

NIXON AND PLEASANT DRIVE DRAINAGE IMPROVEMENTS

PRELIMINARY ENGINEERING REPORT

PREPARED FOR:

CITY OF ROLLINGWOOD
403 NIXON DRIVE
ROLLINGWOOD, TEXAS 78746



PREPARED BY



MARCH 2021

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This document is for interim review
and not for construction, bidding or
permit purposes.

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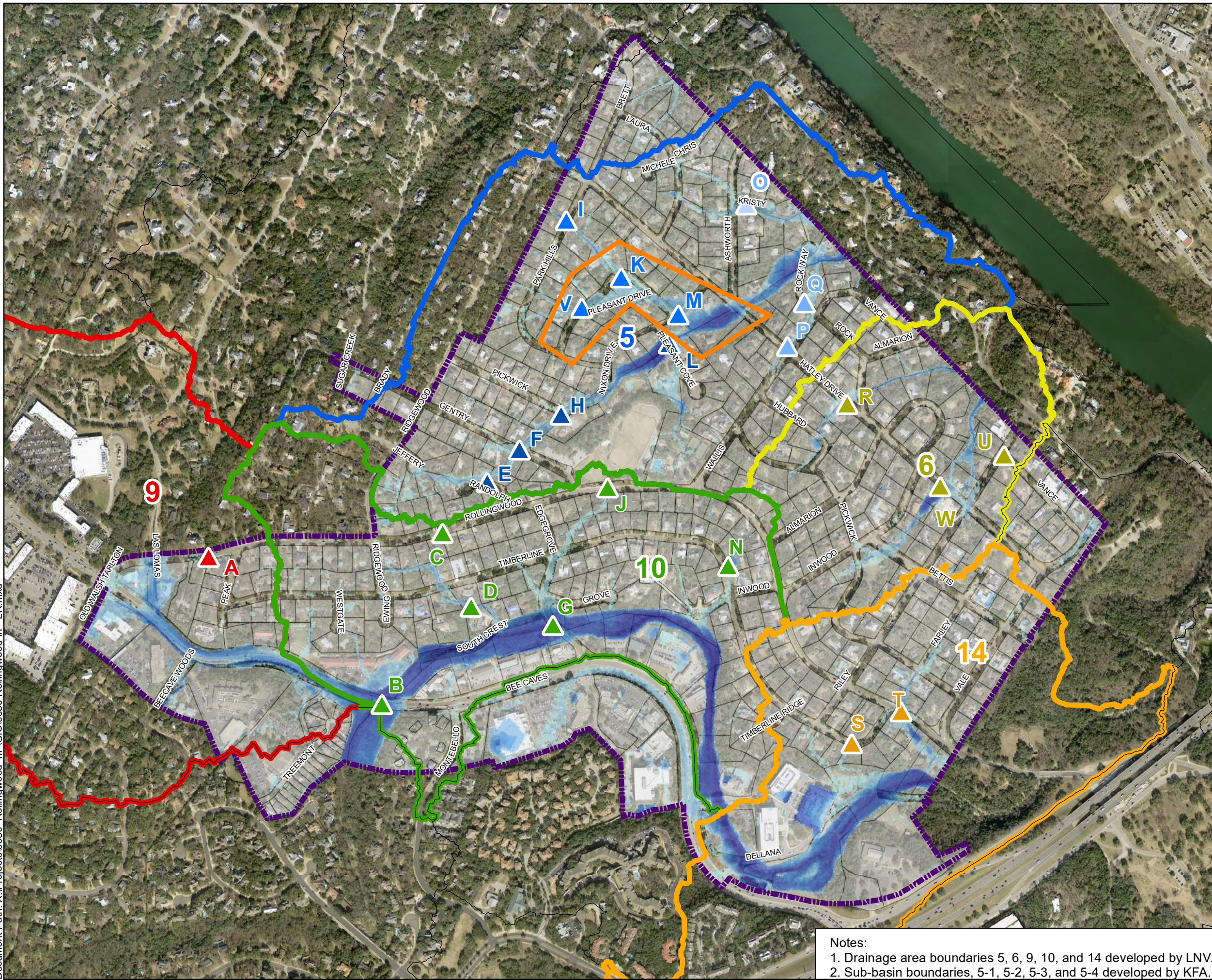
1 INTRODUCTION

K. Friese + Associates, Inc. (KFA) contracted with the City of Rollingwood (City) on November 20, 2020 to provide professional engineering services to develop a Preliminary Engineering Report (PER) for the Nixon Drive and Pleasant Drive Drainage Improvements Project.

The primary objectives of this PER are to investigate the identified drainage issues within the study area, perform analysis to determine technically feasible and cost-effective solutions, to identify project constraints, and to evaluate potential phasing approaches for implementation of the design recommendations.

Refer to **Exhibit 1** for the study area limits of this PER, identified as locations M, K, and V. The three project letters that are identified in the figure are areas of interest that were identified in the Infrastructure Improvements Plan (IIP) the KFA completed in February 2020. The IIP focused on identifying and mitigating local infrastructure concerns, with a focus on stormwater drainage and flooding issues. Points of interest M, K, and V were ranked 2, 3, and 16 respectively in the IIP. The ranking was based on depth of flooding at structures greater than or equal to 6 inches (based on the most recently available building footprint GIS data from the City of Austin GIS database, 2013). And The flooding velocities greater than or equal to 6 feet per second (based on the maximum permissible velocity in the 100-year storm, from the City of Rollingwood Drainage Criteria Manual).

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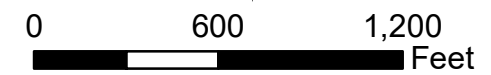
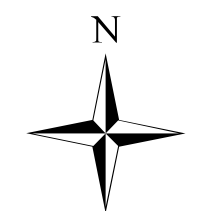
Legend

- Rollingwood City Limits
 - Parcels
 - Area of Interest
 - Drainage Areas
- 100-yr Inundation**
- | | | | |
|--|----------|--|----------|
| | 3-6 in | | 3-4 ft |
| | 6-12 in | | 4-5 ft |
| | 12-18 in | | 5-7 ft |
| | 18-24 in | | 7-10 ft |
| | 2-3 ft | | 10-20 ft |
- Study Limits

Exhibit 1

City of Rollingwood Infrastructure Improvements Plan

Identified Areas of Interest Map



Date: 3/9/2021



Notes:
 1. Drainage area boundaries 5, 6, 9, 10, and 14 developed by LNV
 2. Sub-basin boundaries, 5-1, 5-2, 5-3, and 5-4 developed by KFA.

2 BACKGROUND

The City of Rollingwood within the Pleasant Drive and Nixon Drive area is experiencing neighborhood flooding and public safety hazard issues associated with the fast-moving runoff discharged across properties and roadways during storm events. The existing storm drainage system is dependent on a network of small channels or swales located within private properties and collection of runoff within the roadway itself as the main means of conveyance. The quantity of water quickly overwhelms the capacity of these small drainage channels and the roadway section resulting in frequent overtopping, flooding, and hazardous conditions in the roadway and right-of-way as well as in private property.

The study area consists of a contributing drainage area of approximately 162 acres measured at the point of discharge near the Colorado River (Lady Bird Lake) and approximately 98.6 acres at the creek crossing located near Hatley Drive. The study area, city limits, and watershed are shown below in **Exhibit 2**.

The general characteristics of the watershed is defined as steeply sloping terrain with undulating hills and mostly urbanized residential land cover.

Drainage patterns for the study area consist of runoff generally concentrating around Park Hills Drive to the north and then conveyed in a southerly direction towards Pleasant Drive. Flow becomes concentrated at two points in the system. The first point of concentration is received from the west where flow enters Pleasant Drive between 312 Pleasant Drive and 314 Pleasant Drive. The flow is then collected near 305 Pleasant Drive and travels along the back yard of 303 Pleasant Drive before discharging to Pleasant Drive between 303 and 301 Pleasant Drive within a small privately owned drainage channel. The second point of concentration is received from the northwest from flow that travels across 306 Pleasant Drive and then travels toward the Nixon/Pleasant intersection. Runoff from both locations combine and travel down the hill where flow then enters the low-lying flatter terrain near the intersection. Each of these factors contributes to rapid runoff and high flow concentrations within the study area points of interest that will lead to stormwater accumulation in the roadway and on private property creating hazardous conditions. Stormwater is then ultimately conveyed into the drainage channel between 303 and 305 Nixon Drive and into the main channel that is conveyed to Hatley Drive and ultimately to the Colorado River.

Flooding within the study area is identified and summarized as follows:

- **Intersection flooding at Nixon and Pleasant Drive** – fast moving runoff collects at the intersection resulting in dangerous velocities and flood depths that results in significant public safety hazards that place at risk emergency response vehicles and evacuation routes, the general public, and to private property.
- **300 Pleasant Drive** – The property experiences frequent flooding due to overtopping flows discharged along Pleasant Drive and due to an undersized 18-inch storm drain culvert that serves to relieve the low-lying area from flooding. Runoff has been reported to result in damages to vehicles, property, and has come dangerously close to damaging the residential structure in recent years.
- **303 Nixon Drive** – the property is known to experience frequent flooding issues associated with the fast-moving water discharged from Pleasant Drive and elevation of the road which results in runoff travelling across the residential walkway to the front-door of the home and down the driveway resulting in significant flood risks and damages to the property. At the rear of the property, a natural channel serves to convey major portions of the city’s collected runoff. The property owner has since constructed private improvements to help concentrate and direct flow towards the downstream culvert at Hatley Drive.
- **301 Nixon Drive** – drainage issues are largely associated with the natural channel located at the rear of the property which results in wide shallow flooding and the ponding of water around the Hatley culvert. The property owner has also constructed private improvements to help concentrate and direct flow downstream towards the culvert at Hatley Drive.
- **301, 303 and 305 Pleasant Drive** – the natural terrain has resulted in a minor drainage channel that is used to convey flow from areas upstream north of Pleasant Drive. Property owners have constructed private improvements to the channel to improve the conveyance of flow thru their properties. The direction of flow onto their properties has resulted in nuisance flooding. Several figures on the following page show the existing condition and flooding that occurs in the project area.



Figure 1 – Upstream side Hatley Drive Culvert Facing Northeast



Figure 2 – Channel Upstream of Hatley Drive Facing Northeast



Figure 3 – Culvert at 300 Pleasant Drive Northwest towards Nixon/Pleasant Intersection



Figure 4 – Intersection of Nixon and Pleasant Drive



Figure 5 – Runoff from Creek onto 301 Pleasant Drive



Figure 6 – Driveway flooding at 303 Nixon Drive

3 DATA COLLECTION

3.1 Field Inspection/Observation Methodology

KFA conducted field observations on October 16, 2020 and January 18, 2021 to document the condition of the site, record the existing condition by photographs, and meet with property stakeholders to gain further insights of the drainage issues occurring within the study area.

Photos and videos were additionally provided by Property Owners which documented flooding events on April 7, 2019, January 21, 2021 and an unconfirmed date. These videos were utilized by KFA to confirm drainage patterns and validate modeling results.

3.2 SURVEY DATA

3.2.1 Topographic Field Survey

CivilCorp, LLC performed limited field surveying work in December 2020 and January 2021 to support the hydraulic modeling and analysis. Work included identifying cross-sectional geometries of the drainage channel behind Nixon Drive and roadway, bridge/culvert data, utility easement locations, and other points of interest.

3.2.2 LiDAR Data

2017 Light Detection and Ranging (LiDAR) data for Central Texas at 0.5 meter resolution was downloaded from the Texas Natural Resources Information System (TNRIS) DataHub as collected by the Strategic Mapping Program (StratMap) of the Texas Water Development Board (TWDB).

The two terrain surfaces from the field survey and LiDAR were then mosaiced together to create a 3D terrain file for the project area which was utilized to develop a Digital Elevation Model (DEM) utilized in the hydraulic analysis.

3.3 Spatial Data

Geographic Information System (GIS) Mapping data was obtained from the City of Rollingwood to identify the approximate locations of above- and below-ground stormwater infrastructure, water lines, other utilities, building footprints, right-of-way, and property boundaries.

Existing land use and impervious cover areas were generated by KFA utilizing available GIS shapefiles, aerial imagery and by field observations.

3.4 Environmental Investigations Summary

Environmental investigations concluded that the project area may be impacted by the following environmental constraints:

- According to the Travis/Williamson Counties Karst Zone Map, the review area is located within Karst Zone 1, an area known to contain endangered cave fauna. A karst survey is recommended prior to any construction activities.
- Based on desktop research, an archeological field survey is recommended along the eastern portion of the review area near and along the creek where past human habitation could be present.

- While it does not appear to be a U.S. Army Corps of Engineers (USACE) jurisdictional water based on the Navigable Waters Protection Rule, a formal Waters of the U.S. Delineation is recommended for submission to the USACE for their concurrence.

A copy of the Environmental and Geotechnical Report performed by Raba Kistner on January 2021 is included in **Appendix G**.

3.5 Geotechnical Investigations

No geotechnical investigations were performed as part of this scope of work. Geotechnical investigations will be performed during the final design phases of the project.

3.6 Rainfall Data

On September 27, 2018, the National Oceanic and Atmospheric Administration (NOAA) Hydrometeorological Design Studies Center released an update to Texas’s rainfall frequency values, which redefines the amount of rainfall it takes to qualify as a 100-, 500-, and 1,000-year storm event. The newly updated data is intended to supersede the *USGS Water-Resources Investigations Report 98-4044* (USGS 1998) and *NOAA Technical Paper No. 40 for Rainfall Frequency Atlas of the United States* (TP-40 1963) and represents the best available data for stormwater and floodplain design and analysis.

The study, published as NOAA *Atlas 14, Volume 11 Precipitation-Frequency Atlas of the United States* (Atlas 14), serves to replace the previously effective rainfall frequencies for the region as published by the City of Austin Drainage Criteria Manual. KFA has therefore utilized Atlas 14 precipitation-frequency estimates as the best available data.

KFA reviewed historical rainfall data to compare recent and significant storm events to the Atlas 14 precipitation frequency estimates to estimate a corresponding probability of occurrence (**Table 1**). For comparison, the video recorded on April 7, 2019 was estimated to have 3.3 inches of rainfall over a peak period of four hours which corresponds to an approximately 2 to 5 years recurrence interval.

Table 1: Rollingwood Area Historical Rainfall Events

Date	Precipitation (inches)	Rainfall Duration (hours)	Estimated Recurrence Interval (Precipitation Frequency)
10/17/1998	11.7	8	100 year
11/11/2001	9.8	6	100 year
1/13/2007	7.5	8	25 to 50 year
9/22/2009	4.9	10	5 to 10 year
4/7/2019 (video)	3.3	4	2 to 5 year
<i>Note: Data from nearest weather station at Austin Bergstrom International Airport</i>			

3.7 Known Utilities within Study Area

Identified utilities within the study area are generally located within the right-of-way of the residential streets or along a 7.5-foot and 10-foot utility easement situated between the rear end of the properties along Nixon Drive.

Known utilities include water, sanitary sewer, overhead electric, gas mains, cable television, and telecommunication services. No detailed subsurface utility investigations were performed as part of this study and identification of utilities is based on available block maps, as-built drawings, and field investigations.

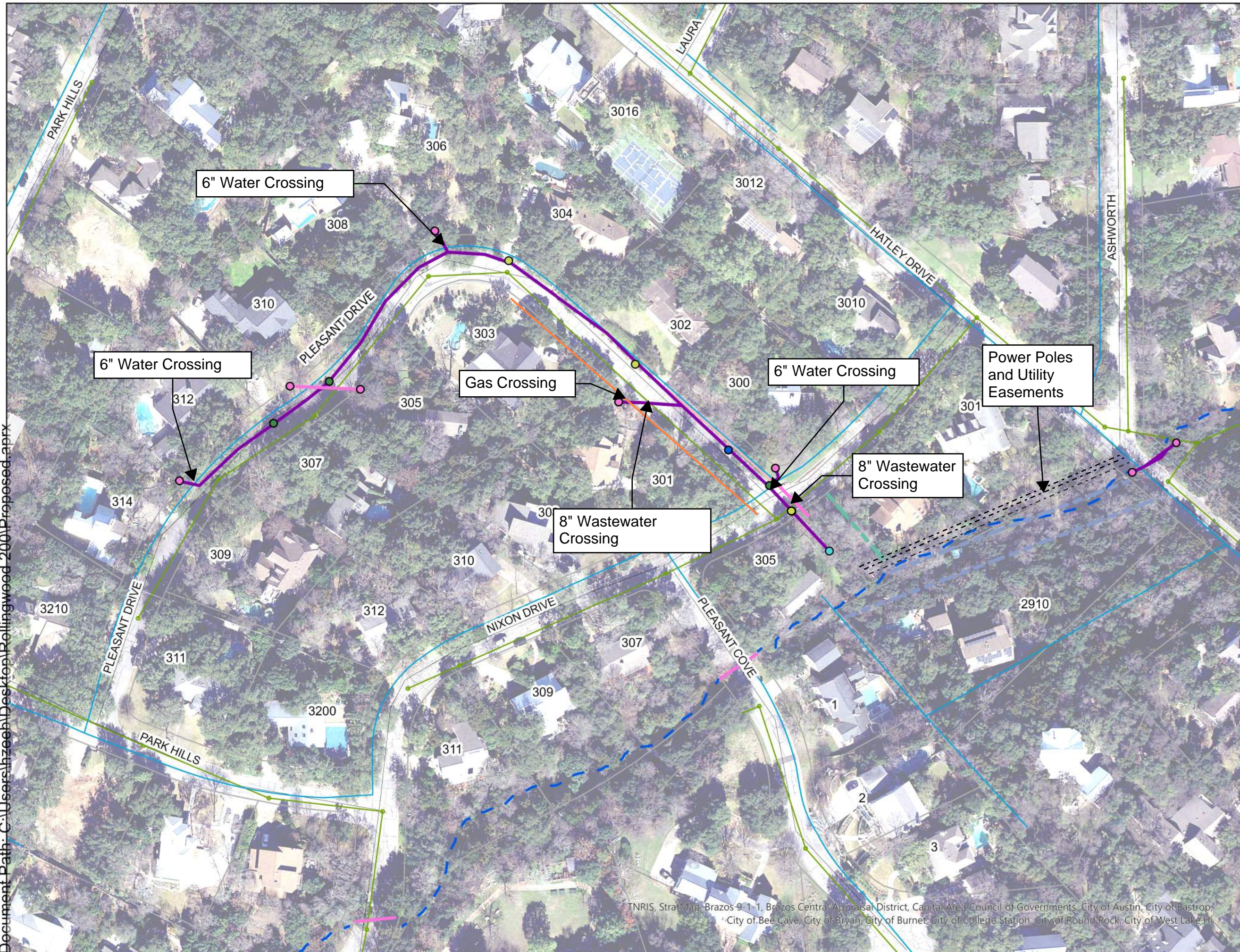
Known utilities and their approximate locations are mapped and provided in **Exhibit 3** with their potential conflicts in **Appendix B**.

The summarized potential conflicts are listed below.

- 1) Channel Improvements between Hatley Drive and Pleasant Drive
 - a. Two public utility easements for overhead utility poles, one 7.5-foot wide and the second 10-foot wide, are located within the channel and are assumed will require relocation of the easement and utility poles.
- 2) Storm Drain Improvements on Pleasant Drive and Nixon Drive
 - a. There are two proposed crossings of the 8-inch sanitary sewer crossing, one located between 303 and 301 Pleasant Drive and a second 8-inch sanitary sewer crossing near the intersection of Pleasant Drive and Nixon Drive.
 - b. There are three proposed 6-inch water main crossing proposed storm drain pipe system. Two crossing along Pleasant Drive and a second at the intersection of Nixon Drive and Pleasant Drive.
 - c. A gas main of an unknown size is located within the western right-of-way behind curb of Pleasant Drive with one proposed crossing for the storm drain pipe system.

Further investigations and verification to identify all utilities horizontal and vertical locations for the selected option and configuration are recommended during the detailed design phase of the project to determine the extent of the utility conflicts and relocations required.

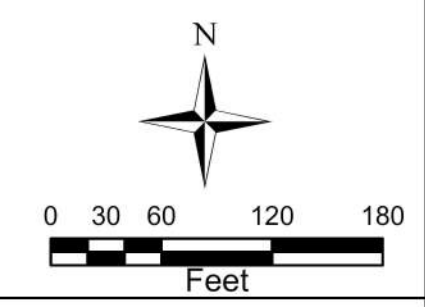
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Legend

- Existing Waterlines
- Existing Wastewater
- Parcels
- Proposed System
- Channel
- Existing Culverts
- Proposed 1' Berm
- Limestone Walls
- Existing
- Proposed
- Proposed Inlets
- 20' Curb Inlet
- Culvert Headwall
- Curb Inlet
- Curb Inlet Sag
- Outfall
- Existing Gas

Exhibit 3
Rollingwood - Nixon/Pleasant
Potential Utility Conflicts Map



Date: 3/9/2021



TNRIS, StratMap, Brazos 9-1-1, Brazos Central Appraisal District, Capital Area Council of Governments, City of Austin, City of Bastrop, City of Bee Cave, City of Bryan, City of Burnet, City of College Station, City of Round Rock, City of West Lake Hills

4 HYDROLOGIC MODELING

Hydrologic analysis was calculated using the HEC-HMS software version 4.2 to simulate the annual exceedance probability (AEP) storm events. The purpose of the HEC-HMS model was to develop peak flow data and to generate rainfall hydrographs as input parameters for the accompanying hydraulic analysis and flood inundation mapping.

Additional information on methodologies are provided in the subsequent sections.

4.1 Drainage Basins and Points of Interests

A total of 17 drainage basin were delineated based on 1-foot contours generated from the 2017 LiDAR data as shown in the drainage map in **Appendix A**. A total of 9 points of interests were defined within the project area located in the right-of-way and within the watershed draining to the culvert outfall at Hatley Drive. The points of interest were placed where at least two drainage basins converged. Each point of interest corresponds to a point where an inflow hydrograph will be assigned in the Innovyze ICM hydraulic model.

4.2 Time of Concentration

Time of concentration flow paths and calculations follow the City of Austin *Design Criteria Manual* (DCM). Sheet flow is defined as less than 100-feet and generally is delineated as flow across a lawn, or from the crown of the road until it meets the gutter. When runoff meets the gutter line, it will become shallow concentrated flow until it enters a storm drain system or well-defined open channel. Per the City DCM, shallow concentrated flow does not have a well-defined channel and has flow depths of 0.1 to 0.5 feet. Time of concentration calculations are shown in **Appendix A** for each basin.

4.3 Curve Numbers

Stormwater discharges were computed using the Soil Conservation Services (SCS) Unit Hydrograph method. The SCS runoff Curve Numbers (CN) were calculated using the National Resource Conservation Services (NRCS) soil type data in conjunction with the CN values outlined in the City of Austin Drainage Criteria Manual along with the estimated impervious cover for existing and ultimate conditions. Rainfall precipitation data was obtained from the City Austin *Drainage Criteria Manual Atlas 14* rainfall distribution.

The soil classifications for the drainage areas are generally characterized as Type C and D soils, as represented in the USDA's Web Soil Survey (Soils Map in **Appendix A**). These soils are regarded to have slow infiltration rates and high runoff potential.

Per the *DCM Manual Table 2-5 NRCS Runoff Curve Numbers*, losses were calculated for each subbasin with most of the basin consisting of residential ½ acre lot land use classifications. A summary of the curve numbers used is provided in **Table 2** and final curve numbers for each basin are shown in **Table 3**. The curve number of each basin was computed as the average value of all points within the subbasin area using ArcGIS tools.

Table 2: Summary of Curve Numbers

Land Use Description	Hydrologic Soil Group			
	A	B	C	D
Residential ½ acre	54	70	80	85

Table 3: Curve Numbers of Subbasins

Subbasins	Soils		CN
	C	D	
28	0%	100%	85
22	0%	100%	85
25	0%	100%	85
24	0%	100%	85
23	0%	100%	85
27	30%	70%	84
21	50%	50%	83
26	80%	20%	81
14	65%	35%	82
20	80%	20%	81
17	80%	20%	81
4	90%	10%	81
19	0%	100%	85
18	0%	100%	85
6	20%	80%	84
7	10%	90%	85
16	20%	80%	84

4.4 Impervious Cover

KFA determined existing impervious cover from aerial imagery for the study area, and from current building footprint shapefiles provided by the City of Rollingwood. Overall existing impervious cover was calculated for each basin using ArcGIS tools and input into HEC-HMS as a percentage of the basin area. The average impervious cover for existing conditions was calculated at 25%.

As requested from the City, ultimate (future land use) impervious cover was estimated to be 50% for every parcel. The future parcel impervious cover percentages were assumed based on recent residential permit records submitted to the City from September 2019 to November 2020 to develop an average percent increase and then added a factor of safety. Data for the final impervious cover area for existing and proposed for each basin is in **Appendix A**.

4.5 Rainfall Events

KFA modeled the synthetic 25- and 100-year storms with the use of a 24-hour HEC-HMS frequency storm distribution for use with the time-varying rainfall simulations. These depths were entered directly into HEC-HMS software as input to the frequency storm meteorologic models. As required by the COA DCM, KFA modeled the Atlas 14 depths and these are summarized in **Table 4**.

Table 4: Depth-Duration-Frequency Values

Duration	Depth of Precipitation (inches) by Recurrence Interval	
	25-yr	100-yr
5-min	0.98	1.28
15-min	1.96	2.54
1-hr	3.66	4.77
2-hr	4.81	6.57
3-hr	5.55	7.81
6-hr	6.78	9.79
12-hr	7.85	11.37
24-hr	8.90	12.80

4.6 Routing

Methodology follows the guidance provided by the U.S. Department of Agriculture *Technical Release No. 55, Urban Hydrology for Small Watersheds* (TR-55). Lag times for each of the drainage areas were computed using TR-55 methodology and reach routing utilizes simplified Lag routing methods.

The calculations for each routing reach are contained in **Appendix A**.

4.7 Ponds

There are no ponds in the HEC-HMS model as the function of the model is to generate the excess precipitations and then apply to 2D mesh zone in the ICM model.

4.8 Results

The excess precipitations from the existing and ultimate conditions analysis were exported from HEC-HMS model, and then applied to 2D Mesh Zone in the existing and Ultimate conditions ICM models, assuming uniformly distribution for the project area. Hydrologic data and calculations are contained in **Appendix A**.

5 HYDRAULIC ANALYSIS

KFA performed both one- and two-dimensional hydraulic modeling to develop an accurate understanding of the flooding within the study area. The Existing Conditions inundation exhibits are included in **Appendix C**. Both the 1D and 2D hydraulic models are included on the CD in **Appendix H**.

5.1 1D Hydraulic Modeling

KFA used HEC-RAS version 6.0 to model the channel from upstream at Nixon Drive near Rollingwood Community Playground to approximately 300’ downstream at the intersection of the channel and Stratford Drive. The existing culverts at Pleasant Cove (54” RCP), Hatley Drive (2-7’x4’ RBC), Rockway Drive (3-7’x5’ RBC), and Stratford Drive (2-48” RCP), sizes and inverts were obtained from the field survey. Existing model showed no culvert could handle the 100-year flow.

The purpose of the RAS model is (1) to simulate the box culvert alternative between Pleasant Cove and the Hatley Drive, and size the box culvert; and (2) to size the proposed channel, then applied the channel in the InfoWorks model to refine the proposed alternatives analysis. The cross-section topography was taken from the 2017 LiDAR data. Discussion of the proposed channel improvements and culvert sizing designed with the HEC-RAS model can be found in **Section 8**.

5.2 2D Hydraulic Modeling

KFA used InfoWorks Integrated Catchment Modeling (ICM) version 8.0 to produce a 1D-2D model of the watershed contributing to the study area that includes closed pipe storm drain (simulated in 1D) and open channel elements (simulated in 2D) connected to an overland terrain surface (represented in 2D). A foundational step to the Nixon and Pleasant Drive Drainage Improvements project is to develop an accurate hydraulic simulation of the existing flood characteristics within the project area that has the ability to adequately represent a range of synthetic flood frequency events. The 2D modeling methods for this project are discussed below in **Table 5**.

Table 5: 2D Modeling Methods

Simulation Name	Hydrology	Storm Drain Infrastructure	Channel Improvements
Existing without Drainage Improvement	Rain-on-Mesh	Not Included	Not Included
Existing with Drainage Improvement	Rain-on-Mesh	Included	Included
Ultimate without Drainage Improvements	Rain-on-Mesh	Not Included	Not Included
Ultimate with Drainage Improvements	Rain-on-Mesh	Included	Included

The existing run without drainage improvements (rain-on-mesh) was created to aid in the understanding of overland flow patterns and identified potential areas for spilling in and out of the project area. This model was also developed for comparison to the flows generated from the HEC-HMS model.

The subsequent sections detail the data collection, modeling parameter development, simulation setup, and validation conducted to simulate the stormwater runoff characteristics within the study area, followed by discussion on the flood reduction alternatives development and proposed improvements.

5.2.1 Terrain Development

The 2D component of the ICM model is heavily dependent upon an accurate terrain surface to appropriately simulate surface flow. The 2017 LiDAR data was exported to an ASCII file and imported as the ground model in InfoWorks ICM. The survey dem was also imported into this existing ground model.

5.2.2 2D Simulation Area

The 2D simulation area defines the area of the mesh analyzed in the 2D hydraulic model where it is anticipated to observe overland stormwater runoff. The initial 2D simulation area as was defined by taking the overall outer drainage boundary from the drainage areas within the study area and applying a 500-foot additional buffer.

5.2.3 2D Mesh Parameters

The 2017 LiDAR DEM ground model grid was used to generate the 2D mesh. InfoWorks ICM uses a triangulated grid, or mesh, to calculate flow at each triangle edge. The software has the ability to perform terrain sensitive meshing which can vary triangle sizes in areas with steeper terrain in order to maintain accuracy in areas with larger elevation differences. Additional mesh parameters were assigned to optimize simulation accuracy while balancing overall model runtime and stability. The parameters used to develop the mesh are presented in **Table 6**.

Table 6: 2D Mesh Parameters

Parameter	Value
Maximum Triangle Area (ft ²)	1,200
Minimum Triangle Area (ft ²)	10
Maximum Height Variation (ft)	0.40
Minimum Angle (degree)	25

5.2.4 Roughness Zones

Overland roughness zones account for variation in surface roughness in the 2D mesh, such as the transition from grass to concrete. Four different primary surface types were identified within the 2D simulation area. The 2D hydraulic model used manning’s n-values to define the roughness for various surface types; these are presented in **Table 7**. A separate value for the channel was used to represent its unmaintained condition relative to other open spaces.

Table 7: 2D Roughness Zones

Surface Type	Manning's N-Value
Commercial/Industrial	0.16
Multi Family	0.12
Single Family	0.1
Transportation / ROW	0.02
Open Space	0.04
Limestone Channel	0.035
Open Water	0.035

5.2.5 Storm Drain Infrastructure

Culverts sizes and inverts at Pleasant Cove, Hatley Drive, Rock Way Cove, and Stratford Drive were field surveyed. An 18” RCP at 300 Nixon Drive that transitions to a 20” RCP at the outfall between 303 and 305 Nixon Drive was also field surveyed. Two additional 18” RCP were observed during field visits, one located at 3203 Nixon Drive, and the second between 310 and 305 Pleasant Drive. A few images are included in the figures below showing existing drainage infrastructure. Invert elevations were not obtained in the preliminary survey. Invert elevations for these inverts were based on the terrain data. The existing system is shown in **Exhibit 4** and is also included in **Appendix D**

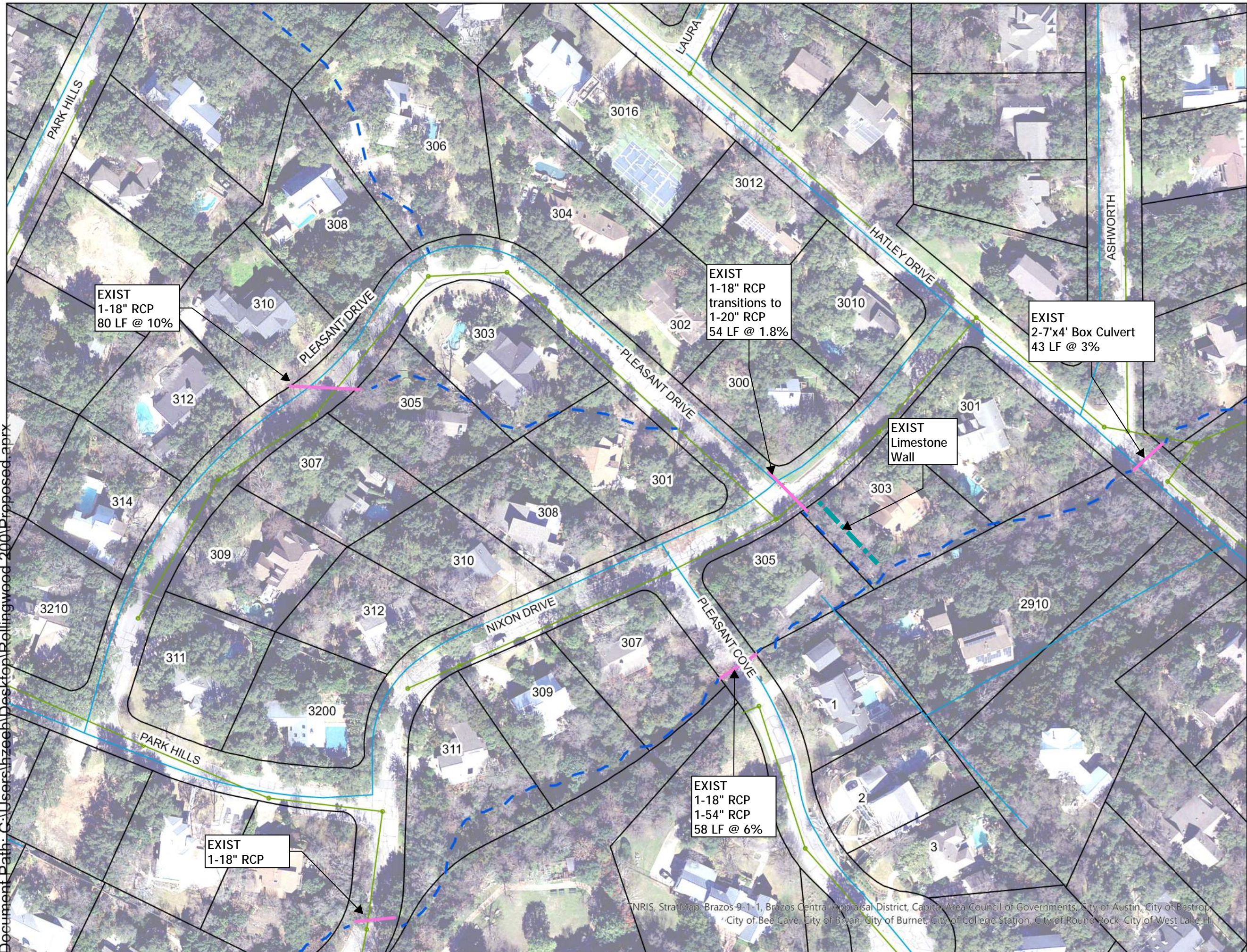


**Figure 7 – Downstream of Pleasant Cove
18-inch and 54-inch RCP, Facing West**



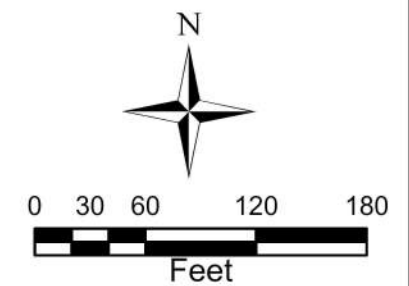
**Figure 8 – Downstream of 301 Pleasant Drive
Private Culvert, Facing Northwest**

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- Legend**
- Existing Waterlines
 - Existing Wastewater
 - Parcels
 - - - Channel
 - Existing Culverts

Exhibit 4
Rollingwood - Nixon/Pleasant
Existing System



Date: 3/10/2021



TNRIS, StratMap, Brazos 9-1-1, Brazos Central Appraisal District, Capital Area Council of Governments, City of Austin, City of Bastrop, City of Bee Cave, City of Bryan, City of Burnet, City of College Station, City of Round Rock, City of West Lake Hills



Figure 9 – Downstream of 20-inch RCP, between 303 and 305 Nixon Drive Facing Northwest



Figure 10 – Upstream of 305 Pleasant Drive Facing Northwest



Figure 11 – Downstream of 306 Pleasant Drive Private Channel, Facing Northwest



Figure 12 – Upstream 310 Pleasant Drive Culvert Facing Southeast

There are several methods for modeling nodes connecting 1D pipes to the 2D surface. InfoWorks ICM has the ability to model inlet capacity for curb and grate inlets using the node type Manhole – Inlet 2D. Inlet parameters such as curb opening height, grate opening area, gutter depression, and gutter depression width were assumed to be TxDOT standard design. Based on the existing model results, three areas were identified that received large amounts of concentrated storm water flows. The first location is between 303 and 305 Pleasant Drive, the second location is at 306 Pleasant Drive, and the third one is between 314 and 312 Pleasant Drive. The culvert inlet structures (culvert with headwall) were built in ICM model to allow the proposed storm sewer inlets to catch the most water in a culvert with headwall type inlet. Roadway cross slopes were assumed to be 2 percent at all locations.

5.2.6 2D Channels

The vegetated trapezoidal channel southeast of Nixon Drive was modeled as a 2D reach to stabilize the models and appropriately distribute the transition from 1D to 2D flow across the uniform manmade channels. Cross sections based on RAS model (proposed channel) were added to the reaches to represent the channel using Mesh Level Zone. Banklines and inline banks were added to the reaches to connect the 1D channel to the 2D surface at Hatley Drive culvert. These lines allow flow exceeding the capacity of the cross-sections to spill laterally onto the 2D surface.

5.2.7 Boundary Conditions

The normal depth boundary condition is utilized in this analysis for each of the hydraulic model runs to establish the starting water surface elevations at the downstream boundary. Normal depth is established by calculating the average slope of the channel, which was taken far enough downstream of the study area points of interest to remove errors that may exist. The boundary condition was also checked for contributing influences from the Colorado River, also known as tailwater conditions. A watershed area comparison was performed to evaluate the timing of the peaks for the localized storm drainage system for this study and the much larger contributing drainage area of the Colorado River. Due to the large size disparity between the two systems, the probability of the river peaking at the same time as the Nixon/Pleasant area is highly unlikely.

5.2.8 Hydraulic Results – Existing Conditions

5.2.8.1 HEC-HMS vs ICM Model

The ICM Model uses excess rainfall from the storm events and distributes it over the watershed. The existing conditions, for the HEC-HMS model and the ICM model peak discharges were compared to confirm the accuracy of the flows from the two models. The peak flows from the two models are within 6% of each other in the two models. The flows comparison between HEC-HMS model and the ICM model are listed in **Table 8**.

Table 8: Flow comparison, HEC-HMS vs. ICM under existing conditions

Locations	Drainage Area (MI2)	HEC-HMS Results				ICM Results		Comparison	
		25-yr HEC-HMS (CFS)	Excess Prep (IN)	100-yr HEC-HMS (CFS)	Excess Prep (IN)	25-yr InfoWorks (CFS)	100-yr InfoWorks (CFS)	25-yr Diff (CFS)	100-yr Diff (CFS)
Hatley Dr. (J_14)	0.154	783	7.5	1031	11.3	792	1083	9	51
Nixon-Pleasant (J_18_06)	0.055	274	7.5	370	11.3	294	452	20	82
Pleasant Cove (J_23_27)	0.084	444	7.5	600	11.3	482	599	38	-1
Pleasant Dr Middle (R_07)	0.027	129	7.5	175	11.3	132	171	3	-4
Pleasant_Upper (R_19)	0.015	85	7.5	115	11.3	92	130	7	15
Rocky Way (J_20_26)	0.184	904	7.43	1223	11.2	855	1211	-49	-12
Stratford Dr (J_17_04)	0.235	1071	7.36	1450	11.1	1042	1041	-29	-29

The flow results calculated using the HEC-HMS model correlates closely to the ICM model with some minor computed differences in flows. The possible reason is that the ICM model was applied the uniformly excess rainfall distribution (rain on Mesh), whereas the HEC-HMS model was based on the basin curve number and the impervious cover percentage.

5.2.8.2 Existing vs Proposed ICM Model

The flows, water depths, velocities, and the water surface elevations are compared in ICM models, under the existing and the proposed conditions. This specifically models the storm sewer system along Pleasant Drive, the limestone channel improvements, and the culvert upgrade at Hatley Drive. To evaluate public safety for street flow, flow of water will be limited to a maximum of 6 inches depth for the 25-year and a maximum flow velocity of 10 ft/s.

