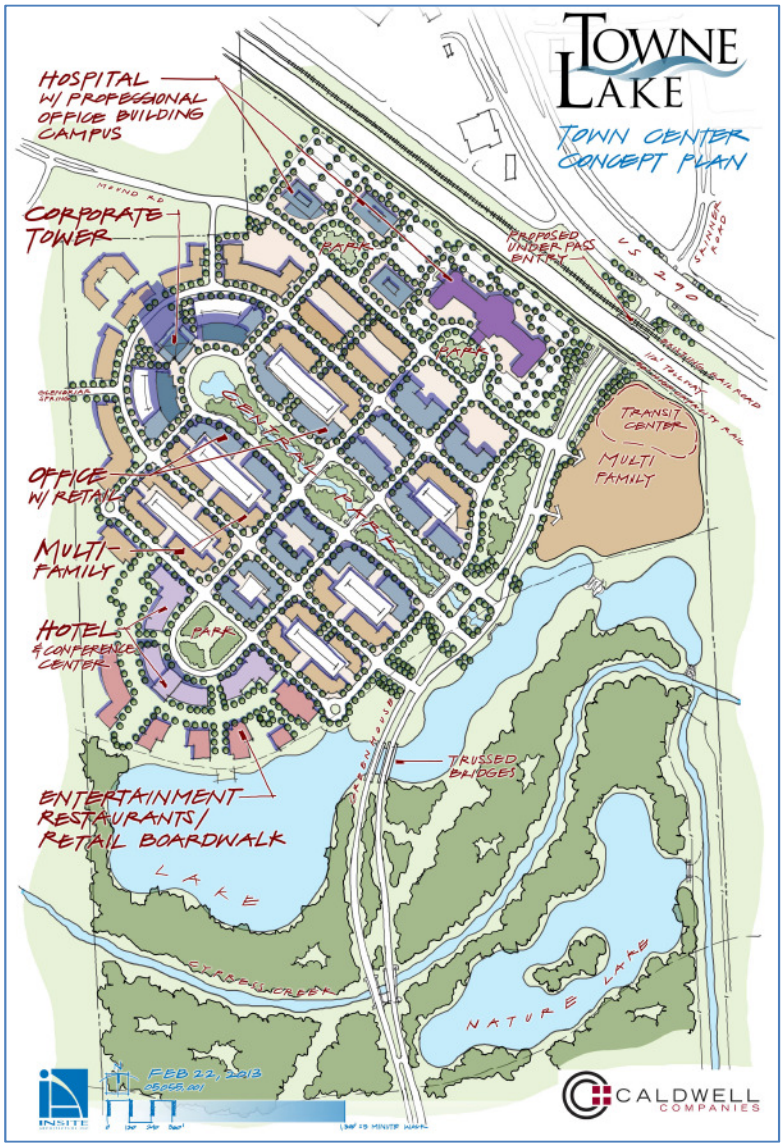
Introduction and Overview

This report presents an update to the 2016 CDS analysis of the long-range development potential for the proposed Business Center Business Center in the Towne Lake master-planned community. As in the previous project, CDS was tasked with examining the development potential of five major commercial land uses for the property: office, retail, industrial/warehouse, multifamily, and hospitality/hotel with this update focusing on the viability of a proposed land use plan for the Towne Lake Business Center. A major corporate office anchor will be the principal driver of the project. In addition, the plan acknowledges the potential for transit-oriented development related to commuter rail and bus service and possibly interregional high-speed rail service. Case studies of existing developments in Texas that are similar to what is expected to make up the Towne Lake Business Center were used to analyze potential demand in both the present and near future.

Figure 1: Towne Lake Land Plan and Business Center Site



Source: InSite Architecture. and Caldwell Co.

The subject Business Center property is located on the north end of Towne Lake, along US Highway 290 and its feeder road. The planned extension of Greenhouse Road going north forms the spine of the Business Center plan and will provide direct access to the US 290 feeder road. It will also connect the Business Center property to the rest of Towne Lake, and further south to Interstate 10. To bypass the impediment of the existing railroad facilities along US 290, the extension of Greenhouse Road will pass under the railroad tracks and connect with Skinner Road to the north at its intersection under US 290. Completion of the underpass and US 290 feeder road intersection are critical to providing access to the Business Center property. Without this connection, the property loses value for commercial development due to poor access. For this analysis, timely completion of Greenhouse Road extension and connection to the US 290 feeder road will be assumed.

KEY FINDINGS

The Towne Lake Business Center represents a major opportunity to create a new activity node on the US 290 Corridor in northwest Harris County in an area which currently lacks such a destination, particularly in comparison to other major Houston-area corridors such as the I-10 Katy Freeway, US 59 Southwest Freeway, and I-45 North Freeway. However, the potential infrastructure and economic benefits of the development hinge on making the correct initial decisions related to transportation infrastructure at the outset of the project.

Business Center's Strong Market Conditions

The walkable, mixed-use model envisioned by Caldwell Companies for the Business Center is designed to give the project the best possible chance of success. Academic research has shown stronger metrics of commercial market success for these types of developments, including lease rates and property values. The empirical track record of similar suburban developments in the Houston area and elsewhere in Texas has shown that such projects have a particularly strong appeal for major corporate office users, the type that Caldwell would seek to anchor its project.

Not only is Towne Lake Business Center's development model preferred in today's market, it also has favorable market conditions now and going forward at the proposed location. CDS' analysis of key land uses and market area metrics for comparable developments shows that the Business Center's anticipated development program is reasonable, based upon potential shares of the various land uses within a 20-minute-drive market area. The future market conditions will become even more favorable, with the Houston-Galveston Area Council projecting a 45% increase in population within a 3-mile radius of the Business Center during the 2015-2025 time span. Large tracts of vacant land remain in close proximity to the Business Center that will facilitate the residential development to achieve this population increase.

Transportation Access is Essential

However, despite the favorable market context and preference trends, one piece of transportation infrastructure is essential to enabling the project to occur: an efficient portal to the region's transportation network. Large-scale office development, particularly a major corporate anchor, will be reluctant to locate where highway access is compromised by an at-grade active railroad crossing. This is because the "labor shed" for larger-scaled office users extends across much of the region, requiring efficient access to the highway network. All of the comparable projects examined in this study have efficient highway intersections (sometime multiple intersections) providing access from a wide swath of the metropolitan area to the commercial cores of the developments.

If a similar efficient highway intersection portal is not provided for the Towne Lake Business Center, a corporate anchor and large-scale office development are unlikely; this would also remove the feasibility of a full-service hotel. This outcome would represent a lost opportunity for northwest Harris County, which would lose the chance to provide white-collar businesses with a desirable option in the 290 corridor. Furthermore, the type of development that would be generated instead (single family residential and low-scale business / industrial) would be of considerably lower economic value in terms of tax generation (property, sales, and hotel tax).

The Business Center site has one other feature that adds potential transportation infrastructure and efficiency benefits if the proper road and street access is provided. Its location along a railroad corridor (including the planned Texas Central high-speed rail alignment) and at the point of a major Metropolitan Transit Authority Park-and-Ride facility provides opportunities for enhancing transit service. Transit-supportive development and a walkable urban design environment create conditions to facilitate additional ridership for METRO going towards central Houston that might have instead located further toward the fringe of the region, beyond the reach of practical transit access. Having a large office center in this location could also encourage "reverse commuting" via transit from Houston's urban core, where many younger employees are likely to live. A potential project for a

reversible "L-ramp" to provide direct access from the US 290 HOV/HOT lane to the Cypress Park and Ride facility is already in the Houston-Galveston Area Council's Fiscal Years 2019-2022 Transportation Improvement Program (TIP).

Other Research Supports the Findings

Observations from the similar case study walkable mixed-use suburban developments and review of the academic / institutional research lead to several key points relevant to the market projections for the Business Center at Towne Lake.

1. The land use quantities being envisioned for Business Center are well within reasonable quantities based on the comparable developments. The Woodlands and CityLine feature office space well beyond the scale being contemplated for Business Center, though those projects were in established office corridors. It is reasonable to be conservative about Business Center since the 290 corridor has not yet established itself as a major location for Class A office tenants.
2. The academic research on the relationship between walkable mixed-use development and commercial market performance indicates that this kind of project design is in demand. The enhanced competitiveness through quality design will help lease rates, occupancy, and absorption, thereby further reassuring the quantities of commercial uses being considered at Business Center.
3. In particular, a master plan for a walkable mixed-use center should help attract a large corporate anchor. This is a repeated theme of the office-driven comparable developments (in contrast, office space is a secondary use in Southlake). A particularly salient observation is that ABS and HP, which underwent relocations during a weak period in the Houston office market when many opportunities existed in the region to lease in high-quality buildings with landlord concessions, chose instead to build new buildings in CityPlace in Springwoods Village. This is strong evidence of the appeal of environments such as that being planned for Business Center for these types of occupants. Having high-quality transit service to the project should further enhance this appeal, if the experience of CityLine and its State Farm investment is any indication.
4. Whether or not there is transit service, the need for at least one high-quality thoroughfare intersection and access with a regional highway is apparent. This was common to all other example developments. Office-focused walkable mixed-use centers will likely have a broader commute shed than the market area served by the retail components, and highway access to key labor markets is a must. Fortunately for Business Center, an efficient intersection with 290 will address this issue, allowing access to labor supply along not only US 290 but also the fast-growing areas along the Grand Parkway to the north / northeast and south / southeast.

Value Creation and Tax Generation

CDS' estimate of assessed value for the proposed development program, not including the transit-oriented development (TOD) area, totals $307.5 million for the commercial and multifamily components. High-value commercial uses in the TOD portion would create additional value. By comparison, an all-single-family scenario would generate an estimated $278 million in value, reduced by homestead and other exemptions.

Additionally, the retail / restaurant space in the commercial core would generate in excess of $40 million annually in taxable sales.

METHODOLOGY

Case Study Sites

Key elements of this analysis are the case studies of Business Center-style developments that are similar in concept and potential land use to the anticipated Business Center for Towne Lake. For each case study, CDS obtained market data for each development in each of the five considered land uses. A market area was then established for each development, as well for the Towne Lake Business Center site. Data on each of the five land uses was obtained within these market area boundaries as well. Each case study was used to determine a different scenario for development of the Towne Lake Business Center site.

Case studies were performed for the following developments:

The Town Center in The Woodlands

Located along Interstate 45 in The Woodlands, the Town Center in The Woodlands covers 1,000 acres and includes retail, office, multifamily, light industrial, and hotel projects. Development in the Town Center began with the opening of The Woodlands Mall in 1994 and has continued over the past two decades. The mall was expanded in 1994 and the signature 32-story Allison Tower, headquarters for Anadarko Petroleum, was completed in 2002. A second Anadarko building, the 31-story Hackett Tower, was completed in 2014.

Figure 2: Town Center in The Woodlands Site

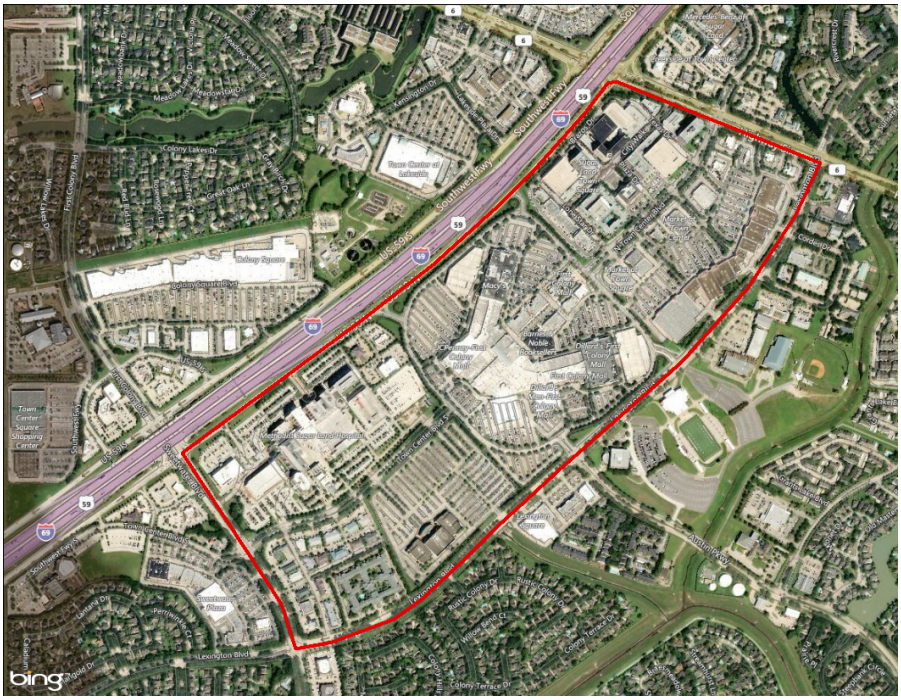
Source: Google Earth

The commercial base of The Woodlands Town Center, combined with the commuter traffic of The Woodlands residents, generates enough travel demand to justify dedicated egress / ingress ramps to and from I-45 toward Houston. Travelers from Conroe can also utilize the Lake Woodlands Drive exit from I-45. In both cases, the ramping systems and overpasses permit traffic bound for Town Center to avoid signalized intersections at the frontage roads.

Sugar Land Town Square

Developed as part of a public-private partnership by Planned Community Developers and the City of Sugar Land beginning in 2003, the Sugar Land Town Square was the culmination of the commercial and retail district developed in Sugar Land around the intersection of US 59 and SH 6. The development is centered on the Sugar Land city hall. Adjacent to the Town Square development is the First Colony Mall, constructed in 1996 and expanded in 2006, and millions of additional square feet of commercial space is located nearby.

Figure 3: Sugar Land Town Square Site



Source: Google Earth

This case study covers more than just the Sugar Land Town Square proper. In addition to the walkable Town Square development that was begun in 2003 it includes all the property bounded by US 59, SH 6, Lexington Blvd., and Sweetwater Blvd. This expanded site includes the First Colony Mall, Market at Town Center shopping center, and the Methodist Hospital – Sugar Land in addition to the Town Square site, an area that makes up the largest part of what is collectively considered to be Sugar Land's "Town Center". It should be noted that parts of the development are not necessarily laid out in an integrated walkable design, but are better described as a mix of destination uses each developed in an isolated fashion.

For regional access, Sugar Land Town Square relies on the sprawling intersection of I-69 (US 59) and SH 6. While SH 6 is not a limited-access highway, it still helps substantially extend the development's market area to the north and southeast. US 59 offers bi-directional egress and ingress for SH 6, and the intersection is large enough to feature triple-left turns onto SH 6 from the frontage roads. In addition, the northbound frontage road has multiple access points directly into the site.

Southlake Town Square

Between SH 114 and E. Southlake Blvd. in Southlake, TX, located on the north side of the Dallas-Fort Worth metropolitan area, is the Southlake Town Square. The Town Square was opened in 1999 with a second phase completed in 2006. The development covers 130 acres and is most heavily focused on retail, dining, and entertainment. Like the Sugar Land Town Square, the Southlake development is centered on the Southlake city hall.

SH 114 provides regional access to Southlake Town Square. Three major thoroughfare exits and full signalized intersections serve the development, as well as entrances directly from the eastbound frontage road.

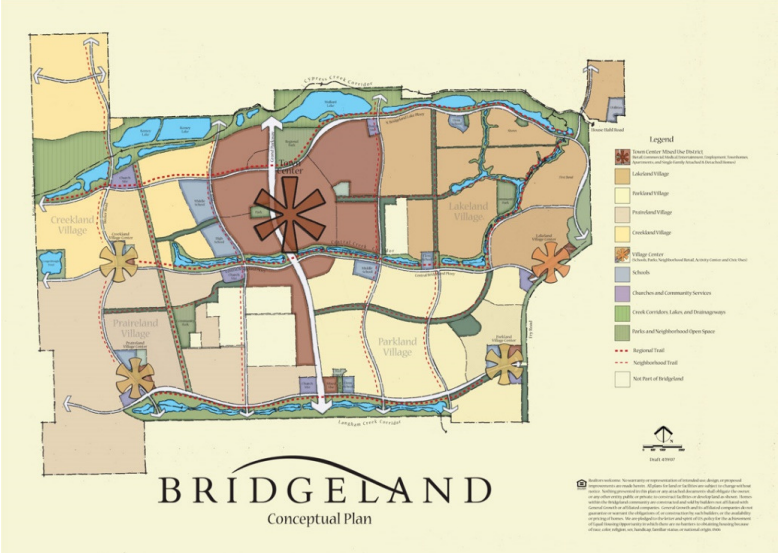
Figure 4: Southlake Town Square Site

Source: Google Earth

Proposed Bridgeland Town Center

With no existing development to consider, the Bridgeland Town Center site was not examined as a case study as the previous three developments were, but was instead analyzed at the market area level. A total of 800 acres in Bridgeland have been set aside by developer Howard Hughes Corporation for the Town Center, straddling both sides of SH 99/Grand Parkway at the intersection with Bridgeland Creek Parkway. No detailed land use plans for the site have been announced, but it has been described as a "downtown area", a "hub for dining, shopping, and entertainment", and a development "modeled after The Woodlands Town Center" (also a Howard Hughes-managed development).

Figure 5: Planned Bridgeland Town Center Site



Source: Washington University in St. Louis

Sitting less than 5 miles to the west of Towne Lake, the Bridgeland site could be considered direct competition for the Towne Lake Business Center in the northwest Houston region. It was analyzed in this project to illustrate the value of its location versus that of the Towne Lake site.

Future Case Study Site: CityPlace, Springwoods Village

Similar to Bridgeland Town Center, the CityPlace component of Springwoods Village on I-45 at the Grand Parkway in northern Harris County was not included in the land use analysis, but needs to be acknowledged as a comparable development that is currently underway. Because so many of its commercial land uses have yet to be built, it was deemed to early to analyze in such a way.

CityPlace is the 60-acre mixed-use walkable commercial core of the Springwoods Village masterplanned community. It is a short walk across Energy Drive from the new Southwestern Energy and upcoming HP Plaza offices. It features fully signalized highway overpass intersections and exits for Springwoods Village Parkway (from I-45 and the Hardy Toll Road) and Holzwarth Road (from the Grand Parkway), plus an intersection and overpass (without a dedicated highway exit) on the Grand Parkway for Energy Drive.

This report contains more information on CityPlace in the Supporting Research and Observations section.

Figure 6: CityPlace Springwoods Village Site Plan

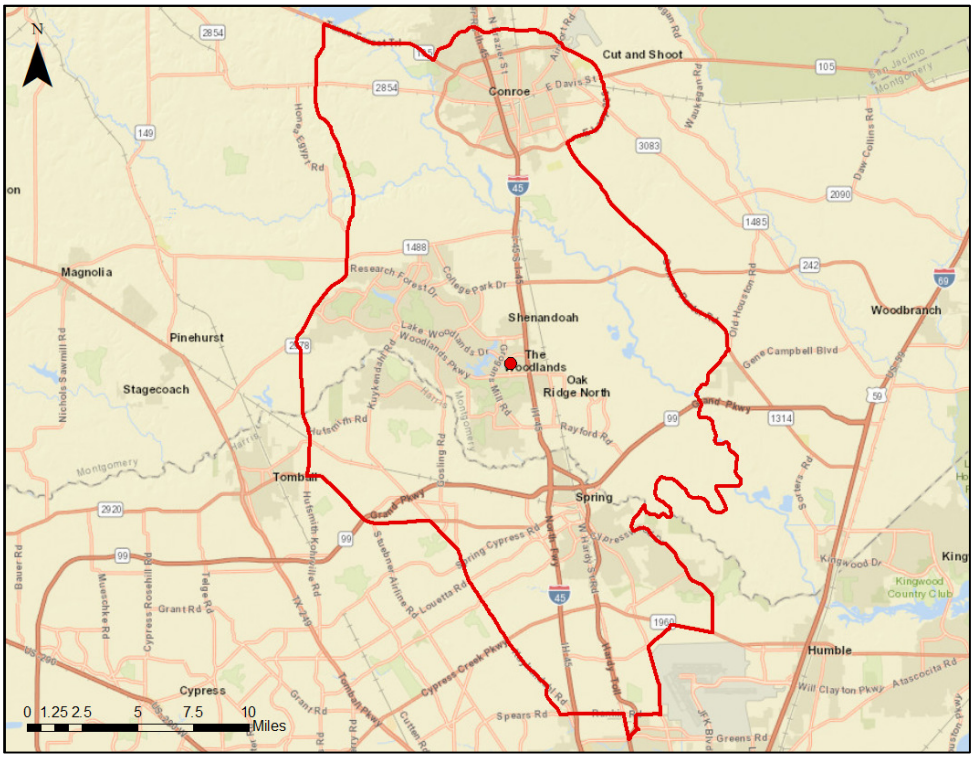
Source: Patrinely Group

Market Areas and Forecasts

For each case study site, as well as for the proposed Towne Lake and Bridgeland development sites, CDS determined a market area in order to understand the impact of these Towne Centre-style developments in their region. These market areas are formed from an aggregation of Traffic Analysis Zones (TAZ), established by regional metropolitan planning organizations (MPO) for forecasting and road planning purposes. The aggregations were chosen by CDS based on a calculated 20-minute drive time from the subject site (considering moderate traffic). The calculation was done using a program called Freeway, an element of Tetrad's PCensus for ArcView program. Additional factors in determining these market areas include the potential for new roads or road capacity to expand the 20-minute drive times, roads and intersections that may be barriers to or facilitators of travel but did not appear to be considered by the drive time calculation, and what CDS understands would generally be considered a part of the region in question by consumers. Maps of each of the market areas can be seen on the following pages.