Table 9: 25-year Flow, depth, velocity, and water surface elevation comparison (ICM model)

Points of Interest	Existing Conditions (25)				Prop Conditions (25yr)			
	Flow (cfs)	Depth (ft)	Velocity (ft/s)	WSE (MSL)	Flow (cfs)	Depth (ft)	Velocity (ft/s)	WSE (MSL)
312 Pleasant Dr.	112	0.96	6.07	594.94	11.00	0.30	3.12	594.50
307 Pleasant Dr.	109	0.76	4.26	589.21	13.00	0.91	1.73	589.50
306 Pleasant Dr.	114	1.02	5.72	589.20	5.00	0.54	1.07	587.15
305 Pleasant Dr.	143	1.22	4.22	584.12	30.00	0.75	3.04	584.15
303 Pleasant Dr.	216	1.52	3.05	567.85	12.00	0.28	1.49	572.12
300 Pleasant Dr.	311	2.27	4.78	562.94	2.00	1.25	0.48	558.76
303 Nixon Dr.	318	1.52	4.07	560.47	12.00	0.48	1.49	560.00
Hatley Dr.	792	8.12	3.08	559.97	757.00	6.48	3.17	557.36
Rocky Way Cove	855	7.22	3.54	544.86	829.00	6.29	4.49	543.93
Stratford Dr.	1042	8.46	4.35	534.45	1038.00	7.65	5.39	529.24

Table 10: 100-year Flow, depth, velocity, and water surface elevation (WSE) comparison (ICM model)

Points of Interest	Existing Conditions (100yr)				Prop Conditions (100yr)			
	Flow (cfs)	Depth (ft)	Velocity (ft/s)	WSE (MSL)	Flow (cfs)	Depth (ft)	Velocity (ft/s)	WSE (MSL)
312 Pleasant Dr.	123	0.89	6.94	596.54	15	0.45	3.58	594.16
307 Pleasant Dr.	183	1.26	5.10	590.10	21	0.98	1.98	589.58
306 Pleasant Dr.	171	1.36	6.37	589.46	5	0.52	1.18	587.33
305 Pleasant Dr.	198	1.26	6.05	584.40	51	0.79	3.24	584.20
303 Pleasant Dr.	313	1.67	4.45	573.40	18	0.39	3.14	572.38
300 Pleasant Dr.	454	4.14	5.48	568.06	2	1.82	0.56	564.45
303 Nixon Dr.	456	1.67	4.45	562.40	19	0.85	2.33	559.16
Hatley Dr.	1082	8.96	3.82	562.05	1014	8.44	2.89	560.60
Rock Way Cove	1211	8.05	3.74	544.89	1105	7.08	5.28	544.68
Stratford Dr.	1421	9.21	5.13	534.65	1347	8.87	4.78	533.95

As can be seen from the table, under the proposed conditions, the flow, depth, velocity, and water surface elevation are all reduced along the properties along the Pleasant Drive, because the proposed storm sewer system collected the majority of the surface water and discharges to the channel through the storm sewer pipe system. The proposed Limestone channel also dramatically reduced the flood inundation area for the properties along the channel, particularly the 301, 303, 305 Nixon Drive properties, as well as 1 Pleasant Cove, and 2910 Hatley Drive.

6 DRAINAGE IMPROVEMENTS OUTSIDE OF PROJECT AREA

During the preliminary design and modeling process for the PER several other areas outside of the project study area were identified that would benefit from drainage infrastructure improvements. The areas of potential drainage improvements outside of the project are depicted in **Exhibit 5**, identified with numbered triangles. This exhibit can also be found in **Appendix D**.

6.1 Area 1: Drainage Improvement Outside Project Area

Area 1, located approximately 500 LF upstream of Pleasant Cove, on Nixon Drive is known to have roadway flooding and system capacity issues.

The drainage infrastructure consists of a single 18-inch RCP which is undersized for the amount of flow received. The hydraulic modeling results performed as part of this study indicate that flow depths for the 100-year frequency storm event are approximately 2 feet which presents a hazardous public safety and flood risk concern.

KFA proposes that additional analysis be performed in this area to further quantify the issues and identify potential mitigating solutions. It is anticipated that at a minimum the existing 18-inch culvert will need to be upsized to accommodate the receiving flows. In the interim, it is recommended that this culvert be frequently inspected and cleaned ahead of and after significant storm events and periodically cleaned to ensure the full hydraulic capacity of the culvert is being utilized.



Figure 13 – 18-inch Culvert on Nixon Drive Facing Northwest

6.2 Area 2: Drainage Improvement Outside Project Area

Area 2 consists of the drainage culvert and inlet located on Pleasant Cove. This area of interest is known to have roadway flooding and system capacity issues.

The drainage infrastructure consists of a single curb inlet on Pleasant Cove which discharges into the main channel thru an 18-inch RCP. The existing inlet is undersized and quickly overwhelmed by the contributing runoff received in the roadway. In addition, the 54-inch culvert crossing has insufficient capacity to drain the main channel and requires upsizing.

The scope of the improvement are anticipated to include upsizing the 54" RCP to a bridge-class culvert crossing and that channel improvements be performed from Pleasant Cove to upstream limits of the Nixon/Pleasant drainage improvements project.



Figure 14 – 18-inch and 54-inch Culverts at Pleasant Cove Facing West

6.3 Area 3: Drainage Improvement Outside Project Area

Area 3 is located approximately 1,000 LF downstream of the study area at the Stratford Drive culvert crossing. The proposed storm sewer improvements for the current area of Nixon Drive and Pleasant Drive included in this report do not make the conditions at this crossing worse than the existing conditions. However, in the process of modeling downstream impacts, KFA found that the current culverts, 2-48-inch concrete pipes, are undersized to handle the upstream flow for both the 25-year and 100-year storm event. The scope of work of the improvements anticipated includes the upsizing of the 2-48” culverts and minor channel improvements directly upstream and downstream of the culvert crossing.

Potential Future Drainage Improvements Located Outside of Study Area:

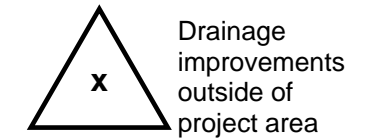
- 1 The existing 18" culvert at Nixon Drive is undersized for existing flows and storm water frequently overtops the roadway. This area would benefit from the upsizing of the culvert to reduce or eliminate storm water ponding and overtopping the roadway. Additional analysis is needed to determine the size of the culvert(s).
- 2 The existing curb inlet and 18" storm sewer is undersized for existing flow as well as the 54" culvert under Pleasant Cove. This area would benefit from an additional storm sewer system construction upstream of the existing inlet on Pleasant Cove. The upsizing of the culvert crossing at Pleasant Cove would also benefit the area by reducing or eliminating the frequency of the roadway overtopping and increasing the capacity of the culvert under the roadway. Additional analysis is needed to determine the size of the culvert(s) and storm sewer system.
- 3 The existing 2-48" culverts at Stratford Drive are currently undersized for existing flows. This area would benefit from the upsizing of the culvert to eliminate or reduce the frequency of stormwater overtopping the roadway. Additional analysis is needed to determine the size of the culvert(s).

Legend

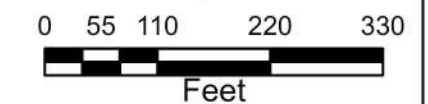
- Existing Waterlines
- Existing Wastewater
- Parcels
- Channel
- Existing Culverts

Depth (ft)

- ≤0.300
- ≤0.600
- ≤1.000
- ≤1.500
- ≤3.000
- ≤4.500
- ≤7.000
- ≤20.000



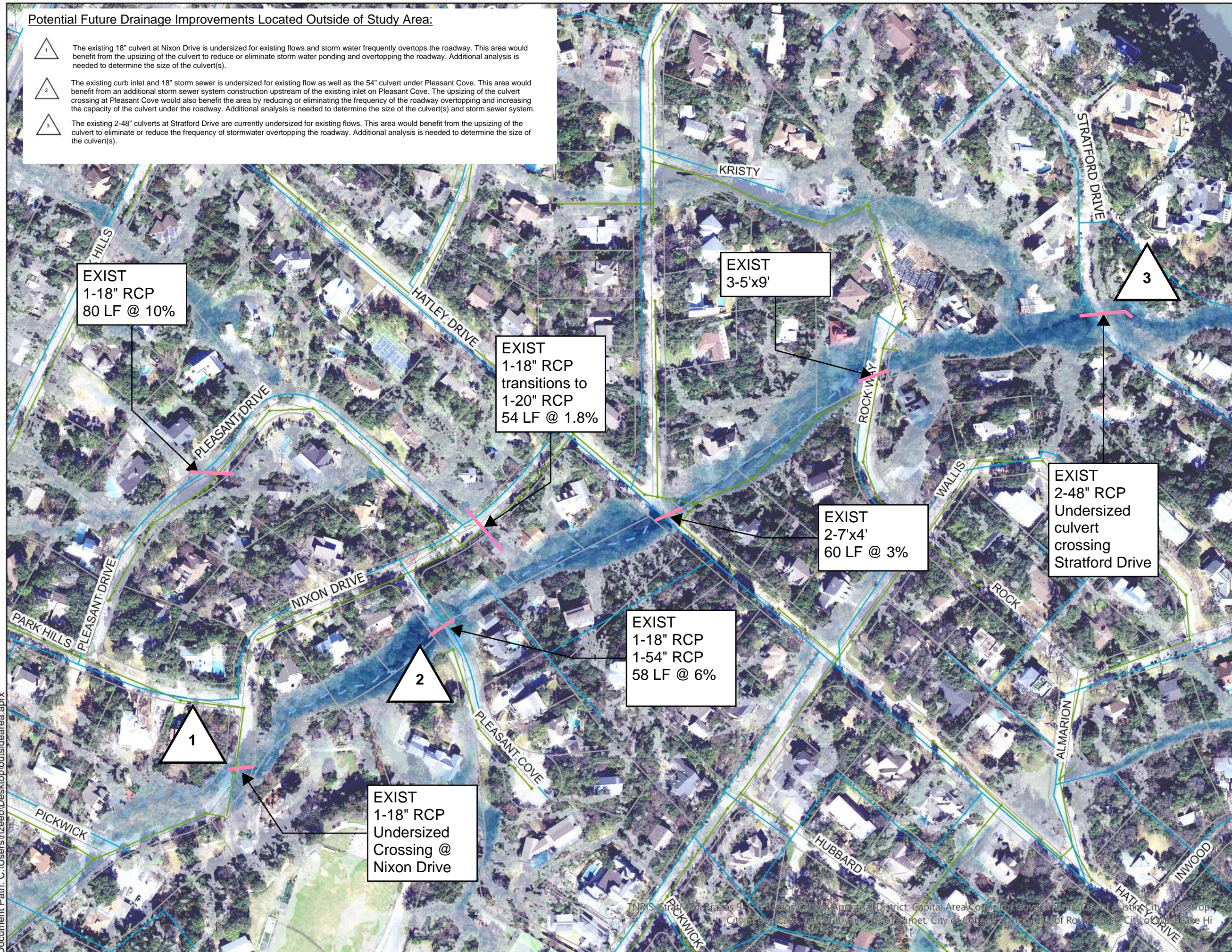
Rollingwood - Nixon/Pleasant
Exhibit 5
Drainage Improvements outside of Project Area



Date: 2/24/2021



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TNRIS, Stratford, Brazos 9, Brazos Canal, Appraisal District, Capital Area Council of Governments, City of Austin, City of Bastrop, City of Bee Cave, City of Bryan, City of Driest, City of College Station, City of Round Rock, City of Westlake, HI

7 ALTERNATIVE ANALYSIS AND RESULTS

The purpose of this PER is for planning purposes only and serves to evaluate the relative benefits of the mitigation strategies developed herein, in order to guide the City in selecting a viable and cost-effective design option for mitigating the flooding and public safety issues occurring around the Nixon Drive and Pleasant Drive area.

The flooding problems that this PER focuses on are reducing the flood depths and dangerous velocities at the Nixon and Pleasant Drive intersection, reducing property flooding, and improving hydraulic conveyance capacity of the main channel behind Nixon Drive that discharges under Hatley Drive.

Evaluations of alternatives were performed for a variety of flood mitigation options using ICM 2D and HEC-RAS 1D hydraulic simulations in order to determine their feasibility. The existing conditions ICM model was used as a baseline condition; the proposed solution was modeled using inflows from the proposed conditions HMS model. Several alternative options and combinations of options were analyzed to facilitate cooperation between the City, and private landowners regarding which infrastructure is within whose right-of-way and to facilitate construction phasing for future flood mitigation projects.

Appendix C includes several inundation maps for the 25- and 100- year floods of the existing and proposed. **Appendix D** includes the existing and proposed storm drain designs for the alternative as well as the potential easements needed. **Appendix E** includes the typical channel cross sections for the proposed solution.

These alternatives included multiple channel modification scenarios, bridge/culvert replacement options, storm drain pipe and inlet systems configurations and phasing strategies.

7.1 Cost Analysis

The estimated costs for each alternative include materials and construction costs, which are based on recent bid tabulations and unit prices for similar regional construction projects, as well as soft costs which are assumed as follows:

- General Conditions – Mobilization, insurance, bonds, Prep ROW, and SW3P: 22%
- Professional Services – Civil Engineering Design, Geotechnical Investigation, additional Environmental Investigation, and Surveying Services: 15%. The professional services assume all phases of the project will be designed, surveyed, and have the geotechnical investigation done simultaneously for cost savings.
- Contingency: 30%

Average unit bid prices from the Texas Department of Transportation (Austin District), bid prices obtained from similar projects, and engineering judgement were utilized for cost estimating. Detailed cost estimates with phasing for the alternative can be found in **Appendix F**.

7.2 Proposed Channel Improvement (Hatley Drive to Pleasant Drive)

Multiple channel improvement options were evaluated from Hatley Drive to the intersection of Pleasant Drive and Nixon Drive.

The proposed scenarios included the following:

7.2.1 Option 1: Earthen Trapezoidal Channel

Option 1 consists of constructing an earthen trapezoidal channel, removal/relocation of encroaching structures, land acquisition for easement, and selective clearing to increase the capacity of the channel. The length of the trapezoidal grass-lined natural channel is approximately 360 LF with a 30 foot channel bottom, 2 to 4 foot channel depth, 3:1 side slopes, and 1.5% running slope, with total easement width needs of approximately 85 LF.

Project Benefits: The project will provide benefits by channelizing the storm water flow at the back of the properties between Hatley Drive to the intersection of Pleasant Drive and Nixon Drive.

Environmental Impact: These proposed improvements associated with the reconstruction and widening of the existing natural channel will result in potential disturbances to the Waters of the U.S. A Jurisdictional Determination is recommended prior to construction. The improvements may require the removal of a significant number of trees and vegetation. The environmental investigation did not see any suitable habitat for endangered species that are known to live within a 0.5 mile radius of the project site, so the impacts to wildlife is anticipated to be minimal.

Land Acquisition Needs: It is estimated that approximately 30,600 SF of land acquisition will be required from property owners. This option would require a significant amount of land acquisition for the property owners adjacent to the channel improvements and relocation of structures encroaching within the proposed easement.

Utility Relocation Needs: Two utility easements with a combined width of 17.5 feet contain several existing utility poles in the channel. These utility poles may need to be relocated with the construction of the channel. The total number of utility poles that require relocation will be determined with the design level survey during the next phase of design for this project.

Project Cost: Total design and construction costs are estimated to \$222,000 for this scenario.

7.2.2 Option 2: Concrete or Mechanically Stabilized Earthen Wall

Option 2 consists of constructing a near vertical rectangular channel section, removal/relocation of encroaching structures, land acquisition for easement, and selective clearing to increase the capacity of the channel. The length of the rectangular hard-armored channel is approximately 360 LF with a 30-foot channel bottom, varying channel depth depending on existing topography, near vertical side slopes, 1.5% running slope and a total easement width need of approximately 50 LF wide. Several pictures of options for what the potential channel improvements could look like are shown in **Figure 15** and **Figure 16**, but are by no means the only options available for lining the channel. The engineers will work with the City and the homeowners on the final look of the lined channel to ensure it is both function and aesthetically pleasing.



Figure 15: Dry Stacked Limestone Wall Lined Channel with Guardrail



Figure 16: Rock Gabion Wall Lined Channel with Guardrail

Project Benefits: The project will provide benefits by reducing easement needs, improving hydraulic capacity, providing flood reduction depths of up to 1.5 ft for the adjacent property owners at 303 and 301 Nixon Drive.

Environmental Impact: These proposed improvements associated with the reconstruction of the existing natural channel will result in potential disturbances to the Waters of the U.S. A Jurisdictional Determination is recommended prior to construction. The improvements may require the removal of a significant number of trees and vegetation. The environmental investigation did

not see any suitable habitat for endangered species that are known to live within a 0.5 mile radius of the project site, so the impacts to wildlife is anticipated to be minimal

Land Acquisition Needs: It is estimated that approximately 19,000 SF of land acquisition will be required from property owners. The land acquisition will include both the area needed for the channel as well as an access path for channel maintenance. The land acquisition needs are significantly decreased from the land needed for option 1.

Utility Relocation Needs: Two utility easements with a combined width of 17.5 feet contain several existing utility poles in the channel. These utility poles may need to be relocated with the construction of the channel. The total number of utility poles that require relocation will be determined with the design level survey during the next phase of design for this project.

Project Cost: Total design and construction costs are estimated to be \$513,000 for this scenario.

7.2.3 Option 3: Concrete Box Culvert

Option 3 consists of constructing a reinforced concrete box (RCB) culvert, removal/relocation of encroaching structures, land acquisition for easement, and selective clearing to increase the capacity of the channel. The length of the RCB culvert is approximately 580 LF and would consist of 2- 10' wide by 6' tall box culverts, and a total easement width need of approximately 50 feet wide. This scenario would also require the existing culvert at Hatley Drive to be upgraded to 2- 10'x6' box culverts.

Project Benefits: The project will provide benefits by containing the majority of the storm water flow in a closed system.

Environmental Impact: These proposed improvements associated with the reconstruction of the existing natural channel will result in potential disturbances to the Waters of the U.S. A Jurisdictional Determination is recommended prior to construction. The improvements may require the removal of a significant number of trees and vegetation. The environmental investigation did not see any suitable habitat for endangered species that are known to live within a 0.5 mile radius of the project site, so the impacts to wildlife is anticipated to be minimal. A karst survey is also recommended for the area to identify any caves or subsurface voids.

Land Acquisition Needs: It is estimated that approximately 29,000 SF of land acquisition will be required from property owners. This option would also entail significant alterations to the existing terrain, including filling in a significant amount of the backyards of 301, 303 and 305 Nixon Drive, as well as filling in the back and side yards of 2910 Hatley Drive and 1 Pleasant Cove to accommodate the large box culverts resulting in significant environmental impacts.

Utility Relocation Needs: Two utility easements with a combined width of 17.5 feet contain several existing utility poles in the channel. These utility poles may need to be relocated with the construction of the channel. The total number of utility poles that require relocation will be determined with the design level survey during the next phase of design for this project.

Project Cost: Total design and construction costs are estimated to be approximately \$2 million for this scenario. This scenario was ultimately deemed cost prohibitive.

7.3 Hatley Drive Box Culvert Upsizing

The existing box culverts at Hatley Drive consist of 2-7'x4' Reinforced Concrete Boxes (RCB). Under existing conditions, the culvert is currently undersized for both the 25-year and 100-year storm event. The 20-year storm has approximately 20 cfs of flow overtopping the roadway and the 100-year storm event has approximately 172 cfs of flow overtopping Hatley Drive.

To increase the capacity of this culvert and reduce the frequency of roadway overtopping, the culvert at Hatley Drive is proposed to be upsized to 2-7'x5' RCBs with wingwalls. The upstream and downstream inverts of the culvert are also proposed to be lowered to allow for more capacity in the culvert by increasing the slope through the culvert. The upsized culverts can handle approximately 1050 cfs of the modeled 1082 cfs for the 100-year storm. The excess flow would equate to approximately 32 cfs of water overtopping Hatley Drive at this culvert in the 100-year storm event.

The existing run with drainage and channel improvements were modeled to simulate the flood inundation along Pleasant Drive with the proposed storm sewer system, and the channel with proposed Limestone channel improvements from Pleasant Drive to Hatley Drive. The proposed channel improvement starts at the Hatley Drive Culvert (2-7'x5') to approximately 360 ft upstream, 70 ft downstream of the Pleasant Cove. See Table 11 below for culverts size details.

The ultimate runs without and with drainage and channel improvements were used to simulate the ultimate (future land use) conditions.

Table 11: Culvert size details

Location	Culvert size	Length (ft)	US Invert (ft)	DS Invert (ft)	Prop Culvert Size	Prop US Invert (ft)	Prop DS Invert (ft)
Pleasant Cove	1-54" RCP	54.48	563.2	562.47	N/A		
Hatley Drive	2-7'x4' MBC	42.74/ 42.11	551.7/ 551.74	551.65/ 551.62	2-7'x5' MBC	550.6	548.8
Rocky Way	3-7'x5' MBC	45.77/45.7 4/46.18	538.22/537. 7/537.46	537.47/537.4 7/537.46	N/A		
Stratford Drive	2-48" RCP	70.99/ 70.93	520.73/ 520.77	519.85/ 519.58	N/A		

Project Benefits: This portion of the project would increase the capacity of the culverts at Hatley drive reducing the amount of water that overtops the roadway in 25-year and larger storm events. I would also further reduce the flooding experience upstream of the culvert due to the increased capacity.

Environmental Impacts: These proposed improvements associated with the reconstruction of the existing natural channel will result in potential disturbances to the Waters of the U.S. A Jurisdictional Determination is recommended prior to construction. The improvements may require the removal of a significant number of trees and vegetation. The environmental investigation did not see any suitable habitat for endangered species that are known to live within a 0.5 mile radius of the project site, so the

impacts to wildlife is anticipated to be minimal. A karst survey is also recommended for the area to identify any caves or subsurface voids.

Land Acquisition Needs: No land acquisition needs are anticipated for the portion of the project. Improvements are anticipated to be contained within the right-of-way.

Utility Relocation Needs: It is anticipated that the waterline that crosses Hatley Drive would need to have temporary measures put in place during construction to support the waterline, but would ultimately be returned to the pre-construction location.

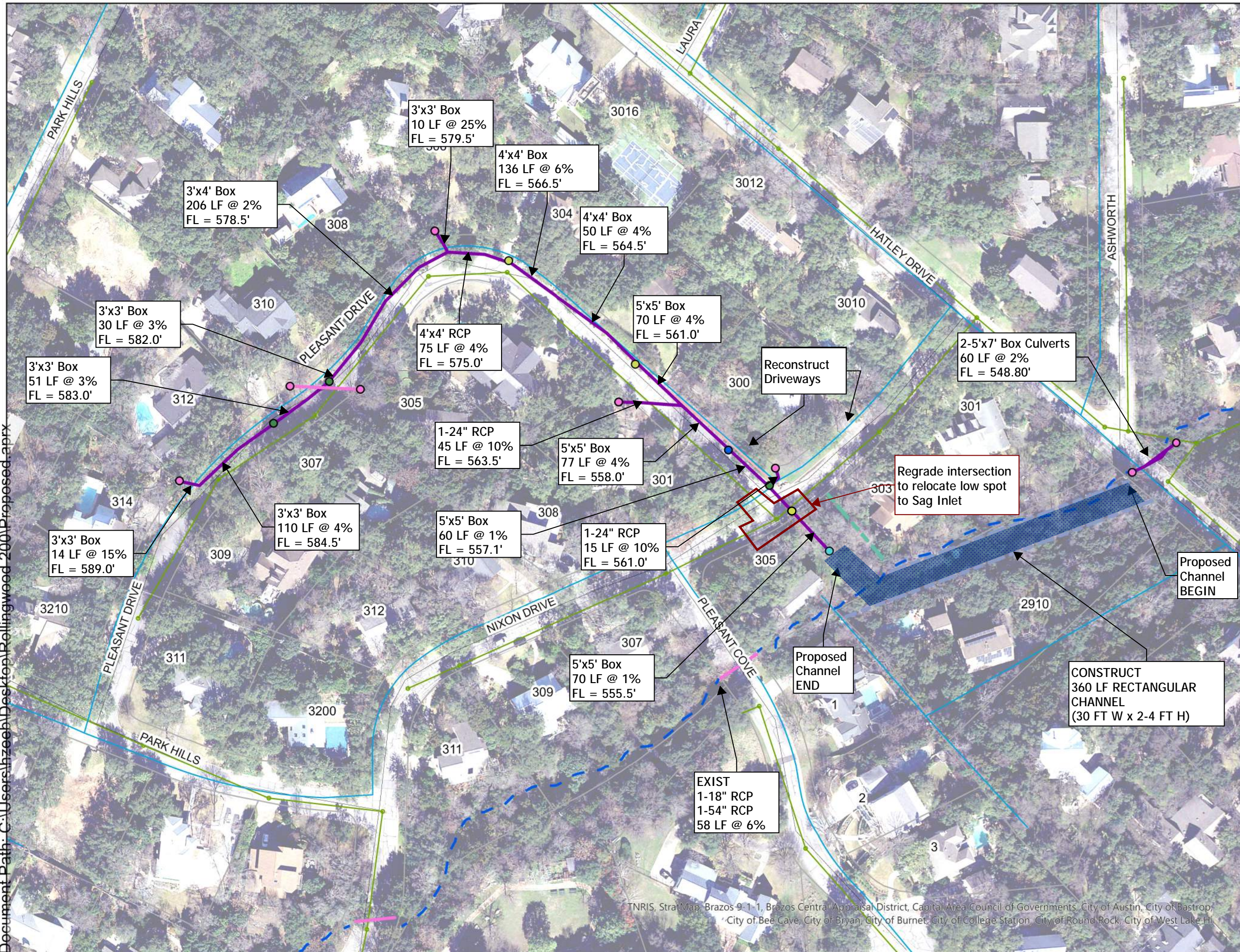
Project Cost: Total design and construction costs are estimated to be \$304,000 for the Hatley Drive culvert upsizing.

7.4 Proposed Storm Drain Improvements (Nixon Drive to 312 Pleasant Drive)

Storm drain improvement configurations were evaluated from the intersection of Pleasant Drive and Nixon Drive to 312 Pleasant Drive. Only one scenario is presented with potential phasing configurations as follows. The three segment options presented below need to be constructed in order from downstream to upstream or from Segment 1, Segment 2, and finally Segment 3.

During the construction phases of the project, the contractor will be open cutting in the roadway to install the storm sewer and inlets and disturbing the existing channel to install the proposed improvements. The contractor will be responsible for restoring the pavement as well as revegetating the earthen areas that are disturbed to pre-construction conditions before the project can be closed out and final payment is made to the contractor. This gives the City assurances that the project area will be properly restored to existing conditions or better prior to the contractor finishing out their contractual obligations. The complete improvements are shown in **Exhibit 6** in **Appendix D** and described in the following sections of the report. Sections 7.3.1 – Section 7.3.3 break down the system into segments that can be constructed in a phase approached. These are shown in **Exhibit 7** also in **Appendix D**.

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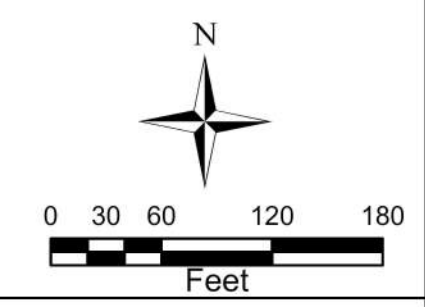
Legend

- Existing Waterlines
- Existing Wastewater
- Parcels
- Proposed System
- Channel
- Existing Culverts
- Proposed 1' Berm
- Limestone Walls
- Existing
- Proposed
- Proposed Inlets
- 20' Curb Inlet
- Culvert Headwall
- Curb Inlet
- Curb Inlet Sag
- Outfall

Exhibit 6

Rollingwood - Nixon/Pleasant

Proposed System

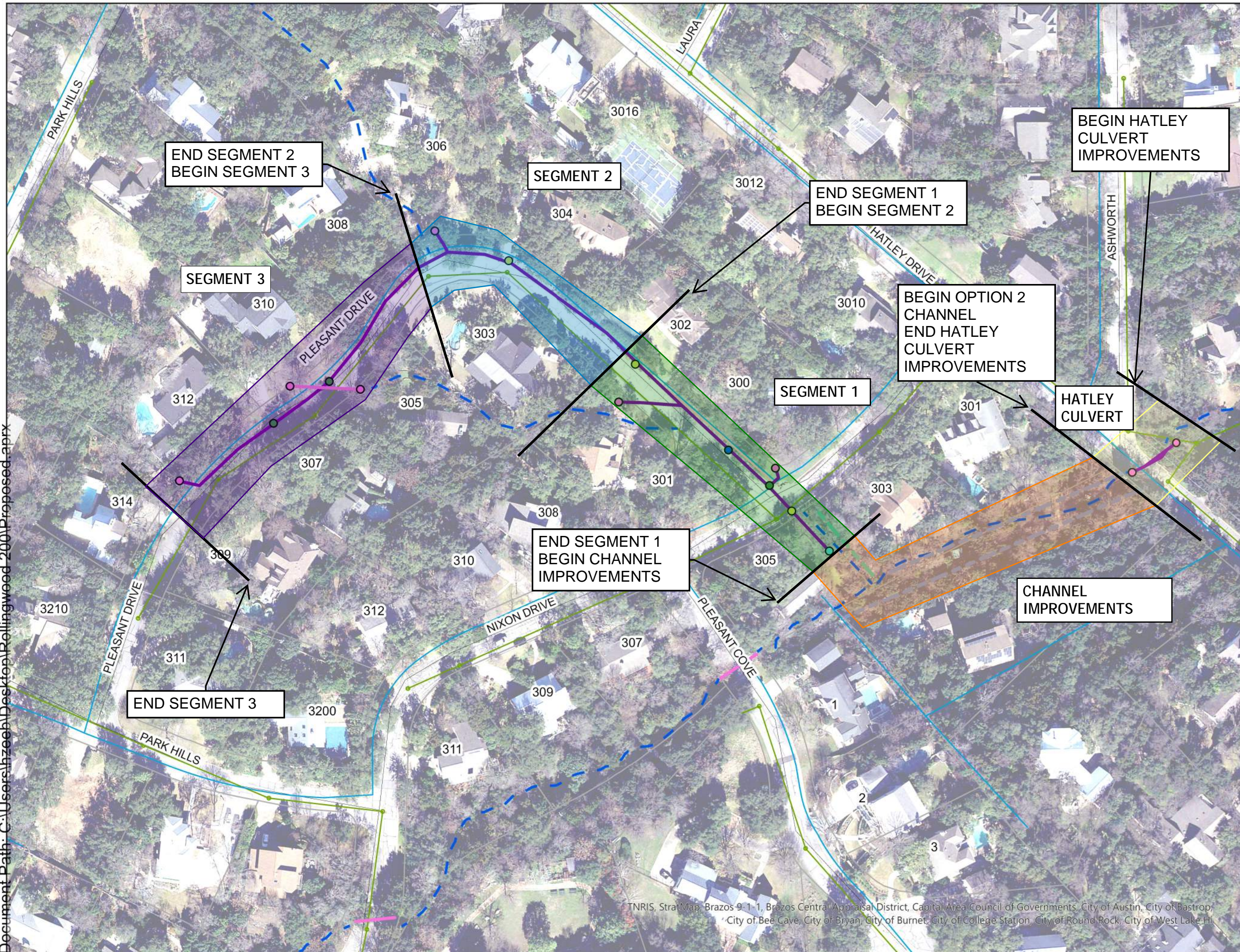


Date: 3/9/2021



TNRIS, StratMap, Brazos 9-1-1, Brazos Central Appraisal District, Capital Area Council of Governments, City of Austin, City of Bastrop, City of Bee Cave, City of Bryan, City of Burnet, City of College Station, City of Round Rock, City of West Lake Hills

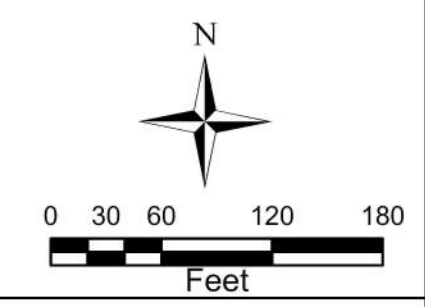
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Legend

- Existing Waterlines
- Existing Wastewater
- Parcels
- Proposed System
- Channel
- Existing Culverts
- Proposed 1' Berm
- Limestone Walls
- Existing
- Proposed
- Proposed Inlets
- 20' Curb Inlet
- Culvert Headwall
- Curb Inlet
- Curb Inlet Sag
- Outfall

Exhibit 7
Rollingwood - Nixon/Pleasant
Proposed Phasing



Date: 3/15/2021



TNRIS, StratMap, Brazos 9-1-1, Brazos Central Appraisal District, Capital Area Council of Governments, City of Austin, City of Bastrop, City of Bee Cave, City of Bryan, City of Burnet, City of College Station, City of Round Rock, City of West Lake Hills

7.4.1 Segment 1 from Nixon Drive to 302 Pleasant Drive

This segment includes the construction of a 5-foot reinforced concrete box that discharges into the existing channel between the 303 and 305 properties on Nixon Drive. The 5-foot box would continue upstream to the middle of the 302 Pleasant Drive Property. A 24-inch culvert would also be constructed to collect the storm water flow that accumulates in the low spot of 300 Pleasant Drive and tie into the 5-foot box. A safety guardrail or a saw tooth curb is also proposed for traffic safety at the corner for the proposed culvert installation. The ultimate safety solution will be determined with the final design. Four additional curb inlets are proposed from the intersection of Nixon and Pleasant Drive up to 302 Pleasant Drive. A culvert and headwall at 301 Pleasant Drive is proposed to capture the upstream flows that normally enter Pleasant Drive at this location.

This segment also includes the reconstruction and regrading of the intersection of Nixon Drive and Pleasant Drive to relocate the low spot to the intersection. One of the four inlets previously mentioned is proposed near the intersection and the new proposed low spot to collect flows that accumulate at the low spot and collect flows that travel down Nixon Drive from Hatley Drive. The two driveways at 300 Pleasant Drive are also proposed to be reconstructed to help prevent storm water that is flowing down the adjacent roadway from entering the property as well as extending the height of the curb along 300 Pleasant Drive to help contain larger stormwater flows in the roadway.

Project Benefits: Segment 1 will consist of repaving and regrading the intersection of Nixon Drive and Pleasant Drive. The existing low spot located on Nixon Drive in front of 300 Pleasant Drive accumulates ponding water during rain events that creates a hazard for cars traveling through the area. When the depth of ponding exceeds the curb height the storm water travels into the neighboring property at 301 Nixon Drive. The proposed improvements will relocate the low spot to the intersection and an inlet is proposed to collect the water that flows to the new low spot. A culvert is also proposed to be installed at 301 Pleasant Drive to capture a portion of the stormwater flow before it enters Pleasant Drive and creates downstream flooding issues. Two additional inlets are proposed in segment 1 that will capture additional storm water flows in the roadway. These proposed improvements will create significant benefits for smaller storm events such as the 2-year and 10-year events. The full benefits of the storm sewer improvements will not be seen for large storm events like the 25-year and 100-year events until the full build out of all three segments is complete.

Environmental Impact: A karst survey is recommended for the area to identify any caves or subsurface voids. The environmental investigation did not see any suitable habitat for endangered species that are known to live within a 0.5 mile radius of the project site, so the impacts to wildlife is anticipated to be minimal. The majority of these improvements are located within existing City right-of-way with minimal to no environmental impacts.

Land Acquisition Needs: A potential easement may be necessary at 301 Pleasant Drive that is approximately 15-foot x 14-foot and an easement that is approximately 20-foot x 110-foot obtained from the property owners of 303 and 305 Nixon Drive. **Exhibit 8** below illustrates the proposed easements and is also included in **Appendix D**.

Project Cost: Total design and construction costs are estimated to be approximately \$451,000 for this Segment of storm sewer improvements.

7.4.2 Segment 2 from 302 Pleasant Drive to 306 Pleasant Drive

Segment 2 consists of the installation of storm sewer improvements from 302 to 306 Pleasant Drive. A culvert entrance and headwall is proposed to be installed at 306 Pleasant Drive where there is a significant amount of concentrated flow that enters Pleasant Drive. An additional inlet is proposed just downstream of the culvert entrance to capture flows that may bypass the culvert inlet in larger storm events, such as the 100-year storm.

Project Benefits: The main benefit of this segment of storm sewer improvements is the installation of the culvert at 306 Pleasant Drive that captures approximately 166 cfs of storm water that currently drains to Pleasant Drive from upstream in the watershed for the 100-year storm event. The location of this culvert will allow the majority of the flow that enters Pleasant Drive at this location to be captured before it continues downstream on Pleasant drive at a quick rate and creates ponding issues in the street and flooding of downstream properties.

Environmental Impact: The environmental impacts for this segment of storm sewer installation would be negligible due to the fact that the majority of the improvements will be installed within existing City right-of-way.

Land Acquisition Needs: A potential easement may be necessary at 306 Pleasant Drive that is approximately 15-feet x 20-feet.

Project Cost: Total design and construction costs are estimated to be approximately \$278,000 for this Segment of storm sewer improvements.

7.4.3 Segment 3 from 306 Pleasant Drive to 312 Pleasant Drive

This segment would complete the storm sewer improvements proposed in the PER from 306 Pleasant Drive to 312 Pleasant Drive. The storm sewer main would transition from a 3'x 4' box to a 3-foot box with two proposed curb inlets. A 36-foot box culvert entrance is proposed at 312 Pleasant Drive to collect the concentrated flow that enters Pleasant Drive from further upstream in the watershed. This option would also take advantage of the existing 18" culvert that carries flow from 310 Pleasant Drive to 305 Pleasant Drive.

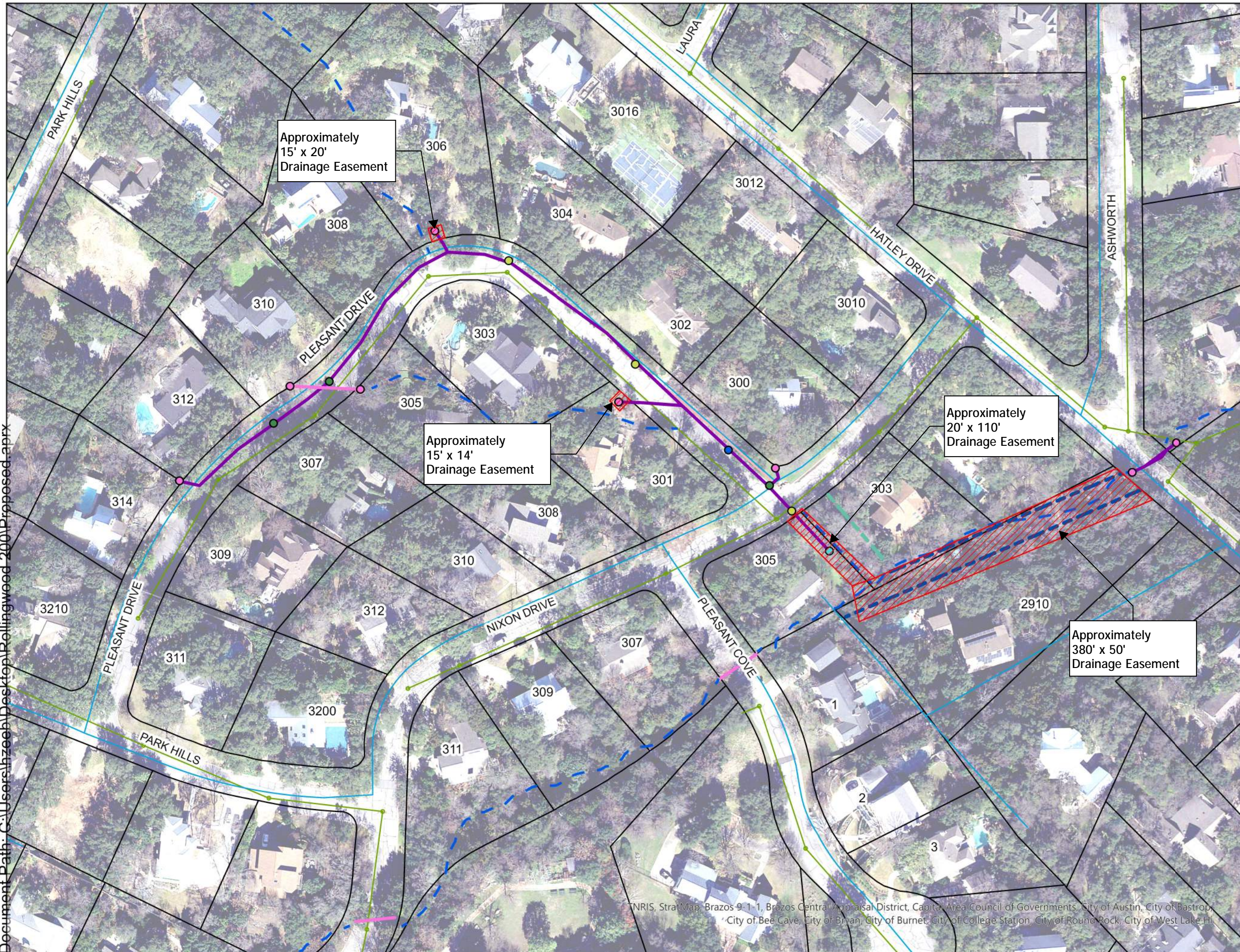
Project Benefits: The third and final segment of storm sewer completes the proposed storm sewer improvements proposed in the PER. This final phase would collect the concentrated flows before it enters Pleasant Drive at the 312 Pleasant Drive property. Additional inlets are located along Pleasant Drive to capture the majority of the storm water flows that come down Pleasant Drive or bypass the culvert at 312 Pleasant Drive in large storm events.

Environmental Impact: The environmental impacts for this segment of storm sewer installation are anticipated to be negligible due to the fact that the majority of the improvements will be installed within existing City right-of-way.

Land Acquisition Needs: No easement needs are anticipated for this segment of the project.

Project Cost: Total design and construction costs are estimated to be approximately \$357,000 for this Segment of storm sewer improvements.

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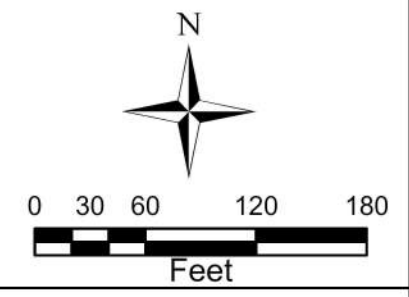
Legend

- Existing Waterlines
- Existing Wastewater
- ▭ Parcels
- Proposed System
- - Channel
- Existing Culverts
- Proposed 1' Berm
- Limestone Walls
- - Existing
- - Proposed
- Proposed Inlets
- 20' Curb Inlet
- Culvert Headwall
- Curb Inlet
- Curb Inlet Sag
- Outfall
- ▨ Proposed Easements

Exhibit 8

Rollingwood - Nixon/Pleasant

Proposed Easements



Date: 3/11/2021



K·FRIESE + ASSOCIATES

PUBLIC PROJECT ENGINEERING

FIRM NO. 6535

TNRIS, StratMap, Brazos 9-1-1, Brazos Central Appraisal District, Capital Area Council of Governments, City of Austin, City of Bastrop, City of Bee Cave, City of Bryan, City of Burnet, City of College Station, City of Round Rock, City of West Lake Hills

8 ADVERSE IMPACTS

The proposed drainage improvements for the channel and storm sewer system did not adversely impact areas downstream or upstream of the project area. The downstream conditions are slightly improved due to lower the peak discharges, and water surface elevations at Rockway Drive and Stratford Drive. As mentioned in Section 5.2.9, the downstream culvert at Stratford Drive is not currently sized to accommodate the 25-year or 100-year flows. The proposed improvements presented in the PER for this project will not cause any additional issues with this undersized culvert crossing at Stratford Drive or any other existing channels or culvert crossings downstream of the project.

9 CONCLUSIONS AND RECOMMENDATIONS

The goal and priority of this drainage study is to examine feasible alternatives for maximizing the removal and reduction of flood hazards associated with contributing runoff largely traveling on Pleasant Drive and to a conveyance channel located behind the homes located on Nixon Drive draining to the Hatley Drive Culvert.

The solutions presented in this report explored options for channel improvements, existing culvert replacements, and the addition of a subsurface storm drainage system on Pleasant Drive. The system was designed holistically considering the entire proposed system and phased in segments to accommodate budget as it is available. With coordination and thoughtful project phasing, the Nixon and Pleasant Drive Drainage Improvements project will have a positive impact on the City of Rollingwood and its residents.

Three channel improvement options were evaluated:

- Option 1: a natural earthen channel
- Option 2: a rectangular concrete or MSE wall channel
- Option 3: a rectangular concrete box system

Option 2 is recommended as the most beneficial option since it provides a compromise of reduced easement requirements and efficient hydraulic benefits to reduce flood depth and protect property. The estimated project cost is \$513,000.

In addition, a closed-pipe storm drainage system was evaluated from Nixon Drive and up Pleasant Drive for a length of approximately 1,000 LF. The system was divided into three segments to assist with the determination for project phasing and implementation. Completion of the entire system is estimated to provide benefits for up to the 25-year to 100-year frequency storm events. The total estimated project cost for the storm drain improvements is \$1,086,000.

The replacement of the culverts at Hatley Drive is also proposed at full buildout to bring the level of service up the 25-year storm event with minor overtopping of the culver in the 100-year storm event for a estimated project cost of \$304,000.

KFA recommended that Channel Option 2 and Storm Drain Improvements Segment 1 be constructed as Phase 1 at an estimated total project cost of \$964,000. The completion of these drainage improvements are anticipated to reduce flood risk for the main channel located between Hatley Drive and Pleasant Cove and significantly reduce the frequency of flooding and public safety risks along the downstream portions

of Pleasant Drive near Nixon Drive. Runoff is estimated to provide benefits for between the 10-year and 25-year storm event and at full phased completion a benefit of up to the 25-year to 100-year event. The cost estimate of the project at full build-out, including Segment 1-3 of the storm drain system, channel improvements, and the Hatley Drive culvert improvements is estimated to be \$1,903,000.

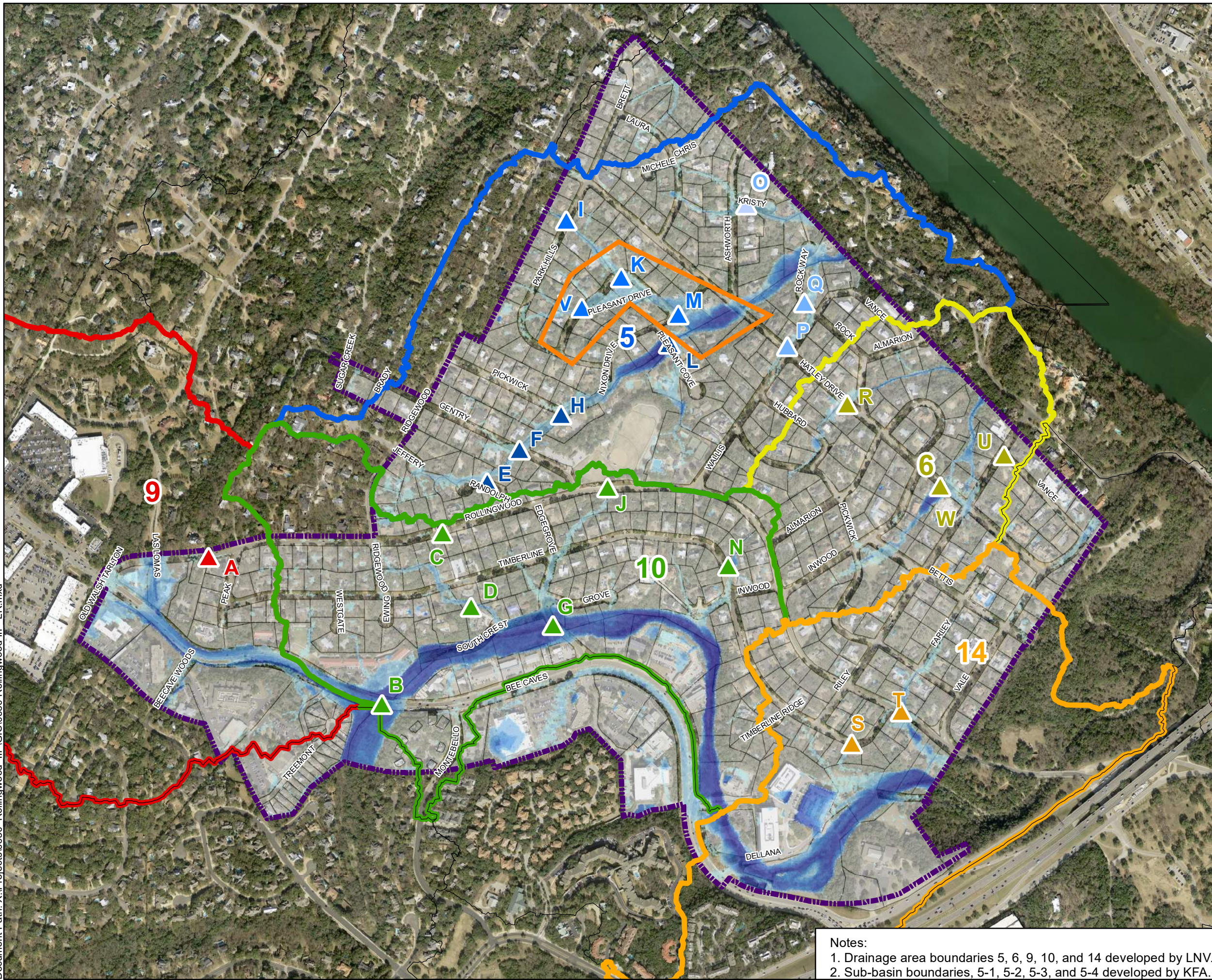
Next steps for project implementation will include:

1. Approval of Options and Segments for implementation.
2. Perform detailed survey, construction documents, environmental investigations, and geotechnical investigations for bidding.
3. Prepare topographic and boundary surveys to develop easement exhibits, metes and bounds descriptions and begin negotiations for proposed land acquisition needs identified.
4. Completion of construction document bid package for implementation.

Finally, the planning-level project costs can be found in **Appendix F**. Please note that construction phase services and permitting costs are not included in the cost estimates. Professional services are presented as a percent of construction and subject to modification depending on the options and segments selected.

Appendix A: Hydrologic and Hydraulic Exhibits and Data

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Legend













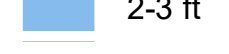


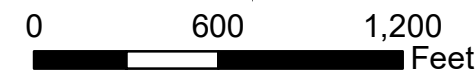
-  Rollingwood City Limits
 -  Parcels
 -  Area of Interest
 -  Drainage Areas
- 100-yr Inundation**
- | | | | |
|---|----------|---|----------|
|  | 3-6 in |  | 3-4 ft |
|  | 6-12 in |  | 4-5 ft |
|  | 12-18 in |  | 5-7 ft |
|  | 18-24 in |  | 7-10 ft |
|  | 2-3 ft |  | 10-20 ft |
-  Study Limits

Exhibit 1

City of Rollingwood Infrastructure Improvements Plan

Identified Areas of
Interest Map



Date: 3/9/2021



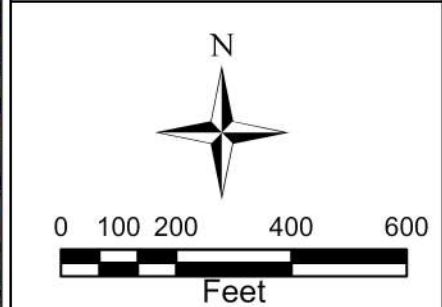
Notes:
 1. Drainage area boundaries 5, 6, 9, 10, and 14 developed by LNV.
 2. Sub-basin boundaries, 5-1, 5-2, 5-3, and 5-4 developed by KFA.

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- Legend**
- Parcels
 - Project Area
 - Rollingwood City Limits
 - Overall Drainage Area
 - Creeks
 - Points of Interest

Exhibit 2
Rollingwood - Nixon/Pleasant
Drainage Area Map



Date: 3/10/2021

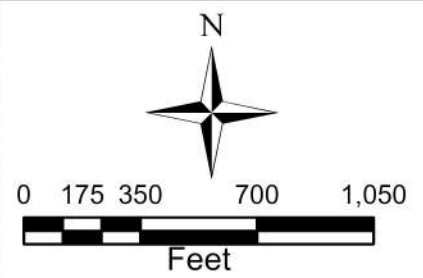


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- ### Legend
-  Contour 2ft
 -  Creeks
 -  Parcels
 -  Rollingwood Basins
 -  Project Area
 -  Flow Arrow

Rollingwood - Nixon/Pleasant Drainage Area Map



Date: 3/8/2021



TNRIS, StateMap, Blazor 9.1.1, Brown Central Appraisal District, Capital Area Council of Governments, City of Austin, City of Bastrop, City of Bee Cave, City of Bryan, City of Burnet, City of College Station, City of Round Rock, City of West Lake Hills

Routing ID	R_25	R_07	R_19	R_23	R_24	R_21	R_14	R_20	R_17	R-16
Routing Description Hide row for printing	Routing Basins 22 and 28 to 25 end	Routing Basin 7 to 18 and 6	Routing Basin 19 to 18 and 6	Routing Upper Basins (start at 25) to end of Basin 27	Routing Basin 24 to end of 23	Routing Basins to end of 21	Routing Basins to end of 14	Routing Basins to end of 20 and 26	Routing Basins to end of 17 and 4	Routing Basins to end of 16
Lag/Muskingum Cunge	Lag	Lag	Lag	Lag	Lag	Lag	Lag	Lag	Lag	Lag
Upstream Elevation ft	604	584	590	566	576	556	558	544	548	566
Downstream Elevation ft	576	566	566	554	566	552	540	524	508	524
Length ft	675	356	546	382	542	200	492	342	631	369
Slope ft/ft	0.0415	0.0506	0.0440	0.0314	0.0185	0.0200	0.0366	0.0585	0.0634	0.1138
Manning's "n"	0.015	0.015	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Shape 1 2 3 4	1	1	1	1	1	1	1	1	1	1
	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular
Bottom W ft										
Depth ft	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Side Slope H:V	6	6	6	6	6	6	6	6	6	6
# of Pipes or Boxes										
Pipe Diameter ft										
Box Height ft										
Box Span ft										
Area ft ²	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Wetted Perimeter ft	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1
V fps	7.96	8.78	3.07	2.60	1.99	2.07	2.80	3.54	3.69	4.94
Lag Time min	1.41	0.68	2.96	2.45	4.54	1.61	2.93	1.61	2.85	1.24

4.0 in

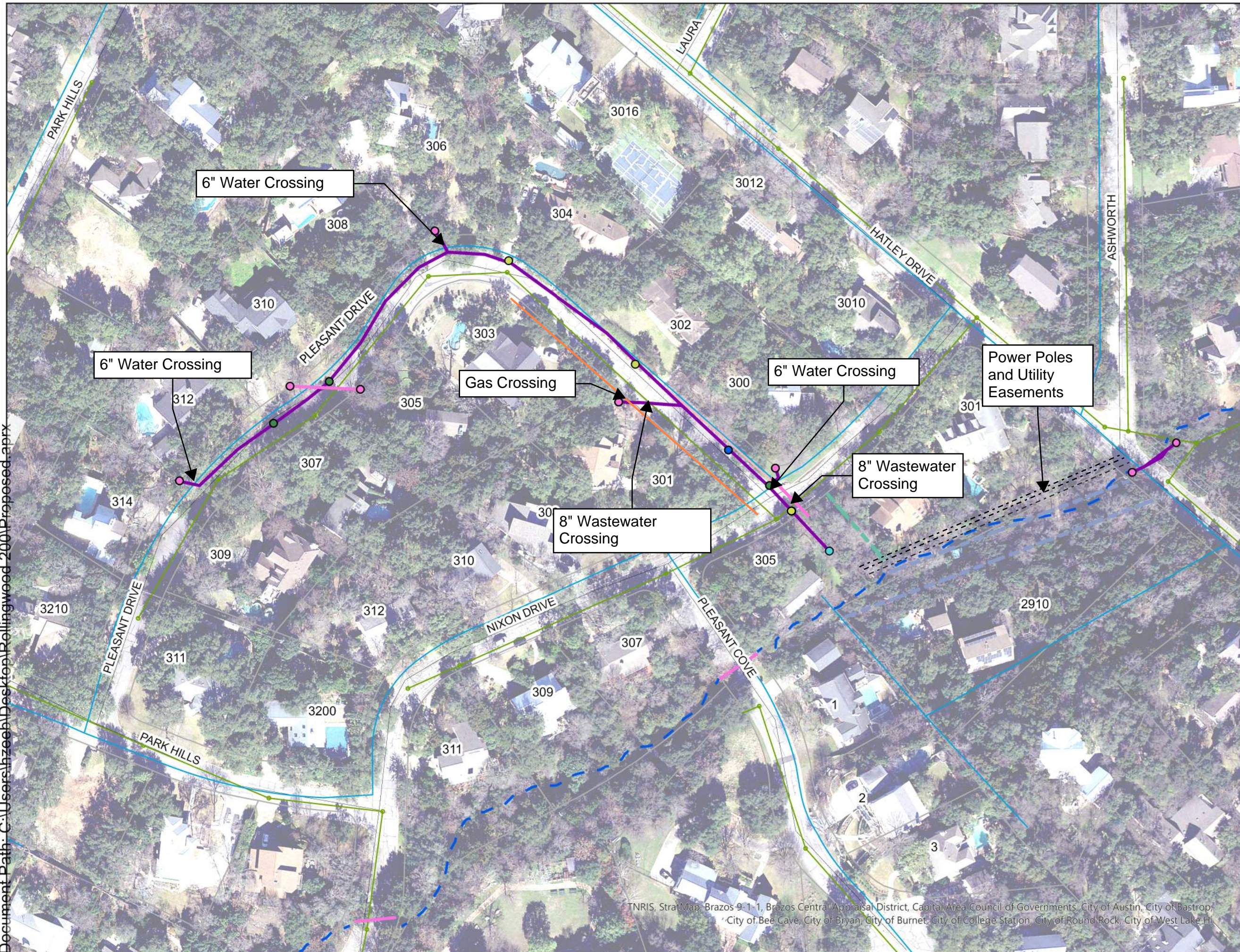
Drainage Basin	Sheet Flow Characteristics					
	Flow Length (ft)	Upstream Elev (ft)	Dwnstrm Elev (ft)	Slope (ft/ft)	Mannings Roughness	Sheet Flow (min)
28	100	679.0	672.0	0.070	0.15	5.3
22	100	654.0	652.0	0.020	0.15	8.8
25	43	646.5	646.0	0.012	0.016	0.9
24	85	624.0	622.0	0.024	0.15	7.2
23	100	625.0	624.5	0.005	0.15	15.3
27	100	648.0	642.0	0.060	0.016	0.9
21	100	619.0	614.0	0.050	0.15	6.1
14	100	618.0	612.0	0.060	0.15	5.7
18	100	624.0	610.0	0.140	0.15	4.0
16	51	606.0	602.0	0.078	0.15	3.0
26	100	654.0	650.0	0.040	0.15	6.7
7	100	654.0	651.0	0.030	0.15	7.5
19	100	654.0	648.0	0.060	0.15	5.7
6	50	620.0	616.0	0.080	0.15	2.9
17	100	586.0	582.0	0.040	0.15	6.7
20	100	640.0	634.0	0.060	0.15	5.7
4	100	630.0	624.0	0.060	0.15	5.7

Drainage Basin	Shallow Concentrated Flow Characteristics						
	Flow Length	Upstream Elev	Dwnstrm Elev	Slope	Mannings Roughness	Velocity	Shall Conc'd Flow
	(ft)	(ft)	(ft)	(ft/ft)		(fps)	(min)
28	344	672.0	653.5	0.054	0.15	3.74	1.5
22	263	652.0	646.5	0.021	0.15	2.33	1.9
25	N/A	N/A	N/A	N/A	N/A	N/A	0
24	252	622.0	604.0	0.071	0.15	4.31	1.0
23	457	624.5	618.0	0.014	0.15	1.92	4.0
27	500	642.0	606.0	0.072	0.15	4.33	1.9
21	180	614.0	604.0	0.056	0.15	3.80	0.8
14	204	612.0	604.0	0.039	0.15	3.20	1.1
18	365	610.0	588	0.060	0.15	3.96	1.5
16	100	602.0	582.0	0.200	0.15	7.22	0.2
26	361	650.0	630.0	0.055	0.15	3.80	1.6
7	879	651.0	642.0	0.010	0.15	1.63	9.0
19	697	648.0	626.0	0.032	0.15	2.87	4.1
6	100	616.0	596.0	0.200	0.15	7.22	0.2
17	229	582.0	568.0	0.061	0.15	3.99	1.0
20	N/A	N/A	N/A	N/A	N/A	N/A	0
4	282	624.0	616.0	0.028	0.15	2.72	1.7

Drainage Basin	Channel Flow Characteristics								Watershed Time of Travel (min)	Watershed Lag Time (min)
	Flow Length (ft)	Upstream Elev (ft)	Dwnstrm Elev (ft)	Slope (ft/ft)	Mannings Roughness	Shape	Velocity (fps)	Channel Flow (min)		
28	1327	653.5	604.0	0.037	0.016	Triangular	17.63	1.3	8.1	6.0
22	887	646.5	604.0	0.048	0.016	Triangular	19.98	0.7	11.4	6.8
25	1481	646.0	602.0	0.030	0.016	Triangular	15.73	1.6	2.5	6.0
24	566	604.0	580.0	0.042	0.15	Triangular	5.96	1.6	9.8	6.0
23	536	618.0	564.0	0.101	0.15	Triangular	9.19	1.0	20.2	12.1
27	609	606.0	570.0	0.059	0.15	Triangular	4.39	2.3	5.2	6.0
21	640	604.0	554.0	0.078	0.15	Triangular	5.05	2.1	9.0	6.0
14	450	604.0	552.0	0.116	0.15	Triangular	6.14	1.2	7.9	6.0
18	577	588.0	566	0.038	0.15	Triangular	1.90	5.1	10.6	6.4
16	400	582.0	566	0.040	0.15	Triangular	3.61	1.8	5.0	6.0
26	1273	630.0	546.0	0.066	0.15	Triangular	7.44	2.9	11.1	6.7
7	1055	642.0	584.0	0.055	0.15	Triangular	6.79	2.6	19.0	11.4
19	816	626.0	590.0	0.044	0.15	Triangular	3.79	3.6	13.3	8.0
6	447	596.0	566	0.067	0.15	Triangular	4.68	1.6	4.7	6.0
17	305	568.0	522	0.151	0.15	Triangular	7.01	0.7	8.3	6.0
20	1450	634.0	530.0	0.072	0.016	Triangular	24.44	1.0	6.7	6.0
4	1563	616.0	482.0	0.086	0.15	Triangular	5.29	4.9	12.3	7.4

Appendix B: Potential Utility Crossing Exhibit

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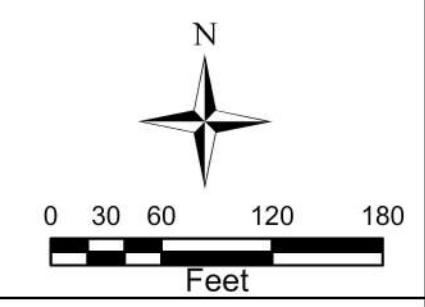
Legend

- Existing Waterlines
- Existing Wastewater
- Parcels
- Proposed System
- - - Channel
- Existing Culverts
- Proposed 1' Berm
- Limestone Walls**
- - - Existing
- - - Proposed
- Proposed Inlets**
- 20' Curb Inlet
- Culvert Headwall
- Curb Inlet
- Curb Inlet Sag
- Outfall
- Existing Gas

Exhibit 3

Rollingwood - Nixon/Pleasant

Potential Utility Conflicts Map



Date: 3/9/2021



TNRIS, StratMap, Brazos 9-1-1, Brazos Central Appraisal District, Capital Area Council of Governments, City of Austin, City of Bastrop, City of Bee Cave, City of Bryan, City of Burnet, City of College Station, City of Round Rock, City of West Lake Hills

Appendix C: Existing and Proposed Indundation Exhibits

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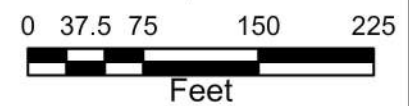


Legend

- Parcels
- Existing Culverts
- Channel
- Depth (ft)
- ≤0.300
- ≤0.600
- ≤1.000
- ≤1.500
- ≤3.000
- ≤4.500
- ≤7.000
- ≤20.000

Rollingwood - Nixon/Pleasant

25-year Existing Inundation



Date: 3/6/2021













TNRIS, SmartMap, Brno 2014, Brazos Capital Appraisal District, Capital Area Council of Governments, City of Austin, City of Bastrop, City of Bee Cave, City of Bryan, City of Burnet, City of College Station, City of Round Rock, City of West Lake Hills

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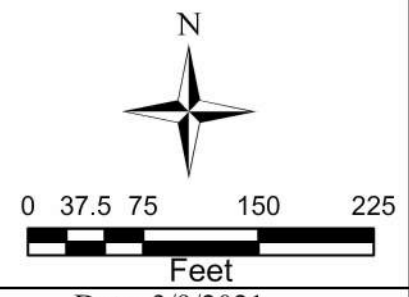


Legend

-  Parcels
-  Proposed System
-  Channel
- Depth (ft)
 -  ≤0.300
 -  ≤0.600
 -  ≤1.000
 -  ≤1.500
 -  ≤3.000
 -  ≤4.500
-  Proposed Wall

Rollingwood - Nixon/Pleasant

25-year Proposed Inundation



Date: 3/9/2021






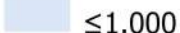

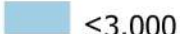
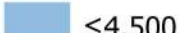
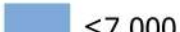
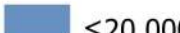


TNRIS, StateMap, Brno 2017, Frazee Central Appraisal District, Capital Area Council of Governments, City of Austin, City of Bastrop, City of Bee Cave, City of Bryan, City of Burnet, City of College Station, City of Round Rock, City of West Lake Hills

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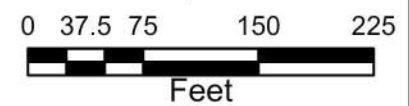


Legend

-  Parcels
-  Existing Culverts
-  Channel
- Depth (ft)
-  ≤0.300
-  ≤0.600
-  ≤1.000
-  ≤1.500
-  ≤3.000
-  ≤4.500
-  ≤7.000
-  ≤20.000

Rollingwood - Nixon/Pleasant

100-year Existing Inundation



Date: 3/6/2021



TNRIS, SmartMap, Brno 2014, Brazos Central Appraisal District, Capital Area Council of Governments, City of Austin, City of Bastrop, City of Bee Cave, City of Bryan, City of Burnet, City of College Station, City of Round Rock, City of West Lake Hills

Document Path: C:\Users\hzeeb\Desktop\Rollingwood 200\Inundation.aprx

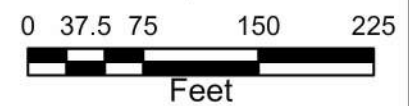


Legend

- Parcels
- Proposed System
- Channel
- Depth (ft)
 - ≤0.300
 - ≤0.600
 - ≤1.000
 - ≤1.500
 - ≤3.000
 - ≤4.500
 - ≤7.000
 - ≤20.000
- Proposed Wall

Rollingwood - Nixon/Pleasant

100-year Proposed Inundation



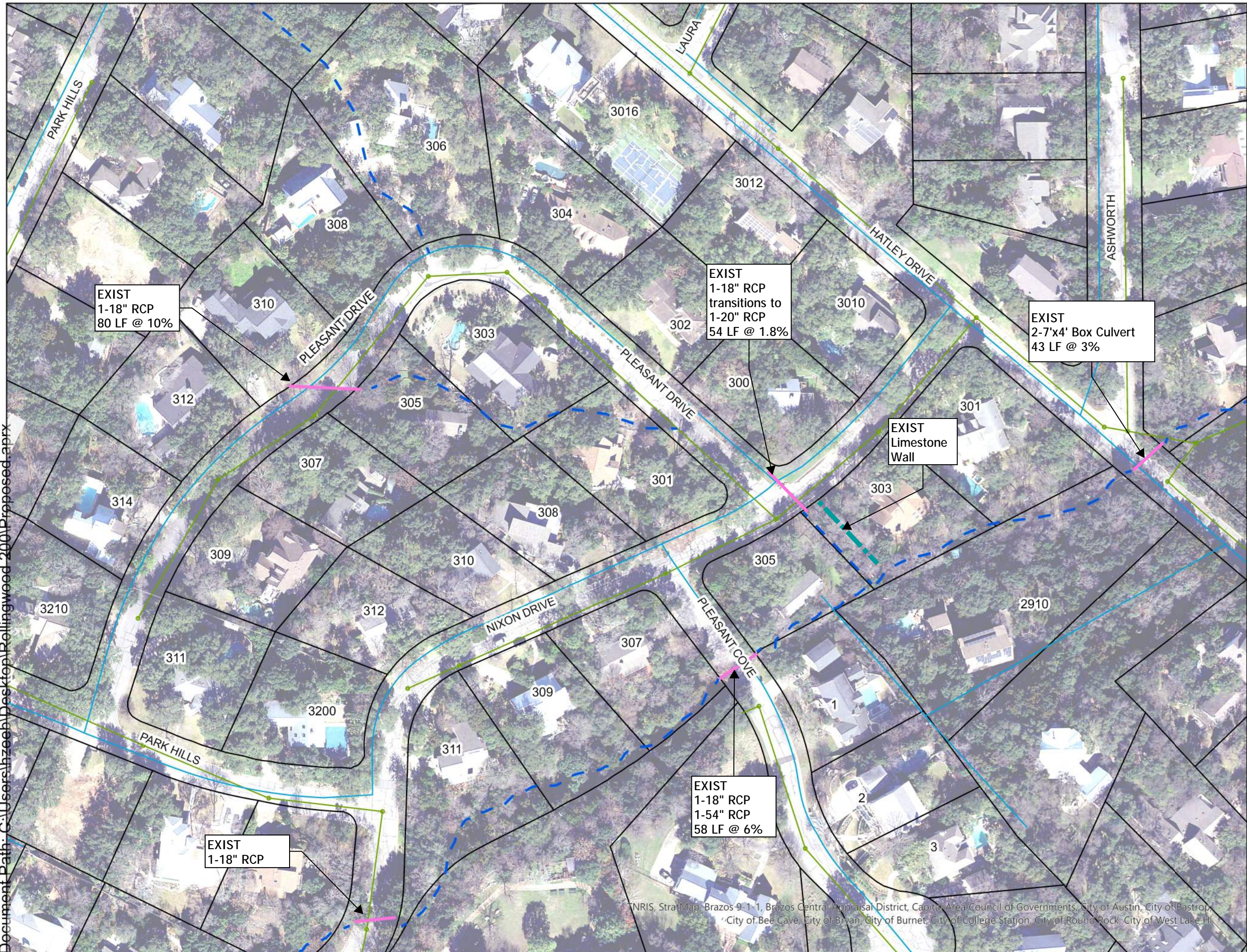
Date: 3/9/2021



TNRIS, StateMap, Brno 2019, Frazee Central Appraisal District, Capital Area Council of Governments, City of Austin, City of Bastrop, City of Bee Cave, City of Bryan, City of Burnet, City of College Station, City of Round Rock, City of West Lake Hills

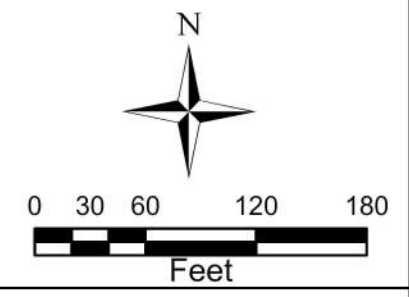
Appendix D: Existing and Proposed Improvement Alternatives

Document Path: C:\Users\hzeeb\Desktop\Rollingwood 200\Proposed.aprx



- Legend**
- Existing Waterlines
 - Existing Wastewater
 - Parcels
 - - - Channel
 - Existing Culverts

Exhibit 4
Rollingwood - Nixon/Pleasant
Existing System



Date: 3/10/2021



TNRIS, StratMap, Brazos 9-1-1, Brazos Central Appraisal District, Capital Area Council of Governments, City of Austin, City of Bastrop, City of Bee Cave, City of Bryan, City of Burnet, City of College Station, City of Round Rock, City of West Lake Hills

Potential Future Drainage Improvements Located Outside of Study Area:

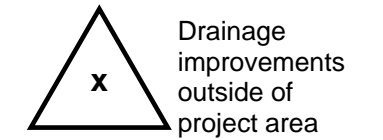
- 1 The existing 18" culvert at Nixon Drive is undersized for existing flows and storm water frequently overtops the roadway. This area would benefit from the upsizing of the culvert to reduce or eliminate storm water ponding and overtopping the roadway. Additional analysis is needed to determine the size of the culvert(s).
- 2 The existing curb inlet and 18" storm sewer is undersized for existing flow as well as the 54" culvert under Pleasant Cove. This area would benefit from an additional storm sewer system construction upstream of the existing inlet on Pleasant Cove. The upsizing of the culvert crossing at Pleasant Cove would also benefit the area by reducing or eliminating the frequency of the roadway overtopping and increasing the capacity of the culvert under the roadway. Additional analysis is needed to determine the size of the culvert(s) and storm sewer system.
- 3 The existing 2-48" culverts at Stratford Drive are currently undersized for existing flows. This area would benefit from the upsizing of the culvert to eliminate or reduce the frequency of stormwater overtopping the roadway. Additional analysis is needed to determine the size of the culvert(s).

Legend

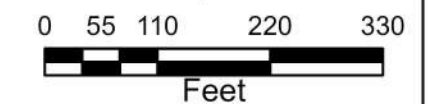
- Existing Waterlines
- Existing Wastewater
- Parcels
- Channel
- Existing Culverts

Depth (ft)

- ≤0.300
- ≤0.600
- ≤1.000
- ≤1.500
- ≤3.000
- ≤4.500
- ≤7.000
- ≤20.000



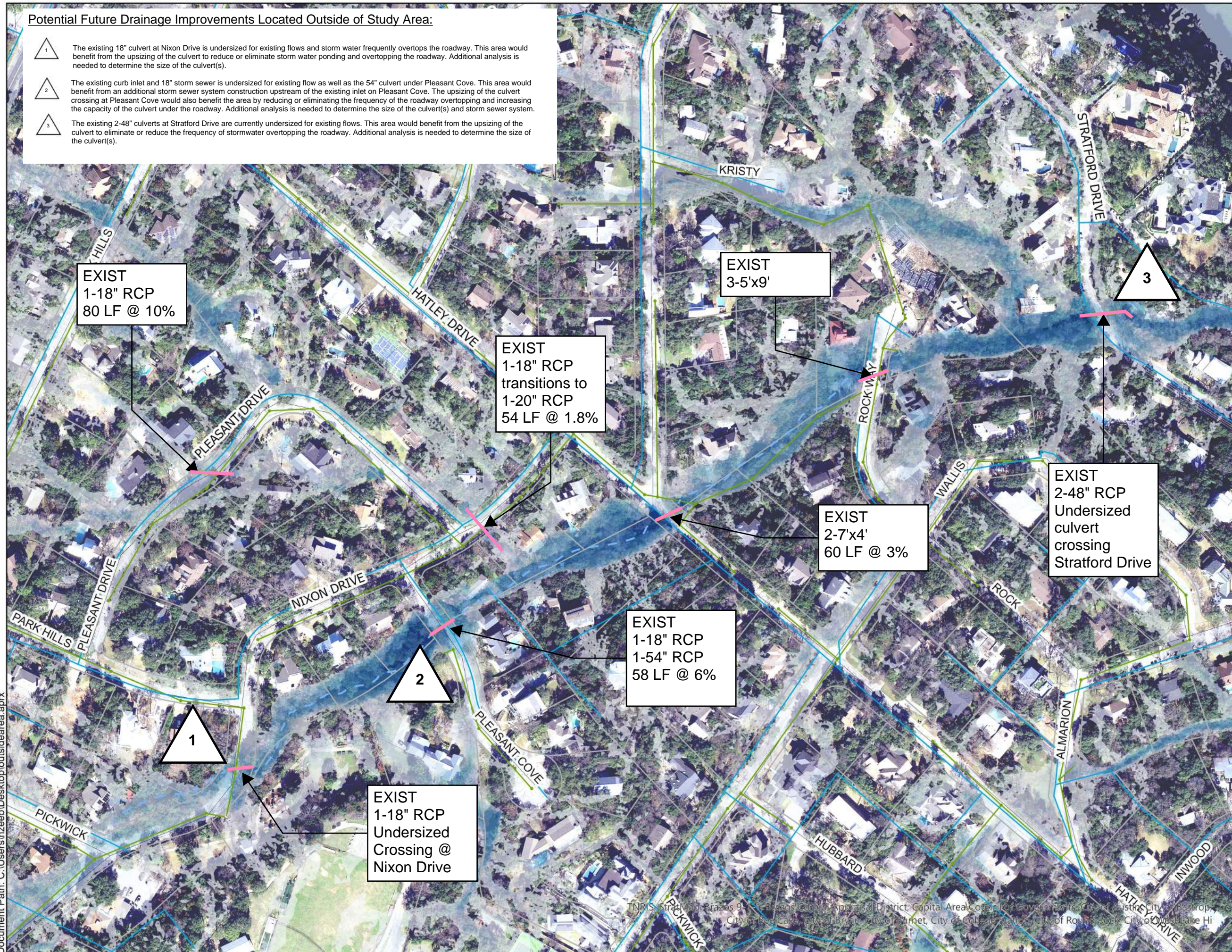
Rollingwood - Nixon/Pleasant
Exhibit 5
Drainage Improvements outside of Project Area



Date: 2/24/2021



Document Path: C:\Users\hzeab\Desktop\outsidearea.aprx



EXIST
1-18" RCP
80 LF @ 10%

EXIST
1-18" RCP
transitions to
1-20" RCP
54 LF @ 1.8%

EXIST
3-5'x9'

EXIST
2-7'x4'
60 LF @ 3%

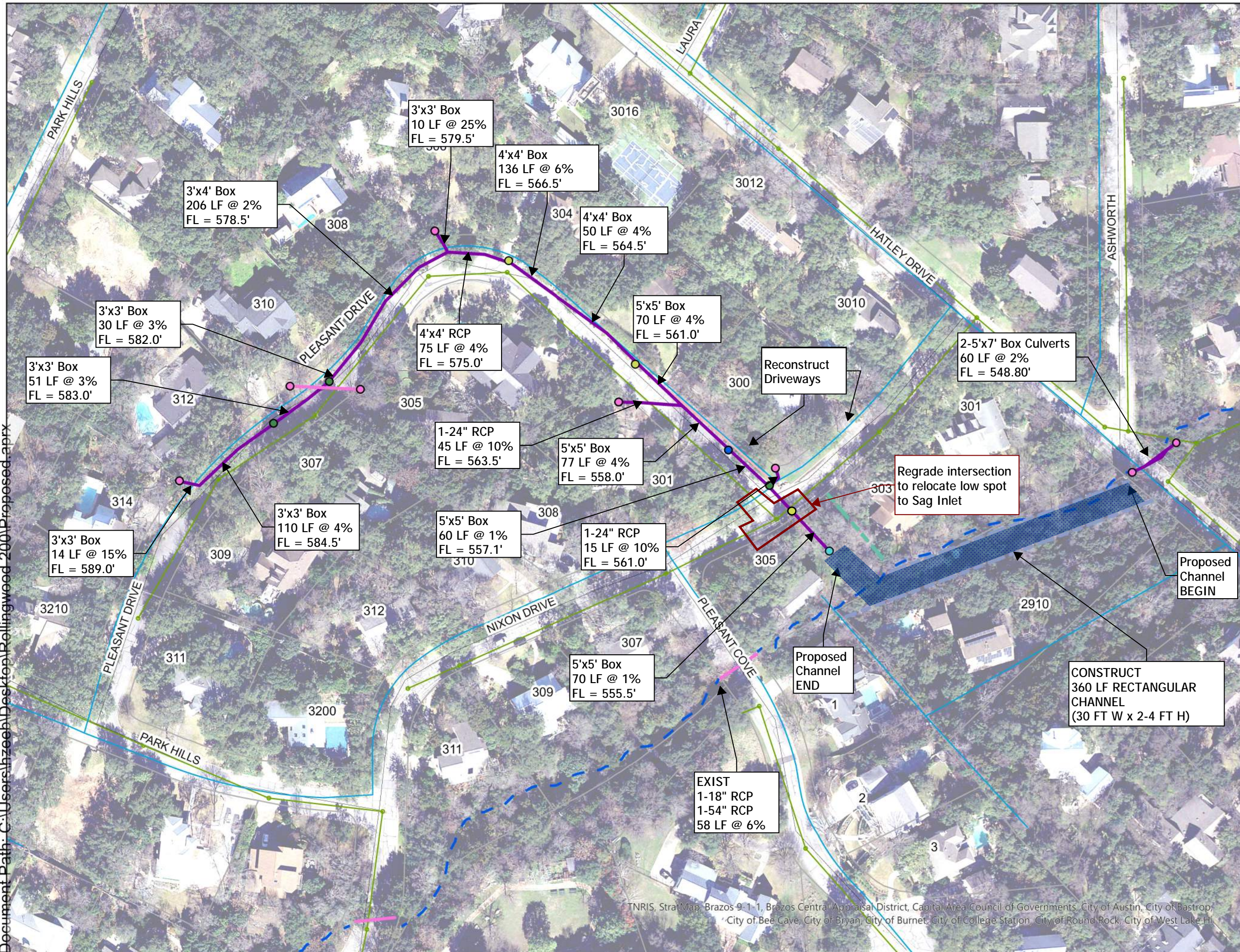
EXIST
2-48" RCP
Undersized
culvert
crossing
Stratford Drive

EXIST
1-18" RCP
1-54" RCP
58 LF @ 6%

EXIST
1-18" RCP
Undersized
Crossing @
Nixon Drive

TNRIS, Stratford, Brazos 9, Brazos Canal, Appraisal District, Capital Area Council of Governments, City of Austin, City of Bastrop, City of Bee Cave, City of Bryan, City of Driest, City of College Station, City of Round Rock, City of West Lake Hills

Document Path: C:\Users\hzeeb\Desktop\Rollingwood 200\Proposed.aprx



Legend

- Existing Waterlines
- Existing Wastewater
- Parcels
- Proposed System
- Channel
- Existing Culverts
- Proposed 1' Berm
- Limestone Walls
- Existing
- Proposed
- Proposed Inlets
- 20' Curb Inlet
- Culvert Headwall
- Curb Inlet
- Curb Inlet Sag
- Outfall

Exhibit 6

Rollingwood - Nixon/Pleasant

Proposed System

0 30 60 120 180
Feet

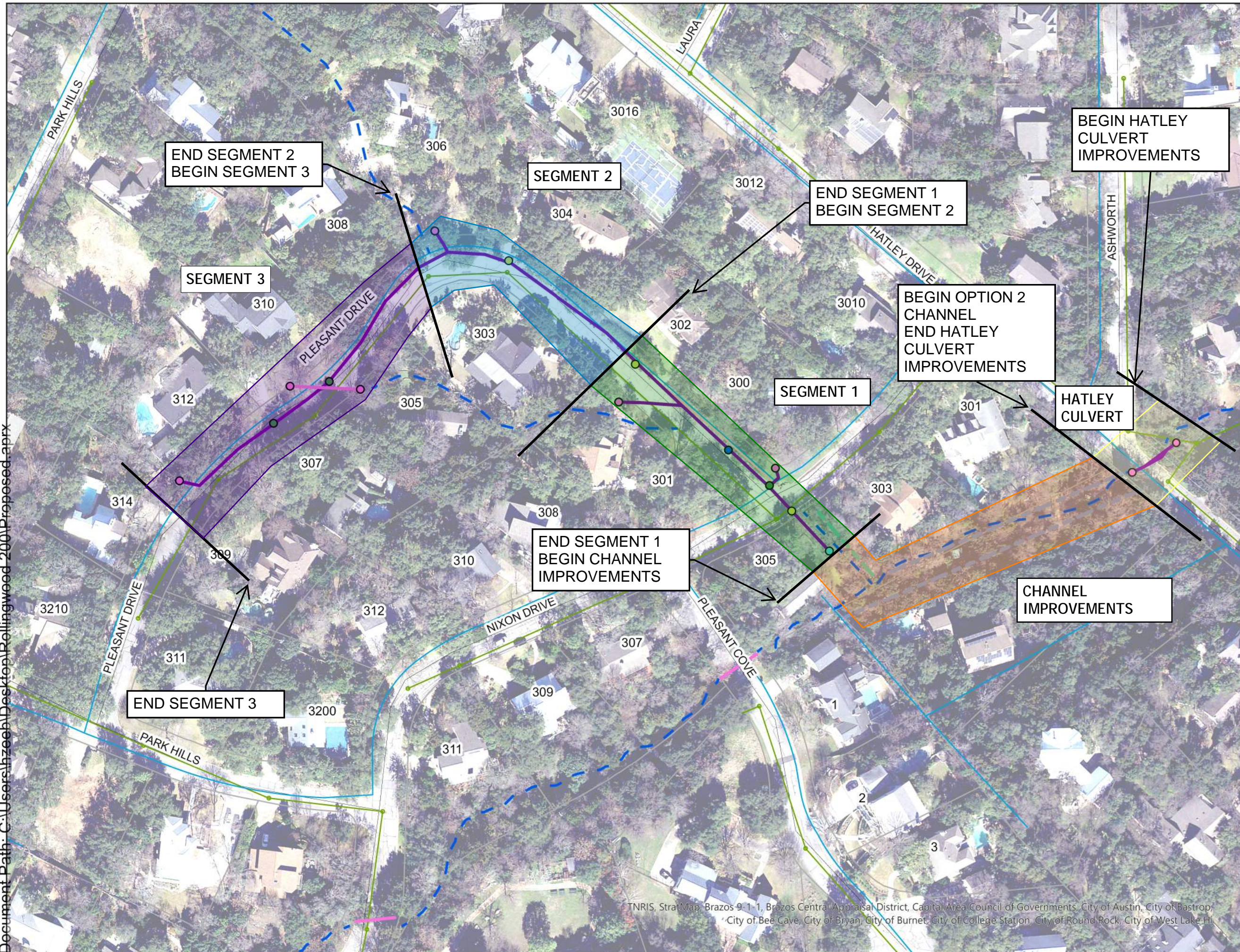
Date: 3/9/2021



K·FRIESE + ASSOCIATES
PUBLIC PROJECT ENGINEERING
FIRM NO. 6535

TNRIS, StratMap, Brazos 9-1-1, Brazos Central Appraisal District, Capital Area Council of Governments, City of Austin, City of Bastrop, City of Bee Cave, City of Bryan, City of Burnet, City of College Station, City of Round Rock, City of West Lake Hills