Figure 7: Towne Lake Market Area

Figure 8: The Woodlands Market Area



Source: CDS, ESRI

Figure 9: Sugar Land Market Area

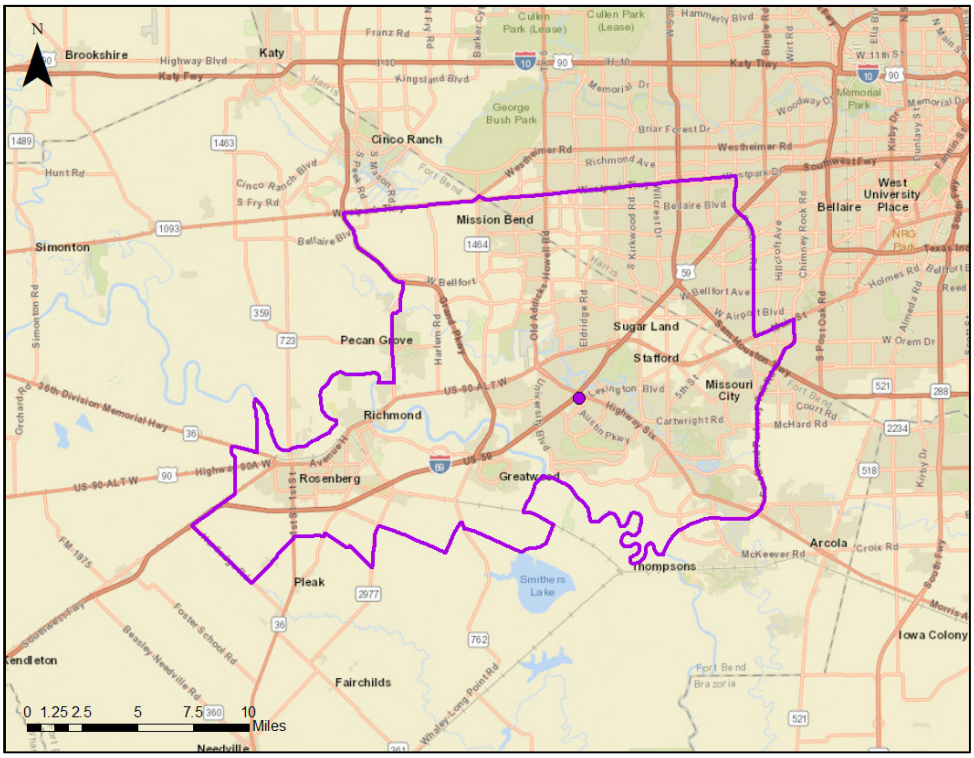
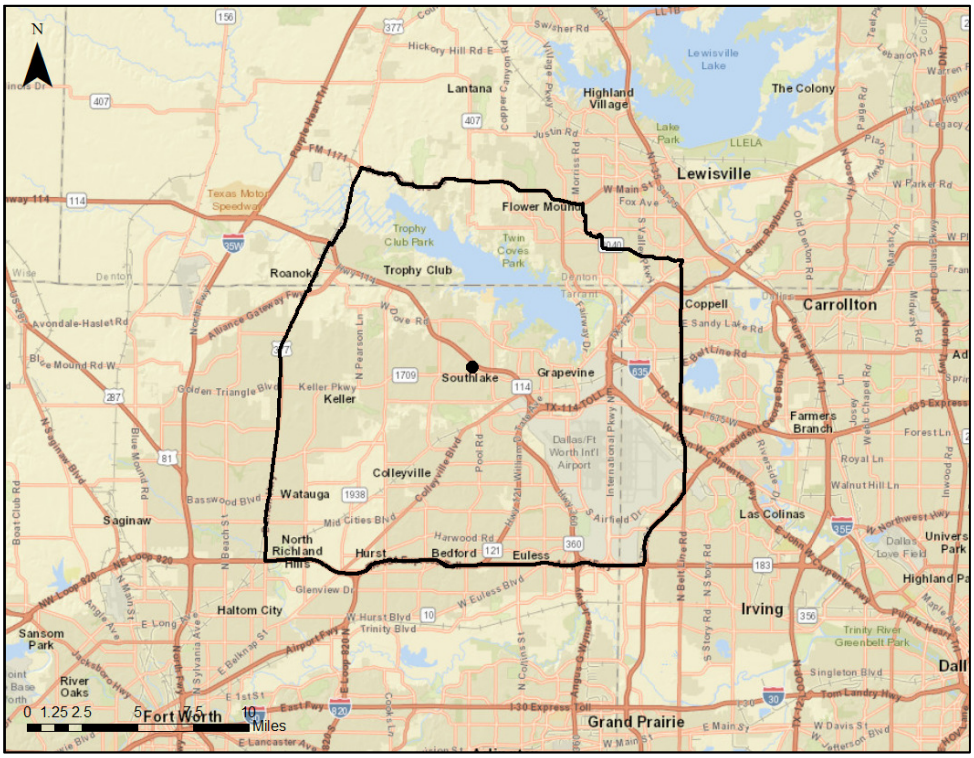
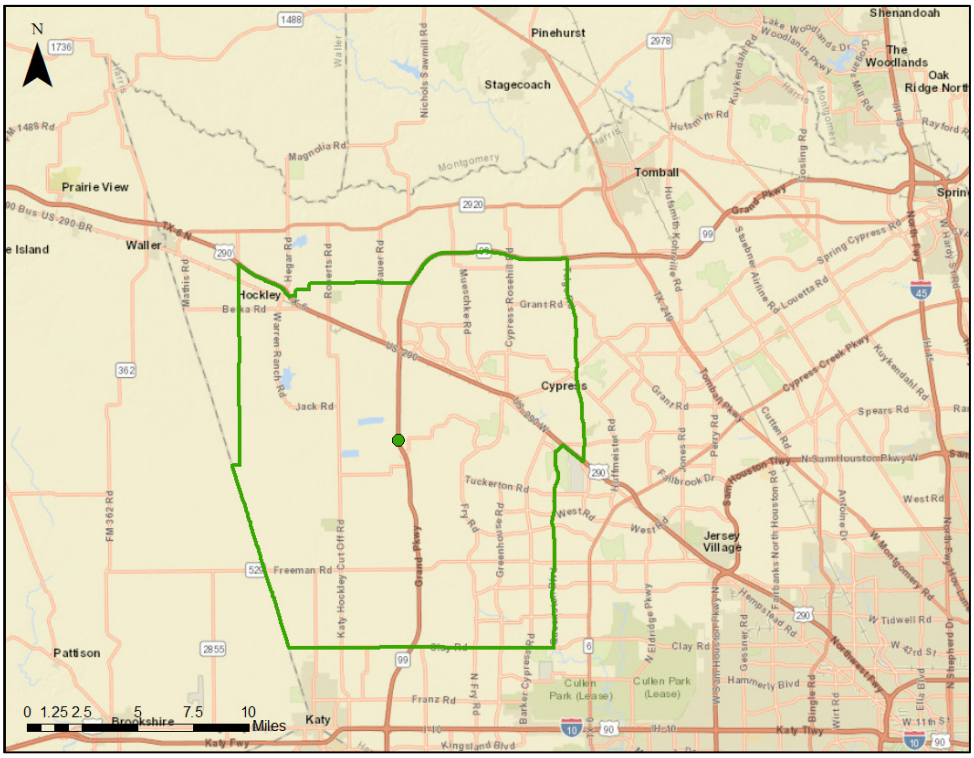


Figure 10: Southlake Market Area



Source: CDS, ESRI

Figure 11: Bridgeland Market Area



Source: CDS, ESRI

The reason for basing these market areas on TAZs is so that the regional forecasts in these geographies can be used in the demand analysis. For the Southlake Town Square market area, TAZ geographies and forecast data from the North Central Texas Council Of Governments (NCTCOG) 2015 forecast were used. This is the same forecast used in the previous Towne Lake Business Center study performed by CDS as it had not been updated and made available at the time of this report. For the remaining projects, all in the Houston region, the TAZ geography from the Houston-Galveston Area Council (H-GAC) was used. The forecast used in these zones is the H-GAC annual regional forecast issued in December 2017. The previous study used CDS' own regional forecast that was issued in July 2016. The CDS forecast has subsequently been updated (November 2017) and was considered for use in this analysis but H-GAC's most recent forecast was ultimately chosen. Population and employment data from both forecasts is provided in 5-year increments from 2010 through 2045. For the purposes of this analysis, data from 2015 through 2035 is going to be used.

Towne Lake-Bridgeland Market Area Overlap

Due to the close proximity of the subject sites, the market areas for Towne Lake and Bridgeland overlap. The forecast data in this overlap area is provided in the market area data tables on the following page. Also provided is a set of adjusted forecast data for these two market areas. To arrive at these adjusted forecast totals, the TAZs located in the overlap area are split between Towne Lake and Bridgeland based on how close they are to the proposed subject site. The split data from the TAZs in the overlap are then added back to the data from the remainder of their respective project's market area. While neither of these projects could be expected to exclusively capture demand from a TAZ in this overlap area, this adjustment process represents a reasonable scenario of how demand could be split between competing projects. It is the opinion of CDS, based on examining both of the proposed locations in question, that Towne Lake is better situated for a Business Center-style development in the near future due to access and proximity to existing population.

Figure 12: Market Area Overlap – Towne Lake and Bridgeland

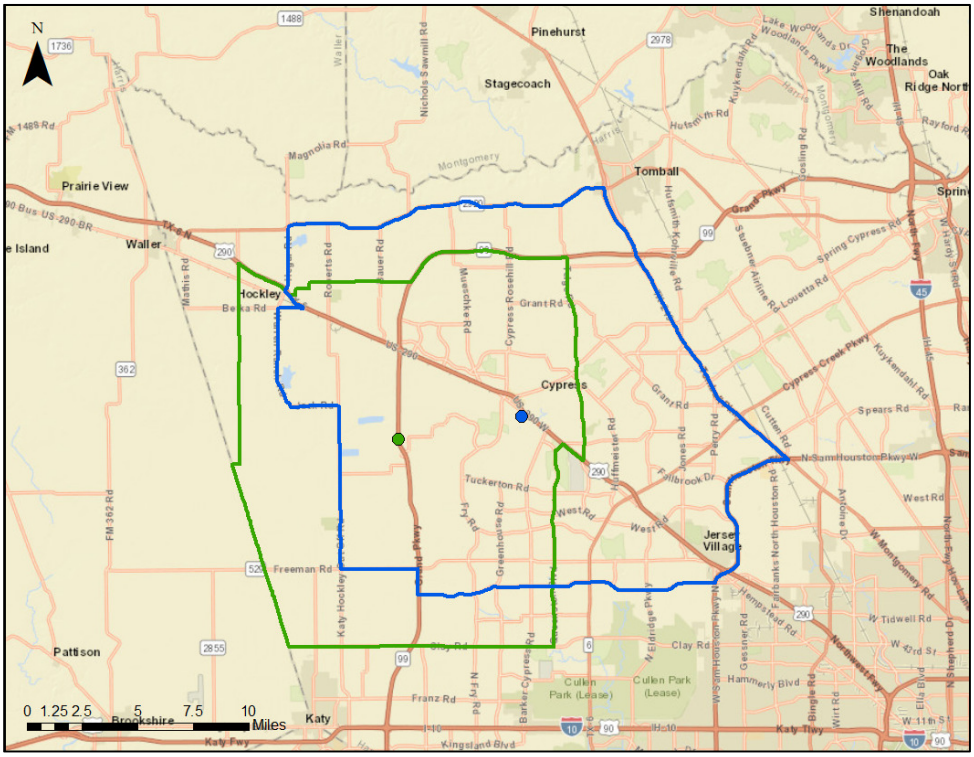


Table 1: Market Area Forecasts - Population

	Population				
Site	**2015**	**2020**	**2025**	**2030**	**2035**
Towne Lake	**447,844**	**535,777**	**619,916**	**674,025**	**715,253**
Bridgeland	231,589	312,452	389,554	446,896	477,272
Overlap Area	*175,692*	*241,535*	*310,242*	*351,789*	*372,870*
Towne Lake Adjusted	***314,905***	***384,362***	***440,236***	***475,064***	***511,514***
Bridgeland Adjusted	*188,836*	*222,332*	*258,992*	*294,068*	*308,141*
The Woodlands	502,826	600,296	689,549	777,770	826,730
Sugar Land	720,595	746,617	788,081	831,827	888,693
Southlake	394,703	437,774	481,958	526,853	572,312