Document Path: C:\Users\hzeeb\Desktop\Rollingwood 200\Proposed.aprx

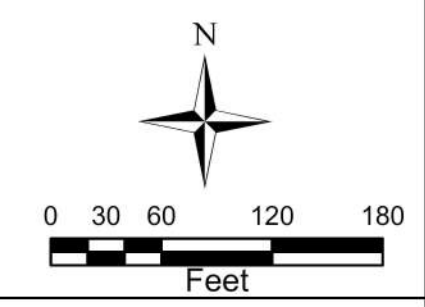


Legend

- Existing Waterlines
- Existing Wastewater
- Parcels
- Proposed System
- Channel
- Existing Culverts
- Proposed 1' Berm
- Limestone Walls
- Existing
- Proposed
- Proposed Inlets

 - 20' Curb Inlet
 - Culvert Headwall
 - Curb Inlet
 - Curb Inlet Sag
 - Outfall

Exhibit 7
Rollingwood - Nixon/Pleasant
Proposed Phasing



Date: 3/15/2021



TNRIS, StratMap, Brazos 9-1-1, Brazos Central Appraisal District, Capital Area Council of Governments, City of Austin, City of Bastrop, City of Bee Cave, City of Bryan, City of Burnet, City of College Station, City of Round Rock, City of West Lake Hills

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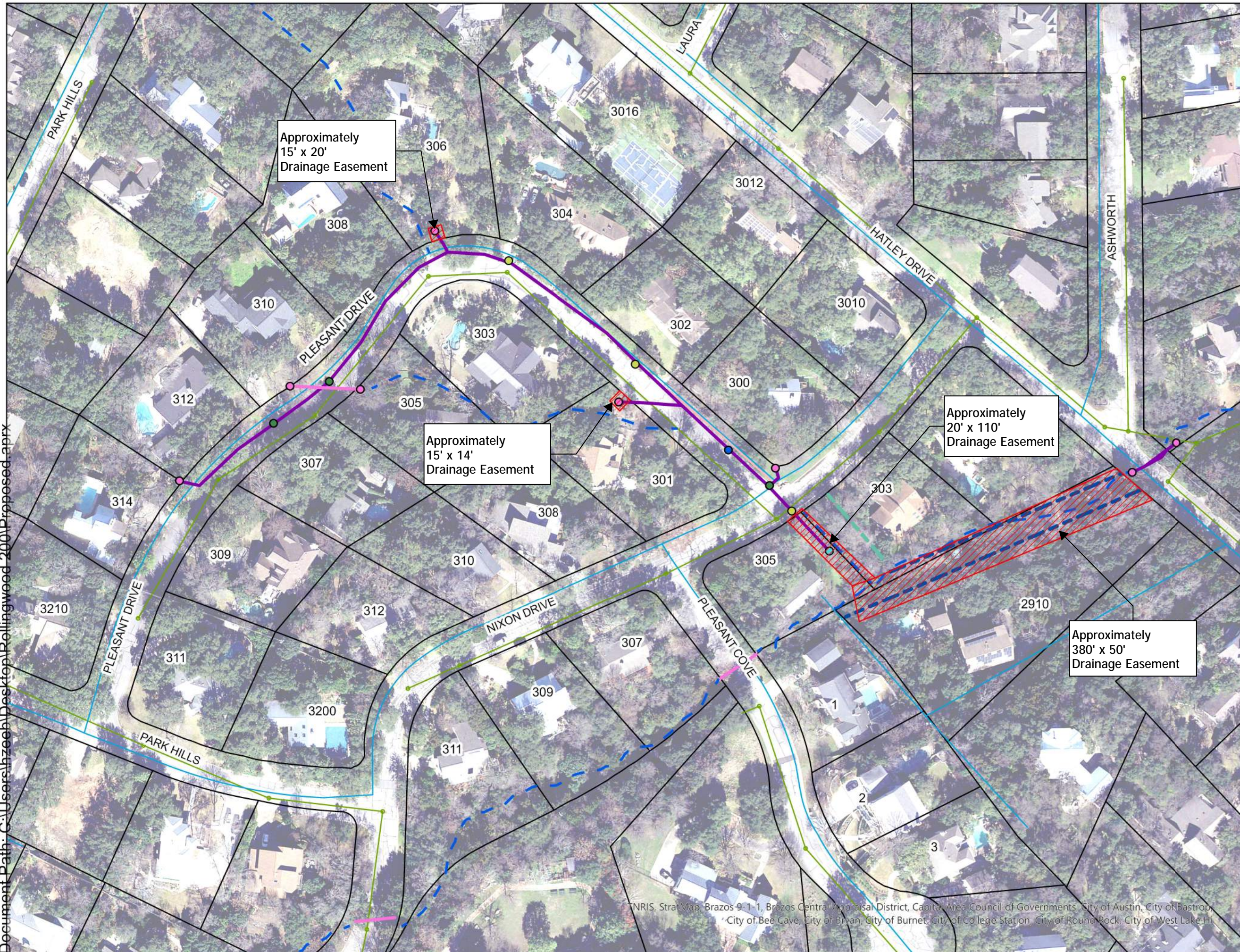
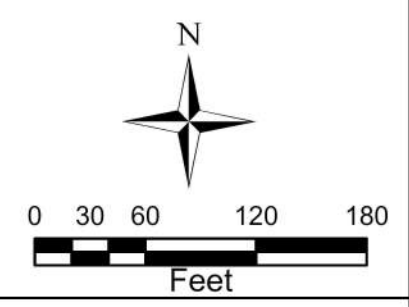


Exhibit 8

Rollingwood - Nixon/Pleasant

Proposed Easements



Date: 3/11/2021



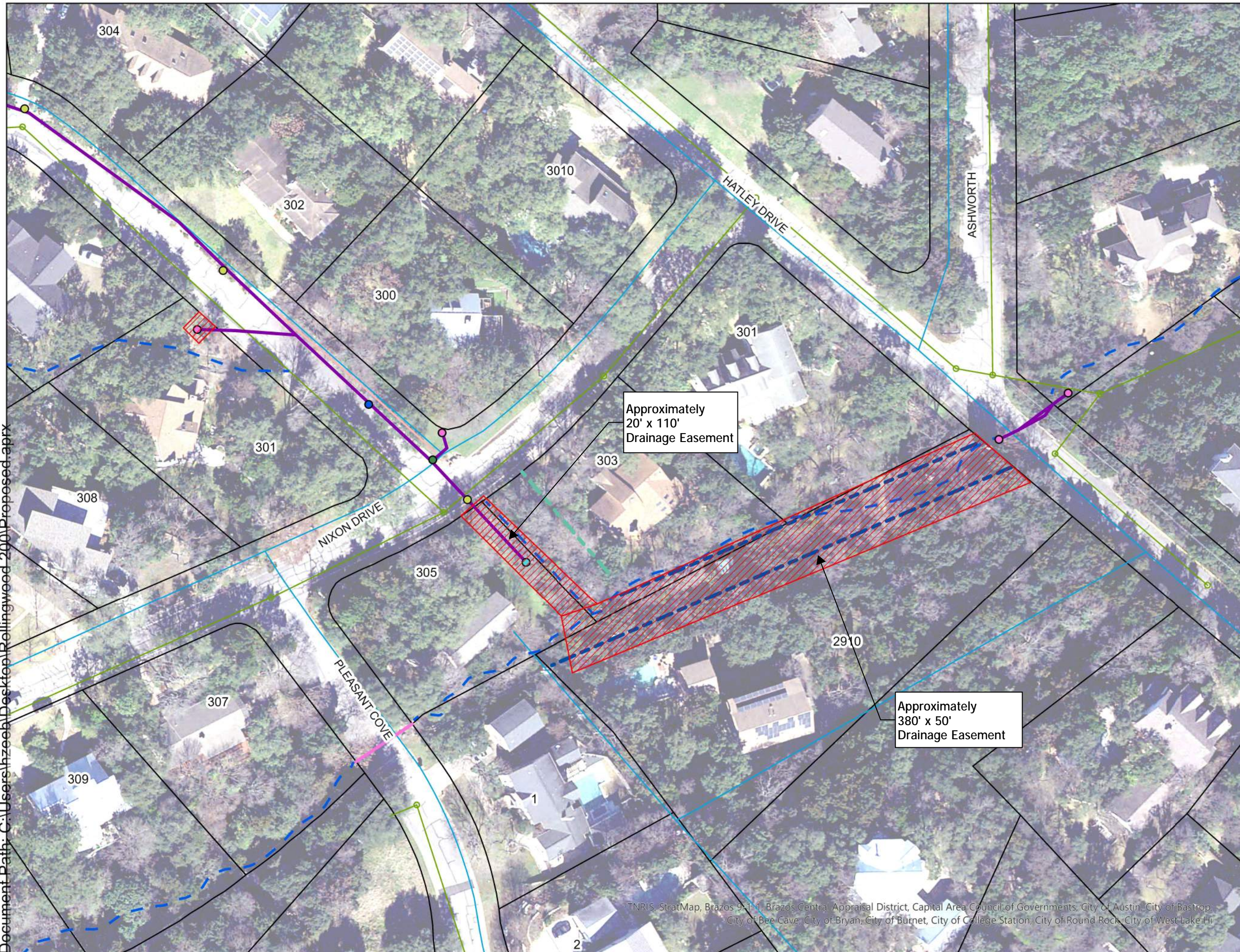
K·FRIESE + ASSOCIATES

PUBLIC PROJECT ENGINEERING

FIRM NO. 6535

TNRIS, StratMap, Brazos 9-1-1, Brazos Central Appraisal District, Capital Area Council of Governments, City of Austin, City of Bastrop, City of Bee Cave, City of Bryan, City of Burnet, City of College Station, City of Round Rock, City of West Lake Hills

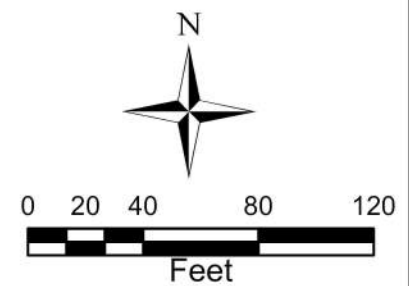
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- Legend**
- Existing Waterlines
 - Existing Wastewater
 - ▭ Parcels
 - Proposed System
 - - Channel
 - Existing Culverts
 - Proposed 1' Berm
 - Limestone Walls
 - - Existing
 - - Proposed
 - Proposed Inlets
 - 20' Curb Inlet
 - Culvert Headwall
 - Curb Inlet
 - Curb Inlet Sag
 - Outfall
 - ▨ Proposed Easements

Rollingwood - Nixon/Pleasant

Proposed Easements

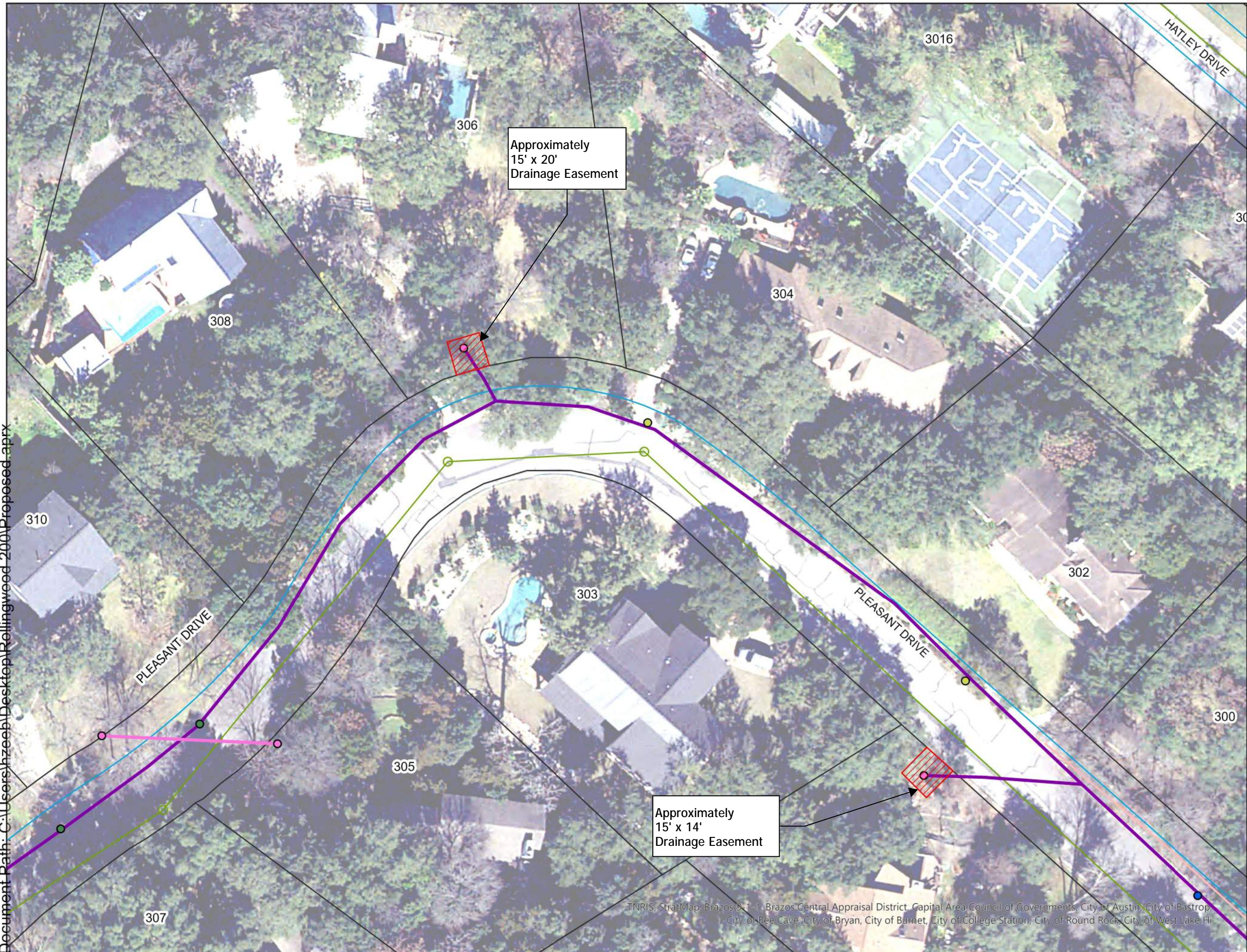


Date: 3/11/2021



TNRIS, StratMap, Brazos 9-1-1, Brazos Central Appraisal District, Capital Area Council of Governments, City of Austin, City of Bastrop, City of Bee Cave, City of Bryan, City of Burnet, City of College Station, City of Round Rock, City of West Lake Hills

Document Path: C:\Users\hzeeb\Desktop\Rollingwood 200\Proposed.aprx



Legend

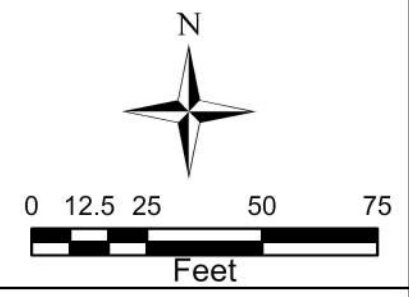
- Existing Waterlines
- Existing Wastewater
- Parcels
- Proposed System
- Channel
- Existing Culverts
- Proposed 1' Berm

Proposed Inlets

- 20' Curb Inlet
- Culvert Headwall
- Curb Inlet
- Curb Inlet Sag
- Proposed Easements

Rollingwood - Nixon/Pleasant

Proposed Easements



Date: 3/10/2021



K·FRIESE + ASSOCIATES

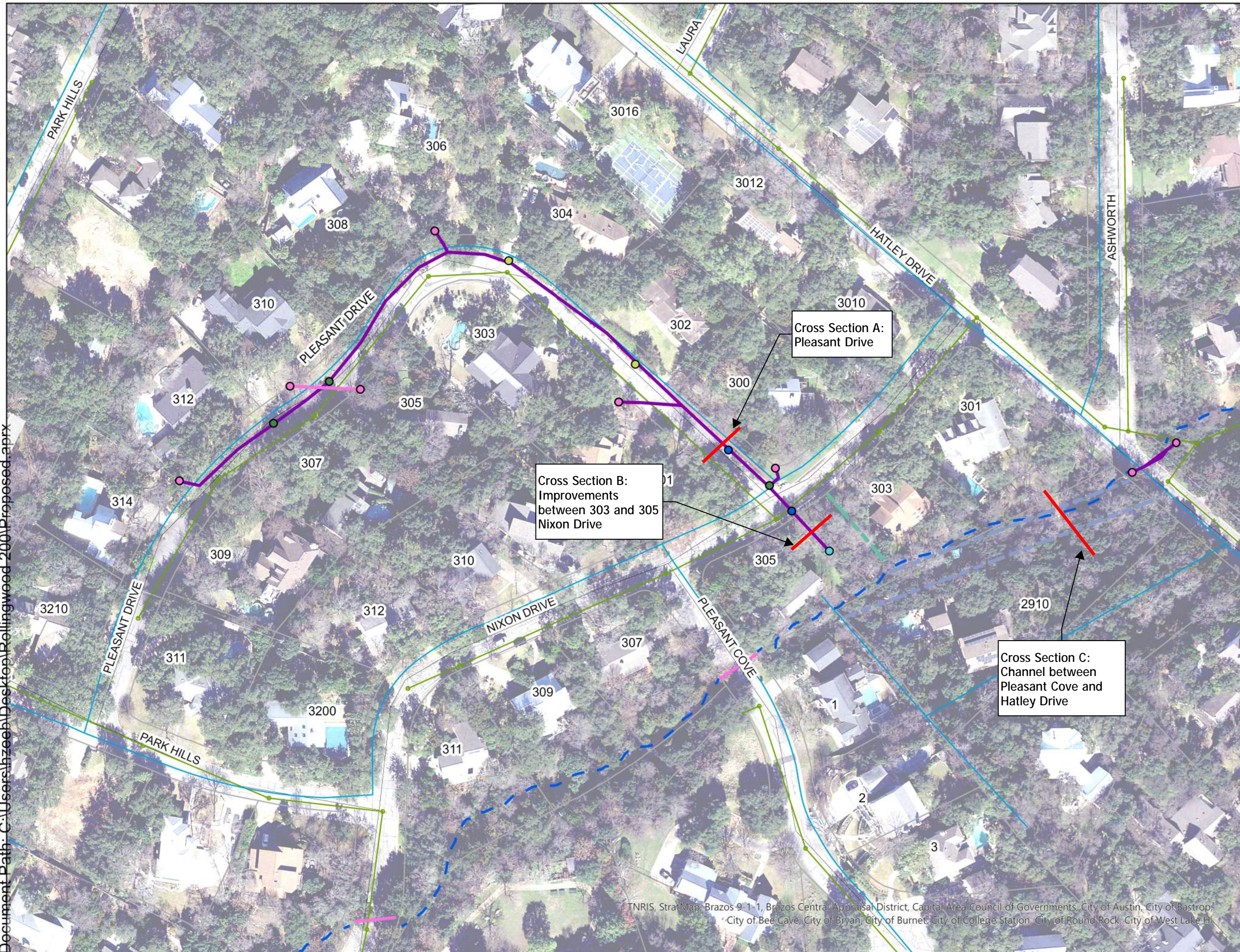
PUBLIC PROJECT ENGINEERING

FIRM NO. 6535

TNRIS, StratMap, Brazos 9-1-1, Brazos Central Appraisal District, Capital Area Council of Governments, City of Austin, City of Bastrop, City of Bee Cave, City of Bryan, City of Burnet, City of College Station, City of Round Rock, City of West Lake Hi

Appendix E: Typical Cross Sections

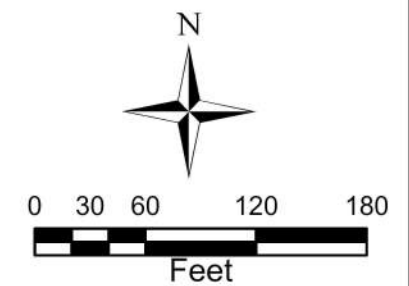
Document Path: C:\Users\hzeeb\Desktop\Rollingwood 200\Proposed.aprx



- Legend**
- Existing Waterlines
 - Existing Wastewater
 - Parcels
 - Proposed System
 - - - Channel
 - Existing Culverts
 - Proposed 1' Berm
 - Limestone Walls**
 - - - Existing
 - - - Proposed
 - Proposed Inlets**
 - 20' Curb Inlet
 - Culvert Headwall
 - Curb Inlet
 - Cross Sections
 - Outfall

Rollingwood - Nixon/Pleasant

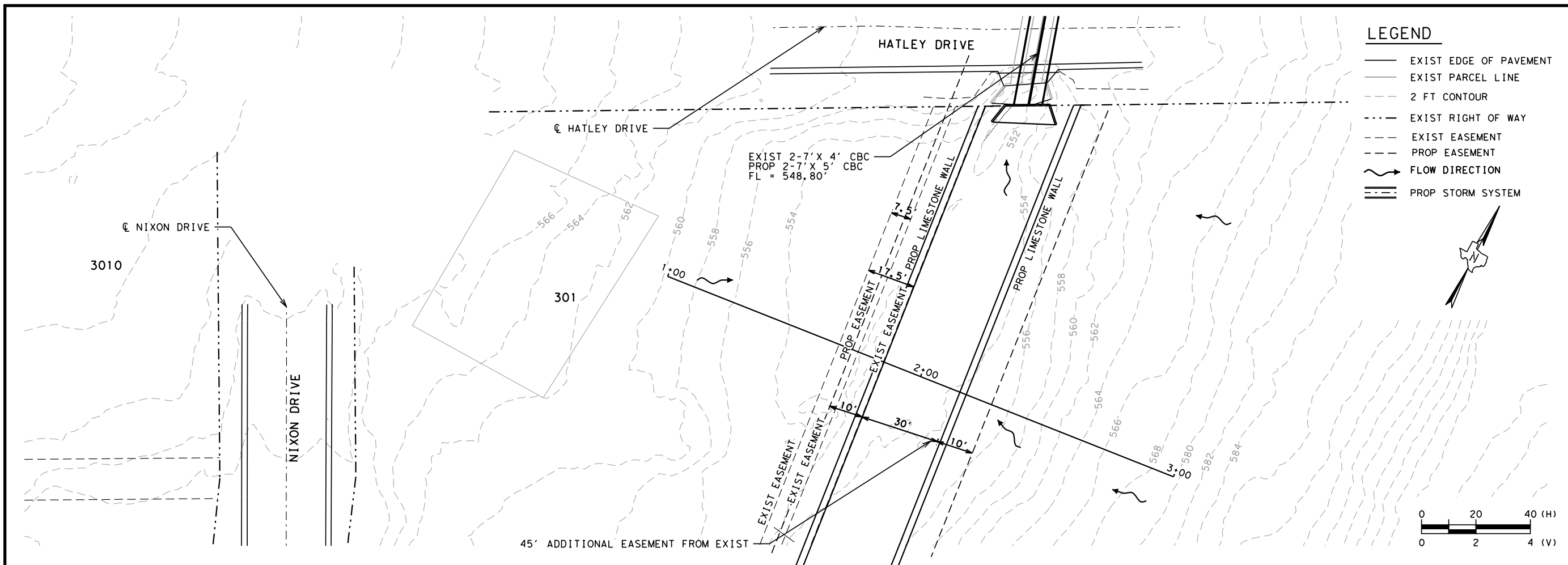
Cross Section Locations



Date: 3/9/2021



TNRIS, StratMap, Brazos 9-1-1, Brazos Central Appraisal District, Capital Area Council of Governments, City of Austin, City of Bastrop, City of Bee Cave, City of Bryan, City of Burnet, City of College Station, City of Round Rock, City of West Lake Hills



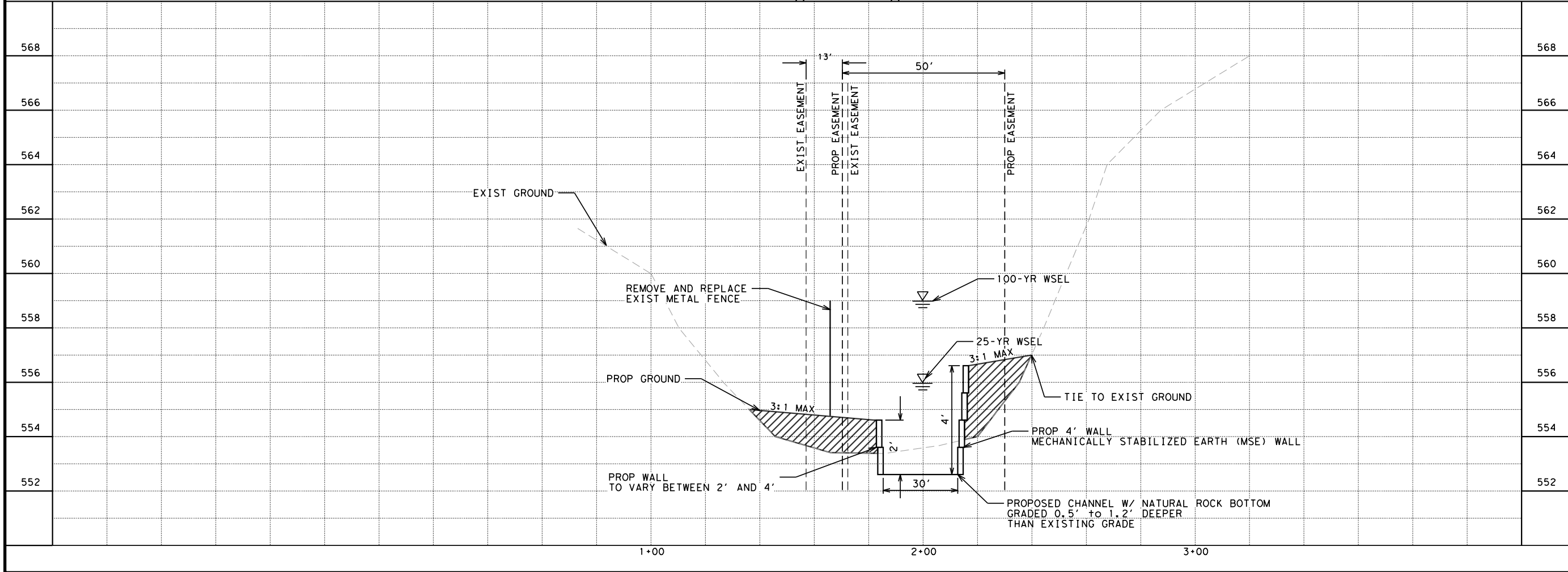
LEGEND

- EXIST EDGE OF PAVEMENT
- EXIST PARCEL LINE
- - - 2 FT CONTOUR
- - - EXIST RIGHT OF WAY
- - - EXIST EASEMENT
- - - PROP EASEMENT
- FLOW DIRECTION
- PROP STORM SYSTEM

REV. NO.	BY	DATE	REVISION DESCRIPTION



K FRIESE & ASSOCIATES, INC.
 1120 S. CAPITAL OF TEXAS HWY, II-100, AUSTIN, TX 78746
 CITY OF ROLLINGWOOD
 NIXON AND PLEASANT DRIVE
 DRAINAGE IMPROVEMENTS
 CROSS SECTION



CROSS SECTION C
CHANNEL
PLEASANT COVE & HATLEY DRIVE

SHEET 3 OF 3	
SCALE	SSCALES
DATE	3/16/2021
SHEET NUMBER	3 OF 3

Appendix F: Cost Estimates

CONSTRUCTION COSTS				
PROPOSED CHANNEL IMPROVEMENTS (FROM HATLEY DRIVE TO PLEASANT DRIVE)				
OPTION 1: EARTHEN TRAPEZOIDAL CHANNEL				
DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL
CHANNEL GRADING	1000	CY	\$ 75	\$ 75,000
PERMANENT EROSION CONTROL AND REVEGETATION	800	LF	\$ 10	\$ 8,000
BARRICADES, SIGNS AND TRAFFIC HANDLING	3	MO	\$ 3,000	\$ 9,000
UTILITY ADJUSTMENT	1	EA	\$ 4,500	\$ 4,500
POWER POLE RELOCATION	5	EA	\$ 5,000	\$ 25,000
SUBTOTAL OPTION I EARTHEN TRAPEZOIDAL CHANNEL				\$ 121,500
MOBILIZATION, INSURANCE AND BONDS, PREP ROW, SW3P (22%)				\$ 26,730
CONTINGENCY (30%)				\$ 44,469
PROFESSIONAL SERVICES (15%) (Engineering, Surveying, Geotechnical, Environmental)				\$ 28,905
SUBTOTAL ESTIMATED CONSTRUCTION COSTS EARTHEN TRAPEZOIDAL CHANNEL IMPROVEMENTS:				\$ 222,000
OPTION 2: CONCRETE OR MECHANICALLY STABILIZED EARTHEN CHANNEL				
DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL
DRY STACKED LIMESTONE WALL	3050	SF	\$ 65	\$ 198,250
CHANNEL GRADING	360	CY	\$ 75	\$ 27,000
METAL FENCE	720	LF	\$ 20	\$ 14,400
PERMANENT EROSION CONTROL AND REVEGETATION	720	LF	\$ 10	\$ 7,200
BARRICADES, SIGNS AND TRAFFIC HANDLING	3	MO	\$ 3,000	\$ 9,000
POWER POLE RELOCATION	5	EA	\$ 5,000	\$ 25,000
SUBTOTAL PHASE II CONCRETE OR MECHANICALLY STABILIZED EARTHEN CHANNEL				\$ 280,850
MOBILIZATION, INSURANCE AND BONDS, PREP ROW, SW3P (22%)				\$ 61,787
CONTINGENCY (30%)				\$ 102,791
PROFESSIONAL SERVICES (15%) (Engineering, Surveying, Geotechnical, Environmental)				\$ 66,814
SUBTOTAL ESTIMATED CONSTRUCTION COSTS CONCRETE OR MECHANICALLY STABILIZED EARTHEN				\$ 513,000
HATLEY BOX CULVERT UPSIZING				
DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL
CONC BOX CULV (7 FT X 5 FT)	120	LF	\$ 557	\$ 66,840
HEADWALL (7 FT x 5 FT)	2	EA	\$ 20,000	\$ 40,000
REMOVE CONC CURB	60	LF	\$ 16	\$ 960
STRUCTURAL EXCAVATION	360	CY	\$ 35	\$ 12,600
REMOVE CONCRETE (HEADWALL)	2	EA	\$ 1,000	\$ 2,000
REMOVE CONCRETE (BOX)	86	LF	\$ 50	\$ 4,300
PAVEMENT RECONSTRUCTION	200	SY	\$ 150	\$ 30,000
CONCRETE CURB AND GUTTER	60	LF	\$ 25	\$ 1,500
MTL W-BEAM GD FEN	120	LF	\$ 30	\$ 3,600
UTILITY ADJUSTMENT	1	EA	\$ 4,500	\$ 4,500
SUBTOTAL HATLEY BOX CULVERT UPSIZING				\$ 166,300
MOBILIZATION, INSURANCE AND BONDS, PREP ROW, SW3P (22%)				\$ 36,586
CONTINGENCY (30%)				\$ 60,866
PROFESSIONAL SERVICES (15%) (Engineering, Surveying, Geotechnical, Environmental)				\$ 39,563
SUBTOTAL ESTIMATED CONSTRUCTION COSTS HATLEY BOX CULVERT UPSIZING:				\$ 304,000

SEGMENT 1: STORM SEWER IMPROVEMENTS (NIXON DRIVE TO 302 PLEASANT DRIVE)				
DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL
RC PIPE (CL III)(24 IN)	60	LF	\$ 72	\$ 4,320
CONC BOX CULV (5 FT X 5 FT)	277	LF	\$ 400	\$ 110,800
CONC HEADWALL W/ENERGY DISSIPATORS (60 IN)	1	EA	\$ 10,000	\$ 10,000
SAG INLET	1	EA	\$ 9,000	\$ 9,000
CURB INLET	2	EA	\$ 8,000	\$ 16,000
20' CURB INLET	1	EA	\$ 15,000	\$ 15,000
SAFETY END TREATMENT (24 IN)	2	EA	\$ 3,200	\$ 6,400
STREET EXCAVATION (FULL DEPTH PVMT REMOVAL)	86	CY	\$ 35	\$ 3,010
SURFACE MILLING ASPHALT (1.5 IN TO 2 IN)	534	SY	\$ 10	\$ 5,340
HOT MIX ASPHALTIC CONCRETE PAVEMENT, 2 IN TYPE D	534	SY	\$ 20	\$ 10,680
HOT MIX ASPHALTIC CONCRETE PAVEMENT 8 IN, TYPE C	217	SY	\$ 15	\$ 3,255
RECONSTRUCTION OF DRIVEWAY APRON	2	EA	\$ 4,000	\$ 8,000
CONCRETE CURB AND GUTTER	337	LF	\$ 25	\$ 8,425
TALL CONCRETE CURB & GUTTER	150	LF	\$ 35	\$ 5,250
MTL W-BEAM GD FEN	30	LF	\$ 30	\$ 900
BARRICADES, SIGNS AND TRAFFIC HANDLING	3	MO	\$ 3,000	\$ 9,000
UTILITY ADJUSTMENT	4	EA	\$ 4,500	\$ 18,000
PERMANENT EROSION CONTROL AND REVEGETATION	337	LF	\$ 10	\$ 3,370
SUBTOTAL SEGMENT 1				\$ 246,750
MOBILIZATION, INSURANCE AND BONDS, PREP ROW, SW3P (22%)				\$ 54,285
CONTINGENCY (30%)				\$ 90,311
PROFESSIONAL SERVICES (15%) (Engineering, Surveying, Geotechnical, Environmental)				\$ 58,702
SUBTOTAL ESTIMATED CONSTRUCTION COSTS SEGMENT 1 STORM SEWER IMPROVEMENTS:				\$ 451,000
SEGMENT 2: STORM SEWER IMPROVEMENTS (302 PLEASANT DRIVE TO 306 PLEASANT DRIVE)				
DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL
CONC BOX CULV (3 FT X 3 FT)	10	LF	\$ 250	\$ 2,500
CONC BOX CULV (4 FT X 4 FT)	261	LF	\$ 325	\$ 84,825
CURB INLET	1	EA	\$ 8,000	\$ 8,000
SAFETY END TREATMENT (3 FT X 3 FT)	1	EA	\$ 5,500	\$ 5,500
STREET EXCAVATION (FULL DEPTH PVMT REMOVAL)	101	CY	\$ 35	\$ 3,535
SURFACE MILLING ASPHALT (1.5 IN TO 2 IN)	452	SY	\$ 10	\$ 4,520
HOT MIX ASPHALTIC CONCRETE PAVEMENT, 2 IN TYPE D	452	SY	\$ 20	\$ 9,040
HOT MIX ASPHALTIC CONCRETE PAVEMENT 8 IN, TYPE C	452	SY	\$ 15	\$ 6,780
CONCRETE CURB AND GUTTER	452	LF	\$ 25	\$ 11,300
BARRICADES, SIGNS AND TRAFFIC HANDLING	3	MO	\$ 3,000	\$ 9,000
UTILITY ADJUSTMENT	1	EA	\$ 4,500	\$ 4,500
PERMANENT EROSION CONTROL AND REVEGETATION	271	LF	\$ 10	\$ 2,710
SUBTOTAL SEGMENT 2				\$ 152,210
MOBILIZATION, INSURANCE AND BONDS, PREP ROW, SW3P (22%)				\$ 33,486
CONTINGENCY (30%)				\$ 55,709
PROFESSIONAL SERVICES (15%) (Engineering, Surveying, Geotechnical, Environmental)				\$ 36,211
SUBTOTAL ESTIMATED CONSTRUCTION COSTS SEGMENT 2 STORM SEWER IMPROVEMENTS:				\$ 278,000

SEGMENT 3: STORM SEWER IMPROVEMENTS (306 PLEASANT DRIVE TO 312 PLEASANT DRIVE)				
DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL
CONC BOX CULV (3 FT X 3 FT)	205	LF	\$ 250	\$ 51,250
CONC BOX CULV (3 FT X 4 FT)	206	LF	\$ 275	\$ 56,650
SAFETY END TREATMENT (3 FT X 3 FT)	1	EA	\$ 5,500	\$ 5,500
SAG INLET	2	EA	\$ 9,000	\$ 18,000
STREET EXCAVATION (FULL DEPTH PVMT REMOVAL)	152	CY	\$ 35	\$ 5,320
SURFACE MILLING ASPHALT (1.5 IN TO 2 IN)	684	SY	\$ 10	\$ 6,840
HOT MIX ASPHALTIC CONCRETE PAVEMENT, 2 IN TYPE D	684	SY	\$ 20	\$ 13,680
HOT MIX ASPHALTIC CONCRETE PAVEMENT 8 IN, TYPE C	684	SY	\$ 15	\$ 10,260
CONCRETE CURB AND GUTTER	410	LF	\$ 25	\$ 10,250
BARRICADES, SIGNS AND TRAFFIC HANDLING	3	MO	\$ 3,000	\$ 9,000
UTILITY ADJUSTMENT	1	EA	\$ 4,500	\$ 4,500
PERMANENT EROSION CONTROL AND REVEGETATION	410	LF	\$ 10	\$ 4,100
SUBTOTAL SEGMENT 3				\$ 195,350
MOBILIZATION, INSURANCE AND BONDS, PREP ROW, SW3P (22%)				\$ 42,977
CONTINGENCY (30%)				\$ 71,498
PROFESSIONAL SERVICES (15%) (Engineering, Surveying, Geotechnical, Environmental)				\$ 46,474
SUBTOTAL ESTIMATED CONSTRUCTION COSTS SEGMENT 3 STORM SEWER IMPROVEMENTS:				\$ 357,000
TOTAL ESTIMATED CONSTRUCTION COSTS SEGMENT 1, 2, and 3 with 30% CONTINGENCY				\$ 1,086,000

*CONSTRUCTION PHASE SERVICES, ROW/EASEMENT ACQUISITION, PERMITTING (FEMA OR TCEQ) NOT INCLUDED IN COST

Appendix G: Supporting Data – Environmental Constraints Analysis

ENVIRONMENTAL CONSTRAINTS ANALYSIS

NIXON AND PLEASANT DRIVE DRAINAGE IMPROVEMENTS City of Rollingwood, Travis County, Texas

RKI Project No. ASF20-128-00

Prepared for:

K FRIESE + ASSOCIATES
1120 S. Capital of Texas Highway, City View 2, Suite 100
Austin, Texas 78746

Prepared by:

The logo for RABA KISTNER features a stylized 'R' icon on the left, composed of a grey square and a red triangle. To the right of the icon, the word 'RABA' is written in red, and 'KISTNER' is written in grey below it.
RABA
KISTNER
12821 West Golden Lane
San Antonio, Texas 78249

January 2021

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Attachments

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Attachment C	Historical Aerial Photographs
Attachment D	Historical Topographic Maps

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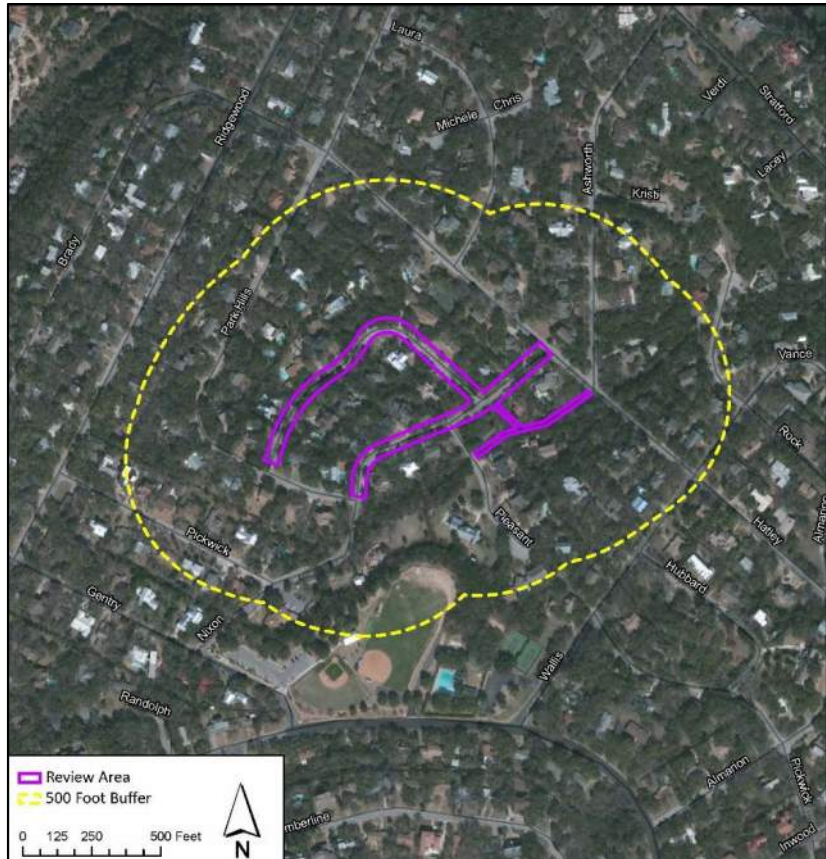
1.0 INTRODUCTION

The City of Rollingwood, Texas is considering storm sewer and drainage improvements along Pleasant Drive and Nixon Drive, as well as improvements to a drainage channel between Pleasant Cove and Hatley Drive in Rollingwood, Texas. **Raba-Kistner, Inc. (RKI)** was contracted to provide an Environmental Constraints Analysis (ECA) to determine the path forward for more advanced planning and permitting of the proposed changes.