Source: H-GAC Forecast December 2017 and NCTCOG Forecast May 2015

Table 2: Market Area Forecasts - Households

	Households				
Site	**2015**	**2020**	**2025**	**2030**	**2035**
Towne Lake	**141,715**	**169,431**	**196,810**	**219,099**	**236,539**
Bridgeland	64,972	88,984	112,474	132,853	144,084
Overlap Area	*49,898*	*70,039*	*90,935*	*106,728*	*114,500*
Towne Lake Adjusted	***103,546***	***125,254***	***144,615***	***160,263***	***174,740***
Bridgeland Adjusted	*53,243*	*63,122*	*73,734*	*84,961*	*91,383*
The Woodlands	177,941	214,891	250,214	282,341	306,699
Sugar Land	250,046	269,811	283,830	299,949	325,965
Southlake	143,060	158,106	173,477	189,021	204,676

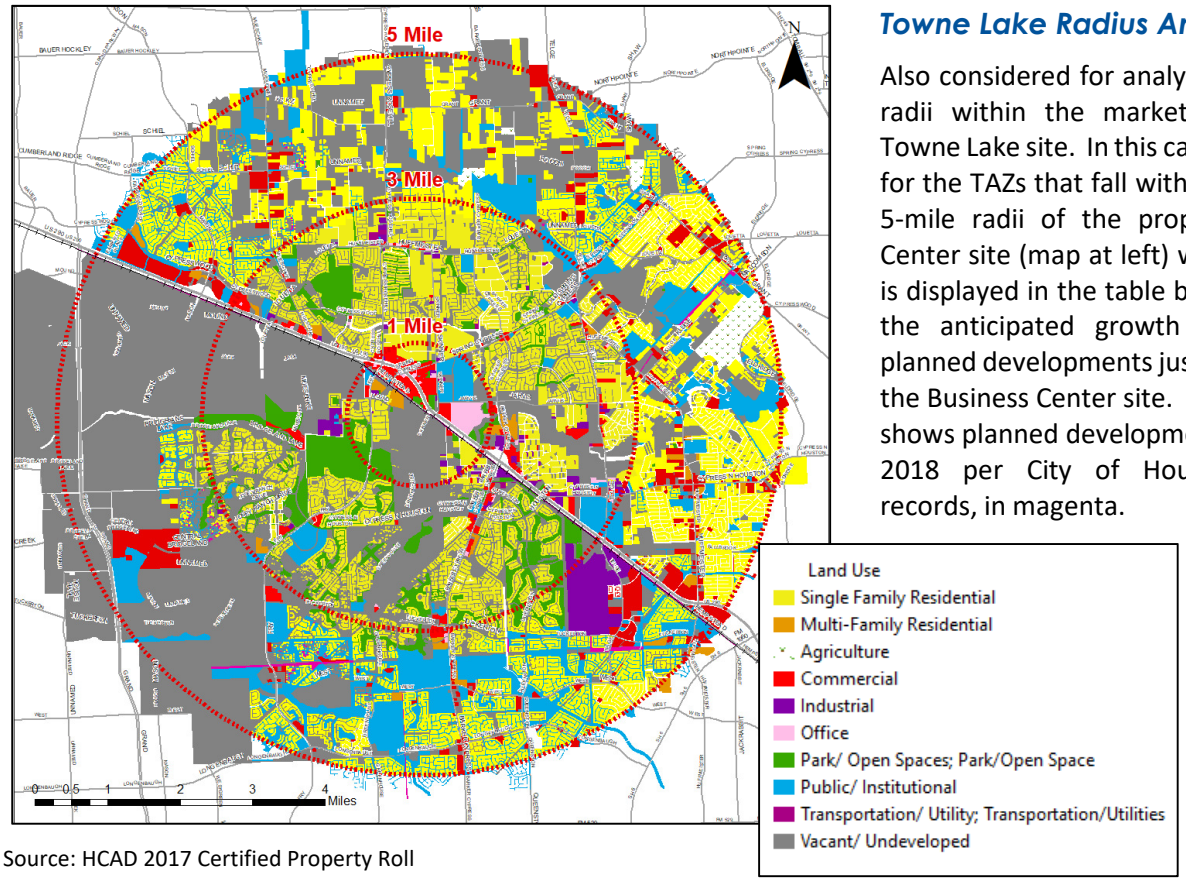
Source: H-GAC Forecast December 2017 and NCTCOG Forecast May 2015

Table 3: Market Area Forecasts - Employment

	Employment				
Site	**2015**	**2020**	**2025**	**2030**	**2035**
Towne Lake	**147,574**	**164,302**	**181,071**	**193,224**	**210,836**
Bridgeland	37,010	46,693	57,564	62,083	66,369
Overlap Area	*31,043*	*39,475*	*48,926*	*52,771*	*56,887*
Towne Lake Adjusted	***120,348***	***134,864***	***147,544***	***158,848***	***175,898***
Bridgeland Adjusted	*33,193*	*36,656*	*42,165*	*43,688*	*44,420*
The Woodlands	221,765	262,427	284,535	299,999	308,328
Sugar Land	273,003	295,838	317,724	327,344	334,905
Southlake	301,477	326,541	352,577	377,623	402,568

Source: H-GAC Forecast December 2017 and NCTCOG Forecast May 2015

Figure 13: Towne Lake Radii Map with Land Use



Source: HCAD 2017 Certified Property Roll

Towne Lake Radius Analysis

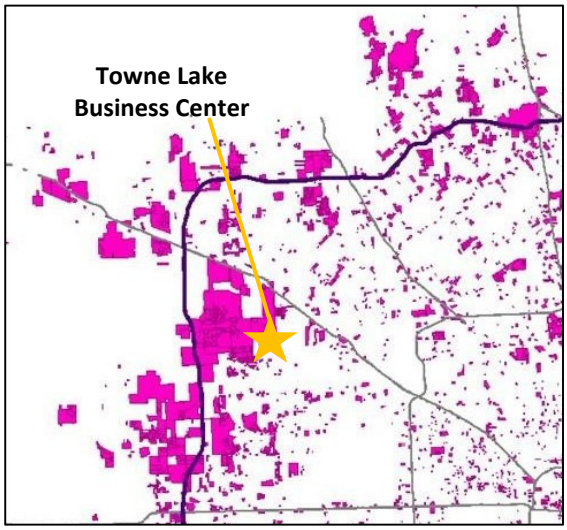
Also considered for analysis was a set of radii within the market area for the Towne Lake site. In this case, the forecast for the TAZs that fall within the 1, 3, and 5-mile radii of the proposed Business Center site (map at left) was totaled and is displayed in the table below. Much of the anticipated growth will occur in planned developments just to the west of the Business Center site. The map below shows planned development as of Spring 2018 per City of Houston planning records, in magenta.

Table 4: Market Area Forecasts – Towne Lake Radii

	Population				
Radius	**2015**	**2020**	**2025**	**2030**	**2035**
1 Mile	7,450	10,191	14,055	16,855	15,821
3 Mile	67,268	82,249	97,720	112,338	114,374
5 Mile	161,046	212,322	261,997	286,337	297,208
	Households				
Radius	**2015**	**2020**	**2025**	**2030**	**2035**
1 Mile	2,162	2,988	4,660	5,501	5,501
3 Mile	20,108	24,473	29,525	34,280	35,921
5 Mile	49,332	65,323	80,751	89,919	94,237
	Employment				
Radius	**2015**	**2020**	**2025**	**2030**	**2035**
1 Mile	7,131	7,685	9,526	9,785	9,863
3 Mile	18,018	19,366	22,458	22,942	23,041
5 Mile	37,605	43,108	50,001	51,924	53,131

Note: H-GAC forecasts do not assume transit-oriented development along US 290 as shown in the plan on Page 1.
Source: H-GAC Forecast December 2017

Figure 14: Planned Developments, Spring 2018



Source: City of Houston Planning Department

Market Area Demographics

The demographics of both the Towne Lake Business Center adjusted and unadjusted market areas are comparable with the other case study market areas. They are understandably similar to the Bridgeland market area as well, as the areas overlap significantly. In most demographics indicating wealth and buying power, the market area stands in the middle of the compared market areas. Differences between the market areas in these demographics are narrow across the board. The population in the Towne Lake market area is the second youngest and second best-educated among the compared areas. It also contains the second-highest share of owner-occupied housing and the second-youngest housing stock. With considerable land still to develop, it has comparable population to The Woodlands and a greater population than Southlake, both market areas with more limited space available for development. Three of these compared market areas (The Woodlands, Sugar Land, and Southlake), have successful "town center" style developments at the present along with a similar demographic profile to both the Towne Lake and Towne Lake adjusted market areas. This should bolster the case for the Towne Lake Business Center's potential.

Table 5: Market Area Demographic Summary – 2018 Estimates

Demographic	Towne Lake	Town Lake Adjusted	Bridgeland	Bridgeland Adjusted	The Woodlands	Sugar Land	Southlake
Area (in Square Miles)*	217.0	155.1	179.9	128.5	285.1	219.9	187.3
Household Population	473,859	431,267	244,967	96,215	537,198	779,770	396,388
Households	155,834	143,437	71,584	27,628	189,879	255,793	148,828
Median Age	34.49	34.77	32.18	31.50	35.12	35.41	39.84
Bachelor's Degree or Higher	38.7%	39.0%	38.1%	31.0%	36.5%	33.8%	47.5%
Median HH Income	$87,958	$86,549	$97,177	$90,407	$79,121	$67,449	$98,175
Households with Income over $75,000	57.1%	56.3%	63.1%	60.1%	52.1%	45.1%	61.1%
Family Households	77.4%	76.7%	84.4%	85.2%	73.9%	77.6%	73.0%
Households with Children	57.3%	56.6%	63.2%	62.7%	53.3%	53.2%	50.9%
Owner-occupied Housing	73.7%	72.4%	85.3%	85.3%	68.7%	64.6%	70.2%
Single Family Housing	80.5%	78.9%	96.1%	98.6%	77.0%	70.8%	77.3%
Median Home Value	$196,599	$196,858	$191,317	$167,308	$201,140	$189,602	$285,514
Median Year Housing Built	2002	2001	2005	2005	2001	1991	1992
Consumer Buying Power (per household)**	$72,574	$72,195	$75,916	$70,100	$72,699	$66,384	$83,983

Source: PCensus for Arcview, 2018 estimates

Market Area and Site Property Data

CDS researched the commercial property inventories in each of the market areas as well as determined the inventories of each of the case study sites in order to perform this analysis.

Proposed commercial land use figures for the Towne Lake Business Center were incorporated into this updated analysis for comparison with the case study sites. These proposed figures include 100,000 sf of retail, 800,000 sf of office, 0 sf of industrial, 550 multifamily rental units, and 300 hotel keys. Other land uses that may have a presence in the Business Center, including condominiums, hospitals, and single-family homes, are not factored into this analysis.

Table 6: Towne Lake Business Center Proposed Commercial Development

Land Use	Square Feet/Units
Retail	100,000
Office	800,000
Industrial	0
Multifamily	550
Hotel	300

Note: Above development program requires US 290 improved underpass intersection, and does not assume transit-oriented development. Lack of an underpass intersection would switch this program to primarily single family residential.

Table 7: Market Area Commercial Property Summary

	Retail		Office		Industrial		Multifamily		Hotel	
Site	Prop	SF	Prop	SF	Prop	SF	Prop	Units	Prop	Rooms
Towne Lake	**1,383**	**22,938,687**	**366**	**7,725,397**	**853**	**31,061,335**	**116**	**31,573**	**80**	**7,051**
Bridgeland	472	8,304,444	72	711,498	135	3,474,587	22	5,383	9	756
The Woodlands	2,047	33,262,021	1,002	26,519,838	965	23,061,835	225	52,550	88	7,924
Sugar Land	2,339	44,420,057	711	21,782,598	1,064	37,355,976	326	71,865	82	6,549
Southlake	464	24,270,283	384	34,437,392	560	75,156,644	231	56,959	92	14,516

Source: CoStar, Enriched Data, and Source Strategies for hotel

Table 8: Case Study Site Commercial Property Summary

	Retail		Office		Industrial		Multifamily		Hotel	
Site	Prop	SF	Prop	SF	Prop	SF	Prop	Units	Prop	Rooms
Towne Lake Proposed	**N/A**	**100,000**	**N/A**	**800,000**	**N/A**	**0**	**N/A**	**550**	**N/A**	**300**
The Woodlands	18	2,149,307	39	4,378,023	3	205,321	4	1,157	7	956
Sugar Land	7	2,105,863	12	3,988,994	0	0	1	10	1	300
Southlake	15	489,693	3	111,208	1	21,187	0	0	1	248

Source: CoStar, Enriched Data, and Source Strategies for hotel

Site Shares and Ratios

Table 9 provides the estimates of the site shares calculated for each of the land uses covered by the proposed Towne Lake Business Center (per the Page 1 site plan that requires an improved underpass intersection at US 290) and the case studies. These shares represent a proper comparison of the Towne Lake Business Center proposed development with the case study projects. The proposed Business Center land use figures are not out of line when compared with the case studies, when considering their share of the current market area's commercial totals.

Table 9: Case Study Site Shares of Market Area Totals

Site	Retail	Office	Industrial	Multifamily	Hotel
Towne Lake Proposed	**0.4%**	**10.4%**	**0.0%**	**1.7%**	**4.3%**
The Woodlands	13.5%	16.4%	0.8%	2.1%	18.4%
Sugar Land	10.3%	19.0%	0.0%	0.0%	5.1%
Southlake	2.0%	0.3%	0.0%	0.0%	1.8%

Source: CoStar, Enriched Data, and Source Strategies for hotel

Table 10 below shows the calculation of a set of ratios based on current reported commercial space and the 2015 population and employment figures from the forecasts was also calculated. These ratios are used to calculate expected increases in commercial space within the market areas based on the 2015-2035 population and employment forecasts.

Retail, office, and industrial ratios are calculated by dividing the total square footage in the market area by the 2015 employment estimate. Retail growth, unlike office and industrial growth, is fueled directly by population and households, and thus could be calculated using households. However, both the H-GAC and NCTCOG forecast employment growth to account for retail that is built to accommodate household growth. The nature of retail growth is understood by the forecasts and thus considered in these ratio calculations.

For multifamily, the ratio is 2015 households divided by the number of multifamily units. The hotel ratio is similar to the multifamily ratio, with 2015 employment used instead of households.

Table 10: Ratios of Commercial Space to Employment/Population

2015 Ratios	SF/Emp	SF/Emp	SF/Emp	HH/Unit	Emp/Room
	Retail	Office	Industrial	Multifamily	Hotel
Site	SF	SF	SF	Units	Rooms
Towne Lake	**155.4**	**52.3**	**210.5**	**14.2**	**20.9**
Bridgeland	224.4	19.2	93.9	43.0	49.0
The Woodlands	150.0	119.6	104.0	9.6	28.0
Sugar Land	162.7	79.8	136.8	10.0	41.7
Southlake	80.5	114.2	249.3	6.9	20.8

ANALYSIS

Site Share and the Forecast

While the site shares for the proposed Town Lake Business Center are in line with those of the case study sites, the Business Center will not be completed in the present-day market environment. Continued growth in the Towne Lake market area will almost definitely increase the total commercial space in the area and will make the site's shares of commercial space increasingly conservative as the years go forward. This brings them further in line with the case studies, if not lower in share of the market area totals.

Forecast Market Area Totals Calculation

The process for forecasting future market area commercial property totals for the Towne Lake market area is detailed in the figure below. The results of this forecast and the new site share calculations are on the following page. These figures can be compared to the present-day site shares of the case study developments as those developments are mature in the present-day environment as the Business Center is expected to be mature in the environment of future years.

Table 11: The Forecast Market Area Totals Calculation Process – Example

1. Current Market Area Commercial Property (see Table 7)

Site	Retail	Office	Industrial	Multifamily	Hotel
Subject	10,000,000	3,000,000	6,000,000	25,000	3,000

2. Market Area Forecast (see Table 3)

	Households			Employment		
Site	2015	2025	2035	2015	2025	2035
Subject	95,000	120,000	150,000	75,000	94,000	117,000

3. Market Area Ratios (see Table 10)

Site	Retail	Office	Industrial	Multifamily	Hotel
Subject	133.3	40.0	80.0	3.8	25.0

4. Market Area Totals – 2035 (see Table 12)

Site	Retail	Office	Industrial	Multifamily	Hotel
Subject	15,600,000	4,680,000	9,360,000	39,474	4,680

1. The process begins with the commercial property inventories for the market area of the subject site.

2. The forecast for the market area of the subject site will be used in the next two steps in the process.

3. The subject site's market area ratios are calculated as follows:

- Retail, Office, and Industrial are SF of space divided by 2015 jobs.
- Multifamily is 2015 households divided by units
- Hotel is 2015 jobs divided by rooms

4. The future year market area totals are calculated by applying the future year market area forecast to the ratios calculated in the previous step.

Example Summary: A site's market area currently contains 3,000,000 SF of office space (see Table 7) and 75,000 total employees (see Table 3). Dividing the SF by the number of employees produces a ratio of 40.0 SF of office per employee (see Table 10). The market area forecast predicts there will be 117,000 employees in a future year (see Table 3). Multiplying the forecast 117,000 employees by the 40.0 SF of office per employee ratio produces a forecast of 4,680,000 SF of office space for the future year (see Table 12).

Towne Lake Business Center Market Share Analysis

Table 12: Forecast SF and Unit Totals for Towne Lake Market Area

See Figure 7 for Towne Lake Market Area

Site	Retail	Office	Industrial	Multifamily	Hotel
Current	22,938,687	7,725,397	31,061,335	31,573	7,051
	Forecast				
2025	28,145,412	9,478,942	38,111,774	43,704	8,651
2030	30,034,456	10,115,143	40,669,734	47,519	9,232
2035	32,772,040	11,037,119	44,376,703	50,425	10,074
	Adjusted Forecast				
2025	22,934,024	7,723,827	31,055,021	31,037	7,050
2030	24,691,101	8,315,583	33,434,283	33,492	7,590
2035	27,341,328	9,208,139	37,022,963	36,062	8,404

Table 13: Forecast Site Shares for Towne Lake Market Area

Shares based on proposed Towne Lake Business Center commercial totals in Table 6

Site	Retail	Office	Industrial	Multifamily	Hotel
Current	0.4%	10.4%	0.0%	1.7%	4.3%
	Forecast				
2025	0.4%	8.4%	0.0%	1.3%	3.5%
2030	0.3%	7.9%	0.0%	1.2%	3.2%
2035	0.3%	7.2%	0.0%	1.1%	3.0%
	Adjusted Forecast				
2025	0.4%	10.4%	0.0%	1.8%	4.3%
2030	0.4%	9.6%	0.0%	1.6%	4.0%
2035	0.4%	8.7%	0.0%	1.5%	3.6%

Table 14: Case Study Site Shares of Market Area Totals for Comparison

Site	Retail	Office	Industrial	Multifamily	Hotel
The Woodlands	13.5%	16.4%	0.8%	2.1%	18.4%
Sugar Land	10.3%	19.0%	0.0%	0.0%	5.1%
Southlake	2.0%	0.3%	0.0%	0.0%	1.8%

Assumptions

The preceding analysis assumes that growth will facilitate demand as all market areas continue to experience healthy occupancies and rents relative to the regional market, something that all presently and historically have done. The use of present-day ratios to calculate future demand assumes that the commercial land use make up of the market area will be similar to what it is today into the future; CDS is cognizant that this may not strictly hold over time.

All private land uses exist in a dynamic world, so assumptions of typical configurations, sizes, and functions of commercial space are always evolving. The changes in the world of retail are particularly notable at the present time. While CDS' findings in this report reflect current practices in retail development, it is important to note that these may be changing significantly over the coming years as online shopping, discount retailers, and the rise of "experiential" establishments drive change in this land use sector.

Near-term economic pressures, particularly those related to low oil and gas prices, are not assumed to last well beyond 2020 and robust long-term regional growth is assumed in both forecasts used. The CDS forecast does specifically assume that the oil and gas-related economic slowdown in the Houston region will affect population and employment growth through 2020 and that growth will return to historical levels in the years thereafter.

Site Share Analysis Conclusions

CDS finds that the proposed land use figures for the Towne Lake Business Center are well within the range of the site share that such a development could be expected to capture. The proposed figures are supportable in the present-day, even before additional population and jobs locate in the area in the coming years. This expected growth will only make the site shares of the proposed land use mix increasingly conservative as the years move forward. It should be stated again that *these presumed site shares have an improved underpass intersection at US 290 as a prerequisite; otherwise, the development program will be primarily single family residential.*

The most aggressive site share seen in the proposed figures is in the office category with 800,000 SF which would make it the category to potentially generate the most concern. This, however, is not out of line with the office development seen in the Woodlands and in Sugar Land. For further analysis of the Towne Lake site's development potential and comparison with the case study areas, see Table 15 below for scenarios applying the case study site market shares to the Towne Lake market area 2035 demand forecast. Attracting an anchor tenant to the Towne Lake Business Center will make the development further comparable with The Woodlands and Sugar Land.

Table 15: Towne Lake Site Development Potential - Case Study Scenarios

Site	Retail	Office	Industrial	Multifamily	Hotel
	Based on 2035 Forecast				
The Woodlands	4,424,225	1,810,088	355,014	1,059	1,854
Sugar Land	3,375,520	2,097,053	0	0	514
Southlake	655,441	33,111	0	0	181
Case Study Averages	2,818,395	1,313,417	118,338	353	850
	Based on 2035 Adjusted Forecast				
The Woodlands	3,691,079	1,510,135	296,184	757	1,546
Sugar Land	2,816,157	1,749,546	0	0	429
Southlake	546,827	27,624	0	0	151
Case Study Averages	2,351,354	1,095,769	98,728	252	709

SUPPORTING RESEARCH AND OBSERVATIONS

CDS sought out additional information to indicate whether the projected land use quantities at Towne Lake Business Center were realistic, given the general lack of modern high-value office product and large corporate anchor users to date in the 290 corridor and greater Cypress area.

The key distinguishing features of the Business Center are that it would have a walkable mixed-use format and the potential in this design concept to accommodate transit-oriented development (TOD) if high-speed rail and / or commuter transit service is provided along the 290 corridor. Recent research on walkable mixed-use centers and observation of other similar developments in Texas do tend to support the conclusions of the CDS quantitative market analysis.

Academic and Institutional Research

CDS reviewed two research papers that examine the potential for increased market appeal for commercial and multifamily uses in a walkable mixed-use center format.

The Walkability Premium in Commercial Real Estate Investments

Gary Pivo (University of Arizona, Urban Planning Program and Responsible Property Investment Center) and Jeffrey D. Fisher (Indiana University, Kelly School of Business and Benecki Center for Real Estate Studies), *Real Estate Economics*, March 2011.