Pleasant Drive and Nixon Drive are currently two-lane residential roadways with curbs and varying shoulder widths. Following are the proposed Improvements to Pleasant Drive, Nixon Drive, and the adjacent channel:

- Stormwater improvements along approximately 0.43 miles of Pleasant and Nixon Drive; and
- Drainage improvements to the existing adjacent channel.

This ECA provides a foundation for future detailed environmental, cultural, and socioeconomic analyses, and evaluates resources and issues that should be considered by the project team as the project develops. The “Review Area,” shown in yellow, is a 500 foot radius from the existing right-of-way limits along Nixon Drive, Pleasant Drive, and includes the drainage channel between Pleasant Cove and Hatley Drive. See **Figure 1** and the inset graphic to the right.



Project Vicinity Map

2.0 NEED AND PURPOSE

2.1 Need

Heavy rainfall and poor drainage has caused flooding due to the excessive amounts of storm water runoff within the residential neighborhood of Rollingwood, threatening public safety and property in the community.

2.2 Purpose

The City of Rollingwood will evaluate the construction of drainage infrastructure along Nixon and Pleasant Drive, and improvements to the existing drainage channel between Pleasant Drive and Hatley Drive, to facilitate proper storm water conveyance and reduce flooding within Rollingwood. This ECA will be incorporated in the Preliminary Engineering Report to ensure the design options do not impact natural or cultural resources.



Photo 1: Current view of the downhill grade at Nixon Drive and Pleasant Drive. View is to the west.

3.0 COMMUNITY FEATURES AND DEMOGRAPHICS

3.1 Land Use

The Review Area is an urban, residential neighborhood located within the City of Rollingwood, which is part of the Austin-Round Rock metropolitan area in Texas. The northern portion of the Review Area encompasses Pleasant and Nixon Drive, and the southern portion is located within a forested drainage area south of Nixon Drive.

3.2 Community Profile

A windshield survey was conducted to observe the community setting and identify community features such as schools, places of worship, parks, and healthcare facilities. For the purposes of this analysis, all areas within a 500-foot radius were searched for these features. **Table 1** and **Figure 2** show the community features identified during the windshield survey.

Table 1: Inventory of Community Features

Name	Type	Address	Description
Rollingwood Municipal Park	Park	403 Nixon Drive Rollingwood, TX 78746	Community park and athletic fields.
Rollingwood City Hall	Municipal	403 Nixon Drive Rollingwood, TX 78746	Government facility operated by the City of Rollingwood.
Rollingwood Pool	Park	4801 Rollingwood Drive Austin, TX 78746	Private Swimming pool operated by the Western Hills Athletic Club.

3.3 Demographics

The Review Area is located within one Census Tract (CT), CT 19.19 As shown in **Tables 2** and **3**, the total estimated population of CT 19.19 (**Figure 2**) is approximately 3,945 people with an average median income of \$183,776. None of these households make less than the 2021 poverty line of \$26,500 for a family of four. The poverty line is established by the Department of Health and Human Services and determines eligibility for certain federal programs.

Table 2: 2019 Total Population

Census Geography	2019 Total Population
CT 19.19	3,945

Source: U.S. Census Bureau, 2019 American Community Survey, Table S0101, ACS data are estimates; they are not counts.

Census data including populations that make up the Review Area and surrounding community, language spoken at home, income levels, and ethnicity were compiled to form a community profile for CT 19.19. Data was obtained from the American Community Survey, an ongoing survey conducted by the United States Census Bureau.

Table 3: Income and Poverty Status

Census Geography	Total Households	Median Household Income (\$)	Persons Below Poverty Level	
			Households with Income in the past 12 months (2019) below poverty level	Percent Poverty (%)
CT 19.19	1,337	183,776	16	0.4%

Source: U.S. Census Bureau, 2019 American Community Survey, Tables S1701 and S1903, ACS data are estimates. *Average of median incomes.

Tables 4 and 5 show the racial and ethnic composition of CT 19.19 in the City of Rollingwood and the number of people who speak English “Less than very well”.

Environmental Justice (EJ) ensures that all people, regardless of race, color, origin, or income, are treated fairly in the development, implementation, and enforcement of environmental laws regulations, and policies (U.S. Environmental Protection Agency [EPA] 2021). Should federal funds be introduced, *Executive Order 12898* would apply. This law requires that projects using federal funds identify and address disproportionately high and adverse human health or environmental effects of their actions on minority and low-income populations. This ensures that no population is unfairly impacted from project activities.

Table 4: Racial and Ethnic Composition

Census Geography	2019 Total Pop.	Not Hispanic														Hispanic	
		White		Black*		Indian*		Asian		Islander*		Other*		Two*		#	%
		#	%	#	%	#	%	#	%	#	%	#	%	#	%		
CT 19.19	3,945	3,503	88.8	0	0.0	0	0.0	315	8.0	0	0.0	0	0.0	127	3.2	542	13.7

Source: U.S. Census Bureau, 2019 American Community Survey, Tables B01001A, B01001B, B01001C, B01001D, B01001E, B01001F, B01001G, and B01001I *The complete Census race descriptions are as follows: White alone; Black or African American alone; American Indian and Alaska Native alone; Asian alone; Native Hawaiian and Other Pacific Islander alone; Some Other Race alone; Two or More Races; and Hispanic or Latino.

Based on the information shown in **Table 4**, there are minority populations in the CT.

Table 5 shows that 2.2 percent of the population over five years old speaks English “less than very well.” For any planned public involvement activities (i.e. public hearings or public meetings), measures should be taken to meaningfully engage these populations during the project development process. For example, public notices could be published in predominant languages spoken in the area, and interpreters may be present to ensure all area residents are able to communicate their ideas effectively and understand the project activities.

Table 5: Limited English Proficiency

Census Geography	Population 5 Years and Older	Spanish Speakers	Number Who Speak English Less Than "Very Well"	Percentage Who Speak English Less Than "Very Well"
CT 19.19	3,810	515	84	2.2

Source: U.S. Census Bureau, 2019 American Community Survey Table S1601. ACS data are estimates; they are not counts.

*Percentage of the population 5 years and older who speak English “Less than Very Well”

3.3 Public Recreation Areas

Projects that require the “use” of land from publicly-owned parks, recreational areas, wildlife and waterfowl refuges, or public and private historical sites may be subject to Chapter 26 of the Texas Parks and Wildlife Code (TPWC). This would include coordination with the Official with Jurisdiction (OWJ), public involvement, and completion of Texas Department of Transportation’s (TxDOT’s) Chapter 26 Compliance Checklist.

If a project is using federal transportation funds, it must also comply with Section 4(f) of the U.S. Department of Transportation Act. Currently, there are no public parks or recreational areas within the Review Area. Therefore, Chapter 26 of the TPWC and Section 4(f) do not apply.

4.0 CULTURAL RESOURCES

4.1 Previous Archaeological Investigations and Known Cultural Resources

A review of the Texas Archaeological Sites Atlas (*Atlas*) determined that only one previous archaeological survey has been recorded within the Review Area (THC 2020) (**Figure 3**). There are no archaeological sites or other known cultural resources within the Review Area. A review of a 1-mile (1.6-kilometer) radius of the Review Area identified eight archaeological projects, 22 previously recorded archaeological sites, two cemeteries, four historical markers, and three historic districts (**Tables 6 and 7**). No other documented cultural resources such as cemeteries, historical markers, archaeological sites, or cultural properties marked within the Texas Freedom Colonies Atlas were identified within one mile (1.6-km) (THC 2020 and TFCA 2020).

No archaeological sites or other known cultural resource has been recorded within or adjacent to the Review Area (**Table 6**). Examining cultural resources within one mile (1.6-km) of the Review Area shows that many archaeological sites occur near the Colorado River or side channels. Some of these sites have a large number of cultural materials that sometimes are found with rock shelter and hearth associations. Perhaps the largest and most significant site within the one-mile (1.6 km) area is 41TV1364 within Zilker Park near Barton Creek. The site was recorded as an intact multicomponent site with multiple occupation layers associated with hearths. Large numbers of lithic debitage and tools have been recorded at this site within trench excavations 23 inches (60 centimeters [cm]) below surface. This site was determined eligible for the NRHP in 2008. Another notable site is 41TV270, which is a rock shelter with a large scatter of lithic artifacts that overlooks the Colorado River. This site was determined eligible in 2004 for the NRHP. Additional NRHP eligible sites include 41TV85 and 41TV1343. Both sites are located nearby drainages. One archaeological site, 41TV1900, was a historic cemetery that was later identified as Woods Cemetery.

The one previous archaeological survey within the Review Area was conducted in 2001, by and for the Lower Colorado River Authority (**Table 7**). This survey closely matches portions of the eastern Review Area between Pleasant Cove and Hatley Drive. No archaeological sites nor any other cultural resource are associated with this project. Other previously conducted archaeological surveys have focused to the east at Zilker Park or to the north on either side of the Colorado River. Many of the previously recorded archaeological projects were conducted by and for the Lower Colorado River Authority.

Table 6. Summary of Known Cultural Resources within 1-mile (1.6-km) of the Review Area.

Cultural Resource	Distance from Review Area	Resource Description	Eligibility Status
41TV85	0.6 mile southeast	Cultural materials eroding from eroding from a high bluff. Materials found included numerous flint chips and other lithic artifacts including a partial Pedernales point.	Eligible 1988
41TV138	0.7 mile west	Burned rock midden, approximately 50 ft in diameter. Numerous flakes, 1 scraper, and 1 chopper were also found.	Indeterminable
41TV183	0.67 mile east	In a sandy terrace of a slope wash near with an unknown amount of lithic materials that were excavated 1964.	Indeterminable
41TV270	0.9 mile north	Rock shelter with a large scatter of lithic materials including numerous flakes, scrapers, choppers, shell, and partially worked stone. Overlooks small drainage into the Colorado River.	Eligible 2004

41TV327	0.5 mile east	A limestone bluff with two rock shelters with 19 th century kilns. Owner reported finding a hammer and pistol.	Indeterminable
41TV328	0.62 mile east	Kiln foundation with a nearby quarry.	Indeterminable
41TV900	0.5 mile north	Late 19 th and early 20 th century cemetery with an unknown number of burials. One headstone was found with the name of John Woods. Small paved road bisects cemetery. Surrounded by rock fence.	Indeterminable
41TV1240	0.6 mile north	Located on lower slopes of drainage into Colorado River. Scatter of lithic flakes along with a core, a blade fragment, and two bifaces. Previously impacted by transmission line and erosion.	Indeterminable
41TV1241	0.8 mile north	A small scatter of 7 lithic flakes found on bluff overlooking Town Lake.	Indeterminable
41TV1242	0.7 mile north	A limestone fireplace with foundation of a limestone rectangular structure nearby. One flake was found in a shovel test.	Indeterminable
41TV1243	0.69 mile north	Large scatter of flakes, cores, bifaces, and other lithic debitage mixed with modern trash. Covers approximately 100 x 75m area.	Indeterminable
41TV1244	0.62 mile north	Chert procurement site based on evidence of large chert cobbles along with cores, unifaces, and crude bifaces found nearby. A small rock shelter was located to the north of the site.	Indeterminable
41TV1245	0.65 mile north	A cistern with limestone walls with concrete steps. Bricks and wire fencing were found nearby.	Indeterminable
41TV1246	0.97 mile northeast	Brick clubhouse constructed in 1937 that used older bricks reportedly from the University of Texas.	Indeterminable
41TV1335	0.9 mile west	Possible campsite based on evidence of burned rocks, lithic debitage, utilized flakes, and a dart point.	Ineligible 2007
41TV1343	0.58 mile east	Located on the first terrace above the Colorado River, the site consists of chert cobbles, cores, debitage, blades, and other tools.	Eligible 1988
41TV1364	0.72 mile southeast	A large, intact, multicomponent site located adjacent to the Colorado River. Trenches exposed a hearth along with numerous lithic debitage and tools.	Eligible 2008
41TV1584	0.85 mile north	No details listed in the Atlas.	Indeterminable
41TV1900	0.62 mile south	A historic era rock wall located on an upper terrace of a small unnamed tributary into the Colorado River. Pieces of whiteware sherds and glass were also found nearby.	Ineligible 2000
41TV2065	0.98 mile north	Located on the second terrace of the Colorado River, this heavily disturbed site consisted of a mix of historic (brick fragments, colorless and purple glass fragments, whiteware sherds, buttons) and some prehistoric materials (2 cores, 1 tested cobble, and 7 to 10 lithic flakes).	Ineligible 2005
41TV2118	0.64 mile south	A historic well located on a hilltop. Nearby were 2 lithic flakes, glass with makers' marks, metal artifacts, and 1 historic ceramic sherd.	Ineligible 2005
41TV2256	0.81 mile east	A two story, historic house built in 1858 on the banks of the Colorado River. Walls are 18-inch thick limestone with a later added long porch and Ionic columns.	Indeterminable
Melvin Jackson Cemetery (TV-C171)	0.57 mile northwest	A small cemetery located between houses. No longer used.	-
Woods Cemetery (TV-C172)	0.57 mile northwest	A small, no longer used cemetery located adjacent to Melvin Jackson.	-

Ashford McGill House (Zilker Park Refractory) (6442)	0.77 mile east	Historical marker commemorating the original house of Ashford McGill built in the 1870s.	-
Deep Eddy Bathing Beach (6446)	0.69 mile east	Historical marker commemorating the location of a 1850s homestead that was turned into a resort in 1902.	-
Johnson Home (6448)	0.8 mile east	Historical marker commemorating the location of an 1858 house and quarry.	-
Swedes of Texas (15128)	0.95 mile east	Historical marker commemorating the numerous Swedes that immigrated to Texas during the 19 th century.	-
Travis County (6447)	0.89 mile east	Historical marker commemorating Travis County, named after William Barrett Travis.	-
Deep Eddy Bathing Beach	0.5 mile east	Historic district listed in 2003 due to historic events and design/architecture.	-
Lions Municipal Golf Course	0.6 mile northeast	Historic district listed in 2016 without any additional details recorded in the <i>Atlas</i> .	-
Zilker Park Historic District	0.5 mile southeast	Historic district listed in 1997 due to historic events and design/architecture.	-

Table 7. Summary of previously conducted cultural resources surveys within 1-mile (1.6 km) of the Review Area.

Year of Investigation	Distance from Review Area	Investigative Firm/TAC Permit No.	Brief Summary of Investigations
2001	Within Review Area	LCRA / TAC Permit #2537	Linear survey that bisects portions of the eastern Review Area. Conducted by and for the Lower Colorado River Authority (Malof et al. 2003).
2004	0.91 mile north	LCRA / TAC Permit #3325	An area survey conducted by and for the Lower Colorado River Authority. Recorded site 41TV2065 (Prikryl et al. 2006).
2005	0.5 mile south	Horizon / TAC Permit not listed in <i>Atlas</i>	An area survey conducted by Horizon for US Army Corps of Engineers – Fort Worth District. Recorded site 41TV2118 and revisited site 41TV1900.
2009	0.85 mile southeast	Antiquities Planning and Consulting / TAC Permit #5162	An area survey conducted under the sponsorship of the City of Austin for a maintenance facility within Zilker Park (Godwin 2009).
2011	0.98 mile north	LCRA / TAC Permit #5886	An area monitor project conducted by and for the Lower Colorado River Authority (Hixson et al. 2012).
Not listed	0.35 mile south	No details in <i>Atlas</i> / TAC Permit #2308	Linear survey without any additional details in the <i>Atlas</i> .
Not listed	0.38 mile north	No details in <i>Atlas</i>	An area survey on the north bank of the Colorado River without any additional details available in the <i>Atlas</i> .
Not listed	0.71 mile northwest	No details in <i>Atlas</i>	An area survey conducted on the southern and western banks of the Colorado River. No additional details available in the <i>Atlas</i> .

4.2 Historical Map and Aerial Photograph Review

A review of the 1954, 1966, 1988, 2010, 2013, 2016, and 2019 U.S. Geological Survey (USGS) 7.5-Minute topographic quadrangle maps for Austin West (**Attachment C**) reveals most of the Review Area was left undeveloped for most of the 20th century while residential structures were built nearby in the Rollingwood development. The earliest map from 1954 depicts Hatley Road in its current alignment with two structures depicted to the southwest near Pleasant Cove. The rest of the Review Area is depicted as lightly sloped undeveloped land. The 1966 map shows additional residential developments to the south, east, and north of the Review Area without any additional construction within the Review Area. The two structures from the 1954 map are still in place; however, the 1966 map indicates a small drainage nearby. The 1988 topographic map depicts Pleasant and Nixon Drives in their current alignment. It also still depicts the small drainage running through the eastern portion of the Review Area. Later topographic maps do not show any significant changes from the 1988 map.

A review of historic aerial photography from 1940 through 2016 (**Attachment D**), determined that the Review Area and the immediately surrounding areas experienced increasing residential development starting in the early 1960s. In addition, the aerial photographs depict a small drainage channel to the east of the Review Area. The earliest photograph from 1940, depicts the Review Area and its vicinity as undeveloped forested land with only a few unpaved roads nearby. The 1954 aerial photograph depicts the Review Area and nearby as undeveloped, but with an unpaved road conforming to Hatley Drive. The 1964 aerial photograph shows residential developments to the west, south, and east of the Review Area, while the Review Area and its immediate vicinity is still undeveloped. By the 1980 photograph, Pleasant Drive and Nixon Drive are constructed along with residential developments along these roads.

4.3 Discussion

The archaeological background review determined there is one previous archaeological survey within the Review Area. No archaeological sites or other cultural resource is within the Review Area. Within a one mile (1.6 kilometer) radius of the Review Area, there are eight archaeological projects, 22 previously recorded archaeological sites, two cemeteries, four historical markers, and three historic districts. Many of these archaeological sites are located near the Colorado River or its tributaries.

A historical map review determined that the Review Area was undeveloped forested land until the 1960s when the first residential developments were constructed nearby. The Review Area and its immediate surroundings were not developed until the late 1970s.

Overall, the cultural assessment of the project location determined that there are no previously recorded cultural resources within the Review Area. An examination of nearby archaeological sites determined that there is a high likelihood for cultural materials near the Colorado River and any drainages that feed into it. USGS topographic maps have indicated that there is a drainage channel located just to the east of the Review Area. However, the Review Area has been previously impacted by residential construction which likely included grading and leveling of landforms as well as impacts from the construction of buildings, fences, and utilities.

Despite these previous impacts, the eastern portion of the Review Area is located on a landform that would have been conducive for past human occupation. As such, **RKI** recommends survey be conducted along the eastern portion of the Review Area near and along the creek (**Figure 3**).

5.0 HAZARDOUS MATERIALS

Several sources are available for determining the potential to encounter hazardous materials over the course of a potential project's construction. RKI reviewed regulatory databases (**Attachment B**), historical aerial photography, and historic topographic maps to identify facilities of concern that may impact the potential project.

5.1 Regulatory Databases

There were no hazardous materials facilities identified within the Review Area. One hazardous materials facility was identified within the one-mile radius of the Review Area.

The facility present within the one-mile radius identified in the Regulatory Database is summarized in **Table 8** and is shown in **Figure 4** and **Attachment B**.

Table 8. Summary of Regulatory Database Finding

Facility Name	Type and Program ID No.	Description	Poses Concern for Excavation/ROW Acquisition?
INTEL 1300 S Mopac Expy, Austin, TX 78746	IHWCA – T2910	Fuel Station	Unlikely. This site is reported with a completed workload and is no longer active as of April 26, 2011.

Historically, railroads can be sources of contamination from potentially hazardous materials. There are no railroads within the Review Area. Additionally, there are no reported spills in the regulatory database search.

5.2 Historic Topographic Maps

Historical topographic maps (**Attachment C**) from the USGS (*Austin West, Texas – Travis County 7.5 Minute Quadrangles*) were reviewed for the Review Area. Although the maps are primarily representative of topography, the map legend occasionally includes structures/features of concern that may be significant from an environmental due diligence perspective (i.e., gravel pits, landfill, mining activities, wells, etc.)

1954: The Review Area is vacant, undeveloped land, surrounded by residential communities. There is a small structure, likely a residential dwelling, adjacent south of the Review Area. There are no markings indicating any potential use of hazardous materials or surface water features. Elevation contours suggest any surface water drainage within or adjacent to the Review Area flows into the Colorado River.

1966 and 1973: The Review Area remains as undeveloped vacant with a structure shown directly adjacent south. A blue-dotted line appears within the Review Area, indicating a stream feature. There are no markings indicating any potential use of hazardous materials.

1988 and 2010: Pleasant Drive and Nixon Drive are shown within the now Rollingwood community with continued residential development in the adjacent areas. The stream feature shown within the Review Area remains visible. There are no markings indicating any potential use of hazardous materials.

2013: The Review Area appears as it does today, including the stream feature found within the southern portion of the Review Area. There are no markings indicating any potential use of hazardous materials.

5.3 Historical Aerial Photography

Historical aerial photography can be used to determine past uses of sites within a review area and identify areas that may have been solid waste disposal areas or other hazardous use sites. Aerial photographs from 1940, 1951, 1954, 1964, 1966, 1973, 1980, 1988, 1995, 2004, 2005, 2010, 2012, 2014, 2016 and 2018 (**Attachment D**) were reviewed to look for potential sites of concern.

1940: The Review Area is undeveloped, primarily forested, property south of the Colorado River. The adjacent channel is portrayed on the southern extent of the Review Area. Multiple drainage/stream features are found throughout and adjacent to the Review Area. There is no evidence of any potentially hazardous materials use.

1951 through 1973: The Review Area remains undeveloped, primarily forested property with the adjacent channel portrayed on the southern extent of the Review Area. Adjacent to the Review Area, residential development begins and continues through the years including the development of Hatley Drive, Ridgewood Road, Pickwick Lane, and associated single-family residential dwellings. In the 1954 aerial, a structure, likely a single family residential dwelling, is shown directly adjacent south of the Review Area. Pleasant Drive and Nixon Drive have not yet begun development. There is no evidence of any potentially hazardous materials use.

1980 through 2016: Pleasant Drive and Nixon Drive is shown to be developed within the Review Area along with associated single-family residential dwellings. The adjacent channel on the southern extent of the Review Area remains undeveloped, primarily forested property. Adjacent to the Review Area, the aerial photographs show the additional development of Park Hills Drive and Pleasant Cove with associated single-family residential dwellings. There is no evidence of any potentially hazardous materials use.

2018: The Review Area appears as it does today, a single-family residential community with an adjacent undeveloped channel on the southern extent of the Review Area. There is no evidence of any potentially hazardous materials use.

5.4 Windshield Survey

As part of the desktop constraints analysis, field personnel also drove the length of the Review Area to record any obvious indicators of potentially hazardous materials that may be visible from existing right-of-way. These indicators can include monitoring wells, industrial facilities, fuel stations, automobile repair businesses and dealerships, and other similar facilities. Indicators of a natural gas pipeline were observed on Pleasant Drive; however, no tanks, monitoring wells, or other indicators of potentially hazardous materials were observed.

6.0 BIOLOGICAL RESOURCES

The Review Area is near the eastern boundary of the Balcones Canyonlands within the Edwards Plateau Ecoregion of Texas. The Edwards Plateau began as a grassland savannah but has become predominately Ashe Juniper and other poor-quality forbs and grasses due to overgrazing and fire control in the last century (Texas A&M University [TAMU] 2020). While the Review Area is primarily urban, RKI reviewed several Texas Parks and Wildlife Department (TPWD) and U.S. Fish and Wildlife Service (USFWS) sources to determine if any biological or water resources would be impacted by a potential drainage project.

RKI reviewed published literature including TPWD's Natural Regions of Texas, TPWD Annotated List of Rare Species for Travis County, TPWD Natural Diversity Database (NDD), USFWS Information for Planning and Conservation (IPaC), and USFWS Critical Habitat Mapper tool.

Based on the desktop and field studies:

- According to the TPWD NDD, six species have the potential to occur within a 0.5 mile radius of the Review Area. Plateau loosestrife (*Lythrum ovalifolium*) was observed in 1915, Texas fescue (*Festuca versuta*) was observed in 1917 and 1949, Texas garter snake (*Thamnophis sirtalis annectens*) was observed in 1942, Heller's marbleseed (*Onosmodium helleri*) was observed in 1943, Low spurge (*Euphorbia peplidion*) was observed in 1992, and an invertebrate cave was observed in 1993, but no recent sightings have been recorded. One federally endangered species, Reddell harvestman (*Texella reddelli*), occurred within a 0.5 mile radius of the Review Area in 1993 (TPWD 2020a) (**Figure 5**). No recent sightings of this species have been recorded.
- Based on a review of TPWD's list of rare, threatened, or endangered species for Travis County coupled with a site visit, there is no suitable habitat for any state or federally listed species within the proposed project area (TPWD 2020).
- According to the Travis/Williamson Counties Karst Zones Map, the Review Area is located within Karst Zone 1, an area known to contain endangered cave fauna (**Figure 5**). A karst survey is recommended prior to any construction activities.
- The USFWS Critical Habitat Mapper shows no critical habitat within the Review Area (USFWS 2020a).
- According to the USFWS IPaC system, there is potential for migratory birds to occur in the Review Area. Migratory bird impacts are not anticipated to occur (USFWS 2020b). **Table 9** summarizes the USFWS provided list of threatened and endangered species that may be encountered in the Review Area.

Table 9: Federally Listed Threatened and Endangered Species

Species Name	Status	Condition Info	Effect?	Pertinent Information
BIRDS				
Piping Plover <i>Charadrius melodus</i>	Threatened	Open sandy beaches, especially above tideline, and alkali flats.	No	Only needs to be considered for wind related projects. No suitable habitat for this species.
Red Knot <i>Calidris canutus rufa</i>	Threatened	Breeds in drier tundra areas, such as sparsely vegetated hillsides. Outside of breeding season, it is found primarily in intertidal, marine habitats, especially near coastal inlets, estuaries, and bays.	No	Only needs to be considered for wind related projects. No suitable habitat for this species.
Least tern <i>Sterna antillarum</i>	Endangered	Prefers sandy beaches for nesting, but it will use a flat gravel roof of a building. On sunny days the hot tar showing through the gravel can burn the feet of chicks or become stuck in their down.	No	Only needs to be considered for wind related projects. May migrate over the site, but is not expected to inhabit the Review Area.
Whooping Crane <i>Grus americana</i>	Endangered	Small ponds, marshes, and flooded grain fields for both roosting and foraging. Potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties (TPWD 2020).	No	This species does not nest outside Aransas, Calhoun, and Refugio counties. May migrate over the site, but is not expected to inhabit the Review Area.
Golden-Cheeked Warbler <i>Denroica chrysoparia</i>	Endangered	Ashe juniper in mixed stands with various oaks (<i>Quercus</i> spp.). Edges of cedar brakes. Dependent on Ashe juniper (also known as cedar) for long fine bark strips, only available from mature trees, used in nest construction; nests are placed in various trees other than Ashe juniper; only a few mature junipers or nearby cedar brakes can provide the necessary nest material; forage for insects in broad-leaved trees and shrubs; nesting late March-early summer.	No	The Ashe-juniper trees this species requires are not present within the Review Area. While it may fly over during migration periods, there would be no effect on this species.
AMPHIBIANS				
Austin Blind Salamander <i>Eurycea waterlooensis</i>	Endangered	Lives in water-filled caves of the Edwards Aquifer near San Marcos, Texas.	May Effect	The Review Area is located in Karst Zone 1; therefore, karst survey is recommended to determine whether habitat for this species is present.
Barton Springs Salamander <i>Eurycea sosrum</i>	Endangered	Dependent upon water flow/quality from the Barton Springs pool of the Edwards Aquifer; known from the outlets of Barton Springs and subterranean water-filled caverns; found under rocks, in gravel, or among aquatic vascular plants and algae, as available; feeds primarily on amphipods.	No	The Review Area does not contain habitat with water flow from Barton Springs or water-filled caverns to support species. No effect is expected.

Species Name	Status	Condition Info	Effect?	Pertinent Information
Jollyville Plateau Salamander <i>Eurycea tonkawae</i>	Threatened	Inhabit aquatic habitats (springs, spring-runs, and wet caves) in the Jollyville Plateau and Brushy Creek areas of the Edwards Plateau.	No	The Review Area does not contain the preferred aquatic habitats for this species. Additionally, the Jollyville Plateau and Brushy Creek Areas are not located within the Review Area. No effect on this species is expected.
CLAMS				
Texas Fatmucket <i>Lampsilis bracteata</i>	Candidate	Occur in slow to moderate current in sand, mud, and gravel substrates among large cobble, boulders, bedrock ledges, horizontal cracks in bedrock slabs, and macrophyte beds. Has also been observed inhabiting the roots of cypress trees and vegetation along steep banks. (TPWD 2020).	No	The Review Area does not contain tributaries in sand, mud, or gravel. No effect on this species is expected.
INSECTS				
Kretschmarr Cave Mold Beetle <i>Texamaurops reddelli</i>	Endangered	Occurs in very small isolated caves within the Edwards Limestone Formation. Has only been found under rocks lightly buried in silt in total darkness (NatureServe 2010).	May Effect	The Review Area is located in Karst Zone 1; therefore, karst survey is recommended to determine whether habitat for this species is present.
Tooth Cave Ground Beetle <i>Rhadine persephone</i>	Endangered	Species is an obligate troglobite known only from small isolated karst caves within the Edwards Limestone Formation. It prefers areas of the cave with deep uncompacted silt (NatureServe 1995).	May Effect	The Review Area is located in Karst Zone 1; therefore, karst survey is recommended to determine whether habitat for this species is present.
Karst Invertebrate Species	Endangered	Karst Zone 1 is an area known to contain endangered cave fauna.	May Effect	The Review Area is located in Karst Zone 1; therefore, karst survey is recommended to determine whether habitat for this species is present.
ARACHNIDS				
Bee Creek Cave Harvestman <i>Texella reddelli</i>	Endangered	Small, blind, cave-adapted harvestman endemic to a few caves in Travis and Williamson counties.	May Effect	The Review Area is located in Karst Zone 1; therefore, karst survey is recommended to determine whether habitat for this species is present.
Bone Cave Harvestman <i>Texella reyesi</i>	Endangered	Small, blind, cave-adapted harvestman endemic to several caves in Travis and Williamson counties.	May Effect	The Review Area is located in Karst Zone 1; therefore, karst survey is recommended to determine whether habitat for this species is present.

Species Name	Status	Condition Info	Effect?	Pertinent Information
Tooth Cave Pseudoscorpion <i>Tartarocreagris texana</i>	Endangered	Small, cave-adapted pseudoscorpion known from small limestone caves of the Edwards Plateau.	May Effect	The Review Area is located in Karst Zone 1; therefore, karst survey is recommended to determine whether habitat for this species is present.
Tooth Cave Spider <i>Neoleptoneta myopica</i>	Endangered	Very small, cave-adapted, sedentary spider.	May Effect	The Review Area is located in Karst Zone 1; therefore, karst survey is recommended to determine whether habitat for this species is present.
Karst Arachnid Species	Endangered	Karst Zone 1 is an area known to contain endangered cave fauna.	May Effect	The Review Area is located in Karst Zone 1; therefore, karst survey is recommended to determine whether habitat for this species is present.
FLOWERING PLANTS				
Bracted Twistflower <i>Streptanthus bracteatus</i>	Candidate	Shallow, well-drained gravelly clays and clay loams over limestone in oak juniper woodlands and associated openings, on steep to moderate slopes and in canyon bottoms; several known soils include Tarrant, Brackett, or Speck over Edwards, Glen Rose, and Walnut geologic formations; populations fluctuate widely from year to year, depending on winter rainfall; flowering mid-April late-May, fruit matures and foliage withers by early summer.	No	While the Review Area does contain well drained gravelly clays and clay loams over limestone, it does not consist of oak juniper woodlands, steep to moderate slopes, or canyon bottoms. The geologic formation is Fredericksburg Group undivided. No effect on this species is expected.

7.0 WATER RESOURCES

7.1 Surface Waters and Wetlands

According to the USGS's *7.5-Minute Series, Austin West, Texas Quadrangle*, the Review Area is approximately 600 feet above mean sea level. There is one blue line depicting an intermittent stream shown connecting to the drainage channel in the eastern portion of the Review Area. This stream was present during field activities, but did not appear to carry flow outside of precipitation events. Based on the Navigable Waters Protection Rule, effective June 22, 2020, this stream would not be a U.S. Army Corps of Engineers (USACE) Jurisdictional Water.

The USFWS National Wetlands Inventory (NWI) identified one feature within the Review Area as a riverine, intermittent, streambed, seasonally flooded stream (R4SBC). This feature is shown adjacent south of Nixon Drive and flows into the Colorado River. The mapped NWI feature is included in **Figure 6**.

According to the available floodplain data (FIRM Panel 48453C0445K Effective January 22, 2020), the Review Area is primarily located in an area of minimal flood hazard and is outside the 100-year floodplain. However, the drainage channel in the eastern portion of the Review Area is located within the 500-year floodplain (**Figure 6**).

8.0 OTHER CONSIDERATIONS

8.1 Important/Prime Farmlands

According to the U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS), *Web Soil Survey*, there are three soils in the Review Area. Eckrant soils and Urban land, 0 to 2 percent slopes, Eckrant soils and Urban land, 5 to 18 percent slopes, and Urban land and Brackett soils, 1 to 12 percent slopes are not considered prime farmland. The Review Area is within the city limits of Rollingwood and is therefore not subject to the Farmland Protection Policy Act (FPPA).

8.2 National Environmental Policy Act Compliance

The proposed project will be funded by the City of Rollingwood, Texas. However, if federal funds are added, the project will be required to adhere to the National Environmental Policy Act of 1969 (NEPA).

NEPA requires federal agencies and projects using federal funds to take a “hard look” at the consequences of their actions. This involves the assessment and documentation related to multiple elements including:

- Assessment of the social, economic, and environmental impacts of a proposed action or project
- Analysis of a range of reasonable alternatives to the proposed project, based on the applicants defined purpose and need for the project
- Consideration of appropriate impact mitigation: avoidance, minimization, and compensation
- Interagency coordination/consultation
- Public involvement (meeting, hearing)

Based on the project parameters known at this time, **RKI** anticipates that this project would be classified as either a Categorical Exclusion (CE) or an Environmental Assessment (EA). In general, projects meeting criteria outlined in *23 CFR 771.117* (FHWA Categorical Exclusions) would qualify as a CE.

From the date of initial scoping, a reasonable estimate for completing the CE process (i.e. environmental clearance) may be approximately six to eight months; whereas, an EA process may have a 12-month duration (for receipt of a Finding of No Significant Impact [FONSI]).

9.0 RECOMMENDATIONS

Prior to construction, the following activities are recommended:

- A karst survey is recommended to ensure there would be no impact to rare, threatened or endangered karst species that may be present in the Review Area.
- Based on desktop research, an archeological field survey is recommended along the eastern portion of the Review Area near and along the creek where past human habitation could be present.
- While it does not appear to be a USACE jurisdictional water based on the Navigable Waters Protection Rule, A formal Waters of the U.S. Delineation is recommended for submission to the USACE for their concurrence.

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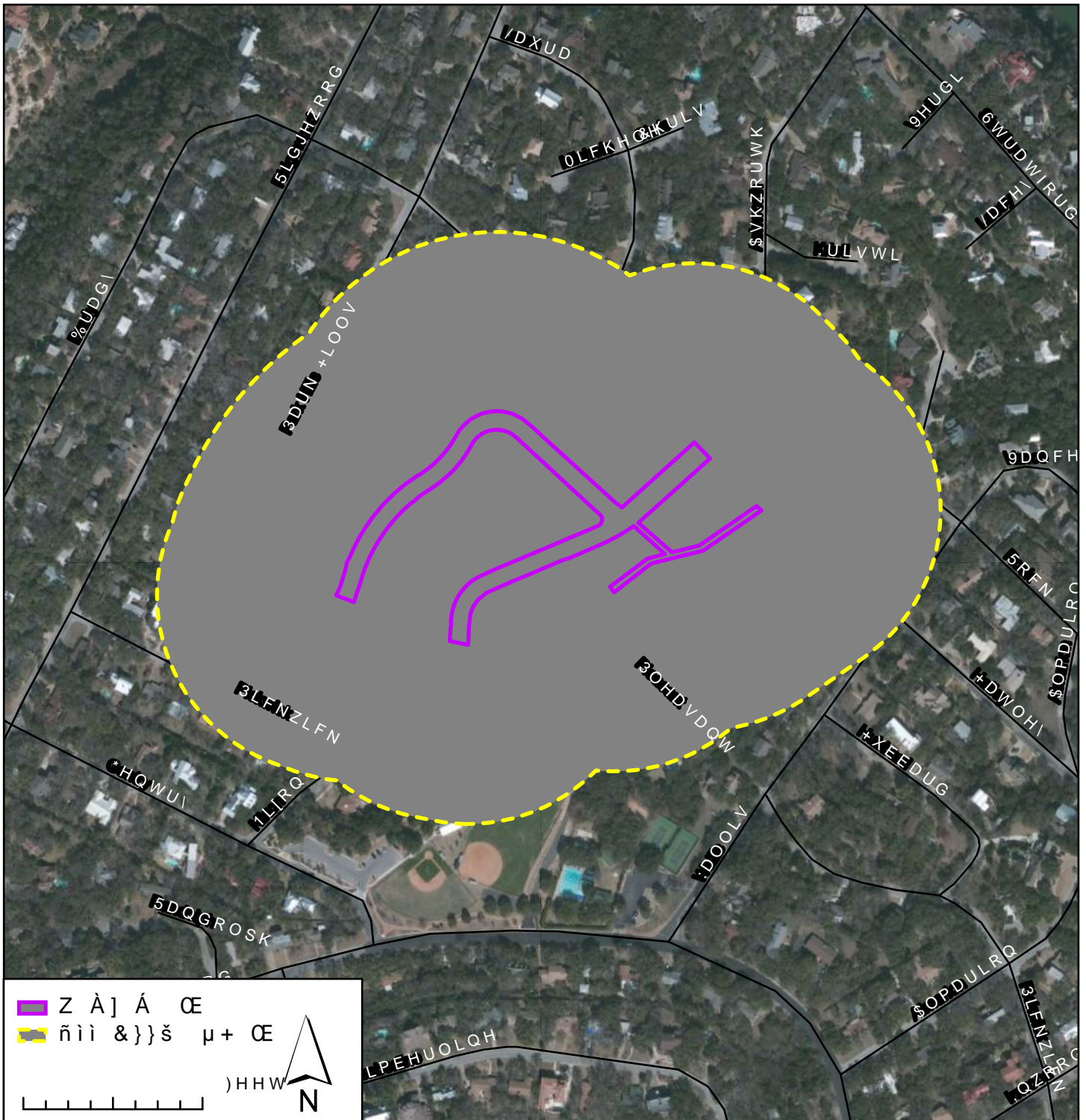
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11.0 ACRONYMS

CE	Categorical Exclusion
CT	Census Tract
EA	Environmental Assessment
ECA	Environmental Constraints Analysis
EJ	Environmental Justice
EPA	U. S. Environmental Protection Agency
FHWA	Federal Highway Administration
FPPA	Farmland Protection Policy Act
FONSI	Finding of No Significant Impact
IHWCA	Industrial and Hazardous Waste Corrective Action Sites
IPAC	Information for Planning and Conservation
LPST	Leaking Petroleum Storage Tank
NDD	Natural Diversity Database
NEPA	National Environmental Policy Act
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory
RKI	Raba Kistner, Inc.
OWJ	Official with Jurisdiction
PST	Petroleum Storage Tank
TAMU	Texas A&M University
TCEQ	Texas Commission on Environmental Quality
TFCA	Texas Freedom Colonies Atlas
THC	Texas Historical Commission
TPWC	Texas Parks and Wildlife Code
TPWD	Texas Parks and Wildlife Department
TxDOT	Texas Department of Transportation
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

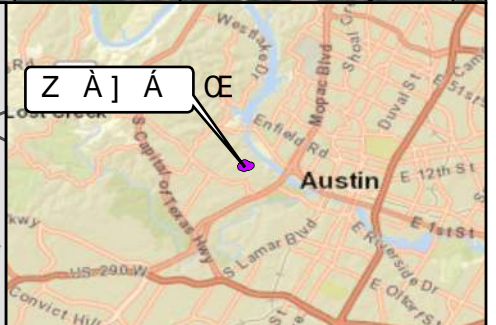
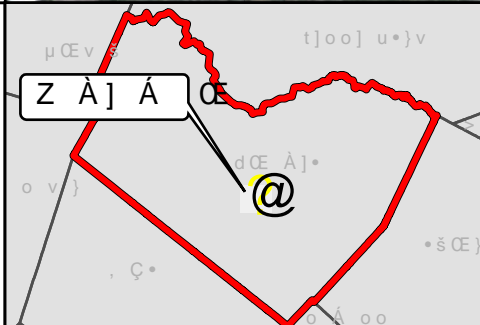
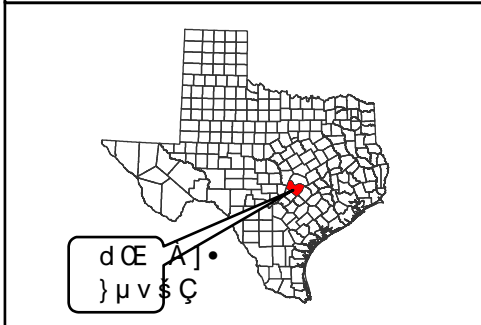
FIGURE 1