The authors of this paper used a measurement called "Walk Score" to quantify the walkability of particular districts and neighborhoods. Walk Score is a private sector rating service, now owned by the real estate data platform Redfin, which attempts to compute the distance to and range of services and amenities within a given location that are accessible via walking. Walk Score ranges from 0 to 100, with 100 being the highest level of pedestrian accessibility. Findings included:

- All else being equal, the authors found that an office property with a Walk Score of 80 was worth 54 percent more per square foot than an office with a 20 Walk Score. For retail and apartment properties, 80 Walk Score properties were worth 54 percent and 6 percent more, respectively. They found no walkability premium for industrial properties.
- Their research also found that walkability had a relatively small positive effect on apartment properties. The authors suspect the reason they did not see this effect in the other uses was that the noise, traffic, security and other disamenities from nonresidential uses may have more disutility for apartment dwellers than for the users of the other property types. It appears, however, that any disamenity effects did not fully offset the positive proximity effects from walkability on apartments. On net, walkability was associated with higher apartment values.
- Comparing properties with 80 and 20 Walk Scores, Net Operating Income (NOI) per foot would be 42 percent higher for office and retail and no different for apartments. For each of these types, the NOI results could not fully explain the higher values. However, as we will see in the next section, an additional portion of higher market values can be explained by lower cap rates, which increase value independent of NOI.

- A one point increase in Walk Score increased the appreciation rate by 2 basis points and reduced income returns by 0.7 basis points. Income return is analogous to the cap rate, so in effect investors were willing to accept a .007 percent lower cap rate and pay .007 percent more per dollar of income for each unit increase in Walk Score. For an 80 versus 20 Walk Score property this converts into 1.2 percent faster appreciation per quarter and a 0.42 percent lower cap rate.
- Total return is the sum of appreciation and income returns. According to the third model, for every 1 unit increase in Walk Score, total returns increased by 1.3 basis points, which as it should be, is equal to the sum of the Walk Score coefficients in the appreciation and income return models. However, the Walk Score coefficient in the total return model was insignificant suggesting that higher appreciation and lower income returns offset one another, resulting in a statistically neutral effect on total returns.
- Generally, the data appear to support the proposition that the walkability premium is driven by a combination of higher NOI and lower cap rates.

The authors hypothesized that walkable properties had incomes and values that were as much or more and produced investment returns as good as or better than less walkable investments. They tested their hypotheses using data for over 4,200 properties of various types from throughout the US. Table 16 summarizes the results and shows that their hypotheses were mostly confirmed.

Walkability was associated with higher value for office, retail and apartment properties. These types of properties with a Walk Score of 80 were worth anywhere from 6 to 54 percent more than properties with a 20 Walk Score, depending on property type. Consistent with their higher values, they also found higher net operating incomes for the office and retail properties.

Table 16: Summary of Results for 80 vs. 20 Walk Scores

Property Type	Market Value	Net Operating Income	Appreciation per quarter	Income Return per quarter	Total Return per quarter
Office	+54%	+42%	1.92%	--	--
Retail	+54%	+42%	--	-0.72%	--
Apartments	+6%	--	--	-0.54%	--
Industrial	--	--	--	--	--

Source: Pivo and Fisher, "The Walkability Premium in Commercial Real Estate Investments," 2011.

FOOT TRAFFIC AHEAD: Ranking Walkable Urbanism in America's Largest Metros 2016

Christopher B. Leinberger & Michael Rodriguez, the Center for Real Estate and Urban Analysis, The George Washington University School of Business, 2016.

In their update to previous research reports of the same topic, the authors describe and define "WalkUPs" as "Walkable Urban Places." Such places are designed to be pedestrian-friendly and have a mix of land uses, typically not separated by large surface parking lots. These places contract to what the authors call "Drivable Suburbia", which stands for the typical automobile-oriented post-World War II development pattern.

A WalkUP development format includes:

- Substantially higher densities (1.0 to 40 floor-area-ratio, though mostly in the 1.0 to 4.0 range)
- Mixed-use real-estate products, or the adjacent spatial mix of products
- Emerging "new" product types, such as rental apartments over a ground-floor grocery store

- Multiple transportation options, such as bus, rail, bicycle, and pedestrian-friendly sidewalks, as well as motor vehicles, that connect to the greater metro area. Within the boundaries of the WalkUP itself, most destinations are within walking distance.

The three metros that are nearly synonymous with Drivable Suburbanism—metro Los Angeles, Houston, and Miami—showed some particularly interesting trends in the 2016 paper. These three metros were achieving more substantial price premiums for occupied office, retail, and multi-family rental space in WalkUPs—48 percent in metro Houston, 74 percent in metro Miami, and 52 percent in metro Los Angeles. They also showed strong capture of total new office and multifamily rental development. Tables 16 and 17 below summarize these findings.

Table 17: Rent per Sq.Ft. WalkUP Premium

2016

METRO AREA	WALKUP RENT PREMIUM		METRO AREA	WALKUP RENT PREMIUM	
	RANK	% PREMIUM Q4 2015		RANK	% PREMIUM Q4 2015
New York City	1	191%	San Antonio	16	47%
Seattle	2	97%	San Diego	17	41%
Boston	3	96%	Portland	18	40%
Chicago	4	77%	Las Vegas	19	39%
Miami	5	74%	Denver	20	35%
Washington, DC	6	66%	Tampa	21	32%
Philadelphia	7	63%	Minneapolis-St. Paul	22	30%
San Francisco Bay	8	58%	Pittsburgh	23	30%
Phoenix	9	57%	Detroit	24	29%
Orlando	10	55%	Sacramento	25	29%
Atlanta	11	53%	Cleveland	26	24%
Los Angeles	12	52%	Cincinnati	27	23%
Charlotte	13	50%	St. Louis	28	21%
Dallas	14	49%	Kansas City	29	12%
Houston	15	48%	Baltimore	30	4%

Table 18: WalkUP Share

Suburban Office and Rental Multifamily Space

METRO AREA	WALKUP SPACE IN SUBURBS		METRO AREA	WALKUP SPACE IN SUBURBS	
	RANK	% SHARE Q1 2010		RANK	% SHARE Q1 2010
Las Vegas	1	53%	Portland	16	13%
Washington, DC	2	49%	San Diego	17	12%
Houston	3	48%	Denver	18	11%
Miami	4	46%	San Francisco Bay	19	11%
Boston	5	41%	Dallas	20	10%
Phoenix	6	40%	Orlando	21	9%
Los Angeles	7	38%	Cleveland	22	7%
Atlanta	8	32%	Chicago	23	7%
Detroit	9	29%	New York City	24	6%
St. Louis	10	26%	Tampa	25	6%
Baltimore	11	22%	Sacramento	26	3%
Kansas City	12	18%	Pittsburgh	27	1%
Seattle	13	17%	Minneapolis-St. Paul	28	1%
Charlotte	14	17%	Cincinnati	29	0%
Philadelphia	15	16%	San Antonio	30	0%

Source: Leinberger and Rodriguez, "Foot Traffic Ahead: Ranking Walkable Urbanism in America's Largest Metros 2016"

Observations of Other Successful Town Centers in Texas

In addition to the case study locations used in the market and development share analysis, CDS also examined two other town center / walkable mixed-use development examples to help understand the potential for the Business Center at Towne Lake, a 146-acre site with access to a METRO Park and Ride and future commute and/or high-speed rail transit, and confirm whether current land use assumptions will have sufficient market support. These other two case studies offer many similarities to the potential development opportunity at Towne Lake Business Center. Importantly, both also rely on improved thoroughfare access to nearby regional

freeways and tollways, further highlighting the importance of an improved underpass intersection at US 290 for the success of the proposed Business Center at Towne Lake development program.

CityLine, Richardson

CityLine is a roughly 200 acre mixed-use project begun in 2013 and developed by KDC in Richardson, north of Dallas. The project is located along the DART light rail line and has a station adjacent. It is also situated adjacent to the President George Bush Turnpike (GBT), just east of its junction with the US 75 freeway. Full signalized intersections and freeway exits for Renner Road (off US 75) and North Plano Road (off the GBT) provide regional highway access.

The driver for the project was the commitment of State Farm Insurance to the occupancy of 2 million square feet in a regional headquarters office building; the Richardson Economic Development Partnership reports that the company had DART light rail access as a requirement in its location search and has a relatively high transit mode share of employee commuters. Due to the company desiring a lively mixed-use environment, it agreed to eschew an internal company cafeteria, so that workers would circulate within the project at meal times. Another major corporate anchor, Raytheon, followed State Farm, though it is located in a campus slightly separated from the mixed-use core.

KDC added several hundred thousand square feet of additional multi-tenant office space, and more than 1 million square feet are planned as future additions. There is also a 41,000 medical office building. It incorporated retail space into the ground floors of most office buildings. A central plaza, CityLine Plaza, is surrounded by 92,000 square feet of retail space. A 148-room Aloft Hotel provides lodging services. CityLine also has a large on-site residential population, with 1,900 multifamily and townhome units. In addition to the public space on the plaza, CityLine includes a 3.5-acre park.

Figure 15: CityLine Site Plan Map

CityPlace (Springwoods Village), Spring (north Harris County)

(*see site plan map on Page 7*)

Coventry Development Corporation (CDC) has owned a large tract of undeveloped land just west of I-45 in Spring, near the Montgomery County border, since the 1960s. As The Woodlands and other developments occurred to the north, the tract became a large infill site. The commitment of ExxonMobil to develop a new major campus started the development a new masterplanned community, Springwoods Village. The ExxonMobil campus forms the northern anchor of the main commercial district of the community, named CityPlace; however, due to the need for high levels of security, the campus itself is somewhat separated from CityPlace by a guarded perimeter. Instead, other corporate anchors have followed ExxonMobil's lead and chosen more integrated and walkable locations in CityPlace. Most notably, Southwestern Energy elected to build its new corporate headquarters on the east end of the commercial district, adjacent to I-45, with two towers containing nearly 600,000 square feet.

The Southwestern Energy buildings, though walkable to the mixed-use heart of CityPlace, are nonetheless still standalone buildings. The mixed-use portion did not kick off until a commitment from the American Bureau of Shipping (ABS) to relocate its Houston office from the Greenspoint area, into a new 10-story building, CityPlace 2, that also features 25,000 square feet of retail space HP also committed to relocate a newly created division to a new CityPlace building after the company split up its Houston operations.

The ground floors of the office buildings and parking garages, plus some stand-alone buildings and a planned cinema will feature up to 400,000 square feet of retail space in total. A full-service 337-room Marriott Hotel is under development. Other limited-service hotels are planned. CityPlace also incudes multifamily; The Mark apartments have 268 units.

Key Points from Supporting Research

Observations from the similar case study walkable mixed-use suburban developments and review of the academic / institutional research lead to several key points relevant to the market projections for Towne Lake Business Center.