PROJECT LOCATION MAP



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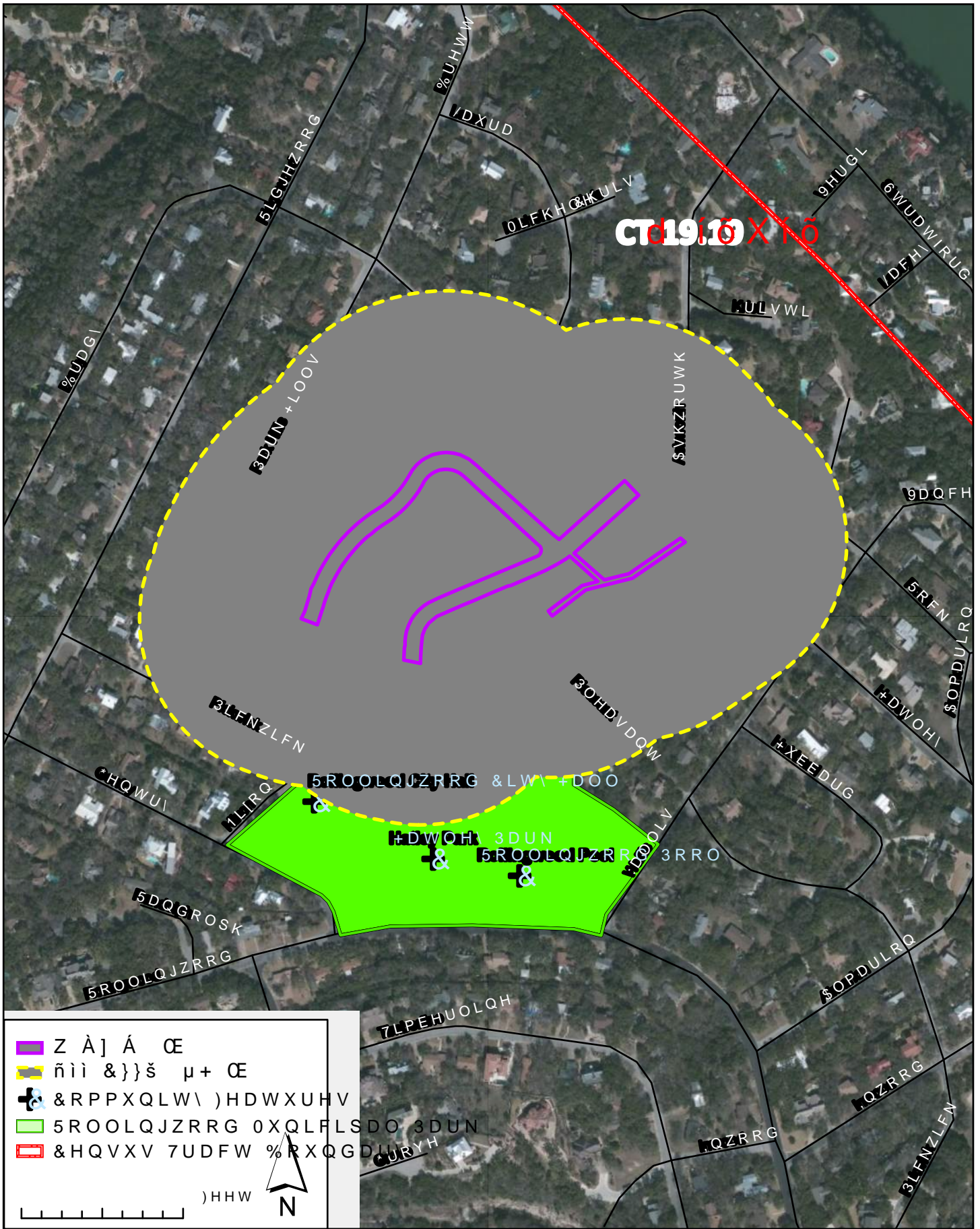


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FIGURE 2

COMMUNITY FEATURES



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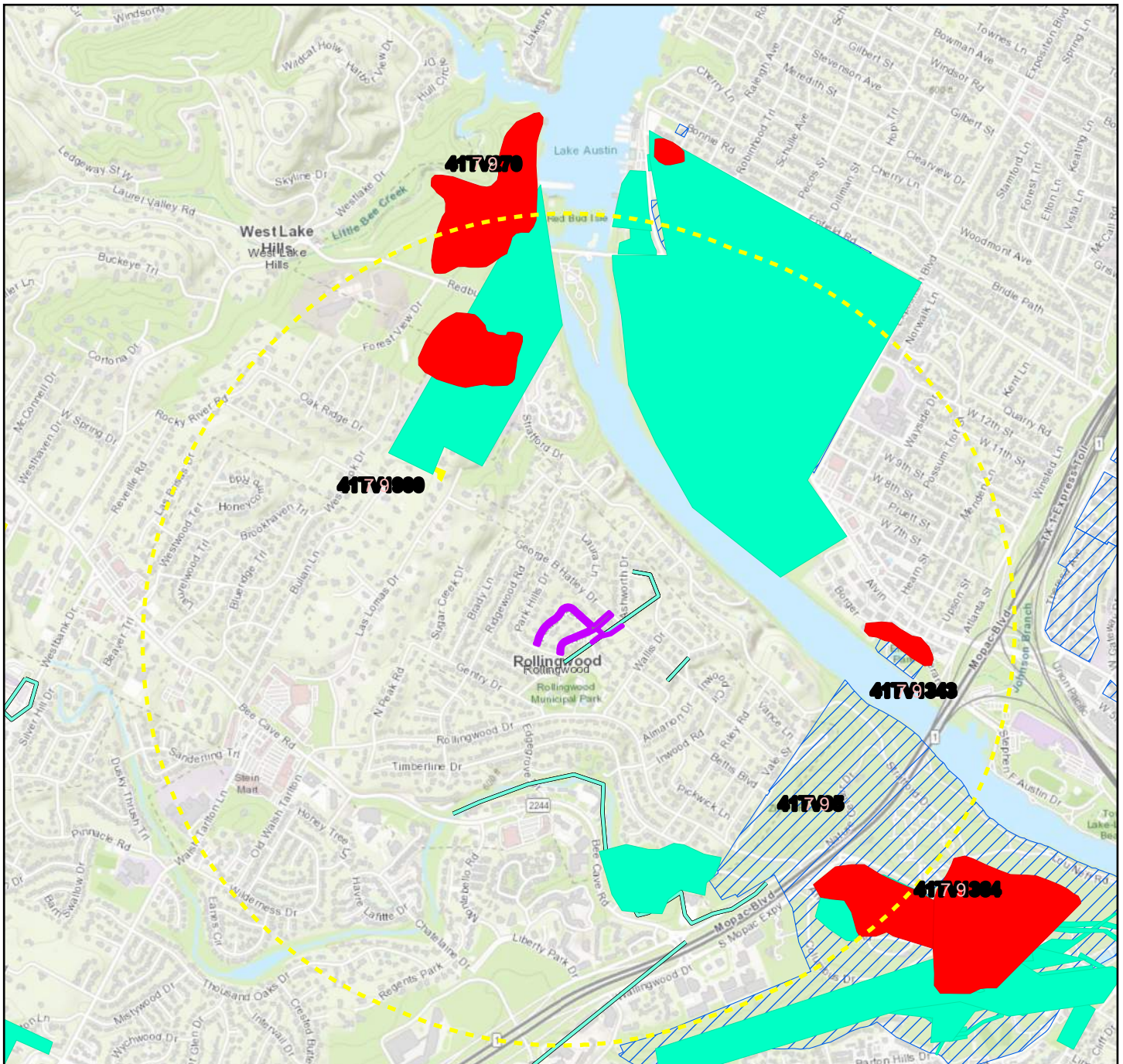
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FIGURE 3

ARCHEOLOGICAL AND HISTORICAL RESOURCES



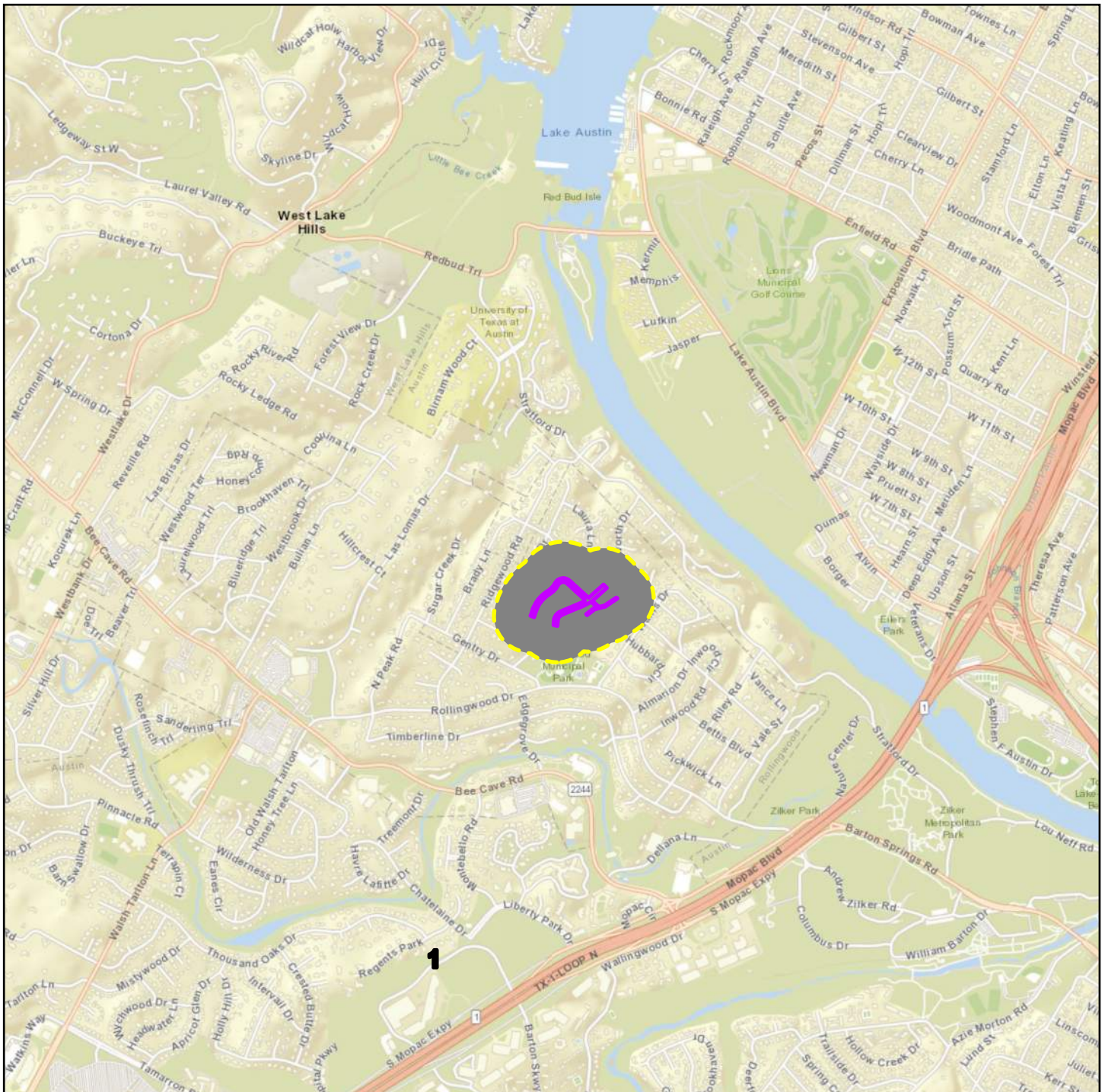
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FIGURE 4

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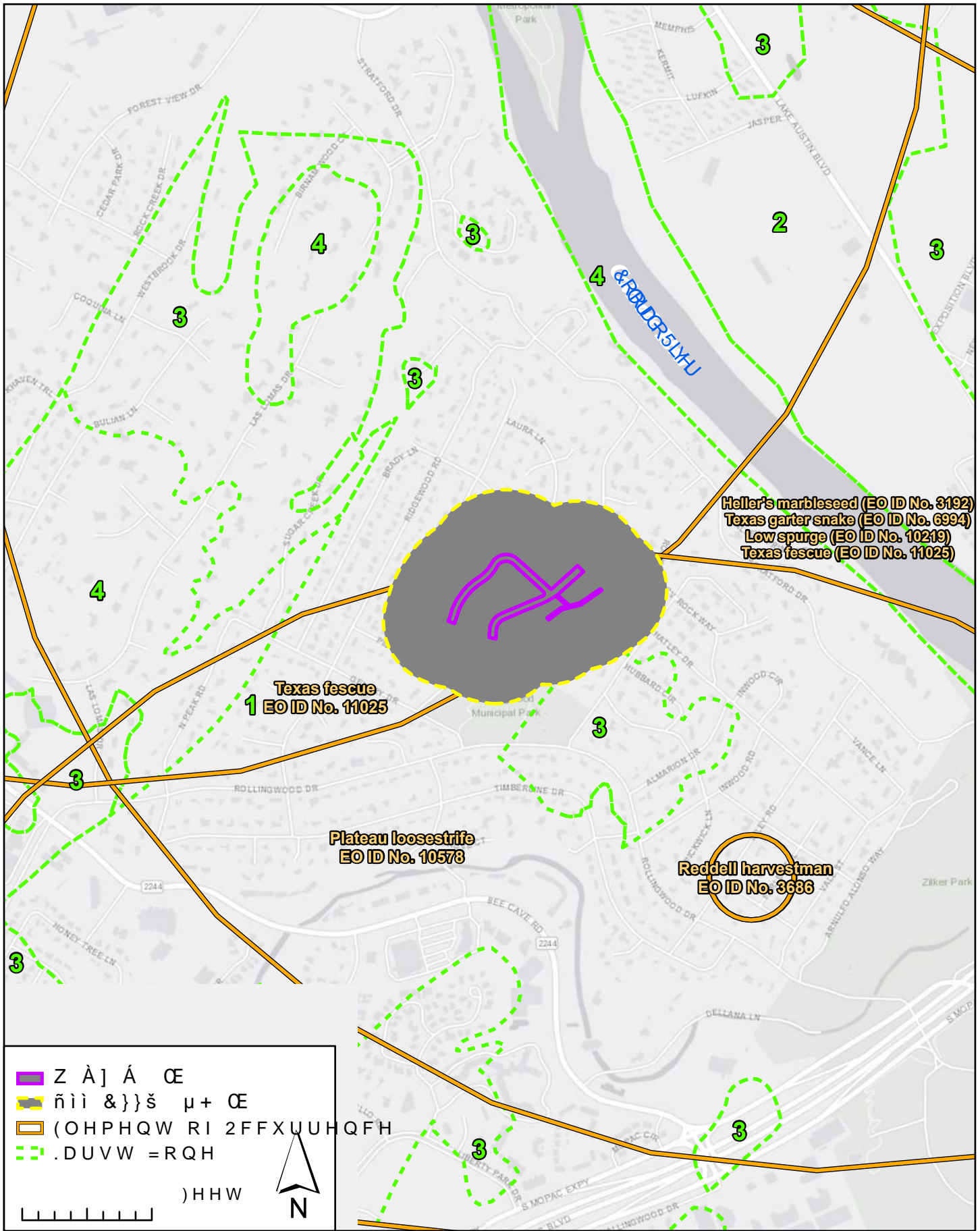
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FIGURE 5

BIOLOGICAL RESOURCES



Heller's marbleseed (EO ID No. 3192)
 Texas garter snake (EO ID No. 6994)
 Low spurge (EO ID No. 10219)
 Texas fescue (EO ID No. 11025)

Texas fescue
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Plateau loosestrife
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Reddell harvestman
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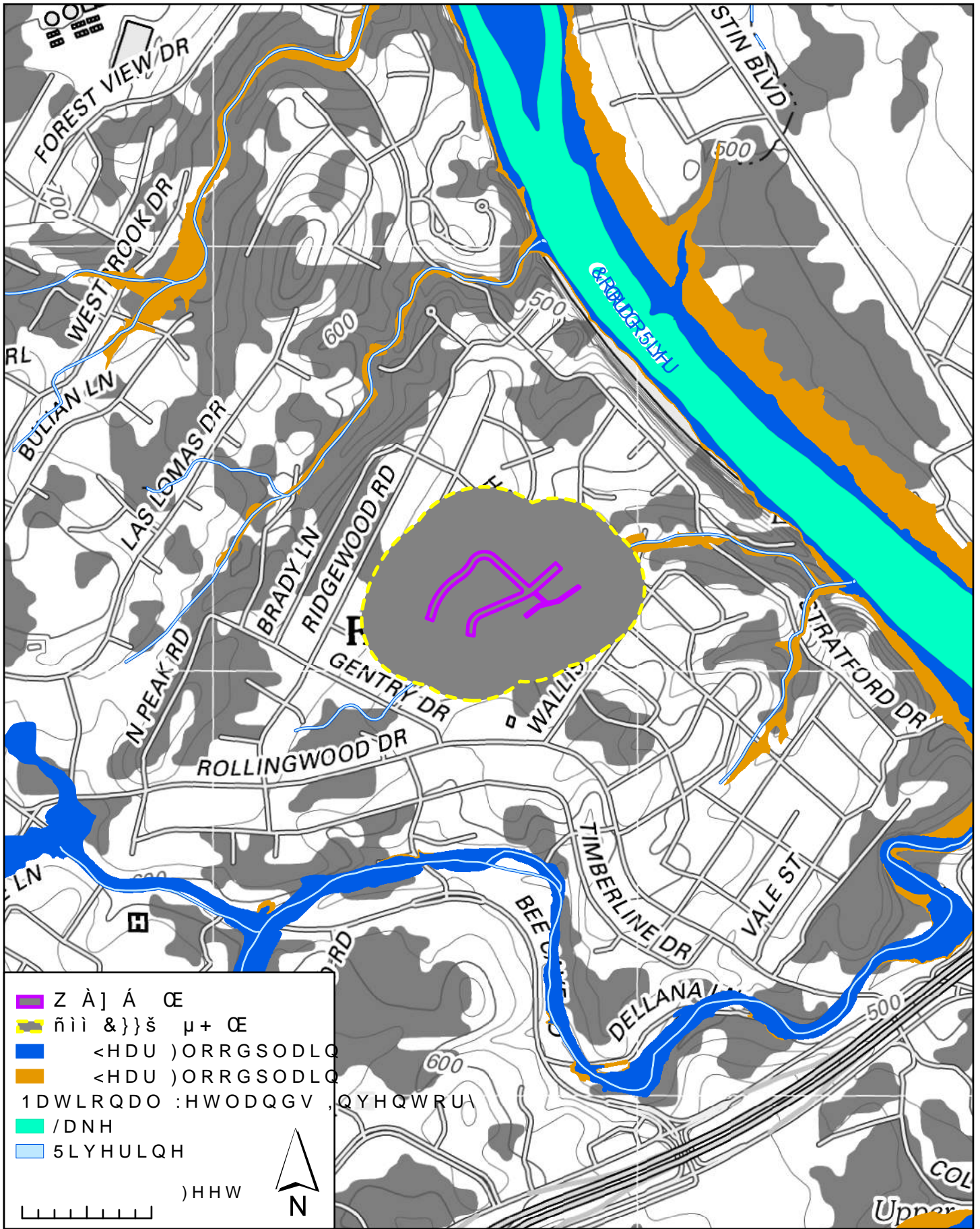
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FIGURE 6

WATER RESOURCES



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ATTACHMENT A

PHOTOGRAPHS



Photo 1: Viewing northwest at Park Hills Drive and Nixon Drive from the southeastern portion of the Review Area.



Photo 2: Viewing northeast on Nixon Drive on the eastern side of the Review Area.



Photo 3: Viewing west at Nixon Drive and Pleasant Drive from the northeastern portion of the Review Area.



Photo 4: Viewing northwest on Pleasant Drive on the eastern side of the Review Area.



Photo 5: Viewing southwest at Pleasant Drive and Park Hills Drive from the southwestern portion of the Review Area.



Photo 6: Viewing northwest at drainage channel from Pleasant Cove on the eastern side of the Review Area.



Photo 7: Viewing southwest at drainage channel from Hatley Drive on the eastern side of the Review Area.



Photo 8: Viewing southwest in drainage channel behind 303 Nixon Drive on the eastern side of the Review Area.



Photo 9: Viewing natural gas pipeline indicator on Pleasant Drive at northeastern portion of the Review Area.

ATTACHMENT B

REGULATORY DATABASE REPORT

Radius Report

[GeoLens by GeoSearch](#)

Target Property:

***Pleasant/Nixon Drainage Improvements
Austin, Travis County, Texas 78746***

Prepared For:

Raba Kistner Environmental-San Antonio

Order #: 158862

Job #: 389166

Project #: ASF20-128-00, Task 7000

Date: 12/15/2020

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Disclaimer

This report was designed by GeoSearch to meet or exceed the records search requirements of the All Appropriate Inquiries Rule (40 CFR § 312.26) and the current version of the ASTM International E1527, Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process or, if applicable, the custom requirements requested by the entity that ordered this report. The records and databases of records used to compile this report were collected from various federal, state and local governmental entities. It is the goal of GeoSearch to meet or exceed the 40 CFR § 312.26 and E1527 requirements for updating records by using the best available technology. GeoSearch contacts the appropriate governmental entities on a recurring basis. Depending on the frequency with which a record source or database of records is updated by the governmental entity, the data used to prepare this report may be updated monthly, quarterly, semi-annually, or annually.

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Target Property Summary

Target Property Information

*Pleasant/Nixon Drainage Improvements
Austin, Texas 78746*

Coordinates

*Area centroid (-97.787194, 30.2777842)
590 feet above sea level*

USGS Quadrangle

Austin West, TX

Geographic Coverage Information

County/Parish: Travis (TX)

ZipCode(s):

Austin TX: 78703, 78746

Database Summary

FEDERAL LISTING

Standard Environmental Records

Database	Acronym	Locatable	Unlocatable	Search Radius (miles)
EMERGENCY RESPONSE NOTIFICATION SYSTEM	ERNSTX	0	0	TP/AP
FEDERAL ENGINEERING INSTITUTIONAL CONTROL SITES	EC	0	0	TP/AP
LAND USE CONTROL INFORMATION SYSTEM	LUCIS	0	0	TP/AP
RCRA SITES WITH CONTROLS	RCRASC	0	0	TP/AP
RESOURCE CONSERVATION & RECOVERY ACT - GENERATOR	RCRAGR06	0	0	0.1250
RESOURCE CONSERVATION & RECOVERY ACT - NON-GENERATOR	RCRANGR06	0	0	0.1250
BROWNFIELDS MANAGEMENT SYSTEM	BF	0	0	0.5000
DELISTED NATIONAL PRIORITIES LIST	DNPL	0	0	0.5000
NO LONGER REGULATED RCRA NON-CORRACTS TSD FACILITIES	NLRRCRAT	0	0	0.5000
RESOURCE CONSERVATION & RECOVERY ACT - NON-CORRACTS TREATMENT, STORAGE & DISPOSAL FACILITIES	RCRAT	0	0	0.5000
SUPERFUND ENTERPRISE MANAGEMENT SYSTEM	SEMS	0	0	0.5000
SUPERFUND ENTERPRISE MANAGEMENT SYSTEM ARCHIVED SITE INVENTORY	SEMSARCH	0	0	0.5000
NATIONAL PRIORITIES LIST	NPL	0	0	1.0000
NO LONGER REGULATED RCRA CORRECTIVE ACTION FACILITIES	NLRRCRAC	0	0	1.0000
PROPOSED NATIONAL PRIORITIES LIST	PNPL	0	0	1.0000
RESOURCE CONSERVATION & RECOVERY ACT - CORRECTIVE ACTION FACILITIES	RCRAC	0	0	1.0000
RESOURCE CONSERVATION & RECOVERY ACT - SUBJECT TO CORRECTIVE ACTION FACILITIES	RCRASUBC	0	0	1.0000
SUB-TOTAL		0	0	

Additional Environmental Records

Database	Acronym	Locatable	Unlocatable	Search Radius (miles)
AEROMETRIC INFORMATION RETRIEVAL SYSTEM / AIR FACILITY SUBSYSTEM	AIRSAFS	0	0	TP/AP
BIENNIAL REPORTING SYSTEM	BRS	0	0	TP/AP
CERCLIS LIENS	SFLIENS	0	0	TP/AP
CLANDESTINE DRUG LABORATORY LOCATIONS	CDL	0	0	TP/AP
EPA DOCKET DATA	DOCKETS	0	0	TP/AP
ENFORCEMENT AND COMPLIANCE HISTORY INFORMATION	ECHOR06	0	0	TP/AP
FACILITY REGISTRY SYSTEM	FRSTX	0	0	TP/AP

Database Summary

Database	Acronym	Locatable	Unlocatable	Search Radius (miles)
HAZARDOUS MATERIALS INCIDENT REPORTING SYSTEM	HMIRSR06	0	0	TP/AP
HAZARDOUS WASTE COMPLIANCE DOCKET FACILITIES	HWCD	0	0	TP/AP
INTEGRATED COMPLIANCE INFORMATION SYSTEM (FORMERLY DOCKETS)	ICIS	0	0	TP/AP
INTEGRATED COMPLIANCE INFORMATION SYSTEM NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM	ICISNPDES	0	0	TP/AP
MATERIAL LICENSING TRACKING SYSTEM	MLTS	0	0	TP/AP
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM	NPDESR06	0	0	TP/AP
PCB ACTIVITY DATABASE SYSTEM	PADS	0	0	TP/AP
PERMIT COMPLIANCE SYSTEM	PCSR06	0	0	TP/AP
SEMS LIEN ON PROPERTY	SEMCLIENS	0	0	TP/AP
SSEHRI PFAS CONTAMINATION SITES	SSEHRIPFAS	0	0	TP/AP
SECTION SEVEN TRACKING SYSTEM	SSTS	0	0	TP/AP
TOXIC SUBSTANCE CONTROL ACT INVENTORY	TSCA	0	0	TP/AP
TOXICS RELEASE INVENTORY	TRI	0	0	TP/AP
ALTERNATIVE FUELING STATIONS	ALTFUELS	0	0	0.2500
FEMA OWNED STORAGE TANKS	FEMAUST	0	0	0.2500
HISTORICAL GAS STATIONS	HISTPST	0	0	0.2500
INTEGRATED COMPLIANCE INFORMATION SYSTEM DRYCLEANERS	ICISCLEANERS	0	0	0.2500
MINE SAFETY AND HEALTH ADMINISTRATION MASTER INDEX FILE	MSHA	0	0	0.2500
MINERAL RESOURCE DATA SYSTEM	MRDS	0	0	0.2500
OPEN DUMP INVENTORY	ODI	0	0	0.5000
SURFACE MINING CONTROL AND RECLAMATION ACT SITES	SMCRA	0	0	0.5000
URANIUM MILL TAILINGS RADIATION CONTROL ACT SITES	USUMTRCA	0	0	0.5000
DEPARTMENT OF DEFENSE SITES	DOD	0	0	1.0000
FORMER MILITARY NIKE MISSILE SITES	NMS	0	0	1.0000
FORMERLY USED DEFENSE SITES	FUDS	0	0	1.0000
FORMERLY UTILIZED SITES REMEDIAL ACTION PROGRAM	FUSRAP	0	0	1.0000
RECORD OF DECISION SYSTEM	RODS	0	0	1.0000
SUB-TOTAL		0	0	

Database Summary

STATE (TX) LISTING

Standard Environmental Records

Database	Acronym	Locatable	Unlocatable	Search Radius (miles)
STATE INSTITUTIONAL/ENGINEERING CONTROL SITES	SIEC01	0	0	TP/AP
PETROLEUM STORAGE TANKS	PST	0	0	0.2500
BROWNFIELDS SITE ASSESSMENTS	BSA	0	0	0.5000
CLOSED & ABANDONED LANDFILL INVENTORY	CALF	0	0	0.5000
COMMERCIAL MANAGEMENT FACILITIES FOR HAZARDOUS WASTE AND INDUSTRIAL SOLID WASTES	WSTMGMT	0	0	0.5000
LEAKING PETROLEUM STORAGE TANKS	LPST	0	0	0.5000
MUNICIPAL SOLID WASTE LANDFILL SITES	MSWLF	0	0	0.5000
OPERATOR CLEANUP PROGRAM SITES	OCP	0	0	0.5000
RAILROAD COMMISSION VCP AND BROWNFIELD SITES	RRCVCP	0	0	0.5000
VOLUNTARY CLEANUP PROGRAM SITES	VCP	0	0	0.5000
STATE SUPERFUND SITES	SF	0	0	1.0000
SUB-TOTAL		0	0	

Additional Environmental Records

Database	Acronym	Locatable	Unlocatable	Search Radius (miles)
GROUNDWATER CONTAMINATION CASES	GWCC	0	0	TP/AP
HISTORIC GROUNDWATER CONTAMINATION CASES	HISTGWCC	0	0	TP/AP
LAND APPLICATION PERMITS	LANDAPP	0	0	TP/AP
MUNICIPAL SETTING DESIGNATIONS	MSD	0	0	TP/AP
NOTICE OF VIOLATIONS	NOV	0	0	TP/AP
SPILLS LISTING	SPILLS	0	0	TP/AP
TCEQ LIENS	LIENS	0	0	TP/AP
TIER I I CHEMICAL REPORTING PROGRAM FACILITIES	TIERII	0	0	TP/AP
DRY CLEANER REGISTRATION DATABASE	DCR	0	0	0.2500
INDUSTRIAL AND HAZARDOUS WASTE SITES	IHW	0	0	0.2500
PERMITTED INDUSTRIAL HAZARDOUS WASTE SITES	PIHW	0	0	0.2500
AFFECTED PROPERTY ASSESSMENT REPORTS	APAR	0	0	0.5000
DRY CLEANER REMEDIATION PROGRAM SITES	DCRPS	0	0	0.5000
INNOCENT OWNER / OPERATOR DATABASE	IOP	0	0	0.5000
RADIOACTIVE WASTE SITES	RWS	0	0	0.5000
RECYCLING FACILITIES	WMRF	0	0	0.5000
SALT CAVERNS FOR PETROLEUM STORAGE	STCV	0	0	0.5000

Database Summary

Database	Acronym	Locatable	Unlocatable	Search Radius (miles)
INDUSTRIAL AND HAZARDOUS WASTE CORRECTIVE ACTION SITES	IHWCA	1	0	1.0000
SUB-TOTAL		1	0	

Database Summary

LOCAL LISTING

Standard Environmental Records

Database	Acronym	Locatable	Unlocatable	Search Radius (miles)
CITY OF AUSTIN UNDERGROUND STORAGE TANKS	AUSTINUST	0	0	0.2500
SUB-TOTAL		0	0	

Additional Environmental Records

Database	Acronym	Locatable	Unlocatable	Search Radius (miles)
EDWARDS AQUIFER PERMITS	EAP	0	0	TP/AP
CITY OF AUSTIN HISTORICAL UNDERGROUND STORAGE TANKS	AUSTINHISTUST	0	0	0.2500
SUB-TOTAL		0	0	

Database Summary

TRIBAL LISTING

Standard Environmental Records

Database	Acronym	Locatable	Unlocatable	Search Radius (miles)
UNDERGROUND STORAGE TANKS ON TRIBAL LANDS	USTR06	0	0	0.2500
LEAKING UNDERGROUND STORAGE TANKS ON TRIBAL LANDS	LUSTR06	0	0	0.5000
OPEN DUMP INVENTORY ON TRIBAL LANDS	ODINDIAN	0	0	0.5000

SUB-TOTAL		0	0	
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Additional Environmental Records

Database	Acronym	Locatable	Unlocatable	Search Radius (miles)
INDIAN RESERVATIONS	INDIANRES	0	0	1.0000

SUB-TOTAL		0	0	
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TOTAL		1	0	
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Database Radius Summary

FEDERAL LISTING

Standard environmental records are displayed in **bold**.

Acronym	Search Radius (miles)	TP/AP (0 - 0.02)	1/8 Mile (> TP/AP)	1/4 Mile (> 1/8)	1/2 Mile (> 1/4)	1 Mile (> 1/2)	> 1 Mile	Total
AIRSAFS	0.0200	0	NS	NS	NS	NS	NS	0
BRS	0.0200	0	NS	NS	NS	NS	NS	0
CDL	0.0200	0	NS	NS	NS	NS	NS	0
DOCKETS	0.0200	0	NS	NS	NS	NS	NS	0
EC	0.0200	0	NS	NS	NS	NS	NS	0
ECHOR06	0.0200	0	NS	NS	NS	NS	NS	0
ERNSTX	0.0200	0	NS	NS	NS	NS	NS	0
FRSTX	0.0200	0	NS	NS	NS	NS	NS	0
HMIRSR06	0.0200	0	NS	NS	NS	NS	NS	0
HWCD	0.0200	0	NS	NS	NS	NS	NS	0
ICIS	0.0200	0	NS	NS	NS	NS	NS	0
ICISNPDES	0.0200	0	NS	NS	NS	NS	NS	0
LUCIS	0.0200	0	NS	NS	NS	NS	NS	0
MLTS	0.0200	0	NS	NS	NS	NS	NS	0
NPDES06	0.0200	0	NS	NS	NS	NS	NS	0
PADS	0.0200	0	NS	NS	NS	NS	NS	0
PCSR06	0.0200	0	NS	NS	NS	NS	NS	0
RCRASC	0.0200	0	NS	NS	NS	NS	NS	0
SEMSLIENS	0.0200	0	NS	NS	NS	NS	NS	0
SFLIENS	0.0200	0	NS	NS	NS	NS	NS	0
SSEHRIPFAS	0.0200	0	NS	NS	NS	NS	NS	0
SSTS	0.0200	0	NS	NS	NS	NS	NS	0
TRI	0.0200	0	NS	NS	NS	NS	NS	0
TSCA	0.0200	0	NS	NS	NS	NS	NS	0
RCRAGR06	0.1250	0	0	NS	NS	NS	NS	0
RCRANGR06	0.1250	0	0	NS	NS	NS	NS	0
ALTFUELS	0.2500	0	0	0	NS	NS	NS	0
FEMAUST	0.2500	0	0	0	NS	NS	NS	0
HISTPST	0.2500	0	0	0	NS	NS	NS	0
ICISCLEANERS	0.2500	0	0	0	NS	NS	NS	0
MRDS	0.2500	0	0	0	NS	NS	NS	0
MSHA	0.2500	0	0	0	NS	NS	NS	0
BF	0.5000	0	0	0	0	NS	NS	0
DNPL	0.5000	0	0	0	0	NS	NS	0
NLRRCRAT	0.5000	0	0	0	0	NS	NS	0

Database Radius Summary

Acronym	Search Radius (miles)	TP/AP (0 - 0.02)	1/8 Mile (> TP/AP)	1/4 Mile (> 1/8)	1/2 Mile (> 1/4)	1 Mile (> 1/2)	> 1 Mile	Total
ODI	0.5000	0	0	0	0	NS	NS	0
RCRAT	0.5000	0	0	0	0	NS	NS	0
SEMS	0.5000	0	0	0	0	NS	NS	0
SEMSARCH	0.5000	0	0	0	0	NS	NS	0
SMCRA	0.5000	0	0	0	0	NS	NS	0
USUMTRCA	0.5000	0	0	0	0	NS	NS	0
DOD	1.0000	0	0	0	0	0	NS	0
FUDS	1.0000	0	0	0	0	0	NS	0
FUSRAP	1.0000	0	0	0	0	0	NS	0
NLRRCRAC	1.0000	0	0	0	0	0	NS	0
NMS	1.0000	0	0	0	0	0	NS	0
NPL	1.0000	0	0	0	0	0	NS	0
PNPL	1.0000	0	0	0	0	0	NS	0
RCRAC	1.0000	0	0	0	0	0	NS	0
RCRASUBC	1.0000	0	0	0	0	0	NS	0
RODS	1.0000	0	0	0	0	0	NS	0
SUB-TOTAL		0	0	0	0	0	0	0

Database Radius Summary

STATE (TX) LISTING

Standard environmental records are displayed in **bold**.

Acronym	Search Radius (miles)	TP/AP (0 - 0.02)	1/8 Mile (> TP/AP)	1/4 Mile (> 1/8)	1/2 Mile (> 1/4)	1 Mile (> 1/2)	> 1 Mile	Total
GWCC	0.0200	0	NS	NS	NS	NS	NS	0
HISTGWCC	0.0200	0	NS	NS	NS	NS	NS	0
LANDAPP	0.0200	0	NS	NS	NS	NS	NS	0
LIENS	0.0200	0	NS	NS	NS	NS	NS	0
MSD	0.0200	0	NS	NS	NS	NS	NS	0
NOV	0.0200	0	NS	NS	NS	NS	NS	0
SIEC01	0.0200	0	NS	NS	NS	NS	NS	0
SPILLS	0.0200	0	NS	NS	NS	NS	NS	0
TIERII	0.0200	0	NS	NS	NS	NS	NS	0
DCR	0.2500	0	0	0	NS	NS	NS	0
IHW	0.2500	0	0	0	NS	NS	NS	0
PIHW	0.2500	0	0	0	NS	NS	NS	0
PST	0.2500	0	0	0	NS	NS	NS	0
APAR	0.5000	0	0	0	0	NS	NS	0
BSA	0.5000	0	0	0	0	NS	NS	0
CALF	0.5000	0	0	0	0	NS	NS	0
DCRPS	0.5000	0	0	0	0	NS	NS	0
IOP	0.5000	0	0	0	0	NS	NS	0
LPST	0.5000	0	0	0	0	NS	NS	0
MSWLF	0.5000	0	0	0	0	NS	NS	0
OCP	0.5000	0	0	0	0	NS	NS	0
RRCVCP	0.5000	0	0	0	0	NS	NS	0
RWS	0.5000	0	0	0	0	NS	NS	0
STCV	0.5000	0	0	0	0	NS	NS	0
VCP	0.5000	0	0	0	0	NS	NS	0
WMRF	0.5000	0	0	0	0	NS	NS	0
WSTMGMT	0.5000	0	0	0	0	NS	NS	0
IHWCA	1.0000	0	0	0	0	1	NS	1
SF	1.0000	0	0	0	0	0	NS	0
SUB-TOTAL		0	0	0	0	1	0	1

Database Radius Summary

LOCAL LISTING

Standard environmental records are displayed in **bold**.

Acronym	Search Radius (miles)	TP/AP (0 - 0.02)	1/8 Mile (> TP/AP)	1/4 Mile (> 1/8)	1/2 Mile (> 1/4)	1 Mile (> 1/2)	> 1 Mile	Total
EAP	0.0200	0	NS	NS	NS	NS	NS	0
AUSTINHISTUST	0.2500	0	0	0	NS	NS	NS	0
AUSTINUST	0.2500	0	0	0	NS	NS	NS	0
<hr/>								
SUB-TOTAL		0	0	0	0	0	0	0

Database Radius Summary

TRIBAL LISTING

Standard environmental records are displayed in **bold**.