5. The land use quantities being envisioned for Business Center are well within reasonable quantities based on the comparable developments. The Woodlands and CityLine feature office space well beyond the scale being contemplated for Business Center, though those projects were in established office corridors. It is reasonable to be conservative about Business Center since the 290 corridor has not yet established itself as a major location for Class A office tenants.
6. The academic research on the relationship between walkable mixed-use development and commercial market performance indicates that this kind of project design is in demand. The enhanced competitiveness through quality design will help lease rates, occupancy, and absorption, thereby further reassuring the quantities of commercial uses being considered at Business Center.
7. In particular, a master plan for a walkable mixed-use center should help attract a large corporate anchor. This is a repeated theme of the office-driven comparable developments (in contrast, office space is a secondary use in Southlake). A particularly salient observation is that ABS and HP, which

underwent relocations during a weak period in the Houston office market when many opportunities existed in the region to lease in high-quality buildings with landlord concessions, chose instead to build new buildings in CityPlace in Springwoods Village. This is strong evidence of the appeal of environments such as that being planned for Business Center for these types of occupants. Having high-quality transit service to the project should further enhance this appeal, if the experience of CityLine and its State Farm investment is any indication.

8. Whether or not there is transit service, the need for at least one high-quality thoroughfare intersection and access with a regional highway is apparent. This was common to all other example developments. Office-focused walkable mixed-use centers will likely have a broader commute shed than the market area served by the retail components, and highway access to key labor markets is a must. Fortunately for Business Center, an efficient intersection with 290 will address this issue, allowing access to labor supply along not only US 290 but also the fast-growing areas along the Grand Parkway to the north / northeast and south / southeast.

POTENTIAL LAND ALLOCATION AND TAX GENERATION

CDS used the results of the market potential analysis to project the land acreage, assessed value, and sale tax generation that could be achieved in the core of the Business Center.

Real Property Assessed Value

CDS collected data from appraisal district records on mixed-use commercial buildings from two of the case study properties described earlier in this report. CDS's previous analysis of property value assumed a different building structure type than what is being assumed in 2018, which is more office-focused and likely to be typical of buildings found in Sugar Land Town Square, The Woodlands Town Center (office core) and CityLine in Richardson.

Table 19: Summary of Assessed Values – Example Developments

Example Development	Building Size	Units	Improvements Assessed Value	Value / Unit
Sugar Land Town Square office w/ ground floor retail	194,593	Square feet	$24,771,800	$127.30
Sugar Land Town Square office building	163,036	Square feet	$21,418,890	$131.38
Sugar Land Town Square Marriott	300	Rooms	$24,008,370	$80,028
CityLine office w/ ground floor retail and garages	1,283,376	Square feet	$382,545,677	$298.08
CityLine office w/ ground floor retail and garage	384,538	Square feet	$105,464,286	$274.26
CityLine Aloft Hotel	90	Rooms	$9,979,709	$110,886
Anthem CityLine Apartments	233	Units	$41,978,462	$180,165
Alexan Central Apartments (CityLine)	351	Units	$33,186,863	$94,549
Windsor CityLine	330	Units	$42,977,975	$130,236
24 Waterway office / retail / garage (The Woodlands)	323,850	Square feet	$70,888,640	$218.89
21 Waterway office / retail (The Woodlands)	112,590	Square feet	$22,259,320	$197.70
The Woodlands Waterway Marriott	343	Rooms	$51,159,150	$149,152

Sources: Fort Bend Central Appraisal District, Collin Central Appraisal District, Montgomery County Appraisal District, CDS

Based upon the research information above, CDS makes the following estimates of new development assessed value increase in Towne Lake Business Center. It should be noted that these amount represent improvements only; underlying land values will also likely increase due to the installation of streets and utilities, but that component of value increase is not included below.

- For office, assuming most properties also have ground floor retail and structured parking, 800,000 square feet @ $250/sq.ft., **$200,000,000**.
- The multifamily properties, with 550 units @ $130,000/unit, **$71,500,000**.
- The 300-room hotel, @ $120,000/room, **$36,000,000**.
- Total office – multifamily – hotel: **$307,500,000**.

These values represent just the business core area as depicted in the site plan on Page 1 and do *not* include the uses that may develop in the Transit-Oriented Development area in the northeastern portion of the site, which would likely include additional high-value multifamily and other commercial uses such as office, retail, and hotel.

Furthermore, the density of assessed value produced in a commercial mixed-use development would be considerably higher than the likely alternative scenario of low to moderate density single family development. In the example properties shown above, the improvement value per acre ranged from approximately $8.5 million to over $40 million. A single family-only scenario, estimated at 638 lots (50-foot to 70-foot width) at an average value of $436,000 per home, would generate market value of approximately $278 million; however, due to exemptions for owner-occupiers, the taxable value would be substantially reduced by the exemptions offered by the various property tax jurisdictions – Harris County's Homestead Exemption, for example, is 20% of value.

Sales Tax Generation

A review of retail space in Sugar Land and Pearland, based on an inventory by CoStar and data from the State of Texas Comptroller, indicate that overall Houston-area suburban spending averages $250/sq.ft. for gross sales and $146/sq.ft. in taxable sales for businesses in the categories of Retail Trade and Accommodations and Food Services (which includes restaurants and drinking places). It should be noted the certain other industry categories (such as fitness clubs) that generate taxable sales are not included in these categories, so the actual figures are a bit higher.

As to what the sales productivity would be in Towne Lake Business Center, based on a survey of retail tenant types in the observed town centers, CDS estimates approximately 90% of the retail space would be leased to sales tax generating businesses. If the Business Center's retail leasing has a higher percentage of other users, such as financial, medical, or some kinds of personal services, this figure might be lower.

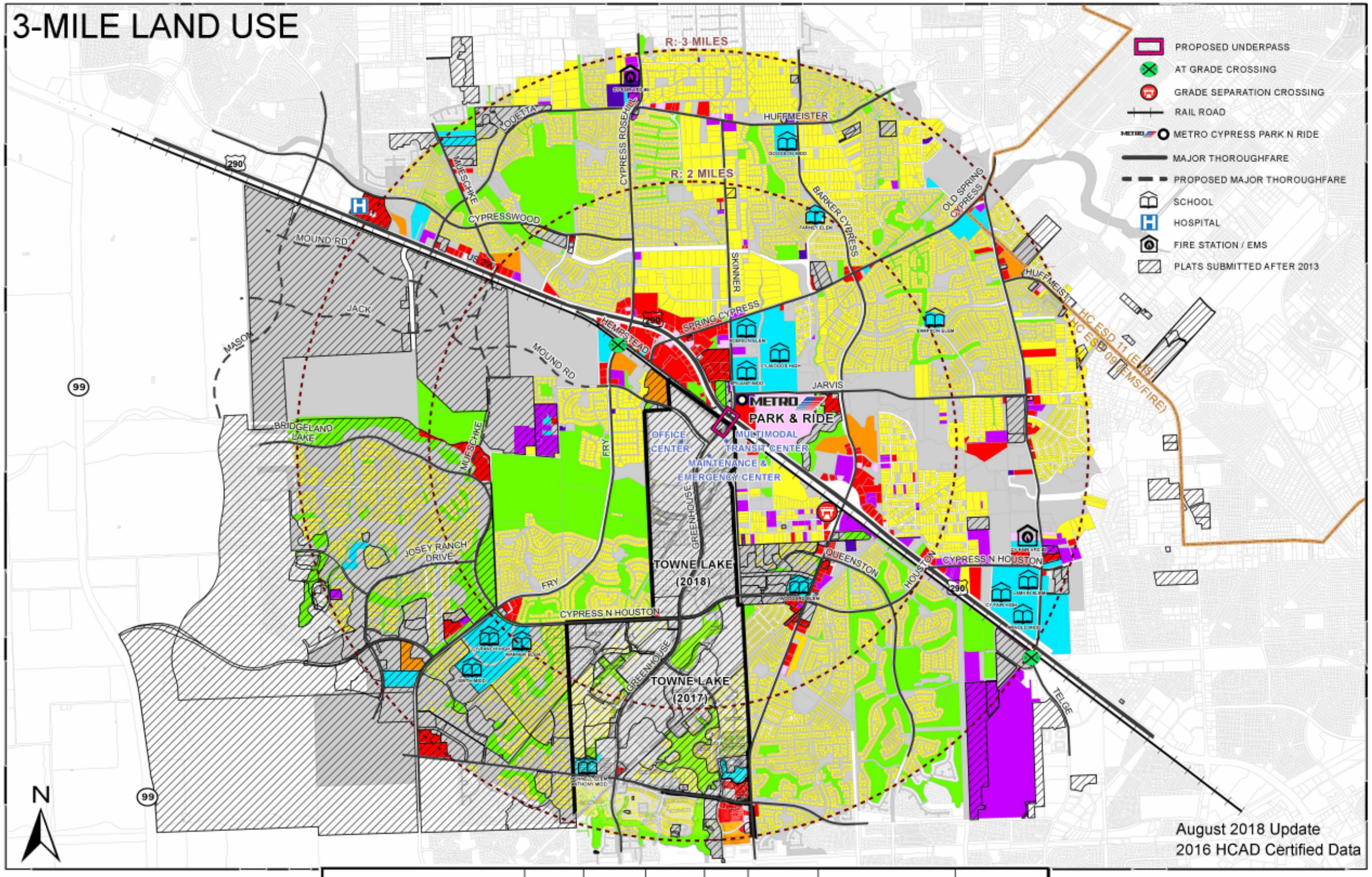
CDS estimates an average gross sales / sq.ft. of $550 – this factor could definitely be higher, but CDS used a conservative estimate for a successful upscale development). CDS also believes that the taxable share of those sales would be higher, as non-taxable categories such as groceries are unlikely to have a large presence in the Business Center's retail mix. So, rather than the 58% taxable share of the cities of Pearland and Sugar Land, CDS estimates the taxable share for the Business Center to be 75%.

For the 100,000 square feet of retail space planned in Towne Lake Business Center, this would equate to 100,000 sq.ft. x $550 $/sq.ft. x 75% taxable = $41,250,000 in annual taxable sales, or **$412,500** in annual 1% sales tax revenue.

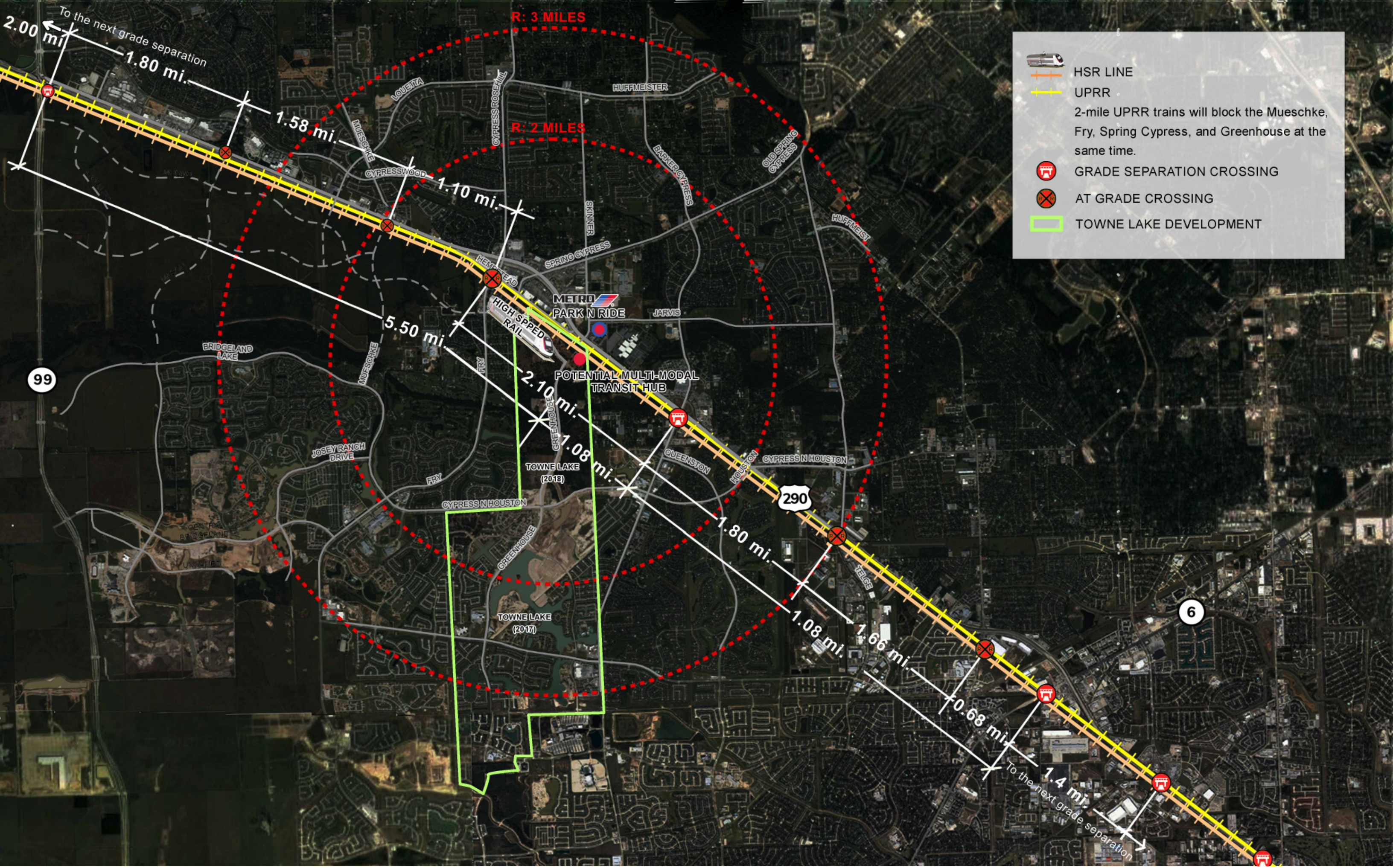
1001 South Dairy Ashford Street, Suite 450
Houston, TX 77077

281-582-0855
www.cdsmr.com

3-MILE LAND USE



Land Use		Number of Parcels	Dwellings/ Units	% Total Dwellings	Square Miles	Acres	Average Property Value	Property Value
	Single-Family Residential	21,450	21,450	87%	8.90	5,693.44	282,277 per dwelling	6,054,848,777
	Multi-Family Residential	12	3,086	13%	0.28	176.48	106,626 per dwelling	329,049,307
		TOTAL	**24,536**					
	Commerial	225			0.96	617.37	26 per sqft	689,543,947
	Industrial	98			0.93	594.18	6 per sqft	161,235,758
	Office	34			0.23	145.93	21 per sqft	132,533,798
	Parks/Open Spaces/Lakes	482			3.65	2,334.83		60,076,462
	Public/Institutional	35			1.00	639.37		5,844,816
	Transportation/ Utilities	25			0.17	105.63		1,958,235
	Vacant/Undeveloped	3,803			15.14	9,691.65		300,285,687
					31.25	**19,998.88**		**7,735,376,787**


R: 3 MILES
R: 2 MILES
2.00 mi.
To the next grade separation
1.80 mi.
1.58 mi.
1.10 mi.
5.50 mi.
2.10 mi.
1.08 mi.
1.80 mi.
1.08 mi.
1.66 mi.
0.68 mi.
1.4 mi.
To the next grade separation
HSR LINE
UPRR
2-mile UPRR trains will block the Mueschke, Fry, Spring Cypress, and Greenhouse at the same time.
GRADE SEPARATION CROSSING
AT GRADE CROSSING
TOWNE LAKE DEVELOPMENT
METRO PARK N RIDE
HIGH SPPED RAIL
POTENTIAL MULTI-MODAL TRANSIT HUB
TOWNE LAKE (2018)
TOWNE LAKE (2017)
LOUETTA
MUESCHKE
CYPRESSWOOD
CYPRESS ROSE HILL
HUFFMEISTER
SKINNER
BARKER CYPRESS
OLD SPRING CYPRESS
HUFFMEIST
SPRING CYPRESS
HEMPSTEAD
JARVIS
BRIDGELAND LAKE
FRY
GREENHOUSE
JOSEY RANCH DRIVE
CYPRESS N HOUSTON
QUEENSTON
HOUSTON
TELGE
99
290
6

PLAT/LEVEL-OF-SERVICE

R: 3 MILES

R: 2 MILES

CY-FAIR VFD #4

LOUETTA

CYPRESS ROSEHILL

HUFFMEISTER

GOODSON MIDD.

MUESCHKE

CYPRESSWOOD

FARNEY ELEM.

BARKER CYPRESS

OLD SPRING CYPRESS

290

MOUND RD

US 290

B D am pm

C D am pm

SKINNER

SPRING CYPRESS

HEMPSTEAD

ROBISON ELEM.

CY-WOODS HIGH

SPILANE MIDD.

SAMPSON ELEM.

HUFFMEIST

HC ESD 11 (EMS)

HC ESD 09 (EMS/FIRE)

JACK

MASON

99

METRO PARK & RIDE

JARVIS

C D am pm

D D am pm

B D am pm

F F am pm

BRIDGELAND LAKE

MUESCHKE

FRY

GREENHOUSE

TOWNE LAKE (2018)

QUEENSTON

HOUSTON

CYPRESS N HOUSTON

CY-FAIR VFD #3

LAMKIN ELEM.

CY-FAIR HIGH

ARNOLD MIDD.

JOSEY RANCH DRIVE

CY-RANCH HIGH

WARNER ELEM.

SMITH MIDD.

TOWNE LAKE (2017)

TELGE

RENNELL ELEM.

ANTHONY MIDD.

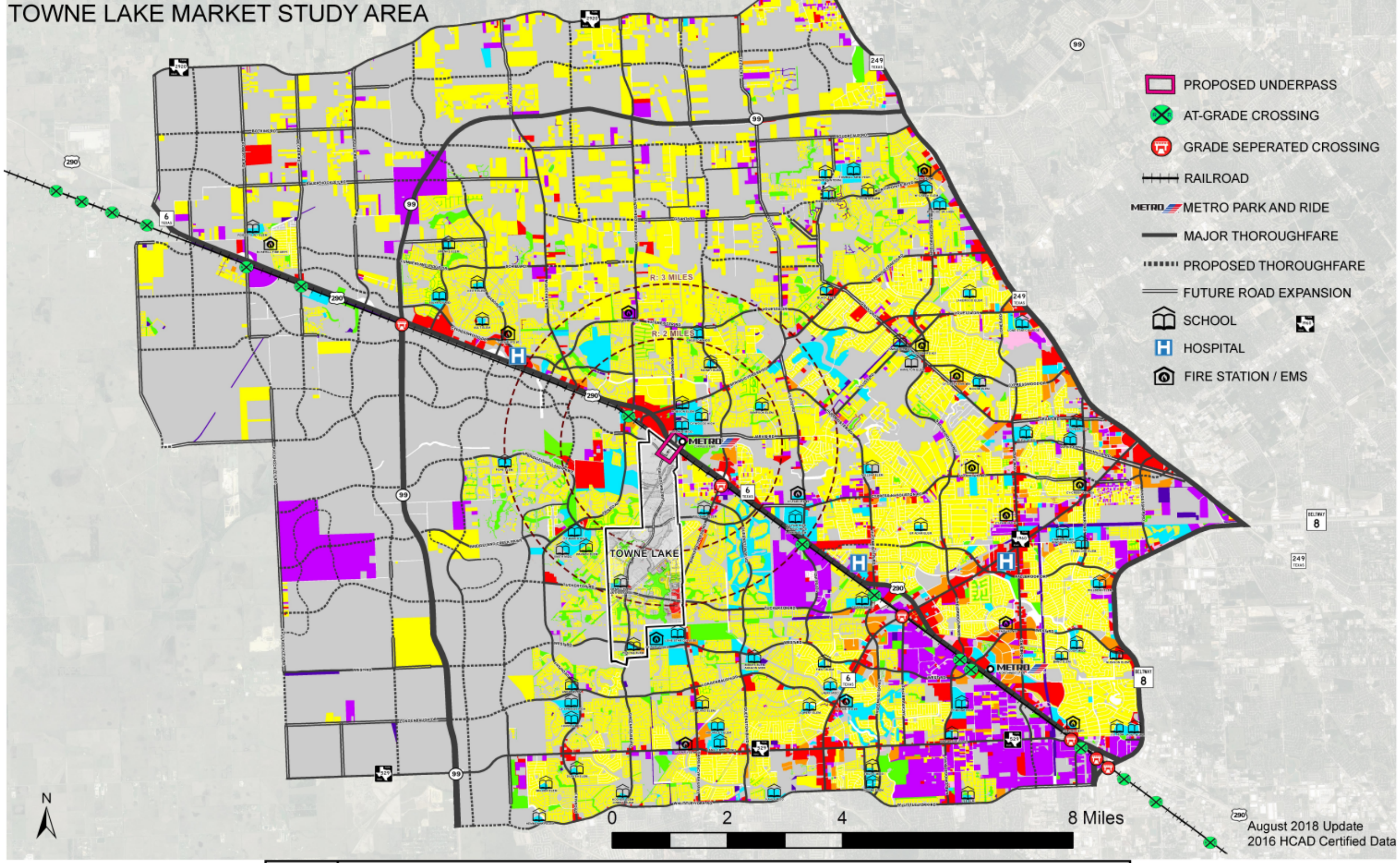
N

99

- PROPOSED UNDERPASS
- AT GRADE CROSSING
- GRADE SEPARATION CROSSING
- RAIL ROAD
- METRO CYPRESS PARK N RIDE
- MAJOR THOROUGHFARE
- PROPOSED MAJOR THOROUGHFARE
- SCHOOL
- HOSPITAL
- FIRE STATION / EMS
- NEW DEVELOPMENT (PLATS SUBMITTED AFTER 2013)
- INTERSECTION LEVEL-OF-SERVICE FROM A TO F (LOS A = free flow, and LOS F = highly congested)

August 2018 Update
2016 HCAD Certified Data

TOWNE LAKE MARKET STUDY AREA



Land Use		Number of Parcels	Dwelling Units	% Total Dwellings	Square Miles	Acres	Average Property Value	Property Value
	Single-Family Residential	124,120	123,480	82%	50.69	32,443.95	$ 218,071.32 per dwelling	$ 26,915,670,229.00
	Multi-Family Residential	275	27,747	18%	2.38	1,523.62	$ 52,761.90 per dwelling	$ 1,463,984,322.00
		TOTAL	**151,227**					
	Commerial	1,629			7.23	4,627.01	$ 15.91 per sqft	$ 3,207,268,646.00
	Industrial	1,412			9.47	6,063.62	$ 9.16 per sqft	$ 2,419,285,665.00
	Office	287			0.68	436.56	$ 39.35 per sqft	$ 748,283,242.00
	Parks/Open Spaces/Lakes	1,637			5.20	3,330.51		$ 13,558,779.00
	Public/Institutional	271			6.91	4,422.81		$ 284,001,228.00
	Transportation/ Utilities	180			1.25	798.18		$ 34,019,251.00
	Vacant/Undeveloped	19,724			121.72	77,903.38		$ 2,248,997,974.00
					205.53	**131,549.64**		**$ 37,335,069,336.00**