Acronym	Search Radius (miles)	TP/AP (0 - 0.02)	1/8 Mile (> TP/AP)	1/4 Mile (> 1/8)	1/2 Mile (> 1/4)	1 Mile (> 1/2)	> 1 Mile	Total
USTR06	0.2500	0	0	0	NS	NS	NS	0
LUSTR06	0.5000	0	0	0	0	NS	NS	0
ODINDIAN	0.5000	0	0	0	0	NS	NS	0
INDIANRES	1.0000	0	0	0	0	0	NS	0

SUB-TOTAL		0	0	0	0	0	0	0
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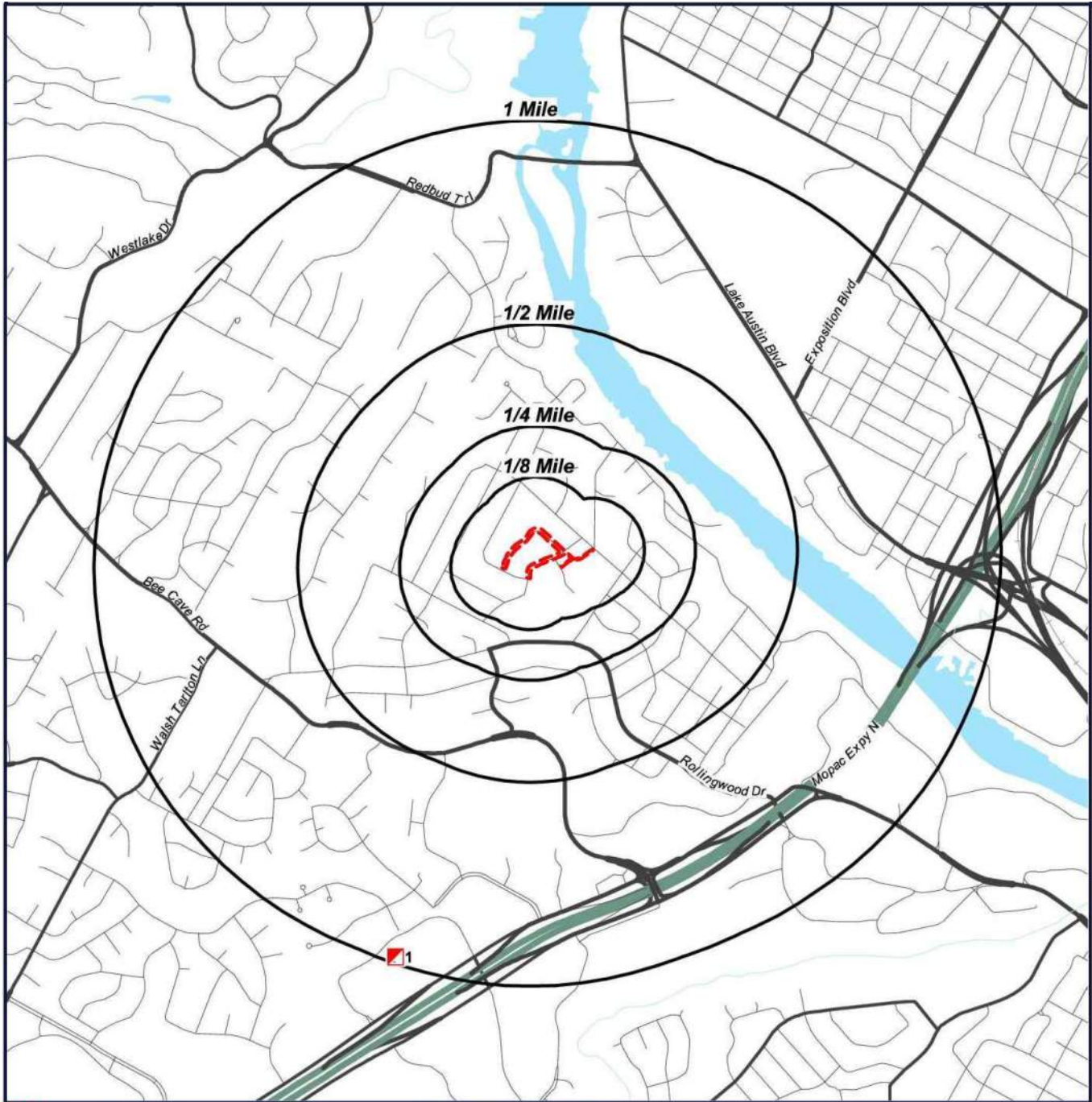
TOTAL		0	0	0	0	1	0	1
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NOTES:

NS = NOT SEARCHED

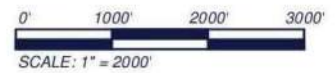
TP/AP = TARGET PROPERTY/ADJACENT PROPERTY

Radius Map 1

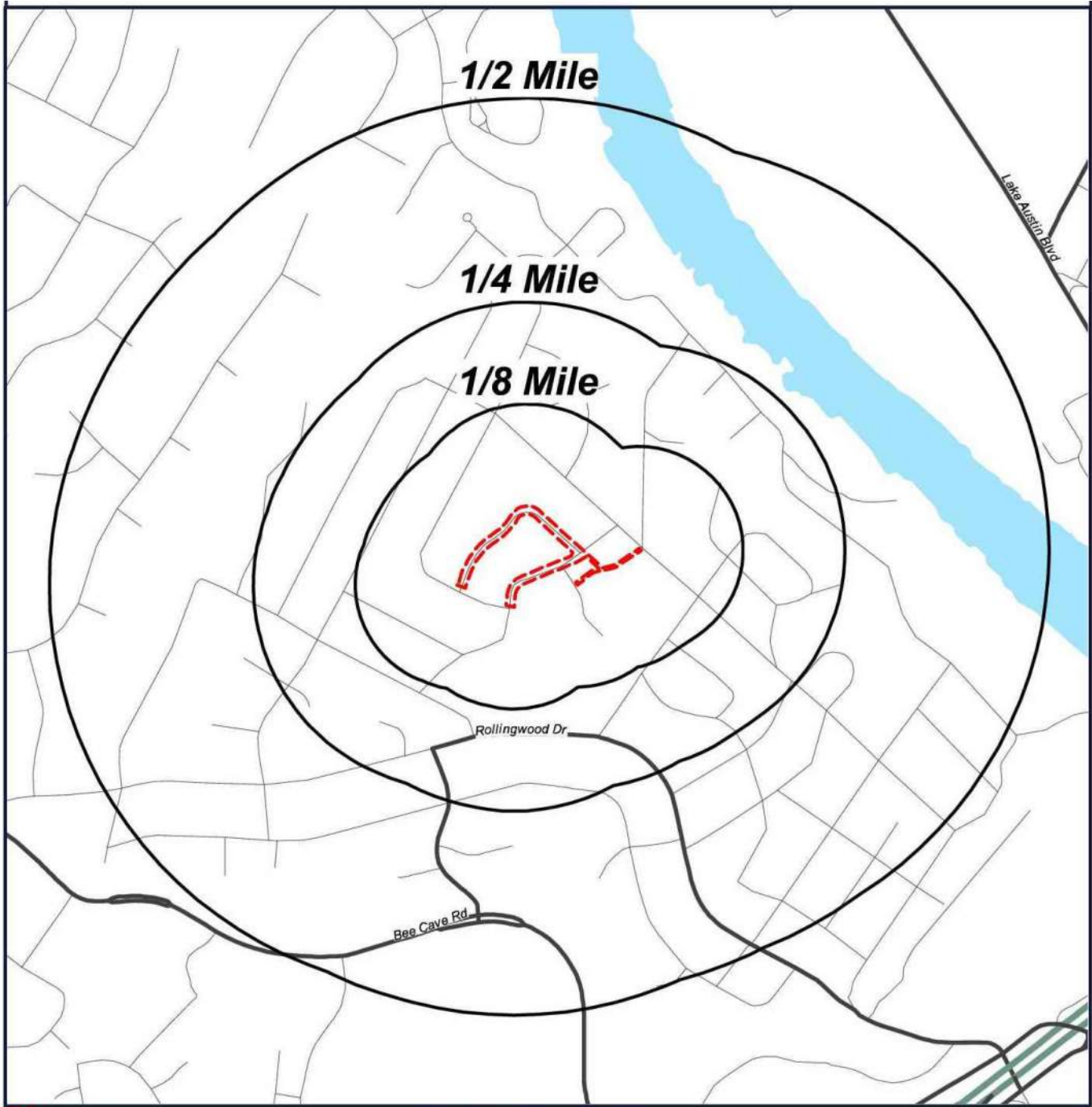




- Target Property (TP)
- IHWCA

**Pleasant/Nixon Drainage
Improvements
Austin, Texas
78746**

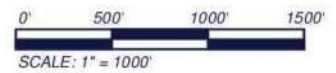


Radius Map 2



-  Target Property (TP)
-  IHWCA



**Pleasant/Nixon Drainage
Improvements
Austin, Texas
78746**



Ortho Map



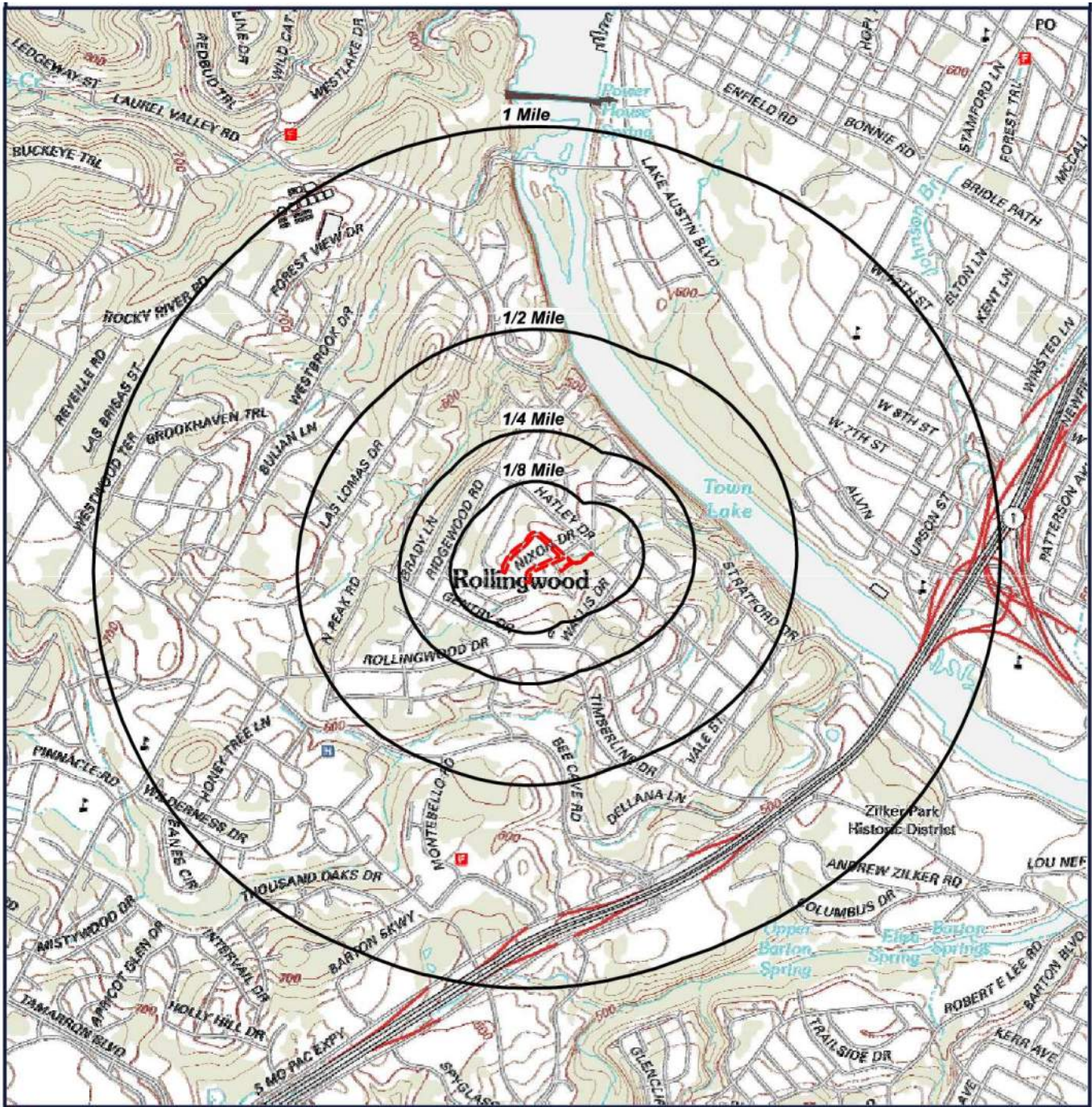
© 2020 Microsoft Corporation © 2020 Maxar © CNES (2020) Distribution Airbus DS © 2020 TomTom

-  Target Property (TP)
-  IHWCA

**Quadrangle(s): Austin
West
Pleasant/Nixon
Drainage
Improvements
Austin, Texas
78746**



Topographic Map



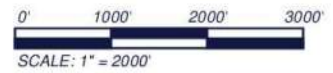
 Target Property (TP)

Quadrangle(s): Austin

West

Source: USGS,
01/24/2013

Pleasant/Nixon
Drainage
Improvements
Austin, Texas
78746



Located Sites Summary

NOTE: Standard environmental records are displayed in **bold**.

Map ID#	Database Name	Site ID#	Relative Elevation	Distance From Site	Site Name	Address	PAGE #
1	IHWCA	T2910	Higher (629 ft.)	0.981 mi. SSW (5180 ft.)	INTEL	1300 S MOPAC EXPY, AUSTIN, TX 78746	20

Site Summary By Database

NOTE: Standard environmental records are displayed in **bold**.

Map ID#	Database Name	Site ID#	Relative Elevation	Distance From Site	Site Name	Address
1	IHWCA	T2910	Higher (629 ft.)	0.981 mi. SSW (5180 ft.)	INTEL	1300 S MOPAC EXPY, AUSTIN, TX 78746

Elevation Summary

Elevations are collected from the USGS 3D Elevation Program 1/3 arc-second (approximately 10 meters) layer hosted at the NGTOC. .

Target Property Elevation: 590 ft.

NOTE: Standard environmental records are displayed in **bold**.

EQUAL/HIGHER ELEVATION

Map ID#	Database Name	Elevation	Site Name	Address	Page #
1	IHWCA	629 ft.	INTEL	1300 S MOPAC EXPY, AUSTIN, TX 78746	20

LOWER ELEVATION

No Records Found

Industrial and Hazardous Waste Corrective Action Sites (IHWCA)

[MAP ID# 1](#)

Distance from Property: 0.981 mi. (5,180 ft.) SSW
Elevation: 629 ft. (Higher than TP)

PROGRAM ID: T2910

RN NUMBER: RN102139128

NAME: INTEL

ADDRESS: 1300 S MOPAC EXPY
AUSTIN, TX 78746

STATUS: INACTIVE

STATUS DATE: 04/26/2011

PHASE: COMPLETED WORKLOAD

LOCATION DESCRIPTION: 1300 S MOPAC EXPY AUSTIN TEXAS 78746

PHASE STATUS DATE: 04/26/2011

SOIL CHEMICAL OF CONCERN CLASS: NOT REPORTED

SOIL REMEDIATION: NOT REPORTED

GROUNDWATER CHEMICAL OF CONCERN CLASS: NOT REPORTED

GROUNDWATER REMEDIATION: NOT REPORTED

[Back to Report Summary](#)

Unlocated Sites Summary

This list contains sites that could not be mapped due to limited or incomplete address information.

No Records Found

Environmental Records Definitions - FEDERAL

AIRSAFS Aerometric Information Retrieval System / Air Facility Subsystem

VERSION DATE: 10/20/14

The United States Environmental Protection Agency (EPA) modified the Aerometric Information Retrieval System (AIRS) to a database that exclusively tracks the compliance of stationary sources of air pollution with EPA regulations: the Air Facility Subsystem (AFS). Since this change in 2001, the management of the AIRS/AFS database was assigned to EPA's Office of Enforcement and Compliance Assurance. Enforcement and Compliance History Online (ECHO) Clean Air Act data from AFS are frozen and reflect data as of October 17, 2014, the EPA retired this system for Clean Air Act stationary sources.

ALTFUELS Alternative Fueling Stations

VERSION DATE: 10/28/20

Nationwide list of alternative fueling stations made available by the U.S. Department of Energy's Office of Energy Efficiency & Renewable Energy. Includes Bio-diesel stations, Ethanol (E85) stations, Liquefied Petroleum Gas (Propane) stations, Ethanol (E85) stations, Natural Gas stations, Hydrogen stations, and Electric Vehicle Supply Equipment (EVSE).

BF Brownfields Management System

VERSION DATE: 10/08/20

Brownfields are real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant. Cleaning up and reinvesting in these properties takes development pressures off of undeveloped, open land, and both improves and protects the environment. The United States Environmental Protection Agency maintains this database to track activities in the various brown field grant programs including grantee assessment, site cleanup and site redevelopment. This database included tribal brownfield sites.

BRS Biennial Reporting System

VERSION DATE: 12/31/17

The United States Environmental Protection Agency (EPA), in cooperation with the States, biennially collects information regarding the generation, management, and final disposition of hazardous wastes regulated under the Resource Conservation and Recovery Act of 1976 (RCRA), as amended. The Biennial Report captures detailed data on the generation of hazardous waste from large quantity generators and data on waste management practices from treatment, storage and disposal facilities. Currently, the EPA states that data collected between 1991 and 1997 was originally a part of the defunct Biennial Reporting System and is now incorporated into the RCRAInfo data system.

CDL Clandestine Drug Laboratory Locations

VERSION DATE: 06/17/20

Environmental Records Definitions - FEDERAL

The U.S. Department of Justice ("the Department") provides this information as a public service. It contains addresses of some locations where law enforcement agencies reported they found chemicals or other items that indicated the presence of either clandestine drug laboratories or dumpsites. In most cases, the source of the entries is not the Department, and the Department has not verified the entry and does not guarantee its accuracy. Members of the public must verify the accuracy of all entries by, for example, contacting local law enforcement and local health departments. The Department does not establish, implement, enforce, or certify compliance with clean-up or remediation standards for contaminated sites; the public should contact a state or local health department or environmental protection agency for that information.

DNPL Delisted National Priorities List

VERSION DATE: 09/21/20

This database includes sites from the United States Environmental Protection Agency's Final National Priorities List (NPL) where remedies have proven to be satisfactory or sites where the original analyses were inaccurate, and the site is no longer appropriate for inclusion on the NPL, and final publication in the Federal Register has occurred.

DOCKETS EPA Docket Data

VERSION DATE: 12/22/05

The United States Environmental Protection Agency Docket data lists Civil Case Defendants, filing dates as far back as 1971, laws broken including section, violations that occurred, pollutants involved, penalties assessed and superfund awards by facility and location. Please refer to ICIS database as source of current data.

DOD Department of Defense Sites

VERSION DATE: 12/01/14

This information originates from the National Atlas of the United States Federal Lands data, which includes lands owned or administered by the Federal government. Army DOD, Army Corps of Engineers DOD, Air Force DOD, Navy DOD and Marine DOD areas of 640 acres or more are included.

EC Federal Engineering Institutional Control Sites

VERSION DATE: 11/23/20

This database includes site locations where Engineering and/or Institutional Controls have been identified as part of a selected remedy for the site as defined by United States Environmental Protection Agency official remedy decision documents. The data displays remedy component information for Superfund decision documents issued in fiscal years 1982-2017, and it includes final and deleted NPL sites as well as sites with a Superfund Alternative Approach (SAA) agreement in place. The only sites included that are not on the NPL, proposed for NPL, or removed from proposed NPL, are those with an SAA Agreement in place. A site listing does not indicate that the institutional and engineering controls are currently in place nor will be in place once the remedy is complete; it only indicates that the decision to include either of them in the remedy is documented as of the completed date of the document. Institutional controls are actions, such as legal controls, that help minimize the

Environmental Records Definitions - FEDERAL

potential for human exposure to contamination by ensuring appropriate land or resource use. Engineering controls include caps, barriers, or other device engineering to prevent access, exposure, or continued migration of contamination.

ECHOR06 Enforcement and Compliance History Information

VERSION DATE: 11/28/20

The U.S. Environmental Protection Agency's Enforcement and Compliance History Online (ECHO) database, provides compliance and enforcement information for facilities nationwide. This database includes facilities regulated as Clean Air Act stationary sources, Clean Water Act direct dischargers, Resource Conservation and Recovery Act hazardous waste handlers, Safe Drinking Water Act public water systems along with other data, such as Toxics Release Inventory releases.

ERNSTX Emergency Response Notification System

VERSION DATE: 09/27/20

This National Response Center database contains data on reported releases of oil, chemical, radiological, biological, and/or etiological discharges into the environment anywhere in the United States and its territories. The data comes from spill reports made to the U.S. Environmental Protection Agency, U.S. Coast Guard, the National Response Center and/or the U.S. Department of Transportation.

FEMAUST FEMA Owned Storage Tanks

VERSION DATE: 12/01/16

This is a listing of FEMA owned underground and aboveground storage tank sites. For security reasons, address information is not released to the public according to the U.S. Department of Homeland Security.

FRSTX Facility Registry System

VERSION DATE: 10/02/20

The United States Environmental Protection Agency's Office of Environmental Information (OEI) developed the Facility Registry System (FRS) as the centrally managed database that identifies facilities, sites or places subject to environmental regulations or of environmental interest. The Facility Registry System replaced the Facility Index System or FINDS database.

FUDS Formerly Used Defense Sites

VERSION DATE: 12/31/18

The Formerly Used Defense Sites (FUDS) inventory includes properties previously owned by or leased to the United States and under Secretary of Defense Jurisdiction, as well as Munitions Response Areas (MRAs). The remediation of these properties is the responsibility of the Department of Defense. This data is provided by the U.S. Army Corps of Engineers (USACE), the boundaries/polygon data are based on preliminary findings and not

Environmental Records Definitions - FEDERAL

all properties currently have polygon data available. **DISCLAIMER:** This data represents the results of data collection/processing for a specific USACE activity and is in no way to be considered comprehensive or to be used in any legal or official capacity as presented on this site. While the USACE has made a reasonable effort to insure the accuracy of the maps and associated data, it should be explicitly noted that USACE makes no warranty, representation or guaranty, either expressed or implied, as to the content, sequence, accuracy, timeliness or completeness of any of the data provided herein. For additional information on Formerly Used Defense Sites please contact the USACE Public Affairs Office at (202) 528-4285.

FUSRAP Formerly Utilized Sites Remedial Action Program

VERSION DATE: 03/04/17

The U.S. Department of Energy (DOE) established the Formerly Utilized Sites Remedial Action Program (FUSRAP) in 1974 to remediate sites where radioactive contamination remained from the Manhattan Project and early U.S. Atomic Energy Commission (AEC) operations. The DOE Office of Legacy Management (LM) established long-term surveillance and maintenance (LTS&M) requirements for remediated FUSRAP sites. DOE evaluates the final site conditions of a remediated site on the basis of risk for different future uses. DOE then confirms that LTS&M requirements will maintain protectiveness.

HISTPST Historical Gas Stations

VERSION DATE: NR

This historic directory of service stations is provided by the Cities Service Company. The directory includes Cities Service filling stations that were located throughout the United States in 1930.

HMIRSR06 Hazardous Materials Incident Reporting System

VERSION DATE: 10/27/20

The HMIRS database contains unintentional hazardous materials release information reported to the U.S. Department of Transportation located in EPA Region 6. This region includes the following states: Arkansas, Louisiana, New Mexico, Oklahoma, and Texas.

HWCD Hazardous Waste Compliance Docket Facilities

VERSION DATE: 10/29/20

This list of the Federal Agency Hazardous Waste Compliance Docket Facilities is maintained by the United States Environmental Protection Agency (EPA). According to the EPA, Section 120(c) of CERCLA requires EPA to establish a listing, known as the Federal Facility Hazardous Waste Compliance Docket (Docket), of Federal facilities which are managing or have managed hazardous waste; or have had a release of hazardous waste. Thus, the Docket identifies all Federal facilities that must be evaluated to determine whether they pose a risk to human health and the environment and it makes this information available to the public. In order for the Docket to remain current and accurate it requires periodic updating.

Environmental Records Definitions - FEDERAL

ICIS Integrated Compliance Information System (formerly DOCKETS)

VERSION DATE: 09/19/20

ICIS is a case activity tracking and management system for civil, judicial, and administrative federal Environmental Protection Agency enforcement cases. ICIS contains information on federal administrative and federal judicial cases under the following environmental statutes: the Clean Air Act, the Clean Water Act, the Resource Conservation and Recovery Act, the Emergency Planning and Community Right-to-Know Act - Section 313, the Toxic Substances Control Act, the Federal Insecticide, Fungicide, and Rodenticide Act, the Comprehensive Environmental Response, Compensation, and Liability Act, the Safe Drinking Water Act, and the Marine Protection, Research, and Sanctuaries Act.

ICISCLEANERS Integrated Compliance Information System Drycleaners

VERSION DATE: 09/19/20

This is a listing of drycleaner facilities from the Integrated Compliance Information System (ICIS). The U.S. Environmental Protection Agency (EPA) tracks facilities that possess NAIC and SIC codes that classify businesses as drycleaner establishments. The following Primary SIC Codes are included in this data: 7211, 7212, 7213, 7215, 7216, 7217, 7218, and/or 7219; the following Primary NAICS Codes are included in this data: 812320, 812331, and/or 812332.

ICISNPDES Integrated Compliance Information System National Pollutant Discharge Elimination System

VERSION DATE: 04/26/20

Authorized by the Clean Water Act, the National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States. This database is provided by the U.S. Environmental Protection Agency.

LUCIS Land Use Control Information System

VERSION DATE: 09/01/06

The LUCIS database is maintained by the U.S. Department of the Navy and contains information for former Base Realignment and Closure (BRAC) properties across the United States.

MLTS Material Licensing Tracking System

VERSION DATE: 06/29/17

MLTS is a list of approximately 8,100 sites which have or use radioactive materials subject to the United States Nuclear Regulatory Commission (NRC) licensing requirements. Disclaimer: Due to agency regulations and policies, this database contains applicant/licensee location information which may or may not be related to the physical location per MLTS site.

Environmental Records Definitions - FEDERAL

MRDS Mineral Resource Data System

VERSION DATE: 03/15/16

MRDS (Mineral Resource Data System) is a collection of reports describing metallic and nonmetallic mineral resources throughout the world. Included are deposit name, location, commodity, deposit description, geologic characteristics, production, reserves, resources, and references. This database contains the records previously provided in the Mineral Resource Data System (MRDS) of USGS and the Mineral Availability System/Mineral Industry Locator System (MAS/MILS) originated in the U.S. Bureau of Mines, which is now part of USGS. The USGS has ceased systematic updates of the MRDS database with their focus more recently on deposits of critical minerals while providing a well-documented baseline of historical mine locations from USGS topographic maps. A few updates last occurred 2015 and early 2016 for select mine site area/s.

MSHA Mine Safety and Health Administration Master Index File

VERSION DATE: 08/07/20

The Mine dataset lists all Coal and Metal/Non-Metal mines under MSHA's jurisdiction since 1/1/1970. It includes such information as the current status of each mine (Active, Abandoned, NonProducing, etc.), the current owner and operating company, commodity codes and physical attributes of the mine. Mine ID is the unique key for this data. This information is provided by the United States Department of Labor - Mine Safety and Health Administration (MSHA).

NLRRCRAC No Longer Regulated RCRA Corrective Action Facilities

VERSION DATE: 09/14/20

This database includes RCRA Corrective Action facilities that are no longer regulated by the United States Environmental Protection Agency or do not meet other RCRA reporting requirements.

NLRRCRAT No Longer Regulated RCRA Non-CORRACTS TSD Facilities

VERSION DATE: 09/14/20

This database includes RCRA Non-Corrective Action TSD facilities that are no longer regulated by the United States Environmental Protection Agency or do not meet other RCRA reporting requirements. This listing includes facilities that formerly treated, stored or disposed of hazardous waste.

NMS Former Military Nike Missile Sites

VERSION DATE: 12/01/84

This information was taken from report DRXTH-AS-IA-83A016 (Historical Overview of the Nike Missile System, 12/1984) which was performed by Environmental Science and Engineering, Inc. for the U.S. Army Toxic and Hazardous Materials Agency Assessment Division. The Nike system was deployed between 1954 and the mid-1970's. Among the substances used or stored on Nike sites were liquid missile fuel (JP-4); starter fluids (UDKH, aniline, and furfuryl alcohol); oxidizer (IRFNA); hydrocarbons (motor oil, hydraulic fluid, diesel fuel, gasoline,

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heating oil); solvents (carbon tetrachloride, trichloroethylene, trichloroethane, stoddard solvent); and battery electrolyte. The quantities of material a disposed of and procedures for disposal are not documented in published reports. Virtually all information concerning the potential for contamination at Nike sites is confined to personnel who were assigned to Nike sites. During deactivation most hardware was shipped to depot-level supply points. There were reportedly instances where excess materials were disposed of on or near the site itself at closure. There was reportedly no routine site decontamination.

NPDES06 National Pollutant Discharge Elimination System

VERSION DATE: 04/01/07

Authorized by the Clean Water Act, the National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States. The NPDES database was collected from the U.S. Environmental Protection Agency (EPA) from December 2002 through April 2007. Refer to the ICIS and/or ICIS-NPDES database as source of current data. This database includes permitted facilities located in EPA Region 6. This region includes the following states: Arkansas, Louisiana, New Mexico, Oklahoma, and Texas.

NPL National Priorities List

VERSION DATE: 09/21/20

This database includes United States Environmental Protection Agency (EPA) National Priorities List sites that fall under the EPA's Superfund program, established to fund the cleanup of the most serious uncontrolled or abandoned hazardous waste sites identified for possible long-term remedial action.

ODI Open Dump Inventory

VERSION DATE: 06/01/85

The open dump inventory was published by the United States Environmental Protection Agency. An "open dump" is defined as a facility or site where solid waste is disposed of which is not a sanitary landfill which meets the criteria promulgated under section 4004 of the Solid Waste Disposal Act (42 U.S.C. 6944) and which is not a facility for disposal of hazardous waste. This inventory has not been updated since June 1985.

PADS PCB Activity Database System

VERSION DATE: 11/19/20

PADS Identifies generators, transporters, commercial storers and/or brokers and disposers of Polychlorinated Biphenyls (PCB) who are required to notify the U.S. Environmental Protection Agency of such activities.

PCSR06 Permit Compliance System

VERSION DATE: 08/01/12

The historic Permit Compliance System tracked enforcement status and permit compliance of facilities controlled

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by the National Pollutant Discharge Elimination System (NPDES) under the Clean Water Act. This database includes permitted facilities located in EPA Region 6 states: Arkansas, Louisiana, New Mexico, Oklahoma, and Texas. This system has since been modernized by United States Environmental Protection Agency and is now integrated into the Integrated Compliance Information System (ICIS). Please refer to the ICIS database as the current source for this data.

PNPL Proposed National Priorities List

VERSION DATE: 09/21/20

This database contains sites proposed to be included on the National Priorities List (NPL) in the Federal Register. The United States Environmental Protection Agency investigates these sites to determine if they may present long-term threats to public health or the environment.

RCRAC Resource Conservation & Recovery Act - Corrective Action Facilities

VERSION DATE: 09/14/20

The Resource Conservation and Recovery Act (RCRA) gives the U.S. Environmental Protection Agency (EPA) the authority to control hazardous waste from the "cradle-to-grave." This includes the generation, transportation, treatment, storage, and disposal of hazardous waste. RCRA also set forth a framework for the management of non-hazardous solid wastes. The 1986 amendments to RCRA enabled EPA to address environmental problems that could result from underground tanks storing petroleum and other hazardous substances. This listing refers to facilities with corrective action activity.

RCRAGR06 Resource Conservation & Recovery Act - Generator

VERSION DATE: 09/14/20

The Resource Conservation and Recovery Act (RCRA) gives the U.S. Environmental Protection Agency (EPA) the authority to control hazardous waste from the "cradle-to-grave." This includes the generation, transportation, treatment, storage, and disposal of hazardous waste. RCRA also set forth a framework for the management of non-hazardous solid wastes. The 1986 amendments to RCRA enabled EPA to address environmental problems that could result from underground tanks storing petroleum and other hazardous substances. This listing refers to facilities currently generating hazardous waste. EPA region 6 includes the following states: Arkansas, Louisiana, New Mexico, Oklahoma, and Texas.

RCRANGR06 Resource Conservation & Recovery Act - Non-Generator

VERSION DATE: 09/14/20

The Resource Conservation and Recovery Act (RCRA) gives the U.S. Environmental Protection Agency (EPA) the authority to control hazardous waste from the "cradle-to-grave." This includes the generation, transportation, treatment, storage, and disposal of hazardous waste. RCRA also set forth a framework for the management of non-hazardous solid wastes. The 1986 amendments to RCRA enabled EPA to address environmental problems that could result from underground tanks storing petroleum and other hazardous substances. This listing refers to facilities classified as non-generators. Non-Generators do not presently generate hazardous waste. EPA

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Region 6 includes the following states: Arkansas, Louisiana, New Mexico, Oklahoma, and Texas.

RCRASC RCRA Sites with Controls

VERSION DATE: 11/17/20

The Resource Conservation and Recovery Act (RCRA) gives the U.S. Environmental Protection Agency (EPA) the authority to control hazardous waste from the "cradle-to-grave." This includes the generation, transportation, treatment, storage, and disposal of hazardous waste. RCRA also set forth a framework for the management of non-hazardous solid wastes. The 1986 amendments to RCRA enabled EPA to address environmental problems that could result from underground tanks storing petroleum and other hazardous substances. This listing refers to facilities with institutional controls in place.

RCRASUBC Resource Conservation & Recovery Act - Subject to Corrective Action Facilities

VERSION DATE: 09/14/20

The Resource Conservation and Recovery Act (RCRA) gives the U.S. Environmental Protection Agency (EPA) the authority to control hazardous waste from the "cradle-to-grave." This includes the generation, transportation, treatment, storage, and disposal of hazardous waste. RCRA also set forth a framework for the management of non-hazardous solid wastes. The 1986 amendments to RCRA enabled EPA to address environmental problems that could result from underground tanks storing petroleum and other hazardous substances. This listing refers to facilities subject to corrective actions.

RCRAT Resource Conservation & Recovery Act - Non-CORRACTS Treatment, Storage & Disposal Facilities

VERSION DATE: 09/14/20

The Resource Conservation and Recovery Act (RCRA) gives the U.S. Environmental Protection Agency (EPA) the authority to control hazardous waste from the "cradle-to-grave." This includes the generation, transportation, treatment, storage, and disposal of hazardous waste. RCRA also set forth a framework for the management of non-hazardous solid wastes. The 1986 amendments to RCRA enabled EPA to address environmental problems that could result from underground tanks storing petroleum and other hazardous substances. This listing refers to facilities recognized as hazardous waste treatment, storage, and disposal sites (TSD).

RODS Record of Decision System

VERSION DATE: 09/21/20

These decision documents maintained by the United States Environmental Protection Agency describe the chosen remedy for NPL (Superfund) site remediation. They also include site history, site description, site characteristics, community participation, enforcement activities, past and present activities, contaminated media, the contaminants present, and scope and role of response action.

SEMS Superfund Enterprise Management System

VERSION DATE: 09/21/20

Environmental Records Definitions - FEDERAL

The U.S. Environmental Protection Agency's (EPA) Office of Solid Waste and Emergency Response, Office of Superfund Remediation and Technology Innovation (OSRTI), has implemented The Superfund Enterprise Management System (SEMS), formerly known as CERCLIS (Comprehensive Environmental Response, Compensation and Liability Information System) to track and report on clean-up and enforcement activities taking place at Superfund sites. SEMS represents a joint development and ongoing collaboration between Superfund's Remedial, Removal, Federal Facilities, Enforcement and Emergency Response programs.

SEMSARCH Superfund Enterprise Management System Archived Site Inventory

VERSION DATE: 09/21/20

The U.S. Environmental Protection Agency's (EPA) Superfund Enterprise Management System Archived Site Inventory (List 8R Archived) replaced the CERCLIS NFRAP reporting system in 2015. This listing reflects sites at which the EPA has determined that assessment has been completed and no further remedial action is planned under the Superfund program.

SEMSLIENS SEMS Lien on Property

VERSION DATE: 06/22/20

The U.S. Environmental Protection Agency's (EPA) Office of Solid Waste and Emergency Response, Office of Superfund Remediation and Technology Innovation (OSRTI), has implemented The Superfund Enterprise Management System (SEMS), formerly known as CERCLIS (Comprehensive Environmental Response, Compensation and Liability Information System) to track and report on clean-up and enforcement activities taking place at Superfund sites. SEMS represents a joint development and ongoing collaboration between Superfund's Remedial, Removal, Federal Facilities, Enforcement and Emergency Response programs. This is a listing of SEMS sites with a lien on the property.

SFLIENS CERCLIS Liens

VERSION DATE: 06/08/12

A Federal CERCLA ("Superfund") lien can exist by operation of law at any site or property at which United States Environmental Protection Agency has spent Superfund monies. These monies are spent to investigate and address releases and threatened releases of contamination. CERCLIS provides information as to the identity of these sites and properties. This database contains those CERCLIS sites where the Lien on Property action is complete. Please refer to the SEMSLIENS database as source of current data.

SMCRA Surface Mining Control and Reclamation Act Sites

VERSION DATE: 06/24/20

An inventory of land and water impacted by past mining (primarily coal mining) is maintained by the Office of Surface Mining Reclamation and Enforcement (OSMRE) to provide information needed to implement the Surface Mining Control and Reclamation Act of 1977 (SMCRA). The inventory contains information on the location, type, and extent of AML impacts, as well as, information on the cost associated with the reclamation of those

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problems. The inventory is based upon field surveys by State, Tribal, and OSMRE program officials. It is dynamic to the extent that it is modified as new problems are identified and existing problems are reclaimed.

SSEHRIPFAS

SSEHRI PFAS Contamination Sites

VERSION DATE: 12/12/19

This PFAS Contamination Site Tracker database is compiled by the Social Science Environmental Health Research Institute (SSEHRI) at Northeastern University. According to the SSEHRI, the database records qualitative and quantitative data from each known site of PFAS contamination, including timeline of discovery, sources, levels, health impacts, community response, and government response. The goal of this database is to compile information and support public understanding of the rapidly unfolding issue of PFAS contamination. All data presented was extracted from government websites, news articles, or publicly available documents, and this is cited in the tracker. Disclaimer: The source conveys this database undergoes regular updates as new information becomes available, some sites may be missing and/or contain information that is incorrect or outdated, as well as their information represents all contamination sites SSEHRI is aware of, not all possible contamination sites. This data is not intended to be used for legal purposes. Limited location details are available with this data. Please access the following source link for the most current information:
<https://pfasproject.com/pfas-contamination-site-tracker/>

SSTS

Section Seven Tracking System

VERSION DATE: 08/04/20

The United States Environmental Protection Agency tracks information on pesticide establishments through the Section Seven Tracking System (SSTS). SSTS records the registration of new establishments and records pesticide production at each establishment. The Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) requires that production of pesticides or devices be conducted in a registered pesticide-producing or device-producing establishment. "Production" includes formulation, packaging, repackaging, and relabeling. For this database, the Product Information is only available for establishments up through 2014 or prior years, product details are no longer released by the EPA within the current SSTS non-Confidential Business Information data.

TRI

Toxics Release Inventory

VERSION DATE: 12/31/18

The Toxics Release Inventory, provided by the United States Environmental Protection Agency, includes data on toxic chemical releases and waste management activities from certain industries as well as federal and tribal facilities. This inventory contains information about the types and amounts of toxic chemicals that are released each year to the air, water, and land as well as information on the quantities of toxic chemicals sent to other facilities for further waste management.

TSCA

Toxic Substance Control Act Inventory

VERSION DATE: 12/31/16

The Toxic Substances Control Act (TSCA) was enacted in 1976 to ensure that chemicals manufactured,

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imported, processed, or distributed in commerce, or used or disposed of in the United States do not pose any unreasonable risks to human health or the environment. TSCA section 8(b) provides the United States Environmental Protection Agency (EPA) authority to "compile, keep current, and publish a list of each chemical substance that is manufactured or processed in the United States." This TSCA Chemical Substance Inventory contains non-confidential information on the production amount of toxic chemicals from each manufacturer and importer site. The EPA has collected Chemical Data Reporting (CDR) data since in 1986 (as Inventory Update Reporting). Collections occur approximately every four years and reporting requirements changed from collection to collection.

USUMTRCA

Uranium Mill Tailings Radiation Control Act Sites

VERSION DATE: 03/04/17

The Legacy Management Office of the Department of Energy (DOE) manages radioactive and chemical waste, environmental contamination, and hazardous material at over 100 sites across the U.S. The L.M. Office manages this database of sites registered under the Uranium Mill Tailings Control Act (UMTRCA).

Environmental Records Definitions - STATE (TX)

APAR Affected Property Assessment Reports

VERSION DATE: 05/20/20

As regulated by the Texas Commission on Environmental Quality, an Affected Property Assessment Report is required when a person is addressing a release of chemical of concern (COC) under 30 TAC Chapter 350, the Texas Risk Reduction Program (TRRP). The purpose of the APAR is to document all relevant affected property information to identify all release sources and COCs, determine the extent of all COCs, identify all transport/exposure pathways, and to determine if any response actions are necessary. The Texas Administrative Code Title 30 §350.4(a)(1) defines affected property as the entire area (i.e. on-site and off-site; including all environmental media) which contains releases of chemicals of concern at concentrations equal to or greater than the assessment level applicable for residential land use and groundwater classification.

BSA Brownfields Site Assessments

VERSION DATE: 11/07/20

The Brownfields Site Assessments database is maintained by the Texas Commission on Environmental Quality (TCEQ). The TCEQ, in close partnership with the U.S. Environmental Protection Agency (EPA) and other federal, state, and local redevelopment agencies, and stakeholders, is facilitating cleanup, transferability, and revitalization of brownfields through the development of regulatory, tax, and technical assistance tools.

CALF Closed & Abandoned Landfill Inventory

VERSION DATE: 11/01/05

The Texas Commission on Environmental Quality, under a contract with Texas State University, and in cooperation with the 24 regional Council of Governments (COGs) in the State, has located over 4,000 closed and abandoned municipal solid waste landfills throughout Texas. This listing contains "unauthorized sites". Unauthorized sites have no permit and are considered abandoned. The information available for each site varies in detail and this historical information is not updated. Please refer to the specific regional COG for the most current information.

DCR Dry Cleaner Registration Database

VERSION DATE: 05/12/20

The database includes dry cleaning drop stations and facilities registered with the Texas Commission on Environmental Quality.

DCRPS Dry Cleaner Remediation Program Sites

VERSION DATE: 09/01/20

This list of DCRP sites is provided by the Texas Commission on Environmental Quality (TCEQ). According to the TCEQ, the Dry Cleaner Remediation Program (DCRP) establishes a prioritization list of dry cleaner sites and administers the Dry Cleaning Remediation fund to assist with remediation of contamination caused by dry

Environmental Records Definitions - STATE (TX)

cleaning solvents.

GWCC Groundwater Contamination Cases

VERSION DATE: 12/31/19

This is a Joint Groundwater Monitoring and Contamination Report provided by the Texas Commission on Environmental Quality (TCEQ) with the Railroad Commission of Texas (RRC). The annual report describes the status of groundwater monitoring activities conducted or required by each agency at regulated facilities or associated with regulated activities. The report provides a general overview of groundwater monitoring by participating members on a program by program basis. Groundwater contamination is broadly defined in the report as any detrimental alteration of the naturally occurring quality of groundwater.

HISTGWCC Historic Groundwater Contamination Cases

VERSION DATE: 12/31/18

This is a Joint Groundwater Monitoring and Contamination Report provided by the Texas Commission on Environmental Quality (TCEQ) that includes historic groundwater contamination cases reported since 1994. These cases have been closed by a program area or agency, such as the TCEQ, the Railroad Commission of Texas, and/or the Texas Alliance of Groundwater Districts. According to the TCEQ report, although enforcement actions may be closed on these cases, the Activity Status Code descriptions allow that groundwater contamination may still be present at the site and may therefore be of interest to regulatory agencies and the general public.

IHW Industrial and Hazardous Waste Sites

VERSION DATE: 10/09/20

Owner and facility information is included in this database of permitted and non-permitted industrial and hazardous waste sites (this database excludes information for one time shipment requests). Industrial waste is waste that results from or is incidental to operations of industry, manufacturing, mining, or agriculture. Hazardous waste is defined as any solid waste listed as hazardous or possesses one or more hazardous characteristics as defined in federal waste regulations. The IHW database is maintained by the Texas Commission on Environmental Quality.

IHWCA Industrial and Hazardous Waste Corrective Action Sites

VERSION DATE: 07/23/20

This database is provided by the Texas Commission on Environmental Quality (TCEQ). According to the TCEQ, the mission of the industrial and hazardous waste corrective action program is to oversee the cleanup of sites contaminated from industrial and municipal hazardous and industrial nonhazardous wastes. The goals of this program are to: Ensure that sites are assessed and remediated to levels that protect human health and the environment; Verify that waste management units or facilities are taken out of service and closed properly; and to Facilitate revitalization of contaminated properties.

Environmental Records Definitions - STATE (TX)

IOP Innocent Owner / Operator Database

VERSION DATE: 11/16/20

Texas Innocent Owner / Operator (IOP), created by House Bill 2776 of the 75th Legislature, provides a certificate to an innocent owner or operator if their property is contaminated as a result of a release or migration of contaminants from a source or sources not located on the property, and they did not cause or contribute to the source or sources of contamination. The IOP database is maintained by the Texas Commission on Environmental Quality.

LANDAPP Land Application Permits

VERSION DATE: 06/18/20

Texas Land Application Permits are a requirement from the Texas Commission on Environmental Quality for any domestic facility that disposes of treated effluent by land application such as surface irrigation, evaporation, drainfields or subsurface land application.

LIENS TCEQ Liens

VERSION DATE: 05/05/20

Liens filed upon State and/or Federal Superfund Sites by the Texas Commission on Environmental Quality.

LPST Leaking Petroleum Storage Tanks

VERSION DATE: 09/04/20

The Leaking Petroleum Storage Tank listing is derived from the Petroleum Storage Tank (PST) database and is maintained by the Texas Commission on Environmental Quality. This listing includes aboveground and underground storage tank facilities with reported leaks.

MSD Municipal Setting Designations

VERSION DATE: 07/09/20

The Texas Commission on Environmental Quality (TCEQ) defines an MSD as an official state designation given to property within a municipality or its extraterritorial jurisdiction that certifies that designated groundwater at the property is not used as potable water, and is prohibited from future use as potable water because that groundwater is contaminated in excess of the applicable potable-water protective concentration level. The prohibition must be in the form of a city ordinance, or a restrictive covenant that is enforceable by the city and filed in the property records. The MSD property can be a single property, multi-property, or a portion of property.

TCEQ Disclaimer: This data is for informational purposes and may not have been prepared for or be suitable for legal, engineering, or surveying purposes. It does not represent an on-the-ground survey and represents only the approximate relative location of property boundaries.

Environmental Records Definitions - STATE (TX)

MSWLF Municipal Solid Waste Landfill Sites

VERSION DATE: 09/04/20

The municipal solid waste landfill database is provided by the Texas Commission on Environmental Quality. This database includes active landfills and inactive landfills, where solid waste is treated or stored.

NOV Notice of Violations

VERSION DATE: 02/24/16

This database containing Notice of Violations (NOV) is maintained by the Texas Commission on Environmental Quality. An NOV is a written notification that documents and communicates violations observed during an inspection to the business or individual inspected.

OCP Operator Cleanup Program Sites

VERSION DATE: 10/09/20

The Operator Cleanup Program oversees Operator-led cleanups to ensure compliance with RRC rules. The Sites in the Operator Cleanup Program enter the program on a case by-case basis through referral from the RRC District Offices or other RRC sections (e.g. Technical Permitting or Legal Enforcement) when groundwater has been impacted or has the potential to be impacted, risk-based site assessment is needed, or when the release consists of a unique or unusual contaminant. Operators can also choose to voluntarily enter their cleanup sites into the RRC's Operator Cleanup Program. Database is provided and maintained by the Railroad Commission of Texas (RRC) and location information is limited to what is available via the agency.

PIHW Permitted Industrial Hazardous Waste Sites

VERSION DATE: 10/09/20

Owner and facility information is included in this database of all permitted industrial and hazardous waste sites. Industrial waste is waste that results from or is incidental to operations of industry, manufacturing, mining, or agriculture. Hazardous waste is defined as any solid waste listed as hazardous or possesses one or more hazardous characteristics as defined in federal waste regulations. Permitted IHW facilities are regulated under 30 Texas Administrative Code Chapter 335 in addition to federal regulations. The IHW database is maintained by the Texas Commission on Environmental Quality.

PST Petroleum Storage Tanks

VERSION DATE: 05/12/20

The Petroleum Storage Tank database is administered by the Texas Commission on Environmental Quality (TCEQ). Both Underground storage tanks (USTs) and Aboveground storage tanks (ASTs) are included in this report. Petroleum Storage Tank registration has been a requirement with the TCEQ since 1986.

Environmental Records Definitions - STATE (TX)

RRCVCP Railroad Commission VCP and Brownfield Sites

VERSION DATE: 09/29/20

According to the Railroad Commission of Texas, their Voluntary Cleanup Program (RRC-VCP) provides an incentive to remediate Oil & Gas related pollution by participants as long as they did not cause or contribute to the contamination. Applicants to the program receive a release of liability to the state in exchange for a successful cleanup.

RWS Radioactive Waste Sites

VERSION DATE: 07/11/06

This Texas Commission on Environmental Quality (TCEQ) database contains all sites in the State of Texas designated as Radioactive Waste sites as of 2006. The TCEQ no longer maintains this site listing.

SF State Superfund Sites

VERSION DATE: 05/26/20

The state Superfund program mission is to remediate abandoned or inactive sites within the state that pose an unacceptable risk to public health and safety or the environment, but which do not qualify for action under the federal Superfund program (NPL - National Priority Listing). As required by the Texas Solid Waste Disposal Act, Texas Health and Safety Code, Chapter 361, the Texas Commission on Environmental Quality identifies and evaluates these facilities for inclusion on the state Superfund registry. This listing includes any recent developments and the anticipated action for these sites as documented in the annual state Superfund registry publication of the Texas Register as well as the Superfund Webpage on the TCEQ website.

SIEC01 State Institutional/Engineering Control Sites

VERSION DATE: 11/07/20

The Texas Risk Reduction Program (TRRP) requires the placement of institutional controls (e.g., deed notices or restrictive covenants) on affected property in different circumstances as part of completing a response action. In its simplest form, an institutional control (IC) is a legal document that is recorded in the county deed records. In certain circumstances, local zoning or ordinances can serve as an IC. This listing may also include locations where Engineering Controls are in effect, such as a cap, barrier, or other engineering device to prevent access, exposure, or continued migration of contamination. The sites included on this list are regulated by various programs of the Texas Commission on Environmental Quality (TCEQ).

SPILLS Spills Listing

VERSION DATE: 10/26/20

This Texas Commission on Environmental Quality database includes releases of hazardous or potentially hazardous materials into the environment.

Environmental Records Definitions - STATE (TX)

STCV Salt Caverns for Petroleum Storage

VERSION DATE: 09/01/06

The salt caverns for petroleum storage database is provided by the Railroad Commission of Texas.

TIERII Tier II Chemical Reporting Program Facilities

VERSION DATE: 12/31/12

The Texas Tier II Chemical Reporting Program in the Department of State Health Services (DSHS) is the state repository for EPCRA-required Emergency Planning Letters (EPLs), which are one-time notifications to the state from facilities that have certain extremely hazardous chemicals in specified amounts. The Program is also the state repository for EPCRA/state-required hazardous chemical inventory reports called Texas Tier Two Reports. This data contains those facility reports for the 2005 through the 2012 calendar years. Please contact the Texas Commission on Environmental Quality Tier II Chemical Reporting Division as the current source for this data, due to confidentiality and safety reasons details such as the location and capacity of on-site hazardous chemicals is only available to local emergency planning agencies, fire departments, and/or owners.

VCP Voluntary Cleanup Program Sites

VERSION DATE: 11/16/20

The Texas Voluntary Cleanup Program (VCP) provides administrative, technical, and legal incentives to encourage the cleanup of contaminated sites in Texas. Since all non-responsible parties, including future lenders and landowners, receive protection from liability to the state of Texas for cleanup of sites under the VCP, most of the constraints for completing real estate transactions at those sites are eliminated. As a result, many unused or underused properties may be restored to economically productive or community beneficial uses. The VCP database is maintained by the Texas Commission on Environmental Quality.

WMRF Recycling Facilities

VERSION DATE: 11/01/12

This listing of recycling facilities is provided by the Texas Commission on Environmental Quality's Recycle Texas Online service. The company information provided in this database is self-reported. Since recyclers post their own information, a facility or company appearing on the list does not imply that it is in compliance with TCEQ regulations or other applicable laws. This database is no longer maintained and includes the last compilation of the program participants before the Recycle Texas Online program was closed.

WSTMGMT Commercial Management Facilities for Hazardous Waste and Industrial Solid Wastes

VERSION DATE: 10/01/19

This publication lists facilities that have permits or authorizations from the Texas Commission on Environmental Quality (TCEQ) to receive, on a commercial basis, and manage hazardous waste, industrial nonhazardous waste, or both.

Environmental Records Definitions - STATE (TX)

Environmental Records Definitions - LOCAL

AUSTINHISTUST

City of Austin Historical Underground Storage Tanks

VERSION DATE: 10/12/20

This is an inventory of historical underground gas storage tanks. An Underground Storage Tank (UST) can pose a very serious threat to human health, the environment, and property if not properly operated and maintained. The UST Leak Prevention Program focuses on all facilities with underground storage tanks storing hazardous materials found within the UST Program jurisdiction. Please credit the City of Austin Planning and Development Review with use of this data.

AUSTINUST

City of Austin Underground Storage Tanks

VERSION DATE: 10/12/20

This is an inventory of active underground gas storage tanks. An Underground Storage Tank (UST) can pose a very serious threat to human health, the environment, and property if not properly operated and maintained. The UST Leak Prevention Program focuses on all facilities with underground storage tanks storing hazardous materials found within the UST Program jurisdiction. Please credit the City of Austin Planning and Development Review with use of this data.

EAP

Edwards Aquifer Permits

VERSION DATE: 07/21/06

This database, maintained by the Texas Commission on Environmental Quality, contains Edward Aquifer permits.

Environmental Records Definitions - TRIBAL

INDIANRES

Indian Reservations

VERSION DATE: 09/27/17

This database is extracted from select geographic and cartographic information from the U.S. Census Bureau. The Bureau of Indian Affairs (BIA) within the U.S. Department of the Interior (DOI) provides the list of federally recognized tribes. The American Indian/Alaska Native/Native Hawaiian (AIANNH) Areas includes the following legal entities: federally recognized American Indian reservations and off-reservation trust land areas, state-recognized American Indian reservations, and Hawaiian home lands (HHLs). The boundaries for federally recognized American Indian reservations and off-reservation trust lands are as of January 2017. The boundaries for state-recognized American Indian reservations and for state designated tribal statistical areas were delineated by state governor-appointed liaisons for the 2010 Census through the State American Indian Reservation Program and Tribal Statistical Areas Program respectively.

LUSTR06

Leaking Underground Storage Tanks On Tribal Lands

VERSION DATE: 04/01/20

This database, provided by the United States Environmental Protection Agency (EPA), contains leaking underground storage tanks on Tribal lands located in EPA Region 6. This region includes the following states: Arkansas, Louisiana, New Mexico, Oklahoma, and Texas.

ODINDIAN

Open Dump Inventory on Tribal Lands

VERSION DATE: 11/08/06

This Indian Health Service database contains information about facilities and sites on tribal lands where solid waste is disposed of, which are not sanitary landfills or hazardous waste disposal facilities, and which meet the criteria promulgated under section 4004 of the Solid Waste Disposal Act (42 U.S.C. 6944).

USTR06

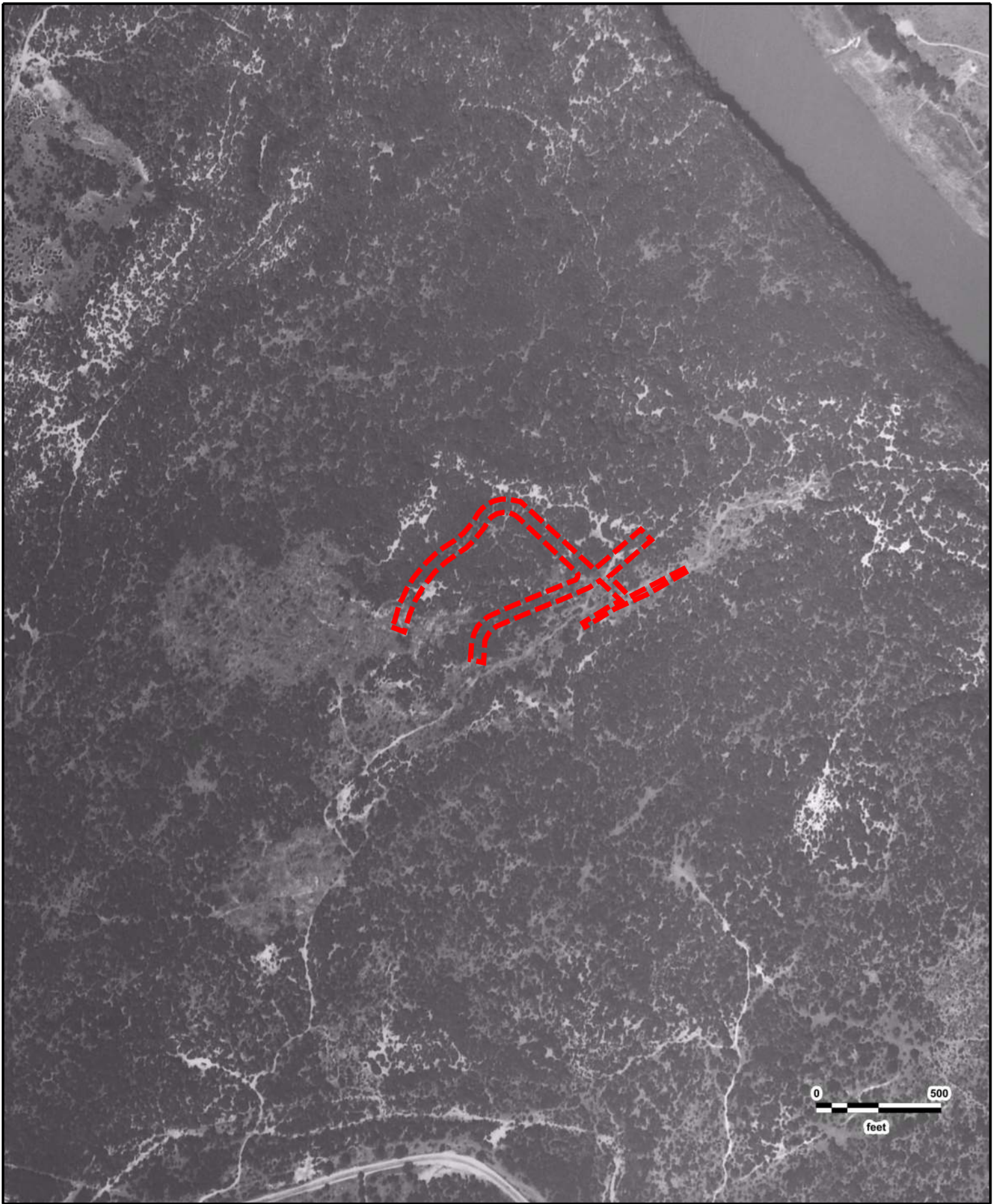
Underground Storage Tanks On Tribal Lands

VERSION DATE: 04/01/20

This database, provided by the United States Environmental Protection Agency (EPA), contains underground storage tanks on Tribal lands located in EPA Region 6. This region includes the following states: Arkansas, Louisiana, New Mexico, Oklahoma, and Texas.

ATTACHMENT C

HISTORICAL AERIAL PHOTOGRAPHS



Pleasant/Nixon Drainage Improvements
ASCS
09/26/1940





Pleasant/Nixon Drainage Improvements
ASCS
01/15/1951

GeoSearch



Pleasant/Nixon Drainage Improvements
USGS
03/01/1954

GeoSearch

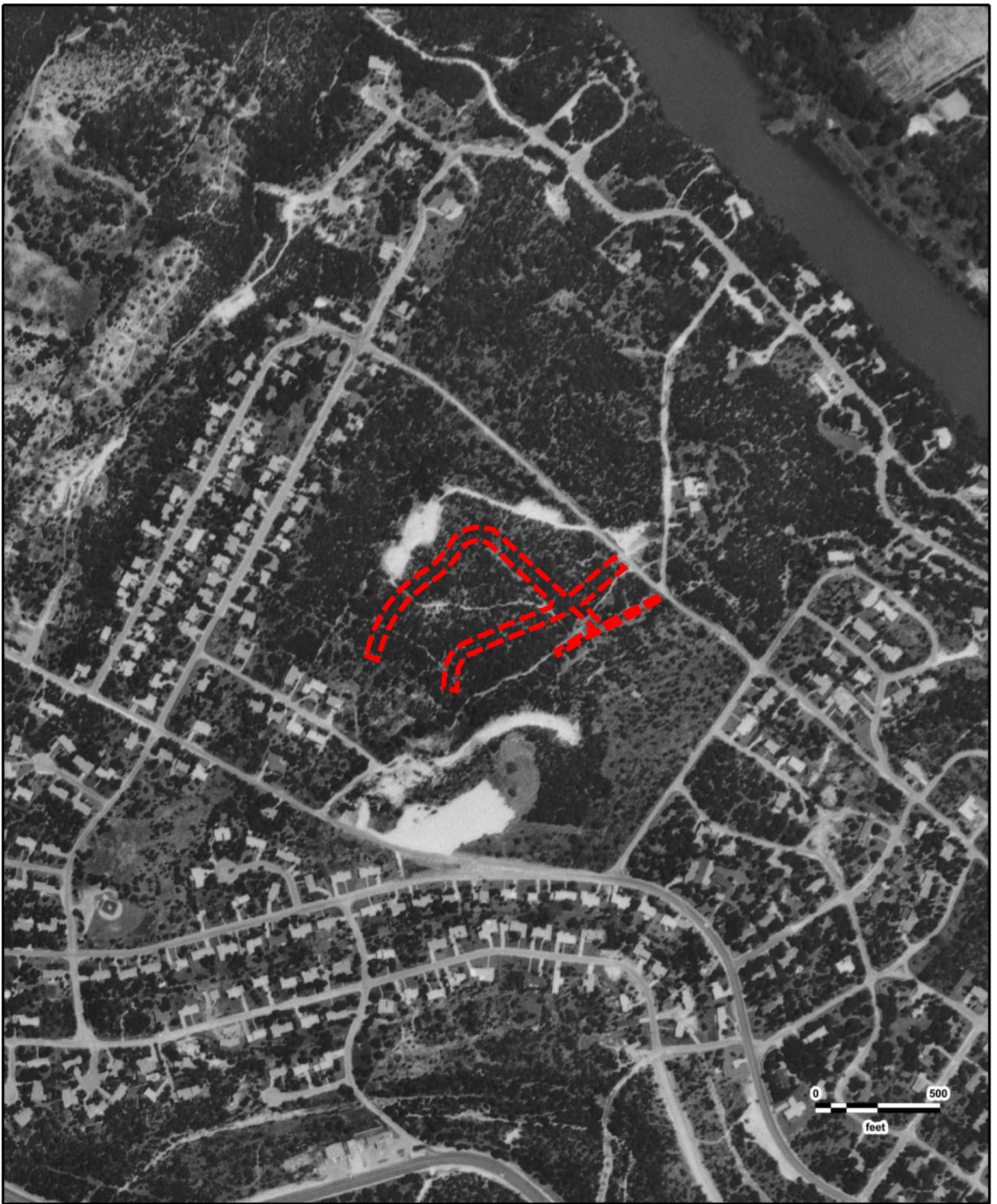


0 500
feet



Pleasant/Nixon Drainage Improvements
ASCS
12/21/1964

GeoSearch



Pleasant/Nixon Drainage Improvements
USGS
05/26/1966

GeoSearch



Pleasant/Nixon Drainage Improvements
ASCS
01/18/1973

GeoSearch



Pleasant/Nixon Drainage Improvements
TXDOT
11/18/1980

GeoSearch



Pleasant/Nixon Drainage Improvements
TXDOT
06/17/1988

GeoSearch



Pleasant/Nixon Drainage Improvements
USGS
01/28/1995





Pleasant/Nixon Drainage Improvements
USDA
2004

GeoSearch



Pleasant/Nixon Drainage Improvements
USDA
2005

GeoSearch



Pleasant/Nixon Drainage Improvements
USDA
2010

GeoSearch



Pleasant/Nixon Drainage Improvements
USDA
2012

GeoSearch



Pleasant/Nixon Drainage Improvements
USDA
2014

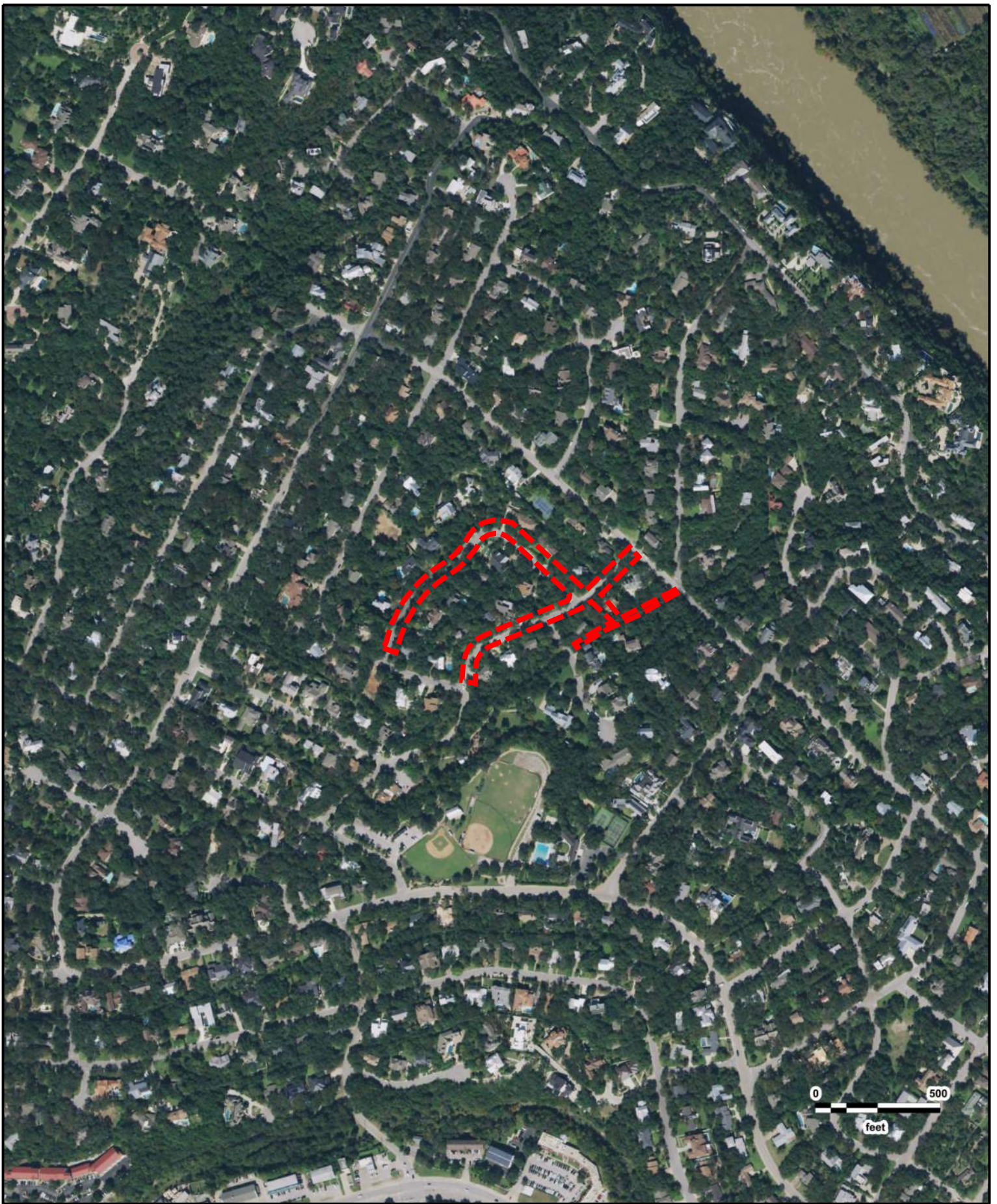
GeoSearch



Pleasant/Nixon Drainage Improvements
USDA
2016

GeoSearch



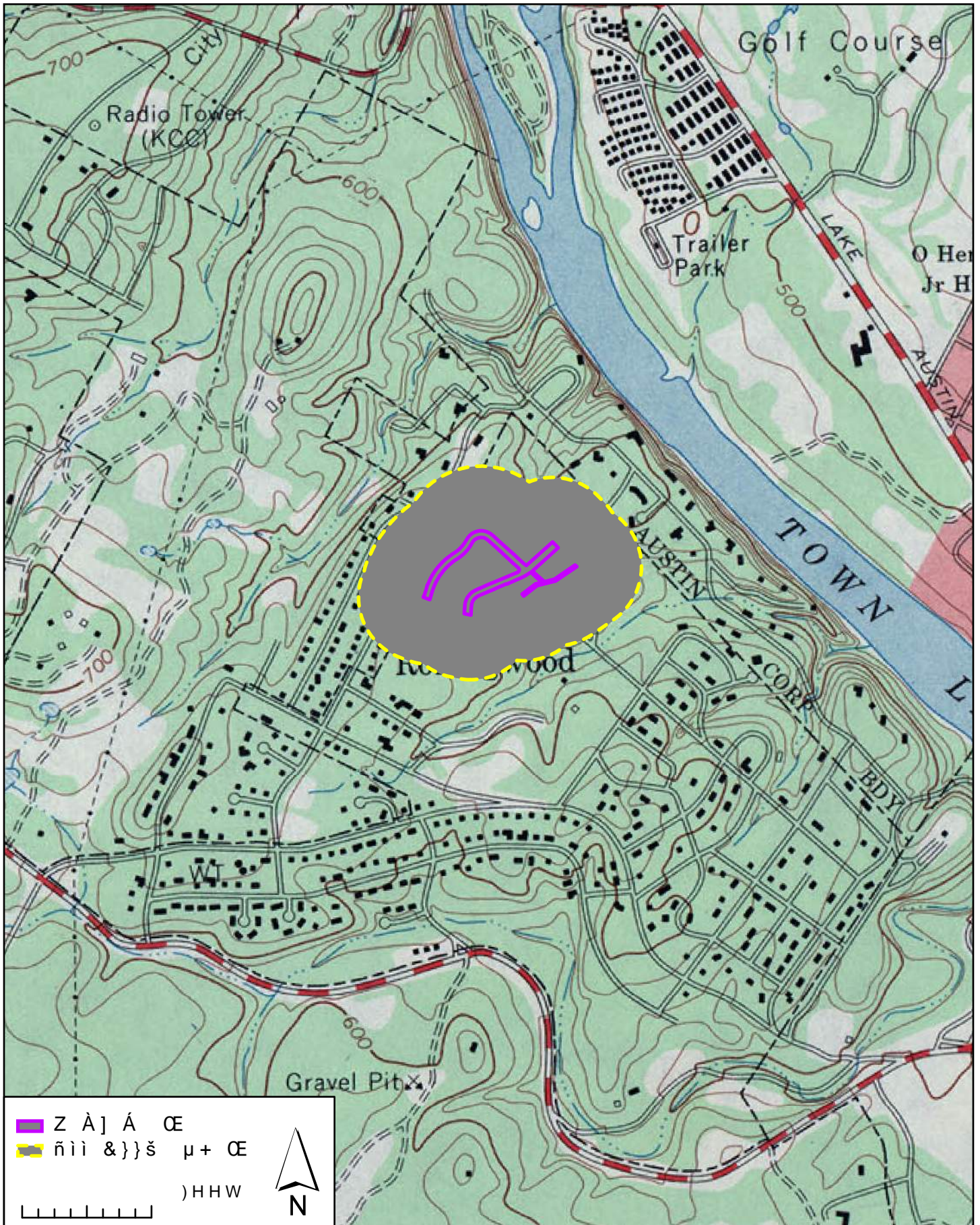


Pleasant/Nixon Drainage Improvements
USDA
2018

GeoSearch

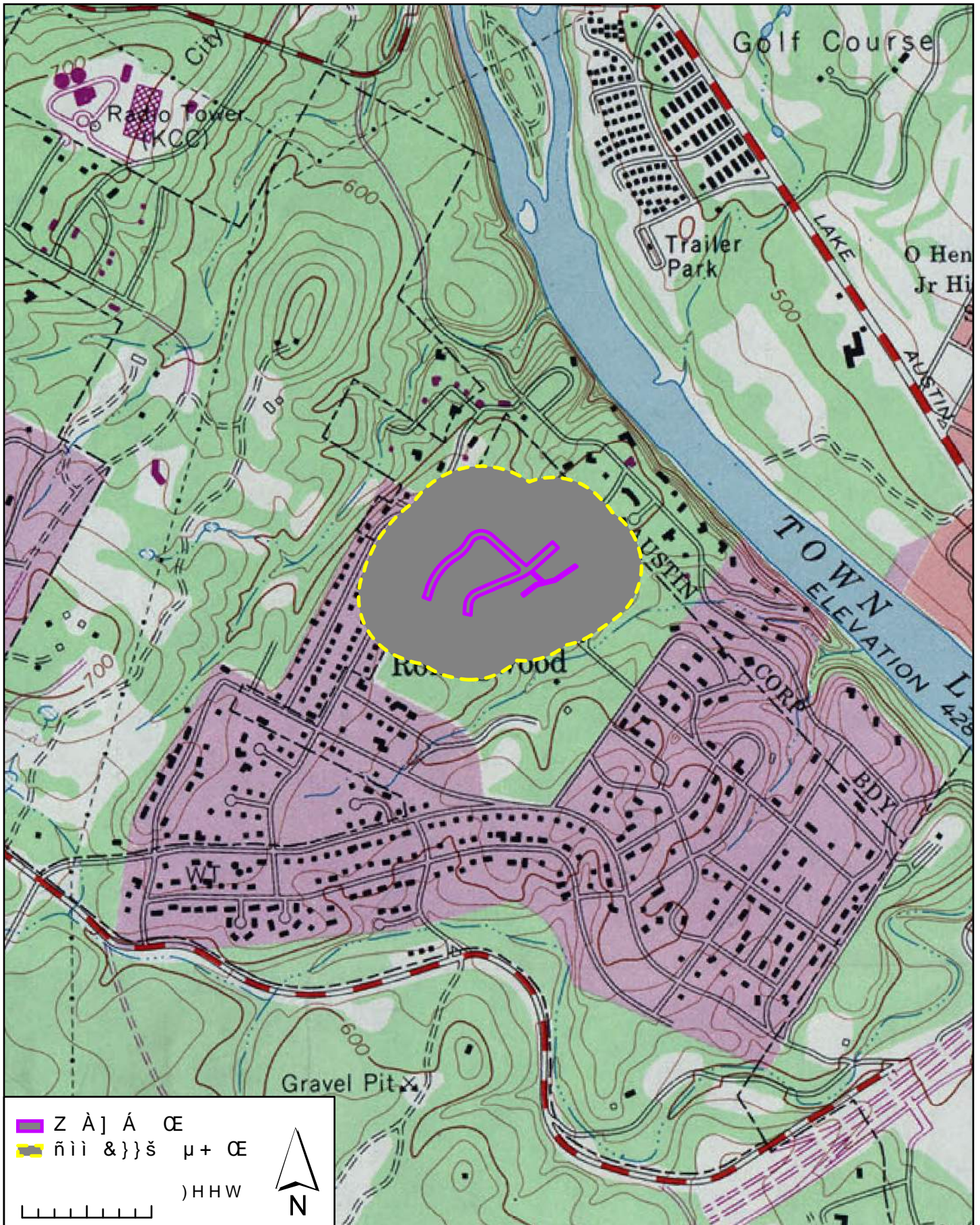
ATTACHMENT D

HISTORIC TOPOGRAPHIC MAPS



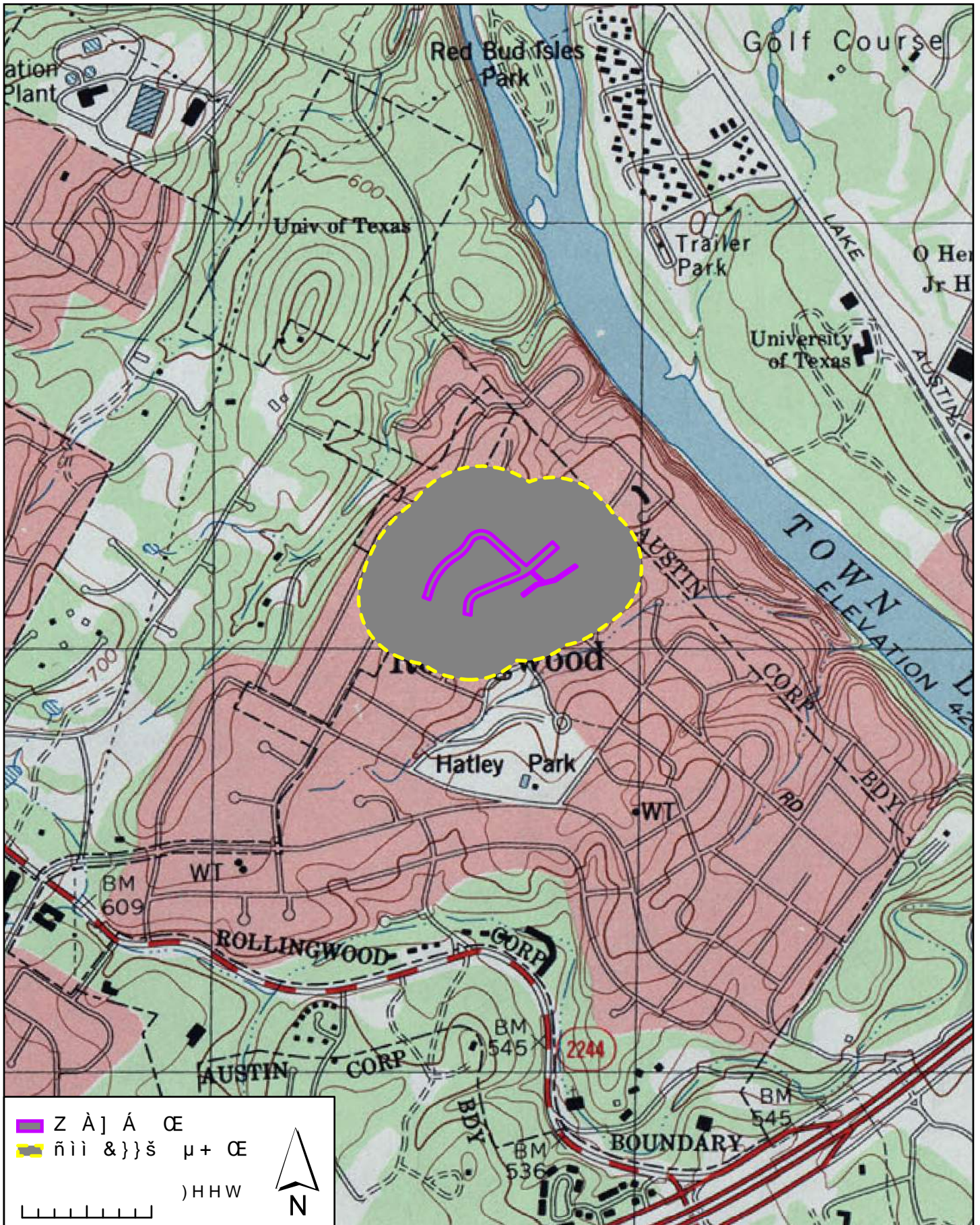
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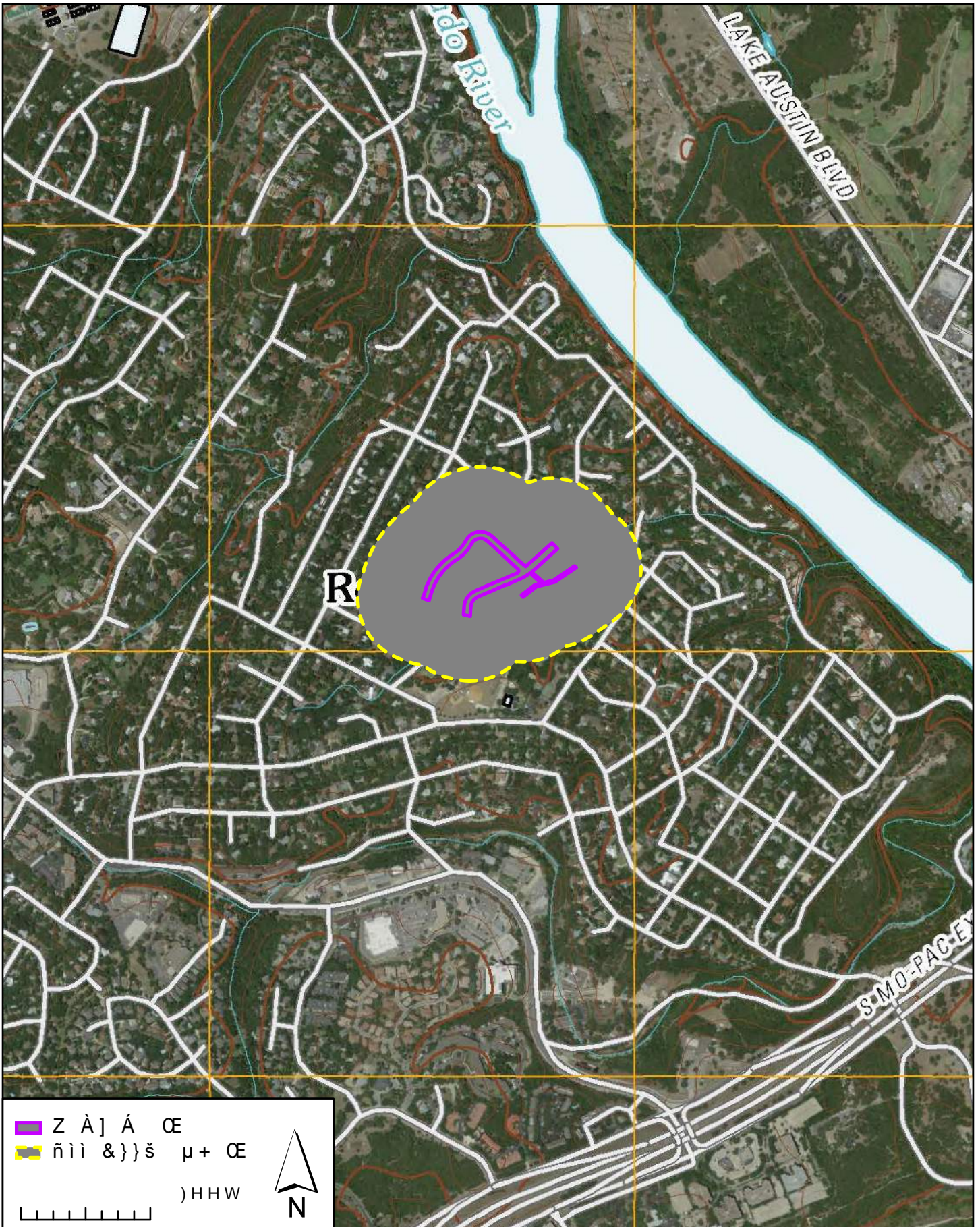
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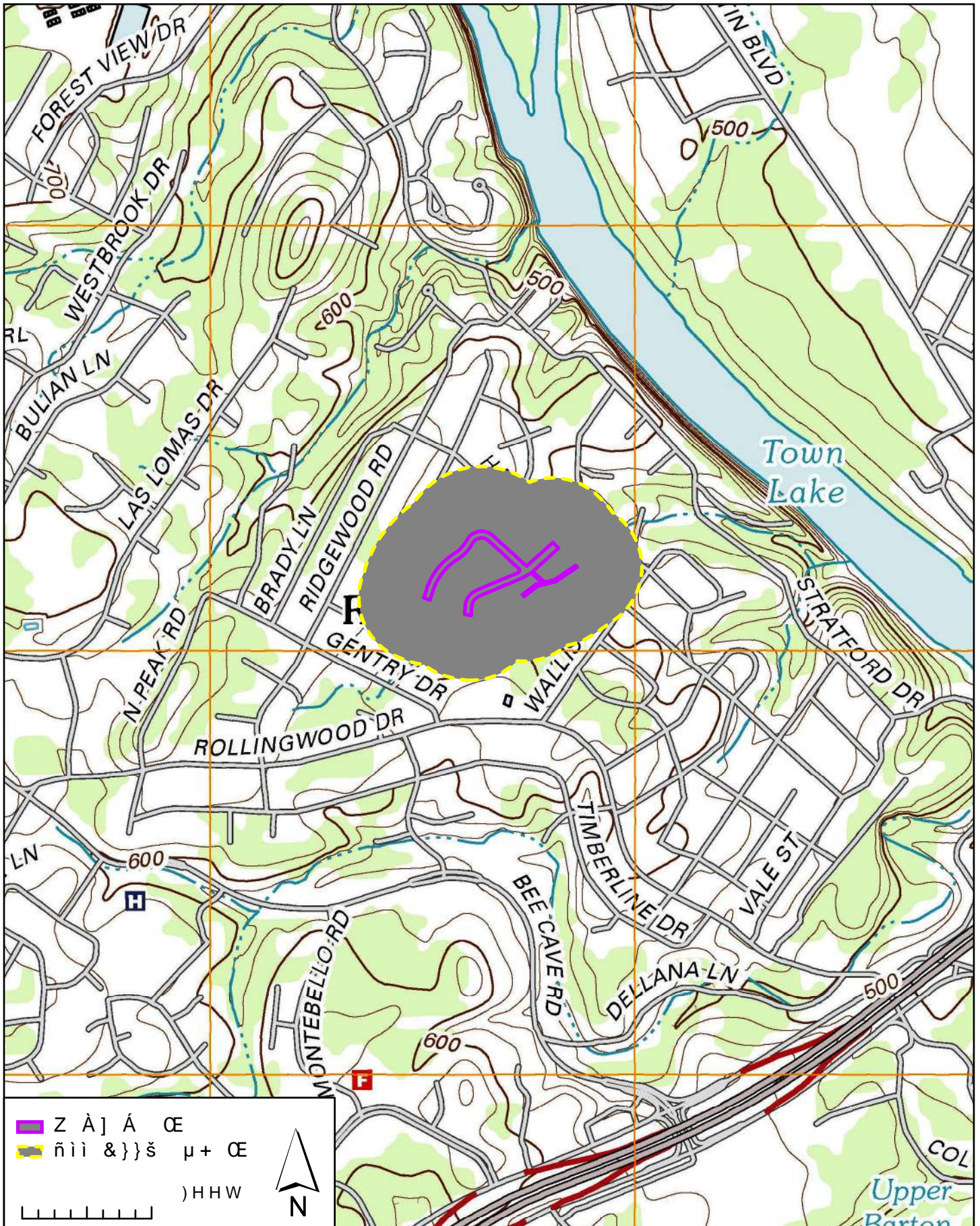
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Appendix H: Hydrologic and Hydraulic Models